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ABSTRACT

The outline curriculum guide has been developed to assist in planning, developing, and instructing a program in appliance service and repair. The material consists of a unit outline and suggested exercises and assignments for 17 areas: shop mathematics, communication skills, safety, orientation to appliance service and repair, blueprint reading, basic hand tools, metal working, drilling and threading procedures, fundamentals of electricity, basic controls and components, resistance heating devices, electrical appliance motors, motor driven appliances, refrigeration, gas terminology and definition, customer and job relations, and business principles and practices. Supplementary course material covers: warranties and service policies; merchandising and warehousing; accounting, marketing and salesmanship; basic chemistry, physics, and thermodynamics; and fundamentals of electronics. Included are lists of suggested references, films, equipment and supplies, and a sample specification form. (BP)

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U.S. DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

Suggested Curriculum Guide

for DEVELOPING
a PROGRAM in

APPLIANCE
SERVICE and
REPAIR



State of Illinois
BOARD OF VOCATIONAL EDUCATION AND REHABILITATION
DIVISION OF VOCATIONAL AND TECHNICAL EDUCATION
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Springfield, Illinois 62706

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48-174

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INTRODUCTION

This suggested curriculum guide has been developed to assist in planning, developing, and instructing a program in appliance service and repair. The material is presented in outline form, listing suggested units of instruction and related laboratory exercises.

The course outline does not cover every detail of instruction, but rather presents a suggested approach to the training of appliance service and repairmen. The course outline may be modified to meet the needs of the local educational agency. The sequence of presentation, as well as topics for special emphasis should be determined by local specialists and will vary according to the needs and backgrounds of the students.

JOB DESCRIPTION

An appliance service and repairman (U.S.O.E. Code: 17.02) installs, services, and repairs household appliances such as toasters, irons, mixers, ranges, dryers, washers, refrigerators, dishwashers, and other major or portable appliances. Repairmen must possess the skill and knowledge to diagnose and correct any difficulty the appliance owner may report. The repairman needs to have a broad understanding of the function of most appliances, although he may develop a special competence in one type.

The appliance service and repairman has a great deal of contact with the public and therefore must understand the basic principles of salesmanship and good business practices. Since much of the service and repair work is conducted in the customer's home, the repairman must also have accepted habits of cleanliness, promptness, honesty, and courtesy.

TYPICAL COURSE CONTENT

SHOP MATHEMATICS

Suggested Unit Outline

- A. Introduction to shop mathematics
- B. Explanation of computation (four basic operations)
- C. Explanation of linear, area, volume and angular measurement
- D. Explanation of decimal numeration system (metric measurement)
- E. Common fractions
- F. Decimal fractions
- G. Powers and roots
- H. Mathematical tables and graphs
- I. Problem solving with the slide rule

Suggested Exercises and Assignments

1. Exercises in mathematical computation
2. Problems in linear, area, volume and angular measurement
3. Problem solving involving fractions, powers and roots
4. Problem solving with the slide rule

COMMUNICATION SKILLS

Suggested Unit Outline

- A. Review of the fundamentals of English
 1. Grammar
 2. Spelling
 3. Punctuation
 4. Capitalization
- B. Vocabulary building
- C. Report and letter writing
- D. Formal and informal speaking

Suggested Exercises and Assignments

1. Exercises in word usage, sentence structure
2. Writing reports on lab experiments and appliance servicing
3. Personal and business letter writing

SAFETY

Suggested Unit Outline

- A. Introduction to principles of safety
- B. Shop and laboratory safety
- C. Safety responsibilities
- D. First Aid
- E. Safety measures to be observed when operating:
 1. Grinding and cutting equipment
 2. Electrical equipment
 3. Power tools
 4. Hand tools
- F. Fire prevention and protection:
 1. Types and uses of fire extinguishers

Suggested Exercises and Assignments

1. Exercises listing safety hazards in the shop
2. Exercises listing safety hazards in the home
3. Simulated First Aid drills

ORIENTATION TO APPLIANCE SERVICE AND REPAIR

Suggested Unit Outline

- A. Introduction to history of home appliances
- B. Discussion of modern day appliances
- C. Discussion of future trends in appliances:
 1. Dielectric heating
 2. High frequency heating
 3. Electronic and electric devices
- D. Discussion of job opportunities in appliance service and repair
- E. Discussion of qualifications of appliance serviceman:
 1. Must be able to drive
 2. Must be willing to continue education (as appliances change)
 3. Must be able to deal with the public
 4. Must present a neat appearance

Suggested Exercises and Assignments

1. Exercises listing modern appliances
2. Exercises listing possible job opportunities in appliance service
3. Exercises listing job advancement possibilities
4. Survey of local appliance service and repair needs

BLUEPRINT READING

Suggested Unit Outline

- A. Fundamentals of blueprint and schematic reading
- B. Principles of sketching and drawing
- C. Utilizing symbols, sections and details
- D. Interpreting blueprints and schematics

Suggested Exercises and Assignments

1. Assignments in sketching and drawing
2. Assignments utilizing symbols, sections and details
3. Exercises in interpreting blueprints

BASIC HAND TOOLS

Suggested Unit Outline

- A. Use of measuring devices:
 1. Review of metric system
 2. Micrometer
 3. Calipers
 4. Dividers
 5. Steel rule

- B. Use, care and safety of hand tools:
 - 1. Screw drivers
 - 2. Wrenches
 - 3. Hammers
 - 4. Vises and clamps
 - 5. Fasteners
 - 6. Saws
 - 7. Files
 - 8. Pliers
 - 9. Flaring tool

Suggested Exercises and Assignments

- 1. "Hands On" experiences with measuring devices
- 2. "Hands On" experiences with hand tools
- 3. Assignments in demonstrating proper use and care of hand tools

METAL WORKING

Suggested Unit Outline

- A. Introduction to sheet metal layout and cutting procedures
- B. Discussion of metal finishing
- C. Proper care and use of the soldering gun, propane torch and oxyacetylene torch
- D. Use of grinders, drills and saws
- E. Basic welding techniques (oxyacetylene and electric arc welding)

Suggested Exercises and Assignments

- 1. Exercises in simple sheet metal layout and cutting operations
- 2. Assignments using the oxyacetylene torch
- 3. Brazing and soldering exercises
- 4. Exercises in refinishing metals
- 5. Assignments demonstrating simple welding techniques
- 6. On-the-job assignments with local metal working companies

DRILLING AND THREADING PROCEDURES

Suggested Unit Outline

- A. Introduction to drilling and threading
- B. Discussion of thread sizes and classifications
- C. Use of taps and dies

Suggested Exercises and Assignments

- 1. Exercises listing thread sizes and classifications
- 2. Practice drilling and tapping
- 3. Make external threads with a die
- 4. On-the-job assignments with local metal working companies

FUNDAMENTALS OF ELECTRICITY

Suggested Unit Outline

- A. Introduction to electricity
- B. Definitions and explanation of terms
- C. Discussion of atomic structures
- D. Discussion of flow of electricity
- E. Explanation of electrical symbols
- F. Discussion of basic electrical circuits and Ohm's Law
- G. Discussion of residential and industrial wiring:
 - 1. Fuses and circuit protection
 - 2. Grounding systems
 - 3. Wire sizes and capacities
 - 4. Entry service and distribution
 - 5. Code requirements
 - 6. Installation of outlets, switches and other devices
 - 7. Wiring three and four-way switches
- H. Explanation of applicable test equipment

Suggested Exercises and Assignments

- 1. Exercises in reading electrical symbols
- 2. Problems in electrical circuitry using Ohm's Law
- 3. Assignments in drawing schematics of typical residential wiring
- 4. Analysis of electrical devices with test equipment
- 5. Calculate circular mill area and current carrying capabilities of various size wires
- 6. On the job experiences related to residential or industrial electricity

BASIC CONTROLS AND COMPONENTS

Suggested Unit Outline

- A. Review of the fundamentals of electricity
- B. Operation of manual and electro mechanical switching devices
- C. Electric timers
- D. Use of thermostats
- E. Methods of speed control

Suggested Exercises and Assignments

- 1. On the job assignments with local appliance repair company
- 2. Locating controls from a schematic drawing
- 3. Troubleshooting controls with power off
- 4. Troubleshooting controls while in operation
- 5. Removal and replacement of controls
- 6. Analysis of whether to repair or replace controls

RESISTANCE HEATING DEVICES

Suggested Unit Outline

- A. Theory of resistance heating
- B. Discussion of heating elements, thermostats and electrical connections
- C. Use of test instruments for calculating proper operation
- D. Preparing work orders for repair
- E. Discussion of nomenclature of parts

Suggested Exercises and Assignments

1. In the laboratory or on-the-job setting:
 - a. Remove and replace faulty heating assembly
 - b. Clean and adjust points on thermostats
 - c. Replace cords and plugs on heating devices
 - d. Inspect and repair specific devices such as room heaters, irons, percolators, electric ranges, hot water heaters, etc.
 - e. Calculate size of wire to furnish power required by heater
 - f. Make a schematic diagram of a heating device
 - g. Prepare a work order for repair

MOTORS FOR ELECTRICAL APPLIANCES

Suggested Unit Outline

- A. Theory of operation of the electric motor
- B. Details of construction
- C. Advantages and disadvantages of specific types of motors
- D. Care to be taken during disassembly and assembly
- E. Preventative maintenance to extend the lifetime of the motor
- F. General points of attention during troubleshooting
- G. When to repair or replace electric motor parts or complete units
- H. Discussion of nomenclature of parts

Suggested Exercises and Assignments

1. In laboratory or on-the-job setting:
 - a. Complete a schematic diagram of specific types of motors
 - b. Study faulty motors and locate source of trouble
 - c. Isolate trouble in motors with power on
 - d. Remove, clean and replace motor units

MOTOR DRIVEN APPLIANCES

Suggested Unit Outline

- A. Theory of operation of specific units
- B. Symptoms preceding trouble
- C. Efficiency in methods of troubleshooting
- D. Advantages and disadvantages in repair or replacement
- F. Introduction to power transfer assemblies
- F. Discussion of nomenclature of parts
- G. Preventative maintenance procedures

Suggested Exercises and Assignments

1. In laboratory or on-the-job setting:
 - a. Complete a list of the main components of specific units
 - b. Analyze belts and pulleys of specific units
 - c. Replace transmission gears

- d. Analyze and troubleshoot driving mechanism of specific units
- e. Inspect and repair appliances such as mixers, blenders, disposals, vacuum cleaners, floor scrubbers, dishwashers, etc.
- f. Replace accessories and study unit in operation

REFRIGERATION

Suggested Unit Outline

- A. Basic theory of refrigeration
- B. Definitions and explanation of terms
- C. Basic principles of evaporation and condensation
- D. Principles of temperature and pressure
- E. Definition of components and their function in a refrigeration system
- F. Explanation of connectors used in refrigeration
- G. Discussion of tools and instruments used in diagnosing problems
- H. Procedures in changing components

Suggested Exercises and Assignments

- 1. In laboratory or on-the-job setting:
 - a. Make a schematic diagram of a refrigeration unit
 - b. Inspect and repair faulty units such as refrigerators, freezers, room air conditioners, etc.
 - c. Discharge a system preliminary to component replacement
 - d. Charge a system after component replacement and check for leaks

GAS TERMINOLOGY AND DEFINITION

Suggested Unit Outline

- A. Definition of natural and manufactured gas
- B. Definition of liquid petroleum gas
- C. Definition of components and their function in gas units
- D. Definition of devices such as regulator valves, orifices, solenoid valves, control thermostats, etc.
- E. Procedures in adjusting, changing or repairing components
- F. Procedures in checking for gas leaks

Suggested Exercises and Assignments

- 1. In laboratory or on-the-job setting:
 - a. Make a list and define main components of a gas appliance
 - b. Make a schematic diagram of a gas appliance
 - c. Inspect and repair faulty gas units such as dryers, ranges, water heaters, etc.
 - d. Check a system for gas leaks

CUSTOMER AND JOB RELATIONS

Suggested Unit Outline

- A. Introduction to customer relations
- B. The sales climate: mental attitude, physical appearance, knowledge of product, interest in customer, closing the sale, etc.

- C. The service climate: mental attitude, physical appearance, knowledge of product, dealing with customers, home etiquette, service charges, etc.
- D. Job relations: getting along with people, enthusiasm, temper, reliability, loyalty to employer, giving and receiving constructive criticism

Suggested Exercises and Assignments

- 1. Role playing assignments in selling a prospective buyer
- 2. Role playing assignments in receiving telephone call requesting service
- 3. Role playing exercises in dealing with customer complaints

BUSINESS PRINCIPLES AND PRACTICES

Suggested Unit Outline

- A. Introduction to principles of economics:
 - 1. Organization and growth
 - 2. Supply and demand
 - 3. Money and the nature of credit
 - 4. The problem of inflation and control
 - 5. Business cycle, theory and control
 - 6. Labor unions and collective bargaining
 - 7. Tax structure
 - 8. The role of government and business
- B. Introduction to principles of accounting:
 - 1. Recording, analyzing, and interpreting financial statements
 - 2. Accounting procedures
 - 3. Typical problems
- C. Introduction to the principles of marketing:
 - 1. Buying and selling
 - 2. Transporting, storing, grading, financing, etc.
 - 3. Customer satisfaction and profit

Suggested Exercises and Assignments

- 1. Assignments surveying local appliance repair shops dealing with accounting and marketing problems
- 2. Exercises listing the steps involved in acquiring, selling, transporting, financing, installing and servicing merchandise
- 3. Exercises in accounting including billing customer for repair charges, keeping records of gas consumption, parts utilization, and expenditures for test equipment
- 4. Exercises listing the required parts and equipment needed for the service vehicle

SUPPLEMENTARY COURSE MATERIAL

The following unit outlines are suggested supplementary areas which would enhance an appliance service and repair training program. They may be added to the basic course outline or offered as additional units, depending upon your assessment of their value.

WARRANTIES, SERVICE POLICIES, ETC.

Suggested Unit Outline

A. Introduction to warranties:

1. General content
2. Obligation of manufacturer
3. Obligation of retailer
4. Service responsibilities
5. Customer responsibilities
6. Parts and service covered within a specific time period

B. Introduction to service policies:

1. General content
2. How they are sold
3. Service responsibilities for manufacturer and retailer
4. Customer responsibilities

Suggested Exercises and Assignments

1. Exercises interpreting actual warranties and service policies
2. Survey local appliance repairmen for their viewpoints regarding warranties and service policies
3. Survey friends and neighbors for their viewpoints regarding warranties and service policies

MERCHANDISING AND WAREHOUSING

Suggested Unit Outline

- A. Introduction to merchandising
 1. Purchase prices, mark-up profits
 2. Service costs
 3. Interest
- B. Merchandise design and display
- C. Advertising and sales promotion
- D. Introduction to warehousing
 1. Utilization of space
 2. Parts storage
 3. Inventories

Suggested Exercises and Assignments

1. In laboratory or on-the-job setting:
 - a. Exercises defining mark-up, profit, costs, interest
 - b. Exercises designing and building typical product display
 - c. Exercises with model warehouses demonstrating good techniques of space utilization and parts storage

ACCOUNTING, MARKETING, AND SALESMANSHIP

Suggested Unit Outline

- A. Introduction to principles of accounting
 - 1. Recording, analyzing, and interpreting financial statements
 - 2. Accounting procedures
 - 3. Related problems
- B. Introduction to marketing
 - 1. Commodity approach to buying and selling
 - 2. Institutions in the marketing system
 - 3. Customer satisfaction and profit
- C. Fundamentals of salesmanship
 - 1. Needs of salesmanship
 - 2. Creative selling
 - 3. The sales atmosphere
 - 4. Traits of a salesman

Suggested Exercises and Assignments

- 1. Exercises in recording and accounting procedures
- 2. Exercises defining marketing terms
- 3. Simulated experiences in salesmanship

BASIC CHEMISTRY, PHYSICS, AND THERMODYNAMICS

Suggested Unit Outline

- A. Introduction to basic chemistry
 - 1. Valence theory
 - 2. Basic reactions
 - 3. Effects of detergents, bleaches, etc.
 - 4. Water chemistry
 - 5. Corrosion
 - 6. Combustion
- B. Introduction to basic physics
 - 1. Work
 - 2. Magnetism
 - 3. Latent heat
 - 4. Heat of combustion
 - 5. Heat of compression
 - 6. Heat of vaporization
- C. Introduction to basic thermodynamics
 - 1. Effects of compression of gases in refrigeration
 - 2. Effects of vaporization in refrigeration
 - 3. Expansion of liquids and gases
 - 4. Effects of temperature

Suggested Exercises and Assignments

- 1. Exercises defining types of detergents, bleaches, etc.
- 2. Exercises demonstrating physical laws of combustion, compression and vaporization
- 3. Exercises demonstrating effects of compression and expansion of liquids and gases

FUNDAMENTALS OF ELECTRONICS

Suggested Unit Outline

- A. Introduction to fundamentals of electronics
- B. Explanation of terms
- C. Voltage, current and resistance in series circuits
- D. Voltage, current and resistance in parallel circuits
- E. Calculation of power in series and parallel circuits
- F. Combination series parallel circuits
- G. Introduction to measuring devices
 - 1. Ohmmeter
 - 2. Voltmeter
 - 3. Ammeter
- H. Alternating current circuits
 - 1. Capacitors
 - 2. Capacitive reactance
 - 3. Circuits with capacitance and resistance
 - 4. Inductors
 - 5. Inductive reactance
 - 6. Circuits with capacitance, resistance and inductance
 - 7. Resonance
- I. Basic vacuum tube theory
 - 1. Diodes
 - 2. Triodes
 - 3. Pentodes
 - 4. How tubes amplify
 - 5. Coupling between amplifiers
 - 6. Application of dynamic characteristic curves
- J. Basic semiconductor theory
 - 1. Diode characteristics
 - 2. Transistor characteristics and biasing
 - 3. How transistors amplify
 - 4. Phototransistors
- K. Power supplies
 - 1. Theory of transformers
 - 2. Full-wave rectifiers
 - 3. Filter circuits
 - 4. Basic regulator circuits

Suggested Exercises and Assignments

- 1. Exercises calculating voltage, current and resistance in DC circuits
- 2. Exercises measuring voltage, current and resistance with test equipment
- 3. Exercises calculating total circuit impedance
- 4. Exercises drawing schematic diagrams of tube and transistor amplifier circuits with appropriate coupling

SUGGESTED LIST OF REFERENCES

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Lang, **Principles of Refrigeration**, Albany, New York, Delmar Publishers, 1972.

APPLIANCE SERVICE AND REPAIR

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Tricomi, Ernst, **How to Repair Major Appliances**, Indianapolis, Howard W. Sams and Company, Inc.

Service manuals from manufacturing companies.

BLUEPRINT READING

Brown, Walter C., **Blueprint Reading for Industry**, Chicago, Goodheart-Wilcox Publishing Co., 1972.

Mullin, R.C., **Electrical Trades Blueprint Reading**, New York, Delmar Publishers, Inc., 1969.

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Wall **Basic Concepts in Chemistry**, New York, McGraw-Hill Book Co., Inc.

COMMUNICATION SKILLS

Gwen, **English Review Manual**, New York, McGraw-Hill Book Co., Inc. 1970

Murphy, **Better Business Communications**, New York, McGraw-Hill Book Co., Inc.

Shuster, **Effective Letters in Business**, New York, McGraw-Hill Book Co., Inc.

ECONOMICS

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Lynn, **Basic Economics**, New York, McGraw-Hill Book Co., Inc.

ELECTRICITY AND ELECTRONICS

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Inc. 1972.

McMackin, Shaver, Weber, **Mathematics of the Shop**, Albany, New York, Delmar Publishers.

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Stanton **Fundamentals of Marketing**, New York, McGraw-Hill Book Co., Inc.

METALWORKING

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MOTORS

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Graham, K.C., **Understanding and Servicing Fractional Horsepower Motors**, American Technical
Society.

PHYSICS

Buech, **Principles of Physics**, New York, McGraw-Hill Book Co., Inc.

SALESMANSHIP

Bender, **How to Sell Well**, New York, McGraw-Hill Book Co., Inc.

Laird and Laird, **Practical Sales Psychology**, New York, McGraw-Hill Book Company, Inc.

WELDING

Althouse, A.D., Turnquist, C.H., and Bowditch, W.A., **Modern Welding**, Chicago, Goodheart-
Wilcox Publishing Co., 1972.

Roden, E.M. and Griffin, J.R., **Basic Arc Welding**, Albany, New York, Delmar Publisher,
1971.

Roden, E.M. and Griffin, J.R., **Basic Oxyacetylene Welding**, Albany, New York, Delmar
Publishers, 1971.

SUGGESTED LIST OF FILMS

SO YOU WANT TO BE AN APPLIANCE SERVICE TECHNICIAN

16 mm, or 8mm, sound, color, 11 minutes, 1971

Vacational Films
111 Euclid Avenue
Park Ridge, IL 60068

INTRODUCTION TO ELECTRICITY

16 mm, sound, black and white

Coronet Films
Wilmette, IL 60091

MEASUREMENT OF ELECTRICITY

16 mm, sound, black and white

Coronet Films
Wilmette, IL 60091

ELEMENTS OF ELECTRIC CIRCUITS

16 mm, sound, black and white, 11 minutes

Encyclopedia Britannica Films
65 E. South Water Street
Chicago, IL 60001

ELECTROMAGNETS

16 mm, sound, black and white, 10 minutes

McGraw-Hill Book Co., Inc.
330 West 42nd Street
New York, New York 10036

HOME ELECTRICAL APPLIANCES

16 mm, sound, black and white, 11 minutes

Encyclopedia Britannica Films
65 E. South Water Street
Chicago, IL 60001

MODERNIZING MOTORS

16 mm, sound, color, 19 minutes, 1960

Dow Corning Corporation
8555 16th Street
Silver Springs, MD 20907

NATURE OF HEAT

16 mm, sound, black and white, 10 minutes

Coronet Films
Wilmette, IL 60091

THE FACTORY: HOW A PRODUCT IS MADE

16 mm, black and white, 13 minutes

Designed to teach basic principles of oxyacetylene safety
Airco Welding Products Division
Air Reduction Co., Inc.
150 East 42 Street
New York, NY 10017

SUGGESTED LIST OF FILMS (continued)

UNDERSTANDING ELECTRIC RANGE COMPONENTS

Filmstrip - 112 frames and cassette tape - 40 minutes
In depth coverage of electric range components including element controls, oven controls and clocks
Whirlpool Corporation
Literature Department
229 Factory Street
La Porte, IN 46350

REFRIGERATION FUNDAMENTALS

Filmstrip - 163 frames and cassette tape - 59 minutes
Basic refrigeration theory and operation
Whirlpool Corporation
Literature Department
229 Factory Street
La Porte, IN 46350

USE AND CARE OF TEST INSTRUMENTS

Filmstrip - 87 frames and cassette tape - 35 minutes
Describes use and care of many test instruments
Whirlpool Corporation
Literature Department
229 Factory Street
La Porte, IN 46350

SERVICING ELECTRIC FURNACES

Filmstrip - 90 frames and cassette tape - 24 minutes
Presents changes in electric furnace controls including solid state devices
Whirlpool Corporation
Literature Department
229 Factory Street
La Porte, IN 46350

PROFESSIONAL APPROACH

Filmstrip - 60 frames and cassette tape - 12 minutes
Proper methods of dealing with customers
Whirlpool Corporation
Literature Department
229 Factory Street
La Porte, IN 46350

EDUCATIONAL SPECIFICATIONS

Laboratory Space2,400 Sq. Ft.

Auxiliary Space:

Office and Planning Area
Storage and Tool Room
Wash-up Area

The laboratory should contain the necessary electrical, hot water, cold water, sewer, and gas outlets. Glare-free lighting with an illumination of approximately 50 foot candles at work table height is recommended. An attempt has been made to arrange the work stations to permit at least three men to work together in repairing or analyzing each large appliance.

The spray booth and the welding area should be connected to exhaust fans capable of providing good ventilation. It is advisable to check with the local building code for specifications.

SUGGESTED LIST OF EQUIPMENT*

Quantity	Description
1	Bench grinder, ½hp., double arbor, equipped with flexible abrasive belt attachment
1	Drill press, ½ inch chuck capacity
1	Metal lathe and armature undercut
1	Arc welder, type: transformer, 250 amp. capacity
1	Spot welder, 220 volt, 60 Hz., 1.5 KVA
1	Arbor Press, 3 ton capacity
1	Air compressor complete, air delivery at 175 psi-4 cu. ft. per min.
2	Portable electric drills, ½ inch
1	Portable electric drill, ½ inch
1	Bearing puller
1	Charging board with Dial-A-Charge cylinder, gauges, hand valves and manifold
1	Bottle soap bubbles
1	Test cord
1	Leak detector
1	Valve core removal tool
1	Charging cylinder with refrigerant
1	Vacuum pump, 5 cu. ft.
1	Evacuation pump
1	Manometer, mercury, closed-end
1	Set of refrigerant hoses
1	Valve kit
4	Machinist's vises, 3½ inch jaw, 5¼ inch max. opening
1	External growler
1	Internal growler

*Based on a maximum of 20 students

SUGGESTED LIST OF EQUIPMENT (continued)

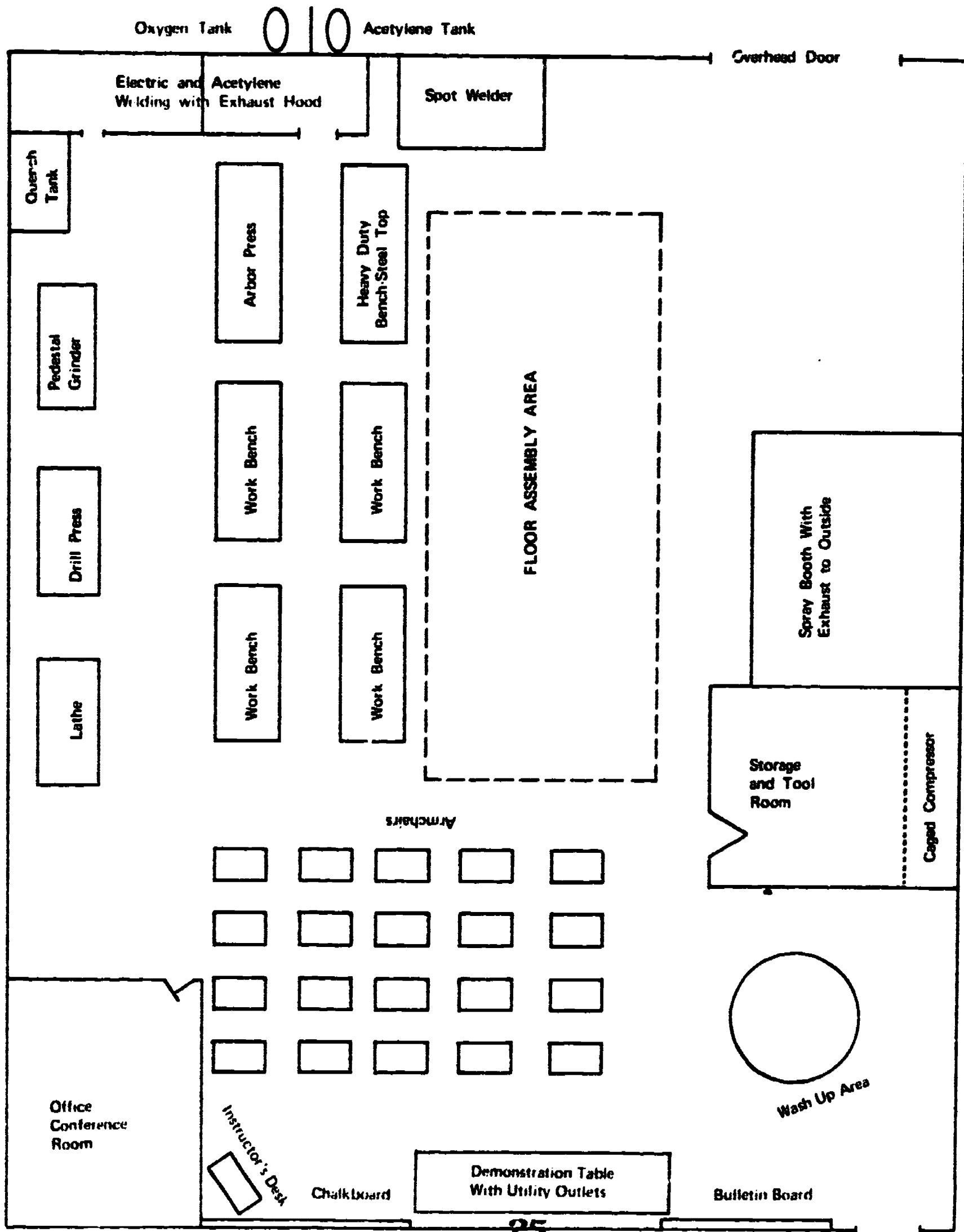
Quantity	Description
10	Machinist's vises, 2½ inch jaw, 2½ inch max. opening
20	Soldering guns, 150 watt
1	Heat gun, 500 degrees
5	Vise grip pliers, 4 inch
5	Vise grip pliers, 6 inch
5	Needle nose pliers, 6 inch, curved nose
2	Pliers, 6½ inch
2	Pliers, 8 inch
2	Wire hose-clamp pliers, 7 inch
2	Sheet metal shears, combination pattern, length of cut, 3 inches
4	Terminal crimpers
1	Pipe wrench, 6 inch
1	Pipe wrench, 8 inch
1	Pipe wrench, 12 inch
3	Allen wrench sets, sizes 5/64 to ½ inch, 7 pieces
3	Socket sets, ½" drive, 7/16 to 1¼ inch, 17 pieces
3	Socket sets, ¾" drive, 7/32 to 7/16 inch, 17 pieces
1	Ball peen hammer, 8 oz.
1	Ball peen hammer, 12 oz.
2	Rawhide mallets
5	Soldering guns, 250 watt
1	Soldering copper, ½ lb. size
12	Wire gauges
1	Micrometer, 0-1 inch
10	Feeler gauges, .003 to .025
1	Tap and die set, NC - ¼ x 20 to ¾ x 10, NF - ¼ x 28 to ¾ x 16
1	Screw extractor set for bolts 3/16 to 1 inch, 6 pieces

SUGGESTED LIST OF EQUIPMENT (continued)

Quantity	Description
2	Hacksaws, tubular frame
20	Individual toolboxes consisting of: <ul style="list-style-type: none"> a. 4 oz. ball peen hammer b. Punch and chisel set, 12 pieces c. pin punch set, sizes 1/16 to 1/2 inch, 7 pieces d. set of 3 crescent wrenches, 4 to 8 inches e. set of box-end, open-end wrenches, 1/2 to 1 inch by 1/16 inch steps, 13 pieces f. chain nose plier g. diagonal plier h. lineman's plier i. combination plier, 6 inch j. waterpump plier, 10 inch length k. stubby slot-head screwdriver l. set of screwdrivers, 4, 6, 8, 10 inch m. stubby phillips screwdriver, tip no. 1 n. set of phillips screwdrivers, size 0, 1, 2, 3, 4, 6, 7, 10 inch tip o. offset screwdriver set, std. tip bit widths - 1/4, 5/16, and 3/8 inch, phillips tip 1 and 2, 3-4 p. nutdriver set, 7 sizes q. test lamp r. electrician's knife s. point file t. hacksaw u. toolbox
1	Twist drill set, (high speed, 1/16 to 1/2 inch) 32 drills
1	Gas welding and cutting torch complete
1	Welding booth
1	Spray booth and exhaust system
1	Solvent tank
1	Shop anvil, weight 30 lbs.
6	Thermometers, scale 100-350 degrees Fahrenheit
2	Thermometers, scale 30-212 degrees Fahrenheit
6	Thermocouples, complete, scale 50-1000 degrees Fahrenheit
1	Recording watt meter, 2 scale
10	Ammeters, tong type, ranges: 0-5/15/40/100 A.C., and 0-150/600 VAC
6	A. C. volt meters, 0-250 scale

SUGGESTED LIST OF EQUIPMENT (continued)

Quantity	Description
10	Multimeters
4	Ohmmeters
5	Electric workbenches, 4 station top, 72 x 48 inches
20	Armchair desks
20	Lab stools, 26 inches high
1	Chalkboard and equipment
1	Teacher's desk and chair
1	Demonstration test bench including: 6 storage drawers, 1 file drawer, 8-15 amp. duplex outlets, 1 duplex outlet variable AC 0-120 volts at 5 amps., variable AC 0-12 volts from 2 jacks at 10 amps., variable A.C. 0-24 volts from 2 jacks at 5 amps., variable DC 0-30 volts from 2 jacks at 5 amps., complete with panel pilot light, controls and circuit breakers
1	File cabinet
1	Bulletin board
2	Storage cabinets
2	Heavy duty work benches, 48 x 72 x 32 inches
1	Overhead projector, miscellaneous training aids, films, transparencies, etc.



Approximately 2,400 Sq. Ft.

SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description
	Assortment of fasteners
	Synthetic enamel
2 gal.	Enamel undercoat
5 gal.	Paint reducer
2 gal.	Lacquer thinner
10 qts.	Lacquer, assorted colors
10	Assorted paint brushes
3 gal.	Rust inhibitive metal primer
10 rolls	Masking tape, 3/4" wide, latex adhesive binding with paper crepe backing
5 lbs.	Steel wool, grade N. 00 to 2
1 gal.	Rubbing compound, coarse grade
2 lbs.	Acid core solder, alloy 40/60, 1/8" diameter
4 lbs.	Rosin core solder, alloy 50/50, 1/8" diameter
2 lbs.	Aluminum flux-core solder
10 oz.	Silver solder, 1100 degree F. melting range
1	Silver solder flux, 10 oz. jar
100 lbs.	Arc welding electrodes, E6011 - 1/8" and E6018 - 1/8"
50 lbs.	Gas welding rods, 1/16" and 1/8"
10 lbs.	Cast iron rod, 3/16" x 18"
8 lbs.	Aluminum brazing rod, 1/16" diameter
8 lbs.	Manganese bronze rod, 3/32" and 1/8" diameter
2 lbs.	Cast iron brazing flux
1 lb.	Aluminum brazing flux
2 lbs.	All purpose brazing flux
2 lbs.	Cast iron welding flux
2 tanks	One of oxygen, one of acetylene

SUGGESTED LIST OF EXPENDABLE SUPPLIES (continued)

Quantity	Description
1	Supply of lubricating oils, greases and materials
4 doz.	Hacksaw blades, 12 inches long, 24 and 32 teeth per inch
4 doz.	Assorted files
4 doz.	Sheets of abrasive paper
1	Assortment of electrical wire
1	Allowance for used appliances to use for demonstration and training aids