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ABSTRACT

This guide is intended to assist industrial arts teachers, school administrators, and architects in planning and designing functional facilities for instructional purposes or in remodeling existing facilities. It was developed under the auspices of the Council for Industrial Arts Education and published by the Missouri State Department of Education. The contents include detailed information on: (1) Educational Planning, Specifications and Definitions, (2) General Considerations, (3) Program and Space Needs, and (4) Equipment and Furniture. Design criteria, a planning check list, a planning reference chart and a bibliography are given in the appendixes. The document is illustrated with photographs. (GR)

**PLANNING AND EQUIPPING
INDUSTRIAL ARTS
INSTRUCTIONAL FACILITIES**

ED0 44501

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FOREWORD

This guide was organized under the auspices of the Council for Industrial Arts Education and published by the Missouri State Department of Education. In preparing this publication, the supervisory personnel in the State Department and the Production Committee were dedicated to the task of positively influencing the planning and constructing of industrial arts instructional facilities in the public schools of Missouri.

This guide is intended principally to assist industrial arts teachers, school administrators and architects in planning and designing functional facilities for instructional purposes. It will also provide assistance in remodeling existing facilities. Industrial arts teacher educators will likewise find the guide helpful in preparing teachers for the profession.

A critical review of the publication will indicate that the Production Committee thoroughly studied available materials concerning the subject. The pictures display many useful ideas gathered from various facilities throughout the state.

The members of the Production Committee are to be commended for their willingness to give of their time and professional skill in the development of this guide. This endeavor is definitely a positive contribution to the profession.



HUBERT WHEELER
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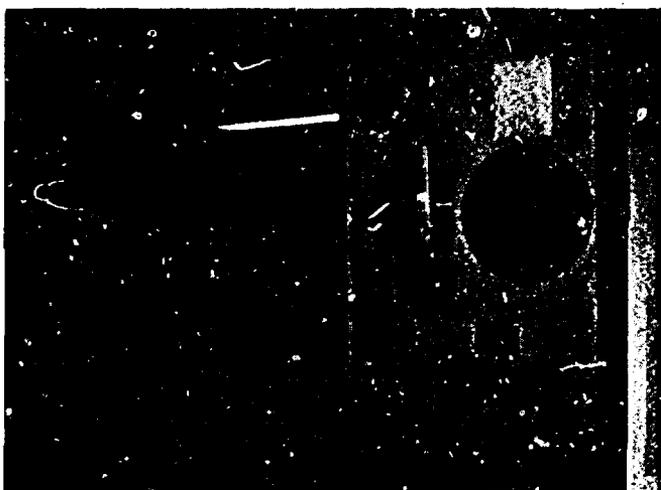
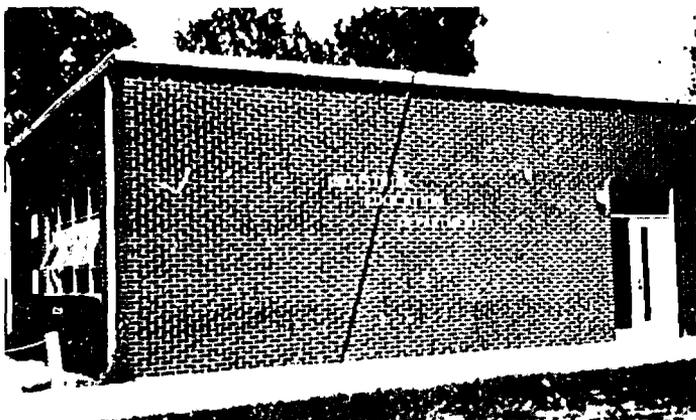
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PART I
EDUCATIONAL PLANNING,
SPECIFICATIONS AND DEFINITIONS

Introduction
Educational Planning
Educational Specifications
Definitions
 Types of Facilities
 Levels
 Instructional Areas and Courses



PART I

EDUCATIONAL PLANNING, SPECIFICATIONS AND DEFINITIONS

INTRODUCTION

The purpose of this publication is to provide general guidelines for educators and architects, in planning facilities necessary for the instructional program of industrial arts. The information is not intended to provide specifications for any one kind of facility but to offer basic suggestions pertinent to the planning of any school industrial arts laboratory. These guidelines should assist local officials in making decisions that will result in facilities that permit the achievement of program objectives in an efficient and effective manner. The industrial arts instructor, with assistance of professional consultants in the field of industrial arts, is the best qualified person in the local community to outline the industrial arts curriculum and the learning activities which suggest the facilities required to house the program. The industrial arts teacher, in turn, needs to work directly with the superintendent, or his designated representative in the total school planning program.

Before facility planning can begin, the philosophy of industrial arts must be clearly specified, communicated, and understood by the instructor, the school administrator, and the board of education. This philosophy will determine the program objectives, which in turn establishes the framework for curriculum and student learning activities.

EDUCATIONAL PLANNING

Educational planning is the process by which those in positions of educational leadership assemble facts and resources pertinent to the total educational enterprise as well as obtain information regarding the nature and needs of the community.

The most important step in the entire process of planning a school plant or addition to an existing one is the determination of the character of the educational program which is to be housed.

Those involved in the planning process should systematically identify and evaluate basic educational needs. This is the most important activity in the overall planning process, and it should precede all other activity. This can be accomplished first through a self-evaluation and later be expanded by an educational survey that would result in a thorough and objective appraisal of the educational program and facilities. Assistance from specialists and consultants from outside the district is usually found to be very beneficial.

Throughout the entire planning process, a clear understanding of the functions and responsibilities is essential for all participants including advisory committees, the school staff, consultants, architects and engineers, as well as the board of education. Participants must have assurance that their proposals will be respected and given serious consideration by the policy-making body.

The highest order of educational leadership is needed on the part of the superintendent, often with a competent consultant to advise and assist him.

Finally, there must be mutual respect and confidence, a frank sharing of concerns and ideas, and a penetrating appraisal by the group of all ideas advanced.

EDUCATIONAL SPECIFICATIONS

Written educational specifications clearly state all decisions growing out of the educational planning process. They should provide the architect with all of the essential information which he must have to understand the architectural problem to be solved and the various limitations under which he must work.

Educational specifications must be defined as an effective means of communication between educators and architectural designers. They are the communicative media through which the educators identify the educational program and factors which affect teaching and learning, thus providing a basis for the architect's development of building plans and specifications. In addition to written educational specifications, discussions and visits to existing facilities may greatly aid in communication and understanding.

Educational specifications should provide a sound basis for architectural planning and the development of functional building plans and specifications.

Much of the information can be presented in straightforward written composition; however, other information is best expressed and presented in diagram or tabular format. Specifications should be prepared in simple language so that they may be rapidly interpreted by the architect and others. Good educational specifications for the industrial arts department should reflect:

1. Philosophy and objectives of the community and school.
2. Number of pupils to be taught in each class or department.
3. Educational program, including curricular offerings and activities of pupils and teachers.
4. Discernible trends in programs, facilities, and space.
5. Space needs including kind, number and approximate size of each instructional or auxiliary area in terms of the program and learning activities involved.
6. Spatial relationships or coordination desired within various parts of the school plant to insure satisfactory functioning of the building.
7. Material, equipment and furniture needs.
8. Facilities and services needed such as audio-visual aids, adequate light, heat, ventilation, air conditioning, aesthetic and acoustical treatment including floor covering, color and decorations.

Well prepared educational specifications are an instrument of good planning and design and, if used effectively, should result in functional facilities which can promote the desired educational program.

DEFINITIONS

Laboratory (shop). A room or rooms appropriately equipped for various areas of industrial arts instruction. This facility will be used by the students and instructors for planning, investigating, testing, conferring, demonstrating, and teaching with visual as well as auditory methods. The manipulation of tools and other equipment along with the evaluation of pupil development will likewise be important activities conducted in the facility. The term laboratory will be used throughout this guide.

The following terms with their definitions are as they appear in the Handbook for Industrial Arts Education—1969 published by the Missouri State Department of Education. Types of Facilities on page 3-14, Levels on pages 2-3, 2-4 and Instructional Areas and Courses on pages 6-1 to 6-6.

TYPES OF FACILITIES

Comprehensive General Laboratory. This facility is a self-contained laboratory in which provision is made for instruction in all of the major areas of industrial arts education.

Multi-Area Laboratory. This facility provides for instruction in more than one of the major instructional content areas in industrial arts education. For example, the study of metals and electricity may be accomplished in a multi-area laboratory.

Area Laboratory. This facility provides for the instruction in several phases of one particular area of study. For example, the study of metal materials and a variety of the associated machine and tool processes might be accomplished in an area laboratory for metals.

Unit Laboratory. This facility provides for instruction in one content area. For example, welding might be taught in a unit laboratory specifically designed for that particular unit of the metals area.

LEVELS

Level I. Exploratory industrial arts (general shop) should be required in the middle and/or junior high school. The course is exploratory in nature and provides an opportunity for students to become oriented to a number of content areas in industrial arts. Since emphasis is placed on breadth of experiences rather than depth, experiences should be provided in as many basic technical areas as possible.

If content is organized according to industrial materials, all students should experience at least four different content areas during each of two years. If the school enrollment justifies only one industrial arts facility, it would be necessary to equip the facility with the tools and equipment essential to conduct an exploratory program in all content areas. However, schools with larger enrollment might find it more efficient to have separate facilities for two or three of the more closely related content areas.

Level II. While the content and experiences at Level I are designed as general education that provide common learnings desirable for all, Level II courses are designed as elective education beginning at the ninth grade and are built upon the exploratory experiences provided at Level I. The Level II courses promote unique interests, needs, and abilities of individuals rather than those common to all.

Courses at Level II are intermediate in nature offering one or two semesters of study in a single industrial arts content area. Courses in each content area may be included in the industrial arts curriculum at Level II, and students should be encouraged to elect more than one course at this level before proceeding to a Level III course.

Level III. Level III courses are advanced technical courses designed to provide experiences in a rather specialized phase of a single content area of industrial arts and must be preceded by a Level II course in the same content area. This level is not to be merely an extension or continuation of competencies developed in Level II, but in addition, it should provide an opportunity for the study of new phases related to the content experienced at Level II. For example, Level II metals should include many facets of metals, i.e., sheet metal, welding, forging, foundry, basic machining, and fundamental properties of metals. In contrast, Level III might be an in-depth study of welding, including such forms of welding as, electric arc, oxyacetylene, resistance and gas shielded arc (Tungsten Inert Gas and Metallic-Inert Gas). A study of metals technology might also be a Level III offering including such content as heat treating, testing, characteristics and strengths of metals, special alloys and their properties, etc.

Although these courses are quite specialized, their primary purpose is to meet the more unique interest and needs of the individual and not to prepare him for a specific occupation.

Level IV. Recognizing that the role of industrial arts at this level is to meet the specialized needs of youth, it is not logical to expect that a standardized program could be proposed that would be equally effective in all senior high schools. The strength of industrial arts offerings at this level is its diversity and its adaptability to new conditions and new circumstances. Decisions regarding specific content organization, methodology, as well as the nature of the learning activities are dependent upon the needs, abilities, and interests that characterize a given group of students to be served. The following suggestions are typical of those that may be considered after a study of the needs, interests, and abilities of students in a given school has been made.

* A specialized course which would deal primarily with research and experimental processes could be established for students who are seeking greater understanding and application of the principles and concepts of the physical sciences and mathematics.

While the nature of an industrial arts program is such that a great deal of individual and small group instruction is undertaken, the distinct and separate needs of both the slow and rapid learner are less likely to be met in classes where the range of ability is too broad. Separate classes for the slow and rapid learners are desirable to supplement the basic program in a school.

* Cooperative experiences can be designed between industrial arts and other subjects such as; mathematics, science, and art to provide opportunities to apply knowledge gained through these other courses.

* Another type of class for technical instruction, but not restricted to the gifted student, could be designed for those preparing for future careers in a technologically oriented area such as engineering.

* Many students with semi-skilled occupational interests are deprived of an opportunity for specific training due to the lack of appropriate programs. A specialized course might be organized that would give a greater amount of attention to skill development and work orientation than the typical industrial arts courses given.

* Courses designed especially to contribute to the development of leisure time interests of youth and adults may be organized.

TERMS FOR INSTRUCTIONAL AREAS AND COURSES

Industrial Crafts Area — A category of information and skills concerned with handicrafts and the craft industry, including the tools, materials, processes, projects, and occupations of the industry. Subject matter and learning experiences are organized under various descriptive categories such as art metals, ceramics, crafts (industrial), industrial crafts, leather, textiles, and other crafts (industrial).

Art Metals — The study of metals which are used in the manufacture or fabrication of ornamental products. Learning experiences generally include experimenting, designing, constructing, and evaluating art metal products.

Ceramics — The study of the tools, materials, and industrial processes involved in the manufacture of products made from nonmetallic resources such as rocks, clay, glass, and sand and the various types and uses of ceramic products. Learning experiences generally include experimenting, designing, constructing and evaluating ceramic products.

Crafts (Industrial) — The study of craft industries including the tools, and processes used to produce craft products from a wide variety of materials such as ceramics, leather, rocks, fibers, metals, and woods. Learning experiences generally include experimenting, designing, constructing, and evaluating useful products with emphasis on industrial applications.

Leather — The study of leather and related materials including the tools and processes used to produce leather products. Learning experiences generally include experimenting, designing, constructing, and evaluating products.

Drafting Area — A category of information and skills concerned with conveying ideas or illustrations graphically through drawings, charts, sketches, maps, and graphs and the related factors such as the role of drafting in history and industry. Subject matter and learning experiences are organized under various descriptive categories such as architectural drafting, descriptive geometry, drafting, drafting technology, engineering, drawing, industrial design, mechanical drawing, technical illustration, and other drafting.

Architectural Drafting — The study of the means of communicating, through lines and symbols, information about buildings. Learning activities include the development of preliminary sketches, plans, elevations, sections, and detail drawings and the study of architectural design, the history of structures, building ordinances, and building materials.

Descriptive Geometry — The study of the representation of points, lines, and surfaces by accurate orthographic drawing and the graphical solution of problems according to form and position in space.

Drafting — The study of the communication of ideas through drawings, sketches, charts, graphs, and maps. Learning experiences include the development of skills through the use of drafting instruments involved in lettering, sketching, geometric construction, orthographic and pictorial drawing, auxiliaries, sections, and working drawings.

Drafting Technology — The study of graphic representation with special emphasis placed on technical requirements, specifications, and standards.

Engineering Drawing — A study of the communication of ideas through lines, symbols, and drawings depicting the mechanical details associated with machine parts, including machine design. Learning activities involve the use of technical drawing instruments and techniques.

Industrial Design — The study of industrial products with special consideration being given to (1) aesthetics and the appropriate use of industrial materials and processes, and (2) their value to society. Learning activities involve the development of skills and creative abilities in the use of media for conveying ideas graphically.

Mechanical Drawing — A study of the communication of ideas through lines, symbols, and drawings. Learning activities involve the use of technical drawing instruments to convey ideas graphically, e.g., orthographic projection, pictorial views, and assembly drawings.

Technical Illustration — The study of the techniques of presenting information graphically including schematics, sections, exploded view, and others which illustrate or clarify verbal or written description.

Electricity/Electronics Area — A category of information and skill concerned with electrical energy including theory, applications, and control related to electrically powered equipment and to various kinds of communications equipment and related factors such as occupations, economics, and consumer information. Subject matter and learning experiences are organized under various descriptive categories such as electricity, electricity/electronics, electronics, and other electricity/electronics.

Electricity — The study of sources, measurement, control, and applications of electrical energy such as those used for heating, power, and illumination, as well as some elementary aspects of the use of electrical energy for communication as in devices such as the telegraph, telephone, and radio. Learning activities include demonstration of, experimenting with, designing, constructing, and testing electrical devices.

Electricity/Electronics — The study of sources, measurement, control, and applications of electrical energy in devices such as those used in heating, power, and illumination, as well as those used in communications such as the telegraph, telephone, radio, television, radar, and computers. Learning activities include demonstration of, experimenting with, designing, constructing, and testing electrical devices.

Electronics — The study of the measurement, control, and applications of electrical energy in devices used for communication such as the telegraph, telephone, radio, television, radar, and computers. Learning activities include demonstration of, experimenting with, designing, constructing, and testing electrical devices.

Graphic Arts Area — A category of skills concerned with graphic reproduction are studied as well as related factors such as occupations, economics, and consumer information. Subject matter and learning experiences are organized under various descriptive categories such as graphic arts, photography, photolithography (offset), printing, and other graphic arts.

Graphic Arts — The study of tools, materials, and processes of the printing industry involving block printing, intaglio printing, letterpress printing, lithography, photography, rubber stamp construction, silk screen printing, thermography, type composition, and binding. Learning experiences include designing, composing, printing, and evaluating reproduction techniques, and the study of history, economics, occupations, and consumer information of the printing industry.

Photography — The study of the tools, materials, and processes used in photography with emphasis on industrial uses. Learning activities include experiences using cameras, developing negatives, and making contact prints, enlargements, and mountings.

Photolithography — (Photo Offset Lithography or Offset) — The study of the technology of graphic reproduction from a flat surface or plate prepared photo-mechanically. Learning experiences include design, hot and/or cold composition, paste-up, camera and dark room techniques, platemaking, and offset presswork.

Printing — The study of the industry and technology involved in graphic reproduction from an inked surface, either relief, intaglio, or flat. Activities include design, composition, imposition, press work, and bindery.

Manufacturing — The study of the technology and the socioeconomic contributions of those industries concerned with the creation of durable consumer products. Learning experiences are developed around functions or concepts of industry and include research and experimentation, product design and development, fabrication (custom and mass), packaging, and distribution.

Industrial Materials and Processes Area — A category of information and skills concerned with industrial-technical materials and processes including their properties and utilization as they are fabricated into usable products. Subject matter and learning experiences are organized under various descriptive categories such as fluid power, industrial materials, industrial materials and processes, industrial processes, instrumentation, numerical control, and other industrial materials and processes.

Industrial Materials — The study, analysis, and testing of industrial materials, e.g., metals, hydrocarbons, wood, finishes, plastics, and earth materials, chemical composition, physical and mechanical properties, fabrication limitations, and performance when exposed to a normal industrial and commercial environment.

Industrial Materials and Processes — The study of the properties and utilization of industrial materials as they are fabricated into usable products, including a study of the utilization and control of the power necessary to efficiently process materials.

Industrial Processes — The study of the methods whereby industrial materials are fabricated by hand, machine, and automated equipment to produce usable products.

Instrumentation — The study of devices necessary to observe and control both manufacturing processes and the performance of mechanical and electrical machinery, including the science of measurement as well as the conversion and recording of physical, chemical, and mechanical state and condition into sensible information.

Numerical Control — The study of industrial automation in which specific commands to perform desired machine tool operations are supplied to the machine control mechanisms by means of information previously programed by punched tape, or magnetic tape.

Metals Area — A category of information and skills concerned with metals including the products manufactured from metals; the technology employed in the production, processing, and use of

metals; and related factors such as occupations, economics, and consumer information. Subject matter and learning experiences are organized under various descriptive categories such as metals, metal machining (metal shop), metal technology, sheet metal, welding, and other metals.

Metals — The study of the tools, materials, and processes used in several facets of the metals industries. Learning experiences generally include experimenting, designing, fabricating, forming, and evaluating metals and metal products.

Metal Machining (Metal Shop) — The study of the operations and related information concerned with the shaping of metals by machine.

Metal Technology — The study of the problems and operations involved in the transformation of metal into usable products with special emphasis placed on technical information, qualities, specifications, and standards. Learning experiences include experimenting, creating, designing, constructing, and evaluating metal products.

Sheet Metal — The study of the operations, problems, and related information concerned with forming and fabricating sheet metal products.

Welding — The study of the operations used in cutting and fabricating metal products by welding techniques.

Plastics Area — A category of information and skills concerned with the production, processing, and uses of plastics and related factors such as occupations, economics, and consumer information. Subject matter and learning experiences are organized under various descriptions such as plastics, plastics technology, and other plastics.

Plastics — The study of the tools, materials, and processes used in several facets of the plastics industry. Learning experiences include experimenting, designing, machining, fabricating, forming, and evaluating plastics and plastic products.

Plastics Technology — The study of the problems and operations involved in the manufacture and transformation of plastics into usable products with special emphasis placed on technical information, qualities, specifications, and standards. Learning experiences include experimenting, creating, designing, fabricating, forming, and evaluating plastic products.

Power and Automotive Area — A category of information and skills concerned with the various forms of power including its generation, transmission, and utilization. Subject matter and learning experiences are organized under various descriptive categories such as automotive mechanics, power and automotive mechanics, power mechanics, transportation, and other power and automotive mechanics.

Fluid Power — A study of hydraulics and pneumatics, including power conversion, transmission, and utilization in both stationary and mobile installations.

Power and Automotive Mechanics — The study of the technology involved in harnessing and controlling power, including its source, generation, transmission, and utilization, with specific

emphasis upon the automobile as a device of power conversion, transmission, and utilization.

Power Mechanics — The study of the development, transmission, and utilization of power, including the theory, maintenance, and servicing of machines and devices for the conversion of power into useful forms. Methods and devices for the transmission of power and output machinery for utilizing power are emphasized.

Transportation — The study of operating principles, design, construction, maintenance, and repair of transportation devices, e.g., automobiles, airplanes, trains, and boats, including an understanding of related physical and chemical principles.

Woods Area — A category of information and skills concerned with woods, including various manufactured products, the technology employed in the manufacture and construction of products using woods, and related factors such as occupations, economics, and consumer information. Subject matter and learning experiences are organized under various descriptive categories such as woods, wood technology, and other woods.

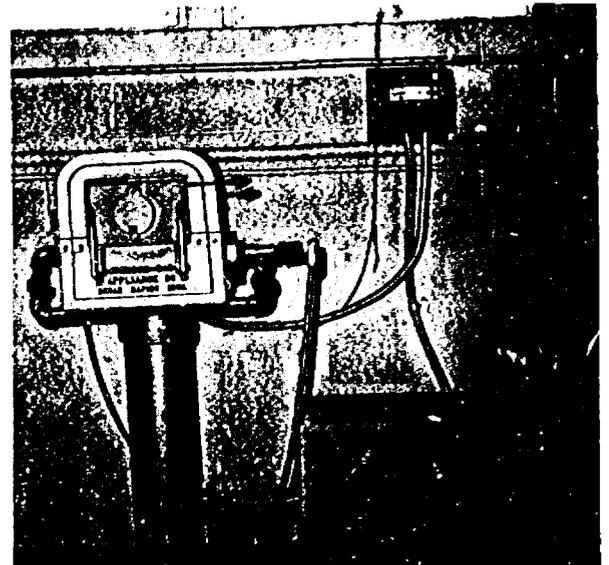
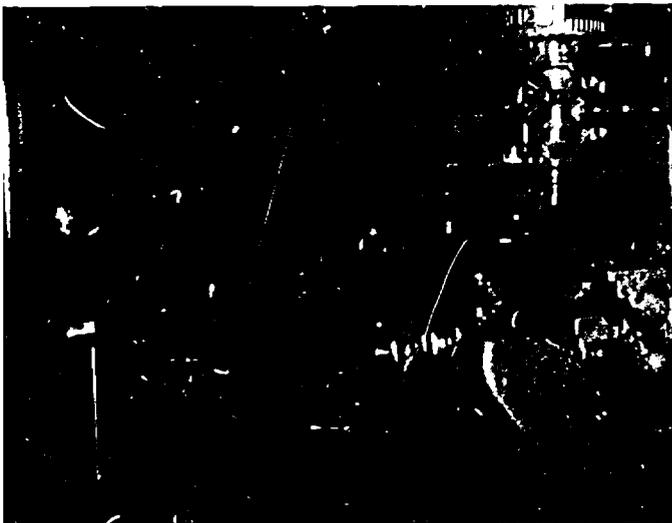
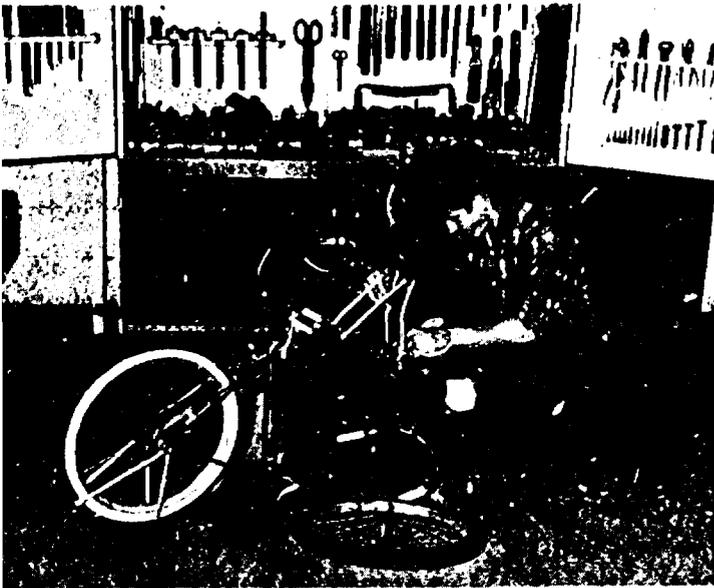
Woods — The study of the tools, materials, and processes used in the woods industries. Learning experiences generally include experimenting, designing, constructing, of wood products and evaluating woods and wood products, using the tools, materials, and processes related to woods industries. The study of such factors as the techniques, economics, and consumer information of the industry are emphasized.

Woods Technology — A study of the woods manufacturing industries and the technology involved in the construction of buildings and the manufacture of articles made from wood and wood products. Learning experiences include experimenting, designing, constructing, operating and evaluating industrial tools, processes, forest products, and related synthetic materials.

PART II

GENERAL CONSIDERATIONS

- Location
- Flexibility
- Sound
- Safety and Health
- Color and Finishes
- Temperature Controls, Ventilation and Exhausts
- Lighting and Electrical Power
- Utilities
- Other Considerations



PART II

GENERAL CONSIDERATIONS

Industrial arts education provides experiences through which the student may acquire skills, knowledges, and appreciations concerning our present day industrial society. As a school subject, it is a study of the materials, tools, processes, organizations and human problems of industry. To satisfy the need, it is necessary to have a well conceived and properly planned industrial arts facility that will provide the basis for the dynamic and stimulating industrial arts curriculum. Along with this, attention has to be given to the contribution which industrial arts makes in the total education of youth. Therefore, this facility is an integral part of the total school plan.

Industrial arts facility planners are confronted with complicated problems in planning facilities. Items of concern which are included in this section of the planning guide deal with location, flexibility, sound control, color dynamics, ventilation, lighting, heating and cooling, and other basic needs.

LOCATION

Industrial arts laboratories should be located in a wing of the main building or in an adjacent building with covered walkways. When possible, laboratories should be placed on the ground floor with an outside entrance to a parking lot or service drive. This entrance should be with a double or overhead door.

Future growth and expandability should be given consideration when designing the instructional facilities. Some other features that deserve consideration are as follows:

- A. North lighting for drafting rooms is most desirable
- B. Laboratories need windows on one side only
- C. One main entrance or exit to main hall or corridor for each laboratory
- D. A double door with removable mullion is recommended for each laboratory
- E. All auxiliary rooms should have openings directly into the laboratories
- F. Toilet facilities, for both boys and girls, should be within 100 feet when not included in the laboratory itself
- G. Convenient outside accessibility is necessary to accommodate adult education groups during non-regular school hours
- H. Accessibility from a service drive for delivery of supplies and equipment
- I. Proximity to those interrelated areas such as: science, art, home economics, and vocational-technical instructional areas

FLEXIBILITY

In this time of change, laboratories must be built with flexibility and expandability expressly in mind. Due to the mobility of our population, enrollment in some schools may change rather rapidly. The experimenting with and changing of instructional approaches will likewise require the utmost of flexibility in facilities. Among the items that will warrant consideration to assure flexibility are:

- A. Partitions between laboratories should be non-bearing walls that are as free as possible of heating and plumbing installations.**
- B. Overhead buss bar type electrical system provides for a great deal of flexibility in relocating machinery and equipment.**

No doubt there are other items that deserve consideration that will add to the flexibility of functional facilities.

SOUND

Due to the nature of the industrial arts program, many noise-producing activities are carried on in the industrial arts department. These noises may be distracting to persons both in the department itself as well as in other areas nearby. Therefore, noise treatment must be provided. In giving special attention to sound control the following items may deserve consideration:

- A. When several laboratories are built in a cluster, the noisier areas may be separated from the quieter areas by storage rooms and offices**
- B. An enclosed planning area separate from the laboratory itself**
- C. Utilization of noise absorption materials such as acoustical materials for ceilings, walls, and floors**
- D. Mounting of machines and equipment on rubber or composition pads. Avoid mounting on columns or other structural members of the building**

It has been shown experimentally that there is an increase of nearly 1/5 in the amount of energy expended when working in a noisy environment as compared with a quiet environment. This in itself indicates the need for giving sound control serious consideration when planning instructional facilities. Because this is a highly technical area, help from a specialist in the field of acoustics should be secured.

SAFETY AND HEALTH

Including the many necessary safety features for adequate and safe instructional facilities is almost an endless task. Although it is an extensive chore, it is one that deserves utmost thought and

consideration. Recognizing that safety education is laced through all areas of the industrial arts curriculum, emphasizes the need for incorporating as many built-in safety features as possible.

Protection from hazards such as: gases, fumes and dust; electrical arc and shock; moving machine parts; and slippery floor surfaces are to mention just a few. More specific items due consideration may include:

- A. A master disconnect switch for the entire power system in each laboratory
- B. All machinery and equipment being properly guarded and shielded
- C. Safety-pilot systems for all kilns, furnaces and ovens
- D. Safety zones marked around each machine with non-skid areas for operator's station
- E. Properly grounded power machines with adequate overload disconnect apparatus
- F. A properly grounded (3 wire) 110-120 volt electrical system
- G. Light fixtures, switches and electrical devices located in finishing or paint rooms must be explosion proof type
- H. Properly installed and adequate ventilation system for the entire area
- I. Adequate exhaust systems for areas with fumes, gases, and dust
- J. Sufficient number of appropriately located and proper type fire extinguishers
- K. Adequate and satisfactory lighting

Consultation with the local fire chief is advisable to insure meeting the local fire and safety code. For the safety check list provided in this guide, refer to Appendix B, page 5-5.

For more specific information regarding safety in school shops and laboratories refer to "An Accident Prevention Program for School Shops and Laboratories — A Suggested Guide for Administrators" listed in Appendix D, page 6-12.

COLOR AND FINISHES

Appropriate colors in the facilities make for more pleasant learning and working conditions. They also aid in the safety program as well as having a great influence on the lighting situation.

Color can destroy or reaffirm the beauty of a building, its utility, its proportion, and its overall space. Furthermore, its psychological effect on pupils must be considered. For example, greens, aquamarines, and blues appear to be restful, while reds are stimulating, yellows exhilarating, and some browns and grays depressing. Northern rooms may be benefited by warm colors; warm exposures, by cool colors.

Attention should be given to surface finishes on walls, woodwork, furniture, and equipment.

Furniture of a neutral color with a nonglare finish is most desirable. Glossy surfaces should be eliminated in order to avoid disturbing glares and highlights.

The frames of machines and equipment should be of neutral shades (gray or green) often times with the immediate work area being highlighted with a color that better reflects the light for increased visibility. The use of bright focal colors on controls and danger points on equipment and machines provides a safer environment, as well as an attractive appearance.

The following safety color code has been suggested by the American Standard Association.

- Red — Used to identify fire protection equipment. Area around or behind such equipment is painted in a red square.
- Orange — Used to designate dangerous parts of machines such as guards, cutting edges, gear boxes, open belts, etc.
- Yellow — Used on construction equipment, coverings or guards on hazardous equipment, ceiling-suspended units, and inside covers of switch and fuse boxes. Yellow, striped with black, is used on handling equipment, traveling conveyors, and low beams in operating areas.
- Green — The basic color for safety units and first-aid equipment. Used on stretchers, first-aid kits, gas masks, safety bulletin boards, etc.
- Blue — Indicates precaution and is used to mark equipment controls, electrical controls, valves, brakes, kilns, etc.
- White — The sanitation color. Used on refuse cans, fountains, and food-dispensing equipment. Also used in corners of dark passageways, stairways, etc.
- Purple — Warns against radiation hazards. It is used on doors leading to dangerous areas and on receptacles for radioactive materials.

TEMPERATURE CONTROLS, VENTILATION, AND EXHAUSTS

Maintaining the proper thermal environment is an important factor in assuring a satisfactory teaching-learning environment. The condition of the air and the surface temperature in the instructional area affects the physical and mental comfort of pupils, therefore, influencing their learning and working efficiency. A carefully controlled atmosphere in laboratories and classrooms reduces excessive stress, strain and fatigue on pupils and teachers alike.

A ventilation system should provide fresh air constantly, especially in small or close spaces such as; the planning areas, teacher's office, dark room and finish room. Air conditioning will be a major benefit with the increase in the utilization of school facilities during the summer months. Many teachers who already have air conditioned facilities indicate that the air is cleaner and less humid, resulting in reduced equipment maintenance and replacement cost.

The following related items are among those that merit consideration in this area when planning instructional facilities for this type of program:

- A. The room temperature should be thermostatically controlled
- B. Finishing rooms should have separate ventilating systems with exhausts that flow directly to the outside
- C. Dust collection equipment for grinders, planers, jointers, saws, sanders, etc.
- D. Hooded exhaust systems for hot metal areas
- E. Exhaust hookups for power mechanics laboratories
- F. Spray booth for each finishing room
- G. An adequate exhaust system for the welding area

LIGHTING AND ELECTRICAL POWER

LIGHTING

Lighting for the instructional facilities may be divided into two categories, natural and artificial. The natural light may enter through windows or sky domes. North and east light should be planned wherever possible, although care should be exercised to avoid glare from these natural sources. Artificial lighting systems should provide a uniform distribution of shadow-free, glare-free illumination that conforms to adopted standards.

General artificial lighting should be provided by indirect or semi-indirect fixtures, the latter provided with ballasts have a low noise level. Local power companies and/or a qualified architect should be consulted for recommendations regarding correct type and number of fixtures to be used.

A General Lighting Chart, Figure 1, page 2-6 provides minimum recommendations regarding the various instructional areas. The following items are among those that require consideration when planning a lighting system for industrial arts facilities:

- A. Fluorescent type fixtures are most often used in drafting rooms. Diagonal mounting helps eliminate shadows.
 Note — Interference filters will be necessary when fluorescent lighting is utilized in the instructional areas utilizing radio and television.
- B. Auxiliary lights may be needed on individual machines where concentrated light is necessary.
- C. The influence of color selection on the lighting situation.
- D. Lighting and fixtures for the finishing room, darkroom, and display areas should meet the special needs of these areas.
- E. Darkening shades or drapes for windows in areas planned for the utilization of visual projectionals.

**FIGURE I
GENERAL LIGHTING CHART**

Recommended Foot Candles of General Illumination at Work Surfaces

Instructional Areas	Rooms						
	Laboratory or Shop	Classroom or Planning Area	Instructor's Office	Material Storageroom	Project Storageroom	Finishing Room	Dark Room
DRAFTING	150	150	30	20	20		
ELECTRICITY/ ELECTRONICS	100	100	30	20	20		
GRAPHIC ARTS	160	30	30	20	20		*
INDUSTRIAL CERAMICS	100	30	30	20	20	100	
INDUSTRIAL CRAFTS	100	30	30	20	20	100	
INDUSTRIAL PLASTICS	100	30	30	20	20		
METALS	100	30	30	20	20	100	
POWER MECHANICS	100	30	30	20	20		
WOOD	100	30	30	20	20	100	

*Special darkroom lights required.

General lighting frequently needs to be supplemented by specific lighting.

ELECTRICAL POWER

The electrical requirements for the power equipment are of vital concern in planning new instructional facilities or revamping existing facilities. Designers of the electrical system for industrial arts departments must make certain that circuits and outlets are adequate in number, kind, and capacity to meet present, as well as future needs of the various laboratories for power machines and lighting in the various laboratories. Centralized boxes or panels utilizing individual circuit breakers and lock-latch doors are highly desirable in every laboratory. A keyed reset switch for panic buttons which are strategically located in the laboratory should also be provided at the master control panel. Sufficient outlets along the walls where power equipment may be located or used are necessary for flexibility; however, tool or cabinet storage and displays should be considered in placing the outlets. Self-retracting drop outlets over benches for portable equipment are desirable.

An overhead buss bar system or an overhead perimeter conduit system may be designed for equipment located throughout the shop. Under floor troughs may also be considered for the electrical power system. In this case, floor type outlets must be covered and flush with the floor. Services should be planned for instructional media, such as; overhead and other projectors, recorders, and closed-circuit television; for clocks, signalling, telephone, and other communications devices; and in the electricity/electronics laboratory, for central and/or individual power supplies. Special attention, such as a red "bulls-eye" jewel indicator to control switch, should be given to electrical service for welders, kilns, electric furnaces, and other equipment with high amperage ratings.

Among the other items that deserve consideration are:

- A. 110/120 volts grounded double wall outlets, located 36-42 inches above the floor and spaced 10-15 feet apart, should be installed along the walls as well as in columns throughout the areas.
- B. For maximum safety, each power machine should be equipped with a magnetic overload switch that is operated with a pushbutton.
- C. Each power machine must have a positive ground.
- D. Single-phase, 110/120 volts is satisfactory for small motors used intermittently; three-phase 208/240 volts best for larger motors using greater amount of power ($\frac{1}{2}$ horsepower and over).
- E. All convenience outlets should be of the three-prong grounded type.
- F. Pilot-light indicators need be provided for equipment that employs electrically heated elements.
- G. All electrical installations must be made according to the National Electrical Code.

Industrial arts instructional laboratories with the exception of the drafting room will require the high voltage, three-phase power system. Either 120/208 volts, three-phase or the 277/480 volts, three-phase grounded electrical system is recommended. Extreme care must be exercised when writing specifications for motors and other electrical apparatus. These specifications must be in accordance with the system installed in the facilities. For example; if the 208 volt system is installed, all motors one-half horsepower or larger should be wired specifically for this particular system.

UTILITIES

Often neglected but important in the operation of industrial arts laboratories are the utility needs — water, gas, air and plumbing. Water needs include two types of sinks: (1) a work type sink with hot and cold water for cleaning equipment, mixing, and quenching work pieces; (2) a hand washing sink which is round, half-round, or trough type. Sinks in the drafting rooms should be built into a cabinet with a hard finish counter. A drinking fountain should be located in the main laboratory area. Floor drains with grease and sand traps should be provided in the finish rooms and some laboratories such as the power laboratory.

Compressed air is needed in many shops for cleaning machines, spray painting equipment, and air driven tools. Several air outlets should be placed throughout the shop to accomodate ease of utilization. The placement of these outlets will be dictated by the location of various work stations and machines.

Metals, crafts, ceramics, plastics, and power mechanics laboratories will need gas service for furnaces, forges, and soldering equipment. Each individual unit should be installed with a separate shutoff valve nearby. The master shutoff valve for the entire system should be located away from the equipment.

**FIGURE II
UTILITY NEEDS**

PROGRAM	Hand Washing Facilities	Water for Quenching and other purposes	Gas	Compressed Air	Toilet*	Floor Drain
Drafting	X			X		
Electricity/Electronics	X		X			
Graphic Arts	X	X				X
Dark Room	X	three tray sink				
Industrial Ceramics	X	double sink	X	X		X
Industrial Crafts	X	double sink	X			
Industrial Plastics	X	X	X	X		
Metals	X	X	X	X	X	X
Power Mechanics	X		X	X	X	X**
Woods	X		X	X	X	X

* A central toilet room might serve all laboratories if properly located.

**Floor drain in Power Mechanics Laboratory should have an oil catch or trap.

OTHER CONSIDERATIONS

Ceilings — Recommended minimum ceiling height for these instructional areas is 10' to 12'. Ceilings in these areas should be finished in the same manner as other classrooms in the building. Unfinished ceilings with exposed joints are unattractive and difficult to maintain. In addition to this, they usually have unsatisfactory sound-absorption and light-reflective factors. Properly installed acoustical ceiling covering contributes greatly to the sound control in this instructional area.

The following chart covers other factors that need to be considered.

**FIGURE III
MISCELLANEOUS CONSIDERATIONS**

INSTRUCTIONAL AREA	RECOMMENDED WORK SURFACES	RECOMMENDED FLOOR COVERINGS*	OUTSIDE ENTRANCE RECOMMENDED
Drafting	Vinyl, Plastic & Wood	Vinyl & Carpeting	
Electricity	Plastic & Wood	Vinyl	
Graphic Arts	Plastic, Vinyl, Metal & Stone	Vinyl	X
Ind. Ceramics	Wood & Plastic	Concrete or seamless vinyl	
Ind. Plastics	Wood, Metal & Plastic	Concrete or Vinyl	
Ind. Crafts	Wood & Metal	Concrete or Vinyl	
Power Mechanics	Wood & Metal	Concrete or wood	X Overhead Door
Woods	Wood	Vinyl and wood	X Double or Overhead Door
Metals	Wood and Metal	Concrete and wood	X Double or Overhead Door

*Use non-skid materials around major fixed machines for safety purposes.

PART III

THE PROGRAM AND SPACE NEEDS

General Description and Objectives

Recommended Course Offerings

Space Allotment

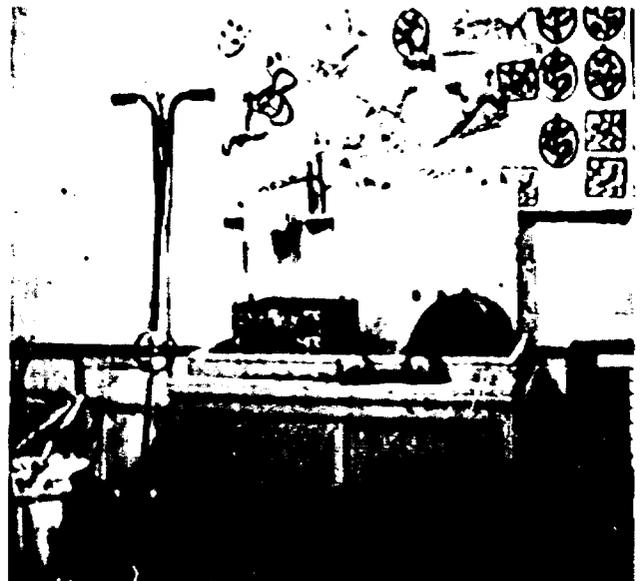
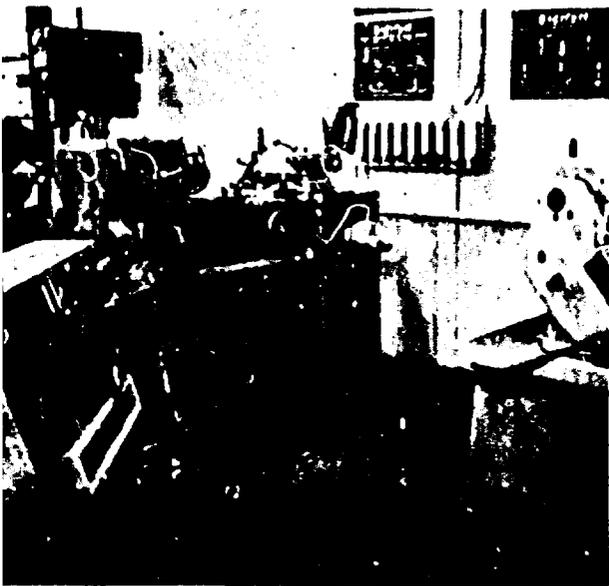
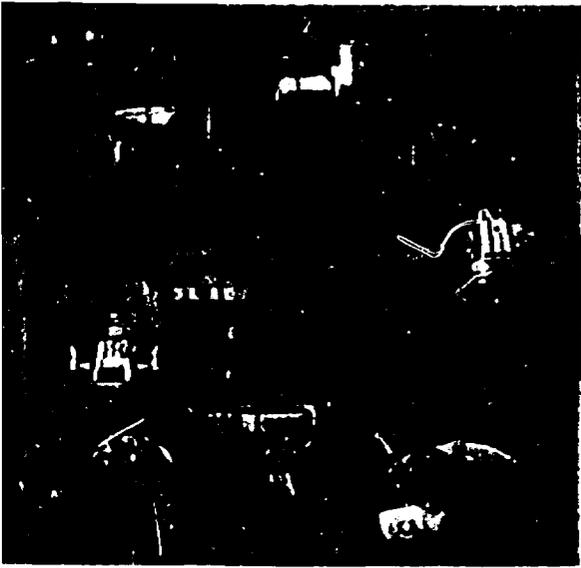
Area laboratories

Auxiliary Areas

Storage

Growth and Expansion

Departmental Library or Resource Center



PART III

THE PROGRAM AND SPACE NEEDS

GENERAL DESCRIPTION

The basic element of the industrial arts program is the study of industry and its associated technology. As formally organized in the school program, it is a body of subject matter planned to develop skills, understandings, and attitudes related to industry and technology. Learning experiences involve activities such as experimenting, designing, constructing, and evaluation through the application of tools, machines, materials, and processes which provide opportunities for creativity and problem solving.

Industrial arts is frequently defined as a phase of general education (common learnings desirable for all), which is acceptable at the elementary and junior high school level; however, this limited definition is not adequate for the senior high school. Industrial arts has educational value beyond common learnings, as it also contributes to the specialized needs and interests of individuals. This restricted definition of industrial arts resulted from past attempts to dichotomize education into two categories — general and vocational.

The present frame of reference for industrial arts is based upon the concept of an educational continuum ranging from general to specialized education. Specialized education encompasses those school experiences designed to take into account and/or promote unique interests, needs, and abilities rather than those that are common to all. Industrial arts can meet many specialized needs of youth at the secondary or post-secondary level. Although some of these needs are occupational, there are many that are not directly related to occupational life.

The systematic study of industry and technology is an essential part of the education of all youth from the elementary school through college. At each educational level, the subject is organized to take advantage of the interests and needs of the student.

Industrial arts education provides an opportunity for individuals to participate in direct experiences involving industrial skills and processes which fosters an awareness of industry in American culture. These experiences are concrete, meaningful, and have educational value as they aid the individual in understanding abstract ideas. These experiences provide opportunities for an individual to apply mathematics, science, art, language arts, and other school subjects on purposeful situations.

Industrial arts education aids in the discovery and development of personal interests, aptitudes, creative thinking and technical abilities. Responsible and resourceful actions and judgments are matured through problem solving and self-expression in an environment related to industry. The future scientist or engineer may learn to solve technical problems, and the future technician or craftsman may develop skills and related understandings in industrial arts courses.

OBJECTIVES

Realistic objectives, clearly stated, are essential to a sound program of industrial arts education. The following statements of purpose are fundamental to quality industrial arts education as it provides opportunities for students to:

* Develop an insight and understanding of tools, machines, materials, and processes as they relate to the production and servicing aspects of industry. The field of industrial arts education is concerned with the study of materials and processes of industry and the creative use of design. Students of industrial arts education have an opportunity to gain a better understanding of mass production, automation, and other industrial methods if they actively participate in meaningful experiences dealing with the manufacturing of consumer goods, utilization and generation of energy as well as the servicing, testing, and repairing of industrial products.

* Discover and develop abilities, aptitudes, and interests related to the technical pursuits and applied sciences.

Opportunities for students to have experiences which assist in the discovery of abilities and to develop their potentialities to the fullest is essential to the basic education of all youth. Allowance for differences of abilities, interests, and needs should be incorporated into the curriculum offerings so the student can better assess his abilities and interests for making an occupational choice, understanding his environment, and preparing himself to meet the changing demands of a technological society.

* Develop basic skills in the safe and proper use of industrial materials, tools, machines, and processes.

Students are provided with experiences which help them develop basic skills relevant to industrial production and servicing. Through these experiences, students gain a basis for making occupational choices. In addition, the skills provide a basis for specialized occupational preparation. Many workers of the future will be required to train and retrain for different occupations during their lifetime. Fundamental skills and knowledge in diversified areas are most essential if this retraining is to be accomplished in an efficient manner.

* Develop problem-solving and creative abilities relating to the tools, machines, materials, processes, and products of industry.

The industrial arts education program provides opportunities for solving various types of technical problems through research and experimentation as well as project planning and construction. The industrial arts laboratory setting provides an environment which makes possible a concrete, understandable approach to the development of critical thinking and problem solving skills. Problem-solving in industrial arts education involves creative thinking and provides experiences which allow students to find solutions to problems and to evaluate the effectiveness of these solutions.

The preceding general description and objectives are as they appear in the Handbook for Industrial Arts Education — 1969 published by the Missouri State Department of Education.

RECOMMENDED COURSE OFFERINGS

Figure IV, page 3-3 indicates the recommended sequence by levels for Industrial Arts Courses as outlined in the Handbook for Industrial Arts Education, page 2-2.

**FIGURE IV
RECOMMENDED SEQUENCE BY LEVELS FOR INDUSTRIAL ARTS COURSES**

LEVEL I Grades 6-7-8-9

EXPLORATORY INDUSTRIAL ARTS. (General Shop)

This course offers a wide range of experiences in a comprehensive general shop, or in several area shops depending on the facilities available. Experiences will be provided which encompass the study of areas such as: metals, drafting, electricity, graphic arts, ceramics, power, plastics, wood, and leather. Possible organizational patterns are shown in Appendix B on pages 6 & 7 of the Handbook for Industrial Arts Education.

Suggested Courses or Content Areas						LEVEL II*				Grades 9-10-11-12										
Suggested Courses or Content Areas		LEVEL III		Grades 10-11-12		LEVEL IV		Grades 11-12		LEVEL V		Grades 12								
Drafting		Electricity		Graphic Arts		Industrial Ceramics		Industrial Crafts		Metals		Industrial Plastics		Power Mechanics		Woods		Innovations or Combinations		
Machine Drafting	Technical Drafting	Architectural Drafting	Graphics	Advanced Electricity	Electricity/Electronics	Electrical Power	Printing	Photography	Offset	Lithography	Metal Machining	Sheet Metal	Welding	Metal Technology	Plastics Technology	Power/Systems	Aerospace Technology	Wood Machining	Wood Technology	Industrial Mechanics

Suggested Content Areas **LEVEL IV** **Grades 11-12**

Advanced or experimental work in a specialized phase of industrial arts; courses named accordingly. Prerequisite: Level III work in the same area, or special arrangement approved by the instructor.

*1. Beginning at Level II the student with special interest in the field of Industrial Arts, should be encouraged to schedule in his high school program, according to ability and time, supporting subjects such as Industrial Mathematics, General Physics, Algebra I, elementary Trigonometry, and Geometry I.

2. Students may enter vocational-industrial or technical education courses upon successful completion of related Level II or Level III in industrial arts courses.

SPACE ALLOTMENT

LABORATORIES

For Area Laboratories. The following chart indicates the minimum recommended space allotment for the area laboratories (excluding auxiliary areas).

**FIGURE V
RECOMMENDED MINIMUM SPACE ALLOTMENT**

AREAS	JUNIOR HIGH SCHOOL			SENIOR HIGH SCHOOL		
	Square Ft. Per Student	Number of Students	Square Ft. Per Area	Square Ft. Per Student	Number of Students	Square Ft. Per Area
DRAFTING	55	24	1320	75	24	1800
IND. CERAMICS	55	24	1320	75	24	1800
IND. CRAFTS	55	24	1320	75	24	1800
IND. PLASTICS	55	24	1320	75	24	1800
GRAPHIC ARTS	55	24	1320	75	24	1800
METALS	70	24	1680	85	24	2040
ELECTRICITY	70	24	1680	85	24	2040
POWER MECHANICS	70	24	1680	85	24	2040
WOODS	80	24	1920	95	24	2280

¹ *For Multi-Area and Comprehensive General Shop Laboratories.* Since the space needs for the multi-area and comprehensive general shop laboratories are greater than those of the area laboratories the following procedure is recommended to determine the minimum space allotment for multi-activity type laboratories (excluding auxiliary areas).

1. Add the total square feet recommended for each area to be included in the multi-activity program.
2. Determine the average of this total and add 1/3 more because it is a multi-activity program.

Example — A Senior High Level I Shop

Woods	2280
Industrial Crafts	1320
Industrial Plastics	1320
Industrial Ceramics	1320

$$\begin{array}{r}
 6240 \div 4 = 1560 \\
 1/3 \text{ more} \quad + \quad 520 \\
 \hline
 2080 \text{ Sq. Ft.}
 \end{array}$$

¹ Willis H. Wegner, *Planning Industrial Arts Shop*, State College of Iowa, Cedar Fall, Iowa, 1966. Page 11.

AUXILIARY AREAS

The following chart indicates the recommended square feet allotment.

FIGURE VI

AUXILIARY AREA	Drafting	Woods	Electricity	Power Mechanics	Metals	Industrial Crafts	Industrial Plastics	Industrial Ceramics	Graphic Arts	COMMENTS
Classroom or Planning Area										Separate & adjacent to lab or shop with connecting door and windows.
Material Storage	50	100/150	50	100	100	75	75	75	75	See Storage of this section for types of Material storage.
Project Storage	50	200	100	100	125	75	75	75	50	See Storage of this section for types of project storage.
Office	90 100		SAME FOR ALL AREAS							
Dark Room									125	Separate, adjacent, Instructors closet. Observation windows.
Finishing Room	150				100			100		Maze entrance. Observation windows.
Tool Room		75	75	75	75	50	50	50	50	Many instructors prefer tool cabinets throughout the shop.

STORAGE

Two kinds of storage should be considered for the comprehensive general shop -- project and material storage. As a rule you can figure approximately 100 square feet for material storage and 150 square feet for project storage.

The storage can vary as follows:

	MATERIAL STORAGE	PROJECT STORAGE
Drafting	Cabinets & shelves	Pigeon-holes or drawers
Electricity	Cabinets & shelves in lab or separate room	Separate room with shelves
Graphic Arts	Shelves in cabinets or separate room (shelves 26" deep)	Cabinets or separate room with shelves for laying material flat.
Metals	*Racks for storing sheet metal 4' X 14'. Racks for storing flats, angles, etc. up to 21' in length.	Floor space in a separate room for large projects & shelves for small projects.
Woods	*Racks to hold lumber up to 14'. Racks for plywood 4' X 8'.	Floor space in separate room for large projects & shelves for small projects.
Power Mechanics	Shelves, cabinets, and benches in separate room	Shelves, cabinets, & benches in separate room.
Industrial Plastics	Shelves in cabinets	Shelves in separate room or cabinet or lockers.
Industrial Crafts	Shelves in cabinets	Shelves in separate room
Industrial Ceramics	Shelves in cabinet or separate room	Shelves in cabinet or separate room.

Small supplies storage should provide for such things as nails, screws, glue, etc. Built-in cabinets with drawers or metal bins or shelves provided for this small supply storage.

Finish room storage should provide fireproof cabinets for finishing supplies, paint varnish, lacquer, etc. If adult evening classes will use the facilities consideration must be given to project and supply storage. The supply storage is necessary if different instructors are employed for the adult classes. Consideration should also be given to storage of custodial supplies, etc.

*Racks can be made of 2" pipe or angle iron. Racks can be fastened to the wall or stand alone on the floor.

GROWTH AND EXPANSION

It is suggested that generally two instructional laboratories be provided in schools with enrollment up to 250 — a drafting room and a comprehensive general shop. For each additional 250 students, an additional laboratory may be required. When more than two laboratories are provided, specialized unit, area, or multi-area laboratories may replace the comprehensive general shop. In larger schools a duplication of similar laboratories may be provided to meet local requirements.

As school enrollments increase, provisions need to be made for orderly growth and expansion of the various instructional areas and departments. Frequently, it is necessary to utilize a particular classroom or laboratory for more than one area of instruction. Therefore, it is advisable to cluster the instructional areas that are somewhat similar or compatible. This is a method of “phasing in” additional areas to enhance the instructional program. Figure VII indicates the compatible instructional areas.

**FIGURE VII
COMPATIBLE AREAS**

Size of School	Laboratory No. 1	Laboratory No. 2	Laboratory No. 3
Small School	Drafting Graphic Arts Electricity	All other areas	
Medium & Large Schools	Drafting Graphic Arts Electricity	Woods Industrial Crafts Ind. Plastics* Ind. Ceramics	Metals Power Mechanics Electricity*

*Can operate in Laboratory No. 2 or 3.

DEPARTMENTAL LIBRARY OR RESOURCE CENTER

There has been a great deal of discussion in recent years about a combination departmental resource center and planning area. This area would serve as the library for study; designing and sketching; for audio-visual aids utilization by individual and for group instruction.

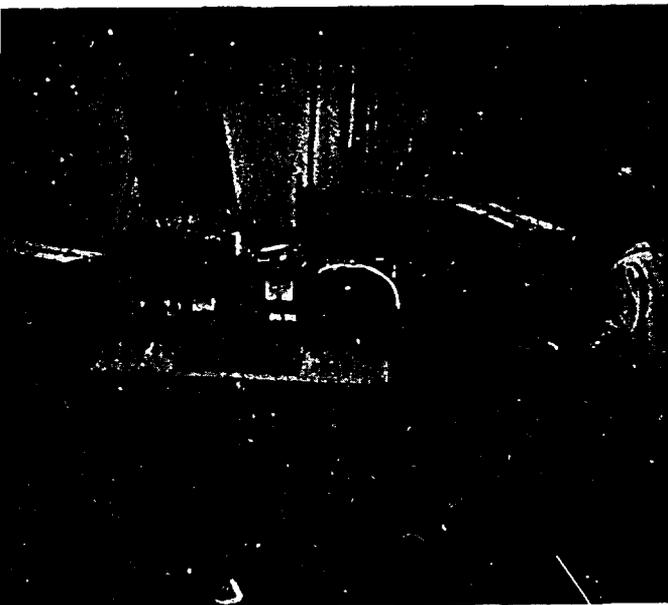
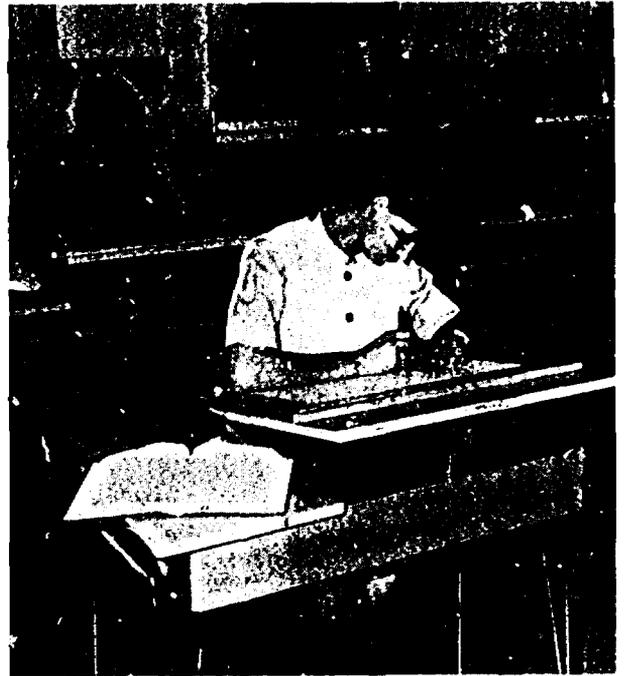
A space of approximately 600 square feet located in or between laboratories would be convenient. This room should be enclosed with glass partitions, so the instructor could visually supervise the pupils' activities without being in the area.

The library should be provided with: chalkboard, bulletin board, reading and drafting tables and chairs, storage space, bookcases, magazine racks, card files, and filing cabinets, space for instructional equipment, teaching aids, and displays; electrical outlets for various items of audio-visual equipment.

PART IV

EQUIPMENT AND FURNITURE

Basic Principles of Equipment Layout
Recommended Equipment Lists
Elementary Industrial Arts
Exploratory Industrial Arts (General Shop)
Drafting
Electricity/Electronics
Graphic Arts
Industrial Ceramics
Industrial Plastics
Metalworking
Power
Woodworking



PART IV

EQUIPMENT AND FURNITURE

BASIC PRINCIPLES OF EQUIPMENT LAYOUT

Arrangement of equipment and furniture will naturally be influenced by the curriculum and the methods of instruction. However, the following suggestions will be helpful in the placement of equipment in many situations.

1. All work stations must include sufficient floor area for the equipment and the student, so the operations can be performed safely and without interference from the other work stations or laboratory traffic.
2. Hazardous work stations and equipment should be "pocketed" and otherwise protected to isolate the worker and to insure safety to other students in the laboratory to minimize the possibility of accidents. These stations may be located some distance from the main entrance and away from major traffic lanes.
3. The equipment should be arranged so that the material being processed does not interfere with other work stations or laboratory traffic. Position equipment to allow for material clearance such as saws, planers, and joiners require 12 to 16 feet front and back.
4. Arrange tall equipment so that visual control throughout the laboratory will not be obstructed.
5. Arrange equipment having related operations so the proper sequence of work can be easily followed with a minimum of student and material movement.
6. Position equipment to provide for safe operation by the operator and to protect other students. For example, the circular saw must be located so that a kick-back will not endanger other students.
7. Provide distinct travel aisles between major areas such as supply centers, storage, tool centers, planning areas, and entrances. Heavy traffic areas should be at least four feet wide. Operators should not be in traffic aisles when operating equipment.
8. Arrange work stations, tool panels, and supply centers so the operations and processes of an activity can be carried out by the students with a minimum of travel.
9. Provide extra space where students tend to congregate, such as around lockers, entrances, and tool panels.
10. Group equipment that have similar requirements for dust collection, ventilation, power, air or gas. Adequate ventilating hoods are also essential.
11. Provide work surfaces next to equipment such as drill presses, jointers, shapers and saws where additional work pieces can be stacked.
12. Arrange equipment so that it can be easily cleaned, maintained and serviced.

13. When locating equipment, be certain to include and show on drawings special features necessary for safe and efficient operation. Arc welding, for example, must be confined to some kind of a booth because of the harmful flash.

RECOMMENDED EQUIPMENT LISTS

The following equipment lists are taken from the publication *A Guide for Equipping Industrial Arts Facilities*. Copies of this publication, NEA Stock No. 641-20290, may be obtained from the American Industrial Arts Association, 1201 16th Street N.W., Washington, D.C. 20036 at a cost of \$4.75.

HOW TO USE THE EQUIPMENT LISTS

It should be emphasized that the lists presented in each Section are provided as recommendations and should be considered open and flexible. They are suggested only as a guide.

Any selection of equipment and tools for inclusion in these lists necessarily involves choices among alternatives. It is not intended that any one school should buy all of the items recommended, nor is this necessary. However, the purchase of all items in each list would assure the kind and amount of equipment sufficient to carry on basic processes within each area.

Each list contains the following information:

Section

Level — Note that the traditional school grade level is avoided in this listing; introductory experiences are considered as basic regardless of the grade level at which they are offered.

Subsection — Tools and equipment have been grouped according to their common use or association, and have been listed within subsection lists.

Item — The common name of the tool, machine, or furnishing.

Number — The quantity recommended is for a class of approximately 24 students. Two Sections (Elementary and General Shop) have unique requirements; instructions for these Sections appear with their respective lists.

ELEMENTARY INDUSTRIAL ARTS

NOTE: Quantities of tools presented in this list are arranged into columns according to the requirements of different types of elementary school programs:

Column I — Schools with central activities room for approximately 24 students.

Column II — Activity room adjacent to regular classroom for 4-8 students.

Column III — Work bench(es) and/or tool cabinet in regular classroom — 4-8 students.

Column IV — Portable tool kit or cabinet — 4-24 students.

Grade level designations in the list are as follows:

A — recommended for K and grades 3

B — recommended for grades 4-6

C — recommended for grades 7-8 (when included as a part of the elementary school).

I. Woodworking Tools	Quantities Recommended				Grade Level	I. Woodworking Tools (cont.)	Quantities Recommended				Grade Level
	Column: I	II	III	IV			Column: I	II	III	IV	
I. WOODWORKING TOOLS											
Awl, Scratch — 6"	1	1	1	1	ABC	Clamp, Spring (no. 2)	12	12	12	12	ABC
Bench Hook wood, approx. 5/8" x 5" x 10"	6	6	6	6	ABC	Drill, Hand (1/4")	3	2	2	2	ABC
Bench, Saw 13" x 24" x 18"H	1	1	1	1	ABC	Files (assorted sizes, shapes, and cuts, with handles, as specified)					
Bit, Auger (set) sizes 4-16	1	1	1	1	ABC	Length Name of Shape Cut					
Bit, Expansive from 7/8" to 3"	1	1	1	1	BC	8" Cabinet (half- round)	12	12	12	12	ABC
Brace, Ratchet — 10"	2	2	2	2	ABC	8" Mill Second-Cut	6	6	6	6	ABC
Brad Driver automatic, self-centering	1	1	1	1	ABC	8" Square Second-Cut	6	6	6	6	ABC
Burnisher — 4 1/2" blade	1	1	1	1	BC	8" Round Second-Cut	6	6	6	6	ABC
Chisel, Butt (set) 3" blade, sizes 1/4", 1/2", 3/4", 1", 1 1/4", 1 1/2"	1	1	1	1	C	File, Card and Brush 9 1/2", brush 1 1/2" x 5"	4	2	2	2	ABC
Chisel, Carving (set) approx. 6"	1	1	1	1	ABC	Gauge, Auger bit	1	1	1	1	ABC
Chisel, Cold (set) cutting edge of 1/4", 3/8", 1/2", 3/4"	1	1	1	1	BC	Hammer, Claw (7 oz.)	6	4	4	6	ABC
Clamp, Bar (36")	2	2	2	2	BC	Hammer, Claw (10 oz.)	6	4	4	6	ABC
Clamp, "C" (2")	12	6	6	12	ABC	Hammer, Claw (13 oz.)	4	1	1	4	ABC
Clamp, "C" (3")	24	12	12	24	BC	Jointer (6") floor model; motor 1/2 HP, 60 cycles; 3-phase; 220V, with magnetic switch and overload protection	2				BC
						Knife, Putty approx. 1"W	1	1	1	1	ABC
						Knife, Sloyd blade approx. 2 5/8"L	2	2	2	2	ABC

I. Woodworking Tools (cont.)	Quantities Recommended					Grade Level	II. Metalworking Tools (cont.)	Quantities Recommended					Grade Level
	Column: I	II	III	IV				Column: I	II	III	IV		
Miter Box with 26" x 4" back saw	1					ABC	Gauge, Wire and sheet metal (American) sizes 0-36	1	1	1	1		ABC
Nail Set (1/16" tip)	1	1	1	1		ABC	Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	1	1	1	1		ABC
Nail Set (3/32" tip)	1	1	1	1		ABC	Hammer, Ball peen (2 oz.)	2	2	2	2		ABC
Plane, Block 1 5/8" cutter	2	2	2	2		A	Hammer, Ball peen (4 oz.)	4	4	4	4		ABC
Plane, Smoothing length 9", blade width 1 3/4"	1	1	1	1		C	Hammer, Chipping	1	1	1	1		ABC
Sander, Finishing heavy duty	1	1	1	1		BC	Kiln, Enameling interior 4" x 8 1/2"; 110V AC; 10 amps.	1	1	1	1		BC
Saw, Back (12")	6	4	4	6		ABC	Punch, Center (set) set of 5; 1/16" to 1/4"	1	1	1	1		BC
Saw, Compass (set)	1	1	1	1		ABC	Punch, Hand (set) set of 7; 3/32" to 9/32"	1	1	1	1		BC
Saw, Coping 6 1/2" pin end	12	8	8	12		ABC	Riveter, "Pop" (set) adjustable to receive 9"-12" blade	1	1	1	1		BC
Saw, Hand, Crosscut 22", 10 point	6	2	2	6		ABC	Saw, Hack (hand) 8"	1	1	1	1		BC
Sawhorse (18")	8	4	4	8		ABC	Sheet Metal Tool 10"L	1	1	1	1		BC
Sawjack approx. 5/8" x 5" x 10"	24	6	6	24		ABC	Snip, Aviation (combination and straight)	1	1	1	1		ABC
Scraper, Cabinet 2 3/4" blade	4			4		BC	Snips, Tinner's, Straight (no. 8)	1	1	1	1		ABC
Scraper, Hand approx. 3" x 5" steel blade	2	2	2	2		ABC	Soldering Copper, Electric (60W) 1/2 copper tip with stand	1	1	1	1		BC
Vise, Woodworker's portable; clamps on type	2	2	2	2		ABC							
II. METALWORKING TOOLS							III. PLASTICS TOOLS						
Divider, Wing 6" steel	1	1	1	1		ABC	Hot Plate, Electric 110V	1			1		ABC
Dresser, Grinding wheel	1	1	1	1		ABC	Oven 12"W x 10"H x 10"D; adjustable shelves; 220V; 3-phase or 110V; single-phase	1					ABC
File Card and Brush 9 1/2"L, brush 1 1/2" x 5"	24	24	24	24		ABC							
File, Needle (set) set of 12, 5 1/2"L, assorted shapes	1	1	1	1		ABC							

III. Plastics Tools (cont.)	Quantities Recommended					Grade Level	IV. Leatherworking Tools (cont.)	Quantities Recommended					Grade Level
	Column: I	II	III	IV				Column: I	II	III	IV		
Strip Heater 23" minimum length; 110V, 250W	1	1	1	1	ABC	Stamp, Leather (set)						ABC	
Thermoforming Press, Vacuum (small) approx. maximum set size 8" x 8", 110V heater	1				ABC	Veiner, Leather stamp	3	3	3	3	ABC		
IV. LEATHERWORKING TOOLS						V. GRAPHIC ARTS TOOLS							
Beveler	5	5	5	5	ABC	Brayer, Block printing 4" width	4	4	4	4	BC		
Board, Cutting approx. ¾" x 8" x 10", maple	24	6	6	24	ABC	Cutter, Linoleum (set) (push-type)	6	4	4	6	BC		
Chisel, Thonging (4-prong) (1/8")	1	1	1	1	ABC	Cutter, Linoleum (set) (pull-type)	6	4	4	6	BC		
Chisel, Thonging (3-prong) (1/8")	2	2	2	2	ABC	Press, Block printing	1	1	1	1	BC		
Chisel, Thonging (single-prong) (1/8")	2	2	2	2	ABC	Slab, Inking approx. 6" x 6" x ¼" or heavier	1	1	1	1	ABC		
Chisel, Thonging (single-prong) (3/32")	1	1	1	1	ABC	VI. CERAMICS TOOLS							
Eyelet Setter	1	1	1	1	ABC	Gloves, Asbestos (pair)	1				BC		
Gauge, Draw	1			1	ABC	Kiln, Electric fire chamber 6½" x 7" x 4"; temp. 3,000 F; 208V or 220V AC	1				ABC		
Knife, Carving (set) to include 3 blades no. 1, no. 2, no. 6 sizes	2	2	2	2	BC	Modeling Tool (set) kit of 10 tools	3	3	3	3	ABC		
Knife, Head 4½"L; 2 3/8" in center	1	1	1	1	ABC	Pyrometer, Portable 30" thermocouple; range to 2500 F	1				ABC		
Knife, Skiving	2	2	2	2	ABC	Sponge, Elephant ear shape	1	1	1	1	ABC		
Knife, Swivel cutter	4	4	4	4	BC	Stilts, Kiln	144				ABC		
Mallet, Rawhide 10 oz.	12	4	4	12	ABC	Triangle, Kiln	144				ABC		
Punch, Leather, Revolving (8"L)	1	1	1	1	BC	VII. WEAVING							
Sewing Machine portable or upright	1				BC	Loom, Table 4 harness; 8" weaving space	3			3	BC		
Skife	2			2	ABC	Needle, Knitting (pair) 10"	12	6	6	12	BC		
Snap Fastener (set)	2	1	1	2	ABC	Needle, Raffia (card) 2 needles; 1 straight, 1 curved	24	8	8	24	ABC		

VIII. General Furnishings	Quantities Recommended				Grade Level	VIII. General Furnishings (cont.)	Quantities Recommended				Grade Level
	Column: I	II	III	IV			Column: I	II	III	IV	
VIII. GENERAL FURNISHINGS						Compass, Pencil	6	6	6	6	ABC
Bench, Elementary, Work wood; craft type; 4 station; top approx. 36" x 47" recommended height; K-24"; primary-27"; intermediate-30" with storage	6	1 to 6	2		ABC	Cutter, Glass	1	1	1	1	ABC
Bench, Woodworking (4 place) 2¼" x 54" x 64" laminated maple top; 2 base units; 36" x 21" x 31"H; equipped with 4 vises	6	2	2		ABC	Desk, Teacher's approx. 42" x 30" x 29"H, welded steel construction	1	1	1		ABC
Blow Torch portable; propane	1			1	BC	Drill, Electric Portable (¼")	1	1	1	1	ABC
Bookcase approx. 60"H x 10"-12"D x 72"L, 3 adjustable shelves, wood or metal	1	1	1	1	ABC	Drill Stand, Fractional for twist drills from 1/16" to 1/2" by 64ths	1	1	1	1	ABC
Broom, Push 18" in length	3	3	3		ABC	Drill, Twist, Straight shank (fractional set) high speed steel, by 64ths 1/16" to 1/2"	1	1	1	1	ABC
Brush, Bench	12	4	4	6	ABC	Fire Blanket	1	1	1	1	ABC
Buffer, Pedestal 2-6" x 1" muslin wheels; wide clearance design; motor 1/3HP; 1725 RPM; 115 V; single phase; 60-cycle; manual starter with overload protection	4				BC	Fire Extinguisher	2	2	2		ABC
Cabinet, Filing 4 drawer, 52"H x 15"W x 28½"D	1	1	1		ABC	First Aid Kit	1	1	1	1	ABC
Cabinet, Storage steel construction, approx. 36" x 48" x 24"D		1	1		ABC	Flocking Gun	1				BC
Cart, Stock metal construction, approx. 36"L x 24"W x 32"H	1			1	ABC	Gloves, Rubber (pair)	1	1	1	1	ABC
Cart, Tool mobile unit; equipped with "junior size" tools when possible, to accommodate up to 20 students				1-2	ABC	Goggles (spectacles), clear observation	10	4	6	6	ABC
Chair, Teacher's welded steel construction, swivel, with casters	1	1	1		ABC	Grinder-Buffer, Bench, Combination motor ¼ HP; 1725 RPM; 115V; 60-cycle; with manual starter and overload protection	1				BC
						Marker, Felt-tip, Color (set) complete with polishing kit	6	2	2	6	ABC
						Oiler, Bench	6	2	2	1	BC
						Oilstone, Combination, India course and fine grits, 8" x 1" x 2"	4	2	2	2	ABC
						Pan, Dust 12" steel	1	1	1	1	ABC
						Pencil Sharpener, Standard	1	1	1		ABC

VIII. General Furnishings (cont.)	Quantities Recommended				Grade Level	VIII. General Furnishings (cont.)	Quantities Recommended				Grade Level
	Column: I	II	III	IV			Column: I	II	III	IV	
Pencil, Woodburning	3	2	2	3	ABC	Scissors (8")	2	2	2	2	ABC
Pliers, Combination (6")	2	1	1	2	ABC	Screen, Projection	1	1	1		ABC
Pliers, Diagonal-cutting (6")	2	2	2	2	ABC	Screwdriver, Standard bit (set) changeable blades	1	1	1	1	ABC
Pliers, Electrician's (8")	1	1	1	1	A	Screwdriver, Standard bit (round blade) (set) set of 5, blade widths 3/16", 1/4", 5/16", 3/8", 1/2"	1	1	1	1	ABC
Pliers, Needle nose (6")	1	1	1	1	ABC	Shield, Face	3	1	1	2	ABC
Pliers, Vise-grip wrench (7")	1	1	1	1	BC	Soldering Gun, Electric	1	1	1	1	C
Projector, Filmstrip (35mm) and slide (2" x 2")	1	1	1		ABC	Spoons, Measuring (set)	1	1	1	1	ABC
Projector, Motion picture, Sound	1	1	1		ABC	Square, Steel framing 12" x 24"	3	1	1	2	ABC
Projector, Overhead	1	1	1		ABC	Square, Try (6")	6	2	2	6	ABC
Protractor, Semi-circular	2	1	1	2	ABC	Square, Try (8")	4	2	2	4	ABC
Rule, Flexible, Steel tape (8')	1	1	1	1	ABC	Table, Overhead projector portable, 26"H	1	1	1	1	ABC
Rule, Steel (12")	2	2	2	2	ABC	T Bevel (6")	1	1	1	1	C
Sander, Band portable, band 1" x 42", 1/2HP, 110V AC	1				BC	Tumbler, Lapidary 25 lb. cap, 1/4 HP motor, 115V AC, 60-cycle	1	1	1		BC
Saw, Band, Wood-cutting 14" floor model; motor 1/2 HP; 60-cycle; 208V or 220V; 3-phase; with magnetic switch and starter	1				C	Wrench, Adjustable end (8")	1	1	1	1	ABC
Saw, Circular, Power 10" floor model; motor 1 1/2 HP; 60-cycle; 208V or 220V; 3-phase; with magnetic switch and starter	1	1			ABC						
Saw, Jig (scroll) 2", metal stand, 1/3 HP, 60-cycle AC, 115V	1				ABC						
Saw, Sabre (bayonet) portable; heavy duty	1			1	BC						

LEVEL I
EXPLORATORY INDUSTRIAL ARTS (General Shop)

I. General	Quantity	I. General (cont.)	Quantity
I. GENERAL		Can, Safety (1 qt.)	4
Awl, Brad	2	Can, Safety (1 gal.)	2
Awl, Scratch (6")	3	Chair, Teacher's welded steel construction; swivel base with casters	1
Bench, Wall type top 100" x 24" x 2¼"T; laminated top; height 32"; bolted construction	2	Chisel, Butt (set) 3" blade; plastic handles; sizes ¼", ½", ¾", 1", 1¼", 1½"	2
Bench, Woodworking (4 place) 2¼" x 54" x 64"; hard maple top; mounted on two 36"W x 21"D x 31"H base units; wood or metal; with 4 vises	5	Clamp, Spring (no. 2)	12
Bookcase approx. 50"H x 10-12"D x 72"L; 3 adjustable shelves; wood or metal	1	Compass, Pencil	6
Broom, Push 18" in length	3	Compressor, Air 120 p.s.i.; motor 1½ HP; 3-phase; 208 or 220V; 60 gallon tank	1
Brush, Bench	12	Countersink, High speed ¼" shank; ½" size	2
Brush, Wire overall length 10"-14"; width 1"; wire length approx. 1-3/16"	6	Cutter, Glass	1
Buffer, Pedestal	1	Desk, Teacher's approx. 42" x 30" x 29" H, welded steel construction	1
Cabinet, Filing 4 drawer; size 52"H x 15"W x 28½"D	2	Die, Letter (set) 3/16" character height	1
Cabinet, Finishing (storage) all steel construction; adjustable shelves, 2 door with locks	1	Die, Number (set) 3/16" character height	1
Cabinet, Paper and drawing storage hardwood; 84" x 48" x 24"; adjustable shelves, locks	1	Divider, Spring (6")	1
Cabinet, Tool Storage approx. 62"W x 22"D x 84"H	2	Divider, Spring (8")	1
Caliper, Inside (6") solid nut	2	Dresser, Abrasive wheel	1
Caliper, Inside (8") solid nut	2	Drill, Electric, Portable (¼")	1
Caliper, Outside (6") solid nut	2	Extension Cord heavy duty; grounded, 25'	2
Caliper, Outside (8") solid nut	2		
Can, Oily waste 10 gallon capacity	2		

I. General (cont.)				Quantity	I. General (cont.)				Quantity
Files (assorted sizes, shapes, and cuts, with handles, as specified)					Grinder, Oil tool				1
					Hammer, Soft face (4 oz.)				2
					Knife, Putty approx. 1"W; flexible tool; steel blade				3
					Knife, Sloyd blade approx. 2 5/8"L				6
					Mallet, Hardwood				2
					Mallet, Rawhide (10 oz.)				2
					Oiler, Bench 1/3 or 1/2 pint size; 5" straight spout				3
					Oilstone, Combination, India coarse and fine grits; 8" x 1" x 2"				1
					Oilstone, Combination, Silicon carbide coarse, fine; 8" x 1" x 2"				1
					Pan, Dust 12" steel				2
					Pencil Sharpener, Standard				1
					Pliers, Combination (6")				2
					Pliers, Combination (8")				2
					Pliers, Diagonal-cutting (6")				2
					Pliers, End-cutting				2
					Press, Drill (15") 15" capacity; variable speed; no. 2 Morse taper in spindle; floor model; 1/4" key chuck; tilting standard table; with 1/4 HP, 208V or 220V, 3-phase motor, and magnetic switch and starter				1
					Projector, Filmstrip (35mm) and slide (2" x 2")				1
					Projector, Motion picture, Sound				1
					Projector, Overhead				1
					Punch, Center (set) set of 5; 1/16"-1/4" diameter				2
					Punch, Pin (set) 4"L; set includes diameter from 1/16"-1/2" by 32nds				1
					Rule, Flexible, Steel tape (6')				3
					Rule, Steel (12")				6
File, Auger bit 7"; standard cut				1					
File Card and Brush 2 1/4"L; brush 1 1/4" x 5"				6					
Fire Blanket				1					
Fire Extinguisher				3					
First Aid Kit				1					
Gauge, Wire and sheet metal (American) sizes 0-36				2					
Gauge, Wire and sheet metal (U.S.S.) sizes 0-36				2					
Goggles (spectacles), Clear observation				12					

I. General (cont.)	Quantity	I. General (cont.)	Quantity
Rule, Steel (36")	3	Table, Blueprint (24" x 6")	1
Sander, Belt, Portable, Electric 3" x 24" or 4" x 24"; 115V AC motor	1	Table, Drafting overall size approx. 38" x 28" x 39"H; wood or metal; or overall size approx. 38½" x 48" x 29"H wood or metal	6
Sander, Combination belt and disc 6" belt and 12" disc; floor model with metal stand; motor 1 HP; 60-cycle; 208 or 220V, 3-phase with magnetic switch and starter	1	Table, Overhead projector	1
Sander, Finishing, Portable, Electric heavy duty	1	Tap and Die, NC (U.S. standard) (set) ¼-20, 5/16-18, 3/8-16, 7/16-14, ½-13, complete with die stock and tap wrench	1
Saw, Hack (hand) adjustable to receive 9"-12" blade; tubular body	3	Tap and Die, NF (S.A.E.) (set) ¼-28, 5/16-24, 3/8-24, 7/16-20, ½-20, complete with die stock and tap wrench	1
Saw, Hack, Close quarter	1	Trammel points	1
Saw, Jeweler's (4")	1	Vise, Bench, Drill capacity opening 3"	1
Scissors (8")	1	Vise, Machinist's bench swivel base, 3" jaw, 4¾" opening	4
Screen, Projection (60" x 60")	1	Vise, Swivel 2" jaw, rapid positioning	1
Screwdriver, Cabinet tip (4" and 6")	2	Wrench, Adjustable end (6")	2
Screwdriver, Offset Phillips (set)	1	Wrench, Adjustable end (8")	1
Screwdriver, Phillips (set) set with points no. 1, no. 2, no. 3	1	Wrench, Adjustable end (10")	1
Screwdriver, Standard bit (round blade) (set) set of 5; blade widths of 3/16", 1/4", 5/16", 3/8", 1/2"	2	Wrench, Adjustable end (12")	1
Screwdriver, Standard bit ("stubby") square shank	2	Wrench, Allen key (hex) (set) set of 11; no. ¼ · no. 12	2
Shield, Face	6	II. CERAMICS (CRAFTS)	
Snips, Tinner's, Straight (no. 8)	2	Box, Clay storage, Portable metal lined; with casters	1
Soldering Copper, Electric (60W)	2	Cabinet, Damp-proof size 18"D x 26"L x 31"H	1
Spray Gun Outfit	1	Cabinet, Drying base height; 18"D x 36"L x 31"H	1
Square, Combination (12")	2	Kiln, Electric fire chamber; 6¼" x 7" x 4"; temp. 3,000 degrees F; 110V, 14.5 amps.	1
Square, Combination (set) (with protractor and center head) 12"	1	Kiln, Front loading 18" x 18" x 19" chamber; temp. to 2,000 degrees F; 208 or 220-230V AC	1
Square, Steel framing (12" x 24")	2	Modeling Tool (set) kit of 10 tools	2
Stapler, hand 8½"; throat depth 4"	1		
Stool, Student's, adjustable 14" seat with back	6		

II. Ceramics (crafts) (cont.)	Quantity	IV. Crafts — Leather (cont.)	Quantity
Molds, Ceramics (assorted)	6	Needle, Lacing	6
Nipper, Tile carbide cutting edges	2	Pencil, Woodburning (interchangeable tips)	1
Potter's Wheel, Electric ½ HP motor; 110V, 208 or 220V; variable speeds; 0-120 RPM, table 24" x 30"	1	Punch, Leather, Revolving 6 tubes size; 8"L	2
Tank, Storage, Slip	1	Shear, Leather (8")	2
Trivets	6	Snap Fastener (set)	2
Wedging Table	1	Spacer, Leather marker size 6	2
III. CRAFTS — ENAMELING		V. CRAFTS — PLASTICS	
Atomizer	1	Molding Press, Injection (small) cap. ¼-¾ oz. of styrene; heater 110V; single-phase; hand operated; mechanical or pneumatic	1
Fork, Enameling 17¼"L	2	Oven approx. 12"W x 10"H x 10"D; 0-550 degrees F; 208V, 220V or 110V	1
Kiln, Enameling 110V AC; welded steel construction; interior 4" x 8½" x 8"	1	Spatula	1
Rack, Enameling 4" x 3" mesh	2	Strip heater	1
Sifter 80 mesh screen	1	Thermoforming Press, Vacuum (medium)	1
Torch, Gas natural gas and air	1	VI. DRAFTING TOOLS	
Tweezers, Bevel point	2	Board, Drafting 18" x 24"—beginning; 24" x 36" or 31" x 42"—advanced	6
IV. CRAFTS — LEATHER		Brush, Duster, Draftsman's 2¼" bristles; 13" overall length	6
Awl, Stitching, Automatic	1	Compass and Divider (set)	6
Chisel, Thonging (set) size 3/32" and 1/8"	2	Compass, Chalkboard 16" minimum length	1
Creaser, Adjustable edge	1	Curve, Irregular (set)	2
Eyelet Setter	1	Cutter, Paper (24")	1
Fid hardwood handle, 2¼"L blade	1	Eraser Shields size 2¼" x 3¼" x .005	6
Knife, Leather	2	Lettering Set	1
Knife, Skiving	2	Machine, Drafting (18")	2
Knife, Swivel cutter	6	Machine, Reproduction moist type; width capacity 42"	1
Leather Modeling Tool (set)	2		

VI. Drafting Tools (cont.)	Quantity	VII. Electricity — Hand Tools (cont.)	Quantity
Pen Set	1	Screwdriver, Insulated (set) single blades 3/16" by 9/32" with 4", 6" and 8" shafts	2
Pencil Pointer, Lead pencil	1	Signal Generator	1
Protractor, Semi-circular	2	Soldering Gun, Electric dual heat; 240/325W, spot light	2
Punch, Paper adjustable; 1-4 holes	1	Tester, Neon lamp type	1
Scale, Architect's 12", triangular	6	Tester, Tube	1
Scale, Decimal (civil engineer's) 12", triangular	1	Transformer, Bell Primary 110V to 115V AC, Secondary 6, 12 and 18V	3
Staple Remover	1	Wire Cutter and Stripper	3
Triangle, 30 degrees - 60 degrees (8")	6	Wrench, Nutdriver (set) set of 8 drivers; sizes 3/16", 1/4", 9/32", 5/16", 11/32", 3/8", 7/16", 1/2"	6
Triangle, 45 degrees (8")	6		
Triangle, Chalkboard (30 - 60) 24" hardwood	1		
T Square (minimum size 24")	6		
VII. ELECTRICITY — HAND TOOLS		VIII. ELECTRICITY — GENERAL FURNISHINGS	
Meter, Ammeter (AC) range 0-25 amps.	1	Bench, Electric (with test panel) 1 1/4" x 28" x 60"; laminated maple top, solid maple base, lock casters, double door cabinet	1
Meter, Ammeter (DC) range 0-10 amps.	1	Electricity Demonstration Panel, Teacher's	1
Meter, Battery tester	1	Electricity Training Panel, Student's	3
Meter, Volt-ohm (multi-range)	6	Electronics Demonstration Panel, Teacher's	1
Meter, VTVM	1	Electronics Training Panel, Student's	3
Oscilloscope (5" screen)	1		
Pliers, Electrician's (8")	2	IX. GENERAL METALS — HAND TOOLS	
Pliers, Long nose (6")	2	Anvil (100 lb.)	1
Power Supply, Low voltage AC and DC 0-15V; maximum 5 amperes	1	Apron, Foundry leather, approx. 44"L	2
Power supply, Variable output 0-20V AC and DC; 10 amperes	1	Apron, Welding leather, approx. 44"L	2
Power Supply, Variable output, Filtered 0-300 V DC; 100 ma.	1	Bellows, Molder's (8")	1
Punch, Chassis (round set) 2 piece dies; 7/8", 3/4", 1", 1 1/8"	1	Bending Jig, Adjustable	1
Punch, Chassis (square set) 2 piece dies; 1/4", 1/2", 1"	1	Bulb, Sponge 8 oz.; rubber bulb	1
		Chisel, Cape 1/4" stock; 1/4" cutting edge	2

IX. General Metals — Hand Tools (cont.)	Quantity	IX. General Metals — Hand Tools (cont.)	Quantity
Chisel, Cold (set) cutting edge of ¼", 3/8", ½", ¾"	2	Hammer, Soft face (8 oz.) with replaceable plastic faces	2
Clamp, "C" (3")	3	Helmet, Welding (hand type) with no. 10 lens and cover	4
Clamp, "C" (4")	3	Helmet, Welding (head type) lift top visor; shade no. 10	2
Clamp, "C" (6")	3	Ladle, Bottom pour 5" diameter of bowl	1
Clamp, "C" (8")	6	Leggings, Molder's (pair)	2
Cutter, Bolt (minimum 14")	1	Micrometer, Outside (1") graduated; .001", with spindle, lock and ratchet adjustment	1
Drill, Blacksmith (set) high speed; ½" shank; sizes 5/8", 11/16", 3/4", 13/16", 7/8", 15/16", 1"	1	Micrometer, Outside (2") graduated; .001", with spindle, lock and ratchet adjustment	1
Extractor, Screw (set) set of 6; no. 1 - no. 6	1	Micrometer, Outside (3") graduated; .001", with spindle, lock and ratchet adjustment	1
Flask, Foundry (small) 10" x 12"; cope 3" deep; drag 3" deep	3	Mold, Ingot	2
Gauge, Center (spring tempered)	1	Pliers, Lineman's (6")	1
Gauge, Depth rule	1	Pliers, Needle nose (6")	2
Gauge, Drill point	1	Pliers, Round nose (6")	2
Gloves, Asbestos (pair) unlined, 14"L, medium size	1	Punch, Pin (set) 4"L, set includes diameter from 1/16" to 1/2" by 32nds	1
Gloves, Leather (pair) cowhide	1	Punch, Tinner's (set)	1
Goggles, Gas welding	2	Rammer, Hardwood	1
Goggles, Melter's	2	Siddle, Foundry wire screen; no. 8 mesh	1
Groover, hand (set) set of 3; sizes 0, 2, 4	1	Rivet Set set of 6; sizes no. 3 - no. 7	1
Hammer, Ball peen (4 oz.)	3	Scriber complete with 3 points; 1 straight, 1 short bent, 1 long bent	2
Hammer, Ball peen (12 oz.)	3	Seamer, Handy	1
Hammer, Ball peen (16 oz.)	3	Shovel, Square point	1
Hammer, Chipping	1	Snip, Aviation (left) 10"L	2
Hammer, Engineer's (40 oz.)	1		
Hammer, Forming	1		
Hammer, Raising	1		
Hammer, Riveting, Machinist's (9 oz.)	1		
Hammer, Setting (12 oz.)	2		

IX. General Metals — Hand Tools (cont.)	Quantity	IX. General Metals — Hand Tools (cont.)	Quantity
Snip, Aviation (right) 10''L	2	Welder, Arc (AC/DC)	1
Snip, Aviation (combination and straight) 10''L	2	Welder, Spot (portable) 208V or 220V; 10' power cable	1
Snips, Hawksbill 3'' cut	1	Welding Outfit, Oxyacetylene including regulators, torch, set of tips; cutting attachments; and set of tips	1
Snips, Tin, Curved blade (3'')	1	Welding Screen, Portable back 6' x 6'; tubular frame construction; fireproof curtain	1
Sparklighter	6		
Sponge, Bulb (8 oz.)	1		
Spoon and Gate Cutter 1'' wide	2		
Sprinkling Can (galvanized steel)	1		
Stake, Beakhorn	1		
Stake, Blowhorn	1		
Stake, Candle mold	1		
Stake, Coppersmith square	1		
Stake, Hatchet	1		
Stake, Hollow mandrel	1		
Stake, Round head	1		
Tongs, Blacksmith, Curved lip 20''L	1		
Tongs, Crucible 17''L	1		
Tongs, Pick-up (flat lips) 24''	1		
Torch, Gas (natural gas and air)	1		
Torch, Propane (kit) with assorted tips for heating and soldering	1		
Trowel, Foundry	1		
Trowel, Square, Molder's	1		
Trowel, Taper (heart) and leaf, Molder's	1		
Truck, Welding cylinder size appropriate to gas bottle size	1		
Vise, Sheet metal 3'' opening	1		
		X. METALS — MACHINES	
		Bar Folder (30'')	1
		Bender, Universal on stand; cap. radius 6''-12''; ¼'' round; mild steel	1
		Brake, Box and pan 24''; capacity 16 ga.; depth of box 3''	1
		Buffer, Pedestal 2-6'' x 1''; muslin wheels, clearance design, motor 1/3HP; 1725 RPM, 115V, single-phase, 60-cycle	1
		Forge, Gas	1
		Forming Roll, Slip 30''; capacity mild steel; 22 ga.	1
		Furnace, Crucible maximum cap. number 16 crucible	1
		Furnace, Bench gas, 2 burner	1
		Grinder, Pedestal 1'' x 7'' model; motor ¼HP, 60-cycle; 110V, single-phase	1
		Lathe, Metalworking (10'')	1
		distance between centers 24''; cabinet model; 60-1600 RPM; motor ¼HP, 208 or 220V, 3-phase. Equipped with drive plate, spindle adaptors, centers, tool post, ring, rocker, wrench, quick-change gear box, thread chasing dial and 3-jawed chuck.	
		Milling Machine, Vertical approx. range 9'' x 40'' table working surface, longitudinal table travel 26'', cross travel 10'', vertical travel of knee 18'', vertical travel of spindle 5'', turret to rotate 360 degrees on column, head	1

X. Metals — Machines (cont.)**Quantity**

to rotate 360 degrees on ram. Other features to be considered: gibs, accuracy and movement of all bearing surfaces, spindle bearings, spindle tapers, spindle speeds, 40-way head, balanced pulleys, power feed table, motors and electrical controls.

Rotary Machine, Combination 1

Saw, Hack, Power
minimum cap. 6" x 6", swivel; vise; automatic lift; motor ¼ HP; 3-phase; magnetic push button starter

Shaper, Metal
12" to 15" stroke; specifications to be included according to need: cutting speeds, table travel — horizontal and vertical, tool head, drive unit, 1 lubricating system, drive unit including motor and switches, cross feed — power and hand, vise and shaper tools.

Shear, Squaring foot 1
capacity 16 gauge mild steel

XI. METALS — GENERAL FURNISHINGS

Bench, Arc welding 1
with fire brick top; 2 station

Bench, Welding (gas) 1

Bench, Metalworking (2 place) 4
laminated maple top; approx. size 4" x 24" x 2¼", angle iron edges; heavy gauge steel legs

Bench, Molding 1
Steel construction; size approx. 30" x 60" x 32"H. Trough galvanized for damp sand storage; storage below for tools, etc.

Bench, Sheet metal (with stake plates) 1
Top 60" x 40" x 2¼"; laminated maple, height 32"; angle iron edges, 3 shelves, with 2 stake plates 30" x 8"

Bench, Soldering 1
Steel, transite covered top, 6' x 30"W x 32"H; steel storage cabinet below

Bench, Wall type 2
top 100" x 24" x 2¼"T; laminated maple top; height 32"; bolted construction; steel legs

Furnace, Crucible 1
maximum capacity number 16 crucible

XII. Power Mechanics — Hand Tools**Quantity****XII. POWER MECHANICS — HAND TOOLS**

Adaptor, Socket 2
for wrenches 1/2"-3/8" drive

Compressor, Piston ring (set) 1
capacity 1 3/8"-7"

Compressor, Valve spring 1

Cutter, Tubing 1
1/8"-1" cap.

Flaring Tool (set) 1
range 3/16"-5/8"

Flywheel Holder (for small gas engine) 1

Gauge, Cylinder pressure 1
gauge range 0-300 p.s.i.

Gauge, Ignition (set) 1

Gauge, Spark plug 1

Gauge, Thickness ("feeler") 2
minimum 6 leaf; ¼" x 2¼"; .0015-.015

Gear Puller 1

Hammer, Ball peen (16 oz.) 3

Pliers, Bent nose (6") 2

Pliers, Hose clamp, Radiator and gas line (8") 1

Pliers, Needle nose (6") 2

Pliers, Tru-arc (number 2) 1

Pliers, Vise-grip wrench (7") 2

Socket, Deep spark plug (13/16") 1

Socket, Deep spark plug (1 1/8") 1

Wrench, Allen key (hex) (set) 2
set includes 11 standard size; no. ¼-no. 12

Wrench, Combination box and open end (set) 1
range of openings 3/8"-1"

Wrench, Ignition (set) 1
size 15/64", 1/4", 9/32", 5/16", 11/32", 3/8"

XII. Power Mechanics — Hand Tools (cont.)	Quantity	XV. Woodworking — Hand Tools (cont.)	Quantity
Wrench, Open end (set) double end wrenches; sizes ¼"-1"	1	Chisel, Carving (set) set of 6 chisels and gauges; approx. 6" long	2
Wrench, Pipe (10")	1	Chisel, Gouge, Inside (set) sizes 1/4", 3/8", 1/2", 3/4", 1"	1
Wrench, Pipe (18")	1	Chisel, Socket firmer (set) set of 6; sizes 1/4", 3/8", 1/2", 5/8", 3/4", 1"	1
Wrench, Socket (3/8" drive) (set)	1	Chisel, Wood turning (set) overall length at least 17"	2
Wrench, Socket (¼" drive) (set)	1	Clamp, Bar (36")	4
Wrench, Socket, Reversible ratchet handle (3/8" drive)	1	Clamp, Bar (48")	4
Wrench, Socket, Reversible ratchet handle (¼" drive)	1	Clamp, Bar (60")	2
Wrench, Torque (3/8" drive)	1	Clamp, Handscrew (number 3;0)	2
XIII. POWER MECHANICS — MACHINES		Clamp, Handscrew (number 0)	2
Engine, Small (2-cycle)	1	Clamp, Handscrew (number 1)	2
Engine, Small (4-cycle)	1	Clamp, Handscrew (number 2)	2
Grinder, Valve (set)	1	Clamp, Handscrew (number 3)	2
Refacer, Valve (set)	1	Countersink Bit (for brace) (set) size 5/8" and 3/4"	1
XIV. POWER MECHANICS — GENERAL FURNISHINGS		Drill, Hand (¼")	1
Cabinet, Mechanics, Roller	1	Drill, Hand (3/8")	1
XV. WOODWORKING — HAND TOOLS		Drill Stand, Fractional for twist drills; from 1/16"-1/2" by 64ths	1
Bit, Auger (set) sizes 4-16	1	Drill, Twist, Straight shank (fractional set) 1 high speed; no. 2 Morse Taper Shank; 5/8"-1" by 8ths	1
Bit, Electrician's 18"L x 5/16"D	1	Gauge, Auger bit for gauging hole depth	1
Bit, Expansive boring size from 7/8"-3"	1	Gauge, Marking (double bar)	3
Bit, Forstner (machine set) ¼" shank; sizes 6, 8, 10, 12, 14, 16 in 16ths of an inch	1	Hammer, Claw (7 oz.)	2
Bit, Plug cutter (set) set of 5; sizes 3/8", 1/2", 5/8", 3/4", 1"	1	Hammer, Claw (13 oz.)	3
Bit, Screwdriver (set)	1	Hammer, Claw (16 oz.)	3
Brace, Ratchet (10")	2	Jig, Dowelling with guides 3/16", 1/4", 5/16", 3/8", 7/16", 1/2"	1
Burnisher round tempered steel; 4¼" blade	1	Level (24" long)	1

XV. Woodworking — Hand Tools (cont.)	Quantity	XVI. Woodworking — Machine (cont.)	Quantity
Miter Box 26" x 4" back saw; 8¼ right angle capacity	1	gap and at least 38" between centers. Motor ¼HP, 60-cycle. 208V or 220V. 3- phase with mounted switch and overload protection. To include cup center, spur center, 3 face plates, 1-6" tool rest, 1-12" tool rest, 1 tool support base, 1 knock-out bar.	
Nail Set (1/16" tip)	3		
Nipper, End cutting (6")	1		
Oilstone, Carving tool slips (set)	1	Router, Portable, Electric motor ½ or 7/8 HP	1
Oilstone, Gouge slip	1		
Oilstone, Slip	1	Saw, Band, Wood-cutting 14" floor model; motor ½HP, 60-cycle; 208V or 220V; 3-phase with magnetic switch and starter or 20" model with 1¼ HP motor	1
Plane, Block (1 5/8" cutter)	2		
Plane, Jack (14"L)	2	Saw, Circular, Power 10" floor model; motor 1½HP, 60- cycle; 208V or 220V; 3-phase with magnetic switch and starter or 12" model with 5HP motor	1
Plane, Jointer (22"L)	1		
Plane, Junior jack	4		
Plane, Smoothing length 9"; blade width 1¼"	2	Saw, Jig (scroll) 24"; metal stand, motor 1/3HP; 60-cycle AC; 115V with magnetic switch and starter	1
Rule, Maple (24")	6		
Saw, Back (12")	2	Saw, Radial-arm, Power 10" complete with stand, 2HP, 60-cycle, 208V or 220V, 3-phase, with magnetic switch and starter	1
Saw, Compass (set)	2		
Saw, Coping (6¼" long, end)	3	Saw, Sabre (bayonet) portable; heavy duty	1
Saw, Hand, Crosscut (22"; 10 point)	1		
Saw, Hand, Rip 26"; 5¼ point, straight back	1	Surface (single surface planer) 12" x 5" cap.; floor model; motor 3HP, 60-cycle, 208V or 220V, 3-phase; with magnetic switch and starter and overload protection or 18" model; 20" cap.; floor model; motor 5HP; 60-cycle; 208V or 220V with switch and overload protec- tion	1
Scraper, Cabinet (2¼" blade)	2		
Scraper, Hand approx. 3" x 5" steel blade	2		
Spokeshave, Straight	1		
Square, Try (8")	6		
Stop, Bench	6		
T Square (minimum size 24")	2		
XVI. WOODWORKING — MACHINE		XVII. GRAPHIC ARTS — HAND TOOLS	
Jointer (6")	1	Bone Folder (1"W x 8"L)	3
Lathe, Wood turning 12" gap bed floor model with enclosed metal cabinet with 16¼" capacity over	1	Borders, Decorations, Miscellaneous	1
		Can, Safety (1 quart)	2
		Chases, Platen cast iron; size to fit print; press handle; type recommended	6
		Composing Stick (6")	6
		Composing Stick (10")	3
		Cutter, Lead and slug	1

XVII. Graphic Arts — Hand Tools (cont.)	Quantity	XVII. Graphic Arts — Hand Tools (cont.)	Quantity
Cutter, Linoleum (set) push type cutters; set of 5 with assorted cutter and handles	2	Spaces, Assorted fonts (14 point)	1
Cutter, Paper (24")	1	Spaces, Assorted fonts (18 point)	1
Fountain Pen (technical set)	1	Spaces, Assorted fonts (24 point)	1
Furniture, Wood, Fonts	1	Spaces, Assorted fonts (30 point)	1
Gauge, Line (12")	3	Spaces, Assorted fonts (36 point)	1
Gauge, Pin (sets)	6	Staple Remover	1
Knife, Ink (square end; 8")	2	Triangle, 30 degrees - 60 degrees (8")	2
Knife, Stencil	2	Triangle, 45 degrees (8")	2
Leads (2 point) (25 lb. pkg.)	1	T Square (minimum size 24")	2
Lettering Set character height 3/16"	1	Tweezers, Type 4 1/4"; fine pointed	2
Numbering Machine, Press 6 wheel	1	Type (assorted sizes and styles)	
Pen Set	1	XVIII. GRAPHIC ARTS — MACHINES	
Pencil Pointer, Lead pencil	1	Planer, Type	1
Planer, Type suggest 2 sizes: 1 1/4" x 3" x 1 1/4" and 3 1/4" x 8" x 2 1/4"	2	suggest 2 sizes: 1 1/4" x 3" x 1 1/4" and 3 1/4" x 8" x 2 1/4"	
Punch, Paper	1	Press, Padding (bench model)	2
Quoin, Hispeed 3 and 9	12	Press, Platen 12" x 18"; hand fed	1
Quoin Key, Hispeed	2	Press, Platen, Hand lever (6" x 16")	1
Reglets, Wood Font	1	Press, Proof	1
Rule, Brass	1	Press, Rubber stamp	1
Scale, Architect's	6	Printmaker, Graphic arts 12" x 12" steel built	1
Silk Screen Unit printing frame; number 12 silk	1	Stapler, Saddle (throat depth 8")	1
Slugs (6 point) (25 lb. pkg.)	1	XIX. GRAPHIC ARTS — GENERAL FURNISHINGS	
Spaces, Assorted fonts (6 point)	1	Cabinet, Proof press	1
Spaces, Assorted fonts (8 point)	1	Cabinet, Type, Double tier	1
Spaces, Assorted fonts (10 point)	1	Imposing Stone Table 27" x 39" (beginning); 31" x 39" (advanced); cast iron surface	1
Spaces, Assorted fonts (12 point)	1		

LEVELS II, III, IV
DRAFTING

I. Audio-Visual Equipment	Introductory	Quantity	Advanced	Quantity	II. Instruments and Tools	Introductory	Quantity	Advanced	Quantity
I. AUDIO-VISUAL EQUIPMENT					II. INSTRUMENTS AND TOOLS				
Chalkboard Drafting Machine Horizontal rail 72"			X	1	Acv-Arc Ruler			X	1
Compass, Chalkboard 16" minimum length	X	1	X	1	Brush, Duster, Draftsman's 2½" bristles, 13" overall length	X	24	X	24
Display Board aluminum frame, cork composition, 48" x 48" - 96" x 96"	X	1	X	1	Chalkboard Drafting Machine			X	1
Divider, Blackboard hardwood	X	1	X	1	Compass and Divider (set)	X	24	X	24
Projection Box, Plastic three plastic hinged planes, 12" x 12"	X	1			Compass, Beam (24")	X	4	X	4
Projection Box, Plastic, Instructor's three plastic hinged planes, 12" x 12"			X	1	Compass, Drop bow (4")			X	1
Projection Box, Plastic Student's three plastic hinged planes, 4" x 4"			X	1	Curve, Irregular (set)	X	1	X	1
Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X	1	Curve, Rule (adjustable)			X	1
Projector, Motion picture, Sound	X	1	X	1	Cutter, Paper (24")	X	1	X	1
Projector, Overhead with acetate roll	X	1	X	1	Dispenser, Drafting tape	X	2	X	2
Protractor, Chalkboard 15" hardwood	X	1	X	1	Divider, Proportional 7½" or larger			X	2
Scale, Chalkboard (demonstration) minimum length 6'	X	1	X	1	Eraser Shields sizes 2½" x 3¾" x .005	X	24	X	24
Screen, Projection	X	1	X	1	Fountain Pen (technical set) 7 sections, sizes 00, 0, 1, 2, 2½, 3, 4			X	6
Triangle, Chalkboard, 30 degrees-60 degrees 24", hardwood	X	1	X	1	Geometric Shapes (set)			X	1
Triangle, Chalkboard, 45 degrees hardwood	X	1	X	1	Lettering Guide Line Instrument	X	24	X	24
					Lettering Set			X	1
					Oilstone, Arkansas wedged shape, fine grain	X	1	X	1
					Pantograph, Drafting 21" hardwood, 7:26 ratio			X	1
					Parallel Rules			X	1
					Pen Holder 6" to 7" length			X	24
					Pen Set			X	24

II. Instruments and Tools (cont.)	Introductory Quantity	Advanced Quantity	II. Instruments and Tools (cont.)	Introductory Quantity	Advanced Quantity
Pen, Speedball (set)		X 1	Triangle, Adjustable (10")		X 6
Pencil Pointer, Lead pencil	X 24	X 24	T Square minimum size 24"	X 24	X 24
Pencil Pointer, Mechanical	X 1	X 1			
Pencil Sharpener, Draftsman's	X 1	X 1	III. MACHINES		
Pencil Sharpener, Standard	X 1	X 1	Acv-Arc Ruler		X 1
Protractor, Semi-circular	X 6	X 6	Chair, Teacher's welded steel construction, swivel, with casters	X 1	X 1
Repair Kit, Drafting instrument		X 1			
Scale, Architect's 12" triangular	X 24	X 24	Desk, Teacher's 42" x 30" x 29", welded steel construction	X 1	X 1
Scale, Decimal, Civil engineer's 12" triangular		X 12	Desk, Teacher's standing approx. 36" x 26" x 42"H, welded steel construction	X 1	X 1
Scale, Mechanical engineer's 12" triangular	X 6	X 12	File, Drafting to accomodate 36" x 48" drawing set		X 1
Scale, Metric 12" triangular		X 1	Frame, Printing to accomodate 14" x 22" drawing		X 1
Scissors (8")	X 1	X 1	Pan, Dust (12" steel)	X 1	X 1
Sign-maker Set		X 1	Rack, Magazine magazine shelving, 60"H x 12"D x 36"L		X 1
Straight Edge, Parallel ruling transparent plastic edging		X 12	Stool, Instructor's adjustable, swivel, thick foam rubber seat, 28"-34", tubular steel construction	X 1	X 1
Template, Architectural		X 12	Stool, Student's adjustable 18"-27" or 24"-33"	X 24	X 24
Template, Electronic		X 6	Table, Drafting overall size approx. 38" x 28" x 39", wood or metal, 6 drawers storage unit	X 24	X 24
Template, Isometric circle		X 6	Table, Overhead projector portable, 26"H	X 1	X 1
Template, Isometric circle Large		X 6	Table, Planning 72" x 30" x 30"H		X 1
Template, Large circle		X 24	Table, Tracing		X 1
Template, Nuts and bolts		X 5	Erasing, Machine, Elec.		X 1
Triangle, 30-60 degrees (8")		X 24			
Triangle, 45 degrees (6")	X 24				
Triangle, 30-60 degrees (10" and 12")	X 24				
Triangle, 45 degrees (8")		X 24			
Triangle, 45 degrees (12")		X 3			

III. Machines (cont.)	Introductory Quantity	Advanced Quantity	V. Miscellaneous (cont.)	Introductory Quantity	Advanced Quantity
Machine, Drafting (18")		X 24	First Aid Kit	X 1	X 1
Machine, Drafting (24")		X 4	Gauge, Screw pitch		X 1
Machine, Reproduction dry type	X 1	X 1	Gauge, Wire and sheet metal (American) sizes 0-36	X 1	X 1
Machine, Reproduction moist type width capacity 42"	X 1	X 1	Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X 1	X 1
Marking Tool, Electric	X 1	X 1	Hammer, Claw (16 oz.)	X 1	X 1
Parallel Rule (18")		X 1	Knife, Carving (set)		X 6
IV. GENERAL FURNISHINGS			Micrometer, Outside (1")		X 1
Board Drafting 18" x 24"—beginning, 24" x 36" or 31" x 42"—advanced	X 24	X 24	Pliers, Straight nose 8", combination	X 1	X 1
Bookcase approx. 60"H x 10-12"D x 72"L three shelves, adjustable, wood or metal	X 1	X 1	Punch, Paper adjustable, 1 to 4 holes	X 1	X 1
Broom, Push 18" in length	X 2	X 2	Rule, Flexible, Steel tape (12')		X 1
Brush, Bench	X 12	X 12	Rule, Flexible, Steel tape (100')		X 1
Cabinet, Filing 4 drawers, 52"H x 15"W x 28½"D	X 1	X 1	Screwdriver, Phillips (set) point numbers 1, 2, 3	X 1	X 1
Cabinet, Storage steel construction, adjustable shelves, 2 doors and locks	X 2	X 2	Screwdriver, Standard bit Round Blade, set 3/16", 1/4", 5/16", 3/8", 1/2"	X 1	X 1
V. MISCELLANEOUS			Screwdriver, Standard bit Square Blade, 6"	X 1	X 1
Caliper, Inside (6")		X 1	Square, Combination set (with protractor and center head) 12" rule		X 1
Caliper, Outside (6")		X 1	Stapler, Hand	X 1	X 1
Die, Letter (set) 3/16", character height	X 1	X 1	T Bevel, Sliding (6")		X 1
Die, Number (set) 3/16", character height	X 1	X 1			
Extension Cord heavy duty, grounded, 25'	X 1	X 1			
Fire Extinguisher	X 1	X 1			

LEVELS II, III, IV
ELECTRICITY/ELECTRONICS

I. Small Tools and Equipment	Introductory	Quantity	Advanced	Quantity	I. Small Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
I. SMALL TOOLS AND EQUIPMENT					Drill, Twist, Straight shank (Fractional Set) high speed steel, 1/16"-1/2" by 64ths	X	1	X	1
Alignment Tool (set)	X	2	X	2	Extension cord 25', heavy duty, grounded	X	2	X	2
Bit, Auger (set) sizes 4-16	X	1	X	1	Files				
Bit, Screwdriver (set) square tang, 1/4", 5/16", 3/8", 1/2"	X	2	X	2	6", mill (flat), second cut	X	4	X	4
Bit, Speed (set) sizes 1/4", 3/8", 1/2", 5/8", 3/4", 1"	X	2	X	2	6", half-round, second cut	X	4	X	4
Brace, Ratchet (10")	X	1	X	1	File Card and Brush	X	6	X	6
Brake, Box and pan 24", capacity 16 ga. depth of box 3"	X	1	X	1	File, Jeweler's (set) assorted shapes, 4"-6"	X	1	X	1
Bulb Type Solder Remover with Teflon Tip	X	1	X	4	File, Needle (set) set of 12 - 5 1/2" L	X	1	X	1
Chisel, Cold (set) 1/4", 3/8", 1/2", 3/4"	X	1	X	1	Gauge, Auger bit	X	1	X	1
Coil Winder	X	1	X	1	Gauge, Screw pitch	X	1	X	1
Countersink, High speed steel 1/4" shank, 1/2" size	X	1	X	1	Gauge, Thickness ("feeler") minimum 6 leaf, 1/2" x 2 1/2" x .0015" - .015"	X	1	X	1
Crimping Tool	X	2	X	2	Gauge, Wire and sheet metal (American) sizes 0-36	X	1	X	1
Die, Letter (set) (3/16")	X	1	X	1	Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X	1	X	1
Die, Number (set) (3/16")	X	1	X	1	Goggles (spectacles), Clear observation	X	12	X	12
Divider, Wing (6")	X	1	X	1	Grinder, Pedestal steel size 1" x 7" - 1 fine grit - 1 coarse wheel, tool rests, 1/2HP, 60-cycle, 110V	X	1	X	1
Drill, Electric Portable (1/4")	X	1	X	1	Hammer, Ball peen (12 oz.)	X	6	X	6
Drill, Hand (1/4")	X	1	X	1	Hammer, Ball peen (16 oz.)	X	6	X	6
Drill Stand, Fractional 1/16"-1/2" by 64ths	X	1	X	1	Hammer, Claw (16 oz.)	X	6	X	6
Drill, Twist (letter set) high speed steel, straight shank	X	1	X	1	Knife, Electrician's	X	6	X	6
Drill, Twist (number set) high speed steel, straight shank, number 1-60	X	1	X	1					

I. Small Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	I. Small Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
Light, Extension			X	2	Saw, Hack (hand) adjustable to receive 9" to 12" blade	X	4	X	4
Magnet, Bar minimum size = 1/4" x 1/4" x 3"	X	24	X	24	Saw, Hand, Crosscut 22", 10 point	X	1	X	1
Nibbler, Hand operated capacity 18" steel	X	2	X	2	Scissors (8")	X	1	X	1
Oiler, Bench 1/2 pint size, 5" steel spout	X	1	X	1	Screwdriver, Insulated (set) regular blades, 3/16" by 9/32" with 4", 6", and 8" shafts	X	12	X	12
Oilstone, Combination, India coarse and fine grits, 8" x 2" x 1"	X	2	X	2	Screwdriver, Phillips (set) set with points no. 1, no. 2, no. 3	X	4	X	4
Pliers, Combination (6")	X	12	X	12	Screwdriver, Retaining type 3/16" blade	X	2	X	2
Pliers, Duckbill (8")	X	6	X	6	Shear, Squaring, Foot operated capacity mild steel 16 ga.			X	1
Pliers, Diagonal cutting (6")	X	12	X	12	Shield, Face	X	6	X	6
Pliers, Needle nose (6")	X	12	X	12	Snip, Aviation (left) 10"L	X	2	X	2
Pliers, Side-cutting (6")	X	12	X	12	Snip, Aviation (right) 10"L	X	2	X	2
Pliers, Vise-grip wrench (7")	X	3	X	3	Snips, Tinner's, Straight (number 8)	X	3	X	3
Press, Drill 15" cap. variable speed, number 2 Morse Taper in spindle, floor model, 1/2HP, magnetic switch	X	1	X	1	Soldering Copper, Electric (60W) 1/4" copper tip	X	6		
Punch, Center (set) 4"L, 1/16"-1/2" by 32nds	X	2	X	2	Soldering Copper, Electric pencil 30W, 7" slim handle	X	6	X	12
Punch, Chassis (round set) 2 piece dies, 7/8", 3/4", 1", 1 1/8"	X	1	X	1	Fittings for Transistors and I.C.	X	1	X	4
Punch, Chassis (square set) 2 piece dies, 1/2", 3/4", 1"	X	1	X	1	Soldering Gun, Electric dual heat, 240/325W, spot light	X	4	X	4
Punch, Pin (set) 4"L, 1/16-1/2" by 32nds	X	2	X	2	Square, Combination 12" rule	X	3	X	3
Reamer, Electrician's hand 1/8" tip, tapered, 5"L graduated to 1/16"	X	1	X	1	Square, Steel framing 12" x 24"	X	1	X	1
Rule, Steel (12") graduated to 1/16"	X	6	X	6	Square, Try (6")			X	6
Saw, Coping 6 1/2" frame	X	1	X	1					

I. Small Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	Introductory Quantity	III. Test Equipment	Introductory Quantity	Advanced Quantity	Introductory Quantity
Tap and Die, NC (U.S. standard) (set) ¼-20, 5/16-18, 3/8-16, 7/16-14, ½-13, complete with die stock and tap wrench	X	1	X	1	III. TEST EQUIPMENT		
Tap and Die, NF (S.A.E.) (set) ¼-28, 5/16-24, 3/8-24, 7/16-20, ½-20	X	1	X	1	Capacitor Substitution Box 100 mmf. - .111 mmd., 350WVDC	X	1 X 1
Tap and Die, Pipe (set) pipe sizes 1/8", ½", ¾", 1"; tap, die and reamer	X	1	X	1	Resistance Substitution Box	X	1 X 1
Welder, spot	X	1	X	1	Oscilloscope (5" screen)	X	12 X 12
Printed Circuit Board Vise	X	24	X	24	Signal Tracer	X	2 X 2
Wrench, Adjustable end (6")	X	4	X	4	Tester, Transistor/ In and Out of Circuit	X	1 X 12
Wrench, Allen key (hex) (set) no. 1½, no. 12	X	2	X	2	Tester, Tube	X	1 X 1
Wrench, Nutdriver (set) set of 8 drivers, sizes 3/6", ¼", 9/32", 5/16", 11/32", 3/8", 7/16", ½"	X	2	X	2	IV. METERING EQUIPMENT		
Wrench, Open end (set) sizes ¼"-1"	X	1	X	1	Meter, Ammeter (AC) range 0-25 amps.	X	1 X 1
Wrench, Socket (3/8" drive) (set) 10 piece set, 7 standard sockets, sizes 3/8"-3/4" by 16ths	X	1	X	1	Meter, Battery tester	X	1 X 1
					Meter, Galvanometer 500-0-500 micro amperes		X 1
					Meter, Grip dip 400 KC - 250 MC		X 1
					Meter, Volt-ohm (multi-range)	X	12 X 12
					Meter, VTVM	X	12 X 12
II. POWER SUPPLY					V. GENERAL FURNISHINGS		
Power Supply, Variable output 0-20V AC and DC at 10 amperes	X	12			Bench, Island-double-face 6' x 48", 12 steel lockers, 6 cabinets	X	6 X 6
Power Supply, Variable output, Filtered 0-300V DC at 100 ma.			X	12	Bench, Electric demonstration 6' x 30" cabinet storage, 0-120V AC and DC outlets		X 1
Signal Generator/Audio Freq.	X	12	X	12	Bookcase approximate 60"H x 10-12"D x 72"L, 3 adjustable shelves, wood or metal	X	1 X 1
Signal Generator/Radio Freq.	X	1	X	12	Broom, Push 18" in length	X	3 X 3

V. General Furnishings (cont.)	Introductory Quantity	Advanced Quantity		V. General Furnishings (cont.)	Introductory Quantity	Advanced Quantity			
Cabinet, Filing 4 drawer, 52"H x 15"W x 28½"D	X	1	X	1	Fire Blanket	X	1	X	1
					Fire Extinguisher - CO ₂	X	2	X	2
Cabinet, Instrument storage 30"W x 18"D x 72"H, with adjustable shelves and lock	X	2	X	2	First Aid Kit	X	1	X	1
					Pan, Dust (12" steel)	X	1	X	1
Cabinet, Parts storage metal, 100 drawers	X	1	X	1	Pencil Sharpener, Standard	X	1	X	1
					Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X	1
Cabinet, Tool storage approximate 62"W x 22"D x 84"H	X	1	X	1	Projector, Motion picture, Sound	X	1	X	1
					Projector, Overhead	X	1	X	1
Chair, Teacher's welded steel construction, swivel, with casters	X	1	X	1	Screen, Projection 60" x 60"	X	1	X	1
					Student Fundamental Units	X	12	X	12
Compressor, Air 120 p.s.i., 60 gallons, 1½ HP motor	X	1	X	1	Table, Overhead projector portable, 26" high	X	1	X	1
Desk, Teacher's approx. 42" x 30" x 29" welded steel construction	X	1	X	1					

**LEVELS II, III, IV
GRAPHIC ARTS**

I. Basic Equipment	Introductory Quantity	Advanced Quantity	Introductory Quantity	Advanced Quantity	I. Basic Equipment (cont.)	Introductory Quantity	Advanced Quantity	Introductory Quantity	Advanced Quantity
I. BASIC EQUIPMENT					Enlarger, Photographic condensor motor for negatives; size 4" x 5" and smaller	X	1	X	2
Airbrush		X	1		Exposure Frame 14" x 19" cap.			X	1
Binding Unit, Plastics length 12"; ring binder capacity ¼"-½"D	X	1	X	1	Ferrotypes Plate chrome plated 10" x 14"	X	4	X	4
Block, Proofing ¾" x 8" x 2½", maple wood	X	2	X	2	Filter, Photo (set)			X	1
Boards, Pressing ¾" x 9" x 12", hard maple	X	4	X	4	Folding Machine paper size: 2¼" x 4¼-9½" x 16"			X	1
Camera, Copying horizontal, dark room type; process camera; maximum film 16" x 20"			X	1	Glue Pot 1 quart	X	1	X	1
Camera, Range finder (35mm)	X	1	X	1	Imposing Stone Table 27" x 39" (beginning); 31" x 39" (advanced), cast iron surface	X	1	X	1
Camera (35mm), Single lens reflex	X	1	X	1	Jogger, paper 14", 20", 110V			X	1
Camera, Reflex, Twin lens	X	2	X	2	Meter, Light miters 45; square ends of rules; ga. width of 63 pica	X	1	X	1
Cutter, Lead and slug	X	1	X	1	Mitering Machine miters 45; square ends of rules; ga. width of 63 pica	X	1	X	1
Cutter, Paper (24")	X	1	X	1	Numbering Machine, Cleaner box 6 wheel machine, 5 movements	X	1	X	1
Cutter, Round corner pedestal model, foot operated, 2½" capacity	X	1	X	1	Numbering Machine, Hand 6 wheel machine, 5 movements	X	1	X	1
Densitometer, Photo			X	1	Numbering Machine, Press 6 wheel	X	2	X	2
Drill, Electric, Portable (¼")	X	1	X	1	Pad Counter stabbing type; 3" adjustable for measuring equal size pads	X	1	X	1
Dryer, Print rotary type; constant temperature; 12" x 18"; chrome plated surface	X	1	X	1					
Duplicating Machine, Spirit			X	1					
Duplicating Machine, Stencil			X	1					

I. Basic Equipment (cont.)	Introductory Quantity	Advanced Quantity		I. Basic Equipment (cont.)	Introductory Quantity	Advanced Quantity	
Perforator bench models; 19" cap.		X	1	Punch, Paper	X	1	X 1
Planer, Type suggest 2 sizes: 1 1/4" x 3" x 1 1/2" and 3 1/4" x 8" x 2 1/2"	X	4	X 4	Quoin, Hi-speed 3" and 9"	X	48	X 48
Plate-maker approx. 24" cap. with flip top	X	1	X 1	Quoin Key, Hi-speed	X	4	X 4
Press, Copying 11" x 16" cap.	X	1	X 1	Silk Screen Unit printing frames number 12 silk	X	2	X 2
Press, Hot stamping 1" type holder	X	1	X 1	Sinks, Developing temperature control; accommodates 3-20" x 24" trays	X	1	X 1
Press, Offset 11" x 15", 3 cylinder	X	1	X 1	Sinks, Platemaking inside dimensions 29" x 48" x 8"D	X	1	X 1
Press, Padding bench model	X	1	X 1	Stapler, Saddle throat depth 8"	X	1	X 1
Press, Platen 12" x 18", hand fed	X	1	X 1	String Holder, Cone 2 1/2 lb. cord	X	1	X 1
Press, Platen, Automatic feed 10" x 15"			X 1	Tanks, Film development	X	5	X 5
Press, Platen, Hand lever 6" x 10"	X	2	X 2	Thermometer, Photographic	X	2	X 2
Press, Proof	X	1	X 1	Timer, Photographic (electric)	X	2	X 2
Press, Proof, Reproduction hand operated			X 1	Timer, Photographic (spring wound)	X	2	X 2
Press, Rubber stamp	X	1	X 1	Tray, Photographic	X	12	X 12
Printer, Contact beginning - 35mm; advanced - adjustable margins to 8" x 8"	X	1	X 1	Trimmer, Paper adjustable; 24" x 24" table	X	1	X 1
Printmaker, Graphic arts 12" x 12" steel bed	X	1	X 1	Truck, Bindery			X 1
Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X 1	Type, (assorted sizes and styles)			
Projector, Motion picture, Sound	X	1	X 1	Typesetter, Linecasting			X 1
Projector, Overhead	X	1	X 1	Typesetter, Photon headsetter			X 1
				Typewriter, Electric			X 1
				Typewriter, Standard	X	1	

I. Basic Equipment (cont.)	Introductory			Quantity	II. Hand Tools and Miscellaneous Supplies (cont.)	Introductory			
	Quantity	Advanced	Quantity			Quantity	Advanced	Quantity	
Vacuum Printing Frame 17" x 21" working area; 110V, 60-cycle motor gauge		X		1	Die, Letter (set) 3/16" character height	X	1	X	1
					Die, Number (set) 3/16" character height	X	1	X	1
II. HAND TOOLS AND MISCELLANEOUS SUPPLIES					Dispenser, Cellophane tape	X	3	X	3
Apron, Rubber	X	2	X	2	Dispenser, Gummed paper	X	1	X	1
Awl, Bookbinder's detachable sharp steel point; 3"L.	X	2	X	2	Drill, Hand (1/4")	X	1	X	1
					Drill, Hand (3/8")	X	1	X	1
Bone Folder 1"W x 8"L	X	8	X	8	Drill Stand, Fractional for twist drills from 1/16"-1/2" by 64ths	X	1	X	1
Brayer, Block printing 4" width	X	2	X	2	Drill, Twist, Straight shank (Fractional set) high speed steel by 64ths from 1/16" to 1/2"	X	1	X	1
Brush, Flat padding 1 1/2"W	X	2	X	2	File Card and Brush 9 1/2"L, brush 1 1/2" x 5"	X	1	X	1
Brush, Bookbinder's 1 or 1 1/2"D	X	2	X	2	Furniture, Wood, Fonts	X	4	X	4
Brush, Opaque sizes 00 and 1	X	6	X	6	Galley (10" x 16")			X	6
Brush, Type approx. size 2 1/2" x 5"			X	2	Galley (8 1/4" x 13")			X	100
Cards, Alphabet (set) size 12" to 42 point; approx. 125 cards with about 75 popular type faces	X	2	X	2	Gauge, Auger bit 1 gauging hole depth	X	1	X	1
Chases, Platen cast iron; sizes to fit platen press handle in type recommended	X	12	X	12	Gauge, Line (12")	X	12	X	12
					Gauge, Line (18")	X	6	X	6
Composing Stick (6")	X	24	X	24	Gauge, Pin (sets)	X	6	X	6
Composing Stick (10")	X	6	X	6	Gauge, Type high standard for letter press printing (1918")	X	1	X	1
Composing Stick (12")	X	2	X	2	Gauge, Wire and sheet metal (American) sizes 0-36	X	1	X	1
Composing Stick (15")	X	1	X	1	Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X	1	X	1
Composing Stick, Micrometer knee (10")	X	1	X	1	Gloves, Thick rubber	X	2	X	2
Cutter, Linoleum (set) push-type cutters; set of 5; assorted cutters and handles	X	6	X	6					

II. Hand Tools and Miscellaneous Supplies (cont.)	Introductory	Quantity	Advanced	Quantity	II. Hand Tools and Miscellaneous Supplies (cont.)	Introductory	Quantity	Advanced	Quantity
Graduate, Darkroom conical type; 16 oz. capacity	X	6	X	6	Rule, Make-up	X	12	X	12
Grease Gun	X	1	X	1	Saw, Back (12")	X	1	X	1
Hammer, Bookbinder's backing 1 lb.; 12 oz. head; wooden handle	X	2	X	2	Saw, Printer's trim	X	1	X	1
Hammer, Claw (16 oz.)	X	1	X	1	Scissors (8")	X	6	X	6
Knife, Ink square end, 8"	X	12	X	12	Screens, Halftone, Contact	X	6	X	6
Knife, Make ready and stripping number 12; "Exacto"	X	12	X	12	Screwdriver, Standard bit (round blade) (set) set of 5; blade widths 3/16", 1/4", 5/16", 3/8", 1/2"	X	6	X	6
Knife, Padding round end	X	2	X	2	Siphon, Photo	X	1	X	1
Light, Darkroom	X	4	X	4	Spaces, Assorted fonts (10 point)				
Light, Flood (10")	X	4	X	4	Spaces, Assorted fonts (12 point)				
Locks, Magnetic galley	X	25	X	25	Spaces, Assorted fonts (18 point)				
Magnifiers etchers type; 10X	X	4	X	4	Square, Steel framing 12" x 24"	X	1	X	1
Mallet, Rawhide 100 oz.	X	2	X	2	Stapler, Hand 8 1/2"; throat depth 4"	X	1	X	1
Marker, Felt-tip, Color (set)	X	6	X	6	Triangle, 30 degrees-60 degrees (8")	X	8	X	8
Needle, Binding	X	24	X	24	Triangle, 45 degrees (6") stainless steel; solid center with lifting knob	X	8	X	8
Oiler, Bench 1/3 or 1/2 pt. size; 5" straight spout	X	4	X	4	T Square minimum size 24"	X	4	X	4
Oiler, Pump (5 oz.)	X	4	X	4	Tweezers, Type 4 1/2", fine point	X	12	X	12
Oilstone, Combination, India coarse grit and fine; 8" x 1" x 2"	X	1	X	1	Wrench, Adjustable end (6")	X	1	X	1
Oilstone, Combination, Silicon carbide coarse and fine grit; 8" x 2" x 1"	X	1	X	1	Wrench, Socket (3/8" drive) (set) 10 piece set; 7 standard sockets; 3/8"-3/4" by 16ths	X	1	X	1
Pliers, Combination (6")	X	2	X	2					
Pliers, Vise-grip wrench (7 1/2")	X	2	X	2					

II. Hand Tools and Miscellaneous Supplies (cont.)	Introductory	Quantity	Advanced	Quantity	III. General Furnishings (cont.)	Introductory	Quantity	Advanced	Quantity
	X		X			X		X	
Wrench, Socket (½" drive) (set) 9 piece set; 7 standard sockets; sizes 3/8"-3/4" by 16ths	X	1	X	1	Cabinet, Quarter case 10¾"W x 18¼"D x 38¼"H; steel construction, cap. 20 quarter size cases	X	1	X	1
III. GENERAL FURNISHINGS					Cabinet, Storage 76"H x 36"W x 18¼"D; steel construction; lock and key provided	X	1	X	1
Bench, Bookbinding (unit) top 2" thick plastic laminated surface; complete with steel shelf and 2 stacking steel drawers; 72"L x 34"W x 34"H	X	1	X	1	Cabinet, Type, Single tier steel construction; school type; floor space 32¼" x 42¼"; height of working space 41"	X	2	X	4
Bench, Demonstration 1¾" x 28" x 6" maple top, lock, casters, double door cabinet			X	1	Can, Oily waste 10 gallon capacity	X	2	X	2
Bookcase approx. 60"H x 10-12"D x 72"L, 3 adjustable shelves, wood or metal	X	1	X	1	Can, Safety (1 qt.)	X	2	X	2
Broom, Push 18" in length	X	3	X	3	Can, Safety (1 gal.)	X	2	X	2
Brush, Bench	X	12	X	12	Can, Safety (5 gal.)	X	1	X	1
Cabinet, Drying rack steel construction with reinforced top; to include 14 dry racks 20" x 28¼" x 1/8"	X	1	X	1	Chair, Teacher's welded steel construction, swivel, with casters	X	1	X	1
Cabinet, Filing 4 drawers, 52"H x 16"W, 28¼"D	X	1	X	1	Compressor, Air 120 p.s.i., 60 gal. in tank, 1¼HP motor	X	1	X	1
Cabinet, Film cutter steel construction; 4 drawers to accomodate 20" x 24" films			X	1	Container, Benzene (1 pt.)	X	4	X	4
Cabinet, Galley galley sizes 8¼" x 13" or 10" x 16"	X	2	X	2	Container, Benzene (1 gal.)	X	2	X	2
Cabinet, Ink and roller 30"W x 25"D x 40"H	X	1	X	1	Container, Benzene (5 gal.)	X	1	X	1
Cabinet, Plate filing 14"W x 24"D x 25¼"H steel mounted on 4 ball bearing wheels	X	1	X	1	Desk, Teacher's approx. 72" x 30" x 29", welded steel construction	X	1	X	1
					Fire Blanket	X	1	X	1
					Fire Extinguisher	X	3	X	3
					First Aid Kit	X	1	X	1
					Goggles (spectacles), Clear observation	X	6	X	3
					Pan, Dust (12" steel)	X	1	X	1
					Pencil Sharpener, Standard	X	1	X	1

III. General Furnishings (cont.)	Introductory			III. General Furnishings (cont.)	Introductory				
	Quantity	Advanced	Quantity		Quantity	Advanced	Quantity		
Rack, Roll, Tympan 18", tension bar with bracket	X	1	X	1	Table, Opaqing (beginning) 10" x 25"; (advanced) 24" x 36"	X	4	X	4
Rack, Roll, Wrapping paper 24", tension bar with bracket	X	1	X	1	Table, Overhead projector	X	1	X	1
Screen, Projection 60" x 60"	X	1	X	1	Table, Pilot press 24" x 48" x 31"	X	2	X	2
Shield, Face	X	3	X	3	Table, Typewriter	X	1	X	1
Table, General purpose hardwood top; size 30" x 5-8'; cabinet storage below, 33" high	X	3	X	3					

**LEVELS II, III, IV
CERAMICS**

I. Raw Material Preparation and Storage	Introductory Quantity	Advanced Quantity			II. Material Forming (cont.)	Introductory Quantity	Advanced Quantity		
I. RAW MATERIAL PREPARATION AND STORAGE					Banding Wheel, Potter's bench	X	6	X	12
Box, Clay storage, Portable metal lined with casters	X	1	X	1	Bench, Marble slab	X	1	X	1
Cabinet, Damp-proof size 18"D x 26"L x 31"H	X	2	X	1	Blunger (1/4HP motor)	X	1	X	1
Filter Press (laboratory model)			X	1	Dry Press table model; overall 15"H x 9"D x 7 1/4"W	X	1	X	1
Muller Mixer Cast aluminum drum, 13 1/4"D x 16 1/4"; motor 1/3HP; 115 volts; single phase	X	1	X	1	Extrusion Machine, Auger type	X	1	X	1
Pug Mill, Extrusion Table model; 40"L x 8 7/8"W x 9 1/4"H; motor 1/3HP; 115V; single-phase	X	1			Jigger, Electric (industrial model) variable speed, 1/4HP motor	X	1	X	1
Pug Mill, Laboratory model tub size 9" x 4'			X	1	Knife, Mold maker's blade length 4 1/2"	X	6	X	6
Pug Mill, Studio model 68" x 30" x 2", 1 1/4HP motor			X	1	Mixer, Slow speed (portable) 1/4HP motor	X	1	X	1
Pug Mill, Vertical 12", 3HP motor	X	1	X	1	Modeling Tool (set) kit of 10 tools	X	6	X	6
Pulverizer, Laboratory model			X	1	Plaster Working Tool average length 7", 6 tools per set	X	6	X	6
Storage Unit, Clay 24" x 24" x 28"	X	1	X	2	Potter's Wheel, Electric 1/4HP motor, table 24" x 30"	X	1	X	2
Wedging Boards 22" x 15" x 14" high or 12" x 15" x 2"T	X	1			Potter's Wheel, Kick 28" diameter, seated type	X	1	X	2
Wedging Table	X	1	X	1	Potter's Wheel, Side-kick 14" aluminum wheel head, standing type	X	1	X	2
II. MATERIAL FORMING					Table, Casting 8' x 2' x 32"H, Top 1" wood	X	1	X	1
Banding Wheel, Potter's bench					Tank, Agitated storage tank size 42" x 42", 1HP motor, approx. 240 gals.	X	1	X	1

II. Material Forming (cont.)	Introductory Quantity	Advanced Quantity	IV. Enameling (cont.)	Introductory Quantity	Advanced Quantity				
Throwing Ribs, Wooden (set)	X	6	X	6	Fork, Firing 20" length	X	1	X	1
Wheel Turning Tool (set) set of six in 9½" lengths	X	1	X	1	Kiln, Enameling 110 volt, 10 amps., interior 4" x 8½" x 8"	X	1	X	1
III. GLAZING				Sifter	X	2	X	3	
Ball Mill, Roller type 2 gallon size; ¼ to 1/3HP motor	X	1	X	2	Trivets	X	3	X	3
Cabinet, Glaze and library 12"D x 36"W x 13½"W	X	1	X	1	V. FIRING				
Compressor, Air 60 gallon tank, 1¼HP motor	X	1	X	1	Furnace, Crucible maximum cap. no. 16 crucible; temp. range 1200-2300 degrees F.	X	1	X	1
Graduate, Cylinder (100cc)	X	3	X	3	Kiln Cut-Off, Automatic (heat control device) Temp. to 2300 degrees F.	X	1	X	1
Graduate, Cylinder (500cc)	X	3	X	3	Kiln, Electric fire chamber 6½" x 7" x 4"; temp. 3000 degrees F.; 110 volts; 14.5 amps.	X	1	X	1
Jars, Grinding 8 sizes, ¼ to 6¼ gallons	X	3	X	3	Kiln, Front loading 18" x 18" x 19" chamber; temp. to 2000 degrees F.; 208 or 220-230V AC	X	1	X	1
Mortar and Pestle	X	6	X	6	Kiln, Gas 32" x 23" x 46" chamber; temp. to 2500 degrees F.; automatic cut off control	X	1	X	1
Scale, Laboratory up to 100 grams	X	1	X	1	Kiln, Starter	X	1	X	1
Scale, Triple beam 310 grams capacity	X	1	X	1	Kiln, Top loading 17" x 17" x 18" chamber; electric; temp. to 2300 degrees F.	X	1	X	1
Seive, Test laboratory 8" D, mesh sizes 30 to 120	X	6	X	6	Pyrometer, Optical	X	1	X	1
Spray Booth, Dry 3'6"W x 6'1"H, working depth 1'11", ¼HP fan motor	X	1	X	1	Pyrometer, Portable 30" thermocouple; range to 2500 degrees F.	X	1	X	1
Spray Gun, Touch-up	X	1	X	1	Pyrometer, Radiation temp. 1000 degrees F.; thermo-electric principles	X	1	X	1
IV. ENAMELING									
Atomizer	X	1	X	1					
Firing Racks three sizes: 3" x 3", 6" x 6", 12" x 12"	X	3	X	3					

VI. Decoration — Finishing	Introductory Quantity	Advanced Quantity		VIII. General Furnishings and Hand Tools (cont.)	Introductory Quantity	Advanced Quantity	
VI. DECORATION — FINISHING				Grinder-Buffer, Bench, Combination ¼HP, 1725 RPM, 115V A.C., hydraulic hand truck	X	1	X 1
Airbrush	X	1	X 1	Lift, Pa'let	X	1	X 1
Cabinet, Drying base height 18"D x 36"L x 31"H	X	1	X 1	Molds, Ceramics, Assorted	X	6	X 6
Knife, Fetting	X	1	X 1	Pan, Dust 12" steel	X	1	X 1
Scraper, Flexible	X	1	X 1	Pencil Sharpener, Standard	X	1	X 1
Scraper, Rigid	X	1	X 1	Pliers, Combination (6")	X	2	X 2
Ware Truck rubber tiered, swivel, 8 shelves, 22" x 28"	X	1	X 1	Press, Drill (15") variable speed number 2, Morse Taper, floor model, ¼HP motor, magnetic switch and starter	X	1	X 1
VII. CAST STONE				Projector, Filmstrip (85mm) and slide (2" x 2")	X	1	X 1
Mason's Tools, Cement (set)	X	1	X 1	Projector, Motion picture, Sound (16mm)	X	1	X 1
Mortar Box	X	1	X 1	Cabinet, Filing four drawers, 52"H x 15"W x 28½"D	X	1	X 1
VIII. GENERAL FURNISHINGS AND HAND TOOLS				Can, Safety (1 qt.)	X	2	X 2
Bench, Woodworking (4 place) 2½" x 54" x 64", hard maple top mounted on two 36"W x 21"D x 31"H base units, wood or metal	X	1	X 1	Can, Safety (1 gal.)	X	2	X 2
Bookcase approx. 60"H x 10-12"D x 72"L, 3 shelves adjust- able, wood or metal	X	1	X 1	Chair, Teacher's welded steel construction, swivel with casters	X	1	X 1
Broom, Push 18" in length	X	3	X 3	Crusher, Jaw (laboratory model)			X 1
Brush, Bench	X	6	X 6	Desk, Teacher's approx. 42" x 30" x 29", welded steel construction	X	1	X 1
Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X	1	X 1	Drill, Hand (3/8")	X	1	X 1
Gauge, Wire and sheet metal (American) sizes 0-36	X	1	X 1	Finishing Rubber size number 1 or number 2	X	1	X 1
Goggles (spectacles), Clear observation	X	12	X 12	Fire Blanket	X	1	X 1
				Fire Extinguisher	X	3	X 3

VIII. General Furnishings and Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity	VIII. General Furnishings and Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity
First Aid Kit	X	1	X	1	Sponge, Elephant ear shape	X	3	X	6
Gauge, Auger bit	X	1	X	1	Sponge, Sheep wool	X	3	X	6
Projector, Overhead	X	1	X	1	Spray Booth, Ceramic 24" x 24" x 28", with 10" electric exhaust fan			X	1
Pump, Slip, Duplex			X	1	Table, Overhead projector portable, 26" high	X	1	X	1
Screen, Projection 60" x 60"	X	1	X	1					
Shield, Face	X	6	X	6					

**LEVELS II, III, IV
PLASTICS**

I. Basic Plastics Equipment	Introductory	Quantity	Advanced	Quantity	I. Basic Plastics Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
I. BASIC PLASTICS EQUIPMENT					Molding Press, Injection (large)				
Autoclave steam pressure regulated to 60 p.s.i.; cap. 2 gal.	X	1	X	1	cap. 3 oz. of styrene heaters; 208 or 220V, 3-phase; motor operated hydraulic system			X	1
Extruder, Medium cap. 1"-1 1/4"; 208V or 220V; 3-phase operation	X	1	X	1	Molding Press, Injection (medium)	X	1	X	1
Extruder, Large maximum cap. 2"; 208 or 220V; 3-phase			X	1	cap. 1 1/4 oz. of styrene, 208 or 220V, 3-phase; motor operated pneumatic or hydraulic system				
Extruder, Small cap. 3/4"; 110V or 208 or 220V; single-phase operation	X	1	X	1	Molding Press, Injection (small)	X	1		
Molder, Blow 6" x 12" platen; cylinder approx. 2 1/4" bore, 2" stock			X	1	cap. 1/4 oz. - 3/4 of styrene heaters; 110V; single-phase; hand operated, mechanic or pneumatic				
Molder, Rotational variable speed drive, 2-15 RPM; motor 1/4HP, 110V with reversing switch; approx. 15" diameter			X	1	Molding Press, Transfer (large)			X	1
Molding Press, Compression (large) cap. 45 ton or more; 208 or 220V; 3-phase; electrical heated platen; size approx. 18" x 18"; piston stock 5"	X	1	X	1	cap. 75 ton or more on clamp; 208 or 220V; 3-phase; heated platen, size 18" x 18" minimum				
Molding Press, Compression (medium) cap. 50 ton; 208 or 220V; 3-phase; electrical heated platen plate; size 12" x 12" minimum; stroke 6"	X	1	X	1	Molding Press, Transfer (medium)			X	1
					cap. approx. 50 ton on clamp; 208 or 220V; 3-phase; heated platen; hand or motor operated; platen size 12" x 12"				
					Oven	X	1	X	1
					approx. 12"W x 10"H x 10"D; 0-550 degrees F.; 208 or 220V or 110V				
					Pre-Expander, Polystyrene			X	1
					steam or electrical 208 or 220V; 3-phase				
					Scrape Granulator			X	1
Molding Press, Compression (small) cap. 20-25 tons; 208 or 220V, 3-phase; electrical heated platen; size 6" x 6" minimum	X	1	X	1	Spray Gun (all-materials)	X	1	X	1
					steam or electric				
					Spray Unit, Reinforced plastics			X	1

I. Basic Plastics Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	II. Auxiliary Plastics Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
Thermoforming Press, Vacuum (large) approx. set size 24" x 36"; 208 or 220V; 3-phase heater	X	1	X	1	Testing Machine, Tensile maximum rated cap. 40,000 lbs., stroke 4"			X	1
Thermoforming Press, Vacuum (medium) approx. maximum wet size 8" x 8"; 110V heater; manual			X	1	Welding Unit, Plastics	X	1	X	1
Thermoforming Press, Vacuum (small) 2-6" x 1" muslin wheels; motor 1/3HP; 1725 RPM; 115V, single- phase; 60-cycle; manual starter with over-all protection with dust collector	X	1	X	1	III. PLASTER CASTING EQUIPMENT				
					Container, Plastic 100 lbs. cap.; metal or plastic with cover	X	1	X	1
					Mixing Bowls (set) set of 3 sizes; stainless steel kitchen type	X	3	X	3
					Scoop, Plaster	X	1	X	1
					Screening Wheel approx. 18" diameter	X	1	X	1
II. AUXILIARY PLASTICS EQUIPMENT					IV. FINISHING EQUIPMENT				
Buffer, Pedestal 2-6" x 1" muslin wheels, wide clearance design; motor 1/3HP, 1725 RPM, 115V, 60-cycle, single-phase, manual starter, overload protection	X	2	X	2	Spray Booth, Dry 5'W x 7'H x 4' working depth; fire deflector curtain and paint arrestor filter cells	X	1	X	1
Scale, Laboratory will weigh 100 grams	X	1	X	1	Spray Gun Outfit	X	1	X	1
Strip heater 22" length; 110V; 250W; switch and pilot light	X	1	X	1	V. WOODWORKING EQUIPMENT				
Timer, Interval 120 minute cap. by seconds	X	1	X	1	Dresser, Abrasive wheel	X	1	X	1
Tester, Guided bend maximum reader; ream source 10,000; stroke 5"	X		X	1	Drill, Electric, Portable (1/4")	X	1	X	1
Tester, Hardness type; M scale; 1/4" ball, 10-100 kg load			X	1	Drill, Electric, Portable (1/4")	X	1	X	1
					Grinder, Edge tool (bench) 1" x 7" motor, including a fine grit and one coarse wheel; motor 1/4HP, 60-cycle, 110V with overload protection	X	1	X	1

V. Woodworking Equipment (cont.)	Introductory Quantity	Advanced Quantity	V. Woodworking Equipment (cont.)	Introductory Quantity	Advanced Quantity				
Jointer (6") motor 1/2HP, 60-cycle, 3-phase, 208 or 220V with magnetic switch and overload protection	X	1	X	1	Saw, Circular, Power 10" floor model; motor 1/2HP, 60-cycle; 208 or 220V; 3-phase, with magnetic switch and starter or 12" floor model	X	1	X	1
Lathe, Spinning (12") variable speed drive; 650-3450 RPM; motor 1HP, magnetic starter; 208 or 220V; 3-phase	X	1	X	1	Saw, Jig (scroll) 2", metal stand; motor 1/3HP; 115V	X	1	X	1
Lathe Wood turning 12" swing; motor 1/2HP, 60-cycle; 208 or 220V; 3-phase; switch and overload protection; including cup center, spur center, 3 face plates, 1-6" tool rest, 1-12" tool rest, 1 tool support base, 1 knock-out bar	X	1	X	1	Saw, Sabre (bayonet) portable; heavy duty; 115V, 60-cycle AC	X	1	X	1
Press, Drill (15") 15" cap.; variable speed; number 2 Morse taper in spindle; floor model; 1/2" key chuck; tilting standard table; with 1/2HP, 220V, 3-phase motor, and magnetic switch and starter	X	1	X	1	VI. METAL WORKING EQUIPMENT				
Router, Portable, Electrical 1/2 or 7/8HP	X	1	X	1	Bender, Universal on stand; cap. radius 6"-12"; 1/2" round mild steel; including accessories for variety of common bends, flats, rounds, tubing	X	1	X	1
Sander, Belt, Portable, Electrical 3" x 24" or 4" x 24"; 115V AC motor	X	1	X	1	Brake, Box and pan 24"; cap. 16 ga., 3" deep; 0-135	X	1	X	1
Sander, Spindle 19" oscillating abrasive sleeves; on floor stand; motor 1/2HP, 3-phase, 60-cycle; 208 or 220V, with magnetic switch and starter	X	1	X	1	Flask, Foundry (small) 10" x 12"; cap. 3" deep, diagonal 3" deep			X	1
Saw, Band, Wood-cutting 16" floor model; motor 1/2HP, 60-cycle; 208 or 220V, 3-phase; with magnetic switch and starter	X	1	X	1	Forming Roll, Slip 30"; cap. mild steel; 22 ga.	X	1	X	1
					Furnace, Crucible maximum cap. number 16 crucible			X	1
					Grinder, Belt 14"W belt; 1HP, 208 or 220V; 3-phase; magnetic switch guards	X	1	X	1
					Lathe, Metalworking (10") minimum distance between centers 24" cabinet models; underneath drive; quick change gear box; 64 thread and spindle changes L.H. or R.H. from 4 to 224; speeds from 60 to 1500 RPM; motor 1/2HP; 208 or 220V; 3-phase; drum switch and			X	1

VI. Metalworking Equipment (cont.)	Introductory			VII. Hand Tools	Introductory			Quantity	
	Quantity	Advanced	Quantity		Quantity	Advanced	Quantity		
magnetic starter. Equipped with drive plate, spindle adapter, centers for head-stock and tailstock, tool post, ring and rocker, thread chasing dial and tool post wrench, 3-jawed chuck, 4-jawed chuck				VII. HAND TOOLS					
Pantograph, Metalworking 2 or 3 dimensional; enlargement up to 1:16; 208 or 220V, single-phase; appropriate cutters		X	1	Awl, Brad	X	2	X	2	
Saw, Hack, Power minimum cap. 6" x 6"; swivel, (adv.) vise; automatic stop; pressure feed control; automatic lift on reverse stroke; built-in coolant tank and pump; motor 1/4HP; 208 or 220V; 3-phase; magnetic push button starter; minimum cap. 5" x 5"; swivel vise; automatic stop; automatic lift on reverse stroke; motor 1/3HP; 208 or 220V; 3-phase; magnetic push button starter			X	1	Bit, Auger (set) size 4-16, single thread screw	X	1	X	1
Shear, Squaring foot maximum cap. mild steel; 16 ga.; minimum cutting length 36"; anti-pinch and toe guard	X	1	X	1	Brace, Ratchet 10"; box ratchet	X	1	X	1
Shearing and Forming Machine, Universal cap. 5/32" mild steel; throat 42" deep; motor 1HP, 208 or 220V, 3-phase, with magnetic switch and starter			X	1	Caliper, Inside (6") solid nut	X	1	X	1
Testing Machine, Universal maximum rated cap. 40,000, 5" ram travel			X	1	Caliper, Outside (6") solid nut	X	1	X	1
Welder, Arc (AC/DC)			X	1	Chisel, Butt (set) 3" blade; plastic handles; sizes 1/4", 1/2", 3/4", 1", 1 1/4", 1 1/2"	X	2	X	2
Welder, Spot	X	1	X	1	Chisel, Carving (set) set of 6; approx. 6"L	X	2	X	2
Welding Outfit, Oxyacetylene			X	1	Chisel, Cold (set) cutting edges of 1/4", 3/8", 1/2", 3/4"	X	2	X	2
					Chisel, Socket firmer (set) set of 6; sizes 1/4", 3/8", 1/2", 5/8", 3/4", 1"	X	1	X	1
					Chisel, Wood turning (set) 14"L	X	1	X	1
					Circle Cutter heavy duty; 1/2" round shank; cap. 1"-8" diameter; 6 extra tools	X	1	X	1
					Clamp, Bar (36")	X	8	X	8
					Clamp, Bar (48")	X	4	X	4
					Clamp, "C" (6")	X	12	X	12
					Clamp, "C" (8")	X	6	X	6
					Clamp, Spring (no. 3) heavy gauge steel; opening 3"	X	12	X	12
					Countersink, Bit (for brace) (set) size 5/8" and 3/4"	X	1	X	1

VII. Hand Tools (cont.)			Introductory	Quantity	Advanced	Quantity	VII. Hand Tools (cont.)			Introductory	Quantity	Advanced	Quantity
Divider, Spring (6")			X	1	X	1	Goggles (spectacles), Clear observation			X	20	X	20
Drill, Hand (1/4")			X	1	X	1	Graduate Cylinder (100cc)			X	2	X	2
Drill, Hand (3/8")			X	1	X	1	Graduate Cylinder (500cc)			X	2	X	2
Drill Stand, Fractional for twist drills; from 1/16"-1/2" by 64ths			X	1	X	1	Hammer, Ball peen (12 oz.)			X	1	X	1
Drill, Twist (number set) high speed steel; straight shank; nos. 1-60			X	1	X	1	Hammer, Soft face			X	2	X	2
Drill, Twist (fractional set) straight shank; high speed steel; 1/16" to 1/2" by 64ths			X	1	X	1	Hammer, Claw (16 oz.)			X	2	X	2
Extractor, Screw (set)			X	1	X	1	Helmet, Welding (arc) (hand type)					X	2
Files (assorted sizes, shapes and cuts, with handles, as specified)							Helmet, Welding (head type)					X	1
	Length	Name & Shape	Cut				Mallet, Rawhide (10 oz.)			X	2	X	2
10"	Mill	Second-Cut	X	6	X	6	Micrometer, Outside (1") graduated in .001"			X	1	X	1
10"	Mill	Bastard	X	6	X	6	Micrometer, Outside (2") graduated in .001"			X	1	X	1
10"	Half-round	Second-Cut	X	6	X	6	Nail Set (1/16" tip)			X	6	X	6
10"	Half-round	Bastard	X	6	X	6	Oiler, Bench 1/3 or 1/2 pts. size; 6" straight spout			X	6	X	6
8"	Round	Second-Cut	X	6	X	6	Oilstone, Combination, India coarse and fine grits; 8" x 1" x 2"			X	2	X	2
8"	Round	Bastard	X	6	X	6	Oilstone, Combination, Silicon carbide coarse and fine grits; 8" x 1" x 2"			X	2	X	2
6"	Warding		X	6	X	6	Pipet Control, Microsyringe					X	1
10"	Cabinet Rasp	Second-Cut	X	3	X	3	Plane, Jack 14"L; cutter 2"W			X	2	X	2
File Card and Brush 9 1/4"L, brush 1 1/4" x 5"			X	6	X	6	Pliers, Combination (6")			X	1	X	1
File, Needle (set) set of 12; 6 1/4"L; assorted shapes			X	1	X	1	Pliers, Combination (8")			X	1	X	1
Gauge, Auger bit for gauging hole depth			X	1	X	1	Pliers, Diagonal cutting (6")			X	1	X	1
Gauge, Marking			X	1	X	1	Pliers, End cutting (6")			X	1	X	1
Gauge, Wire and sheet metal (American) sizes 0-36			X	1	X	1	Pliers, Straight nose (8")			X	1	X	1
Gauge, Wire and sheet metal (U.S.S.) sizes 0-36			X	1	X	1	Pliers, Tongue (10")			X	1	X	1

VII. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity	VII. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity
Pliers, Vise grip wrench (7")	X	1	X	1	Square, Steel framing 12" x 24"	X	2	X	2
Punch, Center (set) set of 5: 1/16"-1/4"; with tapered point	X	3	X	3	Tap and Die, NC (U.S. standard) (set) size: 1/4-20, 5/16-18, 3/8-16, 7/16-14, 1/2-13	X	1	X	1
Punch, Hand (set) set of 7 punches and dies; 3/32"-9/32"; metal box	X	1	X	1	Tap and Die, NF (S.A.E.) (set) size: 1/4-28, 5/16-24, 3/8-24, 7/16-20, 1/2-20	X	1	X	1
Punch, Pin (set) 4"L; diameter 1/16"-1/2" by 32nds	X	1	X	1	T Bevel, Sliding (6")	X	1	X	1
Rule, Steel (12")	X	6	X	6	V Block and Clamps (set)	X	1	X	1
Rule, Steel (24")	X	6	X	6	Wrench, Adjustable end (6")	X	1	X	1
Sanding Drums (set)	X	1	X	1	Wrench, Adjustable end (8")	X	1	X	1
Saw, Back (12")	X	2	X	2	Wrench, Adjustable end (10")	X	1	X	1
Saw, Coping (6 1/4")	X	2	X	2	Wrench, Adjustable end (12")	X	1	X	1
Saw, Hack (hand) adjustable to receive 9"-12" blades	X	2	X	2	Wrench, Allen key (hex) (set) set of 11, nos. 1/4-12	X	1	X	1
Saw, Hand, Crosscut 22"; 10 point	X	2	X	2	Wrench, Combination box and open (set) 3/8"-1"	X	1	X	1
Scissors (8")	X	1	X	1	Wrench, Socket (3/8" drive) (set) size 3/8"-3/4" by 16ths	X	1	X	1
Scraper, Cabinet malleable iron with 2 1/4" blade	X	2	X	2	VIII. GENERAL FURNISHINGS				
Scraper, Hand approx. 3" x 5" steel blade	X	6	X	6	Bench, Arc welding 2 stations with fireproof curtains			X	1
Screwdriver, Standard bit (round blade) (set) set of 5; blade widths 3/16", 1/4", 5/16", 3/8", 1/2"	X	6	X	6	Bench, Gas welding 2 station style; fire brick top			X	1
Shield, Face	X	6	X	6	Bench, Machine hard maple top; approx. 2 1/4" x 40" x 96"; height 32"	X	2	X	2
Snips, Tinner's, Straight (number 8)	X	2	X	2	Bench, Metalworking (4 place) top 2 1/4" x 24" x 4' long; laminated maple, legs heavy gauge steel	X	2	X	2
Square, Combination (12")	X	6	X	6					
Square, Combination set (with protractor and center head) (12")	X	1	X	1					

VIII. General Furnishings (cont.)	Introductory	Quantity	Advanced	Quantity	VIII. General Furnishings (cont.)	Introductory	Quantity	Advanced	Quantity
Bench, Molding steel construction, approx. 30" x 32"H	X	1	X	1	Can, Oily waste	X	2	X	2
					Can, Safety (1 qt.)	X	6	X	6
Bench, Plaster stainless steel top, approx. 26" x 96"	X	1	X	1	Can, Safety (1 gal.)	X	6	X	6
Bench, Woodworking (4 place) 2¼" x 54" x 64"; laminated maple top; 2 wood or metal base units; 36"W x 21"D x 3"H; equipped with 4 vises	X	4	X	6	Chair, Teacher's welded steel construction, swivel, with casters	X	1	X	1
Bookcase approx. 60"H x 10"-12"D x 72"L, 3 adjustable shelves, wood or metal	X	1	X	1	Desk, Teacher's approx. 42" x 30" x 29"H welded steel construction	X	1	X	1
Broom, Push 18" in length	X	3	X	3	Fire Blanket	X	1	X	1
Brush, Bench	X	12	X	12	Fire Extinguisher	X	3	X	3
Cabinet, Filing 4 drawer, 52"H x 15"W x 28½"D	X	1	X	1	First Aid Kit	X	1	X	1
Cabinet, Finishing supply approx. 36" x 12" x 84" with combination box and shelves, doors with locks	X	2	X	2	Microscope			X	1
Cabinet, Parts storage metal, 100 drawers	X	1	X	1	Pan, dust (12" steel)	X	1	X	1
Cabinet, Sheet plastics storage metal, 12 bins	X	1	X	1	Pencil Sharpener, Standard	X	1	X	1
Cabinet, Tool storage approx. size 62"W x 22"D x 84"H	X	1	X	1	Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X	1
					Projector, Motion picture, Sound	X	1	X	1
					Projector, Overhead	X	1	X	1
					Rack, Lumber	X	1	X	1
					Rack, Metal storage	X	1	X	1
					Screen, Projection 60" x 60"	X	1	X	1
					Table, Overhead projector portable, 26"H	X	1	X	1
					Truck, Welding cylinder				

**LEVELS II, III, IV
METALS**

I. Fabricating Machines and Accessories	Introductory	Quantity	Advanced	Quantity	I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity
I. FABRICATING MACHINES AND ACCESSORIES					Cutter, Milling machine, Helical, Plain			X	1
Bar Folder (30")	X	1	X	1	high speed steel, diameter, width of face and arbor hole to be specified according to need				
Arbor, Milling machine 1", "B" bearing			X	2					
Bender, Universal on stand, cap. radius 6"-12", 1/4" round, mild steel, including accessories	X	1	X	1	Cutter, Milling machine, Shell and arbor			X	1
Boring Bar (set) set of 3, 3/8", 1/2", 1/4", dia. bars			X	2	high speed steel, actual size and type to be specified according to need and machine size				
Brake, Box and pan 24", cap. 16 ga. depth of box 3"	X	1	X	1	Cutter, Milling machine, Slitting			X	1
Buffer, Long arm pedestal, 33" between wheels, 5/8" arbor, motor 3/4HP, 3450 RPM, 208V or 220V, 3-phase, 60-cycle			X	1	high speed steel; diameter; thickness, arbor hole and number of teeth to be specified accord. to need				
Buffer, Pedestal 2-6" x 1" muslin wheels, clearance design, motor 1/3HP, 1725 RPM, 115V, single-phase, 60-cycle	X	1			Cutting-Off Tool, Lathe	X	6	X	6
Chuck, Magnetic permanent ceramic			X	1	Drill, Elec., Portable (1/4")	X	1	X	1
Cutter, Milling machine, End (set) high speed steel, actual type and size to be specified according to need and machine size			X	1	Drill, Elec., Portable (3/8")			X	1
Cutter, Milling machine, Gear tooth, Involute (set) high speed, diametral pitch and number forms to be specified according to need			X	1	Drill, Elec., Portable (1/2")			X	1
					Electroplating Unit	X	1	X	1
					50 amps.; 0-9V				
					Forge, Gas			X	1
					Forming, Roll, Slip	X	1	X	1
					30"; cap. mild steel; 22 ga.				
					Furnace, Crucible	X	1	X	1
					maximum cap., no. 16 crucible				
					Furnace, Heat treating	X	1	X	1
					beginning: fire box; 5"H x 7 1/2"W x 13 1/4"L; advanced: fire box; 7"H x 13"W x 16 1/4"L				
					Grinder, Heavy duty pedestal			X	1
					12" with self-contained dust collector, motor 2HP; 220V or 208V; 3-phase, 60-cycle, magnetic starter				

I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity	I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity		
Grinder Pedestal 1" x 7" model, included one fine grit and one coarse wheel, motor ½HP; 220 or 208V, 3-phase, 60-cycle	X	1	X	1	Lathe, Metalworking (14") minimum distance between centers 36"; capacity through spindle 1-1/16"; cam lock spindle nose; center Morse Taper no. 3; spindle speeds; direct drive 215 to 875 RPM, backgeared 30 to 130 RPM; quick change gear box 4 to 224 threads per inch; tailstock spindle no. 3 Morse taper; thread indicator dial; with 3-jawed and 4-jawed chuck; taper attachment, face plate; tool post assembly; centers and spindle sleeve; motor; 2HP, 208V or 220V, 3-phase, pushbutton line starter control-forward, reverse, stop and magnetic reversing linestarter			X	2		
Grinder, Surface minimum table working surface 13½" x 6", minimum longitudinal feed 14"; minimum cross feed 7"; working height 0-11½"; 7" wheel; spindle motor 1HP, 3,450 RPM; diamond dresser			X	1							
Indicator, Dial test Range .030"			X	2							
Jolt Squeezer, Foundry size 17" x 20" x 10"D, cap. 6,000 lbs.			X	1		Lathe, Spinning (12") variable speed drive; speeds 650 to 3450 RPM; 1HP motor; 208V or 220V; 3-phase; magnetic starter; metal spinning face plate; spinning tool rest with fulcrum pins; spinning center; spur center and cut center; set of metal spinning tools; set of wood turning chisels			X	1	
Knurling Tool, Lathe (coarse) to fit tool post of lathe ordered			X	6							
Knurling Tool, Lathe (fine) to fit tool post of lathe ordered			X	6							
Knurling Tool, Lathe (medium) to fit tool post of lathe ordered			X	6			Mandrel, Expansion (set) set; range 3/8" to 2½"			X	2
Lathe, Metalworking (10") minimum distance between centers 24" cabinet models; underneath drive; quick change gear box; 54 thread and spindle changes J.H. or R.H. from 4 to 224; speeds from 50 to 1500 RPM; motor ¾HP, 208V or 220V, 3-phase, drum switch and magnetic starter. Equipped with drive plate, spindle adapter, centers for head-stock and tailstock, tool post, ring and rocker, thread chas. dial and tool post wrench. 3-jawed chuck, 4-jawed chuck	X	3	X	6	Mandrel, Set sizes: ¼", 5/16", 3/8", 7/16", ½", 5/8", ¾", 7/8", 1"				X	1	
					Milling Machine, Horizontal no. 3 Knee and Column, plain style, specifications may vary according to need— these features, however, should be considered: fast, easy feed selection, directional feed controls, power rapid traverse, built-in backlash eliminator, spindle speeds selections, convenient electrical controls, ruggedness of construction, trip dogs and positive safety stops, easy chip removal and sump cleaning, anti-friction bearings, positive lubrication, safety features and simplicity			X	1		

I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity	I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity
of maintenance; includes Morse Taper adaptor					table with raising and lowering mechanism; no. 3 Morse taper spindle; key chuck, 1/2" capacity; belt and pulleys completely guarded; 3/4HP motor (minimum); 208V or 220V; 3-phase; push button magnetic control and starter				
Milling Machine, Universal spindle C/L to table top with cutterhead horizontal 0 to 23", spindle nose to table top with cutterhead, vertical 0-17" with adjustable cutterhead that can be positioned through a full 90° for vertical, angular, or horizontal milling. Other features to be considered: gib design, spindle drive motor, feed motor, coolant system, table working surface, saddle, ram, overarm, feed ranges, spindle speeds, controls, and lubrication			X	1	Rotary Machine, Combination			X	1
Milling Machine, Vertical approx. range, 9" x 40" table working surface, longitudinal table travel 26", cross travel 10", vertical travel of knee 18" vertical travel of spindle 5", turret to rotate 360 degrees on column, head to rotate 360 degrees on ram. Other features to be considered: gibs, accuracy and movement of all bearing surfaces, spindle bearings, spindle tapers, spindle speeds, 4-way head, balanced pulleys, power feed table, motors and electrical controls			X	1	Sand Blaster			X	1
Oven, Core lab type; 0-550 degrees, inside dimensions approx. 12"W x 10"H x 10"D, automatic thermal control			X	1	Sand Muller booth; sand blast gun and hose; cap. approx. 25 lbs. of dry material			X	1
Press Arbor 3 ton cap.; gear driven			X	1	Saw, Band (power), Metal cutting, 18" cap., speeds 50-2000 FPM, attached blade welding device, 208V or 220V, 3-phase, with magnetic switch and starter.			X	1
Press, Drill (15") 15" cap.; variable speed; no. 2 Morse taper in spindle; floor model; 1/2" key chuck; tilting standard table; with 1/4HP, 208V or 220V, 3-phase motor, and magnetic switch and starter	X	2	X	1	Saw, Hack (power) minimum cap. 6" x 6"; swivel, (adv.) vise; automatic stop; pressure feed control; automatic lift on reverse stroke, built-in coolant tank and pump; motor 1/2HP; 208 or 220V; 3-phase; magnetic push button starter; minimum cap. 5" x 5" swivel vise; automatic stop; automatic lift on reverse stroke; motor 1/3HP; 208 or 220V; 3-phase; magnetic push button starter	X	1	X	1
Press, Drill (17") floor model; variable speed 300 to 3100 RPM; production			X	1	Setting Down Machine			X	1
					Shaper, Metal 12"-15" stroke; specifications to be included according to need: cutting speeds, table travel—horizontal and vertical, tool head, drive unit, lubricating system, drive unit including motor and switches, cross feed—power and hand, vise, and shaper tools			X	1
					Shear, ring and circle cap. 20 ga.; mild steel			X	1
					Shear, Squaring, foot cap. 16 ga.; mild steel	X	1	X	1

I. Fabricating Machines and Accessories (cont.)	Introductory	Quantity	Advanced	Quantity	II. Hand Tools and Equipment	Introductory	Quantity	Advanced	Quantity
	X		X			X		X	
Spray Gun Outfit general shop	X	1	X	1	Broom, Push (10")	X	3	X	3
Tension Tester, Core			X	1	Brush, Bench	X	12	X	12
Tester, Hardness bench, Rockwell system, regular hardness test, 10 to 150 kg. and super- ficial tests 3-45 kg.			X	1	Brush, Wire overall length 10"	X	6	X	6
Tool Holder, Lathe (left hand) to fit tool post of lathe ordered	X	6	X	6	Bulb, Sponge 8 oz., rubber bulb	X	1	X	1
Tool Holder, Lathe (right hand) to fit tool post of lathe ordered	X	6	X	6	Caliper, Hermaphrodite (6") lock joint			X	2
Tool Holder, Lathe (straight) to fit tool post of lathe ordered	X	6	X	6	Caliper, Inside (6") solid nut, bolt spring	X	6	X	6
Torch, Gas	X	2	X	2	Caliper, Outside (6") solid nut, bolt spring	X	6	X	6
Weider, Arc (AC/DC)	X	1	X	1	Caliper, Outside (8") solid nut, bolt spring			X	2
Welder, MIG			X	1	Caliper, Vernier 5" cap.			X	1
Welder, Spot	X	1	X	1	Can, Oily waste 10 gal. cap.	X	1	X	1
Welder, TIG			X	1	Can, Safety (1 qt.)	X	2	X	2
Welding Outfit, Oxyacetylene include a regulator, touch, set of tips, cutting attach- ments and set of tips, twin hose	X	1	X	1	Can, Safety (1 gal.)	X	2	X	2
					Chisel, Cape 1/4" stock, 1/4" cutting edge	X	2	X	2
					Chisel, Cold (set) cutting edge of 1/4", 3/8", 1/2", 3/4"	X	1	X	2
					Chisel, Diamond point (set) 1/4", 3/8", 1/2" bits	X	1	X	2
II. HAND TOOLS AND EQUIPMENT					Chisel, Round nose (set) 1/4", 3/8" bits	X	1	X	2
Anvil (100 lb.)	X	1	X	1	Clamp, "C" (4")	X	4	X	4
Apron, Foundry leather, approx. 44"L	X	2	X	2	Clamp, "C" (6")	X	4	X	4
Apron, Rubber	X	1	X	2	Clamp, "C" (8")	X	4	X	4
Apron, Welding leather, approx. 44"L	X	2	X	2	Clamp, "C" (10")	X	4	X	4
Awl, Scratch (6")	X	4	X	4	Countersink, Bit (for brace) (set) sizes: 5/8" and 3/4"	X	1		
Bellows, Molder's (8")	X	1	X	1					

II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity
Countersink, High speed steel ¼" shank, ½" size	X	1	Drill, Twist (number set) high speed steel; straight shank	X	1 X 1
Crucible (no. 4)	X	2 X 2	Drill, Twist (fractional set) high speed steel; straight shank	X	1 X 1
Crucible (no. 10)	X	2 X 3	Drill, Twist (fractional set) Taper set high speed steel, no. 2 Morse Taper, 5/8"-1" by 8ths	X	1 X 1
Crucible Hand Shank (no. 4)	X	1 X 1	Extractor, Screw (set) set of 6, no. 1 - no. 6	X	1 X 1
Crucible Lifter (2-man)	X	1 X 1	Files (assorted sizes, shapes, and cuts, with handles, as specified)		
Crucible Ring Shank 2-man, for nos. 8, 10, 12 crucible	X	1 X 1	Length Name or Shape Ø		
Cutter, Bolt (minimum 14")	X	1 X 1	8" Flat Bastard	X	4 X 4
Cutter, Pipe cap. 1/8"-1" diameter		X 1	10" Flat Bastard	X	4 X 4
Cutter, Sprue ¾" x 10"	X	1 X 1	4" Mill Smooth	X	6 X 6
Die, Dapping 2½ cube, 21 sphere, 3/16" to 2 3/16"	X	1 X 1	6" Mill Smooth	X	6 X 6
Die, Letter (set) 3/16" character height	X	1 X 1	8" Mill	X	6 X 6
Die, Number (set) 3/16" character height	X	1 X 1	6" Round Second-Cut	X	2 X 2
Divider, Spring (4") solid nut		X 2	8" Round Bastard	X	6 X 6
Divider, Spring (6") solid nut	X	6 X 6	8" Three-Square (Triangular)	X	4 X 4
Divider, Spring (8") solid nut		X 2	File Card and Brush 9½"L, brush 1½" x 5"	X	6 X 6
Dresser, Abrasive wheel	X	1 X 1	Flask, Foundry (large) 12" x 18"; cap. 4" deep, drag 4" deep	X	4 X 4
Drill, Hand (¼")	X	1 X 1	Flask, Foundry (small)	X	4 X 4
Drill, Hand (3/8")	X	1 X 1	Gauge, Center spring tempered	X	3 X 6
Drill Stand, Fractional 1 twist drill from 1/16" to ½" by 64ths	X	1 X 1	Gauge, Drill point		X 1
Drill, Twist (letter set) high speed steel; straight shank	X	1 X 1	Gauge, Micrometer, Depth calibrated thousandths; 0-3"		X 1
			Gauge, Radius and fillet with radii from 1/32" to 17/32" by 64ths		X 1

II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity
Gauge, Screw pitch with 22 pitches, 9-40	X 1	X 1	Hammer, Engineer's (48 oz.)	X 1	X 1
Gauge, Small hole set of 4; from 1/8" to 1/2"		X 1	Hammer, Riveting, Machinist's (9 oz.)	X 2	X 2
Gauge, Surface base 3 1/8" x 2 1/2"		X 1	Hammer, Soft face (4 oz.) with replaceable plastic faces	X 2	X 2
Gauge, Telescopic set; 1/2" to 6"		X 1	Hammer, Soft face (8 oz.) with replaceable plastic faces	X 2	X 2
Gauge, Thickness ("feeler") minimum 6" leaf, 1/2" x 2 1/2" x .0015 to .015	X 1	X 1	Helmet, Welding (arc) (head type) no. 10 lens and cover	X 2	X 2
Gauge, Vernier height minimum 0-12"		X 1	Leggings, Molder's (pair)	X 2	X 2
Gauge, Wire and sheet metal (American) sizes 0-36	X 1	X 1	Mallet, Hardwood	X 4	X 4
Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X 1	X 1	Mallet, Rawhide (10 oz.)	X 4	X 2
Gloves, Asbestos (pair) unlined, 14"L, medium size	X 2	X 2	Mallet, Rubber approx. 2"	X 2	X 2
Gloves, Leather (pair) cowhide	X 4	X 6	Micrometer, Inside (set) range 2" to 12"	X 1	X 1
Gloves, Thick rubber (pair) thin latex	X 2	X 2	Micrometer, Outside (1") graduated in .001", with spindle lock and ratchet adjustment	X 4	X 6
Goggles (spectacles), Clear observation	X 24	X 24	Micrometer, Outside (2") graduated in .001", with spindle lock and ratchet adjustment	X 2	X 2
Goggles, Gas welding	X 3	X 3	Micrometer, Outside (3") graduated in .001", with spindle lock and ratchet adjustment	X 1	X 1
Groover, Hand (set) set of 3; sizes 0, 2, 4	X 2	X 2	Micrometer, Outside (screw thread) pitch diameter 0-1", graduated in .001", 14" to 30" threads per inch		X 1
Hammer, Ball peen (8 oz.)	X 2	X 2	Micrometer, Outside (screw thread)		X 1
Hammer, Ball peen (12 oz.)	X 4	X 4	Mold, Ingot	X 1	X 1
Hammer, Ball peen (16 oz.)	X 2	X 2	Nipper, End cutting (6")	X 1	X 1
Hammer, Ball peen (30 oz.)		X 2	Oiler, Bench 1/3 or 1/2 pt. size, 5" straight spout	X 12	X 12
Hammer, Chipping		X 2			
Hammer, Engineer's (40 oz.)	X 2	X 2			

II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity
Oilstone, Combination, India coarse and fine grit, 8" x 1" x 2"	X	2	Rivet Set (set) set of 5; sizes nos. 3-7	X	4
Pan, Dust (12" steel)	X	1	Rule, Circumference (36") tinnern; standard measure- ments to 8ths	X	2
Parallels, Adjustable (set) set of 6 with cap., range 3/8" to 2 1/4"		X	Rule, Flexible, Steel tape (12')	X	2
Pencil Sharpener, Standard	X	1	Rule, Hook (12"L)		X
Plate, Angle 4" x 5" x 6"		X	Rule, Short (set) short set of 5; with holder; 1/4" to 1"		X
Plate, Surface 10" x 15"		X	Rule, Steel (6") 10th, 100ths, 32nds, 64ths	X	6
Pliers, Combination (6")	X	6	Rule, Steel (12") graduated to 1/16"	X	12
Pliers, Combination (8")	X	4	Rule, Steel (24") graduated to 1/16"	X	2
Pliers, Diagonal cutting (6")	X	2	Saw, Hack (hand) adjustable to receive 9" x 12" blade	X	6
Pliers, Needle nose (6")	X	2	Saw, Jeweler's (4")	X	2
Pliers, Straight nose (8")	X	2	Saw, Jeweler's (6")	X	4
Pliers, Vise-grip wrench (7")	X	2	Scissors (8")	X	1
Punch, Center (set) set of 5; 1/16" to 1/4"	X	4	Screwdriver, Offset, Phillips (set) set of tips 3/16", 9/32", and 11/32"		X
Punch, Drive (set) set of 5; punch dia. 1/8"-3/8"; 8"L	X	1	Screwdriver, Offset, Straight slot (set)	X	1
Punch, Hollow (set) 3/8", 1/2", 5/8", 3/4", 1", 1 1/2", 2"	X	1	Screwdriver, Phillips (set) set with points nos. 1, 2, 3	X	1
Rammer, Hardwood	X	2	Screwdriver, Standard bit (round blade) (set) set of 5; blade widths 3/16", 1/4", 5/16", 3/8", 1/2"	X	2
Reamer, Center (set) 60 degrees included angle; high speed; sizes 1/4", 3/8", 1/2", 5/8", 3/4"	X	1	Scriber complete with 3 points: 1 straight, 1 short bent, 1 long bent	X	6
Reamer, Expansion (set) set of 8; A-H		X	Seamer, Handy	X	2
Reamer, Pipe 1/8"-1"; round shank	X	1			
Riddle, Foundry wire screen, no. 8 mesh	X	2			

II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity
Shield, Face	X 12	X 12	Stake, Candle mold	X 1	X 1
Shovel, Square point	X 1	X 1	Stake, Conductor		X 1
Sleeves, Molder's (18"L)	X 1	X 1	Stake, Double seaming set with 4 edges		X 1
Slick and Oval (1")	X 1	X 1	Stake, Grooving		X 1
Slick and Oval (1¼")	X 1	X 1	Stake, Hatchet	X 1	X 1
Snip, Aviation (left) 10"L	X 2	X 2	Stake, Hollow mandrel	X 1	X 1
Snip, Aviation (right) 10"R	X 2	X 2	Stake, Needle case		X 1
Snip, Aviation (combina- tion and straight) (10"L)	X 2	X 2	Stake, Round head		X 1
Snips, Hawkbill (3" cut)	X 1	X 1	Tap and Die, Machine screw (set) including the following sizes: 4-36, 6-32, 8-32, 10-24, 10-32, 12-24, ¼-20	X 1	X 1
Snips, Tinner's, Straight (no. 8)	X 4	X 4	Tap and Die, NC (U.S. standard) (set)	X 1	X 1
Snips, Tinner's, Straight (no. 10)	X 2	X 2	Taper, plug and bottoming tap plus one die in fol- lowing sizes: ¼-20, 5/16-18, 3/8-16, 7/16-14, 1/2-13 complete with die stock and tap wrench		
Soldering Copper, Electric (60W)	X 1	X 1	Tap and Die, NF (S.A.E.) (set)	X 1	X 1
Soldering Copper, Electric (200W)	X 1	X 1	Taper, plug and bottoming tap plus one die in fol- lowing sizes: ¼-28, 5/16-24, 3/8-24, 7/16-20, ½-20 complete with die stock and tap wrench		
Soldering Copper, Electric (300W)		X 1	Tap and Die, Pipe (set) tap die and reamer for following sizes: 1/8", ½", ¾", 1"	X 1	X 1
Soldering Copper (pair) ½ lb.	X 4	X 2	Tongs, Blacksmith, Curved lip 20"L	X 2	X 2
Soldering Copper (pair) 1 lb.	X 2	X 2	Tongs, Pick up (flat lips) 24"	X 2	X 2
Soldering Copper (pair) 1½ lb.	X 1	X 1	Trammel Points	X 1	X 1
Sparklighters	X 6	X 6	Trowel, Foundry		X 1
Square, Combination (12")	X 6	X 6			
Square, Combination set (with protractor and center head) (12")	X 1	X 1			
Stake, Beakhorn	X 1	X 1			
Stake, Blowhorn	X 1	X 1			
Stake, Bottom		X 1			

II. Hand Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	III. General Furnishings	Introductory	Quantity	Advanced	Quantity
Truck, Welding cylinder size appropriate to the gas bottle size	X	1	X	1	III. GENERAL FURNISHINGS				
V Block and Clamps (set)	X	1	X	2	Bench, Arc welding with fire proof curtains; 2 station	X	1	X	2
Vise, Angle, Drill cap. of opening 2¼" (beginning); cap. of opening 3" (advanced)	X	1	X	2	Bench, Gas welding with fire brick top; 2 station	X	1	X	2
Vise, Bench, Drill cap. for opening 3"	X	2	X	2	Bench, Machine laminated maple top, approx. size 96" x 40" x 2¼"; height 32", angle iron edges, one stake plate	X	1	X	1
Vise, Machinist's bench swivel base, 3 jaw, 4¾" opening	X	12	X	12	Bench, Metalworking (2 place) laminated maple top, approx. size 60" x 40" x 2¼", height 32", angle iron edges	X	2	X	2
Vise, Pin (set) range 0-.125" minimum	X	1	X	1	Bench, Metalworking (4 place) laminated maple top, approx. size 4' x 24" x 2¼", angle iron edges, heavy gauge steel legs, height 30"	X	4	X	4
Vise, Pipe	X	1	X	1	Bench, Mol'ing steel construction, approx. size 60" x 30" x 32"H	X	1	X	1
Wrench, Adjustable end (6")	X	2	X	2	Bench, Sheet metal (with stake plates) laminated maple top, approx. size 60" x 40" x 2½", height 32", angle iron edge	X	1	X	1
Wrench, Adjustable end (8")	X	2	X	2	Bench, Soldering steel, transite cover top, 6' x 30" x 32"H	X	2	X	1
Wrench, Adjustable end (10")			X	2	Bench, Spot welding all steel construction; 5' x 24" top	X	1	X	1
Wrench, Adjustable end (12")			X	2	Bench, TIG welding fire brick top			X	1
Wrench, Allen Key (hex) (set)	X	1	X	1	Bookcase approx. 60"H x 10-12"D x 72"L, 3 adjustable shelves, wood or metal	X	1	X	1
Wrench, Box (set) range of opening ¼"-1"	X	1	X	1	Cabinet, Filing 4 drawers, 52"H x 15"W x 28¼"D	X	1	X	1
Wrench, Open end (set) ¼"-1"	X	1	X	1					
Wrench, Pipe (10")	X	1	X	1					
Wrench, Pipe (14")			X	1					
Wrench, Pipe (18")			X	1					
Wrench, Socket (3/8" drive) (set) 10 piece set; 7 standard sockets; sizes 3/8"-3/4" by 16ths	X	1	X	1					
Wrench, Socket (½" drive) (set) 9 piece set; 7 standard sockets; sizes 3/8"-3/4" by 16ths	X	1	X	1					

III. General Furnishings (cont.)	Introductory Quantity	Advanced Quantity	III. General Furnishings (cont.)	Introductory Quantity	Advanced Quantity
Cabinet, Finishing (storage) steel construction, adjustable shelves, 2 doors with locks	X 1	X 1	Furnace, Bench gas, 2 burner	X 2	X 2
Cabinet, Small parts steel, 36" x 12" x 73"H, double doors with lock	X 1	X 1	Projector, Filmstrip (35mm) and slide (2" x 2")	X 1	X 1
Cabinet, Storage steel, 36" x 18" x 78"H, double door with lock	X 4	X 6	Projector, Motion picture, Sound	X 1	X 1
Cabinet, Tool storage approx. 62" x 22" x 83"H with doors and lock	X 1	X 1	Projector, Overhead	X 1	X 1
Chair, Teacher's welded steel construction, swivel, with casters	X 1	X 1	Rack, Metal storage vertical, approx. 4'W x 9'H, or for horizontal storage, 2 racks 84"H x 21" sq. at the bottom	X 1	X 1
Compressor, Air 120 p.s.i., 60 gal. tank, 1½HP motor, 208V or 220V	X 1	X 1	Screen, Projection 60" x 60"	X 1	X 1
Desk Teacher's approx. 72" x 30" x 29", welded steel construction	X 1	X 1	Spray Booth, Dry 3'6"W x 6'1"H, working depth 1'1"; ½HP fan motor		X 1
Fire Blanket	X 1	X 1	Stool, Student's adjustable 14" seat, height without adjustment 26"	X 24	X 24
Fire Extinguisher	X 3	X 3	Table, Drafting overall size approx. 38" x 28" x 39"H, wood or metal	X 1	X 1
First Aid Kit	X 1	X 1	Table, Overhead projector	X 1	X 1

**LEVELS II, III, IV
POWER**

I. Hand Tools	Introductory Quantity	Advanced Quantity	I. Hand Tools (cont.)				Introductory Quantity	Advanced Quantity	
I. HAND TOOLS					Die, Letter (set) 3/16" character height	X	1	X	1
Battery, Storage (6V)	X	1	X	1	Die, Number (set) 3/16" character height	X	1	X	1
Battery, Storage (12V)	X	1	X	1	Divider, Spring (6")	X	1	X	1
Brush, Wire overall length 10-14"; width 1"	X	8	X	2	Dresser, Abrasive wheel	X	1	X	1
Caliper, Hermaphrodite (6")			X	1	Drill, Hand (1/4")	X	1	X	1
Caliper, Inside (8")	X	1	X	1	Drill, Hand (3/8")	X	1	X	1
Caliper, Outside (6")			X	1	Drill Stand, Fractional	X	1	X	1
Caliper, Vernier 5" capacity			X	1	Drill, Twist (number set) high speed steel; straight shank	X	1	X	1
Chisel, Cold (set) cutting edges of 1/4", 3/8", 1/2", 3/4"	X	4	X	4	Drill, Twist (fractional set) high speed steel; straight shank	X	2	X	2
Clamp, "C" (4")	X	2	X	2	Extension Cord heavy duty; grounded, 25'	X	6	X	6
Clamp, "C" (6")	X	2	X	2	Extractor, Screw (set) set of 6; nos. 1-6	X	1	X	1
Clamp, "C" (8")	X	2	X	2	Files (assorted sizes, shapes, and cuts, with handles, as specified)				
Clamp, "C" (10")	X	2	X	2					
Cleaner, Ring Groove	X	1	X	1	Length Name Shape Cut				
Compressor, Piston ring (set) capacity 1 3/8"-7"	X	1	X	2	10" Half-round Smooth	X	2	X	2
Compressor, Valve spring	X	2	X	2	10" Half-round Bastard	X	6	X	6
Cutter, Bolt minimum 14"; 3/8" soft capacity	X	1	X	1	10" Lathe (Long Angle, Safe Edge)	X	3	X	3
Cutter, Bushing			X	1	10" Brass (Flat)	X	3	X	3
Cutter, Muffler adjustable 1 1/2"-2 1/2"			X	1	10" x 3/8" Round Bastard	X	2	X	2
Cutter, Pipe cap. 1/8"-1" diameter			X	1	8" x 1/4" Round Bastard	X	2	X	2
Cutter, Tubing 1/8"-1" cap.	X	1	X	1	10" x 3/8" Square Bastard	X	2	X	2
					6" Slim Taper (triangular)	X	3	X	3

(con't.)

I. Hand Tools (cont.)			Introductory	Quantity	Advanced	Quantity	I. Hand Tools (cont.)			Introductory	Quantity	Advanced	Quantity
8"	Warding		X	2	X	2	Gloves, Leather (pair)	X	2	X	2		
10"	Flat	Second-Cut	X	3	X	3	Goggles (spectacles), Clear observation	X	6	X	6		
10"	Half-round	Bastard	X	6	X	6	Goggles, Gas welding	X	4	X	4		
10"	Round	Bastard	X	6	X	6	Grease Gun, Suction, General Purpose	X	1	X	1		
10"	Aluminum (Flat)		X	3	X	3	Hammer, Ball peen (4 oz.)	X	4	X	4		
File Card and Brush 9½"L			X	6	X	6	Hammer, Ball peen (8 oz.)	X	4	X	4		
File, Contact point (ignition) 2¼" blade			X	1	X	1	Hammer, Ball peen (16 oz.)	X	4	X	4		
Flaring Tool (set) range 3/16"-5/8"					X	1	Hammer, Brass head 1 lb.; 3"L; 1¼" diameter	X	2	X	2		
Flywheel holder for small gas engine			X	1	X	1	Hammer, Chasing 1"; with handle attachment			X	1		
Gauge, Center			X	1	X	1	Hammer, Chipping			X	2		
Gauge, Cylinder pressure gauge range 0-300 p.s.i.			X	1	X	1	Hammer, Claw (16 oz.)	X	1	X	1		
Gauge, Drill, Fractions			X	1	X	1	Hammer, Engineer's (40 oz.)	X	2	X	2		
Gauge, Drill, Number			X	1	X	1	Hammer, Lend (3 lb.)	X	2	X	2		
Gauge, Ignition (set)			X	2	X	2	Hammer, Sledge (5 lb.) medium length handle			X	1		
Gauge, Screw pitch from 9-40					X	2	Hammer, Soft face (8 oz.)	X	2	X	2		
Gauge, Spark plug			X	3	X	3	Helmet, Welding (hand type)	X	3	X	3		
Gauge, Spring tension			X	1	X	1	Helmet, Welding (arc) (head type)	X	2	X	2		
Gauge, Surface base 3 1/8" x 2 1/4"; 2 spindle; 9" x 12"; with scriber					X	1	Hydrometer	X	1	X	1		
Gauge, Thickness ("feeler") minimum 6 leaf, 1/4" x 2 1/4"; .0015-.015			X	8	X	8	Indicator, Dial test range 2 1/4"-6"; in graduation of .001"			X	1		
Gauge, Vacuum and low pressure			X	1	X	1	Mallet, Rawhide (10 oz.)	X	2	X	2		
Gauge, Wire and sheet metal (American) sizes 0-36			X	1	X	1	Mallet, Rubber length of head 3 1/4"; rubber face approx. 2"	X	2	X	2		
Gauge, Wire and sheet metal (U.S.S.) sizes 0-36			X	1	X	1	Micrometer, Inside with range of 2"-12"	X	1	X	1		
							Micrometer, Outside (1")	X	1	X	1		
							Micrometer, Outside (2")	X	1	X	1		

I. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity	I. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity
Micrometer, Outside (3")	X	1	X	1	Puller Assembly 3 hole application; center screw	X	1	X	1
Micrometer, Outside (4")			X	1					
Micrometer, Outside (5")			X	1	Puller Assembly (large) 2-way puller set			X	1
Nipper, End cutting 6"; compound action	X	1	X	1	Puller, Axle			X	1
Nozzle, Blow gun (air line)	X	1	X	1	Puller, Freeze plug			X	1
Oiler, Bench 1/3-1/2 pint size	X	6	X	6	Puller, Gear (set) 3-jaw reversed gear puller			X	1
Oiler, Pump (5 oz.)	X	6	X	6	Puller, Seal (set) with adaptor range from 1 3/8"-2 7/16"			X	1
Oiler, Straight (1/2 pint)	X	6	X	6	Puller, Steering wheel			X	1
Oilstone, Combination, India coarse and fine grits; 8" x 1" x 2"	X	2	X	2	Puller, Valve guide and valve			X	1
Oilstone, Combination, Silicon carbide coarse and fine grits; 8" x 1" x 2"	X	2	X	2	Saw, Hack (hand) adjustable to receive 9"-12" blade	X	4	X	4
Pliers, Battery heavy duty; 6 7/16"L	X	2	X	2	Scissors (8")	X	2	X	2
Pliers, Chain	X	1	X	1	Scraper, Carbon	X	8	X	8
Pliers, Combination (6")	X	8	X	8	Screwdriver, Clutchhead (set)	X	1	X	1
Pliers, Combination (8")	X	6	X	6	Screwdriver, Phillips (set)	X	2	X	2
Pliers, Diagonal cutting (6")	X	2	X	2	Screwdriver, Spiral ratchet			X	1
Pliers, Hose clamp, Radiator and gas line (8")			X	1	Screwdriver, Standard bit (square blade) (4")	X	2	X	2
Pliers, Ignition	X	2	X	2	Screwdriver, Standard bit (square blade) (6")	X	2	X	2
Pliers, Needle nose (6")	X	4	X	4	Screwdriver, Standard bit (square blade) (8")	X	2	X	2
Pliers, Retaining ring (5" or 8")	X	2	X	2	Screwdriver, Standard bit (square blade) (10")	X	2	X	2
Pliers, Side-cutting (6")	X	8	X	8	Screwdriver, Standard bit (square blade) (12")	X	2	X	2
Pliers, Vise-grip wrench (7")	X	2	X	2	Screwdriver, Standard bit ("stubby")	X	4	X	4
Pliers, Waterpump	X	2	X	2	Puller, Wheel (set)			X	1
Press, Arbor hydraulic; 25 ton capacity	X	1	X	1					

I. Hand Tools (cont.)	Introductory Quantity	Advanced Quantity	I. Hand Tools (cont.)	Introductory Quantity	Advanced Quantity
Pump, Oil drum for 55 gallon drums	X 2	X 2	lowing sizes: ¼-20, 5/16-18, 3/8-16, 7/16-14, ¼-13; complete with die stock and tap wrench		
Punch, Center (set) set of 5; 1/16"-1/4" diameter	X 4	X 4	Tap and Die, NF (S.A.E.) (set)	X 1	X 1
Punch, Drift (set) 3/32"-1/2" by 32nds	X 4	X 4	Taper plug and bottoming tap plus one die in fol- lowing sizes: ¼-28, 5/16-24, 3/8-24, 7/16-20, ¼-20; complete with die stock and tap wrench		
Punch, Pin (set) 4"L; 1/16"-1/2" diameter by 32nds	X 1	X 1	Tap and Die, Pipe (set) tap, die and reamer for pipe sizes: 1/8", 1/2", 3/4", 1"	X 1	X 1
Reamer, Cylinder ridge range 2 11/16"-5 5/16" with tungsten carbide cutter		X 1	Tester, Battery cell	X 1	X 1
Reels, Drop cord 3 wire; 60'; heavy duty	X 4	X 4	Tester, Radiator pressure	X 1	X 1
Remover, Stud (set) wedged type action; ½" square drive		X 1	Tool Holder, Lathe (left hand) to fit tool post of lathe ordered		X 1
Rethreader, Axle sizes 5/8"-18, 3/4"-16, 7/8"-14, 1"-14, 1 1/8"-12, 1 ¼"-12		X 1	Tool Holder, Lathe (right hand) to fit tool post of lathe ordered		X 1
Rethreader, Spark plug hole		X 1	Tool Holder, Lathe (straight) to fit tool post of lathe ordered		X 1
Rule, Flexible steel tape (10')	X 1	X 1	Torch, Propane (kit)		X 1
Rule, Steel (12")	X 4	X 4	Wrench, Adjustable end (6")	X 2	X 2
Scriber complete with 3 points: 1 straight, 1 short, and 1 bent	X 2	X 2	Wrench, Adjustable end (3")	X 2	X 2
Shield, Face	X 4	X 4	Wrench, Adjustable end (10")	X 2	X 2
Snips, Tinner's Straight (number 8)	X 1	X 1	Wrench, Adjustable end (12")	X 2	X 2
Soldering Gun, Electric	X 1	X 1	Wrench, Adjustable end (monkey)	X 2	X 2
Spout, Pouring, Oil can	X 1	X 1	Wrench, Allen key (hex) (set) set includes 11 standard sizes: nos. ¼-12	X 2	X 2
Strap, Battery	X 2	X 2	Wrench, Combination box and open end (set)	X 4	X 4
Tap and Die, NC (U.S.S.) (set) Taper plug and bottoming tap plus one die in fol-	X 1	X 1			

I. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity	I. Hand Tools (cont.)	Introductory	Quantity	Advanced	Quantity
range of openings 3/8"-1"					Wrench, Tappet (set)	X		X	1
Wrench, Combination box and open end (metric) (set) set of 10 sizes: 6, 8, 9, 10, 12, 13, 14, 15, 17, 19 mm	X	1	X	1	Wrench, Torque (3/8" drive)	X	1	X	1
Wrench, Socket, Flex handle (3/8" drive)			X	2	Wrench, Torque (1/2" drive)	X	1	X	1
Wrench, Socket, Flex handle (1/2" drive)			X	2	Wrench, Deep Socket (3/8" drive) (set) 3/8"-9/16", 5/8"-13/16", 5/8"-3/16" by 16ths	X	1	X	1
Wrench, Socket, Handle extension (3/8" drive) (4")	X	2	X	2	Wrench, Deep socket (1/2" drive) (set) 1/2"-15/16" by 16ths	X	1	X	1
Wrench, Socket, Handle extension (3/8" drive) (3")	X	2	X	2	Wrench, Drain plug	X	2	X	2
Wrench, Socket, Handle extension (3/8" drive) (set)	X	2	X	2	Wrench, Lug	X	2	X	2
Wrench, Socket, Handle extension (1/2" drive) (3")	X	2	X	2	Wrench, Flare nut (set) size 3/8", 7/16", 1/2", 9/16", 5/8"			X	1
Wrench, Socket, Handle extension (1/2" drive) (8")	X	2	X	2	Wrench, Ignition (set)	X	1	X	1
Wrench, Socket, Handle extension (1/2" drive) (set)	X	2	X	2	Wrench, Pipe (10")	X	2	X	2
Wrench, Socket, Reversible ratchet handle (1/2" drive)	X	2	X	2	Wrench, Pipe (18")			X	1
Wrench, Socket, Reversible ratchet handle (3/8" drive)	X	4	X	4	Wrench, Socket (1/2" drive) (set) 3/16"-1/2" by 32nds	X	2	X	2
Wrench, Socket, Reversible ratchet handle (1/2" drive)	X	6	X	6	Wrench, Socket (3/8" drive) (set) 10 piece, 4 sockets, sizes 3/8"-3/4" by 16ths	X	4	X	4
Wrench, Socket, Speed handle (1/2" drive)	X	2	X	2	Wrench, Socket (1/2" drive) (set) 9 piece set, 7 sockets, sizes 3/8"-3/4" by 16ths	X	6	X	6
Wrench, Socket, Speed handle (3/8" drive)	X	4	X	4	Wrench, Socket (metric) (set) 1/2" drive; size 9mm-22mm			X	2
Wrench, Socket, Speed handle (1/2" drive)	X	6	X	6	II. MACHINES AND GENERAL EQUIPMENT				
Wrench, Socket, Universal joint attachment (1/2" drive)			X	2	Alternator-Generator-Regulator Test Stand alternator test equipment, set			X	1
Wrench, Socket, Universal joint attachment (3/8" drive) (set)	X	2	X	2	Analyzer, Capacitor			X	1
Wrench, Socket, Universal joint attachment (1/2" drive) (set)	X	4	X	4	Analyzer, Engine			X	1
					Anvil (100 lb.)	X	1	X	1

II. Machines and General Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	II. Machines and General Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
Battery Eliminator and Charger	X	1	X	1	Engine, Small (4-cycle)	X	1	X	1
Boring Bar (cylinder set)			X	1	Engine, Steam (model)			X	1
Can, Oil filler and measure (1 qt.)	X	2	X	2	Engine, Turbine (small)	X	1	X	1
Can, Oil filler and measure (2 qt.)	X	1	X	1	Fluidic Training Center			X	1
Can, Oil filler and measure (5 qt.)	X	1	X	1	Grease Gun	X	1	X	1
Can, Oily waste	X	3	X	3	Galvanometer			X	1
Can, Radiator (2 gal.)			X	1	Grease Gun, Chassis			X	1
Can, Safety (1 qt.)	X	3	X	3	Grease Gun, Extended interval			X	1
Can, Safety (1 gal.)	X	2	X	2	Grease Gun, Gear lube			X	1
Carburetor Repair set			X	1	Grinder, Edge tool (bench) 1" x 7" model; 1 fine grit and 1 coarse wheel; motor 1/4HP; 60-cycle; 110V with overload protection	X	1	X	1
Cleaner, Spark plug	X	1	X	1	Grinder, Flexible shaft			X	1
Cleaner, Valve guide wire brush, twist wire shank; 5/16", 11/32", 3/8", 7/16" diameter			X	1	Grinder, Pedestal 1" x 7" model; 1 fine grit and 1 coarse wheel; motor 1/4HP; 60-cycle; 110V with overload protection			X	1
Clutch Aligner (set)			X	1	Grinder, Valve (set) motor 1/3HP; 115V; 60-cycle			X	1
Crane, Portable (2 ton cap.)			X	1	Growler, Armature testing 120V; 60-cycle; 2 scale meter; 2 ranges (0.5 amps., 0.25 amps.)	X	1	X	1
Drill, Electric, Portable (1/4")	X	2	X	2	Gun, Engine cleaning	X	1	X	1
Drill, Electric, Portable (3/8")	X	1	X	1	Hydraulic Instruction Unit			X	1
Drill, Electric, Portable (1/2")			X	1	Jack, Auto, Hydraulic (Standard Type) (2 ton)			X	1
Engine, Automobile with transmission and clutch in running condition	X	1	X	1	Lathe, Armature			X	1
Engine, Diesel small 100HP or less	X	1	X	1	Lathe, Metalworking (10") minimum distance between centers 24" cabinet models; underneath drive; quick change gear box; 54 thread and spindle changes L.H. or R.H. from			X	1
Engine, Outboard motor	X	1	X	1					
Engine, Rocket (small or model)			X	1					
Engine, Small (2-cycle)	X	1	X	1					

II. Machines and General Equipment (cont.)	Introductory Quantity	Advanced Quantity	II. Machines and General Equipment (cont.)	Introductory Quantity	Advanced Quantity
4 to 224; speeds from 50 to 1500 RPM; motor ¼HP, 208V or 220V, 3-phase drum switch and magnetic starter. Equipped with drive plate, spindle adapter, centers for headstock and tailstock, tool post, ring and rocker, thread chasing dial and tool post wrench, 3-jawed chuck, 4-jawed chuck			Spray Gun Outfit		X 1
Lift, Engine safety 30"L; included hook and adaptor; 2 ton capacity	X	1	Tachometer		X 1
Milliammeter, Volt-ohm	X	2	Tank, Hot boiling		X 1
Motor Stand, Universal	X	1	III. GENERAL FURNISHINGS		
Multiscope	X	1	Bench, Metalworking (4 place) top 2¼"T x 24"W x 7'L; laminated maple; angle iron edges; heavy gauge steel legs	X	2 X 2
Pneumatic Instruction Center (pneumatic power unit)	X	1	Bookcase approx. 60"H x 10-12"D x 72"L; wood or steel	X	1 X 1
Press, Drill (15") 15" cap.; variable speed; number 2 Morse taper in spindle; floor model; ¼" key chuck; tilting standard table; with ¼HP, 220V, 3-phase motor, and magnetic switch and starter	X	1	Broom, Push 18" in length; 3" trim; handle	X	3 X 3
Press, Drill (17") floor model; variable speed; 300-3100 RPM; production table with raising and lowering mechanism; number 3 Morse taper spindle; key chuck, ¼" capacity; belt and pulleys completely guarded; ¼HP motor (minimum); 220V; 3-phase; push button magnetic control and starter	X	1	Brush, Bench 8" brush, 3" overall	X	12 X 12
Radiator, Test Plug (set)	X	1	Cabinet, Filing 4 drawer; size 52"H x 15"W x 28¼"D	X	1 X 1
Reamer, Expansion (set) set of 8; A-H	X	1	Chair, Teacher's welded steel construction, swivel base, with casters	X	1 X 1
Reamer, Valve seat (set)	X	1	Compressor, Air 120 p.s.i.; 60 gal. tank; motor 1¼HP; 3-phase; 208V or 220V; automatic pressure control	X	1 X 1
Refacer, Valve (set)	X	1	Desk, Teacher's approx. 42" x 30" x 29"H; welded steel construction	X	1 X 1
Rheostat, 10 ohm	X	1	Fire Blanket	X	1 X 1
Sander, Finishing, Portable, Air	X	1	Fire Extinguisher	X	3 X 3
			First Aid Kit	X	1 X 1
			Hose, Air 25' x 14"; heavy duty; flexible	X	1 X 1
			Hose, Exhaust, Garage	X	1 X 1
			Hose, Water 50'; garden type	X	1 X 1

II. Machines and General Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	II. Machines and General Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
Pan, Dust (12" steel)	X	1	X	1	Tank, Parts cleaning, Solvent 40 gallon capacity	X	1	X	1
Pencil Sharpener, Standard	X	1	X	1	Tester, Coil and condensor 6-12-24V, portable			X	1
Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X	1	Tester, Distributor			X	1
Projector, Motion picture, Sound	X	1	X	1	Transformer, Step-down			X	1
Projector, Overhead	X	1	X	1	Transformer, Step-up			X	1
Screen, Projection 60" x 60"	X	1	X	1	Truck, Welding cylinder size appropriate to gas bottle size			X	1
Stand, Auto safety (2 ton)	X	20	X	20	Vise, Machinist's bench swivel base; 3" jaw; 4 1/4" opening	X	1	X	1
Stand, Auto safety (7 ton)	X	6	X	6	Welder, Arc (AC/DC)			X	1
Table, Overhead projector	X	1	X	1	Welding outfit, Oxyacetylene			X	1
Welding Screen, Portable back 6' x 6'; wings 3'; double frame construction; replaceable fireproof curtains			X	1					

LEVELS II, III, IV
WOODS

	Introductory	Quantity	Advanced	Quantity		Introductory	Quantity	Advanced	Quantity
I. Fabricating Machines					I. Fabricating Machines (cont.)				
I. FABRICATING MACHINES					of the following drills and hollow chisel bits: 1/4", 5/16", 3/8", 7/16", and 1/2" and 3/4" and 5/16" bit bushings. Motor: 1HP, 60-cycle, 208 or 220V; 3-phase; with mounted switch and overload protection				
Drill, Electric, Portable (1/4")	X	1	X	1					
Drill, Electric, Portable (3/8")			X	1					
Grinder, Edge tool (bench) 1" x 7" model including one fine grit and one coarse grit wheel; motor 1/2HP; 60-cycle; 110V with overload protection	X	1	X	1	Plane, Portable, Electric (16")			X	1
Grinder, Oil Tool floor model 2-1/2" x 6" oilstone; wheel, one coarse and one fine grit; 1/4" x 8" emery wheel; 1/2HP; 110V; 60-cycle	X	1	X	1	Press, Drill (15") 15" capacity; variable speed; number 2 Morse taper in spindle; floor model; 1/2" key chuck; tilting standard table; with 1/2HP, 3-phase motor, and magnetic switch and starter	X	1	X	1
Jointer (6") floor model; motor 1/2HP; 60-cycle; 3-phase; 208V or 220V; with magnetic switch and overload protection	X	1	X	1	Router, Portable, Electric 1/2 or 7/8HP motor	X	1	X	1
Jointer (8") long bed; floor model; motor 1/2HP; 60-cycle; 3-phase; 208V or 220V; with magnetic switch and overload protection			X	1	Sander, Belt, Portable, Electric 3" x 24" or 4" x 24"; 115V AC	X	1	X	1
Lathe, Wood turning 12" swing, minimum 38" between center; motor 1/2HP; 60-cycle; 208V or 220V; 3-phase; with mounted switch and overload protection; to include cup center, spur center, 3 face plates, one 6" tool rest, 1 tool support base, 1 knock-out base	X	3	X	3	Sander, Combination belt and disc 6" belt; 12" disc, floor model; motor 1HP, 60-cycle, 208V or 220V; 3-phase; magnetic switch and starter	X	1	X	1
Mortiser, Hollow chisel floor model with 1/2" mortise capacity and to handle stock up to 20"L. Complete with compound table and lateral adjustments, hold down attachment and foot lever control. Machine to include one each			X	1	Sander, Finishing, Portable, Electric (heavy duty)	X	1	X	1
					Sander, Handblock stroke 6" belt with sock cap. 4" thick, 60"L; motor 1HP; 3-phase; 60-cycle; 208 or 220V with magnetic switch and starter			X	1
					Sander, Spindle 19" oscillating abrasive sleeves; floor stand; motor 1/2HP, 3-phase, 208 or 220V with magnetic switch and starter	X	1	X	1
					Saw, Band, Woodcutting	X	1	X	1

I. Fabricating Machines (cont.)	Introductory	Quantity	Advanced	Quantity	II. Hand Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
14" floor model; motor 1/4HP, 60-cycle, 208V or 220V, 3-phase with magnetic switch and starter or 20" model, motor 1/4HP					Awl, Scratch (6")	X	4	X	4
					Bar, Wrecking forged steel, hex stock; 3/4" x 24"L	X	1	X	1
Saw, Circular, Power 10" floor model with motor 1 1/4HP, 60-cycle, 208V or 220V, 3-phase with magnetic switch and starter or 12" model, motor 5HP	X	1	X	1	Bellows, Molder's (8")	X	4	X	4
					Bit, Auger (set) sizes 4-16	X	2	X	2
Saw, Jig (scroll) 24"; metal stand; motor 1/3HP, 60-cycle AC, 115V with magnetic switch and starter	X	1	X	1	Bit, Combination drill and countersink (set) numbers 1-5	X	1	X	1
					Bit, Combination drill and counterbore (set)	X	1	X	1
Saw, Radial-arm, Power 10" saw complete with stand, table extensions; motor totally enclosed and fan cooled; motor 2HP, 60-cycle, 208V or 220V, 3-phase; with magnetic switch and starter			X	1	Bit, Electrician's 18"L x 5/16"D			X	1
					Bit, Expansive boring size from 7/8" to 3"	X	1	X	1
Saw, Sabre (bayonet) portable; heavy duty			X	1	Bit, Extension (18")	X	1	X	1
					Bit, Forstner (brace set) sizes 6, 8, 10, 12, 14, 16 by 16ths of an inch	X	1	X	1
Shaper, Spindle (floor model) complete with interchangeable spindles 5/16", 1/2", 3/4", and 1" adjustable fence, hold down guides and fence guard assembly; motor 1HP, 60-cycle, 208V or 220V, 3-phase, including reversible switch and overload protection			X	1	Bit, Forstner (machine set) 1/4" shank; sizes 6, 8, 10, 12, 14, 16 in 16ths of an inch	X	1	X	1
					Bit, Multi-spur (set) set of 11; sizes 1/4"-1" by 16ths; plus 1 1/8" and 1 1/4"	X	1	X	1
Surfacer (single surface planer) 12" x 5" cap; floor model; motor 3HP, 60-cycle, 208V or 220V, 3-phase with magnetic switch and starter and overload protection; or 18" or 20" cap; floor model; motor 5HP, 60-cycle, 208V or 220V with switch and overload protection			X	1	Bit, Plug cutter (set) set of 5; sizes 3/8", 1/2", 5/8", 3/4", 1"	X	1	X	1
					Bit, Twist, Electrician's 3/8" x 18" with square tang	X	1	X	1
					Block, Sanding rubber, to use 2 1/4" x 9" paper	X	24	X	24
					Brace, Ratchet (10")	X	6	X	6
II. HAND TOOLS AND EQUIPMENT					Bracket, Saw horse (pair) steel; 12" x 4" lumber	X	2	X	2
Awl, Brad	X	2	X	2					

II. Hand Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	II. Hand Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
	X		X			X		X	
Broom Push 18" in length	X	6	X	6	Clamp, Fixture (set) for use with 3/4" pipe	X	6	X	6
Brush, Bench	X	24	X	24	Clamp, Handscrew (no. 3/0)	X	6	X	6
Burnisher round tempered steel; 4 1/4" blade	X	1	X	1	Clamp, Handscrew (no. 0)	X	6	X	6
Can, Oily waste 10 gallon capacity	X	1	X	1	Clamp, Handscrew (no. 1)	X	12	X	12
Can, Safety (1 qt.)	X	4	X	4	Clamp, Handscrew (no. 2)	X	12	X	12
Can, Safety (1 gal.)	X	3	X	3	Clamp, Handscrew (no. 3)	X	6	X	6
Chisel, Butt (set) 3" blade; sizes 1/4", 1/2", 3/4", 1" 1/4"	X	12	X	12	Clamp, Mitre frame	X	1	X	1
Chisel, Carving (set) set of 6 chisels and gauges; approx. 6" long	X	4	X	4	Compass, Pencil	X	3	X	3
Chisel, Gouge, Inside (set) sizes 1/4", 3/8", 1/2", 3/4", 1"	X	3	X	3	Countersink Bit (for brace) (set) size 5/8" and 3/4"	X	2	X	2
Chisel, Gouge, Outside (set) set of 5; sizes 1/4", 3/8", 1/2", 3/4", 1"	X	3	X	3	Countersink, High Speed 1/4" shank, 1/2" size	X	2	X	2
Chisel, Socket firmer (set) set of 6; sizes 1/4", 3/8", 1/2", 5/8", 3/4", 1"	X	4	X	4	Cutter, Glass	X	1	X	1
Chisel, Wood turning (set) overall length at least 17"	X	3	X	3	Die, Letter (set) 3/16" character height	X	1	X	1
Circle Cutter cap. 1" to 8" diameter	X	1	X	1	Die, Number (set) 3/16" character height	X	1	X	1
Clamp, Bar (36")	X	6	X	6	Divider, Wing (6" steel)	X	2	X	2
Clamp, Bar (48")	X	6	X	6	Dowel Centers (pairs) (set) 1/4", 5/16", 3/8", 1/2"	X	1	X	1
Clamp, "C" (3")	X	4	X	4	Dresser, Abrasive wheel	X	1	X	1
Clamp, "C" (4")	X	4	X	4	Drill, Hand (1/4")	X	2	X	4
Clamp, "C" (6")	X	4	X	4	Drill, Hand (3/8")	X	1	X	1
Clamp, "C" (8")	X	4	X	4	Drill Stand (fractional) for twist drills from 1/16" to 1/2" by 64ths	X	1	X	1
Clamp, Corner 3" capacity	X	4	X	4	Drill, Twist, Straight shank (fractional set) high speed, number 2 Morse Taper Shank; 5/8"-1" by 8ths	X	1	X	1
					Files (assorted sizes, shapes, and cuts, with handles, as specified)				

II. Hand Tools and Equipment (cont.)		Introductory Quantity	Advanced Quantity	II. Hand Tools and Equipment (cont.)		Introductory Quantity	Advanced Quantity			
Length	Name or Shape									
7"	Slim, Taper (Triangular) Single	X	3	X	3	Hose, Air 25' x 14"; heavy duty	X	1	X	1
10"	Half-round Rasp	X	6	X	6	Jig, Dowelling with guides 3/16", 1/4", 5/16", 3/8", 7/16", 1/2"	X	2	X	2
10"	Round Rasp	X	6	X	6					
10"	Cabinet Double-Cut (Half-round)	X	12	X	12	Knife, Putty approx. 1"W; flexible tool steel blade	X	3	X	3
	File, Auger bit (7")	X	3	X	3	Knife, Sloyd blade approx. 2 5/8"L	X	6	X	6
	File Card and Brush 9 1/4"L, brush 1 1/4" x 5"	X	6	X	6	Level (24" long)	X	1	X	1
	Funnel	X	2	X	2	Mallet, Hardwood	X	4	X	4
	Gauge, Auger bit gauging hole depth	X	1	X	1	Mallet, Rawhide (10 oz.)	X	4	X	4
	Gauge, Drill, Fractions	X	1	X	1	Miter Box 26" x 4" back saw; 8 1/4" right angle cap.	X	1	X	1
	Gauge, Marking	X	6	X	6	Nail Set (1/16" tip)	X	4	X	4
	Gauge, Marking (double bar)	X	2	X	2	Nail Set (3/32" tip)	X	4	X	4
	Gauge, Screw pitch with 22 pitches from 9 to 40	X	1	X	1	Nipper, End cutting (6")	X	1	X	1
	Gauge, Wire and sheet metal (American) sizes 0-36	X	1	X	1	Nozzle, Blow gun (air line)	X	1	X	1
	Gauge, Wire and sheet metal (U.S.S.) sizes 0-36	X	1	X	1	Oiler, Bench 1/3 or 1/2 pt. size, 5" straight spout	X	6	X	6
	Gloves, Leather (pair)	X	4	X	4	Oiler, Pump 6 oz. capacity	X	1	X	1
	Goggles, Clear observation	X	24	X	24	Oilstone, Carving tool slips (set)	X	1	X	1
	Grease Gun	X	1	X	1	Oilstone, Combination, India coarse and fine grit; 8" x 1" x 2"	X	1	X	1
	Hammer, Claw (7 oz.)	X	3	X	3	Oilstone, Gouge slip	X	1	X	1
	Hammer, Claw (13 oz.)	X	6	X	6	Pan, Dust (12" steel)	X	1	X	1
	Hammer, Claw (16 oz.)	X	6	X	6	Plane, Block 1 5/8" cutter	X	3	X	3
	Hammer, Magnetic standard upholstered	X	2	X	2					

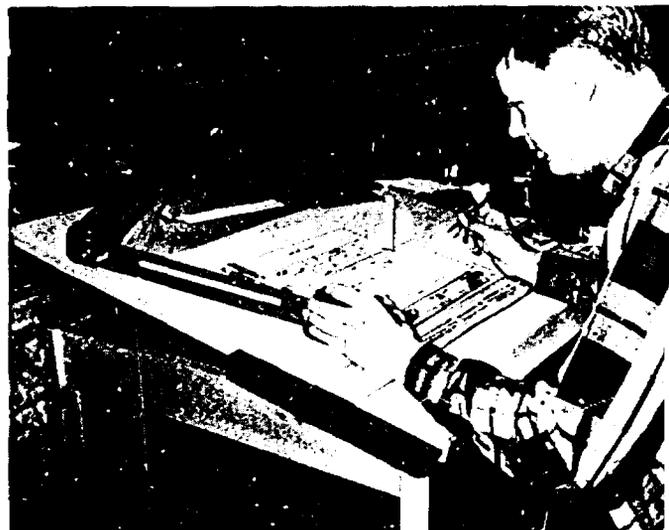
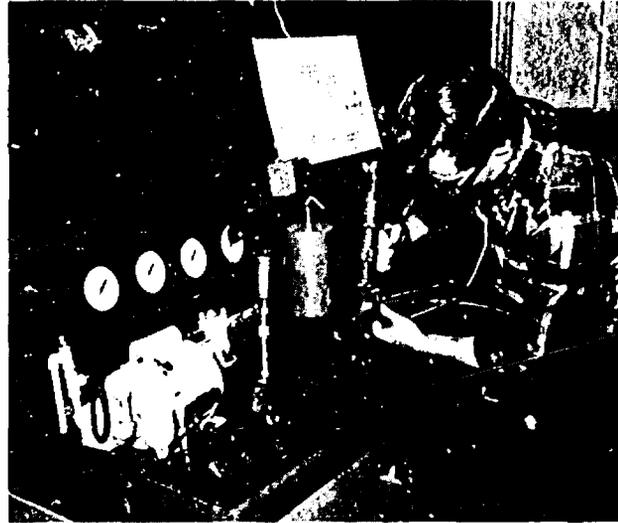
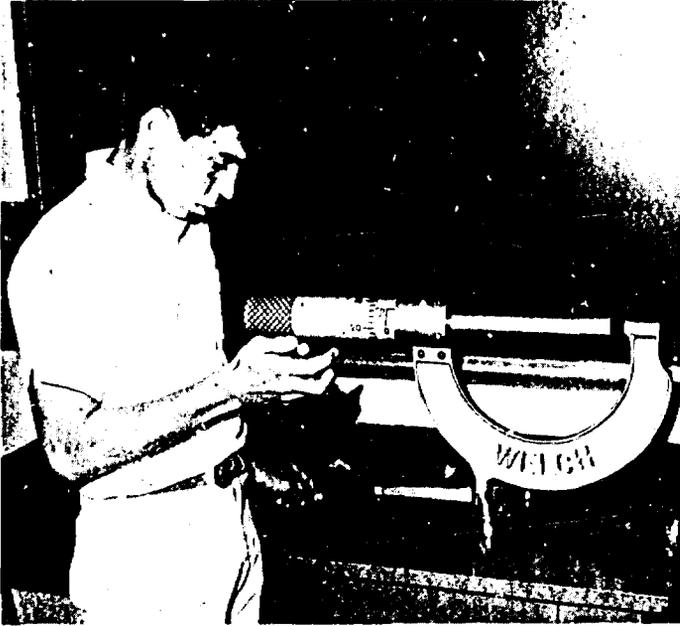
II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	Introductory Quantity	II. Hand Tools and Equipment (cont.)	Introductory Quantity	Advanced Quantity	Introductory Quantity	Advanced Quantity	
									Quantity
Plane Iron, Double	X	24	X	24	Saw, Coping 6¼"L, pin-end	X	12	X	12
Plane, Jack (14"L)	X	18	X	18	Saw, Hack (hand) adjustable to receive 9-12" blade	X	1	X	1
Plane, Jointer (22"L)	X	2	X	2	Saw, Hand, Crosscut 22"-10 point	X	4	X	4
Plane, Rabbet 4"L; 1" cutter	X	4	X	4	Saw, Hand, Rip 26"-5¼ point, straight back	X	4	X	4
Plane, Router with 3 cutters (¼", ½" and V)	X	4	X	4	Saw, Keyhole 10" taper; round blade	X	1	X	1
Plane, Smoothing length: 9", blade width: 1¼"	X	6	X	6	Saw, Veneer			X	4
Pliers, Combination (6")	X	2	X	2	Scale, Architect's graduation 3/32", 1/8", 3/16", 1/4", 3/8", 1/2", 3/4", 1", 1¼", 3", each equaling 1" - 0"	X	1	X	1
Pliers, Vise-grip wrench (7")	X	2	X	2	Scissors (8")	X	4	X	4
Protractor, Machinist's bevel 12" blade	X	2	X	2	Scraper, Cabinet 2¼" blade	X	4	X	4
Punch, Center (set) set of 5: 1/16", 1/4"	X	3	X	3	Scraper, Hand approx. 3" x 5" steel blade	X	6	X	6
Rule, Flexible Steel tape (6')	X	4			Screwdriver, Offset ratchet	X	1	X	1
Rule, Flexible Steel tape (8')			X	4	Screwdriver, Offset, Straight slot (set) set of tips of 3/16", 9/32" and 11/32"	X	2	X	2
Rule, Flexible Steel tape (10')	X	4	X	4	Screwdriver, Phillips (set) set of points numbers 1, 2, 3	X	2	X	2
Rule, Flexible Steel tape (25')	X	1	X	1	Screwdriver, Spiral ratchet	X	2	X	2
Rule, Flexible Steel tape (50')			X	1	Screwdriver, Standard bit (round blade) (set) blades 3/16", 1/4", 5/16", 3/8", 1/2"	X	2	X	2
Rule, Flexible Steel tape (100')	X	1	X	1	Shield, Face	X	12	X	12
Rule, Steel (12")	X	18	X	18	Soldering Copper, Electric (60W) ¼" copper tip with stand	X	1	X	1
Rule, Steel (24")	X	6	X	6					
Rule, Steel (36")	X	3	X	3					
Sanding Drums (set)	X	1							
Saw, Back (12")	X	6	X	6					

II. Hand Tools and Equipment (cont.)	Introductory	Quantity	Advanced	Quantity	III. Experimental and Research Equipment (cont.)	Introductory	Quantity	Advanced	Quantity
Spokeshave, Convex bottom	X	4	X	4	Jack, Auto, Hydraulic (standard type) (1½ ton)			X	3
Spokeshave, Straight	X	4	X	4	Meter, Galvanometer 500-0-500 micro amps.			X	1
Spray Gun Outfit	X	1	X	1	Meter, Moisture content (electric)			X	1
Square, Combination (12")	X	2	X	2	Meter, Volt-ohm (multi-range)			X	1
Square, Steel framing 12" x 24"	X	6	X	6	Microscope	X	1	X	1
Square, Try (6")	X	24	X	24	10x Hygienian eyepiece with pointer, triple revolving nose-pieces; 3 standard objectives; 4x, 10x, 43x; plain stage with side clips; fixed in stage condensor; iris diaphragm; in base illuminator				
Square, Try (12")	X	4	X	4	Oven 12"W x 10"H x 10"D; 220V, 3-phase or 110V, single-phase			X	1
T Bevel (6")	X	3	X	2	Press, Hydraulic, Heated platen minimum cap. 12 tons; with 12" x 12" platen			X	1
Trammel Points	X	2	X	2	Scale, Household cap. approx. 5 lbs.			X	1
Triangle, 30 degrees - 60 degrees (8")	X	1	X	1	Scale, Laboratory precision accuracy; maximum 100 grams			X	1
Triangle, 45 degrees (8")	X	1	X	1					
T Square minimum size 24"	X	1	X	1	IV. GENERAL FURNISHINGS				
Vise, Bench, Drill 3" opening	X	1	X	1	Bench, Demonstration 1¾" x 28" x 60" table top	X	1	X	1
Vise, Miter	X	1	X	1	Bench, Electric demonstration 6' x 30"; 0-120V AC and DC outlets			X	1
Wrench, Adjustable end (8")	X	1			Bench, Woodworking (2 place) 2¼" x 28½" x 64"; hard maple top; wood or metal; base units 36"W x	X	8	X	8
Wrench, Allen key (hex) (set) set includes sizes numbers 1½-12	X	1	X	1					
Wrench, Open end (set) size ¼"-1"	X	1	X	1					
Wrench, Socket (3/8" drive) (set) 10 piece set, 7 standard sockets; 3/8"-3/4" by 16ths	X	1	X	1					
III. EXPERIMENTAL AND RESEARCH EQUIPMENT									
Balance, Beam			X	1					
Hot Plate, Electric (100V)			X	1					

IV. General Furnishings (cont.)	Introductory	Quantity	Advanced	Quantity	IV. General Furnishings (cont.)	Introductory	Quantity	Advanced	Quantity
21"D, overall bench height 33¼" with 2 vises					Dust Collection System	X	1	X	1
Bench, Woodworking (4 place) 2¼" x 54" x 64"; mounted on two 36"W x 21"D x 31"H base units of wood or metal; hard maple top; with 4 vises	X	2	X	2	Fire Blanket	X	1	X	1
Bookcase approx. 60"H x 10" to 12"D x 72"L; 3 adjustable shelves, wood or metal	X	2	X	2	Fire Extinguisher	X	3	X	3
Cabinet, Filing 4 drawers; 52"H x 15"W x 28½"D	X	2	X	2	First Aid Kit	X	1	X	1
Cabinet, Finishing (storage) steel construction, adjustable shelves, 2 doors with locks	X	1	X	1	Pencil Sharpener, Standard	X	1	X	1
Cabinet, Machine accessory 36"W x 21"D x 31"H, wood or metal; 2¼" x 22" x 54", maple top	X	1	X	1	Projector, Filmstrip (35mm) and slide (2" x 2")	X	1	X	1
Cabinet, Nail and screw storage 22½"H x 48"; see-through plastic drawers	X	1	X	1	Projector, Motion picture, Sound	X	1	X	1
Cabinet, Storage 32"W x 22"D x 84"H; 7 shelves; wood or metal construction	X	1	X	1	Projector, Overhead	X	1	X	1
Cabinet, Tool storage approx. 62" x 22"D x 84"H	X	1	X	1	Rack, Glue Clamp 72" x 36" x 32"H	X	1	X	1
Chair, Teacher's welded steel construction, swivel, with casters	X	1	X	1	Rack, Roll, Wrapping paper (24")	X	1	X	1
Compressor, Air 120 p.s.i., 1½HP, 208V motor; 60 gallon tank	X	1	X	1	Screen, Projection 60" x 60"			X	1
Desk, Teacher's 42" x 30" x 29"H, welded steel construction	X	1	X	1	Spray Booth, Dry approx. size 5'W x 7'H x 4" working depth, with fire deflective curtain and paint arrestor filter cells			X	1
					Table, Drafting overall size approx. 38" x 28" x 39"H, wood or metal or overall size approx. 38½" x 48" x 29"H, wood or metal	X	1	X	1
					Table, Overhead projector	X	1	X	1
					Table, Finishing 1¼" x 24" x 50"; ply wood top, covered with 20 ga. galvanized steel	X	1	X	1
					Table, Spraying top size 50" diameter; with lazy susan; bearing attached to outside			X	1

PART V APPENDICES

- Appendix A — Design Criteria for Public School Plants
Accommodating the Physically Handicapped
- Appendix B — Shop Planning Check List
- Appendix C — Facility Planning Reference Chart
- Appendix D — Bibliography



APPENDIX A

DESIGN CRITERIA FOR PUBLIC SCHOOL PLANTS ACCOMODATING THE PHYSICALLY DISABLED

Approximately one out of seven people in our nation has a permanent physical disability. This segment of our population represents human resources of inestimable value and is of great economic significance to the state and entire nation. ¹

The most common design and construction of building and facilities cause problems for the physically handicapped that lessen the social and economic gains now evident in the rehabilitation of these individuals. These architectural barriers make it very difficult to project the physically handicapped into normal situations of education, recreation, and employment. ²

A recent law enacted by the 74th Missouri General Assembly, Section 8.600, RSMo 1967, relating to public buildings and facilities is as follows:

Section 1. In all buildings and facilities for general public use and assembly which are constructed in whole or in part by the use of state funds, or the funds of any political subdivision of this state, practical design and engineering arrangements shall be made to obviate hazards to individuals with physical disabilities.

Section 2. The provisions of this act shall not be applicable to any building or facility for which the contract and/or design was awarded prior to the effective date of this act.

The effective date for this act being October 13, 1967.

The criteria presented in this publication are intended as minimum standards. They are recommended for use by architects and engineers, and others involved in planning and construction of school buildings and facilities in the state of Missouri, so that those individuals with permanent physical disabilities might pursue their interests and aspirations, develop their talents, and exercise their skills.

A. Public Walks

1. At least one primary walk to each building shall be not less than four feet wide and shall have a gradient no greater than five percent, unless the parallel and adjacent public thoroughfare gradient exceeds such percentage in which case the gradient to be constructed shall conform to the gradient of such parallel and adjacent public thoroughfare.

2. The primary walk shall be of a continuing common surface, not interrupted by steps or abrupt changes in level.

3. Whenever the primary walk crosses other walks, driveways, or parking lots it shall blend to a common level. This refers to a blending of walk and driveway to one surface at their juncture.

4. The primary walk or platform shall extend three feet or more beyond the swing of a door, wherever a door swings out onto a platform, ramp or walk.

5. The walk or platform area outside the primary doorway entrance shall be at the same level as the finish floor line inside the door.

¹ American Standards Association, Inc., American Standard Specifications for "Making Buildings and Facilities Accessible to, and Usable by, the Physical Handicapped", ASA Project A117.1 0 1951, 10 East 40th Street, New York 16, N.Y., P. 3 (Foreword)

² *Ibid*, P. 3 (Foreword)

B. Parking Lots

1. A paved or hard surfaced parking area of sufficient size that is accessible and approximate to the facility shall be provided and identified for use by individuals with physical disabilities.
2. At least one walk or ramp both to and from one parking area to a given building or facility, if provided, shall be in conformity with provisions for walks or ramps as given in sections A-2 and 3 and C-1 through 7.
3. Care shall be exercised in planning a parking area for use by individuals with physical disabilities so that they are not compelled to wheel or walk behind parked cars.

C. Ramps with Gradients and Handrails

1. Where ramps with gradients are needed, the slope shall not exceed one foot rise in twelve feet or 8.33 percent rise.
2. Ramps shall have a surface that is nonslip.
3. Ramps shall have closed handrails on at least one side and preferably two sides, that are thirty-two inches in height, measured from the surface of the ramp, and extending at least one foot beyond the top and bottom of the ramp.
4. All outside ramps shall be at least four feet in width, and all inside building ramps shall be either corridor width or a minimum of five feet in width.
5. Ramps shall have a level platform at the top which is at least five feet by five feet. This platform shall extend at least one foot beyond each side of the doorway.
6. Ramps shall have at least six feet of straight clearance at the bottom.
7. Ramps should have level platforms at thirty foot intervals for purposes of rest and safety and shall have level platforms wherever they turn. One continuous ramp up to forty feet in length is permissible where a change in level is three feet four inches or less.

D. Entrances

1. At least one primary entrance to every school building or facility shall be usable by individuals in wheelchairs, and this entrance shall have access to the elevator in a multistory building.

E. Elevators or Ramps for Multiple Story Buildings

1. An elevator or ramp shall be provided in all multiple story buildings (two or more floors).
2. An elevator or ramp shall be provided in all adjoining multiple story additions except where an existing elevator or ramp adequately serves the entire structure.
3. Wherever an elevator is provided it shall be accessible to, and usable by, the physically disabled on the level that they use to enter the building.
4. Elevator cabs shall be large enough to enable a wheelchair to turn.

F. Doors and Doorways

1. Doors shall have a clear opening of no less than thirty-two inches and preferably thirty-six inches when open and shall be operable by a single effort. Automatic doors with hold-open feature are recommended for at least one entrance to the building. Interior doors equipped with closers should have hold-open feature.

2. The floor on the inside and outside of each doorway shall be level for a distance of five feet from the door in the direction the door swings and shall extend one foot beyond each side of the door.

3. Sharp inclines and abrupt changes in level shall be avoided at doorsills. As much as possible, thresholds shall be flush with the floor.

G. Stairs and Handrails

1. Steps shall, wherever possible, and in conformation with existing step formulas, have risers that do not exceed seven inches.

2. Steps in stairs shall have rounded "nosings" and no protruding nosings or abrupt change of surface from face or riser to tread.

3. Stairs shall have closed handrails on each side at least thirty-two inches high as measured from the tread at the face of the riser. At least one handrail shall extend eighteen inches beyond the top step and beyond the bottom step. Care shall be taken that the extension of the handrails is not in itself a hazard. The extension may be made on the side of a continuing wall.

H. Toilet Rooms and Facilities

1. At least one toilet room for each sex and for each floor shall have space to allow for traffic of individuals in wheelchairs.

2. One toilet room for each sex and for each floor shall have at least one toilet stall that is thirty-six inches wide and fifty-six inches deep, with a door (where doors are used) that is thirty-two inches wide and swings out and with handrails on each side which are thirty-three inches above the floor and parallel to the floor. Where no doors are used toilet stalls may be less than fifty-six inches deep, but not less than forty-eight inches to allow for installation of handrails.

I. Water Fountains

1. An appropriate number of water fountains or water dispensings means shall be accessible to, and usable by the physically disabled.

2. Conventional floor-mounted water coolers are satisfactory provided a small fountain is mounted on the side of the cooler thirty inches above the floor.

3. Wall-mounted, hand-operated fountains of the latest design can serve the able-bodied and the physically disabled equally well when the fountain is mounted with the basin thirty-six inches from the floor.

J. Floors

- 1. All non-level floor area including ramps and stair treads shall have nonslip surfaces.**
- 2. Floors on a given story should be of a common level, wherever practicable, unless connected by proper ramps.**

APPENDIX B SHOP PLANNING CHECK LIST

Purpose

Know community to be served.	Yes	No
Facilities planned for specific level.	Yes	No
Purpose of the facility clearly stated.	Yes	No
All provisions made to meet curriculum.	Yes	No
Monies available to plan desired shop.	Yes	No
Facilities adapted to intended purposes.	Yes	No

General Laboratory Arrangement

Laboratories planned for future expansion.	Yes	No
Laboratories designed so they can be made smaller or larger.	Yes	No
Laboratories are not isolated from main educational plant.	Yes	No
Cluster type laboratories connected by covered walk passages.	Yes	No
Partitions constructed so they can be easily moved.	Yes	No
Laboratories are on the ground floor.	Yes	No
Type and height of ceilings are specified.	Yes	No
Laboratories are acoustically treated for auditory comfort.	Yes	No
Type of interior walls are specified.	Yes	No
Type of flooring is specified.	Yes	No
Laboratories are accessible for evening class use.	Yes	No
Noisy laboratories do not disturb other school activities.	Yes	No
Doors designed so the largest piece of equipment can be moved in and out of the laboratory.	Yes	No
Open spaces are provided near entrances and exits to eliminate congestion.	Yes	No
Spacing between benches, machinery, and equipment is sufficient for safety and free passage, preferably 4 ft., no less than 3 ft.	Yes	No
A clear space of 4 to 6 feet is provided in front of tool panels.	Yes	No
There are no obstructions which would prevent the instructor from looking over the entire open laboratory from any point in it.	Yes	No
An open assembly area is planned in laboratories requiring space for assembly of projects.	Yes	No
Laboratories are arranged by units with related processes grouped.	Yes	No
Most-used items are centrally located.	Yes	No
Color dynamics will be used in laboratories.	Yes	No
Shop equipment & furniture planned to be finished in a light color.	Yes	No
Working surfaces are not higher than elbow height.	Yes	No
Temperature for laboratories is 68 degrees measured 60 inches above the floor.	Yes	No
Temperature in classroom is 70 degrees measured 30 inches above the floor.	Yes	No
Spray booths in all finishing areas.	Yes	No
Finish room is dustproof and has an independent exhaust system.	Yes	No

Hand Tools and Storage

Tool panels are placed where the tools will be used most.	Yes	No
Tool panels are placed along natural routes of travel, for efficiency and safety.	Yes	No

Tool panels are not placed near the exit of the laboratory.	Yes	No
Tool panels are well lighted.	Yes	No
Tools will be stored in well-designed tool panels.	Yes	No
Tool panels are of a height and depth so the average student will be able to remove and replace any tool.	Yes	No
Tool panels designed for easy maintenance.	Yes	No
Related tools are placed together on panels.	Yes	No
Tool panels are designed to be easily checked for missing tools.	Yes	No
Tools for each laboratory are color coded with different colors.	Yes	No
The position of tools are outlined to ease in replacing.	Yes	No
Hand tools hung on tool panels are not easy to knock off their hangers.	Yes	No
Heavy tools are stored near the bottom of the tool panel.	Yes	No
Sharp tools are stored below eye level.	Yes	No
Sharp edges of tools hung on panels are protected to prevent injury.	Yes	No

Room Safety

Rooms well lighted.	Yes	No
Maximum fire and panic regulations.	Yes	No
Fire extinguishers located where needed.	Yes	No
Fire-alarm sounding in the shop.	Yes	No
Fire-alarm systems as part of the main system.	Yes	No
Clear traffic lanes (no projections).	Yes	No
Operational lanes marked clearly.	Yes	No
Exit lights above exterior doors.	Yes	No
Nonskid floors.	Yes	No
Excellent construction of storage racks.	Yes	No
Accessible center control electrical switch panel.	Yes	No
Utilities can be shut off where they enter the shop.	Yes	No
Laboratories supplied with adequate electrical wiring.	Yes	No
All electrical materials and workmanship approved by the National Board of Fire Underwriters.	Yes	No
Stairways and ladders protected.	Yes	No
Safety cans available for disposal of oily rags.	Yes	No
Paint and other combustible materials stored in metal cabinets.	Yes	No

Equipment

Proper size of power equipment has been ordered.	Yes	No
An adequate number of machines are provided for the size of classes for which the facility is designed.	Yes	No
Equipment is in excellent working order.	Yes	No
There is a replacement schedule for the equipment.	Yes	No
The equipment is color schemed.	Yes	No
Accessory panels are located near equipment.	Yes	No
Equipment for roughing stock is placed near the storage rooms.	Yes	No
Related equipment are grouped together.	Yes	No
All equipment except for the portable type is fastened securely to the floor, bench, or other stable foundation.	Yes	No
Equipment that creates vibration is cushioned with rubber or felt mountings.	Yes	No
Equipment is mounted to allow toe space and easy cleaning.	Yes	No

Equipment is not mounted on columns or against pipes if they will transmit noise to other parts of the building.

Yes No

School Shop Space

	Sq. Ft. per pupil	Maximum number of students	Total Area	Yes	No
Minimum	75	24	1800	Yes	No
Adequate	100	24	2400	Yes	No
Desirable	125	24	3000	Yes	No

Minimum ratio of the width of the shop to the length is 2:3.
The minimum height of the shop ceiling should be 12 feet.

Yes No
Yes No

Material and Supply Storage

Racks, shelving, drawers, and cabinets are provided in the storage rooms and near tool panels.	Yes	No
Storage rooms are located to ease unloading and storage of supplies as well as convenience in issuing supplies.	Yes	No
Every laboratory has its own storage area.	Yes	No
Special racks and shelving is provided for lumber and bar steel.	Yes	No
Places are provided for waste storage & containers.	Yes	No
Separate storage rooms are provided for extensive use by adult evening classes.	Yes	No

Project Storage

Satisfactory size for student lockers is 18 x 18 x 18".	Yes	No
The locker area is located so it can be supervised by the instructor.	Yes	No
Lockers are available for adult evening classes.	Yes	No
Storage spaces are provided for large project storage.	Yes	No

Instructor's Facilities

Instructor's area is located near the entrance of the laboratory.	Yes	No
The instructor's office has a desk, chairs, and file cabinet.	Yes	No
The instructor's office is enclosed by clear glass windows.	Yes	No
The instructor is provided with a wardrobe locker.	Yes	No
Telephone.	Yes	No

Utilities

Toilet facilities located in or near the laboratories.	Yes	No
Compressed air outlets on the wall in laboratories where it is needed.	Yes	No
Water for hand washing and/or quenching.	Yes	No
Gas services in appropriate places for furnaces, forges, and soldering equipment.	Yes	No

Teaching Aids and Storage

Visual-aid area located in the planning center.	Yes	No
Laboratory or planning area can be darkened for visual-aids.	Yes	No
A built-in or wall hung screen installed in laboratory or planning area.	Yes	No
Electrical outlets conveniently located for visual-aids.	Yes	No

Bulletin Boards and Chalkboards

Bulletin board placed in the planning area and entrance to the laboratory.	Yes	No
Chalkboard in the planning area and laboratory.	Yes	No

Planning Area or Classroom

Planning area located near the laboratory.	Yes	No
Display area located near the entrance.	Yes	No

Electrical

Separate circuits for each machine.	Yes	No
Circuit breakers for overload protection on power circuits.	Yes	No
Outlets, 110 and 220 volt, installed on the walls at convenient locations and intervals.	Yes	No
Safety buttons for equipment installed on the walls at intervals of 15 to 20 feet.	Yes	No
Outside outlets, both 110 and 220 volt.	Yes	No
Provisions made for closed-circuit T.V.	Yes	No
Spare power circuits, one for every 4 active circuits.	Yes	No
Raceway or buss type electrical power system overhead.	Yes	No

Lighting

Lighting in laboratory and classroom produces 110-200 foot candles of light on the work surface.	Yes	No
Lighting produces a uniform distribution of shadow-free and glare-free illumination.	Yes	No
Special darkroom lights are installed.	Yes	No

Health Precautions

First-aid kit located in the laboratory.	Yes	No
Fire extinguishers located near points of danger and labeled.	Yes	No
All electrical switches enclosed.	Yes	No
Welding helmets, safety glasses, and shields provided.	Yes	No
Sterilizing cabinets for face shields and safety glasses.	Yes	No

Heating, Cooling and Ventilating

Thermostat located in the laboratory to control temperature.	Yes	No
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Exhaust system provided for welding, forging, and the hot metals.	Yes	No
Dust collection system provided for grinders, planers, jointers, saws, sanders, etc.	Yes	No
Ventilating system provided for finish room.	Yes	No
Adequate and quiet heating unit provided.	Yes	No
Air conditioning provided for or provisions made for later installation.	Yes	No

APPENDIX C CROSS REFERENCE CHART

TOPICS	PUBLICATIONS															
	A. V. E. for Facility Dev.	Spec. Voc. Practical Arts	A Guide for Planning School Facilities for I.A.—State of N. J.	School Shop Text Development—Rockwell	Principles of Shop Planning—State of Illinois	Pamphlet C-7 I.A. Manual for Secondary School Building	How to Plan a School Workshop—Delta	A Guide for I.A. in Ohio Schools	Freeman Supply—Toledo Shop Planning Packet	Standards for Auto Services A. M. A.	Modern School Shop Planning—Prakken	I. A. V. E. March, 1966 Vol. 55, No. 3	I. A. V. E. March 1967 Vol. 56, No. 3	A. C. I. A. T. E. Planning I. A. Facilities 8th Yearbook, 1959	Guide for Planning and Equipping I. A. Shops in California	Industrial Education Facility Bulletin—Michigan
Ed. Specifications	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X
Ascertaining Community Needs	X	X	X						X					X		
Use of Service Consultant	X								X	X				X		
Teaching Stations	X	X				X				X						
Architectural and Engineering Practice	X			X										X		
Planning Relationship between I.A. and Voc. Ed.	X										X					
Student Group Characteristics	X								X			X				
Local School Philosophy of I.A.	X	X									X			X		
Selection Equipment	X	X	X	X		X	X	X	X	X	X	X	X	X		X
Projection Enrollment				X							X					
Space Requirements	X	X		X			X	X		X				X	X	X
Evaluation Check List		X									X		X	X		
Safety		X	X	X			X	X	X	X	X				X	X
Elementary I.A.		X					X			X	X			X		
Jr. High I.A.	X	X	X			X	X			X	X			X		
St. High I.A.	X	X	X			X	X		X	X	X			X		
Purchasing			X				X	X		X				X		
Bibliography	X	X	X	X		X	X	X		X				X		
Legal Considerations														X		
Planning Concepts	X	X	X	X				X	X	X	X	X	X	X	X	X
Scale Layout Developments			X			X			X	X	X	X	X	X	X	
Equipment Source Check List		X	X													
Determining Number of Laboratories		X		X	X											
Laboratory Organization	X				X		X			X						
Aids and Planning Format			X		X			X								
New Round Design										X	X	X				

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Nair, Ralph D., Editor. *Planning Industrial Arts Facilities*. 8th Edition. 1959. American Council on Industrial Arts Teacher Education, McKnight and McKnight Publishing Company, Bloomington, Illinois. 247 pp.

American Standards Association. *Making Buildings and Facilities Accessible to, and Usable by, the Physical Handicapped*. ASA Project A117.10 1951, 10 East 40th Street, New York 16, N.Y. p. 3.

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School Shop, Prakken Publications, Inc., Box 623, 416 Longshore Drive, Ann Arbor, Michigan 48107.

Publications of the State Government

A Guide for Industrial Arts in Ohio Schools. Ohio State Department of Education. Columbus: The Ohio Industrial Arts Association. State Department of Education. 36 pp.

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United States Office of Education. *Planning and Designing Functional Facilities for Industrial Arts Education* by Marshall Schmitt and James Taylor. For sale by the Superintendent of Document, U.S. Government Printing Office, Washington, D.C. 20402. Catalog No. FS 5.215:51015, price 45 cents. 54 pp.

Other Publications

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Wagner, Willis H. *Planning Industrial Arts Shops.* Department of Industrial Arts & Technology. State College of Iowa, Cedar Falls, Iowa. 32 pp.

The American Industrial Arts Association. *A Guide for Equipping Industrial Arts Facilities.* The Equipment Guide Committee. 1201 16th Street NW, Washington, D.C. 20036. \$4.75. 208 pp.

Williams, William A. Ph.D., Professor of Industrial Education. *An Accident Prevention Program for School Shops and Laboratories.* Department of Vocational Education. The Pennsylvania State University published by National Safety Council — 425 North Michigan Avenue, Chicago, Illinois 60611. \$6.50 (20% discount to schools). 250 pp.