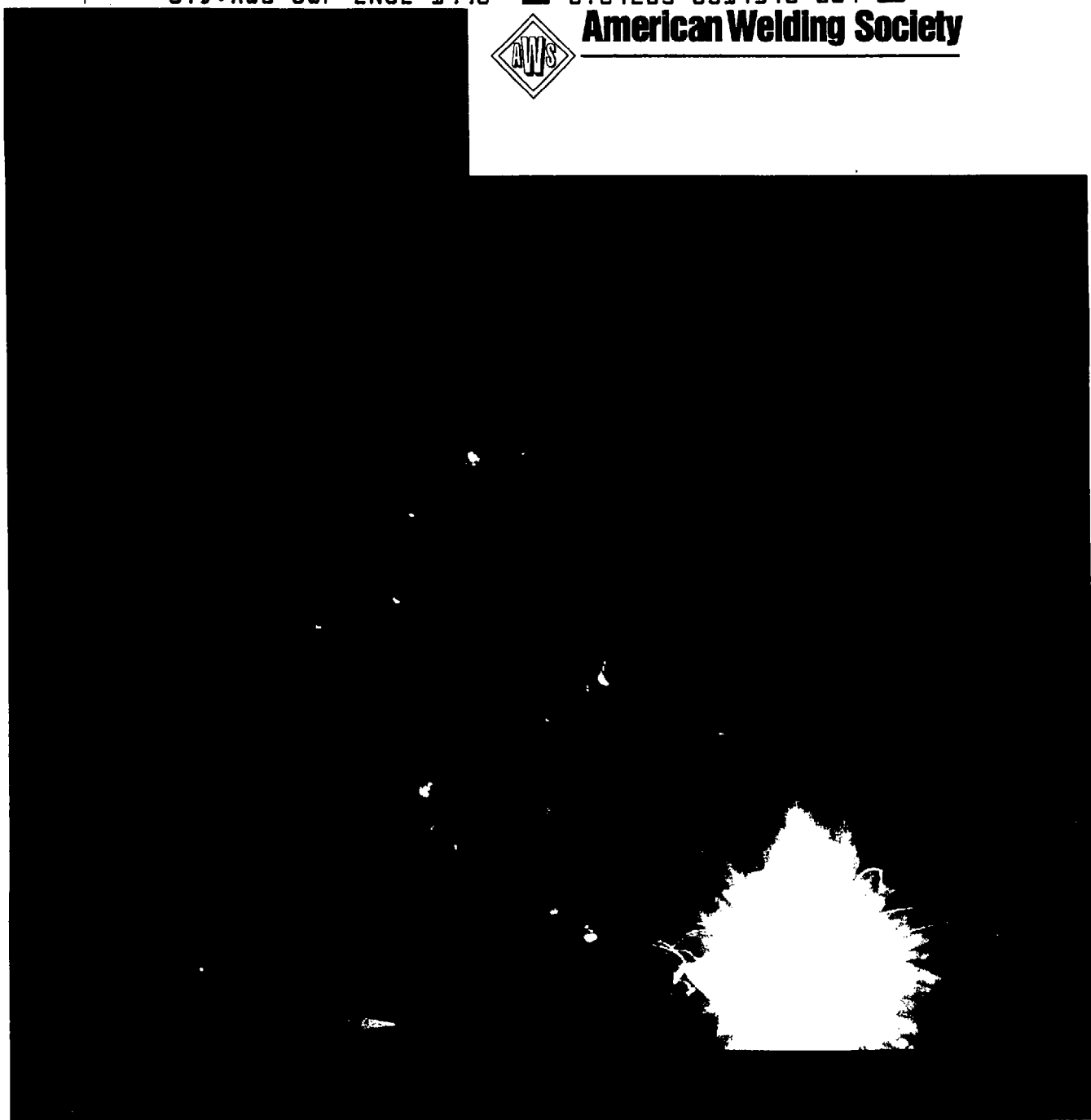




Guide for the Design of a Welder Training Facility



Documents

Document Sharing Hub

Guide for Setting Up a Welder Training Facility

Guide for Setting Up a Welder Training Facility

**Prepared by the
Technical Education Committee**

**Under the Direction of the
Education Committee**

**For the
American Welding Society**



Disclaimer for AWS Education Materials

Note: The primary purpose of AWS is to serve and benefit its members. To this end, AWS provides a forum for the exchange, consideration, and discussion of ideas and proposals that are relevant to welding education and industry, the consensus of which forms the basis for this guide. By providing such a forum, AWS does not assume any duties to which a user of these materials may be required to adhere. By publishing this guide, the American Welding Society does not insure anyone using the information it contains against any liability arising from that use. Publication of education material by the American Welding Society does not carry with it any right to make, use, or sell any patented items. Users of the information in this guide should make any independent investigation of the validity of that information for their particular use and the patent status of any referred to herein.

International Standard Book Number: 0-87171-584-8

American Welding Society
550 N.W. LeJeune Rd., Miami, Florida 33126

1998 by American Welding Society. All rights reserved
Printed in the United States of America

Forward

The American Welding Society (AWS), recognizing the need for competent welding specialists, through the Education Committee (EC) assigned the Technical Education Committee the task of preparing this guide.

Welding has become a very sophisticated and technical science, requiring not only hands-on abilities but also mental application. The future need for competent welding specialists should prompt the establishment of a greater number of education programs. Thus, it becomes imperative that the education given be of a quality and quantity that adequately prepares the graduating students for industrial assignments well into the next century.

As the name implies, it is the intent of this document to serve as a **GUIDE** for those wishing to establish, expand, or enhance a private or public education program for welding specialists. The basic requirements contained in this document are the result of the joint efforts of individuals from industry and academia to standardize the instruction and evaluation of welding specialists throughout the United States of America and the world. Members of the AWS community and the Education Committee have a growing interest in positively promoting Welding Specialist education and providing minimum standards for its delivery.

The Education Committee welcomes comments on this publication, and communications should be addressed to: The American Welding Society, Attention: Director of Education, 550 N.W. LeJeune Road, Miami, Florida, 33126

TABLE OF CONTENTS

1. Scope and Purpose	1
2. Facility and Services	1
2.1 School Facilities	1
2.1.1 Primary Structures(s)	1
2.1.2 Classrooms(s)	2
2.1.3 Laboratory	2
2.1.4 Office(s)	3
2.1.5 Storage	4
2.1.6 Personal Services	4
2.1.7 Budget	4
2.2 Facility Support	5
2.2.1 Lighting	5
2.2.2 Electricity	5
2.2.3 Ventilation	5
2.2.4 Heating	6
2.2.5 Water	6
2.2.6 Safety	6

3. Equipment and Supplies	6
3.1 Instructional Equipment	6
3.1.1. Welding/Cutting	6
3.1.2 Stationary Power	7
3.1.3 Portable Power	8
3.1.4 Individual	8
3.1.5 Testing	9
3.2 Training Materials	10
3.2.1 Instructional Materials	10
3.2.2 Base Metals for Welding Practice	10
3.2.3 Filler Materials and Fluxes	10
3.2.4 Gases	10
APPENDIX A – CONTACT ORGANIZATIONS FOR FURTHER INFORMATION	11
APPENDIX B - LITERATURE AND SOURCE LIST	11

1. GENERAL

1. Scope

This manual defines the physical requirements of a welding instruction facility. It is intended to give guidance to institutions that desire to build or convert facilities to train welders to produce welds using the manual and semi automatic welding processes commonly found in industry. In addition, this guideline provides a list of equipment and supplies that are normally needed to facilitate training and the welding operations themselves. This guideline does not purport to be all-inclusive. Modifications should be made to this guideline to best accommodate the facilities and budget of the institution that is implementing a welding instruction program.

1.2 Objectives

- A) To provide guidance to facility planners in the provision of safe and efficient facilities for the teaching of welding skills.
- B) To assure that needed electrical service, lighting, ventilation and other environmental concerns are addressed in the facility planning stage.
- C) To maximize the quality of the educational experience of the welding student while in the facility.
- D) To provide basic guidance in responding to fire, life safety and environmental regulations as they pertain to welding instructional facilities and equipment.

2. Facility and Services

2.1 School Facilities

2.1.1 Primary Structure(s)

The building should be fireproof and well designed. Welding instructional facilities will function best if located on the ground floor, preferably in a one-story wing of the main building or in a separate building with covered access ways. Instructional areas in which noisy activities are conducted are best placed farthest from other academic areas of the school or production areas in an industrial facility. Walls should be smooth, with no ledges to collect dust. Floors must be fire resistant, waterproof, and contain adequate floor drains. A minimum light level of 100-foot candles (100 candela) 30 inches (762 millimeters) from the floor is recommended. To enhance motivation and morale, adequate natural light from windows and skylights should be available. Walls should be prepared with a low reflective paint to reduce ultraviolet radiation. "Cool" colors-blues or greens are recommended.

The various workstations in a laboratory should meet the following objectives:

- (A) Provide suitable facilities where the instructor may demonstrate the skills and techniques necessary to develop welding competencies
- (B) Provide a place at which the welding students may develop such competencies
- (C) Provide an area in which power sources, equipment and projects may be secured and serviced
- (D) For specific industry welding training facilities, provide special fixturing and production work mock-ups to adequately demonstrate the production work to be expected in order to allow students to experience typical job related welding positions, conditions, and interferences.

A modular system of layout should be considered so that flexibility and expandability can be achieved. The former is accomplished by allowing the maximum possible interchange of workstations and other facilities. Future expansion is planned in terms of multiples of specific workstations needed rather than in terms of the general area to be added. These features would simplify the work of the architect, increase the usable life of the laboratory, and provide the instructor with more possibilities to offer curriculum changes.

The flexibility and expandability of laboratories should be greatly enhanced if architectural design permits use of non-load bearing partitions between adjoining areas. Good planning includes the provision of doors large enough to permit easy entry of the largest piece of equipment into each shop. In addition, placement of such doors to permit the maximum degree of future flexibility with changes in partition locations should be considered.

If facilities are to be used for evening classes, easily accessible outside entrances which eliminate the necessity of opening or lighting other parts of the building offer important savings in operating and maintenance costs.

2.1.2 Classroom(s)

Ideally, a room for instruction should be about 20 feet (6.1 meters) x 24 feet (7.3 meters) and adjacent to the laboratory. Classrooms should provide a clear but protected view of the laboratory area. The minimum ceiling height should be 12 feet (3.7 meters) or higher. Classrooms must be acoustically insulated from laboratory noise. This space should have chalk and tack boards, a demonstration table, adequate seating facilities and provision for darkening (for use with visual aids). At least one bulletin board should be near the main entrance. Instructors and welding personnel must have nominal access to the classroom. Storage for audio-visual equipment, charts, models, samples, reference texts, etc., need to be provided. Exhibit cases have strong appeal to parents and observers, especially when located to permit viewing from the outside corridor.

2.1.3 Laboratory

A minimum of 100 square feet (9.3 square meters) of laboratory floor space per individual is considered a good general planning figure, exclusive of washroom, storage, office space and the classroom. At the outset the architect and laboratory planner must take into account state recommendations as to minimum square footage per individual. While they vary from state to state, factors of 75 square feet (7.0 square meters) to 150 square feet (13.9 square meters) of work space per individual and a minimum of 400 square feet (37.2 square meters) to 800 square feet (74.3 square meters) for material storage are generally accepted requirements for this particular size area and the subjects to be taught. Floor dimensions of 40 feet (12.2 meters) x 85 feet (25.9 meters) are reasonably close to the normally accepted length to width proportions of 2 to 1. The minimum ceiling (clearance) height should be no less than 14 feet (4.3 meters). At least one entrance must be large enough [14 feet (4.3 meters) x 14 feet (4.3 meters)] to accommodate bulky materials, equipment and projects. Future expansion should always be considered. This should permit additional enrollment, new equipment, or extra shop subjects to be reasonably accommodated without going below space-per-individual minimums.

Where a hazard exists around machines, the power equipment should be so placed that welding personnel are not in the line of danger. Added protection is given by enclosing this equipment in a safety zone painted on the floor. Wide aisles of travel should be provided between benches, machines, and in areas in front of tool cabinets and storage lockers. These aisles should be a minimum of 3 feet (.9 meters) in width. Aisles of travel may be designated by painted lines similar to those used in industry. Non-skid surfaces such as sand on shellac should be applied to the floor in the area around machines to minimize danger of slipping.

An area 6 feet (1.8 meters) x 6 feet (1.8 meters) area should be planned for process booths and ought not to contain a power source. Welding booths must be constructed of fire resistant material, with the walls open at least 12 inches (305 millimeters) at the bottom to permit air circulation. All four

sides of the welding booth shall provide complete protection to the welding personnel and others in the area from harmful rays and hot sparks. A minimum of one 10 feet (3.1 meters) x 10 feet (3.1 meters) demonstration area should be available for every 20 welding personnel. Positioning jigs, independent of other activities to prevent congestion, should be provided.

Tools and supplies should be located as near to work areas as practical to reduce travel and interferences. Machines should be placed to allow for ease of cleaning around the base. Cabinets should fit flush to walls or be trimmed to fit flush for the same reason. Bases for cabinets and benches should provide toe space for comfort and safety of workers.

2.1.4 Office(s)

The entrance to the instructor's office should be easily accessible from the classroom, laboratory and facility corridor. Activities in the classroom and laboratory must be visible from the office. The office window space should be designed to provide maximum vision to all areas along with proper ultra violet light protection. The office ought to provide at least 120 square feet (11.2 square meters) of floor space per instructor [size 10 feet (3.1 meters) x 12 feet (3.7 meters)]. The office needs to be planned with at least one 3 foot (.9 meters) wide door, tile or carpet flooring cover, and an acoustical ceiling with fluorescent lighting. For instructional use and laboratory safety the office should have a telephone. It should also have room for file cabinets, desk, bench with storage underneath for weld supplies, a shelf for boots, and room for two chairs for counseling welding personnel.

2.1.5 Storage

Decentralized storage should help conserve space and increase efficiency by reducing individual traffic. A storage area for bar stock should be at least 25 feet long (7.6 meters) and 7 feet wide (2.1 meters), with a door centered at both ends. This permits both economical purchase of steel in long lengths and wall storage within the room. Use of horizontal or vertical racks depends on space limitations and personal preference. Storage of bulk supplies (adequately secured) should be located adjacent to an outside service door for convenient delivery.

Adequate filler metal storage should be considered and should be controlled. Rod, wire, and fluxes, depending on their nature, must be maintained under certain storage conditions. The materials of higher value or requiring temperature control shall require tighter controls to ensure that product quality is retained. Acquisition of an electrode storage oven is highly recommended.

Open tool cabinets in each process area should conserve, personnel time and travel while helping them associate proper tool selection and application with a particular activity. This also provides for easy checking of tools. Space underneath benches and tables is excellent for storage of hardware, small amounts of raw stock or even small projects. Storage for projects of welding personnel and personal belongings is always a problem and should be well thought out.

Cylinder storage should be located near the laboratory but accessible to truck traffic. All volatile material(s) should be stored outside in an identified, isolated area to minimize the potential hazards

involved. Cylinder storage shall follow the guidelines set forth in ANSI/ASC Z49.1. Safety, Cutting and Allied Processes, Part II Specific Processes, 10.8.2 Cylinder Storage.

One door should open directly to the outside from this room so that stock may be loaded into the room with no interference to shop activities. Scrap storage could be located near this entrance. Thus, material storage areas or rooms should be located conveniently for issuing materials to the welding personnel for cutting large stock to project size and for the unloading of delivery trucks.

2.1.6 Personal Services

Personal services should be planned into the laboratory, both for convenience and efficiency. Individual lockers for books and clothing should be near the entrance to keep these items out of the main instructional area. A wash-up sink and water fountain and, where possible, a lavatory (for both genders) should also be included near the entrance.

2.1.7 Budget

Adequate financial resources should be considered and support provided to not only maintain the program, but also enhance it. Funding for power sources, filler metals, gases, and fluxes along with power equipment and hand tools covers just the basics. Additional monies shall be available to provide the pedagogical materials necessary for adequate welding instruction. As necessary, staff and faculty should also have included in the budget resources (i.e., release time and dollars) to provide for their technical as well as professional development.

2.2. FACILITY SUPPORT

2.2.1 Lighting

100 foot candles (100 candela) should be the absolute minimum recommended for general work in any shop while 140 foot candles (140 candela) would be recommended for more difficult or inspection work. In most cases, the use of indirect lighting to avoid glare and evenly diffuse the light is recommended. When needed, individual machines can be lighted by lamp attachments or through their own built-in lighting systems. Providing uniform distribution of shadow free light through the use of indirect or semi-indirect deflectors should also be considered. Adequate lighting shall also be found in each booth.

2.2.2 Electricity

Electrical power shall be supplied with adequate voltage and amperage for each power source. Electrical service shall be 200/208 volt, 230/240 volt or 460/480 volt, single-phase or three phase, and 60 cycle (60 Hertz), alternating current. Current capacity of 75 percent more than the estimated demand should be provided for expansion in the welding facility. Electrical outlets for 110/120-volt service should be placed at convenient locations every 12 feet (3.7 meters) and in every booth.

Ground fault interrupters should be provided throughout the shop. The use of magnetic starters on all rotary equipment is an additional safety feature, which gives a machine motor overload protection as well as low-voltage, and no-voltage protection. After a power failure has been corrected, the machine will not start (even if it was running when the failure occurred) until the operator presses the start button.

A disconnect switch that can be locked out, must be provided to cut off all power equipment, including power sources, in the shop. Panic switches should be strategically located around the entire shop or laboratory and their locations known by all welding personnel. They shall be wired to cut off power to every machine. Fused disconnect switches should be provided for each power source and there should be no exposed wiring.

2.2.3 Ventilation

Individual, movable exhaust hoods are highly desirable at the work site. Welding station exhaust should be separate from other laboratory exhaust systems. The minimum required air velocity at the zone of welding is 100 feet per minute (.5 meters per second) when the hood is at its farthest position from the joint being welded. The hood size and height could be reduced to lower the required capacity of the exhaust system. The use of a qualified heating, ventilation, and air conditioning (HVAC) contractor is strongly recommended, rather than having an inexperienced sheet metal firm perform the construction. Fire resistant, safety yellow, strip curtains could be lowered to form a booth when greater exhaust efficiency is desired at the demonstration area.

For the single welding booth, it is practical to design a hood exhaust system. When there are a large number of booths being used, it is more practical to provide exhaust at the arc than for the entire room. However, the loss of heat during the cold months is a serious objection to the room ventilation method unless a heated air intake system is used. To avoid this heat loss, an air filtration system, which cleans the exhausted air and reintroduces it back into the laboratory to save heat and air conditioned air, should be used. These units need careful placement as welding schools create more smoke than most industry applications due to large numbers of units in a contained work area.

2.2.4 Heating

Heating and cooling capacity must take into consideration the provision for a supply of fresh, clean incoming air. The laboratory heating system should automatically maintain a temperature of 68° Fahrenheit (20° Celsius) measured 60 inches (1.5 meters) above the floor. The classroom and the office should be kept at 70° Fahrenheit (21° Celsius) measured 30 inches (762 millimeters) above the floor. A system of even heat distribution should be kept within 5% of these temperatures for health reasons and for stability of equipment and stored materials.

2.2.5 Water

Hot and cold running water, along with a suitable drinking fountain in the laboratory, and convenient sanitary restrooms nearby are necessities. Washing facilities of either the half round or trough type sink are essential and, as a rule of thumb, should be adequate to accommodate one quarter of the welding personnel simultaneously. Location of the washing facilities should be as near the door as feasible. Inclusion of drinking fountains is highly desirable and should be available within the welding facility. A safety shower and eye wash station should also be located within each laboratory area. Proper drainage must be considered during installation.

2.2.6 Safety

Information regarding safety can be found in ANSI Z49.1 (Safety in Welding and Cutting), AWS F2.2 (Lens Shade Selector), AWS F3.1 (Guide for Welding Fume Control), AWS F4.1 (Recommended Safe Practices for the Preparation for Welding and Cutting of Containers That Have Held Hazardous Substances), as well as all other applicable local, state and federal regulations. Equipment must conform to the OSHA requirements for "lockout and tagout".

All safety features of the primary structure(s) and its support system(s) must conform to any local, state or federal governing codes. The school must be able to pass an inspection of the local and state Fire Marshal and possess a certificate of conformance from the regional OSHA engineer.