

SAFETY REGULATION no. 11

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WELDING AND CUTTING



Effective July 1, 1969

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Trenton, N.J.

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2. Labeling of Hazardous Chemicals—12/1/67.
3. Threshold Limit Values—12/1/67.
5. Conveyors and Cableways—12/1/67.
6. Woodworking Machinery—12/1/67.
10. Work in Confined Spaces—12/1/67.
11. Welding and Cutting—7/1/69.
30. Plan Filing—7/1/69.

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Short Rise Hydraulic Material Lifts—10/15/63.

Promulgated under the Construction Safety Act—P. L. 1962, c. 45:

Construction Safety Code—7/1/68.

Promulgated under the Mine Safety Act—P. L. 1954, c. 197:

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22. Storage of Explosives—8/20/65.
23. Use of Explosives—8/20/65.
24. Rocket Experimentation by Amateurs—11/1/63.

LAW REPRINTS

Construction Safety Act—P. L. 1962, c. 45.

Explosives Act—P. L. 1960, c. 55.

Fireworks Regulation Law—P. L. 1930, c. 42 and P. L. 1937, c. 51.

High Voltage Proximity Act—P. L. 1948, c. 249 and P. L. 1966, c. 261.

Mine Safety Act—P. L. 1954, c. 197.

Railroad and Airline Sanitation—P. L. 1966, c. 112.

Railroad Diesel Locomotive Ventilation—P. L. 1966, c. 119.

Transportation of Dangerous Articles—P. L. 1950, c. 128.

Worker Health and Safety Act—P. L. 1965, c. 54.

(Continued on inside back cover)

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DIVISION OF LABOR.
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TABLE OF CONTENTS

	PAGE
FOREWORD	1
SECTION 1—PURPOSE, SCOPE AND VALIDITY	3
1.1 Purpose	3
1.2 Scope	3
1.3 Validity	3
SECTION 2—DEFINITIONS	4
SECTION 3—INSTALLATION AND OPERATION OF OXYGEN FUEL-GAS SYSTEMS FOR WELDING AND CUTTING	7
3.1 General Provisions	7
3.2 Cylinders and Containers	7
3.3 Manifolding of Cylinders	13
3.4 Service Piping Systems	18
3.5 Protective Equipment, Hose, and Regulators	22
3.6 Acetylene Generators	26
3.7 Calcium Carbide Storage	34
3.8 Public Exhibitions and Demonstrations	36
SECTION 4—APPLICATION, INSTALLATION AND OPERATION OF ARC WELDING AND CUTTING EQUIPMENT	38
4.1 General	38
4.2 Application of Arc Welding Equipment	38
4.3 Installation of Arc Welding Equipment	41
4.4 Operation and Maintenance	44
SECTION 5—INSTALLATION AND OPERATION OF RESIST- ANCE WELDING EQUIPMENT	48
5.1 General	48
5.2 Spot and Seam Welding Machines (Nonportable)	48
5.3 Portable Welding Machines	50
5.4 Flash Welding Equipment	50
5.5 Hazards and Precautions	51
5.6 Maintenance	51
SECTION 6—FIRE PREVENTION AND PROTECTION	52
6.1 Basic Precautions	52
6.2 Special Precautions	52
6.3 Welding or Cutting Containers	53
6.4 Sprinkler Protection	54
6.5 Confined Spaces	54

SECTION 7—PROTECTION OF PERSONNEL	56
7.1 General	56
7.2 Eye Protection	56
7.3 Protective Clothing	58
7.4 Work in Confined Spaces	59
SECTION 8—HEALTH PROTECTION AND VENTILATION	61
8.1 General	61
8.2 Ventilation for General Welding and Cutting	63
8.3 Local Exhaust Hoods and Booths	63
8.4 Ventilation in Confined Spaces	64
8.5 Fluorine Compounds	65
8.6 Zinc	65
8.7 Lead	65
8.8 Beryllium	66
8.9 Cadmium	66
8.10 Mercury	66
8.11 Cutting of Stainless Steel	66
8.12 Other Materials of Toxic Significance	67
8.13 Brazing Atmospheres	67
8.14 Cleaning Compounds	68
8.15 Medical Control and First Aid	68
APPENDIX A—BIBLIOGRAPHY	69
APPENDIX B—DIFFERENCES BETWEEN SAFETY REGULATION No. 11 and USAS Z49.1-1967	74

FOREWORD

This Resolution supersedes Safety Regulation No. 11, Safety in Welding and Cutting, effective February 9, 1959.

This Regulation has again been promulgated to provide reasonable safeguards for workers who use or who may come in proximity to welding and cutting equipment and to bring the Regulation abreast of current developments in the art.

The text of this Regulation has been taken basically from the standard of the United States of America Standards Committee Z 49, Safety in Welding and Cutting, sponsored by the American Welding Society and known as Safety in Welding and Cutting USAS Z 49.1—1967. Section 3 of the USA Standard or Section 3 of this Regulation is also the Standard of the National Fire Protection Association; namely, Oxygen—Fuel Gas Systems for Welding and Cutting, NFPA No. 51—1964.

It has been necessary to modify the text of USAS Z 49.1 in a number of places in order to use it as a Bureau Regulation. The details of these modifications are explained in Appendix B of this Regulation.

This Regulation is promulgated by the Commissioner of Labor and Industry of the State of New Jersey under authority vested in him by Section 9 of the Worker Health and Safety Act, P. L. 1965, c. 154, N.J.S.A., 34:6A as follows:

The commissioner shall make and promulgate rules and regulations reasonably necessary to implement the purposes of this act. Such rules and regulations shall have the force and effect of law and shall be enforced in the manner provided in this act . . .

The same statute provides authority for the commissioner to grant exceptions from the requirements of rules and regulations in accordance with Section 23 as follows:

The commissioner shall have the power and authority to grant exceptions from the literal requirements of rules and regulations promulgated under this act. Such exception shall be granted in any particular case only where it is clearly evident that it is necessary to prevent undue

hardship or where existing conditions prevent compliance. In no case shall any exception be granted unless in the opinion of the commissioner reasonable protection of the health and safety of workers and the public will be maintained hereby. An application for an exception shall be filed in writing with the commissioner, setting forth specifically the requirements of the rules and regulations from which an exception is desired and the reason why enforcement of the applicable provisions of the rules and regulations is unreasonable. The commissioner shall grant or deny the exception within 30 days from the date of receipt by him of the application. The commissioner shall maintain a record of all exceptions granted and shall make such record reasonably available for public examination and shall mail a copy of all rulings granting exceptions to the members of the board.

Prior to promulgation this Regulation was submitted to the New Jersey State Industrial Safety Committee, Public Hearing, and the New Jersey Industrial Safety Board in accordance with requirements of the Act cited above.

SECTION 1

PURPOSE, SCOPE AND VALIDITY

1.1 PURPOSE

- 1.1.1 The purpose of this Regulation is to provide reasonable standards for the installation, operation and maintenance of welding and cutting equipment for the protection of workers from injury and illness.

1.2 SCOPE

- 1.2.1 This Regulation is for the protection of persons from injury and illness and the protection of property (including equipment) from damage by fire and other causes arising from welding and cutting in places of employment included in the Worker Health and Safety Act, P. L. 1965, c. 154, NJSA 34:6A.
- 1.2.2 Specific provisions are included for gas welding, shielded metal space arc welding, submerged arc welding, gas shielded arc welding, brazing and resistance welding. However, the requirements of this standard are generally applicable to the other welding processes shown in Master Chart of Welding Processes, AWS A3.1—1961.
- 1.2.3 No attempt has been made to include all particular hazards which may be inherent when welding and cutting equipment is used in special industries.

1.3 VALIDITY

- 1.3.1 Nothing in this Regulation shall be construed to prevent the enforcement of other rules, regulations and codes of the Bureau which prescribe more restrictive requirements.
- 1.3.2 Should any section, paragraph, sentence, or word of this Regulation be declared for any reason to be invalid such decision shall not affect the remaining portions of this Regulation.

SECTION 2
DEFINITIONS

ACETYLENIC COMPOUNDS	Materials which like acetylene have triple bond between two carbon atoms.
AWS	American Welding Society, 345 East 47th Street, New York, New York 10017.
APPROVED	Acceptable to the commissioner. Devices having been tested and accepted for a specific purpose by a nationally recognized testing agency may be deemed to be acceptable.
BUREAU	The Bureau of Engineering and Safety, Division of Labor, Department of Labor and Industry, State of New Jersey.
CGA	Compressed Gas Association, Inc., 500 Fifth Avenue, New York, New York 10036.
COMMISSIONER	Commissioner of the Department of Labor and Industry or his authorized representative.
DEPARTMENT	Department of Labor and Industry.
EMPLOYEE	Any person engaged in service to an employer for wages, salary or other compensation.
EMPLOYER	Any person or corporation, partnership, individual proprietorship, joint venture, firm, company or legal entity, who engages the services of an employee and who pays his wages, salary or other compensation; and any person exercising supervision of employees on an employer's behalf.

FUEL GAS	Acetylene, hydrogen, LP-Gas, and acetylenic compounds.
LABELED	Equipment or materials to which has been attached a label of a nationally recognized testing laboratory that maintains periodic inspection of production of labeled equipment or materials and by whose labeling is indicated compliance with nationally recognized standards on the conduct of tests to determine suitable usage in a specified manner.
LISTED	Equipment or materials included in a list published by a nationally recognized testing agency that maintains periodic inspection of production of listed equipment or materials and whose listing states either that the equipment or material meets nationally recognized standards or has been tested and found suitable for use in a specified manner.
NATIONALLY RECOGNIZED TESTING AGENCY	A laboratory such as the Underwriter's Laboratories, Inc., U. S. Bureau of Mines, Factory Mutual Laboratories or the American Gas Association Laboratories.
NFPA	National Fire Protection Assoc., 60 Batterymarch Street, Boston, Mass. 02110.
PLACE OF EMPLOYMENT	Any building or other premises occupied by an employer in or about which an employee is suffered or permitted to work.
SHALL	Indicates a mandatory requirement.
SHOULD	Indicates a recommendation or that which advised but not required.
USAS	A standard of the USASI.

USASI	United States of America Standards Institute, 10 East 40th Street, New York, N. Y. 10016.
USDOT	United States Department of Transportation (the Interstate Commerce Commission), Washington, D. C. 20433.
WELDER OR WELDING OPERATOR	Any operator of electric or gas welding and cutting equipment.

SECTION 3

INSTALLATION AND OPERATION OF OXYGEN FUEL-GAS SYSTEMS FOR WELDING AND CUTTING

3.1 GENERAL PROVISIONS

3.1.1 No device or attachment facilitating or permitting mixtures of air or oxygen with flammable gases prior to consumption, except at the burner or in a standard torch, shall be allowed unless approved for the purpose.

3.1.2 Under no condition shall acetylene be generated, piped (except in approved cylinder manifolds) or utilized at a pressure in excess of 15 psi gage pressure or 30 psi absolute pressure. This requirement shall not apply to storage of acetylene dissolved in a suitable solvent in cylinders manufactured and maintained according to USDOT requirements, or to acetylene for chemical use. The use of liquid acetylene shall be prohibited.

NOTE: The 30 psi absolute pressure limit is intended to prevent unsafe use of acetylene in pressurized chambers such as caissons, underground excavations or tunnel construction.

3.1.3 Only approved apparatus such as torches, regulators or pressure-reducing valves, acetylene generators and manifolds shall be used.

3.1.4 Workmen in charge of the oxygen or fuel-gas supply equipment, including generators, and oxygen or fuel-gas distribution piping systems shall be instructed and judged competent by their employers for this important work before being left in charge. Rules and instructions covering the operation and maintenance of oxygen or fuel-gas supply equipment, including generators, and oxygen or fuel-gas distribution piping systems shall be readily available.

3.1.5 All fuel-gas cylinders shall be secured with valve end up in storage, in transit, or in use. All oxygen cylinders shall be secured with valve end up in storage or in use.

3.2 CYLINDERS AND CONTAINERS

3.2.1 Approval and Marking

1. All portable cylinders used for the storage and shipment of compressed gases shall be constructed and maintained in accordance with the regulations of the USDOT.

2. Compressed gas cylinders shall be legibly marked by means of stenciling or labeling which is not readily removable to indicate the chemical or trade name of the gas and the name of the owner of the cylinder and name of the gas supplier. Whenever practical, the marking shall be located on the shoulder of the cylinder. This method conforms to the Method for Marking Portable Compressed Gas Containers to Identify the Material Contained, USAS Z48.1-1954.
3. Compressed gas cylinders shall be equipped with connections complying with the Compressed Gas Cylinder Valve Outlet and Inlet Connections, USAS B57.1-1965.
4. All cylinders with a water weight capacity of over 30 lbs. shall be equipped with means of connecting a valve protection cap or with a collar or recess to protect the valve.
5. Cylinders exceeding one pound LP-Gas capacity or one pound acetylene compound capacity used inside buildings shall be equipped with excess flow valves. Excess flow valves shall be installed in such a manner that any undue strain beyond the excess flow valve will not cause breakage between the cylinder and excess flow valve. Such excess flow valves shall be either integral with the cylinder valve or connected directly to cylinder valve outlet.

3.2.2 Storage of Cylinders—General

1. Cylinders shall be kept away from radiators and other sources of heat.
2. Inside of buildings, cylinders shall be stored in a well-protected, well-ventilated, dry location, at least 20 feet from highly combustible materials such as oil or excelsior. Cylinders shall be stored in definitely assigned places away from elevators, stairs or gangways. Assigned storage spaces shall be located where cylinders will not be knocked over or damaged by passing or falling objects, or subject to tampering by unauthorized persons. Cylinders shall not be kept in unventilated enclosures such as lockers and cupboards.
3. Empty cylinders shall have their valves closed.
4. Valves on cylinders complying with 3.2.1-4 shall be protected in storage, in transit, or in use by a valve protection cap or by other approved method.

3.2.3 Fuel-Gas Cylinder Storage

1. Inside a building, cylinders, except those in actual use or attached ready for use, shall be limited to a total gas capacity of 2000 cubic feet of acetylene or acetylenic compounds or 400 cubic feet of hydrogen or 300 pounds of liquefied petroleum gas except as provided in 3.2.3.2.
2. For storage in excess of 2000 cubic feet total gas capacity of acetylene or acetylenic compounds or 400 cubic feet of hydrogen or 300 pounds of liquefied petroleum gas, a separate room or compartment conforming to 3.6.6-1.8 and 3.6.6-1.9 shall be provided, or cylinders shall be kept outside or in a special building. Special buildings, rooms or compartments shall have no open flame for heating or lighting and shall be well ventilated. They may also be used for storage of calcium carbide in quantities not to exceed 600 pounds, when contained in metal containers complying with 3.7.1-1 and 3.7.1-2. Signs should be conspicuously posted in such rooms reading, "DANGER—NO SMOKING, MATCHES or OPEN LIGHTS." or other equivalent wording. See Specifications for Industrial Accident Prevention Signs, USAS Z35.1-1959.
3. All cylinders shall be stored valve end up.
4. Containers other than USDOT cylinders shall be constructed, installed and charged in accordance with the applicable Safety Regulation for the specific gas.

3.2.4 Oxygen Storage

1. Oxygen cylinders shall not be stored near highly combustible material, especially oil and grease; or near reserve stocks of carbide and acetylene or other fuel-gas cylinders, or near any other substance likely to cause or accelerate fire; or in an acetylene generator compartment.
2. Oxygen cylinders stored in outside generator houses shall be separated from the generator or carbide storage rooms by a noncombustible partition having a fire-resistance rating of at least one hour. This partition shall be without openings and shall be gas-tight.
3. Oxygen cylinders in storage shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease)

by a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least 1/2 hour.

4. Liquid oxygen systems used to supply gaseous oxygen for welding or cutting having a storage capacity of more than 13,000 cubic feet of oxygen (measured at 14.7 psia and 70°F.) or 113 gallons of liquid equivalent connected in service or ready for service shall comply with Safety Regulations concerning oxygen systems.

3.2.5 Operating Procedures

1. Oxygen Cylinders

- 1.1 Cylinders, cylinder valves, couplings, regulators, hose and apparatus shall be kept free from oily or greasy substances. Oxygen cylinders or apparatus shall not be handled with oily hands or gloves. A jet of oxygen shall never be permitted to strike an oily surface, greasy cloths, or enter a fuel oil or other storage tank.

2. Fuel-Gas Cylinders

- 2.1 Fuel gases shall be called by their proper names and not by the word "gas."

3. Handling—General

- 3.1 Valve-protection caps, where cylinder is designed to accept a cap, shall always be in place.
- 3.2 When transporting cylinders by a crane or derrick, a cradle, boat or suitable platform shall be used. Slings or electric magnets shall not be used for this purpose.
- 3.3 Cylinders shall be moved by tilting and rolling them on their bottom edges. Dragging and sliding shall be avoided. When cylinders are transported by vehicle they shall be secured in position. Cylinders shall not be dropped or struck or permitted to strike each other violently.
- 3.4 Valve-protection caps shall not be used for lifting cylinders from one vertical position to another. Bars shall not be used under valves or valve-protection caps to pry cylinders loose when frozen to the ground or otherwise fixed. Valve-protection caps shall be designed to protect cylinder valves

from damage. Before raising cylinders provided with valve-protection caps from a horizontal to a vertical position, the cap shall be properly in place. The cap shall be turned clockwise to see that it is hand-tight.

- 3.5 A suitable cylinder truck, chain or steadying device shall be used to keep cylinders from being knocked over while in use.
- 3.6 Unless cylinders are secured on a special truck, regulators shall be removed and valve-protection caps, when provided for, shall be put in place before cylinders are moved.
- 3.7 Cylinders not having fixed hand wheels shall have keys, handles or nonadjustable wrenches on valve stems while these cylinders are in service. In multiple cylinder installations only one key or handle shall be required for each manifold.
- 3.8 Cylinder valves shall be closed before moving cylinders.
- 3.9 Cylinder valves shall be closed when work is finished.
- 3.10 Valves of empty cylinders shall be closed.
- 3.11 Cylinders shall be kept far enough away from the actual welding or cutting operation so that sparks, hot slag or flame will not reach them, or fire-resistant shields shall be provided.
- 3.12 Cylinders shall not be placed where they might become part of an electric circuit. Contacts with third rails, trolley wires, etc., shall be avoided. Cylinders shall be kept away from radiators, piping systems, layout tables, etc., that may be used for grounding electric circuits such as for arc welding machines. Any practice such as the tapping of an electrode against a cylinder to strike an arc shall be prohibited.
- 3.13 Cylinders shall never be used as rollers or supports, whether full or empty.
- 3.14 The numbers and markings stamped into cylinders shall not be tampered with.
- 3.15 Empty cylinders shall be marked "empty" or "MT" segregated from full cylinders and promptly returned to the supplier with valve-protection caps in place. All valves shall be closed.

- 3.16 No person, other than the gas supplier, shall attempt to mix gases in a cylinder. No one, except the owner of the cylinder or person authorized by him, shall refill a cylinder.
- 3.17 No one shall tamper with safety devices in cylinders or valves.

4. Use—Oxygen Cylinders

- 4.1 Cylinders shall not be dropped or otherwise roughly handled.
- 4.2 Unless connected to a manifold, oxygen from a cylinder shall not be used without first attaching an oxygen regulator to the cylinder valve. Before connecting the regulator to the cylinder valve, the valve shall be opened slightly for an instant and then closed. Always stand to one side of the outlet when opening the cylinder valve.
- 4.3 A hammer or wrench shall not be used to open cylinder valves. If valves cannot be opened by hand, the supplier shall be notified.
- 4.4 Cylinder valves shall not be tampered with nor should any attempt be made to repair them. Supplier's instructions as to its disposition shall be followed.
- 4.5 Complete removal of the stem from a diaphragm-type cylinder valve shall be avoided.

5. Use—Fuel-Gas Cylinders

- 5.1 Fuel-gas cylinders shall be secured with valve end up in storage, in transit, or in use.
- 5.2 Cylinders shall be handled carefully. Rough handling, knocks, or falls are liable to damage the cylinder, valve or safety devices and cause leakage.
- 5.3 Before connecting a regulator to a cylinder valve, the valve shall be opened slightly and closed immediately. The valve shall be opened while standing to one side of the outlet; never in front of it. Never crack a fuel-gas cylinder valve near other welding work or near sparks, flame or other possible sources of ignition.

- 5.4 Before a regulator is removed from a cylinder valve, the cylinder valve shall be closed and the gas released from the regulator.
- 5.5 Nothing shall be placed on top of an acetylene cylinder when in use which may damage the safety device or interfere with the quick closing of the valve.
- 5.6 If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed to the out-of-doors well away from any source of ignition; the cylinder valve should be opened slightly and the fuel-gas allowed to escape slowly.
- 5.7 A warning shall be placed near cylinders having leaking fuse plugs or other leaking safety devices not to approach them with a lighted cigarette or other source of ignition. Such cylinders shall be plainly tagged; the supplier shall be promptly notified and his instructions followed as to their return.
- 5.8 Safety devices shall not be tampered with.
- 5.9 Fuel-gas shall never be used from cylinders through torches or other devices equipped with shut-off valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.
- 5.10 The cylinder valve shall always be opened slowly.
- 5.11 An acetylene cylinder valve shall not be opened more than $1\frac{1}{2}$ turns of the spindle, and preferably no more than $\frac{3}{4}$ of a turn.
- 5.12 Where a special wrench is required it shall be left in position on the stem of the valve while the cylinder is in use so that the fuel-gas flow can be quickly turned off in case of emergency. In the case of manifold or coupled cylinders at least one such wrench shall always be available for immediate use.

3.3 MANIFOLDING OF CYLINDERS

3.1.1 Fuel-Gas Manifolds

1. Manifolds shall be approved either separately for each component part or as an assembled unit.

2. Except as provided in 3.3.1-3, fuel-gas cylinders connected to one manifold inside a building shall be limited to a total capacity not exceeding 300 pounds of liquefied petroleum gas or 3000 cubic feet of acetylene or acetylenic compounds or 600 cubic feet of hydrogen. More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least 50 feet apart or separated by a noncombustible barrier at least 5 ft. high having a fire-resistance rating of at least $\frac{1}{2}$ hour.
3. Fuel-gas cylinders connected to one manifold having an aggregate capacity exceeding 300 pounds of liquefied petroleum gas or 3000 cubic feet of acetylene or acetylenic compounds or 600 cubic feet of hydrogen shall be located outdoors, or in a separate building or room constructed in accordance with 3.6.6-1.8 and 3.6.6-1.9.
4. Separate manifold buildings or rooms may also be used for the storage of drums of calcium carbide and cylinders containing fuel gases as provided in 3.2.3. Such buildings or rooms shall have no open flames for heating or lighting and shall be well-ventilated.
5. High-pressure fuel-gas manifolds shall be provided with approved pressure regulating devices.

3.3.2 High Pressure Oxygen Manifolds (for Use With Cylinders Having an ICC Service Pressure Above 200 PSIG)

1. Manifolds shall be approved either separately for each component part or as an assembled unit.
2. Oxygen manifolds shall not be located in an acetylene generator room. Oxygen manifolds shall be separated from fuel-gas cylinders or combustible materials (especially oil or grease), a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least $\frac{1}{2}$ hour.
3. Except as provided in 3.3.2-4, oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 6000 cubic feet. More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least 50 feet apart or separated by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least $\frac{1}{2}$ hour.

4. An oxygen manifold, to which cylinders having an aggregate capacity of more than 6000 cubic feet of oxygen are connected, shall be located outdoors or in a separate noncombustible building. Such a manifold, if located inside a building having other occupancy, shall be located in a separate room of noncombustible construction having a fire-resistance rating of at least $\frac{1}{2}$ hour or in an area with no combustible material within 20 feet of the manifold.

NOTE: A building having other occupancy refers to a building other than that directly associated with the production of acetylene, the storage of calcium carbide or the storage and manifold of gases used in welding and cutting.

5. An oxygen manifold or oxygen bulk supply system which has storage capacity of more than 13,000 cubic feet of oxygen measured at 14.7 psia and 70°F. or 113 gallons of liquid equivalent connected in service or ready for service shall comply with Safety Regulation on oxygen systems.
6. High-pressure oxygen manifolds shall be provided with approved pressure-regulating devices.

3.3.3 Low-Pressure Oxygen Manifolds (for Use With Cylinders Having an ICC Service Pressure Not Exceeding 200 PSIG)

1. Manifolds shall be of substantial construction suitable for use with oxygen at a pressure of 250 psig. They shall have a minimum bursting pressure of 1000 psig and shall be protected by a safety relief device which will relieve at a maximum pressure of 500 psig.

NOTE: ICC-4L200 cylinders have safety devices which relieve at a maximum pressure of 250 psig (or 235 psig if vacuum insulation is used.)

2. Hose and hose connections subject to cylinder pressure shall comply with 3.5.5. Hose shall have a minimum bursting pressure of 1000 psig.
3. The assembled manifold including leads shall be tested and proven gas-tight at a pressure of 300 psig. The fluid used for testing oxygen manifolds shall be oil-free and not combustible.

4. The location of manifolds shall comply with 3.3.2.
5. The following sign shall be conspicuously posted at each manifold:

LOW-PRESSURE MANIFOLD
DO NOT CONNECT HIGH-PRESSURE CYLINDERS
MAXIMUM PRESSURE—250 PSIG

3.3.4 Portable Outlet Headers

1. The term portable outlet header shall mean any assembly of valves and connections used for service outlet purposes, which is connected to the permanent service piping system by means of hose or other nonrigid conductors.
2. Portable outlet headers shall not be used indoors except for temporary service where the conditions preclude a direct supply from outlets located on the service piping system.
3. Each outlet on the service piping from which oxygen or fuel-gas is withdrawn to supply a portable outlet header shall be equipped with a readily accessible shut-off valve.
4. Hose and hose connections used for connecting the portable outlet header to the service piping shall comply with 3.5.5.
5. Master shut-off valves for both oxygen and fuel-gas shall be provided at the entry end of the portable outlet header.
6. Portable outlet headers for fuel-gas service shall be provided with an approved hydraulic back-pressure valve installed at the inlet and preceding the service outlets, unless an approved pressure-reducing regulator, an approved back-flow check valve, or an approved hydraulic back-pressure valve is installed at each outlet. Outlets provided headers for oxygen service may be fitted for use with pressure-reducing regulators or for direct hose connection.
7. Each service outlet on portable outlet headers shall be provided with a valve assembly that includes a detachable outlet seal cap, chained or otherwise attached to the body of the valve.
8. Materials and fabrication procedures for portable outlet headers shall comply with 3.4.1, 3.4.2 and 3.4.5.

9. Portable outlet headers shall be provided with frames which will support the equipment securely in the correct operating position and protect them from damage during handling and operation.

3.3.5 Manifold Operating Procedures

1. Cylinder manifolds shall be installed under the supervision of someone familiar with the proper practices with reference to their construction and use.
2. All component parts used in the methods of manifolding described in 3.3.5-9 shall be approved as to materials, design and construction either separately or as an assembled unit.
3. All manifolds and parts used in methods of manifolding shall be used only for the gas or gases for which they are approved.
4. When acetylene cylinders are coupled, approved flash arresters shall be installed between each cylinder and the coupler block. For outdoor use only, and where the number of cylinders coupled does not exceed three, one flash arrester installed between the coupler block and regulator is acceptable.
5. Each fuel-gas cylinder lead shall be provided with a back-flow check valve.
6. The aggregate capacity of fuel-gas cylinders connected to a portable manifold inside a building shall not exceed 3000 cubic feet of gas.
7. Acetylene and liquefied fuel-gas cylinders shall be manifolded in a vertical position.
8. The pressure in the gas cylinders connected to and discharged simultaneously through a common manifold shall be approximately equal.
9. Manifolding Cylinders for Direct Supply to Consuming Devices
 - 9.1 The aggregate capacity of fuel-gas cylinders connected as a unit inside a building as described in Notes 2 and 3 shall not exceed 3000 cubic feet of gas or 300 lbs. in the case of liquefied petroleum gas.

NOTE 1: The units described in Notes 2 and 3 are generally called Portable Manifolds.

NOTE 2: In one type of manifolding the gas passes from the cylinders through individual cylinder leads to a single, common coupler block and from there through a single common pressure-reducing regulator to the consuming device.

NOTE 3: In a second type of manifolding the cylinders are connected together in sequence. The individual cylinders are provided with coupler tees attached to the cylinder valve. The gas content of each cylinder passes through the coupler tee and joins the main gas stream flowing through a common line composed of leads joining coupler tee to successive coupler tee. A properly supported regulator serves the entire group of connected cylinders.

3.4 SERVICE PIPING SYSTEMS

3.4.1 Materials and Design

1. General

- 1.1 Piping and fittings shall comply with Section 2, Industrial Gas and Air Piping Systems, of the Code for Pressure Piping, USAS B31.1-1955, insofar as it does not conflict with 3.4.2 and except as provided in 3.4.1-1.2 and 3.4.1-1.3.
- 1.2 Pipe shall be at least Schedule 40 and fittings shall be at least standard weight in sizes up to and including 6-inch nominal.
- 1.3 Copper tubing shall be Types K or L in accordance with the Standard Specification for Seamless Copper Water Tube, ASTM B88-1966a.
- 1.4 Piping shall be steel, wrought iron, brass or copper pipe, or seamless copper, brass or stainless steel tubing, except as provided in 3.4.1-2 and 3.4.1-3.

2. Oxygen Piping

- 2.1 Oxygen piping and fittings at pressure in excess of 700 psig, shall be stainless steel or copper alloys.

- 2.2 Hose connections and hose complying with 3.5.5 may be used to connect the outlet of a manifold pressure regulator to piping providing the working pressure of piping is 250 psig or less and the length of the hose does not exceed 5 feet. Hose shall have a minimum bursting pressure of 1000 psig.

- 2.3 When oxygen is supplied to a service piping system from a low-pressure oxygen manifold without an intervening pressure regulating device, the piping system shall have a minimum design pressure of 250 psig. A pressure regulating device shall be used at each station outlet when the connected equipment is for use at pressure less than 250 psig.

3. Piping for Acetylene and Acetylenic Compounds

- 3.1 Piping for acetylene or acetylenic compounds shall be steel or wrought iron.
- 3.2 Unalloyed copper shall not be used for acetylene or acetylenic compounds except in listed equipment.

3.4.2 Piping Joints

1. Joints in steel or wrought iron piping shall be welded, threaded or flanged. Fittings, such as ells, tees, couplings and unions, may be rolled, forged or cast steel, malleable iron or nodular iron. Gray or white cast iron fittings are prohibited.
2. Joints in brass or copper pipe shall be welded, brazed, threaded or flanged. If of the socket type, they shall be brazed with silver-brazing alloy or similar high melting point (not less than 800° F.) filler metal.
3. Joints in seamless copper, brass, or stainless steel tubing shall be approved gas tubing fittings or the joints shall be brazed. If of the socket type, they shall be brazed with silver-brazing alloy or similar high melting point (not less than 800° F.) filler metal.
4. Threaded connections in oxygen piping shall be tinned or made up with litharge and glycerine (litharge and water are sometimes used for service pressure over 300 psi.) or other joint compounds approved for oxygen service, applied to the externally threaded portion.

3.4.3 Installation

1. Distribution lines shall be installed and maintained in a safe operating condition.
2. Piping located inside or outside of buildings may be placed above or below ground. All piping shall be run as directly as practicable, protected against physical damage, proper allowance being made for expansion and contraction, jarring and vibration. Pipe laid underground in earth shall be located below the frost line and protected against corrosion. After assembly, piping shall be thoroughly blown out with air, nitrogen or carbon dioxide to remove foreign materials.
3. Only piping which has been welded or brazed shall be installed in tunnels, trenches or ducts. Shut-off valves shall be located outside such conduits. Oxygen piping may be placed in the same tunnel, trench or duct with fuel-gas pipe lines, provided there is good natural or forced ventilation.
4. Low points in piping carrying moist gas shall be drained into drip pots constructed so as to permit pumping or draining out the condensate at necessary intervals. Drain valves shall be installed for this purpose having outlets normally closed with screw caps or plugs. No open-end valves or pet-cocks shall be used, except that in drips located out-of-doors, underground, and not readily accessible, valves may be used as such points if they are equipped with means to secure them in the closed position. Pipes leading to the surface of the ground shall be cased or jacketed where necessary to prevent loosening or breaking.
5. Gas cocks or valves shall be provided for all buildings at points where they will be readily accessible for shutting off the gas supply to these buildings in any emergency. There shall also be provided a shut-off valve in the discharge line from the generator, gas holder, manifold or other source of supply.
6. Shut-off valves shall not be installed in safety relief lines in such a manner that the safety relief device can be rendered ineffective.
7. Fittings and lengths of pipe shall be examined internally BEFORE ASSEMBLY and, if necessary, freed from scale or dirt. Oxygen piping and fittings shall be washed out with a

suitable solution which will effectively remove grease and dirt but will not react with oxygen.

NOTE: Hot water solutions of caustic soda or trisodium phosphate are effective cleaning agents for this purpose.

8. Piping shall be thoroughly blown out after assembly to remove foreign materials. For oxygen piping, oil-free air, oil-free nitrogen or oil-free carbon dioxide shall be used. For other piping, air or inert gas may be used.
9. When flammable gas lines or other parts of equipment are being purged of air or gas, open lights or other sources of ignition shall not be permitted near uncapped openings.
10. The surface temperature of acetylene pipe lines shall not be allowed to exceed 130° F.
11. No welding or cutting shall be performed on an acetylene or oxygen pipe line, including the attachment of hangers or supports, until the line has been purged.

3.4.4 Painting and Signs

1. Underground pipe and tubing and outdoor ferrous pipe and tubing shall be covered or painted with suitable material for protection against corrosion.
2. Aboveground piping systems shall be marked in accordance with the Scheme for the Identification of Piping Systems, USAS A13.1-1956.
3. Station outlets shall be marked to indicate the name of the gas.
4. Signs clearly establishing the location and identity of section shut-off valves shall be provided.

3.4.5 Testing

1. Piping systems shall be tested and proved gas-tight at one-and-one-half times the maximum operating pressure, and shall be thoroughly purged of air before being placed in service. The material used for testing oxygen lines shall be oil-free and noncombustible. Flames shall not be used to detect leaks.

2. When flammable gas lines or other parts of equipment are being purged of air or gas, sources of ignition shall not be permitted near uncapped openings.

3.5 PROTECTIVE EQUIPMENT, HOSE, AND REGULATORS

3.5.1 General

1. Equipment shall be installed and used only in the service for which it is approved and as recommended by the manufacturer.

3.5.2 Pressure Relief for Service Piping Systems

1. Service piping systems shall be protected by pressure relief devices set to function at not more than the design pressure of the systems and discharging upward to a safe location.

3.5.3 Piping Protective Equipment

1. The fuel-gas and oxygen piping systems, including portable outlet headers, shall incorporate the protective equipment shown in Figures 1, 2, or 3. When only a portion of a fuel-gas system is to be used with oxygen, only that portion need comply with this section.
2. Approved protective equipment (designated P_p in Figures 1, 2 and 3) shall be installed in fuel-gas piping to prevent:
 - 2.1 Backflow of oxygen into the fuel-gas supply system;
 - 2.2 Passage of a flash back into the fuel-gas supply system; and
 - 2.3 Excessive back pressure of oxygen in the fuel-gas supply system.

NOTE: The three functions of the protective equipment may be combined in one device or may be provided by separate devices.

3. The protective equipment shall be located in the main supply line, as in Figure 1; or at the head of each branch line, as in Figure 2; or at each location where fuel-gas is withdrawn, as in Figure 3. Where branch lines are of 2-inch pipe size or larger or of substantial length, protective equipment (designated as P_p) shall be located as shown in either Figure 2 or 3.

4. Backflow protection shall be provided by an approved device that will prevent oxygen from flowing into the fuel-gas system or fuel from flowing into the oxygen system (See S_p in Figures 1 and 2).
5. Flash-back protection shall be provided by an approved device that will prevent flame from passing into the fuel-gas system.
6. Back-pressure protection shall be provided by an approved pressure relief device set at a pressure not greater than the pressure rating of the backflow or the flash-back protection device, whichever is lower. The pressure-relief device shall be located on the downstream side of the backflow and flash-back protection devices. The vent from the pressure-relief device shall be at least as large as the relief device inlet and shall be installed without low points that may collect moisture. If low points are unavoidable, drip pots with drains closed with screw plugs or caps shall be installed at the low points. The vent terminus shall not endanger personnel or property through gas discharge; shall be located away from ignition sources; and shall terminate in a hood or bend.
7. If pipeline protective equipment incorporates a liquid, the liquid level shall be maintained, and a suitable antifreeze may be used to prevent freezing.
8. Fuel-gas for use with equipment not requiring oxygen shall be withdrawn upstream of the piping protective devices.
9. Where a compressor or booster pump is used in a fuel-gas system requiring oxygen and where this fuel-gas is withdrawn from a source that also supplies a system not requiring oxygen, the latter system shall incorporate a check valve to prevent possible backflow.

5. Hose connections shall be clamped or otherwise securely fastened in a manner that will withstand, without leakage, twice the pressure to which they are normally subjected in service, but in no case less than a pressure of 300 psi. Oil-free air or an oil-free inert gas shall be used for the test.
6. Hose showing leaks, burns, worn places, or other defects rendering it unfit for service shall be replaced.

3.5.6 Pressure-Reducing Regulators

1. Pressure-reducing regulators shall be used only for the gas and pressure for which they are intended. The regulator inlet connections shall comply with Regulator Connection Standards, CGA-1958.
2. Regulators shall be drained of gas before they are attached to a cylinder or before the cylinder valve is open.
3. When regulators or parts of regulators, including gages, need repair, the work shall be performed by skilled mechanics who have been properly instructed.
4. Gages on oxygen regulators shall be marked "USE NO OIL."
NOTE: Oxygen under high pressure may react explosively with oil or grease. Therefore, precautions should be taken to prevent such contact.
5. Union nuts and connections on regulators shall be inspected before use to detect faulty seats which may cause leakage of gas when the regulators are attached to the cylinder valves. Damaged nuts or connections shall be destroyed.

3.6 ACETYLENE GENERATORS

3.6.1 Approval and Marking

1. Generators shall be of approved construction and shall be plainly marked with the maximum rate of acetylene in cubic feet per hour for which they are designed, the weight and size of carbide necessary for a single charge; the manufacturer's name and address; and the name or number of the type of generator.
2. Carbide shall be of the size marked on the generator nameplate.

3.6.2 Rating and Pressure Limitations

1. The total hourly output of a generator shall not exceed the rate for which it is approved and marked. Unless speci-

cally approved for higher ratings, carbide-feed generators shall be rated at 1 cubic foot per hour per pound of carbide required for a single complete charge.

2. Relief valves shall be regularly operated to insure proper functioning. Relief valves for generating chambers shall be set to open at a pressure not in excess of 15 psig. Relief valves for hydraulic back pressure valves shall be set to open at a pressure not in excess of 20 psig.
3. Nonautomatic generators shall not be used for generating acetylene at pressure exceeding 1 psig, and all water overflows shall be visible.

3.6.3 Location

1. Stationary generators shall be placed outside of buildings in generator houses constructed and located in compliance with the applicable sections of 3.6.6, or within buildings in accordance with the applicable sections of 3.6.6.
2. The space around the generator shall be ample for free, unobstructed operation and maintenance and shall permit ready adjustment and charging.

3.6.4 Stationary Acetylene Generators (Automatic and Nonautomatic)

1. Installation

- 1.1 The foundation shall be so arranged that the generator will be level and so that no excessive strain will be placed on the generator or its connections. Acetylene generators shall be grounded.
- 1.2 Generators shall be placed where water will not freeze. The use of common salt (sodium chloride) or other corrosive chemicals for protection against freezing is not permitted. (For heating systems see 3.6.6-3.)
- 1.3 Except when generators are prepared in accordance with 3.6.7-6, sources of ignition shall be prohibited in outside generator houses or inside generator rooms.
- 1.4 Water shall not be supplied through a continuous connection to the generator except when the generator is provided with an adequate open overflow or automatic water shut-off which will effectively prevent overfilling of the generator. Where a noncontinuous connection is used, the supply line shall terminate at a point not less than 2 inches above the

regularly provided opening for filling so that the water can be observed as it enters the generator.

- 1.5 Unless otherwise specifically approved, generators shall not be fitted with continuous drain connections leading to sewers, but shall discharge through an open connection into a suitably vented outdoor receptacle or residue pit which may have such connections.

NOTE: An open connection for the sludge draw-off is desirable to enable the generator operator to observe leakage of generating water from the drain valve or sludge cock.

2. Vent Pipes

- 2.1 Each generator shall be provided with a vent pipe of schedule 40 galvanized iron or steel, except that outside of buildings, vent pipes larger than 4 inches in diameter may be not less than 14 gage galvanized tubing or sheet steel.
- 2.2 The escape or relief pipe shall be rigidly installed without traps and so that any condensation will drain back to the generator.
- 2.3 The escape or relief pipe shall be carried full size to a suitable point outside the building. It shall terminate in a hood or bend located at least 12 feet above the ground preferably above the roof, and as far away as practicable from windows or other openings into buildings and as far away as practicable from sources of ignition such as flues or chimneys and tracks used by locomotives. Generating chamber relief pipes shall not be interconnected but shall be separately led to the outside air. The hood or bend shall be so constructed that it will not be obstructed by rain, snow, ice, insects or birds. The outlet shall be at least 3 feet from combustible construction.

3. Gas Holders

- 3.1 Gas holders shall be constructed on the gasometer principle, the bell being suitably guided. The gas bell shall move freely without tendency to bind and shall have a clearance of at least 2 inches from the shell.
- 3.2 The gas holder may be located in the generator room, in a separate room or out-of-doors. In order to prevent collapse of the gas bell or infiltration of air due to a vacuum

caused by the compressor or booster pump or cooling of the gas, a compressor or booster cut-off shall be provided at a point 12 inches or more above the landing point of the bell. When the gas holder is located indoors, the room shall be ventilated in accordance with 3.6.6-2 and heated and lighted in accordance with 3.6.6-3 through 3.6.6-4.

- 3.3 When the gas holder is not located within a heated building, gas holder seals shall be protected against freezing.
- 3.4 Means shall be provided to stop the generator-feeding mechanism before the gas holder reaches the upper limit of its travel.
- 3.5 When the gas holder is connected to only one generator, the gas capacity of the holder shall be not less than one-third of the hourly rating of the generator.
- 3.6 If acetylene is used from the gas holder without increase in pressure at some points but with increase in pressure by a compressor or booster pump at other points, approved piping protective devices shall be installed in each supply line. The low-pressure protective device shall be located between the gas holder and the shop piping, and the medium-pressure protective device shall be located between the compressor or booster pump and the shop piping. (See Figure 4.)

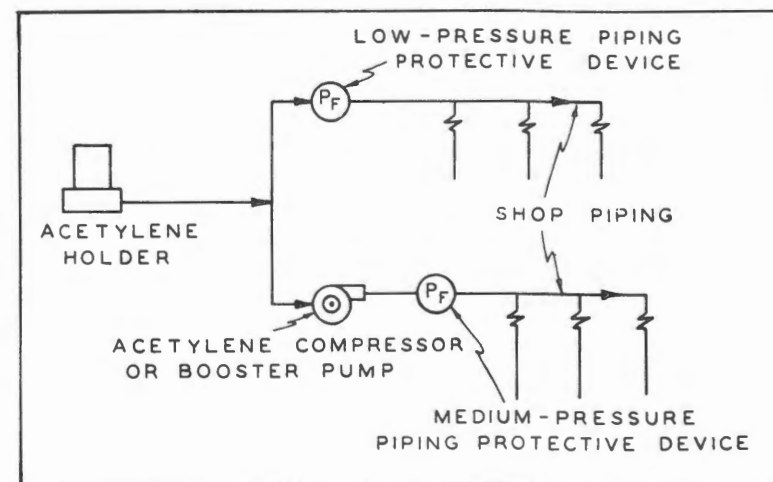


Figure 4—Protective Devices for Gas Holders, Compressors and Booster Pumps.

NOTE: Approved protective equipment (designated P_p) is used to prevent:

- (1) Backflow of oxygen into the fuel-gas supply system.
- (2) Passage of flash back into the fuel-gas supply system; and
- (3) Excessive back pressure of oxygen in the fuel-gas supply system.

The three functions of the protective equipment may be combined in one device or may be provided by separate devices.

4. Compressor or Booster Pumps

- 4.1 The compressor or booster system shall be of an approved type.
- 4.2 Wiring and electrical equipment in compressor or booster pump rooms or enclosures shall conform to the provisions of the National Electrical Code, USAS C1-1965, Article 501, for Class I, Division 2 locations.
- 4.3 Compressors and booster pump equipment shall be located in well-ventilated areas away from open flames, electrical or mechanical sparks, or other ignition sources.
- 4.4 Compressor or booster pumps shall be provided with pressure relief valves which will relieve pressure exceeding 15 psig to a safe outdoor location as provided in 3.6.4-2, or by returning the gas to the inlet side or to the gas supply source.
- 4.5 The booster pump should be water-cooled with visible water supply or arranged with an interlocking device to shut down the booster pump in case of failure of the cooling-water supply.
- 4.6 Compressor or booster pump discharge outlets shall be provided with approved protective equipment. (See 3.5.)

3.6.5 Portable Acetylene Generators

1. General

- 1.1 All portable generators shall be of an approved type.
- 1.2 Portable generators shall not be used within 10 feet of combustible material other than the floor.

- 1.3 Portable generators shall not be used in rooms of total volume less than 35 times the total gas-generating capacity per charge of all generators in the room. Generators shall not be used in rooms having a ceiling height of less than 10 feet.

NOTE: To obtain the gas-generating capacity in cubic feet per charge, multiply the pounds of carbide per charge by 4.5.

- 1.4 Portable generators shall be protected against freezing. The use of salt or other corrosive chemical to prevent freezing is prohibited.

2. Operation and Maintenance

- 2.1 Portable generators shall be cleaned and recharged and the air mixture blown off outside buildings.
- 2.2 When charged with carbide, portable generators shall not be moved by crane or derrick.
- 2.3 When not in use, portable generators shall not be stored in rooms in which open flames are used unless the generators contain no carbide and have been thoroughly purged of acetylene. Storage rooms shall be well-ventilated.
- 2.4 When portable acetylene generators are to be transported and operated on vehicles, they shall be securely anchored to the vehicles. If transported by truck, the motor shall be turned off during charging, cleaning and generating periods.
- 2.5 Portable generators shall be located at a safe distance from the welding position so that they will not be exposed to sparks, slag, or misdirection of the torch flame or overheating from hot materials or processes.

3.6.6 Outside Generator Houses and Inside Generator Rooms for Stationary Acetylene Generators

1. Construction

- 1.1 No opening in any outside generator house shall be located within five feet of any opening in another building.
- 1.2 Walls, floors, and roofs of outside generator houses shall be of noncombustible construction.

- 1.3 When a part of the generator house is to be used for the storage or manifolding of oxygen cylinders, the space to be so occupied shall be separated from the generator or carbide storage section by partition walls continuous from floor to roof or ceiling, of the type of construction stated in 3.6.6-1.8. Such separation walls shall be without openings and shall be joined to the floor, other walls and ceiling or roof in a manner to effect a permanent gas-tight joint.
- 1.4 Exit doors shall be located so as to be readily accessible in case of emergency.
- 1.5 Explosion venting for outside generator houses and inside generator rooms shall be provided in exterior walls or roofs. The venting area shall be equal to not less than one square foot per 50 cubic feet or room volume and may consist of any one or any combination of the following: walls of light, noncombustible material preferably single thickness, single-strength glass; lightly fastened hatch covers; lightly fastened swinging doors in exterior walls opening outward; lightly fastened walls or roof designed to relieve at a maximum pressure of 25 pounds per square foot.
- 1.6 The installation of acetylene generators within buildings shall be restricted to buildings not exceeding one story in height.
- 1.7 Generators installed inside buildings shall be enclosed in a separate room of ample size.
- 1.8 The walls, partitions, floors, and ceilings of inside generator rooms shall be of noncombustible construction having a fire-resistance rating of at least one hour. The walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall of the room shall be an exterior wall.
- 1.9 Openings from an inside generator room to other parts of the building shall be protected by a swinging type self-closing fire door for a Class B opening and having a rating of at least one hour. Windows in partitions shall be wired glass and approved metal frames with fixed sash. Installation shall be in accordance with the Standard for the Installation of Fire Doors and Windows, NFPA No. 80-1967.

2. Ventilation

- 2.1 Inside generator rooms or outside generator houses shall be ventilated at a rate of not less than 12 air changes per hour.

3. Heating

- 3.1 Heating shall be by steam, hot water, enclosed electrically heated elements or other indirect means. Heating by flames or fires shall be prohibited in outside generator houses or inside generator rooms, or in any enclosure communicating with them.

4. Lighting

- 4.1 All electrical wiring and equipment, when used, for artificial lighting shall be installed in accordance with Article 501 of the National Electrical Code, USAS C1-1965 for Class I Division 2 locations.
- 4.2 Lamps installed outside of wired-glass panels set in gas-tight frames in the exterior walls or roof of the generator house or room are acceptable.

5. Electrical Equipment

- 5.1 Electric switches, telephones and all other electrical apparatus which may cause a spark, unless specifically approved for use inside acetylene generator rooms, shall be located outside the generator house or in a room or space separated from the generator room by a gas-tight partition, except that where the generator system is designed so that no carbide fill opening or other part of the generator is open to the generator house or room during the operation of the generator, and so that residue is carried in closed piping from the residue discharge valve to a point outside the generator house or room, electrical equipment in the generator house or room shall conform to the provisions of the National Electrical Code, USAS C1-1965, Article 501, for Class I, Division 2 locations.

3.6.7 Maintenance and Operation

1. Unauthorized persons shall not be permitted in outside generator houses or inside generator rooms.

2. Operating instructions shall be posted in a conspicuous place near the generator or kept in a suitable place available for ready reference.
3. When recharging generators, the order of operations specified in the instructions supplied by the manufacturer shall be followed.
4. In the case of batch-type generators, when the charge of carbide is exhausted and before additional carbide is added, the generating chamber shall always be flushed out with water, renewing the water supply in accordance with the instruction card furnished by the manufacturer.
5. The water-carbide residue mixture drained from the generator shall not be discharged into sewer pipes or stored in areas near open flames. Clear water from residue settling pits may be discharged into sewer pipes.
6. The carbide added each time the generator is recharged shall be sufficient to refill the space provided for carbide without ramming the charge. Steel or other ferrous tools shall not be used in distributing the charge.
7. Generator water chambers shall be kept filled to proper level at all times except while draining during the recharging operation.
8. Whenever repairs are to be made or the generator is to be charged or carbide is to be removed, the water chamber shall be filled to the proper level.
9. Previous to making repairs involving welding, soldering or other hot work or other operations which produce a source of ignition, the carbide charge and feed mechanism shall be completely removed. All acetylene shall be expelled by completely flooding the generator shell with water and the generator shall be disconnected from the piping system. The generator shall be kept filled with water, if possible, or positioned to hold as much water as possible.
10. Hot repairs shall not be made in a room where there are other generators unless all the generators and piping have been purged of acetylene.

3.7 CALCIUM CARBIDE STORAGE

3.7.1 Packaging

1. Calcium carbide shall be contained in metal packages of sufficient strength to prevent rupture. The packages shall be

provided with a screw top or equivalent. These packages shall be constructed water- and air-tight. Solder shall not be used in such a manner that the package would fail if exposed to fire.

2. Packages containing calcium carbide shall be conspicuously marked "Calcium Carbide—Dangerous If Not Kept Dry" or with equivalent warning.
3. A conspicuous sign shall be posted on all calcium carbide storage rooms or buildings reading "DANGER—NO SMOKING, MATCHES OR OPEN LIGHTS. IN CASE OF FIRE DO NOT USE WATER." or other equivalent wording. See Specifications for Industrial Accident Prevention Signs, USAS Z35.1-1959.
4. Sprinkler systems shall not be installed in carbide storage rooms.

3.7.2 Storage Indoors

1. Storage—Under 600 lbs.

- 1.1 Calcium carbide in quantities not to exceed 600 pounds may be stored indoors in dry, waterproof and well-ventilated locations.
- 1.2 Calcium carbide not exceeding 600 pounds may be stored indoors in the same room with fuel-gas cylinders.
- 1.3 Packages of calcium carbide, except for one of each size, shall be kept sealed. The seals shall not be broken when there is carbide in excess of one pound in any other unsealed package of the same size of carbide in the room.

2. Storage—600 lbs. to 5000 lbs. Calcium carbide exceeding 600 pounds but not exceeding 5000 pounds shall be stored:

- 2.1 In accordance with 3.7.2-3; or
- 2.2 In an inside generator room or outside generator house; or
- 2.3 In a separate room in a one-story building which may contain other occupancies, but without cellar or basement beneath the carbide storage section. Such rooms shall be constructed in accordance with 3.6.6-1.8 and 1.9 and ventilated in accordance with 3.6.6-2. These rooms shall be used for no other purpose.

3. Storage—Over 5000 lbs.

- 3.1 Calcium carbide in excess of 5000 pounds shall be stored in one story buildings without cellar or basement and used for no other purpose, or in outside generator houses. The location of such storage buildings shall be away from congested mercantile and manufacturing districts. If the storage building is of noncombustible construction, it may adjoin other one-story buildings if separated therefrom by unpierced fire walls; if it is detached less than 10 feet from such building or buildings, there shall be no opening in any of the mutually exposing sides of such buildings within 10 feet. If the storage building is of combustible construction, it shall be at least 20 feet from any other one- or two-story buildings, and at least 30 feet from any other building exceeding two stories.

3.7.3 Storage Outdoors

1. Calcium carbide in unopened metal containers may be stored outdoors.
2. Carbide containers to be stored outdoors shall be examined to make sure that they are in good condition. Periodic re-examinations shall be made for rusting or other damage to a container that might affect its water or air tightness.
3. Containers shall be stored horizontally in single or double rows. Ample space shall be provided between rows or pairs of rows to facilitate periodic re-examination and the removal of containers found defective. The bottom tier of each row shall be placed on wooden planking or equivalent, so that the containers will not come in contact with the ground or ground water.
4. Storage areas shall be at least 10 feet from lines of adjoining property that may be built upon.
5. Containers of carbide which have been in storage the longest shall be used first.

3.8 PUBLIC EXHIBITIONS AND DEMONSTRATIONS

- 3.8.1 These requirements shall be used to promote the safe usage of oxygen-fuel-gas systems in welding and cutting operations at public exhibitions, demonstrations, displays, and trade shows referred to hereinafter as the "site."

- 3.8.2 Installation and operation of welding, cutting and related equipment shall be done by, or under the supervision of, a competent operator to insure the personal protection of viewers and demonstrators as well as the protection from fire, of material in and around the site and the building itself.
- 3.8.3 Cylinders containing compressed gases for use at the site shall not be charged in excess of one-half their maximum permissible content. (Cylinders of nonliquefied gases and acetylene shall be charged to not more than one-half their maximum permissible charged pressure in psig. Cylinders of liquefied gases shall be charged to not more than one-half the maximum permissible capacity in pounds.)
- 3.8.4 Cylinders located at the site shall be connected for use. Additional cylinders shall be stored outside or in approved storage area.
- 3.8.5 Cylinders in excess of 40 pounds total weight being transported to or from the site shall be carried on a hand or motorized truck.
- 3.8.6 The site shall be constructed, equipped and operated in such a manner that the demonstration will be carried out so as to minimize the possibility of injury to viewers.
- 3.8.7 Sites involving the use of compressed gases shall be located so as not to interfere with the egress of people during an emergency.
- 3.8.8 The Fire Department shall be notified in advance of such use of the site.
- 3.8.9 Each site shall be provided with a portable fire extinguisher of appropriate size and type and with a pail of water.
- 3.8.10 The public and combustible materials at the site shall be protected from flames, sparks, and molten metal.
- 3.8.11 Hoses shall be located and protected so that they will not be physically damaged.
- 3.8.12 Cylinder valves shall be closed when equipment is unattended.
- 3.8.13 Valves on cylinders complying with 3.2.1-4 shall be protected in storage, in transit or in use by a valve protection cap or by other approved method.
- 3.8.14 Cylinders shall be located or secured so that they cannot be knocked over.

SECTION 4

APPLICATION, INSTALLATION AND OPERATION OF ARC WELDING AND CUTTING EQUIPMENT

4.1 GENERAL

- 4.1.1 Welding equipment shall be chosen for safe application to the work to be done as specified in 4.2.
- 4.1.2 Welding equipment shall be installed safely as specified by 4.3.
- 4.1.3 Workmen designated to operate arc welding equipment shall have been properly instructed and qualified to operate such equipment as specified in 4.4.

4.2 APPLICATION OF ARC WELDING EQUIPMENT

4.2.1 General

1. Arc welding equipment shall comply with the Requirements for Electric Arc-Welding Apparatus, USA Standard C87.1-1963, or the Safety Standard for Transformer-Type Arc-Welding Machines, USA Standard C33.2-1956. Special purpose machines not covered by these standards shall conform in all applicable respects to these standards.

4.2.2 Environmental Conditions

1. Standard machines for arc welding service shall be designed and constructed to carry their rated load with rated temperature rises where the temperature of the cooling air does not exceed 40° C. (104° F.) and where the altitude does not exceed 3300 feet, and shall be suitable for operation in atmospheres containing gases, dust and light rays produced by the welding arc.
2. Unusual service conditions may exist, and in such circumstances machines shall be especially designed to safely meet the requirements of the service. Chief among these conditions are:
 - 2.1. Exposure to unusually corrosive fumes.
 - 2.2. Exposure to steam or excessive humidity.
 - 2.3. Exposure to excessive oil vapor.
 - 2.4. Exposure to flammable gases.
 - 2.5. Exposure to abnormal vibration or shock.
 - 2.6. Exposure to excessive dust.
 - 2.7. Exposure to weather.
 - 2.8. Exposure to unusual seacoast or shipboard conditions.

4.2.3 Voltage

1. Open circuit (No load) voltages of arc welding and cutting machines shall be as low as possible consistent with satisfactory welding or cutting being done.
2. The following limits shall not be exceeded for alternating current machines.
 - 2.1. Manual arc welding and cutting—80 volts.
 - 2.2. Automatic (machine or mechanized) arc welding and cutting 100 volts.
3. The following limits shall not be exceeded for direct-current machines.
 - 3.1. Manual arc welding and cutting—100 volts.
 - 3.2. Automatic (machine or mechanized) arc welding and cutting—100 volts.
4. When special welding and cutting processes require values of open circuit voltages higher than the above, means shall be provided to prevent the operator from making accidental contact with the high voltage by adequate insulation or other means.
5. For AC welding under wet conditions or warm surroundings where perspiration is a factor, the use of reliable automatic controls for reducing no load voltage shall be used to reduce the shock hazard.

4.2.4 Design

1. A controller integrally mounted in an electric motor driven welder shall have capacity for carrying rated motor current, shall be capable of making and interrupting stalled rotor current of the motor, and may serve as the running over-

current device if provided with the number of overcurrent units as specified by Table 430-146 of the National Electrical Code, USAS C1-1965.

NOTE: Starters with magnetic undervoltage release should be used with machines installed more than one to a circuit to prevent circuit overload caused by simultaneous starting of several motors upon return of voltage.

2. On all types of arc welding machines, control apparatus shall be enclosed except for the operating wheels, levers or handles. Control handles and wheels shall be large enough to be easily grasped by a gloved hand.
3. Input power terminals, tap change devices and live metal parts connected to input circuits shall be completely enclosed and accessible only by means of tools.
4. Terminals for welding leads shall be protected from accidental electrical contact by personnel or by metal objects i.e. vehicles, crane hooks, etc. Protection may be obtained by the use of: dead-front receptacles for plug connections; recessed openings with nonremovable hinged covers; heavy insulating sleeving or taping or other equivalent electrical and mechanical protection. If a welding lead terminal which is intended to be used exclusively for connection to the work is connected to the grounded enclosure, it shall be done by a conductor at least two AWG sizes smaller than the grounding conductor and the terminal shall be marked to indicate that it is grounded.
5. No connections for portable control devices such as push buttons to be carried by the operator shall be connected to an AC circuit of higher than 120 volts. Exposed metal parts of portable control devices operating on circuits above 50 volts shall be grounded by a grounding conductor in the control cable.
6. Auto transformers or AC reactors shall not be used to draw welding current directly from any AC power source having a voltage exceeding 80 volts.

4.2.5 Equipment Loading

1. Care shall be taken in applying arc welding equipment to insure that the current rating chosen is adequate to handle the job. Welding machines shall not be operated above their

current ratings and corresponding rated duty cycles listed in the standards or above the limits specified by the manufacturer. Consideration shall be given to the fact that actual welding currents may be higher than shown by indicators on the machine if welding is done with short leads or low arc voltages; particularly high over-currents are likely on general-purpose welding machines when using low arc voltage processes such as air carbon-arc cutting, oxygen-arc cutting or gas tungsten-arc welding.

2. Welding cables shall be of the extra flexible type designed especially for the rigors of welding service and of size adequate for current and duty cycles reasonably to be expected. Special attention shall be paid to insulation of cables used with equipment which includes high voltage high frequency oscillators. For average manual shielded metal-arc welding duty cycles, Table 4.2.5-2 may be used as a guide for current capacity; for automatic or semi-automatic installations where duty cycles approach 100%, cables should be in accordance with Chapter 3, Tables 310-13 and 310-15, of the National Electrical Code, USAS C1-1965. These ratings shall be for operation with cables exposed to air singly and not bundled, enclosed in conduit or coiled.

Table 4.2.5-2—Cable Sizes for Arc Welding Machines Based on Safe Operating Temperatures

Welding Current Amperes	CABLE SIZE No.	CABLE SIZE No.
	Copper	Aluminum
100	4	4
150	3	2
200	2	0
300	1/0	3/0
400	2/0	4/0
500	2/0	----
600	3/0	----

4.3 INSTALLATION OF ARC WELDING EQUIPMENT

4.3.1 General

1. Installation including power supply shall be in accordance with the requirements of the National Electrical Code, USAS C1-1965.

will not be in use at the same time. The load value used for each welding machine shall take into account both the magnitude and the duration of the load while the machine is in use. Conductor ratings, based on 100 percent of the rated primary current of the two largest welding machines, 85 percent for the third largest welding machine, 70 percent for the fourth largest welding machine, and 60 percent of the rated primary current for all the remaining welding machines, may provide an ample margin of safety under high production conditions with respect to the maximum permissible temperature of the conductors. Percentage values lower than those given are permissible in cases where the work is such that a high operating duty cycle for individual machines is impossible; conversely, for groups of simultaneously operating automatic welding machines higher percentage values may be required.

4. In operations involving several welders on one structure, DC welding process requirements may require the use of both polarities; or supply circuit limitations for AC welding may require distribution of machines among the phases of the supply circuit. In such cases no load voltages between electrode holders will be 2 times normal in DC or 1, 1.41, 1.73 or 2 times normal on AC machines. Similar voltage differences will exist if both AC and DC welding are done on the same structure. Care should, therefore, be taken to eliminate the probability of welders touching two electrode holders simultaneously. If this cannot be done machines shall be connected as follows:

- 4.1. All DC machines shall be connected with the same polarity.
- 4.2. All AC machines shall be connected to the same phase of the supply circuit and with the same instantaneous polarity.

NOTE: In either case a 120 volt incandescent lamp may be used to test; if connections are correct the lamp will not glow when connected between the electrode holders of machines at no load.

4.4 OPERATION AND MAINTENANCE

- 4.4.1 Workmen assigned to operate or maintain arc welding equipment shall be acquainted with Sections 4, 6, 7 and 8. If doing gas-shielded arc welding, workmen shall be acquainted with the

Recommended Safe Practices for Gas-Shielded Arc Welding, AWS A6.1-1966.

- 4.4.2 Before starting operations all connections to the machine shall be checked to make certain they are properly made. The work lead shall be firmly attached to the work; magnetic work clamps shall be freed from adherent metal particles of spatter on contact surfaces. Coiled welding cable shall be spread out before use to avoid serious overheating and damage to insulation. Jobs requiring alternatively long and short cables shall be equipped with insulated connectors so that idle long lengths can be disconnected when not needed.
- 4.4.3 Grounding of the welding machine frame shall be checked. Special attention shall be given to safety ground connections of portable machines.
- 4.4.4 There shall be no leaks of cooling water, shielding gas or engine fuel.
- 4.4.5 It shall be determined that proper switching equipment for shutting down the machine is provided.
- 4.4.6 Printed rules and instructions covering operation of equipment supplied by the manufacturers shall be strictly followed.
- 4.4.7 When the welder has occasion to leave his work to stop work for any appreciable time, or when the machine is to be moved, the power supply switch in the equipment shall be open. The equipment shall be disconnected from the source of power when not in use.
- 4.4.8 When welding machines are not attended, electrodes and holders shall comply with the following:
1. Carbon and metal electrodes shall be removed from holders to eliminate danger of electrical contact with persons or conducting objects.
 2. Tungsten electrodes shall be removed or retracted within holders.
 3. Electrodes in wire form in semi-automatic holders shall be retracted or cut off to remove possibility of contact.
 4. Electrode holders shall be placed so that they cannot make electrical contact with persons, conducting objects, fuel or compressed gas tanks.

4.4.9 Electric Shock

1. Avoidance of electric shock is largely within the control of the welder; therefore, it is especially important that he shall be thoroughly instructed in detail how to avoid shock.

NOTE 1. Because most contacts required for welding voltages have not caused severe injury or electric shock, parts having these voltages are liable to be handled carelessly. These voltages are nevertheless sufficiently high that, under some circumstances, they may be dangerous to life. Even mild shocks, not dangerous in themselves from normal working voltages or from high frequency stabilizers, can cause involuntary muscular contraction, leading to injurious falls from high places. Severity of shock is determined largely by the path and amount of current flowing through the body and this is determined by voltage and contact resistance of the area of skin involved. Clothing damp from perspiration or wet working conditions may so reduce contact resistance as to increase an imperceptible current to a value high enough to cause such violent muscular contraction as to prevent the welder from letting go of the live part.

NOTE 2. The welder should never permit the live metal parts of an electrode holder to touch his bare skin or any wet covering of his body. He should also protect himself from electrical contact with the work or ground by dry insulating material particularly, he should be protected against large area contacts by insulation when working in a sitting or prone position. Adequately dry gloves are also recommended. He should not use electrode holders for manual shielded metal-arc-welding without well insulated jaws in good repair.

2. Electrode holders shall not be cooled by immersion in water. Water-cooled holders for gas tungsten-arc and gas metal-arc welding shall not be used if any water leak exists. The welding machine supplying power to the arc shall always be turned off whenever changing electrodes in gas tungsten-arc electrode holders, or whenever threading coiled electrodes into gas metal-arc equipment. Special precautions shall be taken to prevent shock-induced falls when the welder is working above ground level. The welder shall not coil or loop welding electrode cable around parts of his body. Cables with splices within 10 feet of the holder shall not be used.

4.4.10 Maintenance

1. All arc welding equipment shall be maintained in safe working order at all times. The operator shall report any equipment defect or safety hazard to his supervisor and the use of the equipment shall be discontinued until its safety has been assured. Repairs shall be made only by qualified personnel.
2. Welding equipment shall be maintained in good mechanical and electrical condition to avoid unnecessary hazards. Commutators shall be kept clean to prevent excessive flashing. Flammable liquids shall not be used for cleaning commutators. Rectifiers shall be frequently inspected to detect accumulations of dust or lint that would interfere with ventilation. Electrical coil ventilating ducts shall be similarly inspected and cleaned. Fuel systems on engine driven machines shall be inspected and checked for possible leaks and accumulations of water that might cause rusting. Rotating and moving components shall be kept properly lubricated.
3. Welding equipment used in the open shall be protected from inclement weather conditions. Protective cover shall not obstruct the ventilation necessary to prevent overheating of the machine.
4. Welding equipment not designed with adequate weather protection shall be stored in a clean dry place when not in use. Such machines which have become wet shall be thoroughly dried and tested before being used.
5. Work and electrode lead cables shall be frequently inspected for wear and damage. Cables with damaged insulation or exposed bare conductors shall be replaced. Joining lengths of work and electrode cables shall be done by the use of connecting means specifically intended for the purpose. The connecting means shall have insulation adequate for the service conditions.
6. To insure against overheating, periodic checks shall be made with ammeters to make sure that load current has not increased beyond the capacity of the welding machine, cable or torch.

SECTION 5

INSTALLATION AND OPERATION OF RESISTANCE WELDING EQUIPMENT

5.1 GENERAL

- 5.1.1 All equipment shall be installed by a qualified electrician in conformance with the National Electrical Code, USAS C1-1965. There shall be a safety-type disconnecting switch or a circuit breaker or circuit interrupter to open each power circuit to the machine, conveniently located at or near the machine, so that the power can be shut off when the machine or its controls are to be serviced.
- 5.1.2 Ignitron tubes used in resistance welding equipment shall be equipped with a thermal protection switch.
- 5.1.3 Welding transformers, cables, and all heat generating components of a resistance welding system that are designed to be water cooled, shall be equipped with a flow switch or other controlling or indicating device, capable of preventing the operation of the equipment under conditions of inadequate water flow.
- 5.1.4 Workmen designated to operate resistance welding equipment shall have been properly instructed and judged competent to operate such equipment.
- 5.1.5 Controls of all automatic or air and hydraulic clamps shall be arranged or guarded to prevent the operation from accidentally activating them.

5.2 SPOT AND SEAM WELDING MACHINES (NONPORTABLE)

- 5.2.1 All external weld initiating control circuits shall operate on low voltage, not over 120 volts, for the safety of the operators.
- 5.2.2 Stored energy or capacitor discharge type of resistance welding equipment and control panels involving high voltage (over 550 volts) shall be suitably insulated and protected by complete enclosures, all doors of which shall be provided with suitable interlocks and contacts wired into the control circuit (similar

to elevator interlocks). Such interlocks or contacts shall be so designed as to effectively interrupt power and short circuit all capacitors when the door or panel is open. A manually operated switch or suitable positive device shall be installed, in addition to the mechanical interlock or contacts, as an added safety measure assuring absolute discharge of all capacitors.

- 5.2.3 All doors and access panels of all resistance welding machines and control panels shall be kept locked and interlocked to prevent access, by unauthorized persons, to live portions of the equipment.
- 5.2.4 All press welding machine operations, where there is a possibility of the operator's fingers being under the point of operation, shall be effectively guarded by the use of a device such as an electronic eye safety circuit, two hand controls or protection similar to that prescribed for punch press operation. See Safety Regulation on mechanical presses. All chains, gears, operating bus linkage, and belts shall be protected by adequate guards, in accordance with the Safety Regulation on machine guarding.
- 5.2.5 The hazard of flying sparks shall be, wherever practical, eliminated by installing a shield guard of safety glass or suitable fire resistant plastic at the point of operation. Additional shields or curtains shall be installed as necessary to protect passing persons from flying sparks. (See 7.2.1-3.)
- 5.2.6 All foot switches shall be guarded to prevent accidental operation of the machine.
- 5.2.7 Two or more safety emergency stop buttons shall be provided on all special multi-spot welding machines, including 2-post and 4-post weld presses.
- 5.2.8 On large machines, four safety pins with plugs and receptacles (one in each corner), shall be provided so that when safety pins are removed and inserted in the ram or platen, the press becomes inoperative.
- 5.2.9 Where technically practical, the secondary of all welding transformers used in multi-spot, projection and seam welding machines shall be grounded. This may be done by permanently grounding one side of the welding secondary current circuit. When not technically practical, a center tapped grounding reactor connected across the secondary or the use of a safety disconnect switch in conjunction with the welding control are acceptable alternates. Safety disconnect shall be arranged to open both sides of the line when welding current is not present.

5.3 PORTABLE WELDING MACHINES

- 5.3.1 All portable welding guns shall have suitable counterbalanced devices for supporting the guns, including cables, unless the design of the gun or fixture makes counterbalancing impractical or unnecessary.
- 5.3.2 All portable welding guns, transformers and related equipment that is suspended from overhead structures, eye beams, trolleys, etc. shall be equipped with safety chains or cables. Safety chains or cables shall be capable of supporting the total shock load in the event of failure of any component of the supporting system.
- 5.3.3 When trolleys are used to support portable welding equipment, transformers, etc. they shall be equipped with suitable forged steel clevises for the attachment of safety chains. Each clevice shall be capable of supporting the total shock load of the suspended equipment in the event of trolley failure.
- 5.3.4 All initiating switches, including retraction and dual schedule switches, located on the portable welding gun shall be equipped with suitable guards capable of preventing accidental initiation through contact with fixturing, operator's clothing, etc. Initiating switch voltage shall not exceed 24 volts.
- 5.3.5 The movable holder, where it enters the gun frame, shall have sufficient clearance to prevent the shearing of fingers carelessly placed on the operating movable holder.
- 5.3.6 The secondary and case of all portable welding transformers shall be grounded. Secondary grounding may be by center tapped secondary or by a center tapped grounding reactor connected across the secondary.

5.4 FLASH WELDING EQUIPMENT

- 5.4.1 Flash welding machines shall be equipped with a hood to control flying flash. In cases of high production, where materials may contain a film of oil and where toxic elements and metal fumes are given off, ventilation shall be provided in accordance with Section 8.
- 5.4.2 For the protection of the operators of nearby equipment, fire resistant curtains or suitable shields shall be set up around the machine and in such a manner that the operators movements are not hampered.

5.5 HAZARDS AND PRECAUTIONS

- 5.5.1 A job hazard analysis shall be made, by a qualified person, of the operations to be performed on each welding machine to determine the safeguards and personal protective equipment that shall be used for each job.

5.6 MAINTENANCE

- 5.6.1 Periodic inspection shall be made by qualified maintenance personnel, and records of the same maintained. The operator shall be instructed to report any equipment defects to his supervisor and the use of the equipment shall be discontinued until safety repairs have been completed.

SECTION 6

FIRE PREVENTION AND PROTECTION

6.1 BASIC PRECAUTIONS

- 6.1.1 Where practicable, the object to be welded or cut shall be moved to a designated safe location.
- 6.1.2 If the object to be welded or cut cannot readily be moved, all movable fire hazards in the vicinity shall be taken to a safe place.
- 6.1.3 If the object to be welded or cut cannot be moved and if all the fire hazards cannot be removed, then guards shall be used to confine the heat, sparks and slag, and to protect the immovable fire hazards.
- 6.1.4 If the rules stated in 6.1.1, 6.1.2 and 6.1.3 above cannot be followed, then welding and cutting shall not be performed.

6.2 SPECIAL PRECAUTIONS

- 6.2.1 When the nature of the work to be performed falls within the scope of 6.1.3, additional precautions in accordance with 6.2.2 through 6.2.8 shall be followed.
- 6.2.2 After combustible floors have been swept clean, they shall be protected by means such as thoroughly wetting with water, covering with damp sand, sheet metal, asbestos or equivalent. Provisions shall be made to protect welders from the hazard of shock when floors are wet.
- 6.2.3 Wherever there are floor openings or cracks in the flooring that cannot be closed, precautions shall be taken so that no readily combustible materials on the floor below will be exposed to sparks which might drop through the floor. The same precautions shall be observed with regard to cracks or holes in walls, open doorways and open or broken windows.
- 6.2.4 Suitable fire extinguishing equipment shall be maintained in a state of readiness for instant use. Such equipment may consist of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed.

- 6.2.5 A person in addition to the welder shall be required to watch for fire whenever welding or cutting is performed in locations where other than a minor fire might develop, or any of the following conditions exist:

- 1. Appreciable combustible material, in building construction or contents, closer than 35 ft. to the point of operation.
- 2. Appreciable combustibles are more than 35 ft. away but are easily ignited by sparks.
- 3. Wall or floor openings with a 35 ft. radius expose combustible material in adjacent areas including concealed spaces in walls or floors.
- 4. Combustible materials are adjacent to the opposite side of metal partitions, walls, ceilings, or roofs and are likely to be ignited by conduction or radiation.

- 6.2.6 Persons watching for fire shall have fire extinguishing equipment readily available and be trained in its use. They shall be familiar with facilities for sounding an alarm in the event of a fire. They shall watch for fires in all exposed areas, try to extinguish them only when obviously within the capacity of the equipment available, or otherwise sound the alarm. A fire watch shall be maintained for at least a half hour after completion of welding or cutting operations to detect and extinguish possible smoldering fires.

- 6.2.7 When welding or cutting must be done in a location not designed for such purposes, inspection and authorization by a designated person shall be required before such operations are begun.

- 6.2.8 The above precautions shall be applied in ship work to opposite sides of tank shells, decks, overheads and bulkheads where direct penetration of sparks or heat transfer in welding may introduce a fire hazard to an adjacent compartment.

6.3 WELDING OR CUTTING CONTAINERS

- 6.3.1 No welding, cutting or other hot work shall be performed on used drums, barrels, tanks or other containers until they have been cleaned so thoroughly as to make absolutely certain that there are no flammable materials present or any substances such as greases, tars, acids or other materials which, when subject to heat, might produce flammable or toxic vapors. Any pipe lines or connections to the drum or vessel shall be disconnected or blanked. See also 7.4.3.

NOTE 1: See Safe Practices for Welding and Cutting Containers That Have Held Combustibles, AWS, A6.0-1965.

NOTE 2: For the cleaning and gas-freeing of tanks, bunkers or compartments on board ship see A Manual for the Safe Handling of Inflammable and Combustible Liquids, U. S. Coast Guard, 1947, and Standards for the Control of Gas Hazards on Vessels to be Repaired, NFPA No. 306-1965.

NOTE 3: For outside, aboveground petroleum storage tanks, etc., see API Accident Prevention Manual No. 1—Cleaning Petroleum Storage Tanks; Section A—Crude Oil and Unfinished Products Tanks, 1955, and Section B—Gasoline Tanks, 1955, American Petroleum Institute, 1955.

NOTE 4: For gasometers or gas holders for natural manufactured gas see Purging Principles and Practices, 1954, American Gas Association.

NOTE 5: For containers that have held nitrocellulose or pyroxylin solutions, the manufacturer or supplier should be consulted for proper methods of cleansing.

NOTE 6: For tank vehicles and tank cars, see API Accident Prevention Manual No. 13, Cleaning Mobile Tanks Used for Transportation of Flammable Liquids, Section A—Tank Vehicles, 1959, American Petroleum Institute.

NOTE 7: Procedures for Cleaning or Safeguarding Small Tanks and Containers, NFPA No. 327-1964.

6.3.2 All hollow spaces, cavities or containers shall be vented to permit the escape of air or gases before preheating, cutting or welding.

6.4 SPRINKLER PROTECTION

6.4.1 Where sprinkler protection or rate of rise systems are interrupted by welding or cutting work, special fire protection or prevention measures shall be employed to insure a reasonable equivalent degree of fire safety. If welding or cutting is to be done quite close to automatic sprinkler heads, sheet asbestos or damp cloth guards may be used to shield the individual heads temporarily.

6.5 CONFINED SPACES

6.5.1 When arc welding is to be suspended for any substantial period of time, such as during lunch or overnight, all electrodes shall

be removed from the holders and the holders carefully located so that accidental contact cannot occur and the machine be disconnected from the power source.

6.5.2 In order to eliminate the possibility of gas escaping through leaks or improperly closed valves, when gas welding or cutting, the torch valves shall be closed and the gas supply to the torch positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable, the torch and hose shall also be removed from the confined space.

SECTION 7

PROTECTION OF PERSONNEL

7.1 GENERAL

7.1.1 A welder or helper working on platforms, scaffolds or runways shall be protected against falling. This may be accomplished by the use of railings, safety belts, life lines, or some other equally effective safeguards. Life belts and similar devices shall be of a type that will permit quick escape of the workman.

7.1.2 Welders shall place welding cable and other equipment so that it is clear of passageways, ladders and stairways.

7.2 EYE PROTECTION

7.2.1 Selection

1. Helmets or hand shields shall be used during all arc welding or arc cutting operations, excluding submerged arc welding. Goggles shall also be worn during arc welding or cutting operations to provide protection from injurious rays from adjacent work, and from flying objects. The goggles may have either clear or colored glass, depending upon the amount of exposure to adjacent welding operations. Helpers or attendants shall be provided with proper eye protection.
2. Goggles or other suitable eye protection shall be used during all gas welding or oxygen cutting operations. Spectacles without side shields, with suitable filter lenses are permitted for use during gas welding operations on light work, for torch brazing or for inspection. Spectacles with side shields and cup type and cover type goggles may be used for all gas welding and oxygen cutting operations.
3. All operators and attendants of resistance welding or resistance brazing equipment shall use transparent face shields or goggles, depending on the particular job, to protect their faces or eyes, as required.
4. Eye protection in the form of suitable goggles shall be provided where needed for brazing operations not covered in the preceding sections.

7.2.2 Specifications for Protectors

1. Helmets and hand shields shall be made of a material which is an insulator for heat and electricity. Helmets, shields and goggles shall be not readily flammable and shall be capable of withstanding sterilization.
2. Helmets and hand shields shall be arranged to protect the face, neck and ears from direct radiant energy from the arc.
3. Helmets shall be provided with filter plates and cover plates designed for easy removal.
4. All parts shall be constructed of a material which will not readily corrode or discolor the skin.
5. Goggles shall be ventilated to prevent fogging of the lenses as much as practicable.
6. Cover lenses or plates shall be provided to protect each helmet, hand shield or goggle filter lens or plate.
7. All glass for lenses and cover plate shall be tempered, substantially free from striae, air bubbles, waves and other flaws. Except when a lens is ground to provide proper optical correction for defective vision, the front and rear surfaces of lenses and windows shall be smooth and parallel.
8. Lenses shall bear some permanent distinctive marking by which the source and shade may be readily identified.
9. Table 7.2.2-9 shall be a guide for the selection of the proper shade numbers. These recommendations may be varied to suit the individual's needs.

TABLE 7.2.2-9

WELDING OPERATION	SHADE NUMBER (1)
Shielded Metal-Arc Welding—1/16, 3/32, 1/8, 5/32 inch electrodes	10
Gas-Shielded Arc Welding (Nonferrous) 1/16, 3/32, 1/8, 5/32 inch electrodes	11
Gas-Shielded Arc Welding (Ferrous)—1/16, 3/32, 1/8, 5/32 inch electrodes	12
Shielded Metal-Arc Welding—3/16, 7/32, 1/4 inch electrodes	12
—5/16, 3/8 inch electrodes	14
Atomic hydrogen welding	10-14
Carbon arc welding	14

TABLE 7.2.2-9—Continued

WELDING OPERATION	SHADE NUMBER (1)
Soldering	2
Torch Brazing	3 or 4
Light Cutting, up to 1 inch	3 or 4
Medium Cutting, 1 inch to 6 inches	4 or 5
Heavy Cutting, 6 inches and over	5 or 6
Gas Welding (Light) up to 1/8 inch	4 or 5
Gas Welding (Medium) 1/8 inch to 1/2 inch	5 or 6
Gas Welding (Heavy) 1/2 inch and over	6 or 8

NOTE TO TABLE

1. In gas welding or oxygen cutting where the torch produces a high yellow light, it is desirable to use a filter or lens that absorbs the yellow or sodium line in the visible light of the operation.
10. All filter lenses and plates shall meet the test for transmission of radiant energy prescribed in 6.3.4-6, of the Safety Code for Head, Eye and Respiratory Protection, USAS Z2.1-1959.

7.2.3 Protection from Arc Welding Rays

1. Where arc welding is regularly carried on in a building, the walls of the welding bay shall be painted with a finish of low reflectivity.
2. Where the work permits, the welder shall be enclosed in an individual booth painted with a finish of low reflectivity such as zinc oxide (an important factor for absorbing ultra-violet radiations) and lamp black, or shall be enclosed with noncombustible screens similarly painted. Booths and screens shall permit circulation of air at floor level. Workers or other persons adjacent to the welding areas shall be protected from the rays by noncombustible or flameproof screens or shields or shall be required to wear appropriate goggles.

7.3 PROTECTIVE CLOTHING

- 7.3.1 Appropriate protective clothing shall be required for any welding operation depending upon the size, nature and location of work to be performed.
- 7.3.2 Protective means which may be employed shall be as follows:
 1. Except when engaged in light work, all welders shall wear flameproof gauntlet gloves.

NOTE 1: Flameproof aprons made of leather, asbestos, or other suitable material may also be desirable as protection against radiated heat and sparks.

NOTE 2: Woolen clothing is preferable to cotton because it is not so readily ignited and helps protect the welder from changes in temperature. Cotton clothing, if used, should be chemically treated to reduce its combustibility. All outer clothing such as jumpers or overalls should be reasonably free from oil or grease.

NOTE 3: Sparks may lodge in rolled-up sleeves or pockets of clothing, or cuffs of overalls or trousers. It is therefore recommended that sleeves and collars be kept buttoned and pockets be eliminated from the front of overalls and aprons. Trousers or overalls should not be turned up on the outside.

2. For heavy work, fire-resistant leggings, high boots, or other equivalent means shall be used.

NOTE: In production work a sheet metal screen in front of the worker's legs can provide further protection against sparks and molten metal in cutting operations.

3. Capes or shoulder covers made of leather or other suitable material shall be worn during overhead welding or cutting operations. Leather skull caps may be worn under helmets to prevent head burns.
4. For overhead welding and cutting, or welding and cutting in extremely confined spaces, ear protection may be desirable. This may be accomplished by placing glass wool or properly fitted rubber plugs in the ears or by covering them with wire screen protectors.
5. Where there is exposure to sharp or heavy falling objects, or a hazard of bumping in confined spaces, hard hats or head protectors shall be used.

7.4 WORK IN CONFINED SPACES

- 7.4.1 As used herein confined space is intended to mean a relatively small or restricted space such as a tank, boiler, pressure vessel or small compartment of a ship.
- 7.4.2 Ventilation shall be a prerequisite to work in confined spaces. For ventilation requirements see Section 8.

7.4.3 When welding or cutting is being performed in any confined spaces the gas cylinders and welding machines shall be left on the outside. Before operations are started, heavy portable equipment mounted on wheels shall be securely blocked to prevent accidental movement.

7.4.4 Where a welder must enter a confined space through a manhole or other small opening, means shall be provided for quickly removing him in case of emergency. When safety belts and lifelines are used for this purpose they shall be so attached to the welder's body that his body cannot be jammed in a small exit opening. An attendant with a preplanned rescue procedure shall be stationed outside to observe the welder at all times and be capable of putting rescue operations into effect.

7.4.5 When arc welding is to be suspended for any substantial period of time, such as during lunch or overnight, all electrodes shall be removed from the holders and the holders carefully located so that accidental contact cannot occur and the machine disconnected from the power source.

7.4.6 In order to eliminate the possibility of gas escaping through leaks or improperly closed valves, when gas welding or cutting, the torch valves shall be closed and the fuel-gas and oxygen supply to the torch positively shut off at some point outside the confined area whenever the torch is not to be used for a substantial period of time, such as during lunch hour or overnight. Where practicable, the torch and hose shall also be removed from the confined space.

7.4.7 After welding operations are completed, the welder shall mark the hot metal or provide some other means of warning other workers.

7.4.8 All work in confined spaces not otherwise covered shall be performed in accordance with Safety Regulation No. 10, Work in Confined Spaces.

SECTION 8

HEALTH PROTECTION AND VENTILATION

8.1 GENERAL

8.1.1 The requirements in this section have been established on the basis of the following three factors in arc and gas welding which govern the amount of contamination to which welders may be exposed:

1. Dimensions of space in which welding is to be done (with special regard to height of ceiling).
2. Number of welders.
3. Possible evolution of hazardous fumes, gases or dust according to the metals involved.

8.1.2 It is recognized that in individual instances other factors may be involved in which case ventilation or respiratory protective devices shall be provided as needed to meet the equivalent requirements of this section. Such factors would include:

1. Atmospheric conditions.
2. Heat generated.
3. Presence of volatile solvents.

8.1.3 When welding must be performed in a space entirely screened on all sides, the screens shall be so arranged that no serious restriction of ventilation exists. It is desirable to have the screens so mounted that they are about 2 feet above the floor unless the work is performed at so low a level that the screen shall be extended nearer to the floor to protect nearby workers from the glare of welding. See also 7.2.3-2.

8.1.4 Local exhaust or general ventilating systems shall be provided in locations where welding is performed on a continuous or permanent basis. The exhaust or ventilating system shall be arranged to keep the amount of toxic fumes, gases or dusts below the threshold limit values of the Safety Regulation No. 3, Threshold Limit Values. Special attention shall be given when using recirculated air to prevent build-up of toxic contaminants.

8.1.5 Where welding operations are incidental to general operations, good practice shall require local exhaust ventilation to prevent contamination of the general work area.

8.1.6 Where welding operations are of a temporary nature, good practice dictates that individual respiratory equipment shall be used and be well maintained. It should not be transferred from one employee to another without being disinfected. For methods of disinfection, see Article 7.5.4 of the Safety Code for Head, Eye and Respiratory Protection, USAS Z2.1-1959.

8.1.7 Manufacturers cautions pertaining to fluxes and electrode coverings shall be carefully observed. See also 8.1.8.

8.1.8 Precautionary Labels

NOTE: A number of potentially hazardous materials are employed in fluxes, coatings, coverings and filler metals used in welding and cutting, or are released to the atmosphere during welding and cutting. These include but are not limited to the materials itemized in 8.5 through 8.14.

1. The suppliers of welding materials shall determine the hazard, if any, associated with the use of their materials in welding and cutting.
2. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers:

CAUTION

Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation.

3. Brazing (welding) filler metals containing cadmium in significant amounts shall carry the following notice on tags, boxes, or other containers:

WARNING

CONTAINS CADMIUM

POISONOUS FUMES MAY BE FORMED ON HEATING

Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators. If chest pain, cough or fever develops after use, call physician immediately.

Keep children away when using.

4. Brazing and gas welding fluxes containing fluorine compounds shall have a cautionary wording to indicate that they contain fluorine compounds.

CAUTION

CONTAINS FLUORIDES

This flux when heated gives off fumes that may irritate eyes, nose and throat.

1. Avoid fumes—use only in well-ventilated spaces.
2. Avoid contact of flux with eyes or skin.
3. Do not take internally.

8.2 VENTILATION FOR GENERAL WELDING AND CUTTING

8.2.1 Mechanical ventilation shall be provided when welding or cutting is done on metals not covered in 8.5 to 8.14 inclusive: For specific materials, see the ventilation requirements of 8.5 to 8.14 inclusive.

1. In a space of less than 10,000 cubic feet per welder.
2. In a room having a ceiling height of less than 16 feet.
3. In confined spaces or where the welding space contains partitions, balconies or other structural barriers to the extent that they significantly obstruct cross ventilation.

8.2.2 Such ventilation shall be at the minimum rate of 2,000 cubic feet per min. per welder, except where local exhaust hoods and booths as per 8.3 or air-line respirators approved by the U. S. Bureau of Mines for such purposes are provided. Natural ventilation shall be considered sufficient for welding or cutting operations where the restrictions in 8.2.1 above are not present.

8.3 LOCAL EXHAUST HOODS AND BOOTHS

8.3.1 Mechanical local exhaust ventilation may be by means of either of the following:

1. Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of air flow sufficient to maintain a velocity in the direction of the hood of 100 linear feet per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a 3-inch wide flanged suction opening are shown in the Table 8.3.1-1.

8.1.5 Where welding operations are incidental to general operations, good practice shall require local exhaust ventilation to prevent contamination of the general work area.

8.1.6 Where welding operations are of a temporary nature, good practice dictates that individual respiratory equipment shall be used and be well maintained. It should not be transferred from one employee to another without being disinfected. For methods of disinfection, see Article 7.5.4 of the Safety Code for Head, Eye and Respiratory Protection, USAS Z2.1-1959.

8.1.7 Manufacturers cautions pertaining to fluxes and electrode coverings shall be carefully observed. See also 8.1.8.

8.1.8 Precautionary Labels

NOTE: A number of potentially hazardous materials are employed in fluxes, coatings, coverings and filler metals used in welding and cutting, or are released to the atmosphere during welding and cutting. These include but are not limited to the materials itemized in 8.5 through 8.14.

1. The suppliers of welding materials shall determine the hazard, if any, associated with the use of their materials in welding and cutting.
2. All filler metals and fusible granular materials shall carry the following notice, as a minimum, on tags, boxes, or other containers:

CAUTION

Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. Use adequate ventilation.

3. Brazing (welding) filler metals containing cadmium in significant amounts shall carry the following notice on tags, boxes, or other containers:

WARNING

CONTAINS CADMIUM

POISONOUS FUMES MAY BE FORMED ON HEATING

Do not breathe fumes. Use only with adequate ventilation such as fume collectors, exhaust ventilators, or air-supplied respirators. If chest pain, cough or fever develops after use, call physician immediately.

Keep children away when using.

4. Brazing and gas welding fluxes containing fluorine compounds shall have a cautionary wording to indicate that they contain fluorine compounds.

CAUTION

CONTAINS FLUORIDES

This flux when heated gives off fumes that may irritate eyes, nose and throat.

1. Avoid fumes—use only in well-ventilated spaces.
2. Avoid contact of flux with eyes or skin.
3. Do not take internally.

8.2 VENTILATION FOR GENERAL WELDING AND CUTTING

8.2.1 Mechanical ventilation shall be provided when welding or cutting is done on metals not covered in 8.5 to 8.14 inclusive: For specific materials, see the ventilation requirements of 8.5 to 8.14 inclusive.

1. In a space of less than 10,000 cubic feet per welder.
2. In a room having a ceiling height of less than 16 feet.
3. In confined spaces or where the welding space contains partitions, balconies or other structural barriers to the extent that they significantly obstruct cross ventilation.

8.2.2 Such ventilation shall be at the minimum rate of 2,000 cubic feet per min. per welder, except where local exhaust hoods and booths as per 8.3 or air-line respirators approved by the U. S. Bureau of Mines for such purposes are provided. Natural ventilation shall be considered sufficient for welding or cutting operations where the restrictions in 8.2.1 above are not present.

8.3 LOCAL EXHAUST HOODS AND BOOTHS

8.3.1 Mechanical local exhaust ventilation may be by means of either of the following:

1. Freely movable hoods intended to be placed by the welder as near as practicable to the work being welded and provided with a rate of air flow sufficient to maintain a velocity in the direction of the hood of 100 linear feet per minute in the zone of welding when the hood is at its most remote distance from the point of welding. The rates of ventilation required to accomplish this control velocity using a 3-inch wide flanged suction opening are shown in the Table 8.3.1-1.

TABLE 8.3.1-1

WELDING ZONE		
FROM ARC OR TORCH	MINIMUM AIR FLOW (1) (3) (4)	DUCT DIAMETER (2)
Inches	Cu.Ft./Min.	Inches
4 to 6	150	3
6 to 8	275	3½
8 to 10	425	4½
10 to 12	600	5½

NOTES TO TABLE

1. When brazing with cadmium bearing materials or when cutting on such materials increased rates of ventilation may be required.
2. Nearest ½ inch duct diameter based on 4000 feet per minute velocity in pipe.
3. All exhaust from operation should be discharged to the outdoors.
4. Minimum air flow should be increased by 20% for hoods not provided with flanges.
 2. A fixed enclosure with a top and not less than two sides which surround the welding or cutting operations and with a rate of air flow sufficient to maintain a velocity away from the welder of not less than 100 linear feet per minute.

8.4 VENTILATION IN CONFINED SPACES

- 8.4.1 All welding and cutting operations carried on in confined spaces shall be adequately ventilated to prevent the accumulation of toxic materials or possible oxygen deficiency. This applies not only to the welder but also to helpers and other personnel in the immediate vicinity. All air replacing that withdrawn shall be clean and respirable.
- 8.4.2 In such circumstances where it is impossible to provide such ventilation, air-line respirators or hose masks approved by the U. S. Bureau of Mines for this purpose shall be used.
- 8.4.3 In areas immediately hazardous to life, hose masks, hose masks with blowers or self-contained breathing equipment shall be used. The breathing equipment shall be approved by the U. S. Bureau of Mines.
- 8.4.4 Where welding operations are carried on in confined spaces and where welders and helpers are provided with hose masks, hose with blowers or self-contained breathing equipment approved by

the U. S. Bureau of Mines, a worker shall be stationed on the outside of such confined spaces to insure the safety of those working within.

8.4.5 Oxygen shall never be used for ventilation. See 3.2.5-1.

8.5 FLUORINE COMPOUNDS

- 8.5.1 A fluorine compound shall mean a compound that contains fluorine, as an element in chemical combination, not as a free gas.
- 8.5.2 In confined spaces, welding or cutting involving fluxes, coverings or other materials which contain fluorine compounds shall be done in accordance with 8.4.

8.6 ZINC

- 8.6.1 In confined spaces, welding or cutting involving zinc-bearing base or filler metals or metals coated with zinc-bearing materials shall be done in accordance with 8.4.
- 8.6.2 Indoors, welding or cutting involving zinc-bearing base or filler metals coated with zinc-bearing materials shall be done in accordance with 8.3.

8.7 LEAD

- 8.7.1 In confined spaces, welding involving lead base metals (erroneously called lead-burning) shall be done in accordance with 8.4.
- 8.7.2 Indoors, welding involving lead base metals shall be done in accordance with 8.3.
- 8.7.3 In confined spaces or indoors, welding or cutting involving metals containing lead other than as an impurity, or involving metals coated with lead-bearing materials, including paint, shall be done using local exhaust ventilation or air-line respirators. Outdoors, such operations shall be done using respiratory protective equipment approved by the U. S. Bureau of Mines for such purposes. In all cases, workers in the immediate vicinity of the cutting operation shall be protected as necessary by local exhaust ventilation or air-line respirators.

8.8 BERYLLIUM

8.8.1 Welding or cutting indoors, outdoors or in confined spaces involving beryllium-containing base or filler metals shall be done using local exhaust ventilation and air-line respirators, unless atmospheric tests under the most adverse conditions have established the workers' exposure is within the threshold limit values of Safety Regulation No. 3, Threshold Limit Values. In all cases, workers in the immediate vicinity of the welding or cutting operations shall be protected as necessary by local exhaust ventilation or air-line respirators.

8.9 CADMIUM

8.9.1 Welding or cutting indoors or in confined spaces involving cadmium-bearing or cadmium-coated base metals shall be done using local exhaust ventilation or air-line respirators unless atmospheric tests under the most adverse conditions have established the workers' exposure is within the threshold limit values of Safety Regulation No. 3, Threshold Limit Values. Outdoors such operations shall be done using respiratory protective equipment such as fume respirators approved by the U. S. Bureau of Mines for such purposes.

8.9.2 Welding (brazing) involving cadmium-bearing filler metals shall be done using ventilation as prescribed in 8.3 or 8.4, if the work is to be done in a confined space.

8.10 MERCURY

8.10.1 Welding or cutting indoors or in a confined space involving metals coated with mercury-bearing materials including paint, shall be done using local exhaust ventilation or air-line respirators unless atmospheric tests under the most adverse conditions have established that the workers' exposure is within the threshold limit values of Safety Regulation No. 3, Threshold Limit Values. Outdoors such operations shall be done using respiratory protective equipment approved by the U. S. Bureau of Mines for such purposes.

8.11 CUTTING OF STAINLESS STEELS

8.11.1 Oxygen cutting, using either a chemical flux or iron-powder or gas-shielded arc cutting of stainless steel, shall be done using mechanical ventilation adequate to remove the fumes generated.

8.12 MATERIALS OF TOXIC SIGNIFICANCE

8.12.1 When welding involves toxic materials, the atmosphere shall not exceed the threshold limit values permitted by Safety Regulation No. 3, Threshold Limit Values.

NOTE: Sections 8.5 through 8.10 cover specific toxic materials when using specific fluxes, coverings or base metals. Other constituents of fluxes, coverings, or materials may be of toxic significance such as antimony, arsenic, bismuth, chromium, cobalt, copper, harmful organic materials, nickel, manganese, magnesium, molybdenum, thorium, and vanadium or their compounds.

8.12.2 Ventilation may be provided as necessary to reduce the concentration below the maximum allowable limits.

8.13 BRAZING ATMOSPHERES

8.13.1 A furnace or retort to be used as a container for a flammable brazing atmosphere (such as AWS Brazing Atmospheres number 2 through 7) shall be purged to remove oxygen and air, by one of the following methods:

1. Below 1400° F. purging shall reduce the oxygen below the explosive level by one of the following methods:

1.1 Evacuate to a pressure below 5 mm mercury and back-fill to working pressure with the flammable atmosphere.

1.2 Purge with a neutral or inert atmosphere for 4 to 6 volumes and subsequently with 4 to 6 volumes of the flammable atmosphere.

NOTE 1: This is usually done at a temperature of not over 200° F.

NOTE 2: Argon being heavier than air or hydrogen or hydrogen containing atmospheres should be piped into the container at the bottom and the exhaust placed at the top. Similarly, hydrogen and hydrogen containing atmospheres, being lighter than argon, should be piped into the container at the top with the argon exhaust at the bottom.

2. Above 1400° F., heated furnaces or retorts may be purged with flammable gas atmosphere with the atmosphere entering the 1400° F. chamber area. Under these conditions,

the air will be progressively consumed, thus eliminating any explosive condition.

NOTE: In all cases adequate area ventilation shall be provided to exhaust and discharge to the out-of-doors all explosive or toxic gases which may emanate from such furnace purging and brazing operations. Where the flammable atmosphere is completely burned in or at the furnace, during the heating cycle, the exhausting requirements may diminish.

3. Recognizing advancements in furnaces and atmospheres, deviations from the requirements in 8.13.1-1 and 8.13.1-2 above shall be permissible if it is demonstrated that such techniques are safe operations.

8.14 CLEANING COMPOUNDS

8.14.1 In the use of cleaning materials, because of their possible toxicity or flammability, appropriate precautions such as manufacturers instructions shall be followed.

8.14.2 Degreasing or other cleaning operations involving chlorinated hydrocarbons shall be so located that no vapors from these operations will reach or be drawn into the atmosphere surrounding any welding operation. In addition, trichloroethylene and perchloroethylene should be kept out of atmospheres penetrated by the ultraviolet radiation of gas-shielded welding operations.

NOTE: A characteristic, objectionable irritating odor of decomposed chlorinated solvents (such as trichloroethylene and perchloroethylene), which include highly toxic phosgene gas and other irritating decomposition products, occurs when such vapors enter into the atmosphere of an arc welding operation.

8.15 MEDICAL CONTROL AND FIRST AID

8.15.1 First aid equipment shall be available at all times. On every shift of welding operations there shall be present employees trained to render first aid. All injuries shall be reported as soon as possible for medical attention. First aid shall be rendered until medical attention can be provided.

NOTE: As with many occupations, a preplacement physical examination, including chest X-ray, is recommended for personnel to be engaged in welding operations. Periodic examinations should also be provided based on advice from the plant physician.

APPENDIX A

BIBLIOGRAPHY

The following codes, standards, specifications, pamphlets and books have either been cited in this Regulation or are deemed to contain information which would be useful in meeting the requirements of this Regulation. This bibliography does not form a part of the mandatory requirements of this Regulation and is included as a matter of information only. Inquiries as to the availability and cost of any of these publications should be addressed directly to the publishers.

GENERAL:

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AWS Definitions—Welding and Cutting, A3.0-1961, American Welding Society.

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American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

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United States of America Standards Institute, 10 East 40th Street, New York, N. Y. 10016.

U. S. Coast Guard, Commandant, 1300 E. Street, Washington, D. C. 20591.

U. S. Superintendent of Documents, Government Printing Office, Washington, D. C. 20402.

APPENDIX B

DIFFERENCES BETWEEN SAFETY REGULATION No. 11 and USAS Z49.1-1967

The Department of Labor and Industry of the State of New Jersey has found it necessary to alter parts of the text material of USAS Z49.1-1967 for use as a Regulation. Descriptive information has been eliminated from the text material and relocated as notes. Sections that were thought to be unenforceable have been eliminated or revised. Certain references had to be changed to recognize other Safety Regulations. These editorial and technical changes have been made in the following Sections of the Safety Regulation.

Section 1

Entirely changed.

Section 2

Entirely changed.

Section 3

3.1.1, 3.1.2, 3.1.5, 3.2.1, 3.2.2, 3.2.3, 3.2.4, 3.2.5, 3.3.1, 3.3.2, 3.3.4, 3.3.5, 3.4.2, 3.4.3, 3.4.4, 3.5.3, 3.5.5, 3.5.6, 3.6.3, 3.6.5, 3.6.6, 3.6.7, 3.7.1, 3.7.3, and 3.8.1.

Section 4

4.2.1, 4.2.3, 4.2.4, 4.2.5, 4.3.2, 4.4.1, 4.4.7, 4.4.8, 4.4.9, and 4.4.10.

Section 5

5.1.1, 5.1.3, and 5.2.4.

Section 6

6.1, 6.2.5, 6.2.6, and 6.4.1.

Section 7

7.1.1, 7.2.1, 7.2.2, 7.2.3, 7.3.1, 7.3.2, and 7.4.2.

Section 8

8.1, 8.5, 8.8, 8.9, 8.10, 8.12, and 8.15.

INDUSTRIAL SAFETY GUIDES

<i>No.</i>	<i>Title</i>
1.	Lift Safely—9/66.
3.	Protection for the Eyes and Head.
4.	Safety Awards Program.
5.	First Aid Fire Protection Equipment.
6.	Simple Mechanics for the Safety Man.
7.	Accident Prevention.
8.	Chemistry for the Safety Man.
9.	Portable Electric Power Tools.
10.	Safety Committee.
11.	Accident Investigation.
12.	Static Electricity.

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AVAILABILITY OF PUBLICATIONS

All publications are distributed free except as follows:

1. There is a charge of 50¢ for the Construction Safety Code.
2. There is a charge of 10¢ for each copy of any one publication in excess of ten.
3. Make check payable to the Commissioner of Labor and Industry.

All requests should be addressed to:

Department of Labor and Industry
Bureau of Engineering and Safety
Post Office Box V
Trenton, New Jersey 08625