NFPA 51

Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes

1997 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes

1997 Edition

This edition of NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, was prepared by the Technical Committee on Industrial and Medical Gases and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 18-20, 1996, in Nashville, TN. It was issued by the Standards Council on January 17, 1997, with an effective date of February 7, 1997, and supersedes all previous editions.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

This edition of NFPA 51 was approved as an American National Standard on February 7, 1997.

Origin and Development of NFPA 51

NFPA standards for the construction, installation, and use of acetylene gas machines and for the storage of calcium carbide date from 1900. In 1925, the first edition of NFPA 51 was adopted.

Subsequent editions of NFPA 51 were dated 1927, 1936, 1942, 1944, 1946, 1951, 1953, 1957, 1958, 1960, 1961, 1964, 1969, 1973, 1974, 1977, 1983, 1987, and 1992. In June 1966, responsibility for NFPA 51 was reassigned from the Committee on Gases and its Sectional Committee on Industrial Gases to the Committee on Industrial and Medical Gases.

The 1997 edition was revised editorially to make the standard easier to use, understand, and enforce.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the storage, transfer, and use of industrial gases. Included are the storage and handling of such gases in their gaseous or liquid phases; the installation of associated storage, piping, and distribution equipment; and operating practices. The Committee also has a technical responsibility for contributions in the same areas for medical gases and clean rooms.

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Standard for the

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 9 and Appendix B.

Chapter 1 General Provisions

1-1 Scope.

1-1.1 This standard applies to the following:

(a) Design and installation of oxygen-fuel gas welding and cutting systems and allied processes (*see definition*), except for systems meeting the criteria in 1-1.5.

(b) Utilization of gaseous fuels generated from flammable liquids under pressure when such fuels are used with oxygen.

(c) Storage, on the site of a welding and cutting system installation, of the following:

1. Gases to be used with such systems where more than one cylinder each of oxygen and fuel gas are stored in any single storage area. [This includes storage of more than one cylinder each in any single storage area even though all such stored cylinders may be intended for use in systems of the kind described in 1-1.5(a).]

2. Calcium carbide.

1-1.2 Unless specifically indicated otherwise, the term "welding and cutting systems" shall be considered to include "allied processes" in this standard.

1-1.3 When only a portion of a fuel gas system is to be used for welding, cutting, or allied processes, only that portion of the system need comply with this standard.

1-1.4 When only a portion of an oxygen system is to be used with fuel gas for welding, cutting, or allied processes, only that portion of the system need comply with this standard.

1-1.5 This standard does not apply to the following:

(a) Systems consisting of a single cylinder of oxygen and a single cylinder of fuel gas used for welding and cutting

NOTE: For information on safety in welding and cutting, see ANSI Z49.1, *Safety in Welding and Cutting*.

(b) Systems in which fuel gases are not to be used with oxygen, as described in NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases*

(c) The manufacture of gases and the filling of cylinders

(d) Storage of empty cylinders

(e) Compressed air-fuel gas systems

1-2 Definitions.

Acetylene, Low Pressure. Acetylene at a pressure not exceeding 1 psig (6.9 kPa gage).

Acetylene, Medium Pressure. Acetylene at pressures exceeding 1 psig (6.9 kPa gage) but not exceeding 15 psig (103 kPa gage).

Allied Processes. Those processes using oxygen-fuel gas mixtures for operations such as scarfing, heat treating, heating, or thermal spraying.

Approved.* Acceptable to the authority having jurisdiction.

Authority Having Jurisdiction.* The organization, office, or individual responsible for approving equipment, an installation, or a procedure.

Backflow Check Valve. A device designed to allow flow in only one direction.

Cylinder Storage. Cylinders of compressed gas standing by on the site (not those in use or attached ready for use).

DOT. U.S. Department of Transportation. Prior to April 1, 1967, DOT regulations and specifications referenced in this standard were promulgated by the Interstate Commerce Commission (ICC).

Fuel Gas. Acetylene, hydrogen, natural gas, LP-Gas, methylacetylene-propadiene, stabilized (as defined in this standard), and other liquefied and nonliquefied flammable gases that are stable because of their composition or because of the conditions of storage and utilization stipulated in this standard.

Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Limited-Combustible Material. A material (as defined in NFPA 220, *Standard on Types of Building Construction*) not complying with the definition of noncombustible material, which, in the form in which it is used, has a potential heat value not exceeding 3500 Btu per lb (8141 kJ/kg) and complies with one of the following paragraphs (a) or (b). Materials subject to increase in combustibility or flame spread rating beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.

NOTE: See NFPA 259, *Standard Test Method for Potential Heat of Building Materials*.

(a) Materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of $\frac{1}{8}$ in. (3.2 mm) that has a flame spread rating not greater than 50.

(b) Materials, in the form and thickness used, other than as described in (a), having neither a flame spread rating greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material on any plane would have neither a flame spread rating greater than 25 nor evidence of continued progressive combustion.

Listed.* Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets identified standards or has been tested and found suitable for a specified purpose.

Machine. A device in which one or more torches using fuel gas and oxygen are incorporated.

Manifold. An assembly of pipe and fittings for connecting two or more cylinders for the purpose of supplying gas to a piping system or directly to a consuming device.

Methylacetylene-Propadiene, Stabilized (MPS). A mixture of gases that, in the liquid phase, shall conform to the following:

(a) Methylacetylene-propadiene (in combination, with a maximum ratio of 3.0 moles of methylacetylene per mole of propadiene in the initial liquid phase in a storage container) — 68 mole percent *maximum*

(b) Propane, butane, isobutane (in combination) — 24 mole percent *minimum* of which at least $\frac{1}{3}$ (8 mole percent of total mixture) shall be butane or isobutane

(c) Propylene — 10 mole percent *maximum*

(d) Butadiene — 2 mole percent *maximum*

Mobile Acetylene Trailer System. A manifolded group of cylinders held together as a unit on a transport vehicle for the purpose of containing and transporting large quantities of acetylene. This system includes the mobile acetylene trailer, pressure regulator(s), flash arrestors, protective devices, meter (optional), and interconnecting piping. The system terminates at the point where acetylene at service pressure enters the user's piping system.

Noncombustible Material. A material (as defined in NFPA 220, *Standard on Types of Building Construction*) that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat. Materials reported as noncombustible, when tested in accordance with ASTM E-136, *Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, shall be considered noncombustible materials.

Oxygen Manifold, High-Pressure. A manifold connecting oxygen containers having a DOT service pressure exceeding 250 psig (1.7 MPa gage).

Oxygen Manifold, Low-Pressure. A manifold connecting oxygen containers having a DOT service pressure not exceeding 250 psig (1.7 MPa gage).

P_F Device. A wet or dry device (or assembly of devices) in a fuel gas line designed to perform the following three functions:

NOTE: A wet P_F device is commonly known as a "hydraulic seal," "hydraulic valve," or "hydraulic back-pressure valve."

(a) Prevent backflow of oxygen into the fuel gas supply system.

(b) Prevent the passage of flame into the fuel gas supply system (flashback).

(c) Prevent the development of a fuel gas-oxygen mixture at sufficient pressure so that its ignition would achieve combustion pressures that could cause failure to perform functions (a) and (b).

This device is given a diagram symbol, P_F.

Piping. Those parts of a system consisting of conduits in the form of rigid pipe or semirigid conduit (tubing). The piping includes some or all of the following:

(a) Main Piping — piping leading directly from the gas supply source to branch or outlet piping

(b) Branch Piping — piping leading from the main piping to outlet piping

(c) Outlet Piping — piping leading to station outlets, either from branch piping or directly from main piping

Portable Outlet Header. An assembly of piping and fittings, used for station outlet purposes, that is connected to the permanent piping of an oxygen-fuel gas system by means of hose or other nonrigid conductors. These devices are commonly used at piers and dry-docks in shipyards where the permanent piping system station outlets cannot be located close enough to the work to provide a direct supply.

Pressure-Relief Device. A device designed to open to prevent a rise of internal fluid pressure in excess of a specified value due to exposure to emergency or abnormal conditions. It may be of the spring-loaded, weight-loaded, or rupture-disc type.

Psia. Pounds per square inch absolute.

Psig. Pounds per square inch gage.

Shall. Indicates a mandatory requirement.

Should. Indicates a recommendation or that which is advised but not required.

Station Outlet. Point at which gas is withdrawn from the permanent piping or portable outlet headers.

TC. Transport Canada

1-3 Fuel Gases in the Liquid Phase.

1-3.1 The use of liquid acetylene is prohibited.

1-3.2 Fuel gases in the liquid phase shall not be piped into any building except as permitted in this section:

(a) Buildings used exclusively to house equipment for vaporization, pressure reduction, or gas mixing

(b) Buildings, or separate fire divisions of buildings, used exclusively for research and experimental laboratories

1-4 Operations and Fire Prevention Practices.

1-4.1 Operating safe practices shall be in accordance with ANSI Z49.1, *Safety in Welding and Cutting*.

1-4.2 Fire prevention practices in relation to cutting and welding shall be in accordance with NFPA 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*.

1-5 Material–Oxygen Compatibility. Oxygen system components, including, but not limited to, containers, valves, valve seats, lubricants, fittings, gaskets, and interconnecting equipment including hoses shall have adequate compatibility with oxygen under the conditions of temperature and pressure to which the components may be exposed in the containment and use of oxygen. Easily ignitible materials shall not be used unless they are parts of equipment or systems that are approved, listed, or proved suitable by tests or by past experience.

NOTE: Compatibility involves both combustibility and ease of ignition. Materials that burn in air will burn violently in pure oxygen at normal pressure and explosively in pressurized oxygen. Also, many materials that do not burn in air will do so in pure oxygen, particularly under pressure. Metals for containers and piping must be carefully selected, depending on service conditions. The various steels are acceptable for many applications, but some service conditions may call for other materials (usually copper or its alloys) because of their greater resistance to ignition and lower rate of combustion.

Similarly, materials that can be ignited in air have lower ignition energies in oxygen. Many such materials may be ignited by friction at a valve seat or stem packing or by adiabatic compression produced when oxygen at high pressure is rapidly introduced into a system initially at low pressure.

1-6 Cylinders and Containers. The terms *cylinder* and *container* are used interchangeably in this standard and include any portable vessel used to supply a fuel gas or oxygen.

1-7 Retroactivity. An existing system that is not in strict compliance with the provisions of this standard shall be permitted to be continued in use when such use does not constitute a distinct hazard to life or adjoining property.

1-8 Alternate Materials and Procedures. The provisions of this standard are not intended to prevent the use of any material, method of construction, or procedure not specifically prescribed herein, provided any such alternate is acceptable to the authority having jurisdiction. The authority having jurisdiction shall require that sufficient evidence be submitted to substantiate any claims made regarding the safety of such alternates.

Chapter 2 Cylinders and Containers

2-1 Fabrication and Marking.

2-1.1 Cylinders shall be designed, fabricated, tested, and marked (stamped) in accordance with regulations of the U.S. Department of Transportation (DOT), Transport Canada (TC), or the Rules for the Construction of Unfired Pressure Vessels, Section VIII, ASME *Boiler & Pressure Vessel Code.*

2-1.2 Cylinders shall be equipped with connections complying with the American-Canadian *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections* (ANSI/CGA V1-1987).

2-1.3 For the primary identification of cylinder, container, or manifold gas supply unit content, each cylinder, container, or unit shall be legibly marked with the name of the gas in accordance with ANSI/CGA C-4, *Method of Marking Portable Compressed Gas Containers to Identify the Material Contained.* These markings shall not be cut into the metal of the cylinder.

2-2 Cylinder Storage — General.

2-2.1 Cylinders permitted inside of buildings shall be stored at least 20 ft (6 m) from flammable and combustible liquids and easily ignited forms of materials such as wood, paper, oil, and grease, and where they will not be exposed to excessive rise in temperature, physical damage, or tampering by unauthorized persons.

2-2.2 Separate rooms or buildings used for gas cylinder storage shall be provided with natural or mechanical ventilation designed to provide a minimum of 1 cfm per sq ft (0.3 m^3/m^2) of floor area. Ventilation systems shall discharge a minimum of 50 ft (15 m) from intakes of air handling systems, air conditioning equipment, and air compressors.

2-3 Fuel Gas Cylinder Storage.

2-3.1 Fuel gas cylinder storage inside of buildings having other occupancy, except those in actual use or attached ready for use, shall be limited to a total gas capacity of 2500 cu ft (70 m^3) of acetylene or nonliquefied flammable gas or a total water capacity of 735 lb (334 kg) for LP-Gas or methylacetylene-propadiene, stabilized, in any one area; and, if there is more than one such storage area within a building, they shall be separated by a distance of at least 100 ft (30 m).

NOTE: A water capacity of 735 lb (334 kg) is equivalent to about 309 lb (140 kg) of propane, 368 lb (167 kg) of methylacetylene-propadiene, stabilized, or 375 lb (170 kg) of butane.

Exception No. 1: The total gas capacity of acetylene or nonliquefied flammable gas in one storage area shall be permitted to be increased to 5000 cu ft (140 m^3) in cylinder storage areas that are protected by an automatic sprinkler system and water supply designed in accordance with NFPA 13, Standard for the Installation of Sprinkler Systems, and furnishing a sprinkler discharge density of at least 0.25 gal per minute per sq ft [(10 L/min)/m^2] over a minimum operating area of at least 3000 sq ft (88 m^2) with sprinklers located not more than 20 ft (6 m) above the floor where the cylinders are stored or that are protected by an automatic water spray fixed system of equal density, designed in accordance with NFPA 15, Standard for Water Spray Fixed Systems for Fire Protection.

Exception No. 2: In buildings protected by automatic sprinkler systems or automatic water spray fixed systems, whether or not Exception No. 1 applies, separation between acetylene or nonliquefied flammable gas storage areas shall be permitted to be reduced in accordance with 2-3.2.

2-3.2 In buildings protected by an automatic sprinkler system and water supply designed in accordance with NFPA 13 for an ordinary hazard or more hazardous occupancy, where the occupancy other than the cylinder storage is not more hazardous than ordinary hazard as defined in NFPA 13, the distance between storage areas can be reduced to 50 ft (15 m). If the occupancy in such protected buildings between the storage areas is free of combustible material, the distance shall be permitted to be reduced to 25 ft (7.5 m).

2-3.3 Fuel gas storage in cylinders inside of buildings in quantities in excess of those permitted in 2-3.1 and Exception No. 1 to 2-3.1 shall be in a separate room as provided in 6-5.1.6 and 6-5.1.7.

2-3.4* Fuel gas cylinders shall be permitted to be stored in unlimited quantities outside or in a separate building having no other occupancy except as provided in 3-1.4, 3-2.3 Exception, 3-3.4, and 7-2.2.

2-3.5 Heating systems, electrical equipment, and control of sources of ignition in separate rooms (2-3.3) or buildings (2-3.4) shall comply with 6-5.3.

2-4 Oxygen Cylinder Storage.

2-4.1 Oxygen cylinders shall not be stored in inside acetylene generator rooms.

2-4.2 Oxygen cylinders stored in outside generator houses shall be separated from the generator or carbide storage rooms by a partition of noncombustible material having a fire resistance rating of at least one hour. This partition shall be without openings and shall be gastight.

2-4.3 Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials (especially oil or grease) by a minimum distance of 20 ft (6 m) or by a barrier of noncombustible material at least 5 ft (1.5 m) high having a fire-resistance rating of at least $\frac{1}{2}$ hour. The barrier shall interrupt all lines of sight between oxygen and fuel gas cylinders within 20 ft of each other.

Chapter 3 Manifolding of Cylinders

3-1 Fuel Gas Manifolds.

3-1.1 Manifolds shall be listed or approved either separately for each component part or as an assembled unit.

3-1.2 Fuel gas cylinders connected to one manifold inside a building shall be limited to a total gas capacity of 3000 cu ft (84 m^3) of acetylene or nonliquefied gas or a total water capacity of 735 lb (334 kg) for LP-Gas or methylacetylene-propadiene, stabilized. More than one such manifold with connected cylinders shall be permitted to be located in the same room provided the manifolds are at least 50 ft (15 m) apart or are separated by a barrier of noncombustible material at least 5 ft (1.5 m) high having a fire-resistance rating of at least $\frac{1}{2}$ hour.

NOTE: A water capacity of 735 lb (334 kg) is equivalent to about 309 lb (140 kg) of propane, 368 lb (167 kg) of methylacetylene-propadiene, stabilized, or 375 lb (170 kg) of butane.

Exception: Fuel gas cylinders connected to one manifold having a total gas capacity exceeding 3000 cu ft (84 m^3) of acetylene or nonliquefied gas or a total water capacity of 735 lb (334 kg) for LP-Gas or methylacetylene-propadiene, stabilized, shall be located outdoors or in a separate building or room constructed in accordance with 6-5.1.6 and 6-5.1.7.

3-1.3 Separate manifold buildings or rooms shall also be permitted to be used for the storage of drums of calcium carbide and cylinders containing fuel gases as provided for in Section 2-3. Such buildings or rooms shall have no open flames for heating or lighting and shall be well ventilated.

3-1.4 High-pressure fuel gas manifolds shall be provided with listed pressure regulating devices.

3-2 High-Pressure Oxygen Manifolds. [For use with cylinders having a DOT service pressure above 250 psig (1.7 MPa gage).]

3-2.1 Manifolds shall be listed or approved either separately for each component part or as an assembled unit.

3-2.2 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) in the same room by a minimum distance of 20 ft (6 m) or by a barrier of noncombustible material at least 5 ft (1.5 m) high having a fire-resistance rating of at least $\frac{1}{2}$ hour.

3-2.3 Oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 6500 cu ft (168 m^3). More than one such manifold with connected cylinders shall be permitted to be located in the same room provided the manifolds are at least 20 ft (6 m) apart.

Exception: An oxygen manifold to which cylinders having an aggregate capacity of more than 6500 cu ft (168 m^3) of oxygen are connected shall be located as follows:

(a) Outdoors, or

(b) In a separate building constructed of noncombustible or limited-combustible materials, or

(c) If located inside a building having occupancy other than that directly associated with the production of acetylene, the storage of calcium carbide, or the storage and manifolding of fuel gases used in welding and cutting, shall be in either a separate room constructed of noncombustible or limited-combustible materials having a fire-resistance rating of at least $\frac{1}{2}$ hour or in an area with no combustible materials within 20 ft (6 m) of the manifold.

3-2.4 An oxygen manifold or oxygen bulk supply system that has storage capacity of more than 20,000 cu ft (566 m^3) of oxygen [measured at 14.7 psia (101 kPa absolute) and 70°F (21.1°C)], including unconnected reserves on hand at the site, shall comply with the provisions of NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites.*

3-2.5 High-pressure oxygen manifolds shall be provided with listed pressure-regulating devices.

3-3 Low-Pressure Oxygen Manifolds. [For use with cylinders having a DOT service pressure not exceeding 250 psig (1.7 MPa gage).]

3-3.1 Manifolds shall be constructed of materials suitable for use with oxygen at a pressure of 250 psig (1.7 MPa gage). They shall have a minimum bursting pressure of 1000 psig (6.9 MPa gage) and shall be protected by a pressure-relief device set to relieve at a maximum pressure of 500 psig (3.5 MPa gage).

3-3.2 Hose and hose connections subject to cylinder pressure shall comply with Section 5-5. Hose shall have a minimum bursting pressure of 1000 psig (6.9 MPa gage).

3-3.3 The assembled manifold, including leads, shall be tested and proven gastight at a pressure of 375 psig (2.6 MPa gage). The material used for testing oxygen manifolds shall be oil-free and nonflammable.

3-3.4 The location of manifolds shall comply with 3-2.2, 3-2.4, 3-3.4.1, and 3-3.4.2.

3-3.4.1 Except as provided in 3-3.4.2, oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 12,000 cu ft (336 m^3). More than one such manifold with connected cylinders shall be permitted to be located in the same room provided the manifolds are at least 50 ft (15 m) apart.

3-3.4.2 An oxygen manifold to which cylinders having an aggregate capacity of more than 12,000 cu ft (336 m^3) of oxygen are connected shall be located:

(a) Outdoors, or

(b) In a separate building constructed of noncombustible or limited-combustible materials, or

(c) If located inside a building having occupancy other than that directly associated with the production of acetylene,

the storage of calcium carbide, or the storage and manifolding of gases used in welding and cutting, shall be in either a separate room constructed of noncombustible or limited-combustible materials having a fire resistance rating of at least ½ hour or in an area with no combustible materials within 20 ft (6 m) of the manifold.

3-3.5 The following sign shall be conspicuously posted at each manifold:

LOW-PRESSURE MANIFOLD

DO NOT CONNECT

HIGH-PRESSURE CYLINDERS

MAXIMUM PRESSURE — 250 PSIG

3-4 Portable Outlet Headers.

3-4.1 Portable outlet headers shall not be used indoors except for temporary service where the conditions preclude a direct supply from station outlets located on the piping system.

3-4.2 Each outlet on the piping system from which oxygen or fuel gas is withdrawn to supply a portable outlet header shall be equipped with a readily accessible shutoff valve.

3-4.3 Hose and hose connections used for connecting the portable outlet header to the piping system shall comply with Section 5-5.

3-4.4 Master shutoff valves for both oxygen and fuel gas shall be provided at the entry end of the portable outlet header.

3-4.5 The high-pressure supply systems for both oxygen and fuel gas serving portable outlet headers shall be provided with listed and labeled or approved pressure regulating devices. If a station outlet is equipped with a detachable regulator, the outlet of the portable header shall terminate in a union connection that complies with Compressed Gas Association Pamphlet E-3, *Pipeline Regulator Inlet Connection Standards.*

3-4.6 Each station outlet on portable outlet headers shall be provided with a valve assembly that includes a detachable outlet dust cap, chained or otherwise attached to the body of the valve.

3-4.7 Materials and fabrication procedures for portable outlet headers shall comply with Sections 4-1, 4-2, and 4-3.

3-4.8 Portable outlet headers shall be provided with frames that will support the equipment securely in the correct operating position and protect them from damage during handling and operation.

Chapter 4 Piping Systems

4-1 Materials and Design.

4-1.1 General.

4-1.1.1 Piping and fittings shall comply with ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*, insofar as it does not conflict with Section 4-1 and except as follows:

(a) Pipe shall be at least Schedule 40 and fittings shall be at least standard weight in sizes up to and including 6-in. nominal.

(b) Copper tubing shall be Type K or L in accordance with ASTM B88, *Standard Specification for Seamless Copper Water Tube.*

4-1.1.2 Piping shall be steel, brass, or copper pipe, or seamless copper, brass, or stainless steel tubing, except as provided in 4-1.2 and 4-1.3.

4-1.2 Oxygen Piping Systems.

4-1.2.1 Materials for fabrication, installation, cleaning, and testing of piping systems shall be selected in accordance with sound engineering practice.

NOTE: For information on materials, fabrication, installation, cleaning, and testing of piping systems for oxygen service see CGA Pamphlet G4.4, *Industrial Practices for Gaseous Oxygen Transmission and Distribution Piping Systems.*

4-1.2.2 Hose connections and hose complying with Section 5-5 shall be permitted to be used to connect the outlet of a manifold pressure regulator to piping providing the working pressure of the piping is 250 psig (1.7 MPa gage) or less and the length of the hose does not exceed 5 ft (1.5 m). Hose shall have a minimum bursting pressure of 1000 psig (6.9 MPa gage).

4-1.2.3 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 (1.7 MPa gage). A pressure regulating device shall be used at each station outlet when the connected equipment is intended for use at pressure less than 250 psig (1.7 MPa gage).

4-1.3 Piping for Acetylene and Methylacetylene-Propadiene, Stabilized.

4-1.3.1 Piping shall be steel.

4-1.3.2 Unalloyed copper shall not be used except in listed equipment.

4-1.3.3 Except in cylinder manifolds, acetylene shall not be piped or utilized at a pressure in excess of 15 psig (103 kPa gage) or 30 psia (206 kPa absolute). This provision is not intended to apply to the storage of acetylene in cylinders manufactured to DOT specifications.

NOTE: The 30-psia (206-kPa absolute) limit is intended to prevent unsafe use of acetylene in pressurized environments such as caissons, underground excavations, or tunnel construction.

4-2 Piping Joints. Also see 4-1.2.1 for oxygen piping.

4-2.1 Joints in steel piping shall be welded, threaded, or flanged. Fittings, such as ells, tees, couplings, and unions, shall be permitted to be rolled, forged, or cast steel, malleable iron, or nodular iron. Gray or white cast-iron fittings are prohibited.

4-2.2 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 filler metal.

4-2.3 Joints in seamless copper, brass, or stainless steel tubing shall be listed or 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 filler metal.

4-2.4 Tapered threaded connections in oxygen pipe shall be tinned or made up with polytetrafluoroethylene (such as Teflon) tape or other thread sealants suitable for oxygen service. Sealants shall be applied to the externally threaded portion only.

4-3 Installation. Also see 4-1.2.1 for oxygen piping.

4-3.1 Piping shall be run as directly as practical and protected against corrosion and physical damage, and allowance shall be made for expansion, contraction, jarring, and vibration. Piping under buildings or foundations shall be avoided or provided with a vented casing or located in a well-ventilated tunnel.

4-3.2 Oxygen piping shall be permitted to be placed in the same tunnel, trench, or duct with fuel gas pipelines, provided there is good natural or mechanical ventilation and there is no contact with oil.

4-3.3 Low points in piping and equipment where moisture can collect shall be drained into drip pots constructed so as to permit pumping or draining out the condensate at necessary intervals. Drain valves having outlets normally closed with screw caps or plugs shall be installed for this purpose. Open-end valves or petcocks shall not be used, except that in drips located outdoors and underground and not readily accessible, valves shall be permitted to be used at outlets 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.

4-3.4 Readily accessible gas valves shall be provided to shut off the gas supply to buildings in cases of emergency. A shutoff valve shall be installed in the discharge from the generator, gas holder, manifold, or other source of supply.

4-4 Cleaning. Also see 4-1.2.1 for oxygen piping and CGA Pamphlet G4.1, *Equipment Cleaned for Oxygen Service.*

4-4.1 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 that will effectively remove grease and dirt but will not react with oxygen. Hot water solutions of caustic soda or trisodium phosphate are effective cleaning agents for this purpose.

4-4.2 Piping shall be thoroughly blown out after assembly to remove foreign materials. For oxygen piping, oil-free air or oil-free nitrogen shall be used. For other piping, air or inert gas shall be permitted to be used.

4-5 Testing. Also see 4-1.2.1 for oxygen piping.

4-5.1 Piping systems shall be hydrostatically tested and proved gastight and leak free at one and one-half ($1\frac{1}{2}$) times the maximum operating pressure, or tested in accordance with ASME B31.3, *Chemical Plant and Petroleum Refinery Piping*, and thoroughly purged of the test medium before being placed in service. The material used for pressure-testing oxygen lines shall be oil-free and nonflammable. Material used externally for bubble-testing oxygen lines shall be oil-free and, if combustible, shall be applied as a dilute water solution that will not leave an objectionable film.

4-5.2 When combustible gas lines or other parts of equipment are being purged of air or gas, sources of ignition shall not be permitted near uncapped openings.

4-6 Painting and Signs.

4-6.1 Underground pipe and tubing and outdoor ferrous pipe and tubing shall be covered or painted with a suitable material for protection against corrosion.

NOTE: For information on marking of aboveground piping systems, see ANSI A13.1, *Scheme for Identification of Piping Systems.*

4-6.2 Station outlets shall be marked to indicate the name of the gas in the connected pipe.

4-6.3 Signs clearly establishing the location and identity of section shutoff valves shall be provided.

Chapter 5 Protective Equipment, Hose, and Regulators

5-1 General.

5-1.1 Equipment shall be installed only for the service for which it is intended and as recommended by the manufacturer.

5-1.2 Where piping systems, or portions of systems, supply only consuming devices in which no internal mixing of fuel gas with oxygen is possible within the consuming device, the system or portion of system need not comply with 5-3.1, 5-3.3, 5-3.6, 5-3.7, 5-3.8, 5-3.9, 5-4.1, or 5-4.2.

5-2 Pressure Relief for Piping Systems.

5-2.1 Listed or approved pressure-relief devices shall be installed in fuel gas piping if the maximum design pressure of the piping or the system components can be exceeded. These devices shall be set to discharge at not more than the maximum design pressure of the piping or system components and to a safe location.

The diagram symbol for such devices is R_F [*see Figures 5-3(b) and (c).*]

5-2.1.1 In systems as shown in Figure 5-3(a) only, pressure-relief devices included as part of P_F devices shall be permitted to fulfill this provision.

5-2.2 Listed or approved pressure-relief devices shall be installed in oxygen piping if the maximum design pressure of the piping or the system components can be exceeded. These devices shall be set to discharge at not more than the maximum design pressure of the piping or system components and to a safe location. The diagram symbol for such devices is R_O.

5-2.2.1 Pressure-relief devices in pressure regulators in the system shall not be used to fulfill this provision.

5-3 Piping Protective Equipment. See Figure 5-3.

5-3.1 The fuel gas and oxygen piping systems shall incorporate the protective equipment shown in Figures 5-3(a), (b), or (c).

5-3.1.1 When only a portion of a fuel gas system is to be used with oxygen, only that portion need comply with 5-3.1.

5-3.2 Portable outlet headers for fuel gas service shall be provided with a listed or approved P_F device installed at the inlet and preceding the station outlets, unless a P_F device is installed at each outlet.

5-3.3 Listed or approved protective equipment (designated P_F) shall be installed in the fuel gas piping.

5-3.4 The P_F device shall be located in the main supply line, as in Figure 5-3(a); or at the head of each branch line, as in Figure 5-3(b); or at each location where fuel gas is withdrawn, as in Figure 5-3(c). The options for the location of a P_F device will depend upon the size and complexity of the piping. In all cases, except as covered in 5-1.2, fuel gas serving an oxygen-fuel gas device shall flow through a P_F device. When a P_F device is located at a fuel gas station outlet, the only other device required is a shutoff valve, V_F [see Figure 5-3(c)]. Where branch lines are of 2-in. pipe size or larger, a P_F device shall be located as shown in either Figure 5-3(b) or (c).

5-3.5 When a P_F device is located as shown in Figures 5-3(a) and 5-3(b), backflow protection of the fuel gas supply also shall be provided at the station outlet by a listed or approved device that will prevent oxygen from flowing into the fuel gas system. The diagram symbol for such a device is S_F.

5-3.6 In a P_F device, the pressure-relief device shall be located on the downstream side of the backflow and flashback protection devices. The vent from the pressure-relief device shall be at least as large as the relief device outlet 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, shall terminate in a hood or bend, and shall discharge outdoors at a safe location.

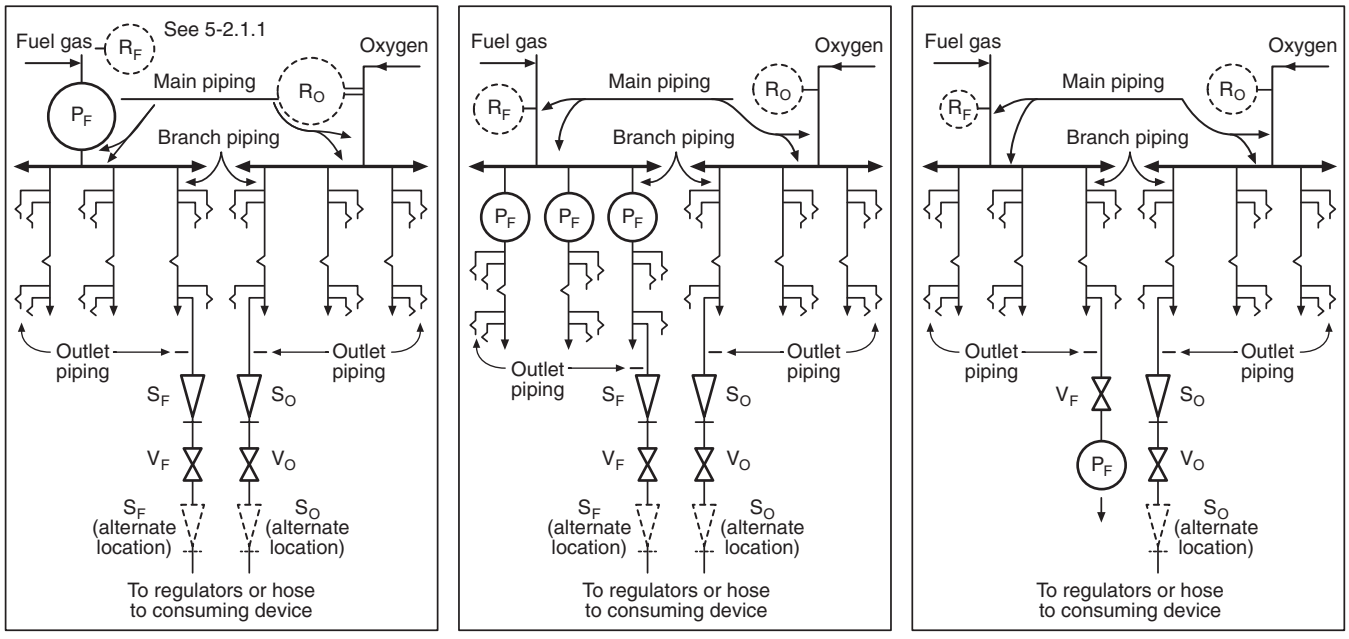
5-3.7 If pipeline protective equipment incorporates a liquid, the liquid level shall be maintained, and a suitable antifreeze shall be permitted to be used to prevent freezing.

5-3.8 Fuel gas for use with equipment not requiring oxygen shall be withdrawn upstream of the piping protective devices.

5-3.9 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.

5-4 Station Outlet Protective Equipment.

5-4.1 A listed or approved shutoff valve shall be installed at each outlet and located on the upstream side of other station outlet equipment except as provided in 5-4.2. The diagram symbols for such shutoff valves are V_F and V_O.



Legend:

P_F = Protective equipment in fuel gas piping
V_F = Fuel gas station outlet valve
V_O = Oxygen station outlet valve
S_F = Backflow check valve
S_O = Backflow check valve
R_O = Pressure-relief device (oxygen)
R_F = Pressure-relief device (fuel gas)

Figure 5-3 Schematic arrangements of piping and station outlet protective equipment. (See Sections 5-2, 5-3, and 5-4.)

5-4.2 A listed or approved backflow check valve shall be installed at each station outlet, including those on portable outlet headers, either upstream or downstream of the shutoff valve, V_F or V_O. The diagram symbols for such check valves are S_F and S_O.

5-4.2.1 When a P_F device is located at the station outlet as shown in Figure 5-3(c), an additional check valve is not required in the fuel gas line.

5-4.3 If the station outlet is equipped with a detachable regulator, the outlet shall terminate in a union connection that complies with Compressed Gas Association Pamphlet E-3, *Pipeline Regulator Inlet Connection Standards.*

5-4.4 If the station outlet is connected directly to a hose, the outlet shall terminate in a union connection complying with Compressed Gas Association Pamphlet E-1, *Standard Connections for Regulator Outlets, Torches and Fitted Hose for Welding and Cutting Equipment.*

5-4.5 Station outlets shall be permitted to terminate in pipe threads to which permanent connections are to be made, such as to a machine.

5-4.6 Station outlets shall be equipped with a detachable outlet dust cap that shall be secured in place except when a hose, a regulator, or piping is attached.

5-4.7 Where station outlets are equipped with backflow and flashback protective devices, as many as four torches shall be permitted to be supplied from one station outlet through rigid piping, provided each outlet from such piping is equipped with a shutoff valve and provided the fuel gas capacity of any one torch does not exceed 15 cu ft (425 L) per hour of acetylene, LP-Gas, or methylacetylene-propadiene, stabilized; or 50 cu ft (1.4 kL) per hour of natural gas, methane, or hydrogen. This provision does not apply to machines.

5-5 Hose and Hose Connections. Hose and hose connections for oxygen and fuel gas service, including hose used to connect portable outlet headers to piping systems, shall comply with Compressed Gas Association Pamphlet E-1, *Standard Connections for Regulator Outlets, Torches and Fitted Hose for Welding and Cutting Equipment.*

5-6 Pressure Reducing Regulators. Regulators or automatic reducing valves shall be used only for the gas for which they are intended.

Chapter 6 Acetylene Generators

6-1 Listing and Marking. Generators shall be listed; shall be of the carbide-to-water type; and shall be plainly marked with the rate in cubic feet of acetylene per hour for which they are designed, the amount or weight and size of carbide necessary for a single charge, the manufacturer's name and address, and the type or model designation.

6-2 Rating and Pressure Limitations.

6-2.1 The total hourly output of a generator shall not exceed the rate for which it is marked.

6-2.2 Acetylene shall not be generated at a pressure in excess of 15 psig (103 kPa gage).

6-2.3 Nonautomatic generators shall not be used for generating acetylene at pressures exceeding 1 psig (6.9 kPa gage). Water overflows shall be visible.

6-3 Location. Stationary generators shall be located in outside generator houses or inside generator rooms complying with Section 6-5.

6-4 Stationary Acetylene Generators (Automatic and Nonautomatic).

6-4.1 Installation.

6-4.1.1 Generators shall be installed on a level foundation so that no excessive strain will be placed on the generator or its connections.

6-4.1.2 The area around the generator shall be adequate for operation, maintenance, adjustment, and charging.

6-4.1.3 Generators shall be protected against freezing. The use of salt or other corrosive chemical to prevent freezing is prohibited.

6-4.1.4 Except when generators are provided with an adequate overflow or automatic water shutoff to prevent overfilling of the generator, the water supply pipe shall terminate not less than 2 in. (50 mm) above the opening used for filling so that the water can be observed as it enters the generator.

6-4.1.5 Pressure relief valves for generating chambers shall be set to open at a pressure not in excess of 15 psig (103 kPa gage). Pressure relief valves for hydraulic back-pressure valves shall be set to open at a pressure not in excess of 20 psig (138 kPa gage).

6-4.1.6 Generators shall not be fitted with continuous drain connections leading to sewers but shall discharge through an open connection into a vented outdoor residue settling pit that, if approved, shall be permitted to have a clear water connection to the sewer. Ventilation shall permit dissolved acetylene gas to dissipate.

6-4.2 Stationary Generator Vent Pipes. Equipment shall be installed with sufficient clearance for operation and maintenance.

6-4.2.1 Each generator shall be provided with a vent pipe of Schedule 40 galvanized iron or steel.

Exception: Outside of buildings, vent pipes larger than 4 in. in diameter shall be not less than 14-gage galvanized tubing or sheet steel.

6-4.2.2 The vent pipe shall be rigidly installed without traps so that any condensation will drain back to the generator. Means shall be provided to prevent accumulation of condensate in the vent pipes.

6-4.2.3 The vent pipe shall be full size to the termination point outside of the building and shall terminate in a hood or bend. This hood or bend shall be located at least 12 ft (4 m) above the ground, at least 3 ft (1 m) from combustible construction, and 5 ft (1.5 m) from building openings and sources of ignition. The hood or bend shall be constructed so that it will not be obstructed by rain, snow, ice, insects, or birds. Vent pipes shall not be interconnected but shall lead separately to the outside.

6-4.3 Acetylene Gas Holders.

6-4.3.1 Gas holders shall be constructed using the gasometer principle. The gas bell shall move freely, shall be guided, and shall have a clearance of at least 2 in. (50 mm) from the shell.

6-4.3.2 Gas holders shall be permitted to be located outdoors, in the generator room, or in a connecting room complying with the provisions for generator rooms. (*See Section 6-5.*)

6-4.3.3 When not located within a heated building, gas holders shall be protected against freezing.

6-4.3.4 To prevent collapse of the gas bell due to a vacuum caused by a compressor or booster pump, a compressor or booster cutoff shall be provided at a point 12 in. (300 mm) or more above the landing point of the bell.

6-4.3.5 An automatic device shall be installed on the gas holder to stop the generation of gas before the holder bell reaches the upper limit of its travel.

6-4.3.6 The gas capacity of a gas holder, connected to a single generator, shall be not less than one-third the hourly rated capacity of the generator.

6-4.3.7 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, 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 6-4.3.7.*)

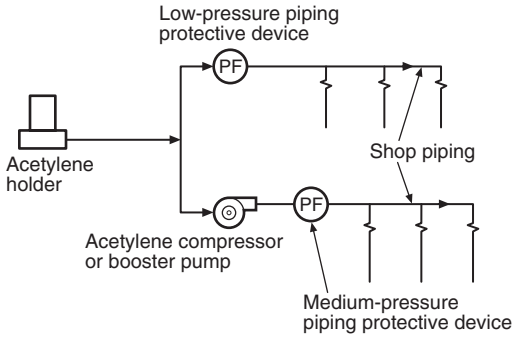


Figure 6-4.3.7 Protective devices for gas holders, compressors, and booster pumps.

6-4.4 Acetylene Compressor or Booster Pump Equipment.

6-4.4.1 Compressors or booster pumps shall be listed or approved.

6-4.4.2 Wiring and electrical equipment in compressor or booster pump rooms or enclosures shall conform to the provisions of NFPA 70, *National Electrical Code®*, Article 501, for Class I, Division 2 or Class I, Zone 2 locations.

6-4.4.3 Compressor or booster pumps shall be provided with pressure relief valves that will relieve pressure exceeding 15 psig (103 kPa gage) to a safe outdoor location as provided in 6-4.2.3, or by returning the gas to the inlet side or to the gas supply source.

6-4.4.4 Compressors or booster pumps cooled by water recirculation shall be provided with interlocks to shut down the compressors or pumps in event of cooling water supply failure.

6-4.4.5 Compressor or booster discharge outlets shall be provided with piping protective equipment. (*See Section 5-3.*)

6-4.4.6 Compressors and booster pump equipment shall be located in well-ventilated areas away from open flames, electrical or mechanical sparks, or other ignition sources.

6-5 Outside Generator Houses and Inside Generator Rooms for Stationary Acetylene Generators.

NOTE: When the word *building* is used in this section, it means a building having occupancy other than that directly associated with the production of acetylene, the storage of calcium carbide, or the storage and manifolding of gases used in welding and cutting.

6-5.1 Construction.

6-5.1.1 Openings in any outside generator house shall not be located within 5 ft (1.5 m) of any opening in another building.

6-5.1.2 Walls, floors, and roofs of outside generator houses shall be constructed of noncombustible or limited-combustible materials.

6-5.1.3 Exit doors shall be located so as to be readily accessible in case of emergency.

6-5.1.4 Buildings in which acetylene generators are located shall not exceed one story in height, except that generators shall be permitted to be installed on the top floor or roof of a multi- or single-story building.

6-5.1.5 Generators installed inside buildings shall be enclosed in a separate room.

6-5.1.6 The walls, partitions, floors, and ceilings of inside generator rooms shall be constructed of noncombustible or limited-combustible materials 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.

6-5.1.7 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.

NOTE: For information on fire doors, see NFPA 80, *Standard for Fire Doors and Windows.*

6-5.1.8 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 1 sq ft per 50 cu ft (0.1 m^2 per 1.4 m^3) of room volume and shall be permitted to consist of any one or any combination of the following: walls of light material, lightly fastened hatch covers, lightly fastened swinging doors in exterior walls opening outward, lightly fastened walls or roofs designed to relieve at a maximum pressure of 25 lb per sq ft (1.2 kPa).

6-5.2 Ventilation. Inside generator rooms or outside generator houses shall be well ventilated with vents located at floor and ceiling levels.

6-5.3 Heating Systems, Electrical Equipment, and Sources of Ignition.

6-5.3.1 Heating shall be by steam, hot water, 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.

6-5.3.2 Electrical equipment and wiring in outside generator houses or inside generator rooms shall conform to the provisions of NFPA 70, *National Electrical Code*, Article 501, for Class I, Division 2 or Class I, Zone 2 locations.

6-5.3.3 Sources of ignition shall be prohibited in outside generator houses or inside generator rooms.

Chapter 7 Calcium Carbide Storage

7-1 Packaging.

7-1.1 Calcium carbide shall be stored in packages meeting DOT or TC regulations.

7-1.2 Packages containing calcium carbide shall be conspicuously marked "Calcium Carbide — Dangerous If Not Kept Dry" or with equivalent warning.

7-2 Storage in Buildings.

7-2.1 Storage of calcium carbide inside buildings shall be in a dry, waterproof, and well-ventilated location.

7-2.2 Calcium carbide in quantities not exceeding 600 lb (273 kg), and in sealed packages except as provided for in 7-2.2.1, shall be permitted to be stored inside buildings or in the same room with fuel gas cylinders.

7-2.2.1 A maximum of two packages of any one size are permitted to be unsealed at the same time provided that one of the packages contains no more than 1 lb (0.5 kg) of calcium carbide.

7-2.3 Calcium carbide exceeding 600 lb (273 kg) but not exceeding 5000 lb (2273 kg) shall be stored as follows:

(a) In accordance with 7-2.4, or

(b) In an inside generator room or outside generator house, or

(c) In a separate room in a one-story building that may contain other occupancies but without cellar or basement beneath the carbide storage section. Such rooms shall be constructed in accordance with 6-5.1.6 and 6-5.1.7. These rooms shall be used for no other purpose.

7-2.4 Calcium carbide in excess of 5000 lb (2273 kg) 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 areas. If the storage building is constructed of noncombustible or limited-combustible materials, it shall be permitted to adjoin other one-story buildings if separated therefrom by unpierced walls having a fire-resistance rating of at least 3 hours; if it is detached less than 10 ft (3 m) from such building or buildings, there shall be no opening in any of the mutually exposing sides of such buildings within 10 ft (3 m). If the storage building is of combustible construction, it shall be at least 20 ft (6 m) from any other one- or two-story building and at least 30 ft (9 m) from any other building exceeding two stories.

7-3 Storage Outside Buildings.

7-3.1 Calcium carbide in unopened containers in good condition (water- and airtight) shall be permitted to be stored outdoors.

7-3.2 Containers shall be stored horizontally in single or double rows. 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.

7-3.3 Storage areas shall be at least 10 ft (3 m) from lines of adjoining property that may be built upon.

Chapter 8 Mobile Acetylene Trailer Systems

8-1 General Provisions. The mobile acetylene trailer system and discharging of the trailer system shall comply with Compressed Gas Association Pamphlet G1.6, *Recommended Practices for Mobile Acetylene Trailer Systems.*

8-2 Discharge Stations at Consumer Sites.

8-2.1 The discharge station site shall be outdoors or in a separate building used for that purpose exclusively. The site shall be such that the trailer and associated equipment shall not be beneath or exposed by failure of electric power lines, flammable or combustible liquid lines, or flammable gas lines.

8-2.2 Minimum distances from the trailer, the trailer discharge connection, or a building housing the trailer, to exposures shall be as follows:

(a)	Property line	25 ft (7.5 m)
(b)	Buildings constructed of combustible materials	50 ft (15 m)
(c)	Buildings constructed of noncombustible or limited-combustible materials	15 ft (4.5 m)
(d)	Bulk oxygen systems	50ft (15 m)
(e)	All classes of flammable and combustible liquid storage above ground	50 ft (15 m)
(f)	All classes of flammable and combustible liquid below ground:	
	Tank	20 ft (6 m)
	Vent or fill opening of tank	25 ft (7.5 m)
(g)	Other flammable gas storage	50 ft (15 m)

8-2.3 The site shall be so located as to be readily accessible and provide adequate space for trailer positioning.

8-2.4 The site shall be posted ACETYLENE — FLAMMABLE GAS — NO SMOKING — NO OPEN FLAMES or equivalent.

8-2.5 The mobile acetylene trailer system shall be electrically bonded and grounded.

8-2.6 Acetylene meters, where utilized, shall be a type recommended by the meter manufacturer for acetylene service and shall operate at pressures not to exceed 15 psig (103 kPa gage).

8-2.7 Where protective walls or roofs are provided on outdoor installations, they shall be constructed of noncombustible or limited-combustible materials (*see definitions*).

8-2.8 Electrical equipment within 15 ft (4.5 m) of outdoor installations shall be in accordance with Article 501 of NFPA 70, *National Electrical Code*, for Class I, Division 2 or Class I, Zone 2 locations.

8-3 Indoor Discharge Stations.

8-3.1 Separate buildings housing mobile acetylene trailer systems shall be constructed of noncombustible or limited-combustible materials. Heating, if provided, shall be by steam, hot water, or other indirect means.

8-3.2 Adequate ventilation to the outdoors shall be provided. Inlet openings shall be located near the floor in exterior walls only. Outlet openings shall be located at the high point of the room in exterior walls or roof. Inlet and outlet openings shall each have a minimum total area of 1 sq ft per 1000 cu ft (0.1 m^2 per 28 m^3) of room volume.