NFPA

51

OXYGEN-FUEL GAS SYSTEMS FOR WELDING & CUTTING 1977

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See Official NFPA Definitions at the back of this pamphlet.

Standard for the

Design and Installation of

OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING

NFPA 51 — 1977

1977 Edition of 51

This edition supersedes the 1974 edition. The 1977 edition of the Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Cutting and Welding includes amendments prepared by the Committee on Industrial and Medical Gases and adopted at the 1977 Fall Meeting of the NFPA on Nov. 15, 1977.

Changes, other than editorial, are indicated by vertical lines in the margin of the pages in which they appear.

Origin and Development of 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 No. 51 was adopted.

Subsequent editions of No. 51 were dated 1927, 1936, 1942, 1944, 1946, 1951, 1953, 1957, 1958, 1960, 1961, 1964, 1969, 1973 and 1974. In June, 1966, responsibility for No. 51 was reassigned from the Committee on Gases and its Sectional Committee on Industrial Gases to the Committee on Industrial and Medical Gases.

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This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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Standard for the
Design and Installation of

OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING

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CHAPTER 1. GENERAL PROVISIONS

10. Scope

101. This Standard applies to:

1011. Design and installation of oxygen-fuel gas welding, cutting and scarfing systems, except for systems meeting the criteria in 1021.

1012. Fuel gases when used with oxygen for welding, cutting, scarfing, heating, and heat-treating operations. When only a portion of a fuel gas system is to be used with oxygen for welding, cutting, heating, and heat-treating operations, only that portion of the system need comply with this Standard.

1013. Oxygen when used with any fuel gas for welding, cutting, scarfing, heating and heat-treating operations. When only a portion of an oxygen system is to be used with fuel gas for welding, cutting, scarfing, heating and heat-treating operations, only that portion of the system need comply with this Standard.

1014. Utilization of gaseous fuels generated from flammable liquids under pressure when such fuels are used with oxygen.

1015. Storage, on the site of a welding and cutting system installation, of:

(a) Gases to be used with such systems where more than one cylinder each of oxygen and fuel gas is 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 1021).

(b) Calcium carbide.

102. This Standard does not apply to:

1021. Systems comprised of a single cylinder of oxygen, a single cylinder of a fuel-gas, regulators, hoses and a torch. (See

American National Standard Safety in Cutting and Welding, ANSI Z49.1.)

1022. Systems in which liquefied petroleum gas is not to be used with oxygen. See Standard for the Storage and Handling of Liquefied Petroleum Gases (NFPA No. 58).

1023. Systems in which other fuel gases are not to be used with oxygen.

1024. The manufacture of gases and the filling of cylinders.

1025. Storage of empty cylinders.

11. Definitions

ACETYLENE, LOW PRESSURE — Acetylene at a pressure not exceeding 1 psig.

ACETYLENE, MEDIUM PRESSURE — Acetylene at pressures exceeding 1 psig. but not exceeding 15 psig.

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 which are stable because of their composition or because of the conditions of storage and utilization stipulated in this Standard.

HYDRAULIC BACK-PRESSURE VALVE — Used interchangeably with "hydraulic seal" and "hydraulic valve."

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 which, in the liquid phase, shall conform to the following:

1. 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*
2. Propane, butane, isobutane (in combination)	— 24 mole percent *minimum*, of which at least ⅓ (8 mole percent of total mixture) shall be butane and/or isobutane
3. Propylene	— 10 mole percent *maximum*
4. Butadiene	— 2 mole percent *maximum*

OXYGEN MANIFOLD, HIGH-PRESSURE — A manifold connecting oxygen containers having a DOT service pressure exceeding 250 psig.

OXYGEN MANIFOLD, LOW-PRESSURE — A manifold connecting oxygen containers having a DOT service pressure not exceeding 250 psig.

PIPING — Either pipe or tubing or both for any purpose and made of any material that is acceptable in this Standard.

a. Pipe — a rigid conduit

b. Tubing — a semi-rigid conduit

PORTABLE OUTLET HEADER — An assembly of piping and fittings used for service-outlet purposes which is connected to the permanent service piping by means of hose or other non-rigid conductors. These devices are commonly used at piers and drydocks in shipyards where the service piping cannot be located close enough to the work to provide a direct supply.

PSIA — Pounds per square inch absolute.

PSIG — Pounds per square inch gage.

STATION OUTLET — Point at which gas is withdrawn from the service piping system.

12. Fuel Gases in the Liquid Phase

121. The use of liquid acetylene is prohibited.

122. Fuel gases in the liquid phase shall not be piped into any building except as permitted in 1221 and 1222.

1221. Buildings used exclusively to house equipment for vaporization, pressure reduction, or gas mixing.

1222. Buildings, or separate fire divisions of buildings, used exclusively for research and experimental laboratories.

13. Operations and Fire Prevention Practices

131. Operating safe practices shall be in accordance with American National Standard, Safety in Welding and Cutting, (ANSI Z49.1–1973).*

132. Fire prevention practices in relation to cutting and welding shall be in accordance with the Standard for Cutting and Welding Processes, NFPA No. 51B (ANSI).

14. Material — Oxygen Compatibility

141. 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 ignitable materials shall be avoided unless they are parts of equipments or systems that are approved, listed, or proved suitable by tests or by past experience.**

15. Cylinders and Containers

151. The terms "cylinder" and "container" are used interchangeably in this Standard and include any portable vessel used to supply a fuel gas or oxygen.

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*Available from American Welding Society, 2501 NW 7th Street, Miami, Florida 33125.

**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.

16. Retroactivity

161. An existing system which is not in strict compliance with the provisions of this Standard may be continued in use when such use does not constitute a distinct hazard to life or adjoining property.

CHAPTER 2. CYLINDERS AND CONTAINERS

20. Fabrication and Marking

201. Cylinders used for the storage of fuel gas or oxygen shall be constructed in accordance with DOT* Specifications effective at the date of manufacture. Cylinders shall be charged with gas, shipped, and maintained in accordance with DOT Regulations.**

2010. Cylinders shall be equipped with connections complying with the American-Canadian Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections (ANSI B57.1-1977, CSA B96-1977)†.

202. Containers other than DOT* cylinders, for the storage of LP-Gas or methylacetylene-propadiene, stabilized, shall be constructed, installed, and charged with gas in accordance with the Standard for the Storage and Handling of Liquefied Petroleum Gases, NFPA No. 58.

203. 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 American Standard Method of Marking Portable Compressed Gas Containers to Identify the Material Contained (ANSI Z48.1-1973).† These markings shall not be cut into the metal of the cylinder.

21. Cylinder Storage — General

211. Cylinders permitted inside of buildings shall be stored at least 20 feet 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.

212. Separate rooms or buildings used for cylinder storage shall be well ventilated.

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*See Definitions.

**In Canada, the Specifications and Regulations of the Canadian Transport Commission for Canada apply.

†Available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N. Y. 10036

22. Fuel Gas Cylinder Storage*

221. Except as permitted by 222 and 223, 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 2,500 cubic feet of acetylene or nonliquefied flammable gas or a total water capacity of 735 pounds for LP-Gas or methyl-acetylene-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 feet (735 pounds water capacity is equivalent to about 309 pounds of propane, 368 pounds of methyl-acetylene-propadiene, stabilized, or 375 pounds of butane).

222. The total gas capacity of acetylene or nonliquefied flammable gas in one storage area may be increased to 5,000 cubic feet in cylinder storage areas protected by an automatic sprinkler system and water supply designed in accordance with NFPA 13, Installation of Sprinkler Systems, and which will furnish a sprinkler discharge density of at least 0.25 gallons per minute per square foot when sprinklers are operating over an area of at least 3,000 square feet with sprinklers located not more than 20 feet above the floor where the cylinders are stored; or protected by an automatic water spray fixed system of equal capacity, designed in accordance with NFPA 15, Water Spray Fixed Systems.

223. In buildings protected by automatic sprinkler systems or automatic water spray fixed systems, whether or not 222 applies, separation between acetylene or nonliquefied flammable gas storage areas may be reduced in accordance with 2231.

2231. 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 may be reduced to 50 feet. If the occupancy in such protected buildings between the storage areas is free of combustible material, the distance may be reduced to 25 feet.

224. Fuel gas storage in cylinders inside of buildings in quantities in excess of those permitted in 221 and 222 shall be in a separate room as provided in 6416 and 6417.

*Storage of cylinders of dissolved acetylene with the valve end up will minimize possibility of liquid solvent being discharged.

225. Fuel gas cylinders may be stored in unlimited quantities outside or in a separate building having no other occupancy except as provided in 304, 314, 324, and 712.

226. Heating systems, electrical equipment, and control of sources of ignition in separate rooms (224) or buildings (225), shall comply with 643.

23. Oxygen Cylinder Storage

231. Oxygen cylinders shall not be stored in inside acetylene generator rooms.

232. 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 gastight.

233. Oxygen cylinders in storage 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 ½ hour.

CHAPTER 3. MANIFOLDING OF CYLINDERS

30. Fuel Gas Manifolds

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

302. Except as provided in 303, fuel gas cylinders connected to one manifold inside a building shall be limited to a total gas capacity of 3,000 cubic feet of acetylene or nonliquefied gas or a total water capacity of 735 pounds for LP-Gas or methylacetylene-propadiene, stabilized. 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 are separated by a noncombustible barrier at least 5 feet high having a fire resistance rating of at least ½ hour. 735 pounds water capacity is equivalent to about 309 pounds of propane, 368 pounds of methylacetylene-propadiene, stabilized, or 375 pounds of butane.

303. Fuel gas cylinders connected to one manifold having a total gas capacity exceeding 3,000 cubic feet of acetylene or nonliquefied gas or a total water capacity of 735 pounds for LP-Gas or methylacetylene-propadiene, stabilized, shall be located outdoors or in a separate building or room constructed in accordance with 6416 and 6417. 735 pounds water capacity is equivalent to about 309 pounds of propane, 368 pounds of methylacetylene-propadiene, stabilized, or 375 pounds of butane.

304. Separate manifold buildings or rooms may also be used for the storage of drums of calcium carbide and cylinders containing fuel gases as provided for in Section 22. Such buildings or rooms shall have no open flames for heating or lighting and shall be well ventilated.

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

31. High-Pressure Oxygen Manifolds (for use with cylinders having a DOT* service pressure above 250 psig)

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

*See Definitions.

312. 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, a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least ½ hour.

313. Except as provided in 314, 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 20 feet apart.

314. An oxygen manifold to which cylinders having an aggregate capacity of more than 6000 cubic feet of oxygen are connected shall be located:

(a) outdoors, or

(b) in a separate noncombustible building, 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 of noncombustible construction having a fire resistance rating of at least ½ hour or in an area with no combustible materials within 20 feet of the manifold.

315. An oxygen manifold or oxygen bulk supply system which has storage capacity of more than 20,000 cubic feet of oxygen (measured at 14.7 psia and 70° F), including unconnected reserves on hand at the site, shall comply with the provisions of the Standard for Bulk Oxygen Systems at Consumer Sites, NFPA No. 50.

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

32. Low-Pressure Oxygen Manifolds (for use with cylinders having a DOT* service pressure not exceeding 250 psig)

321. 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 set to relieve at a maximum pressure of 500 psig.

*See Definitions.

322. Hose and hose connections subject to cylinder pressure shall comply with Section 54. Hose shall have a minimum bursting pressure of 1000 psig.

323. The assembled manifold including leads shall be tested and proven gastight at a pressure of 375 psig. The material used for testing oxygen manifolds shall be oil-free and nonflammable.

324. The location of manifolds shall comply with 312, 315, 3241 and 3242.

3241. Except as provided in 3242, oxygen cylinders connected to one manifold shall be limited to a total gas capacity of 12,000 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.

3242. An oxygen manifold to which cylinders having an aggregate capacity of more than 12,000 cubic feet of oxygen are connected shall be located:

(a) outdoors, or

(b) in a separate noncombustible building, 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 of noncombustible construction having a fire resistance rating of at least ½ hour or in an area with no combustible materials within 20 feet of the manifold.

325. The following sign shall be conspicuously posted at each manifold:

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

33. Portable Outlet Headers

331. 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.

332. 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 shutoff valve.

333. Hose and hose connections used for connecting the portable outlet header to the service piping shall comply with Section 54.

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

335. Portable outlet headers for fuel gas service shall be provided with a back-pressure valve installed at the inlet and preceding the service outlets, unless a back-flow check valve or a back-pressure valve is installed at each outlet. These valves shall be listed or approved. Outlets provided for oxygen service may be fitted for use with pressure-reducing regulators for direct hose connection.

336. 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.

337. Materials and fabrication procedures for portable outlet headers shall comply with Sections 40, 41 and 44.

338. 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.

CHAPTER 4. SERVICE PIPING SYSTEMS

40. Materials and Design

401. General

4011. Piping and fittings shall comply with American National Standard Code for Pressure Piping, Chemical Plant and Petroleum Refinery Piping, ANSI B31.3 (1976) insofar as it does not conflict with Section 41 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-inch nominal.

b. Copper tubing shall be Types K or L in accordance with the Standard Specification for Seamless Copper Water Tube, ASTM B88–75a.*

4012. Piping shall be steel, brass or copper pipe, or seamless copper, brass or stainless steel tubing, except as provided in 402 and 403.

402. Oxygen Piping Systems

4021. CGA Pamphlet G-4.4, Industrial Practices For Gaseous Oxygen Transmission and Distribution Piping Systems,** shall be used as a guide for selection of materials for, and fabrication, installation, cleaning and testing of oxygen piping systems.

4022. Hose connections and hose complying with Section 54 may be used to connect the outlet of a manifold pressure regulator to piping providing the working pressure of the 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.

4023. 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 intended for use at pressure less than 250 psig.

*Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

**Available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, NY 10036.

403. Piping for Acetylene and Methylacetylene-propadiene, stabilized

4031. Piping shall be steel.

4032. Unalloyed copper shall not be used except in listed equipment.

4033. Except in cylinder manifolds, acetylene shall not be piped or utilized at a pressure in excess of 15 psig or 30 psia. This provision is not intended to apply to the storage of acetylene in cylinders manufactured to DOT Specifications. The 30 psia limit is intended to prevent unsafe use of acetylene in pressurized environments such as caissons, underground excavations or tunnel construction.

41. Piping Joints (also see 4021 for oxygen piping)

411. Joints in steel 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.

412. 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.

413. 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.

414. 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.

42. Installation (also see 4021 for oxygen piping)

421. Piping shall be run as directly as practicable, protected against corrosion and physical damage, and allowance 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.

422. Oxygen piping may 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.

423. 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. Open-end valves or petcocks shall not be used, except that in drips located outdoors and underground and not readily accessible, valves may 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.

424. 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.

43. Cleaning (also see 4021 for oxygen piping and CGA Pamphlet G-4.1, Equipment Cleaned for Oxygen Service*)

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

432. 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 may be used.

44. Testing (also see 4021 for oxygen piping)

441. Piping systems shall be tested and proved gastight at one and one-half (1½) times the maximum operating pressure, and thoroughly purged of air 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.

*Available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, NY 10036.

442. 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.

45. Painting and Signs

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

452. Aboveground piping systems shall be marked in accordance with ANSI Standard A13.1–1975, "Scheme for Identification of Piping Systems."*

453. Station outlets shall be marked to indicate the name of the gas in the connected pipe.

454. Signs clearly establishing the location and identity of section shutoff valves shall be provided.

*Available from American Society of Mechanical Engineers, 345 East 47th Street, New York, N. Y. 10017.

CHAPTER 5.

PROTECTIVE EQUIPMENT, HOSE, AND REGULATORS

50. General

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

502. Where service piping systems, or portions of systems, supply only consuming devices in which no mixing of fuel gas with oxygen or air is possible within the consuming device, the system or portion of system need not comply with 521, 522, 523, 531 or 532.

51. Pressure Relief for Service Piping Systems

511. If the design pressure can be exceeded, 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 to a safe location.

52. Piping Protective Equipment

521. The fuel gas and oxygen piping systems, including portable outlet headers shall incorporate the protective equipment shown in Figures 1, 2, or 3.

5211. When only a portion of a fuel gas system is to be used with oxygen, only that portion need comply with 521.

522. Listed or approved protective equipment (designated P_F) shall be installed in the fuel gas piping to prevent: (1) backflow of oxygen into the fuel gas supply system; (2) passage of a flash back into the fuel gas supply system; and (3) development of back pressures in excess of the pressure rating of the system components.

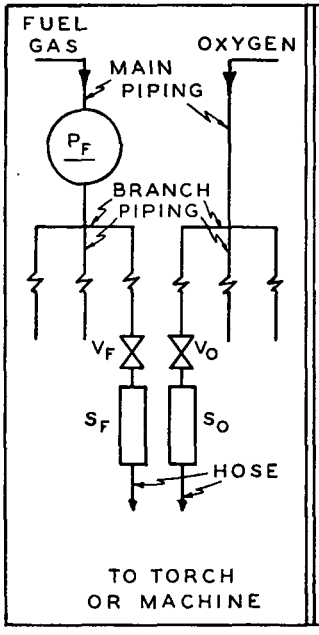

Figure 1

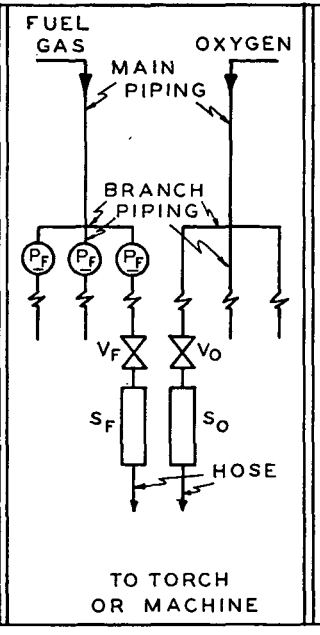

Figure 2

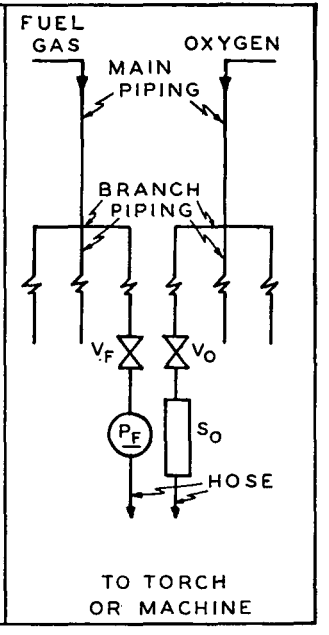

Figure 3

Schematic Arrangements of Piping and Station Outlet Protective Equipment. (See Sections 52 and 53.)

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 prevention device(s) at fuel gas station outlet
S_O — Backflow prevention device(s) at oxygen station outlet

5221. 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_F) shall be located as shown in either Figure 2 or 3.

5222. Backflow protection shall be provided by a listed or approved device that will prevent oxygen from flowing into the fuel gas system.

5223. Flash-back protection shall be provided by a listed or approved device that will prevent flame from passing into the fuel gas system.

5224. Over-pressure protection shall be provided by a listed or 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 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.

523. If pipeline protective equipment incorporates a liquid, the liquid level shall be maintained, and a suitable antifreeze may be used to prevent freezing.

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

525. 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.

53. Station Outlet Protective Equipment

531. A shutoff valve (designated V_F and V_O) shall be installed at each station outlet and shall be located on the upstream side of other station outlet equipment.

532. A check valve, hydraulic seal, or combination of these devices shall be provided at each station outlet, including those on portable headers, to prevent backflow, as shown in Figures 1, 2, and 3 and designated as S_F and S_O. If a check valve is used, it shall be located immediately upstream or downstream of the shutoff valve V_F or V_O.

533. When pipeline protective equipment (designated P_F) is located at the station outlet as in Figure 3, no additional check valve or hydraulic seal is required.

534. 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."*

535. 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."*

536. Station outlets may terminate in pipe threads to which permanent connections are to be made, such as to a machine.

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

538. Where station outlets are equipped with backflow and flash-back protective devices, as many as four torches may 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 fifteen cubic feet per hour of acetylene, LP-Gas, or methylacetylene-propadiene, stabilized; or fifty cubic feet per hour of natural gas, methane or hydrogen. This provision does not apply to machines.

54. Hose and Hose Connections

541. Hose for oxygen and fuel gas service, including hose used to connect portable outlet headers to service piping, shall comply with the Compressed Gas Association, "Specification for Fitted Rubber Welding Hose — 1973."*

*Available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N. Y. 10036

542. Hose connections shall comply with Compressed Gas Association "Pamphlet E-1, Standard Connections for Regulator Outlets, Torches and Fitted Hose For Welding and Cutting Equipment."*

55. Pressure Reducing Regulators

551. Regulators or automatic reducing valves shall be used only for the gas for which they are intended.

*Available from Compressed Gas Association, Inc., 500 Fifth Avenue, New York, N.Y. 10036.

CHAPTER 6. ACETYLENE GENERATORS

60. Listing and Marking

601. Generators shall be listed, 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.

61. Rating and Pressure Limitations

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

612. Acetylene shall not be generated at a pressure in excess of 15 psig.

613. Nonautomatic generators shall not be used for generating acetylene at pressures exceeding one psig. Water overflows shall be visible.

62. Location

621. Stationary generators shall be located in outside generator houses or inside generator rooms complying with Section 64.

63. Stationary Acetylene Generators (Automatic and Nonautomatic)

631. Installation

6311. Generators shall be installed on a level foundation so that no excessive strain will be placed on the generator or its connections.

6312. The area around the generator shall be adequate for operation, maintenance, adjustment, and charging.

6313. Generators shall be protected against freezing. The use of salt or other corrosive chemical to prevent freezing is prohibited.

6314. 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 inches above the opening used for filling so that the water can be observed as it enters the generator.

6315. 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.

6316. Generators shall not be fitted with continuous drain connections leading to sewers, but shall discharge through an open connection into a suitably vented outdoor residue settling pit which, if approved, may have a clear water connection to the sewer.

632. Stationary Generator Vent Pipes

6321. 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.

6322. 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.

6323. 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 feet above the ground, at least 3 feet from combustible construction and as far as practicable 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.

633. Acetylene Gas Holders

6331. Gas holders shall be constructed in a standard manner using the gasometer principle. The gas bell shall move freely, shall be suitably guided, and shall have a clearance of at least two inches from the shell.

6332. Gas holders may be located outdoors, in the generator room, or in a connecting room complying with the provisions for generator rooms. (See Section 64.)