NFPA No.

51

OXYGEN-FUEL GAS SYSTEMS FOR WELDING & CUTTING 1964

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National Fire Protection Association

International

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Standard for the

Installation and Operation of

OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING

NFPA No. 51 — 1964

1964 Edition of No. 51

The 1964 edition of the Standard for the Installation and Operation of Oxygen-Fuel Gas Systems for Welding and Cutting supersedes the 1961 edition. It incorporates changes prepared by the Sectional Committee on Industrial Gases, approved by the Committee on Gases, and adopted at the 1964 Annual Meeting.

This revision is primarily an editorial rearrangement of the entire document for greater ease of use. However, technical changes and additions have been made. These include recognition of properly stabilized acetylenic compounds as fuel gases, added material on service piping system installation in Chapter 4, and a much more complete treatment of piping and station outlet protective equipment in Chapter 5.

Origin and Development of No. 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 covered acetylene used in cutting and welding operations.

Subsequent editions of No. 51 were dated 1927, 1936, 1942, 1944, 1946, 1951, 1953, 1957, 1958, 1960 and 1961.

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Interpretation Procedure of the Committee on Gases

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 60 Batterymarch Street, Boston, Mass. 02110.

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Standard for the

Installation and Operation of

OXYGEN-FUEL GAS SYSTEMS FOR WELDING AND CUTTING

NFPA No. 51 — 1964

CHAPTER 1. GENERAL PROVISIONS

10. Scope

101. This Standard applies to:

1011. Installation and operation of oxygen-fuel gas welding and cutting systems.

1012. Fuel gases when used with oxygen for welding, cutting, heating, and heat-treating operations.

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

1014. Storage of calcium carbide and gases used in welding, cutting, heating and heat-treating processes.

102. This Standard does not apply to:

1021. 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).

1022. Systems in which natural or manufactured gas is not to be used with oxygen.

1023. The manufacture of gases and the filling of 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.

ACETYLENIC COMPOUNDS — Materials which, like acetylene, have a triple bond between two carbon atoms.

FUEL GAS — Acetylene, hydrogen, LP-Gas, and other liquefied and nonliquefied flammable gases.

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

ICC — Abbreviation for the Interstate Commerce Commission.

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.

OXYGEN MANIFOLD, HIGH-PRESSURE — A manifold connecting oxygen containers having an ICC service pressure exceeding 200 psig.

OXYGEN MANIFOLD, LOW-PRESSURE — A manifold connecting oxygen containers having an ICC service pressure not exceeding 200 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.

NOTE: 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. Approved Equipment

121. Equipment such as torches, manifolds, pressure regulators and acetylene generators shall be approved. "Approved" means acceptable to the authority having jurisdiction.

13. Liquid Acetylene and Acetylenic Compounds

131. The use of liquid acetylene or liquid acetylenic compounds is prohibited unless properly stabilized.

14. Fire Prevention Practices

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

CHAPTER 2. CYLINDERS AND CONTAINERS

20. Approval and Marking

201. Cylinders used for the shipment of compressed gases shall be constructed in accordance with ICC Specifications effective at the date of manufacture. They shall be charged with gas and maintained in accordance with ICC Regulations.*

202. Containers other than ICC cylinders, for the storage of liquefied petroleum gases, shall be constructed, installed, and charged with gas in accordance with the Standard for 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 (ASA Z48.1—1954).† These markings shall not be cut into the metal of the cylinder.

21. Storage of Cylinders — General

211. Cylinders permitted inside of buildings shall be stored at least 20 feet from highly combustible materials and where they will not be exposed to excessive rise in temperature, physical damage, or tampering by unauthorized persons.

212. Empty cylinders shall have their valves closed while in storage and during shipment.

213. Where caps are provided for valve protection, such caps shall be in place except when the cylinders are in service or connected ready for service.

22. Fuel Gas Cylinder Storage

221. Fuel gas cylinders stored inside of buildings, except those in actual use or attached ready for use, shall be limited to a total capacity of 2,000 cubic feet of gas or 300 pounds of liquefied petroleum gas.

*In Canada, the Specifications and Regulations of the Board of Transport Commissioners for Canada apply.

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

222. Fuel gas cylinders stored inside of buildings except those in actual use or attached ready for use, exceeding 2,000 cubic feet total gas capacity of cylinders or 300 pounds of liquefied petroleum gas shall be in a separate room as provided in 6516 and 6517.

223. Fuel gas cylinders may be stored outside or in a separate building.

224. Separate rooms or buildings shall be well ventilated. Heating systems, electrical equipment and control of sources of ignition shall comply with 653.

225. Cylinders of dissolved acetylene should be stored with the valve end up to minimize possibility of solvent being discharged as liquid.

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.

24. Operating Procedures

241. Cylinders shall not be lifted with magnets.

242. Welding or cutting work shall not be supported by compressed gas cylinders.

243. Gas shall not be transferred from one cylinder to another or mixed with another gas in a cylinder.

244. If cylinders are found to have leaky valves or fittings which cannot be stopped by closing of the valve, the cylinders shall be taken outdoors away from sources of ignition and slowly emptied. Leakage through a valve outlet may be temporarily stopped by attaching a regulator. The owner of the cylinder should be advised so that it may be repaired when returned to

him. It is advisable to tag the cylinder in such a way as to indicate the nature of the trouble.

245. Cylinders shall be located at a safe distance from the welding position so that they will not be exposed to sparks, slag, or misdirection of the torch flame or overheating from hot materials or processes.

246. Cylinders not having fixed handwheels shall have keys or handles on valve stems while these cylinders are in service. In multiple cylinder installations only one key or handle is required for each manifold.

247. (a) Pressure adjusting screws on regulators should be fully released before the regulator is attached to a cylinder and the cylinder valve opened.

(b) Valves on cylinders of compressed gas shall be opened slowly.

(c) Before a regulator is removed from a cylinder valve, the cylinder valve shall be closed and the gas released from the regulator.

248. (a) High-pressure oxygen cylinders shall be used only with pressure-regulating devices approved and marked for use with oxygen.

(b) As oxygen under high pressure may react violently with oil or grease, every possible precaution shall be taken to prevent oxygen from coming in contact with oil or grease. Oxygen cylinders, valves, regulators, hose, and other apparatus shall be kept free from oil or grease and shall not be handled with oily hands, oily gloves, or with greasy equipment.

249. Fuel gas shall not be used from cylinders through torches or other devices equipped with shutoff valves without reducing the pressure through a suitable regulator attached to the cylinder valve or manifold.

CHAPTER 3. MANIFOLDING OF CYLINDERS

30. Fuel Gas Manifolds

301. Manifolds shall be 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 capacity not exceeding 300 pounds of liquefied petroleum gas or 3000 cubic feet of other fuel gas. More than one such manifold with connected cylinders may be located in the same room provided the manifolds are at least 50 feet apart.

303. Fuel gas cylinders connected to one manifold having an aggregate capacity exceeding 300 pounds of liquefied petroleum gas or 3000 cubic feet of other fuel gas shall be located outdoors, or in a separate building or room constructed in accordance with 6516 and 6517.

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 approved pressure regulating devices.

31. High-Pressure Oxygen Manifolds (for use with cylinders having an ICC service pressure above 200 psig)

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

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), 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 50 feet apart.

314. An oxygen manifold, to which cylinders having an aggregate capacity of more than 6000 cubic feet of oxygen are con-

nected, should be located outdoors or in a separate noncombustible building. Such a manifold, if located inside a building having other occupancy, shall be located in a separate room of noncombustible construction having a fire resistance of at least ½ hour or in an area with no combustible material within 20 feet of the manifold.

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

315. An oxygen manifold or oxygen bulk supply system which has storage capacity of (a) more than 13,000 cubic feet of oxygen (measured at 14.7 psia and 70°F), connected in service or ready for service, or (b) more than 25,000 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. 566).

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

32. Low-Pressure Oxygen Manifolds (for use with cylinders having an ICC service pressure not exceeding 200 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 which will relieve at a maximum pressure of 500 psig.

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

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 300 psig. The material used for testing oxygen manifolds shall be oil-free and nonflammable.

324. The location of manifolds shall comply with 312, 313, 314 and 315.

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 an approved hydraulic back-pressure valve installed at the inlet and preceding the service outlets, unless an approved pressure-reducing regulator, an approved back-flow check valve, or an approved hydraulic back-pressure valve is installed at each outlet. Outlets provided on headers for oxygen service may be fitted for use with pressure-reducing regulators or 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.

34. Manifold Operating Procedures

341. The pressure in the gas cylinders connected to and discharged simultaneously through a common manifold shall be approximately equal.

CHAPTER 4. SERVICE PIPING SYSTEMS

40. Materials and Design

401. General

4011. Piping and fittings shall comply with Section 2 (Industrial Gas and Air Piping Systems) of the American Standard Code for Pressure Piping, ASA B31.1—1955* 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 B88–62.†

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

402. Oxygen Piping

4021. Oxygen piping and fittings at pressures in excess of 700 psig, shall be stainless steel or nonferrous metal.

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 of Mechanical Engineers, 345 East 47th Street, New York 17, New York.

†Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia 3, Pa.

403. Piping for Acetylene and Acetylenic Compounds

4031. Piping for acetylene or acetylenic compounds shall be steel or wrought iron.

4032. Unalloyed copper shall not be used for acetylene or acetylenic compounds except in listed equipment.

4033. Acetylene shall not be piped (except in approved cylinder manifolds) or utilized at a pressure in excess of 15 psig.

NOTE: This provision is not intended to apply to the storage of acetylene in cylinders manufactured to ICC Specifications, or to the storage of stabilized liquid acetylene or to the storage of stabilized liquid acetylenic compounds.

41. Piping Joints

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

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 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. Threaded connections in oxygen pipe shall be tinned or made up with litharge and glycerine, litharge and water, or other joint compound approved for oxygen service applied to the male threads only.

42. Installation

421. Piping shall be run as directly as practicable, protected against corrosion and physical damage, and allowance made for expansion, contraction, jarring and vibration.

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.

425. Fittings and lengths of pipe shall be examined internally BEFORE ASSEMBLY and, if necessary, freed from scale or dirt. Oxygen piping and fittings shall be washed out with a suitable solution which will effectively remove grease and dirt but will not react with oxygen.

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

426. 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.

43. Painting and Signs

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

432. Aboveground piping systems shall be marked in accordance with American Standard A13.1–1956, "Scheme for Identification of Piping Systems."*

433. Station outlets shall be marked to indicate their intended usage.

434. Signs clearly establishing the location and identity of section shutoff valves should be provided.

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*Available from American Society of Mechanical Engineers, 345 East 47th Street, New York 17, N. Y.

44. Testing

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

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.

CHAPTER 5.
PROTECTIVE EQUIPMENT, HOSE, AND REGULATORS

50. General

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

51. Pressure Relief for Service Piping Systems

511. 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. Approved protective equipment (designated P_p) 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) excessive back pressure of oxygen in the fuel gas supply system. The three functions of the protective equipment may be combined in one device or may be provided by separate devices.

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

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

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

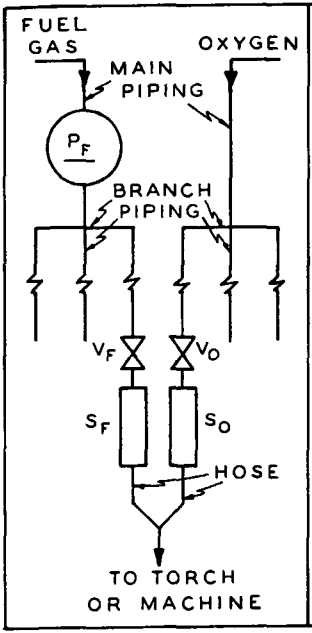

Figure 1

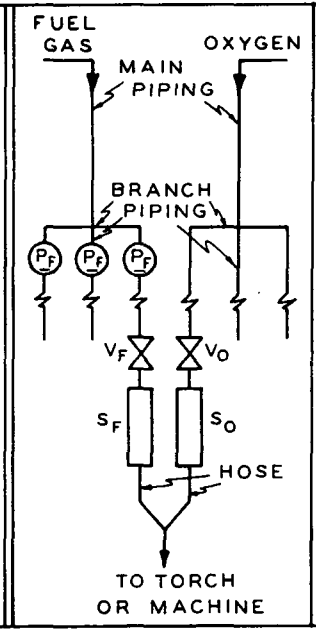

Figure 2

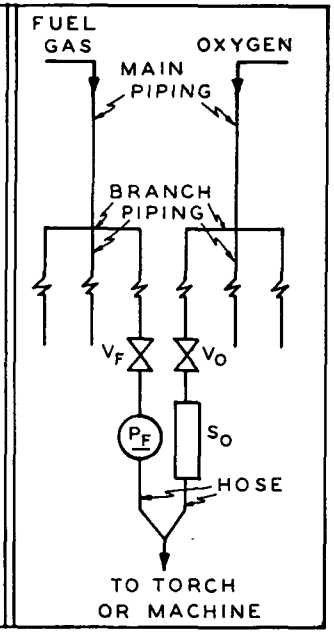

Figure 3

Schematic Arrangements of Piping and Station Outlet Protective Equipment. (See Sections 51 and 52.)

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

5224. Back-pressure protection shall be provided by an approved pressure-relief device set at a pressure not greater than the pressure rating of the backflow or the flash-back protection device, whichever is lower. The pressure-relief device shall be located on the downstream side of the backflow and flash-back protection devices. The vent from the pressure-relief device shall be at least as large as the relief device inlet and shall be installed without low points that may collect moisture. If low points are unavoidable, drip pots with drains closed with screw plugs or caps shall be installed at the low points. The vent terminus shall not endanger personnel or property through gas discharge; shall be located away from ignition sources; and shall terminate in a hood or bend.

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 should incorporate a check valve to prevent possible backflow.

53. Station Outlet Protective Equipment

531. A check valve, pressure regulator, 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.

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

533. 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.

534. If the station outlet is equipped with a detachable regulator, the outlet shall terminate in a union connection that com-

plies with IAA specifications, "Regulator Connection Standards."*

535. If the station outlet is connected directly to a hose, the outlet shall terminate in a union connection complying with IAA specifications, "Hose Connection Standards."*

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 seal cap secured in place. This cap shall be used to seal the outlet except when a hose, a regulator, or piping is attached.

538. Where station outlets are equipped with approved 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.

NOTE: 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 IAA-RMA "Specification for Rubber Welding Hose."*

NOTE: The generally recognized colors are red for acetylene and other fuel-gas hose, green for oxygen hose, and black for inert gas or air hose.

542. When parallel lengths of oxygen and fuel gas hose are taped together for convenience and to prevent tangling, not more than four inches out of each eight shall be covered by tape.

543. Metal-clad or armored hose is not recommended. However, as part of a machine or appliance when conditions of use make metal reinforcing advantageous, hose may be used provided the metal reinforcing is internal and is not exposed on the inside or the outside of the hose.

544. Hose connections shall comply with IAA "Standard Hose Connection Specifications."*

545. Hose connections shall be clamped or otherwise securely fastened in a manner that will withstand, without leaking, twice

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

the pressure to which they are normally subjected but not less than a pressure of 300 psig.

546. Hose shall be inspected frequently for leaks, burns, worn places, loose connections or other defect which may render the hose unfit for service. When hose shows excessive wear or has been subjected to a flash back, it shall be inspected and tested, before being returned to service, at twice the normal pressure to which it is subjected in service, but not less than 200 psig. Defective hose shall be destroyed.

55. Pressure Reducing Regulators

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

552. Regulators should be returned to the supplier for repairs, calibrations, or adjustments. When regulators or parts of regulators, including gages, need repair, the work shall be performed by skilled mechanics who have been properly instructed.

553. Low-pressure gages attached to regulators shall be periodically tested to insure their accuracy. Oxygen gages shall not be tested with oil.

554. Union nuts and connections on regulators shall be inspected before use to detect faulty seats which may cause leakage of gas when the regulators are attached to the cylinder valves. Damaged nuts or connections shall be destroyed.

CHAPTER 6. ACETYLENE GENERATORS

60. Approval and Marking

601. Generators shall be approved, of the carbide-to-water types, 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 approved and marked. Unless specifically approved for higher ratings, carbide-feed generators shall be rated at one cubic foot per hour per pound of carbide required for a single complete charge.

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. Generators, especially in congested areas, should be placed in outside generator houses constructed and located in compliance with Section 65.

622. The installation of approved generators within buildings may be permitted in accordance with Section 65.

NOTE: The authority having jurisdiction may prohibit acetylene generators in certain buildings or certain areas.

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

NOTE: An open connection for the residue drain at the generator is desirable to enable the operator to observe leakage of generating water from the drain valve.

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 65.)

6333. When not located within a heated building, gas holders shall be protected against freezing.

6334. 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 inches or more above the landing point of the bell.

6335. 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.

6336. 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.

6337. If acetylene is used from the gas holder without increase in pressure at some points but with increase in pressure by a compressor or booster pump at other points, approved piping protective devices shall be installed in each supply line. The low-

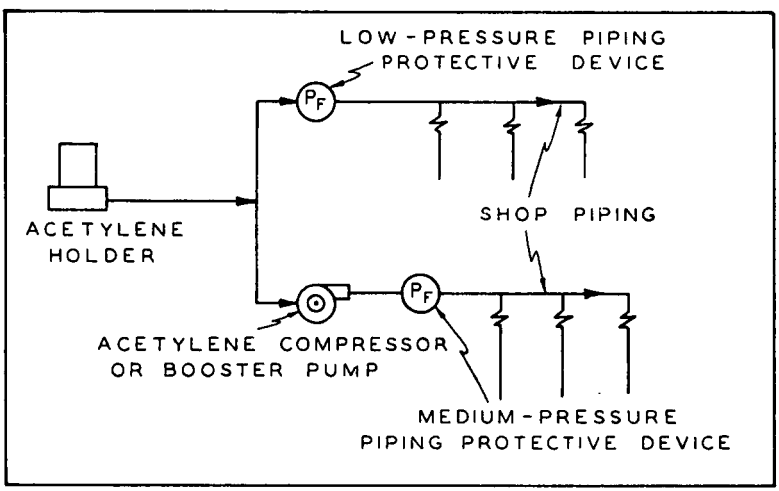

Figure 4
Protective Devices for Gas Holders, Compressors and Booster Pumps.

pressure protective device shall be located between the gas holder and the shop piping, and the medium-pressure protective device shall be located between the compressor or booster pump and the shop piping. (See Figure 4.)

634. Acetylene Compressor or Booster Pump Equipment

6341. Compressors or booster pumps shall be approved.

6342. Wiring and electrical equipment in compressor or booster pump rooms or enclosures shall conform to the provisions of the National Electrical Code, NFPA No. 70, Article 501, for Class I, Division 2 locations.

6343. Compressor or booster pumps shall be provided with pressure relief valves which will relieve pressure exceeding 15 psig to a safe outdoor location as provided in 6323, or by returning the gas to the inlet side or to the gas supply source.

6344. 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.

6345. Compressor or booster pump discharge outlets shall be provided with approved protective equipment. (See Section 52.)

6346. Compressors and booster pump equipment shall be located in well-ventilated areas away from open flames, electrical or mechanical sparks, or other ignition sources.

64. Portable Acetylene Generators

641. Portable generators shall be of a type approved for portable use.

642. Portable generators shall not be operated within 10 feet of combustible material other than floors.

643. The rooms in which portable generators are operated shall have a minimum total volume of 35 times the total acetylene generating capacity per charge of all generators in the room. These rooms shall have a minimum ceiling height of ten feet.

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

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

645. Portable generators shall be taken outdoors for cleaning, charging or purging.

646. Charged portable generators shall not be moved by cranes or derricks.

647. When not in use, portable generators shall not be stored in rooms in which open flames are used unless the generators contain no carbide and have been thoroughly purged of acetylene. Storage rooms shall be well ventilated.

648. Portable generators, transported and operated on vehicles, shall be securely anchored.

649. Portable generators shall be located at a safe distance from the welding position so that they will not be exposed to sparks, slag, or misdirection of the torch flame or overheating from hot materials or processes.

65. 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.

651. Construction

6511. Openings in any outside generator house shall not be located within 5 feet of any opening in another building.

6512. Walls, floors, and roofs of outside generator houses shall be of noncombustible construction.

6513. Exit doors shall be located so as to be readily accessible in case of emergency.

6514. Buildings in which acetylene generators are located shall not exceed one story in height except that they may be installed on the top floor or roof of a multi- or single-story building.

6515. Generators installed inside buildings shall be enclosed in a separate room of ample size.

6516. The walls, partitions, floors, and ceilings of inside generator rooms shall be of noncombustible construction having a fire-resistance rating of at least one hour. The walls or partitions shall be continuous from floor to ceiling and shall be securely anchored. At least one wall of the room shall be an exterior wall.