NFPA 50
Standard for Bulk Oxygen Systems at Consumer Sites

1996 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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NFPA 50

Standard for

Bulk Oxygen Systems at Consumer Sites

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This edition of NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites*, 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 13-15, 1995, in Chicago, IL. It was issued by the Standards Council on January 12, 1996, with an effective date of February 2, 1996, 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 50 was approved as an American National Standard on February 2, 1996.

Origin and Development of NFPA 50

Development of NFPA 50 was initiated by the Compressed Gas Association, Inc., who submitted a complete text to the NFPA Committee on Gases in 1955. Working responsibility for the project was assigned to the Sectional Committee on Industrial Gases, and the standard was Tentatively Adopted in 1956. A revised edition was Officially Adopted in 1957, and subsequent revised editions were adopted in 1962 and 1965 as NFPA 566.

In June 1966 responsibility for NFPA 566 was reassigned to the Committee on Industrial and Medical Gases. With the 1971 edition, the standard was redesignated as NFPA 50.

Since the 1971 edition, revised editions were adopted in 1973, 1974, 1979, 1985, 1990, and 1996.

Technical 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 membership may have occurred. A key to classifications is found at the back of this document.

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.

Contents

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Bulk Oxygen Systems at Consumer Sites

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

Information on referenced publications can be found in Chapter 5 and Appendix B.

FOREWORD

Oxygen gas is colorless, odorless, tasteless, and nontoxic. It comprises about 21 percent of normal air and is about 10 percent heavier than air. At atmospheric pressure and temperatures below –297°F (–182.5°C) oxygen is a liquid. Oxygen is stable in both gas and liquid phases. In the absence of moisture, oxygen in the gaseous or liquid form is noncorrosive.

Oxygen is nonflammable. Ignition of combustible materials can occur more readily in an oxygen-rich atmosphere than in air, and combustion proceeds at a faster rate although no more total heat is released. This standard, therefore, provides primarily for protection of the bulk oxygen system from involvement by fire from sources apart from the system itself. It is important to locate bulk oxygen systems in well-ventilated locations since oxygen-rich atmospheres can collect temporarily in confined areas in the event of functioning of a safety relief device or leakage from the system.

Chapter 1 General

1-1 Scope.

1-1.1 This standard shall cover the general principles recommended for the installation of bulk oxygen systems on consumer premises where the supply to the consumer premises originates outside the consumer premises and is delivered by mobile equipment.

1-1.2 Retroactivity. Unless otherwise stated, the provisions of this standard shall not be applied retroactively to existing systems that were in compliance with the provisions of the standard in effect at the time of installation where such use does not constitute a distinct hazard to life or adjoining property.

1-1.3 This standard shall not apply to oxygen manufacturing plants or other establishments operated by the oxygen supplier or his agent for the purpose of storing oxygen and refilling portable containers, trailers, mobile supply trucks, or tank cars.

1-1.4 This standard shall not apply to oxygen storage systems having capacities less than those stated in the definition of Bulk Oxygen System in Section 1-3.

NOTE: For information on oxygen systems having capacities less than those stated in the definition of Bulk Oxygen System in Section 1-3, see NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes,* NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders,* and NFPA 99, *Standard for Health Care Facilities (Chapter 4 and Vacuum Systems).*

1-1.5 Where a bulk oxygen system is intended for medical gas applications, additional provisions are included in NFPA 99, *Standard for Health Care Facilities.*

1-2* Materials. 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 can be exposed in the containment and use of oxygen. Easily ignitible materials shall be avoided unless they are parts of equipment or systems that are approved, listed, or proved suitable by tests or by past experience.

1-3 Definitions. For the purpose of the standard, the following terms are defined as follows:

Approved. Acceptable to the authority having jurisdiction.

NOTE: The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization concerned with product evaluations that is in a position to determine compliance with appropriate standards for the current production of listed items.

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

NOTE: The phrase "authority having jurisdiction" is used in NFPA documents in a braod manner, since jurisdictions and approved agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiciton may be a federal, state, local or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or department official may be the authority having jurisdiction.

Bulk Oxygen System. A bulk oxygen system is an assembly of equipment, such as oxygen storage containers, pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping, that has a storage capacity of more than 20,000 ft^3 (566 m^3) of oxygen (NTP) including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers may be stationary or movable, and the oxygen may be stored as gas or liquid.

Combustible Liquid. Combustible liquid shall mean a liquid having a closed cup flash point at or above 100°F (37.8°C) and shall be subdivided as follows: Class II liquids shall include those having a flash point at or above 100°F (37.8°C) and below 140°F (60°C). Class IIIA liquids shall include those having a flash point at or above 140°F (60°C) and below 200°F (93.4°C). Class IIIB liquids shall include those having flash points at or above 200°F (93.4°C).

Cubic Foot. Cubic foot of gas at 14.7 psia (101 kPa) and 70°F (21°C).

Fire-Resistive Construction. A type of building construction as defined in NFPA 220, *Standard on Types of Building Construction.*

Flammable Liquid. Flammable liquid Class I shall mean any liquid having a closed cup flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (276 kPa) at 100°F (37.8°C).

Gallon. A standard U.S. gallon.

Listed. Equipment or materials included in a list published by an organization acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of listed equipment or materials, and whose listing states either that the equipment or material meets appropriate designated standards or has been tested and found suitable for use in a specified manner.

NOTE: The means for identifying listed equipment may vary for each organization concerned with product evaluation, some of which do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

Noncombustible/Limited-Combustible Construction. A type of building construction as defined in NFPA 220, *Standard on Types of Building Construction.*

Noncombustible Material (as defined in NFPA 220, *Standard on Types of Building Construction)*. A material which, 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, *Standard Method of Test for Behavior of Materials in a Vertical Tube Furnace at 750°C*, shall be considered noncombustible materials.

Shall. Indicates a mandatory requirement.

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

Wood Frame Construction. A type of building construction as defined in NFPA 220, *Standard on Types of Building Construction.*

Chapter 2 Siting

2-1 Location of Bulk Oxygen Systems.

2-1.1 Bulk oxygen storage systems shall be located aboveground out of doors, or shall be installed in a building of fire-resistive or noncombustible/limited-combustible construction, adequately vented, and used for that purpose exclusively. The location selected shall be such that containers and associated equipment shall not be beneath or exposed by the failure of electric power lines, piping containing all classes of flammable or combustible liquids (*see definitions, Section 1-3*), or piping containing flammable gases.

2-1.2 The system shall be located so that it is readily accessible to mobile supply equipment at ground level and to authorized personnel. Bulk oxygen systems shall not be located on rooftops of buildings or other structures.

2-1.3 On bulk liquid oxygen storage systems, the tank's liquid delivery connections, pressure relief device outlets, and the mobile supply equipment withdrawal connection shall be at least 8 ft (2.5 m) from the inlet of underground sewer systems.

2-1.4 Where oxygen is stored as a liquid, surfacing of noncombustible material shall be provided at ground level under liquid delivery connections for the storage container and mobile supply equipment. This area of noncombustible surfacing shall be at least 3 ft (1 m) in diameter from points at ground level where leakage of liquid oxygen might fall during unloading and normal operation of the system. The area under the mobile supply equipment shall be at least the full width of the vehicle and at least 8 ft (2.5 m) in the direction of the vehicle axis. For purposes of this standard, asphaltic or bitumastic paving is considered to be combustible. The slope, if any, of such areas shall take into consideration the possible flow of spilled liquid oxygen to adjacent combustible material. If expansion joints are used, fillers shall also be of noncombustible materials.

2-1.5* Where it is necessary to locate a bulk oxygen system on ground lower than all classes of adjacent flammable or combustible liquid storage, suitable means shall be taken (such as by diking, diversion curbs, or grading) with respect to the adjacent flammable or combustible liquid storage to prevent accumulation of liquids under the bulk oxygen system.

2-2* Distance between Bulk Oxygen Systems and Exposures. Except as provided in 2-2.14, the minimum distance from any bulk oxygen storage container to exposures, measured in the most direct line (except as indicated in 2-2.5 and 2-2.11), shall be as indicated in 2-2.1 to 2-2.14 inclusive.

2-2.1 50 ft (15 m) from buildings of wood frame construction.

2-2.2 Not less than 1 ft (0.3 m) (or other distance to permit system maintenance) from buildings of other than wood frame construction.

2-2.3 At least 10 ft (3 m) from any opening in walls of adjacent structures. This provision shall apply to all elements of a bulk oxygen system where the oxygen storage is high pressure gas. Where the storage is as a liquid, this provision shall apply to only pressure regulators, safety devices, vaporizers, manifolds, and interconnecting piping.

2-2.4 All Classes of Flammable and Combustible Liquid Storage Aboveground.

Distance		Capacity	
(ft)	(m)	(gal)	(L)
25*	7.5	1000 or less	3785
50*	15	1001 or more	3789

*Can be reduced to 15 ft (4.6 m) for Class IIIB combustible liquids.

2-2.5 All Classes of Flammable and Combustible Liquid Storage Belowground.

Distance Measured Horizontally from Oxygen Storage Container to Tank		Distance from Oxygen Storage Container to Filling and Vent Connections or Openings to Tank	
(ft)	(m)	(ft)	(m)
15	4.6	25	7.5

2-2.6 Flammable Gases Aboveground.

Flammable Gas	Quantity	Distance	
		(ft)	(m)
Liquefied Hydrogen*	Any	75	22.5
Other Liquefied Gases	1000 gal (3785 L) or less	25	7.5
	Over 1000 gal (3785 L)	50	15
Non-liquefied or Dissolved Gases	25,000 ft^3 (708m^3) (NTP) or less	25	7.5
	Over 25,000 ft^3 (708 m^3) (NTP)	50	15

*See NFPA 50B, *Standard for Liquefied Hydrogen Systems at Consumer Sites.*

2-2.7 50 ft (15 m) from solid materials that burn rapidly, such as excelsior or paper.

2-2.8 25 ft (7.5 m) from solid materials that burn slowly, such as coal and heavy timber.

2-2.9 75 ft (22.5 m) in one direction and 35 ft (11 m) in approximately 90 degrees direction from confining walls [not including protective structures having a minimum fire resistance rating of two hours less than 12 ft (3.7 m) high] where the container is enclosed on three sides or fewer to provide adequate ventilation in courtyards and similar confining areas.

2-2.10 50 ft (15 m) from places of public assembly.

2-2.11 50 ft (15 m) in a direct line from the inner container pressure relief device discharge piping outlets and filling and vent connections from areas occupied by nonambulatory patients.

2-2.12 10 ft (3 m) from any public sidewalk or parked vehicles.

2-2.13 5 ft (1.5 m) from any line of adjoining property that can be built upon.

2-2.14 The distances in 2-2.1, 2-2.4 to 2-2.8 inclusive, 2-2.12, and 2-2.13 shall not apply where protective structures having a minimum fire resistance of 2 hours interrupt the line-of-sight between uninsulated portions of the bulk oxygen storage installation and the exposure. In such cases, the bulk oxygen installation shall be a minimum distance of 1 ft (0.3 m) (or greater distance if required for system maintenance) from the protective structure.

The protective structure (in lieu of distance) protects uninsulated oxygen storage containers or supports, control equipment enclosures, and system piping (or parts thereof) from external fire exposure. Liquid oxygen storage containers are insulated. Such containers can provide line-of-sight protection for uninsulated system components.

Chapter 3 System Fabrication

3-1 Bulk Oxygen Storage Containers.

3-1.1 Foundations and Supports. Permanently installed containers shall be provided with substantial supports of noncombustible material on firm foundations of noncombustible material.

3-1.2 Liquid oxygen containers shall comply with one of the following:

(a) Be fabricated from materials meeting the impact test requirements of Paragraph UG-84 of the ASME *Boiler and Pressure Vessel Code*, Section VIII — Unfired Pressure Vessels. Containers operating at pressures above 15 psig (103 kPa) shall be designed, constructed, and tested in accordance with appropriate requirements of the ASME *Boiler and Pressure Vessel Code*, Section VIII — Unfired Pressure Vessels. Insulation surrounding the liquid oxygen container shall be of noncombustible material, or

(b) Be designed, constructed, tested, and maintained in accordance with U.S. Department of Transportation (DOT) Specifications and Regulations for 4L containers.

3-1.3 High-pressure gaseous oxygen containers shall comply with one of the following:

(a) Be designed, constructed, and tested in accordance with appropriate requirements of the ASME *Boiler and Pressure Vessel Code*, Section VIII — Unfired Pressure Vessels, or

(b) Be designed, constructed, tested, and maintained in accordance with U.S. Department of Transportation (DOT) Specifications and Regulations.

3-2 Piping, Tubing, and Fittings.

3-2.1 Piping, tubing, and fittings shall be suitable for oxygen service and for the pressures and temperatures involved.

3-2.2 Material specifications and thickness requirements for piping and tubing shall conform to ANSI/ASME B31.3, *Code for Chemical Plant and Petroleum Refinery Piping.*

3-2.3* Piping or tubing for operating temperatures below –20°F (–28.9°C) shall be fabricated from materials meeting the impact test requirements of Chapter III of ANSI/ASME B31.3, *Code for Chemical Plant and Petroleum Refinery Piping*, when tested at the minimum operating temperature to which the piping can be subjected in service.

3-3 Safety Relief Devices.

3-3.1 Bulk oxygen storage containers, regardless of design pressure, shall be equipped with safety relief devices as required by the ASME Code or the DOT Specifications and Regulations. (*See Section 3-1.*)

3-3.2 Bulk oxygen storage containers designed and constructed in accordance with DOT Specifications [*see 3-1.3(b)*] shall be equipped with safety relief devices as required by the DOT.

3-3.3 Bulk oxygen storage containers designed and constructed in accordance with the ASME *Boiler and Pressure Vessel Code*, Section VIII — Unfired Pressure Vessels, shall be equipped with safety relief devices meeting the provisions of CGA Publication S-1.3, *Safety Relief Device Standards for Compressed Gas Storage Containers.*

3-3.4 Insulation casing on liquid oxygen containers shall be equipped with suitable safety relief devices.

3-3.5 All safety relief devices shall be so designed or located that moisture cannot collect and freeze in a manner that would interfere with proper operation of the device.

3-4 Liquid Oxygen Vaporizers.

3-4.1 The vaporizer shall be anchored and its connecting piping shall provide for the effects of expansion and contraction due to temperature changes.

3-4.2 The vaporizer and its piping shall be protected on the oxygen and heating medium sections with safety relief devices.

3-4.3 Heat used in an oxygen vaporizer shall be indirectly supplied only through mediums such as steam, air, water, or water solutions that do not react with oxygen.

3-4.4 If electric heaters are used to provide the primary source of heat, the vaporizing system shall be electrically grounded.

3-5 Equipment Assembly and Installation.

3-5.1 Equipment making up a bulk oxygen system shall be cleaned in order to remove oil, grease, or other readily oxidizable materials before placing the system in service.

3-5.2 Joints in piping and tubing shall be permitted to be made by welding or brazing, or by use of flanged, threaded, socket, slip, or compression fittings. Gaskets or thread sealants shall be suitable for oxygen service. Brazing materials shall have a melting point above 1000°F (538°C).

3-5.3 Valves, gauges, regulators, and other accessories shall be suitable for oxygen service.

3-5.4 Installation of bulk oxygen systems shall be supervised by personnel familiar with proper practices with reference to their construction and use.

3-5.5 After installation all field-erected piping shall be tested and proved gastight at maximum operating pressure. Any medium used for testing shall be oil-free and nonflammable.

3-5.6 Storage containers, piping, valves, regulating equipment, and other accessories shall be protected against physical damage and against tampering by the general public. A shut-off valve shall be located in liquid product withdrawal lines as close to the container as practical.

3-5.7 Any enclosure containing oxygen control or operating equipment shall be vented.

3-5.8 The bulk oxygen storage location shall be permanently placarded to indicate: "OXYGEN — NO SMOKING — NO OPEN FLAMES."

3-5.9 Bulk oxygen installations are not hazardous (classified) locations as defined and covered in Article 500 of NFPA 70, *National Electrical Code*®. General purpose types of electrical wiring and equipment shall be acceptable. Such equipment shall be installed in accordance with the applicable provisions of NFPA 70, *National Electrical Code*.

Chapter 4 Operation and Maintenance

4-1 Operating Instructions. For installations that require any operation of equipment by the user, legible instructions shall be maintained at operating locations.

4-2 Maintenance.

4-2.1 Each bulk oxygen system installed on consumer premises shall be inspected annually and maintained by a qualified representative of the equipment owner.

4-2.2 Weeds and long dry grass shall be cut back within 15 ft (4.6 m) of any bulk oxygen storage container.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes,* 1992 edition.

NFPA 55, *Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders,* 1993 edition.

NFPA 70, *National Electrical Code*, 1996 edition.

NFPA 99, *Standard for Health Care Facilities,* 1996 edition.

NFPA 220, *Standard on Types of Building Construction*, 1995 edition.

5-1.2 ASME Publications. American Society of Mechanical Engineers, 345 East 47th St., New York, NY 10017.

ANSI/ASME B31.3, *Code for Chemical Plant and Petroleum Refinery Piping*, 1993.

ASME *Boiler and Pressure Vessel Code,* 1995.

5-1.3 CGA Publication. Compressed Gas Association, Inc., 1235 Jefferson Davis Highway, Arlington, VA 22202.

S-1.3, *Safety Relief Device Standards for Compressed Gas Storage Containers*, 1980.

5-1.4 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E 136, *Standard Method of Test for Behavior of Materials in a Vertical Tube Furnace at 750° C*, 1994.

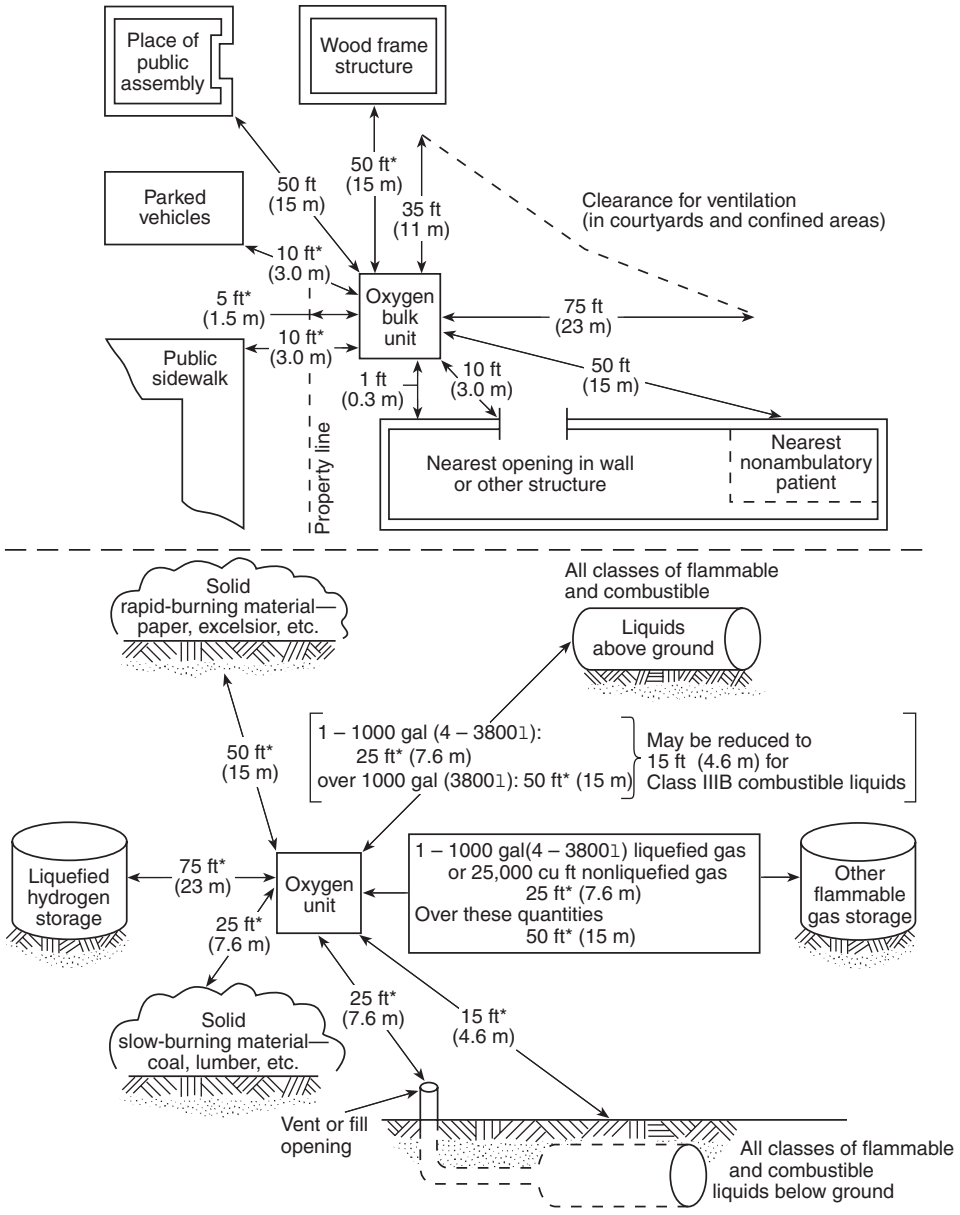
5-1.5 U.S. Government Publication. The following publication is available from the U.S. Government Printing Office, Washington, DC 20402.

DOT Specifications and Regulations. *Code of Federal Regulations*, Title 49, Transportation, Parts 171-190. (Also available from the Association of American Railroads, American Railroads Bldg., 1920 L St. NW, Washington, DC 20036, and American Trucking Assn., Inc., 1916 P St. NW, Washington, DC 20036.)

Appendix A Explanatory Material

Appendix A is not a part of the requirements of this NFPA document but is included for informational purposes only. This appendix contains explanatory material, numbered to correspond with the applicable text paragraphs.

A-1-2 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. Data regarding the combustibility and ease of ignition of materials is available in NFPA 53, *Guide on Fire Hazards in Oxygen-Enriched Atmospheres.*



*NOTE: These distances do not apply where protective structures having a minimum fire resistance rating of two hours interrupt the line-of-sight between uninsulated portions of the bulk oxygen storage installation and the exposure. The protective structures protect uninsulated oxygen storage containers or supports, control equipment, and system piping (or parts thereof) from external fire exposure. Liquid oxygen storage containers are insulated. Such containers may provide line-of-sight protection for uninsulated system components. Interruption of the line-of-sight means that an "eye" on any part of the uninsulated portion of the bulk oxygen storage installation cannot "see" any part of the exposure. [*See 2-2(n)*].

Figure A-2-2 Distance between bulk oxygen systems and exposures. (This diagram is not a part of the requirements of this standard, and the text shall govern.)

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. Other recognized ignition mechanisms include particle impact, mass impact, static electric discharge, electrical arc, fresh metal exposure, resonance, and promoted ignition.

A-2-1.5 When locating bulk oxygen systems near all classes of aboveground flammable or combustible liquid storage that may be either indoors or outdoors, it is advisable to locate the system on ground higher than the flammable or combustible liquid storage.

A-2-2 Figure A-2-2 serves to illustrate the separation distances between bulk oxygen systems and exposures.

A-3-2.3 Some materials suitable for low temperature piping are austenitic chromium-nickel alloy steels, copper, copper-silicon alloys, aluminum, and some brasses and bronzes.

Appendix B Referenced Publications

B-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

B-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 50B, *Standard for Liquefied Hydrogen Systems at Consumer Sites*, 1994 edition.

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