



MEDICAL GAS SAFETY

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Not every college campus or university will have medical gases but if you do, you should be aware of some fire safety and health safety issues with these gases. NFPA 99, Health Care Facilities Code-2012 edition, lists medical gas (gases used for medical care or treatment) as oxygen, nitrous oxide, medical air, carbon dioxide and helium. You may have some of these gases on your campus, which may not be used for medical applications. The hazards are independent of the use of the gas. However, this article will address the gases that are used for medical purposes and will not include the hazards of the gases if used for other applications such as industrial processes.

Oxygen, nitrous oxide, carbon dioxide and helium can occur in both the liquid or gaseous state. If there is a large demand for a particular gas, it may be more efficient to utilize the gas in the liquid state as you can take advantage of the expansion ratio and store a large amount of gas in a smaller container. In the liquid state, gases are stored in containers, which have hazards that are different from the gases in the gaseous stage. Medical gases stored in the gaseous state, are stored in compressed gas cylinders of varying sizes.

For the purposes of this article, the hazards of the two oxidizing gases, oxygen and nitrous oxide, will be examined. The topics that will be discussed include storage, personnel protection (freeze hazard), transfilling, ventilation and special precautions when handling cylinders.

Storage:

As mentioned previously, oxygen and nitrous oxide can be stored as a liquid or as a gas. If they are stored as a liquid they will be in a container of various sizes. Bulk oxygen has a storage capacity exceeding 20,000 ft³. Bulk nitrous oxide has a storage capacity exceeding 28,000 ft³. One of the hazards of cryogenic liquids is



the potential freeze hazard if the liquid contacts skin. The freezing point of liquid oxygen is -368.77°F (-182.96°C). Contact with this liquid will cause severe frostbite and caution and protection should be used when working around these systems.

Dewar containers are containers for the storage of cryogenic liquids of much smaller capacities than bulk systems. Several common capacities for liquid oxygen Dewars are 160, 180 and 240 liter containers. Because the liquid oxygen has an expansion ratio of 1:860 at ambient temperatures, the liquid oxygen will expand and will vent from all containers of all sizes, including bulk stor-

age. The venting of these gases should be considered when locating the containers such that they do not vent next to building openings such as window, doors and other openings and has clearances to public walkways, parked vehicles, wood framed structures and places of public assembly. Figure A.5.1.3.5.12(a) shows the

clearances from the oxygen bulk unit.

Another hazard associated with the bulk storage of liquid oxygen or nitrous oxide is the compatibility of the cryogenic liquid and the surface below the container, the foundation and the fill point. Oxidizing cryogenic liquids

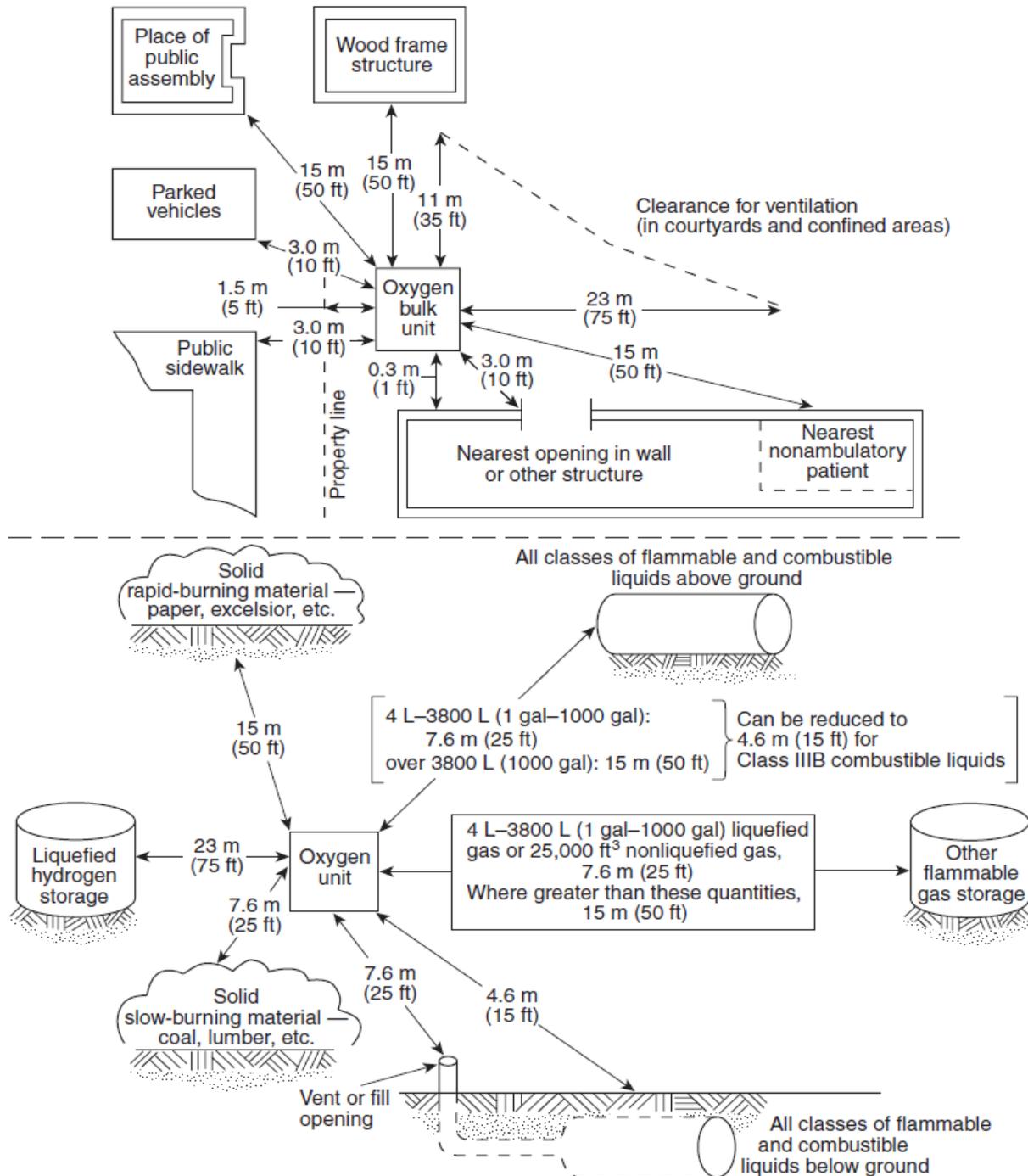


FIGURE A.5.1.3.5.12(a) Distance Between Bulk Oxygen Systems and Exposures.

are not compatible with hydrocarbon based surfaces such as asphalt and are not compatible with hydrocarbon materials in general and the mixture of liquid oxygen with a hydrocarbon based material can react violently. NFPA 55, Compressed Gases and Cryogenic Fluids Code, requires stationary tanks to be provided with concrete or masonry foundations or structural steel supports on firm concrete or masonry foundations.

According to NFPA 99, the design and construction of central supply locations and the storage of positive pressure medical gases equal to or in excess of 3000 ft³ shall meet the following requirements:

- Constructed in a manner to allow hand trucks to move cylinders in and out of the room.
- Secured by a lockable door, gate or other means.
- If outdoors, have a wall or fence constructed of noncombustible material.
- If indoors, be constructed of noncombustible or limited-combustible materials.
- They shall comply with the NFPA 70, National Electrical Code®, for ordinary locations.
- Heated by indirect means such as steam or hot water.
- A means to secure all cylinders whether full or empty.
- Power in the room is supplied by the essential electrical system.
- All racks, shelves and supports shall be noncombustible or limited-combustible material.
- All electrical devices (light switches, receptacles, etc.) protected from mechanical damage.

Transfilling:

There will be times when it will be necessary or desirable to transfill compressed gases from one cylinder to another or to transfill liquid oxygen from one container to another. This is often a cost savings measure where a large supply of gas can be used as the main source and transfilling of smaller cylinders and containers is cost effective. This may occur in the laboratory or for patient needs if you have health care facilities on campus.

For cylinders, the mixing of different gases inside a cyl-

inder shall be prohibited because of the possibility of contamination and compatibility issues. Additionally, the transfilling of medical gases from one cylinder to another in a patient room is prohibited because of the possibility of leakage which could produce an oxygen enriched atmosphere and cause materials to burn more vigorously if ignited.

There are two different, yet similar requirements for transfilling liquid oxygen containers. NFPA 99 separates the requirements into systems utilizing pressures above 50 psi and those equal to or below 50 psi. For systems operating above 50 psi, the requirements are as follows:

- A 1-hour fire-resistive fire barrier, separating the transfilling from any portion of the facility that houses, examines or treats patients.
- The area has mechanical ventilation
- The area is sprinklered
- The flooring is ceramic or concrete
- Signage posted indicating transfilling is occurring and there is no smoking permitted
- The individual performing the transfilling has been properly trained

For systems operating at 50 psi or under, the requirements are as follows:

- The area is well ventilated
- The flooring is noncombustible
- Signage posted indicating no smoking is permitted
- The individual performing the transfilling has been properly trained
- The guidelines of CGA P-2.6, Transfilling of Low-Pressure Liquid Oxygen to be Used for Respiration, are met

Special Precautions for Handling Oxygen Cylinders and Manifolds:

In addition to the storage and operational uses of medical gases, there are special precautions that must be adhered to for safety when utilizing oxygen cylinders. These precautions center around compatibility of materials and oxygen cylinders and the protection of the cylinders from damage.

As mentioned previously, oxygen can react violently with incompatible materials. Therefore, care must be used to ensure oil, grease or readily flammable material does not come in contact with the oxygen cylinders. This also includes oily or greasy hands, gloves or rags.

The cylinder should also be protected against mechanical damage. If a cylinder should fall over and the valve sheared off, the high pressure cylinder will be propelled like a rocket and could cause severe injury or death. Therefore the cylinder valve covers must remain on the cylinders when not in use. In addition, the cylinders should be restrained by some mechanical means to ensure they do not fall over.

Conclusion:

Not all college campuses will use medical gases. Those that comprise of teaching hospitals or have medical facilities will have and use these gases. Following the requirements of NFPA 99, Health Care Facilities Code and NFPA 55, Compressed Gases and Cryogenic Fluids Code, will help ensure that personnel, students and patients are protected from the hazards associated with medical gases.

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