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MEDICAL GAS STORAGE GUIDELINES AND REQUIREMENTS

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PREFACE

The guidelines provided within this document are for the storage of non-flammable medical gases (including oxygen). They are based upon industry standards and the National Fire Protection Association (NFPA) set of codes and standards. Specifically, the following standards are referenced:

NFPA 99 – Health Care Facilities Code (2012 edition)

- Chapter 5 – Gas and Vacuum Systems (i.e. piped-in medical gas systems)
- Chapter 11 – Gas Equipment (Individual cylinders not intended for use in a piped-in system)

The 2012 edition of NFPA 99 is the standard that has been adopted by the Centers for Medicare and Medicaid Services (CMS) and The Joint Commission.

It should be noted that Authorities Having Jurisdiction (AHJ's) other than CMS and The Joint Commission may have requirements more stringent than those found within NFPA 99. In this case the facility would be required to follow the most stringent requirements.

INDEX

Cylinder Capacity 4

Cylinder Storage Requirements for Quantities up to 300 Cubic Feet..... 5

Cylinder Storage Requirement for Quantities Above 300 Cubic Feet
and up to 3,000 Cubic Feet..... 6

Cylinder Storage Requirements for Quantities 3000 Cubic Feet or Greater..... 8

Transfilling Liquid Oxygen Guidelines 13

CYLINDER CAPACITY

E-Cylinder: Approximately 25 Cubic Feet of Gas per Cylinder



H-Cylinder: Approximately 250 Cubic Feet of Gas per Cylinder



Liquid Oxygen Dewars: 41 Liters of Liquid / Approximately 1,235 Cubic Feet of Gas per Container



CYLINDER STORAGE REQUIREMENTS

I. QUANTITIES UP TO 300 CUBIC FEET PER SMOKE COMPARTMENT – exposed to the corridor (12 E-Cylinders or 1 H-Cylinder)

CYLINDER STORAGE GUIDELINES:

- Cylinders may be exposed to the corridor rather than enclosed in a room, however cylinders may not infringe on the designed width of the corridor.
- Cylinders must be properly secured.
- Cylinders in use by patients, on crash carts, stretchers, wheelchairs or in patient rooms for PRN use are not to be included in the 300 cu. ft. count.
- This allowance is only for patient care areas and cannot be applied to non-patient care areas.

NOTE: Both CMS and The Joint Commission have indicated that this allowance only applies to cylinders outside of an enclosure, exposed to but not projecting into the corridor. Therefore, those cylinders located within an enclosure (stored) will need to meet the more stringent requirements for oxygen storage of 3000 cubic feet or less. See Section II, below.

Code Reference: NFPA 99 (2012 Edition) Section 11.3.3.1

“Individual cylinder storage associated with patient care areas, not to exceed 22,500 square feet of floor area, shall not be required to be stored in enclosures.”

The standard references 300 cubic feet in an area of 22,500 square feet (no reference to “smoke compartment”). However, CMS and The Joint Commission both interpret this as “per smoke compartment.”

II. QUANTITIES UP TO 3000 CUBIC FEET PER LOCATION (120 E-Cylinders or 12 H-Cylinders or 2 Liquid Dewars)

NOTE: Cylinders Not Intended For Piped-In System

CYLINDER STORAGE GUIDELINES:

- Other than the requirement for non-combustible or limited combustible construction there is nothing in NFPA 99 that regulates the construction requirements for the room. This room does not have to be considered a “hazardous area” and the door is not required to be equipped with a self-closing device or have any particular fire resistance rating unless the other contents of the room warrant the room as a “hazardous area”.
- There are no specific requirements for ventilation of the room.
- Storage temperatures must not exceed 130 degrees Fahrenheit.
- No flammable liquids or gases may be stored within the room.
- Flammable and combustible materials must be a minimum 5 feet from cylinder storage (20 feet if the room is not protected by automatic sprinklers). A metal storage cabinet (or flammable liquids cabinet) may be utilized for storage purposes to eliminate the storage buffer requirements providing it has a minimum 30-minute fire resistance rating.
- Cylinder valve protection caps (when provided) shall be secured tightly in place unless the cylinder is connected for use.
- Cylinders must be secured by chains, racks or in stands.
- Racks for cylinder storage shall be permitted to be of wooden construction. Wrappers shall be removed prior to storage.
- Doors or gates must have a locking mechanism but do not have to be locked at all times.

Code Reference: NFPA 99 (2012 Edition) Section 11.3.2

11.3.2* Storage for nonflammable gases greater than 8.5 m³ (300 ft³), but less than 85 m³ (3000 ft³), at STP shall comply with the requirements in 11.3.2.1 through 11.3.2.3.

11.3.2.1 Storage locations shall be outdoors in an enclosure or within an enclosed interior space of noncombustible or limited combustible construction, with doors (or gates outdoors) that can be secured against unauthorized entry.

11.3.2.2 Oxidizing gases, such as oxygen and nitrous oxide, shall not be stored with any flammable gas, liquid, or vapor.

11.3.2.3 Oxidizing gases such as oxygen and nitrous oxide shall be separated from combustibles or materials by one of the following:

- (1) Minimum distance of 6.1 m (20 ft)

(2) Minimum distance of 1.5 m (5 ft) if the entire storage location is protected by an automatic sprinkler system designed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*

(3) Enclosed cabinet of noncombustible construction having a minimum fire protection rating of 1/2 hour

11.3.2.4 Gas cylinder and cryogenic liquid container storage shall comply with 5.1.3.5.12.

11.3.2.5 Cylinder and container storage locations shall comply with 5.1.3.3.1.7 with respect to temperature limitations.

11.3.2.6 Cylinder or container restraints shall comply with 11.6.2.3.

11.3.2.7 Smoking, open flames, electric heating elements, and other sources of ignition shall be prohibited within storage locations and within 6.1 m (20 ft) of outside storage locations.

11.3.2.8 Cylinder valve protection caps shall comply with 11.6.2.3.

11.3.2.9 Gas cylinder and liquefied gas container storage shall comply with 5.1.3.5.12

11.3.4.1 A precautionary sign, readable from a distance of 1.5 m (5 ft), shall be displayed on each door or gate of the storage room or enclosure.

11.3.4.2 The sign shall include the following wording as a minimum:

**CAUTION
OXIDIZING GAS(ES) STORED WITHIN
NO SMOKING**

III. QUANTITIES OF 3000 CUBIC FEET AND GREATER PER LOCATION

CYLINDER STORAGE GUIDELINES:

- The main differences (see above for other requirements) between storage of greater than 3000 cubic feet and less than 3000 cubic feet are the requirements for a 1-hour fire resistance rated enclosure and the requirement for ventilation of the room.
- Cylinders must be secured by chains, racks or in stands.
- Enclosures housing oxygen cylinders may not be used for any other purposes.
- The requirements for signage also apply for quantities greater than 3000 cubic feet. The required wording of the signage is dependent on the types of gasses located in the room. See below.

Code Reference: NFPA 99 (2012 Edition) Section 5.1.3 / 9.3.7

5.1.3* Category 1 Sources.

5.1.3.1 Central Supply System Identification and Labeling.

5.1.3.1.1* Containers, cylinders, and tanks shall be designed, fabricated, tested, and marked (stamped) in accordance with regulations of DOT, Transport Canada (TC) *Transportation of Dangerous Goods Regulations*, or the ASME *Boiler and Pressure Vessel Code*, "Rules for the Construction of Unfired Pressure Vessels," Section VIII. [55:7.1.5.1]

5.1.3.1.2 Cylinder contents shall be identified by attached labels or stencils naming the contents in accordance with CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*.

5.1.3.1.3 Liquid containers shall have additional product identification visible from all directions with a minimum of 51 mm (2 in.) high letters such as a 360-degree wraparound tape for medical liquid containers.

5.1.3.1.4 Cryogenic liquid containers shall be provided with gas-specific outlet connections in accordance with CGA V-5, *Diameter-Index Safety System (Noninterchangeable Low Pressure Connections for Medical Gas Applications)*, or CGAV-1, *Compressed Gas Association Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*.

5.1.3.1.5 Cylinder and cryogenic liquid container outlet connections shall be affixed in such a manner as to be integral to the valve(s), unremovable with ordinary tools, or so designed as to render the attachment point unusable when removed.

5.1.3.1.6 The contents of cylinders and cryogenic liquid containers shall be verified prior to use.

5.1.3.1.7 Labels shall not be defaced, altered, or removed, and connecting fittings shall not be modified.

5.1.3.1.8 Locations containing positive pressure gases other than oxygen and medical air shall have their door(s) labeled as follows:

**Positive Pressure Gases
NO Smoking or Open Flame
Room May Have Insufficient Oxygen
Open Door and Allow Room to
Ventilate Before Entering**

5.1.3.1.9 Locations containing central supply systems or cylinders containing only oxygen or medical air shall have their door(s) labeled as follows:

**Medical Gases
NO Smoking or Open Flame**

5.1.3.2 Central Supply System Operations.

5.1.3.2.1 The use of adapters or conversion fittings to adapt one gas-specific fitting to another shall be prohibited.

5.1.3.2.2 Cylinders and containers shall be handled in strict accordance with 11.6.2.

5.1.3.2.3 Only gas cylinders, reusable shipping containers, and their accessories shall be permitted to be stored in rooms containing central supply systems or gas cylinders.

5.1.3.2.4 No flammable materials, cylinders containing flammable gases, or containers containing flammable liquids shall be stored in rooms with gas cylinders.

5.1.3.2.5 If cylinders are wrapped when received, the wrappers shall be removed prior to storage.

5.1.3.2.6 Cylinders without correct markings or whose markings and gas-specific fittings do not match shall not be used.

5.1.3.2.7 Cryogenic liquid storage units intended to supply gas to the facility shall not be used to transfill other liquid storage vessels.

5.1.3.2.8 Care shall be exercised when handling cylinders that have been exposed to freezing temperatures or containers that contain cryogenic liquids to prevent injury to the skin.

5.1.3.2.9 Cylinders containing compressed gases and containers for volatile liquids shall be kept away from radiators, steam piping, and like sources of heat.

5.1.3.2.10 When cylinder valve protection caps are supplied, they shall be secured tightly in place unless the cylinder is connected for use.

5.1.3.2.11 Containers shall not be stored in a tightly closed space.

5.1.3.3.2* Design and Construction. Locations for central supply systems and the storage of positive-pressure gases shall meet the following requirements:

(1) They shall be constructed with access to move cylinders, equipment, and so forth, in and out of the location on hand trucks complying with 11.4.3.1.1.

(2) They shall be secured with lockable doors or gates or otherwise secured.

(3) If outdoors, they shall be provided with an enclosure (wall or fencing) constructed of noncombustible materials with a minimum of two entry/exits.

(4) If indoors, they shall be constructed and use interior finishes of noncombustible or limited-combustible materials such that all walls, floors, ceilings, and doors are of a minimum 1-hour fire resistance rating.

(5)*They shall be compliant with *NFPA 70, National Electrical Code*, for ordinary locations.

(6) They shall be heated by indirect means (e.g., steam, hot water) if heat is required.

(7) They shall be provided with racks, chains, or other fastenings to secure all cylinders from falling, whether connected, unconnected, full, or empty.

(8)*They shall be supplied with electrical power compliant with the requirements for essential electrical systems as described in Chapter 6.

(9) They shall have racks, shelves, and supports, where provided, constructed of noncombustible materials or limited-combustible materials.

(10) They shall protect electrical devices from physical damage.

9.3.7 Medical Gas Storage or Transfilling.

9.3.7.2 Outdoor storage/installations for medical gases and cryogenic fluids shall be provided with ventilation per NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.

9.3.7.3* Medical gases and cryogenic fluids that are in use per Chapter 11 shall not require special ventilation.

9.3.7.4 Transfilling area shall be provided with ventilation in accordance with NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.

9.3.7.5 Indoor storage or manifold areas and storage or manifold buildings for medical gases and cryogenic fluids shall be provided with natural ventilation or mechanical exhaust ventilation in accordance with 9.3.7.5.1 through 9.3.7.8.

9.3.7.5.1* For the purposes of this section, the volume of fluid (gas and liquid) to be used in determining the ventilation requirements shall be the volume of the stored fluid when expanded to standard temperature and pressure (STP) of either the largest single vessel in the enclosed space or of the entire volume of the connected vessels that are on a common manifold in the enclosed space, whichever is larger.

9.3.7.5.2 Natural Ventilation.

9.3.7.5.2.1 Natural ventilation shall consist of two nonclosable louvered openings, each having an aggregate free opening area of at least 155 cm²/35 L (24 in.²/1000 ft³) of the fluid designed to be stored in the space and in no case less than 465 cm² (72 in.²).

9.3.7.5.2.2 One opening shall be located within 30 cm (1 ft) of the floor, and one shall be located within 30 cm (1 ft) of the ceiling.

9.3.7.5.2.3 The openings shall be located to ensure cross ventilation.

9.3.7.5.2.4 Natural ventilation openings shall be directly to the outside atmosphere without ductwork.

9.3.7.5.2.5 Mechanical ventilation shall be provided if natural ventilation requirements cannot be met.

9.3.7.5.3 Mechanical Ventilation.

9.3.7.5.3.1 Mechanical exhaust to maintain a negative pressure in the space shall be provided continuously, unless an alternative design is approved by the authority having jurisdiction.

9.3.7.5.3.2 Mechanical exhaust shall be at a rate of 1 L/sec of airflow for each 300 L (1 cfm per 5 ft³ of fluid) designed to be stored in the space and not less than 24 L/sec (50 cfm) nor more than 235 L/sec (500 cfm).

9.3.7.5.3.3 Mechanical exhaust inlets shall be unobstructed and shall draw air from within 300 mm (1 ft) of the floor and adjacent to the cylinder or containers.

9.3.7.5.3.4 Mechanical exhaust air fans shall be supplied with electrical power from the essential electrical system.

9.3.7.5.3.5 Dedicated exhaust systems shall not be required, provided that the system does not connect to spaces that contain combustible or flammable materials.

9.3.7.5.3.6 The exhaust duct material shall be noncombustible.

9.3.7.5.3.7 A means of make-up air shall be provided according to one of the following:

(1) Air shall be permitted via noncombustible ductwork to be transferred from adjacent spaces, from outside the building, or from spaces that do not contain combustible or flammable materials via noncombustible ductwork

(2) Air shall be permitted to be transferred from a corridor under the door up to the greater of 24 L/sec (50 cfm) or 15 percent of the room exhaust in accordance with NFPA 90A, *Standard for the Installation of Air Conditioning and Ventilating Systems*.

(3) Supply air shall be permitted to be provided from any building ventilation system that does not contain flammable or combustible vapors.

9.3.7.6 Discharge from the natural and mechanical ventilation systems shall be sited by a minimum separation distance in accordance with NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.

9.3.7.7 A storage room shall maintain a temperature not greater than 52°C (125°F).

9.3.7.8 A transfer or manifold room shall maintain a temperature not greater than 52°C (125°F) and not less than -7°C (20°F).

IV. TRANSFILLING LIQUID OXYGEN GUIDELINES

- The room where transfilling takes place must be separated from any portion of the facility where patients are housed, examined or treated by a fire barrier having a minimum 1-hour fire resistance rating.
 - Notes
 - Having a 1-hour enclosure of the room does not satisfy the code requirement. The room utilized for the transferring must be separated from all patient care areas of the building by a minimum 1-hour fire resistance rated separation.
 - The above requirement for the 1-hour separation is not applicable if the transferring pressure is less than 50 psi.
- The floor surface must be either concrete or ceramic tile.
- The area must be protected by automatic sprinklers.
 - Sprinkler protection not required if the transfilling pressure is less than 50 psi.
- The area must have mechanical ventilation.
 - Mechanical ventilation not required if transfilling pressure is less than 50 psi.
- A sign must indicate that the transfilling of liquid oxygen is taking place and smoking is not permitted must be posted.

Code Reference: NFPA 99 (2012 Edition) Section 11.5.2.3

11.5.2.3 Transfilling Liquid Oxygen. Transfilling of liquid oxygen shall comply with 11.5.2.3.1 or 11.5.2.3.2, as applicable.

11.5.2.3.1 Transfilling to liquid oxygen base reservoir containers or to liquid oxygen portable containers over 344.74 kPa (50 psi) shall include the following:

(1) A designated area separated from any portion of a facility wherein patients are housed, examined, or treated by a fire barrier of 1 hour fire-resistive construction.

(2) The area is mechanically ventilated, is sprinklered, and has ceramic or concrete flooring.

(3) The area is posted with signs indicating that transfilling is occurring and that smoking in the immediate area is not permitted.

(4) The individual transfilling the container(s) has been properly trained in the transfilling procedures.

11.5.2.3.2 Transfilling to liquid oxygen portable containers at 344.74 kPa (50 psi) and under shall include the following:

(1) The area is well ventilated and has noncombustible flooring.

(2) The area is posted with signs indicating that smoking in the area is not permitted.

(3) The individual transfilling the liquid oxygen portable container has been properly trained in the transfilling procedure.

(4) The guidelines of CGA P-2.6, *Transfilling of Low-Pressure Liquid Oxygen to be Used for Respiration*, are met.