

# CHAPTER 53

## COMPRESSED GASES

### SECTION 5301 GENERAL

**5301.1 Scope.** Storage, use and handling of *compressed gases* in *compressed gas* containers, cylinders, tanks and systems shall comply with this chapter and NFPA 55, including those gases regulated elsewhere in this code. Partially full *compressed gas* containers, cylinders or tanks containing residual gases shall be considered as full for the purposes of the controls required.

Liquefied natural gas for use as a vehicular fuel shall also comply with NFPA 52 and NFPA 59A.

*Compressed gases* classified as hazardous materials shall also comply with Chapter 50 for general requirements and chapters addressing specific hazards, including Chapters 58 (Flammable Gases), 60 (Highly Toxic and Toxic Materials), 63 (Oxidizers, Oxidizing Gases and Oxidizing Cryogenic Fluids) and 64 (Pyrophoric Materials).

Compressed hydrogen (CH<sub>2</sub>) for use as a vehicular fuel shall also comply with Chapters 23 and 58 of this code, the *International Fuel Gas Code* and NFPA 2.

Cutting and welding gases shall also comply with Chapter 35.

LP-gas shall also comply with Chapter 61 and the *International Fuel Gas Code*.

#### Exceptions:

1. Gases used as refrigerants in refrigeration systems (see Section 606).
2. Compressed natural gas (CNG) for use as a vehicular fuel shall comply with Chapter 23, NFPA 52 and the *International Fuel Gas Code*.
3. *Cryogenic fluids* shall comply with Chapter 55.

**5301.2 Permits.** Permits shall be required as set forth in Section 105.6.

### SECTION 5302 DEFINITIONS

**5302.1 Definitions.** The following terms are defined in Chapter 2:

**COMPRESSED GAS.**

**COMPRESSED GAS CONTAINER.**

**COMPRESSED GAS SYSTEM.**

**NESTING.**

**TUBE TRAILER.**

### SECTION 5303 GENERAL REQUIREMENTS

**5303.1 Containers, cylinders and tanks.** *Compressed gas* containers, cylinders and tanks shall comply with this section. *Compressed gas* containers, cylinders or tanks that are not designed for refillable use shall not be refilled after use of the original contents.

**5303.2 Design and construction.** *Compressed gas* containers, cylinders and tanks shall be designed, fabricated, tested, marked with the specifications of manufacture and maintained in accordance with the regulations of DOTn 49 CFR Parts 100-185 or the *ASME Boiler and Pressure Vessel Code*, Section VIII.

**5303.3 Pressure relief devices.** Pressure relief devices shall be in accordance with Sections 5303.3.1 through 5303.3.5.

**5303.3.1 Where required.** Pressure relief devices shall be provided to protect containers, cylinders and tanks containing *compressed gases* from rupture in the event of overpressure.

**Exception:** Cylinders, containers and tanks where exempt from the requirements for pressure relief devices specified by the standards of design *listed* in Section 5303.3.2.

**5303.3.2 Design.** Pressure relief devices to protect containers shall be designed and provided in accordance with CGA S-1.1, CGA S-1.2, CGA S-1.3 or the *ASME Boiler and Pressure Vessel Code*, Section VIII, as applicable.

**5303.3.3 Sizing.** Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated and to material-specific requirements as applicable.

**5303.3.4 Arrangement.** Pressure relief devices shall be arranged to discharge upward and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent structures or personnel.

**Exception:** DOTn specification containers having an internal volume of 30 cubic feet (0.855 m<sup>3</sup>) or less.

**5303.3.5 Freeze protection.** Pressure relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner that would interfere with the operation of the device.

**5303.4 Marking.** Stationary and portable *compressed gas* containers, cylinders, tanks and systems shall be marked in accordance with Sections 5303.4.1 through 5303.4.3.

**5303.4.1 Stationary compressed gas containers, cylinders and tanks.** Stationary *compressed gas* containers, cylinders and tanks shall be marked with the name of the gas and in accordance with Sections 5003.5 and 5003.6. Markings shall be visible from any direction of approach.

**5303.4.2 Portable containers, cylinders and tanks.** Portable *compressed gas* containers, cylinders and tanks shall be marked in accordance with CGA C-7.

**5303.4.3 Piping systems.** Piping systems shall be marked in accordance with ASME A13.1. Markings used for piping systems shall consist of the content's name and include a direction-of-flow arrow. Markings shall be provided at each valve; at wall, floor or ceiling penetrations; at each change of direction; and at not less than every 20 feet (6096 mm) or fraction thereof throughout the piping run.

**Exceptions:**

1. Piping that is designed or intended to carry more than one gas at various times shall have appropriate signs or markings posted at the manifold, along the piping and at each point of use to provide clear identification and warning.
2. Piping within gas manufacturing plants, gas processing plants, refineries and similar occupancies shall be marked in an *approved* manner.

**5303.5 Security.** *Compressed gas* containers, cylinders, tanks and systems shall be secured against accidental dislodgement and against access by unauthorized personnel in accordance with Sections 5303.5.1 through 5303.5.3.

**5303.5.1 Security of areas.** Areas used for the storage, use and handling of *compressed gas* containers, cylinders, tanks and systems shall be secured against unauthorized entry and safeguarded in an *approved* manner.

**5303.5.2 Physical protection.** *Compressed gas* containers, cylinders, tanks and systems that could be exposed to physical damage shall be protected. Guard posts or other *approved* means shall be provided to protect *compressed gas* containers, cylinders, tanks and systems indoors and outdoors from vehicular damage and shall comply with Section 312.

**5303.5.3 Securing compressed gas containers, cylinders and tanks.** *Compressed gas* containers, cylinders and tanks shall be secured to prevent falling caused by contact, vibration or seismic activity. Securing of *compressed gas* containers, cylinders and tanks shall be by one of the following methods:

1. Securing containers, cylinders and tanks to a fixed object with one or more restraints.
2. Securing containers, cylinders and tanks on a cart or other mobile device designed for the movement of *compressed gas* containers, cylinders or tanks.
3. Nesting of *compressed gas* containers, cylinders and tanks at container filling or servicing facilities or in sellers' warehouses not accessible to the public. Nesting shall be allowed provided the nested containers, cylinders or tanks, if dislodged, do not obstruct the required *means of egress*.
4. Securing of *compressed gas* containers, cylinders and tanks to or within a rack, framework, cabinet or similar assembly designed for such use.

**Exception:** *Compressed gas* containers, cylinders and tanks in the process of examination, filling, transport or servicing.

**5303.6 Valve protection.** *Compressed gas* container, cylinder and tank valves shall be protected from physical damage by means of protective caps, collars or similar devices in accordance with Sections 5303.6.1 and 5303.6.2.

**5303.6.1 Compressed gas container, cylinder or tank protective caps or collars.** *Compressed gas* containers, cylinders and tanks designed for protective caps, collars or other protective devices shall have the caps or devices in place except when the containers, cylinders or tanks are in use or are being serviced or filled.

**5303.6.2 Caps and plugs.** *Compressed gas* containers, cylinders and tanks designed for valve protection caps or other protective devices shall have the caps or devices in place. When outlet caps or plugs are installed, they shall be in place.

**Exception:** *Compressed gas* containers, cylinders or tanks in use, being serviced or being filled.

**5303.7 Separation from hazardous conditions.** *Compressed gas* containers, cylinders and tanks and systems in storage or use shall be separated from materials and conditions that pose exposure hazards to or from each other. *Compressed gas* containers, cylinders, tanks and systems in storage or use shall be separated in accordance with Sections 5303.7.1 through 5303.7.11.2.

**5303.7.1 Incompatible materials.** *Compressed gas* containers, cylinders and tanks shall be separated from each other based on the hazard class of their contents. *Compressed gas* containers, cylinders and tanks shall be separated from *incompatible materials* in accordance with Section 5003.9.8.

**5303.7.2 Combustible waste, vegetation and similar materials.** Combustible waste, vegetation and similar materials shall be kept not less than 10 feet (3048 mm) from *compressed gas* containers, cylinders, tanks and systems. A noncombustible partition, without openings or penetrations and extending not less than 18 inches (457 mm) above and to the sides of the storage area is allowed in lieu of such distance. The wall shall either be an independent structure, or the exterior wall of the building adjacent to the storage area.

**5303.7.3 Ledges, platforms and elevators.** *Compressed gas* containers, cylinders and tanks shall not be placed near elevators, unprotected platform ledges or other areas where falling would result in *compressed gas* containers, cylinders or tanks being allowed to drop distances exceeding one-half the height of the container, cylinder or tank.

**5303.7.4 Temperature extremes.** *Compressed gas* containers, cylinders and tanks, whether full or partially full, shall not be exposed to artificially created high temperatures exceeding 125°F (52°C) or subambient (low) temperatures unless designed for use under the exposed conditions.

**5303.7.5 Falling objects.** *Compressed gas* containers, cylinders, tanks and systems shall not be placed in areas

where they are capable of being damaged by falling objects.

**5303.7.6 Heating.** *Compressed gas* containers, cylinders and tanks, whether full or partially full, shall not be heated by devices that could raise the surface temperature of the container, cylinder or tank to above 125°F (52°C). Heating devices shall comply with the *International Mechanical Code* and NFPA 70. *Approved* heating methods involving temperatures of less than 125°F (52°C) are allowed to be used by trained personnel. Devices designed to maintain individual *compressed gas* containers, cylinders or tanks at constant temperature shall be *approved* and shall be designed to be fail-safe.

**5303.7.7 Sources of ignition.** Open flames and high-temperature devices shall not be used in a manner that creates a hazardous condition.

**5303.7.8 Exposure to chemicals.** *Compressed gas* containers, cylinders, tanks and systems shall not be exposed to *corrosive* chemicals or fumes that could damage containers, cylinders, tanks, valves or valve-protective caps.

**5303.7.9 Exhausted enclosures.** Where exhausted enclosures are provided as a means to segregate *compressed gas* containers, cylinders and tanks from exposure hazards, such enclosures shall comply with the requirements of Section 5003.8.5.

**5303.7.10 Gas cabinets.** Where gas cabinets are provided as a means to separate *compressed gas* containers, cylinders and tanks from exposure hazards, such gas cabinets shall comply with the requirements of Section 5003.8.6.

**5303.7.11 Tube trailers.** Tube trailers, including those containing compatible *compressed gases*, shall be surrounded by a clear space of not less than 3 feet (914 mm) to allow for maintenance, access and inspection.

**5303.7.11.1 Individual tube trailers containing incompatible materials.** Increased separation distances between individual tube trailers containing incompatible gases shall be provided where required by Section 5303.7.1.

**5303.7.11.2 Connections.** Piping systems used to connect tube trailers to a user piping system shall not be viewed as an encroachment into the 3-foot (914 mm) clear space.

**5303.8 Wiring and equipment.** Electrical wiring and equipment shall comply with NFPA 70. *Compressed gas* containers, cylinders, tanks and systems shall not be located where they could become part of an electrical circuit. *Compressed gas* containers, cylinders, tanks and systems shall not be used for electrical grounding.

**5303.9 Service and repair.** Service, repair, modification or removal of valves, pressure-relief devices or other *compressed gas* container, cylinder or tank appurtenances shall be performed by trained personnel.

**5303.10 Unauthorized use.** *Compressed gas* containers, cylinders, tanks and systems shall not be used for any purpose other than to serve as a vessel for containing the product that it is designed to contain.

**5303.11 Exposure to fire.** *Compressed gas* containers, cylinders and tanks that have been exposed to fire shall be removed from service. Containers, cylinders and tanks so removed shall be handled by *approved*, qualified persons.

**5303.12 Leaks, damage or corrosion.** Leaking, damaged or corroded *compressed gas* containers, cylinders and tanks shall be removed from service. Leaking, damaged or corroded *compressed gas* systems shall be replaced or repaired in accordance with the following:

1. *Compressed gas* containers, cylinders and tanks that have been removed from service shall be handled in an *approved* manner.
2. *Compressed gas* systems that are determined to be leaking, damaged or corroded shall be repaired to a serviceable condition or removed from service.

**5303.13 Surface of unprotected storage or use areas.** Unless otherwise specified in Section 5303.14, *compressed gas* containers, cylinders and tanks are allowed to be stored or used without being placed under overhead cover. To prevent bottom corrosion, containers, cylinders and tanks shall be protected from direct contact with soil or unimproved surfaces. The surface of the area on which the containers are placed shall be graded to prevent accumulation of water.

**5303.14 Overhead cover.** *Compressed gas* containers, cylinders and tanks are allowed to be stored or used in the sun except in locations where extreme temperatures prevail. Where extreme temperatures prevail, overhead covers shall be provided.

**5303.15 Lighting.** *Approved* lighting by natural or artificial means shall be provided.

**5303.16 Vaults.** Generation, compression, storage and dispensing equipment for *compressed gases* shall be allowed to be located in either above- or below-grade vaults complying with Sections 5303.16.1 through 5303.16.14.

**5303.16.1 Listing required.** Vaults shall be *listed* by a nationally recognized testing laboratory.

**Exception:** Where *approved* by the *fire code official*, below-grade vaults are allowed to be constructed on site, provided that the design is in accordance with the *International Building Code* and that special inspections are conducted to verify structural strength and compliance of the installation with the *approved* design in accordance with Section 1707 of the *International Building Code*. Installation plans for below-grade vaults that are constructed on site shall be prepared by, and the design shall bear the stamp of, a professional engineer. Consideration shall be given to soil and hydrostatic loading on the floors, walls and lid; anticipated seismic forces; uplifting by ground water or flooding; and to loads imposed from above, such as traffic and equipment loading on the vault lid.

**5303.16.2 Design and construction.** The vault shall completely enclose generation, compression, storage or dispensing equipment located in the vault. There shall not be openings in the vault enclosure except those necessary for vault ventilation and access, inspection, filling, emptying or venting of equipment in the vault. The walls and floor

of the vault shall be constructed of reinforced concrete not less than 6 inches (152 mm) thick. The top of an above-grade vault shall be constructed of noncombustible material and shall be designed to be weaker than the walls of the vault to ensure that the thrust of any explosion occurring inside the vault is directed upward.

The top of an at- or below-grade vault shall be designed to relieve safely or contain the force of an explosion occurring inside the vault. The top and floor of the vault and the tank foundation shall be designed to withstand the anticipated loading, including loading from vehicular traffic, where applicable. The walls and floor of a vault installed below grade shall be designed to withstand anticipated soil and hydrostatic loading. Vaults shall be designed to be wind and earthquake resistant, in accordance with the *International Building Code*.

**5303.16.3 Secondary containment.** Vaults shall be substantially liquid-tight and there shall not be backfill within the vault. The vault floor shall drain to a sump. For pre-manufactured vaults, liquid tightness shall be certified as part of the listing provided by a nationally recognized testing laboratory. For field-erected vaults, liquid tightness shall be certified in an *approved* manner.

**5303.16.4 Internal clearance.** There shall be sufficient clearance within the vault to allow for visual inspection and maintenance of equipment in the vault.

**5303.16.5 Anchoring.** Vaults and equipment contained therein shall be suitably anchored to withstand uplifting by groundwater or flooding. The design shall verify that uplifting is prevented even where equipment within the vault is empty.

**5303.16.6 Vehicle impact protection.** Vaults shall be resistant to damage from the impact of a motor vehicle, or vehicle impact protection shall be provided in accordance with Section 312.

**5303.16.7 Arrangement.** Equipment in vaults shall be *listed* or *approved* for above-ground use. Where multiple vaults are provided, adjacent vaults shall be allowed to share a common wall. The common wall shall be liquid and vapor tight and shall be designed to withstand the load imposed when the vault on either side of the wall is filled with water.

**5303.16.8 Connections.** Connections shall be provided to permit the venting of each vault to dilute, disperse and remove vapors prior to personnel entering the vault.

**5303.16.9 Ventilation.** Vaults shall be provided with an exhaust ventilation system installed in accordance with Section 5004.3. The ventilation system shall operate continuously or be designed to operate upon activation of the vapor or liquid detection system. The system shall provide ventilation at a rate of not less than 1 cubic foot per minute (cfm) per square foot [ $0.00508 \text{ m}^3/(\text{s} \cdot \text{m}^2)$ ] of floor area, but not less than 150 cfm ( $4 \text{ m}^3/\text{min}$ ). The exhaust system shall be designed to provide air movement across all parts of the vault floor for gases having a density greater than air and across all parts of the vault ceiling for gases having a density less than air. Supply ducts shall extend to within

3 inches (76 mm), but not more than 12 inches (305 mm), of the floor. Exhaust ducts shall extend to within 3 inches (76 mm), but not more than 12 inches (305 mm) of the floor or ceiling, for heavier-than-air or lighter-than-air gases, respectively. The exhaust system shall be installed in accordance with the *International Mechanical Code*.

**5303.16.10 Monitoring and detection.** Vaults shall be provided with *approved* vapor and liquid detection systems and equipped with on-site audible and visual warning devices with battery backup. Vapor detection systems shall sound an alarm when the system detects vapors that reach or exceed 25 percent of the lower explosive limit (LEL) or one-half the immediately dangerous to life and health (IDLH) concentration for the gas in the vault. Vapor detectors shall be located not higher than 12 inches (305 mm) above the lowest point in the vault for heavier-than-air gases and not lower than 12 inches (305 mm) below the highest point in the vault for lighter-than-air gases. Liquid detection systems shall sound an alarm upon detection of any liquid, including water. Liquid detectors shall be located in accordance with the manufacturers' instructions. Activation of either vapor or liquid detection systems shall cause a signal to be sounded at an *approved*, constantly attended location within the facility served by the tanks or at an *approved* location. Activation of vapor detection systems shall also shut off gas-handling equipment in the vault and dispensers.

**5303.16.11 Liquid removal.** Means shall be provided to recover liquid from the vault. Where a pump is used to meet this requirement, it shall not be permanently installed in the vault. Electric-powered portable pumps shall be suitable for use in Class I, Division 1 locations, as defined in NFPA 70.

**5303.16.12 Relief vents.** Vent pipes for equipment in the vault shall terminate not less than 12 feet (3658 mm) above ground level.

**5303.16.13 Accessway.** Vaults shall be provided with an *approved* personnel accessway with a minimum dimension of 30 inches (762 mm) and with a permanently affixed, nonferrous ladder. Accessways shall be designed to be nonsparking. Travel distance from any point inside a vault to an accessway shall not exceed 20 feet (6096 mm). At each entry point, a warning sign indicating the need for procedures for safe entry into confined spaces shall be posted. Entry points shall be secured against unauthorized entry and vandalism.

**5303.16.14 Classified area.** The interior of a vault containing a flammable gas shall be designated a Class I, Division 1 location, as defined in NFPA 70.

## SECTION 5304 STORAGE OF COMPRESSED GASES

**5304.1 Upright storage.** *Compressed gas* containers, cylinders and tanks, except those designed for use in a horizontal position, and all *compressed gas* containers, cylinders and tanks containing nonliquefied gases, shall be stored in an upright position with the valve end up. An upright position

shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.80 rad) from the vertical.

**Exceptions:**

1. *Compressed gas* containers with a water volume less than 1.3 gallons (5 L) are allowed to be stored in a horizontal position.
2. Cylinders, containers and tanks containing nonflammable gases, or cylinders, containers and tanks containing nonliquefied flammable gases that have been secured to a pallet for transportation purposes.

**5304.2 Material-specific regulations.** In addition to the requirements of this section, indoor and outdoor storage of *compressed gases* shall comply with the material-specific provisions of Chapters 54, 58 and 60 through 67.

### SECTION 5305 USE AND HANDLING OF COMPRESSED GASES

**5305.1 Compressed gas systems.** *Compressed gas* systems shall be suitable for the use intended and shall be designed by persons competent in such design. *Compressed gas* equipment, machinery and processes shall be *listed* or *approved*.

**5305.2 Controls.** *Compressed gas* system controls shall be designed to prevent materials from entering or leaving process or reaction systems at other than the intended time, rate or path. Automatic controls shall be designed to be fail safe.

**5305.3 Piping systems.** Piping, including tubing, valves, fittings and pressure regulators, shall comply with this section and Chapter 50. Piping, tubing, pressure regulators, valves and other apparatus shall be kept gas tight to prevent leakage.

**5305.4 Valves.** Valves utilized on *compressed gas* systems shall be suitable for the use intended and shall be accessible. Valve handles or operators for required shutoff valves shall not be removed or otherwise altered to prevent access.

**5305.5 Venting.** Venting of gases shall be directed to an *approved* location. Venting shall comply with the *International Mechanical Code*.

**5305.6 Upright use.** *Compressed gas* containers, cylinders and tanks, except those designed for use in a horizontal position, and all *compressed gas* containers, cylinders and tanks containing nonliquefied gases, shall be used in an upright position with the valve end up. An upright position shall include conditions where the container, cylinder or tank axis is inclined as much as 45 degrees (0.80 rad) from the vertical. Use of nonflammable liquefied gases in the inverted position where the liquid phase is used shall not be prohibited provided that the container, cylinder or tank is properly secured and the dispensing apparatus is designed for liquefied gas use.

**Exception:** *Compressed gas* containers, cylinders and tanks with a water volume less than 1.3 gallons (5 L) are allowed to be used in a horizontal position.

**5305.7 Transfer.** Transfer of gases between containers, cylinders and tanks shall be performed by qualified personnel

using equipment and operating procedures in accordance with CGA P-1.

**Exception:** The fueling of vehicles with CNG or CH<sub>2</sub>, conducted in accordance with Chapter 23.

**5305.8 Use of compressed gas for inflation.** Inflatable equipment, devices or balloons shall only be pressurized or filled with compressed air or inert gases.

**5305.9 Material-specific regulations.** In addition to the requirements of this section, indoor and outdoor use of *compressed gases* shall comply with the material-specific provisions of Chapters 54, 58 and 60 through 67.

**5305.10 Handling.** The handling of *compressed gas* containers, cylinders and tanks shall comply with Sections 5305.10.1 and 5305.10.2.

**5305.10.1 Carts and trucks.** Containers, cylinders and tanks shall be moved using an *approved* method. Where containers, cylinders or tanks are moved by hand cart, hand truck or other mobile device, such carts, trucks or devices shall be designed for the secure movement of containers, cylinders or tanks. Carts and trucks utilized for transport of *compressed gas* containers, cylinders and tanks within buildings shall comply with Section 5003.10. Carts and trucks utilized for transport of *compressed gas* containers, cylinders and tanks exterior to buildings shall be designed so that the containers, cylinders and tanks will be secured against dropping or otherwise striking against each other or other surfaces.

**5305.10.2 Lifting devices.** Ropes, chains or slings shall not be used to suspend *compressed gas* containers, cylinders and tanks unless provisions at time of manufacture have been made on the container, cylinder or tank for appropriate lifting attachments, such as lugs.

### SECTION 5306 MEDICAL GASES

**[W] 5306.1 General.** Compressed gases at hospitals and similar facilities intended for inhalation or sedation including, but not limited to, analgesia systems for dentistry, podiatry, veterinary and similar uses shall comply with Sections 5306.2 through 5306.4 in addition to other requirements of this chapter.

**Exception:** All new distribution piping, supply manifolds, connections, regulators, valves, alarms, sensors and associated equipment shall be in accordance with the Plumbing Code.

**5306.2 Interior supply location.** Medical gases shall be stored in areas dedicated to the storage of such gases without other storage or uses. Where containers of medical gases in quantities greater than the permit amount are located inside buildings, they shall be in a 1-hour exterior room, a 1-hour interior room or a gas cabinet in accordance with Section 5306.2.1, 5306.2.2 or 5306.2.3, respectively. Rooms or areas where medical gases are stored or used in quantities exceeding the *maximum allowable quantity per control area* as set forth in Section 5003.1 shall be in accordance with the *Inter-*

*national Building Code* for high-hazard Group H occupancies.

**5306.2.1 One-hour exterior rooms.** A 1-hour exterior room shall be a room or enclosure separated from the remainder of the building by *fire barriers* constructed in accordance with Section 707 of the *International Building Code* or horizontal assemblies constructed in accordance with Section 711 of the *International Building Code*, or both, with a *fire-resistance rating* of not less than 1 hour. Openings between the room or enclosure and interior spaces shall be self-closing smoke- and draft-control assemblies having a *fire protection rating* of not less than 1 hour. Rooms shall have not less than one exterior wall that is provided with not less than two nonclosable louvered vents. Each vent shall have a minimum free opening area of 24 square inches (155 cm<sup>2</sup>) for each 1,000 cubic feet (28 m<sup>3</sup>) at normal temperature and pressure (NTP) of gas stored in the room and shall be not less than 72 square inches (465 cm<sup>2</sup>) in aggregate free opening area. One vent shall be within 6 inches (152 mm) of the floor and one shall be within 6 inches (152 mm) of the ceiling. Rooms shall be provided with not less than one automatic sprinkler to provide container cooling in case of fire.

**5306.2.2 One-hour interior room.** Where an exterior wall cannot be provided for the room, automatic sprinklers shall be installed within the room. The room shall be exhausted through a duct to the exterior. Supply and exhaust ducts shall be enclosed in a 1-hour-rated shaft enclosure from the room to the exterior. *Approved mechanical ventilation* shall comply with the *International Mechanical Code* and be provided at a minimum rate of 1 cubic foot per minute per square foot [0.00508 m<sup>3</sup>/(s · m<sup>2</sup>)] of the area of the room.

**5306.2.3 Gas cabinets.** Gas cabinets shall be constructed in accordance with Section 5003.8.6 and the following:

1. The average velocity of ventilation at the face of access ports or windows shall be not less than 200 feet per minute (1.02 m/s) with not less than 150 feet per minute (0.76 m/s) at any point of the access port or window.
2. They shall be connected to an exhaust system.
3. They shall be internally sprinklered.

**5306.3 Exterior supply locations.** Oxidizer medical gas systems located on the exterior of a building with quantities greater than the permit amount shall be located in accordance with Section 6304.2.1.

**5306.4 Transfilling.** Transfilling areas and operations including, but not limited to, ventilation and separation, shall comply with NFPA 99.

**[W]5306.5 Medical gas systems.** The maintenance and testing of ((M)) medical gas systems including, but not limited to, distribution piping, supply manifolds, connections, pressure regulators and relief devices and valves, shall comply with the maintenance and testing requirements of NFPA 99 and the general provisions of this chapter.

## SECTION 5307 CARBON DIOXIDE (CO<sub>2</sub>) SYSTEMS USED IN BEVERAGE DISPENSING APPLICATIONS

**5307.1 General.** Carbon dioxide systems with more than 100 pounds (45.4 kg) of carbon dioxide used in beverage dispensing applications shall comply with Sections 5307.2 through 5307.5.2.

**5307.2 Permits.** Permits shall be required as set forth in Section 105.6.

**5307.3 Equipment.** The storage, use, and handling of liquid carbon dioxide shall be in accordance with Chapter 53 and the applicable requirements of NFPA 55, Chapter 13. Insulated liquid carbon dioxide systems shall have pressure relief devices vented in accordance with NFPA 55.

**5307.4 Protection from damage.** Carbon dioxide systems shall be installed so the storage tanks, cylinders, piping and fittings are protected from damage by occupants or equipment during normal facility operations.

**5307.5 Required protection.** Where carbon dioxide storage tanks, cylinders, piping and equipment are located indoors, rooms or areas containing carbon dioxide storage tanks, cylinders, piping and fittings and other areas where a leak of carbon dioxide can collect shall be provided with either ventilation in accordance with Section 5307.5.1 or an emergency alarm system in accordance with Section 5307.5.2.

**5307.5.1 Ventilation.** Mechanical ventilation shall be in accordance with the *International Mechanical Code* and shall comply with all of the following:

1. Mechanical ventilation in the room or area shall be at a rate of not less than 1 cubic foot per minute per square foot [0.00508 m<sup>3</sup>/(s · m<sup>2</sup>)].
2. Exhaust shall be taken from a point within 12 inches (305 mm) of the floor.
3. The ventilation system shall be designed to operate at a negative pressure in relation to the surrounding area.

**5307.5.2 Emergency alarm system.** An emergency alarm system shall comply with all of the following:

1. Continuous gas detection shall be provided to monitor areas where carbon dioxide can accumulate.
2. The threshold for activation of an alarm shall not exceed 5,000 parts per million (9,000 mg/m<sup>3</sup>).
3. Activation of the emergency alarm system shall initiate a local alarm within the room or area in which the system is installed.

## SECTION 5308 COMPRESSED GASES NOT OTHERWISE REGULATED

**5308.1 General.** *Compressed gases* in storage or use not regulated by the material-specific provisions of Chapters 6, 54, 55 and 60 through 67, including asphyxiant, irritant and radioactive gases, shall comply with this section in addition to other requirements of this chapter.

**5308.2 Ventilation.** Indoor storage and use areas and storage buildings shall be provided with mechanical exhaust ventilation or natural ventilation in accordance with the requirements of Section 5004.3 or 5005.1.9. Where mechanical ventilation is provided, the systems shall be operational during such time as the building or space is occupied.

