

manifolds, connections, pressure regulators and relief devices and valves, shall be installed in accordance with NFPA 99 and the general provisions of this chapter. Existing medical gas systems shall be maintained in accordance with the maintenance, inspection and testing provisions of NFPA 99 for medical gas systems.

SECTION 5307 COMPRESSED GASES NOT OTHERWISE REGULATED

5307.1 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.

5307.2 General. Carbon dioxide and other simple asphyxiant gas systems with more than 50 pounds (22.7 kg) in use, per system, shall comply with this section.

Exception: One (1) additional 50-pound DOT 3AA cylinder of carbon dioxide may be connect to the same system provided an isolation valve is in place, and only one cylinder can be in use at a time.

5307.2.1 Permits. Permits shall be required as set forth in Section 105.6 through 105.12.

5307.2.1.1 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.

5307.2.1.2 Protection from damage. Carbon dioxide and other simple asphyxiant gas systems shall be installed so the storage tanks, cylinders, piping fittings, detection and notification devices are protected from damage by occupants or equipment during normal facility operations, in accordance with Sections 5303.5 and 5303.6

5307.2.2 Gas Ventilation Requirements. Where any ASME vessels containing liquefied carbon dioxide and other simple asphyxiant gases or more than two 50-pound DOT AA3 gaseous carbon dioxide cylinders and other simple asphyxiant gases, are connected to a piping system and located within the structure, a mechanical exhaust ventilation system shall be provided in accordance with the *International Mechanical Code*. A separate plan submittal for the installation of this mechanical exhaust ventilation system is required by the Planning and Development Department.

5307.2.2.1 Exhaust. The mechanical exhaust ventilation system shall be designed at a rate not less than one cubic foot per minute, per square foot of floor area, within the area inside the structure where the ASME vessel or DOT cylinders are located. The ventilation system shall be designed to operate at a negative pressure in relation to the surrounding area.

5307.2.2.2 Exhaust intake. The exhaust intake shall be taken from a point within 12 inches (305mm) of the floor. The exhaust system intake shall be located not less than 2 feet away from any gas detector or located on the opposite wall of any gas detector.

5703.2.2.3 Exhaust termination. The termination point of exhaust outlets and ducts discharging to the outdoors shall be located not less than 10 feet from property lines, 3 feet above the roof line and 10 feet from operable openings into the building and 10 feet above adjoining grade.

5307.2.2.4 Automatic activation. The exhaust system shall automatically activate when either of the following thresholds is reached:

1. The concentration of carbon dioxide reaches 3-percent (30,000 ppm).
2. The concentration of oxygen reaches 19.5-percent in an oxygen deficient environment.

Exception: Continuous ventilation.

5307.2.2.5 Manual activation. A manual activation switch shall be provided at the entrance of the area where the ASME vessel or DOT cylinders are located. This manual activation switch shall be clearly marked with its function.

5307.2.3 Equipment venting. On all new and existing installations, emergency relief vents, burst disks and pump vents shall be terminated outside the building and at least 10 feet from openings into the building or property lines.

5307.2.4 Gas detection. Compressed gases such as carbon dioxide, helium, argon, nitrogen shall be provided with a gas detection and alarm systems. The gas detection and alarm systems shall be installed, inspected, tested, calibrated and maintained per the manufacturer's instructions or annually.

5307.2.4.1 Gas detectors. Gas detectors shall be field tested at the time of final inspection and annually, or as required per the manufacturer. Testing, inspection and maintenance of detection devices shall be performed with an approved test gas. All test gases shall have a recognized certification that documents the type and percentage of gas.

5307.2.4.2 Records. Records of inspections and maintenance shall be available for review upon request by the Phoenix Fire Department.

5307.2.4.3 Specific gas detection. Where the gas is carbon dioxide, the gas detection systems shall be designed to detect carbon dioxide. All other simple asphyxiants shall use an oxygen sensor.

5307.2.4.4 Location. Gas detection shall be provided at each point of use and at vessels or cylinders inside structures. Basements or subterranean spaces that could be physically entered and that have product lines shall have gas detection.

5307.2.4.5 Carbon dioxide two tier detection. The detection system shall be capable of two tier detection. Tier 1 shall be set at 0.5% carbon dioxide or 5,000 ppm. Tier 2 shall be set at 3% carbon dioxide or 30,000 ppm.

5307.2.4.6 Simple asphyxiant two tier detection. The detection system shall be capable of two-tier detection. Tier 1 shall be set at 19.5-percent oxygen in an oxygen deficient environment. Tier 2 shall be set at 18-percent in an oxygen deficient environment.

5307.2.4.7 Installation. Asphyxiant gas detection systems or appropriate gas detection for the gas, shall be installed per the manufacture manual.

5307.2.4.8 Power. The power supply to the gas detection system shall be circuit locked and labeled. Approved backup power shall be provided.

5307.2.5 Supervisory signal. At 0.5-percent (5,000 ppm) carbon dioxide or 19.5-percent oxygen, a local warning/supervisory signal with visible and audible indications shall occur at a constantly manned location and shall be transmitted off-site to a UL-approved third party monitoring station as a supervisory signal alarm when the facility has a system monitoring signals off site.

5307.2.6 Evacuation alarm. At 3-percent (30,000 ppm) carbon dioxide or 18-percent oxygen, an evacuation alarm shall sound for the occupancy and shall transmitted off-site to a UL approved third-party monitoring station as a gas-specific alarm.

Exception: When the facility does not have a system capable of transmitting signals off site then established approved protocols shall be in place to call 911.

5307.2.6.1 Monitoring. Connection to the fire alarm panel or monitoring panel shall be completed by a fire protection company holding a Phoenix Fire Department Business Certificate. A separate permit obtained by an approved fire alarm contractor from the Fire Department is required.

5307.2.7 Notification. Evacuation notification devices with audible and visible notification shall be provided:

1. Near every point-of-use.
2. In the area or room where the asphyxiant gas cylinders are located.
3. In the common area where public gathers.
4. At the entrance to the room with required detection.
5. It shall be clear to the responders upon approach to the hazard that asphyxiant gas is present.
6. As required by the *fire code official*.

5307.2.7.1 Notification devices. Notification devices shall comply with the following:

1. The notification device shall be rated not less than 100 candela for a visual effect and 75 decibels for an audible effect.

2. The notification devices shall be identified and labeled for the gas being detected. Use of the building fire alarm notification devices for evacuation is acceptable, provided the asphyxiant gas detection has visible and audible clear indicators in the hazard area upon both the warning level and alarm level of the gas.

5307.3 Tank and piping requirements. Piping systems shall be designed and constructed and tested in accordance with ASME/ANSI B31.3 Process Piping Code.

5307.3.1 Piping and marking. Piping and tubing shall be identified in accordance with ASME A13.1 to indicate the material conveyed. 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 repeated at not less than every 20 feet (6096 mm) or fraction thereof throughout the piping run.

5307.3.2 Piping design. Gas piping systems shall be designed as follows:

1. Piping systems shall be designed to a bursting pressure of at least four times the system design pressure.

All fittings used in the piping system shall be designed for a working pressure not to exceed 125-percent of designed pressure of the hose.

5307.3.3 Piping materials. Carbon dioxide Gas piping systems shall be of listed and approved materials for each specific gas in use. Rigid plastic piping shall not be allowed.

Exception: Non-listed materials requires a special report by an Arizona registered engineer on the piping material shall be submitted to the *fire code official* for approval.

A special report on the piping material shall not be required if the piping material has been listed by a third-party testing group such as UL or FM for the intended use.

5307.3.4 Leak tests. All piping systems shall be leak tested in accordance with the following:

1. Piping systems shall be tested by a pneumatic pattern at a pressure equal to the working pressure for 15 minutes or as long as it takes to check each joint. The test medium shall be carbon dioxide.
2. Soap testing of all fittings shall be witnessed at the time of inspection.

5307.4 Carbon dioxide enrichment systems. The design, installation and maintenance of carbon dioxide enrichment systems with more than 100 pounds (45.4 kg) of carbon dioxide, and carbon dioxide enrichment systems with any quantity of carbon dioxide having a remote fill connection, shall comply with Sections 5307.4.1 through 5307.4.7.

5307.4.1 Documentation. The following information shall be provided with the application for permit:

1. Total aggregate quantity of liquid carbon dioxide in pounds or cubic feet at *normal temperature and pressure*.
2. Location and total volume of the room where the carbon dioxide enrichment operation will be conducted. Identify whether the room is at grade or below grade.
3. Location of containers relative to equipment, building openings and *means of egress*.
4. Manufacturer's specifications and pressure rating, including cut sheets, of all piping and tubing to be used.
5. A piping and instrumentation diagram that shows piping support and remote fill connections.
6. Details of container venting, including but not limited to vent line size, material and termination location.
7. Alarm and detection system and equipment, if applicable.
8. Seismic support for containers.

5307.4.2 Equipment. Pressure relief, vent piping, fill indicators, fill connections, vent terminations, piping systems and the storage, use and handling of the carbon dioxide shall be in accordance with Chapter 53 and NFPA 55.

5307.4.3 Gas detection system. A gas detection system shall be provided in rooms or indoor areas in which the carbon dioxide enrichment process is located, in rooms or indoor areas in which container systems are located, and in other areas where carbon dioxide is expected to accumulate. Carbon dioxide sensors shall be provided within 12 inches (305 mm) of the floor in the area where the gas is expected to accumulate or leaks are most likely to occur. The system shall be designed **in accordance with Sections 5307.2 through 5307.2.7.1.**

5307.4.3.1 System activation. System activation shall be in accordance with **Sections 5307.2 through 5307.2.7.1 and this section.**

Activation of the low level gas detection system alarm shall automatically:

1. Stop the flow of carbon dioxide to the piping system.
2. Activate the mechanical exhaust ventilation system.
3. Activate an audible and visible supervisory alarm signal at an *approved* location within the building.

Activation of the high-level gas detection system alarm shall automatically:

1. Stop the flow of carbon dioxide to the piping system.

2. Activate the mechanical exhaust ventilation system.
3. Activate an audible and visible evacuation alarm both inside and outside of the carbon dioxide enrichment area, and the area in which the carbon dioxide containers are located.

5307.4.4 Pressurization and ventilation. Rooms or indoor areas in which carbon dioxide enrichment is provided shall be maintained at a negative pressure in relation to the surrounding areas in the building. A mechanical ventilation system shall be provided in accordance with the *International Mechanical Code* that complies with all of the following:

1. Mechanical ventilation in the room or area shall be at a rate of not less than 1 cfm per square foot [$0.00508 \text{ m}^3/(\text{s} \cdot \text{m}^2)$].
2. When activated by the gas detection system, the mechanical ventilation system shall remain on until manually reset.
3. The exhaust system intakes shall be taken from points within 12 inches (305 mm) of the floor.
4. The ventilation system shall discharge to the outdoors in an *approved* location.

5307.4.5 Signage. Hazard identification signs shall be posted at the entrance to the room and indoor areas where the carbon dioxide enrichment process is located, and at the entrance to the room or indoor area where the carbon dioxide containers are located. The sign shall be not less than 8 inches (200 mm) in width and 6 inches (150 mm) in height and indicate:

CAUTION – CARBON DIOXIDE GAS
VENTILATE THE AREA BEFORE ENTERING.
A HIGH CARBON DIOXIDE (CO₂) GAS
CONCENTRATION
IN THIS AREA CAN CAUSE ASPHYXIATION.

5307.4.6 Seismic and structural design. Carbon dioxide system containers and piping shall comply with the seismic design requirements in Chapter 16 of the *International Building Code* and shall not exceed the floor loading limitation of the building.

5307.4.7 Container refilling. Carbon dioxide containers located indoors shall not be refilled unless filled from a remote connection located outdoors.