



## Second Revision No. 23-NFPA 55-2025 [ Global Comment ]

[See attached Word document which reintroduces Chapter 10 from the 2023 edition.]

### Supplemental Information

| <u>File Name</u>                              | <u>Description</u> | <u>Approved</u> |
|-----------------------------------------------|--------------------|-----------------|
| 55_SR23_Ch_10.docx                            |                    |                 |
| 55_Global_SR-23_Ch10_legislative_changes.docx | for editorial use  |                 |
| 55_Global_SR-23_FINAL.pdf                     | for balloting      |                 |

### Submitter Information Verification

**Committee:** IMG-AAA

**Submission Date:** Fri Jun 06 16:11:16 EDT 2025

### Committee Statement

**Committee Statement:** Since hydrogen gas is under the scope of the NFPA 2 technical committee on hydrogen technologies, Chapter 10 was deleted at the previous First Draft meeting. This revision reintroduces Chapter 10 without reference to hydrogen gas and instead is limited to bulk flammable gas systems which fall under the NFPA 55 technical committee scope. This has resulted in a reorganization and deletion of requirements that were specific to hydrogen.

The values in Table 10.4.2.2.1(a) and Table 10.4.2.2.1(b) have been revised to reflect the values in the bulk compressed hydrogen gas tables that existed in the 2010-2016 Editions of NFPA 55. This has been done to revert to the 2016 edition of NFPA 55, before the 2020 edition of the code reduced the setback distances, based on changes to criteria that were specifically discussed for hydrogen. These revised table values are more conservative and have a more established safe operational experience for gases other than hydrogen. The longer distances would be conservative, which is more appropriate for other flammable gases, given that the table numbers were derived for hydrogen specifically. The changes to exposure groups 2 and 3 were maintained, based on more conservative categorization. Table 10.4.2.2.1(c) was not included, even though these values existed for hydrogen in the older versions of the code, because these higher pressure are not applicable to non-hydrogen gas storage systems.

**Response Message:** SR-23-NFPA 55-2025

**[Global SR-23]**

**Chapter 10 ~~Gas-Hydrogen~~Bulk Flammable Gas Systems**

**10.1 Applicability.**

The storage, use, and handling of hydrogen in ~~hydrogen-compressed~~bulk flammable gas systems shall be in accordance with ~~comply~~ the applicable provisions~~requirements~~ of Chapters 1 through 7 and Chapter 10.

**~~10.1.1 Quantities Less Than or Equal to the MAQ.~~**

The storage, use, and handling of hydrogen in gaseous hydrogen systems in quantities less than or equal to the MAQ shall be in accordance with Sections 10.1 and 10.2.

**~~10.1.2 Quantities Greater Than the MAQ.~~**

The storage, use, and handling of hydrogen in gaseous hydrogen systems in quantities greater than the MAQ shall be in accordance with Sections 10.1, 10.2, and 10.3.

**~~10.1.3\* Quantities Greater Than 5000 scf (141.6 Nm<sup>3</sup>).~~**

The storage, use, and handling of hydrogen in gaseous hydrogen systems (bulk gaseous hydrogen systems) in quantities greater than 5000 scf (141.6 Nm<sup>3</sup>) shall be in accordance with Sections 10.1, 10.2, 10.3, and 10.4.

**~~A.10.1.3~~**

~~ANSI/CGA H 5, Standard for Bulk Hydrogen Supply Systems, provides guidance on designing, installing, testing, starting up, and removing bulk hydrogen supply systems.~~

**10.2 General.**

**10.2.1 Marking.**

**10.2.1.1**

Hazard identification signs shall be provided in accordance with Section 6.12.

**10.2.1.2**

In addition to the requirement in 10.2.1.1, the area in which a ~~hydrogen~~bulk flammable gas system is located shall be permanently placarded as follows:

**WARNING:**HYDROGEN[NAME OF GAS] — FLAMMABLE GAS  
NO SMOKING — NO OPEN FLAMES

**10.2.2 Piping Systems.**

Piping, tubing, valves, and fittings shall be designed, and installed, and tested in accordance with the applicable sections of ASME B31, *Code for Pressure Piping*, and Sections 704.1.2.3, 704.1.2.4, and 704.1.2.5 of the ICC *International Fuel Gas Code (IFGC)*. Cast, ductile, malleable, or high-silicon iron pipe, valves, and fittings shall not be used ~~ASME B31.3, Process Piping~~.

**~~A.10.2.2~~**

~~Any reference to listed or approved equipment in the noted sections of the IFGC is within the context of ASME B31.12, Hydrogen Piping and Pipelines, and describes a material or component that conforms to the specifications integral to ASME B31.12.~~

**~~10.2.2.1~~**

~~Prior to acceptance and initial operation, all piping installations shall be inspected and pressure tested in accordance with ASME B31, Code for Pressure Piping, and Section 705 of the ICC International Fuel Gas Code (IFGC).~~

**~~10.2.2.2~~**

~~Brazing materials used for joints in piping and tubing systems shall have a melting point above 1000°F (538°C).~~

**~~10.2.2.3~~**

~~Underground piping systems shall be in accordance with 7.1.17.~~

### **10.2.3 Hydrogen-Bulk Flammable Gas Venting Systems.**

~~Bulk flammable gas venting systems discharging to the atmosphere shall comply with Section 6.16. Hydrogen venting systems serving pressure relief devices discharging hydrogen to the atmosphere shall be in accordance with CGA G-5.5, *Hydrogen Vent Systems*.~~

#### **10.2.3.1**

~~Bulk flammable gas systems discharging to the atmosphere shall have a hazard analysis and risk assessment that are available to the authority having jurisdiction (AHJ). Venting from the relief vents from the hydrogen supply piping serving listed fuel cell systems shall be permitted to be discharged into an enclosure integral to the fuel cell system where the concentration of hydrogen is diluted below 25 percent of the lower flammable limit (LFL) at the outlet of the enclosure.~~

##### ~~10.2.3.1.1~~

~~The hydrogen supply piping system shall be designed to isolate the source of hydrogen from the relief vent in the event of loss of dilution ventilation or power.~~

#### **10.2.3.2**

~~Cleaning and purging of piping systems shall be in accordance~~comply with 7.1.18.

### **10.2.4 Equipment Assembly.**

#### **10.2.4.1**

~~All equipment shall be approved for flammable gas service. Valves, gauges, regulators, and other accessories used for hydrogen compressed gas systems shall be specified for hydrogen service by the manufacturer or the hydrogen supplier.~~

##### ~~10.2.4.1.1~~

~~Storage containers, piping, valves, regulating equipment, and other appurtenances serving hydrogen compressed gas systems shall be accessible and shall be protected against physical damage and tampering.~~

##### ~~10.2.4.2~~

~~Cabinets or enclosures containing hydrogen control or operating equipment shall be ventilated to prevent the accumulation of hydrogen.~~

#### **10.2.4.2**

~~Mobile hydrogen supply units used as part of a hydrogen compressed~~bulk flammable gas system shall be secured to prevent movement.

### **10.2.5\* Compression and ProcessingAssociated Equipment.**

~~Compression and gas processing equipment integral to hydrogen compressed~~bulk flammable gas storage systems shall be designed for use with gaseous hydrogen ( $\text{GH}_2$ )the flammable gas and for the maximum pressures and temperatures to which it can be subjected under normal operating conditions.

#### **A.10.2.5**

The requirements in 10.2.5 extend only to the source valve of the bulk flammable gas system.

#### **10.2.5.1 Pressure Relief.**

Compression and gas processing equipment shall have pressure relief devices that limit each stage pressure to the maximum allowable working pressure for the compression cylinder and piping associated with that stage of compression.

#### **10.2.5.2 Unattended Operation.**

~~Where operated unattended,~~ $\text{GH}_2$  compression equipment is operated unattended, it shall be equipped with a high discharge and a low suction pressure automatic shutdown control.

#### **10.2.5.3 Automatic Shutdown.**

When an automatic shutdown control shuts down a system, the system shall remain out of service until personnel authorized by the owner determines the cause of the ~~shut-down~~shutdown and that the system is safe to restart.

#### **10.2.5.4 Stationary Compressors.**

##### ~~10.2.5.4.1 Valves.~~

#### **10.2.5.4.1**

~~Valves~~Stationary compressor valves shall be installed such that each compressor is able to be isolated for maintenance.

#### **10.2.5.4.2**

The discharge line shall be equipped with a check valve to prevent the backflow of gas from high-pressure sources located downstream of the stationary compressor.

#### **10.2.5.5 Foundations.**

##### **10.2.5.5.1**

Foundations used for supporting equipment shall be designed and constructed to prevent frost heaving.

##### **10.2.5.5.2**

The structural aspects of such foundations shall be designed and constructed in accordance with the provisions of the applicable building code.

#### **10.2.5.6 Emergency Shutdown- (ESD).**

When an emergency shutdown (ESD) system is required, activation of the emergency shutdown system shall shut down operation of all compressors serving a single gas installation.

#### **10.2.5.7 Relief Valves.**

##### **10.2.5.7.1**

Each compressor shall be provided with a vent or relief device that will prevent ~~overpressurizing~~overpressurization of the compressor under normal or upset conditions.

##### **10.2.5.7.2**

Pressure relief devices ~~used to~~that serve pumps or compression equipment shall be connected to a vent pipe system in accordance with 10.2.3.

#### **10.2.5.8 Pressure Monitoring.**

##### **10.2.5.8.1**

The pressure on the compressor discharge shall be monitored by a control system.

##### **10.2.5.8.2**

Discharge pressures ~~in excess of~~greater than the equipment maximum operating pressure shall cause the compressor to shut down.

#### **10.2.5.9 Protection.**

Transfer piping and compressors shall be protected from vehicular damage.

#### **10.2.6 Operation and Maintenance.**

##### **10.2.6.1**

~~For~~Where installations ~~that require any operation of equipment by the user, the operating instructions shall direct the user shall be instructed in the operation of the equipment and emergency shutdown procedures.~~

##### **10.2.6.2**

~~Instructions~~Operating instructions shall be maintained at the operating site at a location acceptable to the authority having jurisdiction~~AHJ~~.

##### **10.2.6.1 Operating Instructions.**

##### **10.2.7**

~~Emergency isolation shall comply with the requirements in 7.7.3.6.~~

#### **10.2.8\* Listed or Approved Hydrogen Equipment.**

##### **A-10.2.8**

~~The compressed gas system equipment referenced is intended to include fuel cell applications, generation of hydrogen from portable or transportable hydrogen generation equipment, batteries, and similar devices and equipment that utilize hydrogen for the purpose of power generation. It does not include hydrogen production facilities intended to produce hydrogen used for distribution or repackaging operations operated by gas producers, distributors, and repackagers.~~

#### **~~10.2.8.1~~**

~~Listed or approved hydrogen-generating and hydrogen-consuming equipment shall be in accordance with the listing requirements and manufacturers' instructions.~~

#### **~~10.2.8.2~~**

~~Such equipment shall not be required to meet the requirements of Chapter 7.~~

#### **~~10.2.9\* Metal Hydride Storage Systems.~~**

##### **~~A.10.2.9~~**

~~Numerous metal hydrides are currently being tested for gaseous hydrogen storage applications. While certain Class D extinguishing agents have been effective on some metal hydride materials, they have not been tested on the wide range of hydrides. It is crucial to understand any adverse chemical reactions between the hydride and the agent prior to using the fire suppressant. Additionally, it is important to understand that the application should be limited to small incipient stage fires. Larger fires would require the use of personal protective equipment in the application of the extinguishing agent.~~

##### **~~10.2.9.1 General Requirements.~~**

###### **~~10.2.9.1.1 Metal Hydride Storage System Requirements.~~**

~~The storage and use of metal hydride storage systems shall be in accordance with 10.2.9.~~

###### **~~10.2.9.1.2 Metal Hydride Systems Storing or Supplying Hydrogen.~~**

~~Those portions of the system that are used as a means to store or supply hydrogen shall also comply with Chapter 7 and Chapter 10 as applicable.~~

###### **~~10.2.9.1.3 Classification.~~**

~~The hazard classification of the metal hydride storage system, as required by 5.1.1 and 5.1.3, shall be based on the hydrogen stored without regard to the metal hydride content.~~

###### **~~10.2.9.1.4 Listed or Approved Systems.~~**

~~Metal hydride storage systems shall be listed or approved for the application and designed in a manner that prevents the addition or removal of the metal hydride by other than the original equipment manufacturer.~~

###### **~~10.2.9.1.5 Containers, Design, and Construction.~~**

~~Compressed gas cylinders, containers, and tanks used for metal hydride storage systems shall be designed and constructed in accordance with 7.1.5.1.~~

###### **~~10.2.9.1.6 Service Life and Inspection of Containers.~~**

~~Metal hydride storage system cylinders, containers, and tanks shall be inspected at intervals not to exceed 5 years.~~

###### **~~10.2.9.1.7 Marking and Labeling.~~**

~~Marking and labeling of cylinders, containers, tanks, and systems shall be in accordance with 7.1.5 and the requirements in 10.2.9.1.7.1 through 10.2.9.1.7.4.~~

###### **~~10.2.9.1.7.1 System Marking.~~**

~~Metal hydride storage systems shall be marked with the following:~~

- ~~(1) Manufacturer's name~~
- ~~(2) Service life indicating the last date the system can be used~~
- ~~(3) A unique code or serial number specific to the unit~~
- ~~(4) System name or product code that identifies the system by the type of chemistry used in the system~~
- ~~(5) Emergency contact name, telephone number, or other contact information~~
- ~~(6) Limitations on refilling of containers to include rated charging pressure and capacity~~

###### **~~10.2.9.1.7.2 Valve Marking.~~**

~~Metal hydride storage system valves shall be marked with the following:~~

- ~~(1) Manufacturer's name~~
- ~~(2) Service life indicating the last date the valve can be used~~
- ~~(3) Metal hydride service in which the valve can be used or a product code that is traceable to this information~~

#### **~~10.2.9.1.7.3 Pressure Relief Device Marking.~~**

~~Metal hydride storage system pressure relief devices shall be marked with the following:~~

- ~~(1) Manufacturer's name~~
- ~~(2) Metal hydride service in which the device can be used or a product code that is traceable to this information~~
- ~~(3) Activation parameters to include temperature, pressure, or both~~

#### **~~(A) Pressure Relief Devices Integral to Container Valves.~~**

~~The required markings for pressure relief devices that are integral components of valves used on cylinders, containers, and tanks shall be allowed to be placed on the valve.~~

#### **~~10.2.9.1.7.4 Pressure Vessel Markings.~~**

~~Cylinders, containers, and tanks used in metal hydride storage systems shall be marked with the following:~~

- ~~(1) Manufacturer's name~~
- ~~(2) Design specification to which the vessel was manufactured~~
- ~~(3) Authorized body approving the design and initial inspection and test of the vessel~~
- ~~(4) Manufacturer's original test date~~
- ~~(5) Unique serial number for the vessel~~
- ~~(6) Service life identifying the last date the vessel can be used~~
- ~~(7) System name or product code that identifies the system by the type of chemistry used in the system~~

#### **~~10.2.9.1.8 Temperature Extremes.~~**

~~Metal hydride storage systems, whether full or partially full, shall not be exposed to temperatures exceeding the range stipulated by the manufacturer.~~

#### **~~10.2.9.1.9 Falling Objects.~~**

~~Metal hydride storage systems shall not be placed in areas where they are capable of being damaged by falling objects.~~

#### **~~10.2.9.1.10 Piping Systems.~~**

~~Piping, including tubing, valves, fittings, and pressure regulators, serving metal hydride storage systems shall be maintained gastight to prevent leakage.~~

#### **~~10.2.9.1.10.1 Leaking Systems.~~**

~~Leaking systems shall be removed from service.~~

#### **~~10.2.9.1.11 Refilling of Containers.~~**

~~The refilling of listed or approved metal hydride storage systems shall be in accordance with the listing requirements and manufacturers' instructions.~~

#### **~~10.2.9.1.11.1 Industrial Trucks.~~**

~~The refilling of metal hydride storage systems serving powered industrial trucks shall be in accordance with NFPA 2.~~

#### **~~10.2.9.1.11.2 Hydrogen Purity.~~**

~~The purity of hydrogen used for the purpose of refilling containers shall be in accordance with the listing and the manufacturers' instructions.~~

#### **~~10.2.9.1.12 Electrical.~~**

~~Electrical components for metal hydride storage systems shall be designed, constructed, and installed in accordance with NFPA 70.~~

#### **~~10.2.9.2 Portable Containers or Systems.~~**

##### **~~10.2.9.2.1 Securing Containers.~~**

~~Cylinders, containers, and tanks shall be secured in accordance with 7.1.8.4.~~

##### **~~10.2.9.2.1.1 Use on Mobile Equipment.~~**

~~Where a metal hydride storage system is used on mobile equipment, the equipment shall be designed to restrain cylinders, containers, or tanks from dislodgement, slipping, or rotating when the equipment is in motion.~~

##### **~~10.2.9.2.1.2 Motorized Equipment.~~**

~~Metal hydride storage systems used on motorized equipment shall be installed in a manner that protects valves, pressure regulators, fittings, and controls against accidental impact.~~

#### **~~(A) Protection from Damage.~~**

~~Metal hydride storage systems, including cylinders, containers, tanks, and fittings, shall not extend beyond the platform of the mobile equipment.~~

##### **~~10.2.9.2.2 Valves.~~**

~~Valves on cylinders, containers, and tanks shall remain closed except when containers are connected to closed systems and ready for use.~~

### **~~10.3 General Hydrogen Systems Having Quantities Greater Than the MAQ.~~**

#### **~~10.3.1~~**

~~The storage, use, and handling of hydrogen in gaseous hydrogen systems in quantities greater than the MAQ shall be in accordance with Sections 10.1, 10.2, and 10.3.~~

#### **~~10.3.2 Hydrogen Equipment Enclosures.~~**

~~Hydrogen equipment enclosures shall be in accordance with NFPA 2.~~

##### **~~10.3.1 Bonding and Grounding.~~**

~~The hydrogen compressed gas system shall be electrically bonded and grounded.~~

##### **~~10.3.1.1~~**

~~The hydrogen compressed bulk flammable gas system shall be electrically bonded and grounded.~~

##### **~~10.3.1.2~~**

~~Mobile hydrogen supply units shall be electrically bonded to the storage system before hydrogen the flammable gas is discharged from the supply unit.~~

#### **~~10.3.2 Cargo Transport Unloading.~~**

##### **~~10.3.2.1~~**

~~Vehicular protection shall be provided in accordance with 7.1.8.3.~~

##### **~~10.3.2.2~~**

~~Unloading connections on delivery equipment shall not be positioned closer to any of the exposures than the distances given for the bulk hydrogen compressed flammable gas storage system.~~

##### **~~10.3.2.3~~**

~~During transfer of hydrogen flammable gas from cargo vehicles to the hydrogen compressed bulk flammable gas storage system, the hand or emergency brake of the vehicle shall be set, and chock blocks shall be used to prevent the vehicle from moving. both of the following shall apply:~~

- ~~(1) The hand or emergency brake of the vehicle shall be set~~
- ~~(2) Chock blocks shall be used to prevent the vehicle from moving~~

#### **10.3.2.4**

Cargo vehicles equipped with an air-brake interlock in front of the unloading connection to protect against drive-aways shall be engaged such that the interlock is activated.

#### **10.3.2.5**

Mobile ~~hydrogen~~flammable gas supply units shall be electrically bonded to the ~~hydrogen-compressed~~bulk flammable gas storage system before ~~hydrogen~~the flammable gas is discharged from the supply unit.

#### **10.3.2.6 Transfer System Depressurization.**

##### **10.3.2.6.1**

~~The transfer~~Transfer systems shall be capable of depressurizing to facilitate disconnection.

##### **10.3.2.6.2**

Bleed connections shall be connected to a ~~hydrogen~~flammable gas venting system in accordance with 10.2.3.

#### **10.3.2.7**

Where required, check valves on delivery systems shall ~~be in accordance~~comply with 7.4.1.3.2.

#### **10.3.2.8**

~~Prohibitions on smoking or the use of open flame shall be in accordance with 7.7.3.2.~~Signs shall be posted in areas containing flammable gases stating that smoking, or the use of open flame, or both is prohibited within 25 ft (7.6 m) of the storage or use are perimeter.

#### **10.3.2.9**

An emergency shutoff valve shall be provided in accordance with 7.4.1.11.

#### **~~10.3.3 Indoor Non-Bulk Hydrogen Compressed Gas System Location.~~**

##### **~~10.3.3.1~~**

~~Hydrogen systems of less than 5000 scf (141.6 Nm<sup>3</sup>) and greater than the MAQ, where located inside buildings, shall be in accordance with the following:~~

- ~~(1) In a ventilated area in accordance with the provisions of Section 6.16~~
- ~~(2) Separated from incompatible materials in accordance with the provisions of 7.1.10.2~~
- ~~(3) A distance of 25 ft (7.6 m) from open flames and other sources of ignition~~
- ~~(4) A distance of 50 ft (15 m) from intakes of ventilation, air conditioning equipment, and air compressors located in the same room or area as the hydrogen system~~
  - ~~(a) The distance shall be permitted to be reduced to 10 ft (3.1 m) where the room or area in which the hydrogen system is installed is protected by a listed detection system per Article 500.7(K) of NFPA 70 and the detection system shuts down the fuel supply in the event of a leak that results in a concentration that exceeds 25 percent of the LFL~~
  - ~~(b) Emergency shutoff valves shall be provided in accordance with 7.4.1.11~~
- ~~(5) A distance of 50 ft (15 m) from other flammable gas storage~~
- ~~(6) Protected against damage in accordance with the provisions of 7.1.8.3~~

#### **~~10.3.3.2 Systems Installed in One Room.~~**

##### **~~10.3.3.2.1~~**

~~More than one system of 5000 scf (141.6 Nm<sup>3</sup>) or less shall be permitted to be installed in the same room or area, provided the systems are separated by at least 50 ft (15 m) or a full height fire resistive partition having a minimum fire resistance rating of 2 hours is located between the systems.~~

##### **~~10.3.3.2.2~~**

~~The separation distance between multiple systems of 5000 scf (141.6 Nm<sup>3</sup>) or less shall be permitted to be reduced to 25 ft (7.6 m) in buildings where the space between storage areas is free of combustible~~

~~materials and protected with a sprinkler system designed for Extra Hazard, Group 1 occupancies in accordance with the requirements of Section 6.10.~~

### ~~10.3.3.2.3~~

~~The required separation distance between individual portable systems in the process of being filled or serviced in facilities associated with the manufacture or distribution of hydrogen and its mixtures shall not be limited by 10.3.5.2.1 or 10.3.5.2.2 when such facilities are provided with Protection Level 2 controls and the applicable requirements of Chapters 1 through 7.~~

## ~~10.3.4 Outdoor Non-Bulk Hydrogen Compressed Gas Location.~~

### ~~10.3.4.1~~

~~The outdoor storage or use of non-bulk gaseous hydrogen shall be in accordance with 7.7.2.~~

## ~~10.3.3 Maintenance.~~

### ~~10.3.3.1~~

~~Maintenance shall be performed annually by a qualified representative of the equipment owner.~~

### ~~10.3.3.2~~

~~The maintenance shall include inspection for physical damage, leak tightness, ground system integrity, vent system operation, equipment identification, warning signs, operator information and training records, scheduled maintenance and retest records, alarm operation, and other safety-related features.~~

### ~~10.3.5.3~~

~~Scheduled maintenance and retest activities shall be formally documented, and records shall be maintained a minimum of 3 years.~~

## ~~10.4 Bulk Gaseous Hydrogen System.~~

### ~~10.4.1~~

~~The use, storage, and handling of hydrogen in gaseous hydrogen systems (bulk hydrogen systems) in quantities greater than 5000 scf (141.6 Nm<sup>3</sup>) shall be in accordance with Sections 10.1, 10.2, 10.3, and 10.4.~~

## ~~10.4 Outdoor Bulk Hydrogen Compressed~~Flammable Gas Systems.

### ~~10.4.1 General Requirements.~~

#### ~~10.4.1.1 Bulk Hydrogen Compressed Gas.~~

~~Systems located above ground either at grade or above grade shall be in accordance~~comply with 10.4.

#### ~~10.4.1.2\*~~

Electrical wiring and equipment shall be in accordance with Article 500 of *NFPA 70*.

#### ~~A.10.4.1.2~~

NFPA 497 can be used as a guide for the extent of the area classification.

#### ~~10.4.1.2.1~~

~~Specific locations for Class 1, Division 1, Group B (hydrogen) and Class 1, Division 2, Group B (hydrogen) areas shall be in accordance with Table 10.4.2.1.2.1.~~

~~Table 10.4.1.2.1 Electrical Area Classification~~

| Location                                                                                                                                  | Classification      | Extent of Classified Area                                                             |
|-------------------------------------------------------------------------------------------------------------------------------------------|---------------------|---------------------------------------------------------------------------------------|
| Within 3 ft (1 m) of any vent outlet and any points where hydrogen is vented to the atmosphere under normal operations                    | Class 1, Division 1 | Between 0 ft (0 m) and 3 ft (0.9 m) and measured spherically from the outlet.         |
| Between 3 ft (1 m) and 15 ft (4.6 m) of any vent outlet and any points where hydrogen is vented to the atmosphere under normal operations | Class 1, Division 2 | Between 3 ft (0.9 m) and 15 ft (4.6 m) and measured spherically from the vent outlet. |
| Storage equipment excluding the piping system downstream of the source valve                                                              | Class 1, Division 2 | Between 0 ft (0 m) and 15 ft (4.6 m) and measured spherically from the source.        |

#### 10.4.2 Location.

##### 10.4.2.1\* Minimum Distance.

The minimum distance from a bulk hydrogen-compressed flammable gas system located outdoors to specified exposures shall be in accordance with Table 10.4.2.1(a), or Table 10.4.2.1(b) for bulk flammable gases, or Table 10.4.2.2.1(c). (See also Annex G.)

**Table 10.4.2.1(a) Minimum Distance (D) from Outdoor Bulk Hydrogen-Compressed Flammable Gas Systems to Exposures — Typical Maximum Pipe Size**

| Pressure                                                                                                                                                                                            | >15 to<br>≤250 psig    |      | >250 to<br>≤3000 psig   |      | >3000 to<br>≤7500 psig    |      | >7500 to<br>≤15,000 psig   |      |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|------|-------------------------|------|---------------------------|------|----------------------------|------|
| Internal Pipe Diameter (ID)                                                                                                                                                                         | >103.4 to<br>≤1724 kPa |      | >1724 to<br>≤20,684 kPa |      | >20,684 to<br>≤51,711 kPa |      | >51,711 to<br>≤103,421 kPa |      |
| $d_{mm}$                                                                                                                                                                                            | $d = 52.5_{mm}$        |      | $d = 18.97_{mm}$        |      | $d = 7.31_{mm}$           |      | $d = 7.16_{mm}$            |      |
| Group 1 Exposures                                                                                                                                                                                   | m                      | ft   | m                       | ft   | m                         | ft   | m                          | ft   |
| Lot lines                                                                                                                                                                                           | 512                    | 1640 | 614                     | 2046 | 429                       | 139  | 510                        | 1634 |
| Air intakes (HVAC, compressors, other)                                                                                                                                                              |                        |      |                         |      |                           |      |                            |      |
| Operable openings in buildings and structures                                                                                                                                                       |                        |      |                         |      |                           |      |                            |      |
| Ignition sources such as open flames and welding                                                                                                                                                    |                        |      |                         |      |                           |      |                            |      |
| Group 2 Exposures                                                                                                                                                                                   | m                      | ft   | m                       | ft   | m                         | ft   | m                          | ft   |
| Places of public assembly                                                                                                                                                                           | 56                     | 1620 | 67                      | 2024 | 34                        | 1013 | 45                         | 1316 |
| Parked cars                                                                                                                                                                                         |                        |      |                         |      |                           |      |                            |      |
| <u>Hazardous materials storage systems above or below ground</u>                                                                                                                                    |                        |      |                         |      |                           |      |                            |      |
| <u>Ordinary combustibles, including fast-burning solids such as ordinary lumber, excelsior, paper, or combustible waste and vegetation other than that found in maintained landscaped areas</u>     |                        |      |                         |      |                           |      |                            |      |
| <u>Building of combustible construction</u>                                                                                                                                                         |                        |      |                         |      |                           |      |                            |      |
| Group 3 Exposures                                                                                                                                                                                   | m                      | ft   | m                       | ft   | m                         | ft   | m                          | ft   |
| Buildings of noncombustible non-fire-rated construction                                                                                                                                             | 45                     | 1317 | 56                      | 1619 | 34                        | 1012 | 4                          | 1314 |
| <del>Buildings of combustible construction</del>                                                                                                                                                    |                        |      |                         |      |                           |      |                            |      |
| Flammable gas storage systems above or below ground                                                                                                                                                 |                        |      |                         |      |                           |      |                            |      |
| <del>Hazardous materials storage systems above or below ground</del>                                                                                                                                |                        |      |                         |      |                           |      |                            |      |
| Heavy timber, coal, or other slow-burning combustible solids                                                                                                                                        |                        |      |                         |      |                           |      |                            |      |
| <del>Ordinary combustibles, including fast-burning solids such as ordinary lumber, excelsior, paper, or combustible waste and vegetation other than that found in maintained landscaped areas</del> |                        |      |                         |      |                           |      |                            |      |
| Unopenable openings in buildings and structures                                                                                                                                                     |                        |      |                         |      |                           |      |                            |      |
| Encroachment by overhead utilities (horizontal distance from the vertical plane below the nearest overhead electrical wire of building service)                                                     |                        |      |                         |      |                           |      |                            |      |

| Pressure                    | >15 to<br>≤250 psig    | >250 to<br>≤3000 psig   | >3000 to<br>≤7500 psig    | >7500 to<br>≤15,000 psig   |
|-----------------------------|------------------------|-------------------------|---------------------------|----------------------------|
| Internal Pipe Diameter (ID) | >103.4 to<br>≤1724 kPa | >1724 to<br>≤20,684 kPa | >20,684 to<br>≤51,711 kPa | >51,711 to<br>≤103,421 kPa |
| $d_{mm}$                    | $d = 52.5_{mm}$        | $d = 18.97_{mm}$        | $d = 7.31_{mm}$           | $d = 7.16_{mm}$            |

Piping containing other hazardous materials

Flammable gas metering and regulating stations such as natural gas or propane

Building or structure constructed of noncombustible or limited-combustible materials\*

(a) Sprinklered building or structure or unsprinklered building or structure having noncombustible contents

(b) Building with adjacent walls with fire resistance rating of 2 hours or greater

\*See 10.4.2.2.1.3.

**Table 10.4.2.1(b) Minimum Distance (D) from Outdoor Bulk Hydrogen-Compressed Flammable Gas Systems to Exposures by Maximum Pipe Size with Pressures >15 to ≤3000 psig**

| Pressure                    |        | >15 to ≤250 psig<br>>103.4 to ≤1724 kPa |        |                      |        |            |        | >250 to ≤3000 psig<br>>1724 to ≤20,684 kPa |         |                      |        |             |        |
|-----------------------------|--------|-----------------------------------------|--------|----------------------|--------|------------|--------|--------------------------------------------|---------|----------------------|--------|-------------|--------|
|                             |        | Exposures**                             |        |                      |        |            |        | Exposures**                                |         |                      |        |             |        |
| Internal Pipe Diameter (ID) |        | Group 1                                 |        | Group 2              |        | Group 3    |        | Group 1                                    |         | Group 2              |        | Group 3     |        |
| ID (in.)                    | d (mm) | D = 0.0952d                             |        | D = 0.1019d - 0.3485 |        | D = 0.0762 |        | D = 0.3168d                                |         | D = 0.3384d - 0.4188 |        | D = 0.2636d |        |
|                             |        | m                                       | ft     | m                    | ft     | m          | ft     | m                                          | ft      | m                    | ft     | m           | ft     |
| 0.2                         | 5.1    | 0.51                                    | 2.04   | 0.20                 | 1.01   | 0.40       | 1.02   | 1.64                                       | 5.012   | 1.31                 | 4.04   | 1.32        | 4.05   |
| 0.3                         | 7.6    | 0.72                                    | 2.06   | 0.40                 | 1.02   | 0.61       | 2.02   | 2.46                                       | 8.018   | 2.22                 | 7.08   | 2.02        | 7.08   |
| 0.4                         | 10.2   | 1.02                                    | 3.08   | 0.71                 | 2.03   | 0.81       | 3.03   | 3.27                                       | 11.025  | 3.04                 | 10.012 | 2.73        | 9.010  |
| 0.5                         | 12.7   | 1.23                                    | 4.010  | 0.91                 | 3.04   | 1.01       | 3.04   | 4.09                                       | 13.031  | 3.95                 | 13.015 | 3.34        | 11.013 |
| 0.6                         | 15.2   | 1.44                                    | 5.012  | 1.21                 | 4.05   | 1.21       | 4.05   | 4.811                                      | 16.037  | 4.76                 | 16.019 | 4.05        | 13.015 |
| 0.7                         | 17.8   | 1.74                                    | 6.013  | 1.52                 | 5.06   | 1.42       | 4.06   | 5.613                                      | 19.043  | 5.67                 | 18.022 | 4.75        | 15.018 |
| 0.8                         | 20.3   | 1.95                                    | 6.015  | 1.72                 | 6.07   | 1.52       | 5.06   | 6.415                                      | 21.049  | 6.58                 | 21.026 | 5.46        | 18.020 |
| 0.9                         | 22.9   | 2.25                                    | 7.017  | 2.02                 | 7.08   | 1.72       | 6.07   | 7.317                                      | 24.055  | 7.39                 | 24.030 | 6.07        | 20.023 |
| 1.0                         | 25.4   | 2.46                                    | 8.019  | 2.23                 | 7.09   | 1.92       | 6.08   | 8.019                                      | 26.062  | 8.210                | 27.033 | 6.78        | 22.026 |
| 1.1                         | 27.9   | 2.76                                    | 9.021  | 2.53                 | 8.010  | 2.13       | 7.09   | 8.821                                      | 29.068  | 9.011                | 30.037 | 7.49        | 24.028 |
| 1.2                         | 30.5   | 2.97                                    | 10.023 | 2.83                 | 9.011  | 2.33       | 8.010  | 9.722                                      | 32.074  | 9.912                | 32.041 | 8.09        | 26.031 |
| 1.3                         | 33.0   | 3.18                                    | 10.025 | 3.04                 | 10.012 | 2.53       | 8.010  | 10.524                                     | 34.080  | 10.713               | 35.044 | 8.710       | 29.033 |
| 1.4                         | 35.68  | 3.48                                    | 11.027 | 3.34                 | 11.013 | 2.73       | 9.011  | 11.326                                     | 37.086  | 11.615               | 38.048 | 9.411       | 31.036 |
| 1.5                         | 38.1   | 3.69                                    | 12.029 | 3.54                 | 12.014 | 2.94       | 10.012 | 12.128                                     | 40.092  | 12.516               | 41.052 | 10.012      | 33.038 |
| 1.6                         | 40.6   | 3.99                                    | 13.031 | 3.85                 | 12.015 | 3.14       | 10.013 | 12.930                                     | 42.098  | 13.317               | 44.055 | 10.712      | 35.041 |
| 1.7                         | 43.2   | 4.110                                   | 13.033 | 4.15                 | 13.016 | 3.34       | 11.014 | 13.732                                     | 45.0105 | 14.218               | 47.059 | 11.413      | 37.043 |
| 1.8                         | 45.7   | 4.411                                   | 14.035 | 4.35                 | 14.017 | 3.54       | 11.014 | 14.534                                     | 47.0111 | 15.019               | 49.062 | 12.014      | 40.046 |
| 1.9                         | 48.3   | 4.611                                   | 15.037 | 4.66                 | 15.018 | 3.75       | 12.015 | 15.336                                     | 50.0117 | 15.920               | 52.066 | 12.715      | 42.049 |

| Pressure                    |        | >15 to ≤250 psig<br>>103.4 to ≤1724 kPa |        |                      |        |            |        | >250 to ≤3000 psig<br>>1724 to ≤20,684 kPa |         |                      |        |             |        |
|-----------------------------|--------|-----------------------------------------|--------|----------------------|--------|------------|--------|--------------------------------------------|---------|----------------------|--------|-------------|--------|
|                             |        | Exposures <sup>*†</sup>                 |        |                      |        |            |        | Exposures <sup>*†</sup>                    |         |                      |        |             |        |
| Internal Pipe Diameter (ID) |        | Group 1                                 |        | Group 2              |        | Group 3    |        | Group 1                                    |         | Group 2              |        | Group 3     |        |
| ID (in.)                    | d (mm) | D = 0.0952d                             |        | D = 0.1019d - 0.3485 |        | D = 0.0762 |        | D = 0.3168d                                |         | D = 0.3384d - 0.4188 |        | D = 0.2636d |        |
|                             |        | m                                       | ft     | m                    | ft     | m          | ft     | m                                          | ft      | m                    | ft     | m           | ft     |
| 2.0                         | 50.8   | 4.812                                   | 16.039 | 4.86                 | 16.019 | 3.95       | 13.016 | 16.137                                     | 53.0123 | 16.821               | 55.070 | 13.416      | 44.051 |
| 2.1                         | 53.3   | 5.112                                   | 17.040 | 5.16                 | 17.020 | 4.15       | 13.017 | 16.939                                     | 55.0129 | 17.622               | 58.073 | 14.016      | 46.054 |

Note: Linear interpolation of internal pipe diameters and distances between table entries is allowed.

\*For a list of exposures in each exposure group, see Column 1 of Table 10.4.2.2.1(a) 10.4.2.1(a).

†When calculating the minimum separation distance (D) using the formulas indicated, based on the exposure group and pressure indicated, the internal pipe diameter (d) is entered in millimeters (mm). The calculated distance (D) is expressed in units of measure in meters (m). To convert distance (D) to units of measure in feet, multiply the value of (D) in meters by 3.2808 and round to the nearest whole foot.

Table 10.4.2.1(c) Minimum Distance (D) from Outdoor Bulk Hydrogen Compressed Gas Systems to Exposures by Maximum Pipe Size with Pressures >3000 to ≤15,000 psig

| Pressure                    |        | >3000 to ≤7500 psig<br>>20,684 to ≤51,711 kPa |       |                    |       |                    |      | >7500 to ≤15,000 psig<br>>51,711 to ≤103,421 kPa |        |                    |       |                     |      |
|-----------------------------|--------|-----------------------------------------------|-------|--------------------|-------|--------------------|------|--------------------------------------------------|--------|--------------------|-------|---------------------|------|
|                             |        | Exposures <sup>*†</sup>                       |       |                    |       |                    |      | Exposures <sup>*†</sup>                          |        |                    |       |                     |      |
| Internal Pipe Diameter (ID) |        | Group 1                                       |       | Group 2            |       | Group 3            |      | Group 1                                          |        | Group 2            |       | Group 3             |      |
| ID (in.)                    | d (mm) | D = 1.105d - 4.078                            |       | D = 0.6831d - 1.99 |       | D = 0.459d - 0.355 |      | D = 1.448d - 5.368                               |        | D = 0.9291d - 2.65 |       | D = 0.602d - 0.3103 |      |
|                             |        | m                                             | ft    | m                  | ft    | m                  | ft   | m                                                | ft     | m                  | ft    | m                   | ft   |
| 0.2                         | 5.1    | 1.6                                           | 5.0   | 1.5                | 5.0   | 2.0                | 7.0  | 2.0                                              | 7.0    | 2.0                | 7.0   | 3.0                 | 9.0  |
| 0.3                         | 7.6    | 4.3                                           | 14.0  | 3.2                | 11.0  | 3.0                | 10.0 | 6.0                                              | 18.0   | 4.0                | 14.0  | 4.0                 | 14.0 |
| 0.4                         | 10.2   | 7.2                                           | 24.0  | 5.0                | 16.0  | 4.0                | 14.0 | 9.0                                              | 31.0   | 7.0                | 22.0  | 6.0                 | 19.0 |
| 0.5                         | 12.7   | 10.0                                          | 33.0  | 6.7                | 22.0  | 5.0                | 18.0 | 13.0                                             | 43.0   | 9.0                | 30.0  | 7.0                 | 24.0 |
| 0.6                         | 15.2   | 12.7                                          | 42.0  | 8.4                | 28.0  | 7.0                | 22.0 | 17.0                                             | 55.0   | 11.0               | 38.0  | 9.0                 | 29.0 |
| 0.7                         | 17.8   | 15.6                                          | 51.0  | 10.2               | 33.0  | 8.0                | 26.0 | 20.0                                             | 67.0   | 14.0               | 46.0  | 10.0                | 34.0 |
| 0.8                         | 20.3   | 18.4                                          | 60.0  | 11.9               | 39.0  | 9.0                | 29.0 | 24.0                                             | 79.0   | 16.0               | 53.0  | 12.0                | 39.0 |
| 0.9                         | 22.9   | 21.2                                          | 70.0  | 13.7               | 45.0  | 10.0               | 33.0 | 28.0                                             | 91.0   | 19.0               | 61.0  | 13.0                | 44.0 |
| 1.0                         | 25.4   | 24.0                                          | 79.0  | 15.4               | 50.0  | 11.0               | 37.0 | 31.0                                             | 103.00 | 21.0               | 69.0  | 15.0                | 49.0 |
| 1.1                         | 27.9   | 26.8                                          | 88.0  | 17.1               | 56.0  | 12.0               | 41.0 | 35.0                                             | 115.00 | 23.0               | 76.0  | 16.0                | 54.0 |
| 1.2                         | 30.5   | 29.6                                          | 97.0  | 18.8               | 62.0  | 14.0               | 45.0 | 39.0                                             | 127.00 | 26.0               | 84.0  | 18.0                | 59.0 |
| 1.3                         | 33.0   | 32.4                                          | 106.0 | 20.6               | 67.0  | 15.0               | 49.0 | 42.0                                             | 139.00 | 28.0               | 92.0  | 20.0                | 64.0 |
| 1.4                         | 35.6   | 35.3                                          | 116.0 | 22.3               | 73.0  | 16.0               | 52.0 | 46.0                                             | 152.00 | 30.0               | 100.0 | 21.0                | 69.0 |
| 1.5                         | 38.1   | 38.0                                          | 125.0 | 24.0               | 79.0  | 17.0               | 56.0 | 50.0                                             | 163.00 | 33.0               | 107.0 | 23.0                | 74.0 |
| 1.6                         | 40.6   | 40.8                                          | 134.0 | 25.7               | 84.0  | 18.0               | 60.0 | 53.0                                             | 175.00 | 35.0               | 115.0 | 24.0                | 79.0 |
| 1.7                         | 43.2   | 43.7                                          | 143.0 | 27.5               | 90.0  | 19.0               | 64.0 | 57.0                                             | 188.00 | 37.0               | 123.0 | 26.0                | 84.0 |
| 1.8                         | 45.7   | 46.4                                          | 152.0 | 29.2               | 96.0  | 21.0               | 68.0 | 61.0                                             | 199.00 | 40.0               | 131.0 | 27.0                | 89.0 |
| 1.9                         | 48.3   | 49.3                                          | 162.0 | 31.0               | 102.0 | 22.0               | 72.0 | 65.0                                             | 212.0  | 42.0               | 139.0 | 29.0                | 94.0 |

| Pressure                    |        | >3000 to ≤7500 psig<br>>20,684 to ≤51,711 kPa |       |                                 |       |                                 |      | >7500 to ≤15,000 psig<br>>51,711 to ≤103,421 kPa |       |                                 |       |                                  |      |
|-----------------------------|--------|-----------------------------------------------|-------|---------------------------------|-------|---------------------------------|------|--------------------------------------------------|-------|---------------------------------|-------|----------------------------------|------|
|                             |        | Exposures**                                   |       |                                 |       |                                 |      | Exposures**                                      |       |                                 |       |                                  |      |
| Internal Pipe Diameter (ID) |        | Group 1                                       |       | Group 2                         |       | Group 3                         |      | Group 1                                          |       | Group 2                         |       | Group 3                          |      |
| ID (in.)                    | d (mm) | <del>D = 1.105d<br/>4.078</del>               |       | <del>D = 0.6831d<br/>1.99</del> |       | <del>D = 0.459d<br/>0.355</del> |      | <del>D = 1.448d<br/>5.368</del>                  |       | <del>D = 0.9291d<br/>2.65</del> |       | <del>D = 0.602d<br/>0.3103</del> |      |
|                             |        | m                                             | ft    | m                               | ft    | m                               | ft   | m                                                | ft    | m                               | ft    | m                                | ft   |
| 2.0                         | 50.8   | 52.1                                          | 171.0 | 32.7                            | 107.0 | 23.0                            | 75.0 | 68.0                                             | 224.0 | 45.0                            | 146.0 | 30.0                             | 99.0 |

Note: Linear interpolation of internal pipe diameters and distances between table entries is allowed.

\*For a list of exposures in each exposure group see Column 1 of Table 10.4.2.2.1(a).

\*\*When calculating the minimum separation distance (D) using the formulas indicated, based on the exposure group and pressure indicated, the internal pipe diameter (d) is entered in millimeters (mm). The calculated distance (D) is expressed in units of measure in meters (m). To convert distance (D) to units of measure in feet, multiply the value of (D) in meters by 3.2808 and round to the nearest whole foot.

#### A.10.4.2.1

The exposures integral to Table 10.4.2.1(a), and Table 10.4.2.1(b), and Table 10.4.2.2.1(c) have been arranged into groups based on similar risks. The estimated leak area was changed from 3 percent to 1 percent of the pipe diameter to evaluate separation distances. The thresholds are applicable to the exposures identified in each group, as follows:

- (1) *Group 1 Exposures.* The distances specified are those required to reduce the radiant heat flux level to 1500 Btu/hr/ft<sup>2</sup> (4732 W/m<sup>2</sup>) at the property line or the distance to a point in the unignited hydrogen jet where the hydrogen content is reduced to an 8 percent mole fraction (i.e., volume fraction) of hydrogen, whichever is greater. In all cases, the distance required to achieve an 8 percent mole fraction was the greater distance and was used to establish the requirements.
- (2) *Group 2 Exposures.* The distances specified are those required to reduce the radiant heat flux level to 1500 Btu/hr/ft<sup>2</sup> (4732 W/m<sup>2</sup>) for persons exposed a maximum of 3 minutes.
- (3) *Group 3 Exposures.* The distances specified are those required to reduce the radiant heat flux level to 6340 Btu/hr/ft<sup>2</sup> (20,000 W/m<sup>2</sup>) or the visible flame length for combustible materials, or a radiant heat flux level of 8000 Btu/hr/ft<sup>2</sup> (25,237 W/m<sup>2</sup>) or the visible flame length for noncombustible equipment. In both cases, the visible flame length was used to establish the requirements.

A 50 percent safety factor was added to all the resulting separation distance values.

*Table 10.4.2.1(a) Exposures Group 1.* Lot lines (i.e., property lines) are those property lines between parcels and should not be construed to be the imaginary property lines that are drawn for the purposes of protecting the exterior walls of multiple buildings placed on the same lot or parcel. Railroad easements that are not accessible to the public other than by rail travel can be used as a means of spatial separation, with the required separation being measured between the hydrogen bulk flammable gas system and the nearest railroad track. ~~It should be noted that in~~ In these cases, the addition or relocation of track can result in an encroachment that will necessitate relocation of the hydrogen bulk flammable gas system at the system user's expense.

Where the property on the other side of a property line is determined to be unbuildable or unoccupiable due to natural features, including, but not limited to, waterways, terrain, wetlands, or similar features, encroachment by the hydrogen bulk flammable gas system on the property line can be acceptable with the approval of the ~~authority having jurisdiction~~ AHJ. Should the property that is encroached upon become buildable or otherwise occupiable, the hydrogen bulk flammable gas system location should be reevaluated by the system user and the AHJ notified of the results.

*Table 10.4.2.1(a) Exposure Group 2.* The exposed persons of concern are non-work-related persons or members of the public who are not involved with servicing the system, as these persons ~~typically~~ are typically neither trained nor knowledgeable in the operation of the system but are on the premises. By comparison, service personnel or those involved with servicing the system are trained and engaged in activities related to the system operation, including, but not limited to, inspecting the system, monitoring system inventory, delivering product, system maintenance, or similar functions. Administrative controls, engineering controls, or construction features are typically used to restrict persons other than service personnel from being within the zone of potential exposure. The permit holder is responsible for

managing and administering the controls to restrict access. Examples of such controls could include painted lines or signs or a physical barrier such as a fence.

~~CGA PS-48, Clarification of Existing Hydrogen Setback Distances and Development of New Hydrogen Setback Distances in NFPA 55, provides guidance and clarification on the types of exposures, as well as the application of the separation distances.~~

#### **10.4.2.1.1 Distance Measurement.**

The distance shall be measured from the part of the bulk ~~hydrogen-compressed~~flammable gas system closest to the exposure.

#### **10.4.2.1.2\* Minimum Distance.**

The minimum distance to exposures for individual components of the bulk ~~hydrogen-compressed~~flammable gas system shall be taken from Table 10.4.2.1(a), ~~or Table 10.4.2.1(b), or Table 10.4.2.1(c),~~ based on the maximum internal diameter and respective system design pressure in which they are installed.

##### **A.10.4.2.1.2**

~~Table 10.4.2.1(a), and Table 10.4.2.1(b), and Table 10.4.2.2.1(c) define minimum distances between exposures and components of a bulk hydrogen-compressed~~flammable gas system. The exposure distances are a function of exposure type (Groups 1, 2, and 3), system design pressure, and maximum internal diameter. A bulk ~~hydrogen-compressed~~flammable gas system might have portions of the system that operate within differing pressure ranges. For example, components that operate within a system between 15 psig and 250 psig (103 kPa and 1724 kPa) with the largest pipe size less than or equal to 2.1 in. (52.5 mm) have a minimum Group 1 exposure distance of 16 ft (5 m). Components that operate within a different portion of the system between 250 psig and 3000 psig (1724 kPa and 20,684 kPa) with the largest pipe size less than or equal to 0.75 in. (18.97 mm) have a minimum Group 1 exposure of 20 ft (6 m). It is not necessary to apply the 20 ft (6 m) minimum Group 1 exposure distances to the components that form a portion of the system that operate between 15 psig and 250 psig (103 kPa and 1724 kPa).

#### **10.4.2.1.3 Group 3 Exposures.**

For the Group 3 exposures ~~of cited in Table 10.4.2.1(a),~~ buildings or structures constructed of noncombustible or limited-combustible materials where clearance is required for the performance of service or maintenance-related activities, ~~a minimum horizontal clearance of 5 ft (1.5 m) shall be provided with a minimum horizontal clearance of 5 ft (1.5 m) between the exterior wall and the system.~~

#### **10.4.2.1.4\* Vent Stacks.**

The vent stack shall not be considered part of the bulk ~~hydrogen-compressed~~flammable gas system for determining separation distances in 10.4.2. ~~[See Table 10.4.2.1(a), and Table 10.4.2.1(b), and Table 10.4.2.2.1(c).]~~

##### **A.10.4.2.1.4**

The vent stack begins at the downstream side of a pressure relief device or vent valve.

#### **10.4.2.1.5 Other Internal Pipe Diameters.**

The separation distance for piping systems with internal diameters other than those specified in Table 10.4.2.1(a) for the pressure range selected shall be permitted with tabular distances determined based on the use of Table 10.4.2.1(b) ~~or Table 10.4.2.2.1(c).~~

#### **10.4.2.1.6 Air Intakes.**

Distances ~~to air intakes~~ in Table 10.4.2.1(a) ~~to air intakes~~ shall apply only to mechanical piping connections or potential leak points that are part of the outdoor bulk ~~hydrogen-compressed~~flammable gas system.

#### **10.4.2.1.7 Courts.**

Where a bulk flammable gas system is located in a court or enclosed court, the installation shall meet all ~~of the following requirements:~~

- (1) Courts shall have natural or mechanical ventilation in accordance with Section 6.16.
- (2) Explosion control shall be provided in accordance with ~~the requirements of~~ Section 6.9.

- (3) The distance from any part of the system to exterior building walls and related exposures shall meet the requirements of Table 10.4.2.1(a), ~~and Table 10.4.2.1(b), or Table 10.4.2.2.1(c).~~
- (4) Fire barrier walls shall meet the requirements of 10.4.2.4.1(1) through 10.4.2.4.1(4) and 10.4.2.4.1(7) through ~~10.4.2.4.1(11)~~ 10.4.2.4.1(9).
- (5) Vents and ventilation exhausts shall terminate above the walls or outside of the court.

#### **10.4.2.2 Maximum Internal Diameter of Interconnecting Piping.**

The maximum internal diameter of the piping system used for interconnecting piping between the shutoff valve on any single storage container to the point of connection to the system source valve shall not be required to ~~be in accordance~~ comply with the values shown in Table 10.4.2.1(a) ~~when in accordance~~ if it complies with Table 10.4.2.1(b) ~~or Table 10.4.2.2.1(c).~~

##### **10.4.2.2.1\* Determination of Internal Diameter.**

~~The internal diameter of the piping system shall be determined by the diameter of the piping serving that portion of a storage array with content greater than 5000 scf (141.6 Nm<sup>3</sup>). The piping system size used in the application of Table 10.4.2.2.1(a), Table 10.4.2.2.1(b), or Table 10.4.2.2.1(c) shall be determined based on that portion of the system with the greatest maximum internal diameter.~~

##### **A.10.4.2.2.1**

Systems that employ compressors downstream of a bulk supply typically operate at higher pressures than ~~that of~~ the bulk supply. As a result, the diameter of the piping system can vary with the pressure. The use of a higher pressure rating or variation of internal diameters is not warranted unless there is a storage component with a hydrogen bulk flammable gas content that exceeds 5000 scf (141.6 Nm<sup>3</sup>) located downstream of the primary storage source and upstream of the source valve. The volume of gas contained within the piping system is not included in determining the quantity in storage.

For example, a 3000 psi (20,684 kPa) storage system that supplies a 6000 psi (41,369 kPa) compressor that directly feeds a process with less than 5000 scf (141.6 Nm<sup>3</sup>) of intervening storage at a pressure of 6000 psi (41,369 kPa) or less is considered a 3000 psi (20,684 kPa) system. ~~Conversely, a system with the primary storage of 3000 psi (20,684 kPa) might supply a compressor that in turn delivers hydrogen to intermediate storage with a quantity of greater than 5000 scf (141.6 Nm<sup>3</sup>). The piping serving the intermediate storage system from a point of discharge on the compressor can have an internal diameter of less than that serving the primary storage system upstream of the compressor. Accordingly, each portion of the system must be analyzed with respect to the tabular distances. See the typical piping and instrumentation drawings (P&IDs) shown in Figure A.3.3.100.9.1(a) through Figure A.3.3.100.9.1(f) for additional information in this regard.~~

The use of Table 10.4.2.1(b) ~~and Table 10.4.2.2.1(c)~~ is based on the maximum internal diameter of the piping system over the range of pressures specified. In practice, it is common to maintain a consistent size of piping throughout the system; however, there might be cases where the ~~ID~~ internal diameter of the piping system varies. In such cases, the piping with the largest internal diameter in the system is used to establish the system pipe size for the purposes of using the table, regardless of the length of the piping. It is not uncommon for portions of the system equipped with pressure gauges, pressure transducers, or other instrumentation to be served by small-diameter piping systems. However, the maximum internal diameter of the piping system will control the establishment of distance for the exposures indicated.

##### **10.4.2.2.1.1**

The internal diameter of the piping system shall be determined by the diameter of the piping serving that portion of a storage array with content greater than 5000 scf (141.6 Nm<sup>3</sup>).

##### **10.4.2.2.1.2**

The piping system size used in the application of Table 10.4.2.1(a), ~~or Table 10.4.2.1(b), or Table 10.4.2.2.1(c)~~ shall be determined based on that portion of the system with the greatest maximum internal diameter.

##### **10.4.2.2.2**

Separation distances determined ~~based on the use of~~ using Table 10.4.2.1(b) ~~or Table 10.4.2.2.1(c)~~ shall be subject to review and approval by the AHJ.

#### 10.4.2.3\* Determination of System Pressure.

The system pressure shall be determined by the maximum operating pressure of the storage array with content greater than 5000 scf (141.6 Nm<sup>3</sup>), irrespective of those portions of the system elevated to a higher pressure.

##### A.10.4.2.3

The methodology used to determine the distances listed in Table 10.4.2.1(b) ~~and Table 10.4.2.2.1(c)~~ has been evaluated for piping up to and including internal diameters of approximately 3 in. (76 mm). The establishment of risk-informed separation distances for piping systems with greater internal diameters are subject to a hazard analysis that demonstrates an equivalent level of risk under the ~~provisions~~requirements of Section 1.6.

Portions of a system might operate at higher pressures than the bulk flammable gas supply; ~~however,~~ those portions of the system do not require the use of a pressure rating higher than that of the bulk supply unless there is a storage component exceeding 5000 scf (141.6 Nm<sup>3</sup>) downstream of the primary storage source and upstream of the source valve. The volume of gas contained within the piping system is not included when the quantity in storage is determined. For example, a 3000 psig (20,684 kPa) storage system that supplies a 6000 psig (41,369 kPa) compressor that directly feeds a process with less than 5000 scf (141.6 Nm<sup>3</sup>) of intervening storage at a pressure of 6000 psig (41,369 kPa) or less is considered a 3000 psig (20,684 kPa) system.

#### 10.4.2.4\* Reduction of Distance by Mitigation Means.

##### A.10.4.2.4

Distances to assumed lot lines established for the purpose of determining exterior wall and opening protection should not be confused with lot lines that are property lines in the true sense of the definition. Distances to assumed lot lines can be disregarded in the application of Table 10.4.2.1(a) ~~and Table 10.4.2.2.1(c)~~. The lot lines described under item (a) of Group 1 Exposures in Table 10.4.2.1(a) are property lines used to separate one lot from another or to separate a property from a street or other public space.

A permit holder cannot exercise any right of control over the property of others, whether the ownership is public or private. In cases where the permit holder owns an adjacent lot or parcel, the separation from property lines assumes that the permit holder could transfer ownership of the adjacent property at some point, and therefore the requirements for property line separation should be observed.

##### 10.4.2.4.1 Fire Barriers.

The distances to ~~Group 1 and 2 exposures shown~~cited in Table 10.4.2.1(a) ~~and Table 10.4.2.1(b), and Table 10.4.2.2.1(c)~~ shall be permitted to be reduced by one-half for Group 1 and Group 2 exposures, ~~and Group 3 exposures shall be permitted to be reduced to 0 ft (0 m) for Group 3 exposures~~ where fire barrier walls are located between the system and the exposure and constructed in accordance with all of the following requirements:

- (1) The fire barrier wall shall be without openings or penetrations, except for penetration by conduit or piping if such penetration is protected with a firestop system in accordance with the adopted building code.
  - ~~(a) Penetrations of the fire barrier wall by conduit or piping shall be permitted provided that the penetration is protected with a firestop system in accordance with the adopted building code.~~
- (2) Fire barrier walls shall have a minimum fire resistance rating of not less than 2 hours.
- (3) The fire barrier wall shall interrupt the line of sight between the bulk ~~hydrogen~~ compressed flammable gas system and the exposure.
- (4) The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations.
- (5) \*The wall shall not have more than two sides at 90 degree (1.57 rad) directions or not more than three sides with connecting angles of 135 degrees (2.36 rad), ~~except as provided in 10.4.2.2.4.1(6) for walls permitted to be reduced to less than 135 degrees (2.36 rad) for installations consisting of three walls complying with 8.12.2.7.2.~~
- (6) ~~The connecting angles between fire barrier walls shall be permitted to be reduced to less than 135 degrees (2.36 rad) for installations consisting of three walls when in accordance with 8.12.2.7.2.~~

- (6) Where the number of fire barrier walls creates a court or enclosed court, the requirements of 10.4.2.1.5 shall apply.
- (7) Fire barrier walls shall be designed and constructed as a structure in accordance with the requirements of the applicable building code without exceeding the specified allowable stresses for the materials of construction and shall be designed to resist the overturning effects or failure caused by lateral forces due to deflagration overpressure, wind, flood, and seismic events.
- (8) Where clearance is required between the bulk ~~hydrogen-compressed~~flammable gas system and the barrier wall for the performance of service or maintenance-related activities, a minimum horizontal clearance of 5 ft (1.5 m) shall be provided between the structure and the system.
- (9) The fire barrier wall shall be either an independent structure or be the exterior wall of the building adjacent to the storage or use area that is of noncombustible construction and has a 2-hour fire rating adjacent to the storage or use area when the exterior building wall meets the requirements for fire barrier walls.
- (11) ~~The construction requirements for a fire barrier wall that is part of a hydrogen equipment enclosure and used to reduce separation distances shall be in accordance with 7.1.22.16 of NFPA 2.~~

#### **A.10.4.2.4.1**

~~As stated by Sandia National Laboratories researchers Houf, Schefer, and Evans in "Evaluation of Barrier Walls for Mitigation of Unintended Releases of Hydrogen," the purpose of the Sandia study was to extend the available database on barrier walls as a hazard mitigation strategy and to provide technical data for risk informed decisions in hydrogen codes and standards regarding barrier wall design and implementation. Additional analysis by Sandia (LaChance, Phillips, and Houf) in a paper titled "Risk Associated with the Use of Barriers in Hydrogen Refueling Stations" provided insights on the effectiveness of various barrier designs in terms of the following:~~

- ~~(1) Deflecting jet flames~~
- ~~(2) Reducing the extent of the flammable cloud resulting from an unignited release~~
- ~~(3) Reducing the magnitude of the radiative heat flux produced by a jet flame from an ignited release~~
- ~~(4) Minimizing the amount of ignition overpressure produced from the barrier confinement~~

~~Houf, Schefer, and Evans have determined that for the conditions investigated, 2000 psi (13.79 MPa) source pressure and a 1/8 in. (3.175 mm) diameter round leak, the barrier configurations studied were found to (1) reduce horizontal jet flame impingement hazard by deflecting the jet flame, (2) reduce radiation hazard distances for horizontal jet flames, and (3) reduce horizontal unignited jet flammability hazard distances. For the one wall vertical barrier and the three wall barrier configurations examined in the tests, the simulations of the peak overpressure hazard from ignition were found to be approximately 5.8 psi (40 kPa) on the release side of the barrier and approximately 0.73 psi to 0.44 psi (5 kPa to 3 kPa) on the downstream side of the barrier. Although an overpressure can be expected due to latent ignition of a flammable cloud, the overpressure is expected to be limited to a localized area. Special designs for overpressure in addition to the structural loads imposed by the building code have not been required. The function of the fire barrier wall is to protect the exposure from the system and not the converse. The code assumes that other factors will enter into locating any material or structure in proximity to the bulk hydrogen compressed gas system. For example, if a property or lot line is involved opposite the hydrogen installation, the proximity of a building to be constructed on the lot line is regulated by the building code based on the type and occupancy of structure to be constructed.~~

#### **A.10.4.2.4.1(5)**

~~See Figure A.8.12.2.7.2.1, which addresses bulk cryogenic systems located in a courtyard. This figure also applies to the case where any or all of the three walls are constructed as fire barrier walls, provided the distances to walls constructed as fire barrier walls for exposure protection are not less than that required by Table 10.4.2.1(a); and Table 10.4.2.1(b); or Table 10.4.2.2.1(c).~~

#### **10.4.2.4.2 Passive Means.**

Fire barrier walls located and constructed perin accordance with 10.4.2.4.1 shall not permit the reduction of distances to air intakes.

#### **10.4.2.4.3\* Active Means.**

Active control systems that mitigate the risk of system leaks and failures shall be permitted to be used as a means to reduce separation distances where approved by the AHJ under the authority as granted by Section 1.6.

#### **A.10.4.2.4.3**

Following are operating principles for two types of detectors:

- (1) *Flame Detectors.* Ultraviolet flame detectors typically use a vacuum photodiode Geiger–Muller tube to detect the ultraviolet radiation that is produced by a flame. The photodiode allows a burst of current to flow for each ultraviolet photon that hits the active area of the tube. When the number of current bursts per unit time reaches a predetermined level, the detector initiates an alarm. A single wavelength infrared flame detector uses one of several different photocell types to detect the infrared emissions in a single wavelength band that are produced by a flame. These detectors generally include provisions to minimize alarms from commonly occurring infrared sources such as incandescent lighting or sunlight. An ultraviolet/infrared (UV/IR) flame detector senses ultraviolet radiation with a vacuum photodiode tube and a selected wavelength of infrared radiation with a photocell and uses the combined signal to indicate a fire. These detectors need exposure to both types of radiation before an alarm signal can be initiated. A multiple wavelength infrared (IR/IR) flame detector senses radiation at two or more narrow bands of wavelengths in the infrared spectrum. These detectors electronically compare the emissions between the bands and initiate a signal where the relationship between the two bands indicates a fire.
- (2) *Spark/Ember Detectors.* A spark/ember-sensing detector usually uses a solid state photodiode or phototransistor to sense the radiant energy emitted by embers, typically between 0.5 microns and 2.0 microns in normally dark environments. These detectors can be made extremely sensitive (microwatts), and their response times can be made very short (microseconds).

[72:A.17.8.2]

#### **10.4.2.5 Required Separation Distance for All Systems.**

Separation distances shall be required for bulk ~~hydrogen-compressed~~flammable gas systems independent of system pressure or internal diameter of piping systems in accordance with Table 10.4.2.1(a) or Table 10.4.2.1(b)~~10.4.2.2.5.1 through 10.4.2.2.5.4.~~

##### **10.4.2.5.1**

Unloading connections on delivery equipment shall not be positioned closer to any of the exposures cited in Table 10.4.2.1(a)~~, or Table 10.4.2.1(b), or Table 10.4.2.2.1(c)~~ than the distances given for the storage system.

##### **10.4.2.5.2**

The separation distance between independent gaseous ~~and liquid~~ systems shall meet the minimum distance requirements for Group 3 exposures ~~shown~~cited in Table 10.4.2.1(a)~~, and Table 10.4.2.1(b), and Table 10.4.2.2.1(c).~~

##### **10.4.2.5.3**

The separation distance between integrated gaseous ~~and liquid~~ systems shall be permitted to be reduced to 0 ft (0 m) where such systems are integrated with a shared control system.

##### **10.4.2.5.4**

Systems within 50 ft (15 m) of aboveground storage of all classes of flammable and combustible liquids shall be located on ground higher than such storage, except where dikes, diversion curbs, grading, or separating solid walls are used to prevent accumulation of these liquids under the system.

#### **10.4.2.6\* Co-location.**

~~Bulk hydrogen-compressed gas systems shall be allowed to integrate or co-locate other nonliquefied flammable gas systems as a component of the hydrogen gas system without separation, where the output of the system is designed to deliver a product in which the gases are mixed or blended for delivery into the user's system.~~

#### **A.10.4.2.6**

Compressed ~~hydrogen~~bulk flammable gas storage systems are permitted to be installed adjacent to other flammable gas storage systems with no defined minimum separation distance between them. The intent

of a minimum separation distance is to prevent the escalation of a fire if a leak occurs. If a fire were to start at one bulk flammable gas storage system, the separation distance would prevent its spread to another bulk flammable gas storage system. Yet ~~However~~, a separation distance is not required between two systems storing the same flammable gas. ~~Hydrogen has~~ Bulk flammable gases have been stored safely in single- and multi-tube assemblies for over 60 years. As long as sound engineering practices ~~is~~ are used, storing different flammable gases in adjacent tubes is an equally safe practice. A ~~compressed hydrogen gas~~ bulk flammable gases storage system is permitted to be installed adjacent to another flammable gas storage system with no defined minimum separation distance between them.

#### 10.4.2.6.1

Bulk ~~hydrogen-compressed~~ flammable gas systems shall be allowed to integrate or co-locate other ~~nonliquefied~~ flammable gas systems as a component of the hydrogen flammable gas system without separation, where the output of the system is designed to deliver a product in which the gases are mixed or blended for delivery into the user's system.

#### 10.4.2.6.2

~~The~~ For integration or co-location, the following provisions ~~requirements~~ shall apply ~~in order to allow adjacent~~ for storage:

- ~~(1) The tubes shall be designed, built, and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 or approved by the DOT or the TC for use as an exempted compressed gas shipping container.~~
- ~~(2) Hydrogen manifolds shall be designed and tested in accordance with ASME B31.12, Hydrogen Piping and Pipelines, to ensure initial leaktightness. Other gas manifolds shall be designed and tested in accordance with ASME B31.3, Process Piping.~~
- ~~(3) Pressure relief devices protecting storage vessels excluding cylinders with a water volume less than 20 ft<sup>3</sup> (566 L) shall meet design requirements and be piped to a vent system that has been designed and installed in accordance with CGA G-5.5, Hydrogen Vent Systems.~~
- (1) Where systems are provided with an emergency shutdown device, the device shall be common to all the co-located flammable gases.
- (2) An event that causes the shutdown or isolation of the ~~hydrogen~~ one system shall simultaneously shut down or isolate the other flammable gas system.

### 10.4.3 Indoor Bulk ~~Hydrogen-Compressed~~ Flammable Gas Systems.

#### 10.4.3.1 General.

##### 10.4.3.1.1 Location.

The location of bulk ~~hydrogen-compressed~~ flammable gas systems shall ~~be in accordance~~ comply with Table 10.4.3.1.1.

**Table 10.4.3.1.1 Location of Bulk ~~Hydrogen-Compressed~~ Flammable Gas Systems**

| Location                                                                      | Quantity of <del>Hydrogen</del> <u>Flammable</u> Gas          |                                                           |
|-------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------|
|                                                                               | ≥5000 to<br><15,000 scf<br>(≥142 to<br><425 Nm <sup>3</sup> ) | ≥15,000 scf<br>(≥425 Nm <sup>3</sup> )                    |
| In a detached building in accordance with Section 6.5                         | A                                                             | A                                                         |
| In a Protection Level 2 occupancy in accordance with <del>Section 6.3.2</del> | A                                                             | Detached building required in accordance with Section 6.5 |
| Not in a Protection Level 2 occupancy                                         | N/A                                                           | Detached building required in accordance with Section 6.5 |

A: Allowed. N/A: Not allowed.

##### 10.4.3.1.2\* Fire Protection.

Fire protection shall ~~be in accordance~~ comply with the requirements of Section 6.10.

#### **A.10.4.3.1.2**

HydrogenFlammable gas fires should not be extinguished until the supply of hydrogenflammable gas has been shut off because of the danger of re-ignition or explosion. In the event of fire, large quantities of water should be sprayed on adjacent equipment to cool the equipment and prevent involvement in the fire. Combination fog and solid stream nozzles are preferred, to permit the widest adaptability in fire control. Small hydrogenflammable gas fires can be extinguished with dry chemical extinguishers or with carbon dioxide, nitrogen, and steam. Re-ignition can occur if a heated surface adjacent to the flame is not cooled with water or other means.

#### **10.4.3.2 Detached Buildings.**

##### **10.4.3.2.1**

Detached buildings shall be constructed ~~of noncombustible or limited combustible materials in accordance with the requirements of Section 6.5~~in accordance with the applicable building code.

##### **10.4.3.2.2**

Ventilation shall be provided in accordance with ~~the requirements of Section 6.16.~~

##### ~~**10.4.3.2.2.1**~~

~~Outlet openings shall be located at the high point of the room in exterior walls or the roof.~~

##### ~~**10.4.3.2.2.2**~~

~~Inlet and outlet openings shall each have a minimum total area of 1 ft<sup>2</sup>/1000 ft<sup>3</sup> (1 m<sup>2</sup>/305 m<sup>3</sup>) of room volume.~~

##### ~~**10.4.3.2.2.3**~~

~~Discharge from outlet openings shall be directed or conducted to the atmosphere.~~

##### **10.4.3.2.3\***

Explosion control shall be provided in accordance with ~~the requirements of Section 6.9.~~

#### **A.10.4.3.2.3**

For guidance in these construction techniques, see NFPA 68.

##### **10.4.3.2.4**

Electrical equipment shall ~~be in accordance~~comply with Article 501 of *NFPA 70* for Class I, Division 2 locations.

##### **10.4.3.2.5**

Heating, if provided, shall be by steam, hot water, or other indirect means except ~~that electrical heating shall be permitted to be used if in compliance with 10.4.5.2.4~~as provided in 10.4.3.2.6.

##### **10.4.3.2.6**

Electrical heating shall be permitted to be used if in compliance with 10.4.3.2.4.

#### **10.4.4 Security.**

##### **10.4.4.1\***

User storage sites shall be fenced or otherwise secured and posted to prevent entry by unauthorized personnel.

##### **A.10.4.4.1**

The basis of this requirement is to prevent unauthorized personnel or those unfamiliar with gas storage systems from tampering with the equipment. Where the ~~GH<sub>2</sub>~~bulk flammable gas is located in an area open to the general public, a common practice is to fence and lock the storage or use area, with access restricted to the supplier and the user personnel. Where the storage or use is located within the user's secure area and is not accessible by the general public, it is not always necessary to fence or otherwise secure individual gas storage or use areas. Personnel access patterns can still mandate that the system be fenced, as determined by the supplier and the user.

##### ~~**10.4.4.2**~~

~~Administrative controls shall be allowed to be used to control access to individual storage, use, and handling areas located in secure facilities not accessible by the general public.~~

#### **10.4.4.2**

At least two means of egress shall be provided from any fenced or enclosed area.

#### **~~10.4.3 Underground Bulk Hydrogen Compressed Gas Systems.~~**

##### **~~10.4.3.1 Underground Systems.~~**

~~Bulk hydrogen compressed gas systems installed underground where compressed gas containers are to be buried in contact with earth or fill shall be in accordance with 10.4.3.1.~~

##### **~~10.4.3.1.1 Design.~~**

~~Pressure compressed gas containers installed underground using burial methods shall be of seamless construction in accordance with the ASME Boiler and Pressure Vessel Code.~~

##### **~~10.4.3.1.1.1\*~~**

~~Compressed gas containers shall be designed to include cyclic pressure life calculations using fracture mechanics methods.~~

##### **~~A.10.4.3.1.1.1~~**

~~Fracture mechanic methods given in recognized standards such as API RP 579-1/ASME FFS-1, *Fitness for Service*, or BS 7910, *Guide to Methods for Assessing the Acceptability of Flaws in Metallic Structures*, can be used. Additional information is provided in BS 7910.~~

##### **~~10.4.3.1.1.2 Compressed Gas Container Examination.~~**

##### **~~(A)~~**

~~Compressed gas containers shall be examined for internal and external surface flaws and inclusions before burial or at the time of manufacture.~~

##### **~~(B)~~**

~~Compressed gas containers with flaws or inclusions exceeding the lesser of 5 percent of the wall thickness or 0.12 in. (3 mm) shall not be used.~~

##### **~~10.4.3.1.2 Composite Containers. (Reserved)~~**

##### **~~10.4.3.1.3 Corrosion Protection.~~**

~~Compressed gas containers and underground piping shall be protected from corrosion in accordance with 7.1.10.9, 7.1.15, or 7.1.17 as applicable.~~

##### **~~10.4.3.1.4\* Outlet Connections.~~**

##### **~~A.10.4.3.1.4~~**

~~Straight threads alone are not considered to be a seal.~~

##### **~~10.4.3.1.4.1~~**

~~Threaded compressed gas container outlet connections shall be designed with primary and secondary seals that shall be tested for functionality.~~

##### **~~10.4.3.1.4.2~~**

~~The seal design shall include a method of detecting a leak in the primary seal.~~

##### **~~10.4.3.1.5 Piping Systems.~~**

##### **~~10.4.3.1.5.1~~**

~~Joints in the piping system shall be installed and inspected in accordance with the requirements of ASME B31, *Code for Pressure Piping*, or other approved standards.~~

##### **~~10.4.3.1.5.2~~**

~~Valves, controls, safety devices, and instrumentation shall be above ground and accessible to authorized personnel.~~

##### **~~10.4.3.1.6 Location.~~**

~~Compressed gas containers shall be located in accordance with 10.4.3.1.6.1 through 10.4.3.1.6.6.~~

##### **~~10.4.3.1.6.1~~**

~~Underground compressed gas containers shall not be located beneath buildings.~~

#### **~~10.4.3.1.6.2~~**

~~Compressed gas containers and associated equipment shall be located with respect to foundations and supports of other structures such that the loads carried by such structures cannot be transmitted to the tank.~~

#### **~~10.4.3.1.6.3~~**

~~The distance from any part of the compressed gas container to the nearest wall of a basement, pit, cellar, or lot line shall not be less than 10 ft (3.1 m).~~

#### **~~10.4.3.1.6.4~~**

~~A structure or foundation of a structure on the same property shall not be erected or constructed within 10 ft (3.1 m) of any point on the container surface, unless the footings extend to the bottom of the container or the container's foundation.~~

#### **~~10.4.3.1.6.5~~**

~~A minimum distance of 1 ft (0.3 m), shell to shell, shall be maintained between adjacent underground containers.~~

#### **~~10.4.3.1.6.6\*~~**

~~A minimum distance of 3 ft (0.9 m) shall be maintained between compressed gas containers and buried utilities.~~

#### **~~A.10.4.3.1.6.6~~**

~~Buried utilities include electrical, sewer, water, gas, storm drains, and similar services. A greater distance may be required by the service provided. For example, public utility easements might dictate greater distances.~~

#### **~~10.4.3.1.7 Foundations.~~**

~~Underground compressed gas containers shall be set on foundations constructed in accordance with the building code, and surrounded with not less than 6 in. (152 mm) of noncorrosive material.~~

#### **~~10.4.3.1.7.1~~**

~~The concrete shall extend a minimum of 1 ft (0.3 m) horizontally beyond the footprint of the tank in all directions.~~

#### **~~10.4.3.1.8 Depth, Cover, and Fill.~~**

~~Containers shall be buried such that the top of the container is covered with a minimum of 1 ft (0.3 m) of earth and with concrete a minimum of 4 in. (101 mm) thick placed over the earthen cover.~~

#### **~~10.4.3.1.9\* Anchorage and Security.~~**

~~Compressed gas containers installed underground in flood hazard areas shall be anchored to prevent flotation, collapse, or lateral movement resulting from hydrostatic loads, including the effects of buoyancy, during conditions of the design flood.~~

#### **~~A.10.4.3.1.9~~**

~~Flood hazard areas are typically identified on either (1) the special flood hazard area shown on the flood insurance rate map or (2) the area subject to flooding during the design flood and shown on a jurisdiction's flood hazard map, or are otherwise legally designated.~~

#### **~~10.4.3.1.10 Venting of Underground Compressed Gas Containers.~~**

~~Vent pipes for underground compressed gas containers shall be in accordance with 10.2.2.~~

#### **~~10.4.3.1.11 Overfill Protection and Prevention Systems.~~**

~~An approved means or method shall be provided to prevent the overfilling of the storage containers.~~

#### **~~10.4.3.1.12 Physical Protection.~~**

~~Piping and control equipment ancillary to underground containers that is located above ground shall be protected from physical damage in accordance with 7.1.8.3.~~

#### **~~10.4.3.2~~**

~~The minimum distances to exposures in Table 10.4.2.2.1(a), Table 10.4.2.2.1(b), and Table 10.4.2.2.1(c) shall apply only to those portions of the system that are located above ground.~~

**~~10.4.4 Installation in Vaults Above and Below Ground. (Reserved)~~**



## Second Revision No. 11-NFPA 55-2025 [ Detail ]

### 1.3.2(11)

(11)\* Compressed hydrogen gas (GH<sub>2</sub>), or liquefied hydrogen gas (LH<sub>2</sub>) generated, installed, stored, piped, used, or handled in accordance with NFPA 2 when there are no specific or applicable requirements in NFPA 55 in accordance with NFPA 2

### A.1.3.2(11)

NFPA 55 is used as the source document for the fundamental requirements for compressed hydrogen gas (GH<sub>2</sub>), or liquefied hydrogen gas (LH<sub>2</sub>) system installations. Correlation between NFPA 55 and NFPA 2 is the responsibility of the two technical committees involved. The installation requirements for bulk GH<sub>2</sub> or LH<sub>2</sub> are viewed as fundamental provisions. On the other hand, use-specific requirements for designated applications such as vehicular fueling are not resident in NFPA 55 and are under the purview of the NFPA 2 Technical Committee. Where there are specific provisions or controls included in NFPA 55, the specific controls of NFPA 55 will govern except that modifications made to provisions that have been extracted can be followed when the modifications have been made within NFPA's extract procedure as indicated in the *Manual of Style for NFPA Technical Committee Documents*. NFPA 2 does not apply to mixtures of GH<sub>2</sub> and other gases with a hydrogen concentration of less than 95 percent by volume when in accordance with NFPA 55. [2: 1.3.3(2)]

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 08:45:49 EDT 2025

## Committee Statement

**Committee Statement:** This revision aligns with the committee scopes of NFPA 2 and NFPA 55, where hydrogen storage, use, and handling requirements have been removed from the committee scope of NFPA 55 and now reside in NFPA 2. The annex has been revised to clarify that NFPA 2 does not apply to hydrogen mixtures of less than 95% hydrogen.

**Response Message:** SR-11-NFPA 55-2025



## Second Revision No. 9-NFPA 55-2025 [ Section No. 1.3.2 ]

[Detail SR-11](#)

### 1.3.2

This code shall not apply to the following:

- (1)\* Off-site transportation of materials covered by this code
- (2) Storage, use, and handling of radioactive gases in accordance with NFPA 801
- (3)\* ~~Use~~ Storage, use, and handling of compressed medical ~~compressed~~ gases at health care facilities in accordance with NFPA 99, except as specified in Chapter 17
- (4) Systems consisting of cylinders of oxygen and cylinders of fuel gas used for welding and cutting in accordance with NFPA 51
- (5)\* Flammable gases used as a vehicle fuel when stored on a vehicle
- (6)\* Storage, use, and handling of liquefied and nonliquefied compressed gases in laboratory work areas in accordance with NFPA 45
- (7) Storage, use, and handling of liquefied petroleum gases in accordance with NFPA 58
- (8) Storage, use, and handling of compressed gases within closed-cycle refrigeration systems complying with the mechanical code
- (9) Liquefied natural gas (LNG) storage at utility plants under NFPA 59A
- (10) Compressed natural gas (CNG) and LNG utilized as a vehicle fuel in accordance with NFPA 52
- (11)\* Compressed hydrogen gas (GH<sub>2</sub>), or liquefied hydrogen gas (LH<sub>2</sub>) ~~generated, installed, stored, piped, used, or handled in accordance with NFPA 2 when there are no specific or applicable requirements in NFPA 55~~ in accordance with NFPA 2
- (12) Nonflammable mixtures of ethylene oxide with other chemicals
- (13) Ethylene oxide in chambers 10 scf (0.283 Nm<sup>3</sup>) or less in volume or for containers holding 7.05 oz (200 g) of ethylene oxide or less

## Submitter Information Verification

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**Submittal Date:** Wed May 28 08:14:22 EDT 2025

## Committee Statement

**Committee Statement:** This revision addresses an existing conflict between NFPA 99 and NFPA 55 with regard to storage of compressed medical gases at health care facilities. This scope update aligns with the historical application of the two documents and reinstates a provision to clarify the quantities formerly allowed to be regulated under the scope of NFPA 99. With the exception of bulk storage, this revision clarifies that all medical gas storage falls under the scope of NFPA 99. Since the quantity thresholds are already addressed in NFPA 99, the 3,000 scf storage requirement proposed in the public comment has not been included with this revision.

**Response** SR-9-NFPA 55-2025

**Message:**

[Public Comment No. 15-NFPA 55-2025 \[Section No. 1.3.2\]](#)



## Second Revision No. 21-NFPA 55-2025 [ Section No. 2.2 ]

### 2.2 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2024 edition.

NFPA 2, *Hydrogen Technologies Code*, 2023 2026 edition.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2022 2026 edition.

~~NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2024 edition.~~

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2025 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2025 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2024 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2024 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen–Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2023 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2023 2026 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2020 2024 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2024 2026 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2023 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2024 edition.

NFPA 70<sup>®</sup>, *National Electrical Code*<sup>®</sup>, 2023 2026 edition.

NFPA 72<sup>®</sup>, *National Fire Alarm and Signaling Code*<sup>®</sup>, 2025 edition.

NFPA 79, *Electrical Standard for Industrial Machinery*, 2024 edition.

NFPA 99, *Health Care Facilities Code*, 2024 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2025 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*, 2025 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2023 edition.

NFPA 275, *Standard Method of Fire Tests for the Evaluation of Thermal Barriers*, 2022 edition.

NFPA 318, *Standard for the Protection of Semiconductor Fabrication Facilities*, 2025 edition.

NFPA 400, *Hazardous Materials Code*, 2025 edition.

~~NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 2024 edition.~~

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, 2024 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition.

NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, 2025 edition.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Thu May 29 12:15:16 EDT 2025

## Committee Statement

**Committee Statement:** This revision was developed by NFPA staff for editorial purposes, in accordance with 4.4.9.6.2 and 4.4.9.6.3 of the Regulations Governing the Development of NFPA Standards ([www.nfpa.org/regs](http://www.nfpa.org/regs)).

NFPA 12 has been added to the list of references in accordance with the NFPA Manual of Style.

**Response Message:** SR-21-NFPA 55-2025



## Second Revision No. 19-NFPA 55-2025 [ Sections 2.3.2, 2.3.3, 2.3.4, 2.3.5 ]

### 2.3.1 ASME Publications.

American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME A13.1, *Scheme for the Identification of Piping Systems*, 2020 2023 .

ASME B16.11, *Forged Fittings, Socket-Welding and Threaded* , 2021.

~~ASME A13.1, *Scheme for the Identification of Piping Systems* , 2020.~~

~~ASME B31, *Code for Pressure Piping* , 2018.~~

ASME B31.3, *Process Piping*, 2023 2024 .

~~ASME B31.12, *Hydrogen Piping and Pipelines* , 2019.~~

*Boiler and Pressure Vessel Code* , 2023.

ASME BPVC.VIII.1, *Rules for Construction of Pressure Vessels, Section VIII, Division 1*, 2023.

### 2.3.2 ASSE Publications.

American Society of Sanitary Engineering, 18927 Hickory Creek Drive, Suite 220, Mokena, IL 60448.

ASSE/IAPMO/ANSI 6015, *Bulk Medical Gas/Cryogenic Fluid Central Supply Systems Installers*, 2024 2024 .

ASSE/IAPMO/ANSI 6035, *Bulk Medical Gas/Cryogenic Fluid Central Supply Systems Verifiers*, 2024 2024 .

### 2.3.3 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM B88, *Standard Specification for Seamless Copper Water Tube*, 2022.

ASTM B819, *Standard Specification for Seamless Copper Tube for Medical Gas Systems*, 2019.

ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2023d 2024 .

ASTM E136, *Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C*, 2024c .

ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*, 2009, reaffirmed 2023.

ASTM E1529, *Standard Test Methods for Determining Effects of Large Hydrocarbon Pool Fires on Structural Members and Assemblies*, 2022.

ASTM E2652, *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace with a Cone-shaped Airflow Stabilizer, at 750°C*, 2022.

ASTM E2965, *Standard Test Method for Determination of Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*, 2022a.

**2.3.4 CGA Publications.**

Compressed Gas Association, 8484 Westpark Drive, Suite 220, McLean, VA 22102.

CGA C-7, *Guide to Classification and Labeling of Compressed Gases*, 2020.

CGA G-4.1, *Cleaning Equipment for Oxygen Service*, 2018.

CGA G-4.10, *Use of Nonmetallic Materials in High Pressure Oxygen Breathing Gas Applications*, 2017, reaffirmed 2023.

CGA G-6.1, *Standard for Large Insulated Liquid Carbon Dioxide Systems at User Sites*, 2022.

CGA G-6.2, *Commodity Specification for Carbon Dioxide*, 2011.

CGA G-6.5, *Standard for Small Stationary Insulated Carbon Dioxide Supply Systems*, 2023.

CGA G-6.6, *Standard for Carbon Dioxide Bulk Transfer Hoses*, 2022.

CGA G-6.7, *Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure*, 2019.

CGA G-6.13, *Standard for Stationary Uninsulated Cylinder Supply Systems for Carbon Dioxide*, 2023.

CGA G-6.14, *Standard for Carbon Dioxide Monitoring in Industrial and Near Consumer Applications*, 2023.

CGA G-8.1, *Standard for Nitrous Oxide Systems at Customer Sites*, 2013, reaffirmed 2018.

ANSI/CGA G-13, *Storage and Handling of Silane and Silane Mixtures*, 2023.

ANSI/CGA M-1, *Standard for Medical Gas Supply Systems at Health Care Facilities*, 2018.

CGA P-1, *Safe Handling of Compressed Gases in Containers*, 2022.

CGA P-18, *Standard for Bulk Inert Gas Systems*, 2020.

CGA P-23, *Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components*, 2015.

CGA P-41, *Standard for Locating Bulk Liquid Storage Systems in Courts*, 2023.

CGA P-74, *Standard for Tube Trailer Supply Systems at Customer Sites*, 2019.

CGA S-1.1, *Pressure Relief Device Standards — Part 1 — Cylinders for Compressed Gases*, 2022 2025.

CGA S-1.2, *Pressure Relief Device Standards — Part 2 — Portable Containers for Compressed Gases*, 2019 2024.

CGA S-1.3, *Pressure Relief Device Standards — Part 3 — Stationary Storage Containers for Compressed Gases*, 2020 2024.

CGA V-6, *Standard Bulk Refrigerated Liquid Transfer Connections*, 2021.

**Supplemental Information**

| <u>File Name</u>                              | <u>Description</u> | <u>Approved</u> |
|-----------------------------------------------|--------------------|-----------------|
| 55_SR-19_2.3.2-2.3.5_legislative_changes.docx | for prod use       |                 |

**Submitter Information Verification**

**Committee:** IMG-AAA

**Submission Date:** Thu May 29 09:00:28 EDT 2025

**Committee Statement**

**Committee  
Statement:**  
**Response  
Message:**

Reference have been added, removed, and updated to their current edition to  
comply with the NFPA Manual of Style.  
SR-19-NFPA 55-2025



## Second Revision No. 16-NFPA 55-2025 [ Section No. 3.3.46 ]

### 3.3.46\* Fire Barrier Wall.

A wall, other than a fire wall, having a fire resistance rating. [5000, 2024]

#### A.3.3.46 Fire Barrier Wall.

It should be understood that a fire barrier wall and a fire wall are not the same thing, and the terms should not be used interchangeably. A fire wall is defined in NFPA 221 as a wall that separates buildings or subdivides a building to prevent the spread of fire and has a fire resistance rating and structural stability.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 13:50:01 EDT 2025

## Committee Statement

**Committee Statement:** The definition of "fire barrier wall" extracted from NFPA 5000 includes the term "fire wall," but there is no definition of a fire wall in NFPA 55. The annex note identifies how "fire wall" is defined in NFPA 221 to provide more information to the reader.

**Response Message:** SR-16-NFPA 55-2025

Public Comment No. 9-NFPA 55-2024 [Section No. 3.3.46]



## Second Revision No. 17-NFPA 55-2025 [ Section No. 3.3.89 ]

### 3.3.89 Refrigerated Flammable Gas.

A flammable gas ~~that has been liquefied by cooling~~ at an absolute pressure of 14.7 psi (101 kPa) and a temperature of 70°F (21°C) that is cooled to maintain a liquefied state .

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 14:00:32 EDT 2025

## Committee Statement

**Committee Statement:** Added the specific standard temperature and pressure to the definition to improve the clarity in understanding how "refrigerated flammable gas" is used within the code.

**Response Message:** SR-17-NFPA 55-2025

[Public Comment No. 2-NFPA 55-2024 \[Section No. 3.3.89\]](#)



## Second Revision No. 1-NFPA 55-2025 [ Section No. 6.10.2.1 ]

### 6.10.2.1

Where sprinkler protection is required, the area in which compressed gases or cryogenic fluids are stored or used shall be protected with a sprinkler system designed to be not less than that required by ~~11.2.3.1.1~~ of NFPA 13 for the Ordinary Hazard Group 2 density/area curve.

### Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Tue May 27 09:23:42 EDT 2025

### Committee Statement

**Committee Statement:** The specific cross-reference to NFPA 13 has been deleted since there is no process, other than extracts, to accurately update cross-references to specific requirements within other NFPA documents.

**Response Message:** SR-1-NFPA 55-2025



## Second Revision No. 24-NFPA 55-2025 [ Section No. 6.10.2.2 ]

### 6.10.2.2

Where sprinkler protection is required, the area in which the flammable or pyrophoric compressed gases or flammable cryogenic fluids are stored or used shall be protected with a sprinkler system designed ~~to be not less than that required by~~ in accordance with NFPA 13 for the ~~Ordinary~~ Extra Hazard Group ~~2~~ 1 density/area curve.

### 6.10.2.3

Unless specifically required by this code, buildings of Type I or Type II construction shall be permitted to be Ordinary Hazard Group 2.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Fri Jun 06 16:19:01 EDT 2025

## Committee Statement

**Committee Statement:** This revision provides a general fire protection requirement for flammable and pyrophoric gases since not all flammable gases contain the same hazards (e.g., cylinder closures vary, cylinder robustness, cylinder pressure relief protection, ethylene oxide storage). This revision provides a means for storage or use areas of noncombustible construction with limited access to water.

It is understood that a hose stream may extinguish a jet flame, however the spray from a Extra Hazard 1 sprinkler system is not expected to extinguish a jet flame while providing the safety benefit of reducing the likelihood of fire spread by wetting the surrounding area and cooling affected gases.

The fire control goal for fire exposing cylinders or tanks with flammable gas storage is to suppress a possible exposure fire and also to cool the storage vessels. In cylinder or tank storage areas, accumulations of ordinary combustibles are possible. Trash and vegetation are prevented elsewhere in the code, but ordinary combustibles are not and are sometimes needed.

**Response Message:** SR-24-NFPA 55-2025

Public Comment No. 7-NFPA 55-2024 [Section No. 6.10.2.2]



## Second Revision No. 3-NFPA 55-2025 [ Section No. 6.16 ]

### 6.16\* Exhaust Ventilation.

Indoor storage and use areas and storage buildings for compressed gases and cryogenic fluids shall be provided with mechanical exhaust ventilation.

#### A.6.16

Fixed natural ventilation can be shown to be acceptable to the AHJ in accordance with Section 1.6. When using natural ventilation, consideration should be given to the risk assessment, as well as national consensus standards such as UL 60079-10-1, *Explosive Atmospheres — Part 10-1: Classification of Areas — Explosive Gas Atmospheres*. Variations in atmospheric conditions can undermine the performance of natural ventilation and should be addressed when seeking the approval of the AHJ.

#### 6.16.1 Compressed Air.

The requirements of Section 6.16 shall not apply to cylinders, containers, and tanks containing compressed air.

#### 6.16.2 Mechanical Code.

In addition to the requirements of Section 6.16, exhaust ventilation systems shall be designed and installed in accordance with the requirements of the mechanical code.

#### 6.16.3 Continuous Operation.

Exhaust ventilation systems shall operate continuously unless an alternative design is approved by the AHJ.

#### 6.16.4\* Ventilation Rate.

Exhaust ventilation shall be provided at a rate of not less than 1 scf/min/ft<sup>2</sup> (0.0051 m<sup>3</sup>/sec/m<sup>2</sup>) of floor area over the area of storage or use.

#### 6.16.5 Shutoff Controls.

A manual exhaust ventilation shutoff switch shall be provided outside the room in a position adjacent to the principal access door to the room or in an approved location.

##### 6.16.5.1 Manual Shutoff Switch.

The switch shall be the breakglass or equivalent type and shall be labeled as follows:

WARNING:

VENTILATION SYSTEM EMERGENCY SHUTOFF

#### 6.16.6

The exhaust ventilation system design shall take into account the density of the potential gases released.

##### 6.16.6.1\*

For gases that are heavier than air, exhaust shall be taken from a point within 12 in. (305 mm) of the floor.

##### 6.16.6.1.1

The use of supplemental inlets shall be allowed to be installed at points above the 12 in. (305 mm) threshold level.

**6.16.6.2\***

For gases that are lighter than air, exhaust shall be taken from a point within 12 in. (305 mm) of the ceiling.

**6.16.6.2.1**

The use of supplemental inlets shall be allowed to be installed at points below the 12 in. (305 mm) threshold level.

**6.16.6.3**

The location of both the exhaust and inlet air openings shall be designed to provide air movement across all portions of the floor or ceiling of the room or area to prevent the accumulation of vapors within the ventilated space.

**6.16.7 Recirculation of Exhaust.**

Exhaust ventilation shall not be recirculated.

**6.16.8 Exhaust Ventilation Discharge.**

Exhaust Ventilation discharge systems shall terminate at a point not less than 50 ft (15 m) from intakes of air-handling systems, air-conditioning equipment, and air compressors.

**6.16.9 Air Intakes.**

Storage and use of compressed gases shall be located not less than 20 ft (6 m) from air intakes. *(See Sections 7.5 through 7.11 for material-specific requirements.)*

**Submitter Information Verification**

**Committee:** IMG-AAA

**Submission Date:** Tue May 27 11:28:06 EDT 2025

**Committee Statement**

**Committee Statement:** As described in Section 1.6 for equivalency, nothing in the code prevents the use of systems, methods, or devices of equivalent or superior quality. Though Section 6.16 requires mechanical ventilation, the AHJ can still accept natural ventilation in accordance with Section 1.6. Since the code cannot address every unique situation where natural ventilation might be acceptable or account for all the variations in atmospheric conditions that can undermine the performance of natural ventilation, this revision adds an annex to provide direction on what should be considered by both the AHJ and the user when looking to utilize natural ventilation.

**Response Message:** SR-3-NFPA 55-2025

[Public Comment No. 10-NFPA 55-2024 \[Section No. 6.16\]](#)



## Second Revision No. 4-NFPA 55-2025 [ Section No. 7.1.10.2.2 ]

### 7.1.10.2.2

The distances shown in Table 7.1.10.2 shall be permitted to be reduced without limit where compressed gas cylinders, containers, ~~and or~~ tanks are separated by a fire barrier of noncombustible construction that has a fire resistance rating of at least 2 0.5 hours ~~and that~~ interrupts the line of sight between the containers.

#### 7.1.10.2.2.1

Flammable, unstable (reactive) Class 2, 3, and 4, or pyrophoric gases exceeding 1000 scf (28.3 Nm<sup>3</sup>) for non-liquefied and 150 lb (68 kg) for liquefied gases shall be separated by a fire barrier with a fire resistance rating of at least 2 hours that interrupts the line of sight between the containers.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Tue May 27 11:56:06 EDT 2025

## Committee Statement

**Committee Statement:** The 0.5 hour that has historically been used in accordance with this code is often used in cylinder storage cages used to hold small quantities of cylinders. This approach is often applied at laboratory facilities where gases of many or all hazard classes need to be separated to be stored safely. This revision addressed the need for more robust separation where significant quantities of flammable, unstable (reactive), and pyrophoric gases are stored as these hazard classes can create a higher risk.

**Response Message:** SR-4-NFPA 55-2025

Public Comment No. 1-NFPA 55-2024 [Section No. 7.1.10.2.2]



## Second Revision No. 25-NFPA 55-2025 [ Sections 7.6, 7.7, 7.8, 7.9, 7.10, 7.11 ]

### 7.6 Corrosive Gases.

#### 7.6.1 General.

The storage or use of corrosive compressed gases ~~exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1~~ shall be in accordance with ~~Chapters 4 through 6 and~~ Sections 7.1 through 7.4 and 7.6.

#### 7.6.2 Outdoor Distance to Exposures.

The outdoor storage or use of corrosive compressed gas shall not be within 20 ft (6.1 m) of buildings not associated with the manufacture or distribution of corrosive gases, lot lines, streets, alleys, public ways, or means of egress.

##### 7.6.2.1

A 2-hour fire barrier wall without openings or penetrations and that extends not less than 30 in. (762 mm) above and to the sides of the storage or use area shall be permitted in lieu of the 20 ft (6.1 m) distance.

##### 7.6.2.1.1\*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve.

##### 7.6.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

##### 7.6.2.1.3

The 2-hour fire barrier shall be located at least 5 ft (1.5 m) from any exposure.

##### 7.6.2.1.4

The 2-hour fire barrier wall shall not have more than two sides at approximately 90- degree (1.57 rad) directions or not more than three sides with connecting angles of approximately 135 degrees (2.36 rad).

### 7.6.3 Indoor Use.

The indoor use of corrosive gases ~~exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1~~ shall be provided with a gas cabinet, exhausted enclosure, or gas room.

#### 7.6.3.1 Gas Cabinets.

Gas cabinets shall be in accordance with Section 6.17.

#### 7.6.3.2 Exhausted Enclosures.

Exhausted enclosures shall be in accordance with Section 6.18.

#### 7.6.3.3 Gas Rooms.

Gas rooms shall be in accordance with Section 6.4.

#### 7.6.3.4 Treatment Systems.

Treatment systems, except as provided for in 7.6.3.4.1, gas cabinets, exhausted enclosures, and gas rooms containing corrosive gases in use shall be provided with exhaust ventilation, with all exhaust directed to a treatment system designed to process the accidental release of gas.

**7.6.3.4.1**

Treatment systems shall not be required for corrosive gases in use where ~~provided with~~ the following are provided :

- (1) Gas detection in accordance with 7.10.5.2.1.1
- (2) Fail-safe automatic closing valves in accordance with 7.10.5.2.2

**7.6.3.4.2**

Treatment systems shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning, or otherwise processing the release of corrosive gas in accordance with 7.10.5.4.1.

**7.6.3.4.3**

Treatment system sizing shall be in accordance with 7.10.5.4.

**7.7 Flammable Gases.****7.7.1\* Storage, Use, and Handling.**

The storage or use of flammable gases ~~exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1~~ shall be in accordance with ~~Chapters 4 through 6 and Sections 7.1 through 7.4 and Section 7.7.~~

**7.7.1.1**

~~The storage or use of flammable gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be in accordance with Chapters 4 through 6 and Sections 7.1 through 7.4 and Section 7.7 .~~

**7.7.1.2**

~~Storage, use, and handling of compressed natural gas shall be in accordance with 7.7.1 .~~

**7.7.2 Outdoor Distance to Exposures.**

The outdoor storage or use of non-bulk flammable compressed gas shall be located from lot lines, public streets, public alleys, public ways, or buildings not associated with the manufacture or distribution of such gases in accordance with Table 7.7.2.

Table 7.7.2 Distance to Exposures for Non-Bulk Flammable Gases

| <u>Maximum<br/>Amount<br/>per<br/>Storage<br/>Area<br/>(scf)</u> | <u>Minimum<br/>Distance<br/>Between<br/>Storage<br/>Areas<br/>(ft)</u> | <u>Minimum<br/>Distance<br/>to Lot<br/>Lines of<br/>Property<br/>That Can<br/>Be Built<br/>Upon<br/>(ft)</u> | <u>Minimum<br/>Distance<br/>to Public<br/>Streets,<br/>Public<br/>Alleys or<br/>Public<br/>Ways<br/>(ft)</u> | <u>Minimum Distance to Buildings on the<br/>Same Property.</u> |                                |                                |
|------------------------------------------------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|--------------------------------|--------------------------------|
|                                                                  |                                                                        |                                                                                                              |                                                                                                              | <u>Less Than<br/>2-Hour<br/>Construction</u>                   | <u>2-Hour<br/>Construction</u> | <u>4-Hour<br/>Construction</u> |
| 0–4225                                                           | 5                                                                      | 5                                                                                                            | 5                                                                                                            | 5                                                              | 0                              | 0                              |
| 4226–<br>21,125                                                  | 10                                                                     | 10                                                                                                           | 10                                                                                                           | 10                                                             | 5                              | 0                              |
| 21,126–<br>50,700                                                | 10                                                                     | 15                                                                                                           | 15                                                                                                           | 20                                                             | 5                              | 0                              |
| 50,701–<br>84,500                                                | 10                                                                     | 20                                                                                                           | 20                                                                                                           | 20                                                             | 5                              | 0                              |
| 84,501–<br>200,000                                               | 20                                                                     | 25                                                                                                           | 25                                                                                                           | 20                                                             | 5                              | 0                              |

For SI units, 1 ft = 304.8 mm; 1 scf = 0.02832 Nm<sup>3</sup>.

Note: The minimum required distances ~~does~~ do not apply where fire barriers without openings or penetrations having that have a minimum fire-resistive rating of 2 hours interrupt the line of sight between the storage and the exposure. The configuration of the fire barriers shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

#### 7.7.2.1

##### 7.7.2.1.1

Where a protective structure is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1 .)

##### **A.7.7.2.1.1**

~~See A.7.6.2.1.1 .~~

##### 7.7.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

##### 7.7.2.2

Bulk gas systems for flammable gases shall be in accordance with Table 10.4.2.1(a), and Table 10.4.2.1(b), or Table 10.4.2.2.1(c) where the quantity of flammable compressed gas exceeds 5000 scf (141.6 Nm<sup>3</sup>).

Table 7.7.2.2(a) Minimum Distance (D) from Outdoor Bulk Flammable Compressed Gas Systems to Exposures — Typical Maximum Pipe Size

| <b>Pressure</b>                                                                                                                                                                                               | <b>&gt;15 to<br/>≤250 psig</b>    |           | <b>&gt;250 to<br/>≤3000 psig</b>   |           | <b>&gt;3000 to<br/>≤7500 psig</b>    |           | <b>&gt;7500 to<br/>≤15,000 psig</b>   |           |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------|------------------------------------|-----------|--------------------------------------|-----------|---------------------------------------|-----------|
| <b>Internal Pipe Diameter (ID)</b>                                                                                                                                                                            | <b>&gt;103.4 to<br/>≤1724 kPa</b> |           | <b>&gt;1724 to<br/>≤20,684 kPa</b> |           | <b>&gt;20,684 to<br/>≤51,711 kPa</b> |           | <b>&gt;51,711 to<br/>≤103,421 kPa</b> |           |
| <b>d mm</b>                                                                                                                                                                                                   | <b>d = 52.5<br/>mm</b>            |           | <b>d = 18.97<br/>mm</b>            |           | <b>d = 7.31<br/>mm</b>               |           | <b>d = 7.16 mm</b>                    |           |
| <b>Group 1 Exposures</b>                                                                                                                                                                                      | <b>m</b>                          | <b>ft</b> | <b>m</b>                           | <b>ft</b> | <b>m</b>                             | <b>ft</b> | <b>m</b>                              | <b>ft</b> |
| Lot lines                                                                                                                                                                                                     | 5                                 | 16        | 6                                  | 20        | 4                                    | 13        | 5                                     | 16        |
| Air intakes (HVAC,<br>compressors, other)                                                                                                                                                                     |                                   |           |                                    |           |                                      |           |                                       |           |
| Operable openings in buildings<br>and structures                                                                                                                                                              |                                   |           |                                    |           |                                      |           |                                       |           |
| Ignition sources such as open<br>flames and welding                                                                                                                                                           |                                   |           |                                    |           |                                      |           |                                       |           |
| <b>Group 2 Exposures</b>                                                                                                                                                                                      | <b>m</b>                          | <b>ft</b> | <b>m</b>                           | <b>ft</b> | <b>m</b>                             | <b>ft</b> | <b>m</b>                              | <b>ft</b> |
| Places of public assembly                                                                                                                                                                                     | 5                                 | 16        | 6                                  | 20        | 3                                    | 10        | 4                                     | 13        |
| Parked cars                                                                                                                                                                                                   |                                   |           |                                    |           |                                      |           |                                       |           |
| <b>Group 3 Exposures</b>                                                                                                                                                                                      | <b>m</b>                          | <b>ft</b> | <b>m</b>                           | <b>ft</b> | <b>m</b>                             | <b>ft</b> | <b>m</b>                              | <b>ft</b> |
| Buildings of noncombustible<br>non-fire-rated construction                                                                                                                                                    | 4                                 | 13        | 5                                  | 16        | 3                                    | 10        | 4                                     | 13        |
| Buildings of combustible<br>construction                                                                                                                                                                      |                                   |           |                                    |           |                                      |           |                                       |           |
| Flammable gas storage<br>systems above or below<br>ground                                                                                                                                                     |                                   |           |                                    |           |                                      |           |                                       |           |
| Hazardous materials storage<br>systems above or below<br>ground                                                                                                                                               |                                   |           |                                    |           |                                      |           |                                       |           |
| Heavy timber, coal, or other<br>slow-burning combustible<br>solids                                                                                                                                            |                                   |           |                                    |           |                                      |           |                                       |           |
| Ordinary combustibles,<br>including fast-burning solids<br>such as ordinary lumber,<br>excelsior, paper, or<br>combustible waste and<br>vegetation other than that<br>found in maintained<br>landscaped areas |                                   |           |                                    |           |                                      |           |                                       |           |
| Unopenable openings in<br>buildings and structures                                                                                                                                                            |                                   |           |                                    |           |                                      |           |                                       |           |
| Encroachment by overhead<br>utilities (horizontal distance<br>from the vertical plane below<br>the nearest overhead electrical<br>wire of building service)                                                   |                                   |           |                                    |           |                                      |           |                                       |           |

Piping containing other  
hazardous materials

Flammable-gas metering and  
regulating stations such as  
natural gas or propane

Building or structure  
constructed of noncombustible  
or limited-combustible  
materials\*

(a) Sprinklered building or  
structure or unsprinklered  
building or structure having  
noncombustible contents

(b) Building with adjacent walls  
with fire resistance rating of 2  
hrs or greater

Table 7.7.2.2(b) Minimum Distance (D) from Outdoor Bulk Flammable Compressed Gas Systems to Exposures by Maximum Pipe Size with Pressures >15 to ≤3000 psig

| Pressure                    |           | >15 to ≤250 psig<br>>103.4 to ≤1724 kPa |      |                            |      |               |      | >250 to ≤3000 psig<br>>1724 to ≤20,684 kPa |      |                         |      |                |      |
|-----------------------------|-----------|-----------------------------------------|------|----------------------------|------|---------------|------|--------------------------------------------|------|-------------------------|------|----------------|------|
|                             |           | Exposures <sup>*†</sup>                 |      |                            |      |               |      | Exposures <sup>*†</sup>                    |      |                         |      |                |      |
| Internal Pipe Diameter (ID) |           | Group 1                                 |      | Group 2                    |      | Group 3       |      | Group 1                                    |      | Group 2                 |      | Group 3        |      |
| ID<br>(in.)                 | d<br>(mm) | D =<br>0.0952d                          |      | D =<br>0.1019d -<br>0.3485 |      | D =<br>0.0762 |      | D =<br>0.3168d                             |      | D = 0.3384d<br>- 0.4188 |      | D =<br>0.2636d |      |
|                             |           | m                                       | ft   | m                          | ft   | m             | ft   | m                                          | ft   | m                       | ft   | m              | ft   |
| 0.2                         | 5.1       | 0.5                                     | 2.0  | 0.2                        | 1.0  | 0.4           | 1.0  | 1.6                                        | 5.0  | 1.3                     | 4.0  | 1.3            | 4.0  |
| 0.3                         | 7.6       | 0.7                                     | 2.0  | 0.4                        | 1.0  | 0.6           | 2.0  | 2.4                                        | 8.0  | 2.2                     | 7.0  | 2.0            | 7.0  |
| 0.4                         | 10.2      | 1.0                                     | 3.0  | 0.7                        | 2.0  | 0.8           | 3.0  | 3.2                                        | 11.0 | 3.0                     | 10.0 | 2.7            | 9.0  |
| 0.5                         | 12.7      | 1.2                                     | 4.0  | 0.9                        | 3.0  | 1.0           | 3.0  | 4.0                                        | 13.0 | 3.9                     | 13.0 | 3.3            | 11.0 |
| 0.6                         | 15.2      | 1.4                                     | 5.0  | 1.2                        | 4.0  | 1.2           | 4.0  | 4.8                                        | 16.0 | 4.7                     | 16.0 | 4.0            | 13.0 |
| 0.7                         | 17.8      | 1.7                                     | 6.0  | 1.5                        | 5.0  | 1.4           | 4.0  | 5.6                                        | 19.0 | 5.6                     | 18.0 | 4.7            | 15.0 |
| 0.8                         | 20.3      | 1.9                                     | 6.0  | 1.7                        | 6.0  | 1.5           | 5.0  | 6.4                                        | 21.0 | 6.5                     | 21.0 | 5.4            | 18.0 |
| 0.9                         | 22.9      | 2.2                                     | 7.0  | 2.0                        | 7.0  | 1.7           | 6.0  | 7.3                                        | 24.0 | 7.3                     | 24.0 | 6.0            | 20.0 |
| 1.0                         | 25.4      | 2.4                                     | 8.0  | 2.2                        | 7.0  | 1.9           | 6.0  | 8.0                                        | 26.0 | 8.2                     | 27.0 | 6.7            | 22.0 |
| 1.1                         | 27.9      | 2.7                                     | 9.0  | 2.5                        | 8.0  | 2.1           | 7.0  | 8.8                                        | 29.0 | 9.0                     | 30.0 | 7.4            | 24.0 |
| 1.2                         | 30.5      | 2.9                                     | 10.0 | 2.8                        | 9.0  | 2.3           | 8.0  | 9.7                                        | 32.0 | 9.9                     | 32.0 | 8.0            | 26.0 |
| 1.3                         | 33.0      | 3.1                                     | 10.0 | 3.0                        | 10.0 | 2.5           | 8.0  | 10.5                                       | 34.0 | 10.7                    | 35.0 | 8.7            | 29.0 |
| 1.4                         | 35.6      | 3.4                                     | 11.0 | 3.3                        | 11.0 | 2.7           | 9.0  | 11.3                                       | 37.0 | 11.6                    | 38.0 | 9.4            | 31.0 |
| 1.5                         | 38.1      | 3.6                                     | 12.0 | 3.5                        | 12.0 | 2.9           | 10.0 | 12.1                                       | 40.0 | 12.5                    | 41.0 | 10.0           | 33.0 |
| 1.6                         | 40.6      | 3.9                                     | 13.0 | 3.8                        | 12.0 | 3.1           | 10.0 | 12.9                                       | 42.0 | 13.3                    | 44.0 | 10.7           | 35.0 |
| 1.7                         | 43.2      | 4.1                                     | 13.0 | 4.1                        | 13.0 | 3.3           | 11.0 | 13.7                                       | 45.0 | 14.2                    | 47.0 | 11.4           | 37.0 |
| 1.8                         | 45.7      | 4.4                                     | 14.0 | 4.3                        | 14.0 | 3.5           | 11.0 | 14.5                                       | 47.0 | 15.0                    | 49.0 | 12.0           | 40.0 |
| 1.9                         | 48.3      | 4.6                                     | 15.0 | 4.6                        | 15.0 | 3.7           | 12.0 | 15.3                                       | 50.0 | 15.9                    | 52.0 | 12.7           | 42.0 |
| 2.0                         | 50.8      | 4.8                                     | 16.0 | 4.8                        | 16.0 | 3.9           | 13.0 | 16.1                                       | 53.0 | 16.8                    | 55.0 | 13.4           | 44.0 |

| Pressure                           |                  | <u>&gt;15 to ≤250 psig</u><br><u>&gt;103.4 to ≤1724 kPa</u> |           |                                                 |           |                             |           | <u>&gt;250 to ≤3000 psig</u><br><u>&gt;1724 to ≤20,684 kPa</u> |           |                                      |           |                              |           |
|------------------------------------|------------------|-------------------------------------------------------------|-----------|-------------------------------------------------|-----------|-----------------------------|-----------|----------------------------------------------------------------|-----------|--------------------------------------|-----------|------------------------------|-----------|
|                                    |                  | <u>Exposures</u> <sup>*†</sup>                              |           |                                                 |           |                             |           | <u>Exposures</u> <sup>*†</sup>                                 |           |                                      |           |                              |           |
| <u>Internal Pipe Diameter (ID)</u> |                  | <u>Group 1</u>                                              |           | <u>Group 2</u>                                  |           | <u>Group 3</u>              |           | <u>Group 1</u>                                                 |           | <u>Group 2</u>                       |           | <u>Group 3</u>               |           |
| <u>ID</u><br>(in.)                 | <u>d</u><br>(mm) | <u>D =</u><br><u>0.0952d</u>                                |           | <u>D =</u><br><u>0.1019d -</u><br><u>0.3485</u> |           | <u>D =</u><br><u>0.0762</u> |           | <u>D =</u><br><u>0.3168d</u>                                   |           | <u>D = 0.3384d</u><br><u>-0.4188</u> |           | <u>D =</u><br><u>0.2636d</u> |           |
|                                    |                  | <u>m</u>                                                    | <u>ft</u> | <u>m</u>                                        | <u>ft</u> | <u>m</u>                    | <u>ft</u> | <u>m</u>                                                       | <u>ft</u> | <u>m</u>                             | <u>ft</u> | <u>m</u>                     | <u>ft</u> |
| 2.1                                | 53.3             | 5.1                                                         | 17.0      | 5.1                                             | 17.0      | 4.1                         | 13.0      | 16.9                                                           | 55.0      | 17.6                                 | 58.0      | 14.0                         | 46.0      |

Note: Linear interpolation of internal pipe diameters and distances between table entries is allowed.

\* For a list of exposures in each exposure group see Column 1 of Table 7.7.2.2(a) :

† When calculating the minimum separation distance (D) using the formulas indicated, based on the exposure group and pressure indicated, the internal pipe diameter (d) is entered in millimeters (mm). The calculated distance (D) is expressed in units of measure in meters (m). To convert distance (D) to units of measure in feet, multiply the value of (D) in meters by 3.2808 and round to the nearest whole foot.

Table 7.7.2.2(c) Minimum Distance (D) from Outdoor Bulk Flammable Compressed Gas Systems to Exposures by Maximum Pipe Size with Pressures >3000 to ≤15,000 psig

| Pressure                           |                  | <u>&gt;3000 to ≤7500 psig</u><br><u>&gt;20,684 to ≤51,711 kPa</u> |           |                                               |           |                                               |           | <u>&gt;7500 to ≤15,000 psig</u><br><u>&gt;51,711 to ≤103,421 kPa</u> |           |                                               |           |                                                |           |
|------------------------------------|------------------|-------------------------------------------------------------------|-----------|-----------------------------------------------|-----------|-----------------------------------------------|-----------|----------------------------------------------------------------------|-----------|-----------------------------------------------|-----------|------------------------------------------------|-----------|
|                                    |                  | <u>Exposures</u> <sup>*†</sup>                                    |           |                                               |           |                                               |           | <u>Exposures</u> <sup>*†</sup>                                       |           |                                               |           |                                                |           |
| <u>Internal Pipe Diameter (ID)</u> |                  | <u>Group 1</u>                                                    |           | <u>Group 2</u>                                |           | <u>Group 3</u>                                |           | <u>Group 1</u>                                                       |           | <u>Group 2</u>                                |           | <u>Group 3</u>                                 |           |
| <u>ID</u><br>(in.)                 | <u>d</u><br>(mm) | <u>D = 1.105d</u><br><u>-4.078</u>                                |           | <u>D =</u><br><u>0.6831d -</u><br><u>1.99</u> |           | <u>D =</u><br><u>0.459d -</u><br><u>0.355</u> |           | <u>D = 1.448d</u><br><u>-5.368</u>                                   |           | <u>D =</u><br><u>0.9291d -</u><br><u>2.65</u> |           | <u>D =</u><br><u>0.602d -</u><br><u>0.3103</u> |           |
|                                    |                  | <u>m</u>                                                          | <u>ft</u> | <u>m</u>                                      | <u>ft</u> | <u>m</u>                                      | <u>ft</u> | <u>m</u>                                                             | <u>ft</u> | <u>m</u>                                      | <u>ft</u> | <u>m</u>                                       | <u>ft</u> |
| 0.2                                | 5.1              | 1.6                                                               | 5.0       | 1.5                                           | 5.0       | 2.0                                           | 7.0       | 2.0                                                                  | 7.0       | 2.0                                           | 7.0       | 3.0                                            | 9.0       |
| 0.3                                | 7.6              | 4.3                                                               | 14.0      | 3.2                                           | 11.0      | 3.0                                           | 10.0      | 6.0                                                                  | 18.0      | 4.0                                           | 14.0      | 4.0                                            | 14.0      |
| 0.4                                | 10.2             | 7.2                                                               | 24.0      | 5.0                                           | 16.0      | 4.0                                           | 14.0      | 9.0                                                                  | 31.0      | 7.0                                           | 22.0      | 6.0                                            | 19.0      |
| 0.5                                | 12.7             | 10.0                                                              | 33.0      | 6.7                                           | 22.0      | 5.0                                           | 18.0      | 13.0                                                                 | 43.0      | 9.0                                           | 30.0      | 7.0                                            | 24.0      |
| 0.6                                | 15.2             | 12.7                                                              | 42.0      | 8.4                                           | 28.0      | 7.0                                           | 22.0      | 17.0                                                                 | 55.0      | 11.0                                          | 38.0      | 9.0                                            | 29.0      |
| 0.7                                | 17.8             | 15.6                                                              | 51.0      | 10.2                                          | 33.0      | 8.0                                           | 26.0      | 20.0                                                                 | 67.0      | 14.0                                          | 46.0      | 10.0                                           | 34.0      |
| 0.8                                | 20.3             | 18.4                                                              | 60.0      | 11.9                                          | 39.0      | 9.0                                           | 29.0      | 24.0                                                                 | 79.0      | 16.0                                          | 53.0      | 12.0                                           | 39.0      |
| 0.9                                | 22.9             | 21.2                                                              | 70.0      | 13.7                                          | 45.0      | 10.0                                          | 33.0      | 28.0                                                                 | 91.0      | 19.0                                          | 61.0      | 13.0                                           | 44.0      |
| 1.0                                | 25.4             | 24.0                                                              | 79.0      | 15.4                                          | 50.0      | 11.0                                          | 37.0      | 31.0                                                                 | 103.00    | 21.0                                          | 69.0      | 15.0                                           | 49.0      |
| 1.1                                | 27.9             | 26.8                                                              | 88.0      | 17.1                                          | 56.0      | 12.0                                          | 41.0      | 35.0                                                                 | 115.00    | 23.0                                          | 76.0      | 16.0                                           | 54.0      |
| 1.2                                | 30.5             | 29.6                                                              | 97.0      | 18.8                                          | 62.0      | 14.0                                          | 45.0      | 39.0                                                                 | 127.00    | 26.0                                          | 84.0      | 18.0                                           | 59.0      |
| 1.3                                | 33.0             | 32.4                                                              | 106.0     | 20.6                                          | 67.0      | 15.0                                          | 49.0      | 42.0                                                                 | 139.00    | 28.0                                          | 92.0      | 20.0                                           | 64.0      |
| 1.4                                | 35.6             | 35.3                                                              | 116.0     | 22.3                                          | 73.0      | 16.0                                          | 52.0      | 46.0                                                                 | 152.00    | 30.0                                          | 100.0     | 21.0                                           | 69.0      |
| 1.5                                | 38.1             | 38.0                                                              | 125.0     | 24.0                                          | 79.0      | 17.0                                          | 56.0      | 50.0                                                                 | 163.00    | 33.0                                          | 107.0     | 23.0                                           | 74.0      |

| Pressure                           |               | <u>&gt;3000 to ≤7500 psig</u><br><u>&gt;20,684 to ≤51,711 kPa</u> |           |                                              |           |                                              |           | <u>&gt;7500 to ≤15,000 psig</u><br><u>&gt;51,711 to ≤103,421 kPa</u> |           |                                              |           |                                               |           |
|------------------------------------|---------------|-------------------------------------------------------------------|-----------|----------------------------------------------|-----------|----------------------------------------------|-----------|----------------------------------------------------------------------|-----------|----------------------------------------------|-----------|-----------------------------------------------|-----------|
|                                    |               | <u>Exposures <sup>*†</sup></u>                                    |           |                                              |           |                                              |           | <u>Exposures <sup>*†</sup></u>                                       |           |                                              |           |                                               |           |
| <u>Internal Pipe Diameter (ID)</u> |               | <u>Group 1</u>                                                    |           | <u>Group 2</u>                               |           | <u>Group 3</u>                               |           | <u>Group 1</u>                                                       |           | <u>Group 2</u>                               |           | <u>Group 3</u>                                |           |
| <u>ID (in.)</u>                    | <u>d (mm)</u> | <u><math>D = \frac{1.105d}{4.078}</math></u>                      |           | <u><math>D = \frac{0.6831d}{1.99}</math></u> |           | <u><math>D = \frac{0.459d}{0.355}</math></u> |           | <u><math>D = \frac{1.448d}{5.368}</math></u>                         |           | <u><math>D = \frac{0.9291d}{2.65}</math></u> |           | <u><math>D = \frac{0.602d}{0.3103}</math></u> |           |
|                                    |               | <u>m</u>                                                          | <u>ft</u> | <u>m</u>                                     | <u>ft</u> | <u>m</u>                                     | <u>ft</u> | <u>m</u>                                                             | <u>ft</u> | <u>m</u>                                     | <u>ft</u> | <u>m</u>                                      | <u>ft</u> |
| 1.6                                | 40.6          | 40.8                                                              | 134.0     | 25.7                                         | 84.0      | 18.0                                         | 60.0      | 53.0                                                                 | 175.00    | 35.0                                         | 115.0     | 24.0                                          | 79.0      |
| 1.7                                | 43.2          | 43.7                                                              | 143.0     | 27.5                                         | 90.0      | 19.0                                         | 64.0      | 57.0                                                                 | 188.00    | 37.0                                         | 123.0     | 26.0                                          | 84.0      |
| 1.8                                | 45.7          | 46.4                                                              | 152.0     | 29.2                                         | 96.0      | 21.0                                         | 68.0      | 61.0                                                                 | 199.00    | 40.0                                         | 131.0     | 27.0                                          | 89.0      |
| 1.9                                | 48.3          | 49.3                                                              | 162.0     | 31.0                                         | 102.0     | 22.0                                         | 72.0      | 65.0                                                                 | 212.0     | 42.0                                         | 139.0     | 29.0                                          | 94.0      |
| 2.0                                | 50.8          | 52.1                                                              | 171.0     | 32.7                                         | 107.0     | 23.0                                         | 75.0      | 68.0                                                                 | 224.0     | 45.0                                         | 146.0     | 30.0                                          | 99.0      |

Note: Linear interpolation of internal pipe diameters and distances between table entries is allowed.

<sup>\*</sup> For a list of exposures in each exposure group see Column 1 of Table 7.7.2.2(a).

<sup>†</sup> When calculating the minimum separation distance (D) using the formulas indicated, based on the exposure group and pressure indicated, the internal pipe diameter (d) is entered in millimeters (mm). The calculated distance (D) is expressed in units of measure in meters (m). To convert distance (D) to units of measure in feet, multiply the value of (D) in meters by 3.2808 and round to the nearest whole foot.

#### 7.7.2.2.1

Where fire barriers are used as a means of distance reduction, fire barriers shall be in accordance with 10.4.2.4.

#### 7.7.2.2.2

Mobile acetylene trailer systems (MATS) shall be located in accordance with 15.2.3.

#### 7.7.2.3

The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

#### 7.7.2.4

Storage and use of flammable compressed gases shall not be located within 50 ft (15.2 m) of air intakes or the minimum distance from a bulk flammable gas storage system as specified in Table 10.4.2.1(a), or Table 10.4.2.1(b) ~~Table 11.4.2.2.1(c)~~, whichever is less.

#### 7.7.2.5

Storage and use of flammable gases outside of buildings shall also be separated from building openings by 25 ft (7.6 m) or the minimum distance from a bulk flammable gas storage system as specified in Table 11.4.2.2.1(a), Table 11.4.2.2.1(b), or Table 11.4.2.2.1(c), whichever is less.

#### 7.7.2.5.1

Fire barriers shall be permitted to be used as a means to separate storage areas from openings or a means of egress used to access the public way.

#### 7.7.2.6

Vents from tube trailers and fixed storage systems under weather protection shall discharge outside the weather protection.

### ~~7.7.3 Ignition Source Control. Quantities Greater than the MAQ.~~

~~Ignition sources in areas containing flammable gases shall be in accordance with 7.7.3 .~~

#### ~~7.7.3.1 Static-Producing Equipment. Indoor.~~

~~Static-producing equipment located in flammable gas areas shall be grounded. The storage and use of flammable gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be in accordance with 7.7.3 .~~

#### ~~7.7.3.2 No Smoking or Open Flame. Outdoor.~~

~~Signs shall be posted in areas containing flammable gases stating that smoking or the use of open flame, or both, is prohibited within 25 ft (7.6 m) of the storage or use area perimeter. The storage and use of flammable gases exceeding 2000 scf (56 Nm<sup>3</sup>) shall be in accordance with 7.7.3 .~~

#### ~~7.7.3.3 Heating.~~

~~Heating, where provided, shall be by indirect means. Equipment used for heating applications in rooms or areas where flammable gases are stored or used shall be listed and labeled for use in hazardous environments established by the gases present and shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions.~~

##### ~~7.7.3.3.1~~

~~Equipment used for heating applications in rooms or areas where flammable gases are stored or used shall be listed and labeled for use in hazardous environments established by the gases present.~~

##### ~~7.7.3.3.2~~

~~Equipment used for heating applications in rooms or areas where flammable gases are stored or used shall be installed in accordance with the conditions of the listing and the manufacturer's installation instructions.~~

#### ~~7.7.3.4 Electrical.~~

~~Areas in which the storage or use of compressed gases exceeds the quantity thresholds for gases requiring special provisions are used or stored shall be in accordance with NFPA 70.~~

#### ~~7.7.3.5 Maintenance of Piping Systems.~~

##### ~~7.7.3.5.1~~

~~Maintenance of flammable gas system piping and components shall be performed annually by a qualified representative of the equipment owner.~~

##### ~~7.7.3.5.2~~

~~This maintenance shall include inspection for physical damage, leak tightness, ground system integrity, vent system operation, equipment identification, warning signs, operator information and training records, scheduled maintenance and retest records, alarm operation, and other safety-related features.~~

##### ~~7.7.3.5.3~~

~~Scheduled maintenance and retest activities shall be formally documented, and records shall be maintained for a minimum of 3 years.~~

#### ~~7.7.3.6 Emergency Isolation.~~

7.7.3.6.1

For ~~systems~~ Systems with pressurized piping above a gauge pressure of 15 psi (103 kPa), shall include an approved method of means for emergency isolation ~~shall be provided that includes through~~ one of the following:

- (1) Automatic shutoff valves, located as close to the bulk source as practical, that are tied to leak detection systems
- (2)\* Attended control stations where trained personnel can monitor alarms or supervisory signals and can trigger emergency responses

**A.7.7.3.6.1(2)**

When relying on trained personnel monitoring controls for emergency response, the operator should consider the urgency for the monitoring to be uninterrupted. Additionally, the use of audible notifications in a control station area to an upset condition could be critical to establish such continuous surveillance and avoid such notifications being missed.

- (3) A constantly monitored control station with an alarm and remote shutoff of the gas supply system [See A.7.7.3.6.1(2).]
- (4) Excess flow valves at the bulk source

7.7.3.6.2

The requirements of 7.7.3.6.1 shall not apply to the following:

- (1) Piping for inlet connections designed to prevent backflow
- (2) Piping for pressure relief devices

7.8 Oxidizing Gases.

7.8.1 General.

The storage or use of oxidizing compressed gases ~~exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1~~ shall be in accordance with ~~Chapters 4 through 6 and Sections 7.1 through 7.4 and~~ Section 7.8.

7.8.2 Outdoor Distance to Exposures.

The outdoor storage or use of oxidizing compressed gas shall be in accordance with Table 7.8.2.

Table 7.8.2 Distance to Exposures for Oxidizing Gases

| <u>Quantity of Gas Stored (at NTP)</u> |                       | <u>Distance to a Building Not Associated with the Manufacture or Distribution of Oxidizing Gases or to a Public Way or Property Line</u> |          | <u>Minimum Distance Between Storage Areas</u> |          |
|----------------------------------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------|----------|-----------------------------------------------|----------|
|                                        |                       | <u>ft</u>                                                                                                                                | <u>m</u> | <u>ft</u>                                     | <u>m</u> |
| <u>scf</u>                             | <u>Nm<sup>3</sup></u> |                                                                                                                                          |          |                                               |          |
| 0–50,000                               | 0–1416                | 5                                                                                                                                        | 1.5      | 5                                             | 1.5      |
| 50,001–100,000                         | 1417–2832             | 10                                                                                                                                       | 3.0      | 10                                            | 3.0      |
| ≥100,001                               | ≥2833                 | 15                                                                                                                                       | 4.6      | 15                                            | 4.6      |

7.8.2.1

The distances shall not apply where fire barriers having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure.

7.8.2.1.1

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1.)

#### A.7.8.2.1.4

See A.7.6.2.1.1.

#### 7.8.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

#### 7.8.2.2

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter.

#### 7.8.2.3

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

### 7.9 Pyrophoric Gases.

#### 7.9.1 General.

Pyrophoric compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be stored and used in accordance with Chapters 4 through 6 and Sections 7.1 through 7.4 and Section 7.9.

#### 7.9.2 Outdoor Distance to Exposures.

The outdoor storage or use of pyrophoric compressed gas shall be in accordance with Table 7.9.2.

Table 7.9.2 Distance to Exposures for Pyrophoric Gases

| <u>Maximum<br/>Amount<br/>per<br/>Storage<br/>Area</u> |                       | <u>Minimum<br/>Distance<br/>Between<br/>Storage<br/>Areas</u> |          | <u>Minimum<br/>Distance<br/>to<br/>Property<br/>Lines</u> |          | <u>Minimum<br/>Distance<br/>to Public<br/>Ways</u> |          | <u>Minimum Distance to Buildings on<br/>the Same Property</u> |          |                     |          |                     |          |                |
|--------------------------------------------------------|-----------------------|---------------------------------------------------------------|----------|-----------------------------------------------------------|----------|----------------------------------------------------|----------|---------------------------------------------------------------|----------|---------------------|----------|---------------------|----------|----------------|
|                                                        |                       |                                                               |          |                                                           |          |                                                    |          | <u>Less Than</u>                                              |          | <u>2-Hour</u>       |          | <u>2-Hour</u>       |          | <u>4-Ho</u>    |
|                                                        |                       |                                                               |          |                                                           |          |                                                    |          | <u>2-Hour</u>                                                 |          | <u>Construction</u> |          | <u>Construction</u> |          | <u>Constru</u> |
| <u>scf</u>                                             | <u>Nm<sup>3</sup></u> | <u>ft</u>                                                     | <u>m</u> | <u>ft</u>                                                 | <u>m</u> | <u>ft</u>                                          | <u>m</u> | <u>ft</u>                                                     | <u>m</u> | <u>ft</u>           | <u>m</u> | <u>ft</u>           | <u>m</u> |                |
| 250                                                    | 7.1                   | 5                                                             | 1.5      | 25                                                        | 7.6      | 5                                                  | 1.5      | 5                                                             | 1.5      | 0                   | 0        |                     | 0        |                |
| >250<br>to<br>2500                                     | >7.1<br>to<br>71.0    | 10                                                            | 3.0      | 50                                                        | 15.2     | 10                                                 | 3.0      | 10                                                            | 3.0      | 5                   | 1.5      |                     | 0        |                |
| >2500<br>to<br>7500                                    | >71.0<br>to<br>212.4  | 20                                                            | 6.0      | 100                                                       | 30.5     | 20                                                 | 6.0      | 20                                                            | 6.0      | 10                  | 3.0      |                     | 0        |                |

#### 7.9.2.1

The distances shall be allowed to be reduced to 5 ft (1.5 m) where fire barriers having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure.

##### 7.9.2.1.1

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1.)

**A.7.9.2.1.1**

~~See A.7.6.2.1.1 .~~

**7.9.2.1.2**

The fire barrier shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

**7.9.2.1.3**

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter.

**7.9.2.1.4**

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

**7.9.2.2**

Storage and use of pyrophoric gases outside buildings shall be separated from building openings by 25 ft (7.6 m).

**7.9.2.2.1**

Fire barriers shall be permitted to be used as a means to separate storage areas from building openings that are used to access the public way.

**7.9.3 Silane and Silane Mixtures.**

Silane and silane mixtures exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 indoors or 100 scf (2.8 Nm<sup>3</sup>) outdoors shall be stored, used, and handled in accordance with the provisions of ANSI/CGA G-13, *Storage and Handling of Silane and Silane Mixtures*.

**7.9.4 Emergency Isolation.**

Systems exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 indoors or 100 scf (2.8 Nm<sup>3</sup>) outdoors with pressurized piping above a gauge pressure of 15 psi (103 kPa) shall include an approved means for emergency isolation in accordance with 7.7.3.6.

**7.10 Toxic and Highly Toxic Gases.****7.10.1 General.**

The storage or use of toxic or highly toxic gases ~~exceeding the quantity thresholds for gases that require special provisions as specified in Table 6.3.1.1~~ shall be in accordance with ~~Chapters 4 through 6 and Sections 7.1 through 7.4 and Section 7.10.~~

**7.10.2 Outdoor Distance to Exposures.**

The outdoor storage or use of toxic or highly toxic compressed gases shall not be within 75 ft (23 m) of lot lines, streets, alleys, public ways or means of egress, or buildings not associated with such storage or use.

**7.10.2.1**

A 2-hour fire barrier wall without openings or penetrations that extends not less than 30 in. (762 mm) above and to the sides of the storage or use area and that interrupts the line of sight between the storage or use area and the exposure shall be permitted in lieu of the 75 ft (23 m) distance.

**7.10.2.1.1**

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1 .)

**A.7.10.2.1.1**

~~See A.7.6.2.1.1 .~~

**7.10.2.1.2**

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

**7.10.2.1.3**

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure.

**7.10.2.1.4**

The 2-hour fire barrier wall shall not have more than two sides at approximately 90-degree (1.5 rad) directions or more than three sides with connecting angles of approximately 135 degrees (2.36 rad).

**7.10.2.1.5**

The minimum distance requirement for exposures shall be reduced to 5 ft (1.5 m) from buildings and 25 ft (7.6 m) from exit discharges where gases are stored in gas cabinets as specified in this code.

**7.10.2.2**

Where the storage or use area is located closer than 75 ft (23 m) to a building not associated with the manufacture or distribution of toxic or highly toxic compressed gases, openings in the building other than for piping shall not be permitted above the height of the top of the 2-hour fire barrier wall or within 50 ft (15 m) horizontally from the storage area, regardless of whether the openings are shielded by a fire barrier.

**7.10.2** ~~Ventilation and Arrangement.~~**7.10.3** Quantities Greater than the MAQ.**7.10.3.1** Indoor.

The storage and use of toxic or highly toxic gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be in accordance with 7.10.3 through 7.10.8 .

**7.10.3.2** Outdoor.

The storage and use of toxic gases exceeding 810 scf and highly toxic gases exceeding 20 scf shall be in accordance with 7.10.3 through 7.10.8 .

**7.10.4** ~~Indoors~~ Ventilation .

The indoor storage or use of highly toxic gases or toxic gases shall be provided with a gas cabinet, exhausted enclosure, or gas room.

**7.10.4.1**

Gas cabinets shall be in accordance with Section 6.17.

**7.10.4.2**

Exhausted enclosures shall be in accordance with Section 6.18.

**7.10.4.3**

Gas rooms shall be in accordance with Section 6.4.

**7.10.4.4** Air Intakes.

Storage and use of toxic or highly toxic compressed gases shall not be located within 75 ft (23 m) of air intakes.

**7.10.5** Treatment Systems.

Except as provided in 7.10.5.1 and 7.10.5.2, gas cabinets, exhausted enclosures, and gas rooms containing toxic or highly toxic gases shall be provided with exhaust ventilation, with all exhaust directed to a treatment system designed to process accidental release of gas.

#### **7.10.5.1 Storage of Toxic or Highly Toxic Gases.**

Treatment systems shall not be required for toxic or highly toxic gases in storage where cylinders, containers, and tanks are provided with the controls specified in 7.10.5.1.1 through 7.10.5.1.3.

##### **7.10.5.1.1 Valve Outlets Protected.**

Valve outlets shall be equipped with outlet plugs, caps, or both, that are rated for the container service pressure.

##### **7.10.5.1.2 Handwheels Secured.**

Where provided, handwheel-operated valves shall be secured to prevent movement.

##### **7.10.5.1.3 Containment Devices Provided.**

Approved cylinder containment vessels or cylinder containment systems shall be provided at an approved location.

#### **7.10.5.2 Use of Toxic Gases.**

Treatment systems shall not be required for toxic gases in use where cylinders, containers, and tanks are provided with the controls specified in 7.10.5.2.1 and 7.10.5.2.2.

##### **7.10.5.2.1 Gas Detection.**

###### **7.10.5.2.1.1**

A gas detection system with a sensing interval not exceeding 5 minutes shall be provided.

###### **7.10.5.2.1.2**

The gas detection system shall monitor the exhaust system at the point of discharge from the gas cabinet, exhausted enclosure, or gas room.

##### **7.10.5.2.2 Fail-Safe Automatic Closing Valve.**

An approved automatic-closing fail-safe valve shall be located on or immediately adjacent to and downstream of active cylinder, container, or tank valves.

###### **7.10.5.2.2.1**

The fail-safe valve shall close when gas is detected at the permissible exposure limit, short-term exposure limit (STEL), or ceiling limit by the gas detection system.

###### **7.10.5.2.2.2**

For attended operations, a manual closing valve shall be permitted when in accordance with 7.10.5.4.3.

###### **7.10.5.2.2.3**

For gases used at unattended operations for the protection of public health, such as chlorine at water or wastewater treatment sites, the automatic valve shall close if the concentration of gas detected by a gas detection system reaches one-half of the IDLH.

###### **7.10.5.2.2.4**

The gas detection system shall also alert persons ~~on-site~~ on site and a responsible person ~~off-site~~ off site when the gas concentration in the storage/use area reaches the OSHA PEL, OSHA ceiling limit, or OSHA STEL for the gas employed.

#### **7.10.5.3 Treatment System Design and Performance.**

Treatment systems shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning, or otherwise processing stored or used toxic or highly toxic gas, or both.

**7.10.5.3.1**

Where a total containment system is used, the system shall be designed to handle the maximum anticipated pressure of release to the system when it reaches equilibrium.

**7.10.5.3.2**

Treatment systems shall be capable of reducing the allowable discharge concentrations to one-half half of the IDLH threshold at the point of discharge.

**7.10.5.4 Treatment System Sizing.****7.10.5.4.1 Worst-Case Release of Gas.**

Treatment systems shall be sized to process the maximum worst-case release of gas based on the maximum flow rate of release from the largest vessel utilized in accordance with 7.10.5.4.2.

**7.10.5.4.2 Largest Compressed Gas Vessel.**

The entire contents of the single largest compressed gas vessel shall be considered.

**7.10.5.4.3 Attended Operations — Alternative Method of System Sizing.****7.10.5.4.3.1**

Where source cylinders, containers, and tanks are used in attended process operations, with an operator present at the enclosure where the activity occurs, the volume of the release shall be limited to the estimated amount released from the process piping system within a period not to exceed 5 minutes.

**7.10.5.4.3.2**

Such process piping systems shall comply with the requirements of 7.10.5.4.3.2(A) through 7.10.5.4.3.2(E).

**(A) Local Exhaust.**

All gas transfer operations shall be conducted within a zone of local exhaust that is connected to a treatment system.

**(B) Gas Detection.**

Gas detection shall be used to provide a warning to alert the operators to emission of gas into the zone of local exhaust, and meet all of the following ~~requirements also shall apply~~ :

- (1) The system shall be capable of detecting gas at the PEL or the ceiling limit for the gas being processed.
- (2) Activation of the gas detection system shall provide a local alarm.

**(C) Process Shutdown.**

Operations involving the gas detected shall be shut down and leaks repaired.

**(D) Piping System Construction.**

Piping systems used to convey gases shall be of all-welded construction throughout, with the exception of fittings used to connect cylinders, containers, ~~or~~ tanks, or any combination thereof, to the process system.

**(E) Piping System Accessibility.**

Piping systems shall be designed to provide for readily accessible manual shutdown controls.

**7.10.5.5 Rate of Release.**

The time release shall be in accordance with Table 7.10.5.5 for the type of container indicated.

Table 7.10.5.5 Rate of Release

| <u>Container Type</u>                            | <u>Time Release</u>                           |                                               |
|--------------------------------------------------|-----------------------------------------------|-----------------------------------------------|
|                                                  | <u>Nonliquefied Gases</u>                     | <u>Liquefied Gases</u>                        |
| Cylinders without restrictive flow orifices      | 5 minutes                                     | 30 minutes                                    |
| Portable tanks without restrictive flow orifices | 40 minutes                                    | 240 minutes                                   |
| All others                                       | Based on peak flow from maximum valve orifice | Based on peak flow from maximum valve orifice |

**7.10.5.6\* Maximum Flow Rate of Release.****7.10.5.6.1**

For portable cylinders, containers, and tanks, the maximum flow rate of release shall be calculated based on assuming the total release from the cylinder or tank within the time specified.

**7.10.5.6.2\***

When portable cylinders, containers, or tanks are equipped with reduced flow orifices, the worst-case rate of release shall be determined by the maximum achievable flow from the valve based on the following formula:

$$CFM = (767 \times A \times P) \frac{(28.96 / MW)^{1/2}}{60} \quad [7.10.5.6.2]$$

where:

*CFM* = standard cubic feet per minute of gas of concern under flow conditions

*A* = area of orifice in square inches (See Table A.7.10.5.6 for areas of typical restricted flow orifices.)

*P* = supply pressure of gas at NTP in pounds per square inch absolute

*MW* = molecular weight

**7.10.5.6.3**

For mixtures, the average of the molecular weights shall be used.

**7.10.6 Outdoor Leaking Cylinders, Containers, and Tanks.**

When cylinders, containers, or tanks are used outdoors in excess of the quantities specified in Table 6.3.1.1 in the column for unsprinklered areas (unprotected by gas cabinets or exhausted enclosures), a gas cabinet, exhausted enclosure, or containment vessel or system shall be provided to control leaks from leaking cylinders, containers, and tanks in accordance with 7.10.6.1 through 7.10.6.2.3.

**7.10.6.1 Gas Cabinets or Exhausted Enclosures.**

Where gas cabinets or exhausted enclosures are provided to handle leaks from cylinders, containers, or tanks, exhaust ventilation shall be provided that is directed to a treatment system in accordance with the provisions of 7.10.5.

**7.10.6.2 Containment Vessels or Systems.**

Where containment vessels or containment systems are provided, they shall comply with the requirements of 7.10.6.2.1 through 7.10.6.2.3.

**7.10.6.2.1 Performance.**

Containment vessels or containment systems shall be capable of fully containing or terminating a release.

**7.10.6.2.2 Personnel.**

Trained personnel capable of operating the containment vessel or containment system shall be available at an approved location.

**7.10.6.2.3 Location.**

Containment vessels or systems shall be capable of being transported to the leaking cylinder, container, or tank.

**7.10.7 Emergency Power.****7.10.7.1 General.**

Emergency power shall comply with the requirements of 7.10.7 in accordance with *NFPA 70*.

**7.10.7.2 Alternative to Emergency Power.**

Emergency power shall not be required where fail-safe engineering is provided for mechanical exhaust ventilation, treatment systems, and temperature control, and standby power is provided to alternative systems that utilize electrical energy.

**7.10.7.3 Where Required.**

Emergency power shall be provided for the following systems:

- (1) Exhaust ventilation
- (2) Treatment system
- (3) Gas detection system
- (4) Temperature control system
- (5) Required alarm systems

**7.10.7.4 Level.**

Emergency power systems shall comply with the requirements for a Level 2 system in accordance with *NFPA 110*.

**7.10.8 Gas Detection.**

Except as provided in 7.10.8.1, a continuous gas detection system in accordance with the requirements of 7.10.8.2 through 7.10.8.6 shall be provided for the indoor storage or use of toxic or highly toxic compressed gases.

**7.10.8.1 Where Gas Detection Is Not Required.**

A gas detection system shall not be required for toxic gases where the physiological warning properties for the gas are at a level below the accepted PEL or the ceiling limit for the gas.

**7.10.8.2 Local Alarm.**

The gas detection system shall initiate a local alarm that is both audible and visible.

**7.10.8.3 Alarm Monitored.**

The gas detection system shall transmit a signal to a constantly attended control station for quantities exceeding one toxic or highly toxic compressed gas cylinder.

**7.10.8.4 Automatic Shutdown.****7.10.8.4.1**

Activation of the gas detection system shall automatically shut off the flow of gas related to the system being monitored.

#### 7.10.8.4.2

An automatic shutdown shall not be required for reactors utilized for the production of toxic or highly toxic gases when such reactors are operated at gauge pressures less than 15 psi (103.4 kPa), are constantly attended, and are provided with readily accessible emergency shutoff valves.

#### 7.10.8.5 Detection Points.

Detection shall be provided at the locations specified in 7.10.8.5.1 through 7.10.8.5.4.

##### 7.10.8.5.1 Treatment System Discharge.

Detection shall be provided at the discharge from the treatment system.

##### 7.10.8.5.2 Point of Use.

Detection shall be provided in the room or area in which the gas is used.

##### 7.10.8.5.3 Source.

Detection shall be provided at the source cylinder, container, or tank used for delivery of the gas to the point of use.

##### 7.10.8.5.4 Storage.

Detection shall be provided in the room or area in which the gas is stored.

#### 7.10.8.6 Level of Detection.

The gas detection system shall detect the presence of gas at or below the PEL or the ceiling limit of the gas for those points identified in 7.10.8.5.2 and 7.10.8.5.3 and at not less than one-half ~~half of~~ the IDLH level for points identified in 7.10.8.5.1.

#### 7.10.9 Automatic Smoke Detection System.

An automatic smoke detection system shall be provided for the indoor storage or use of highly toxic compressed gases in accordance with *NFPA 72*.

#### 7.10.10 Emergency Isolation.

Systems with pressurized piping above a gauge pressure of 15 psi (103 kPa) shall include an approved means for emergency isolation in accordance with 7.7.3.6.

#### 7.11 Unstable Reactive Gases (Nondetonable).

The storage or use of unstable reactive (nondetonable) gases ~~exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.4~~ shall be in accordance with ~~Chapters 4 through 6 and~~ Sections 7.1 through 7.4 and Section 7.11.

##### 7.11.1 Distances to Exposures for Class 2.

###### 7.11.1.1

The outdoor storage or use of unstable reactive Class 2 compressed gas shall not be located within 20 ft (6 m) of buildings, lot lines, streets, alleys, or public ways or means of egress.

###### 7.11.1.2

A 2-hour fire barrier wall without openings or penetrations shall be permitted in lieu of the 20 ft (6 m) distance required by 7.11.1.1.

###### 7.11.1.2.1

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1 .)

###### **A.7.11.1.2.1**

~~See A.7.6.2.1.1 .~~

**7.11.1.2.2**

The fire barrier wall shall be either an independent structure or the exterior wall of the building.

**7.11.1.2.3**

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure.

**7.11.1.2.4**

The 2-hour fire barrier wall shall not have more than two sides at approximately 90° degree (1.57 rad) directions or not more than three sides with connecting angles of approximately 135 degrees (2.36 rad).

**7.11.2 Distances to Exposures for Class 3.****7.11.2.1**

The outdoor storage or use of unstable reactive Class 3 (nondetonable) compressed gas shall not be within 75 ft (23 m) of buildings, lot lines, streets, alleys, or public ways or means of egress.

**7.11.2.2**

A 2-hour fire barrier wall without openings or penetrations, extending not less than 30 in. (762 mm) above and to the sides of the storage or use area, that interrupts the line of sight between the storage or use and the exposure shall be permitted in lieu of the 75 ft (23 m) distance specified in 7.11.2.1.

**7.11.2.2.1**

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. (See A.7.6.2.1.1 .)

**~~A.7.11.2.2.1~~**

~~See A.7.6.2.1.1 .~~

**7.11.2.2.2**

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.

**7.11.2.2.3**

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure.

**7.11.2.2.4**

The 2-hour fire barrier wall shall not have more than two sides at approximately 90° degree (1.57 rad) directions or more than three sides with connecting angles of approximately 135 degrees (2.36 rad).

**7.11.3 Quantities Greater than the MAQ .****7.11.3.1 Storage, Use, and Handling Indoor .**

The indoor storage or use of unstable reactive (nondetonable) gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be in accordance with Chapters 1 through 6, ~~and~~ Sections 7.1 through 7.4, and Section 7.11.

**7.11.3.2 Outdoor.**

The outdoor storage or use of unstable reactive (nondetonable) gases exceeding the quantity in Table 7.11.3.2 shall be in accordance with Chapters 1 through 6, ~~and~~ Sections 7.1 through 7.4, and Section 7.11.

Table 7.11.3.2 Outdoor Thresholds for Unstable Reactive Gases

| Class          | Storage |                 | Use  |                 |
|----------------|---------|-----------------|------|-----------------|
|                | scf     | Nm <sup>3</sup> | scf  | Nm <sup>3</sup> |
| 3 nondetonable | 200     | 6               | 100  | 3               |
| 2              | 3000    | 85              | 1500 | 42              |
| 1              | NL      | NL              | NL   | NL              |

NL = No limit

**7.11.3.3 Storage Configuration.****7.11.3.3.1**

Unstable reactive Class 3 compressed gases stored in cylinders, containers, or tanks shall be arranged to limit individual groups of cylinders, containers, or tanks to areas not exceeding 100 ft<sup>2</sup> (9.3 m<sup>2</sup>).

**7.11.3.3.2**

Multiple areas shall be separated by aisles.

**7.11.3.3.3**

Aisle widths shall not be less than the height of the cylinders, containers, or tanks or less than 4 ft (1.2 m), whichever is greater.

**7.11.3.4 Basements.**

Unstable reactive compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall not be stored in basements.

**7.11.3.5 Emergency Isolation.**

Systems with pressurized piping above a gauge pressure of 15 psi (103 kPa) shall include an approved means for emergency isolation in accordance with 7.7.3.6.

**7.11.4 Unstable Reactive Gases (Detonable).****7.11.4.1 Storage or Use.****7.11.4.1.1**

The indoor storage or use of unstable reactive (detonable) gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 6.3.1.1 shall be in accordance with Chapters 1 through 6, Sections 7.1 through 7.4, and 7.11.4.

**7.11.4.1.2**

The outdoor storage or use of unstable reactive (detonable) gases exceeding the quantity of 20 scf (0.6 Nm<sup>3</sup>) shall be in accordance with Chapters 1 through 6, ~~and~~ Sections 7.1 through 7.4, and Section 7.11.

**7.11.4.2 Location.**

The location of storage areas shall be determined based on the requirements of the building code for explosive materials.

**Supplemental Information****File Name****Description****Approved**

55\_SR25\_Ch\_7.docx

55\_SR-25\_7.6-7.11\_legislative\_changes.docx for prod use

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Mon Jun 09 15:45:10 EDT 2025

## Committee Statement

**Committee Statement:** This change clarified the applicability of the material specific sections of Chapter 7 (7.6 through 7.11) to clarify indoor vs. outdoor and general vs. a higher applicability threshold. The applicability threshold is well defined indoors in Chapter 6 (see MAQ table) and is unchanged. The outdoor applicability thresholds are clearly defined and increased for some use requirements. These increased thresholds are based on increased dispersion and lack of containment that is inherent with outdoor storage and use. Physical hazards were based on two times the indoor MAQ, which aligns with similar indoor MAQ increases. Several editorial revisions and reorganizations have been made to clarify and improve usability.

In the First Draft Report, Chapter 10 was deleted, and so the setback distance tables were copied into Chapter 7. Since Chapter 10 has been re-instated in Second Revision No 23, this change re-establishes the pointer to the Chapter 10 tables, rather than having the tables in Chapter 7. The clarifies the requirement in Chapter 7 that explicitly refers to bulk flammable gas storage.

The annex note on 7.7.6.1(2) provides more information on what should be considered along with reasons for constant attendance to reduce the chance of missing alarms.

**Response Message:** SR-25-NFPA 55-2025

[Public Comment No. 11-NFPA 55-2024 \[Sections 7.6, 7.7, 7.8, 7.9, 7.10, 7.11\]](#)

[Public Comment No. 8-NFPA 55-2024 \[Section No. 7.7.6.1\]](#)



## Second Revision No. 13-NFPA 55-2025 [ New Section after 8.13.11 ]

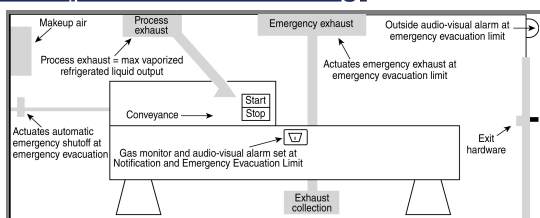
### **8.13.12\*** Inert Cryogenic Liquid Processing Rooms.

Inert cryogenic liquid processing room piping located indoors, where a release of cryogenic liquid can collect and create a hazard, shall be provided with all of the controls required in Section 6.16 and 8.13.12.1 through 8.13.12.6, or those based on a risk assessment approved by the AHJ.

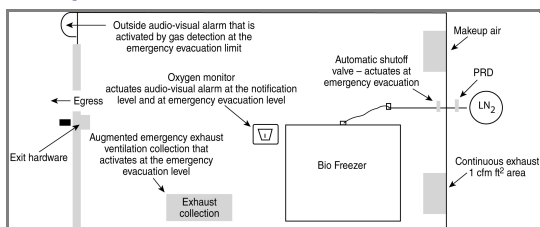
#### **A.8.13.12**

Figure A.8.13.12(a) and Figure A.8.13.12(b) illustrate examples of controls provided for inert cryogenic liquid processing rooms.

#### **Figure A.8.13.12(a) Example A — Food Freezing.**



#### **Figure A.8.13.12(b) Example B — Bio Lab.**



### **8.13.12.1**

The requirements of 8.13.12 shall not apply to closed systems.

### **8.13.12.2**

Unobstructed paths of egress and doors equipped with listed exit hardware shall be provided in accordance with the adopted building code.

### **8.13.12.3\***

A gas detection and emergency audio and visual alarm system shall be installed that activates at a breathing atmosphere detection level of 19.5 percent oxygen and is designed to inform processing room occupants to evacuate and inform other business occupants of the event.

**A.8.13.12.3**

The monitor and alarm notification system can be a fixed system or a series of individual combination monitor-alarm devices individually provided for each occupant. However, where individual monitor-alarms are used, it is still necessary that the control devices be automatically actuated by gas detection and that other business personnel are notified.

It is recommended that a notification signal be set at approximately 20 percent oxygen in breathable air, as 20 percent oxygen is unnatural and is an indication of a leak. A 20 percent setting is recommended to allow the operator to put the system in a safe condition before the emergency alarm system is activated at the immediately dangerous to life and health level (19.5 percent oxygen), which requires evacuation. Consider consulting with monitor supplier's available settings.

**8.13.12.4\***

An automatic emergency shutoff valve shall be provided that is actuated by the gas detection system at the emergency alarm activation level that shuts down the flow of inert cryogenic liquid unless an exhaust ventilation system that complies with 8.13.12.5 is provided.

**A.8.13.12.4**

Automatic emergency shutoff valves should be power-to-open and spring-to-closed on failure or alarm.

An automatic emergency shutoff valve is not required for a process that is supplied from a portable container where the flow of liquid is controlled by manually opening, throttling and closing the container liquid use valve, and the valve is always accessible at arm's length during liquid transfer.

**8.13.12.4.1**

Emergency shutoff valves shall be located in accordance with 8.13.11.2.3.2 .

**8.13.12.4.2**

Points of manual activation for emergency shutoff valves shall be identified by a sign.

**8.13.12.5**

Emergency exhaust ventilation that is independent from process exhaust and is activated by the gas detection system at the emergency alarm activation level shall be provided.

**8.13.12.5.1\***

Emergency exhaust ventilation designed to collect gasifying inert cryogenic liquid shall be sited in a location where accumulation is expected in the event of a leak.

**A.8.13.12.5.1**

Liquid nitrogen and flashing gas collect around the lower levels of the room, until the gasified liquid warms up. Gaseous nitrogen can diffuse throughout the room, displacing and creating harmful oxygen concentrations in breathable air.

**8.13.12.5.2\***

Continuous exhaust ventilation shall be provided in accordance with Section 6.16 with a minimum performance of  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ).

**A.8.13.12.5.2**

The content of this annex note is consistent with the information provided in CGA TR-8, *Risk Informed Methods For Industrial Gas Applications of Liquid Nitrogen and Liquid Carbon Dioxide in Occupied Spaces*.

Table A.8.13.12.5.2 provides information to determine exhaust ventilation by room size and nominal valve size upstream of the opening of the system to the room. A formula to determine a protected area and calculate the required emergency exhaust ventilation capacity is provided in this annex note. It is only applicable for emergency exhaust ventilation systems with a capacity of up to  $5 \text{ cfm/ft}^2$  ( $0.0254 \text{ m}^3/\text{sec/m}^2$ ). Where higher capacities are necessary, use an alternate risk assessment model approved by the AHJ.

To determine the required emergency exhaust ventilation capacity, use the applicable information in Table A.8.13.12.5.2 and the formula provided. Continuous ventilation provided in accordance with 6.17.3.1 can be credited towards the emergency exhaust ventilation capacity required.

Exhaust ventilation capacity is based on the room area and credible leak rate of system piping. The user should verify that the room size fits the area range in the exhaust ventilation column for the valve size in Table A.8.13.12.5.2. The valve size used in the table is the size of the valve that controls the flow of liquid into the individual process equipment.

Where room areas that are greater than those indicated in the  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) column of Table A.8.13.12.5.2, an exhaust ventilation capacity of  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) will satisfy the ventilation requirement. Where the room areas fit within the greater than  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) to  $5.0 \text{ cfm/ft}^2$  ( $0.0254 \text{ m}^3/\text{sec/m}^2$ ) room range column, the exhaust ventilation capacity requires more than  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ), and calculation using Equation A.8.13.12.5.2 is necessary to determine the needed exhaust ventilation capacity.

$$\left[ \frac{1 \text{ ft}^3 / \text{min}}{\text{ft}^2} \right] \times \frac{\text{area range upper limit}}{\text{room area}} = \text{exhaust ventilation capacity} \quad \text{[A.8.13.12.5.2]}$$

Unless the following conditions are satisfied, an alternate risk assessment model approved by the AHJ should be provided:

- (1) The room length to width ratio does not exceed 3 to 1.
- (2) The valve pipe size in Table A.8.13.12.5.2 is based on either the nominal diameter pipe size or outer tube diameter for the inert cryogenic liquid distribution system.
- (3) The nominal operating pressure of the inert cryogenic liquid tanks is 125 psi (862 KPI) or less.

Table A.8.13.12.5.2 Protected Area Based on Exhaust Ventilation

| <b>Valve Size</b><br><b>in.      mm</b> |            | <b>Area Range by Exhaust Ventilation</b>   |                                                             |                                                          |                                                                           |
|-----------------------------------------|------------|--------------------------------------------|-------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------------|
| <b>in.</b>                              | <b>mm.</b> | <b>1.0 cfm/ft<sup>2</sup></b><br><b>2a</b> | <b>0.00508 m<sup>3</sup>/sec/m<sup>2</sup></b><br><b>2a</b> | <b>&gt;1.0 to 5.0 cfm/ft<sup>2</sup></b><br><b>2b</b>    | <b>&gt;0.00508 to 0.0254 m<sup>3</sup>/sec/m<sup>2</sup></b><br><b>2b</b> |
| 3 NPS                                   | 75 NPS     | Room area > 36000 ft <sup>2</sup>          | Room area > 3345 m <sup>2</sup>                             | 36000 ft <sup>2</sup> ≥ room area ≥ 7200 ft <sup>2</sup> | 3345 m <sup>2</sup> ≥ room area ≥ 669 m <sup>2</sup>                      |
| 2 NPS                                   | 50 NPS     | Room area > 16000 ft <sup>2</sup>          | Room area > 1486 m <sup>2</sup>                             | 16000 ft <sup>2</sup> ≥ room area ≥ 3200 ft <sup>2</sup> | 1486 m <sup>2</sup> ≥ room area ≥ 297 m <sup>2</sup>                      |
| 1.5 NPS                                 | 38 NPS     | Room area > 9700 ft <sup>2</sup>           | Room area > 901 m <sup>2</sup>                              | 9700 ft <sup>2</sup> ≥ room area ≥ 1940 ft <sup>2</sup>  | 901 m <sup>2</sup> ≥ room area ≥ 180 m <sup>2</sup>                       |

| <u>Valve Size</u> | <u>Area Range by Exhaust Ventilation</u> |                                                                  |                                                                                      |                                                                             |                                                                                                                  |
|-------------------|------------------------------------------|------------------------------------------------------------------|--------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
| <u>in.</u>        | <u>mm.</u>                               | <u>1.0 cfm/ft<sup>2</sup></u><br><u>ft<sup>2</sup></u> <u>2a</u> | <u>0.00508 m<sup>3</sup>/sec/m<sup>2</sup></u><br><u>sec/m<sup>2</sup></u> <u>2a</u> | <u>&gt;1.0 to 5.0 cfm/ft<sup>2</sup></u><br><u>ft<sup>2</sup></u> <u>2b</u> | <u>&gt;0.00508 to 0.0254 m<sup>3</sup>/sec/m<sup>2</sup></u><br><u>m<sup>3</sup>/sec/m<sup>2</sup></u> <u>2b</u> |
| <u>1 NPS</u>      | <u>25 NPS</u>                            | Room area > 4100 ft <sup>2</sup>                                 | Room area > 381 m <sup>2</sup>                                                       | 4100 ft <sup>2</sup> ≥ room area ≥ 820 ft <sup>2</sup>                      | 381 m <sup>2</sup> ≥ room area ≥ 76 m <sup>2</sup>                                                               |
| <u>0.5 NPS</u>    | <u>13 NPS</u>                            | Room area > 1400 ft <sup>2</sup>                                 | Room area > 130 m <sup>2</sup>                                                       | 1400 ft <sup>2</sup> ≥ room area ≥ 280 ft <sup>2</sup>                      | 130 m <sup>2</sup> ≥ room area ≥ 26 m <sup>2</sup>                                                               |
| <u>0.5 ODT</u>    | <u>13 ODT</u>                            | Room area > 500 ft <sup>2</sup>                                  | Room area > 46 m <sup>2</sup>                                                        | 500 ft <sup>2</sup> ≥ room area ≥ 100 ft <sup>2</sup>                       | 46 m <sup>2</sup> ≥ room area ≥ 9 m <sup>2</sup>                                                                 |

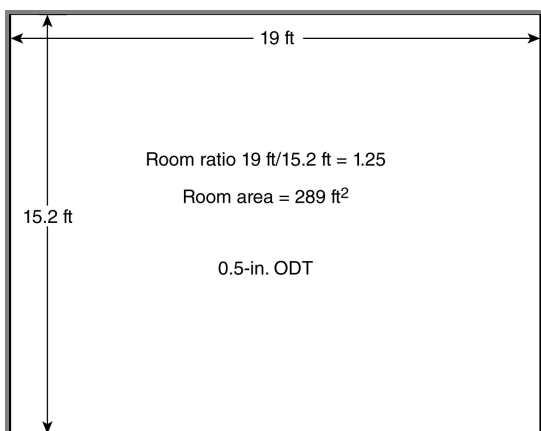
(a) A room size with an area, according to NPS size, that is greater than or equal to the area in the denoted column provided with 1.0 cfm/ft<sup>2</sup> (0.00508 m<sup>3</sup>/sec/m<sup>2</sup>) exhaust ventilation satisfies the capacity requirements.

(b) A room size with an area, according to NPS size, that fits the area range in the denoted column is required to be provided with calculated emergency exhaust ventilation with a performance greater than 1.0 cfm/ft<sup>2</sup> (0.00508 m<sup>3</sup>/sec/m<sup>2</sup>).

(c) Valve size is based on nominal pipe diameter (NPS) or outside tube diameter (ODT) for those listed.

The following example illustrates the room ratio and dimensions for an inert cryogenic liquid system (0.5 in. ODT). (See Figure A.8.13.12.5.2.)

**Figure A.8.13.12.5.2 Ratio and Dimensions Example of an Inert Cryogenic Processing Room.**



This example calculates a room with dimensions of 19.0 ft by 15.2 ft with a process ODT of 0.5 in. tube. Example:  $[(1 \text{ ft}^3/\text{min})/\text{ft}^2] \times (500 \text{ ft}^2/289 \text{ ft}^2) = 1.73 \text{ ft}^3/\text{min}/\text{ft}^2 =$  exhaust ventilation capacity.

#### **8.13.12.5.2.1**

A risk assessment shall be performed to determine if more exhaust ventilation is needed.

#### **8.13.12.5.2.2\***

Where more exhaust ventilation is needed, one of the following conditions shall be met:

- (1) The exhaust ventilation is augmented to provide more than 1.0 cfm/ft<sup>2</sup> (0.00508 m<sup>3</sup>/sec/m<sup>2</sup>), in accordance with the risk assessment and be activated by the gas detection system at the emergency activation level in accordance with 12.2.3.
- (2) An automatic emergency shutoff valve that is designed to be activated by the gas detection system at the emergency activation level is provided in accordance with 8.13.11.2.3 .

#### A.8.13.12.5.2.2

Other risk assessment means can be used to calculate the necessary emergency exhaust ventilation capacity where approved by the AHJ, in accordance with Section 1.6 .

#### 8.13.12.5.3

A means of makeup air with a capacity equal to or greater than the room's maximum exhaust ventilation aggregated capacity shall be provided.

#### 8.13.12.6

The capacity of the process exhaust ventilation system shall be greater than the design vaporized cryogenic liquid supply rate.

#### 8.13.12.6.1

The cryogenic liquid supply system shall be designed to prevent the flow of liquid unless the process exhaust ventilation system is running.

## Supplemental Information

| <u>File Name</u>          | <u>Description</u> | <u>Approved</u> |
|---------------------------|--------------------|-----------------|
| 55_SR13_8.13.docx         |                    |                 |
| 55_SR-13_8.13.12_NEW.docx | for prod use       |                 |

## Submitter Information Verification

**Committee:** IMG-AAA

**Submission Date:** Wed May 28 12:32:43 EDT 2025

## Committee Statement

**Committee Statement:** Inert liquid processing rooms are inherently open systems because they apply the inert gas directly to items intended to be cooled (frozen) and are subject to releasing inert gas into the breathable air not only from a loss of structural containment (as in a closed system) but also from a loss of control. The statistical probabilities for open systems are different than for closed systems. Open systems are generally more likely to create dangerous concentrations in the breathable air without careful consideration for controls-based mitigations (automatic isolation of piping) in combination with ventilation rates.

The importance for egress from these areas is noted to ensure efficient evacuation on alarm since concentration rates can elevate quickly in large releases. A notification alarm for low O<sub>2</sub> is recommended at 20% and an evacuation alarm at the IDLH of 19.5% O<sub>2</sub> (See A.8.13.12.2). Since processing rooms typically have a control system that incorporates a fume hood, the demand for an independent room ventilation system is noted to ensure that these systems are not confused. The processing system fume hood operation is subject to potential controls failure (see CSB report for Gainesville). Room

ventilation should have independent controls from the process in order to provide reliability and avoid a common mode of failure. Since smaller releases of a cryogenic liquids will drop to the floor the preferred location for ventilation exhaust exits from the room is best placed near the floor and the long standing 12" rule. Continuous ventilation rates of 1 CFM/SF is already noted in code but is a minimum. Open system leak rates can easily overwhelm this minimum requirement in many cases. When the required risk assessment determines a ventilation rate above 1CFM/SF, the larger rate must be accommodated by either a continuous rate that meets or exceeds this requirement, or by a system that meets the minimum 1CFM/SF and is then augmented up to the requirements when an emergency is automatically detected. Automatic emergency shutoff is a control alternative to augmented ventilation. A reasonable risk assessment must be conducted to determine the mitigations used. A reasonable risk assessment must include a determination of a credible leak rate, the size of the room and the exhaust ventilation rate. An example of such a reasonable risk assessment is noted in the annex reference of CGA TR-8.

Practical applications for common sized systems are tabulated using the principles outlined in CGA TR-8 to offer a quick assessment. Rules are established to define the limits of applying the tabulated values. Other risk assessment methods are not excluded from use.

The make-up air requirements must balance with the exhaust requirements and are written in harmony with the IBC.

**Response** SR-13-NFPA 55-2025  
**Message:**



## Second Revision No. 8-NFPA 55-2025 [ New Section after 10.3.2.2.1 ]

### 11.3.2.2.2\*

The distances for combined gaseous and flammable refrigerated liquid storage systems upstream of their respective source valves shall comply with 11.4.2.2 for the gaseous system and 11.3.2.2 for the flammable refrigerated liquid system.

### A.11.3.2.2.2

Combined gaseous and flammable refrigerated liquid storage systems having separate source valves for the gaseous system and for the flammable refrigerated liquid system can be viewed as having two source valves for determining minimum separation distances for bulk storage systems in accordance with 11.4.2.2 and 11.3.2.2 . Identifying two source valves means that each portion of the system is subject to its respective minimum separation distances in accordance with 11.4.2.2 or 11.3.2.2 .

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Tue May 27 16:16:27 EDT 2025

## Committee Statement

**Committee Statement:** This revision addresses combined bulk liquid storage and bulk gaseous storage systems.

During the First Draft meeting Chapter 10, Gas Hydrogen Systems, was deleted in its entirety since the scope over hydrogen resides wholly in NFPA 2.

Additionally, the separation distance requirement of 11.3.2.2.2 in this code was deleted during the First Draft meeting since it included cross-references to the deleted chapter (see CI-16). Second Revision No. 23 has reintroduced a revised Chapter 10 titles Bulk Flammable Gas Systems, with all references to hydrogen removed. With Chapter 10 being reintroduced, this revision brings back the separation distance requirement with updated cross-reference to the reintroduced Chapter 10, Bulk Flammable Gas Systems, along with the cross-references to the appropriate section within this chapter.

**Response Message:** SR-8-NFPA 55-2025



## Second Revision No. 12-NFPA 55-2025 [ Chapter 12 ]

### Chapter 13 Carbon Dioxide Systems

#### 13.1 General.

##### 13.1.1

The storage, use, and handling of carbon dioxide systems greater than 100 lb (45 kg) shall be in accordance with the provisions of Chapters 1 through 8 and Chapter 13, as applicable.

##### 13.1.2

The storage, use, and handling of carbon dioxide systems used in medical gas applications shall be in accordance with Chapter 17 and ANSI/CGA M-1, *Standard for Medical Gas Supply Systems at Health Care Facilities*, in addition to the requirements of this chapter.

##### 13.1.3

Operating instructions shall be provided by the system manufacturer that detail the installation, use, and maintenance.

##### 13.1.3.1

Operating instructions shall account for potential exposure of personnel to extremely low temperatures, high concentrations of carbon dioxide, and oxygen depletion.

##### 13.1.3.2

Operating instructions shall account for pressurizing or draining liquid lines to prevent the formation of dry ice.

##### 13.1.3.3

The storage, use, and handling of carbon dioxide systems used for suppression shall be in accordance with NFPA 12.

#### 13.2 Carbon Dioxide Monitoring Systems.

##### 13.2.1\*

Carbon dioxide monitoring systems shall be installed and maintained in accordance with CGA G-6.14, *Standard for Carbon Dioxide Monitoring in Industrial and Near Consumer Applications*, for all indoor and enclosed areas.

##### A.13.2.1

Carbon dioxide is heavier than air with the potential to migrate to the lower areas of buildings, floors, and rooms, as well as into basements. When locating gas monitoring systems, consideration should be given to this characteristic.

##### 13.2.2

Section 13.2 shall not apply to manufacturer locations where non-stationary DOT containers are filled and distributed for use.

##### 13.2.3

All indoor and enclosed areas where carbon dioxide is expected to accumulate shall be protected by a gas monitoring system that activates an audible and visible alarm at 30,000 ppm instantaneous reading to notify occupants to evacuate the affected area immediately. (See A.13.2.1.)

#### **13.2.4**

All indoor and enclosed areas where carbon dioxide is expected to accumulate shall be protected with a gas monitoring system that activates at 15,000 ppm instantaneous reading to notify persons responsible for the system operation that a hazardous condition requires immediate attention. (See A.13.2.1 and A.13.2.5 .)

#### **13.2.5\***

All indoor and enclosed areas shall be managed to prevent the permissible exposure limits (PEL) are not exceeded.

##### **A.13.2.5**

A 15,000 ppm instantaneous reading notification should not be relied upon to assure in all cases that a 5000 ppm OSHA 8-hour time weighted average (TWA) has not been exceeded. Administrative monitoring of excursions below the 5000 ppm OSHA 8-hour TWA-PEL can be a practical piece of information in the overall surveillance and periodic maintenance of the system to help ensure compliance with the OSHA 8-hour TWA-PEL. Some examples of possible administrative monitoring and corrective actions include the following:

- (1) Having an automated shutoff that activates at an instantaneous reading of 5000 ppm or over a TWA that is less than 8 hours.
- (2) Having an alert that activates at an instantaneous reading below 5000 ppm 8-hour TWA (e.g., 4000 ppm 8-hour TWA or 5000 ppm instantaneous reading) which notifies personnel that corrective action might be required before the 5000 ppm 8-hour TWA-PEL is reached.
- (3) Having a monitoring system that extrapolates readings based upon the current trend and is able to recommend corrective action when it appears the OSHA 8-hour TWA-PEL will be reached before the end of the current shift.

Administrative monitoring set points and TWA selection should consider instantaneous readings that are likely to occur during normal system operation. For example, instantaneous readings can spike briefly when hoses are connected or disconnected. When an instantaneous reading of 5000 ppm triggers an immediate alarm, it can cause personnel to ignore the warnings or tamper with the monitor due to alarm fatigue (i.e., desensitization due to the frequency of alarms). Set points should be low enough to allow time for corrective action but high enough to avoid being triggered by normal operation when exposures are within acceptable limits.

#### **13.2.6\***

Gas detectors shall be located at a height of 12 in. (1 ft) from the floor or ground in areas where carbon dioxide is anticipated to accumulate.

##### **A.13.2.6**

The gas detector should be located in proximity to the supply container system. (See A.13.2.1 .)

#### **13.2.7**

Gas monitoring systems shall be maintained in accordance with the manufacturer's instructions to continuously operate.

### **13.3 Ventilation Systems.**

#### **13.3.1 General.**

#### **13.3.1.1**

All mechanical exhaust ventilation inlet points shall collect within 12 in. (1 ft) of the floor and discharge outdoors where people and structures will not be negatively affected.

#### **13.3.1.2**

Section 13.3 shall not apply to manufacturer locations where non-stationary DOT containers are filled and distributed for use.

### **13.3.2 Indoor Ventilation Systems.**

#### **13.3.2.1**

Indoor ventilation systems shall be provided in accordance with Section 6.16 .

#### **13.3.2.2**

Where storage systems are located, exhaust ventilation systems shall be designed to maintain negative pressure in relation to the surrounding area.

#### **13.3.2.3**

Exhaust ventilation systems activated at the emergency evacuation set point in accordance with 13.2.2 shall be shut off manually under the authority of the person controlling the scene.

### **13.3.3 Enclosed Outdoor Area Ventilation Systems.**

#### **13.3.3.1**

Ventilation systems installed in areas bounded on three or more sides by exterior building walls, freestanding walls, barriers, or fences shall comply with one of the following:

- (1) Systems in bounded areas comply with CGA P-41, *Standard for Locating Bulk Liquid Storage Systems in Courts*
- (2) Systems in bounded areas align with 13.3.3.2

#### **13.3.3.2**

The bounded area shall comply with CGA G-6.5, *Standard for Small Stationary Insulated Carbon Dioxide Supply Systems* , and all of the following:

- (1) Enclosed areas are provided with opening areas in the barriers and fences.
- (2) The opening areas are equal to at least 25 percent of the surface area of the barriers and fences.
- (3) The opening areas are in direct conveyance with ground level.
- (4) The opening areas are at least 12 in. (1 ft) tall.
- (5) The opening areas allow the free flow of air to the outdoor environment.
- (6) The openings are permitted to be grated for security purposes.

### **13.4 Piping Systems.**

#### **13.4.1 General.**

All carbon dioxide systems and distribution piping shall comply with Section 13.4 .

#### **13.4.2 Materials of Construction.**

**13.4.2.1\* \_**

Carbon dioxide piping shall be located and supported to protect against damage from strain on piping and fittings; the effects of expansion, contraction, and vibration; mechanical damage; moving objects or impact; and heat sources.

**A.13.4.2.1 \_**

Liquid carbon dioxide is typically transferred at temperatures from 0 °F to –20 °F (–18 °C to –29 °C). Rapid depressurization can cause the liquid to auto-refrigerate to as low as –109.3 °F (–78.5 °C), causing temperatures to decrease, and piping stresses to increase rapidly due to contraction of piping.

**13.4.2.1.1 \_**

Liquid carbon dioxide piping, tubing, hoses, and fittings shall be designed in accordance with ASME B31.3, *Process Piping*, codes and standards, and CGA G-6.6, *Standard for Carbon Dioxide Bulk Transfer Hoses*.

**13.4.2.1.2 \_**

All of the following prohibited materials shall not be used in liquid carbon dioxide service:

- (1) ASTM grade A-120 pipe (galvanized water pipe)
- (2) Type F furnace butt-welded steel pipe
- (3) Cast iron or malleable iron fittings and pipe
- (4) Cadmium plating for food service

**13.4.2.1.3 \_**

Plastic pipe and fittings shall be used in accordance with ASME B31.3, *Process Piping*.

**13.4.2.1.3.1 \_**

PVC and CPVC shall not be used in pressurized service above 15 psi (103.4 kPa).

**13.4.2.1.3.2\* \_**

Nonmetallic piping shall be protected from damage by rodents.

**A.13.4.2.1.3.2 \_**

Protection from rodent damage can be accomplished by locating the piping in a safe area or by protecting it with outer metal piping.

**13.4.2.1.3.3\* \_**

When metal pipe or tubing has potential exposure to external corrosion, it shall be made of non-corrosive material.

**A.13.4.2.1.3.3 \_**

An example of a suitable noncorrosive material is stainless steel, or a suitable corrosion allowance can be added to the thickness of the material being used.

**13.4.2.1.4\* \_**

Threaded carbon steel pipe shall be schedule 80 seamless or resistance welded.

**A.13.4.2.1.4**

Grade A or B in accordance with ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service* , or grade A and B in accordance with ASTM A530, *Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe* , is recommended.

**13.4.2.1.5**

Non-threaded carbon steel pipe shall be schedule 40 seamless or resistance welded.

**13.4.2.1.6**

Threaded and socket-weld fittings for steel piping shall be a minimum of Class 2000 lb (907 kg) forged steel in accordance with ANSI B16.11, *Forged Fittings, Socket-Welding and Threaded* .

**13.4.2.1.7**

Butt-weld fittings shall be of the same pressure rating as the pipe with which they are used.

**13.4.2.2**

Carbon steel piping shall be protected from corrosion due to condensation of ambient moisture.

**13.4.2.3**

Piping intended to contain liquid carbon dioxide shall have means to pressurize the piping system with vapor before introducing liquid carbon dioxide and have means to maintain pressure in the piping system while draining.

**13.4.2.4**

Ball valves that are expected to contain liquid carbon dioxide shall have a means to allow trapped liquid to escape from the ball to the liquid side in the closed position.

**13.4.2.5**

If the carbon dioxide used with the piping system does not have a quantitative viral load (QVL) assay level of 99 percent or greater and is not in accordance with CGA G-6.2, *Commodity Specification for Carbon Dioxide* , an engineering analysis shall be conducted to determine if an internal corrosion allowance for the equipment is required.

**13.4.3** Fill Connection.**13.4.3.1**

The point of fill connections shall comply with CGA V-6, *Standard Bulk Refrigerated Liquid Transfer Connections* , or be a unique connection as described in CGA G-6.5, *Standard for Small Stationary Insulated Carbon Dioxide Supply Systems* , and CGA G-6.13, *Standard for Stationary Uninsulated Cylinder Supply Systems for Carbon Dioxide* .

**13.4.4** Distribution System.

#### 13.4.4.1 Piping and Appurtenances.

Piping and appurtenances shall be designed and assembled of a suitable material in accordance with 13.4.2 for the use intended, through the full range of pressure and temperature to which they will be subjected.

#### 13.4.4.2 Piping Systems.

Piping systems shall be designed and constructed to allow for expansion, contraction, vibration, settlement, and fire exposure.

#### 13.4.4.3 Joints.

Joints in piping and tubing shall be in accordance with ASME B31.3, *Process Piping*.

#### 13.4.4.4 Valves and Accessory Equipment.

Valves and accessory equipment shall be designed for the intended use and constructed for the pressures and temperatures of the application.

#### 13.4.4.5 Emergency Shutoff Valve.

Distribution piping or the supply container shall be equipped with an emergency shutoff valve in accordance with all of the following:

- (1) Emergency shutoff valves are manually or automatically operated to shut off the flow of gas or liquid in the event of a leak.
- (2) Emergency shutoff valves are located as close to the supply container as possible.
- (3) Emergency shutoff valves are identified in accordance with 8.4.6 .

#### 13.4.5 Pressure Relief Devices.

##### 13.4.5.1\* \_

Where fluids can be blocked-in and subjected to heating and a consequent expansion that leads to pressures beyond the design pressure, a pressure relief device shall be provided.

##### A.13.4.5.1 \_

Refrigerated liquids or liquefied compressed gases trapped between two isolation valves will experience significant pressure rise [ $\sim 85$  psi ( $\sim 590$  kPa) per  $^{\circ}\text{F}$ ] when allowed to warm to ambient temperature.

##### 13.4.5.2 \_

Relief devices shall be set to operate at a pressure not exceeding the piping system test pressure or 120 percent of the design pressure of that portion of the piping or hose in accordance with ASME B31.3, *Process Piping* , whichever is less.

#### 13.4.6 Vent Pipe Systems.

##### 13.4.6.1 \_

Pressure relief devices (PRDs) on containers, piping, and hoses that are located in confined areas shall be vented outdoors.

##### 13.4.6.1.1 \_

Outdoor venting of PRDs shall avoid locations occupied by personnel and be directed away from low points where carbon dioxide is expected to accumulate.

##### 13.4.6.2 \_

Back pressure control devices and vent valves on containers located in confined areas shall be vented to avoid locations occupied by personnel and directed away from low points where carbon dioxide is expected to accumulate.

**13.4.6.3** \_

Vent lines shall be sized and arranged so as not to restrict the discharge of the PRD in accordance with [CGA S-1.3, Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases](#) .

**13.4.6.4** \_

Piping shall be made to prevent the restriction or closure of vent pipes due to frozen condensation or rainwater and obstruction by insect or animal nests.

**13.4.6.5** \_

Vent piping shall be installed such that dynamic forces will not unscrew the safety relief device.

**13.4.6.6** \_

Carbon dioxide vent piping shall not share a common header with other cryogenic or refrigerated liquids.

**13.5** Filling Controls.**13.5.1** \_

Filling controls shall be provided and be visible from the delivery point to allow the delivery operator to monitor the internal pressure and fill status of stationary containers during filling.

**13.5.2** \_

Filling controls shall be located on the container or at a remote fill location.

**13.6** Uninsulated Carbon Dioxide Compressed Gas Systems.**13.6.1** General.

Uninsulated carbon dioxide compressed gas systems filled in place shall comply with Section [13.6](#) .

**13.6.2** Pressure Relief Devices.

Uninsulated cylinder systems used for liquid carbon dioxide shall be equipped with pressure relief devices piped from the uppermost part of the cylinders and communicating with the vapor space.

**13.6.3\*** Pressure and Level Indicators.

Uninsulated cylinder system tanks shall be provided with a pressure gauge for indicating the pressure of liquid carbon dioxide and designed for the temperatures and pressures associated with liquid carbon dioxide service.

**A.13.6.3** \_

Level indicators are not required for uninsulated cylinder systems.

**13.6.4** Fill Controls.

Uninsulated cylinder systems filled onsite through a remote filling connection shall have a validated fill process to determine when the containers have been filled to their design capacity in accordance with [CGA G-6.13, Standard for Stationary Uninsulated Cylinder Supply Systems for Carbon Dioxide](#) .

**13.6.5** Fill Systems.

Uninsulated cylinder systems with a remote fill connection shall have fill and vent piping and controls in accordance with [CGA G-6.13, Standard for Stationary Uninsulated Cylinder Supply Systems for Carbon Dioxide](#) .

**13.7** Small Insulated Liquid Carbon Dioxide Systems.

### 13.7.1\* General.

Small insulated carbon dioxide compressed gas systems filled and used in a stationary location shall comply with Section 13.7 .

#### A.13.7.1 \_

Indoor insulated liquid carbon dioxide container systems not refilled in the location of use, which are 4L cylinders refilled at a repackaging plant or those moved from their location of use and then refilled, are not considered filled in a stationary location. These include, for example, ASME containers that are moved to the facility dock or outdoors, refilled, and then moved back to the use point.

### 13.7.2 Pressure Relief Devices.

Insulated cylinder systems used for liquid carbon dioxide shall be equipped with pressure relief devices piped from the uppermost part of the container and communicating with the vapor space.

### 13.7.3 Pressure and Level Indicators.

#### 13.7.3.1 \_

Insulated cylinder system tanks shall be provided with a pressure gauge for indicating the pressure of liquid carbon dioxide that is designed for the temperatures and pressures associated with liquid carbon dioxide.

#### 13.7.3.2\* \_

Level indicators shall be provided.

#### A.13.7.3.2 \_

Level indicators that measure differential pressure between the vapor and liquid spaces of the tank can malfunction if ambient air temperature falls below carbon dioxide saturation temperature at tank operating pressure. Condensing vapor in the instrument lines causes erratic readings. This problem can sometimes be mitigated by insulating and heat tracing the instrument lines. Otherwise, a different means of measuring tank level, such as measuring total tank weight using piezoelectric sensors, could be used.

### 13.7.4 Fill Controls.

Small insulated liquid carbon dioxide systems filled onsite through a remote filling connection shall be filled in accordance with CGA G-6.5, *Standard for Small Stationary Insulated Carbon Dioxide Supply Systems* .

### 13.7.5 Fill Systems.

Insulated cylinder systems with a remote fill connection shall have fill and vent piping as well as controls in accordance with CGA G-6.5, *Standard for Small Stationary Insulated Carbon Dioxide Supply Systems* .

## 13.8 Large Insulated Carbon Dioxide Systems.

### 13.8.1 General.

Large insulated carbon dioxide compressed gas systems shall comply with Section 13.8 .

### 13.8.2 Materials of Construction.

#### 13.8.2.1 \_

Large carbon dioxide containers shall be designed and fabricated using materials and methods suitable for the expected operating and upset temperatures and pressures, both high and low.

### 13.8.2.2

The container shall not be operated below its minimum design metal temperature (MDMT).

### 13.8.2.3

When an upset condition occurs that drops the container below its MDMT, the container shall be isolated, removed from service, and returned to service in accordance with CGA G-6.7, *Safe Handling of Liquid Carbon Dioxide Containers That Have Lost Pressure*.

## 13.8.3 Pressure Relief Devices.

### 13.8.3.1\*

Large carbon dioxide systems shall have safety relief valves and back pressure control devices sized, located, and vented in accordance with CGA G-6.1, *Standard for Large Insulated Liquid Carbon Dioxide Systems at User Sites*.

#### A.13.8.3.1

Sizing of the pressure relief device (PRD) for a foam-insulated carbon dioxide container is performed in accordance with CGA S-1.3, *Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases*. When sizing the PRD for exposure to fire, CGA S-1.3 allows a container that is isolated from engulfment by fire to use a smaller PRD. Depending on the likelihood of engulfment by fire, the PRD on a foam-insulated container can be 30 percent as large as for other containers. The vast majority of foam-insulated carbon dioxide containers in industrial service are supplied with the 30 percent PRD where insulated from fire engulfment. It should be addressed with the container supplier or container manufacturer where the siting of a foam-insulated container is not appropriately isolated from fire engulfment in accordance with CGA S-1.3, as the container will likely need a larger PRD container connection (nozzle) than standard foam-insulated containers are supplied with. In accordance with ASME BPVC, *Rules for the Construction of Unfired Pressure Vessels, Section VIII Division 1*, it is the user's responsibility to assure the proper size of PRD is on an ASME container.

## 13.8.4 Pressure and Level Indicators.

### 13.8.4.1

Large carbon dioxide systems shall be provided with a device for indicating the pressure of liquid carbon dioxide that is designed for the temperatures and pressures associated with liquid carbon dioxide service.

### 13.8.4.2

Large carbon dioxide systems shall be provided with a device for indicating the liquid level of the carbon dioxide that is designed for the temperatures and pressures associated with liquid carbon dioxide service. (See A.13.7.3.2.)

### 13.8.4.3

The size and location of the pressure and level indicators shall be readable and understood by personnel located at the fill location, except where in accordance with 13.8.4.3.1.

#### 13.8.4.3.1

When visibility of the tank pressure or level indicators are restricted, either auxiliary pressure and level indicators at the fill location or an engineered system to stop the fill process when the maximum fill level has been reached shall be installed.

## 13.8.5 Fill Controls.

### 13.8.5.1

Large carbon dioxide systems shall have a vapor balance connection that opens to the vapor space at the maximum fill level.

#### **13.8.5.1.1**

The vapor balance connection shall provide an indication to the driver filling the tank when the maximum fill level has been reached.

#### **13.8.5.2**

The maximum fill level shall be set in accordance with CGA G-6.1, *Standard for Large Insulated Liquid Carbon Dioxide Systems at User Sites*.

#### **13.8.5.3**

Large carbon dioxide systems shall be filled in accordance with the manufacturer's instructions.

### **13.8.6 Indoor Installation Requirements.**

#### **13.8.6.1**

Large carbon dioxide containers shall be insulated.

#### **13.8.6.2**

Indoor installations of foam insulated containers shall be isolated from engulfment in fire with the use of fire barriers, distance, a fire suppression system, or sheltered by noncombustible construction.

#### **13.8.6.3**

Indoor systems installed in a building constructed of combustible or limited-combustible materials, or containing sources of heat that could endanger the integrity of the storage container shall be protected by a fire detection system.

##### **13.8.6.3.1**

When fire detection systems are required, a heat sensing system or smoke detection system shall be installed in the room or enclosure containing the storage container.

##### **13.8.6.3.2**

Heat sensing systems shall be set to activate when the temperature reaches 120°F (48.9°C).

##### **13.8.6.3.3**

When the heat or smoke detection system is activated, the system shall sound a local alarm.

##### **13.8.6.3.4**

When the heat or smoke detection system is activated, the system shall send a signal to a proprietary or central monitoring station, or a continuously occupied location if one is provided on site.

### **13.8.7 Outdoor Installation Requirements.**

**13.8.7.1**

Outdoor installations shall be located in accordance with Table 13.8.7.1.

Table 13.8.7.1 Minimum Separation Distance Between Outdoor Stationary Large Insulated Liquid Carbon Dioxide Containers and Exposures

| <u>Exposure</u>                                                                  | <u>Minimum Distance</u> |            |
|----------------------------------------------------------------------------------|-------------------------|------------|
|                                                                                  | <u>ft</u>               | <u>m</u>   |
| <u>(1) Buildings, regardless of construction type</u>                            | <u>2</u>                | <u>0.6</u> |
| <u>(2) Wall openings other than building exits</u>                               | <u>2</u>                | <u>0.6</u> |
| <u>(3) Air intakes</u>                                                           | <u>10</u>               | <u>3.1</u> |
| <u>(4) Property lines</u>                                                        | <u>5</u>                | <u>1.5</u> |
| <u>(5) Places of public assembly (assembly occupancies)</u>                      | <u>50</u>               | <u>15</u>  |
| <u>(6) Nonambulatory patient areas</u>                                           | <u>50</u>               | <u>15</u>  |
| <u>(7) Combustible materials (e.g., paper, leaves, weeds, dry grass, debris)</u> | <u>15</u>               | <u>4.5</u> |
| <u>(8) Incompatible hazardous materials</u>                                      | <u>20</u>               | <u>6.1</u> |
| <u>(9) Building exits</u>                                                        | <u>10</u>               | <u>3.1</u> |

**13.8.7.2**

Outdoor installations of foam insulated containers that are exposed to engulfment in fire shall be protected by one of the methods specified in 13.8.7.2.1 and 13.8.7.2.2.

**13.8.7.2.1**

Containers shall be protected from engulfment in fire by fire barriers or a fire suppression system.

**13.8.7.2.1.1**

Fire barrier wall construction shall comply with 8.6.2.

**13.8.7.2.1.2**

Fire barrier sizing shall protect the entire container from exposure.

**13.8.7.2.2**

Container pressure relief systems shall be sized for engulfment in fire in accordance with CGA S-1.3, Pressure Relief Device Standards—Part 3—Stationary Storage Containers for Compressed Gases.

**13.8.8 Operation Requirements.****13.8.8.1**

Large carbon dioxide systems shall be operated at temperatures not lower than the minimum design metal temperature of the container.

**13.8.8.2\***

If the container is used with carbon dioxide liquid or gas that does not meet the specifications listed in CGA G-6.2, Commodity Specification for Carbon Dioxide, and has a carbon dioxide assay level greater than or equal to 99 percent, an engineering analysis shall be conducted to determine if an internal corrosion allowance is required.

**A.13.8.8.2**

An internal corrosion allowance is not necessary for containers where the carbon dioxide liquid and gas meet the specifications listed in CGA G-6.2, *Commodity Specification for Carbon Dioxide*, and that have a carbon dioxide assay level greater than or equal to 99 percent in accordance with CGA G.6.1, *Standard for Large Insulated Liquid Carbon Dioxide Systems at User Sites*.

**13.8.9** Fill Connections.

Point of fill connections serving large carbon dioxide containers filled by mobile transport equipment shall not be positioned closer to exposures than the minimum distances in Table 13.8.7.1.

**13.9** Occupiable Refrigerator Rooms.

Carbon dioxide containers, cylinders, piping, and equipment located in occupiable refrigerator rooms where a leak of carbon dioxide is expected to collect shall be in accordance with the provision of 13.9.1 through 13.9.3.

**13.9.1**

Occupiable refrigerator rooms shall be provided with an unobstructed path of egress and a door equipped with listed exit hardware in accordance with the adopted building code.

**13.9.2**

Occupiable refrigerator rooms shall be provided with a gas monitoring system in accordance with Section 13.2.

**13.9.3**

Where emergency exhaust ventilation is installed, it shall be activated by the gas monitoring system at 30,000 ppm in accordance with Section 6.16.

**13.9.4**

Occupiable refrigerator rooms shall be provided with a means to shut off the flow of carbon dioxide gas.

**13.9.4.1**

Where an automatic shutoff valve is installed, it shall be activated by the gas monitoring system at 30,000 ppm.

**13.9.4.1.1**

Automatic shutoff valves shall fail closed.

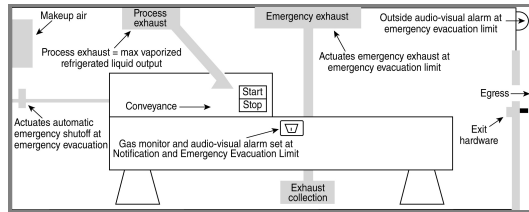
**13.10\*** Carbon Dioxide Liquid Processing Rooms.

Carbon dioxide liquid processing room piping located indoors, where a release of liquid carbon dioxide is expected to collect and create a hazard, shall be in accordance with Section 6.16 and 13.10.1 through 13.10.7, or in accordance with the risk assessment approved by the AHJ.

**A.13.10 Carbon Dioxide Liquid Processing Rooms.**

Figure A.13.10 illustrates an example of controls provided for carbon dioxide liquid processing rooms.

**Figure A.13.10 Carbon Dioxide Liquid Processing Room.**

**13.10.1**

Section 13.10 shall not apply to closed systems.

**13.10.2**

Unobstructed paths of egress and doors equipped with listed exit hardware shall be provided in accordance with the adopted building code.

**13.10.3\***

A gas detection and notification audio and visual alarm system that activates at a breathing atmosphere detection level of 15,000 ppm carbon dioxide shall be provided and designed to notify room occupants of a gas leak.

**A.13.10.3**

The notification alarm is to be set at 15,000 ppm carbon dioxide in breathable air. A 15,000 ppm setting is an instantaneous measurement. The setting was determined based on one-half of the short-term exposure limit time weighted average as indicated in ACGIH's *TLVs and BEIs Based on The Documentation of The Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposures Indices*. The notification alarm is required to allow the operator time to react to a leak before the emergency alarm system that requires evacuation is activated. The notification alarm will not protect against system leaks that create an exposure that can exceed the Occupational Safety and Health Administration permissible exposure limit of 5000 ppm 8-hour time weighted average. It is up to the business employer under the Occupational Safety and Health Administration regulations in 29 CFR 1910.1000, "Air Contaminants," to manage employee workplace exposures.

**13.10.4\***

A gas detection and emergency audio and visual alarm system that activates at a breathing atmosphere detection level of 30,000 ppm carbon dioxide shall be provided and designed to inform processing room occupants to evacuate and other business occupants of the event.

**A.13.10.4**

The monitor and alarm notification system can be a fixed system or a series of individual combination monitor-alarm devices provided individually for each occupant. However, where individual monitor-alarms are used, it is still necessary that the devices be automatically actuated by gas detection and that other business personnel are notified.

**13.10.5\***

An automatic emergency shutoff valve that is actuated by the gas detection system at the emergency alarm activation level and shuts down the flow of liquid carbon dioxide shall be provided, except where in accordance with 13.10.5 .

**A.13.10.5 \_**

Automatic emergency shutoff valves should be power-to-open and spring-to-closed on failure or alarm.

**13.10.5.1 \_**

Emergency shutoff valves shall be located in accordance with 8.13.11.2.3.2 as it is applied to cryogenic liquids.

**13.10.5.2 \_**

Emergency shutoff valves shall be identified by means of a sign.

**13.10.6 \_**

Emergency exhaust ventilation that is independent from process exhaust and is activated by the gas detection system at the emergency alarm activation level shall be provided.

**13.10.6.1\* \_**

Emergency exhaust ventilation that is designed to collect gasifying carbon dioxide shall be sited in a location where accumulation is expected in the event of a leak and within 12 in. (25 mm) of the floor.

**A.13.10.6.1 \_**

Carbon dioxide gas collects around the lower levels of the room until the gasified carbon dioxide warms up. Carbon dioxide can diffuse throughout the room and create harmful carbon dioxide concentrations in breathable air.

**13.10.6.2\* \_**

Continuous exhaust ventilation shall be provided with a capacity based on the results of a risk assessment with a minimum performance of  $1.0 \text{ cfm/ft}^2$   $(0.00508 \text{ m}^3/\text{sec/m}^2)$ .

**A.13.10.6.2** \_

The content of this annex note is consistent with the information provided in CGA TR-8, *Risk Informed Methods For Industrial Gas Applications of Liquid Nitrogen and Liquid Carbon Dioxide in Occupied Spaces*.

Table A.13.10.6.2 provides information to determine exhaust ventilation by room size and nominal valve size upstream of the opening of the system to the room. A formula to determine a protected area and calculate the required emergency exhaust ventilation capacity is provided in this section. It is only applicable for emergency exhaust ventilation systems with a capacity of up to  $5 \text{ cfm/ft}^2$  ( $0.0254 \text{ m}^3/\text{sec/m}^2$ ). Where higher capacities are necessary, use an alternate risk assessment model approved by the AHJ.

To determine the required emergency exhaust ventilation capacity, use the applicable information in Table A.13.10.6.2 and the formula provided. Continuous ventilation provided in accordance with 6.16.3 can be credited towards the emergency exhaust ventilation capacity required.

Exhaust ventilation capacity is based on the room area and credible leak rate of system piping. The user should verify that the room size fits the area range in the exhaust ventilation column for the valve size in Table A.13.10.6.2. The valve size used in the table is the size of the valve that controls the flow of liquid into the individual process equipment.

Where room areas are greater than those indicated in the  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) column of Table A.13.10.6.2, an exhaust ventilation capacity of  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) will satisfy the ventilation requirement. Where the room areas fit within the greater than  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) to  $5.0 \text{ cfm/ft}^2$  ( $0.0254 \text{ m}^3/\text{sec/m}^2$ ) room range column, the exhaust ventilation capacity requires more than  $1.0 \text{ cfm/ft}^2$  ( $0.00508 \text{ m}^3/\text{sec/m}^2$ ) and calculation using Equation A.13.10.6.2 is necessary to determine the needed exhaust ventilation capacity.

$$\left[ \frac{1 \text{ ft}^3 / \text{min}}{\text{ft}^2} \right] \times \frac{\text{area range upper limit}}{\text{room area}} = \text{exhaust ventilation capacity} \quad [\text{A.13.10.6.2}]$$

Unless the following rules are satisfied, an alternate risk assessment model approved by the AHJ should be provided:

- (1) The room length to width ratio does not exceed 3 to 1.
- (2) The valve pipe size in Table A.13.10.6.2 is based on either the nominal diameter pipe size or outer tube diameter for the carbon dioxide liquid distribution system.
- (3) The nominal operating pressure of the liquid carbon dioxide tanks is 300 psi (2070 KPI) or less.

Table A.13.10.6.2 Protected Area Based on Exhaust Ventilation

| Valve Pipe Size $\frac{\text{in.}}{\text{mm}}$ |        | Room Ranges Based on Ventilation Ranges   |                                                           |                                                                   |                                                                               |
|------------------------------------------------|--------|-------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------|-------------------------------------------------------------------------------|
| in.                                            | mm     | $1.0 \text{ cfm/ft}^2$<br>$\underline{a}$ | $0.00508 \text{ m}^3 / \text{sec/m}^2$<br>$\underline{a}$ | $>1.0 \text{ to } 5.0 \text{ cfm/ft}^2$<br>$\underline{b}$        | $>0.00508 \text{ to } 0.0254 \text{ m}^3 / \text{sec/m}^2$<br>$\underline{b}$ |
| 2 NPS                                          | 50 NPS | Room area $> 36864 \text{ ft}^2$          | Room area $> 3424.8 \text{ m}^2$                          | $36864 \text{ ft}^2 \geq \text{room area} \geq 7396 \text{ ft}^2$ | $3424.8 \text{ m}^2 \geq \text{room area} \geq 687.1 \text{ m}^2$             |
| 1.5 NPS                                        | 38 NPS | Room area $> 22201 \text{ ft}^2$          | Room area $> 2062.5 \text{ m}^2$                          | $22201 \text{ ft}^2 \geq \text{room area} \geq 4489 \text{ ft}^2$ | $2062.5 \text{ m}^2 \geq \text{room area} \geq 417.04 \text{ m}^2$            |

| <u>Valve Pipe Size <math>\underline{C}</math></u> |               | <u>Room Ranges Based on Ventilation Ranges</u>                                    |                                                                                                                     |                                                                                               |                                                                                                                                  |
|---------------------------------------------------|---------------|-----------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <u>in.</u>                                        | <u>mm</u>     | <u>1.0 cfm/ft <math>\underline{2}</math></u><br><u><math>\underline{a}</math></u> | <u>0.00508 m <math>\underline{3}</math> /</u><br><u>sec/m <math>\underline{2}</math> <math>\underline{a}</math></u> | <u>&gt;1.0 to 5.0 cfm/</u><br><u>ft <math>\underline{2}</math> <math>\underline{b}</math></u> | <u>&gt;0.00508 to 0.0254</u><br><u>m <math>\underline{3}</math> /sec/m <math>\underline{2}</math> <math>\underline{b}</math></u> |
| <u>1 NPS</u>                                      | <u>25 NPS</u> | Room area ><br>9409 ft $\underline{2}$                                            | Room area ><br>874.1 m $\underline{2}$                                                                              | 9409 ft $\underline{2}$ $\geq$ room<br>area $\geq$ 1849 ft $\underline{2}$                    | 874.1 m $\underline{2}$ $\geq$ room<br>area $\geq$ 171.8 m $\underline{2}$                                                       |
| <u>0.5 NPS</u>                                    | <u>13 NPS</u> | Room area ><br>3136 ft $\underline{2}$                                            | Room area ><br>291.3 m $\underline{2}$                                                                              | 3136 ft $\underline{2}$ $\geq$ room<br>area $\geq$ 625 ft $\underline{2}$                     | 291.3 m $\underline{2}$ $\geq$ room<br>area $\geq$ 58 m $\underline{2}$                                                          |
| <u>0.5 ODT</u>                                    | <u>13 ODT</u> | Room area ><br>1156 ft $\underline{2}$                                            | Room area ><br>107.4 m $\underline{2}$                                                                              | 1156 ft $\underline{2}$ $\geq$ room<br>area $\geq$ 225 ft $\underline{2}$                     | 107.4 m $\underline{2}$ $\geq$ room<br>area $\geq$ 21 m $\underline{2}$                                                          |

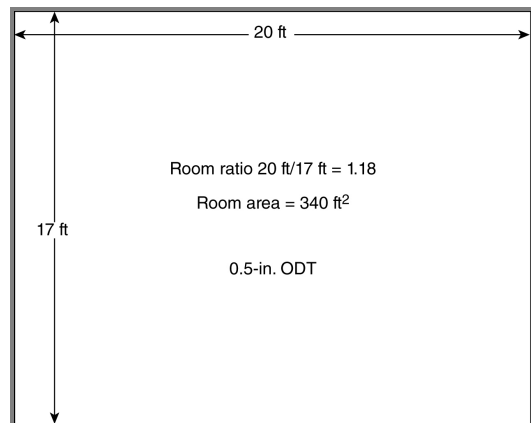
(a) A room size with an area, according to NPS size, greater than or equal to the area in the denoted column provided with 1.0 cfm/ft  $\underline{2}$  (0.00508 m  $\underline{3}$  /sec/m  $\underline{2}$  ) exhaust ventilation satisfies the capacity requirements.

(b) A room size with an area, according to NPS size, that fits the area range in the denoted column is required to be provided with calculated emergency exhaust ventilation with a performance greater than 1.0 cfm/ft  $\underline{2}$  (0.00508 m  $\underline{3}$  /sec/m  $\underline{2}$  ).

(c) Valve size is based on nominal pipe diameter (NPS) or outside tube diameter (ODT) for those listed.

The following example illustrates the room ratio and dimensions for a liquid carbon dioxide system (0.5 in. ODT). (See Figure A.13.10.6.2 .)

**Figure A.13.10.6.2 Ratio and Dimensions Example of a Carbon Dioxide Liquid Processing Room.**



This example calculates a room with dimensions for a carbon dioxide liquid system (0.5 ODT) of 0.5 in. tube.

Example:  $[(1 \text{ ft}^3 / \text{min}) / \text{ft}^2] \times (1156 \text{ ft}^2 / 340 \text{ ft}^2) = 3.40 \text{ ft}^3 / \text{min/ft}^2 = \text{exhaust ventilation capacity}$

### **13.10.6.2.1**

A risk assessment shall be conducted to determine if more exhaust ventilation is needed.

### 13.10.6.2.2

Where more exhaust ventilation is needed, one of the following conditions shall be met:

- (1) The exhaust ventilation is augmented to provide more than 1.0 cfm/ft<sup>2</sup> (0.00508 m<sup>3</sup>/sec/m<sup>2</sup>), in accordance with the risk assessment and is activated by the gas detection system at the emergency activation level in accordance with 13.2.3.
- (2) An automatic emergency shutoff valve is provided in accordance with 8.13.11.2.3 that is designed to be activated by the gas detection system at the emergency activation level.

### 13.10.6.3

A means of makeup air with a capacity equal to or greater than the room's maximum exhaust ventilation aggregated capacity shall be provided.

### 13.10.7

The capacity of the process exhaust ventilation system shall be greater than the design vaporized liquid carbon dioxide supply rate.

#### 13.10.7.1

The liquid carbon dioxide supply system shall be designed to prevent the flow of liquid unless the process exhaust ventilation system is running.

### 12.1 General.

#### 12.1.1

The storage, use, and handling of carbon dioxide systems shall be in accordance with the provisions of Chapter 12 as well as Chapter 1 and Chapters 4 through 7, as applicable.

#### 12.1.2

The storage, use, and handling of carbon dioxide systems used in medical gas applications shall be in accordance with Chapter 16 and ANSI/CGA M-1, *Standard for Medical Gas Supply Systems at Health Care Facilities*, in addition to the provisions stated herein.

### 12.2 Uninsulated Carbon Dioxide Compressed Gas Systems. (Reserved)

### 12.3 Insulated Carbon Dioxide Compressed Gas Systems.

The storage, use, and handling of carbon dioxide in insulated systems shall be in accordance with the provisions of Chapter 1 and Chapters 4 through 7, as applicable.

### 12.4 Insulated Liquid Carbon Dioxide Systems.

#### 12.4.1 Pressure Relief Devices.

Containers used for liquid carbon dioxide shall be equipped with pressure relief devices piped from the uppermost part of the containers and communicating with the vapor space.

##### 12.4.1.1 Physical Protection.

###### 12.4.1.1.1

Pressure relief devices shall be located to minimize tampering, damage, and obstruction to flow.

###### 12.4.1.1.2

The inlet and outlet of the relief devices shall not be blocked by a valve or plug during normal operation.

##### 12.4.1.2 Vent Pipe Systems.

Pressure relief devices shall be piped to the outdoors where the discharge will not impinge on the structure, personnel, or means of egress and will not create a hazardous concentration of carbon dioxide.

#### 12.4.1.2.1

Pressure relief devices from portable DOT 4L containers that are not a component of a stationary system shall not be required to meet the requirements of 12.4.1.2 :

#### 12.4.1.2.2\*

Vent piping systems serving pressure relief devices shall be protected from water intrusion to prevent moisture or solid carbon dioxide from collecting and freezing and interfering with the operation of the pressure relief device.

#### A.12.4.1.2.2

Vent pipes must be protected to prevent the intrusion of water that can freeze and interfere with the operation of the pressure relief device. Covers can be employed to protect the vent pipe against the elements. Carbon dioxide released through vent pipes can be transformed to the solid state through the production of what is dry ice in the form of "snow." It is possible for dry ice to form a plug in the vent line system. For this reason, designers might choose to locate the pressure relief device at the end of a vent line rather than on the unit itself. There are alternative designs that accomplish this intent. It is important that the system designer provide a system that is not susceptible to the formation of ice plugs due to moisture or solid carbon dioxide so that vent lines function as intended.

#### 12.4.1.2.3\*

Vent piping systems serving pressure relief devices shall be designed to prevent backflow restrictions exceeding 10 percent backpressure on the pressure relief device under full flow conditions.

#### A.12.4.1.2.3

Where cylinders, containers, and tanks are in locations remote from the filling connection, a means to determine when the containers have been filled to their design capacity should be provided and be verifiable from the filling connection. A functional pressure gauge equipped on the filling equipment connected to the fill box on the outside of the building is one method used to determine when the container being filled and the delivery vehicle pressures quickly equalize and the transfer of product is complete.

### 12.4.2 Pressure and Level Indicators.

#### 12.4.2.1

Cylinders, containers, and tanks shall be provided with a pressure gauge and a level gauge or device for indicating the quantity of liquid carbon dioxide.

#### 12.4.2.2

These devices shall be designed for the temperatures and pressures associated with liquid carbon dioxide service.

#### 12.4.2.3

Where cylinders, containers, and tanks are in locations remote from the filling connection, a means to determine when the containers have been filled to their design capacity shall be provided and shall be verifiable from the filling connection.

### 12.4.3 Piping Systems.

#### 12.4.3.1 \_

Carbon dioxide piping shall be located and supported to protect against damage from strain on piping and fittings; the effects of expansion, contraction, and vibration; mechanical damage; and heat sources.

#### 12.4.3.2 \_

Piping, tubing, and hoses and fittings shall be designed to a bursting pressure of at least four times the system design pressure.

#### 12.5\* Materials of Construction.

Materials of construction shall be employed for potential exposure to a temperature of  $-109.3^{\circ}\text{F}$  ( $-78.5^{\circ}\text{C}$ ).

#### A.12.5 \_

Materials used in the system can become brittle and fail if subjected to low temperatures. Maintain the system at or above the minimum design temperature by appropriate design materials or operating instructions to prevent system failure.

In North America, the majority of the containers in refrigerated carbon dioxide service are fabricated using low-alloy carbon steels such as SA-212, SA-515, SA-516, and SA-612. Containers manufactured before 1990 typically had a minimum design metal temperature (MDMT), the lowest temperature at which a container is designed to operate at a given pressure at  $-20^{\circ}\text{F}$  ( $-28.9^{\circ}\text{C}$ ). When the container wall is at an operating temperature colder than the MDMT, it is out of its intended operating condition.

#### 12.6 Operating Instructions.

Operating instructions shall account for potential exposure of personnel to extremely low temperatures in accordance with 12.7.3 :

#### 12.7 Small Insulated Liquid Carbon Dioxide Indoor Systems.

##### 12.7.1\* \_

Container foundations or floors in multistoried buildings shall be designed to support the weight of the system at its full capacity in accordance with the building code.

#### A.12.7.1 \_

The building code establishes requirements for the structure based on loads imposed by the elements of construction as well as for the loads that could be imposed by machinery or equipment. Building owners are responsible for understanding the limitations of loads on the building in which these installations are to be located. A professional engineer representing the building owner might have to make a determination as to the adequacy of the structure regarding the loads that are to be imposed for systems of this nature.

##### 12.7.2\* \_

Rooms or areas where container systems are filled and used indoors or in enclosed outdoor locations shall be provided with a gas detection and alarm system that shall be capable of detecting and notifying the building occupants of a gas release of carbon dioxide at, or in excess of, the Time-Weighted Average Permissible Exposure Limit (TWA-PEL) published by the Occupational Safety and Health Administration (OSHA) and the Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) published by the American Conference of Governmental Industrial Hygienists (ACGIH). More conservative set points shall be permitted to be used.

##### 12.7.2.1\* \_

Activation of the gas detection system shall initiate an audible alarm within the room or area in which the system is installed.

#### A.12.7.2.1 \_

The American Conference of Governmental Industrial Hygienists (ACGIH), in *TLVs<sup>®</sup> and BEIs<sup>®</sup>, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices*, has established threshold limit values (TLVs<sup>®</sup>). The threshold limit value—time weighted average basis (TLV-TWA<sup>®</sup>) for CO<sub>2</sub> has been established at 5000 ppm, with a short-term exposure limit (STEL-TLV<sup>®</sup>) value of 30,000 ppm.

As stated by ACGIH, the TLV-TWA represents a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek to which it is believed that nearly all workers can be repeatedly exposed, day after day, without adverse effect. The STEL-TLV is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, to impair self-rescue, or to materially reduce work efficiency, provided that the daily TLV-TWA is not exceeded. The STEL-TLV is not a separate, independent exposure guideline; rather, it supplements the TLV-TWA where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. TLV-STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals.

#### 12.7.2.2 \_

Subsection 12.7.2 shall not apply to manufacturer locations where containers are filled indoors and distributed for use.

#### 12.7.2.3 \_

Activation of the gas detection system shall sound a local alarm to notify persons responsible for system operation of a hazard condition in the area in which the system is installed.

#### 12.7.3 \_

A warning sign shall be posted at the entrance to the building, room, enclosure, or confined area where the container is located.

#### 12.7.3.1 \_

The warning sign shall be at least 8 in. (200 mm) wide and 6 in. (150 mm) high and state the following:

**CAUTION — CARBON DIOXIDE GAS**

Ventilate the area before entering.

A high carbon dioxide (CO<sub>2</sub>) gas concentration in this area can cause suffocation.

### 12.8 Small Insulated Liquid Carbon Dioxide Outdoor Systems.

#### 12.8.1 \_

Container systems located in enclosed spaces shall be in accordance with Section 12.7 for indoor systems.

#### 12.8.1.1\* \_

Aboveground outdoor locations shall not be required to be provided with a gas detection and alarm system in accordance with 12.7.2 where the system is unenclosed.

#### A.12.8.1.1

Aboveground locations include locations that are above grade. Although some installations may be above ground, the actual grade of the terrain on which the installation is located could result in entrapment of vapors. Designers should avoid locating enclosures in areas where natural terrain features or other impediments serve to act as impediments to the dissipation of vapors should a release occur.

#### 12.8.1.1.1

To be considered unenclosed, enclosures constructed to limit access or otherwise provide a visual or architectural barrier for the installation shall be constructed in accordance with the requirements in Section 6.6 for weather protection or with the following:

The enclosure shall be constructed without a roof or overhead cover.

Supports and walls shall not obstruct more than three sides nor more than 75 percent of the perimeter of the storage or use area, with 25 percent of the perimeter being open to the atmosphere.

#### 12.8.1.1.2

Enclosures that do not meet the requirements of 12.8.1.1.1 shall be permitted when constructed in accordance with the following:

The enclosure shall be constructed without a roof or overhead cover.

Continuous mechanical exhaust ventilation shall be provided.

#### 12.8.1.1.2.1

Where mechanical exhaust ventilation is provided, it shall be in accordance with the following:

The exhaust system shall be installed in accordance with the requirements of the mechanical code.

The exhaust system shall be designed to consider the density of the potential vapors released with exhaust taken from a point within 12 in. (305 mm) of the floor.

The location of both the exhaust and the inlet air openings shall be designed to provide air movement across all portions of the enclosure to prevent the accumulation of vapors.

The rate of exhaust ventilation shall be not less than  $1 \text{ scf/min/ft}^2$  ( $0.028 \text{ Nm}^3/\text{min/m}^2$ ) of floor area within the enclosure.

#### 12.9 Large Indoor Insulated Liquid Carbon Dioxide Systems. (Reserved)

#### 12.10 Large Outdoor Insulated Liquid Carbon Dioxide Systems.

##### 12.10.1 Location.

Outdoor stationary large insulated liquid carbon dioxide systems shall be located in accordance with Table 12.10.1 :

Table 12.10.1 Minimum Separation Distance Between Outdoor Stationary Large Insulated Liquid Carbon Dioxide Containers and Exposures

| <u>Exposure</u>                                                                  | <u>Minimum Distance</u> |            |
|----------------------------------------------------------------------------------|-------------------------|------------|
|                                                                                  | <u>ft</u>               | <u>m</u>   |
| <u>(1) Buildings, regardless of construction type</u>                            | <u>2</u>                | <u>0.6</u> |
| <u>(2) Wall openings other than building exits</u>                               | <u>2</u>                | <u>0.6</u> |
| <u>(3) Air intakes</u>                                                           | <u>10</u>               | <u>3.1</u> |
| <u>(4) Property lines</u>                                                        | <u>5</u>                | <u>1.5</u> |
| <u>(5) Places of public assembly (assembly occupancies)</u>                      | <u>50</u>               | <u>15</u>  |
| <u>(6) Nonambulatory patient areas</u>                                           | <u>50</u>               | <u>15</u>  |
| <u>(7) Combustible materials (e.g., paper, leaves, weeds, dry grass, debris)</u> | <u>15</u>               | <u>4.5</u> |
| <u>(8) Incompatible hazardous materials</u>                                      | <u>20</u>               | <u>6.1</u> |
| <u>(9) Building exits</u>                                                        | <u>10</u>               | <u>3.1</u> |

#### 12.10.1.1 Point-of-Fill Connections.

Point-of-fill connections serving stationary containers filled by mobile transport equipment shall not be positioned closer to exposures than the minimum distances in Table 12.10.1 :

#### 12.10.2 Fire Barriers.

A 2-hour fire barrier wall shall be permitted in lieu of the distances specified by Table 12.10.1 when in accordance with the provisions of 12.10.2.1 through 12.10.2.4 :

##### 12.10.2.1

The fire barrier wall shall be without openings or penetrations.

##### 12.10.2.1.1

Penetrations of the fire barrier wall by conduit or piping shall be permitted provided that the penetration is protected with a firestop system in accordance with the building code.

##### 12.10.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage system.

##### 12.10.2.3

The fire barrier wall shall be located not less than 5 ft (1.5 m) from any exposure.

##### 12.10.2.4

The fire barrier wall shall not have more than two sides at approximately 90 degree (1.57 rad) directions or not more than three sides with connecting angles of approximately 135 degrees (2.36 rad).

#### 12.11 Carbon Dioxide Beverage Systems.

##### 12.11.1 General.

Systems with more than 100 lb (45 kg) of carbon dioxide used in beverage dispensing applications shall comply with 12.11.2 through 12.11.4 :

##### 12.11.2 Equipment.

The storage, use, and handling of carbon dioxide shall be in accordance with Chapters 1 through 7 and the requirements of this chapter, as applicable.

### 12.11.3 Protection from Damage.

Carbon dioxide system storage tanks, cylinders, piping, and fittings shall be installed so they are protected from damage by occupants or equipment during normal facility operations.

### 12.11.4 Required Protection.

Carbon dioxide storage tanks, cylinders, piping, and equipment located indoors, in rooms, and other areas where a leak of carbon dioxide can collect shall be provided with either ventilation in accordance with 12.11.4.1 or an emergency alarm system in accordance with 12.11.4.2 .

#### 12.11.4.1 Ventilation.

Mechanical ventilation shall be in accordance with the *Uniform Mechanical Code* and shall comply with all of the following:

Mechanical ventilation in a room or area shall be at a rate of not less than  $1 \text{ ft}^3 / \text{min} / \text{ft}^2$  ( $0.00508 \text{ m}^3 / \text{s} / \text{m}^2$ ).

Exhaust shall be taken from a point within 12 in. (305 mm) of the floor.

The ventilation system shall be designed to operate with a negative pressure in relation to the surrounding area.

#### 12.11.4.2 Emergency Alarm System.

Emergency alarm systems shall comply with all of the following:

Areas where carbon dioxide can accumulate, continuous gas detection shall be provided.

The system shall be capable of detecting and notifying the building occupants of a gas release of carbon dioxide at, or in excess of, the Time-Weighted Average-Permissible Exposure Limit (TWA-PEL) published by the Occupational Safety and Health Administration (OSHA) and the Threshold Limit Value-Short Term Exposure Limit (TLV®-STEL) published by the American Conference of Governmental Industrial Hygienists (ACGIH). More conservative set points shall be permitted to be used.

The emergency alarm system activation shall initiate a local alarm within the room or area in which the system is installed.

## Supplemental Information

| <u>File Name</u>                       | <u>Description</u> | <u>Approved</u> |
|----------------------------------------|--------------------|-----------------|
| 55_SR12_CH12.docx                      |                    |                 |
| 55_SR-12_Ch12_legislative_changes.docx | for editorial use  |                 |

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 10:00:02 EDT 2025

## Committee Statement

**Committee Statement:** This revision originated from a proposal by Compressed Gas Association's (CGA) for a complete rewrite of and a complete substitution of Chapter 13 of the 2023 edition of NFPA 55 on Carbon Dioxide to be consistent with current industry practices and to address safe operation of Carbon Dioxide Systems.

This revision expands upon and fully addresses the hazards and mitigation strategies for those CO<sub>2</sub> hazards, including monitoring and ventilation, which were absent or not completely addressed in the current edition of the code. This revision introduces code requirements and applicable annex information, including references to CGA publications that provide additional details related to the identified code areas. This revision also significantly reorganizes the chapter.

Specifically:

- The General section (12.1) has been expanded to include a requirement for operational instructions and appropriate reference to NFPA 12 for CO<sub>2</sub> used in fire suppression systems.

- The requirements for Carbon Dioxide Monitoring Systems and Ventilation Systems have been expanded, rearranged, and moved to proposed sections 12.2 and 12.3 respectively, addressing all types of installations. They have appeared historically and, in some cases, redundantly when discussing individual systems. The Ventilation System section details proposed code specifics about both indoor and enclosed outdoor area systems. The revisions align with CGA G-6.14. The 15000ppm is ½ of the short-term exposure limit (OSHA STEL). The evacuation alarm is set at the STEL concentration but at an instantaneous measurement to provide a reasonable margin for escape before that limit is reached at the time weighted average.

- Piping Systems requirements (proposed 12.4) have been moved, combined, and significantly expanded, reflecting greater details related to materials of construction, fill connections, pressure relief devices, and distribution and venting systems common to all types of installations. The pipe schedule requirements are used to ensure that a proper level of piping wall thickness (given the typical pressure of CO<sub>2</sub>) is retained after threads are added to the pipe. The reader is reminded of consideration for corrosion protection and to maintain pipe and fitting uniformity to avoid stress risers. CO<sub>2</sub> gas in compliance with G-6.2 helps to ensure reasonable corrosion considerations. Pressurization with CO<sub>2</sub> vapor prior to liquid introduction is critical to avoid dry ice formation. Shutoff valves that are properly located and automated are necessary to protect the majority of the system from an uncontrolled release in the event of a loss of containment.

- The previously “reserved” section on Uninsulated Carbon Dioxide Systems has been developed (see 12.6) with reference to the CGA G-6.13 publication providing significant details regarding the filling and filling controls for these relatively new systems.

- Small Insulated Liquid Carbon Dioxide Systems (section 12.7) utilized for beverage dispensing in restaurants, bars, and convenience stores as well as carbon dioxide installations in other businesses (e.g., horticulture, dry cleaning,) has been revised to address filling and filling controls issues specific with these systems and provide reference to common issues with all CO<sub>2</sub> systems (e.g., monitoring, ventilation, piping).

- Large Insulated Liquid Carbon Dioxide Systems (section 12.8) have both common and unique requirements for indoor installations (12.8.6) and outdoor installation (12.8.7). The common information is either detailed in 12.8 or referenced to other common information in chapter 12 (e.g., monitoring, ventilation, piping). Vapor balance connections is an important provision to protect against overpressure while additionally protecting against under pressure which could result in solid ice production. Foam insulation requires additional consideration for fire protection as the foam will degrade and the heat ingress from the fire could then exceed relief system design criteria.

- The historic section of Chapter 12 associated with and solely identified as Carbon Dioxide Beverage Systems (section 13.11 in the 2023 edition of the code) is now completely covered by the sections on uninsulated, small insulated, or large insulated systems, more appropriately based on the requirements of the type of system used.

- A section titled Occupiable Refrigeration Rooms (section 12.9) has been added that describes the safety requirements for these areas that may not contain an actual system

previously covered in proposed 12.6, 12.7 or 12.8 but have a CO2 hazard that should be addressed by code.

#### Section 12.9 substantiations.

This new section is in response to the recent incident where an operator was trapped due to a door jam in a refrigeration room during a CO2 leak. Accordingly, the reader is reminded of the need for unobstructed egress. The requirement for gas detection was also added accordingly. Relevant sections for CO2 that are not occupiable refrigerator rooms are adopted. Determination of use rate influences refrigeration requirements and preclude otherwise venting.

#### 12.10 substantiations

CO2 liquid processing rooms are inherently open systems because they apply CO2 directly to items intended to be cooled (frozen) and are subject to releasing CO2 into the breathable air not only from a loss of structural containment (as in a closed system) but also from a loss of control. The statistical probabilities for open systems are different than for closed systems. Open systems are more likely to create dangerous concentrations in the breathable air without careful consideration for controls-based mitigations (automatic isolation of piping) in combination with ventilation rates.

The importance for egress from these areas is noted to ensure efficient evacuation on alarm since concentration rates can elevate quickly in large releases. Notification and evacuation alarm limits are the same as for closed systems. Since processing rooms typically have a control system that incorporates a fume hood, the demand for an independent room ventilation system is noted to ensure that these systems are not confused. The processing system fume hood operation is subject to potential controls failure (see CSB report for Gainesville). Room ventilation should have independent controls from the process in order to provide reliability and avoid a common mode of failure. Since smaller releases of CO2 can predominantly migrate to the floor the preferred location for ventilation exhaust exits from the room is best placed near the floor and the long standing 12" rule as noted in CGA G-6.5 is referenced. Continuous ventilation rates of 1 CFM/SF is already noted in code but is a minimum. Open system leak rates can easily overwhelm this minimum requirement in many cases. When the required risk assessment determines a ventilation rate above 1CFM/SF, the larger rate must be accommodated by either a continuous rate that meets or exceeds this requirement, or by a system that meets the minimum 1CFM/SF and is then augmented up to the requirements when an emergency is automatically detected. Automatic emergency shutoff is a control alternative to augmented ventilation. A reasonable risk assessment must be conducted to determine the mitigations used. A reasonable risk assessment must include a determination of a credible leak rate, the size of the room and the exhaust ventilation rate. An example of such a reasonable risk assessment is noted in the annex reference of CGA TR-8.

Practical applications for common sized systems are tabulated using the principles outlined in CGA TR-8 to offer a quick assessment. Rules are established to define the limits of applying the tabulated values. Other risk assessment methods are not excluded from use.

The make-up air requirements must balance with the exhaust requirements and are written in harmony with the IBC.

**Response** SR-12-NFPA 55-2025

**Message:**

[Public Comment No. 4-NFPA 55-2024 \[Global Input\]](#)



## Second Revision No. 10-NFPA 55-2025 [ Section No. 16.1 ]

### 17.1 General.

#### 17.1.1\*

~~The storage, use, and handling of cryogenic~~ Cryogenic fluid central supply systems that deliver compressed medical gases (CMGs) to health care facilities shall be in accordance with the requirements of this chapter, Chapter 1 and Chapters 4 through 16 as applicable.

#### 17.1.2 Applicability.

##### 17.1.2.1

Cryogenic fluid central supply system installations up to, but not including, the source valve shall be covered by NFPA 55.

##### 17.1.2.2

The source valve and all downstream piping and components, including wiring to storage system alarms, shall be covered by NFPA 99.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 08:30:01 EDT 2025

## Committee Statement

**Committee Statement:** This revision clarifies the requirement addresses the system and not the containers of cryogenic fluid. This revision aligns with action taken on SR-9.

**Response Message:** SR-10-NFPA 55-2025



## Second Revision No. 15-NFPA 55-2025 [ Section No. A.6.16.4 ]

### A.6.16.4

Where provided, mechanical exhaust ventilation of  $1\text{ft}^3/\text{min}/\text{ft}^2$  ( $0.00508\text{ m}^3/\text{s}/\text{m}^2$ ) is the minimum prescribed performance required by this code ~~and some~~. Some installations might require a risk assessment to determine the level needed based on the size of the room and the credible design leak rate. For an example, see CGA TR-8, *Risk Informed Methods for Industrial Gas Applications of Liquid Nitrogen and Liquid Carbon Dioxide in Occupied Spaces*. Where the minimum ventilation rate in 6.16.4 is determined to be inadequate, augmented ventilation should be provided.

### Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Wed May 28 13:46:19 EDT 2025

### Committee Statement

**Committee Statement:** TR-8 is a CGA document that can provide a model risk assessment to determine needed exhaust ventilation.

**Response Message:** SR-15-NFPA 55-2025

[Public Comment No. 6-NFPA 55-2024 \[Section No. A.6.16.4\]](#)



## Second Revision No. 14-NFPA 55-2025 [ Section No. A.8.13.11.3.2.2 ]

### A.8.13.11.3.2.2

Where provided, mechanical exhaust ventilation prescribed in 6.17.2.2 is the minimum performance required by this code. Some installations can require an approved risk assessment to determine the level needed based on the size of the room and credible the design leak rate. For an example, see CGA TR-8, *Risk Informed Methods for Industrial Gas Applications of Liquid Nitrogen and Liquid Carbon Dioxide in Occupied Spaces* .

### Submitter Information Verification

**Committee:** IMG-AAA

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### Committee Statement

**Committee Statement:** TR-8 is a CGA document that can provide a model risk assessment to determine needed exhaust ventilation.

**Response Message:** SR-14-NFPA 55-2025

Public Comment No. 5-NFPA 55-2024 [Section No. A.8.13.11.3.2.2]



**Second Revision No. 22-NFPA 55-2025 [ Section No. E.1.1 ]**



### E.1.1 NFPA Publications.

National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 1, *Fire Code*, 2024 edition.

NFPA 2, *Hydrogen Technologies Code*, 2023 2026 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2024 edition.

~~NFPA 51, *Gas Systems for Welding, Cutting*, 1969 edition.~~

NFPA 51, *Standard for the Design and Installation of Oxygen–Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2023 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2024 edition.

NFPA 52, *Vehicular Natural Gas Fuel Systems Code*, 2023 2026 edition.

NFPA 53, *Recommended Practice on Materials, Equipment, and Systems Used in Oxygen-Enriched Atmospheres*, 2024 2026 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2024 edition.

NFPA 68, *Standard on Explosion Protection by Deflagration Venting*, 2023 edition.  
2024

~~NFPA 70 <sup>®</sup>, *National Electrical Code* <sup>®</sup>, 2023 edition.~~

NFPA 69, *Standard on Explosion Prevention Systems*, 2024 edition.

~~NFPA 72 <sup>®</sup>, *National Fire Alarm and Signaling Code* <sup>®</sup>, 2025 edition.~~

~~NFPA 70 <sup>®</sup>, *National Electrical Code* <sup>®</sup>, 2026 edition.~~

NFPA 77, *Recommended Practice on Static Electricity*, 2024 edition.

NFPA 99, *Health Care Facilities Code*, 2024 edition.

NFPA 101<sup>®</sup>, *Life Safety Code*<sup>®</sup>, 2024 edition.

~~NFPA 220, *Standard on Types of Building Construction*, 1969 edition.~~

NFPA 220, *Standard on Types of Building Construction*, 2024 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*, 2024 edition.

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2023 edition.

NFPA 286, *Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth*, 2024 edition.

NFPA 400, *Hazardous Materials Code*, 2025 edition.

NFPA 497, *Recommended Practice for the Classification of Flammable Liquids, Gases, or Vapors and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas*, 2024 edition.

NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operations*, 2024 edition.

~~NFPA 566, *Standard for the Installation of Bulk Oxygen Systems at Consumer Sites*, 1969 edition.~~

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2022 edition.

NFPA 5000<sup>®</sup>, *Building Construction and Safety Code*<sup>®</sup>, 2024 edition.

*Fire Protection Guide to Hazardous Materials*, 2010 edition.

## Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Thu May 29 12:22:18 EDT 2025

## Committee Statement

**Committee Statement:** This revision was developed by NFPA staff for editorial purposes, in accordance with 4.4.9.6.2 and 4.4.9.6.3 of the Regulations Governing the Development of NFPA Standards ([www.nfpa.org/regs](http://www.nfpa.org/regs)).

NFPA 221 has been added to the list of references in accordance with the NFPA Manual of Style.

**Response Message:** SR-22-NFPA 55-2025



## Second Revision No. 20-NFPA 55-2025 [ Sections E.1.2.2, E.1.2.3, E.1.2.4, E.1.2.5, E.1.2.6, E.1.2... ]

### E.1.2.2 ACGIH Publications.

American Conference of Governmental Industrial Hygienists, 1330 Kemper Meadow Drive 3640 Park 42 Drive , Cincinnati, OH 45241 0 .

~~TLVs<sup>®</sup> and BEIs<sup>®</sup> , Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices , 2023 edition.~~

~~TLVs<sup>®</sup> and BEIs<sup>®</sup> , Based on The Documentation of The Threshold Limit Values for Chemical Substances and Physical Agents & Biological Exposures Indices , 2023.~~

### E.1.2.3 API Publications.

American Petroleum Institute, 200 Massachusetts Avenue, NW, Suite 1100, Washington, DC 20001-5571.

~~API STD 520, Sizing, Selection, and Installation of Pressure-Relieving Devices – Part I– Sizing and Selection, 10th edition, 2023.~~

~~API STD 520, Sizing, Selection, and Installation of Pressure-Relieving Devices – Part II– Installation, 7th edition, 2020.~~

~~API 521, Pressure Relieving and Depressuring Systems , seventh edition, 2020.~~

~~API STD 537, Flare Details for Petroleum, Petrochemical, and Natural Gas Industries, 3rd edition, 2017.~~

~~API 579-1/ASME FFS-1, Fitness-For-Service , fourth edition, June 2021.~~

### E.1.2.3 ASME Publications.

American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME A13.1, *Scheme for the Identification of Piping Systems*, 2020 2023 .

~~ASME B31.12, Hydrogen Piping and Pipelines , 2019.~~

~~Boiler and Pressure Vessel Code , 2023.~~

ASME BPVC.VIII.1, *Rules for Construction of Pressure Vessels, Section VIII, Division 1*, 2023.

### E.1.2.4 ASTM Publications.

ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM A106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service* , 2019a.

ASTM A380/A380 M, *Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems*, 2017 2025 .

ASTM A530, *Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe* , 2018.

ASTM E681, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*, 2009, reaffirmed 2023.

### E.1.2.5 BSI Publications.

BSI British Standards, 12950 Worldgate Drive, Suite 800 Herndon, VA 20170.

~~BS 7910, Guide to Methods for Assessing the Acceptability of Flaws in Metallic Structures , 2019.~~

**E.1.2.5 CGA Publications.**

Compressed Gas Association, 8484 Westpark Drive, Suite 220, McLean, VA 22102.

CGA G-1.6, *Standard for Mobile Acetylene Trailer Systems*, 2018 2024 .

CGA G-6.1, *Standard for Large Insulated Liquid Carbon Dioxide Systems at User Sites* , 2022.

CGA G-6.2, *Commodity Specification for Carbon Dioxide* , 2011.

ANSI/CGA M-1, *Standard for Medical Gas Supply Systems at Health Care Facilities* , 2018.

CGA M-1.1, *Guidance for Compressed Medical Gas Cryogenic Fluid Central Supply System Training*, 2019, reaffirmed 2025 .

CGA P-18, *Standard for Bulk Inert Gas Systems (an American National Standard)*, 2020.

CGA P-41, *Standard for Locating Bulk Liquid Storage Systems in Courts*, 2023.

CGA P-50, *Standard for Site Security*, 2021.

CGA P-51, *Standard for Transportation Security in the Compressed Gas Industry*, 2021.

CGA P-52, *Security Guidelines for Qualifying Customers Purchasing Compressed Gases*, 2014 2021 .

~~CGA P-76, *Hazards of Oxygen-Deficient Atmospheres* , 2018.~~

CGA G-1.11, *Guideline for Handling Acetylene Cylinders and Ancillary Equipment in Fires (Formally SB-4) — 1st edition*, 2018, reaffirmed 2023.

~~CGAG-8.5, *Standard for Nitrous Oxide Security and Control (Formally SB-6)* , 2020.~~

CGA S-1.3, *Pressure Relief Device Standards — Part 3 — Stationary Storage Containers for Compressed Gases*, 2020 2024 .

CGA SB-6, *Nitrous Oxide Security and Control* , 2008.

CGA TR-8, *Risk Informed Methods For Industrial Gas Applications of Liquid Nitrogen and Liquid Carbon Dioxide in Occupied Spaces* , 2024.

**E.1.2.7 ICC Publications.**

~~International Code Council, 500 New Jersey Avenue, NW, 6th Floor, Washington, DC 20001.~~

~~*International Fire Code*, 2024.~~

**E.1.2.8 SFPE Publications.**

~~Society of Fire Protection Engineers, 9711 Washingtonian Blvd., Suite 380, Gaithersburg, MD 20878.~~

~~“Predicting 1st and 2nd Degree Skin Burns from Thermal Radiation,” *SFPE Engineering Guide* , March 2000.~~

**E.1.2.6 UL Publications.**

Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 558, *Safety Industrial Trucks, Internal Combustion Engine-Powered*, 2012, revised 2024 2024 .

UL 583, *Electric-Battery-Powered Industrial Trucks*, 2022.

UL 2075, *Gas and Vapor Detectors and Sensors*, 2013, revised 2023 2025 .

UL 60079-10-1, *Explosive Atmospheres - Part 10-1: Classification of Areas - Explosive Gas Atmospheres* , 2024.

**Submitter Information Verification**

**Committee:** IMG-AAA

**Submittal Date:** Thu May 29 09:14:51 EDT 2025

## Committee Statement

|                             |                                                                                                                   |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Committee Statement:</b> | Reference have been added, removed, and updated to their current edition to comply with the NFPA Manual of Style. |
| <b>Response Message:</b>    | SR-20-NFPA 55-2025                                                                                                |



## Second Revision No. 26-NFPA 55-2025 [ Section No. E.3 ]

### E.3 References for Extracts in Informational Sections.

NFPA 1, ~~*Fire Code*~~, 2024 edition.

NFPA 2, *Hydrogen Technologies Code*, 2026 edition.

NFPA 72<sup>®</sup>, *National Fire Alarm and Signaling Code*<sup>®</sup>, 2025 edition.

NFPA 99, *Health Care Facilities Code*, 2024 edition.

NFPA 400, *Hazardous Materials Code*, 2025 edition.

NFPA 5000<sup>®</sup>, *Building Construction and Safety Code*<sup>®</sup>, 2024 edition.

### Supplemental Information

| <u>File Name</u>        | <u>Description</u> | <u>Approved</u> |
|-------------------------|--------------------|-----------------|
| 55_SR-26_E.3_FINAL.docx | for prod use       |                 |

### Submitter Information Verification

**Committee:** IMG-AAA

**Submittal Date:** Tue Jul 15 11:32:20 EDT 2025

### Committee Statement

**Committee Statement:** This revision was developed by NFPA staff for editorial purposes, in accordance with 4.4.9.6.2 and 4.4.9.6.3 of the Regulations Governing the Development of NFPA Standards ([www.nfpa.org/regs](http://www.nfpa.org/regs)).

NFPA 1 has been removed and NFPA 2 has been added to this list in accordance with the NFPA Manual of Style.

**Response Message:** SR-26-NFPA 55-2025