**Chapter 63 Compressed Gases and Cryogenic Fluids**

63.1 General Provisions

63.1.1 Application

63.1.1.1\*

The installation, storage, use, and handling of compressed gases and cryogenic fluids in portable and stationary containers, cylinders, equipment, and tanks in all occupancies shall comply with the requirements of Chapter 63; NFPA 55, and Sections 60.1 through 60.4 of this Code.

63.1.1.2

Where the provisions of Chapter 63 or NFPA 55 conflict with the provisions of Chapter 60, the provisions of Chapter 63 and NFPA 55 shall apply.

63.1.1.3

The requirements in this chapter shall apply to users, producers, distributors, and others who are involved with the storage, use, or handling of compressed gases or cryogenic fluids. [55:1.3]

63.1.1.4 Specific Applications

Chapter 63 shall not apply to the following:

\* Off-site transportation of materials covered by Chapter 63

Storage, use, and handling of radioactive gases in accordance with NFPA 801

\* Use and handling of medical compressed gases at health care facilities in accordance with NFPA 99, except as specified in Chapter 17 of NFPA 55

Systems consisting of cylinders of oxygen and cylinders of fuel gas used for welding and cutting in accordance with NFPA 51

\* Flammable gases used as a vehicle fuel when stored on a vehicle

\* Storage, use, and handling of liquefied and nonliquefied compressed gases in laboratory work areas in accordance with NFPA 45

Storage, use, and handling of liquefied petroleum gases in accordance with NFPA 58

Storage, use, and handling of compressed gases within closed-cycle refrigeration systems complying with the mechanical code

Liquefied natural gas (LNG) storage at utility plants under NFPA 59A

Compressed natural gas (CNG) and liquefied natural gas (LNG), utilized as a vehicle fuel in accordance with NFPA 52

\* Compressed hydrogen gas (GH2), or liquefied hydrogen gas (LH2) generated, installed, stored, piped, used, or handled in accordance with NFPA 2 when there are no specific or applicable requirements in NFPA 55

Nonflammable mixtures of ethylene oxide with other chemicals

Ethylene oxide in chambers 10 scf (0.283 Nm3) or less in volume or for containers holding 7.05 oz (200 g) of ethylene oxide or less

[55:1.1.2]

63.1.2 Permits

Permits, where required, shall comply with Section 1.12.

63.1.2.1

The permit applicant shall apply for approval to close storage, use, or handling facilities at least 30 days prior to the termination of the storage, use, or handling of compressed or liquefied gases.

63.1.2.2

Such application shall include any change or alteration of the facility closure plan filed pursuant to 60.1.4.7.

63.1.2.3

This 30-day period shall be permitted to be waived by the AHJ if special circumstances require such waiver.

63.1.2.3.1

Permits shall not be required for routine maintenance.

63.1.2.3.2

For repair work performed on an emergency basis, application for permit shall be made within 2 working days of commencement of work.

63.1.3 General Definitions

63.1.3.1 Absolute Pressure

See 3.3.1.

63.1.3.2 ASTM

See 3.3.17.

63.1.3.3 Automatic Emergency Shutoff Valve

See 3.3.18.

63.1.3.4 Bulk Hydrogen Compressed Gas System

See 3.3.278.1.

63.1.3.5 Bulk Inert Gas System

See 3.3.278.2

63.1.3.6 Bulk Liquefied Hydrogen System

See 3.3.278.3.

63.1.3.7 Bulk Oxygen System

See 3.3.278.4.

63.1.3.8 Cathodic Protection

See 3.3.40.

63.1.3.9 Cathodic Protection Tester

See 3.3.41.

63.1.3.10 CGA

See 3.3.44.

63.1.3.11 Compressed Gas Container

See 3.3.72.2.

63.1.3.12 Compressed Gas System

See 3.3.278.6.

63.1.3.13 Continuous Gas Detection System

See 3.3.278.7.

63.1.3.14 Cryogenic Fluid

See 3.3.80.

63.1.3.14.1 Flammable Cryogenic Fluid

See 3.3.80.1.

63.1.3.14.2 Inert Cryogenic Fluid

See 3.3.80.2.

63.1.3.14.3 Oxidizing Cryogenic Fluid

See 3.3.80.3.

63.1.3.15 Cylinder

See 3.3.82.

63.1.3.16 Cylinder Containment Vessel

See 3.3.83.

63.1.3.17 Cylinder Pack

See 3.3.84.

63.1.3.18 Distributor

See 3.3.94.

63.1.3.19 Emergency Shutoff Valve

See 3.3.102.

63.1.3.20 Ethylene Oxide Drum

See 3.3.104.

63.1.3.21 Excess Flow Control

See 3.3.105.

63.1.3.22 Exhausted Enclosure

See 3.3.107.

63.1.3.23 Explosion Control

See 3.3.114.

63.1.3.24 Gallon

See 3.3.144.

63.1.3.25 Gas

See 3.3.146.

63.1.3.25.1 Compressed Gas

See 3.3.146.1.

63.1.3.25.2 Corrosive Gas

See 3.3.146.2.

63.1.3.25.3 Flammable Gas

See 3.3.146.3.

63.1.3.25.4 Flammable Liquefied Gas

See 3.3.146.4.

63.1.3.25.5 Highly Toxic Gas

See 3.3.146.5.

63.1.3.25.6 Inert Gas

See 3.3.146.6.

63.1.3.25.7 Nonflammable Gas

See 3.3.146.10.

63.1.3.25.8 Other Gas

See 3.3.146.11.

63.1.3.25.9 Oxidizing Gas

See 3.3.146.12.

63.1.3.25.10 Pyrophoric Gas

See 3.3.146.13.

63.1.3.25.11 Toxic Gas

See 3.3.146.16.

63.1.3.25.12 Unstable Reactive Gas

See 3.3.146.17.

63.1.3.26 Gas Cabinet

See 3.3.147

63.1.3.27 Gas Manufacturer/Producer

See 3.3.148.

63.1.3.28 Gas Room

See 3.3.149.

63.1.3.29 Gaseous Hydrogen System

See 3.3.150.

63.1.3.30 Hazard Rating

See 3.3.155.

63.1.3.31 Immediately Dangerous to Life and Health (IDLH)

See 3.3.165.

63.1.3.32 Indoor Area

See 3.3.14.5.

63.1.3.33 ISO Module

See 3.3.174.

63.1.3.34 Liquid Oxygen Ambulatory Container

A container used for liquid oxygen not exceeding 0.396 gal (1.5 L) specifically designed for use as a medical device as defined by 21 USC Chapter 9, the United States Food, Drug and Cosmetic Act that is intended for portable therapeutic use and to be filled from its companion base unit which is liquid oxygen home care container.

63.1.3.35 Liquid Oxygen Home Care Container

A container used for liquid oxygen not exceeding 15.8 gal (60 L) specifically designed for use as a medical device as defined by 21 USC Chapter 9, the United States Food, Drug and Cosmetic Act that is intended to deliver gaseous oxygen for therapeutic use in a home environment.

63.1.3.36 Manual Emergency Shutoff Valve

See 3.3.182.

63.1.3.37 Mechanical Code

See 3.3.56.3.

63.1.3.38 Mobile Supply Unit

See 3.3.193..

63.1.3.39 Nesting

See 3.3.196.

63.1.3.40\* Normal Temperature and Pressure (NTP)

See 3.3.197.

63.1.3.41 OSHA

See 3.3.206.

63.1.3.42 Outdoor Area

See 3.3.14.8.

63.1.3.43 Permissible Exposure Limit (PEL)

See 3.3.176.2.

63.1.3.44 Portable Tank

See 3.3.279.4.

63.1.3.45 Pressure Vessel

See 3.3.222.

63.1.3.46 Short-Term Exposure Limit (STEL)

See 3.3.176.3.

63.1.3.47 Stationary Tank

See 3.3.279.6.

63.1.3.48 TC

See 3.3.280,

63.1.3.49 Treatment System

See 3.3.278.14.

63.1.3.50 Tube Trailer

See 3.3.287.

63.1.3.51 Valve Outlet Cap or Plug

See 3.3.295.3

63.1.3.52 Valve Protection Cap

See 3.3.295.4.

63.1.3.53 Valve Protection Device

See 3.3.295.5.

63.1.4 Hazardous Materials Classification

63.1.4.1\* Pure Gases

Hazardous materials shall be classified according to hazard categories as follows:

Physical hazards, which shall include the following:

Flammable gas

Flammable cryogenic fluid

Oxidizing gas

Oxidizing cryogenic fluid

Pyrophoric gas

Unstable reactive (detonable) gas, Class 3 or Class 4

Unstable reactive (nondetonable) gas, Class 3

Unstable reactive gas, Class 1 or Class 2

Health hazards, which shall include the following:

Corrosive gas

Cryogenic fluids

Highly toxic gas

Toxic gas

[55:5.1.1]

63.1.4.2 Other Hazards

Although it is possible that there are other known hazards, the classification of such gases is not within the scope of Chapter 63 and they shall be handled, stored, or used as an other gas. [55:5.1.2]

63.1.4.3 Mixtures

Mixtures shall be classified in accordance with the hazards of the mixture as a whole. [55:5.1.3]

63.1.4.4 Responsibility for Classification

Classification shall be performed by an approved organization, individual, or testing laboratory. [55:5.1.4]

63.1.4.4.1 Toxicity

The toxicity of gas mixtures shall be classified in accordance with CGA P-20, Standard for the Classification of Toxic Gas Mixtures, or by testing in accordance with the requirements of 29 CFR 1910.1000, DOT 49 CFR 173, or ISO 10298, Determination of toxicity of a gas or gas mixture. [55:5.1.4.1]

63.1.4.4.2 Flammability of Gas Mixtures

For gas mixtures other than those containing ammonia and nonflammable gases, flammability of gas mixtures shall be classified in accordance with CGA P-23, Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components, or by physical testing in accordance with the requirements of ASTM E681, Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases), or ISO 10156, Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets. [55:5.1.4.2]

63.2 Building-Related Controls

63.2.1 General

63.2.1.1 Occupancy

63.2.1.1.1 Occupancy Requirements

Occupancies that contain compressed gases or cryogenic fluids shall comply with Section 63.2 in addition to other applicable requirements of NFPA 55. [55:6.1.1.1]

63.2.1.1.2 Occupancy Classification

The occupancy of a building or structure, or portion of a building or structure, shall be classified in accordance with the building code. [55:6.1.1.2]

63.2.2 Control Areas

63.2.2.1 Construction Requirements

Control areas shall be separated from each other by fire barriers in accordance with Table 60.4.2.2.1. [55:6.2.1]

63.2.2.2 Number of Control Areas

The maximum number of control areas within a building shall be in accordance with Table 60.4.2.2.1. [400:5.2.2.1]

63.2.2.3

Where only one control area is present in a building, no special construction provisions shall be required. [400:5.2.2.2]

63.2.2.4 Quantities Less Than or Equal to the MAQ

Indoor control areas with compressed gases or cryogenic fluids stored or used in quantities less than or equal to those shown in Table 63.2.3.1.1 shall be in accordance with 63.2.1, 63.2.3.1.6, 63.2.3.1.7, 63.2.7, 63.2.8, 63.2.12, 63.2.16, 63.2.17, and the applicable provisions of Chapters 1 through 5 and Chapters 7 through 16 of NFPA 55. [55:6.2.4]

63.2.3 Occupancy Protection Levels

63.2.3.1 Quantity Thresholds for Compressed Gases and Cryogenic Fluids Requiring Special Provisions

63.2.3.1.1 Threshold Exceedances

Where the quantities of compressed gases or cryogenic fluids stored or used within an indoor control area exceed those shown in Table 63.2.3.1.1, the area shall meet the requirements for Protection Levels 1 through 5 in accordance with the building code, based on the requirements of 63.2.3.2. [55:6.3.1.1]

Table 63.2.3.1.1 Maximum Allowable Quantity (MAQ) of Hazardous Materials per Control Area

Material

Class

Storage

Use — Closed Systems

Use — Open Systems

High Hazard Protection Level

Solid Pounds

Liquid Gallons

Gasa scf (lb)

Solid Pounds

Liquid Gallons

Gasa scf (lb)

Solid Pounds

Liquid

Gallons

Cryogenic fluid

Flammable

2

NA

45b,c

NA

NA

45b,c

NA

NA

45b,c

Oxidizing

3

NA

45d,e

NA

NA

45d,e

NA

NA

45d,e

Inert

NA

NA

NL

NA

NA

NL

NA

NA

NL

Flammable, gasf

Gaseous

2

NA

NA

1000d,e

NA

NA

1000d,e

NA

NA

Liquefied

2

NA

NA

(150)d,e

NA

NA

(150)d,e

NA

NA

LP

2

NA

NA

(300)g,h,i

NA

NA

(300)g

NA

NA

Inert gas

Gaseous

NA

NA

NA

NL

NA

NA

NL

NA

NA

Liquefied

NA

NA

NA

NL

NA

NA

NL

NA

NA

Oxidizing gas

Gaseous

3

NA

NA

1500d,e

NA

NA

1500d,e

NA

NA

Liquefied

3

NA

NA

(150)d,e

NA

NA

(150)d,e

NA

NA

Pyrophoric gas

Gaseous

2

NA

NA

50d,j

NA

NA

50d,j

NA

NA

Liquefied

2

NA

NA

(4)d,j

NA

NA

(4)d,j

NA

NA

Unstable (reactive) gas

Gaseous

4 or 3 detonable

1

NA

NA

10d,j

NA

NA

10d,j

NA

NA

3 nondetonable

2

NA

NA

50d,e

NA

NA

50d,e

NA

NA

2

3

NA

NA

750d,e

NA

NA

750d,e

NA

NA

1

NA

NA

NA

NL

NA

NA

NL

NA

NA

Unstable (reactive) gas

Liquefied

4 or 3 detonable

1

NA

NA

(1)d,j

NA

NA

(1)d,j

NA

NA

3 nondetonable

2

NA

NA

(2)d,e

NA

NA

(2)d,e

NA

NA

2

3

NA

NA

(150)d,e

NA

NA

(150)d,e

NA

NA

1

NA

NA

NA

NL

NA

NA

NL

NA

NA

Corrosive gas

Gaseous

4

NA

NA

810d,e

NA

NA

810d,e

NA

NA

Liquefied

NA

NA

(150)d,e

NA

NA

(150)d,e

NA

NA

Highly Toxic gas

Gaseous

4

NA

NA

20e,k

NA

NA

20e,k

NA

NA

Liquefied

NA

NA

(4)e,k

NA

NA

(4)e,k

NA

NA

Toxic gas

Gaseous

4

NA

NA

810d,e

NA

NA

810d,e

NA

NA

Liquefied

NA

NA

(150)d,e

NA

NA

(150)d,e

NA

NA

NA: Not applicable within the context of NFPA 55 (refer to the applicable building or fire code for additional information on these materials).

NL: Not limited in quantity.

Notes:

For use of control areas, see Section 6.2 of NFPA 55.

Table values in parentheses or brackets correspond to the unit name in parentheses or brackets at the top of the column.

The aggregate quantity in use and storage is not permitted to exceed the quantity listed for storage. In addition, quantities in specific occupancies are not permitted to exceed the limits in the building code.

aMeasured at NTP [70°F (20°C) and 14.7 psi (101.3 kPa)].

bNone allowed in unsprinklered buildings unless stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this code. cWith pressure-relief devices for stationary or portable containers vented directly outdoors or to an exhaust hood.

dQuantities are permitted to be increased 100 percent where stored or used in approved cabinets, gas cabinets, exhausted enclosures, gas rooms, as appropriate for the material stored. Where Footnote e also applies, the increase for the quantities in both footnotes is permitted to be applied accumulatively.

eMaximum quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13. Where Footnote d also applies, the increase for the quantities in both footnotes is permitted to be applied accumulatively.

fFlammable gases in the fuel tanks of mobile equipment or vehicles are permitted to exceed the MAQ where the equipment is stored and operated in accordance with the applicable fire code.

gSee NFPA 58 and Chapter 69 for requirements for liquefied petroleum gas (LP-Gas). LP-Gas is not within the scope of NFPA 55 or Chapter 63.

hAdditional storage locations are required to be separated by a minimum of 300 ft (92 m).

iIn mercantile occupancies, storage of LP-Gas is limited to a maximum of 200 lb (91 kg) in nominal 1 lb (0.45 kg) LP-Gas containers.

jPermitted only in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13.

kAllowed only where stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this code.

[55:Table 6.3.1.1]

63.2.3.1.2 Quantities Greater Than the MAQ

Building-related controls in areas with compressed gases or cryogenic fluids stored or used within an indoor area in quantities greater than those shown in Table 63.2.3.1.1 shall be in accordance with the requirements of Section 63.2. [55:6.3.1.2]

63.2.3.1.3 Aggregate Allowable Quantities

The aggregate quantity in use and storage shall not exceed the quantity listed for storage. [55:6.3.1.3]

63.2.3.1.4 Incompatible Materials

When the classification of materials in individual containers requires the area to be placed in more than one protection level, the separation of protection levels shall not be required, provided the area is constructed to meet the requirements of the most restrictive protection level and that the incompatible materials are separated as required by 63.3.1.11.2. [55:6.3.1.4]

63.2.3.1.5 Multiple Hazards

Where a compressed gas or cryogenic fluid has multiple hazards, all hazards shall be addressed and controlled in accordance with the provisions for the protection level for which the threshold quantity is exceeded. [55:6.3.1.5]

63.2.3.1.6 Flammable and Oxidizing Gases

63.2.3.1.6.1

Flammable and oxidizing gases shall not be stored or used in other than industrial or storage occupancies. [55:6.3.1.6.1]

63.2.3.1.6.2

Cylinders, containers, or tanks not exceeding 250 scf (7.1 Nm3) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted. [55:6.3.1.6.2]

63.2.3.1.6.3

Hydrogen gas systems located in a hydrogen gas room that meet the requirements of Section 6.5 of NFPA 55 shall be permissible in quantities up to those allowed by Table 63.2.3.1.1 in assembly, educational, institutional, residential, or business occupancies. [55:6.3.1.6.3]

63.2.3.1.7 Toxic and Highly Toxic Compressed Gases

Except for containers or cylinders not exceeding 20 scf (0.6 Nm3) content at NTP stored or used within gas cabinets or exhausted enclosures of educational occupancies, toxic or highly toxic compressed gases shall not be stored or used in other than industrial and storage occupancies. [55:6.3.1.7]

63.2.3.2 Classification of Protection Levels

The protection level required shall be based on the hazard class of the material involved as indicated in 63.2.3.2.1 through 63.2.3.2.5. [55:6.3.2]

63.2.3.2.1 Protection Level 1

Occupancies used for the storage or use of unstable reactive Class 4 and unstable reactive Class 3 detonable compressed gases in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified Protection Level 1. [55:6.3.2.1]

63.2.3.2.2 Protection Level 2

Occupancies used for the storage or use of flammable, pyrophoric, and nondetonable, unstable reactive Class 3 compressed gases or cryogenic fluids in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 2. [55:6.3.2.2]

63.2.3.2.3 Protection Level 3

Occupancies used for the storage or use of oxidizing and unstable reactive Class 2 compressed gases or cryogenic fluids in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 3. [55:6.3.2.3]

63.2.3.2.4 Protection Level 4

Occupancies used for the storage or use of toxic, highly toxic, and corrosive compressed gases in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 4. [55:6.3.2.4]

63.2.3.2.5 Protection Level 5

Buildings and portions thereof used for fabrication of semiconductors or semiconductor research and development and containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard level 5 contents permitted in control areas shall be classified as Protection Level 5. [55:6.3.2.5]

63.2.4 Gas Rooms

Where a gas room is used to increase the threshold quantity for a gas requiring special provisions or where otherwise required by the material- or application-specific requirements of Chapters 7 through 16 of NFPA 55, the room shall meet the requirements of 63.2.4.1 through 63.2.4.5. [55:6.4]

63.2.4.1 Pressure Control

Gas rooms shall operate at a negative pressure in relationship to the surrounding area. [55:6.4.1]

63.2.4.2 Exhaust Ventilation

Gas rooms shall be provided with an exhaust ventilation system. [55:6.4.2]

63.2.4.3 Construction

Gas rooms shall be constructed in accordance with the building code. [55:6.4.3]

63.2.4.4 Separation

Gas rooms shall be separated from other occupancies by a minimum of 1-hour fire resistance. [55:6.4.4]

63.2.4.5 Limitation on Contents

The function of compressed gas rooms shall be limited to storage and use of compressed gases and associated equipment and supplies. [55:6.4.5]

63.2.5\* Detached Buildings

Occupancies used for the storage or use of compressed gases, including individual bulk hydrogen compressed gas systems in quantities exceeding those specified in Table 63.2.5, shall be in detached buildings constructed in accordance with the provisions of the building code. [55:6.6]

Table 63.2.5 Detached Buildings Required Where Quantity of Material Exceeds Amount Shown

Quantity of Material

Gas Hazard

Class

scf

Nm3

Individual bulk hydrogen compressed gas systems

NA

15,000

425

Unstable reactive (detonable)

4 or 3

Quantity thresholds for gases requiring special provisions\*

Unstable reactive (nondetonable)

3

2000

57

Unstable reactive (nondetonable)

2

10,000

283

Pyrophoric gas†

NA

2,000

57

NA: Not applicable.

\*See Table 63.2.3.1.1.

†Detached buildings are not required for gases in high-hazard gas rooms that support Protection Level 5 fabrication facilities separated from other areas by a fire barrier with a fire resistance rating of not less than 2 hours, where the gas is located in internally sprinklered gas cabinets equipped with continuous leak detection and automatic shutdown, where the supply is from cylinders that do not exceed 125 lb (57 kg) water capacity per 49 CFR 173.192 for Hazard Zone A toxic gases, and where the gas cabinets are not manifolded upstream of pressure control devices.

[55:Table 6.6]

63.2.6 Weather Protection

63.2.6.1

For other than explosive materials and hazardous materials presenting a detonation hazard, a weather protection structure shall be permitted to be used for sheltering outdoor storage or use areas, without requiring such areas to be classified as indoor storage or use. [55:6.7.1]

63.2.6.2

Weather protected areas constructed in accordance with 63.2.6.4 shall be regulated as outdoor storage or use. [55:6.7.2]

63.2.6.3

Weather protected areas that are not constructed in accordance with 63.2.6.4 shall be regulated as indoor storage or use. [55:6.7.2.1]

63.2.6.4

Buildings or structures used for weather protection shall be in accordance with the following:

The building or structure shall be constructed of noncombustible materials.

Walls shall not obstruct more than one side of the structure.

Walls shall be permitted to obstruct portions of multiple sides of the structure, provided that the obstructed area does not exceed 25 percent of the structure's perimeter area.

The building or structure shall be limited to a maximum area of 1500 ft2 (140 m2), with increases in area allowed by the building code based on occupancy and type of construction.

The distance from the structure constructed as weather protection to buildings, lot lines, public ways, or means of egress to a public way shall not be less than the distance required for an outside hazardous material storage or use area without weather protection based on the hazard classification of the materials contained.

Reductions in separation distance shall be permitted based on the use of fire barrier walls where permitted for specific materials in accordance with the requirements of Chapters 7 through 11 of NFPA 55.

[55:6.7.3]

63.2.7\* Electrical Equipment

Electrical wiring and equipment shall be in accordance with this subsection and NFPA 70. [55:6.8]

63.2.7.1 Standby Power

63.2.7.1.1

Where the following systems are required by NFPA 55 for the storage or use of compressed gases or cryogenic fluids that exceed the quantity thresholds for gases requiring special provisions, such systems shall be connected to a standby power system in accordance with NFPA 70:

Mechanical ventilation

Treatment systems

Temperature controls

Alarms

Detection systems

Other electrically operated systems

[55:6.8.1.1]

63.2.7.1.2

The requirements of 63.2.7.1.1 shall not apply where emergency power is provided in accordance with 63.2.7.2 and NFPA 70. [55:6.8.1.2]

63.2.7.1.3

When standby power is required, the system shall meet the requirements for a Level 2 system in accordance with NFPA 111. [55:6.8.1.3]

63.2.7.2 Emergency Power

When emergency power is required, the system shall meet the requirements for a Level 2 system in accordance with NFPA 110 or NFPA 111. [55:6.8.2]

63.2.8\* Employee Alarm System

Where required by government regulations, an employee alarm system shall be provided to allow warning for necessary emergency action as called for in the emergency action plan required by 4.2.1.1 of NFPA 55, or for reaction time for safe egress of employees from the workplace or the immediate work area, or both. [55:6.9]

63.2.9 Explosion Control

Explosion control shall be provided as required by Table 63.2.9 in accordance with NFPA 68 or NFPA 69 where amounts of compressed gases in storage or use exceed the quantity thresholds requiring special provisions. [55:6.10]

Table 63.2.9 Explosion Control Requirements

Material

Class

Explosion Control Methods

Barricade Construction

Explosion Venting or Prevention Systems

Flammable cryogenic fluid

—

Not required

Required

Flammable gas

Nonliquefied

Not required

Required

Liquefied

Not required

Required

Pyrophoric gas — Not required Required

Unstable reactive gas

4

Required Not required

3 (detonable)

Required Not required

3 (nondetonable)

Not required

Required

[55:Table 6.10]

63.2.10\* Fire Protection Systems

Except as provided in 63.2.10.1, buildings or portions thereof required to comply with Protection Levels 1 through 5 shall be protected by an approved automatic fire sprinkler system complying with Section 13.3 and NFPA 13. [55:6.11]

63.2.10.1

Rooms or areas that are of noncombustible construction with wholly noncombustible contents shall not be required to be protected by an automatic fire sprinkler system. [55:6.11.1]

63.2.10.2 Sprinkler System Design

63.2.10.2.1

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. [55:6.11.2.1]

63.2.10.2.2

When sprinkler protection is required, the area in which the flammable or pyrophoric 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 Extra Hazard Group 1 density/ area curve. [55:6.11.2.2]

63.2.11 Lighting

Approved lighting by natural or artificial means shall be provided for areas of storage or use. [55:6.12]

63.2.12 Hazard Identification Signs

63.2.12.1 Location

Hazard identification signs shall be placed at all entrances to locations where compressed gases are produced, stored, used, or handled in accordance with NFPA 704. [55:6.13.1]

63.2.12.1.1

Ratings shall be assigned in accordance with NFPA 704. [55:6.13.1.1]

63.2.12.1.2

The AHJ shall be permitted to waive 63.2.12.1 where consistent with safety. [55:6.13.1.2]

63.2.12.2 Application

Signage shall be provided as specified in 63.2.12.2.1 and 63.2.12.2.2. [55:6.13.2]

63.2.12.2.1 Signs

Signs shall not be obscured or removed. [55:6.13.2.1]

63.2.12.2.2 No Smoking

Signs prohibiting smoking or open flames within 25 ft (7.6 m) of area perimeters shall be provided in areas where toxic, highly toxic, corrosive, unstable reactive, flammable, oxidizing, or pyrophoric gases are produced, stored, or used. [55:6.13.2.2]

63.2.13 Spill Control, Drainage, and Secondary Containment

Spill control, drainage, and secondary containment shall not be required for compressed gases. [55:6.14]

63.2.14 Shelving

63.2.14.1

Shelves used for the storage of cylinders, containers, and tanks shall be of noncombustible construction and designed to support the weight of the materials stored. [55:6.15.1]

63.2.14.2

Shelves and containers shall be secured from overturning. [55:6.15.2]

63.2.15 Vent Pipe Termination

The termination point for piped vent systems serving cylinders, containers, tanks, and gas systems used for the purpose of operational or emergency venting shall be located to prevent impingement exposure on the system served and to minimize the effects of high temperature thermal radiation or the effects of contact with the gas from the escaping plume to the supply system, personnel, adjacent structures, and ignition sources. [55:6.16]

63.2.16 Ventilation

Indoor storage and use areas and storage buildings for compressed gases and cryogenic fluids shall be provided with mechanical exhaust ventilation or fixed natural ventilation, where natural ventilation is shown to be acceptable for the material as stored. [55:6.17]

63.2.16.1 Compressed Air

The requirements of 63.2.16 shall not apply to cylinders, containers, and tanks containing compressed air. [55:6.17.1]

63.2.16.2 Ventilation Systems

In addition to the requirements of 63.2.16, ventilation systems shall be designed and installed in accordance with the requirements of the mechanical code. [55:6.17.2]

63.2.16.3 Mechanical Exhaust Ventilation

Where mechanical exhaust ventilation is provided, the system shall be operational during the time the building or space is occupied. [55:6.17.3]

63.2.16.4 Continuous Operation

When operation of ventilation systems is required, systems shall operate continuously unless an alternative design is approved by the AHJ. [55:6.17.3.1]

63.2.16.5 Ventilation Rate

Mechanical exhaust or fixed natural ventilation shall be provided at a rate of not less than 1 scf/min/ft2 (0.0051 m3/sec/m2) of floor area over the area of storage or use. [55:6.17.3.2]

63.2.16.6 Shutoff Controls

Where powered ventilation is provided, a manual 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. [55:6.17.3.3]

63.2.16.7 Manual Shutoff Switch

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

WARNING:

VENTILATION SYSTEM EMERGENCY SHUTOFF

[55:6.17.3.3.1]

63.2.16.8 Inlets to the Exhaust System

63.2.16.8.1

The exhaust ventilation system design shall take into account the density of the potential gases released. [55:6.17.4.1]

63.2.16.8.2\*

For gases that are heavier than air, exhaust shall be taken from a point within 12 in. (305 mm) of the floor. The use of supplemental inlets shall be allowed to be installed at points above the 12 in. (305 mm) threshold level. [55:6.17.4.2]

63.2.16.8.3\*

For gases that are lighter than air, exhaust shall be taken from a point within 12 in. (305 mm) of the ceiling. The use of supplemental inlets shall be allowed to be installed at points below the 12 in. (305 mm) threshold level. [55:6.17.4.3]

63.2.16.8.4

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 to prevent the accumulation of vapors within the ventilated space. [55:6.17.4.4]

63.2.16.9 Recirculation of Exhaust

Exhaust ventilation shall not be recirculated. [55:6.17.5]

63.2.16.10 Ventilation Discharge

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. [55:6.17.6]

63.2.16.11 Air Intakes

Storage and use of compressed gases shall be located not less than 20 ft (6 m) from air intakes. (See 63.3.4 through 63.3.16 for material-specific requirements.) [55:6.17.7]

63.2.17 Gas Cabinets

Where a gas cabinet is required, is used to provide separation of gas hazards, or is used to increase the threshold quantity for a gas requiring special provisions, the gas cabinet shall be in accordance with the requirements of 63.2.17.1 through 63.2.17.5. [55:6.18]

63.2.17.1 Construction

63.2.17.1.1 Materials of Construction

The gas cabinet shall be constructed of not less than 0.097 in. (2.46 mm) (12 gauge) steel. [55:6.18.1.1]

63.2.17.1.2 Access to Controls

The gas cabinet shall be provided with self-closing limited access ports or noncombustible windows to give access to equipment controls. [55:6.18.1.2]

63.2.17.1.3 Self-Closing Doors

The gas cabinet shall be provided with self-closing doors. [55:6.18.1.3]

63.2.17.2 Ventilation Requirements

63.2.17.2.1

The gas cabinet shall be provided with an exhaust ventilation system designed to operate at a negative pressure relative to the surrounding area. [55:6.18.2.1]

63.2.17.2.2

Where toxic, highly toxic, pyrophoric, unstable reactive Class 3 or Class 4, or corrosive gases are contained, the velocity at the face of access ports or windows, with the access port or window open, shall not be less than 200 ft/min (61 m/min) average, with not less than 150 ft/min (46 m/min) at any single point. [55:6.18.2.2]

63.2.17.3 Fire Protection

Gas cabinets used to contain toxic, highly toxic, or pyrophoric gases shall be internally sprinklered. [55:6.18.3]

63.2.17.4 Quantity Limits

Gas cabinets shall contain not more than three cylinders, containers, or tanks. [55:6.18.4]

63.2.17.5 Separation of Incompatibles

Incompatible gases, as defined by Table 63.3.1.11.2, shall be stored or used within separate gas cabinets. [55:6.18.5]

63.2.18 Exhausted Enclosures

63.2.18.1 Ventilation Requirements

Where an exhausted enclosure is required or used to increase the threshold quantity for a gas requiring special provisions, the exhausted enclosure shall be provided with an exhaust ventilation system designed to operate at a negative pressure in relationship to the surrounding area. [55:6.19.1]

63.2.18.1.1 Control Velocity at Access Openings

Where toxic, highly toxic, pyrophoric, unstable reactive Class 3 or Class 4, or corrosive gases are contained, the velocity at the face openings providing access shall be not less than 200 ft/min (61 m/min) average, with not less than 150 ft/min (46 m/min) at any single point. [55:6.19.1.1]

63.2.18.1.2 Separation of Incompatible Gases Within Enclosures

Cylinders, containers, and tanks within enclosures shall be separated in accordance with Table 63.3.1.11.2. [55:6.19.1.2]

63.2.18.1.3 Fire Protection

Exhausted enclosures shall be internally sprinklered. [55:6.19.1.3]

63.2.18.2 Separation

Incompatible gases, as defined by Table 63.3.1.11.2, shall be stored or used within separate exhausted enclosures. [55:6.19.2]

63.2.19\* Source Valve

Bulk gas systems shall be provided with a source valve. [55:6.20]

63.2.19.1

The source valve shall be marked. [55:6.20.1]

63.2.19.2

The source valve shall be designated on the design drawings for the installation. [55:6.20.2]

63.3 Compressed Gases

63.3.1 General

The storage, use, and handling of compressed gases in cylinders, containers, and tanks shall be in accordance with the provisions of Chapters 1 through 7 of NFPA 55. [55:7.1]

63.3.1.1 Compressed Gas Systems

63.3.1.1.1 Design

Compressed gas systems shall be designed for the intended use and shall be designed by persons competent in such design. [55:7.1.2.1]

63.3.1.1.2 Installation

Installation of bulk compressed gas systems shall be supervised by personnel knowledgeable in the application of the standards for their construction and use. [55:7.1.2.2]

63.3.1.2 Insulated Liquid Carbon Dioxide Systems

Insulated liquid carbon dioxide systems shall be in accordance with Chapter 13 of NFPA 55. [55:7.1.3]

63.3.1.3 Insulated Liquid Nitrous Oxide Systems

Insulated liquid nitrous oxide systems shall be in accordance with Chapter 16 of NFPA 55. [55:7.1.4]

63.3.1.4\* Listed or Approved Hydrogen Equipment

63.3.1.4.1

Listed or approved hydrogen-generating and hydrogen-consuming equipment shall be in accordance with the listing requirements and manufacturers' instructions. [55:10.2.8.1]

63.3.1.4.2

Such equipment shall not be required to meet the requirements of Chapter 7 of NFPA 55. [55:10.2.8.2]

63.3.1.5\* Metal Hydride Storage Systems

63.3.1.5.1 General Requirements

63.3.1.5.1.1 Metal Hydride Storage System Requirements

The storage and use of metal hydride storage systems shall be in accordance with 63.3.1.5. [55:10.2.9.1.1]

63.3.1.5.1.2 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 of NFPA 55 as applicable. [55:10.2.9.1.2]

63.3.1.5.1.3 Classification

The hazard classification of the metal hydride storage system, as required by 63.1.4.1 and 63.1.4.3, shall be based on the hydrogen stored without regard to the metal hydride content. [55:10.2.9.1.3]

63.3.1.5.1.4 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. [55:10.2.9.1.4]

63.3.1.5.1.5 Containers, Design, and Construction

Compressed gas cylinders, containers, and tanks used for metal hydride storage systems shall be designed and constructed in accordance with 63.3.1.6.1. [55:10.2.9.1.5]

63.3.1.5.1.6 Service Life and Inspection of Containers

Metal hydride storage system cylinders, containers, or tanks shall be inspected at intervals not to exceed 5 years. [55:10.2.9.1.6]

63.3.1.5.1.7 Marking and Labeling

Marking and labeling of cylinders, containers, tanks, and systems shall be in accordance with 63.3.1.6 and the requirements in 63.3.1.5.1.7.1 through 63.3.1.5.1.7.4. [55:10.2.9.1.7]

63.3.1.5.1.7.1 System Marking

Metal hydride storage systems shall be marked with the following:

Manufacturer's name

Service life indicating the last date the system can be used

A unique code or serial number specific to the unit

System name or product code that identifies the system by the type of chemistry used in the system

Emergency contact name, telephone number, or other contact information

Limitations on refilling of containers to include rated charging pressure and capacity

[55:10.2.9.1.7.1]

63.3.1.5.1.7.2 Valve Marking

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

Manufacturer's name

Service life indicating the last date the valve can be used

Metal hydride service in which the valve can be used or a product code that is traceable to this information

[55:10.2.9.1.7.2]

63.3.1.5.1.7.3 Pressure Relief Device Marking

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

Manufacturer's name

Metal hydride service in which the device can be used or a product code that is traceable to this information

Activation parameters to include temperature, pressure, or both

[55:10.2.9.1.7.3]

(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. [55:10.2.9.1.7.3(A)]

63.3.1.5.1.7.4 Pressure Vessel Markings

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

Manufacturer's name

Design specification to which the vessel was manufactured

Authorized body approving the design and initial inspection and test of the vessel

Manufacturer's original test date

Unique serial number for the vessel

Service life identifying the last date the vessel can be used

System name or product code that identifies the system by the type of chemistry used in the system

[55:10.2.9.1.7.4]

63.3.1.5.1.8 Temperature Extremes

Metal hydride storage systems, whether full or partially full, shall not be exposed to temperatures exceeding the range stipulated by the manufacturer. [55:10.2.9.1.8]

63.3.1.5.1.9 Falling Objects

Metal hydride storage systems shall not be placed in areas where they are capable of being damaged by falling objects. [55:10.2.9.1.9]

63.3.1.5.1.10 Piping Systems

Piping, including tubing, valves, fittings, and pressure regulators, serving metal hydride storage systems shall be maintained gastight to prevent leakage. [55:10.2.9.1.10]

63.3.1.5.1.10.1 Leaking Systems

Leaking systems shall be removed from service. [55:10.2.9.1.10.1]

63.3.1.5.1.11 Refilling of Containers

The refilling of listed or approved metal hydride storage systems shall be in accordance with the listing requirements and manufacturers' instructions. [55:10.2.9.1.11]

63.3.1.5.1.11.1 Industrial Trucks

The refilling of metal hydride storage systems serving powered industrial trucks shall be in accordance with NFPA 2. [55:10.2.9.1.11.1]

63.3.1.5.1.11.2 Hydrogen Purity

The purity of hydrogen used for the purpose of refilling containers shall be in accordance with the listing and the manufacturers' instructions. [55:10.2.9.1.11.2]

63.3.1.5.1.12 Electrical

Electrical components for metal hydride storage systems shall be designed, constructed, and installed in accordance with NFPA 70. [55:10.2.9.1.12]

63.3.1.5.2 Portable Containers or Systems

63.3.1.5.2.1 Securing Containers

Cylinders, containers, and tanks shall be secured in accordance with 63.3.1.9.5. [55:10.2.9.2.1]

63.3.1.5.2.1.1 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. [55:10.2.9.2.1.1]

63.3.1.5.2.1.2 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. [55:10.2.9.2.1.2]

(A) Protection From Damage

Metal hydride storage systems, including cylinders, containers, tanks, and fittings, shall not extend beyond the platform of the mobile equipment. [55:10.2.9.2.1.2(A)]

63.3.1.5.2.2 Valves

Valves on cylinders, containers, and tanks shall remain closed except when containers are connected to closed systems and ready for use. [55:10.2.9.2.2]

63.3.1.6 Cylinders, Containers, and Tanks

63.3.1.6.1 Design and Construction

Cylinders, containers, and tanks shall be designed, fabricated, tested, and marked (stamped) in accordance with Department of Transportation (DOT) regulations, Transport Canada's (TC) Transportation of Dangerous Goods Regulations, or the ASME Boiler and Pressure Vessel Code. [55:7.1.5.1]

63.3.1.6.2 Defective Cylinders, Containers, and Tanks

63.3.1.6.2.1

Defective cylinders, containers, and tanks shall be returned to the supplier. [55:7.1.5.2.1]

63.3.1.6.2.2

Suppliers shall repair the cylinders, containers, and tanks, remove them from service, or dispose of them in an approved manner. [55:7.1.5.2.2]

63.3.1.6.2.3

Suppliers shall ensure that defective cylinders, containers, and tanks that have been repaired are evaluated by qualified individuals to verify that the needed repairs and any required testing has been performed and that those repaired or tested are in a serviceable condition before returning them to service. [55:7.1.5.2.3]

63.3.1.6.3 Supports

Stationary cylinders, containers, and tanks shall be provided with engineered supports of noncombustible material on noncombustible foundations. [55:7.1.5.3]

63.3.1.6.4 Cylinders, Containers, and Tanks Containing Residual Gas

Compressed gas cylinders, containers, and tanks containing residual product shall be treated as full except when being examined, serviced, or refilled by a gas manufacturer, authorized cylinder requalifier, or distributor. [55:7.1.5.4]

63.3.1.6.5 Pressure Relief Devices

63.3.1.6.5.1

When required by 63.3.1.6.5.2, pressure relief devices shall be provided to protect containers and systems containing compressed gases from rupture in the event of overpressure from thermal exposure. [55:7.1.5.5.1]

63.3.1.6.5.2

Pressure relief devices to protect containers shall be designed and provided in accordance with CGA S-1.1, Pressure Relief Device Standards — Part 1 — Cylinders for Compressed Gases, for cylinders; CGA S-1.2, Pressure Relief Device Standards — Part 2 — Cargo and Portable Tanks for Compressed Gases, for portable tanks; and CGA S-1.3, Pressure Relief Device Standards — Part 3 — Stationary Storage Containers for Compressed Gases, for stationary tanks or in accordance with applicable equivalent requirements in the country of use. [55:7.1.5.5.2]

63.3.1.6.5.3

Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. [55:7.1.5.5.3]

63.3.1.6.5.4

The pressure relief device shall have the capacity to prevent the maximum design pressure of the container or system from being exceeded. [55:7.1.5.5.4]

63.3.1.6.5.5

Pressure relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container, adjacent structures, or personnel. This requirement shall not apply to DOT specification containers having an internal volume of 2.0 scf (0.057 Nm3) or less. [55:7.1.5.5.5]

63.3.1.6.5.6

Pressure relief devices or vent piping shall be designed or located so that moisture cannot collect and freeze in a manner that would interfere with operation of the device. [55:7.1.5.5.6]

63.3.1.7 Cathodic Protection

Where required, cathodic protection shall be in accordance with 63.3.1.7. [55:7.1.6]

63.3.1.7.1 Operation

Where installed, cathodic protection systems shall be operated and maintained to continuously provide corrosion protection. [55:7.1.6.1]

63.3.1.7.2 Inspection

Container systems equipped with cathodic protection shall be inspected for the intended operation by a cathodic protection tester. The frequency of inspection shall be determined by the designer of the cathodic protection system. [55:7.1.6.2]

63.3.1.7.2.1

The cathodic protection tester shall be certified as being qualified by the National Association of Corrosion Engineers, International (NACE). [55:7.1.6.2.1]

63.3.1.7.3 Impressed Current Systems

Systems equipped with impressed current cathodic protection systems shall be inspected in accordance with the requirements of the design and 63.3.1.7.2. [55:7.1.6.3]

63.3.1.7.3.1

The design limits of the cathodic protection system shall be available to the AHJ upon request. [55:7.1.6.3.1]

63.3.1.7.3.2

The system owner shall maintain the following records to demonstrate that the cathodic protection is in conformance with the requirements of the design:

The results of inspections of the system

The results of testing that has been completed

[55:7.1.6.3.2]

63.3.1.7.4

Repairs, maintenance, or replacement of a cathodic protection system shall be under the supervision of a corrosion expert certified by NACE. [55:7.1.6.4]

63.3.1.7.4.1

The corrosion expert shall be certified by NACE as a senior corrosion technologist, a cathodic protection specialist, or a corrosion specialist or shall be a registered engineer with registration in a field that includes education and experience in corrosion control. [55:7.1.6.4.1]

63.3.1.8 Labeling Requirements

63.3.1.8.1 Containers

Individual compressed gas cylinders, containers, and tanks shall be marked or labeled in accordance with DOT requirements or those of the applicable regulatory agency. [55:7.1.7.1 ]

63.3.1.8.2 Label Maintenance

The labels applied by the gas manufacturer to identify the liquefied or nonliquefied compressed gas cylinder contents shall not be altered or removed by the user. [55:7.1.7.2]

63.3.1.8.3 Stationary Compressed Gas Cylinders, Containers, and Tanks

63.3.1.8.3.1

Stationary compressed gas cylinders, containers, and tanks shall be marked in accordance with NFPA 704. [55:7.1.7.3.1]

63.3.1.8.3.2

Markings shall be visible from any direction of approach. [55:7.1.7.3.2]

63.3.1.8.4 Piping Systems

63.3.1.8.4.1

Except as provided in 63.3.1.8.4.2, piping systems shall be marked in accordance with ASME A13.1, Scheme for the Identification of Piping Systems, or other applicable approved standards as follows:

Marking shall include the name of the gas and a direction-of-flow arrow.

Piping that is used to convey more than one gas at various times shall be marked to provide clear identification and warning of the hazard.

Markings for piping systems shall be provided at the following locations:

At each critical process control valve

At wall, floor, or ceiling penetrations

At each change of direction

At a minimum of every 20 ft (6.1 m) or fraction thereof throughout the piping run

[55:7.1.7.4.1]

63.3.1.8.4.2

Piping within gas manufacturing plants, gas processing plants, refineries, and similar occupancies shall be marked in an approved manner. [55:7.1.7.4.2]

63.3.1.9 Security

63.3.1.9.1 General

Compressed gas cylinders, containers, tanks, and systems shall be secured against accidental dislodgement and against access by unauthorized personnel. [55:7.1.8.1]

63.3.1.9.2\* Security of Areas

Storage, use, and handling areas shall be secured against unauthorized entry. [55:7.1.8.2]

63.3.1.9.3

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. [55:7.1.8.2.1]

63.3.1.9.4 Physical Protection

63.3.1.9.4.1

Compressed gas cylinders, containers, tanks, and systems that could be exposed to physical damage shall be protected. [55:7.1.8.3.1]

63.3.1.9.4.2

Guard posts or other means shall be provided to protect compressed gas cylinders, containers, tanks, and systems indoors and outdoors from vehicular damage in accordance with Section 4.11 of NFPA 55. [55:7.1.8.3.2]

63.3.1.9.5 Securing Compressed Gas Cylinders, Containers, and Tanks

Compressed gas cylinders, containers, and tanks in use or in storage shall be secured to prevent them from falling or being knocked over by corralling them and securing them to a cart, framework, or fixed object by use of a restraint, unless otherwise permitted by 63.3.1.9.5.1 and 63.3.1.9.5.2. [55:7.1.8.4]

63.3.1.9.5.1

Compressed gas cylinders, containers and tanks in the process of examination, servicing, and refilling shall not be required to be secured. [55:7.1.8.4.1]

63.3.1.9.5.2

At cylinder-filling plants, authorized cylinder requalifier's facilities, and distributors' warehouses, the nesting of cylinders shall be permitted as a means to secure cylinders. [55:7.1.8.4.2]

63.3.1.10 Valve Protection

63.3.1.10.1 General

Compressed gas cylinder, container, and tank valves shall be protected from physical damage by means of protective caps, collars, or similar devices. [55:7.1.9.1]

63.3.1.10.1.1

Valve protection of individual valves shall not be required to be installed on individual cylinders, containers, or tanks installed on tube trailers or similar transportable bulk gas systems equipped with manifolds that are provided with a means of physical protection that will protect the valves from physical damage when the equipment is in use. Protective systems required by DOT for over the road transport shall provide an acceptable means of protection. [55:7.1.9.1.1]

63.3.1.10.1.1.1

Valve protection of individual valves shall not be required on cylinders, containers, or tanks that comprise bulk or non-bulk gas systems where the containers are stationary, or portable equipped with manifolds, that are provided with physical protection in accordance with Section 4.11 of NFPA 55 and 63.3.1.9.4 or other approved means. Protective systems required by DOT for over the road transport shall provide an acceptable means of protection. [55:7.1.9.1.1.1]

63.3.1.10.2 Valve-Protective Caps

Where compressed gas cylinders, containers, and tanks are designed to accept valve-protective caps, the user shall keep such caps on the compressed gas cylinders, containers, and tanks at all times, except when empty, being processed, or connected for use. [55:7.1.9.2]

63.3.1.10.3 Valve Outlet Caps or Plugs

63.3.1.10.3.1

Gastight valve outlet caps or plugs shall be provided and in place for all full or partially full cylinders, containers, and tanks containing toxic, highly toxic, pyrophoric, or unstable reactive Class 3 or Class 4 gases that are in storage. [55:7.1.9.3.1]

63.3.1.10.3.2

Valve outlet caps and plugs shall be designed and rated for the container service pressure. [55:7.1.9.3.2]

63.3.1.11 Separation From Hazardous Conditions

63.3.1.11.1 General

63.3.1.11.1.1

Compressed gas cylinders, containers, tanks, and systems in storage or use shall be separated from materials and conditions that present exposure hazards to or from each other. [55:7.1.10.1]

63.3.1.11.2\* Incompatible Materials

Gas cylinders, containers, and tanks shall be separated in accordance with Table 63.3.1.11.2. [55:7.1.10.2]

Table 63.3.1.11.2 Separation of Gas Cylinders, Containers, and Tanks by Hazard Class

Gas Category

Other gas

Unstable Reactive Class 2, Class 3, or Class 4

Corrosive

Oxidizing

Flammable

Pyrophoric

Toxic or Highly Toxic

ft

m

ft

m

ft

m

ft

m

ft

m

ft

m

Toxic or highly toxic

NR

20

6.1

20

6.1

20

6.1

20

6.1

20

6.1

—

—

Pyrophoric

NR

20

6.1

20

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Flammable

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6.1

Corrosive

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6.1

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6.1

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Unstable reactive Class 2, Class 3, or Class 4

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20

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20

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6.1

Other gas

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NR

NR

NR

NR

NR

NR: No separation required.

[55: Table 7.1.10.2]

63.3.1.11.2.1

Subparagraph 63.3.1.11.2 shall not apply to gases contained within closed piping systems. [55:7.1.10.2.1]

63.3.1.11.2.2

The distances shown in Table 63.3.1.11.2 shall be permitted to be reduced without limit where compressed gas cylinders, containers, and tanks are separated by a barrier of noncombustible construction that has a fire resistance rating of at least 0.5 hour and interrupts the line of sight between the containers. [55:7.1.10.2.2]

63.3.1.11.2.3

The 20 ft (6.1 m) distance shall be permitted to be reduced to 5 ft (1.5 m) where one of the gases is enclosed in a gas cabinet or without limit where both gases are enclosed in gas cabinets. [55:7.1.10.2.3]

63.3.1.11.2.4

Cylinders without pressure relief devices shall not be stored without separation from flammable and pyrophoric gases with pressure relief devices. [55:7.1.10.2.4]

63.3.1.11.2.5\*

Spatial separation shall not be required between cylinders deemed to be incompatible in gas production facilities where cylinders are connected to manifolds for the purposes of filling, analysis of compressed gases, or manufacturing procedures, assuming the prescribed controls for the manufacture of gas mixtures are in place. [55:7.1.10.2.5]

63.3.1.11.3\* Clearance From Combustibles and Vegetation

Combustible waste, vegetation, and similar materials shall be kept a minimum of 10 ft (3.1 m) from compressed gas cylinders, containers, tanks, and systems. [55:7.1.10.3]

63.3.1.11.3.1

A noncombustible partition without openings or penetrations and extending not less than 18 in. (457 mm) above and to the sides of the storage area shall be permitted in lieu of the minimum distance. [55:7.1.10.3.1]

63.3.1.11.3.2

The noncombustible partition shall be either an independent structure or the exterior wall of the building adjacent to the storage area. [55:7.1.10.3.2]

63.3.1.11.4 Ledges, Platforms, and Elevators

Compressed gas cylinders, containers, and tanks shall not be placed near elevators, unprotected platform ledges, or other areas where compressed gas cylinders, containers, or tanks could fall distances exceeding one-half the height of the container, cylinder, or tank. [55:7.1.10.4]

63.3.1.11.5 Temperature Extremes

Compressed gas cylinders, containers, and tanks, whether full or partially full, shall not be exposed to temperatures exceeding 125°F (52°C) or subambient (low) temperatures unless designed for use under such exposure. [55:7.1.10.5]

63.3.1.11.5.1

Compressed gas cylinders, containers, and tanks that have not been designed for use under elevated temperature conditions shall not be exposed to direct sunlight outdoors where ambient temperatures exceed 125°F (52°C). The use of a weather protected structure or shaded environment for storage or use shall be permitted as a means to protect against direct exposure to sunlight. [55:7.1.10.5.1]

63.3.1.11.6 Falling Objects

Compressed gas cylinders, containers, and tanks shall not be placed in areas where they are capable of being damaged by falling objects. [55:7.1.10.6]

63.3.1.11.7 Heating

Compressed gas cylinders, containers, and tanks, whether full or partially full, shall not be heated by devices that could raise the surface temperature of the container, cylinder, or tank to above 125°F (52°C). [55:7.1.10.7]

63.3.1.11.7.1 Electrically Powered Heating Devices

Electrical heating devices shall be in accordance with NFPA 70. [55:7.1.10.7.1]

63.3.1.11.7.2 Fail-Safe Design

Devices designed to maintain individual compressed gas cylinders, containers, and tanks at constant temperature shall be designed to be fail-safe. [55:7.1.10.7.2]

63.3.1.11.8 Sources of Ignition

Open flames and high-temperature devices shall not be used in a manner that creates a hazardous condition. [55:7.1.10.8]

63.3.1.11.9 Exposure to Chemicals

Compressed gas cylinders, containers, and tanks shall not be exposed to corrosive chemicals or fumes that could damage cylinders, containers, tanks, or valve-protective caps. [55:7.1.10.9]

63.3.1.11.10 Exposure to Electrical Circuits

Compressed gas cylinders, containers, and tanks shall not be placed where they could become a part of an electrical circuit. [55:7.1.10.10]

63.3.1.11.10.1\*

Electrical devices mounted on compressed gas piping, cylinders, containers, or tanks shall be installed, grounded, and bonded in accordance with the methods specified in NFPA 70(NEC). [55:7.1.10.10.1]

63.3.1.12 Service and Repair

Service, repair, modification, or removal of valves, pressure relief devices, or other compressed gas cylinder, container, and tank appurtenances shall be performed by trained personnel and with the permission of the container owner. [55:7.1.11]

63.3.1.13 Unauthorized Use

Compressed gas cylinders, containers, and tanks shall not be used for any purpose other than to serve as a vessel for containing the product for which it was designed. [55:7.1.12]

63.3.1.14 Cylinders, Containers, and Tanks Exposed to Fire

Compressed gas cylinders, containers, and tanks exposed to fire shall not be used or shipped while full or partially full until they are requalified in accordance with the pressure vessel code under which they were manufactured. [55:7.1.13]

63.3.1.15 Leaks, Damage, or Corrosion

63.3.1.15.1 Removal From Service

Leaking, damaged, or corroded compressed gas cylinders, containers, and tanks shall be removed from service. [55:7.1.14.1]

63.3.1.15.2 Replacement and Repair

Leaking, damaged, or corroded compressed gas systems shall be replaced or repaired. [55:7.1.14.2]

63.3.1.15.3\* Handling of Cylinders, Containers, and Tanks Removed From Service

Compressed gas cylinders, containers, and tanks that have been removed from service shall be handled in an approved manner. [55:7.1.14.3]

63.3.1.15.4 Leaking Systems

Compressed gas systems that are determined to be leaking, damaged, or corroded shall be repaired to a serviceable condition or shall be removed from service. [55:7.1.14.4]

63.3.1.16 Surfaces

63.3.1.16.1

To prevent bottom corrosion, cylinders, containers, and tanks shall be protected from direct contact with soil or surfaces where water might accumulate. [55:7.1.15.1]

63.3.1.16.2

Surfaces shall be graded to prevent accumulation of water. [55:7.1.15.2]

63.3.1.17 Storage Area Temperature

63.3.1.17.1 Compressed Gas Containers

Storage area temperatures shall not exceed 125°F (52°C). [55:7.1.16.1]

63.3.1.18 Installation of Underground Piping

63.3.1.18.1

Underground piping shall be of welded construction without valves, unwelded mechanical joints, or connections installed underground. [55:7.1.17.1]

63.3.1.18.1.1

Valves or connections located in boxes or enclosures shall be permitted to be installed underground where such boxes or enclosures are accessible from above ground and where the valves or connections contained are isolated from direct contact with earth or fill. [55:7.1.17.1.1]

63.3.1.18.1.1.1

Valve boxes or enclosures installed in areas subject to vehicular traffic shall be constructed to resist uniformly distributed and concentrated live loads in accordance with the building code for areas designated as vehicular driveways and yards, subject to trucking. [55:7.1.17.1.1.1]

63.3.1.18.1.2\*

Piping installed in trench systems located below grade where the trench is open to above shall not be considered to be underground. [55:7.1.17.1.2]

63.3.1.18.2

Gas piping in contact with earth or other material that could corrode the piping shall be protected against corrosion in an approved manner. [55:7.1.17.2]

63.3.1.18.2.1

When cathodic protection is provided, it shall be in accordance with 63.3.1.7. [55:7.1.17.2.1]

63.3.1.18.3

Underground piping shall be installed on at least 6 in. (150 mm) of well-compacted bedding material. [30:27.6.5.1]

63.3.1.18.4

In areas subject to vehicle traffic, the pipe trench shall be deep enough to permit a cover of at least 18 in. (450 mm) of well-compacted backfill material and pavement. [30:27.6.5.2]

63.3.1.18.5

In paved areas where a minimum 2 in. (50 mm) of asphalt is used, backfill between the pipe and the asphalt shall be permitted to be reduced to 8 in. (200 mm) minimum. [30:27.6.5.3]

63.3.1.18.6

In paved areas where a minimum 4 in. (100 mm) of reinforced concrete is used, backfill between the pipe and the asphalt shall be permitted to be reduced to 4 in. (100 mm) minimum. [30:27.6.5.4]

63.3.1.18.7

In areas not subject to vehicle traffic, the pipe trench shall be deep enough to permit a cover of at least 12 in. (300 mm) of well-compacted backfill material. [55:7.1.17.7]

63.3.1.18.8

A greater burial depth shall be provided when required by the manufacturer's instructions or where frost conditions are present. [30:27.6.5.6]

63.3.1.18.9

Piping within the same trench shall be separated horizontally by at least two pipe diameters. Separation shall need not exceed 9 in. (230 mm). [30:27.6.5.7]

63.3.1.18.10

Two or more levels of piping within the same trench shall be separated vertically by a minimum 6 in. (150 mm) of well-compacted bedding material. [30:27.6.5.8]

63.3.1.19 Cleaning and Purging of Gas Piping Systems

63.3.1.19.1 General

63.3.1.19.1.1

Piping systems shall be cleaned and purged in accordance with the requirements of 63.3.1.19 when one or more of the following conditions exist:

The system is installed and prior to being placed into service

There is a change in service

\* There are alterations or repair of the system involving the replacement of parts or addition to the piping system and prior to returning the system to service

\* The design standards or written procedures specify cleaning and purging

[55:7.1.18.1.1]

63.3.1.19.1.2

Cleaning and purging of the internal surfaces of piping systems shall be conducted by qualified individuals trained in cleaning and purging operations and procedures, including the recognition of potential hazards associated with cleaning and purging. [55:7.1.18.1.2]

63.3.1.19.1.3\*

A written cleaning or purging procedure shall be provided to establish the requirements for the cleaning and purging operations to be conducted. [55:7.1.18.1.3]

63.3.1.19.1.3.1\*

An independent or third-party review of the written procedure shall be conducted after the procedure has been written and shall accomplish the following:

Evaluate hazards, errors, and malfunctions related to each step in the procedure

Review the measures prescribed in the procedure for applicability

Make recommendations for additional hazard mitigation measures if deemed necessary

[55:7.1.18.1.3.1]

63.3.1.19.1.3.2

The completed written procedure shall be:

Maintained on site by the facility owner/operator

Provided to operating personnel engaged in cleaning or purging operations

Made available to the AHJ upon request

[55:7.1.18.1.3.2]

63.3.1.19.1.3.3

Where generic cleaning or purging procedures have been established, a job-specific operating procedure shall not be required. [55:7.1.18.1.3.3]

63.3.1.19.1.3.4

Generic procedures shall be reviewed when originally published or when the procedure or operation is changed. [55:7.1.18.1.3.4]

63.3.1.19.1.4

Written procedures to manage a change in process materials, technology, equipment, procedures, and facilities shall be established by the facility owner/operator. [55:7.1.18.1.4]

63.3.1.19.1.4.1

The management-of-change procedures shall ensure that the following topics are addressed prior to any change in the configuration or design of the piping system:

The technical basis for the proposed change

The safety and health implications

Whether the change is permanent or temporary

Whether modifications to the cleaning and purging procedures are required as a result of the identified changes

[55:7.1.18.1.4.1]

63.3.1.19.1.4.2

When modifications to the cleaning and purging procedures are required, the written procedure shall be updated to incorporate any elements identified by the management-of-change procedures. [55:7.1.18.1.4.2]

63.3.1.19.1.5

Prior to cleaning or purging, piping systems shall be inspected and tested to determine that the installation, including the materials of construction, and method of fabrication, comply with the requirements of the design standard used and the intended application for which the system was designed. [55:7.1.18.1.5]

63.3.1.19.1.5.1

Inspection and testing of piping systems shall not be required to remove a system from service. [55:7.1.18.1.5.1]

63.3.1.19.1.5.2

Purging of piping systems shall not be required for systems that are utilized for operations designated by written operating procedures in accordance with the requirements of the cleaning or purging procedure specified in 63.3.1.19.1.1. [55:7.1.18.1.5.2]

63.3.1.19.1.5.3\*

Personnel in the affected area(s), as determined by the cleaning or purging procedure, shall be informed of the hazards associated with the operational activity and notified prior to the initiation of any such activity. [55:7.1.18.1.5.3]

63.3.1.19.2\* Cleaning

Piping system designs shall be documented to specify the requirements for the internal cleaning of the piping system prior to installation and initial use. [55:7.1.18.2]

63.3.1.19.2.1

The internal surfaces of gas piping systems shall be cleaned to ensure that the required standard of cleanliness specified by the design is met prior to placing the gas piping system into service. [55:7.1.18.2.1]

63.3.1.19.2.2\*

When piping systems are cleaned in stages during installation or assembly, the interior of the cleaned piping shall be protected against the infiltration of unwanted contaminants. [55:7.1.18.2.2]

63.3.1.19.3\* Purging

Piping systems used to contain gases with a physical or health hazard in any of the categories specified by 63.1.4 shall be purged prior to being placed into service for initial use. [55:7.1.18.3]

63.3.1.19.3.1

Piping systems shall be purged to remove the internal contents preceding the following activities or operations:

Activating or placing a piping system into service

Deactivating or removing a piping system from service

Changing the service of a piping system from one gas to another, except when such gas is supplied to a manifold or piping system designed for the purpose of filling or otherwise processing cylinders, containers, or tanks in a process with established procedures

Performing service, maintenance, or modifications on a system where personnel or designated areas will potentially be exposed to the internal contents of the piping system

Performing hot work, including but not limited to welding, cutting or brazing on the piping system

[55:7.1.18.3.1]

63.3.1.19.3.2

The termination point for the release of purged gases shall be in accordance with 63.2.15. [55:7.1.18.3.2]

63.3.1.19.3.2.1

The release of purged gases or mixtures containing any quantity of corrosive, toxic, or highly toxic gases shall be through a treatment system in accordance with the applicable requirements of 63.3.5.3.4 or 63.3.9.3. [55:7.1.18.3.2.1]

63.3.1.19.3.2.2

The termination point for the release of purged gases resultant from the purging of piping systems out of service, other than those in accordance with 63.3.1.19.3.2.1, shall not be required to be in accordance with 63.2.15 where the contained volume of the piping system (when released to indoor areas) does not result in a concentration in the room or area that will reduce the oxygen concentration in the room or area below a level of 19.5 percent or that exceeds any of the following limits:

Ceiling limit

Permissible exposure limit

Short-term exposure limit

Twenty-five percent of the lower flammable limit

[55:7.1.18.3.2.2]

63.3.2 Storage

63.3.2.1 General

63.3.2.1.1 Applicability

The storage of compressed gas cylinders, containers, and tanks shall be in accordance with 63.3.2. [55:7.2.1.1]

63.3.2.1.2 Upright Storage Flammable Gas in Solution and Liquefied Flammable Gas

Cylinders, containers, and tanks containing liquefied flammable gases and flammable gases in solution shall be positioned in the upright position. [55:7.2.1.2]

63.3.2.1.2.1 Cylinders and Containers of 1.3 Gal (5 L) or Less

Containers with a capacity of 1.3 gal (5 L) or less shall be permitted to be stored in a horizontal position. [55:7.2.1.2.1]

63.3.2.1.2.2 Cylinders, Containers, and Tanks Designed for Horizontal Use

Cylinders, containers, and tanks designed for use in a horizontal position shall be permitted to be stored in a horizontal position. [55:7.2.1.2.2]

63.3.2.1.2.3 Palletized Cylinders, Containers, and Tanks

Cylinders, containers, and tanks, with the exception of those containing flammable liquefied compressed gases, that are palletized for transportation purposes shall be permitted to be stored in a horizontal position. [55:7.2.1.2.3]

63.3.2.1.3 Classification of Weather Protection as an Indoor Versus an Outdoor Area

For other than explosive materials and hazardous materials presenting a detonation hazard, a weather protection structure shall be permitted to be used for sheltering outdoor storage or use areas without requiring such areas to be classified as indoor storage. [55:7.2.1.3]

63.3.2.2 Material-Specific Regulations

63.3.2.2.1 Indoor Storage

Indoor storage of compressed gases shall be in accordance with the material-specific provisions of 63.3.4 through 63.3.10. [55:7.2.2.1]

63.3.2.2.2 Exterior Storage

63.3.2.2.2.1 General

Exterior storage of compressed gases shall be in accordance with the material-specific provisions of 63.3.4 through 63.3.10. [55:7.2.2.2.1]

63.3.2.2.2.2 Separation

Distances from property lines, buildings, and exposures shall be in accordance with the material-specific provisions of 63.3.4 through 63.3.10. [55:7.2.2.2.2]

63.3.3 Use and Handling

63.3.3.1 General

63.3.3.1.1 Applicability

The use and handling of compressed gas cylinders, containers, tanks, and systems shall be in accordance with 63.3.3.1. [55:7.3.1.1]

63.3.3.1.2 Controls

63.3.3.1.2.1

Compressed gas system controls shall be designed to prevent materials from entering or leaving the process at an unintended time, rate, or path. [55:7.3.1.2.1]

63.3.3.1.2.2

Automatic controls shall be designed to be failsafe. [55:7.3.1.2.2]

63.3.3.1.3 Piping Systems

Piping, tubing, fittings, and related components shall be designed, fabricated, and tested in accordance with the requirements of the applicable parts in ASME B31.3, Process Piping. [55:7.3.1.3]

63.3.3.1.3.1 Integrity

Piping, tubing, pressure regulators, valves, and other apparatus shall be kept gastight to prevent leakage. [55:7.3.1.3.1]

63.3.3.1.3.2 Backflow Prevention

Backflow prevention or check valves shall be provided where the backflow of hazardous materials could create a hazardous condition or cause the unauthorized discharge of hazardous materials. [55:7.3.1.3.2]

63.3.3.1.4 Valves

63.3.3.1.4.1

Valves utilized on compressed gas systems shall be designed for the gas or gases and pressure intended and shall be accessible. [55:7.3.1.4.1]

63.3.3.1.4.2

Valve handles or actuators for required shutoff valves shall not be removed or otherwise altered to prevent access. [55:7.3.1.4.2]

63.3.3.1.5 Vent Pipe Termination

63.3.3.1.5.1

Venting of gases shall be directed to an approved location. [55:7.3.1.5.1]

63.3.3.1.5.2

The termination point for piped vent systems serving cylinders, containers, tanks, and gas systems used for the purpose of operational or emergency venting shall be in accordance with 63.2.15. [55:7.3.1.5.2]

63.3.3.1.6 Upright Use

63.3.3.1.6.1

Compressed gas cylinders, containers, and tanks containing flammable liquefied gas, except those designed for use in a horizontal position and those compressed gas cylinders, containers, and tanks containing nonliquefied gases, shall be used in a "valve end up" upright position. [55:7.3.1.6.1]

63.3.3.1.6.2

An upright position shall include a position in which the cylinder, container, or tank axis is inclined as much as 45 degrees from the vertical and in which the relief device is always in direct communication with the gas phase. [55:7.3.1.6.2]

63.3.3.1.7 Inverted Use

Cylinders, containers, and tanks containing nonflammable liquefied gases shall be permitted to be used in the inverted position when the liquid phase is used. [55:7.3.1.7]

63.3.3.1.7.1

Flammable liquefied gases at processing plants shall be permitted to use this inverted position method while transfilling. [55:7.3.1.7.1]

63.3.3.1.7.2

The cylinder, container, or tank shall be secured, and the dispensing apparatus shall be designed for use with liquefied gas. [55:7.3.1.7.2]

63.3.3.1.8 Cylinders and Containers of 1.3 Gal (5 L) or Less

Cylinders or containers with a water volume of 1.3 gal (5 L) or less shall be permitted to be used in a horizontal position. [55:7.3.1.8]

63.3.3.1.9 Transfer

Transfer of gases between cylinders, containers, and tanks shall be performed by qualified personnel using equipment and operating procedures in accordance with CGA P-1, Safe Handling of Compressed Gases in Containers. [55:7.3.1.9]

63.3.3.1.10 Use of Compressed Gases for Inflation

Inflatable equipment, devices, or balloons shall only be pressurized or filled with compressed air or inert gases. [55:7.3.1.10]

63.3.3.1.11 Emergency Shutoff Valves

63.3.3.1.11.1

Accessible manual or automatic emergency shutoff valves shall be provided to shut off the flow of gas in case of emergency. [55:7.3.1.11.1]

63.3.3.1.11.1.1\*

Manual emergency shutoff valves or the device that activates an automatic emergency shutoff valve on a bulk source or piping system serving the bulk supply shall be identified by means of a sign. [55:7.3.1.11.1.1]

63.3.3.1.11.2

Emergency shutoffs shall be located at the point of use and at the tank, cylinder, or bulk source, and at the point where the system piping enters the building. [55:7.3.1.11.2]

63.3.3.1.12 Emergency Isolation

63.3.3.1.12.1

Where compressed gases from sources in excess of the quantity thresholds in Table 63.2.3.1.1 having a hazard ranking in one or more of the following hazard classes in accordance with NFPA 704 are carried in pressurized piping above a gauge pressure of 15 psi (103 kPa), an approved method of emergency isolation shall be provided:

Health hazard Class 3 or Class 4

Flammability Class 4

Instability Class 3 or Class 4

[55:7.3.1.12.1]

63.3.3.1.12.2

Approved means of meeting the requirements for emergency isolation shall include any of the following:

Automatic shutoff valves, located as close to the bulk source as practical, tied to leak detection systems

Attended control stations where trained personnel can monitor alarms or supervisory signals and can trigger emergency responses

A constantly monitored control station with an alarm and remote shutoff of the gas supply system

Excess flow valves at the bulk source

[55:7.3.1.12.2]

63.3.3.1.12.3

The requirements of 63.3.3.1.12 shall not be required for the following:

Piping for inlet connections designed to prevent backflow at the source

Piping for pressure relief devices

[55:7.3.1.12.3]

63.3.3.1.12.4 Location Exemptions

The requirements of 63.3.3.1.12 shall not apply to the following:

Piping for inlet connections designed to prevent backflow

Piping for pressure relief devices

Systems containing 430 scf (12.7 Nm3) or less of flammable gas

[55:7.3.1.12.4]

63.3.3.2 Material-Specific Regulations

63.3.3.2.1 Indoor Use

Indoor use of compressed gases shall be in accordance with the requirements of 63.3.4 through 63.3.10. [55:7.3.2.1]

63.3.3.2.2 Exterior Use

63.3.3.2.2.1 General

Exterior use of compressed gases shall be in accordance with the requirements of 63.3.4 through 63.3.10. [55:7.3.2.2.1]

63.3.3.2.2.2 Separation

Distances from property lines, buildings, and exposure hazards shall be in accordance with the material-specific provisions of 63.3.4 through 63.3.10. [55:7.3.2.2.2]

63.3.3.3 Handling

63.3.3.3.1 Applicability

The handling of compressed gas cylinders, containers, and tanks shall be in accordance with 63.3.3.3. [55:7.3.3.1]

63.3.3.3.2 Carts and Trucks

63.3.3.3.2.1

Cylinders, containers, and tanks shall be moved using an approved method. [55:7.3.3.2.1]

63.3.3.3.2.2

Where cylinders, containers, and tanks are moved by hand cart, hand truck, or other mobile device, such carts, trucks, or devices shall be designed for the secure movement of cylinders, containers, and tanks. [55:7.3.3.2.2]

63.3.3.3.3 Lifting Devices

Ropes, chains, or slings shall not be used to suspend compressed gas cylinders, containers, and tanks unless provisions at time of manufacture have been made on the cylinder, container, or tank for appropriate lifting attachments, such as lugs. [55:7.3.3.3]

63.3.4 Medical Gas Systems

Medical gas systems for health care shall be in accordance with NFPA 99. [55:7.4]

63.3.5 Corrosive Gases

63.3.5.1 General

The storage or use of corrosive compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.5. [55:7.5.1]

63.3.5.2 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. [55:7.5.2]

63.3.5.2.1

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. [55:7.5.2.1]

63.3.5.2.1.1\*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.5.2.1.1]

63.3.5.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.5.2.1.2]

63.3.5.2.1.3

The 2-hour fire barrier shall be located at least 5 ft (1.5 m) from any exposure. [55:7.5.2.1.3]

63.3.5.2.1.4

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). [55:7.5.2.1.4]

63.3.5.3 Indoor Use

The indoor use of corrosive gases shall be provided with a gas cabinet, exhausted enclosure, or gas room. [55:7.5.3]

63.3.5.3.1 Gas Cabinets

Gas cabinets shall be in accordance with 63.2.17. [55:7.5.3.1]

63.3.5.3.2 Exhausted Enclosures

Exhausted enclosures shall be in accordance with 63.2.18. [55:7.5.3.2]

63.3.5.3.3 Gas Rooms

Gas rooms shall be in accordance with 63.2.4. [55:7.5.3.3]

63.3.5.3.4 Treatment Systems

Treatment systems, except as provided for in 63.3.5.3.4.1, 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. [55:7.5.3.4]

63.3.5.3.4.1

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

Gas detection in accordance with 63.3.9.3.2.1.1

Fail-safe automatic closing valves in accordance with 63.3.9.3.2.2

[55:7.5.3.4.1]

63.3.5.3.4.2

Treatment systems shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning, or otherwise processing the release of corrosive gas in accordance with 63.3.9.3.4.1. [55:7.5.3.4.2]

63.3.5.3.4.3

Treatment system sizing shall be in accordance with 63.3.9.3.4. [55:7.5.3.4.3]

63.3.6 Flammable Gases

63.3.6.1 Storage, Use, and Handling

63.3.6.1.1\*

The storage or use of flammable gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.6. [55:7.6.1.1]

63.3.6.1.2

Storage, use, and handling of gaseous hydrogen shall be in accordance with 63.3.6.1 and Chapter 10 of NFPA 55. [55:7.6.1.2]

63.3.6.1.3

Storage, use, and handling of compressed natural gas shall be in accordance with 63.3.6.1. [55:7.6.1.3]

63.3.6.2 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 63.3.6.2. [55:7.6.2]

Table 63.3.6.2 Distance to Exposures for Non-Bulk Flammable Gases

Maximum Amount per Storage Area (scf)

Minimum Distance Between Storage Areas (ft)

Minimum Distance to Lot Lines of Property That Can Be Built Upon (ft)

Minimum Distance to Public Streets, Public Alleys or Public Ways (ft)

Minimum Distance to Buildings on the Same Property

Less Than 2-Hour Construction

2-Hour Construction

4-Hour Construction

0-4225

5

5

5

5

0

0

4226-21,125

10

10

10

10

5

0

21,126-50,700

10

15

15

20

5

0

50,701-84,500

10

20

20

20

5

0

84,501-200,000

20

25

25

20

5

0

For SI units, 1 ft = 304.8 mm; 1 scf = 0.02832 Nm3.

Note: The minimum required distances does not apply where fire barriers without openings or penetrations having a minimum fire-resistive rating of 2 hours interrupt the fine 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. [55: Table 7.6.2]

63.3.6.2.1

Bulk hydrogen gas installations shall be in accordance with Chapter 10 of NFPA 55. [55:7.6.2.1]

63.3.6.2.1.1\*

Where a protective structure is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.6.2.1.1]

63.3.6.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.6.2.1.2]

63.3.6.2.2

Bulk gas systems for flammable gases other than hydrogen shall be in accordance with Table 10.4.2.2.1(a), Table 10.4.2.2.1(b), or Table 10.4.2.2.1(c) of NFPA 55 where the quantity of flammable compressed gas exceeds 5000 scf (141.6 Nm3). [55:7.6.2.2]

63.3.6.2.2.1

Where fire barriers are used as a means of distance reduction, fire barriers shall be in accordance with 10.4.2.2.4 of NFPA 55. [55:7.6.2.2.1]

63.3.6.2.2.2

Mobile acetylene trailer systems (MATS) shall be located in accordance with 15.2.3 of NFPA 55. [55:7.6.2.2.2]

63.3.6.2.3

The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [55:7.6.2.3]

63.3.6.2.4

Storage and use of flammable compressed gases shall not be located within 50 ft (15.2 m) of air intakes. [55:7.6.2.4]

63.3.6.2.5

Storage and use of flammable gases outside of buildings shall also be separated from building openings by 25 ft (7.6 m). 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. [55:7.6.2.5]

63.3.6.3 Indoor Non-Bulk Hydrogen Compressed Gas System Location

63.3.6.3.1

Hydrogen systems of less than 5000 scf (141.6 Nm3) and greater than the MAQ, where located inside buildings, shall be in accordance with the following:

In a ventilated area in accordance with the provisions of 63.2.16

Separated from incompatible materials in accordance with the provisions of 63.3.1.11.2

A distance of 25 ft (7.6 m) from open flames and other sources of ignition

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

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.

Emergency shutoff valves shall be provided in accordance with 63.3.3.1.11.

A distance of 50 ft (15 m) from other flammable gas storage

Protected against damage in accordance with the provisions of 63.3.1.9.4.

[55:10.3.5.1]

63.3.6.3.2 Systems Installed in One Room

63.3.6.3.2.1

More than one system of 5000 scf (141.6 Nm3) 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. [55:10.3.5.2.1]

63.3.6.3.2.2

The separation distance between multiple systems of 5000 scf (141.6 Nm3) 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 63.2.10. [55:10.3.5.2.2]

63.3.6.3.2.3

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 63.3.6.3.2.1 or 63.3.6.3.2.2 when such facilities are provided with Protection Level 2 controls and the applicable requirements of Chapters 1 through 7 of NFPA 55. [55:10.3.5.2.3]

63.3.6.4 Maintenance

[55:10.3.7]

63.3.6.4.1

Maintenance shall be performed annually by a qualified representative of the equipment owner. [55:10.3.7.1]

63.3.6.4.2

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. [55:10.3.7.2]

63.3.6.4.3

Scheduled maintenance and retest activities shall be formally documented, and records shall be maintained a minimum of 3 years. [55:10.3.7.3]

63.3.6.5 Ignition Source Control

Ignition sources in areas containing flammable gases shall be in accordance with 63.3.6.5. [55:7.6.3]

63.3.6.5.1 Static Producing Equipment

Static producing equipment located in flammable gas areas shall be grounded. [55:7.6.3.1]

63.3.6.5.2 No Smoking or Open Flame

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. [55:7.6.3.2]

63.3.6.5.3 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. [55:7.6.3.3]

63.3.6.6 Electrical

Areas in which the storage or use of compressed gases exceeds the quantity thresholds for gases requiring special provisions shall be in accordance with NFPA 70. [55:7.6.4]

63.3.6.7 Maintenance of Piping Systems

63.3.6.7.1

Maintenance of flammable gas system piping and components shall be performed annually by a qualified representative of the equipment owner. [55:7.6.5.1]

63.3.6.7.2

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. [55:7.6.5.2]

63.3.6.7.3

Scheduled maintenance and retest activities shall be formally documented, and records shall be maintained a minimum of 3 years. [55:7.6.5.3]

63.3.7 Oxidizing Gases

63.3.7.1 General

The storage or use of oxidizing compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.7. [55:7.7.1]

63.3.7.2 Distance to Exposures

The outdoor storage or use of oxidizing compressed gas shall be in accordance with Table 63.3.7.2. [55:7.7.2]

Table 63.3.7.2 Distance to Exposures for Oxidizing Gases

Quantity of Gas Stored (at NTP)

Distance to a Building Not Associated with the Manufacture or Distribution of Oxidizing Gases or to a Public Way or Property Line

Minimum Distance Between Storage Areas

scf

Nm3

ft

m

ft

m

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

[55: Table 7.7.2]

63.3.7.2.1

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. [55:7.7.2.1]

63.3.7.2.1.1\*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.7.2.1.1]

63.3.7.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.7.2.1.2]

63.3.7.2.2

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter. [55:7.7.2.2]

63.3.7.2.3

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [55:7.7.2.3]

63.3.8 Pyrophoric Gases

63.3.8.1 General

Pyrophoric compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be stored and used in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.8. [55:7.8.1]

63.3.8.2 Silane and Silane Mixtures

Silane and silane mixtures shall be stored, used, and handled in accordance with the provisions of ANSI/CGA G-13, Storage and Handling of Silane and Silane Mixtures. [55:7.8.2]

63.3.8.3 Distance to Exposures

The outdoor storage or use of pyrophoric compressed gas shall be in accordance with Table 63.3.8.3. [55:7.8.3]

Table 63.3.8.3 Distance to Exposures for Pyrophoric Gases

Minimum Distance to Buildings on the Same Property

Maximum Amount per Storage Area

Minimum Distance Between Storage Areas

Minimum Distance to Property Lines

Minimum Distance to Public Ways

Less Than 2-Hour Construction

2-Hour Construction

4-Hour Construction

scf

Nm3

ft

m

ft

m

ft

m

ft

m

ft

m

ft

m

250

7.1

5

1.5

25

7.6

5

1.5

5

1.5

0

0

0

0

>250 to 2500

>7.1 to 71.0

10

3.0

50

15.2

10

3.0

10

3.0

5

1.5

0

0

>2500 to 7500

>71.0 to 212.4

20

6.0

100

30.5

20

6.0

20

6.0

10

3.0

0

0

[55: Table 7.8.3]

63.3.8.3.1

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. [55:7.8.3.1]

63.3.8.3.1.1\*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.8.3.1.1]

63.3.8.3.1.2

The fire barrier shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.8.3.1.2]

63.3.8.3.1.3

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter. [55:7.8.3.1.3]

63.3.8.3.1.4

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [55:7.8.3.1.4]

63.3.8.3.2

Storage and use of pyrophoric gases outside buildings shall be separated from building openings by 25 ft (7.6 m). [55:7.8.3.2]

63.3.8.3.2.1

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. [55:7.8.3.2.1]

63.3.9 Toxic and Highly Toxic Gases

63.3.9.1 General

The storage or use of toxic and highly toxic gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.9. [55:7.9.1]

63.3.9.2 Ventilation and Arrangement

63.3.9.2.1 Indoors

The indoor storage or use of highly toxic gases or toxic gases shall be provided with a gas cabinet, exhausted enclosure, or gas room. [55:7.9.2.1]

63.3.9.2.1.1

Gas cabinets shall be in accordance with 63.2.17. [55:7.9.2.1.1]

63.3.9.2.1.2

Exhausted enclosures shall be in accordance with 63.2.18. [55:7.9.2.1.2]

63.3.9.2.1.3

Gas rooms shall be in accordance with 63.2.4. [55:7.9.2.1.3]

63.3.9.2.2 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. [55:7.9.2.2]

63.3.9.2.2.1

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. [55:7.9.2.2.1]

63.3.9.2.2.1.1\*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.9.2.2.1.1]

63.3.9.2.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.9.2.2.1.2]

63.3.9.2.2.1.3

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure. [55:7.9.2.2.1.3]

63.3.9.2.2.1.4

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). [55:7.9.2.2.1.4]

63.3.9.2.2.2

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. [55:7.9.2.2.2]

63.3.9.2.3 Air Intakes

Storage and use of toxic and highly toxic compressed gases shall not be located within 75 ft (23 m) of air intakes. [55:7.9.2.3]

63.3.9.3 Treatment Systems

Except as provided in 63.3.9.3.1 and 63.3.9.3.2, 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. [55:7.9.3]

63.3.9.3.1 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 63.3.9.3.1.1 through 63.3.9.3.1.3. [55:7.9.3.1]

63.3.9.3.1.1 Valve Outlets Protected

Valve outlets shall be equipped with outlet plugs or caps, or both, rated for the container service pressure. [55:7.9.3.1.1]

63.3.9.3.1.2 Handwheels Secured

Where provided, handwheel-operated valves shall be secured to prevent movement. [55:7.9.3.1.2]

63.3.9.3.1.3 Containment Devices Provided

Approved cylinder containment vessels or cylinder containment systems shall be provided at an approved location. [55:7.9.3.1.3]

63.3.9.3.2 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 63.3.9.3.2.1 and 63.3.9.3.2.2. [55:7.9.3.2]

63.3.9.3.2.1 Gas Detection

63.3.9.3.2.1.1

A gas detection system with a sensing interval not exceeding 5 minutes shall be provided. [55:7.9.3.2.1.1]

63.3.9.3.2.1.2

The gas detection system shall monitor the exhaust system at the point of discharge from the gas cabinet, exhausted enclosure, or gas room. [55:7.9.3.2.1.2]

63.3.9.3.2.2 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. [55:7.9.3.2.2]

63.3.9.3.2.2.1

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. [55:7.9.3.2.2.1]

63.3.9.3.2.2.2

For attended operations, a manual closing valve shall be permitted when in accordance with 63.3.9.3.4.3. [55:7.9.3.2.2.2]

63.3.9.3.2.2.3

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. [55:7.9.3.2.2.3]

63.3.9.3.2.2.4

The gas detection system shall also alert persons on-site and a responsible person 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. [55:7.9.3.2.2.4]

63.3.9.3.3 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. [55:7.9.3.3]

63.3.9.3.3.1

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. [55:7.9.3.3.1]

63.3.9.3.3.2

Treatment systems shall be capable of reducing the allowable discharge concentrations to one-half the IDLH threshold at the point of discharge. [55:7.9.3.3.2]

63.3.9.3.4 Treatment System Sizing

63.3.9.3.4.1 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 63.3.9.3.4.2. [55:7.9.3.4.1]

63.3.9.3.4.2 Largest Compressed Gas Vessel

The entire contents of the single largest compressed gas vessel shall be considered. [55:7.9.3.4.2]

63.3.9.3.4.3 Attended Operations — Alternative Method of System Sizing

63.3.9.3.4.3.1

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. [55:7.9.3.4.3.1]

63.3.9.3.4.3.2

Such process piping systems shall comply with the requirements of 63.3.9.3.4.3.2(A) through 63.3.9.3.4.3.2(E). [55:7.9.3.4.3.2]

(A) Local Exhaust

All gas transfer operations shall be conducted within a zone of local exhaust that is connected to a treatment system. [55:7.9.3.4.3.2(A)]

(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 the following requirements also shall apply:

The system shall be capable of detecting gas at the permissible exposure limit (PEL) or the ceiling limit for the gas being processed.

Activation of the gas detection system shall provide a local alarm.

[55:7.9.3.4.3.2(B)]

(C) Process Shutdown

Operations involving the gas detected shall be shut down and leaks repaired. [55:7.9.3.4.3.2(C)]

(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. [55:7.9.3.4.3.2(D)]

(E) Piping System Accessibility

Piping systems shall be designed to provide for readily accessible manual shutdown controls. [55:7.9.3.4.3.2(E)]

63.3.9.3.5 Rate of Release

The time release shall be in accordance with Table 63.3.9.3.5 for the type of container indicated. [55:7.9.3.5]

Table 63.3.9.3.5 Rates of Release

Container Type

Time Release

Nonliquefied Gases

Liquefied Gases

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

[55: Table 7.9.3.5]

63.3.9.3.6\* Maximum Flow Rate of Release

63.3.9.3.6.1

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. [55:7.9.3.6.1]

63.3.9.3.6.2\*

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:

[63.3.9.3.6.2]

where:

CFM

= standard cubic feet per minute of gas of concern under

flow conditions

A

= area of orifice in square inches (See Table A.63.3.9.3.6 for

areas of typical restricted flow orifices.)

P

= supply pressure of gas at NTP in pounds per square

inch absolute

MW

= molecular weight [55:7.9.3.6.2]

63.3.9.3.6.3

For mixtures, the average of the molecular weights shall be used. [55:7.9.3.6.3]

63.3.9.4 Leaking Cylinders, Containers, and Tanks

When cylinders, containers, or tanks are used outdoors in excess of the quantities specified in Table 63.2.3.1.1 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 63.3.9.4.1 through 63.3.9.4.2.3. [55:7.9.4]

63.3.9.4.1 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 63.3.9.3. [55:7.9.4.1]

63.3.9.4.2 Containment Vessels or Systems

Where containment vessels or containment systems are provided, they shall comply with the requirements of 63.3.9.4.2.1 through 63.3.9.4.2.3. [55:7.9.4.2]

63.3.9.4.2.1 Performance

Containment vessels or containment systems shall be capable of fully containing or terminating a release. [55:7.9.4.2.1]

63.3.9.4.2.2 Personnel

Trained personnel capable of operating the containment vessel or containment system shall be available at an approved location. [55:7.9.4.2.2]

63.3.9.4.2.3 Location

Containment vessels or systems shall be capable of being transported to the leaking cylinder, container, or tank. [55:7.9.4.2.3]

63.3.9.5 Emergency Power

63.3.9.5.1 General

Emergency power shall comply with the requirements of 63.3.9.5 in accordance with NFPA 70. [55:7.9.5.1]

63.3.9.5.2 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. [55:7.9.5.2]

63.3.9.5.3 Where Required

Emergency power shall be provided for the following systems:

Exhaust ventilation

Treatment system

Gas detection system

Temperature control system

Required alarm systems

[55:7.9.5.3]

63.3.9.5.4 Level

Emergency power systems shall comply with the requirements for a Level 2 system in accordance with NFPA 110. [55:7.9.5.4]

63.3.9.6 Gas Detection

Except as provided in 63.3.9.6.1, a continuous gas detection system in accordance with the requirements of 63.3.9.6.2 through 63.3.9.6.6 shall be provided for the indoor storage or use of toxic or highly toxic compressed gases. [55:7.9.6]

63.3.9.6.1 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. [55:7.9.6.1]

63.3.9.6.2 Local Alarm

The gas detection system shall initiate a local alarm that is both audible and visible. [55:7.9.6.2]

63.3.9.6.3 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. [55:7.9.6.3]

63.3.9.6.4 Automatic Shutdown

63.3.9.6.4.1

Activation of the gas detection system shall automatically shut off the flow of gas related to the system being monitored. [55:7.9.6.4.1]

63.3.9.6.4.2

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), constantly attended, and provided with readily accessible emergency shutoff valves. [55:7.9.6.4.2]

63.3.9.6.5 Detection Points

Detection shall be provided at the locations specified in 63.3.9.6.5.1 through 63.3.9.6.5.4. [55:7.9.6.5]

63.3.9.6.5.1 Treatment System Discharge

Detection shall be provided at the discharge from the treatment system. [55:7.9.6.5.1]

63.3.9.6.5.2 Point of Use

Detection shall be provided in the room or area in which the gas is used. [55:7.9.6.5.2]

63.3.9.6.5.3 Source

Detection shall be provided at the source cylinder, container, or tank used for delivery of the gas to the point of use. [55:7.9.6.5.3]

63.3.9.6.5.4 Storage

Detection shall be provided in the room or area in which the gas is stored. [55:7.9.6.5.4]

63.3.9.6.6 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 63.3.9.6.5.2 and 63.3.9.6.5.3 and at not less than one-half the IDLH level for points identified in 63.3.9.6.5.1. [55:7.9.6.6]

63.3.9.7 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. [55:7.9.7]

63.3.10 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 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55 and 63.3.1 through 63.3.3 and 63.3.10. [55:7.10]

63.3.10.1 Distances to Exposures for Class 2

63.3.10.1.1

The outdoor storage or use of unstable reactive Class 2 compressed gas shall not be within 20 ft (6 m) of buildings, lot lines, streets, alleys, or public ways or means of egress. [55:7.10.1.1]

63.3.10.1.2

A 2-hour fire barrier wall without openings or penetrations shall be permitted in lieu of the 20 ft (6 m) distance required by 63.3.10.1.1. [55:7.10.1.2]

63.3.10.1.2.1\*

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.10.1.2.1]

63.3.10.1.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building. [55:7.10.1.2.2]

63.3.10.1.2.3

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure. [55:7.10.1.2.3]

63.3.10.1.2.4

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). [55:7.10.1.2.4]

63.3.10.2 Distances to Exposures for Class 3

63.3.10.2.1

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. [55:7.10.2.1]

63.3.10.2.2

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 63.3.10.2.1. [55:7.10.2.2]

63.3.10.2.2.1\*

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [55:7.10.2.2.1]

63.3.10.2.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [55:7.10.2.2.2]

63.3.10.2.2.3

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure. [55:7.10.2.2.3]

63.3.10.2.2.4

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). [55:7.10.2.2.4]

63.3.10.3 Storage Configuration

63.3.10.3.1

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 ft2 (9.3 m2). [55:7.10.3.1]

63.3.10.3.2

Multiple areas shall be separated by aisles. [55:7.10.3.2]

63.3.10.3.3

Aisle widths shall not be less than the height of the cylinders, containers, or tanks or 4 ft (1.2 m), whichever is greater. [55:7.10.3.3]

63.3.10.4 Basements

Unstable reactive compressed gases shall not be stored in basements. [55:7.10.4]

63.3.10.5 Unstable Reactive Gases (Detonable)

63.3.10.5.1 Storage or Use

The storage or use of unstable reactive (detonable) gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 63.2.3.1.1 shall be in accordance with Chapters 1 through 6 of NFPA 55, 63.3.1 through 63.3.3, and 63.3.10.5. [55:7.10.5.1]

63.3.10.5.2 Location

The location of storage areas shall be determined based on the requirements of the building code for explosive materials. [55:7.10.5.2]

63.4 Cryogenic Fluids

63.4.1 General

This section shall apply to all cryogenic fluids, including those fluids regulated elsewhere in this Code, except that where specific requirements are provided in Sections 63.5, 63.7, or 63.12, those specific requirements shall apply in accordance with the applicable chapter. [55:8.1]

63.4.1.1

Storage, use, and handling of cryogenic fluids shall be in accordance with Chapters 1 through 6 of NFPA 55 and Section 63.4 as applicable. [55:8.1.1]

63.4.2\* Containers — Design, Construction, and Maintenance

Containers employed for the storage or use of cryogenic fluids shall be designed, fabricated, tested, marked (i.e., stamped), and maintained in accordance with Department of Transportation (DOT) regulations, Transport Canada's (TC) Transportation of Dangerous Goods Regulations, the ASME Boiler and Pressure Vessel Code, "Rules for the Construction of Unfired Pressure Vessels", or regulations of other administering agencies. [55:8.2]

63.4.2.1 Aboveground Tanks

Aboveground tanks for the storage of cryogenic fluids shall be in accordance with 63.4.2.1. [55:8.2.1]

63.4.2.1.1 Construction of the Inner Vessel

The inner vessel of storage tanks in cryogenic fluid service shall be designed and constructed in accordance with the ASME Boiler and Pressure Vessel Code and shall be vacuum jacketed in accordance with 63.4.2.1.2. [55:8.2.1.1]

63.4.2.1.2 Construction of the Vacuum Jacket (Outer Vessel)

63.4.2.1.2.1

The vacuum jacket used as an outer vessel for storage tanks in cryogenic fluid service shall be designed to withstand the maximum internal and external pressure to which it will be subjected under operating conditions, including conditions of emergency pressure relief of the annular space between the inner vessel and the outer vessel. [55:8.2.1.2.1]

63.4.2.1.2.2

The jacket shall be designed to withstand a minimum collapsing pressure differential of 30 psi (207 kPa). [55:8.2.1.2.2]

63.4.2.1.2.3 Vacuum Level Monitoring

63.4.2.1.2.3.1

A connection shall be provided on the exterior of the vacuum jacket to allow measurement of the pressure within the annular space between the inner vessel and the outer vessel. [55:8.2.1.2.3.1]

63.4.2.1.2.3.2

The connection shall be fitted with a bellows-sealed or diaphragm-type valve equipped with a vacuum gauge tube that is shielded to protect against damage from impact. [55:8.2.1.2.3.2]

63.4.2.2 Nonstandard Containers

63.4.2.2.1

Containers, equipment, and devices that are not in compliance with recognized standards for design and construction shall be permitted if approved by the AHJ upon presentation of evidence that they are designed and constructed for safe operation. [55:8.2.2.1]

63.4.2.2.2

The following data shall be submitted to the AHJ with reference to the deviation from the standard with the application for approval:

Type and use of container, equipment, or device

Material to be stored, used, or transported

Description showing dimensions and materials used in construction

Design pressure, maximum operating pressure, and test pressure

Type, size, and setting of pressure relief devices

[55:8.2.2.2]

63.4.2.3 Foundations and Supports

Stationary tanks shall be provided with concrete or masonry foundations or structural steel supports on firm concrete or masonry foundations, and the requirements of 63.4.2.3.1 through 63.4.2.3.5 also shall apply. [55:8.2.3]

63.4.2.3.1 Excessive Loads

Stationary tanks shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell. [55:8.2.3.1]

63.4.2.3.2 Expansion and Contraction

Foundations for horizontal containers shall be constructed to accommodate expansion and contraction of the container. [55:8.2.3.2]

63.4.2.3.3\* Support of Ancillary Equipment

63.4.2.3.3.1

Foundations shall be provided to support the weight of vaporizers or heat exchangers. [55:8.2.3.3.1]

63.4.2.3.3.2

Foundations shall be designed to withstand soil and frost conditions as well as the anticipated seismic, snow, wind, and hydrostatic loading under operating conditions. [55:8.2.3.3.2]

63.4.2.3.4 Temperature Effects

Where drainage systems, terrain, or surfaces beneath stationary tanks are arranged in a manner that can subject stationary tank foundations or supports to temperatures below -130°F (-90°C), the foundations or supports shall be constructed of materials that are capable of withstanding the low-temperature effects of cryogenic fluid spillage. [55:8.2.3.4]

63.4.2.3.5 Corrosion Protection

Portions of stationary tanks in contact with foundations or saddles shall be painted to protect against corrosion. [55:8.2.3.5]

63.4.2.4 Pressure Relief Devices

63.4.2.4.1 General

63.4.2.4.1.1

Where a bulk gas source system is connected to an indoor cryogenic fluid piping system protected by a pressure relief device that is designed to protect against exceeding the maximum allowable working pressure or maximum process operating pressure, releases shall be directed to a safe location outdoors to the open air. [55:8.2.4.1.1]

63.4.2.4.1.2

Pressure relief devices shall be provided to protect containers and piping systems containing cryogenic fluids from damage due to overpressure. [55:8.2.4.1.2]

63.4.2.4.1.3

Pressure relief devices shall be designed in accordance with CGA S-1.1, Pressure Relief Device Standards — Part 1 — Cylinders for Compressed Gases, and CGA S-1.2, Pressure Relief Device Standards — Part 2 — Cargo and Portable Tanks for Compressed Gases, for portable tanks; and CGA S-1.3, Pressure Relief Device Standards — Part 3 — Stationary Storage Containers for Compressed Gases, for stationary tanks. [55:8.2.4.1.3]

63.4.2.4.2 Containers Open to the Atmosphere

Portable containers that are open to the atmosphere and are designed to contain cryogenic fluids at atmospheric pressure shall not be required to be equipped with pressure relief devices. [55:8.2.4.2]

63.4.2.4.3 Equipment Other Than Containers

Heat exchangers, vaporizers, insulation casings surrounding containers, vessels, and coaxial piping systems in which liquefied cryogenic fluids could be trapped due to leakage from the primary container shall be provided with a pressure relief device. [55:8.2.4.3]

63.4.2.4.4 Sizing

63.4.2.4.4.1

Pressure relief devices shall be sized in accordance with the specifications to which the container was fabricated. [55:8.2.4.4.1]

63.4.2.4.4.2

The pressure relief device shall have the capacity to prevent the maximum design pressure of the container or system from being exceeded. [55:8.2.4.4.2]

63.4.2.4.5 Accessibility

Pressure relief devices shall be located such that they are accessible for inspection and repair. [55:8.2.4.5]

63.4.2.4.5.1\*

ASME pressure relief valves shall be made to be tamper resistant in order to prevent adjusting of the set pressure by other than authorized personnel. [55:8.2.4.5.1]

63.4.2.4.5.2

Non-ASME pressure relief valves shall not be field adjusted. [55:8.2.4.5.2]

63.4.2.4.6 Arrangement

63.4.2.4.6.1 Pressure Relief Devices

Pressure relief devices shall be arranged to discharge unobstructed to the open air in such a manner as to prevent impingement of escaping gas on personnel, containers, equipment, and adjacent structures or its entrance into enclosed spaces. [55:8.2.4.6.1]

63.4.2.4.6.2 Portable Containers With Volume Less Than 2.0 scf (0.057 Nm3)

63.4.2.4.6.2.1

The arrangement of the discharge from pressure relief devices from DOT-specified containers with an internal water volume of 2.0 scf (0.057 Nm3) or less shall be incorporated in the design of the container. [55:8.2.4.6.2.1]

63.4.2.4.6.2.2

Additional safeguards regarding placement or arrangement shall not be required. [55:8.2.4.6.2.2]

63.4.2.4.7 Shutoffs Between Pressure Relief Devices and Containers

63.4.2.4.7.1 General

Shutoff valves installed between pressure relief devices and containers shall be in accordance with 63.4.2.4.7. [55:8.2.4.7.1]

63.4.2.4.7.2 Location

Shutoff valves shall not be installed between pressure relief devices and containers unless the valves or their use meet the requirements of 63.4.2.4.7.2.1 or 63.4.2.4.7.2.2. [55:8.2.4.7.2]

63.4.2.4.7.2.1\* Security

Shutoff valves shall be locked in the open position, and their use shall be limited to service-related work performed by the supplier under the requirements of the ASME Boiler and Pressure Vessel Code. [55:8.2.4.7.2.1]

63.4.2.4.7.2.2 Multiple Pressure Relief Devices

Shutoff valves controlling multiple pressure relief devices on a container shall be installed so that either the type of valve installed or the arrangement provides the full required flow through the relief devices at all times. [55:8.2.4.7.2.2]

63.4.2.4.8 Temperature Limits

Pressure relief devices shall not be subjected to cryogenic fluid temperatures except when operating. [55:8.2.4.8]

63.4.3 Pressure Relief Vent Piping

63.4.3.1 General

Pressure relief vent piping systems shall be constructed and arranged to direct the flow of gas to a safe location and in accordance with 63.4.3. [55:8.3.1]

63.4.3.2 Sizing

Pressure relief device vent piping shall have a cross-sectional area not less than that of the pressure relief device vent opening and shall be arranged so as not to restrict the flow of escaping gas. [55:8.3.2]

63.4.3.3 Arrangement

Pressure relief device vent piping and drains in vent lines shall be arranged so that escaping gas discharges unobstructed to the open air and does not impinge on personnel, containers, equipment, and adjacent structures or enter enclosed spaces. [55:8.3.3]

63.4.3.4 Installation

Pressure relief device vent lines shall be installed in a manner that excludes or removes moisture and condensation to prevent malfunction of the pressure relief device due to freezing or ice accumulation. [55:8.3.4]

63.4.3.5 Overfilling

Controls shall be provided to prevent overfilling of stationary containers. [55:8.3.5]

63.4.4 Marking

63.4.4.1 General

Cryogenic containers and systems shall be marked in accordance with nationally recognized standards and in accordance with 63.4.4. [55:8.4.1]

63.4.4.1.1 Portable Containers

63.4.4.1.1.1

Portable cryogenic containers shall be marked in accordance with CGA C-7, Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers. [55:8.4.1.1.1]

63.4.4.1.1.2\*

All DOT-4L/TC-4LM liquid cylinders shall have product identification visible from all directions with minimum 2 in. (51 mm) high letters. [55:8.4.1.1.2]

63.4.4.1.2 Stationary Tanks

Stationary tanks shall be marked in accordance with NFPA 704. [55:8.4.1.2]

63.4.4.1.3 Identification Signs

Visible hazard identification signs shall be provided in accordance with NFPA 704 at entrances to buildings or areas in which cryogenic fluids are stored, handled, or used. [55:8.4.1.3]

63.4.4.2 Identification of Contents

Stationary containers shall be placarded with the identity of their contents to indicate the name of the material contained. [55:8.4.2]

63.4.4.3 Container Specification

Stationary containers shall be marked with the manufacturing specification and maximum allowable working pressure on a permanent nameplate. [55:8.4.3]

63.4.4.3.1

The nameplate shall be installed on the container in an accessible location. [55:8.4.3.1]

63.4.4.3.2

The nameplate shall be marked in accordance with nationally recognized standards. [55:8.4.3.2]

63.4.4.4 Identification of Container Connections

63.4.4.4.1

Container inlet and outlet connections, liquid-level limit controls, valves, and pressure gauges shall be identified using one of the methods prescribed by 63.4.4.4.1.1 through 63.4.4.4.1.2. [55:8.4.4.1]

63.4.4.4.1.1

They shall be marked with a permanent tag or label identifying their function. [55:8.4.4.1.1]

63.4.4.4.1.2

They shall be identified by a schematic drawing that indicates their function and designates whether they are connected to the vapor or liquid space of the container. [55:8.4.4.1.2]

63.4.4.4.1.2.1

When a schematic drawing is provided, it shall be attached to the container and maintained in a legible condition. [55:8.4.4.1.2.1]

63.4.4.5 Identification of Piping Systems

Piping systems shall be identified in accordance with ASME A13.1, Scheme for the Identification of Piping Systems. [55:8.4.5]

63.4.4.6 Identification of Emergency Shutoff Valves

Emergency shutoff valves on stationary containers shall be identified, visible, and indicated by means of a sign. [55:8.4.6]

63.4.5 Security

63.4.5.1 General

Cryogenic containers and systems shall be secured against accidental dislodgement and against access by unauthorized personnel in accordance with 63.4.5. [55:8.5.1]

63.4.5.2\* Security of Areas

Areas used for the storage of containers and systems shall be secured against unauthorized entry. [55:8.5.2]

63.4.5.2.1

Administrative controls shall be allowed to be used to control access to individual storage areas located in secure facilities not accessible by the general public. [55:8.5.2.1]

63.4.5.3 Securing of Containers

Stationary containers shall be secured to foundations in accordance with the building code. [55:8.5.3]

63.4.5.3.1

Portable containers subject to shifting or upset shall be secured. [55:8.5.3.1]

63.4.5.3.2

Nesting shall be permitted as a means of securing portable containers. [55:8.5.3.2]

63.4.5.4 Securing of Vaporizers

Vaporizers, heat exchangers, and similar equipment shall be secured to foundations, and their connecting piping shall be designed and constructed to provide for the effects of expansion and contraction due to temperature changes. [55:8.5.4]

63.4.5.5 Physical Protection

Containers, piping, valves, pressure relief devices, regulating equipment, and other appurtenances shall be protected against physical damage and tampering. [55:8.5.5]

63.4.6 Separation From Hazardous Conditions

63.4.6.1 General

Cryogenic containers and systems in storage or use shall be separated from materials and conditions that present exposure hazards to or from each other in accordance with 63.4.6. [55:8.6.1]

63.4.6.2\* Stationary Cryogenic Containers

Stationary containers located outdoors shall be separated from exposure hazards in accordance with the minimum separation distances indicated in Table 63.4.6.2. [55:8.6.2]

Table 63.4.6.2 Minimum Separation Distance Between Stationary Cryogenic Containers and Exposures

Exposure

Minimum Distance

ft

m

(1) Buildings, regardless of construction type

1

0.3

(2) Wall openings

1

0.3

(3) Air intakes

10

3.1

(4) Property lines

5

1.5

(5) Places of public assembly (assembly occupancies)

50

15

(6) Nonambulatory patient areas

50

15

(7) Combustible materials, (e.g., paper, leaves, weeds, dry grass, debris)

15

4.5

(8) Incompatible hazardous materials

20

6.1

(9) Building exits

10

3.1

[55: Table 8.6.2]

63.4.6.2.1 Fire Barriers

A 2-hour fire barrier wall shall be permitted in lieu of the distances specified in Table 63.4.6.2 for items 1, 4, 7, 8 and 9, where in accordance with the provisions of 63.4.6.2.1.1 through 63.4.6.2.1.4. [55:8.6.2.1]

63.4.6.2.1.1

The fire barrier wall shall be without openings or penetrations. [55:8.6.2.1.1]

63.4.6.2.1.1.1

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. [55:8.6.2.1.1.1]

63.4.6.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage system. [55:8.6.2.1.2]

63.4.6.2.1.3

The fire barrier wall shall be located not less than 5 ft (1.5 m) from any exposure. [55:8.6.2.1.3]

63.4.6.2.1.4

The fire barrier 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). [55:8.6.2.1.4]

63.4.6.2.1.4.1\*

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 63.4.12.2.7.2. [55:8.6.2.1.4.1]

63.4.6.2.1.5

Where the requirement of 63.4.6.2.1.4 is met, the bulk system shall be a minimum distance of 1 ft (0.3 m) from the fire barrier wall. [55:8.6.2.1.5]

63.4.6.2.2 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 63.4.6.2. [55:8.6.2.2]

63.4.6.2.3 Surfaces Beneath Containers

The surface of the area on which stationary containers are placed, including the surface of the area located below the point at which connections are made for the purpose of filling such containers, shall be compatible with the fluid in the container. [55:8.6.2.3]

63.4.6.3 Portable Cryogenic Containers

Portable containers used for cryogenic fluids located outdoors shall be separated from exposure hazards in accordance with Table 63.4.6.3. [55:8.6.3]

Table 63.4.6.3 Minimum Separation Distance Between Portable Cryogenic Containers and Exposures

Minimum Distance

Exposure

ft

m

(1) Building exits

10

3.1

(2) Wall openings

1

0.3

(3) Air intakes

10

3.1

(4) Property lines

5

1.5

(5) Room or area exits

3

0.9

(6) Combustible materials, (e.g., paper, leaves, weeds, dry grass, or debris)

15

4.5

(7) Incompatible hazardous materials

20

6.1

[55: Table 8.6.3]

63.4.6.3.1

Non-bulk portable containers of liquefied hydrogen shall be separated from exposure hazards in accordance with Table 63.4.6.3.1. [55:8.6.3.1]

Table 63.4.6.3.1 Distance to Exposures for Non-Bulk Liquefied Hydrogen (LH2)

Minimum Distance to Buildings on the Same Property

Maximum Amount per Storage Area (gal)

Minimum Distance Between Storage Areas (ft)

Minimum Distance to Lot Lines of Property That Can Be Built Upon (ft)

Minimum Distance to Public Streets, Public Alleys, or Public Ways (ft)

Less than 2-Hour Construction

2-Hour Construction

4-Hour Construction

0-39.7

5

5

5

5

0

0

39.8-186.9

10

10

10

10

5

0

187-448.7

10

15

15

20

5

0

448.8-747.8

10

20

20

20

5

0

>747.8

20

25

25

20

5

0

For SI units: 1 ft = 305 mm.

Notes:

For requirements on minimum distance to air intakes, see 63.3.6.2.4.

For requirements on minimum distance to building openings including exits, see 63.3.6.2.5.

When 63.4.6.3.2 is used as a means of distance reduction, the configuration of the fire barriers should be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

[55:Table 8.6.3.1]

63.4.6.3.2 Fire Barriers

A 2-hour fire barrier wall shall be permitted in lieu of the distances specified by Table 63.4.6.3 or Table 63.4.6.3.1 when in accordance with the provisions of 63.4.6.3.2.1 through 63.4.6.3.2.4. [55:8.6.3.2]

63.4.6.3.2.1

The fire barrier wall shall be without openings or penetrations. [55:8.6.3.2.1]

63.4.6.3.2.1.1

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. [55:8.6.3.2.1.1]

63.4.6.3.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage system. [55:8.6.3.2.2]

63.4.6.3.2.3

The fire barrier wall shall be located not less than 5 ft (1.5 m) from any exposure. [55:8.6.3.2.3]

63.4.6.3.2.4

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). [55:8.6.3.2.4]

63.4.7 Electrical Wiring and Equipment

63.4.7.1 General

Electrical wiring and equipment shall be in accordance with NFPA 70 and NFPA 79, as applicable, and 63.4.7. [55:8.7.1]

63.4.7.2 Location

Containers and systems shall not be located where they could become part of an electrical circuit. [55:8.7.2]

63.4.7.3 Electrical Grounding and Bonding

Containers and systems shall not be used for electrical grounding. [55:8.7.3]

63.4.7.3.1

When electrical grounding and bonding are required, the system shall be in accordance with NFPA 70. [55:8.7.3.1]

63.4.7.3.2

The grounding system shall be protected against corrosion, including corrosion caused by stray electrical currents. [55:8.7.3.2]

63.4.8 Service and Repair

Service, repair, modification, or removal of valves, pressure relief devices, or other container appurtenances shall be in accordance with nationally recognized codes and standards. [55:8.8]

63.4.8.1 Containers

Containers that have been removed from service shall be handled in an approved manner. [55:8.8.1]

63.4.8.1.1 Testing

Containers out of service in excess of 1 year shall be inspected and tested as required under 63.4.8.1.2. [55:8.8.1.1]

63.4.8.1.2 Pressure Relief Device Testing

The pressure relief devices shall be tested for operability and to determine if they are set at the relief pressure required by the tank design. [55:8.8.1.2]

63.4.8.1.3

Containers that have previously been used for flammable cryogenic fluids and have been removed from service shall be purged with an inert gas to remove residual flammable gas and stored with all valves closed and the valve outlets plugged. [55:8.8.1.3]

63.4.8.2 Systems

Service and repair of containers or systems shall be performed by trained personnel in accordance with nationally recognized standards and with the permission of the container owner. [55:8.8.2]

63.4.9 Unauthorized Use

Containers shall not be used for any purpose other than to serve as a vessel for containing the product for which it is designated. [55:8.9]

63.4.10 Leaks, Damage, and Corrosion

63.4.10.1

Leaking, damaged, or corroded containers shall be removed from service. [55:8.10.1]

63.4.10.2

Leaking, damaged, or corroded systems shall be replaced, repaired, or removed from service. [55:8.10.2]

63.4.11 Lighting

Where required by the AHJ, lighting, including emergency lighting, shall be provided for fire appliances and operating facilities such as walkways, control valves, and gates ancillary to stationary containers. [55:8.11]

63.4.12 Storage

63.4.12.1 Indoor Storage

63.4.12.1.1 Installation

Stationary containers indoors shall be installed in accordance with Chapters 9 and 11 of NFPA 55 or with ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites. [55:8.12.1.1]

63.4.12.1.2 Stationary Containers

Stationary containers shall be in accordance with 63.4.2. [55:8.12.1.2]

63.4.12.1.3 Cryogenic Fluids

Cryogenic fluids in stationary or portable containers stored indoors shall be stored in buildings, rooms, or areas constructed in accordance with the building code. [55:8.12.1.3]

63.4.12.1.4 Ventilation

Ventilation shall be in accordance with 63.2.16. [55:8.12.1.4]

63.4.12.2 Outdoor Storage

63.4.12.2.1 General

Cryogenic fluids in stationary or portable containers stored outdoors shall be in accordance with 63.4.12.2. [55:8.12.2.1]

63.4.12.2.2 Access

Stationary containers shall be located to provide access by mobile supply equipment and authorized personnel. [55:8.12.2.2]

63.4.12.2.2.1

Where exit access is provided to serve areas in which equipment is installed, the minimum width shall be not less than 28 in. (710 mm). [55:8.12.2.2.1]

63.4.12.2.3 Physical Protection

Cryogenic fluid containers, cylinders, tanks, and systems that could be exposed to physical damage shall be protected. [55:8.12.2.3]

63.4.12.2.3.1

Guard posts or other means shall be provided to protect cryogenic fluid containers, cylinders, tanks, and systems indoors and outdoors from vehicular damage. (See Section 4.11 of NFPA 55.) [55:8.12.2.3.1]

63.4.12.2.4 Diked Areas Containing Other Hazardous Materials

Containers of cryogenic fluids shall not be located within diked areas with other hazardous materials. [55:8.12.2.4]

63.4.12.2.5\* Areas Subject to Flooding

Stationary containers located in flood hazard areas shall be anchored to prevent flotation during conditions of the design flood as designated by the building code. [55:8.12.2.5]

63.4.12.2.5.1 Elevated Tanks

Structures supporting elevated tanks and tanks that are supported at a level above that designated in the design flood shall be anchored to resist lateral shifting due to flood and other hydrostatic effects. [55:8.12.2.5.1]

63.4.12.2.5.2 Underground Tanks

Underground tanks 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. [55:8.12.2.5.2]

63.4.12.2.6 Drainage

63.4.12.2.6.1

The area surrounding stationary and portable containers shall be provided with a means to prevent accidental discharge of fluids from endangering personnel, containers, equipment, and adjacent structures and from entering enclosed spaces in accordance with this Code. [55:8.12.2.6.1]

63.4.12.2.6.2

The stationary container shall not be placed where spilled or discharged fluids will be retained around the container. [55:8.12.2.6.2]

63.4.12.2.6.3

The provisions of 63.4.12.2.6.2 shall be permitted to be altered or waived where the AHJ determines that the container does not constitute a hazard after consideration of special features such as the following:

Crushed rock utilized as a heat sink

Topographical conditions

Nature of occupancy

Proximity to structures on the same or adjacent property

Capacity and construction of containers and character of fluids to be stored

[55:8.12.2.6.3]

63.4.12.2.6.4

The grade for a distance of not less than 50 ft (15.2 m) from where cryogenic fluid storage or delivery systems are installed shall be higher than the grade on which flammable or combustible liquids are stored or used. [55:8.12.2.6.4]

63.4.12.2.6.4.1\* Drainage Control

(A)

Where the grade differential between the storage or delivery system and the flammable or combustible liquids storage or use area is not in accordance with 63.4.12.2.6.4, diversion curbs or other means of drainage control shall be used to divert the flow of flammable or combustible liquids away from the cryogenic system. [55:8.12.2.6.4.1 (A)]

(B)

The means of drainage control shall prevent the flow of flammable or combustible liquid to a distance not less than 50 ft (15.2 m) from all parts of the delivery system. [55:8.12.2.6.4.1(B)]

63.4.12.2.7 Outdoor Installations

63.4.12.2.7.1\* Enclosed Courts

Stationary containers shall not be installed within enclosed courts. [55:8.12.2.7.1]

63.4.12.2.7.2\* Courts

Stationary containers shall be sited so that they are open to the surrounding environment except that encroachment by building walls of unlimited height shall be permitted when in accordance with the distances specified by Table 63.4.6.2 or the material-specific tables in Chapters 9, 11, 13, and 16 of NFPA 55. [55:8.12.2.7.2]

63.4.12.2.7.2.1\*

Where exterior building walls encroach on the system to form a court, the system shall be located at a distance not less than the height of the wall from at least two court walls. [55:8.12.2.7.2.1]

63.4.12.2.7.2.2

The required distance between the exterior walls of the building forming the court and the container shall be determined independently without regard to fire barrier walls used to allow encroachment by fire exposure hazards. [55:8.12.2.7.2.2]

63.4.12.2.7.3 Fire Department Access

Fire apparatus access roadways or other approved means shall be in accordance with Section 18.2. [55:8.12.2.7.3]

63.4.13 Use and Handling

63.4.13.1 General

Use and handling of containers and systems shall be in accordance with 63.4.13. [55:8.13.1]

63.4.13.1.1 Operating Instructions

Operating instructions shall be provided for installations that require the operation of equipment. [55:8.13.1.1]

63.4.13.1.2 Attended Delivery

A qualified person shall be in attendance at all times cryogenic fluid is transferred from mobile supply units to a storage system. [55:8.13.1.2]

63.4.13.1.3 Cleaning and Purging of Gas Piping Systems

Cleaning and purging of piping systems shall be in accordance with 63.3.1.19. [55:8.13.1.3]

63.4.13.1.4 Inspection

63.4.13.1.4.1

Cryogenic fluid storage systems shall be inspected and maintained by a qualified representative of the equipment owner as required by the material-specific requirements of Chapters 9, 11, 13, and 16 of NFPA 55. [55:8.13.1.4.1]

63.4.13.1.4.2\*

The interval between inspections other than those specified by material-specific requirements shall be based on nationally recognized good practices or standards. [55:8.13.1.4.1.1]

63.4.13.1.4.3

A record of the inspection shall be prepared and provided to the user or the AHJ upon request. [55:8.13.1.4.2]

63.4.13.1.5 Design

63.4.13.1.5.1 Nationally Recognized Good Practices

Where nationally recognized good practices or standards have been established for the process employed, such practices and standards shall be followed. [55:8.13.1.5.1]

63.4.13.1.5.2 Piping Systems

Piping, tubing, fittings, and related components shall be designed, fabricated, and tested in accordance with the requirements of ASME B31.3, Process Piping, or other approved standards and shall be in accordance with 63.4.13.2. [55:8.13.1.5.2]

63.4.13.2 Piping and Appurtenances

63.4.13.2.1

Piping systems shall be designed for the use intended through the full range of pressure and temperature to which they will be subjected. [55:8.13.2.1]

63.4.13.2.2

Piping systems shall be designed and constructed to allow for expansion, contraction, vibration, settlement, and fire exposure. [55:8.13.2.2]

63.4.13.3 Joints

Joints in piping and tubing shall be in accordance with the requirements of ASME B31.3, Process Piping, or other approved standards. [55:8.13.3]

63.4.13.4 Valves and Accessory Equipment

Valves and accessory equipment shall be acceptable for the intended use at the temperatures of the application and shall be designed and constructed to withstand the maximum pressure at the minimum temperature to which they will be subjected. [55:8.13.4]

63.4.13.5 Shutoff Valves on Containers

Shutoff valves shall be provided on all container connections, except for pressure relief devices. [55:8.13.5]

63.4.13.5.1

Shutoff valves for containers with multiple pressure relief devices shall be permitted in accordance with 63.4.2.4.7. [55:8.13.5.1]

63.4.13.5.2

Shutoff valves shall be accessible and located as close as practical to the container. [55:8.13.5.2]

63.4.13.6 Shutoff Valves on Piping

63.4.13.6.1

Shutoff valves shall be installed in piping containing cryogenic fluids where needed to limit the volume of liquid discharged in the event of piping or equipment failure. [55:8.13.6.1]

63.4.13.6.2

Pressure relief valves shall be installed where liquid or cold gas can be trapped between shutoff valves in the piping system. (See 63.4.2.4.) [55:8.13.6.2]

63.4.13.7 Physical Protection and Support

63.4.13.7.1

Aboveground piping systems shall be supported and protected from physical damage. [55:8.13.7.1]

63.4.13.7.2

Piping passing through walls shall be protected from mechanical damage. [55:8.13.7.2]

63.4.13.8 Corrosion Protection

63.4.13.8.1

Aboveground piping that is subject to corrosion shall be protected against corrosion. [55:8.13.8.1]

63.4.13.8.2

Belowground piping shall be protected against corrosion. [55:8.13.8.2]

63.4.13.9 Cathodic Protection

Where required, cathodic protection shall be in accordance with 63.4.13.9. [55:8.13.9]

63.4.13.9.1 Operation

Where installed, cathodic protection systems shall be operated and maintained to continuously provide corrosion protection. [55:8.13.9.1]

63.4.13.9.2 Inspection

63.4.13.9.2.1

Container systems equipped with cathodic protection shall be inspected for the intended operation by a cathodic protection tester. [55:8.13.9.2.1]

63.4.13.9.2.1.1

The examinations shall be documented. [55:8.13.9.2.1.1]

63.4.13.9.2.1.2

A record of the examination history shall be maintained by the owner and shall be available to the AHJ upon request. [55:8.13.9.2.1.2]

63.4.13.9.2.2

The cathodic protection tester shall be certified as being qualified by the National Association of Corrosion Engineers, International (NACE). [55:8.13.9.2.2]

63.4.13.9.3 Impressed Current Systems

63.4.13.9.3.1

Systems equipped with impressed current cathodic protection systems shall be inspected in accordance with the requirements of the design and 63.4.13.9.2. [55:8.13.9.3.1]

63.4.13.9.3.2

The design limits shall be available to the AHJ upon request. [55:8.13.9.3.2]

63.4.13.9.3.3

The system owner shall maintain the following records to demonstrate that the cathodic protection is in conformance with the requirements of the design:

The results of inspections of the system

The results of testing that has been completed

[55:8.13.9.3.3]

63.4.13.9.4

Repairs, maintenance, or replacement of a cathodic protection system shall be under the supervision of a corrosion expert certified by NACE. [55:8.13.9.4]

63.4.13.9.4.1

The corrosion expert shall be certified by NACE as a senior corrosion technologist, a cathodic protection specialist, or a corrosion specialist or shall be a registered engineer with registration in a field that includes education and experience in corrosion control. [55:8.13.9.4.1]

63.4.13.10 Testing

63.4.13.10.1

Piping systems shall be tested and proved free of leaks after installation as required by the codes and standards to which they are designed and constructed. [55:8.13.10.1]

63.4.13.10.2

Test pressures shall not be less than 150 percent of the maximum allowable working pressure when hydraulic testing is conducted or 110 percent when testing is conducted pneumatically. [55:8.13.10.2]

63.4.13.11 Material-Specific Requirements

63.4.13.11.1 Indoor Use

Indoor use of cryogenic fluids shall be in accordance with the material-specific provisions of Chapters 9, 11, 13, and 16 of NFPA 55 or with ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites, and 63.4.13.2. [55:8.13.11.1]

63.4.13.11.2 Outdoor Use

63.4.13.11.2.1 General

Outdoor use of cryogenic fluids shall be in accordance with the material-specific provisions of Chapters 9, 11, 13, and 16 of NFPA 55 or with ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites, and 63.4.13.2. [55:8.13.11.2.1]

63.4.13.11.2.2 Separation

Distances from property lines, buildings, and exposure hazards shall be in accordance with Table 63.4.6.2 and Table 63.4.6.3 and the material-specific provisions of Chapters 9, 11, 13, and 16 of NFPA 55 or with ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites. [55:8.13.11.2.2]

63.4.13.11.2.3 Emergency Shutoff Valves

63.4.13.11.2.3.1\*

Accessible manual or automatic emergency shutoff valves shall be provided to shut off the cryogenic fluid supply in case of emergency. [55:8.13.11.2.3.1]

(A)

Manual emergency shutoff valves or the device that activates an automatic emergency shutoff valve on a bulk source or piping systems serving the bulk supply shall be identified by means of a sign. [55:8.13.11.2.3.1(A)]

63.4.13.11.2.3.2

Emergency shutoff valves shall be located at the point of use, at the source of supply, and at the point where the system piping enters the building. [55:8.13.11.2.3.2]

63.4.13.11.3 Filling and Dispensing

63.4.13.11.3.1 General

Filling and dispensing of cryogenic fluids shall be in accordance with 63.4.13.1.2. [55:8.13.11.3.1 ]

63.4.13.11.3.2 Dispensing Areas

Dispensing of cryogenic fluids associated with physical or health hazards shall be conducted in approved locations. [55:8.13.11.3.2]

63.4.13.11.3.2.1 Indoor Dispensing Areas

Dispensing indoors shall be conducted in areas constructed in accordance with the building code. [55:8.13.11.3.2.1]

63.4.13.11.3.2.2 Ventilation

Indoor areas in which cryogenic fluids are dispensed shall be ventilated in accordance with the requirements of 63.2.16 and the mechanical code. [55:8.13.11.3.2.2]

63.4.13.11.3.2.3 Piping Systems

Piping systems utilized for filling or dispensing of cryogenic fluids shall be designed and constructed in accordance with 63.4.13.2. [55:8.13.11.3.2.3]

63.4.13.11.3.3 Vehicle Loading and Unloading Areas

Loading and unloading areas shall be constructed in accordance with the requirements of Chapter 9 of NFPA 55 for liquid oxygen, Chapter 11 of NFPA 55 for liquid hydrogen, Chapter 13 of NFPA 55 for liquid carbon dioxide, and Chapter 16 of NFPA 55 for liquid nitrous oxide or ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites, for inert cryogenic fluids, as applicable. [55:8.13.11.3.3]

63.4.13.11.3.4\*

A noncombustible, delivery vehicle spill pad shall be provided when required by the material-specific requirements of Chapter 9 of NFPA 55 for liquid oxygen, Chapter 11 of NFPA 55 for liquid hydrogen, Chapter 13 of NFPA 55 for liquid carbon dioxide, and Chapter 16 of NFPA 55 for liquid nitrous oxide or ANSI/CGA P-18, Standard for Bulk Inert Gas Systems at Consumer Sites. [55:8.13.11.3.4]

63.4.13.11.3.4.1\*

A noncombustible spill pad shall be provided for delivery areas where bulk liquid helium is transferred from delivery vehicles. [55:8.13.11.3.4.1]

63.4.13.11.3.5 Filling Controls

A pressure gauge and full trycock valve shall be provided and shall be visible from the delivery point to allow the delivery operator to monitor the internal pressure and liquid level of stationary containers during filling. [55:8.13.11.3.5]

63.4.13.11.3.5.1

When the containers being filled are remote from the delivery point and pressure gauges or full trycock valves are not visible, redundant gauges and valves shall be installed at the filling connection. [55:8.13.11.3.5.1]

63.4.13.11.4 Handling

63.4.13.11.4.1 Applicability

Handling of cryogenic containers shall be in accordance 63.4.13.11.4. [55:8.13.11.4.1]

63.4.13.11.4.2 Carts and Trucks

63.4.13.11.4.2.1

Cryogenic containers shall be moved using an approved method. [55:8.13.11.4.2.1]

63.4.13.11.4.2.2

Where cryogenic containers are moved by hand cart, hand truck, or other mobile device, that device shall be designed for the secure movement of the container. [55:8.13.11.4.2.2]

63.4.13.11.4.3 Design

Carts and trucks used to transport cryogenic containers shall be designed to provide a stable base for the commodities to be transported and shall have a means of restraining containers to prevent accidental dislodgement. [55:8.13.11.4.3]

63.4.13.11.4.4 Closed Containers

63.4.13.11.4.4.1

Pressurized containers shall be closed while being transported. [55:8.13.11.4.4.1]

63.4.13.11.4.4.2

Containers designed for use at atmospheric conditions shall be transported with appropriate loose-fitting covers in place to prevent spillage. [55:8.13.11.4.4.2]

63.5 Bulk Oxygen Systems

63.5.1

Bulk oxygen systems shall comply with Chapter 9 of NFPA 55.

63.5.2 Cleaning and Purging of Gas Piping Systems

Cleaning and purging of piping systems shall be in accordance with 63.3.1.19. [55:9.4.1.9]

63.5.3

Cleaning of oxygen systems used in medical gas service shall be in accordance with NFPA 99. (See also 9.4.3.1 of NFPA 55.) [55:9.4.1.9.1]

63.6 Gas Hydrogen Systems

63.6.1

Bulk hydrogen compressed gas systems shall comply with NFPA 2 and Chapter 10 of NFPA 55.

63.6.2

Cleaning and purging of piping systems shall be in accordance with 63.3.1.19. [55:10.2.3.2]

63.7 Bulk Liquefied Hydrogen Systems

63.7.1

Bulk liquefied hydrogen systems shall comply with NFPA 2 and Chapter 11 of NFPA 55.

63.7.2

Cleaning and purging of piping systems shall be in accordance with 63.3.1.19. [55:11.2.3.9]

63.8 Gas Generation Systems

63.8.1 General

Gas generation systems shall comply with NFPA 2 and Chapter 12 of NFPA 55.

63.9 Insulated Liquid Carbon Dioxide Systems

Insulated liquid carbon dioxide systems shall comply with Chapter 13 of NFPA 55.

63.9.1 General

The storage, use, and handling of liquid carbon dioxide in insulated systems shall be in accordance with the provisions of Chapter 13 and Chapters 1 through 7 of NFPA 55, as applicable.

63.9.2 Permits

63.9.2.1

For other than vehicles equipped for and using compressed gas as a fuel for propelling the vehicle, an operational permit shall be required for liquid carbon dioxide systems in excess of 100 lb (45.4 kg) of carbon dioxide.

63.9.2.2

A construction permit shall be required for the installation of, or modification to, a liquid carbon dioxide (CO2) system where the quantity exceeds the amount listed in 63.9.2.

63.9.2.3

The following information shall be provided to the authority having jurisdiction with the application for permit:

Total aggregate quantity of liquid CO2 in pounds or cubic feet at normal temperature and pressure

Location and total volume of the room where the liquid CO2 will be located and whether the room is at or below grade

Location of containers relative to equipment, building openings, and means of egress

Manufacturer's specifications and pressure rating, including cut sheets, of all piping and/or tubing to be used

A piping and instrumentation diagram that shows piping support and remote fill connections

Details of container venting, including, but not limited to, vent line size, material, and termination location

Alarm and detection system and equipment, if applicable

Seismic support for containers

63.9.3 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. [55:13.4.1]

63.9.4 Physical Protection

63.9.4.1

Pressure relief devices shall be located to minimize tampering, damage, and obstruction to flow. [55:13.4.1.1.1]

63.9.4.2

The inlet and outlet of the relief devices shall not be blocked by a valve or plug during normal operation. [55:13.4.1.1.2]

63.9.5 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. [55:13.4.1.2]

63.9.5.1

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 63.9.5. [55:13.4.1.2.1]

63.9.5.2

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. [55:13.4.1.2.2]

63.9.5.3

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. [55:13.4.1.2.3]

63.9.6 Pressure and Level Indicators

63.9.6.1

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. [55:13.4.2.1]

63.9.6.2

These devices shall be designed for the temperatures and pressures associated with liquid carbon dioxide service. [55:13.4.2.2]

63.9.6.3

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. [55:13.4.2.3]

63.9.7 Piping Systems

63.9.7.1

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. [55:13.4.3.1]

63.9.7.2

Piping, tubing, and hoses and fittings shall be designed to a bursting pressure of at least four times the system design pressure. [55:13.4.3.2]

63.9.7.3 Materials of Construction

Materials of construction shall be employed for potential exposure to a temperature of -109.3°F (-78.5°C). [55:13.5]

63.9.7.4 Operating Instructions

Operating instructions shall account for potential exposure of personnel to extremely low temperatures in accordance with 13.7.3 of NFPA 55. [55:13.6]

63.9.8 Safety Measures

63.9.8.1

Rooms or areas inside assembly, business, educational, institutional, and residential occupancies containing a liquid carbon dioxide (CO2) system shall comply with the safety measures in 63.9.9.1.

63.9.8.2

The provisions of 63.9.9.1 shall not apply to liquid carbon dioxide (CO2) systems located above grade in outdoor areas with enclosure walls obstructing on no more than 75 percent of the perimeter at ground level.

63.9.8.3 Gas Detection System

63.9.8.3.1

A continuous gas detection system shall be provided in the room or area where container systems are filled and used, and in areas where the heavier-than-air gas can congregate.

63.9.8.3.2

Carbon dioxide (CO2) sensors shall be provided within 12 in. (305 mm) of the floor in the area where the gas is most likely to accumulate or leaks are most likely to occur.

63.9.8.3.3

The system shall be designed to detect and notify at a low-level alarm and high-level alarm.

63.9.8.4

The threshold for activation of the low-level alarm shall not exceed a carbon dioxide concentration of 5,000 ppm TWA (9,000 mg/m3). When carbon dioxide is detected at the low-level alarm, the system shall activate a signal at a normally attended location within the building.

63.9.8.5

The threshold for activation of the high-level alarm shall not exceed a carbon dioxide concentration of 30,000 ppm (54,000 mg/m3). When carbon dioxide is detected at the high-level alarm, the system shall activate an audible and visual alarm in an approved location.

63.9.9 Signage

63.9.9.1

Hazard identification signs shall be posted at the entrance to the room and confined to the area where liquid carbon dioxide containers are located. The sign shall be a minimum 8 in. (200 mm) wide and 6 in. (150 mm) high and indicate:

CAUTION - CARBON DIOXIDE GAS

Ventilate the area before entering.

A high carbon dioxide (CO2) gas concentration

in this area can cause asphyxiation.

63.9.10 Performance Design Option

63.9.10.1

Carbon dioxide (CO2) systems shall not be required to be provided with a gas detection system where a complete discharge of the stored carbon dioxide cannot result in a concentration exceeding 5,000 ppm in the room where the container is located or the area where the carbon dioxide is likely to congregate. The maximum concentration (ppm) shall be determined as follows:

Calculate the volume (scf) of CO2 gas at standard temperature and pressure that is contained in the storage containers as follows:

To convert pounds of liquid to volume (scf) of CO2 gas, multiply the pounds by 8.741.

To convert gallons of liquid to volume (scf) of CO2 gas, multiply the gallons by 74.04.

Calculate the volume of the room containing the CO2 containers, or the area where the CO2 is likely to congregate, in cubic feet as follows:

The volume of the room or area shall be based on a height limitation of 5 ft (1524 mm) or the ceiling, whichever is less.

The boundary of the area shall be to walls or partitions 5 ft (1524 mm) or more in height that obstruct gas dispersion at the floor level.

All doors in the boundary walls shall be considered closed.

CO2 shall be assumed to congregate in basements, pits, or lower floors where openings are present between the containers and the lower floor.

Divide the volume of CO2 gas by the volume of the room. If the result does not exceed 0.005 (5,000 ppm), the design meets the performance option criteria.

63.9.11 Seismic and Structural Design

63.9.11.1

Liquid carbon dioxide system containers and piping shall comply with the seismic design requirements in accordance with the building code and shall not exceed the floor loading limitation of the building.

63.9.11.2

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.

63.9.12 Small Insulated Liquid Carbon Dioxide Outdoor Systems

63.9.12.1

Container systems located in enclosed spaces shall be in accordance with Section 13.7 of NFPA 55 for indoor systems. [55:13.8.1]

63.9.12.1.1\*

Aboveground outdoor locations shall not be required to be provided with a gas detection and alarm system in accordance with 13.7.2 of NFPA 55 where the system is unenclosed. [55:13.8.1.1]

63.9.12.1.1.1

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 63.2.6 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.

[55:13.8.1.1.1]

63.9.12.1.1.2

Enclosures that do not meet the requirements of 63.9.12.1.1.1 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.

[55:13.8.1.1.2]

63.9.12.1.1.2.1

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 scf/min/ft2 (0.028 Nm3/min/m2) of floor area within the enclosure.

[55:13.8.1.1.2.1]

63.9.13 Large Indoor Insulated Liquid Carbon Dioxide Systems. (Reserved)

63.9.14 Large Outdoor Insulated Liquid Carbon Dioxide Systems

63.9.14.1 Location

Outdoor stationary large insulated liquid carbon dioxide systems shall be located in accordance with Table 63.9.14.1. [55:13.10.1]

Table 63.9.14.1 Minimum Separation Distance Between Outdoor Stationary Large Insulated Liquid Carbon Dioxide Containers and Exposures

Exposure

Minimum Distance

ft

m

Buildings, regardless of construction type

2

0.6

Wall openings other than building exits

2

0.6

Air intakes

10

3.1

Property lines

5

1.5

Places of public assembly (assembly occupancies)

50

15

Nonambulatory patient areas

50

15

Combustible materials, (e.g., paper, leaves, weeds, dry grass, debris)

15

4.5

Incompatible hazardous materials

20

6.1

Building exits

10

3.1

[55:13.10.1]

63.9.14.2 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 63.9.14.1. [55:13.10.1.1]

63.9.14.3 Fire Barriers

A 2-hour fire barrier wall shall be permitted in lieu of the distances specified by Table 63.9.14.1 when in accordance with the provisions of 63.9.14.3.1 through 63.9.14.3.4. [55:13.10.2]

63.9.14.3.1

The fire barrier wall shall be without openings or penetrations. [55:13.10.2.1]

63.9.14.3.1.1

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. [55:13.10.2.1.1]

63.9.14.3.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage system. [55:13.10.2.2]

63.9.14.3.3

The fire barrier wall shall be located not less than 5 ft (1.5 m) from any exposure. [55:13.10.2.3]

63.9.14.3.4

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). [55:13.10.2.4]

63.10 Storage, Handling, and Use of Ethylene Oxide for Sterilization and Fumigation

63.10.1 General

Storage, handling, and use of ethylene oxide for sterilization and fumigation shall comply with Chapter 14 of NFPA 55.

63.10.2 Cleaning and Purging of Gas Piping Systems

63.10.2.1

Cleaning and purging of piping systems shall be in accordance with 63.3.1.19. [55:14.4.1.3]

63.10.2.2

Piping and valves that have been used to transport ethylene oxide to or from a sterilizer to the emission control or release point shall be drained and purged in accordance with 63.3.1.19 prior to dismantling. [55:14.4.3.1]

63.11 Carbon Dioxide Beverage Systems

[55:13.11]

63.11.1 General

Systems with more than 100 lb (45 kg) of carbon dioxide used in beverage dispensing applications shall comply with 63.11.2 through 63.11.4. [55:13.11.1]

63.11.2 Equipment

The storage, use, and handling of carbon dioxide shall be in accordance with Chapters 1 through 7 of NFPA 55 and the requirements of this chapter, as applicable. [55:13.11.2]

63.11.3 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. [55:13.11.3]

63.11.4 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 63.11.4.1 or an emergency alarm system in accordance with 63.11.4.2. [55:13.11.4]

63.11.4.1 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 ft3/min/ft2 (0.00508 m3/s/m2).

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.

[55:13.11.4.1]

63.11.4.2 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.

[55:13.11.4.2]

63.12 Liquid Oxygen in Home Care

63.12.1 General

The storage and use of liquid oxygen (LOX) in home care shall comply with Sections 63.4 and 63.12.

63.12.1.1

Gas equipment used in the home for health care shall conform to applicable requirements of NFPA 99.

63.12.2 Information and Instructions

The seller of liquid oxygen shall provide the user with information in written form that includes, but is not limited to, the following:

Manufacturer's instructions and labeling for storage and use of the containers

Locating containers away from ignition sources, exits, electrical hazards, and high temperature devices in accordance with 63.12.3.2

Restraint of containers to prevent falling in accordance with 63.12.3.3

Requirements for handling containers in accordance with 63.12.3.4

Safeguards for refilling of containers in accordance with 63.12.3.5

63.12.3 Containers

Containers of liquid oxygen in home care shall be in accordance with 63.12.3.1 through 63.12.3.5.

63.12.3.1\*

Containers shall be stored, used, and operated in accordance with the manufacturer's instructions and labeling.

63.12.3.2

Containers shall not be located in areas as follows:

Where they can be overturned due to operation of a door

Where they are in the direct path of egress

Where they are subject to damage from falling objects

Where they can become part of an electrical circuit

Where open flames and high temperature devices could cause a hazard

63.12.3.3\*

Liquid oxygen home care containers shall be restrained by one of the following methods while in storage or use to prevent falling caused by contact, vibration, or seismic activity:

Restraining containers to a fixed object with one or more restraints

Restraining containers within a framework, stand, or assembly designed to resist container movement

Restraining containers by locating a container against two points of contact

63.12.3.4

Containers shall be transported by use of a cart or hand truck designed for such use.

63.12.3.4.1

Liquid oxygen home care containers equipped with a roller base shall not be required to be transported by use of a cart or truck.

63.12.3.4.2

Liquid oxygen ambulatory containers shall be permitted to be hand carried.

63.12.3.5

The filling of containers shall be in accordance with 63.12.3.5.1 through 63.12.3.5.2.

63.12.3.5.1

Liquid oxygen home care containers shall be filled outdoors.

63.12.3.5.1.1\*

A drip pan compatible with liquid oxygen shall be provided under home care container filling and vent connections used during the filling process.

63.12.3.5.2

Liquid oxygen ambulatory containers shall be allowed to be filled indoors when the supply container is designed for filling such containers and written instructions are provided by the container manufacturer.

63.12.3.5.3\*

The use of open flames and high temperature devices shall be in accordance with the adopted fire prevention code.

63.12.4 Maximum Quantity

The maximum aggregate quantity of liquid oxygen allowed in storage and in use in a single dwelling unit shall be 31.6 gal (120 L).

63.12.4.1

The maximum aggregate quantity of oxygen allowed in day care shall be limited by the maximum allowable quantity set forth in the adopted fire prevention code or building code.

63.12.4.2

Where individual sleeping rooms are separated from the remainder of the dwelling unit by fire barriers and horizontal assemblies having a minimum fire-resistance rating of 1 hour in accordance with the adopted building code, the maximum aggregate quantity per dwelling unit shall be allowed to be increased to a maximum of 31.6 gal (120 L) of liquid oxygen per sleeping room.

63.12.5 Smoking

Smoking shall be prohibited in rooms or areas where liquid oxygen is in use.

63.12.5.1\*

A sign stating "OXYGEN — NO SMOKING" shall be posted in the room or area where the liquid oxygen containers are stored or used.