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MEMORANDUM

TO: Technical Committee on Special Equipment, Processes and Hazardous Materials

FROM: Joe Yee, *Committee Administrator*

DATE: May 19, 2023

SUBJECT: NFPA 1 Proposed Tentative Interim Amendment (TIA) No. 1708

The attached proposed Tentative Interim Amendment (TIA) Log No. 1708 is being submitted to you for ballot to revise NFPA 55 extracts 2.4, Various paragraphs in 3.3 and Chapter 63. This proposed TIA was submitted by Robert Davidson of Davidson Code Concepts, LLC and we have received written agreement to the processing of the submitted TIA from Michael Snyder of Dekra Process Safety.

This proposed TIA will be published for public comment in the May/June 2023 issue of *NFPA News* with a Public Comment Closing Date of July 12, 2023. Any public comments received will be circulated to the committee. Finally, the Standards Council will review and consider the issuance of this TIA.

In accordance with Section 5 of the *Regulations Governing the Development of NFPA Standards,* you are being balloted on the technical merits of the proposed TIA and whether this matter is of an emergency nature.

The ballot can now be accessed through the NFPA online ballot system at the following link: NFPA Ballot Link**.** The link will bring you to your profile page and once you sign in, select the My Committees tab and click on the blue Vote button which will direct you to the ballot site.

Please complete the ballot on or before **June 2, 2023, 11:59 pm ET.**

While completing your ballot, please remember the following:

- **A comment is required for both Question No. 1 and Question No. 2 for the online TIA ballot. Comments must accompany all Negative, Abstaining and Agree votes.**
- **If you vote "Agree" on Question 1, simply add "Agree" to the comment field and if you vote "Agree" on Question 2, insert the applicable letter(s) selections in the comment field which can be found in the Instructions box on the ballot site.**

You must hit SUBMIT to SAVE your work**.** **Note**: the system session will time you out after 45 minutes; any work not submitted at that time will not be saved! You may return to finish or change your ballot at any time up to the closing date. Ballot comments exceeding 4,000 characters must be submitted in a Word document via email, to Joe Yee at jyee@nfpa.org.

Note: Please remember that the return of ballots and attendance at committee meetings are required in accordance with the Regulations Governing the Development of NFPA Standards.

NFPA 1-Proposed 2024 Edition
Fire Code
TIA Log No.: 1708
Reference: (NFPA 55 extracts) 2.4, Various paragraphs in 3.3 and Chapter 63
Comment Closing Date: July 12, 2023
Submitter: Robert Davidson, Davidson Code Concepts, LLC
www.nfpa.org/1

See attached for proposed text changes.

Substantiation: NFPA documents are updated to the most current edition to comply with the NFPA Extract Policy. The current text of NFPA 1 contains extracts from the 2020 edition of NFPA 55 but the second draft report for the 2023 edition has been published. This TIA updates the extracted language and makes other adjustments as necessary for the changes to the updated extract text. For technical substantiation on any changes, see the first and second draft reports for the source document.

Emergency Nature: The standard contains an error or an omission that was overlooked during the regular revision process.

The second draft report was not available at the time of the NFPA 1 second draft meeting. Therefore, to ensure accuracy in extracted material, the updates were done after the second draft report for the source document was posted. By waiting to update the extracts the final product in NFPA 1 will be more closely aligned to what is in the source document and ensures the most up to date information is contained in NFPA 1.

55-20_NFPA 1 to be updated[55-23]

2.4
NFPA 55, *Compressed Gases and Cryogenic Fluids Code,* 2023~~0~~ edition.

3.3.1* Absolute Pressure.

Pressure based on a zero reference point, the perfect vacuum. [**55,** 2023~~0~~]

Commented [CM1]: Add a space after the comma in all of the extract tags in Chapter 3.

A.3.3.1 Absolute Pressure.

Measured from this reference point, the standard atmospheric pressure at sea level is an absolute pressure of 14.7 psi (101.3 kPa). [**55,** 2023~~0~~] (FCC-HAZ)

3.3.17.5 Indoor Area.

An area that is within a building or structure having overhead cover, other than a structure qualifying as "weather protection." [**55,** 2023~~0~~] (FCC-HAZ)

3.3.17.8 Outdoor Area.

An area that is not an indoor area. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.20 ASTM.

American Society for Testing and Materials, now known as "ASTM International." [**55,** 2023~~0~~] (FCC-HAZ)

3.3.21 Automatic Emergency Shutoff Valve.

A designated fail-safe automatic closing valve designed to shut off the flow of gases or liquids that is initiated by a control system where the control system is activated by either manual or automatic means. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.43* Cathodic Protection.

A technique to resist the corrosion of a metal surface by making the surface the cathode of an electrochemical cell. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.43 Cathodic Protection.

This protection renders a metallic container or piping system or component negatively charged with respect to its surrounding environment. [**55,** 2023~~0~~]

3.3.44 Cathodic Protection Tester.

A person who demonstrates an understanding of the principles and measurements of all common types of cathodic protection systems applicable to metal piping and container systems and who has education and experience in soil resistivity, stray current, structure-to-soil potential, and component electrical isolation measurements of metal piping and container systems. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.52* Cleaning Media.

Materials used to clean piping systems. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.52 Cleaning Media.

Cleaning methods that incorporate chemical washing techniques can include the use of chemical substances, usually liquid, capable of dissolving or dispersing a foreign substance or contaminants and techniques such as rinsing, heating, steaming, or vacuuming applied either individually or in combination with other techniques. Air, inert gas, steam, and water are acceptable cleaning media. [**55,** 2023~~0~~]

3.3.58.3 Mechanical Code.

The mechanical or mechanical construction code adopted by the jurisdiction. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.74.2 Compressed Gas Container.

A pressure vessel designed to hold compressed gas at an absolute pressure greater than 1 atmosphere at 68°F (20°C) that includes cylinders, containers, and tanks. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.81 Cryogenic Fluid.

A fluid with a boiling point lower than –130°F (–90°C) at an absolute pressure of 14.7 psi (101.3 kPa). [**55,** 2023~~0~~] (FCC-HAZ)

3.3.81.1 Flammable Cryogenic Fluid.

A cryogenic fluid that forms flammable mixtures in air when in its vapor state. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.81.2 Inert Cryogenic Fluid.

A cryogenic fluid that vaporizes to produce an inert gas when in its vapor state. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.81.3 Oxidizing Cryogenic Fluid.

An oxidizing gas in the cryogenic state. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.83 Cylinder.

A pressure vessel designed for absolute pressures higher than 40 psi (276 kPa) and having a circular cross-section. It does not include a portable tank, multiunit tank car tank, cargo tank, or tank car. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.84 Cylinder Containment Vessel.

A gastight recovery vessel designed so that a leaking compressed gas container can be placed within its confines, thereby encapsulating the leaking container. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.85* Cylinder Pack.

An arrangement of cylinders into a cluster where the cylinders are confined into a grouping or arrangement with a strapping or frame system and connections are made to a common manifold. The frame system is allowed to be on skids or wheels to permit movement. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.85 Cylinder Pack.

Six-packs and *twelve-packs* are terms used to further define cylinder packs with a specific number of cylinders. The characteristic internal water volume of individual cylinders in a cylinder pack ranges from 1.52 scf to 1.76 scf (43 L to 50 L) or a water capacity of 95 lb to 110 lb (43 kg to 50 kg). [**55,** 2020~~3~~]

3.3.95 Distributor.

A business engaged in the sale or resale, or both, of compressed gases or cryogenic fluids, or both. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.103 Emergency Shutoff Valve.

A designated valve designed to shut off the flow of gases or liquids. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.105 Ethylene Oxide Drum.

For the purposes of this code, containers built to UN specification 1A1. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.106 Excess Flow Control.

A fail-safe system or approved means designed to shut off flow due to a rupture in pressurized piping systems. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.108* Exhausted Enclosure.

An appliance or piece of equipment that consists of a top, a back, and two sides that provides a means of local exhaust for capturing gases, fumes, vapors, and mists. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.108 Exhausted Enclosure.

Such enclosures include laboratory hoods, exhaust fume hoods, and similar appliances and equipment used to retain and exhaust locally the gases, fumes, vapors, and mists that could be released. Rooms or areas provided with general ventilation, including rooms, such as control areas, with dedicated hazardous vapor/gas exhaust systems, in and of themselves, are not exhausted enclosures. [**55,** 2023~~0~~]

3.3.115* Explosion Control.

A means of either preventing an explosion through the use of explosion suppression, fuel reduction, or oxidant reduction systems or a means to prevent the structural collapse of a building in the event of an explosion through the use of deflagration venting, barricades, or related construction methods. [**55,** 2020~~3~~] (FCC-HAZ)

A.3.3.115 Explosion Control.

NFPA 68 provides guidance on the use of deflagration venting systems in buildings and other enclosures. The primary purpose of a venting system is to relieve the overpressure produced in an explosion to limit the potential damage to the building where the explosion occurs. Although some structural damage can be anticipated, the use of relief venting is expected to prevent massive building failure and collapse. In cases where detonation is probable, venting is often used in conjunction with barricade construction where the pressure-resistant portions of the building have been constructed to resist the pressures anticipated should an explosive event occur. Design of barricade systems is highly specialized and the subject of military standards applicable to the subject. NFPA 69 provides guidance on the use of suppression, ventilation systems, and the limiting of oxidants as a means to prevent the occurrence of an explosion. When relief vents are to be used as a means to provide explosion relief, the fundamental requirements of the building code for structural elements, including snow, wind, and seismic events, should be considered. In some instances, the requirements for wind resistance can

impose more rigorous requirements on the relief vents than required by the engineering analysis used to determine the relief pressure. In such cases, users must demonstrate that the relief vents will not become airborne or release in such a manner as to create secondary hazards within or external to the building in which they are installed. Specific designs might require approval by the AHJ. [**55,** 202~~3~~0]

3.3.147.1* Compressed Gas.

A material, or mixture of materials, that (1) is a gas at 68°F (20°C) or less at an absolute pressure of 14.7 psi (101.3 kPa) and (2) has a boiling point of 68°F (20°C) or less at an absolute pressure of 14.7 psi (101.3 kPa) and that is liquefied, nonliquefied, or in solution, except those gases that have no other health or physical hazard properties are not considered to be compressed gases until the pressure in the packaging exceeds an absolute pressure of 40.6 psi (280 kPa) at 68°F (20°C). [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.147.1 Compressed Gas.

The states of a compressed gas are categorized as follows:

(1) Nonliquefied compressed gases are gases, other than those in solution, that are in a packaging under the charged pressure and are entirely gaseous at a temperature of 68°F (20°C).
(2) Liquefied compressed gases are gases that, in a packaging under the charged pressure, are partially liquid at a temperature of 68°F (20°C). Cryogenic fluids represent a transient state of a gas that is created through the use of refrigeration. Cryogenic fluids cannot exist in the liquid form or partial liquid form at temperatures of 68°F (20°C); hence, they are not "compressed gases" as defined.
(3) Compressed gases in solution are nonliquefied gases that are dissolved in a solvent.
(4) Compressed gas mixtures consist of a mixture of two or more compressed gases contained in a packaging, the hazard properties of which are represented by the properties of the mixture as a whole.

[**55,** 202~~0~~3]

3.3.147.2 Corrosive Gas.

A gas that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact. [**55,** 202~~3~~0] (FCC-HAZ)

3.3.147.3* Flammable Gas.

A material that is a gas at 68°F (20°C) or less at an absolute pressure of 14.7 psi (101.3 kPa)~~,~~ ~~that is ignitable at an absolute pressure of 14.7 psi (101.3 kPa) when in a mixture of 13 percent or less by volume with air, or that has a flammable range at an absolute pressure of 14.7 psi (101.3 kPa) with air of at least 12 percent, regardless of the lower limit.~~ [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.147.3 Flammable Gas.

The term *flammable gas* includes both Category 1A flammable gas and Category 1B flammable gas where not otherwise specified in this code. [**55,** 2023]

3.3.147.4 Flammable Liquefied Gas.

A liquefied compressed gas that, when under a charged pressure, is partially liquid at a temperature of 68°F (20°C) and is flammable. [**55,** 202~~3~~0] (FCC-HAZ)

3.3.147.5 Highly Toxic Gas.

A chemical that has a median lethal concentration (LC_{50}) in air of 200 ppm by volume or less of gas or vapor, or 2 mg/L or less of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.147.6* Inert Gas.

A nonreactive, nonflammable, noncorrosive gas such as argon, helium, krypton, neon, nitrogen, and xenon. [**55,** 2023~~0~~3] (FCC-HAZ)

A.3.3.147.6 Inert Gas.

Inert gases do not react readily with other materials under normal temperatures and pressures. For example, nitrogen combines with some of the more active metals such as lithium and magnesium to form nitrides, and at high temperatures it will also combine with hydrogen, oxygen, and other elements. The gases neon, krypton, and xenon are considered rare due to their scarcity. Although these gases are commonly referred to as inert gases, the formation of compounds is possible. For example, xenon combines with fluorine to form various fluorides and with oxygen to form oxides; the compounds formed are crystalline solids. Radon is inert under the definition provided, but because it is radioactive, it is not considered inert for the purposes of NFPA 55. [**55,** 2023~~0~~]

3.3.147.10 Nonflammable Gas.

A gas that does not meet the definition of a flammable gas. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.147.11* Other Gas.

A gas that is not a corrosive gas, flammable gas, highly toxic gas, oxidizing gas, pyrophoric gas, toxic gas, or unstable reactive gas with a hazard rating of Class 2, Class 3, or Class 4 gas. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.147.11 Other Gas.

A gas classified as an “other gas” might be a nonflammable gas or an inert gas. [**55,** 2023~~0~~]

3.3.147.12 Oxidizing Gas.

A gas that can support and accelerate combustion of other materials more than air does. [**55,~~*~~** 2023~~0~~] (FCC-HAZ)

3.3.147.13 Pyrophoric Gas.

A gas with an autoignition temperature in air at or below 130°F (54.4°C). [**55,** 2023~~0~~] (FCC-HAZ)

3.3.147.16 Toxic Gas.

A gas with a median lethal concentration (LC_{50}) in air of more than 200 ppm but not more than 2000 ppm by volume of gas or vapor, or more than 2 mg/L but not more than 20 mg/L of mist, fume, or dust, when administered by continuous inhalation for 1 hour (or less if death occurs within 1 hour) to albino rats weighing between 0.44 lb and 0.66 lb (200 g and 300 g) each. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.147.17* Unstable Reactive Gas.

A gas that, in the pure state or as commercially produced, will vigorously polymerize, decompose, or condense; become self-reactive; or otherwise undergo a violent chemical change under conditions of shock, pressure, or temperature. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.147.17 Unstable Reactive Gas.

Unstable reactive materials are subdivided into five classifications. Class 4 materials are materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. They include the following:

(1) Materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures
(2) Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 482°F (250°C) of 1000 W/mL or greater

[**55,** 2023~~0~~]

Class 3 materials are materials that in themselves are capable of detonation or explosive decomposition or explosive reaction but require a strong initiating source or heat under confinement before initiation. Class 3 materials include the following:

(1) Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 482°F (250°C) at or above 100 W/mL and below 1000 W/mL
(2) Materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures
(3) Materials that react explosively with water without requiring heat or confinement

[**55,** 2023~~0~~]

Class 2 materials are materials that readily undergo violent chemical change at elevated temperatures and pressures, including the following:

(1) Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 482°F (250°C) at or above 10 W/mL and below 100 W/mL
(2) Materials that react violently with water or form potentially explosive mixtures with water

[**55,** 2023~~0~~]

Class 1 materials are materials that in themselves are normally stable but that can become unstable at elevated temperatures and pressures, including the following:

(1) Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 482°F (250°C) at or above 0.01 W/mL and below 10 W/mL
(2) Materials that react vigorously with water, but not violently
(3) Materials that change or decompose on exposure to air, light, or moisture

[**55,** 2023~~0~~]

Class 0 materials are materials that in themselves are normally stable, even under fire conditions, including the following:

(1) Materials that have an instantaneous power density (product of heat of reaction and reaction rate) at 482°F (250°C) below 0.01 W/mL
(2) Materials that do not react with water
(3) Materials that do not exhibit an exotherm at temperatures less than or equal to 932°F (500°C) when tested by differential scanning calorimetry

[**55,** 2023~~0~~]

3.3.148* Gas Cabinet.

A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage or use. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.148 Gas Cabinet.

Doors and access ports for exchanging cylinders and accessing pressure-regulating controls are permitted to be included as part of a gas cabinet. [**55,** 2023~~0~~]

3.3.149 Gas Manufacturer/Producer.

A business that produces compressed gases or cryogenic fluids, or both, or fills portable or stationary gas cylinders, containers, or tanks. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.150 Gas Room.

A separately ventilated, fully enclosed room in which only compressed gases, cryogenic fluids, associated equipment, and supplies are stored or used. [**55,** 2023~~0~~] (FCC-HAZ)

3.3.151* Gaseous Hydrogen (GH_2) System.

An assembly of equipment that consists of, but is not limited to, storage containers, pressure regulators, pressure relief devices, compressors, manifolds, and piping and that terminates at the source valve. [**55,** 202~~0~~3] (FCC-HAZ)

A.3.3.151 Gaseous Hydrogen (GH_2) System.

The system includes stationary or portable containers, pressure regulators, pressure-relief devices, manifolds, interconnecting piping, and controls as required. [**55,** 2023~~0~~]

3.3.156* Hazard Rating.

The numerical rating of the health, flammability, self-reactivity, and other hazards of the material, including its reaction with water. [**55,** 2023~~0~~] (FCC-HAZ)

A.3.3.156 Hazard Rating.

The criteria for hazard rating are as defined in NFPA 704. [**55,** 2023~~0~~]

3.3.166* Immediately Dangerous to Life and Health (IDLH).

A concentration of airborne contaminants, normally expressed in parts per million (ppm) or milligrams per cubic meter, that represents the maximum level from which one could escape within 30 minutes without any escape-impairing symptoms or irreversible health effects. [**55,** 202~~0~~3] (FCC-HAZ)

A.3.3.166 Immediately Dangerous to Life and Health (IDLH).

This level is established by the National Institute for Occupational Safety and Health (NIOSH). If adequate data do not exist for precise establishment of IDLH, an independent certified industrial hygienist, industrial toxicologist, or appropriate regulatory agency should make such determination. [**55,** 2023~~0~~]

3.3.177* ISO Module.

An assembly of tanks or tubular cylinders permanently mounted in a frame conforming to International Organization for Standardization (ISO) requirements. [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.177 ISO Module.

The characteristic internal water volume of individual tubular cylinders is 43 scf (1218 L) or a water capacity of 2686 lb (1218 kg). The frame of an ISO container module and its corner castings are specially designed and dimensioned to be used in multimodal transportation service on container ships, special highway chassis, and container-on-flatcar railroad equipment. [**55,** 202~~3~~0]

3.3.179.2* Permissible Exposure Limit (PEL).

The maximum permitted 8-hour, time-weighted average concentration of an airborne contaminant. [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.179.2 Permissible Exposure Limit (PEL).

The maximum permitted time-weighted average exposures to be utilized are those published in 29 CFR 1910.1000. [**55,** 202~~0~~3]

3.3.179.3* *Short-Term Exposure Limit (STEL).*

The concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of a degree sufficient to increase the likelihood of accidental injury, impairment of self-rescue, or the material reduction of work efficiency, without exceeding the daily permissible exposure limit (PEL). [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.179.3 Short-Term Exposure Limit (STEL).

STEL limits are published in 29 CFR 1910.1000. [**55,** 202~~3~~0]

3.3.185 Manual Emergency Shutoff Valve.

A designated valve designed to shut off the flow of gases or liquids that is manually operated. [**55,** 202~~0~~3] (FCC-HAZ)

3.3.197* Mobile Supply Unit.

Any supply source that is equipped with wheels so it is able to be moved around. [**55,** 202~~0~~3] (FCC-HAZ)

A.3.3.197 Mobile Supply Unit.

Examples include ISO modules, tube trailers, and cylinder packs. [**55,** 202~~0~~3]

3.3.200 Nesting.

A method of securing cylinders upright in a tight mass using a contiguous three-point contact system whereby all cylinders in a group have a minimum of three contact points with other cylinders or a solid support structure (e.g., a wall or railing). [**55,** 202~~3~~0] (FCC-HAZ)

3.3.201* Normal Temperature and Pressure (NTP).

A temperature of 70°F (21°C) at an absolute pressure of 14.7 psi (101.3 kPa). [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.201 Normal Temperature and Pressure (NTP).

There are different definitions of normal conditions. The normal conditions defined here are the ones most commonly used in the compressed gas and cryogenic fluid industry. [**55,** 202~~3~~0]

3.3.211 OSHA.

The Occupational Safety and Health Administration of the US Department of Labor. [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.227 Pressure Vessel.

Pressure vessels of any type can be subject to additional regulations imposed by various states or other legal jurisdictions. Users should be aware that compliance with DOT or ASME requirements might not satisfy all of the required regulations for the location in which the vessel is to be installed or used. [**55:**A.8.2]

3.3.234 Purging.

A method used to free the internal volume of a piping system of unwanted contents that results in the existing contents being removed or replaced. [**55,** 202~~3~~0] (FCC-HAZ)

3.3.255 Separation of Hazards.

Physically separated by a specified distance, construction, or appliance. [**55,** 202~~3~~0] (FCC-HAZ)

3.3.273 Standard Cubic Foot (scf) of Gas.

An amount of gas that occupies one cubic foot at an absolute pressure of 14.7 psi (101 kPa) and a temperature of 70°F (21°C). [**55,** 202~~0~~3] (FCC-HAZ)

3.3.284.1* Bulk Hydrogen Compressed Gas System.

A gaseous hydrogen (GH_2) system with a storage capacity of more than 5000 scf (141.6 Nm^3) of compressed hydrogen gas. [**55,** 202~~3~~0] (FCC-HAZ)

A.3.3.284.1 Bulk Hydrogen Compressed Gas System.

The bulk system terminates at the source valve, which is the point where the gas supply, at service pressure, first enters the supply line, or at a piece of equipment that utilizes the hydrogen gas, such as a hydrogen dispenser. The containers are either stationary or movable, and the source gas for the system is stored as a compressed gas. [**55,** 202~~3~~0]

Bulk hydrogen compressed gas systems can include a bulk storage source, transfer piping and manifold system, compression system, and other components. The gaseous source can include a tube trailer, tube bank, or other high pressure storage vessels used to serve the piping system that transports hydrogen to the end user. Compressors can be installed downstream of the storage supply to boost the pressure of the source gas, and intermediate high pressure storage might be present. This is done where the end use requires hydrogen at a pressure higher than that of the bulk supply. In these instances, there may be intermediate storage vessels used to store the gas at elevated pressures. It is not uncommon for the bulk supply as delivered to be furnished at nominal gauge pressure of 3000 psi (20,684 kPa), and the intermediate high

pressure storage to be stored at gauge pressures up to 15,000 psi (103,421 kPa). See Figure A.3.3.278.1(a) through Figure A.3.3.278.1(f). [**55,** 2023~~0~~]

Figure A.3.3.284.1(a) Symbol Legend for Figure A.3.3.274.1(b) through Figure A.3.3.274.1(f). [55:Figure A.3.3.95.9.1(a)]

Figure A.3.3.284.1(b) Typical Tube Trailer. [55:Figure A.3.3.95.9.1(b)]

Figure A.3.3.284.1(c) Typical Bulk Compressed Gaseous Storage System. [55:Figure A.3.3.95.9.1(c)]

Figure A.3.3.284.1(d) Typical Tube Trailer Discharge Stanchion and Pressure Control Manifold. [55:Figure A.3.3.95.9.1(d)]

Figure A.3.3.284.1(e) Typical Chemical Energy Storage Module (CESM). [55:Figure A.3.3.95.9.1(e)]

Figure A.3.3.284.1(f) Typical Compressor Module. [55:Figure A.3.3.95.9.1(f)]

3.3.284.2* Bulk Inert Gas System.

An assembly of equipment that consists of, but is not limited to, storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and piping, with a storage capacity of more than 20,000 scf (566 Nm^3) of inert gas, ~~including unconnected reserves on-hand at the site,~~ and that terminates at the source valve. [**55,** 2023~~0~~] (FCC-HAZ)

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A.3.3.284.2 Bulk Inert Gas System.

The bulk system terminates at the source valve, which is commonly the point where the gas supply, at service pressure, first enters the supply line or a piece of equipment that utilizes the gas or the liquid. The containers are either stationary or movable, and the source gas is stored as a compressed gas or cryogenic fluid. [**55,** 2023]

Bulk inert gas systems can be used to supply gas in either its compressed gaseous or liquefied form. Systems that may be used to supply both gaseous and liquid forms are referred to as hybrid systems. The following bulk inert gas systems are typical of those in use:

When the primary supply of the gas as stored is from a compressed gaseous source that is used in the compressed and gaseous form, the bulk inert gas system is said to be a bulk inert compressed gas system.

When the primary supply of the gas as stored is in a liquid form and the system is designed to transfer only liquid, the system is said to be a bulk liquefied inert gas system.

When the primary supply of the gas as stored is in a liquid form and the system is designed to transfer or store the gas in a compressed gaseous form, with or without a feature that may also allow the subsequent transfer and use of liquid, the bulk inert gas system is said to be a hybrid bulk inert gas system.

For the purposes of the application of the code, a hybrid system is viewed as a bulk liquefied inert gas system.

[**55,** 2023]

3.3.284.3* Bulk Liquefied Hydrogen System.

A liquefied hydrogen (LH_2) system with a storage capacity of more than 39.7 gal (150 L) of liquefied hydrogen. [**55,** 202~~0~~3] (FCC-HAZ)

A.3.3.284.3 Bulk Liquefied Hydrogen System.

The bulk system terminates at the source valve, which is commonly the point where the gas supply, at service pressure, first enters the supply line or a piece of equipment that utilizes the gas or the liquid, such as a hydrogen dispenser. The containers are either stationary or movable, and the source gas for the system is stored as a cryogenic fluid. [**55,** 2023]

A bulk liquefied hydrogen system can include a liquid source where the liquid is vaporized and subsequently compressed and transferred to storage in the compressed gaseous form. It is common for liquid hydrogen systems to be equipped with vaporizers that are used to gasify the cryogen for ultimate use in the compressed state; however, there are also systems that can be used to transfer liquid in the cryogenic state. For systems that are composed of combined gaseous and liquefied hydrogen storage systems and have separate source valves for both systems, the system can be viewed as having two source valves for determining minimum separation distances for bulk storage systems in accordance with 10.4.2.2 and 11.3.2.2 of NFPA 55. Identifying two source valves means that each portion of the system is subject to its respective minimum separation distances in accordance with 10.4.2.2 or 11.3.2.2 of NFPA 55. [**55,** 2023]

3.3.284.4* Bulk Oxygen System.

An assembly of equipment, such as oxygen storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and interconnecting piping, that has a storage capacity of more than 20,000 scf (566 Nm^3) of oxygen and that terminates at the source valve. [**55,** 202~~0~~3] (FCC-HAZ)

A.3.3.284.4 Bulk Oxygen System.

The bulk oxygen system terminates at the source valve, which is commonly the point where oxygen at service pressure first enters the supply line or a piece of equipment that utilizes the oxygen gas or liquid. The oxygen containers are either stationary or movable, and the oxygen is stored as a compressed gas or cryogenic fluid. [**55,** 202~~0~~3]

Bulk oxygen systems can be used to supply gas in either its compressed gaseous or liquefied form. Systems that may be used to supply both gaseous and liquid forms are referred to as hybrid systems. The following bulk oxygen systems are typical of those in use:

(1) When the primary supply of the gas as stored is from a compressed gaseous source that is used in the compressed and gaseous form, the bulk oxygen system is said to be a bulk compressed oxygen gas system.
(2) When the primary supply of the gas as stored is in a liquid form and the system is designed to transfer only liquid, the system is said to be a bulk liquefied oxygen system.
(3) When the primary supply of the gas as stored is in a liquid form and the system is designed to transfer or store the gas in a compressed gaseous form, with or without a feature that may also allow the subsequent transfer and use of liquid, the bulk oxygen system is said to be a hybrid bulk oxygen system. For the purposes of the application of the *Code*, a hybrid system is viewed as a bulk liquefied oxygen system.

[**55,** 202~~0~~3]

3.3.284.7 Continuous Gas Detection System.

A gas detection system in which the instrument is maintained in continuous operation and the interval between sampling of any point does not exceed 30 minutes. [**55,** 20233~~0~~] (FCC-HAZ)

3.3.284.8 Cylinder Containment System.

A gastight recovery system comprising equipment or devices that can be placed over a leak in a compressed gas container, thereby stopping or controlling the escape of gas from the leaking container. [**55,** 20233~~0~~] (FCC-HAZ)

3.3.284.14 Treatment System.

An assembly of equipment capable of processing a hazardous gas and reducing the gas concentration to a predetermined level at the point of discharge from the system to the atmosphere. [**55,** 20233~~0~~] (FCC-HAZ)

A.3.3.285.4 Portable Tank.

A portable tank does not include any cylinder having less than 1000 lb (453.5 kg) water capacity, cargo tank, tank car tank, or trailers carrying cylinders of over 1000 lb (453.5 kg) water capacity. [**55,** ~~2020~~2023]

3.3.285.6* Stationary Tank.

A packaging designed primarily for stationary installations not intended for loading, unloading, or attachment to a transport vehicle as part of its normal operation in the process of use. [**55,** 20230~~3~~] (FCC-HAZ)

A.3.3.285.6 Stationary Tank.

A stationary tank does not include a cylinder having less than 1000 lb (453.5 kg) water capacity. [**55,** 20233~~0~~]

3.3.286 TC.

Transport Canada. [**55,** 20233~~0~~] (FCC-HAZ)

3.3.293* Tube Trailer.

A truck or semitrailer on which a number of very long compressed gas tubular cylinders have been mounted and manifolded into a common piping system. [**55,** 20233~~0~~] (FCC-HAZ)

A.3.3.293 Tube Trailer.

The characteristic internal water volume of individual tubular cylinders ranges from 43 scf to 93 scf (1218 L to 2632 L) or a water capacity of 2686 lb to 5803 lb (1218 kg to 2632 kg). [**55,** 20233~~0~~]

3.3.301.3 Valve Outlet Cap or Plug.

A removable device that forms a gastight seal on the outlet to the control valve that is provided on a source containing a compressed gas or cryogenic fluid. [**55,** 20230~~3~~] (FCC-HAZ)

3.3.301.4 Valve Protection Cap.

A rigid, removable cover provided for container valve protection during handling, transportation, and storage. [**55,** 202~~30~~] (FCC-HAZ)

Chapter 63 Compressed Gases and Cryogenic Fluids

63.1 General Provisions.

63.1.1.3

The requirements in this chapter shall apply to ~~users, producers, distributors, and others who are involved with~~ the installation, storage, use, ~~or~~ and handling of compressed gases ~~or~~ and cryogenic fluids in portable and stationary cylinders, containers, equipment, and tanks in all occupancies. [**55:**1.3.1]

63.1.1.4 Specific Applications.

Chapter 63 shall not apply to the following:

(1)* Off-site transportation of materials covered by Chapter 63
(2) Storage, use, and handling of radioactive gases in accordance with NFPA 801
(3)* 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
(4) Systems consisting of cylinders of oxygen and cylinders of fuel gas used for welding and cutting in accordance with NFPA 51
(5)* Flammable gases used as a vehicle fuel when stored on a vehicle
(6)* Storage, use, and handling of liquefied and nonliquefied compressed gases in laboratory work areas in accordance with NFPA 45
(7) Storage, use, and handling of liquefied petroleum gases in accordance with NFPA 58
(8) Storage, use, and handling of compressed gases within closed-cycle refrigeration systems complying with the mechanical code
(9) Liquefied natural gas (LNG) storage at utility plants under NFPA 59A
(10) Compressed natural gas (CNG) and ~~liquefied natural gas (~~LNG~~),~~ utilized as a vehicle fuel in accordance with NFPA 52
(11)* Compressed hydrogen gas (GH_2), or liquefied hydrogen gas (LH_2) generated, installed, stored, piped, used, or handled in accordance with NFPA 2 when there are no specific or applicable requirements in NFPA 55
(12) Nonflammable mixtures of ethylene oxide with other chemicals
(13) Ethylene oxide in chambers 10 scf (0.283 Nm^3) or less in volume or for containers holding 7.05 oz (200 g) of ethylene oxide or less

[**55:**1.3~~1~~.2]

A.63.1.1.4(1)

For regulations on the transportation of gases, see 49 CFR 100–185, "Transportation," and *Transportation of Dangerous Goods Regulations*. [**55:**A.1.3~~1~~.2(1)]

A.63.1.1.4(3)

Cryogenic fluid central supply system installations are intended to be covered by the requirements of this *Code*. Instrumentation and alarms that are attendant to the system and designed to interface with the application in a health care facility are to be retained within the purview of NFPA 99. See Section 17.1.2 of NFPA 55. [**55:**A.1.3~~1~~.2(3)]

A.63.1.1.4(5)

For information, see NFPA 52, or NFPA 58. [**55:**A.1.31.2(5)]

A.63.1.1.4(6)

The storage and use of compressed gases and cryogenic fluids outside the boundaries of laboratory work areas are covered by NFPA 55. [**55:**A.1.31.2(6)]

A.63.1.1.4(11)

NFPA 55 is used as the source document for the fundamental requirements for compressed hydrogen gas (GH_2), or liquefied hydrogen gas (LH_2) system installations. Correlation between NFPA 55 and NFPA 2 is the responsibility of the two technical committees involved. The installation requirements for bulk GH_2 or LH_2 are viewed as fundamental provisions. On the other hand, use-specific requirements for designated applications such as vehicular fueling are not resident in NFPA 55 and are under the purview of the NFPA 2 Technical Committee. Where there are specific provisions or controls included in NFPA 55, the specific controls of NFPA 55 will govern except that modifications made to provisions that have been extracted can be followed when the modifications have been made within NFPA's extract procedure as indicated in the *Manual of Style for NFPA Technical Committee Documents*. [**55:**A.1.31.2(11)]

~~**A.63.1.3.40 Normal Temperature and Pressure (NTP).**~~

~~There are different definitions of normal conditions. The normal conditions defined here are the ones most commonly used in the compressed gas and cryogenic fluid industry. [**55:**2020]~~

63.1.4.1* Pure Gases.

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

(1) Physical hazards, which shall include the following:
   (a) Flammable gas
   (b) Flammable cryogenic fluid
   (c) Oxidizing gas
   (d) Oxidizing cryogenic fluid
   (e) Pyrophoric gas
   (f) Unstable reactive (detonable) gas, Class 3 or Class 4
   (g) Unstable reactive (nondetonable) gas, Class 3
   (h) Unstable reactive gas, Class 1 or Class 2

(2) Health hazards, which shall include the following:
   (a) Corrosive gas
   (b) Cryogenic fluids
   (c) Highly toxic gas
   (d) Toxic gas

[**55:**5.1.1]

A.63.1.4.1

Not all hazardous materials are placed into the high hazard category, and some of these materials have been recognized as being of low ordinary hazard, depending on their nature in a fire. Inert compressed gases and cryogenic fluids are one example; there are others. Compressed gases and cryogenic fluids represent the gas phase of an array of hazardous

materials. As the genre of hazardous materials is expanded, there are other materials in hazard categories or hazard classes that may in fact be high hazard materials by definition, but which in some cases do not have a MAQ and, therefore, are not required to comply with the requirements for high hazard occupancies. Examples of such materials are Class IIIB combustible liquids, Class 1 unstable reactive materials (including gases), Class 1 water-reactive solids and liquids, Class 1-3 water-reactive gases, Class 1 oxidizing solids and liquids, and Class IV and V organic peroxides. [**55:**A.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 of Gas Mixtures.

The toxicity of gas mixtures shall be classified in accordance with NFPA 400 or with ~~CGA P-20, *Standard for the Classification of Toxic Gas Mixtures,* or by testing in accordance with~~ the requirements of 29 CFR 1910.120~~0~~00, ~~DOT~~ 49 CFR 173.115, or ISO 10298, *Gas cylinders — Gases and gas mixtures — Determination of toxicity ~~of a gas or gas mixture~~for the selection of cylinder valve outlets*. [**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, *Gas Cylinders — 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]

63.2.2.4 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 and ~~,~~ 63.2.3.1.7, and subsections 63.2.1, 63.2.7, 63.2.8, 63.2.12, 63.2.15~~6~~, 63.2.1~~7~~6, 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]

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

			Storage			Use — Closed Systems			Use — Open Systems	
Material	**Class**	**High Hazard Protection Level**	**Solid Pounds**	**Liquid Gallons**	**Gas[a] scf (lb)**	**Solid Pounds**	**Liquid Gallons**	**Gas[a] scf (lb)**	**Solid Pounds**	**Liquid Gallons**
Cryogenic fluid	Flammable	2	NA	45[b,c]	NA	NA	45[b,c]	NA	NA	45[b,c]
	Oxidizing	3	NA	45[d,e]	NA	NA	45[d,e]	NA	NA	45[d,e]
	Inert	NA	NA	NL	NA	NA	NL	NA	NA	NL
Flammable, gas[f]	Gaseous Category 1A and 1B (High BV)[l]	2	NA	NA	1000[d,e]	NA	NA	1000[d,e]	NA	NA
	Gaseous Category 1B (Low BV)[l]	2	NA	NA	162,500[d,e]	NA	NA	162,500[d,e]	NA	NA
	Liquefied Category 1A and 1B (High BV)[l]	2	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
	Liquefied Category 1B (Low BV)[l]	2	NA	NA	(10,000)[d,e,j]	NA	NA	(10,000)[d,e]	NA	NA

	~~Gaseous Liquefied~~ 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	1500[d,e]	NA	NA	1500[d,e]	NA	NA
	Liquefied	3	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
Pyrophoric gas	Gaseous	2	NA	NA	50[d,j]	NA	NA	50[d,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	10[d,j]	NA	NA	10[d,j]	NA	NA
	3 nondetonable	2	NA	NA	50[d,e]	NA	NA	50[d,e]	NA	NA
		3	NA	NA	750[d,e]	NA	NA	750[d,e]	NA	NA
	2	NA	NA	NA	NL	NA	NA	NL	NA	NA
	1									
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
		3	NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
	2	NA	NA	NA	NL	NA	NA	NL	NA	NA
	1									
Corrosive gas	Gaseous	4	NA	NA	810[d,e]	NA	NA	810[d,e]	NA	NA
	Liquefied		NA	NA	(150)[d,e]	NA	NA	(150)[d,e]	NA	NA
Highly toxic gas	Gaseous	4	NA	NA	20[e,k]	NA	NA	20[e,k]	NA	NA
	Liquefied		NA	NA	(4)[e,k]	NA	NA	(4)[e,k]	NA	NA
Toxic gas	Gaseous	4	NA	NA	810[d,e]	NA	NA	810[d,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:

(1) For use of control areas~~,~~ (see Section 6.2 of NFPA 55.)

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

(3) 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.

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

[b]None allowed in unsprinklered buildings unless stored or used in gas rooms or in approved gas cabinets or exhausted enclosures~~,~~ as specified in this code.

[c]With pressure-relief devices for stationary or portable containers vented directly outdoors or to an exhaust hood.

[d]Quantities are permitted to be increased 100 percent where stored or used in approved cabinets, gas cabinets, exhausted enclosures, or 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.

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

[f]Flammable 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.

[g]See 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.

[h]Additional storage locations are required to be separated by a minimum of 300 ft (92 m).

[i]In 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.

[j]Permitted only in buildings equipped throughout with ~~an~~ automatic sprinkler systems in accordance with NFPA 13.

[k]Allowed only where stored or used in gas rooms or in approved gas cabinets or exhausted enclosures~~,~~ as specified in this code.

[l]High BV Category 1B flammable gas has a burning velocity greater than 3.9 in./s (10 cm/s). Low BV Category 1B flammable gas has a burning velocity 3.9 in./s (10 cm/s) or less.

[**55:**Table 6.3.1.1]

A.63.2.3.1.1 Maximum Allowable Quantity.

Table 63.2.3.1.1 allows for a 100 percent increase in the MAQ for quantities stored in approved cabinets or other specified control. A combination of storage both inside and outside approved cabinets within the control area is permitted. Storage amounts up to the MAQ are allowed outside of cabinets where the 100 percent increase is applied. Footnotes ([d]) and ([e]) allow quantities to be increased by an additional 100 percent where sprinklers are installed throughout the building. [**55:**A.6.3.1.1]

As an example, Table A.63.2.3.1.1 shows the MAQ for oxidizing gas with various control scenarios. [**55:**A.6.3.1.1]

Table A.63.2.3.1.1 Oxidizing Gas with Various Control Scenarios

Controls	Maximum Allowed Outside Cabinets		Maximum Total Allowed	
	scf	Nm^3	scf	Nm^3
No cabinets, no sprinklers	1500	42.48	1500	42.48

Controls	Maximum Allowed Outside Cabinets		Maximum Total Allowed	
	scf	Nm^3	scf	Nm^3
No cabinets, fully sprinklered	3000	84.96	3000	84.96
Cabinets, no sprinklers	1500	42.48	3000	84.96
Cabinets, fully sprinklered	3000	84.96	6000	169.92

[**55:**Table A.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~~ When 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 Nm^3) 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 Nm^3) 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]

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

Gas Hazard	Class	Quantity of Material	
		scf	Nm^3
Individual bulk hydrogen compressed gas systems	N/A	15,000	425
Unstable reactive (detonable)	4 or 3	Quantity thresholds for gases requiring special provisions*	
Unstable reactive (nondetonable)	3	2,000	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]

A.63.2.5

Bulk hydrogen compressed gas systems terminate at the source valve. In cylinder filling or packaging operations, cylinders located on filling manifolds located downstream of the source valve are not considered to be part of the bulk gas system. For definitions of *source valve* and *bulk hydrogen compressed gas system*, see 3.3.940 and 3.3.10095.9.1 [of NFPA 55]. Additional

requirements for source valves can be found in 63.2.19. The 15,000 scf (425 Nm^3) threshold only applies to the supply and not to cylinders being filled from the system. An example of an individual bulk hydrogen system would be supply containers manifolded together into an individual system, such as a bundle or a tube trailer that exceeds 15,000 scf and which is intended to feed a process. [**55:**A.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:

(1) The building or structure shall be constructed of noncombustible materials.
(2) Walls shall not obstruct more than one side of the structure.
(3) 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.
(4) The building or structure shall be limited to a maximum area of 1500 ft^2 (140 m^2), with increases in area allowed by the building code based on occupancy and type of construction.
(5) 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.
(6) 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~~subsection 63.2.7, ~~and~~ *NFPA 70*, and NFPA 79, as applicable. [**55:**6.8]

A.63.2.7

Electrical and electronic equipment and wiring for use in hazardous locations as defined in Article 500 of *NFPA 70* should meet the requirements of Articles 500 and 501 of *NFPA 70*. Note that Article 505 also details requirements for this equipment and wiring in hazardous locations and uses a zone classification method rather than the division method of Article 500. [**55:**A.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*:

(1) Mechanical ventilation
(2) Treatment systems
(3) Temperature controls
(4) Alarms
(5) Detection systems
(6) 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]

A.63.2.8

Under the requirements of 29 CFR 1910.38 established by OSHA regulations, employers must establish an employee alarm system that complies with 29 CFR 1910.165. The requirements of 29 CFR 1910.165 for the employee alarm system include, but are not limited to, systems that are capable of being perceived above ambient noise or light levels by all employees in the affected portions of the workplace. Tactile devices should be used to alert those employees who would not otherwise be able to recognize the audible or visual alarm. The alarm system can be electrically powered or powered by pneumatic or other means. State, local, or other governmental regulations might also establish requirements for employee alarm systems. [**55:**A.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]

3**Table 63.2.9 Explosion Control Requirements**

		Explosion Control Methods	
Material	**Class**	**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]

A.63.2.10

The intent of this section is to require a water-based fire extinguishing system to keep vessels containing compressed gases cool in the event of an exposure fire, thereby minimizing the likelihood of a release and associated consequences. Accordingly, alternative fire extinguishing systems, such as dry-chemical or gaseous agent systems, should not be substituted. [**55:**A.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

Where~~n~~ 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/ft^2 (0.0051 m^3/sec/m^2) 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]

A.63.2.16.8.2

Examples of gases that are heavier than air include, but are not limited to, carbon dioxide, argon, and nitrous oxide. [**55:**A.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]

A.63.2.16.8.3

Examples of gases that are lighter than air include, but are not limited to, hydrogen, helium, and methane. [**55:**A.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 or area 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 63.3.10 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.

63.2.17.4.1

Gas cabinets shall contain not more than three cylinders, containers, or tanks, where each contains greater than or equal to 10 scf (0.28 m^3). [**55:**6.18.4.1]

63.2.17.4.2

Gas cabinets shall contain not more than 30 cylinders, containers, or tanks, where the capacity of each is less than 10 scf (0.28 m^3) in place of a cylinder, container, or tank containing greater than or equal to 10 scf (0.28 m^3). [**55:**6.18.4.2]

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]

63.2.17.6*

All cylinders in gas cabinets shall be individually secured to prevent falling or rolling and designed to allow exhaust airflow around the cylinders. [**55:**6.18.6]

A.63.2.17.6

Cylinders should be secured with straps, chains, or racks installed in gas cabinets to prevent falling or rolling. Racks should be of open design that allows air to move through the cabinet. [**55:**A.6.18.6]

63.2.17.7*

The interior of gas cabinets handling flammable gases or flammable liquefied gases shall be electrically classified as determined by a qualified individual in accordance with the requirements of *NFPA 70*. [**55:**6.18.7]

A.63.2.17.7

It is prudent that all electrical equipment inside a gas cabinet meets at least a Class I, Division 2 classification unless a hazard analysis and risk assessment indicate another classification is more prudent. The area outside the gas cabinet should be classified based on the situation and activities occurring in that area independent of the gas cabinet itself. NFPA 497 can also be a valuable source for proper classifications. [**55:**A.6.18.7]

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]

A.63.2.19

Figure A.63.2.19 shows three possible locations of the source valve. [**55:**A.6.20]

Figure A.63.2.19 Three Examples of Source Valve Locations. [55: Figure A.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

Where the primary supply of compressed gas is stored in a bulk liquid form, the provisions of Chapter 8 shall apply to piping and other gaseous system components downstream of the liquid vaporizer and upstream of the source valve. [**55:**7.1.1]

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]

63.3.1.1.3

Tube trailers used as gas supply systems shall comply with the mandatory requirements of CGA P-74, *Standard for Tube Trailer Supply Systems at Customer Sites*. [**55:**7.1.2.3]

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.

A.63.3.1.4

The compressed gas system equipment referenced is intended to include fuel cell applications, generation of hydrogen from portable or transportable hydrogen generation equipment, batteries, and similar devices and equipment that utilize hydrogen for the purpose of power generation. It does not include hydrogen production facilities intended to produce hydrogen used for distribution or repackaging operations operated by gas producers, distributors, and repackagers. [**55:**A.10.2.8]

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.

A.63.3.1.5

Numerous metal hydrides are currently being tested for gaseous hydrogen storage applications. While certain Class D extinguishing agents have been effective on some metal hydride materials, they have not been tested on the wide range of hydrides. It is crucial to understand any adverse chemical reactions between the hydride and the agent prior to using the fire suppressant. Additionally, it is important to understand that the application should be limited to small incipient stage fires. Larger fires would require the use of personal protective equipment in the application of the extinguishing agent. [**55:**A.10.2.9]

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~~ and 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:

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

[**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:

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

[**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:

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

[**55:**10.2.9.1.7.3]

63.3.1.5.1.7.3(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:

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

[**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]

63.3.1.5.2.1.2(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 (i.e., 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 Containers~~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 Nm^3) 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]

63.3.1.6.5.7 Shutoffs Between Pressure Relief Devices and Containers.

63.3.1.6.5.7.1 General.

Shutoff valves installed between pressure relief devices and containers shall be in accordance with 63.3.1.6.5.7.2 through 63.3.1.6.5.7.4. [**55:**7.1.5.5.7.1]

63.3.1.6.5.7.2 Location.

Shutoff valves shall not be installed between pressure relief devices and containers unless the valves or their use meet the requirements of 63.3.1.6.5.7.3 or 63.3.1.6.5.7.4. [**55:**7.1.5.5.7.2]

63.3.1.6.5.7.3* Security.

Shutoff valves, where used, 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:**7.1.5.5.7.3]

A.63.3.1.6.5.7.3

Where multiple valves or pressure relief devices are connected to a vent stack or common header, the potential exists for one valve to discharge into the header or stack while personnel are performing maintenance on another valve or pressure relief device. One solution is to install valves on the inlet and outlet of pressure relief devices for maintenance. Closing a full-area stop valve on the outlet of a pressure relief device that is being replaced prevents the backflow of gas from another device connected to the same stack or header. The ASME *Boiler and Pressure Vessel Code* requires that full-area stop valves be locked open and provided with manual vent valves for maintaining pressure during maintenance operations. Further, the ASME Code requires that if the full-area stop valve is closed, an operator must be present at all times to maintain the vessel pressure within acceptable limits and must lock the full-area stop valve in the open position before leaving the station. See the *ASME Boiler and Pressure Vessel Code* for complete details and requirements. [**55:**A.7.1.5.5.7.3]

63.3.1.6.5.7.4 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:**7.1.5.5.7.4]

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:

(1) The results of inspections of the system
(2) 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:

(1) Marking shall include the name of the gas and a direction-of-flow arrow.
(2) 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.
(3) Markings for piping systems shall be provided at the following locations:
    (a) At each critical process control valve
    (b) At wall, floor, or ceiling penetrations
    (c) At each change of direction
    (d) 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]

A.63.3.1.9.2

The goal of this requirement is to prevent unauthorized personnel or those unfamiliar with gas storage systems from tampering with the equipment as well as to prevent the inadvertent or unauthorized removal or use of compressed gases from storage areas. Where the compressed gases are located in an area open to the general public, a common practice is to fence and lock the storage or use area, with access restricted to supplier and user personnel. When the storage or use area is located within the user's secure area and is not accessible by the general public, it is not always necessary to fence or otherwise secure the individual gas storage or use areas. Personnel access patterns may still mandate that the system be fenced, as determined by the supplier and the user. [**55:**A.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]

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

		Unstable Reactive Class 2, Class 3, or Class 4		Corrosive		Oxidizing		Flammable		Pyrophoric		Toxic or Highly Toxic	
Gas Category	**Other gas**	**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	6.1	20	6.1	20	6.1	—	—	20	6.1
Flammable	NR	20	6.1	20	6.1	20	6.1	—	—	20	6.1	20	6.1
Oxidizing	NR	20	6.1	20	6.1	—	—	20	6.1	20	6.1	20	6.1
Corrosive	NR	20	6.1	—	—	20	6.1	20	6.1	20	6.1	20	6.1
Unstable reactive Class 2, Class 3, or Class 4	NR	—	—	20	6.1	20	6.1	20	6.1	20	6.1	20	6.1
Other gas	—	NR		NR		NR		NR		NR		NR	

NR: No separation required.

[**55:** Table 7.1.10.2]

A.63.3.1.11.2

Figure A.63.3.1.11.2 is a schematic showing the separation distances required by 63.3.1.11.2. [**55:**A.7.1.10.2]

Figure A.63.3.1.11.2 Separation of Gas Cylinders by Hazard. [55:Figure A.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 distances shown in Table 63.3.1.11.2 shall be permitted to be reduced without limit where it has been determined that compressed gas cylinders, containers, and tanks are not incompatible. [**55:**7.1.10.2.3]

A.63.3.1.11.2.3

The NFPA *Fire Protection Guide to Hazardous Materials* can be used for guidance on compatibility. Additionally, safety data sheets and other sources such as the Hazardous Materials Expert Assistant (HMEX) provide information about the compatibility of chemicals. [**55:**A.7.1.10.2.3]

63.3.1.11.2.~~3~~4

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~~4]

63.3.1.11.2.~~4~~5

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.~~5~~4]

63.3.1.11.2.~~5~~6*

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.~~6~~5]

A.63.3.1.11.2.~~5~~6

Analysis of gas mixtures often includes the analysis of individual cylinders that have been disconnected from the filling manifolds. The analysis procedure is a production step where cylinders of many different types and contents are processed. It is not unusual for an individual gas mixture to contain gases otherwise deemed to be incompatible in the pure state. For example, a mixture of hydrogen and air is routinely manufactured for use as a calibrating gas mixture used to validate the operation of flammable gas detection systems. Analytical operations involving incompatible gases, which may be located within an individual laboratory, typically require that the gases being analyzed be connected to individual work stations or analytical instruments as the process is conducted. The typical analytical process is an attended process where technicians have "hands on" control of the cylinder under examination, which serves to mitigate events that may otherwise occur in unattended operations, including storage or the use of an unattended source of supply. [**55:**A.7.1.10.2.~~6~~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]

A.63.3.1.11.3

Clearance is required from combustible materials to minimize the effects of exposure fires to the materials stored or used. The requirement to separate the materials from vegetation should

not be interpreted to mean that the area is maintained free of all vegetation. In some settings, gas systems are located on grounds that are maintained with formal landscaping. Some judgment must be exercised to determine whether the vegetation poses what might be viewed as an exposure hazard to the materials stored. Cut lawns, formal landscaping, and similar vegetation do not ordinarily present a hazard and should be allowed. On the other hand, tall, dry grass or weeds and vegetation that fringes on the border of an urban–wildland interface might be viewed as a hazard. [**55:**A.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.~~one of the following apply:

1. The compressed gas cylinders, containers, or tanks are designed for use under such exposure
2. The compressed gas cylinders, containers, or tanks are located at compressed gas manufacturing facilities where all of the following apply:
    a. Temperatures above 125°F (52°C) and below subambient (low) temperatures are permitted for the purposes of filling, analysis, and other related procedures
    b. Engineering controls are employed to prevent any hazards
    c. The temperature extremes will not degrade the original mechanical properties of the containers, cylinders, or tanks

[**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). [**55:**7.1.10.5.1]

63.3.1.11.5.2

The use of a weather ~~protected~~ protection structure or shaded environment for storage or use shall be permitted as a means to protect against direct exposure to sunlight. [**55:**7.1.10.5.2~~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]

63.3.1.11.9.1

Compressed gas cylinders shall not be located where they could be exposed to spills of flammable and combustible liquids. [**55:**7.1.10.9.1]

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]

Commented [CM3]: Add space.

A.63.3.1.11.10.1

Electrical devices can include pressure transducers, signal transmitters, shutoff controls, and similar devices. Some of these devices may be nonincendive and suitable for use in hazardous areas. Flammability of gases is not the only concern with respect to electrical circuits, because piping serving systems in use can act as conductors of electrical energy, exposing unrelated portions of the system to electrical hazards if improperly installed. [**55:**A.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]

A.63.3.1.15.3

The gas supplier should be consulted for advice under these circumstances. [**55:**A.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]

A.63.3.1.18.1.2

Underground piping systems are those systems that are buried and in contact with earth fill or similar materials. Piping located in open-top or grated-top trenches is not considered to be underground although it may be below grade. [**55:**A.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]

63.3.1.18.7

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]

63.3.1.19.1.1

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:

(1) The system is installed and prior to being placed into service
(2) There is a change in service
(3)* 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

(4)* The design standards or written procedures specify cleaning and purging
[**55:**7.1.18.1.1]

A.63.3.1.19.1.1(3)

The replacement of parts in a system to repair leaks, the addition of gaskets, and similar routine maintenance is not intended to establish the need for cleaning of the entire piping system. The requirement is to not introduce new containments during the repair (e.g., cutting oils, grinding debris, contaminated hardware). Conversely, when a piping system is extended, or when the system needs to be rendered safe for maintenance purposes, purging the system before disassembly likely will be required as will internal cleaning if new piping or materials of construction are introduced. [**55:**A.7.1.18.1.1(3)]

A.63.3.1.19.1.1(4)

Cleaning and purging of piping systems can be conducted as individual functions, that is, just cleaning, just purging, or in combination as required to satisfy the requirements of the procedures. [**55:**A.7.1.18.1.1(4)]

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]

A.63.3.1.19.1.3

It is not intended that a new written procedure be required each time the activity occurs within a facility. [**55:**A.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:

(1) Evaluate hazards, errors, and malfunctions related to each step in the procedure
(2) Review the measures prescribed in the procedure for applicability
(3) Make recommendations for additional hazard mitigation measures if deemed necessary
[**55:**7.1.18.1.3.1]

A.63.3.1.19.1.3.1

The review of the written procedures should not be performed solely by the same person(s) responsible for developing the procedures. It can be performed by an independent person or group within the company or department or by a third-party consultant. [**55:**A.7.1.18.1.3.1]

63.3.1.19.1.3.2

The completed written procedure shall be as follows:

(1) Maintained on site by the facility owner/operator
(2) Provided to operating personnel engaged in cleaning or purging operations
(3) 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:

(1) The technical basis for the proposed change
(2) The safety and health implications
(3) Whether the change is permanent or temporary
(4) 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]

A.63.3.1.19.1.5.3

The notification is given to warn personnel that such procedures are about to occur so ~~that~~ they will be out of zones potentially affected by the cleaning or purging procedure. The intended notification is to be commensurate with the operation to be conducted, and the timing of the notification should be relevant to the activity conducted so that personnel in the area can respond in a timely manner. Notification could be an audible and/or visible alarm or an announcement over a public address system, private network, radio, or similar and reliable means of electronic transmission. [**55:**A.7.1.18.1.5.3]

Verbal notification can be used in operations where the piping system is limited to the area occupied by those that will be conducting the cleaning or purging procedures and related operating personnel. These areas frequently are found in occupancies where the gas used to charge the piping system is supplied from portable containers, as well as those areas where the piping system is located primarily in the occupied work area. [**55:**A.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]

A.63.3.1.19.2

For additional information on cleaning techniques used for stainless steel parts and equipment, see ASTM A380/A380 M, *Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems*. [**55:**A.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]

A.63.3.1.19.2.2

During construction, visual inspection should be performed on sections of pipe as the piping system is being assembled to ensure that no gross contamination is left in the pipe. Where the standard of cleanliness is high, fabrication techniques should be utilized that do not introduce contamination into the pipe. Examples of these techniques can include, but are not limited to, constant inert gas purging or assembly in a particulate-controlled environment. The use of piping and components with a high-quality interior surface finish~~,~~ and high-quality materials of

construction all have an effect on the ability to maintain a high degree of cleanliness. [**55:**A.7.1.18.2.2]

Cleaning after construction can typically be accomplished by one or more of the following methods:

(1) Pigging
(2) Mechanical scraping
(3) High-velocity gas flow
(4) Liquid washing
(5) Use of cleaning media
(6) Application of high vacuum
(7) Solvent cleaning
(8) Water washing
(9) Steam cleaning

[**55:**A.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]

A.63.3.1.19.3

Purging can be accomplished by continuous media or gas flow, evacuation or vacuum, or repeated pressurizing and venting cycles commonly referred to as pulse purging or cycle purging. In some cases, purge procedures can involve more than one type of purging technique. Purging can be accomplished by manual or automatic means. Automated purge panels or manifold systems operated by a programmable logic controller are commonly used as a means to enhance the results of a purging process where high purity gas delivery systems are employed. [**55:**A.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:

(1) Activating or placing a piping system into service
(2) Deactivating or removing a piping system from service
(3) 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
(4) 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
(5) 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:

(1) Ceiling limit
(2) Permissible exposure limit
(3) Short-term exposure limit
(4) Twenty-five percent of the lower flammable limit

[**55:**7.1.18.3.2.2]

63.3.2 Subatmospheric Gas Sources (SAGS).

63.3.2.1

The storage and use of subatmospheric gas sources (type 1 or 2) with compatible gases shall meet all the requirements of this code based on the assigned hazard categories listed in Section 5.1 of NFPA 55. [**55:**7.2.1]

63.3.2.2

SAGS cylinders with incompatible gases shall meet the requirements of 17.14.2.1 through 17.14.2.6 in NFPA 318. [**55:**7.2.2]

63.3.~~2~~ 3 Storage.

63.3.~~2~~3.1 General.

63.3.~~2~~3.1.1 Applicability.

The storage of compressed gas cylinders, containers, and tanks shall be in accordance with 63.3.2. [**55:**7.~~3~~2.1.1]

63.3.~~2~~3.1.2 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.~~3~~2.1.2]

63.3.~~2~~3.1.2.1 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.~~3~~2.1.2.1]

63.3.~~2~~3.1.2.2 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.~~3~~2.1.2.2]

63.3.~~2~~3.1.2.3 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~~3.1.2.3]

63.3.~~2~~3.1.3 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:**7.3~~2~~.1.3]

63.3.~~2~~3.2 Material-Specific Regulations.

63.3.~~2~~3.2.1 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~~3.2.1]

63.3.~~2~~3.2.2 Exterior Storage.

63.3.~~2~~3.2.2.1 General.

Exterior storage of compressed gases shall be in accordance with the material-specific provisions of 63.3.4 through 63.3.10. [**55:**7.3~~2~~.2.2.1]

63.3.~~2~~3.2.2.2 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~~3.2.2.2]

63.3.~~3~~4 Use and Handling.

63.3.~~3~~4.1 General.

63.3.~~3~~4.1.1 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~~4.1.1]

63.3.~~3~~4.1.2 Controls.

63.3.~~3~~4.1.2.1

Compressed gas system controls shall be designed to prevent materials from entering or leaving the process at an unintended time, rate, or path. [**55:**7.4~~3~~.1.2.1]

63.3.~~3~~4.1.2.2

Automatic controls shall be designed to be fail-safe. [**55:**7.4~~3~~.1.2.2]

63.3.~~3~~4.1.3 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:**7.4~~3~~.1.3]

63.3.~~3~~4.1.3.1 Integrity.

Piping, tubing, pressure regulators, valves, and other apparatus shall be kept gastight to prevent leakage. [**55:**7.~~4~~3.1.3.1]

63.3.~~3~~4.1.3.2 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~~4.1.3.2]

63.3.~~3~~4.1.4 Valves.

63.3.~~3~~4.1.4.1

Valves utilized on compressed gas systems shall be designed for the gas or gases and pressure intended and shall be accessible. [**55:**7.~~4~~3.1.4.1]

63.3.~~3~~4.1.4.2

Valve handles or actuators for required shutoff valves shall not be removed or otherwise altered to prevent access. [**55:**7.~~4~~3.1.4.2]

63.3.~~3~~4.1.5 Vent Pipe Termination.

63.3.~~3~~4.1.5.1

Venting of gases shall be directed to an approved location. [**55:**7.~~4~~3.1.5.1]

63.3.~~3~~4.1.5.2

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~~4.1.5.2]

63.3.~~3~~4.1.6 Upright Use.

63.3.~~3~~4.1.6.1

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~~4.1.6.1]

63.3.~~3~~4.1.6.2

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~~4.1.6.2]

63.3.~~3~~4.1.7 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~~4.1.7]

63.3.~~3~~4.1.7.1

Flammable liquefied gases at processing plants shall be permitted to use this inverted position method while transfilling. [**55:**7.43.1.7.1]

63.3.34.1.7.2

The cylinder, container, or tank shall be secured, and the dispensing apparatus shall be designed for use with liquefied gas. [**55:**7.43.1.7.2]

63.3.34.1.8 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:**7.34.1.8]

63.3.34.1.9 Transfer.

Transfer of gases between cylinders, containers, and tanks shall be performed by qualified ~~personnel~~ individuals using equipment and operating procedures in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*. [**55:**7.34.1.9]

63.3.34.1.10 Use of Compressed Gases for Inflation.

Inflatable equipment, devices, or balloons shall only be pressurized or filled with compressed air or inert gases. [**55:**7.34.1.10]

63.3.34.1.11 Emergency Shutoff Valves.

63.3.34.1.11.1

Accessible manual or automatic emergency shutoff valves shall be provided to shut off the flow of gas in case of emergency. [**55:**7.43.1.11.1]

63.3.34.1.11.1*

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:**7.43.1.11.1.1]

A.63.3.34.1.11.1.1

In operations where an automatic emergency shutoff valve is activated by a control system that is operated from a remote station or by remote station software, the software system should be designed to provide a visual indication of the emergency shutdown control system. The visual emergency shutdown function should be able to be identified by trained operators and recognizable to emergency response personnel. [**55:**A.7.43.1.11.1.1]

63.3.34.1.11.2

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:**7.43.1.11.2]

63.3.34.1.12 Emergency Isolation.

63.3.34.1.12.1

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:

(1) Health hazard Class 3 or Class 4
(2) Flammability Class 4
(3) Instability Class 3 or Class 4

[**55:**7.~~43~~.1.12.1]

63.3.~~3~~4.1.12.2

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

(1) Automatic shutoff valves, located as close to the bulk source as practical, tied to leak detection systems
(2) Attended control stations where trained personnel can monitor alarms or supervisory signals and can trigger emergency responses
(3) A constantly monitored control station with an alarm and remote shutoff of the gas supply system
(4) Excess flow valves at the bulk source

[**55:**7.~~43~~.1.12.2]

63.3.~~3~~4.1.12.3

The requirements of 63.3.~~3~~4.1.12 shall not be required for the following:

(1) Piping for inlet connections designed to prevent backflow at the source
(2) Piping for pressure relief devices

[**55:**7.~~43~~.1.12.3]

63.3.~~3~~4.1.12.4 Location Exemptions.

The requirements of 63.3.~~3~~4.1.12 shall not apply to the following:

(1) Piping for inlet connections designed to prevent backflow
(2) Piping for pressure relief devices
(3) Systems containing 430 scf (12.7 Nm^3) or less of flammable gas

[**55:**7.~~43~~.1.12.4]

63.3.~~3~~4.2 Material-Specific Regulations.

63.3.~~3~~4.2.1 Indoor Use.

Indoor use of compressed gases shall be in accordance with the requirements of 63.3.~~4~~5 through 63.3.~~10~~11. [**55:**7.~~43~~.2.1]

63.3.~~3~~4.2.2 Exterior Use.

63.3.~~3~~4.2.2.1 General.

Exterior use of compressed gases shall be in accordance with the requirements of 63.3.~~4~~5 through 63.3.~~10~~11. [**55:**7.~~43~~.2.2.1]

63.3.~~3~~4.2.2 Separation.

Distances from property lines, buildings, and exposure hazards shall be in accordance with the material-specific provisions of 63.3.~~4~~ 5 through 63.3.~~10~~11. [**55:**7.~~4~~3.2.2.2]

63.3.~~3~~4.3 Handling.

63.3.~~3~~4.3.1 Applicability.

The handling of compressed gas cylinders, containers, and tanks shall be in accordance with 63.3.~~3~~4.3. [**55:**7.~~3~~4.3.1]

63.3.~~3~~4.3.2 Carts and Trucks.

63.3.~~3~~4.3.2.1

Cylinders, containers, and tanks shall be moved using an approved method. [**55:**7.~~4~~3.3.2.1]

63.3.~~3~~4.3.2.2

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~~4.3.2.2]

63.3.~~3~~4.3.3 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.~~4~~3.3.3]

63.3.~~4~~ 5 Medical Gas Systems.

Medical gas systems for health care shall be in accordance with NFPA 99. [**55:**7.~~5~~4]

63.3.~~5~~ 6 Corrosive Gases.

63.3.~~5~~6.1 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 subsections 63.3.1 through 63.3.~~3~~ 4 and 63.3.~~5~~6. [**55:**7.~~6~~5.1]

63.3.~~5~~6.2 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~~6.2]

63.3.~~5~~6.2.1

A 2-hour fire barrier wall without openings or penetrations and that extends not less than 30 in. (762 mm) above and to the sides of the storage or use area shall be permitted in lieu of the 20 ft (6.1 m) distance. [**55:**7.~~5~~6.2.1]

63.3.~~5~~6.2.1.1*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.~~5~~6.2.1.1]

A.63.3.~~5~~6.2.1.1

Portions of the system upstream of the source valve include the containers or bulk supply as well as control equipment designed to control the flow of gas into a piping system. The piping system downstream of the source valve is protected by excess flow control should failure occur in the piping system and is not required to be protected by the fire barrier. The fire barrier serves to protect those portions of the system that are the most vulnerable along with the necessary controls used to operate the system. [**55:**A.7.~~6~~5.2.1.1]

63.3.~~5~~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.~~5~~6.2.1.2]

63.3.~~5~~6.2.1.3

The 2-hour fire barrier shall be located at least 5 ft (1.5 m) from any exposure. [**55:**7.~~5~~6.2.1.3]

63.3.~~5~~6.2.1.4

The 2-hour fire barrier wall shall not have more than two sides at approximately 90 degree (1.57 rad) directions or not more than three sides with connecting angles of approximately 135 degrees (2.36 rad). [**55:**7.~~6~~5.2.1.4]

63.3.~~5~~6.3 Indoor Use.

The indoor use of corrosive gases shall be provided with a gas cabinet, exhausted enclosure, or gas room. [**55:**7.~~6~~5.3]

63.3.~~5~~6.3.1 Gas Cabinets.

Gas cabinets shall be in accordance with 63.2.17. [**55:**7.~~5~~6.3.1]

63.3.~~5~~6.3.2 Exhausted Enclosures.

Exhausted enclosures shall be in accordance with 63.2.18. [**55:**7.~~6~~5.3.2]

63.3.~~5~~6.3.3 Gas Rooms.

Gas rooms shall be in accordance with 63.2.4. [**55:**7.~~6~~5.3.3]

63.3.~~5~~6.3.4 Treatment Systems.

Treatment systems, except as provided for in 63.3.~~5~~6.3.4.1, gas cabinets, exhausted enclosures, and gas rooms containing corrosive gases in use shall be provided with exhaust ventilation, with all exhaust directed to a treatment system designed to process the accidental release of gas. [**55:**7.~~6~~5.3.4]

63.3.~~5~~6.3.4.1

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

(1) Gas detection in accordance with 63.3.~~9~~10.3.2.1.1
(2) Fail-safe automatic closing valves in accordance with 63.3.~~9~~10.3.2.2

[**55:**7.~~5~~6.3.4.1]

63.3.~~5~~6.3.4.2

Treatment systems shall be capable of diluting, adsorbing, absorbing, containing, neutralizing, burning, or otherwise processing the release of corrosive gas in accordance with 63.3.~~9~~10.3.4.1. [**55:**7.~~5~~6.3.4.2]

63.3.~~5~~6.3.4.3

Treatment system sizing shall be in accordance with 63.3.~~9~~10.3.4. [**55:**7.~~6~~5.3.4.3]

63.3.~~6~~ 7 Flammable Gases.

63.3.~~6~~7.1 Storage, Use, and Handling.

63.3.~~6~~7.1.1*

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 subsections 63.3.1 through 63.3.~~3~~ 4 and 63.3.~~6~~7. [**55:**7.~~7~~6.1.1]

A.63.3.~~6~~7.1.1

All liquefied and nonliquefied flammable compressed gases are regulated by 63.3.~~6~~ 7 unless they are specifically indicated as not applicable in accordance with 63.1.1.4. [**55:**A.7.~~7~~6.1.1]

63.3.~~6~~7.1.2

Storage, use, and handling of gaseous hydrogen shall be in accordance with 63.3.~~6~~7.1 and Chapter 10 of NFPA 55. [**55:**7.~~7~~6.1.2]

63.3.~~6~~7.1.3

Storage, use, and handling of compressed natural gas shall be in accordance with 63.3.~~6~~7.1. [**55:**7.~~7~~6.1.3]

63.3.~~6~~7.2 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~~7.2. [**55:**7.~~7~~6.2]

5**Table 63.3.~~6~~7.2 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 Nm^3.

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 line of sight between the storage and the exposure. The configuration of the fire barriers shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [**55:**Table 7.~~6~~7.2]

Commented [CM4]: Delete space.

63.3.~~6~~7.2.1

Bulk hydrogen gas installations shall be in accordance with Chapter 10 of NFPA 55. [**55:**7.~~7~~6.2.1]

63.3.~~6~~7.2.1.1*

Where a protective structure is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.~~7~~6.2.1.1]

A.63.3.~~6~~7.2.1.1

See A.63.3.~~5~~6.2.1.1. [**55:**A.7.~~7~~6.2.1.1]

63.3.~~6~~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~~6.2.1.2]

63.3.~~6~~7.2.2*

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 Nm^3). [**55:**7.~~7~~6.2.2]

A.63.3.7.2.2

Even though Chapter 10 of NFPA 55 is specific to hydrogen gas systems, the tables referenced in 63.3.7.2.2 [e.g., Table 10.4.2.2.1(a) through Table 10.4.2.2.1(c) of NFPA 55] can be used for all flammable gases, including hydrogen. [**55:**A.7.7.2.2]

63.3.~~6~~7.2.2.1

Where fire barriers are used as a means of distance reduction, fire barriers shall be in accordance with 10.4.2.2.4 of NFPA 55. [**55:**7.~~7~~6.2.2.1]

63.3.~~6~~7.2.2.2

Mobile acetylene trailer systems (MATS) shall be located in accordance with 15.2.3 of NFPA 55. [**55:**7.~~7~~6.2.2.2]

63.3.~~6~~7.2.3

The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [**55:**7.~~7~~6.2.3]

63.3.~~6~~7.2.4

Storage and use of flammable compressed gases shall not be located within 50 ft (15.2 m) of air intakes or the minimum distance from a hydrogen bulk storage system as specified in 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, whichever is less. [**55:**7.~~7~~6.2.4]

63.3.~~6~~7.2.5

Storage and use of flammable gases outside of buildings shall also be separated from building openings by 25 ft (7.6 m) or the minimum distance from a hydrogen bulk storage system as specified in 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, whichever is less. [**55:**7.7.2.5]

63.3.~~6~~7.2.5.1

Fire barriers shall be permitted to be used as a means to separate storage areas from openings or a means of egress used to access the public way. [**55:**7.~~6~~7.2.5.1]

63.3.7.2.6

Vents from tube trailers and fixed storage systems under weather protection shall discharge outside the weather protection. [**55:**7.7.2.6]

63.3.~~6~~7.3 Indoor Non-Bulk Hydrogen Compressed Gas System Location.

63.3.~~6~~7.3.1

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

(1) In a ventilated area in accordance with the provisions of 63.2.16
(2) Separated from incompatible materials in accordance with the provisions of 63.3.1.11.2
(3) A distance of 25 ft (7.6 m) from open flames and other sources of ignition
(4) A distance of 50 ft (15 m) from intakes of ventilation, air-conditioning equipment, and air compressors located in the same room or area as the hydrogen system
    (a) The distance shall be permitted to be reduced to 10 ft (3.1 m) where the room or area in which the hydrogen system is installed is protected by a listed detection system per Article 500.7(K) of *NFPA 70* and the detection system shuts down the fuel supply in the event of a leak that results in a concentration that exceeds 25 percent of the LFL.
    (b) Emergency shutoff valves shall be provided in accordance with 63.3.~~3~~4.1.11.
(5) A distance of 50 ft (15 m) from other flammable gas storage
(6) Protected against damage in accordance with the provisions of 63.3.1.9.4.

[**55:**10.3.5.1]

Commented [CM5]: Delete period.

63.3.~~6~~7.3.2 Systems Installed in One Room.

63.3.~~6~~7.3.2.1

More than one system of 5000 scf (141.6 Nm^3) 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~~7.3.2.2

The separation distance between multiple systems of 5000 scf (141.6 Nm^3) 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~~7.3.2.3

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~~7.3.2.1 or 63.3.~~6~~7.3.2.2 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]

63.3.7.4 Outdoor Non-Bulk Hydrogen Compressed Gas Location.

63.3.7.4.1

The outdoor storage or use of non-bulk gaseous hydrogen shall be in accordance with 63.3.7.2. [**55:**10.3.6.1]

63.3.~~6~~7.4 Maintenance. [Renumber rest of sections]

~~[**55:**10.3.7]~~

63.3.~~6~~7.4.1

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

63.3.~~6~~7.4.2

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~~7.4.3

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~~7.5 Ignition Source Control.

Ignition sources in areas containing flammable gases shall be in accordance with 63.3.~~6~~7.5. [**55:**7.~~6~~7.3]

63.3.~~6~~7.5.1 Static Producing Equipment.

Static producing equipment located in flammable gas areas shall be grounded. [**55:**7.~~7~~6.3.1]

63.3.~~6~~7.5.2 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.~~7~~6.3.2]

63.3.~~6~~7.5.3 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.~~7~~6.3.3]

63.3.~~6~~7.6 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~~7.4]

63.3.~~6~~7.7 Maintenance of Piping Systems.

63.3.~~6~~7.7.1

Maintenance of flammable gas system piping and components shall be performed annually by a qualified representative of the equipment owner. [**55:**7.~~7~~6.5.1]

63.3.~~6~~7.7.2

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.~~7~~6.5.2]

63.3.~~6~~7.7.3

Scheduled maintenance and retest activities shall be formally documented, and records shall be maintained a minimum of 3 years. [**55:**7.~~6~~7.5.3]

63.3.~~7~~8 Oxidizing Gases.

63.3.~~7~~8.1 General.

The storage or use of oxidizing compressed gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 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~~4 and 63.3.~~7~~8. [**55:**7.~~8~~7.1]

63.3.~~7~~8.2 Distance to Exposures.

The outdoor storage or use of oxidizing compressed gas shall be in accordance with Table 63.3.~~7~~8.2. [**55:**7.~~8~~7.2]

6**Table 63.3.~~7~~8.2 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	Nm^3	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 7.8~~7~~.2]

63.3.7~~8~~.2.1

The distances shall not apply where fire barriers having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure. [**55:**7.8~~7~~.2.1]

63.3.7~~8~~.2.1.1*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.8~~7~~.2.1.1]

A.63.3.7~~8~~.2.1.1

See A.63.3.5~~6~~.2.1.1. [**55:**A.7.8~~7~~.2.1.1]

63.3.7~~8~~.2.1.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [**55:**7.8~~7~~.2.1.2]

63.3.7~~8~~.2.2

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter. [**55:**7.7~~8~~.2.2]

63.3.7~~8~~.2.3

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [**55:**7.7~~8~~.2.3]

63.3.~~8~~ 9 Pyrophoric Gases.

63.3.~~8~~9.1 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~~ 4 and 63.3.~~8~~9. [**55:**7.9~~8~~.1]

63.3.~~8~~9.2 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:**7.9~~8~~.2]

63.3.~~8~~9.3 Distance to Exposures.

The outdoor storage or use of pyrophoric compressed gas shall be in accordance with Table 63.3.~~8~~9.3. [**55:**7.9~~8~~.3]

7**Table 63.3.~~8~~9.3 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~~9.3]

63.3.~~8~~9.3.1

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:**7.9~~8~~.3.1]

63.3.~~8~~9.3.1.1*

Where a fire barrier is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.9~~8~~.3.1.1]

A.63.3.~~8~~9.3.1.1

See A.63.3.~~5~~6.2.1.1. [**55:**A.7.9~~8~~.3.1.1]

63.3.8~~9~~.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:**7.9~~8~~.3.1.2]

63.3.~~8~~9.3.1.3

The fire barrier shall be at least 5 ft (1.5 m) from the storage or use area perimeter. [**55:**7.9~~8~~.3.1.3]

63.3.~~8~~9.3.1.4

The configuration of the fire barrier shall allow natural ventilation to prevent the accumulation of hazardous gas concentrations. [**55:**7.9~~8~~.3.1.4]

63.3.~~8~~9.3.2

Storage and use of pyrophoric gases outside buildings shall be separated from building openings by 25 ft (7.6 m). [**55:**7.9~~8~~.3.2]

63.3.~~8~~9.3.2.1

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:**7.9~~8~~.3.2.1]

63.3.~~9~~10 Toxic and Highly Toxic Gases.

63.3.10~~9~~.1 General.

The storage or use of toxic ~~and~~ or highly toxic gases exceeding the quantity thresholds for gases ~~requiring~~ that require 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~~ 4 and 63.3.~~9~~10. [**55:**7.10~~9~~.1]

63.3.10~~9~~.2 Ventilation and Arrangement.

63.3.10~~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:**7.10~~9~~.2.1]

63.3.10~~9~~.2.1.1

Gas cabinets shall be in accordance with 63.2.17. [**55:**7.10~~9~~.2.1.1]

63.3.10~~9~~.2.1.2

Exhausted enclosures shall be in accordance with 63.2.18. [**55:**7.10~~9~~.2.1.2]

63.3.10~~9~~.2.1.3

Gas rooms shall be in accordance with 63.2.4. [**55:**7.10~~9~~.2.1.3]

63.3.10~~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:**7.10~~9~~.2.2]

63.3.10~~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:**7.10~~9~~.2.2.1]

63.3.10~~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:**7.10~~9~~.2.2.1.1]

A.63.3.10~~9~~.2.2.1.1

See A.63.3.~~5~~6.2.1.1. [**55:**A.7.10~~9~~.2.2.1.1]

63.3.10~~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:**7.10~~9~~.2.2.1.2]

63.3.10~~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:**7.10~~9~~.2.2.1.3]

63.3.10~~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:**7.10~~9~~.2.2.1.4]

63.3.10.2.2.1.5

The minimum distance requirement for exposures shall be reduced to 5 ft (1.5 m) from buildings and 25 ft (7.6 m) from exit discharges where gases are stored in gas cabinets as specified in this code. [**55:**7.10.2.2.1.5]

63.3.10~~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~~10.2.2.2]

63.3.10~~9~~.2.3 Air Intakes.

Storage and use of toxic ~~and~~ or highly toxic compressed gases shall not be located within 75 ft (23 m) of air intakes. [**55:**7.10~~9~~.2.3]

63.3.10~~9~~.3 Treatment Systems.

Except as provided in 63.3.~~9~~10.3.1 and 63.3.~~9~~10.3.2, 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:**7.10~~9~~.3]

63.3.10~~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~~10.3.1.1 through 63.3.9.3.1.3. [**55:**7.10~~9~~.3.1]

63.3.10~~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:**7.10~~9~~.3.1.1]

63.3.10~~9~~.3.1.2 Handwheels Secured.

Where provided, handwheel-operated valves shall be secured to prevent movement. [**55:**7.10~~9~~.3.1.2]

63.3.10~~9~~.3.1.3 Containment Devices Provided.

Approved cylinder containment vessels or cylinder containment systems shall be provided at an approved location. [**55:**7.10~~9~~.3.1.3]

63.3.10~~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 63.3.10~~9~~.3.2.1 and 63.3.10~~9~~.3.2.2. [**55:**7.10~~9~~.3.2]

63.3.10~~9~~.3.2.1 Gas Detection.

63.3.10~~9~~.3.2.1.1

A gas detection system with a sensing interval not exceeding 5 minutes shall be provided. [**55:**7.~~9~~10.3.2.1.1]

63.3.10~~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:**7.10~~9~~.3.2.1.2]

63.3.10~~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:**7.10~~9~~.3.2.2]

63.3.10~~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:**7.10~~9~~.3.2.2.1]

63.3.10~~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~~10.3.2.2.2]

63.3.10~~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:**7.10~~9~~.3.2.2.3]

63.3.10~~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:**7.10~~9~~.3.2.2.4]

63.3.10~~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:**7.10~~9~~.3.3]

63.3.10~~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:**7.10~~9~~.3.3.1]

63.3.10~~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:**7.10~~9~~.3.3.2]

63.3.10~~9~~.3.4 Treatment System Sizing.

63.3.10~~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~~10.3.4.2. [**55:**7.10~~9~~.3.4.1]

63.3.10~~9~~.3.4.2 Largest Compressed Gas Vessel.

The entire contents of the single largest compressed gas vessel shall be considered. [**55:**7.10~~9~~.3.4.2]

63.3.10~~9~~.3.4.3 Attended Operations — Alternative Method of System Sizing.

63.3.10~~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:**7.10~~9~~.3.4.3.1]

63.3.10~~9~~.3.4.3.2

Such process piping systems shall comply with the requirements of 63.3.~~9~~10.3.4.3.2(A) through 63.3.~~9~~10.3.4.3.2(E). [**55:**7.10~~9~~.3.4.3.2]

63.3.10~~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:**7.10~~9~~.3.4.3.2(A)]

63.3.10~~9~~.3.4.3.2(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:

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

[**55:**7.10~~9~~.3.4.3.2(B)]

63.3.10~~9~~.3.4.3.2(C)

Process Shutdown. Operations involving the gas detected shall be shut down and leaks repaired. [**55:**7.10~~9~~.3.4.3.2(C)]

63.3 10~~9~~.3.4.3.2(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:**7.10~~9~~.3.4.3.2(D)]

63.3.10~~9~~.3.4.3.2(E)

Piping System Accessibility. Piping systems shall be designed to provide for readily accessible manual shutdown controls. [**55:**7.10~~9~~.3.4.3.2(E)]

63.3.10~~9~~.3.5 Rate of Release.

The time release shall be in accordance with Table 63.3.~~9~~10.3.5 for the type of container indicated. [**55:**7.10~~9~~.3.5]

8**Table 63.3.10~~9~~.3.5 Rate~~s~~ 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 7.10~~9~~.3.5]

63.3.10~~9~~.3.6* Maximum Flow Rate of Release.

A.63.3.10~~9~~.3.6

The areas for typical restricted flow orifices are shown in Table A.63.3.~~9~~10.3.6. [**55:**A.7.10~~9~~.3.6]

9**Table A.63.3.10~~9~~.3.6 Typical Orifice Areas**

Orifice Diameter		Area	
in.	cm	$in.^2$	cm^2
0.006	0.015	2.83×10^{-5}	1.83×10^{-4}
0.010	0.025	7.85×10^{-5}	5.06×10^{-4}
0.014	0.036	1.54×10^{-4}	9.93×10^{-4}

[**55:**Table A.7.10~~9~~.3.6]

63.3.10~~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:**7.10~~9~~.3.6.1]

63.3.10~~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~~10.3.6.2]

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

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~~10.3.6 for areas of typical restricted flow orifices.)*

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

MW = molecular weight

[**55:**7.10~~9~~.3.6.2]

A.63.3. 10~~9~~.3.6.2

The formula has been taken from industry publications including the Scott Specialty Gases *Design and Safety Handbook*. It is based on estimated flow rates for air at 70°F (21°C) discharging to normal atmospheric pressure through an average shape and quality orifice. It can be assumed to be ±15 percent accurate. Correction factors have been built into the formula as presented in 63.3.~~9~~10.3.6.2 to accommodate the use of gases other than air (e.g., use of specific gravity data). [**55:**A.7.10~~9~~.3.6.2]

63.3.10~~9~~.3.6.3

For mixtures, the average of the molecular weights shall be used. [**55:**7.10~~9~~.3.6.3]

63.3.10~~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~~10.4.1 through 63.3.~~9~~10.4.2.3. [**55:**7.10~~9~~.4]

63.3.10~~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~~10.3. [**55:**7.10~~9~~.4.1]

63.3.10~~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~~10.4.2.1 through 63.3.~~9~~10.4.2.3. [**55:**7.10~~9~~.4.2]

63.3.10~~9~~.4.2.1 Performance.

Containment vessels or containment systems shall be capable of fully containing or terminating a release. [**55:**7.~~9~~10.4.2.1]

63.3.10~~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~~10.4.2.2]

63.3.10~~9~~.4.2.3 Location.

Containment vessels or systems shall be capable of being transported to the leaking cylinder, container, or tank. [**55:**7.10~~9~~.4.2.3]

63.3.10~~9~~.5 Emergency Power.

63.3.10~~9~~.5.1 General.

Emergency power shall comply with the requirements of 63.3.~~9~~10.5 in accordance with *NFPA 70*. [**55:**7.10~~9~~.5.1]

63.3.10~~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:**7.10~~9~~.5.2]

63.3.10~~9~~.5.3 Where Required.

Emergency power shall be provided for the following systems:

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

[**55:**7.10~~9~~.5.3]

63.3.10~~9~~.5.4 Level.

Emergency power systems shall comply with the requirements for a Level 2 system in accordance with NFPA 110. [**55:**7.10~~9~~.5.4]

63.3.10~~9~~.6 Gas Detection.

Except as provided in 63.3.~~9~~10.6.1, a continuous gas detection system in accordance with the requirements of 63.3.~~9~~10.6.2 through 63.3.~~9~~10.6.6 shall be provided for the indoor storage or use of toxic or highly toxic compressed gases. [**55:**7.10~~9~~.6]

63.3.10~~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:**7.10~~9~~.6.1]

63.3.10~~9~~.6.2 Local Alarm.

The gas detection system shall initiate a local alarm that is both audible and visible. [**55:**7.10~~9~~.6.2]

63.3.10~~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:**7.10~~9~~.6.3]

63.3.10~~9~~.6.4 Automatic Shutdown.

63.3.10~~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:**7.10~~9~~.6.4.1]

63.3.10~~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:**7.10~~9~~.6.4.2]

63.3.10~~9~~.6.5 Detection Points.

Detection shall be provided at the locations specified in 63.3.~~9~~10.6.5.1 through 63.3.~~9~~10.6.5.4. [**55:**7.10~~9~~.6.5]

63.3.10~~9~~.6.5.1 Treatment System Discharge.

Detection shall be provided at the discharge from the treatment system. [**55:**7.10~~9~~.6.5.1]

63.3.10~~9~~.6.5.2 Point of Use.

Detection shall be provided in the room or area in which the gas is used. [**55:**7.10~~9~~.6.5.2]

63.3.10~~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~~10.6.5.3]

63.3.10~~9~~.6.5.4 Storage.

Detection shall be provided in the room or area in which the gas is stored. [**55:**7.10~~9~~.6.5.4]

63.3.10~~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~~10.6.5.2 and 63.3.~~9~~10.6.5.3 and at not less than one-half the IDLH level for points identified in 63.3.~~9~~10.6.5.1. [**55:**7.10~~9~~.6.6]

63.3.10~~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:**7.10~~9~~.7]

63.3.~~10~~ 11 Unstable Reactive Gases (Nondetonable).

The storage or use of unstable reactive (nondetonable) gases exceeding the quantity thresholds for gases requiring special provisions as specified in Table 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~~ 4 and 63.3.~~10~~11. [**55:**7.1~~0~~1]

63.3.~~10~~11.1 Distances to Exposures for Class 2.

63.3.~~10~~11.1.1

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:**7.1~~1~~0.1.1]

63.3.~~10~~11.1.2

A 2-hour fire barrier wall without openings or penetrations shall be permitted in lieu of the 20 ft (6 m) distance required by 63.3.~~10~~11.1.1. [**55:**7.1~~1~~0.1.2]

63.3.~~10~~11.1.2.1*

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.1~~1~~0.1.2.1]

A.63.3.~~10~~11.1.2.1

See A.63.3.5.2.1.1. [**55:**A.7.1~~1~~0.1.2.1]

63.3.~~10~~11.1.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building. [**55:**7.1~~1~~0.1.2.2]

63.3.~~10~~11.1.2.3

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure. [**55:**7.1~~1~~0.1.2.3]

63.3.~~10~~11.1.2.4

The 2-hour fire barrier wall shall not have more than two sides at approximately 90 degree (1.57 rad) directions or not more than three sides with connecting angles of approximately 135 degrees (2.36 rad). [**55:**7.1~~0~~1.1.2.4]

63.3.~~10~~11.2 Distances to Exposures for Class 3.

63.3.~~10~~11.2.1

The outdoor storage or use of unstable reactive Class 3 (nondetonable) compressed gas shall not be within 75 ft (23 m) of buildings, lot lines, streets, alleys, or public ways or means of egress. [**55:**7.1~~1~~0.2.1]

63.3.~~10~~11.2.2

A 2-hour fire barrier wall without openings or penetrations, extending not less than 30 in. (762 mm) above and to the sides of the storage or use area, that interrupts the line of sight between the storage or use and the exposure shall be permitted in lieu of the 75 ft (23 m) distance specified in 63.3.~~10~~11.2.1. [**55:**7.1~~0~~1.2.2]

63.3.~~10~~11.2.2.1*

Where a fire barrier wall is used to protect compressed gas systems, the system shall terminate downstream of the source valve. [**55:**7.1~~1~~0.2.2.1]

A.63.3.~~10~~11.2.2.1

See A.63.3.~~5~~6.2.1.1. [**55:**A.7.1~~1~~0.2.2.1]

63.3.~~10~~11.2.2.2

The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area. [**55:**7.1~~0~~.2.2.2]

63.3.~~10~~11.2.2.3

The 2-hour fire barrier wall shall be located at least 5 ft (1.5 m) from any exposure. [**55:**7.1~~0~~.2.2.3]

63.3.~~10~~11.2.2.4

The 2-hour fire barrier wall shall not have more than two sides at approximately 90 degree (1.57 rad) directions or more than three sides with connecting angles of approximately 135 degrees (2.36 rad). [**55:**7.1~~0~~.2.2.4]

63.3.~~10~~11.3 Storage Configuration.

63.3.~~10~~11.3.1

Unstable reactive Class 3 compressed gases stored in cylinders, containers, or tanks shall be arranged to limit individual groups of cylinders, containers, or tanks to areas not exceeding 100 ft^2 (9.3 m^2). [**55:**7.1~~0~~.3.1]

63.3.~~10~~11.3.2

Multiple areas shall be separated by aisles. [**55:**7.1~~0~~.3.2]

63.3.~~10~~11.3.3

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:**7.1~~0~~1.3.3]

63.3.~~10~~11.4 Basements.

Unstable reactive compressed gases shall not be stored in basements. [**55:**7.1~~0~~1.4]

63.3.~~10~~11.5 Unstable Reactive Gases (Detonable).

63.3.~~10~~11.5.1 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~~4, and 63.3.~~10~~11.5. [**55:**7.1~~0~~1.5.1]

63.3.~~10~~11.5.2 Location.

The location of storage areas shall be determined based on the requirements of the building code for explosive materials. [**55:**7.1~~0~~1.5.2]

63.3.12 Subatmospheric Gas (Type 1 and Type 2) Sources.

63.3.12.1 General.

The storage and use of subatmospheric gas (type 1 and type 2) sources shall meet the requirements of 7.14.2.1 through 7.14.2.6 in NFPA 318. [**55:**7.12.1]

63.3.12.1.1

Where the storage and use of subatmospheric gas (type 1 and type 2) sources do not meet the requirement in 63.3.11.1, the storage and use of subatmospheric gas (type 1 and type 2) shall meet all the requirements of this standard based on the assigned hazard categories listed in Section 5.1 of NFPA 55. [**55:**7.12.1.1]

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~~other sections, 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]

63.4.1.2

Storage, use, and handling of inert cryogenic fluids shall be in accordance with CGA P-18, *Standard for Bulk Inert Gas Systems.* [**55:**8.1.2]

63.4.1.3

Storage, use, and handling of inert cryogenic fluids in medical gas applications shall be in accordance with Chapter 17 and ANSI/CGA M-1, *Standard for Medical Gas Supply Systems at Health Care Facilities*, in addition to the provisions stated herein. [**55:**8.1.3]

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]

A.63.4.2

Pressure vessels of any type can be subject to additional regulations imposed by various states or other legal jurisdictions. Users should be aware that compliance with DOT or ASME requirements might not satisfy all the required regulations for the location in which the vessel is to be installed or used. [**55:**A.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, in-cluding ~~conditions of~~ emergency pressure relief of the annular space between the inner vessel and the outer vessel. [**55:**8.2.1.2.1]

Commented [CM6]: Delete hyphen.

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:

(1) Type and use of container, equipment, or device
(2) Material to be stored, used, or transported
(3) Description showing dimensions and materials used in construction
(4) Design pressure, maximum operating pressure, and test pressure
(5) 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.

A.63.4.2.3.3

Vaporizers or heat exchangers used to vaporize cryogenic fluids can accumulate a large load of ice during operation. Additional requirements to be considered in the design include snow load for the area where the installation is located as well as the requirements for seismic conditions. The operating conditions of systems vary, and the designer has a responsibility to consider all the loads that might be imposed. Foundations that could be used to support delivery vehicles as well might require special consideration relevant to live loads as well as for the dead loads imposed by the equipment itself. [**55:**A.8.2.3.3]

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~~ Containers 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]

A.63.4.2.4.5.1

Pressure relief valves typically are spring-loaded valves where the relief pressure is set by adjustment of a spring. Valves should be made to be tamper resistant in order to prevent adjustment by other than authorized personnel typically found at a retest facility. An ASME pressure relief valve is designed to comply with the requirements of the ASME *Boiler and Pressure Vessel Code* and typically is equipped with a wire and lead seal to resist tampering. [**55:**A.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 Nm^3).

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 Nm^3) 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]

A.63.4.2.4.7.2.1

The ASME *Boiler and Pressure Vessel Code* requires that full-area stop valves be locked open and provided with manual vent valves for maintaining pressure during maintenance operations. Further, the ASME Code requires that if the full-area stop valve is closed, an operator must be present at all times to maintain the vessel pressure within acceptable limits and must lock the full-area stop valve in the open position before leaving the station. See the ASME *Boiler and Pressure Vessel Code* for complete details and requirements. [**55:**A.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* *Classification and Labeling of Compressed Gases*~~*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]

A.63.4.4.1.1.2

An example of this identification is 360 degree wraparound tape. [**55:**A.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]

A.63.4.5.2

The purpose of this requirement is to prevent unauthorized personnel or those unfamiliar with cryogenic storage systems from tampering with the equipment. Where the bulk storage system is located in an area open to the general public, a common practice is to fence the system and lock it, with access restricted to supplier personnel and sometimes user personnel. When the bulk storage system is located within the user's secure area and is not open to the general public, it is not always necessary to fence the bulk storage system. Personnel access patterns may still mandate that the system be fenced, as determined by the supplier and the user. [**55:**A.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]

10**Table 63.4.6.2 Minimum Separation Distance Between Stationary Cryogenic Containers and Exposures**

	Minimum Distance	
Exposure	**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]

A.63.4.6.2

It is not uncommon to have inert cryogenic fluids used to provide stage effects for theatrical performances that are conducted within assembly occupancies. The fluids are sometimes placed within these occupancies with special controls, including ventilation systems, fire detection systems, monitors for oxygen deficiency, warning signs, and remote fill indicating devices that indicate tank volume when a remote filling point is provided and stationary tanks are involved. Such installations are normally permitted on a case-by-case basis under the requirements of Section 1.~~6~~5 of NFPA 55. [**55:**A.8.6.2]

Clearance is required from combustible materials to minimize the effects of exposure fires to the materials stored or used. The requirement to separate the materials from vegetation should not be interpreted to mean that the area is maintained free of all vegetation. In some settings, gas systems are located on grounds that are maintained with formal landscaping. Some judgment must be exercised to determine whether the vegetation poses what might be viewed as an exposure hazard to the materials stored. Cut lawns, formal landscaping, and similar vegetation do not ordinarily present a hazard, and should be allowed. On the other hand, tall, dry grass or weeds and vegetation that fringes on the border of an urban–wildland interface might be viewed as a hazard. [**55:**A.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]

A.63.4.6.2.1.4.1

See Figure A.63.4.12.2.7.2.1, which addresses bulk cryogenic systems located in a courtyard. This figure also applies to the case where any or all of the three walls are constructed as fire barrier walls. [**55:**A.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]

11**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]

12**Table 63.4.6.3.1 Distance to Exposures for Non-Bulk Liquefied Hydrogen (LH_2)**

				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:

(1) For requirements on minimum distance to air intakes, see 63.3.6.2.4.
(2) For requirements on minimum distance to building openings including exits, see 63.3.6.2.5.
(3) 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~~ in 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]

A.63.4.12.2.5

Flood hazard areas typically are identified on either (1) the special flood hazard area shown on the flood insurance rate map or (2) the area subject to flooding during the design flood and shown on a jurisdiction's flood hazard map or otherwise legally designated. [**55:**A.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:

(1) Crushed rock utilized as a heat sink
(2) Topographical conditions
(3) Nature of occupancy
(4) Proximity to structures on the same or adjacent property
(5) 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.63.4.12.2.6.4.1

The intent of these provisions is to make certain that the cryogenic installation is not exposed to the potential of a pool fire from the release of flammable or combustible liquids. Cryogenic

fluids are not diked in order that they are allowed to dissipate should leakage occur. Studies conducted by NASA (NSS 1740.16, *Safety Standard for Hydrogen and Hydrogen Systems*, 1997) show that the use of dikes around liquid hydrogen storage facilities serves to prolong ground-level flammable cloud travel and that the dispersion mechanism is enhanced by vaporization-induced turbulence. The travel of spilled or leaked cryogenic fluid to distances greater than a few feet (meters) from the source given the nature of the typical leak is considered to be implausible due to the character of cryogenic fluids and their ability to quickly absorb heat from the surrounding environment. [**55:**A.8.12.2.6.4.1]

63.4.12.2.6.4.1(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)]

63.4.12.2.6.4.1(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]

A.63.4.12.2.7.1

CGA P-41, *Locating Bulk Storage Systems in Courts*, provides guidance to determine the suitability of a court or enclosed court. [**55:**A.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]

A.63.4.12.2.7.2

The placement of stationary containers is limited with respect to exposure hazards. Table 63.4.6.2 establishes the minimum separation distance between a building and any stationary tank at 1 ft (0.3 m). Additional limitations are placed on wall openings, air intakes, and other exposures. The material-specific tables for ~~liquid hydrogen and~~ liquid oxygen and flammable cryogenic liquids specify increased distances according to the type of construction adjacent to the tank. A problem arises when courtyards are configured so as to interrupt the free movement of air around a tank where an asphyxiation hazard, a flammable hazard, or an oxygen-enriched environment can be created. [**55:**A.8.12.2.7.2]

Placement of stationary containers proximate to the wall of the building served is allowable, provided the minimum separation distances for exposure hazards are met. When additional walls encroach on the installation to form a court, the focus of concern shifts away from the

exposure hazards associated with the building itself to the hazards associated with personnel due to hazardous atmospheres that can be created due to the lack of free air movement and ventilation. [**55:**A.8.12.2.7.2]

By specifying the minimum distance between the tank and the encroaching walls that form the court, the circulation of adequate air is ensured. Placing the tank at not less than the height of two of the three encroaching walls results in creating an opening such that the angular dimension between the top of two of the three encroaching walls and the point over which the tank is placed is not greater than 45 degrees, thereby allowing the circulation of air through the space in which the tank is installed. [**55:**A.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]

A.63.4.12.2.7.2.1

The separation distances shown in Figure A.63.4.12.2.7.2.1 are required to provide for ventilation in the space in order to avoid creating a confined space. Chapter 8 of NFPA 55 is a generic chapter used to establish minimum requirements for all cryogens. Material-specific requirements for oxygen, hydrogen, or other gases might require greater separation distances based on the type of construction or the related exposure. For example, wall number 3 shown in Figure A.63.4.12.2.7.2.1 could be an exterior building wall, and the gas could be hydrogen. Refer to Table 63.4.6.2 of this *Code*, and Table 9.3.2, Table 11.3.2.2, Table 13.10.1, and Table 16.2 of NFPA 55 for specific details regarding building walls, wall openings, air intakes, and similar conditions. [**55:**A.8.12.2.7.2.1]

Figure A.63.4.12.2.7.2.1 Bulk Cryogenic System Located in a Courtyard. [55:Figure A.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~~ department access roadways or other approved means shall be in accordance with ~~Section 18.2~~this *Code*. [**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~~ individual 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]

A.63.4.13.1.4.2

~~ANSI/~~CGA P-18, *Standard for Bulk Inert Gas Systems ~~at Consumer Sites~~*, recommends periodic inspection intervals for inert gas systems. [**55:**A.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:

(1) The results of inspections of the system
(2) 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~~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.63.4.13.11.2.3.1

In operations where an automatic emergency shutoff valve is activated by a control system that is operated from a remote station or by remote station software, the software system should be

designed to provide a visual indication of the emergency shutdown control system. The visual emergency shutdown function should be able to be identified by trained operators and recognizable to emergency response personnel. [**55:**A.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]

A.63.4.13.11.3.4

The inert cryogens, nitrogen and argon, do not require the installation of a noncombustible spill pad, because they do not typically condense oxygen from the air in sufficient quantities to pose a hazard during transfer. [**55:**A.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]

A.63.4.13.11.3.4.1

The noncombustible spill pad is provided for liquid helium transfer operations, because the cryogen is at a temperature that is sufficiently low enough to liquefy oxygen, presenting a hazard when in contact with combustible surfaces. [**55:**A.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 with 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.

63.5.2 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.

63.6.2

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.

63.7.2

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

63.9 Insulated Liquid Carbon Dioxide Systems.

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]

A.63.9.5.2

Vent pipes must be protected to prevent the intrusion of water that can freeze and interfere with the operation of the pressure relief device. Covers can be employed to protect the vent pipe against the elements. Carbon dioxide released through vent pipes can be transformed to the solid state through the production of what is dry ice in the form of "snow." It is possible for dry ice to form a plug in the vent line system. For this reason, designers might choose to locate the pressure relief device at the end of a vent line rather than on the unit itself. There are alternative designs that accomplish this intent. It is important that the system designer provide a system that is not susceptible to the formation of ice plugs due to moisture or solid carbon dioxide so that vent lines function as intended. [**55:**A.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]

A.63.9.5.3

Where cylinders, containers, and tanks are in locations remote from the filling connection, a means to determine when the containers have been filled to their design capacity should be provided and be verifiable from the filling connection. A functional pressure gauge equipped on the filling equipment connected to the fill box on the outside of the building is one method used to determine when the container being filled and the delivery vehicle pressures quickly equalize and the transfer of product is complete. [**55:**A.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]

A.63.9.7.3

Materials used in the system can become brittle and fail if subjected to low temperatures. Maintain the system at or above the minimum design temperature by appropriate design materials or operating instructions to prevent system failure. [**55:**A.13.5]

In North America, the majority of the containers in refrigerated carbon dioxide service are fabricated using low-alloy carbon steels such as SA-212, SA-515, SA-516, and SA-612. Containers manufactured before 1990 typically had a minimum design metal temperature (MDMT), the lowest temperature at which a container is designed to operate at a given pressure at −20°F (−28.9°C). When the container wall is at an operating temperature colder than the MDMT, it is out of its intended operating condition. [**55:**A.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]

63.9.7.5 Small Insulated Liquid Carbon Dioxide Indoor Systems.

63.9.7.5.1*

Container foundations or floors in multistoried buildings shall be designed to support the weight of the system at its full capacity in accordance with the building code. [**55:**13.7.1]

A.63.9.7.5.1

The building code establishes requirements for the structure based on loads imposed by the elements of construction as well as for the loads that could be imposed by machinery or equipment. Building owners are responsible for understanding the limitations of loads on the building in which these installations are to be located. A professional engineer representing the building owner might have to make a determination as to the adequacy of the structure regarding the loads that are to be imposed for systems of this nature. [**55:**A.13.7.1]

63.9.7.5.2*

Rooms or areas where container systems are filled and used indoors or in enclosed outdoor locations shall be provided with a gas detection and alarm system that shall be capable of detecting and notifying the building occupants of a gas release of carbon dioxide at, or in excess of, the Time-Weighted Average–Permissible Exposure Limit (TWA-PEL) published by the Occupational Safety and Health Administration (OSHA) and the Threshold Limit Value–Short Term Exposure Limit (TLV-STEL) published by the American Conference of Governmental Industrial Hygienists (ACGIH). More conservative set points shall be permitted to be used. [**55:**13.7.2]

A.63.9.7.5.2

Enclosed areas can include indoor as well as outdoor locations such as one with four solid walls and no roof or ceiling. The PEL is established by OSHA in 29 CFR 1910.1000, Table Z-1. [**55:**A.13.7.1]

63.9.7.5.2.1*

Activation of the gas detection system shall initiate an audible alarm within the room or area in which the system is installed. [**55:**13.7.2.1]

A.63.9.7.5.2.1

The American Conference of Governmental Industrial Hygienists (ACGIH), in *TLVs®and BEIs®, Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* has established threshold limit values (TLVs®). The threshold limit value–time weighted average basis (TLV-TWA®) for CO_2 has been established at 5000 ppm, with a short-term exposure limit (STEL-TLV®) value of 30,000 ppm. [**55:**A.13.7.2.1]

As stated by ACGIH, the TLV-TWA represents a time-weighted average concentration for a conventional 8-hour workday and a 40-hour workweek to which it is believed that nearly all workers can be repeatedly exposed, day after day, without adverse effect. The STEL-TLV is the concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, to impair self-rescue, or to materially reduce work efficiency, provided that the daily TLV-TWA is not exceeded. The STEL-TLV is not a separate, independent exposure guideline; rather, it supplements the TLV-TWA where there are recognized acute effects from a substance whose toxic effects are primarily of a chronic nature. TLV-STELs are recommended only where toxic effects have been reported from high short-term exposures in either humans or animals. [**55:**A.13.7.2.1]

63.9.7.5.2.2

Subsection 13.7.2 shall not apply to manufacturer locations where containers are filled indoors and distributed for use. [**55:**13.7.2.2]

63.9.7.5.2.3

Activation of the gas detection system shall sound a local alarm to notify persons responsible for system operation of a hazard condition in the area in which the system is installed. [**55:**13.7.2.3]

63.9.7.5.3

A warning sign shall be posted at the entrance to the building, room, enclosure, or confined area where the container is located. [**55:**13.7.3]

63.9.7.5.3.1

The warning sign shall be at least 8 in. (200 mm) wide and 6 in. (150 mm) high and state the following:

CAUTION — CARBON DIOXIDE GAS

Ventilate the area before entering.

A high carbon dioxide (CO_2) gas concentration in this area can cause suffocation.

[**55:**13.7.3.1]

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]

A.63.9.12.1.1

Aboveground locations include locations that are above grade. Although some installations may be above ground, the actual grade of the terrain on which the installation is located could result in entrapment of vapors. Designers should avoid locating enclosures in areas where natural terrain features or other impediments serve to act as impediments to the dissipation of vapors should a release occur. [**55:**A.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:

(1) The enclosure shall be constructed without a roof or overhead cover.
(2) 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:

(1) The enclosure shall be constructed without a roof or overhead cover.
(2) 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:

(1) The exhaust system shall be installed in accordance with the requirements of the mechanical code.
(2) 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.
(3) 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.
(4) The rate of exhaust ventilation shall be not less than 1 scf/min/ft^2 (0.028 Nm^3 /min/m^2) 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]

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

Exposure	Minimum Distance	
	ft	m
(1) Buildings, regardless of construction type	2	0.6
(2) Wall openings other than building exits	2	0.6
(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 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.

63.10.2 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:

(1) Mechanical ventilation in a room or area shall be at a rate of not less than 1 $ft^3/min/ft^2$ (0.00508 $m^3/s/m^2$).
(2) Exhaust shall be taken from a point within 12 in. (305 mm) of the floor.
(3) 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:

(1) Areas where carbon dioxide can accumulate, continuous gas detection shall be provided.
(2) 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.
(3) 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]

F.3 References for Extracts in Informational Sections.

NFPA 55, *Compressed Gases and Cryogenic Fluids Code*, ~~2020~~ 2023 edition.

TENTATIVE INTERIM AMENDMENT BALLOT

EMERGENCY NATURE SELECTION OF RESPONSES

A. The standard contains an error or an omission that was overlooked during the regular revision process.

B. The NFPA Standard contains a conflict within the NFPA Standard or with another NFPA Standard.

C. The proposed TIA intends to correct a previously unknown existing hazard.

D. The proposed TIA intends to offer to the public a benefit that would lessen a recognized (known) hazard or ameliorate a continuing dangerous condition or situation.

E. The proposed TIA intends to accomplish a recognition of an advance in the art of safeguarding property or life where an alternative method is not in current use or is unavailable to the public.

F. The proposed TIA intends to correct a circumstance in which the revised NFPA Standard has resulted in an adverse impact on a product or method that was inadvertently overlooked in the total revision process or was without adequate technical (safety) justification for the action.