

NFPA 55

Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks

2005 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA 55

Standard for the

Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks

2005 Edition

This edition of NFPA 55, *Standard for the Storage, Use, and Handling of Compressed Gases and Cryogenic Fluids in Portable and Stationary Containers, Cylinders, and Tanks*, was prepared by the Technical Committee on Industrial and Medical Gases and acted on by NFPA at its November Association Technical Meeting held November 13–17, 2004, in Miami Beach, FL. It was issued by the Standards Council on January 14, 2005, with an effective date of February 7, 2005, and supersedes all previous editions.

This edition of NFPA 55 was approved as an American National Standard on February 7, 2005.

Origin and Development of NFPA 55

NFPA 55 was developed by the Industrial and Medical Gases Committee in recognition of the need to provide information on the use of cylinder gases in one standard. The Compressed Gas Association assisted the project by submitting a draft that was used as the framework for the standard.

NFPA 55 supersedes NFPA 43C, *Code for the Storage of Gaseous Oxidizing Materials*, which was developed by the Committee on Hazardous Chemicals and transferred to the Industrial and Medical Gases Committee. The committee believed that one standard covering storage of all gas cylinders was needed and, with the new NFPA 55, the need for NFPA 43C no longer existed.

Since this standard was introduced in 1993, it has been widely used and accepted by users of different types of gases as a single source covering requirements for installation and usage of gases in portable cylinders. The 1998 edition clarified many requirements and provided additional advisory information to assist the users of the standard. Editorial changes were also incorporated for clarity.

The 2003 edition of NFPA 55 was a complete revision of the document that significantly expanded the document scope and introduced requirements for areas not addressed in previous editions. For example, the 1998 edition covered only compressed and liquefied gases in portable cylinders and only at consumer (user) locations; the 2003 edition covered the use of compressed and liquefied gases in portable and stationary containers and at manufacturer sites and consumer sites. This expansion to manufacturer sites took a large portion of gas usage that was outside the scope of NFPA 55 and placed it under NFPA 55.

There were many new subjects and requirements in the 2003 edition, including the following:

- (1) Requirements for cryogenic fluids
- (2) Use of the concept of control areas for defining storage amounts and requirements
- (3) An expanded classification scheme to cover a greater range of gaseous materials
- (4) Specifications for a Hazardous Materials Management Plan
- (5) Requirements for treating waste gases
- (6) More detailed requirements in many of the areas than the 1998 edition of NFPA 55 covered

The document was also restructured to comply with the *Manual of Style for NFPA Technical Committee Documents*.

The 2005 edition of NFPA 55 is a complete revision of the document.

The following are some of the significant changes to the document:

- (1) Incorporation of the requirements of NFPA 50, *Standard for Bulk Oxygen Systems at Consumer Sites*, into Chapter 9
- (2) Incorporation of the requirements of NFPA 50A, *Standard for Gaseous Hydrogen Systems at Consumer Sites*, into Chapter 10
- (3) Incorporation of NFPA 50B, *Standard for Liquefied Hydrogen Systems at Consumer Sites*, into Chapter 11
- (4) Clarification of threshold storage requirements in Chapters 6 and 7
- (5) Clarification of the separation distance tables formerly in NFPA 50, 50A, and 50B and now in Chapters 9–11
- (6) Schematic drawings added to annex material to illustrate system siting requirements in Chapters 9 and 11

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the storage, transfer, and use of industrial gases. Included are the storage and handling of such gases in their gaseous or liquid phases; the installation of associated storage, piping, and distribution equipment; and operating practices. The Committee also has a technical responsibility for contributions in the same areas for medical gases and clean rooms.

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A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for mandatory extracts are given in Chapter 2 and those for nonmandatory extracts are given in Annex D. Editorial changes to extracted material consist of revising references to an appropriate division in this document or the inclusion of the document number with the division number when the reference is to the original document. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex D.

Chapter 1 Administration

1.1 Scope.

1.1.1 Applicability. This standard shall apply to the installation, storage, use, and handling of compressed gases and cryogenic fluids in portable and stationary containers, cylinders, equipment, and tanks in all occupancies.

1.1.2 Exemptions. This standard shall not apply to the following:

- (1)*Off-site transportation of materials covered by this standard
- (2) Storage, use, and handling of radioactive gases in accordance with NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*
- (3) Storage, use, and handling of medical compressed gases at health care facilities in accordance with NFPA 99, *Standard for Health Care Facilities*
- (4)*Except for Chapter 9, storage, use, and handling of bulk oxygen in medical gas systems at health care facilities
- (5) Systems consisting of cylinders of oxygen and cylinders of fuel gas used for welding and cutting in accordance with NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*
- (6) Acetylene cylinders in acetylene cylinder charging plants in accordance with NFPA 51A, *Standard for Acetylene Cylinder Charging Plants*

- (7) Ethylene oxide containers stored, handled, or used for sterilization and fumigation in accordance with NFPA 560, *Standard for the Storage, Handling, and Use of Ethylene Oxide for Sterilization and Fumigation*
- (8)*Flammable gases used as a vehicle fuel when stored on a vehicle
- (9)*Storage, use, and handling of liquefied and nonliquefied compressed gases in laboratory work areas that are in accordance with NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*
- (10) Storage, use, and handling of liquefied petroleum gases in accordance with NFPA 58, *Liquefied Petroleum Gas Code*
- (11) Storage, use, and handling of gases within closed-cycle refrigeration systems complying with the mechanical code
- (12) Liquefied natural gas (LNG) storage at utility plants under NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*
- (13) LNG handled as a vehicle fuel under NFPA 57, *Liquefied Natural Gas (LNG) Vehicular Fuel Systems Code*
- (14) Compressed natural gas (CNG) handled as a vehicle fuel under NFPA 52, *Compressed Natural Gas (CNG) Vehicular Fuel Systems Code*

1.2* Purpose. The purpose of this standard shall be to provide fundamental safeguards for the installation, storage, use, and handling of compressed gases and cryogenic fluids in portable and stationary containers, cylinders, and tanks.

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

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units and Formulas. International (SI) units shall be used as the standard unit of measure. SI units shall be followed by inch-pound units in parentheses.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

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

NFPA 1, *Uniform Fire Code*TM, 2003 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2002 edition.

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition.

NFPA 51, *Standard for the Design and Installation of Oxygen-Fuel Gas Systems for Welding, Cutting, and Allied Processes*, 2002 edition.

NFPA 51A, *Standard for Acetylene Cylinder Charging Plants*, 2001 edition.

NFPA 52, *Compressed Natural Gas (CNG) Vehicular Fuel Systems Code*, 2002 edition.

NFPA 57, *Liquefied Natural Gas (LNG) Vehicular Fuel Systems Code*, 2002 edition.

NFPA 58, *Liquefied Petroleum Gas Code*, 2004 edition.

NFPA 59A, *Standard for the Production, Storage, and Handling of Liquefied Natural Gas (LNG)*, 2001 edition.

NFPA 69, *Standard on Explosion Prevention Systems*, 2002 edition.

NFPA 70, *National Electrical Code*[®], 2005 edition.

NFPA 72[®], *National Fire Alarm Code*[®], 2002 edition.

NFPA 99, *Standard for Health Care Facilities*, 2005 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems*, 2002 edition.

NFPA 496, *Standard for Purged and Pressurized Enclosures for Electrical Equipment*, 2003 edition.

NFPA 560, *Standard for the Storage, Handling, and Use of Ethylene Oxide for Sterilization and Fumigation*, 2002 edition.

NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, 2001 edition.

NFPA 801, *Standard for Fire Protection for Facilities Handling Radioactive Materials*, 2003 edition.

NFPA 5000[®], *Building Construction and Safety Code*[®], 2003 edition.

2.3 Other Publications.

2.3.1 ASME Publications. American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

ASME A13.1, *Scheme for the Identification of Piping Systems*, 1996.

ASME B31.3, *Process Piping*, 2002.

ASME International, *Boiler and Pressure Vessel Code*, "Rules for the Construction of Unfired Pressure Vessels," Section VIII, 2001.

2.3.2 ASTM Publications. American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 681-01, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*, 2002.

ASTM E 1529, *Determining Effects of Large Hydrocarbon Pool Fire on Structural Members and Assemblies*, 2003.

2.3.3 CGA Publications. Compressed Gas Association, 4221 Walney Road, 5th floor, Chantilly, VA 20151-2923.

CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*, 2000.

CGA G-4.1, *Cleaning Equipment for Oxygen Service*, 1996.

CGA G-5.5, *Hydrogen Vent Systems*, 1996.

CGA P-1, *Safe Handling of Compressed Gases in Containers*, 2000.

CGA P-18, *Standard for Bulk Inert Gas Systems at Consumer Sites*, 1992.

CGA P-20, *Standard for the Classification of Toxic Gas Mixtures*, 1995.

CGA P-23, *Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components*, 1995.

CGA P-32, *Safe Storage and Handling of Silane and Silane Mixtures*, 2000.

CGA S-1.1, *Pressure Relief Device Standards – Part 1 – Cylinders for Compressed Gases*, 2001.

CGA S-1.2, *Pressure Relief Device Standards – Part 2 – Cargo and Portable Tanks for Compressed Gases*, 1995.

CGA S-1.3, *Pressure Relief Device Standards – Part 3 – Stationary Storage Containers for Compressed Gases*, 1995.

2.3.4* CTC Publication. Canadian Transport Commission, Queen's Printer, Ottawa, Ontario, Canada. (Available from the Canadian Communications Group Publication Centre, Ordering Department, Ottawa, Canada K1A 0S9.)

Transportation of Dangerous Goods Regulations.

2.3.5 IAPMO Publication. International Association of Plumbing and Mechanical Officials, 5001 E. Philadelphia Street, Ontario, CA 91761.

Uniform Mechanical Code, 2003 edition.

2.3.6 ISO Publications. International Organization for Standardization Publications, 1 rue de Varembé, Case Postale 56, CH-1211 Geneve 20, Switzerland.

ISO 10156, *Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*, 1996.

ISO 10298, *Determination of toxicity of a gas or gas mixture*, 1995.

2.3.7 U.S. Government Publications. U. S. Government Printing Office, Washington, DC 20402.

Title 29, Code of Federal Regulations, Part 1910.1000.

Title 49, Code of Federal Regulations, Part 173.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements

of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. A document, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1* Absolute Pressure. Pressure based on a zero reference point, the perfect vacuum.

3.3.2 Area.

3.3.2.1 Control Area. A designated area, either indoors or outdoors, within which limited quantities of hazardous materials are allowed to be stored, used, handled, or dispensed.

3.3.2.2 Indoor Area. An area that is within a building or structure having overhead cover, other than a structure qualifying as “weather protection” in accordance with 6.5.2. (See also 3.3.2.3, *Outdoor Area*.)

3.3.2.3 Outdoor Area. An area that is not an indoor area.

3.3.3 ASME. American Society of Mechanical Engineers. [58, 2004]

3.3.4 ASTM. American Society for Testing and Materials.

3.3.5 Building. Any structure used or intended for supporting or sheltering any use or occupancy. [101, 2003]

3.3.6 Building Code. The building or construction code adopted by the jurisdiction.

3.3.7 Bulk Hydrogen Compressed Gas System. An assembly of equipment, consisting of but not limited to, storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and piping, with a storage capacity of more than 400 ft³ (scf) (11 m³) of compressed hydrogen gas including unconnected reserves on hand at the site. The bulk system terminates at the point where the gas supply, at service pressure, first enters the supply line. The containers are either stationary or movable, and the source gas is stored as a compressed gas.

3.3.8 Bulk Inert Gas System. An assembly of equipment, consisting of but not limited to, storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and piping, with a storage capacity of more than 20,000 ft³ (scf) (566 m³) of inert gas including unconnected reserves on hand at the site. The bulk system terminates at the point where the gas supply, at service pressure, first enters the supply line. The containers are either stationary or movable, and the source gas is stored as a compressed gas or cryogenic fluid.

3.3.9 Bulk Liquefied Hydrogen Gas System. An assembly of equipment, consisting of but not limited to, storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and piping, with a storage capacity of more than 39.7 gal (150 L) of liquefied hydrogen including unconnected reserves on hand at the site. The bulk system terminates at the point where the gas supply, at service pressure, first enters the supply line. The containers are either stationary or movable, and the source gas is stored as a cryogenic fluid.

3.3.10 Bulk Oxygen System. An assembly of equipment, such as oxygen storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and interconnecting piping, with a storage capacity of more than 20,000 ft³ (scf) (566 m³) of oxygen including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen at service pressure first enters the supply line. The oxygen containers are either stationary or movable, and the oxygen is stored as a compressed gas or cryogenic fluid.

3.3.11 CFR. The Code of Federal Regulations of the United States Government. [1, 2003]

3.3.12 CGA. Compressed Gas Association.

3.3.13 Combustible Liquid. A liquid having a closed-cup flash point at or above 100°F (37.8°C), subdivided as follows: (a) Class II liquids include those having a flash point at or above 100°F (37.8°C) and below 140°F (60°C); (b) Class IIIA liquids include those having a flash point at or above 140°F (60°C) and below 200°F (93.4°C); (c) Class IIIB liquids include those having a flash point at or above 200°F (93.4°C).

3.3.14 Container. A vessel, such as a cylinder, portable tank, or stationary tank, that varies in shape, size, and material of construction.

3.3.14.1 Compressed Gas Container. A pressure vessel designed to hold compressed gas at an absolute pressure greater than 1 atmosphere at 20°C (68°F) that includes cylinders, containers, and tanks.

3.3.15 Court. An open, uncovered, unoccupied space, unobstructed to the sky, bounded on three or more sides by exterior building walls. [101, 2003]

3.3.15.1 Enclosed Court. A court bounded on all sides by the exterior walls of a building or by the exterior walls and lot lines on which walls are permitted. [5000, 2003]

3.3.16 Cryogenic Fluid. A fluid with a boiling point lower than -90°C (-130°F) at an absolute pressure of 101.325 kPa (14.7 psia).

3.3.17 Cylinder. A pressure vessel designed for pressures higher than 276 kPa (40 psia) and having a circular cross-section. It does not include a portable tank, multiunit tank car tank, cargo tank, or tank car.

3.3.18* 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.

3.3.19 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.

3.3.20 Detached Building. A separate building that is separated from other structures or uses as required by *NFPA 5000* for a freestanding structure. [5000, 2003]

3.3.21 Distributor. A business engaged in the sale or resale, or both of compressed gases or cryogenic fluids, or both.

3.3.22 DOT. U.S. Department of Transportation. [57, 2002]

3.3.23 Emergency Shutoff Valve. A designated valve designed to shut off the flow of gases or liquids.

3.3.23.1 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.

3.3.23.2 Manual Emergency Shutoff Valve. A designated valve designed to shut off the flow of gases or liquids that is manually operated.

3.3.24 Excess Flow Control. A fail-safe system or approved means designed to shut off flow due to a rupture in pressurized piping systems.

3.3.25* 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.

3.3.26* 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.

3.3.27* Flammable Liquid (Class I). Any liquid having a closed-cup flash point not exceeding 37.8°C (100°F).

3.3.28 Gallon. A standard U.S. gallon.

3.3.29 Gas.

3.3.29.1* Compressed Gas. A material, or mixture of materials, that (1) is a gas at 20°C (68°F) or less at an absolute pressure of 101.325 kPa (14.696 psia) and (2) that has a boiling point of 20°C (68°F) or less at an absolute pressure of 101.325 kPa (14.7 psia) 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 280 kPa (40.6 psia) at 20°C (68°F).

3.3.29.2 Corrosive Gas. A gas that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact.

3.3.29.3 Flammable Gas. A material that is a gas at 20°C (68°F) or less at an absolute pressure of 101.325 kPa (14.7 psia), that is ignitable at an absolute pressure of 101.325 kPa (14.7 psia) when in a mixture of 13 percent

or less by volume with air, or that has a flammable range at an absolute pressure of 101.325 kPa (14.7 psia) with air of at least 12 percent, regardless of the lower limit.

3.3.29.4 Flammable Liquefied Gas. A liquefied compressed gas that, when under a charged pressure, is partially liquid at a temperature of 20°C (68°F) and is flammable.

3.3.29.5 Highly Toxic Gas. A chemical that has a median lethal concentration (LC₅₀) 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 200 g and 300 g (0.44 lb and 0.66 lb) each.

3.3.29.6 Inert Gas. A nonreactive, nonflammable, noncorrosive gas such as argon, helium, krypton, neon, nitrogen, and xenon.

3.3.29.7 Irritant Gas. A chemical that is not corrosive, but that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41, for an exposure of 4 or more hours or by other appropriate techniques, it results in an empirical score of 5 or more. A chemical is classified as an eye irritant if so determined under the procedure listed in 16 CFR 1500.42, or other appropriate techniques.

3.3.29.8 Nonflammable Gas. A gas that does not meet the definition of a flammable gas.

3.3.29.9* 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.

3.3.29.10 Oxidizing Gas. A gas that can support and accelerate combustion of other materials.

3.3.29.11 Pyrophoric Gas. A gas with an autoignition temperature in air at or below 54.4°C (130°F).

3.3.29.12 Toxic Gas. A gas with a median lethal concentration (LC₅₀) 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 200 g and 300 g (0.44 lb and 0.66 lb) each.

3.3.29.13* 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.

3.3.29.13.1 Class 2 Unstable Reactive Gas. Materials that readily undergo violent chemical change at elevated temperatures and pressures.

3.3.29.13.2 Class 3 Unstable Reactive Gas. Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction, but that require a strong initiating source or that must be heated under confinement before initiation.

3.3.29.13.3 Class 4 Unstable Reactive Gas. Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures.

3.3.30* Gas Cabinet. A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage and use. [5000, 2003]

3.3.31 Gas Manufacturer/Producer. A business that produces compressed gases or cryogenic fluids, or both, or fills portable or stationary gas containers, cylinders, or tanks.

3.3.32* Gas Room. A separately ventilated, fully enclosed room in which only compressed gases, cryogenic fluids, associated equipment and supplies are stored or used.

3.3.33* Gaseous Hydrogen System. A system in which the hydrogen is delivered, stored, and discharged in the gaseous form to a piping system. The gaseous hydrogen system terminates at the point where hydrogen at service pressure first enters the distribution piping.

3.3.34 Handling. The deliberate movement of material in containers by any means to a point of storage or use.

3.3.35* Hazard Rating. The numerical rating of the health, flammability, and self-reactivity, and other hazards of the material, including its reaction with water, specified in NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*.

3.3.36* 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.

3.3.37* ISO Module. An assembly of tanks or tubular cylinders permanently mounted in a frame conforming to International Organization for Standardization (ISO) requirements.

3.3.38 Limit.

3.3.38.1 Ceiling Limit. The maximum concentration of an airborne contaminant to which a person might be exposed. The ceiling limits utilized are those published in 29 CFR 1910.1000. [5000, 2003]

3.3.38.2* Permissible Exposure Limit (PEL). The maximum permitted 8-hour, time-weighted average concentration of an airborne contaminant.

3.3.38.3* 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).

3.3.39 Limited Combustible. A building construction material not complying with the definition of noncombustible material that, in the form in which it is used, has a potential heat value not exceeding 3500 Btu/lb (8141 kJ/kg), where tested in accordance with NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, and complies with (a) or (b): (a) materials having a structural base of noncombustible material, with a surfacing not exceeding a thickness of 1/8 in. (3.2 mm) that has a flame spread index not greater than 50; and (b) materials, in the form and thickness used, other than as described in (a), having neither a flame spread index greater than 25 nor evidence of continued progressive combustion and of such composition that surfaces that would be exposed by cutting through the material

on any plane would have neither a flame spread index greater than 25 nor evidence of continued progressive combustion. (Materials subject to increase in combustibility or flame spread index beyond the limits herein established through the effects of age, moisture, or other atmospheric condition shall be considered combustible.) [220, 1999]

3.3.40* Liquefied Hydrogen System. A system into which liquefied hydrogen is delivered and stored and from which it is discharged in the liquid or gaseous form to a piping system. The system originates at the storage container fill connection and terminates at the point where hydrogen at service pressure first enters the supply line.

3.3.41 Material Safety Data Sheet (MSDS). Written or printed material concerning a hazardous material that is prepared in accordance with the provisions of 29 CFR 1910.1200.

3.3.42 Maximum Allowable Quantity Per Control Area (MAQ). A threshold quantity of hazardous material in a specific hazard class that once exceeded requires the application of additional administrative procedures, construction features or engineering controls.

3.3.43 Mechanical Code. The mechanical or mechanical construction code adopted by the jurisdiction.

3.3.44* Mobile Supply Unit. Any supply source that is equipped with wheels so it is able to be moved around.

3.3.45 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 (for example, a wall or railing).

3.3.46 Noncombustible Material. A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat. Materials that are reported as passing ASTM E 136 are considered noncombustible materials.

3.3.47* Normal Temperature and Pressure (NTP). A temperature of 21°C (70°F) at an absolute pressure of 101.325 kPa (14.7 psia).

3.3.48 OSHA. The Occupational Safety and Health Administration of the U.S. Department of Labor.

3.3.49 Qualified Individual. An individual knowledgeable in the hazards of compressed gases and cryogenic fluids through training and work experience.

3.3.50 Remotely Located, Manually Activated Shutdown Control. A control system that is designed to initiate shutdown of the flow of gas or liquid that is manually activated from a point located some distance from the delivery system.

3.3.51 Separation of Hazards. Physically separated by a specified distance, construction, or appliance.

3.3.52 Standard Cubic Foot of Gas. Cubic foot of gas at 14.7 psia (101 kPa) and 70°F (21°C).

3.3.53 Storage. An inventory of compressed gases or cryogenic fluids in containers that are not in the process of being examined, serviced, refilled, loaded, or unloaded.

3.3.54 System.

3.3.54.1* Compressed Gas System. An assembly of equipment designed to contain, distribute, or transport compressed gases. [318, 2002]

3.3.54.2 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.

3.3.54.3 Cylinder Containment System. A gastight recovery system comprised of 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.

3.3.54.4 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.

3.3.55 Tank.

3.3.55.1* Portable Tank. Any packaging over 227.1 L (60 U.S. gal) capacity designed primarily to be loaded into or on, or temporarily attached to, a transport vehicle or ship and equipped with skids, mountings, or accessories to facilitate handling of the tank by mechanical means.

3.3.55.2* 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.

3.3.56 TC. Transport Canada.

3.3.57* Tube Trailer. A truck or semi trailer on which a number of very long compressed gas tubular cylinders have been mounted and manifolded into a common piping system.

3.3.58 Use. To place a material into action, including solids, liquids, and gases.

3.3.59 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.

3.3.60 Valve Protection Cap. A rigid, removable cover provided for container valve protection during handling, transportation, and storage.

3.3.61 Valve Protection Device. A device attached to the neck ring or body of a cylinder for the purpose of protecting the cylinder valve from being struck or from being damaged by the impact resulting from a fall or an object striking the cylinder. [1, 2003]

Chapter 4 General Requirements

4.1 Permits. Permits shall be obtained in accordance with the requirements of the jurisdiction in which the facility operates.

4.2 Emergency Plan.

4.2.1 Emergency Plan Requirements.

4.2.1.1 An emergency plan shall be prepared and updated wherever compressed gases or cryogenic fluids are produced, handled, stored, or used where required by the authority having jurisdiction (AHJ).

4.2.1.2 The plan shall be available for inspection by the AHJ upon reasonable notice and shall include the following information:

- (1) The type of emergency equipment available and its location
- (2) A brief description of any testing or maintenance programs for the available emergency equipment
- (3) An indication that hazard identification labeling is provided for each storage area
- (4) The location of posted emergency procedures
- (5) A material safety data sheet (MSDS or equivalent) that is available for each compressed gas or cryogenic fluid stored or used on the site
- (6) A list of personnel who are designated and trained to be liaison personnel for the fire department and who are responsible for the following:
 - (a) Aiding the emergency responders in pre-emergency planning
 - (b) Identifying the location of the compressed gases and cryogenic fluids stored or used
 - (c) Accessing material safety data sheets
 - (d) Knowing the site emergency procedures
- (7) A list of the types and quantities of compressed gases and cryogenic fluids found within the facility

4.3 Facility Closure.

4.3.1 Temporarily Out-of-Service Facilities. Facilities that are temporarily out of service shall continue to maintain a permit and be monitored and inspected.

4.3.2 Permanently Out-of-Service Facilities. Facilities for which a permit is not kept current or that are not monitored and inspected on a regular basis shall be deemed to be permanently out of service and shall be closed in accordance with 4.3.3.

4.3.3 Closure Plan.

4.3.3.1 The permit holder or applicant shall submit a plan to the fire department to terminate storage, dispensing, handling, or use of hazardous materials at least 30 days prior to facility closure.

4.3.3.2 The plan shall demonstrate that hazardous materials that were stored, dispensed, handled, or used in the facility have been transported, disposed of, or reused in a manner that eliminates the need for further maintenance and any threat to public health and safety.

4.3.3.3 The plan shall be submitted with a permit application for facility closure in accordance with Section 4.1.

4.4 Management Plan and Hazardous Materials Documentation.

4.4.1 Hazardous Materials Management Plan. When required by the AHJ, permit applications shall include a hazardous materials management plan (HMMP).

4.4.1.1 Contents. The HMMP shall include an emergency response training plan and facility site plan designating the following:

- (1) Storage and use areas
- (2) Maximum amount of each material stored or used in each area
- (3) Range of container sizes
- (4) Product-conveying piping containing liquids or gases, other than utility-owned fuel gas lines and low-pressure fuel gas line
- (5) Locations of emergency isolation and mitigation valves and devices

- (6) ON and OFF positions of valves for valves that are of the self-indicating type
- (7) Storage plan that is legible and drawn approximately to scale showing the intended storage arrangement, including the location and dimensions of aisles, with separate distribution systems permitted to be shown on separate pages

4.4.1.2 Location. The location of the HMMP shall be posted adjacent to permits when an HMMP is provided.

4.4.2 Hazardous Materials Inventory Statement. When required by the AHJ, permit applications shall include a hazardous materials inventory statement (HMIS).

4.4.3 Material Safety Data Sheets. Material safety data sheets (MSDS) shall be readily available on the premises for hazardous materials regulated by this code.

4.5 Release of Hazardous Materials.

4.5.1 Prohibited Releases. Hazardous materials shall not be released into a sewer, storm drain, ditch, drainage canal, lake, river, or tidal waterway; upon the ground, sidewalk, street, or highway; or into the atmosphere unless such release is permitted by the following:

- (1) Federal, state, or local governing regulations
- (2) Permits of the jurisdictional air quality management board
- (3) National Pollutant Discharge Elimination System Permit
- (4) Waste discharge requirements established by the jurisdictional water quality control board
- (5) Local sewer pretreatment requirements for publicly owned treatment works

4.5.2 Control and Mitigation of Unauthorized Discharges. Provisions shall be made for controlling and mitigating unauthorized discharges.

4.5.3 Records of Unauthorized Discharges. Accurate records of the unauthorized discharge of hazardous materials shall be kept by the permittee.

4.5.4 Notification of Unauthorized Discharges. The fire department shall be notified immediately or in accordance with approved emergency procedures when an unauthorized discharge becomes reportable under state, federal, or local regulations.

4.5.5 Container Failure. When an unauthorized discharge due to primary container failure is discovered, the involved primary container shall be repaired or removed from service.

4.5.6 Responsibility for Cleanup of Unauthorized Discharges.

4.5.6.1 The person, firm, or corporation responsible for an unauthorized discharge shall institute and complete all actions necessary to remedy the effects of such unauthorized discharge, whether sudden or gradual, at no cost to the jurisdiction.

4.5.6.2 When deemed necessary by the AHJ, cleanup of an unauthorized discharge shall be permitted to be initiated by the fire department or by an authorized individual or firm, and costs associated with such cleanup shall be borne by the owner, operator, or other person responsible for the unauthorized discharge.

4.6 Personnel Training. Persons responsible for the operation of areas in which hazardous materials are stored, dispensed, handled, or used shall be familiar with the chemical nature of

the materials and the appropriate mitigating actions necessary in the event of fire, leak, or spill.

4.7 Fire Department Liaison.

4.7.1 Responsible persons shall be designated and trained to be liaison personnel for the fire department.

4.7.2 Liaison personnel shall aid the fire department in pre-planning emergency responses and identification of the locations where hazardous materials are located and shall have access to MSDS and be knowledgeable in the site emergency response procedures.

4.8 Ignition Source Controls.

4.8.1 Smoking. Smoking shall be prohibited in the following locations:

- (1) Within 25 ft (7.6 m) of outdoor storage or dispensing areas
- (2) In rooms or areas where hazardous materials are stored or dispensed or used in open systems in amounts requiring a permit in accordance with Section 4.1

4.8.2 Open Flames and High-Temperature Devices. Open flames and high-temperature devices shall not be used in a manner that creates a hazardous condition.

4.8.3 Energy-Consuming Equipment. Energy-consuming equipment shall be listed for use with the hazardous materials stored or used.

4.9 Signs.

4.9.1 General.

4.9.1.1 Design and Construction. Signs shall be durable, and the size, color, and lettering of signs shall be in accordance with nationally recognized standards.

4.9.1.2 Language. Signs shall be in English as the primary language or in symbols allowed by this standard.

4.9.1.3 Maintenance. Signs shall not be obscured or removed.

4.9.2 Hazard Identification Signs.

4.9.2.1 General. Visible hazard identification signs in accordance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, shall be placed on the following, except where the AHJ has received a hazardous materials management plan and a hazardous materials inventory statement in accordance with 4.4.1 through 4.4.2 and has determined that omission of such signs is consistent with safety:

- (1) Stationary aboveground tanks
- (2) Stationary aboveground containers
- (3) At entrances to locations where hazardous materials are stored, dispensed, used, or handled in quantities requiring a permit
- (4) At other entrances and locations designated by the AHJ

4.9.2.2 Identification of Containers, Cartons, and Packages. Individual containers, cartons, or packages shall be conspicuously marked or labeled in accordance with nationally recognized standards.

4.9.2.3 Identification of Gas Rooms and Cabinets. Rooms or cabinets containing compressed gases shall be conspicuously labeled as follows: COMPRESSED GAS.

4.9.3 No Smoking Signs. Signs prohibiting smoking shall be provided for an entire site or building, or in the following locations:

- (1) In rooms or areas where hazardous materials are stored or dispensed or used in open systems in amounts requiring a permit in accordance with Section 4.1
- (2) Within 25 ft (7.6 m) of outdoor storage, dispensing, or open-use areas
- (3) In areas containing flammable gases

Chapter 5 Classification of Hazards

5.1 Hazardous Materials Classification.

5.1.1 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) Nonflammable gas
 - (c) Oxidizing gas
 - (d) Pyrophoric gas
 - (e) Unstable reactive (detonable) gas, Class 3 or Class 4
 - (f) Unstable reactive (nondetonable) gas, Class 2 or Class 3
- (2) Health hazards, which shall include the following:
 - (a) Corrosive gas
 - (b) Cryogenic fluids
 - (c) Highly toxic gas
 - (d) Toxic gas
 - (e) Irritant gas

5.1.2 Other Hazards. Although it is possible that there are other known hazards, the classification of such gases is not within the scope of this standard and they shall be handled, stored, or used as an *other gas*.

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

5.1.4 Responsibility for Classification. Classification shall be performed by an approved organization, individual, or testing laboratory.

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

5.1.4.2 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 E 681-01, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases)*, or ISO 10156, *Gases and gas mixtures — Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets*.

Chapter 6 Building-Related Controls

6.1 General.

6.1.1 Occupancy. Occupancies containing compressed gases and cryogenic fluids shall comply with this chapter in addition

to other applicable requirements of this standard. The occupancy of a building or structure, or portion of a building or structure, shall be classified in accordance with *NFPA 5000, Building Construction and Safety Code*.

6.1.1.1 Quantities Less than or Equal to the MAQ. Building-related controls in areas with compressed gases or cryogenic fluids stored or used within an indoor control area in quantities less than or equal to those shown in Table 6.3.1 shall be in accordance with 6.3.1.3 and 6.3.1.4 and Sections 6.8, 6.12, 6.15, and 6.16.

6.1.1.2 Quantities Greater than the MAQ. Building-related controls in areas with compressed gases or cryogenic fluids stored or used within an indoor control area in quantities greater than those shown in Table 6.3.1 shall be in accordance with the requirements of Chapter 6.

6.2 Control Areas.

6.2.1 Construction Requirements. Control areas shall be separated from each other by not less than a 1-hour fire-resistive occupancy separation as required by *NFPA 5000, Building Construction and Safety Code*.

6.2.2 Number. The number of control areas in buildings or portions of buildings shall not exceed that allowed by *NFPA 5000*.

6.3 Occupancy Protection Levels.

6.3.1 Quantity Thresholds for Compressed Gases and Cryogenic Fluids Requiring Special Provisions. Where the quantities of compressed gases or cryogenic fluids stored or used within an indoor control area exceed those shown in Table 6.3.1, the area shall meet the requirements for Protection Level 1 through 5 in accordance with *NFPA 5000, Building Construction and Safety Code*, based on the requirements of 6.3.2. The aggregate quantity in use and storage shall not exceed the quantity listed for storage.

6.3.1.1 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 providing the area is constructed to meet the requirements of the most restrictive protection level and that the incompatible materials are separated as required by 7.1.6.2.

6.3.1.2 Multiple Hazards. Where a compressed gas or cryogenic fluid has multiple hazards, all hazards shall be addressed and controlled in accordance with the provisions for the protection level for which the threshold quantity is exceeded.

6.3.1.3 Flammable and Oxidizing Gases.

6.3.1.3.1 Flammable and oxidizing gases shall not be stored or used in other than industrial and storage occupancies.

6.3.1.3.2 Containers, cylinders, or tanks not exceeding 7.1 m³ (250 ft³) content at normal temperature and pressure (NTP) and used for maintenance purposes, patient care, or operation of equipment shall be permitted.

6.3.1.4 Toxic and Highly Toxic Compressed Gases. Except for containers or cylinders not exceeding 0.6 m³ (20 ft³) 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.

6.3.2 Classification of Protection Levels. The protection level required shall be based on the hazard class of the material involved as indicated in 6.3.2.1 through 6.3.2.5.

Table 6.3.1 Maximum Allowable Quantity of Gases per Control Area (Quantity Thresholds for Gases Requiring Special Provisions)

Material	Unsprinklered Areas		Sprinklered Areas	
	No Gas Cabinet, Gas Room, or Exhausted Enclosure	Gas Cabinet, Gas Room, or Exhausted Enclosure	No Gas Cabinet, Gas Room, or Exhausted Enclosure	Gas Cabinet, Gas Room, or Exhausted Enclosure
<i>Corrosive Gas</i>				
Liquefied	68 kg (150 lb)	136 kg (300 lb)	136 kg (300 lb)	272 kg (600 lb)
Nonliquefied	23 m ³ (810 ft ³)	46 m ³ (1620 ft ³)	46 m ³ (1620 ft ³)	92 m ³ (3240 ft ³)
<i>Cryogenic Fluid</i>				
Flammable	0 L (0 gal)	170 L (45 gal)	170 L (45 gal)	170 L (45 gal)*
Oxidizing	170 L (45 gal)	340 L (90 gal)	340 L (90 gal)	681 L (180 gal)
<i>Flammable Gas</i>				
Liquefied	114 L (30 gal)	227 L (60 gal)	227 L (60 gal)	454 L (120 gal)
Nonliquefied	28 m ³ (1000 ft ³)	56 m ³ (2000 ft ³)	56 m ³ (2000 ft ³)	112 m ³ (4000 ft ³)
<i>Highly Toxic Gas</i>				
Liquefied	0 kg (0 lb)	2.3 kg (5 lb)	0 kg (0 lb)	4.5 kg (10 lb)
Nonliquefied	0 m ³ (0 ft ³)	0.6 m ³ (20 ft ³)	0 m ³ (0 ft ³)	1.1 m ³ (40 ft ³)
<i>Nonflammable Gas</i>				
Liquefied	No limit	No limit	No limit	No limit
Nonliquefied	No limit	No limit	No limit	No limit
<i>Oxidizing Gas</i>				
Liquefied	57 L (15 gal)	114 L (30 gal)	114 L (30 gal)	227 L (60 gal)
Nonliquefied	43 m ³ (1500 ft ³)	85 m ³ (3000 ft ³)	85 m ³ (3000 ft ³)	170 m ³ (6000 ft ³)
<i>Pyrophoric Gas</i>				
Liquefied	0 kg (0 lb)	0 kg (0 lb)	1.8 kg (4 lb)	3.6 kg (8 lb)
Nonliquefied	0 m ³ (0 ft ³)	0 m ³ (0 ft ³)	1.4 m ³ (50 ft ³)	2.8 m ³ (100 ft ³)
<i>Toxic Gas</i>				
Liquefied	68 kg (150 lb)	136 kg (300 lb)	136 kg (300 lb)	272 kg (600 lb)
Nonliquefied	23 m ³ (810 ft ³)	46 m ³ (1620 ft ³)	46 m ³ (1620 ft ³)	92 m ³ (3240 ft ³)
<i>Unstable Reactive (Detonable) Gas, Class 3 or Class 4</i>				
Liquefied	0 kg (0 lb)	0 kg (0 lb)	0.5 kg (1 lb)	1 kg (2 lb)
Nonliquefied	0 m ³ (0 ft ³)	0 m ³ (0 ft ³)	0.3 m ³ (10 ft ³)	0.6 m ³ (20 ft ³)
<i>Unstable Reactive (Nondetonable) Gas, Class 3</i>				
Liquefied	1 kg (2 lb)	2 kg (4 lb)	2 kg (4 lb)	4 kg (8 lb)
Nonliquefied	1.4 m ³ (50 ft ³)	3 m ³ (100 ft ³)	3 m ³ (100 ft ³)	6 m ³ (200 ft ³)
<i>Unstable Reactive Gas, Class 2</i>				
Liquefied	114 L (30 gal)	227 L (60 gal)	227 L (60 gal)	454 L (120 gal)
Nonliquefied	21 m ³ (750 ft ³)	43 m ³ (1500 ft ³)	43 m ³ (1500 ft ³)	85 m ³ (3000 ft ³)
<i>Unstable Reactive Gas, Class 1</i>				
Liquefied	No limit	No limit	No limit	No limit
Nonliquefied	No limit	No limit	No limit	No limit

Note: The maximum quantity indicated is the aggregate quantity of materials in storage and use combined.

*A gas cabinet or exhausted enclosure is required. Pressure-relief devices or stationary or portable containers shall be vented directly outdoors or to an exhaust hood. (See 8.2.6.)

6.3.2.1 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.

6.3.2.2 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.

6.3.2.3 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.

6.3.2.4 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.

6.3.2.5 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.

6.4 Gas Rooms. Gas rooms shall meet the requirements of 6.4.1 through 6.4.5.

6.4.1 Pressure Control. Gas rooms shall operate at a negative pressure in relationship to the surrounding area.

6.4.2 Exhaust Ventilation. Gas rooms shall be provided with an exhaust ventilation system.

6.4.3 Construction. Gas rooms shall be constructed in accordance with *NFPA 5000, Building Construction and Safety Code*.

6.4.4 Separation. Gas rooms shall be separated from other occupancies by a minimum of 1-hour fire resistance.

6.4.5 Limitation on Contents. The function of compressed gas rooms shall be limited to storage and use of compressed gases and associated equipment and supplies.

6.5 Detached Buildings. Occupancies used for the storage or use of compressed gases in quantities exceeding those specified in Table 6.5 shall be in detached buildings constructed in accordance with the provisions of *NFPA 5000, Building Construction and Safety Code*.

6.5.1 For such storage or use areas to be regulated as outdoor storage or use, compliance with 6.5.3 and 6.5.4 shall be required.

6.5.2 Classification of Weather Protection as an Indoor Versus 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. For such storage or use areas to be regulated as outdoor storage or use, compliance with conditions in 6.5.3 and 6.5.4 shall be required. Where storage or use areas are provided with weather protection that does not comply with these conditions, the storage or use area shall be regulated as an indoor storage or use area.

Table 6.5 Detached Buildings (Detached Building Required Where Quantity of Material Exceeds Amount Shown)

Gas Hazard	Class	Quantity of Material	
		m ³	ft ³
Unstable reactive (detonable)	4 or 3	Quantity thresholds for gases requiring special provisions*	
Unstable reactive (nondetonable)	3	57	2,000
Unstable reactive (nondetonable)	2	283	10,000
Pyrophoric gas	NA	57	2,000

NA: Not applicable.

*See Table 6.3.1.

6.5.3 Supports and walls shall not obstruct more than one side or more than 25 percent of the perimeter of the storage or use area.

6.5.4 The distance from the structure and the structural supports 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. Where the weather protection structure is constructed of noncombustible materials, reductions in the separation distance shall be permitted based on the use of fire barrier walls when permitted for specific materials in accordance with the requirements of Chapters 7 through 11.

6.6 Electrical Equipment. Electrical wiring and equipment shall be in accordance with Section 6.6 and NFPA 70, *National Electrical Code*, notably Article 505.

6.6.1 Standby Power.

6.6.1.1 Where the following systems are required by this standard due to 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, *National Electrical Code*:

- (1) Mechanical ventilation
- (2) Treatment systems
- (3) Temperature controls
- (4) Alarms
- (5) Detection systems
- (6) Other electrically operated systems

6.6.1.2 The requirements of 6.6.1.1 shall not apply where emergency power is provided in accordance with NFPA 70, *National Electrical Code*.

6.6.2 Emergency Power. When emergency power is required, the system shall meet the requirements for a Protection Level 2 system in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*.

6.7 Emergency Alarm. A manual emergency alarm system shall be provided in buildings, rooms, or areas used for the storage or use of compressed gases or cryogenic fluids in amounts that exceed quantity thresholds requiring special provisions.

6.7.1 Activation of an emergency alarm-initiating device shall sound a local alarm to alert occupants in the immediate area of an emergency situation involving a compressed gas or cryogenic fluid.

6.8* Employee Alarm System. When 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, or for reaction time for safe egress of employees from the workplace or the immediate work area, or both.

6.9* Explosion Control. Explosion control shall be provided as required by Table 6.9 in accordance with NFPA 69, *Standard on Explosion Prevention Systems*, where amounts of compressed gases in storage or use exceed the quantity thresholds requiring special provisions.

Table 6.9 Explosion Control Requirements

Material	Class	Explosion Control Methods	
		Barricade Construction	Explosion Venting or Prevention Systems
Cryogenic flammable	—	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

6.10* Fire Protection Systems. Except as provided in 6.10.1, 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 NFPA 13, *Standard for the Installation of Sprinkler Systems*.

6.10.1 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.

6.10.2 Sprinkler System Design.

6.10.2.1 When sprinkler protection is provided, 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 NFPA 13 for Ordinary Hazard Group 2 with a minimum design area of 278.7 m² (3000 ft²).

6.10.2.2 When sprinkler protection is provided, 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 NFPA 13 for Extra Hazard Group 1 with a minimum design area of 232.25 m² (2500 ft²).

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

6.12 Hazard Identification Signs.

6.12.1 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, *Standard System for the Identification of the Hazards of Materials for Emergency Response*.

6.12.1.1 Ratings shall be assigned in accordance with NFPA 704.

6.12.1.2 The authority having jurisdiction shall be permitted to waive this requirement where consistent with safety.

6.12.2 Application. Signage shall be provided as specified in 6.12.2.1 and 6.12.2.2.

6.12.2.1 Signs. Signs shall not be obscured or removed.

6.12.2.2 No Smoking. Signs prohibiting smoking or open flames within 7.6 m (25 ft) 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.

6.13 Spill Control, Drainage, and Secondary Containment. Spill control, drainage, and secondary containment shall not be required for compressed gases.

6.14 Shelving.

6.14.1 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.

6.14.2 In seismically active areas, shelves and containers shall be secured from overturning.

6.15 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.

6.16 Ventilation. Indoor storage and use areas and storage buildings for compressed gases and cryogenic fluids shall be provided with mechanical exhaust ventilation or natural ventilation, where natural ventilation can be shown to be acceptable for the material as stored.

6.16.1 Mechanical Ventilation. Where mechanical ventilation is provided, the system shall be operational during the time the building or space is occupied.

6.16.2 Compressed Air. The requirements of Section 6.16 and 6.16.1 shall not apply to cylinders, containers, and tanks containing compressed air.

6.16.3 Mechanical Ventilation Rate. Mechanical ventilation shall be at a rate of not less than 0.3048 m³/min/m² (1 ft³/min/ft²) of floor area over the area of storage or use.

6.16.4 Continuous Operation. Systems shall operate continuously unless an alternate design is approved by the code official.

6.16.5 Shutoff Controls. Where powered ventilation is provided, a manual shutoff switch shall be provided outside of the room in a position adjacent to the principal access door to the room or in an approved location.