

NFPA 59

Utility LP-Gas Plant Code

2004 Edition



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

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NFPA 59

Utility LP-Gas Plant Code

2004 Edition

This edition of NFPA 59, *Utility LP-Gas Plant Code*, was prepared by the Technical Committee on LP-Gases at Utility Gas Plants and acted on by NFPA at its November Association Technical Meeting held November 15–19, 2003, in Reno, NV. It was issued by the Standards Council on January 16, 2004, with an effective date of February 5, 2004, and supersedes all previous editions.

Note: The text of 10.3.5 and 10.3.5(B) was revised from that published in the ROP and ROC to reflect a Tentative Interim Amendment issued by the Standards Council on January 15, 2004.

This edition of NFPA 59 was approved as an American National Standard on January 16, 2004.

Origin and Development of NFPA 59

NFPA 58, *Standard on Liquefied Petroleum Gases*, was applied to utility gas plants to the degree it covered them until NFPA 59 was adopted in 1949. Subsequent editions were adopted in 1954, 1956, 1958, 1962, 1963, 1968, 1974, 1976, 1979, 1984, 1989, 1992, 1995, 1998, and 2001.

The first edition of NFPA 59 resulted from the formation of a special committee under the sponsorship of the American Gas Association (AGA), which was made up of utility engineers, specialists in gas plant construction, and engineers in the liquefied petroleum gas industry. The standard was initially the result of the AGA Committee acting in an advisory capacity to the Sectional Committee on Utility Gas of the NFPA Committee on Gases.

With the formation in 1966 of the Committee on Fuel Gases, NFPA 59 was assigned to that committee and then to a new Subcommittee on Utility Gas Plants. In 1972, responsibility for NFPA 59 was reassigned to the Committee on Liquefied Petroleum Gases, which retained the Subcommittee on Utility Gas Plants.

In 1992, the subcommittee was discharged, and NFPA 59 was assigned to the Technical Committee on LP-Gases at Utility Gas Plants. The committee maintains correlation with NFPA 58 by overlapping committee membership and concurrent or joint meetings.

Changes in the 2004 edition include reorganization of the document to conform to the *NFPA Manual of Style*. The former Chapter 1 has been split into three chapters: Chapter 1 Administration; Chapter 3, Definitions; and Chapter 4, General Requirements.

Technical Committee on LP-Gases at Utility Gas Plants

Hugh F. Keepers, Chair
Texas A&M University System, TX [SE]

William J. Young, Secretary
Superior Energy Systems, Ltd., OH [M]

Per E. Duus, CBI Technical Services Co., IL [M]
Richard G. Fredenburg, State of North Carolina, NC [U]
Philip M. Heidrich, Starr Technical Risks Agency, Inc., TX [I]
Richard A. Hoffmann, Hoffmann & Feige, NY [SE]
Stanley T. Kastanas, U.S. Department of Transportation, DC [E]
James P. Lewis, Project Technical Liaison Associates, Inc., TX [SE]

Jerry W. Lucas, Heritage Propane, OK [IM]
Rep. National Propane Gas Association
Nancy C. Pehrson, CenterPoint Energy, Inc., MN [U]
Kevin L. Ritz, Baltimore Gas & Electric Co., MD [U]
Steven D. Ruffcorn, Standby Systems, Inc., MN [M]
James H. Stannard, Jr., Stannard & Co., GA [SE]
Herbert F. Zepp, Smith & Norrington Engineering Corp., NH [SE]

Alternates

William R. Copes, Baltimore Gas & Electric Co., MD [U]
(Alt. to K. L. Ritz)
Swapan Kumar Hazra, Hindustan Aegis LPG Bottling Co., Ltd., India [U]
(Alt. to N. C. Pehrson)

John L. Ritzmann, Consultant, VA [SE]
(Alt. to H. F. Zepp)
Richard C. Ward, Atlanta Gas Light Company, GA [IM]
(Voting Alt. to AGA Rep.)

Nonvoting

Al Linder, Watsonville, CA
Rep. TC on Liquefied Petroleum Gases
(Member Emeritus)

Bruce A. Schwartz, Vienna, VA

Theodore C. Lemoff, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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 design, construction, location, installation, operation, and maintenance of refrigerated and nonrefrigerated liquefied petroleum gas plants to the point of introduction into the utility gas distribution system or those plants that are subject to the requirements of Title 49, Code of Federal Regulations, Part 192, "Pipeline Safety Law," issued pursuant to the laws in 49 U.S.C. *et seq.*

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Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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, Annex F lists the complete title and edition of the source documents for both mandatory and nonmandatory extracts. 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 F.

Chapter 1 Administration

1.1 Scope.

1.1.1* This code shall apply to the design, construction, location, installation, operation, and maintenance of refrigerated and nonrefrigerated utility gas plants. Coverage of liquefied petroleum gas systems at utility gas plants shall extend to the point where LP-Gas or a mixture of LP-Gas and air is introduced into the utility distribution system.

1.1.2 When operations that involve the liquid transfer of LP-Gas from the utility gas plant storage into cylinders or portable tanks (as defined by NFPA 58, *Liquefied Petroleum Gas Code*) are carried out in the utility gas plant, these operations shall conform to NFPA 58.

1.1.3 Installations that have an aggregate water capacity of 4000 gal (15.14 m³) or less shall conform to NFPA 58, *Liquefied Petroleum Gas Code*.

1.2 Purpose. (Reserved)

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

1.3.1 Unless otherwise specified, the provisions of this code 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 code. Where specified, the provisions of this code shall be retroactive.

1.3.2 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 code deemed appropriate.

1.3.3 The retroactive requirements of this code 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.

1.4 Equivalency. Nothing in this code 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 code.

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

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

1.5 Enforcement. This code shall be administered and enforced by the authority having jurisdiction designated by the governing authority. (See Annex E for sample wording for enabling legislation.)

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this code 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 11, *Standard for Low-, Medium-, and High-Expansion Foam*, 2002 edition.

NFPA 11A, *Standard for Medium- and High-Expansion Foam Systems*, 1999 edition.

NFPA 12, *Standard on Carbon Dioxide Extinguishing Systems*, 2000 edition.

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Systems*, 2004 edition.

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

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2003 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2001 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2003 edition.

NFPA 17, *Standard for Dry Chemical Extinguishing Systems*, 2002 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2003 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection*, 2003 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2002 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2003 edition.

NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*, 2003 edition.

NFPA 54, *National Fuel Gas Code*, 2002 edition.

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

NFPA 70, *National Electrical Code*®, 2002 edition.

NFPA 101®, *Life Safety Code*®, 2003 edition.

NFPA 290, *Standard for Fire Testing of Passive Protection Materials for Use on LP-Gas Containers*, 2003 edition.

NFPA 780, *Standard for the Installation of Lightning Protection Systems*, 2000 edition.

NFPA 1961, *Standard on Fire Hose*, 2002 edition.

NFPA 1962, *Standard for the Inspection, Care, and Use of Fire Hose, Couplings, and Nozzles and the Service Testing of Fire Hose*, 2003 edition.

NFPA 1963, *Standard for Fire Hose Connections*, 2003 edition.

NFPA 1971, *Standard on Protective Ensemble for Structural Fire Fighting*, 2000 edition.

NFPA 1981, *Standard on Open-Circuit Self-Contained Breathing Apparatus for Fire and Emergency Services*, 2002 edition.

2.3 Other Publications.

2.3.1 API Publications. American Petroleum Institute, 1220 L Street, NW, Washington, DC 20005.

API 607, *Fire Test for Soft-Seated Quarter-Turn Valves*, 1998 edition.

API 620, *Design and Construction of Large, Welded, Low-Pressure Storage Tanks*, 2001 edition.

2.3.2 ASCE Publication. American Society of Civil Engineers, 345 East 47th Street, New York, NY 10017.

ASCE 7, *Minimum Design Loads for Buildings and Other Structures*, 2002 edition.

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

ASME *Boiler and Pressure Vessel Code*, 1949, 1980, 1986, and 2001 editions.

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

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

ASTM A 47, *Standard Specification for Ferritic Malleable Iron Castings*, 1999 edition.

ASTM A 395, *Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*, 1999 edition.

ASTM A 536, *Specifications for Ductile Iron Castings*, 1999 edition.

2.3.5 UL Publication. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 132, *Standard on Safety Relief Valves for Anhydrous Ammonia and LP-Gas*, 1997 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this code. Where terms are not included, common usage of the terms shall apply.

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* Code. A standard that is an extensive compilation of provisions covering broad subject matter or that is suitable for adoption into law independently of other codes and standards.

3.2.4 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.

3.2.5* 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.

3.2.6 Shall. Indicates a mandatory requirement.

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

3.3 General Definitions.

3.3.1 Buried. Installations in which the top of the container (excluding the manway) is below the surrounding grade.

3.3.2 Container. Any vessel, including cylinders, tanks, portable tanks, and cargo tanks, used for the transporting or storing of LP-Gases. [58:3.3]

3.3.3 Field-Erected Container. A container that is fabricated in whole or in part at or near its final location.

3.3.4 Filling Density. The percent ratio of the weight of the gas in a container to the weight of water at 60°F (15.6°C) that the container will hold.

3.3.5* Fire Protection. Fire protection for the purposes of this code shall be defined in the broad sense to include fire prevention, fire detection, and fire suppression. [58:3.3]

3.3.6 Gas. Liquefied petroleum gas in either the liquid or vapor state. The more specific terms *liquid LP-Gas* or *vapor LP-Gas* are normally used for clarity. [58:3.3]

3.3.7* Gas-Air Mixer. A device or a system of piping and controls that mixes LP-Gas vapor with air to produce a mixed gas of a lower heating value than the LP-Gas. [58:3.3]

3.3.8 Liquefied Petroleum Gas (LP-Gas). Any material having a vapor pressure not exceeding that allowed for commercial propane that is composed predominantly of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or isobutane), and butylenes. [58:3.3]

3.3.9 Mounded Container. An ASME container designed for underground service installed above the minimum depth required for underground service and covered with earth, sand, or other material, or an ASME container designed for above-ground service installed above grade and covered with earth, sand, or other material. [58:3.3]

3.3.10 psia. Pounds per square inch, absolute. [58:3.3]

3.3.11 psig. Pounds per square inch gauge. [58:3.3]

3.3.12 Redundant Fail-Safe Product Control Measures (RFPCM). Specified product storage controls that are more stringent than the basic requirements of this standard. (RFPCM would be used to alleviate the requirement for special protection and to be a factor in reducing distance requirements.)

3.3.13 Refrigerated LP-Gas. LP-Gas that is maintained as a liquid at temperatures below ambient temperature to reduce the storage pressure including fully refrigerated LP-Gas at pressures near atmospheric pressure but not exceeding 15 psig (103 kPag) and semi-refrigerated LP-Gas at pressures above 15 psig (103 kPag). [58:3.3]

3.3.14 Shop-Fabricated Container. A container that is completely fabricated within a plant under shop-controlled conditions.

3.3.15 Sources of Ignition. Devices or equipment that, because of their modes of use or operation, are capable of providing sufficient thermal energy to ignite flammable LP-Gas vapor-air mixtures when introduced into such a mixture or when such a mixture comes into contact with them, and that will permit propagation of flame away from them. [58:3.3]

3.3.16* Special Protection. A means of limiting the temperature of an LP-Gas container for purposes of minimizing the possibility of failure of the container as the result of fire exposure. [58:3.3]

3.3.17 Systems. An assembly of equipment that consists essentially of liquefied petroleum gas unloading equipment; a container or containers; major devices such as vaporizers, relief valves, excess-flow valves, and regulators; and interconnecting piping. In the case of refrigerated storage, it also includes compressors, condensers, and other related equipment and controls. Such systems include any unloading equipment, storage equipment, or interconnecting piping up to the outlet of the first stage regulator, vaporizer, or mixing device, whichever is the last unit before the liquefied petroleum gas enters other plant equipment or distribution lines.

3.3.18* Utility Gas Plant. A plant that stores and vaporizes LP-Gas for distribution that supplies either LP Gas or LP-Gas gas/air mixtures to a gas distribution system of 10 or more customers.

3.3.19 Vaporizer. A device, other than a container, that receives LP-Gas in liquid form and adds sufficient heat to convert the liquid to a gaseous state. [58:3.3]

3.3.19.1 Direct-Fired Vaporizer. A vaporizer in which heat furnished by a flame is directly applied to some form of heat exchange surface in contact with the liquid LP-Gas to be vaporized. This classification includes submerged-combustion vaporizers. [58:3.3]

3.3.19.2 Electric Vaporizer. A vaporizer that uses electricity as a source of heat. [58:3.3]

3.3.19.2.1 Direct Immersion Electric Vaporizer. A vaporizer wherein an electric element is immersed directly in the LP-Gas liquid and vapor. [58:3.3]

3.3.19.2.2 Indirect Electric Vaporizer. An immersion-type vaporizer wherein the electric element heats an interface solution in which the LP-Gas heat exchanger is immersed or heats an intermediate heat sink. [58:3.3]

3.3.19.3 Indirect (or Indirect-Fired) Vaporizer. A vaporizer in which heat furnished by steam, hot water, the ground, surrounding air, or other heating medium is applied to a vaporizing chamber or to tubing, pipe coils, or other heat exchange surface containing the liquid LP-Gas to be vaporized; the heating of the medium used is at a point remote from the vaporizer. [58:3.3]

3.3.19.4 Waterbath (or Immersion-Type) Vaporizer. A vaporizer in which a vaporizing chamber, tubing, pipe coils, or other heat exchange surface containing liquid LP-Gas to be vaporized is immersed in a temperature-controlled bath of water, water-glycol combination, or other noncombustible heat transfer medium that is heated by an immersion heater not in contact with the LP-Gas heat exchange surface. [58:3.3]

Chapter 4 General Requirements

4.1 Qualification of Personnel. Persons engaged in gas operating and emergency procedures and in the handling of liquefied petroleum gases shall be trained in the properties and safe handling of these gases and in emergency procedures. This training shall be repeated at least annually.

4.2* Odorizing Gases. All LP-Gases shall be odorized by the addition of a warning agent of such character that they are detectable by a distinct odor down to a concentration in air of not over one-fifth the lower limit of flammability.

Exception: Odorization shall not be required if harmful in the use or further processing of the liquefied petroleum gas or if odorization will serve no useful purpose as a warning agent in such use or further processing.

4.3 Acceptance of Equipment. In systems containers of over 2000 gal (7.6 m³) water capacity, each container valve, excess-flow valve, gauging device, relief device directly connected on the liquefied petroleum gas container, and direct-fired vaporizer shall be approved. (See 3.2.1, *Approved*.)

4.4 Damage from Vehicles. Where damage to liquefied petroleum gas systems from vehicular traffic is a possibility, precautions (such as warning signs or devices, or barricades) shall be taken against such damage. (See 5.8.2.)

4.5 Ignition Source Control. [58:6.20]

4.5.1 Scope. [58:6.20.1]

4.5.1.1 This section shall apply to the minimization of ignition of flammable LP-Gas-air mixtures resulting from the normal or accidental release of nominal quantities of liquid or vapor from LP-Gas systems installed and operated in accordance with this code. [58:6.20.1.1]

4.5.1.2* The installation of lightning protection equipment shall not be required on LP-Gas storage containers. [58:6.20.1.2]

4.5.1.3* Grounding and bonding shall not be required on LP-Gas systems. [58:6.20.1.3]

4.5.2 Electrical Equipment. [58:6.20.2]

4.5.2.1 Electrical equipment and wiring installed in unclassified areas shall be in accordance with NFPA 70, *National Electrical Code*[®], for nonclassified locations. [58:6.20.2.1]

4.5.2.2* Fixed electrical equipment and wiring installed within a classified area specified in Table 4.5.2.2 shall be installed in accordance with NFPA 70, *National Electrical Code*. [58:6.20.2.2]

Table 4.5.2.2 Electrical Area Classification

Part	Location	Extent of Classified Area ^a	Equipment Shall be Approved for <i>National Electrical Code</i> , Class I ^a , Group D ^b
A	Unrefrigerated containers other than cylinders and ASME vertical containers of less than 1000 lb (454 kg) water capacity	Within 15 ft (4.6 m) in all directions from connections, except connections otherwise covered in Table 4.5.2.2	Division 2
B	Refrigerated storage containers	Within 15 ft (4.6 m) in all directions from connections otherwise covered in Table 4.5.2.2	Division 2
		Area inside dike to the level of the top of the dike	Division 2
C ^c	Tank vehicle and tank car loading and unloading	Within 5 ft (1.5 m) in all directions from connections regularly made or disconnected for product transfer	Division 1
		Beyond 5 ft (1.5 m) but within 15 ft (4.6 m) in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and grade (see Figure A.4.5.2.2)	Division 2
D	Gauge vent openings other than those on cylinders and ASME vertical containers of less than 1000 lb (454 kg) water capacity	Within 5 ft (1.5 m) in all directions from point of discharge	Division 1
		Beyond 5 ft (1.5 m) but within 15 ft (4.6 m) in all directions from point of discharge	Division 2
E	Relief device discharge other than those on cylinders and ASME vertical containers of less than 1000 lb (454 kg) water capacity and vaporizers	Within direct path of discharge	Note: Fixed electrical equipment should preferably not be installed.
F ^c	Pumps, vapor compressors, gas–air mixers and vaporizers (other than direct-fired or indirect-fired with an attached or adjacent gas-fired heat source)		
	Indoors without ventilation	Entire room and any adjacent room not separated by a gastight partition	Division 1
		Within 15 ft (4.6 m) of the exterior side of any exterior wall or roof that is not vaportight or within 15 ft (4.6 m) of any exterior opening	Division 2
	Indoors with ventilation	Entire room and any adjacent room not separated by a gastight partition	Division 2
	Outdoors in open air at or above grade	Within 15 ft (4.6 m) in all directions from this equipment and within the cylindrical volume between the horizontal equator of the sphere and grade (see Figure A.4.5.2.2)	Division 2
G	Vehicle fuel dispenser	Entire space within dispenser enclosure, and 18 in. (460 mm) horizontally from enclosure exterior up to an elevation 4 ft (1.2 m) above dispenser base; entire pit or open space beneath dispenser	Division 1
		Up to 18 in. (460 mm) above ground within 20 ft (6.1 m) horizontally from any edge of enclosure (Note: For pits within this area, see part H of this table.)	Division 2

Table 4.5.2.2 *Continued*

Part	Location	Extent of Classified Area ^a	Equipment Shall be Approved for <i>National Electrical Code</i> , Class I ^a , Group D ^b
H	Pits or trenches containing or located beneath LP-Gas valves, pumps, vapor compressors, regulators, and similar equipment		
		Without mechanical ventilation	
		Entire pit or trench	Division 1
	With mechanical ventilation	Entire room and any adjacent room not separated by a gastight partition	Division 2
		Within 15 ft (4.6 m) in all directions from pit or trench when located outdoors	Division 2
I	Special buildings or rooms for storage of cylinders	Entire room	Division 2
J	Pipelines and connections containing operational bleeds, drips, vents, or drains	Within 5 ft (1.5 m) in all directions from point of discharge	Division 1
		Beyond 5 ft (1.5 m) from point of discharge, same as part F of this table	
K ^c	Cylinder filling		
		Indoors with ventilation	
	Outdoors in open air	Within 5 ft (1.5 m) in all directions from a point of transfer	Division 1
		Beyond 5 ft (1.5 m) and entire room	Division 2
		Within 5 ft (1.5 m) in all directions from a point of transfer	Division 1
L	Piers and wharves	Within 5 ft (1.5 m) in all directions from connections regularly made or disconnected for product transfer	Division 1
		Beyond 5 ft (1.5 m) but within 15 ft (4.6 m) in all directions from a point where connections are regularly made or disconnected and within the cylindrical volume between the horizontal equator of the sphere and the vessel deck (<i>see Figure A.4.5.2.2</i>)	Division 2

^aThe classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

^b See Article 500 Hazardous (Classified) Locations, in NFPA 70, *National Electrical Code*, for definitions of classes, groups, and divisions.

^c See A.6.20.2.2 [of NFPA 58]. [58:Table 6.20.2.2]

4.5.2.3 The provisions of 4.5.2.2 shall apply to vehicle fuel operations. [58:6.20.2.3]

4.5.2.4 The provisions of 4.5.2.2 shall not apply to fixed electrical equipment at residential or commercial installations of LP-Gas systems or to systems covered by Section 6.21 [of NFPA 58]. [58:6.20.2.4]

4.5.2.5 Fired vaporizers, calorimeters with open flames, and other areas where open flames are present either intermittently or constantly shall not be considered electrically classified areas. [58:6.20.2.5]

4.5.2.6 Electrical equipment installed on LP-Gas cargo tank vehicles shall comply with Section 9.2 [of NFPA 58]. [58:6.20.2.6]

4.5.3 Other Sources of Ignition. [58:6.20.3]

4.5.3.1 Open flames or other sources of ignition shall not be used or installed in pump houses, cylinder filling rooms, or other similar locations. [58:6.20.3.1]

4.5.3.2 Direct-fired vaporizers or indirect-fired vaporizers attached or installed adjacent to gas-fired heat sources shall not be installed in pump houses or cylinder filling rooms. [58:6.20.3.2]

4.5.3.3 Open flames, cutting or welding tools, portable electric tools, and extension lights capable of igniting LP-Gas shall not be installed or used within classified areas specified in Table 4.5.2.2. [58:6.20.3.3]

4.5.3.4* Open flames or other sources of ignition shall not be prohibited where LP-Gas facilities have been purged of all liquid and vapor. [58:6.20.3.4]

4.6 Lighting. Lighting shall be provided to illuminate operating facilities such as walkways, essential control valves, and loading and unloading facilities in particular.

4.7 Fixed Electrical Equipment in Classified Areas.

4.7.1 Fixed electrical equipment and wiring installed within the classified areas specified in Table 4.5.2.2 shall comply with Table 4.5.2.2 and shall be installed in accordance with NFPA 70, *National Electrical Code*[®], for hazardous locations.

4.7.2 Direct-fired vaporizers, calorimeters with open flames, and other areas where open flames are present, either intermittently or constantly, shall not be considered electrically classified areas.

4.8 Source of Ignition.

4.8.1 Smoking and nonprocess ignition sources within the protective enclosure shall be prohibited, unless in accordance with 4.8.2 through 4.8.4.

4.8.2 Smoking shall be permitted only in designated and properly signposted areas.

4.8.3 Welding, cutting, hotwork, use of portable electric tools and extension lights, and similar operations shall be conducted only at times and places specifically authorized.

4.8.3.1 Welding and cutting shall be conducted in accordance with the provisions of NFPA 51B, *Standard for Fire Prevention During Welding, Cutting, and Other Hot Work*. Portable electric tools and extension lights capable of igniting LP-Gas shall not be permitted within the classified areas specified in Table 4.5.2.2.

4.8.3.2 Portable electric tools and extension lights capable of igniting LP-Gas shall be permitted where the LP-Gas facilities have been freed of all liquid and vapor or where special precautions are observed under carefully controlled conditions.

4.8.4 Vehicles and other mobile equipment that constitute potential ignition sources shall be prohibited within diked areas or within 50 ft (15 m) of containers that contain LP-Gas, flammable liquids, or flammable refrigerants, except where specifically authorized and under constant supervision or where loading or unloading at facilities specifically designed for the purpose.

4.8.5* Electrical grounding and bonding shall be provided as required by NFPA 70, *National Electrical Code*.

4.8.6* If stray currents are present or if impressed currents are used on loading and unloading systems (such as for cathodic protection), protective measures shall be taken to prevent ignition.

4.8.7 Metallic storage containers for LP-Gas generally do not require lightning protection. Grounding systems shall be provided for LP-Gas storage containers in accordance with Chapter 3, Section 4.4, and 6.3.2 of NFPA 780, *Standard for the Installation of Lightning Protection Systems*.

Chapter 5 Nonrefrigerated Containers

5.1 Provision for Construction and Original Test of Nonrefrigerated Containers.

5.1.1 Shop-fabricated containers shall be designed, constructed, and tested in accordance with one of the following:

- (1) ASME *Boiler and Pressure Vessel Code*, Section VIII, "Rules for Construction of Unfired Pressure Vessels," excluding UG-125 through UG 136
- (2) The rules of the authority under which the containers are installed, provided such rules conform to the rules of ASME *Boiler and Pressure Vessel Code*, Section VIII

5.1.2 The provisions of 5.1.1 shall not be construed as prohibiting the continued use or reinstallation of containers that are constructed and maintained in accordance with ASME *Boiler and Pressure Vessel Code* in effect at the time of fabrication. (See Section 1.4.)

5.2 Design Pressure and Classification of Nonrefrigerated Containers.

5.2.1* Shop-fabricated containers for nonrefrigerated storage shall be in accordance with Table 5.2.1.

5.2.2 Field-erected nonrefrigerated containers shall be built in accordance with ASME *Boiler and Pressure Vessel Code* except that construction using joint efficiencies in Table UW 12, Column C, Division 1, of ASME *Boiler and Pressure Vessel Code* shall not be permitted.

Table 5.2.1 Minimum Design Pressure for Shop-Fabricated Nonrefrigerated Containers

For Gases with Vapor Pressure at 100°F (37.8°C) Not to Exceed		Minimum Design Pressure (ASME <i>Boiler and Pressure Vessel Code</i> , Section VIII)	
psi	kPa	psi	kPa
80	552	100	689
100	689	125	862
125	862	156	1076
150	1034	187	1289
175	1207	219	1510
215	1482	250	1724

Table 5.4.1.2 Nonrefrigerated Container Installation Minimum Distances

Water Capacity of Each Container		Minimum Distances Between Containers		Minimum Distances from Container to Nearest Important Building or Group of Buildings Not Associated with the Utility Gas Plant or to a Line of Adjoining Property That Can Be Built Upon	
gal	m ³	ft	m	ft	m
2001–30,000	7.6–114	5	1.5	50	15
30,001–70,000	114–265			75	23
70,001–90,000	265–341			100	30
90,001–120,000	341–454			125	38
120,001–200,000	454–757			200	61
200,001–1,000,000	757–3785			300	91
1,000,001 or more	Over 3785			400	122

5.2.3 Field-erected containers for nonrefrigerated storage shall be designed for a pressure of not less than 125 percent of the maximum vapor pressure of the product at 100°F (37.8°C) to be stored in the containers, but in no case shall the container be designed for a pressure of 25 psi (172 kPa) or less.

5.3 ASME Container Markings.

5.3.1 ASME containers shall be identified by the attachment of a nameplate.

5.3.1.1 The marking specified shall be on a stainless steel nameplate attached to the container and located to remain visible after the container is installed.

5.3.1.2 The nameplate shall be attached so as to minimize corrosion of the nameplate or its fastening means and so as not to contribute to corrosion of the container.

5.3.1.3 Where the container is buried, mounded, insulated, or otherwise covered so as to obscure the nameplate, the information contained on the nameplate shall be duplicated and installed on adjacent piping or on a structure in a clearly visible location.

5.3.2 The container marking shall contain the following information:

- (1) Name and address of the container supplier or the trade name of the container
- (2) Water capacity of the container in pounds or U.S. gallons
- (3) Design pressure in pounds per square inch (psi)
- (4) The wording "This container shall not contain a product having a vapor pressure in excess of ___ psi at 100°F" (see Table 5.2.1)
- (5) Outside surface area in square feet
- (6) Year of manufacture
- (7) Shell thickness and head thickness
- (8)*OL (overall length), OD (outside diameter), HD (head design)
- (9) Manufacturer's serial number
- (10) ASME Boiler and Pressure Vessel Code symbol

5.4 Location of Nonrefrigerated Containers.

5.4.1 Nonrefrigerated Aboveground Containers.

5.4.1.1 Containers shall be located outside of buildings.

5.4.1.2 Containers shall be located in accordance with Table 5.4.1.2 with respect to the distance between containers, the distance between containers and the nearest important building or group of buildings not associated with the LP-Gas plant, or a line of adjoining property that can be built upon.

5.4.1.3 Spacing of containers from buildings associated with utility gas plants shall be permitted to be reduced to 50 percent of the distances in Table 5.4.1.2, with a minimum separation of 50 ft (15 m).

5.4.1.4 Multiple aboveground containers (or groups of containers) installed for use in a single location shall be limited to the number of containers in one group, with each group separated from the next group in accordance with the degree of fire protection provided in Table 5.4.1.4.

5.4.1.5 Containers shall be oriented so that their longitudinal axes do not point toward other containers, aboveground liquefied natural gas tanks, and flammable liquid storage tanks on the same or adjoining property.

Table 5.4.1.4 Fire Protection Requirements for Container Groups

Fire Protection Provided by	Maximum Number of Containers in One Group	Minimum Separation Between Groups	
		ft	m
Hose streams only (See 13.1.1.)	6	50	15
Fixed monitor nozzles per 13.5.4.5	6	25	7.6
Fixed water spray per 13.5.4.4	9	25	7.6
Insulation per 13.5.4.18	9	25	7.6

5.4.1.6 The minimum horizontal separation between aboveground LP-Gas containers and aboveground tanks containing liquids having flash points below 200°F (93.4°C) shall be 20 ft (6 m). [58:6.4.5.5]

5.4.1.7 No horizontal separation shall be required between aboveground LP-Gas containers and underground tanks containing flammable or combustible liquids installed in accordance with NFPA 30, *Flammable and Combustible Liquids Code*. [58:6.4.5.6]

5.4.1.8 Nonrefrigerated LP-Gas containers shall not be located within dikes that enclose flammable liquid tanks and shall not be located within dikes that enclose refrigerated LP-Gas tanks.

5.4.1.9* The area under containers shall be graded or shall have dikes or curbs installed so that the flow or accumulation of flammable liquids with flash points below 200°F (93.4°C) is prevented. [58:6.4.5.3]

5.4.2 Nonrefrigerated Underground Containers.

5.4.2.1 Underground containers shall include both buried and partially buried (or mounded) containers.

5.4.2.2 Containers shall be located outside of any buildings.

(A) Buildings or roadways shall not be constructed over any underground containers.

(B) Sides of adjacent containers shall be separated by not less than 3 ft (1 m).

5.4.2.3 The orientation of containers shall be in accordance with the following:

- (1) Where containers are installed parallel with ends in line, any number of containers shall be permitted to be in one group.
- (2) Where more than one row is installed, the adjacent ends of the tanks in each row shall be separated by not less than 10 ft (3 m).

5.4.2.4 The location of containers shall be in accordance with the following:

- (1) Containers shall be located not less than 50 ft (15 m) from the nearest important building or group of buildings or line of adjacent property that can be built upon.
- (2) Containers shall be located not less than 50 ft (15 m) from buildings associated with the utility gas plant.
- (3) They shall be located not less than 10 ft (3 m) from flammable liquids storage containers.

5.4.2.5 When the provisions of 6.24.3 through 6.24.5 [of NFPA 58] are met, the minimum distance from an ASME container to a building shall be reduced by one-half for ASME containers of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity. [58:6.3.2]

5.4.2.6 The ground within 25 ft (7.6 m) of any underground nonrefrigerated container manway and appurtenances shall be kept clear of ignitable material such as weeds and long, dry grass.

5.4.3 Stacking. Nonrefrigerated containers shall not be stacked one above the other.

5.4.4 Connection to a Common Manifold. Containers connected to a common manifold shall be installed so that their maximum liquid filling levels present the same plane to minimize the possibility of overfilling lower level tanks.

5.5 Installation of Nonrefrigerated Storage Containers.

5.5.1 Nonrefrigerated Aboveground Containers.

5.5.1.1 Every container shall be supported to prevent the concentration of excessive loads on the supporting portion of the shell or heads.

5.5.1.2 Supports for containers shall be of solid masonry, concrete, or steel.

(A) Structural metal supports shall be permitted to be employed where they are protected against fire in an approved manner.

(B) Metal supports shall be protected against fire with a material that has a fire resistance rating of at least 2 hours.

(C) Steel skirts that have only one opening that is 18 in. (460 mm) or less in diameter shall be protected in accordance with 5.5.1.2(B), but fireproofing shall be required to be applied only to the outside of the skirt.

5.5.1.3 Horizontal containers shall be mounted on not more than two saddles so as to permit expansion and contraction, not only of the container but also of the connected piping.

5.5.1.4 Means to minimize corrosion shall be provided on that portion of the container that is in contact with the foundations or saddles.

5.5.1.5 Containers shall be kept properly painted or otherwise protected from the elements.

5.5.1.6 Vertical containers shall be designed to be self-supporting without the use of guy wires and shall take into account wind, seismic forces (earthquake), and hydrostatic test loads.

5.5.1.7 Design pressure (*see Table 5.2.1*) shall be the pressure at the top head with allowance made for increased pressure on the lower shell sections and bottom head due to the static pressure of the product.

5.5.1.8 Wind loading on containers of 10,000 gal (37.9 m³) or larger shall be in accordance with ASCE 7, *Minimum Design Loads for Buildings and Other Structures*. Wind speeds shall be based on a mean occurrence interval of 100 years.

5.5.1.9 A seismic design for installations of containers of 10,000 gal (37.9 m³) or larger shall be made that meets the approval of the authority having jurisdiction.

5.5.1.10* If insulation is used, it shall be capable of limiting the container temperature to not over 800°F (427°C) for a minimum of 50 minutes, as determined by test with insulation applied to a steel plate and subjected to a test flame substantially over the area of the test plate, and shall be resistant to weathering and the action of hose streams. (*See Annex D.*)

5.5.2 Nonrefrigerated Underground Containers.

5.5.2.1 Buried containers shall be placed so that the top of the container is not less than 6 in. (150 mm) below the grade of the surrounding area.

5.5.2.2 Partially buried (or mounded) containers shall have not less than 12 in. (300 mm) of cover, sufficient to provide surface drainage without erosion or other deterioration.

5.5.2.3 The container manway shall not be covered with the backfill or mounding material.

5.5.2.4 Where the container manway cover is below ground level, a manway that provides access shall be installed. No other part of the container shall be exposed.

5.5.2.5 Containers shall be set on a firm foundation and surrounded with earth or sand that is firmly tamped in place.

5.5.2.6 Foundations of firm earth shall be permitted to be used.

5.5.2.7 Backfill shall be free of rocks or other abrasive materials.

5.5.2.8 Provisions shall be made to take care of settling and rotation.

5.5.2.9* Containers shall be protected to minimize corrosion.

5.5.2.10 All connections shall be in the container manway or at openings along the top length of the container. Bottom connections to the container shall be prohibited, except as permitted in 5.5.2.10(A) or 5.5.2.10(B).

(A) Where tanks are mounded and the bottom of the tank is 30 in. (0.76 m) or more above the surrounding grade, bottom connections shall be permitted where access to connections is provided by an opening or tunnel with a 4 ft (1.2 m) minimum diameter and a 3 ft (0.9 m) minimum clear area.

(B) Bottom connections shall be permitted on mounded tanks where they extend beyond the mound. The connection shall be part of the ASME tank or shall be installed in compliance with ASME *Boiler and Pressure Vessel Code* and shall be designed for the forces that can act on the connection.

5.5.3 Field welding on containers shall be limited to attachments to nonpressure parts such as saddle plates, wear plates, or brackets applied by the container manufacturer. [58:6.21.3.4(D)]

5.5.4 Where necessary to prevent flotation due to possible high floodwaters around aboveground or mounded containers, or high water table for those underground and partially underground, containers shall be securely anchored. [58:6.6.1.6]

5.6 Reinstallation of Nonrefrigerated Containers.

5.6.1 Containers once installed underground or aboveground that have been out of service for more than 1 year shall not be reinstalled aboveground or underground unless they withstand, without distortion, hydrostatic pressure retests at the pressure specified for the original hydrostatic test as required by the code under which they were constructed.

5.6.2 Reinstallation of containers in all other respects shall be in accordance with all the provisions of this code. (See Section 5.5; see also Chapter 10 for relief valve requirements.)

5.7 Filling Densities.

5.7.1 Nonrefrigerated containers shall be filled in accordance with the following formula:

$$V = \frac{D}{G \times F}$$

where:

V = maximum liquid volume (in percentage of total container capacity) at temperature T

D = filling density from Table 5.7.2 in percentage

G = specific gravity of LP-Gas at 60°F (15.6°C) to be placed in container

F = correction factor for correcting liquid volume from 60°F (15.6°C) to volume at temperature T (For F values, see Table B.2.)

T = temperature of liquid LP-Gas in container (in degrees Fahrenheit)

5.7.2 Filling densities of underground nonrefrigerated containers shall be in accordance with Table 5.7.2.

Table 5.7.2 Maximum Permitted Filling Density

Specific Gravity at 60°F (15.6°C)	Aboveground Containers		Underground Containers, All Capacities (%)
	0 to 1200 U.S. gal (1000 imperial gal, 4.5 m ³) Total Water Capacity (%)	Over 1200 U.S. gal (1000 imperial gal, 4.5 m ³) Total Water Capacity (%)	
0.496–0.503	41	44	45
0.504–0.510	42	45	46
0.511–0.519	43	46	47
0.520–0.527	44	47	48
0.528–0.536	45	48	49
0.537–0.544	46	49	50
0.545–0.552	47	50	51
0.553–0.560	48	51	52
0.561–0.568	49	52	53
0.569–0.576	50	53	54
0.577–0.584	51	54	55
0.585–0.592	52	55	56
0.593–0.600	53	56	57

5.7.3 Where the maximum ground temperatures do not exceed 60°F (15.6°C), the filling density shall be based on Table 5.7.2 or on accepted engineering practices for the operating conditions involved with the approval of the authority having jurisdiction.

5.8 Loading and Unloading Facility Spacing.

5.8.1 Loading and unloading connections shall be at least 75 ft (23 m) from uncontrolled sources of ignition, process areas, control buildings, offices, shops, and other occupied or important plant structures, other than equipment directly associated with the transfer operation.

5.8.2 Filling pipe inlet terminals shall meet all the following requirements:

- (1) The filling pipe inlet terminal shall not be located inside a building.
- (2) Such terminals shall be located at least 25 ft (7.6 m) from a container and shall be supported and protected from physical damage by vehicular movement.
- (3) Filling pipe inlet terminals shall be located at least 5 ft (1.5 m) behind any barriers provided for such protection.

5.9 Supplemental Product Control.

5.9.1 Application. This section provides alternative provisions for the location and installation of ASME containers that incorporate the use of redundant fail-safe product control measures for the purpose of enhancing safety and to mitigate distance and special protection requirements.