NFPA No.

58

STORAGE AND HANDLING

LIQUEFIED PETROLEUM GASES 1976

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See Inside Back Cover for Official NFPA Definitions

Printing errors in Liquified Petroleum Gases, NFPA 58-1976

In printing the 1976 edition of NFPA 58, Par. 7100 in the 1974 edition was inadvertently replaced by an amended Par. 7110. Also, the superseded Par. 7110 was incorrectly retained in the 1976 edition. See pages 58-129 and 58-130.

The correct version of Subsection 710 is as follows:

710. Construction of Structures or Buildings

7100. Separate buildings or structures shall be one story in height and shall have walls, floors, ceilings and roofs constructed of noncombustible materials. Exterior walls, ceilings and roofs shall be constructed as follows:

(a) Of lightweight material designed for explosion venting,* or

(b) If of heavy construction, such as solid brick masonry, concrete block or reinforced concrete construction, explosion venting* windows or panels in walls or roofs shall be provided having an explosion venting area of at least 1 square foot for each 50 cubic feet of the enclosed volume.*

7101. The floor of such structures shall not be below ground level. Any space beneath the floor shall preferably be of solid fill. If not so filled, the perimeter of the space shall be left entirely unenclosed:

***See NFPA No. 68, Guide for Explosion Venting.**

The correct version of Subsection 711 is as follows:

711. Structure or Building Ventilation

7110. The structure shall be ventilated utilizing air inlets and outlets arranged to provide air movement across the floor as uniformly as practical and in accordance with 7110(a) or (b). The bottom of such openings shall not be more than 6 inches above the floor.

(a) When mechanical ventilation is used, air circulation shall be at least at the rate of one cubic foot per minute per square foot of floor area. Outlets shall discharge at least five feet away from any opening into the structure or any other structure.

(b) When natural ventilation is used, outlet and inlet openings shall be provided, each having a total free area of at least one square inch for each square foot of floor area.

An errata sheet covering this matter is available free from the NFPA Publications Department.

Standard for the Storage and Handling of

Liquefied Petroleum Gases

NFPA No. 58 — 1976

1976 Edition of No. 58

This edition supersedes the 1974 edition. The 1976 edition was adopted at the NFPA Fall Meeting on November 16, 1976.

Changes, other than editorial, are indicated by vertical lines in the margin of the pages in which they appear.

With the 1969 edition, this standard has been approved as an American National Standard as ANSI Z106.1. The 1976 edition is being submitted for similar approval. The ANSI designation and date of approval will be printed on the front cover of copies of this edition printed after approval has been received.

Origin and Development of No. 58

The first NFPA Standard on LP-Gas was adopted in 1932. In the next 8 years, separate standards covering various LP-Gas applications were adopted. In 1940, several standards were combined and adopted as NFPA No. 58.

Revisions of NFPA No. 58 were adopted in 1943, 1946, 1948, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1963, 1965, 1967, 1969, 1972, and 1974.

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This text represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

Interpretation Procedure of the Committee on Liquefied Petroleum Gases

Those desiring an interpretation shall supply the Chairman with five identical copies of a statement in which shall appear specific reference to a single problem, paragraph, or section. Such a statement shall be on the business stationery of the inquirer and shall be duly signed.

When applications involve actual field situations they shall so state and all parties involved shall be named.

The Interpretations Committee will reserve the prerogative to refuse consideration of any application that refers specifically to proprietary items of equipment or devices. Generally inquiries should be confined to interpretation of the literal text or the intent thereof.

Requests for interpretations should be addressed to the National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210.

Contents

Standard for the Storage and Handling of Liquefied Petroleum Gases

NFPA No. 58 — 1976

CHAPTER 1. GENERAL PROVISIONS

10. INTRODUCTION

100. General Properties of LP-Gas

1000. LP-Gases, as defined in this Standard (see 110), are gases at normal room temperatures and atmospheric pressure. They liquefy under moderate pressure, readily vaporizing upon release of this pressure. It is this property which permits transporting and storing them in concentrated liquid form, while normally using them in vapor form. The potential fire hazard of LP-Gas vapor is comparable to that of natural or manufactured gas, except that LP-Gas vapors are heavier than air. The ranges of flammability are considerably narrower and lower than those of natural or manufactured gas. For example, the lower flammable limits of the more commonly used LP-Gases are: Propane, 2.15 percent; Butane, 1.55 percent. These figures represent volumetric percentages of gas in gas-air mixtures.

1001. The boiling point of pure normal butane is 31 F (minus 0.56 C); of pure propane minus 44 F (minus 42.2 C). Both products are liquids at atmospheric pressure at temperatures lower than their boiling points. Vaporization is rapid at temperatures above the boiling point, thus liquid propane normally does not present a flammable liquid hazard. For additional information on these and other properties of the principal LP-Gases, see Appendix A.

101. Federal Regulations

1010. Regulations of the U. S. Department of Transportation (DOT) are referenced throughout this Standard. Prior to April 1, 1967, these regulations were promulgated by the Interstate Commerce Commission (ICC).

11. SCOPE

110. Liquefied Petroleum Gas

1100. As used in this Standard, the terms "liquefied petroleum gas(es)", "LP-Gas" and "LPG" are synonymous and shall mean

and include any material having a vapor pressure not exceeding that allowed for commercial propane composed predominantly of the following hydrocarbons, either by themselves or as mixtures: Propane, Propylene, Butane (normal butane or iso-butane) and Butylene (including isomers).

1101. LP-Gas stored or used in systems within the scope of this Standard shall not contain ammonia. When such a possibility exists (such as may result from the dual use of transportation or storage equipment), the LP-Gas shall be tested in accordance with A-100 in Appendix A.

111. Application of Standard

1110. This Standard applies to the design, construction, installation and operation of all LP-Gas systems except those designated by 112.

112. Nonapplication of Standard

1120. This Standard does not apply to:

(a) LP-Gas refrigerated storage systems.

(b) Marine and pipeline terminals, natural gas processing plants, refineries or tank farms ("tank farm" storage at industrial locations is covered by NFPA No. 58) *

(c) LP-Gas (including refrigerated storage) at utility gas plants. The Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants, NFPA No. 59, shall apply.

(d) Chemical plants where specific approval of construction and installation plans, based on substantially similar requirements, is obtained from the authority having jurisdiction.

(e) LP-Gas used with oxygen. The Standard for the Installation and Operation of Oxygen-Fuel Gas Systems for Cutting and Welding, NFPA No. 51, shall apply.

(f) Those portions of nonindustrial appliance and piping installations at pressures of ½ psig or less covered by Part 1 of the *National Fuel Gas Code*, NFPA No. 54.

*For LP-Gas installations (including refrigerated storage) at such facilities, it is recommended that ANSI B138.1 — 1972 (API Standard 2510), "The Design and Construction of Liquefied Petroleum Gas Installations at Marine and Pipeline Terminals, Natural Gas Processing Plants, Refineries and Tank Farms," be applied. Available from the American Petroleum Institute, 2101 L St., N.W., Washington, D.C. 20037.

(g) Those portions of industrial and higher pressure non-industrial appliance and piping installations covered by Part 2 of the *National Fuel Gas Code*, NFPA No. 54. For purposes of application of NFPA No. 58, the provisions of Part 2 of the *National Fuel Gas Code* are applicable to piping beyond the first stage of pressure regulation.

113. Retroactivity

1130. Unless otherwise stated, the provisions of this standard shall not be applied retroactively.

(a) Existing plants, appliances, equipment, buildings, structures and installations for the storage, handling or use of LP-Gas in compliance with the provisions of this Standard in effect at the time of manufacture or installation may be continued in use provided that such continued use does not constitute a distinct hazard to life or adjoining property.

(b) The stocks of equipment and appliances on hand in such locations as manufacturer's storage, distribution warehouses, and dealer's storage and showrooms in compliance with the provisions of this Standard in effect at the time of manufacture may be placed in use (provided such use does not constitute a distinct hazard to life or adjoining property), but all new equipment and appliances manufactured after the effective date of this Standard shall comply with its provisions.

12. APPROVAL OF EQUIPMENT AND SYSTEMS

120. Method of Approval

1200. Systems, or components assembled to make up systems, shall be approved as specified in Table 1-1. This provision shall be considered to have been met by one of the following methods:

(a) Listing by Underwriters Laboratories Inc., or other nationally recognized testing laboratory.

(b) Approval by the authority having jurisdiction.

1201. Approval applies to the complete system, or to the individual components of which it is comprised, as specified in Table 1-1:

Table 1-1

Containers Used	Capacity in Water Gal.	Approval Applies To:
DOT Cylinders	Up to 120 (1000 lb.)	1. Container Valves and Connectors 2. Manifold Valve Assemblies 3. Regulators and Relief Valves
ASME Tanks	2000 or less	1. Container System,* including Regulator, or 2. Container Assembly* and Regulator separately
ASME Tanks	Over 2000	1. Container Valves 2. Container Excess Flow Valves, Back Flow Check Valves, or alternate means of providing this protection such as remotely controlled Manual or Automatic Internal Valves 3. Container Gaging Devices 4. Regulators and Container Safety Relief Valves

*Where necessary to alter or repair such listed systems or assemblies in the field in order to provide for different operating pressures, change from vapor to liquid withdrawal, or the like, such changes may be made by the use of listed components.

13. LP-GAS ODORIZATION

130. LP-Gas to be Odorized

1300. All LP-Gases shall be ordorized 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.[1, 2] Odorization, however, is not required if harmful in the use or further processing of the LP-Gas, or if odorization will serve no useful purpose as a warning agent in such further use or processing. (See 1000 and Appendix A for flammable limits of the LP-Gases.)

[1] It is recognized that no odorant will be completely effective as a warning agent in every circumstance.

[2] It is recommended that odorants be qualified as to compliance with 1300 by tests or experience. Where qualifying is by tests, such tests should be certified to by a nationally recognized laboratory not associated with the odorant manufacturer. Experience has shown that ethyl mercaptan and thiophane (tetrahydrothiophene), in the ratio of 1.0 pound of odorant per 10,000 gallons of liquid LP-Gas, have been recognized as effective odorants. Other odorants and quantities meeting the provisions of 1300 may be used.

14. NOTIFICATION OF INSTALLATIONS

140. Fixed Installations

1400. Plans for fixed (stationary) installations utilizing storage containers of over 2,000 gallons individual water capacity, or with aggregate water capacity exceeding 4,000 gallons, shall be submitted to the authority having jurisdiction before the installation is started. (See also 3380(g)).

141. Temporary Installations

1410. The authority having jurisdiction shall be notified of temporary (not to exceed 6 months) installations of the sizes covered in 1400 before the installation is started.

15. PERSONNEL

150. Qualification of Personnel

1500. In the interests of safety, all persons employed in handling LP-Gases shall be trained in proper handling and operating procedures.

16. DEFINITIONS, GLOSSARY OF TERMS AND ABBREVIATIONS

AGA. American Gas Association.

ANSI. American National Standards Institute.

API. American Petroleum Institute.

API-ASME CONTAINER (OR TANK). A container constructed in accordance with the pressure vessel code jointly developed by the American Petroleum Institute and the American Society of Mechanical Engineers (see Appendix C).

ASME. American Society of Mechanical Engineers.

ASME CODE. The Boiler and Pressure Vessel Code (Section VIII for Unfired Pressure Vessels) of the American Society of Mechanical Engineers. Only Division I of Section VIII of the ASME Code is applicable in this Standard except UG–125 through UG–135 shall not apply.

ASME CONTAINER (OR TANK). A container constructed in accordance with the ASME CODE. (See Appendix C.)

ASTM. American Society for Testing and Materials.

BUREAU OF EXPLOSIVES (B OF E). An agency of the Association of American Railroads.

CARGO TANK. (Primarily a DOT designation.) A container used to transport LP-Gas over the highway as liquid cargo, either mounted on a conventional truck chassis or as an integral part of a transporting vehicle in which the container constitutes in whole, or in part, the stress member used as a frame. Essentially a permanent part of the transporting vehicle.

CGA. Compressed Gas Association, Inc.

CHARGING. See Filling.

COMPRESSED GAS. Any material or mixture having in the container an absolute pressure exceeding 40 psia at 70 F, or regardless of the pressure at 70 F, having an absolute pressure exceeding 104 psia at 130 F.

CONTAINER. Any vessel, including cylinders, tanks, portable tanks and cargo tanks, used for the transporting or storing of the LP-Gases.

CONTAINER APPURTENANCES. Items connected to container openings needed to make a container a gastight entity. These include, but are not limited to, safety relief devices; shutoff, backflow check, excess flow check and internal valves; liquid level gages; pressure gages and plugs.

CONTAINER ASSEMBLY. An assembly consisting essentially of the container and fittings for all container openings. These include shutoff valves, excess flow valves, liquid level gaging devices, safety relief devices and protective housings.

CYLINDER. A portable container constructed to DOT (formerly ICC) cylinder specifications or, in some cases, constructed in accordance with the ASME Code of a similar size and for similar service. The maximum size permitted under DOT specifications is 1,000 pounds water capacity.

DIRECT GAS-FIRED TANK HEATER. A gas-fired device which applies heat from a gas burner flame directly to a portion of a container surface in contact with LP-Gas liquid to vaporize the product at the rate needed to supply the connected gas-consuming devices.

DISPENSING DEVICE (OR DISPENSER). A device normally used to transfer and measure LP-Gas for engine fuel into a fuel container, serving the same purpose for an LP-Gas service station as that served by a gasoline dispenser in a gasoline service station.

DISTRIBUTING PLANT. A facility, the primary purpose of which is the distribution of gas, and which receives LP-Gas in tank car, truck transport or truck lots, distributing this gas to the end user by portable container (package) delivery, by tank truck or through gas piping. Such plants have bulk storage (2,000 gallons water capacity

or more) and usually have container filling and truck loading facilities on the premises. So-called "bulk plants" are considered as being in this category. Normally no persons other than the plant management or plant employees have access to these facilities.

DISTRIBUTING POINT. A facility, other than a distributing plant or industrial plant, which normally receives gas by tank truck, and which fills small containers or the engine fuel tanks of motor vehicles on the premises. Any such facility having LP-Gas storage of 100 gallons or more water capacity, and to which persons other than the owner of the facility or his employees have access, is considered to be a distributing point. An LP-Gas service station is one type of distributing point.

DOT. U.S. Department of Transportation.

DOT CYLINDER. See Cylinder.

EXCESS FLOW VALVE (also called EXCESS-FLOW CHECK VALVE). A device designed to close when the liquid or vapor passing through it exceeds a prescribed flow rate as determined by pressure drop.

FILL, FILLING. Transferring liquid LP-Gas into a container.

FILLING BY VOLUME. See Volumetric Filling.

FILLING BY WEIGHT. See Weight Filling.

FIXED LIQUID LEVEL GAGE. A type of liquid level gage using a relatively small positive shutoff valve and designed to indicate when the liquid level in a container being filled reaches the point at which this gage or its connecting tube communicates with the interior of the container.

FIXED MAXIMUM LIQUID LEVEL GAGE. A fixed liquid level gage which indicates the liquid level at which the container is filled to its maximum permitted filling density.

FLEXIBLE CONNECTOR. A short (not exceeding 36 inches overall length) component of a piping system fabricated of flexible material (such as hose) and equipped with suitable connections on both ends. LP-Gas resistant rubber and fabric (or metal), or a combination of them, or all metal may be used. Flexible connectors are used where there is the need for, or the possibility of, greater relative movement between the points connected than is acceptable for rigid pipe.

FLOAT GAGE. A gage constructed with a float inside the container resting on the liquid surface which transmits its position through suitable leverage to a pointer and dial outside the container indicating the liquid level. Normally the motion is transmitted magnetically through a nonmagnetic plate so that no LP-Gas is released to the atmosphere.

GALLON. U.S. Standard. 1 U.S. gallon = 0.833 Imperial gallons = 231 cubic inches = 3.785 liters.

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.

GAS-AIR MIXER. A device, or system of piping and controls, which mixes LP-Gas vapor with air to produce a mixed gas of a lower heating value than the LP-Gas. The mixture thus created is normally used in industrial or commercial facilities as a substitute for some other fuel gas. The mixture may replace another fuel gas completely, or may be mixed to produce similar characteristics and mixed with the basic fuel gas. Any gas-air mixer which is designed to produce a mixture containing more than 85 percent air is not subject to the provisions of this standard.

ICC. U.S. Interstate Commerce Commission.

ICC CYLINDER. See Cylinder.

INDUSTRIAL PLANT. An industrial facility, which utilizes gas incident to plant operations, with LP-Gas storage of 2,000 gallons water capacity or more, and which receives gas in tank car, truck transport or truck lots. Normally LP-Gas is used through piping systems in the plant, but may also be used to fill small containers, such as for engine fuel on industrial (i.e., forklift) trucks. Since only plant employees have access to these filling facilities, they are not considered to be distributing points.

INTERNAL VALVE. A primary shutoff valve for containers which has adequate means of actuation and which is constructed in such a manner that its seat is inside the container and that damage to parts exterior to the container or mating flange will not prevent effective seating of the valve.

LIQUEFIED PETROLEUM GAS (LP-GAS or LPG). Any material having a vapor pressure not exceeding that allowed for commercial propane composed predominantly of the following hydrocarbons, either by themselves or as mixtures: Propane, Propylene, Butane (normal butane or iso-butane) and Butylenes.

LOAD, LOADING. See Filling.

LPG. See Liquefied Petroleum Gas.

LP-GAS. Liquefied Petroleum Gas.

LP-GAS SERVICE STATION. See Distributing Point. A facility open to the public which consists of LP-Gas storage containers, piping and pertinent equipment, including pumps and dispensing devices, and any buildings, and in which LP-Gas is stored and dispensed into engine fuel containers of highway vehicles.

LP-GAS SYSTEM. An assembly consisting of one or more containers with a means for conveying LP-Gas from the container(s) to dispensing or consuming devices (either continuously or intermittently) and which incorporates components intended to achieve control of quantity, flow, pressure, or state (either liquid or vapor).

MAGNETIC GAGE. See Float Gage.

MOVABLE FUEL STORAGE TENDERS OR FARM CARTS. Containers not in excess of 1,200 gallons water capacity, equipped with wheels to be towed from one location to another. They are basically non-highway vehicles, but may occasionally be moved over public roads or highways for short distances to be used as a fuel supply for farm tractors, construction machinery and similar equipment.

NFPA. National Fire Protection Association.

NLPGA. National LP-Gas Association.

PERMANENT INSTALLATION. See Stationary Installation.

PIPING, PIPING SYSTEMS. Pipe, tubing, hose and flexible rubber or metallic hose connectors made up with valves and fittings into complete systems for conveying LP-Gas in either the liquid or vapor state at various pressures from one point to another.

POINT OF TRANSFER. The location where connections and disconnections are made or where LP-Gas is vented to the atmosphere in the course of transfer operations.

PORTABLE CONTAINER. A container designed to be readily moved, as distinguished from containers designed for stationary installations. Portable containers designed for transportation filled to their maximum filling density include "cylinders", "cargo tanks" and "portable tanks", all three of which are separately defined. Containers designed to be readily moved from one usage location to another, but substantially empty of product are "portable storage containers" and are separately defined.

PORTABLE STORAGE CONTAINER. A container similar to, but distinct from those designed and constructed for stationary installation, designed so that it can be readily moved over the highways, substantially empty of liquid, from one usage location to another. Such containers either have legs or other supports attached, or are mounted on running gear (such as trailer or semitrailer chassis) with suitable supports, which may be of the fold-down type, permitting them to be placed or parked in a stable position on a reasonably firm and level surface. For large volume, limited duration product usage (such as at construction sites and normally for 12 months or less) portable storage containers function in lieu of permanently installed stationary containers.

PORTABLE TANK (also called SKID TANK). A container of more than 1,000 pounds water capacity used to transport LP-Gas handled as a "package", that is, filled to its maximum permitted filling density. Such containers are mounted on skids or runners and have all container appurtenances protected in such a manner that they can be safely handled as a "package".

PSI, PSIG and PSIA. Pounds per square inch, pounds per square inch gage, and pounds per square inch absolute, respectively.

ROTARY GAGE. A variable liquid level gage consisting of a small positive shutoff valve located at the outer end of a tube, the bent inner end of which communicates with the container interior. The tube is installed in a fitting designed so that the tube can be rotated with a pointer on the outside to indicate the relative position of the bent inlet end. The length of the tube and the configuration to which it is bent is suitable for the range of liquid levels to be gaged. By a suitable outside scale, the level in the container at which the inner end begins to receive liquid can be determined by the pointer position on the scale at which a liquid-vapor mixture is observed to be discharged from the valve.

SKID TANK. See Portable Tank.

SLIP TUBE GAGE. A variable liquid level gage in which a relatively small positive shutoff valve is located at the outside end of a straight tube, normally installed vertically, and communicates with the container interior. The installation fitting for the tube is designed so that the tube can be slipped in and out of the container and the liquid level at the inner end determined by observing when the shutoff valve vents a liquid-vapor mixture.

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.

When required in this standard, special protection consists of any of the following: applied insulating coatings, mounding, burial, water spray fixed systems or fixed monitor nozzles, meeting the criteria specified in this standard (see 392), or by any means listed (see official NFPA definition of "Listed") for this purpose.

STATIONARY INSTALLATION (also called "FIXED" or "PERMANENT" INSTALLATION). An installation of LP-Gas containers, piping and equipment for use indefinitely at a particular location; an installation not normally expected to change in status, condition or place.

UL. Underwriters Laboratories Inc.

UNIVERSAL CYLINDER. A DOT cylinder specification container, constructed and fitted with appurtenances in such a manner that it may be connected for service with its longitudinal axis in either the vertical or the horizontal position, and so that its fixed maximum liquid level gage, relief device(s) and withdrawal appurtenance will function properly in either position.

VAPORIZER. A device for converting liquid LP-Gas to vapor by means other than atmospheric heat transfer through the surface of the container.

VAPORIZING-BURNER (also called VAPORIZER-BURNER and SELF-VAPORIZING LIQUID BURNER). A burner containing an integral vaporizer which receives LP-Gas in liquid form and which uses part of the heat generated by the burner to vaporize the liquid in the burner so that it is burned as a vapor.

VAPORIZER, DIRECT-FIRED. 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.

VAPORIZER, INDIRECT (also called INDIRECT-FIRED). A vaporizer in which heat furnished by steam, hot water 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 being at a point remote from the vaporizer.

VAPORIZER, WATERBATH (also called Immersion Type). 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 heat transfer medium, which is heated by an immersion heater not in contact with the LP-Gas heat exchange surface.

VARIABLE LIQUID LEVEL GAGE. A device to indicate the liquid level in a container throughout a range of levels. See Float, Rotary and Slip Tube Gage.

VOLUMETRIC FILLING. Filling a container by determination of the volume of LP-Gas in the container. Unless a container is filled by a fixed maximum liquid level gage, correction of the volume for liquid temperature is necessary.

VOLUMETRIC LOADING. See Volumetric Filling.

WATER CAPACITY. The amount of water, in either pounds or gallons, at 60 F (15.6 C) required to fill a container liquid full of water.

WEIGHT FILLING. Filling containers by weighing the LP-Gas in the container. No temperature determination or correction is required as a unit of weight is a constant quantity regardless of temperature.

CHAPTER 2. LP-GAS EQUIPMENT AND APPLIANCES

20. SCOPE

200. Application

2000. This chapter includes the basic provisions for individual components, or for such components shop-fabricated into subassemblies, container assemblies or complete container systems.

2001. The field assembly of components, subassemblies, container assemblies or complete container systems into complete LP-Gas systems is covered by Chapter 3. See Definition of LP-Gas System.

21. CONTAINERS

210. General

2100. This section includes design, fabrication and marking provisions for containers, and features normally associated with container fabrication, such as container openings, appurtenances required for these openings to make the containers gastight entities, physical damage protecting devices, and container supports attached to, or furnished with the container by the manufacturer.

2101. Containers shall be designed, fabricated, tested and marked (or stamped) in accordance with the Regulations of the U.S. Department of Transportation (DOT)[1], the Rules for the Construction of Unfired Pressure Vessels, Section VIII, Division 1, ASME Boiler and Pressure Vessel Code[2], or the API-ASME Code for Unfired Pressure Vessels for Petroleum Liquids and Gases[3] applicable at the date of manufacture; and as follows:

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1. Code of Federal Regulations, Title 49, Parts 171-190. Available from the U. S. Government Printing Office, Washington, D. C., the Association of American Railroads, Bureau of Explosives, American Railroads Bldg., 1920 L Street, N. W., Washington, D. C. 20036, or the American Trucking Associations, Inc., 1616 P St., N. W., Washington, D. C. 20036. Prior to April 1, 1967, these regulations were promulgated by the Interstate Commerce Commission. In Canada, the regulations of the Canadian Transport Commission apply. Available from the Canadian Transport Commission, Union Station, Ottawa, Canada.

2. Available from the American Society of Mechanical Engineers, 345 East 47th St., New York, N.Y. 10017.

3. Contact the American Petroleum Institute, 2101 L St., N. W., Washington, D. C. 20037, for information concerning this obsolete Code. Construction of containers to the API-ASME Code has not been authorized after July 1, 1961.

(a) Adherence to applicable ASME Code Case Interpretations and Addenda shall be considered as compliance with the ASME Code.

(b) Containers fabricated to earlier editions of Regulations, Rules or Codes may continue in use in accordance with 1130 and Appendices B & C.

2102. Containers complying with 2101 may be reused, or reinstalled, as follows:

(a) The owner of a container shall be responsible for its suitability for continued service. DOT Specification containers shall be requalified in accordance with DOT regulations.

(b) Containers which have been involved in a fire shall have been requalified for continued service before being reused or reinstalled as follows:

(1) DOT containers in accordance with DOT regulations.

(2) ASME or API-ASME containers by retesting, using the hydrostatic test procedure applicable at the time of original fabrication.

2103. Containers for general use shall not have individual water capacities greater than 120,000 gallons. Containers in service stations shall not have individual water capacities greater than 30,000 gallons.

2104. Welding for the repair or alterations of containers shall comply with the Regulations, Rules or Code under which the container was fabricated. Other welding is permitted only on saddle plates, lugs or brackets attached to the container by the container manufacturer.

2105. Heating or cooling coils shall not be installed inside storage containers.

211. Container Design or Service Pressure

2110. The minimum design, or service, pressure of DOT specification containers shall be in accordance with the appropriate DOT regulations.

2111. The minimum design pressure for ASME containers shall be in accordance with Table 2-1.

Table 2-1

For Gases with Vapor Pressure in psig at 100 F (37.8 C) not to Exceed	Minimum Design Pressure in psig ASME Code, Section VIII, Division 1, 1974 Edition (Note 1)
80	100 (Note 2)
100	125
125	156
150	187
175	219
215	250
215	312.5 (Note 3)

NOTE 1. See Appendix C for information on earlier ASME or API-ASME Code.

NOTE 2. New containers for 100 psig design pressure (or equivalent under earlier codes) not authorized after December 31, 1947.

NOTE 3. See 3810 for certain service conditions which require a higher relief valve setting.

212. Container Openings

2120. Containers shall be equipped with openings suitable for the service in which the container is to be used. Such openings may be either in the container proper or in the manhole cover, or part in one and part in the other.

2121. Containers of more than 30 and less than 2,000 gallons water capacity, designed to be filled volumetrically, and manufactured after December 1, 1963, shall be equipped for filling into the vapor space.

2122. ASME containers of 2,000 gallons or less water capacity shall have not more than two plugged openings.

2123. Containers of 125 gallons or more water capacity manufactured after July 1, 1961, shall be provided with a connection for liquid evacuation, not smaller than ¾ inch National Pipe Thread. A plugged opening will not meet this provision.

2124. Containers of more than 2,000 gallons water capacity and all containers installed in LP-Gas service stations shall be provided with an opening for a pressure gage (see 2241).

2125. Connections for safety relief valves shall be located and installed in such a way as to have direct communication with the vapor space, whether the container is in storage or in use. If located in a well inside the container with piping to the vapor space,

the design of the well and piping shall permit sufficient safety-relief valve discharge capacity. If located in a protecting enclosure, design shall be such as to permit this enclosure to be protected against corrosion and to permit inspection.

2126. Containers to be filled on a volumetric basis manufactured after December 31, 1965, shall be fabricated so that they can be equipped with a fixed liquid level gage(s) capable of indicating the maximum permitted filling level(s) computed in accordance with the procedures contained in Appendix E.

213. Portable Container Appurtenance Physical Damage Protection

2130. Portable containers of 1,000 pounds (nominal 120 gallons) water capacity or less shall incorporate protection against physical damage to container appurtenances and immediate connections to these while in transit, storage, while being moved into position for use, and when in use except in residential and commercial installations, by:

(a) Recessing connections into the container so that valves will not be struck if the container is dropped on a flat surface, or,

(b) A ventilated cap or collar designed to permit adequate safety relief valve discharge and capable of withstanding a blow from any direction equivalent to that of a 30 pound weight dropped 4 feet. Construction shall be such that the force of the blow will not be transmitted to the valve. Collars shall be designed so that they do not interfere with the free operation of the cylinder valve.

2131. Portable containers of more than 1,000 pounds (nominal 120 gallons) water capacity, including skid tanks or for use as cargo containers, shall incorporate protection against physical damage to container appurtenances by recessing, protective housings, or by location on the vehicle. Such protection shall comply with the provisions under which the tanks are fabricated, and shall be designed to withstand static loadings in any direction equal to twice the weight of the container and attachments when filled with LP-Gas, using a safety factor of not less than four, based on the ultimate strength of the material to be used. (See Chapters 3 and 6 for additional provisions applying to the LP-Gas system used.)

214. Containers with Attached Supports

2140. Containers of more than 2,000 gallons water capacity designed for permanent installation in stationary service may be provided with steel saddles designed to permit mounting the containers on flat topped concrete foundations. The total height of the outside bottom of the container shell above the top of the concrete foundation shall not exceed 6 inches.

2141. Containers of 2,000 gallons water capacity or less, designed for permanent installation in stationary service, may be equipped with nonfireproofed structural steel supports and designed to permit mounting on concrete foundations in accordance with 2141 (a) or (b).

(a) For installation on concrete foundations raised above the ground level by more than 12 inches, the structural steel supports shall be designed so that the bottoms of the horizontal members are not less than 2 inches, nor more than 12 inches below the outside bottom of the container shell.

(b) For installation on concrete pads at the ground level, or not to exceed 2 inches above the ground level, the structural steel supports may be designed so that the bottoms of the structural members are not more than 24 inches below the outside bottom of the container shell. (See 3122(a)(3) for installation provisions for such containers which are customarily used as components of prefabricated container-pump assemblies.)

2142. Containers to be used as portable storage containers (see definition) for temporary stationary service (normally less than 12 months at any given location) and to be moved only when substantially empty of liquid shall comply with 2142(a) and (b).

(a) If mounted on legs or supports, such supports shall be of steel, and shall either be welded to the container by the manufacturer at the time of fabrication or shall be attached to lugs which have been so welded to the container. The following shall also apply:

(1) The bottom of the legs or supports shall be not less than 2 inches or more than 12 inches below the outside bottom of the container shell.

(2) The legs or supports or the lugs for the attachment of these legs or supports shall be secured to the container in accordance with the code or rule under which the container is designed and built, with a minimum factor of safety of four, to withstand loading in any direction equal to twice the weight of the empty container and attachments.

(b) If the container is mounted on a trailer or semitrailer running gear so that the unit can be moved by a conventional over-the-road tractor, attachment to the vehicle, or attachments to the container to make it a vehicle, shall comply with the appropriate DOT requirements for cargo tank service; except that stress calculations shall be based on twice the weight of the empty container. The unit shall also comply with applicable State and DOT motor carrier regulations and shall be approved by the authority having jurisdiction.

2143. Portable tanks (see definition) shall comply with DOT portable tank container specifications as to container design and construction, securing of skids or lugs for the attachment of skids and protection of fittings. In addition, the bottom of the skids shall be not less than 2 inches or more than 12 inches below the outside bottom of the container shell.

215. Container Markings

2150. Containers shall be marked as provided in the Regulations, Rules or Code under which they are fabricated and in accordance with 2151 through 2153.

2151. When LP-Gas and one or more other compressed gases are to be stored or used in the same area, the containers shall be marked to identify their contents in accordance with ANSI Standard Z48.1-1954, "Method of Marking Portable Compressed Gas Containers to Identify the Material Contained."

2152. Portable DOT containers designed to be filled by weight, including those optionally filled volumetrically but which may require check weighing, shall be marked with:

(a) The water capacity of the container in pounds.

(b) The tare weight of the container in pounds, fitted for service. The tare weight is the container weight plus the weight of all permanently attached valves and other fittings, but does not include the weight of protecting devices removed in order to load the container.

2153. ASME containers shall be marked in accordance with 2153(a) through (g). The markings specified shall be on a metal nameplate attached to the container, so located as to remain visible after the container is installed.

(a) Service for which the container is designed; i.e. underground, aboveground, or both.

(b) Name and address of container supplier or trade name of container.

(c) Water capacity of container in pounds or U.S. Gallons.

(d) Design pressure in psig.

(e) The wording "This container shall not contain a product having a vapor pressure in excess of ___ psig at 100F." (See Table 2-1.)

(f) Tare weight of container fitted for service for containers to be filled by weight.

(g) Outside surface area in square feet.

22. CONTAINER APPURTENANCES

220. General

2200. This section includes fabrication and performance provisions for container appurtenances, such as safety relief devices, container shutoff valves, back-flow check valves, internal valves, excess-flow check valves, plugs, liquid level gages and pressure gages connected directly into the container openings described in 212. Shop installation of such appurtenances in containers listed as container assemblies or container systems in accordance with 1200 is a responsibility of the fabricator under the listing. Field installation of such appurtenances is covered in Chapter 3.

2201. Container appurtenances shall be fabricated of materials suitable for LP-Gas service and resistant to the action of LP-Gas under service conditions. Cast iron shall not be used. Cast malleable or ductile iron is not considered as cast iron in this standard. The following also shall apply:

(a) Pressure containing metal parts of appurtenances, such as those listed in 2200, except fusible elements, shall be of steel, ductile (nodular) iron, malleable iron or brass. Ductile iron shall meet the requirements of ASTM A395–74 or equivalent and malleable iron the requirements of ASTM A47–68 or equivalent. Approved or listed liquid level gages are exempted from this provision.

2202. Container appurtenances shall have a rated working pressure of at least 250 psig.

2203. Gaskets used to retain LP-Gas in containers shall be resistant to the action of LP-Gas. They shall be made of metal or other suitable material confined in metal having a melting point over 1500°F or shall be protected against fire exposure, except that aluminum O-rings and spiral wound metal gaskets are acceptable and gaskets for use with approved or listed liquid level gages are exempted from this provision. When a flange is opened, the gasket shall be replaced.

221. Safety Relief Devices (See 236 for hydrostatic relief valves.)

2210. Containers shall be equipped with one or more safety relief devices which, except as otherwise provided for in 2211, shall be designed to relieve vapor.

2211. DOT containers shall be equipped with safety relief valves or fusible plug safety relief devices as required by DOT Regulations. (See Appendix D for additional information.)

2212. ASME containers shall be equipped with spring-loaded safety relief valves set to start-to-discharge, with relation to the design pressure of the container, in accordance with Table 2-2.

Table 2-2

Containers	Minimum	Maximum
All ASME Codes prior to the 1949 Edition, and the 1949 Edition, paragraphs U-68 and U-69	110%	125%*
ASME Code, 1949 Edition, Paragraphs U-200 and U-201, and all ASME Codes later than 1949	88%	100%*

*Manufacturers of relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

2213. Safety relief devices for ASME containers shall also comply with 2213(a) through (e).

(a) Safety relief devices shall be of sufficient individual or aggregate capacity as to provide the rate of flow required by Appendix D for the container on which they are installed, and to discharge at not less than the rate indicated before the pressure is in excess of 120 percent of the maximum (not including the 10 percent referred to in the Note of Table 2-2) permitted start-to-discharge pressure setting of the device. This provision is applicable to all containers (including containers installed partially aboveground) except containers installed wholly underground in accordance with D-120.

(b) Each safety relief valve shall be plainly and permanently marked with: (1) the pressure in psig at which the valve is set to discharge; (2) the actual discharge rate in cubic feet per minute of air at 60 F and 14.7 psia; and (3) the manufacturer's name and catalog number. Example: A safety relief valve is marked 250-4050 AIR. This indicates that the valve is set to start-to-discharge at 250 psig; and that its rate of discharge is 4050 cfm of air.

(c) Shutoff valves shall not be located between a safety relief device and the container, unless the arrangement is such that the

relief device capacity flow specified in 2213(a) will be achieved through additional safety relief devices which remain operative.

(d) Safety relief valves shall be so designed that the possibility of tampering will be minimized. Externally set or adjusted valves shall be provided with an approved means of sealing the adjustment.

(e) Fuse plugs, with a yield point of 208 F minimum and 220 F maximum, with a total discharge area not exceeding 0.25 square inch, and which communicate directly with the vapor space of the container, may be used in addition to the spring-loaded safety relief valves (as specified in Table 2-2) for aboveground containers of 1,200 gallons water capacity or less.

222. Connections for Flow Control (Filling, Withdrawal, Equalizing)

2220. Shutoff valves, excess-flow check valves, back-flow check valves and quick closing internal valves, used individually or in suitable combinations, at container filling, withdrawal and equalizing connections, shall comply with 2201 and 2202.

2221. Filling, withdrawal and equalizing connections shall be equipped with the appurtenances for the appropriate type and capacity of container and the service in which they are to be used in accordance with Table 2-3. Cylinder valve outlet connections on all DOT cylinders except those used for engine fuel, from which vapor can be withdrawn shall not be interchangeable with those used for liquid withdrawal.

(a) If the loading or transfer point is not on the container, it shall be equipped as specified for filling connections on the container.

2222. The appurtenances specified in Table 2-3 shall comply with 2222(a) through 2222(d).

(a) Manual shutoff valves shall be designed to provide positive closure under service conditions.

(b) Excess-flow check valves shall be designed to close automatically at the rated flows of vapor or liquid specified by the manufacturer. Excess flow valves shall be designed with a bypass, not to exceed a No. 60 drill size opening, to allow equalization of pressure.

(c) Back-flow check valves, which may be of spring-loaded or weight-loaded type with in-line or swing operation, shall close when flow is either stopped or reversed. Both valves of double back-flow check valves shall comply with this provision.

Table 2-3. Filling Withdrawal and Equalizing Connections

Type of Use	General Uses												Used as Fuel on Vehicles			Portable Tanks			Cargo Tanks		
Type of Container	DOT Cylinder Specifications									ASME			DOT or ASME			ASME			ASME		
Water Capacity of Containers — Pounds	1 to 1,000			50 to 1,000			2.5 to 245			—			Any			Any			Any		
Water Capacity of Containers — Gallons	—			—			—			Up to 120,000			Any			Any			Any		
Conditions under which Container is Used	Replacement or Exchange Outdoors			Filled at Point of Use Outdoors			When Used Inside Buildings			Filled at Point of Use Outdoors			Replacement or Fixed			Transportation of LP-Gas			Transportation of LP-Gas		
Connection Use (Note 1): "F" — Filling, "W" — Withdrawal, "E" — Equalizing	F	W	E	F	W	E	F	W	E	F	W	E	F	W	E	F	W	E	F	W	E
Appurtenances to be provided (Note 2):																					
1. Positive (Manual) Shutoff Valve	√ 3*	√ 3*	√	5*	5*						√ 6*										
2. Positive (Manual) Shutoff & Internal Excess Flow Check Valve			√	√	√	√	√	√	√	√	√	√	√ 8*	√	√	√	√	√	√		√
3. Positive (Manual) Shutoff & External Excess Flow Check Valve (Note 4)				√	√	√	√	√	√	√	√	√				√	√	√	√		√
4. Single Back Flow Check Valve				√																	
5. Positive (Manual) Shutoff & Internal Back Flow Check Valve										√			√			√			√		
6. Excess Flow Check Valve & Back Flow Check Valve			√	√		√				√		√			√	√		√	√		√
7. Double Back Flow Check Valve				√						√			√			√			√		
8. Quick Closing Internal Valve										√	√	√				√	√	√	√	√ 7*	√
Column Number	1			2			3			4			5			6			7		

* Note Number.

Notes to Table 2-3

Note 1: Containers are not required to be equipped with all three connections, but if used, appurtenances shall be those shown. Suitably fitted multipurpose valves may be used.

Note 2: If more than one appurtenance, or combination of appurtenances, is shown for any connection use, any one of the appurtenances or combinations shown will comply. (See also DOT regulations for cargo and portable containers.)

Note 3: Single manual shutoff valve normally used for both filling and withdrawal.

Note 4: External excess flow check valves shall be installed in such a way that any undue strain beyond them will not cause breakage between the container and the excess flow check valves.

Note 5: Containers of less than 50 pounds water capacity need only be equipped with a positive shutoff valve for filling at the point of use.

Note 6: An excess flow check valve is not required in the withdrawal connection provided the following are all complied with:

(a) Container water capacity does not exceed 2,000 gallons.

(b) Withdrawal outlet is equipped with a manually operable (having a handwheel or the equivalent) shutoff valve, which is:

(1) threaded directly into the container outlet, or

(2) an integral part of a substantial fitting which is threaded directly into or on the container outlet, or

(3) threaded directly into a substantial fitting which is threaded directly into or on the container outlet.

(c) The controlling orifice between the container contents and the shutoff valve outlet does not exceed $\frac{5}{16}$ inch in diameter for vapor withdrawal or $\frac{1}{8}$ inch for liquid withdrawal.

(d) An approved pressure-reducing regulator is directly attached to the outlet of the shutoff valve and is rigidly supported, or is adequately supported and properly protected on or at the container, and is connected to the shutoff valve by means of a suitable flexible connection.

Note 7: See 6210(c) for special requirements for containers constructed to DOT cargo tank specifications.

Note 8: Authorized for exchangeable (removable) containers only.

(d) Internal valves (see definition), either manually or automatically operated and designed to remain closed except during operating periods, shall be considered positive shutoff valves. (See 6210(c) for special requirements for such valves used on cargo units.)

2223. The appurtenances specified in Table 2-3 may be installed as individual components or as combinations completely assembled by the appurtenance manufacturer.

223. Liquid Level Gaging Devices

2230. Liquid level gaging devices shall be provided on all containers filled by volume. Fixed level gages or variable gages of the slip tube, rotary tube or float types (or combinations of such gages) may be used to comply with this provision.

2231. Every container constructed after December 31, 1965, designed to be filled on a volumetric basis, shall be equipped with a fixed liquid level gage(s) to indicate the maximum filling level(s) for the service(s) in which the container is to be used (see 4125). This may be accomplished either by using a dip tube of appropriate length, or by the position of the gaging device in the container. The following shall apply:

(a) ASME containers manufactured after December 31, 1969, shall have permanently attached to the container adjacent to the fixed liquid level gage, or on the container nameplate, markings showing the percentage full that is indicated by that gage.

(b) Containers constructed to DOT cylinder specifications shall have stamped on the container, and on the exterior of removable dip tube gaging devices, the letters "DT" followed by the vertical distance (to the nearest tenth inch) from the top of the boss or coupling into which the gage, or the container valve of which it is a part, is made up, to the end of the dip tube. (See 2231(c)(2) for DOT containers designed for loading in either the vertical or horizontal position.)

(c) Each container manufactured after December 31, 1972, equipped with a fixed liquid level gage for which the tube is not welded in place shall be permanently marked adjacent to such gage or on container nameplate as follows:

(1) Containers designed to be filled in one position shall be marked with the letters "DT" followed by the vertical distance (to the nearest tenth inch) measured from the top center of the container boss or coupling into which the gage is installed to the maximum permitted filling level.

(2) Portable universal type containers that may be filled in either vertical or horizontal position shall be marked as follows:

a. For Vertical Filling: With the letters "VDT" followed by the vertical distance (to the nearest tenth inch), measured from the top center of the container boss or coupling into which the gage is installed to the maximum permitted filling level.

b. For Horizontal Filling: With the letters "HDT" followed by the vertical distance (to the nearest tenth inch), measured from the top centerline of the container boss or coupling opening into which the gage is installed to the inside top of the container when in the horizontal position.

(d) Cargo tanks having several fixed level gages positioned at different levels, shall have stamped adjacent to each gage the loading percentage (to the nearest 2/10 percent) of the container content which that particular gage indicates. (See 6210(d) for other provisions as to gage location and correlation with other gages on cargo units.)

(e) The intent of 2231 may be achieved by other methods acceptable to the authority having jurisdiction.

2232. Variable liquid level gages shall comply with 2232(a) through (e).

(a) Variable liquid level gages shall be so marked that the maximum liquid level, in inches or percent of capacity of the container in which they are to be installed, is readily determinable. These markings shall indicate the maximum liquid level for propane, for 50/50 butane-propane mixtures, and for butane at liquid temperatures from 20° F to 130° F and in increments not greater than 20 degrees.

(b) The markings indicating the various liquid levels from empty to full shall either be directly on the system nameplate or on the gaging device or on both.

(c) Dials of magnetic float or rotary gages shall show whether they are for cylindrical or spherical containers, and whether for aboveground or underground service.

(d) The dials of gages for use only on aboveground containers of over 1,200 gallons water capacity shall be so marked.

(e) Variable liquid level gages shall comply with the accuracy provisions of 4125(b) if they are used for filling containers.

2233. Gaging devices requiring bleeding of product to the atmosphere, such as fixed liquid level, rotary tube, and slip tube gages, shall be designed so that the bleed valve maximum opening to the atmosphere is not larger than a No. 54 drill size, unless equipped with excess-flow check valves.

224. Pressure Gages

2240. Pressure gages shall comply with 2201 and 2202.

2241. Pressure gages shall be attached directly to the container opening or to a valve or fitting which is directly attached to the container opening. If the effective opening into the container will permit a flow greater than that of a No. 54 drill size, an excess-flow check valve shall be provided.

225. Other Container Connections

2250. Container openings, other than those equipped as provided in 221, 222, 223, and 224, shall be equipped with one of the following:

(a) A positive shutoff valve in combination with an excess-flow valve.

(b) A combination of an internal excess-flow valve and a plug.

(c) A plug.

23. PIPING (INCLUDING HOSE), FITTINGS AND VALVES

230. General

2300. This section includes basic design provisions and material specifications for pipe, tubing, pipe and tubing fittings, valves (including hydrostatic relief valves), hose, hose connections and flexible connectors used to connect container appurtenances with the balance of the LP-Gas system in accordance with the installation provisions of Chapter 3.

2301. Piping, pipe and tubing fittings and valves used to supply utilization equipment within the scope of the *National Fuel Gas Code*, NFPA No. 54, shall comply with that Code.

2302. Pipe and tubing shall comply with 2310 and 2320 or shall be of material which has been investigated and tested to determine that it is safe and suitable for the proposed service and is recommended for that service by the manufacturer, and be acceptable to the authority having jurisdiction.

231. Pipe

2310. Pipe shall be wrought iron or steel (black or galvanized), brass, or copper and shall comply with 2310(a) through (f).

(a) Wrought iron pipe; ANSI B36.10–1970 "Wrought-Steel and Wrought Iron Pipe."

(b) Steel pipe; ANSI B125.1, "Welded and Seamless Steel Pipe" (ASTM A53–73).

(c) Steel pipe; ANSI B125.30 "Seamless Carbon Steel Pipe for High Temperature Service" (ASTM A106–75a).

(d) Steel pipe; ANSI B125.2 "Black and Hot Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Ordinary Uses" (ASTM A120–73).

(e) Brass pipe; ANSI H27.1 "Seamless Red Brass Pipe" (ASTM B43–75).

(f) Copper pipe; ANSI H26.1 "Seamless Copper Pipe" (ASTM B42–75).

232. Tubing

2320. Tubing shall be steel, brass or copper and shall comply with 2320(a) through (c):

(a) Steel tubing; ASTM A539–73 "Electric-Resistance Welded Coiled Steel Tubing for Gas and Oil Lines."

(b) Brass tubing*; ANSI H36.1 "Seamless Brass Tube" (ASTM B135–74).

(c) Copper tubing*:

(1) Type K or L, ANSI H23.1 "Seamless Copper Water Tube," (ASTM B88–75a).

(2) ANSI H23.5, ASTM B280–75a, "Seamless Copper Tube for Air Conditioning and Refrigeration Field Service."

233. Pipe and Tubing Fittings

2330. Fittings shall be steel, brass, copper, malleable iron or ductile (nodular) iron, and shall comply with 2330(a) and (b). Cast iron pipe fittings (ells, tees, crosses, couplings, unions, flanges or plugs) shall not be used.

(a) Pipe joints in wrought iron, steel, brass or copper pipe may be screwed, welded or brazed.

(1) Fittings used at pressures higher than container pressure, such as on the discharge of liquid transfer pumps, shall be suitable for a working pressure of at least 350 psig.

(2) Except as provided in 2330(a)(1), fittings used with liquid LP-Gas, or with vapor LP-Gas at operating pressures over 125 psig shall be suitable for a working pressure of 250 psig.

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*Heavy walled seamless brass or copper tubing, not exceeding $\frac{3}{32}$ inch internal diameter with a wall thickness not less than $\frac{1}{64}$ inch, is required where LP-Gas in liquid form enters certain types of buildings (See 3150(c)(3)).

(3) Fittings for use with vapor LP-Gas at pressures not exceeding 125 psig shall be suitable for a working pressure of 125 psig.

(4) Soldering or brazing filler material shall have a melting point exceeding 1,000 F.

(b) Tubing joints in steel, brass or copper tubing shall be made with approved gas tubing fittings and may be flared, soldered or brazed.

(1) Fittings used at pressures higher than container pressure, such as on the discharge of liquid transfer pumps, shall be suitable for a working pressure of at least 350 psig.

(2) Except as provided in 2330(b)(1), fittings used with liquid LP-Gas, or with vapor LP-Gas at operating pressures over 125 psig, shall be suitable for a working pressure of 250 psig.

(3) Fittings for use with vapor LP-Gas at pressures not exceeding 125 psig shall be suitable for a working pressure of 125 psig.

(4) Soldering or brazing filler material shall have a melting point exceeding 1,000 F.

234. Valves, Other than Container Valves

2340. Pressure containing metal parts of valves (except appliance valves), including manual positive shutoff valves, excess-flow check valves, backflow check valves, emergency shutoff valves (see 2343), and remotely controlled valves (either manually or automatically operated) used in piping systems, shall be of steel, ductile (nodular) iron, malleable iron or brass. Ductile iron shall meet the requirements of ASTM A395–74 or equivalent and malleable iron the requirements of ASTM A47-68 or equivalent. All materials used, including valve seat discs, packing, seals, and diaphragms shall be resistant to the action of LP-Gas under service conditions.

2341. Valves shall be designed for the appropriate working pressure, as follows:

(a) Valves used at pressures higher than container pressure, such as on the discharge of liquid transfer pumps, shall be suitable for a working pressure of at least 350 psig. (400 psig WOG valves comply with this provision.)

(b) Except as provided in 2341(a), valves to be used with liquid LP-Gas, or with vapor LP-Gas at pressures in excess of 125 psig, shall be suitable for a working pressure of at least 250 psig.

(c) Valves (except appliance valves) to be used with vapor LP-Gas at pressures not to exceed 125 psig shall be suitable for a working pressure of at least 125 psig.

2342. Manual shutoff valves, emergency shutoff valves (see 2343), excess-flow check valves and backflow check valves used in piping systems shall comply with the provisions for container valves. (See 2222(a), (b) and (c).)

2343. Emergency shutoff valves shall be approved and incorporate all of the following means of closing (see 3168 and 3223):

(a) Automatic shutoff through thermal (fire) actuation. When fusible elements are used they shall have a melting point not exceeding 250° F.

(b) Manual shutoff from a remote location.

(c) Manual shutoff at the installed location.

235. Hose, Hose Connections and Flexible Connectors

2350. Hose, hose connections and flexible connectors (see definition) shall be fabricated of materials resistant to the action of LP-Gas both as liquid and vapor. If wire braid is used for reinforcement it shall be of corrosion resistant material such as stainless steel.

2351. The correctness of design, construction and performance of hose, shall be determined by:

(a) Listing by Underwriters' Laboratories, Inc., or other nationally recognized testing laboratory, or

(b) Approval by the authority having jurisdiction.

2352. Hose, hose connections and flexible connectors used for conveying LP-Gas liquid or vapor at pressures in excess of 5 psig, and as provided in Section 33 regardless of the pressure, shall comply with 2352(a) and (b):

(a) Hose shall be designed for a minimum bursting pressure of 1,750 psig, (350 psi working pressure) and shall be identified "LP-Gas" or "LPG" at not greater than 10-foot intervals.

(b) Hose assemblies, after the application of connections, shall be capable of withstanding a test pressure of not less than 700 psig.

2353. Hoses or flexible connectors used to supply LP-Gas to utilization equipment or appliances shall be installed in accordance with the provisions of 3167 and 3169.

236. Hydrostatic Relief Valves

2360. Hydrostatic relief valves, designed to relieve the hydrostatic pressure which might develop in sections of liquid piping

completely closed off by shutoff valves, shall have pressure settings in accordance with Table 2-4.

Table 2-4

Located in Piping Directly Connected to	Pressure Settings Minimum	Maximum
DOT (ICC) Cylinders	400.0 psig	500 psig
ASME Containers, 250 psig design*	350.0 psig	500 psig
ASME Containers, 312.5 psig design*	437.5 psig	500 psig
Pump Discharge Systems	450.0 psig	500 psig

*Or equivalent. (See 2111 and Appendix C)

NOTE: See 317 for installation provisions for hydrostatic relief valves.

24. EQUIPMENT

240. General

2400. This section includes fabrication and performance provisions for LP-Gas equipment such as pumps, compressors, vaporizers, strainers, meters and regulators.

2401. Equipment shall be designed for a rated working pressure appropriate to the service in which it is to be used, as follows:

(a) For use with liquid LP-Gas, or vapor LP-Gas at pressures over 125 psig, the rated working pressure shall be at least 250 psig.

(b) For use with vapor LP-Gas at pressures not to exceed 125 psig, but above 20 psig, the rated working pressure shall be at least 125 psig.

(c) For use with vapor LP-Gas at pressures not to exceed 20 psig, the rated working pressure of the equipment shall be adequate for the service in which it is to be used.

2402. Equipment shall be fabricated of materials suitable for LP-Gas service and resistant to the action of LP-Gas under service conditions. Pressure containing metal parts shall be of steel, ductile (nodular) iron, higher-strength gray iron or brass meeting the requirements of ASTM A395–74 or A536–72 (grade 60–40–18 or 65–45–12), A47–68 or A126–73 (Class B or C), or equivalent. Cast iron shall not be used for strainers or flow indicators which shall comply with provisions for materials for construction of valves. (See 2340.) Aluminum or zinc may be used for approved regulators.

241. Pumps

2410. Pumps shall be designed for LP-Gas service and may be of rotary, centrifugal, turbine or reciprocating type.

2411. Positive displacement pumps shall be equipped with a pressure actuated bypass valve or recirculating system which shall limit the differential pressure developed by the pump to the maximum for which it is rated. If this primary recirculating system is designed to return the excess product to the supply container or into the pump suction with a shutoff valve in the line, a secondary safety recirculation system shall be provided which shall have no means of rendering it inoperative. This secondary system may have a pressure setting greater than that of the primary system but not in excess of 400 psig. Either or both of these devices may be integral with the pump, or if not, shall be provided in the pump piping in accordance with 3190(b).

242. Compressors

2420. Compressors shall be designed for LP-Gas service and may be of the rotary or reciprocating type and shall be equipped with suitable glands or seals to minimize any release of LP-Gas.

2421. Means shall be provided to limit the suction pressure to the maximum for which the compressor is designed.

2422. Means shall be provided to prevent the entrance of LP-Gas liquid into the compressor suction, either integral with the compressor, or installed externally in the suction piping (see 3191(b)).

243. Vaporizers, Tank Heaters, Vaporizing-Burners and Gas-Air Mixers

2430. Vaporizers may be of the indirect type (utilizing steam, hot water or other heating medium), or direct fired. This subsection does not apply to engine fuel vaporizers or to integral vaporizer-burners such as those used with weed burners or tar kettles.

2431. Indirect vaporizers shall comply with 2431(a) through (e):

(a) Indirect vaporizers with an inside diameter of more than 6 inches shall be constructed in accordance with the applicable provision of the 1974 ASME Code for a design pressure of 250 psig and shall be permanently and legibly marked with:

(1) The marking required by the code.

(2) The allowable working pressure and temperature for which designed.

(3) The sum of the outside surface area and the inside heat exchange surface area in square feet.

(4) The name or symbol of the manufacturer.

(b) Indirect vaporizers having an inside diameter of 6 inches or less are exempt from the ASME Code, and need not be marked. They shall be constructed for a minimum 250 psig design pressure.

(c) Indirect vaporizers shall be provided with a suitable automatic means to prevent liquid passing through the vaporizer to the vapor discharge piping. This means may be integral with the vaporizer, or otherwise provided in the external piping (see 3615).

(d) Indirect vaporizers, including atmospheric type vaporizers using heat from the surrounding air or the ground, and of more than one quart capacity, shall be equipped, at or near the discharge, with a spring-loaded safety relief valve providing an effective rate of discharge in accordance with Appendix D. Fusible plugs shall not be used.

(e) Indirect atmospheric type vaporizers of less than one quart capacity need not be equipped with safety relief valves, but shall be installed in accordance with 3618.

2432. Direct-fired vaporizers shall comply with 2432(a) through (f).

(a) Design and construction shall be in accordance with the applicable requirements of the 1974 ASME Code for the working conditions to which the vaporizer will be subjected, and it shall be permanently and legibly marked with:

(1) The markings required by the code.

(2) The outside surface area in square feet.

(3) The area of the heat exchange surface in square feet.

(4) The maximum vaporizing capacity in gallons per hour.

(5) The rated heat input in Btuh.

(6) The name or symbol of the manufacturer.

(b) Direct-fired vaporizers shall be equipped, at or near the discharge, with a spring-loaded safety relief valve providing an effective rate of discharge in accordance with Appendix D. The relief valve shall be located so as not to be subject to temperatures in excess of 140 F. Fusible plugs shall not be used.

(c) Direct-fired vaporizers shall be provided with suitable automatic means to prevent liquid passing from the vaporizer to its vapor discharge piping.

(d) A means for manually turning off the gas to the main burner and pilot shall be provided.

(e) Direct-fired vaporizers shall be equipped with an automatic safety device to shut off the flow of gas to the main burner if the pilot

light is extinguished. If the pilot flow exceeds 2,000 Btuh, the safety device shall shut off the flow of gas to the pilot also.

(f) Direct-fired vaporizers shall be equipped with a limit control to prevent the heater from raising the product pressure above the design pressure of the vaporizer equipment, and to prevent raising the pressure within the storage container above the pressure shown in the first column of Table 2-1 corresponding with the design pressure of the container (or its 1974 ASME Code equivalent — see Note 1 of Table 2-1).

2433. Waterbath vaporizers shall comply with 2433(a) through (j).

(a) The vaporizing chamber, tubing, pipe coils, or other heat exchange surface containing the LP-Gas to be vaporized, hereinafter referred to as "heat exchanger," shall be constructed in accordance with the applicable provisions of the ASME Code for a minimum design pressure of 250 psig and shall be permanently and legibly marked with:

(1) The marking required by the Code.

(2) The allowable working pressure and temperature for which designed.

(3) The sum of the outside surface and the inside heat exchange surface area in square feet.

(4) The name or symbol of the manufacturer.

(b) Heat exchangers for waterbath vaporizers having an inside diameter of 6″ or less are exempt from the ASME Code and need not be marked. They shall be constructed for a 250 psig minimum design pressure.

(c) Heat exchangers for waterbath vaporizers shall be provided with a suitable automatic control to prevent liquid passing through the heat exchanger to the vapor discharge piping. This control shall be integral with the vaporizer.

(d) Heat exchangers for waterbath vaporizers shall be equipped at or near the discharge with a spring loaded safety relief valve providing an effective rate of discharge in accordance with Appendix D. Fusible plugs shall not be used.

(e) Waterbath sections of waterbath vaporizers shall be designed to eliminate a pressure build-up above the design pressure.

(f) The immersion heater which provides heat to the waterbath shall be installed so as not to contact the heat exchanger and may be electric or gas-fired.

(g) A control to limit the temperature of the waterbath shall be provided.

(h) Gas-fired immersion heaters shall be equipped with an automatic safety device to shut off the flow of gas to the main burner and pilot in the event of flame failure.

(i) Gas-fired immersion heaters with an input of 400,000 Btu's per hour or more shall be equipped with an electronic flame safeguard and programming to provide for pre-purge prior to ignition, proof of pilot before main burner valve opens, and full shutdown of main gas and pilot upon flame failure.

(j) A means shall be provided to shut off the source of heat in case the level of the heat transfer medium falls below the top of the heat exchanger.

2434. Direct gas-fired tank heaters shall be designed exclusively for aboveground use. They may be an integral part of a fuel storage container, directly connected to the container liquid section, or to the vapor section, or to both, and shall comply with 2434(a) through (d).

(a) Tank heaters shall be permanently and legibly marked with:

(1) The rated input to the burner in Btuh.

(2) The maximum vaporizing capacity in gallons per hour.

(3) The name or symbol of the manufacturer.

(b) Tank heaters shall be provided with a means for manually turning off the gas to the main burner and the pilot.

(c) Tank heaters shall be equipped with an automatic safety device to shut off the flow of gas to the main burner if the pilot is extinguished. If the pilot flow exceeds 2,000 Btuh, the safety device shall shut off the flow of gas to the pilot also.

(d) Direct gas-fired tank heaters shall be equipped with a limit control to prevent the heater from raising the pressure in the storage container to more than 75 percent of the pressure shown in the first column of Table 2-1 corresponding with the design pressure of the container (or its 1974 ASME Code equivalent — see Note 1 of Table 2-1).

2435. Vaporizing-burners shall be constructed with a minimum design pressure of 250 psig with a factor of safety of five, and shall comply with 2435(a) through (e):

(a) The vaporizing-burner, or the appliance in which it is installed shall be permanently and legibly marked with:

(1) The maximum burner input in Btuh.

(2) The name or symbol of the manufacturer.

(b) Vaporizing coils or jackets shall be made of ferrous metals or high temperature alloys.

(c) The vaporizing section shall be protected by a hydrostatic relief valve, located where it will not be subjected to temperatures in excess of 140°F, and with a pressure setting such as to protect the components involved but not lower than 250 psig. The relief valve discharge shall be directed upward and away from the component parts of the vaporizing burner. Fusible plugs shall not be used.

(d) A means shall be provided for manually turning off the gas to the main burner and the pilot.

(e) Vaporizing-burners shall be provided with an automatic safety device to shut off the flow of gas to the main burner and pilot in the event the pilot is extinguished. See Prevention of Fire and Dust Explosions in Grain Elevators and Bulk Grain Handling Facilities, NFPA No. 61B, for ignition and combustion controls applicable to vaporizing-burners associated with grain dryers.

2436. Gas-air mixers shall comply with 2436(a) through (e).

(a) Gas-air mixers shall be designed for the air, vapor, and mixture pressures to which they are subjected. Piping materials shall comply with applicable portions of this standard.

(b) Gas-air mixers shall be designed so as to prevent the formation of a combustible mixture. Gas-air mixers which are capable of producing combustible mixtures shall be equipped with safety interlocks on both the LP-Gas and air supply lines to shut down the system if combustible limits are approached.

(c) In addition to the interlocks provided for in 2436(b), a method shall be provided to prevent air from accidentally entering gas distribution lines without LP-Gas being present. Check valves shall be installed in the air and LP-Gas supply lines close to the mixer to minimize the possibility of backflow of gas into the air supply lines or of air into the LP-Gas system. Gas mixing control valves in the LP-Gas and air supply lines which are arranged to fail closed when actuated by safety interlock trip devices shall be considered as acceptable shutdown devices.

(d) Where it is possible for condensation to take place between the vaporizer and the gas-air mixer, an interlock shall be provided to prevent LP-Gas liquid from entering the gas-air mixer.

(e) Gas-air mixers which utilize the kinetic energy of the LP-Gas vapor to entrain air from the atmosphere, and are so designed that maximum air entrained is less than 85 percent of the mixture, need not include the interlocks specified in 2436(b), (c), and (d), but shall be equipped with a check valve at the air intake to prevent the escape of gas to atmosphere when shutdown. Gas-air mixers of this type receiving air from a blower, compressor, or any source

of air other than directly from the atmosphere, shall include a method of preventing air without LP-Gas, or mixtures of air and LP-Gas within the flammable range, from entering the gas distribution system accidentally.

244. Strainers

2440. Strainers shall be designed to minimize the possibility of particulate materials clogging lines and damaging pumps, compressors, meters or regulators. The strainer element shall be accessible for cleaning.

245. Meters

2450. Vapor meters of the tin or brass case type of soldered construction shall not be used at pressures in excess of 1 psig.

2451. Vapor meters of the die cast or iron case type may be used at any pressure equal to or less than the working pressure for which they are designed and marked.

246. Dispensing Devices

2460. Components of dispensing devices, such as meters, vapor separators, valves and fittings within the dispenser, shall comply with 2401(a) and 2402.

2461. Pumps of dispensers used to transfer LP-Gas shall comply with 2401(a), 2402 and with 241. Such pumps shall be equipped to permit control of the flow and to minimize the possibility of leakage or accidental discharge. Means shall be provided on the outside of the dispenser to readily shut off the power in the event of fire or accident. This means may be integral with the dispenser or provided externally when the dispenser is installed. (See 3195.)

2462. Dispensing hose shall comply with 2350 through 2352. An excess-flow check valve or an automatic shutoff valve complying with 2222(a), (b) and (c) and 2342, or 2222(d) and 2343, shall be installed in or on the dispenser at the point at which the dispenser hose is connected to the liquid piping. A differential back pressure valve shall be considered as meeting these provisions.

247. Regulators

2470. Final stage regulators (excluding appliance regulators) shall be equipped on the low pressure side with one or both of the following: (See 3141(b) for required protection from the elements which may be integral with the regulator.)

(a) A relief valve having a start-to-discharge pressure setting within limits specified in Table 2-5.

(b) A shutoff device that shuts the gas off at the inlet side when the downstream pressure reaches the overpressure limits specified in Table 2-5. Such a device shall not open to permit flow of gas until it has been manually reset.

Table 2-5

Regulator Delivery Pressure in psig	Relief Valve Start-to-Discharge Pressure Setting, % of Regulator Delivery Pressure	
	Minimum	Maximum
1 or less	170%	300%
Above 1, not over 3	140%	250%
Above 3	125%	250%

248. Sight Flow Glasses

2480. Flow indicators, either of the simple observation type or combined with a back-flow check valve, may be used in applications in which the observation of liquid flow through the piping is desirable or necessary.

25. APPLIANCES

250. General

2500. This section includes basic construction and performance provisions for LP-Gas consuming appliances.

251. Approved Appliances

2510. New residential, commercial and industrial LP-Gas consuming appliances, except for those covered in 2511 and 2520, shall be approved.

2511. For an appliance, class of appliance, or appliance accessory for which no applicable standard has been developed, approval of the authority having jurisdiction may be required before installation is made.

252. Provisions for Appliances

2520. Any appliance, originally manufactured for operation with a gaseous fuel other than LP-Gas, and in good condition, may be

used with LP-Gas provided it is properly converted, adapted and tested for performance with LP-Gas before being placed into use.

2521. Unattended heaters used inside buildings for animal or poultry production or care shall be equipped with approved automatic devices to shut off the flow of gas to the main burners, and pilots if used, in the event of flame extinguishment or combustion failure. (See 3402 for exception to this provision when such heaters are used in buildings without enclosing walls.)

2522. Appliances using vaporizing-burners shall comply with 2434.

2523. Appliances used in mobile homes and recreational vehicles shall be approved for such service.

2524. LP-Gas appliances used on commercial vehicles (see Section 38) shall be approved for the service (see 251) and shall comply with 2524(a) through (c).

(a) Gas-fired heating appliances and water heaters shall be equipped with automatic devices designed to shut off the flow of gas to the main burner and the pilot in the event the pilot flame is extinguished.

(b) Catalytic heating appliances shall be equipped with an approved automatic device to shut off the flow of gas in the event of combustion failure.

(c) Gas-fired heating appliances and water heaters to be used in vehicles intended for human occupancy shall make provisions for complete separation of the combustion system and the living space. If this separation is not integral with the appliance, it shall be provided otherwise by the method of installation (see 3831).

CHAPTER 3

INSTALLATION OF LP-GAS SYSTEMS

30. SCOPE

300. Application

3000. This chapter applies to the field installation of LP-Gas systems utilizing components, subassemblies, container assemblies and container systems fabricated in accordance with Chapter 2.

3001. Section 31 includes general provisions applicable to most stationary systems. Sections 32 to 38 extend and modify Section 31 for systems installed for specific purposes.

3002. Installation of systems used in the highway transportation of LP-Gas is covered in Chapter 6.

3003. LP-gas systems shall be installed in accordance with this Standard and other national standards which may apply. These include:

(a) National Fuel Gas Code, NFPA No. 54 (ANSI Z223.1).

(b) Stationary Combustion Engines and Gas Turbines, NFPA No. 37.

(c) Mobile Home Parks, NFPA No. 501A (ANSI A119.3).

(d) Mobile Homes, NFPA No. 501B (ANSI A119.1).

(e) Recreational Vehicles, NFPA No. 501C (ANSI A119.2).

(f) Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment, NFPA No. 96.

(g) Ovens and Furnaces, NFPA No. 86A.

(h) Incinerators and Rubbish Handling, NFPA No. 82.

(i) Motor Craft (Pleasure and Commercial), NFPA No. 302.

(j) Grain Elevators and Bulk Handling, NFPA No. 61B (Grain Dryers).

31. GENERAL PROVISIONS

310. Application

3100. This section includes location and installation criteria for containers; the installation of container appurtenances and regulators; piping service limitations; the installation of piping (including flexible connectors and hose); hydrostatic relief valves and equipment (other than vaporizers, see Section 36); and the testing of piping systems.

3101. The provisions of this section are subject to modification for systems used for certain specific purposes (see 3001).

311. Location of Containers

3110. LP-Gas containers shall be located outside of buildings, except as follows:

(a) Portable containers as specifically provided for in Section 33.

(b) Containers in buildings used exclusively for container filling, vaporization, pressure reduction, gas mixing, gas manufacturing or distribution and complying with Chapter 7.

(c) Containers on LP-Gas vehicles complying with, and parked or garaged in accordance with Chapter 6.

(d) Containers used with LP-Gas stationary or portable engine fuel systems complying with Section 35.

(e) Containers used with LP-Gas fueled industrial trucks complying with 3561.

(f) Containers on LP-Gas fueled vehicles garaged in accordance with 3560.

(g) Portable containers awaiting use or resale when stored in accordance with Chapter 5.

3111. Containers installed outside of buildings, whether of the portable type replaced on a cylinder exchange basis, or permanently installed and refilled at the installation, shall be located with respect to the nearest container, important building, group of buildings, or line of adjoining property which may be built upon, in accordance with Table 3-1, or with 3112 and 3114.

Table 3-1

Minimum Distances

Water Capacity Per Container Gallons	Containers: Mounded or Underground (Note (d))	Containers: Aboveground	Between Aboveground Containers
Less than 125 (Note (a))	10 feet	None (Note(b))	None
125 to 250	10 feet	10 feet	None
251 to 500	10 feet	10 feet	3 feet
501 to 2,000	25 feet (Note(c))	25 feet (Note(c))	3 feet
2,001 to 30,000	50 feet	50 feet	5 feet
30,001 to 70,000	50 feet	75 feet	(¼ of sum of diameters of adjacent containers)
70,001 to 90,000	50 feet	100 feet	
90,001 to 120,000	50 feet	125 feet	

NOTES TO TABLE 3-1

Note (a) At a consumer site, if the aggregate water capacity of a multi-container installation comprised of individual containers having a water capacity of less than 125 gallons is 501 gallons or more, the minimum distance shall comply with the appropriate portion of this table, applying the aggregate capacity rather than the capacity per container. If more than one such installation is made, each installation shall be separated from any other installation by at least 25 feet. Do not apply the MINIMUM DISTANCES BETWEEN ABOVEGROUND CONTAINERS to such installations.

Note (b) The following shall apply to aboveground containers installed alongside of buildings:

(1) DOT specification containers shall be located and installed so that the discharge from the container safety relief device is at least 3 feet horizontally away from any building opening below the level of such discharge, and shall not be beneath any building unless this space is well ventilated to the outside and is not enclosed for more than 50 percent of its perimeter. The discharge from container safety relief devices shall be located not less than 5 feet in any direction away from any exterior source of ignition, openings into direct-vent (sealed combustion system) appliances, or mechanical ventilation air intakes.

(2) ASME containers of less than 125 gallons water capacity shall be located and installed so that the discharge from safety relief devices shall not terminate in or beneath any building and shall be located at least 5 feet horizontally away from any building opening below the level of such discharge, and not less than 5 feet in any direction away from any exterior source of ignition, openings into direct vent (sealed combustion system) appliances, or mechanical ventilation air intakes.

(3) The filling connection and the vent from liquid level gages on either DOT or ASME containers filled at the point of installation shall be not less than 10 feet in any direction away from any exterior source of ignition, openings into direct-vent (sealed combustion system) appliances, or mechanical ventilation air intakes.

Note (c) This distance may be reduced to not less than 10 feet for a single container of 1,200 gallons water capacity or less provided such container is at least 25 feet from any other LP-Gas container of more than 125 gallons water capacity.

Note (d) Minimum distances for underground containers shall be measured from the relief valve and filling or liquid level gage vent connection at the container, except that no part of an underground container shall be less than 10 feet from a building or line of adjoining property which may be built upon.

3112. Where storage containers having an aggregate water capacity of more than 4000 gallons are located in heavily populated or congested areas, the siting provisions of 3111 and Table 3–1 may be modified as indicated by the fire safety analysis described in 3912.

3113. In the case of buildings of other than wood-frame construction devoted exclusively to gas manufacturing and distribution operations, including LP-Gas service stations, the above distances may be reduced provided that in no case shall containers having a water capacity exceeding 500 gallons be located closer than 10 feet to such gas manufacturing and distributing buildings.

3114. The following provisions shall also apply:

(a) Containers shall not be stacked one above the other.

(b) Loose or piled combustible material and weeds and long dry grass shall not be permitted within 10 feet of any container.

(c) Suitable means shall be used to prevent the accumulation or flow of liquids having flash points below 200° F (93.4° C) under adjacent LP-Gas containers such as by dikes, diversion curbs or grading. Determination of flash points shall be in accordance with Standard on Basic Classification of Flammable and Combustible Liquids, NFPA No. 321.

(d) When tanks containing flammable or combustible liquids (see NFPA 321 for definitions of these liquids) are within a diked area, LP-Gas containers shall be outside the diked area and at least 10 feet away from the centerline of the wall of the diked area.

(e) 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 feet. This provision shall not apply when LP-Gas containers of 125 gallons or less water capacity are installed adjacent to fuel oil supply tanks of 660 gallons or less capacity. No horizontal separation is 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. See 3114(c) for flash point determinations.

(f) The minimum separation between LP-Gas containers and oxygen or gaseous hydrogen containers shall be in accordance with Table 3-2 except that lesser distances are permitted where protective structures such as fire walls, interrupt the line of sight between uninsulated portions of the oxygen or hydrogen containers and the LP-Gas containers. Also, see NFPA Nos. 50 and 51 for oxygen sys-

tems and NFPA No. 50A on gaseous hydrogen systems. The minimum separation between LP-Gas containers and liquefied hydrogen containers shall be in accordance with NFPA No. 50B.

(g) Where necessary to prevent flotation due to possible high flood waters around aboveground containers, or high water table for those underground, containers shall be securely anchored.

(h) When LP-Gas containers are to be stored or used in the same area with other compressed gases, the containers shall be marked to identify their content in accordance with ANSI Standard Z48.1 "Method of Marking Portable Compressed Gas Containers to Identify the Material Contained."

3115. Because of the pronounced volatility of LP-Gas in installations covered by this Standard, dikes normally serve no useful purpose. (See 3114(c).)

312. Installation of Containers

3120. DOT cylinder specification containers shall be installed only aboveground, and shall be set upon a firm foundation, or otherwise firmly secured. The possible effect on the outlet piping of settling shall be guarded against by a flexible connection or special fitting. (See 3164 and 3167.)

3121. ASME containers may be installed aboveground, or partially or totally underground, and may be in either a vertical or horizontal position, provided the design contemplates the installation position. Where physical damage to LP-Gas containers, or systems of which they are a part, from vehicles is a possibility, precautions against such damage shall be taken.

3122. ASME containers designed for permanent installation in stationary service aboveground, except as provided in 3122(a)(2)b and 3122(c), shall be placed on substantial masonry or noncombustible structural supports on concrete or firm masonry foundations, and supported as follows:

(a) Horizontal containers shall be mounted on saddles in such a manner as to permit expansion and contraction, and not to cause an excessive concentration of stresses. Structural steel supports may be used if protected against fire in an approved manner, or if in compliance with 3122(c), and as follows:

(1) Containers of more than 2,000 gallons water capacity shall be provided with concrete or masonry foundations formed to fit the container contour, or if furnished with saddles in compliance with 2140, may be placed on flat-topped foundations.

Table 3-2

LP-Gas Containers Having An	Separation From Oxygen Containers Having An			Separation From Gaseous Hydrogen Containers Having An		
Aggregate Water Capacity of	Aggregate capacity of 400 CF* or less	Aggregate capacity of more than 400 CF* to 20,000 CF*, including unconnected reserves.	Aggregate capacity of more than 20,000 CF,* including unconnected reserves.	Aggregate capacity of less than 400 CF*	Aggregate capacity of 400 CF* to 3000 CF*	Aggregate capacity of more than 3000 CF*
1200 Gallons or less	None	20 Feet	25 Feet			
Over 1200 Gal.	None	20 Feet	50 Feet			
500 Gals. or less				None	10 Feet	25 Feet
Over 500 Gals.				None	25 Feet	50 Feet

*Cubic feet measured at 70°F and atmospheric pressure.

(2) Containers of 2,000 gallons water capacity or less may be installed on concrete or masonry foundations formed to fit the container contour, or if equipped with attached supports complying with 2141(a), may be installed as follows:

a. If the bottoms of the horizontal members of the container saddles, runners or skids are to be more than 12 inches above grade, fire-resistive foundations shall be provided. A container shall not be mounted with the outside bottom of the container shell more than 5 feet above the surface of the ground.

b. For temporary use at a given location, not to exceed 6 months, fire-resitive foundations or saddles are not required provided the outside bottom of the container shell is not more than 5 feet above the surface of the ground and that flexible piping connections are used. (See 2352.)

(3) Containers, or container-pump assemblies mounted on a common base complying with 2141(b), may be placed on concrete pads at ground level or within 2 inches of ground level, provided the liquid piping from the container is sufficiently flexible to minimize the possibilities of leakage or breakage in the event of the failure of the container supports.

(b) Vertical containers shall be installed in accordance with good engineering practice.

(c) With the approval of the authority having jurisdiction, single containers complying with 2140 or 2141 may be installed in isolated locations, with nonfireproofed steel supports resting on concrete pads or footings, provided the outside bottom of the container shell is not more than 5 feet above the ground level.

(d) Suitable means of preventing corrosion shall be provided on that part of the container in contact with the saddles or foundations or on that part of the container in contact with masonry.

3123. Single containers constructed as portable storage containers (see definition) for temporary stationary service in accordance with 2142(a) shall be placed on concrete pads, paved surfaces or firm earth for such temporary service (normally not more than 12 months at a given location) and the following shall apply:

(a) The surface on which they are placed shall be substantially level and, if not paved, shall be cleared (and kept cleared) of dry grass and weeds, and other combustible material within 10 feet of the container.

(b) Flexible connections shall be used to compensate for any settling or misalignment.

(c) If such containers are to be set with the bottoms of the skids or runners above the ground, nonfireproofed structural supports may be used for isolated locations with the approval of the authority having jurisdiction, and provided the height of the outside bottom of the container shell above the ground does not exceed 5 feet. Otherwise, fire-resistive supports shall be provided.

3124. If the container is mounted on, or is part of, a vehicle as provided in 2142(b), the unit shall be parked in compliance with the provisions of 3111 as to the location of a container of that capacity for normal stationary service, and in accordance with the following:

(a) The surface shall be substantially level and if not paved shall be suitable for heavy vehicular use, and shall be cleared (and kept cleared) of dry grass and weeds, and other combustible material within 10 feet of the container.

(b) Flexible connections shall be used to compensate for any settling or misalignment.

3125. Portable containers of 2,000 gallons water capacity or less complying with 2143, may be installed for stationary service as provided in 3122(a)(2) for stationary containers.

3126. ASME container assemblies or container systems listed for underground installation, or container assemblies listed for interchangeable aboveground-underground service, may be installed underground as follows:

(a) The top of the container shall be at least 6 inches below grade, unless the container might be subject to abrasive action or physical damage from vehicular traffic or from other causes such as in LP-Gas service stations. In this case, it shall be placed not less than 2 feet below grade or equivalent protection shall be otherwise provided (such as by the use of a concrete slab) to prevent imposing the weight of a loaded vehicle directly on the container shell.

(b) The portion of the container to which the manhole or other connections are attached, need not be covered. However, where necessary, protection of the manhole and other connections against vehicular traffic damage shall be provided. When there is the possibility of a manhole or housing becoming flooded, the discharge from the regulator vent lines shall be above the highest probable water level.

(c) Containers shall be protected against corrosion for the soil conditions at the container site by a method in accordance with good engineering practice. Precaution shall be taken to prevent damage to the coating during handling. Any damage to the coating shall be repaired before backfilling.

(d) Containers shall be set substantially level on a firm foundation (firm earth may be used) and surrounded by earth or sand firmly tamped in place. Backfill shall be free of rocks or similar abrasives.

(e) When a container is to be abandoned underground, the procedure described in C-21 of Appendix C shall apply.

3127. Partially underground, unmounded ASME containers shall be installed as follows:

(a) The portion of the container below the surface, and for a vertical distance of at least 3 inches above the surface, shall be protected to resist corrosion as required for underground containers. (See 3126(c).)

(b) Containers shall be set substantially level on a firm foundation, with backfilling to be as required for underground containers. (See 3126.)

(c) Spacing provisions shall be as specified for aboveground containers in 3111 and Table 3–1.

(d) The container shall be located so as not to be subject to vehicular damage, or shall be adequately protected against such damage.

3128. 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. Welding to container proper shall comply with 2104.

3129. Aboveground containers shall be kept properly painted.

313. Installation of Container Appurtenances

3130. Safety relief devices shall be installed on containers in accordance with 3131 through 3134.

3131. Safety relief devices on portable DOT cylinder specification containers, or their equivalent of ASME construction, of 1,000 pounds (120 gallons) water capacity or less, shall be installed to minimize the possibility of relief device(s) discharge(s) impingement on the container.

3132. Safety relief devices on ASME containers of 125 gallons water capacity or more permanently installed in stationary service, portable storage containers (see definition), portable containers (tanks) of nominal 120 gallons water capacity or more, or cargo tanks, shall be installed so that any gas released is vented away from the container upward and unobstructed to the open air. The following provisions shall also apply:

(a) Means shall be provided, such as rain caps, to minimize the possibility of the entrance of water or other extraneous matter (which might render the relief device inoperative or restrict its capacity) into the relief device or any discharge piping. If necessary, provision shall be made for drainage. The rain cap or other protector shall be designed to remain in place except when the relief device operates and shall permit the safety relief device to operate at sufficient discharge capacity.

(b) On each aboveground container of more than 2,000 gallons water capacity, the relief valve discharge shall be virtually upward and unobstructed to the open air at a point at least 7 feet above the top of the container. The following also shall apply:

(1) Relief valve discharge piping shall comply with 3132(f).

(2) In providing for drainage in accordance with 3132(a), the design of relief valve discharge(s) and attached piping shall:

a. Be such as to protect the container against flame impingement which might result from ignited product escaping from the drain opening.

b. Be directed so that a container(s), piping or equipment which might be installed adjacent to container on which the relief device is installed is not subjected to flame impingement.

(c) On underground containers of 2,000 gallons or less water capacity, except those installed in LP-Gas service stations covered in 3132(e), the relief device may discharge into the manhole or housing, provided such manhole or housing is equipped with ventilated louvers, or their equivalent, of adequate area as specified in 3135(d).

(d) On underground containers of more than 2,000 gallons water capacity, except those installed in LP-Gas service stations, the discharge from safety relief valves shall be piped vertically and directly upward to a point at least 7 feet above the ground. Relief valve discharge piping shall comply with 3132(f).

(e) On underground containers in LP-Gas service stations, the safety relief valve discharge shall be piped vertically and directly upward to a point at least 10 feet above the ground. Discharge piping shall comply with 3132(f) and shall be adequately supported and protected against physical damage.

(f) The discharge terminals from safety relief devices shall be located so as to provide protection against physical damage. Discharge piping used shall be adequate in size to permit sufficient safety relief device discharge capacity. Such piping shall comply with 3161 or 3162. Return bends and restrictive pipe or tubing fittings shall not be used.

(g) Shutoff valves shall not be installed between safety relief devices and the container, or between the relief devices and the discharge piping, except for specially designed relief valve-shutoff valve combinations covered by 2213(c), or where two or more separate relief valves are installed, each with its individual shutoff valve, and the shutoff valve stems are mechanically interconnected in a manner which will allow the rated discharge required for the container from the relief valve or valves which remain in communication with the container.

3133. Safety relief devices on portable storage containers (constructed and installed in accordance with 2142 and 3123 respectively) used temporarily in stationary type service, shall be installed in accordance with the applicable provisions of 3132.

3134. Additional provisions (over and above the applicable provision in 3131 and 3132) apply to the installation of safety relief devices in containers used in connection with vehicles as follows:

(a) For containers installed on vehicles in accordance with Section 38, see 3813(a).

(b) For cargo containers (tanks) installed on cargo vehicles in accordance with Section 62, see 6210(a).

3135. Container appurtenances other than safety relief devices shall be installed and protected as follows:

(a) All container openings except those used for safety relief devices (see 221), liquid level gaging devices (see 223), pressure gages (see 224), service connections for flow control (filling, withdrawal and equalizing connections, see 222) and plugged openings, shall be equipped with positive shutoff valves and either excess-flow or back-flow check valves, as follows:

(1) Except for DOT cylinders, excess flow or backflow check valves shall be located between the LP-Gas in the container and the shutoff valves, either inside the container, or at a point immediately outside where the line enters or leaves the container. If outside, installation shall be made so that any undue strain beyond the excess flow or backflow check valve will not cause breakage between the container and such valve. All connections, including couplings, nozzles, flanges, standpipes and manways, which are listed on the ASME Manufacturers' Data Report for the container are considered part of the container. On DOT cylinders, the excess flow valve where required may be located at the outlet of the cylinder shutoff valve.

(2) Shutoff valves shall be located as close to the container as practicable.

(3) The connections, or line, leading to or from any individual opening shall have greater capacity than the rated flow of the excess-flow valve protecting the opening.

(b) Valves, regulators, gages and other container appurtenances shall be protected against tampering and physical damage. The use of other than frangible shank locks is not desirable as it prevents access to gas controls in an emergency.

(c) Valves in the assembly of portable multicontainer systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system. This provision shall not be construed as requiring an automatic changeover device.

(d) Connections to containers installed underground shall be located within a substantial dome, housing or manhole and with access thereto protected by a substantial cover. Underground systems shall be installed so that all terminals for connecting hose and any opening through which there can be a flow from safety relief valves or pressure regulator vents are located above the normal maximum water table. Terminals for connecting hoses, openings for flow from safety relief valves, and the interior of domes, housing and manholes, shall be kept clean of debris. Such manholes or housings shall be provided with ventilated louvers or their equivalent. The area of such openings shall equal or exceed the combined discharge areas of the safety relief devices and other vent lines which discharge into the manhole or housing.

(e) Container inlet and outlet connections, except safety relief valves, liquid level gaging devices and pressure gages, on containers of 2,000 gallons water capacity or more or on containers of any capacity used in LP-Gas service stations, shall be labeled to designate whether they communicate with the vapor or liquid space. Labels may be on valves. (See 3813(f) for requirements for labeling smaller containers used for vehicular installations covered by Section 38.)

(f) Every storage container of more than 2,000 gallons water capacity or of any capacity used in LP-Gas service stations, shall be provided with a suitable pressure gage. (See 224.)

314. Regulator Installation

3140. Regulators used to control distribution or utilization pressure shall be as close to the container as is practicable. First stage regulating equipment shall be outside of buildings except as used with containers and liquid piping systems covered by 3110(a), (b), (d), (e) and (f), and 3150(c).

3141. Regulators shall be securely attached to container valves, containers, supporting standards or building walls.

(a) First stage regulators shall be either directly connected to the container shutoff valve or attached thereto by means of a suitable flexible connection.

(b) All regulators for outdoor installations, except regulators used for portable industrial applications, shall be designed, installed, or protected so their operation will not be affected by the elements (freezing rain, sleet, snow, ice, mud, or debris). This protection may be integral with the regulator.

3142. On regulating equipment installed outside of buildings, the discharge from a safety relief device shall be located not less than 3 feet horizontally away from any building opening below the level of such discharge, and not beneath any building unless this space is well ventilated to the outside and is not enclosed for more than 50 percent of its perimeter.

3143. On regulators installed inside buildings, the discharge from the safety relief device and from above the regulator and relief valve diaphragms, shall be vented to the outside air with the discharge outlet located not less than 3 feet horizontally away from any building opening below the level of such discharge. This provision shall not apply to appliance regulators otherwise protected (see NFPA No. 54), or to regulators used in connection with containers in buildings as provided for in 3110(a), (b), (d), (e) and (f).

315. Piping System Service Limitations

3150. This subsection describes the physical state (vapor or liquid) and pressure at which LP-Gas may be transmitted through piping systems under various circumstances:

(a) LP-Gas liquid or vapor may be piped at all normal operating pressures outside of buildings.

(b) LP-Gas vapor at pressures not exceeding 20 psig may be piped into any building.

(c) LP-Gas vapor at pressures exceeding 20 psig or LP-Gas liquid shall not be piped into any building except those meeting the following descriptions: (See Note below.)

(1) Buildings, or separate areas of buildings, constructed in accordance with Chapter 7, and used exclusively to:

a. House equipment for vaporization, pressure reduction, gas mixing, gas manufacturing or distribution.

b. House internal combustion engines, industrial processes, research and experimental laboratories, or equipment or processing having a similar hazard.

NOTE: Complete compliance with Chapter 7 for buildings, or separate areas of buildings, housing industrial processes and other occupancies cited in 3150(c)(1)b may not be necessary depending upon the prevailing conditions. Construction of buildings or separate areas of buildings housing certain internal combustion engines is covered in NFPA No. 37.

(2) Buildings or structures under construction or undergoing major renovation, provided the temporary piping meets the provisions of 331 and 3391.

(3) In buildings or structures other than those covered by 3150(c)(1) and (2) in which liquid feed systems are used, liquid piping may enter the building or structure to connect to a vaporizer provided heavy walled seamless brass or copper tubing not exceeding $\frac{3}{32}$ inch internal diameter and with a wall thickness not less than $\frac{3}{64}$ inch is used.

316. Installation of Pipe, Tubing, Pipe and Tubing Fittings, Valves and Hose

3160. LP-Gas normally is transferred into containers as a liquid, but may also be conveyed as a liquid or vapor under container or lower regulated pressure. Piping shall comply with the following:

(a) Piping used at pressures higher than container pressure, such as on the discharge side of liquid transfer pumps, shall be suitable for a working pressure of at least 350 psig.

(b) Vapor LP-Gas piping with operating pressures in excess of 125 psig, and liquid piping not covered by 3160(a), shall be suitable for a working pressure of at least 250 psig.

(c) Vapor LP-Gas piping, subject to pressures of not more than 125 psig, shall be suitable for a working pressure of at least 125 psig.

3161. Pipe joints may be threaded, flanged, welded, or brazed using pipe and fittings complying with 231 and 233 as follows:

(a) When joints are threaded or threaded and back welded:

(1) For LP-Gas vapor at pressures in excess of 125 psig, or for LP-Gas liquid, the pipe and nipples shall be Schedule 80 or heavier.

(2) For LP-Gas vapor at pressures of 125 psig or less, the pipe and nipples shall be Schedule 40 or heavier.

(b) When joints are welded or brazed:

(1) The pipe shall be Schedule 40 or heavier.

(2) The fittings or flanges shall be suitable for the service in which they are to be used.

(3) Brazed joints shall be made with a brazing material having a melting point exceeding 1,000 degrees F.

3162. Tubing joints may be flared, soldered or brazed using tubing and fittings, and solder or brazing material complying with 232 and 233.

3163. Piping in systems shall be run as directly as is practicable from one point to another, and with as few restrictions, such as ells and bends, as conditions will permit, giving consideration to provisions of 3164.

3164. Provision shall be made in piping including interconnecting of permanently installed containers, to compensate for expansion, contraction, jarring and vibration, and for settling. Where necessary, flexible connectors complying with 235 may be used. (See 3167.) The use of nonmetallic hose for permanently interconnecting such containers is prohibited.

3165. Piping outside buildings may be underground or aboveground or both. Piping shall be well supported and protected against physical damage. Where underground piping is beneath driveways, roads or streets, possible damage by vehicles shall be taken into account.

3166. Underground piping shall be protected against corrosion as may be warranted by soil conditions. Where condensation may occur, piping shall be pitched back to the container or suitable means provided for revaporizing the condensate.

3167. Flexible connections used in piping systems, shall comply with 235 for the service in which they are to be used, shall be installed in accordance with the manufacturer's instructions, and shall also comply with the following:

(a) Flexible connectors in lengths up to 36 inches (see 2352 and 2353) may be used for liquid or vapor piping, on portable or stationary tanks, or on cargo tank vehicles to compensate for expansion, contraction, jarring, vibration and settling. This is not to be construed to mean that flexible connectors shall be used if provisions were incorporated in the design to compensate for these effects.

(b) Hoses may be installed if flexibility is required for liquid or vapor transfer. The use of wet hose (see 4053 for explanation of term "wet hose") is recommended for liquid.

3168. By December 31, 1978, (1) stationary single container systems of over 4000 gallons water capacity, or (2) stationary multiple container systems with an aggregate water capacity of more than 4000 gallons utilizing a common or manifolded liquid transfer line, shall comply with 3168(a) and (b).

(a) When a hose or swivel type piping 1½ inch or larger is used for liquid transfer or a 1¼ inch or larger vapor hose or swivel type piping is used in this service (excluding flexible connectors in such liquid and vapor piping), an emergency shutoff valve complying with 2343 shall be installed in the transfer line where the hose or swivel type piping is connected to the fixed piping of the system. The preceding sizes are nominal. Where the flow is only in one direction, a backflow check valve may be used in lieu of an emergency shutoff valve if installed in the fixed piping downstream of the hose or swivel type piping.

(1) Emergency shutoff valves shall be installed so that the temperature sensitive element in the thermally actuated shutoff system is not more than 5 feet in an unobstructed direct line from the nearest end of the hose or swivel type piping connected to the line in which the valve is installed.

(b) The emergency shutoff valve(s) or backflow check valve(s) specified in 3168(a) shall be installed in the plant piping so that any break resulting from a pull will occur on the hose or swivel type piping side of the connection while retaining intact the valves and piping on the plant side of the connection. This may be accomplished by use of concrete bulkheads or equivalent anchorage or by the use of a weakness or shear fitting.

3169. Hose may be used on the low pressure side of regulators to connect to other than domestic and commercial appliances as follows:

(a) The appliance connected shall be of a portable type requiring a flexible connection.

(b) For use inside buildings, the hose shall be of a minimum length, not exceeding 6 feet (except as provided for in 3313(b)), and shall not extend from one room to another, nor pass through any partitions, walls, ceilings or floors (except as provided for in 3326). It shall not be concealed from view or used in concealed locations. For use outside buildings, hose length may exceed 6 feet, but shall be kept as short as practicable.

(c) Hose shall be securely connected to the appliance. The use of rubber slip ends is not permissible.

(d) A shutoff valve shall be provided in the piping immediately upstream of the inlet connection of the hose. When more than one such appliance shutoff is located near another, precautions shall be taken to prevent operation of the wrong valve.

(e) Hose used for connecting appliances to wall or other outlets shall be protected against physical damage.

317. Hydrostatic Relief Valve Installation

3170. A hydrostatic relief valve, complying with 2360, shall be installed in each section of piping (including hose) in which liquid LP-Gas can be isolated between shutoff valves so as to relieve to a safe atmosphere the pressure which could develop from the trapped liquid.

318. Testing Piping Systems

3180. After assembly, piping systems (including hose) shall be tested and proven free of leaks at not less than the normal operating pressure. Piping within the scope of the National Fuel Gas Code, NFPA No. 54 [see 1120 (f) and (g)], shall be pressure tested in accordance with that Code. Tests shall not be made with a flame.

319. Equipment Installation

3190. Pumps shall be installed as recommended by the manufacturer and in accordance with 3190(a) through (c).

(a) Installation shall be made so that the pump casing shall not be subjected to excessive strains transmitted to it by the suction and discharge piping. This shall be accomplished by piping design, the use of flexible connectors or expansion loops, or by other effective methods, in accordance with good engineering practice.

(b) Positive displacement pumps shall be equipped with a suitable pressure limiting device, or devices, to limit the normal operating pressure to 350 psig, or to a pressure of not more than 400 psig under emergency conditions, in accordance with 2411. If such a pressure limiting device(s) is not integral with the pump, it (they) shall be installed in the piping adjacent to the pump. In either case the following shall apply:

(1) The bypass valve or recirculating device to limit the normal operating discharge pressure to not more than 350 psig shall discharge either into a storage container (preferably the supply container from which the product is being pumped) or into the pump suction.

(2) If this primary device is equipped with a shutoff valve, an adequate secondary device designed to operate at not more than 400 psig shall, if not integral with the pump, be incorporated in the pump piping. This secondary device shall be designed or installed so that it cannot be rendered inoperative, and shall discharge either into the supply container or into the pump suction.

(c) A pump operating control or disconnect switch shall be located near the pump. Remote control points shall be provided as

necessary for other plant operations such as container filling, loading or unloading of cargo vehicles and tank cars, or operation of motor fuel dispensers.

3191. Compressors shall be installed as recommended by the manufacturer and in accordance with 3191(a) and (b).

(a) Installation shall be made so that the compressor housing shall not be subjected to excessive strains transmitted to it by the suction and discharge piping. Flexible connectors may be used where necessary to accomplish this.

(b) If the compressor is not equipped with an integral means to prevent the LP-Gas liquid entering the suction (see 2422), a suitable liquid trap shall be installed in the suction piping as close to the compressor as practicable.

3192. The installation of vaporizers of the types covered by 243 is covered in Section 36 and of engine fuel vaporizers in Section 35. Integral vaporizing-burners, such as are used for weed burners or tar kettles, are considered to be part of these units (or "appliances"). For appliance installation standards see Section 34.

3193. Strainers shall be installed so that the strainer element can be serviced.

3194. Liquid or vapor meters shall be installed as recommended by the manufacturer, and in compliance with the applicable provisions of 3194(a) and (b).

(a) Liquid meters shall be securely mounted and shall be installed so that the meter housing is not subjected to excessive strains from the connecting piping. If not provided in the piping design, flexible connectors may be used where necessary to accomplish this.

(b) Vapor meters shall be securely mounted and installed so as to minimize the possibility of physical damage.

3195. LP-Gas engine fuel dispensing devices installed in service stations shall be installed as recommended by the manufacturer and in accordance with 3195(a) through (h).

(a) Installation shall not be within a building, but may be under a weather shelter or canopy, provided this area is adequately ventilated and is not enclosed for more than 50 percent of its perimeter.

(b) Dispensing devices shall be located as follows:

(1) Not less than 10 feet from aboveground storage containers of more than 2,000 gallons water capacity.

(2) Not less than 20 feet from any building (not including canopies covered in 3195(a)), basement, cellar, pit or line of adjoining property which may be built upon.

(3) Not less than 10 feet from sidewalks, streets or thoroughfares.

(c) Dispensing devices shall either be installed on a concrete foundation or be part of a complete storage and dispensing unit mounted on a common base (to be mounted as provided in 3121). In either case, they shall be adequately protected against physical damage.

(d) Control for the pump used to transfer LP-Gas through the dispensing device into motor vehicle tanks shall be provided at the device in order to minimize the possibility of leakage or accidental discharge. The following also shall apply:

(1) Means shall be provided at some point outside the dispensing device, such as a remote switch (see 3190(c)), to shut off the power in the event of fire or accident.

(2) A manual shutoff valve and an excess-flow check valve of suitable capacity shall be located in the liquid line between the pump and the dispenser inlet.

(e) Provision shall be made for venting the LP-Gas contained in the dispenser to a safe location.

(f) The dispensing hose shall comply with 235. An excess-flow check valve, or an automatic shutoff valve (see 2222(d) and 2343) shall be installed at the terminus of the liquid piping at the point of attachment of the dispensing hose. A differential back pressure valve shall be considered as meeting this provision.

(g) Piping leading to, and within the dispenser, and the dispensing hose shall be provided with hydrostatic relief valves as specified in 3170 (see also 2360).

(h) No drains or blowoffs from the dispensing device shall be directed toward, or be in close proximity to sewer systems.

32. DISTRIBUTING AND INDUSTRIAL LP-GAS SYSTEMS

320. Application

3200. This section includes provisions for LP-Gas systems installed at distributing plants, industrial plants, and distributing points (see definitions). These provisions extend and modify the provisions of Section 31 for these applications.

321. General

3210. The location and installation of storage containers and the installation of container appurtenances, piping, and equipment shall comply with Section 31.

322. Installation of Liquid Transfer Facilities

3220. Points of transfer (see definition) or the nearest part of a structure housing transfer operations shall be located in accordance with 4221.

3221. Separate buildings, and attachments to or rooms within other buildings, housing points of transfer or transfer pumps and compressors, constructed or converted to such use after December 31, 1972, shall comply with Chapter 7.

3222. The track of the railroad siding or the roadway surface, at the transfer points, shall be relatively level. Adequate clearances from buildings, structures or stationary containers shall be provided for the siding or roadway approaches to the unloading or loading points. Substantial bumpers shall be provided at the ends of sidings, and as necessary to protect storage containers and points of transfer.

3223. Safeguards shall be provided to prevent the uncontrolled discharge of LP-Gas in the event of failure in the hose or swivel type piping. The provisions of 3168 shall apply. For all other LP-Gas systems, the following shall apply:

(a) The connection, or connecting piping, into which the liquid is being transferred shall be equipped with:

1. A back-flow check valve, or

2. An emergency shutoff valve complying with 2343, or

3. An excess flow valve properly sized in accordance with 3135(a)(3).

(b) The connection, or connecting piping, from which the liquid is being withdrawn shall be equipped with:

1. An emergency shutoff valve complying with 2343, or

2. An excess flow valve properly sized in accordance with 3135(a)(3).

3224. See 4055 for railroad tank car transfer operations.

3225. If gas is to be discharged from containers inside a building, the installation provisions of 4041(a) shall apply.

323. Installation of Gas Distribution Facilities

3230. This subsection applies to the installation of facilities used for gas manufacturing, gas storage, gas-air mixing and vaporization, and compressors not associated with liquid transfer.

3231. Except as provided in 3232 and 3233, separate buildings, and attachments to or rooms within other buildings, housing gas distribution facilities, constructed or converted to such use after December 31, 1972, shall comply with Chapter 7.

3232. Facilities for vaporizing LP-Gas shall be designed, located and installed in accordance with Section 36.

3233. Facilities for storing LP-Gas in portable containers at industrial plants and distributing points shall comply with Chapter 5.

3234. Buildings housing vapor compressors shall be located in accordance with 4221 considering the building as one housing a point of transfer.

3235. The use of pits to house gas distribution facilities shall be avoided unless automatic flammable vapor detecting systems are installed in the pit. Drains or blowoff lines shall not be directed into or in proximity of sewer systems.

3236. If gas is to be discharged from containers inside a building, the installation provisions of 4041(a) shall apply.

324. Installation of Electrical Equipment

3240. Installation of electrical equipment shall comply with Section 37.

325. Protection Against Tampering for Section 32 Systems

3250. To minimize the possibilities for trespassing and tampering, the area which includes container appurtenances, pumping equipment, loading and unloading facilities and container loading facilities, shall be protected by one of the following methods:

(a) Enclosure with at least a 6-foot high industrial-type fence, unless otherwise adequately protected. There shall be at least two means of emergency access from the fenced or other enclosure. If guard service is provided, it shall be extended to the LP-Gas installation. Guard personnel shall be properly trained. (See 1500.)

(b) As an alternate to fencing the operating area, suitable devices which can be locked in place, shall be provided. Such devices,

when in place, shall effectively prevent unauthorized operation of any of the container appurtenances, system valves or equipment.

326. Lighting

3260. If operations are normally conducted during other than daylight hours, adequate lighting shall be provided to illuminate storage containers, containers being loaded, control valves and other equipment.

327. Ignition Source Control

3270. Ignition source control shall comply with Section 37.

33. LP-GAS SYSTEMS IN BUILDINGS OR ON THE ROOFS OF BUILDINGS

330. Application

3300. This section includes installation and operating provisions for LP-Gas systems containing liquid LP-Gas located inside of, or on the roofs of, buildings or structures. Systems covered include those utilizing portable containers inside or on the roofs of buildings, and those in which the liquid is piped from outside containers into buildings or onto the roof.

3301. These provisions are in addition to those specified in Section 31.

3302. Liquid transfer systems are covered in Chapter 4.

3303. Engine fuel systems used inside buildings are covered in Section 35.

3304. LP-Gas transport or cargo vehicles stored, serviced or repaired in buildings are covered in Chapter 6.

331. General Provisions for Containers, Equipment, Piping and Appliances

3310. If operational requirements make portable use of containers necessary and if location outside of buildings or structures is impracticable, containers, equipment and piping may be used on the roofs of, or inside of buildings or structures, as provided in 3311 through 3317, and in accordance with such other provisions of Section 33 as may be applicable to the particular use or occupancy. Permanent installations using portable containers on roofs are covered in 338. Containers in use shall mean *connected* for use.

3311. Containers shall comply with DOT cylinder specifications (see 2101 and 2110), shall not exceed 245 pounds water capacity (nominal 100 pounds LP-Gas capacity) each, shall comply with other applicable provisions of Section 21, and be equipped as provided in Section 22 (see 222 and Table 2-3). They shall also comply with the following:

(a) Containers shall be marked as provided in 215.

(b) Containers with water capacities greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall be equipped with shutoff and excess-flow valves as provided in 2221 (Column 3, Table 2-3). The installation of excess-flow valves shall take into account the type of valve protection provided for the container in accordance with 2130.

(c) Valves on containers shall be protected in accordance with 2130.

(d) Containers having water capacities greater than 2½ pounds (nominal 1 pound LP-Gas capacity) connected for use shall stand on a firm and substantially level surface. If necessary, they shall be secured in an upright position.

(e) Containers and the valve protecting devices used with them shall be oriented so as to minimize the possibility of impingement of the safety relief device discharge on the container and adjacent containers.

3312. Regulators, if used, shall be suitable for use with LP-Gas. Manifolds and fittings connecting containers to pressure regulator inlets shall be designed for at least 250 psig service pressure.

3313. Piping, including pipe, tubing, fittings, valves and hose, shall comply with Section 23, except that a minimum working pressure of 250 psig shall apply to all components. The following also shall apply:

(a) Piping shall be installed in accordance with the provisions of 316 for liquid piping or for vapor piping for pressures above 125 psig. (See 3160(b).)

(b) Hose, hose connections and flexible connectors used shall be designed for a working pressure of at least 350 psig, shall comply with 235, and be installed in accordance with 3169. Hose length may exceed that specified by 3169(b), but shall be as short as practicable, although long enough to permit compliance with the spacing requirements (see 3322 and 3323) without kinking or straining hose or causing it to be close enough to a burner to be damaged by heat. See 338 for permanent roof installations.

3314. Containers, regulating equipment, manifolds, pipe, tubing and hose, shall be located so as to minimize exposure to abnormally high temperatures (such as might result from exposure to convection and radiation from heating equipment or installation in confined spaces), physical damage or tampering by unauthorized persons.

3315. Heat producing equipment shall be located and used so as to minimize the possibility of the ignition of combustibles.

3316. Containers shall be located at least 5 feet from the edge of the floor or roof. Where there is no wall, parapet, rail or other protection, provisions shall be made to preclude the possibility of containers falling over the edge.

(a) Filling containers on roofs is prohibited. See 4010.

3317. Portable heaters, including salamanders, shall be equipped with an approved automatic device to shut off the flow of gas to the main burner, and pilot if used, in the event of flame extinguishment or combustion failure. Such portable heaters shall be self-supporting unless designed for container mounting (see 3323). Container valves, connectors, regulators, manifolds, piping or tubing shall not be used as structural supports. The following shall also apply:

(a) Portable heaters manufactured on or after May 17, 1967, having an input of more than 50,000 Btuh, and those manufactured prior to May 17, 1967, with inputs of more than 100,000 Btuh, shall be equipped with either:

(1) A pilot which must be lighted and proved before the main burner can be turned on, or

(2) An approved electric ignition system.

(b) The provisions of 3317 are not applicable to the following:

(1) Tar kettle burners, hand torches or melting pots.

(2) Portable heaters with less than 7,500 Btuh input if used with containers having a maximum water capacity of 2½ pounds.

332. Buildings Under Construction or Undergoing Major Renovation

3320. Containers may be used in buildings or structures under construction or undergoing major renovation when such buildings are not occupied by the public or, if partially occupied by the public, containers may be used in the unoccupied portions with the prior approval of the authority having jurisdiction. Such use shall be in accordance with 3321 through 3328.

3321. Containers, equipment, piping and appliances shall comply with 331.

3322. For temporary heating, such as curing concrete, drying plaster and similar applications, heaters (other than integral heater-container units covered in 3323) shall be located at least 6 feet from any LP-Gas container.

3323. Integral heater-container units specifically designed for the attachment of the heater to the container, or to a supporting standard attached to the container, may be used, provided they are designed and installed so as to prevent direct or radiant heat application to the container. Blower and radiant type units shall not be directed toward any LP-Gas container within 20 feet.

3324. If two or more heater-container units of either the integral or nonintegral type are located in an unpartitioned area on the same floor, the container(s) of each such unit shall be separated from the container(s) of any other such unit by at least 20 feet.

3325. If heaters are connected to containers manifolded together for use in an unpartitioned area on the same floor, the total water capacity of containers manifolded together serving any one heater shall not be greater than 735 pounds (nominal 300 pounds LP-Gas capacity), and if there is more than one such manifold it shall be separated from any other by at least 20 feet.

3326. On floors on which no heaters are connected for use, containers may be manifolded together for connection to a heater or heaters on another floor, provided:

(a) The total water capacity of the containers connected to any one manifold is not greater than 2,450 pounds (nominal 1,000 pounds LP-Gas capacity), and

(b) Manifolds of more than 735 pounds water capacity (nominal 300 pounds LP-Gas capacity), if located in the same unpartitioned area shall be separated from each other by at least 50 feet.

3327. The provisions of 3324, 3325 and 3326 may be altered by the authority having jurisdiction if compliance is impractical.

3328. Storage of containers awaiting use shall be in accordance with Chapter 5.

333. Buildings Undergoing Minor Renovation When Frequented by the Public

3330. Containers may be used for repair or minor renovation in buildings frequented by the public as follows:

(a) During the hours of the day the public normally is in the building the following shall apply:

(1) The maximum water capacity of individual containers shall be 50 pounds (nominal 20 pounds LP-Gas capacity) and the number of containers in the building shall not exceed the number of workmen assigned to using the LP-Gas.

(2) Containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall not be left unattended.

(b) During the hours of the day when the building is not open to the public, containers may be used in the building for repair or minor renovation in accordance with 331 and 332, provided, however, that containers with a greater water capacity than 2½ pounds (nominal 1 pound LP-Gas capacity) shall not be left unattended.

334. Buildings Housing Industrial Occupancies

3340. Containers may be used in buildings housing industrial occupancies for processing, research or experimental purposes as follows:

(a) Containers, equipment and piping used shall comply with 331.

(b) If containers are manifolded together, the total water capacity of the connected containers shall be not more than 735 pounds (nominal 300 pounds LP-Gas capacity). If there is more than one such manifold in a room, it shall be separated from any other by at least 20 feet.

(c) The amount of LP-Gas in containers for research and experimental use in the building shall be limited to the smallest practical quantity.

3341. Containers may be used to supply fuel for temporary heating in buildings housing industrial occupancies with essentially noncombustible contents, if portable equipment for space heating is essential and a permanent heating installation is not practicable, provided containers and heaters comply with and are used in accordance with 332.

335. Buildings Housing Educational and Institutional Occupancies

3350. Containers may be used in buildings housing educational and institutional laboratory occupancies for research and experimental purposes, but not in classrooms, as follows:

(a) The maximum water capacity of individual containers used shall be:

(1) 50 pounds (nominal 20 pounds LP-Gas capacity) if used in educational occupancies.

(2) 12 pounds (nominal 5 pounds LP-Gas capacity) if used in institutional occupancies.

(b) If more than one such container is located in the same room, the containers shall be separated by at least 20 feet.

(c) Containers not connected for use shall be stored in accordance with Chapter 5, except that they shall not be stored in a laboratory room.

336. Temporary Heating in Buildings in Emergencies

3360. Containers may be used in buildings for temporary emergency heating purposes if necessary to prevent damage to the buildings or contents, and if the permanent heating system is temporarily out of service, provided the containers and heaters comply with and are used in accordance with 331 and 332, and the temporary heating equipment is not left unattended.

337. Use in Buildings for Demonstrations or Training, or in Small Containers

3370. Containers having a maximum water capacity of 12 pounds (nominal five pounds LP-Gas capacity) may be used temporarily inside buildings for public exhibitions or demonstrations, including use in classroom demonstrations. If more than one such container is located in the same room, the containers shall be separated by at least 20 feet.

3371. Containers may be used temporarily in buildings for training purposes related to the installation and use of LP-Gas systems, provided:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity), but not more than 20 pounds of LP-Gas may be placed in a single container.

(b) If more than one such container is located in the same room, the containers shall be separated by at least 20 feet.

(c) The training location shall be acceptable to the authority having jurisdiction.

(d) Containers shall be promptly removed from the building when the training class has terminated.

3372. Containers having a maximum water capacity of 2½ pounds (nominal 1 pound LP-Gas capacity) may be used in buildings as part of approved self-contained torch assemblies or similar appliances other than mobile cooking appliances.

338. Permanent Installations Using Portable Containers on Roofs

3380. Containers may be installed on roofs of buildings of fire-resistive construction, or noncombustible construction having essentially noncombustible contents, or of other construction or contents which are protected with automatic sprinklers, (see NFPA No. 220, Standard Types of Building Construction) in accordance with 331 and the following:

(a) The total water capacity of containers connected to any one manifold shall not be greater than 980 pounds (nominal 400 pounds LP-Gas capacity). If more than one manifold is located on the roof, it shall be separated from any other by at least 50 feet.

(b) Containers shall be located in areas where there is free air circulation, at least 10 feet from building openings (such as windows and doors) and at least 20 feet from air intakes of air conditioning and ventilating systems.

(c) Containers shall not be located on roofs which are entirely enclosed by parapets more than 18 inches high unless either, (1) the parapets are breached with low-level ventilation openings no more than 20 feet apart, or (2) all openings communicating with the interior of the building are at or above the top of the parapets.

(d) Containers shall not be refilled on roofs.

(e) The container valve outlet shall be tightly plugged and the provisions of 2130 shall be complied with during movement of containers within a building. Only emergency stairways not generally used by the public shall be used and reasonable precautions shall be taken to prevent the container from falling down the stairs. Freight or passenger elevators may be used when not occupied by the public.

(f) Piping shall be in accordance with 3313, provided, however, that hose shall not be used for connecting to containers.

(g) The fire department shall be advised of each such installation.

339. Liquid Piped into Buildings or Structures

3390. Liquid LP-Gas piped into buildings in accordance with 3150(c)(1) shall comply with 316.

3391. Liquid LP-Gas piped into buildings in accordance with 3150(c)(2) from containers located and installed outside the building or structure in accordance with 311 and 312, shall comply with the following:

(a) Liquid piping shall not exceed ¾ inch I.P.S. and shall comply with 315 and 316. If approved by the authority having jurisdiction, copper tubing complying with 2320(c)(1) and with a maximum outside diameter of ¾ inch may be used. Liquid piping in buildings shall be kept to a minimum, and shall be protected against construction hazards by:

(1) Securely fastening it to walls or other surfaces to provide adequate protection against breakage.

(2) Locating it so as to avoid exposure to high ambient temperatures.

(b) A readily accessible shutoff valve shall be located at each intermediate branch line where it leaves the main line. A second shutoff valve shall be located at the appliance end of the branch and upstream of any flexible appliance connector.

(c) Excess-flow valves complying with 2222(b) and 2342 shall be installed in the container outlet supply line, downstream of each shutoff valve, and at any point in the piping system where the pipe size is reduced. They shall be sized for the reduced size piping.

(d) Hose shall not be used to carry liquid between the container and the building, or at any point in the liquid line except as the appliance connector. Such connectors shall be as short as practicable and shall comply with 235, 3167 and 3169.

(e) Hydrostatic relief valves shall be installed in accordance with 317.

(f) Provision shall be made so that the release of fuel when any section of piping or appliances are disconnected shall be minimized by use of one of the following methods:

(1) An approved automatic quick-closing coupling which shuts off the gas on both sides when uncoupled.

(2) Closing the shutoff valve closest to the point to be disconnected and allowing the appliance or appliances on that line to operate until the fuel in the line is consumed.

34. INSTALLATION OF APPLIANCES

340. Application

3400. This section includes installation provisions for LP-Gas appliances fabricated in accordance with Section 25.

3401. Installation of appliances on commercial vehicles is covered in Section 38.

3402. With the approval of the authority having jurisdiction, unattended heaters used for the purpose of animal or poultry production inside structures without enclosing walls need not be equipped with an automatic device designed to shut off the flow of gas to main burners and pilot, if used, in the event of flame extinguishment or combustion failure.

341. Reference Standards

3410. LP-Gas appliances shall be installed in accordance with this Standard and other national standards which may apply. These include:

(a) National Fuel Gas Code, NFPA No. 54 (ANSI Z223.1).

(b) Stationary Combustion Engines and Gas Turbines, NFPA No. 37.

(c) Mobile Home Parks, NFPA No. 501A (ANSI A119.3)

(d) Mobile Homes, NFPA No. 501B (ANSI A119.1).

(e) Recreational Vehicles, NFPA No. 501C (ANSI A119.2).

(f) Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment, NFPA No. 96.

(g) Ovens and Furnaces, NFPA No. 86A.

(h) Incinerators and Rubbish Handling, NFPA No. 82.

(i) Motor Craft (Pleasure and Commercial), NFPA No. 302.

(j) Grain Elevators and Bulk Handling, NFPA No. 61B. (Grain Dryers.)

35. ENGINE FUEL SYSTEMS

350. Application

3500. This section includes installation provisions for that part of an LP-Gas system supplying fuel to internal combustion engines, from the withdrawal valve on the fuel container to the engine fuel

intake manifold. This part of the system includes the supply piping, regulation, vaporization, gas-air mixing and carburetion equipment. This section applies to stationary engine fuel installations and to those mounted on vehicles, and includes certain operating procedures for vehicular systems.

3501. Containers supplying fuel to stationary engines, or to portable engines used in lieu of stationary engines (see 352), shall be installed in accordance with Section 31 (see Section 33 for portable engines used in buildings, structures or on roofs under certain conditions).

3502. Containers supplying fuel to engines on vehicles, regardless of whether the engine is used to propel the vehicle or is mounted on it for other purposes, shall be constructed and installed in accordance with Section 38.

351. General Provisions for LP-Gas Engine Fuel Systems

3510. In installations involving the vaporization of gas by other than heat from the ambient atmosphere through the container walls, the following shall apply:

(a) Devices which supply heat directly to the fuel container shall be equipped with an automatic device to cut off the supply of heat before the pressure in the container reaches 200 psig.

(b) Vaporizers shall be fabricated of materials suitable for LP-Gas service and resistant to the action of LP-Gas under service conditions (see 240 for general requirements for similar equipment). Such vaporizers shall be designed for engine fuel service and shall comply with the following:

(1) The vaporizer proper, any part of it, or any devices used with it, which may be subjected to container pressure, shall have a design pressure of at least 250 psig, and shall be plainly and permanently marked at a readily visible point as follows:

a. With the design pressure of the fuel-containing portion in psig.

b. With the water capacity of the fuel-containing portion in pounds.

(2) Vaporizers shall not be equipped with fusible plugs.

(3) Each vaporizer shall have a valve, or suitable plug, located at or near the lowest portion of the section occupied by the water or other heating liquid to permit substantially complete drainage. The engine cooling system drain or water hoses may serve this purpose, if effective.

(4) Vaporizers shall be securely fastened in position.

(5) Engine exhaust gases may be used as a direct source of heat to vaporize the fuel if the materials of construction of those parts of the vaporizer in contact with the exhaust gases are resistant to corrosion from these gases, and if the vaporizer system is designed to prevent excessive pressures (see 3510(a)).

3511. Gas regulating and mixing equipment shall be installed as follows:

(a) Approved automatic pressure reducing equipment, properly secured, shall be installed between the fuel supply container and the gas-air mixer to regulate the pressure of the fuel delivered to the gas-air mixer.

(b) An approved automatic shutoff valve shall be provided in the fuel system at some point ahead of the inlet of the gas-air mixer, designed to prevent the flow of fuel to the mixer when the ignition is off, or if the engine should stop. (See 3543(a) for use of atmospheric type regulators (zero governors) to meet this provision on engines used exclusively out-of-doors.)

3512. Piping shall comply with Section 23 as to material and design, and be installed in accordance with 315 and 316, except that steel tubing shall have a minimum wall thickness of 0.049 inches. Flexible connectors or hose complying with 235 may be used between the container and regulator, or between the regulator and the gas-air mixer, with the approval for this application of any of the authorities listed in 1200. On engine fuel lines on vehicles where a hose in excess of 60 inches in length is used, the hose shall have stainless steel wire braid reinforcement and comply with 235. All piping shall be so installed, braced and supported as to reduce to a minimum the possibility of damage due to vibration, strains or wear. Hydrostatic relief valves shall be installed in accordance with 3170.

352. Engine Installations Other than on Vehicles

3520. Stationary engines and gas turbines installed in buildings, including portable engines used in lieu of, or to supplement, stationary engines, shall comply with the Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines, NFPA No. 37, and the applicable provisions of Chapters 1 and 2 and Section 31 of this Standard.

3521. Portable engines, except as provided in 3520, may be used in buildings only for emergencies, and the following shall apply:

(a) The capacity of the LP-Gas containers used with such engines and the equipment used to provide fuel to them shall comply with the applicable provisions of Section 33.

(b) An approved automatic shutoff valve shall be provided in the fuel system ahead of the engine, designed to prevent the flow of fuel to the engine when the ignition is off, or if the engine should stop.

(c) Provision shall be made to supply sufficient air for combustion and cooling. Exhaust gases shall be discharged to a point outside the building, or to an area in which they will not constitute a hazard.

3522. Installation of piping, gas mixing, vaporizing and regulating equipment for engine installations covered in 3520 and 3521 shall be in accordance with 351.

353. General Provisions for Vehicles Having Engines Mounted on Them

3530. This subsection includes provisions for the installation of equipment on vehicles to supply LP-Gas as a fuel for engines mounted on these vehicles. The term "vehicles" includes any readily portable mobile unit, whether the engine is used to propel it or is mounted on it for other purposes. It supplements the installation provisions of 351, applying them specifically to engines mounted on vehicles.

3531. Gas vaporizing, regulating, mixing and carburetion equipment to provide LP-Gas as a fuel for engines shall be installed in accordance with 351 and the following:

(a) in the case of industrial trucks (including forklift trucks) and other engines on vehicles operating in buildings other than those used exclusively to house engines, the automatic shutoff valve in the fuel line shall be designed to close if the engine should stop.

(b) The source of air for combustion shall be completely isolated from the driver and passenger compartment, ventilating system or air conditioning system on the vehicle.

354. General Purpose Vehicles Propelled by LP-Gas

3540. This subsection applies to that part of the LP-Gas installation specified in 350 used to supply engine fuel for the propulsion of vehicles such as passenger cars, taxicabs, buses, trucks (including tractors, tractor-semitrailer units and truck trains) and farm tractors.

3541. Fuel containers shall comply with and be installed, located, mounted and protected as provided in 381.

3542. Gas vaporizing equipment, if required, shall comply with 351.

3543. Gas regulating, mixing and carburetion equipment shall comply with 3511 and with the following:

(a) Engine fuel systems on vehicles operating, garaged or serviced in buildings, other than those used exclusively to house engines, shall be equipped with automatic shutoff valves as provided by 3531(a). Atmospheric type regulators (zero governors) shall be considered as automatic shutoff valves only in the case of completely outdoor operations, such as farm tractors, construction equipment or similar outdoor engine applications.

(b) The source of air for combustion shall be isolated as provided in 3531(b).

3544. Piping shall comply with 3512.

3545. Vehicles fueled with LP-Gas may be stored or repaired in garages as provided by 3560.

355. Industrial (and Forklift) Trucks Powered by LP-Gas

3550. This subsection applies to LP-Gas installations on industrial trucks (including forklift trucks) both to propel them and to provide the energy for their materials handling attachments. LP-Gas fueled industrial trucks shall comply with the Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks, NFPA No. 505.

3551. Fuel containers shall comply with 381. Relief valve discharge shall comply with 3813(a).

3552. Gas vaporizing equipment, if required, shall comply with 351.

3553. Gas regulating and mixing equipment shall comply with 3511, except that engines shall have automatic shutoff valves as provided in 3531(a).

3554. Piping shall comply with 3512.

356. Operating Procedures for Vehicles

3560. Vehicles with LP-Gas engine fuel systems mounted on them (see 3530) and general purpose vehicles propelled by LP-Gas engines (see 3540) may be stored or serviced inside garages, provided:

(a) The fuel system is leak free and the container(s) is not filled beyond the limits specified in Chapter 4.

(b) The container shutoff valve is closed on vehicles or engines under repair except when engine is operated.

(c) The vehicle is not parked near sources of heat, open flames, or similar sources of ignition, or near inadequately ventilated pits.

3561. Industrial trucks (including forklift trucks) powered by LP-Gas engine fuel systems shall comply as to operation with the Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks, NFPA No. 505, and with the following:

(a) Refueling of such trucks shall be accomplished as follows:

(1) Trucks with permanently mounted containers shall be refueled out-of-doors.

(2) Exchange of removable fuel containers preferably should be done out-of-doors, but may be done indoors. If done indoors, means shall be provided in the fuel piping system to minimize the release of fuel when containers are exchanged, using one of the following methods:

a. Use of an approved quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line, or

b. Closing the shutoff valve at the fuel container, and allowing the engine to run until the fuel in the line is exhausted.

(b) LP-Gas fueled industrial trucks may be used in buildings or structures as follows:

(1) The number of fuel containers on such a truck shall not exceed two.

(2) With the approval of the authority having jurisdiction, industrial trucks may be used in buildings frequented by the public, including the times when such buildings are occupied by the public. The total water capacity of the fuel containers on an individual truck shall not exceed 105 pounds (nominal 45 pounds LP-Gas capacity).

(3) Trucks shall not be parked and left unattended in areas occupied by or frequented by the public except with the approval of the authority having jurisdiction. If so left, the fuel system shall be checked to be sure there are no leaks and that the container shutoff valve is closed.

(4) In no case shall industrial trucks be parked and left unattended in areas of excessive heat or near sources of ignition.

36. VAPORIZER INSTALLATION

360. Application

3600. This section applies to the installation of vaporizing devices covered in 243. It does not apply to engine fuel vaporizers,

or to integral vaporizing-burners such as those used for weed burners or tar kettles.

361. Installation of Indirect-Fired Vaporizers

3610. Indirect-fired vaporizers shall comply with 2431, and shall be installed as provided in 3611 through 3618.

3611. Indirect vaporizers may be installed out-of-doors, in buildings used exclusively for gas manufacturing or distribution, or in separate structures constructed in accordance with Section 71. Any such buildings shall be well ventilated near the floor line and roof.

3612. Indirect vaporizers may also be installed in structures attached to, or rooms within, buildings not used for gas manufacturing or distribution, provided such attached structures or rooms comply with Section 72, and that there are no openings of any sort from the vaporizer room into the building or structure of which it is a part.

3613. The housing for the vaporizer covered by 3611 or 3612 shall not have any unprotected drains to sewers or sump pits. Safety relief valves on vaporizers within buildings in industrial or gas manufacturing plants shall be piped to a point outside the building and shall discharge vertically upward.

3614. The device supplying the heat necessary for producing steam, hot water, or other heating medium may be installed out-of-doors, in a separate building, or in a structure attached to, or room within, another gas manufacturing or distributing building (but not buildings used for other purposes), provided:

(a) The housing provided shall comply with either Section 71 or 72, and shall be well ventilated near the floor line and roof.

(b) If part of another structure, the wall separating it from all other compartments or rooms containing LP-Gas vaporizers, pumps and central gas mixing devices, shall have no openings of any sort through it, and otherwise shall conform with Section 72.

(c) The heat supplying device, if out-of-doors, or the housing in which it is installed, shall be located with respect to other LP-Gas facilities and operations as required by Section 37.

NOTE: The requirements of 3614 are not applicable to domestic water heaters supplying heat for domestic system vaporizers.

3615. The heating medium piping into and from the vaporizer shall be provided with a suitable means for preventing the flow of gas into the heating system in the event of a tube rupture in the vaporizer. If the vaporizer is not provided with a suitable means to

prevent liquid passing through the vaporizer to the gas distribution piping (see 2431(c)), such protection shall be provided in the external piping.

3616. Gas-fired heating systems supplying heat for vaporization purposes shall be equipped with automatic safety devices to shut off gas to the main burners if the pilot light should fail.

3617. Vaporizers may be an integral part of a fuel storage container, directly connected to either the liquid or vapor space, or to both. A limit control shall be provided to prevent the heater from raising the product pressure above the design pressure of the vaporizer equipment, or the pressure within the storage container above the pressure shown in the first column of Table 2-1 corresponding with the design pressure of the container (or its 1974 Code equivalent — see Note 1 of Table 2-1).

3618. Atmospheric vaporizers employing heat from the ground or surrounding air shall be installed as follows:

(a) Buried underground, or

(b) Located inside a building close to the point of entry of the supply pipe, provided the capacity of the unit does not exceed one quart.

(c) Vaporizers of less than one quart capacity, not equipped with safety relief valves (see 2431(e)) may be installed provided one of the authorities listed in 1200 certifies that it is safe without such a valve.

(d) Vaporizers designed primarily for domestic service shall be protected against tampering and physical damage.

362. Installation of Direct Gas-Fired Vaporizers

3620. Direct gas-fired vaporizers shall comply with 2432, and shall be installed as provided in 3621 through 3625.

3621. Direct gas-fired vaporizers may be installed out-of-doors, in buildings used exclusively for gas manufacturing or distribution, or in separate structures constructed in accordance with Section 71. Any such buildings shall be well ventilated near the floor line and roof.

3622. Direct gas-fired vaporizers may also be installed in structures attached to, or in rooms within, another gas manufacturing or distributing structure (but not buildings used for other purposes), provided:

(a) The housing provided shall comply with either Section 71 or 72, and shall be well ventilated near the floor line and roof.

(b) If part of another structure, the wall separating it from all other compartments or rooms containing LP-Gas vaporizers, pumps and central gas mixing devices shall have no openings of any sort through it, and otherwise shall conform to Section 72.

3623. The housing for the vaporizer covered in 3621 and 3622 shall not have unprotected drains or sump pits. Safety relief valves on vaporizers within buildings in industrial or gas manufacturing plants shall be piped to a point outside the building and shall discharge vertically upward.

3624. Direct gas-fired vaporizers may be connected to the liquid space or to both the liquid and the vapor space of the container, but in any case there shall be a manually operated shutoff valve in each connection at the container, to permit completely shutting off all flow of vapor or liquid.

3625. Direct gas-fired vaporizers of any capacity shall be located in accordance with Table 3-3.

Table 3-3

Exposure	Minimum Distance Required
Container	10 feet
Container shutoff valves	15 feet
Point of transfer (See 4001)	20 feet
Nearest important building or group of buildings or line of adjoining property which may be built upon (except buildings in which vaporizer is installed. See 3621 and 3622).	25 feet

363. Installation of Direct Gas-Fired Tank Heaters

3630. Gas-fired tank heaters shall comply with 2433, and shall be installed as follows:

(a) The container heated by a direct gas-fired tank heater shall be located in accordance with Table 3-4 with respect to the nearest important building, group of buildings, or line of adjoining property which may be built upon.

Table 3-4

Container Water Capacity	Minimum Distance Required
500 gallons or less	10 feet
501 to 1200 gallons	25 feet
Over 1200 gallons	50 feet

(b) Pressure regulating and reducing equipment, if located within 10 feet of a direct-fired tank heater, shall be separated from the open flame by a substantially airtight noncombustible partition.

364. Installation of Vaporizing-Burners

3640. Vaporizing-burners shall comply with 2434, and shall be installed as follows:

(a) Vaporizing-burners shall be installed outside of buildings. The minimum distance between any container and a vaporizing-burner shall be in accordance with Table 3-5.

Table 3-5

Container Water Capacity	Minimum Distance Required
500 gallons or less	10 feet
501 to 2000 gallons	25 feet
Over 2000 gallons	50 feet

(b) Pressure regulating and control equipment shall be so located or so protected as not to be subject to temperatures above 140 F, unless it is designed and recommended for use by the manufacturer for a higher temperature.

(c) Pressure regulating and control equipment located downstream of the vaporizing section shall be designed to withstand the maximum discharge temperature of the hot vapor.

(d) Dehydrators and dryers utilizing vaporizing-burners shall be equipped with automatic devices both upstream and downstream of the vaporizing section. These devices shall be installed and connected to shut off in the event of excessive temperature, flame failure, and if applicable, insufficient air flow.

(e) Manually operated positive shutoff valves shall be located at the containers to shut off all flow to the vaporizing-burners.

365. Installation of Waterbath Vaporizers

3650. Waterbath vaporizers shall comply with 2433 and shall be installed as follows:

(a) If a waterbath vaporizer is electrically heated and all electrical equipment is suitable for Class 1, Group D locations, the unit shall be treated as indirect-fired and installed in accordance with 361.

(b) All others shall be treated as direct-fired vaporizers and installed in accordance with 362.

37. IGNITION SOURCE CONTROL

370. Application

3700. This section includes provisions to minimize the possibility 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 Standard.

3701. Liquefied petroleum gas storage containers do not require lightning protection (see NFPA No. 78, Lightning Protection Code).

3702. Since liquefied petroleum gas is contained in a closed system of piping and equipment, the system need not be electrically conductive or electrically bonded for protection against static electricity (see NFPA No. 77, Recommended Practice on Static Electricity).

371. Electrical Equipment

3710. Electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with the National Electrical Code, NFPA No. 70 (ANSI Standard C1), for ordinary locations except that fixed electrical equipment in classified areas shall comply with 3711.

3711. Fixed electrical equipment and wiring installed within classified areas specified in Table 3-6 shall comply with Table 3-6 and shall be installed in accordance with the National Electrical Code, NFPA No. 70 (ANSI Standard C1). This provision does not apply to fixed electrical equipment at residential or commercial installations of LP-Gas systems or to systems covered by Section 38.

3712. Electrical equipment installed on LP-Gas cargo vehicles shall comply with 6004.

(text continued on page 93)

Table 3-6

Part	*Location*	*Extent of Classified Area*[1]	*Equipment Shall Be Suitable for National Electrical Code, Class 1, Group D*[2]
A	Storage Containers Other Than DOT Cylinders.	Within 15 feet in all directions from connections, except connections otherwise covered in Table 3-6.	Division 2
B	Tank Vehicle and Tank Car Loading and Unloading.[3]	Within 5 feet in all directions from connections regularly made or disconnected for product transfer.	Division 1
		Beyond 5 feet but within 15 feet 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 3-1)	Division 2
C	Gage Vent Openings Other Than Those On DOT Cylinders.	Within 5 feet in all directions from point of discharge.	Division 1
		Beyond 5 feet but within 15 feet in all directions from point of discharge.	Division 2
D	Relief Valve Discharge Other Than Those on DOT Cylinders.	Within direct path of discharge.	Division 1 *Note:* Fixed electrical equipment should preferably not be installed.
		Within 5 feet in all directions from point of discharge.	Division 1
		Beyond 5 feet but within 15 feet in all directions from point of discharge except within the direct path of discharge.	Division 2

[1] The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

[2] See Article 500 — "Hazardous Locations" in NFPA No. 70 (ANSI Standard C1) for definitions of Classes, Groups, and Divisions.

[3] When classifying extent of hazardous area, consideration shall be given to possible variations in the spotting of tank cars and tank vehicles at the unloading points and the effect these variations of actual spotting point may have on the point of connection.

(*Continued*)

Part	Location	Extent of Classified Area[1]	Equipment Shall Be Suitable for National Electrical Code, Class 1, Group D[2]
E	Pumps, vapor compressors, gas-air mixers and vaporizers other than direct fired.		
	Indoors without ventilation.	Entire room and any adjacent room not separated by a gastight partition.	Division 1
		Within 15 feet of the exterior side of any exterior wall or roof that is not vaportight or within 15 feet of any exterior opening.	Division 2
	Indoors with adequate ventilation.[4]	Entire room and any adjacent room not separated by a gastight partition.	Division 2
	Outdoors in open air at or abovegrade.	Within 15 feet in all directions from this equipment and within the cylindrical volume between the horizontal equator of the sphere and grade. (See Figure 3-1)	Division 2
F	Service Station Dispensing Units.	Entire space within dispenser enclosure, and 18 inches horizontally from enclosure exterior up to an elevation 4 ft. above dispenser base. Entire pit or open space beneath dispenser.	Division 1
		Up to 18 inches abovegrade within 20 ft. horizontally from any edge of enclosure. *Note:* For pits within this area, see Part G of this table.	Division 2

[1] The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

[2] See Article 500 — "Hazardous Locations" in NFPA No. 70 (ANSI Standard C1) for definitions of Classes, Groups, and Divisions.

[4] Where specified for the prevention of fire or explosion during normal operation, ventilation is considered adequate where provided in accordance with the provisions of this standard.

(Continued)

Part	Location	Extent of Classified Area[1]	Equipment Shall Be Suitable for National Electrical Code, Class 1, Group D[2]
G	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
		Entire room and any adjacent room not separated by a gastight partition.	Division 2
		Within 15 feet in all directions from pit or trench when located outdoors.	Division 2
	With adequate mechanical ventilation.	Entire pit or trench.	Division 2
		Entire room and any adjacent room not separated by a gastight partition.	Division 2
		Within 15 feet in all directions from pit or trench when located outdoors.	Division 2
H	Special Buildings or rooms for storage of portable containers.	Entire room.	Division 2
I	Pipelines and connections containing operational bleeds, drips, vents or drains.	Within 5 ft. in all directions from point of discharge.	Division 1
		Beyond 5 ft. from point of discharge, same as Part E of this table.	

[1] The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

[2] See Article 500 — "Hazardous Locations" in NFPA No. 70 (ANSI Standard C1) for definitions of Classes, Groups, and Divisions.

(Continued)

Part	Location	Extent of Classified Area[1]	Equipment Shall Be Suitable for National Electrical Code, Class 1, Group D[2]
J	Container Filling:		
	Indoors without ventilation	Entire room	Division 1
	Indoors with adequate ventilation[4]	Within 5 feet in all directions from connections regularly made or disconnected for product transfer.	Division 1
		Beyond 5 feet and entire room.	Division 2
	Outdoors in open air	Within 5 feet in all directions from connections regularly made or disconnected for product transfer.	Division 1
		Beyond 5 feet but within 15 feet 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 3-1)	Division 2

[1] The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.

[2] See Article 500 — "Hazardous Locations" in NFPA No. 70 (ANSI Standard C1) for definitions of Classes, Groups, and Divisions.

[4] Where specified for the prevention of fire or explosion during normal operation, ventilation is considered adequate where provided in accordance with the provisions of this standard.

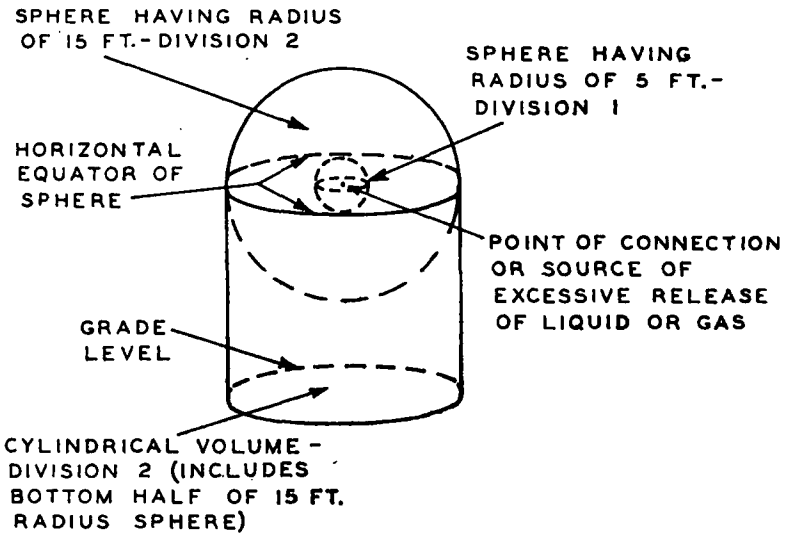

Figure 3-1
(See Table 3-6)

372. Other Sources of Ignition

3720. Open flames or other sources of ignition shall not be permitted in vaporizer rooms (except those housing direct-fired vaporizers), pump houses, container filling rooms or other similar locations. Direct-fired vaporizers shall not be permitted in pump houses or container filling rooms.

3721. Open flames (except as provided for in Section 36), cutting or welding, portable electric tools and extension lights capable of igniting LP-Gas, shall not be permitted within classified areas specified in Table 3-6 unless the LP-Gas facilities have been freed of all liquid and vapor, or special precautions observed under carefully controlled conditions.

38. INSTALLATION OF LP-GAS SYSTEMS ON VEHICLES

380. Application

3800. This section applies to all installations of LP-Gas systems on vehicles, whether or not self-propelled, except for such systems (or parts of systems) as are covered in 3801. LP-Gas systems on vehicles may be either vapor-withdrawal or liquid-withdrawal type.

Provisions are included for installations served by exchangeable (removable) container systems and by permanently mounted containers on the following types of vehicles:

(a) Passenger vehicles such as private cars, taxicabs and buses.

(b) Commercial, industrial (including forklift trucks), construction or public service vehicles such as trucks, semitrailers, trailers, portable tar kettles, mobile laboratories, clinics and mobile cooking units, such as catering and canteen vehicles.

3801. This section does not apply to:

(a) Systems installed on mobile homes. (See 3003(d).)

(b) Systems installed for purposes other than propulsion on recreational vehicles. (See 3003(e).) Section 35 is applicable to the installation of LP-Gas engine fuel equipment for the propulsion of such vehicles. (See 3801(c).)

(c) That part of the system installed on vehicles to provide LP-Gas as engine fuel to engines mounted on these vehicles, which is covered by Section 35.

(d) Tank trucks, truck transports (trailers and semitrailers) and similar units used to transport LP-Gas as cargo, which are covered by Chapter 6.

NOTE: Section 35 is applicable to the installation of LP-Gas engine fuel piping and equipment on such vehicles.

381. Construction, Location, Mounting and Protection of Containers and Systems

3810. Containers shall comply with Section 21 and appurtenances used to equip them for service shall comply with Section 22. In addition 3810(a) through (g) shall apply:

(a) ASME containers shall be constructed for a minimum 250 psig design pressure.

(b) Containers installed in enclosed spaces on vehicles, (including recesses or cabinets covered in 3811), and all engine fuel containers for industrial trucks, shall be constructed as follows:

(1) DOT cylinder specification containers shall be designed and constructed for at least a 240 psig service pressure.

(2) ASME containers shall be constructed for at least a 312.5 psig design pressure.

(3) Engine fuel containers shall be equipped with internal type spring-loaded safety relief valves. Fusible plugs shall not be used.

(c) Portable (removable) containers shall comply with 213.

(d) Containers to be permanently mounted shall be constructed so that after mounting the protection of all container appurtenances, and the connections to these appurtenances, they comply with 3812(c).

(e) Individual LP-Gas fuel containers used on passenger-carrying vehicles shall not exceed 200 gallons water capacity.

(f) Individual LP-Gas containers used on other than passenger-carrying vehicles normally operating on the highway shall not exceed 300 gallons water capacity. This shall not be construed as applying to the use of LP-Gas from the cargo tanks of vehicles covered by Chapter 6.

(g) Containers designed for stationary service only, and not in compliance with 213, shall not be used.

3811. Containers utilized for the purposes covered by this section shall not be installed, transported or stored (even temporarily) inside any vehicle covered by Section 38, except as provided in 3812(d), or as provided by applicable DOT regulations. The LP-Gas supply system, including the containers, may be installed on the outside of the vehicle, or in a recess or cabinet vaportight to the inside of the vehicle but accessible from and vented to the outside, with the vents located near the top and bottom of the enclosure, and 3 feet horizontally away from any opening into the vehicle below the level of the vents.

3812. Containers shall be securely mounted on the vehicle, or within the enclosing recess or cabinet, and located and installed so as to minimize the possibility of damage to containers, their appurtenances or contents as follows:

(a) Containers shall be installed with as much road clearance as practicable but not less than the minimum road clearance of the vehicle under maximum spring deflection. This clearance shall be measured to the bottom of the container, or to the lowest fitting, support or attachment on the container or container housing, whichever is lower.

(b) Fuel containers shall be securely mounted to prevent jarring loose and slipping or rotating, and the fastenings shall be designed and constructed to withstand without permanent visible deformation static loading in any direction equal to four times the weight of the container filled with fuel. When containers are mounted within a vehicle housing, the securing of the housing to the vehicle shall comply with this provision. Any hoods, domes or removable portions of the housing or cabinet shall be provided with means to keep them firmly in place in transit. Field welding shall comply with 3128.

(c) All container valves, appurtenances and connections shall be adequately protected to prevent damage due to accidental contacts with stationary objects, from loose objects, stones, mud, or ice, thrown up from the ground or floor, and from damage due to overturn or similar vehicular accident. In the case of permanently mounted containers, this provision may be met by the location on the vehicle, with parts of the vehicle furnishing the protection. On portable (removable) containers the protection for container valves and connections shall be permanently attached to the container. (See 2130 and 2131.) Such weather protection as may be necessary to insure safe operation shall be provided for containers and systems mounted on the outside of the vehicle.

(d) Engine fuel containers on passenger carrying vehicles may be installed in the luggage compartment (trunk) of passenger cars, taxicabs, and other similar vehicles but they shall not be installed in the driver's compartment or the passenger compartment of any vehicle. Engine fuel containers shall be installed on passenger carrying vehicles as follows:

(1) Containers shall be located in a place and in a manner to minimize the possibility of damage to the container and its fittings. Containers located in the rear of the vehicles, when protected by substantial bumpers, shall be considered in conformance with this requirement. In case the fuel container must be installed near the engine or exhaust system, it shall be shielded against direct heating.

(2) Except as provided in 3812(d)(3), fuel containers on passenger-carrying vehicles shall be installed and fitted so that no gas from fueling and gaging operations, or from relief valves, can be released inside the passenger or luggage compartments, or within any space containing radio equipment, as follows:

a. Remote (outside) filling connections shall be used, and

b. The discharges from gaging devices and container relief valves shall be piped to the outside of the vehicle. Relief valve discharge shall be directed upward within 45° of the vertical and so that any gas released will not impinge on the vehicle, and so that the possibility of impingement on adjacent vehicles is minimized.

(3) If fuel containers cannot be installed and fitted in accordance with 3812(d)(2), the following shall apply:

a. The passenger-carrying compartment, and any space containing radio equipment, shall be isolated from the space in which the container and container fittings are located by a seal to prevent direct seepage of gas to these spaces.

b. This sealed-off container space shall be adequately vented to the outside of the vehicle so that:

1. Any LP-Gas released within it will be readily dissipated to the outside, and

2. The seal will not be damaged due to the sudden increases in air pressure which may occur when the luggage compartment is closed quickly.

c. The relief valve discharge shall be piped to outside the vehicle in accordance with 3812(d)(2)b.

3813. Containers installed on portable tar kettles alongside the kettle, or on the vehicle frame, shall be protected against radiant or convected heat from open flame or other burners by the use of a heat shield or by the location of the container(s) on the vehicle so as to prevent the temperature of the fuel in the container from becoming abnormally high. In addition, the following shall apply:

(a) Container location, mounting and protection shall comply with 3812(a), (b) and (c) except that the protection for DOT container valves need not be permanently attached to the container, however the protection shall comply with 2130(a) and (b);

(b) Piping shall comply with 3816 (a), (b), (d), (e), (g), (h), and (i);

(c) Flexible connections shall comply with 2350, 2351 and 2352;

(d) Container valves shall be closed when burner is not in use;

(e) Containers shall not be refilled while burners are in use as provided in 4061(b).

3814. Container appurtenances shall be installed in accordance with 3814(a) through (g).

(a) Container safety relief valves shall be located and installed as follows:

(1) Except as provided in 3812(d), safety relief valves on portable containers installed inside cabinets or recesses complying with 3811 may discharge within the enclosure.

(2) Relief discharge outlets on containers installed on the outside of the vehicle shall be located:

a. Outside of enclosed spaces, at least 3 feet horizontally away from any opening into the vehicle below the level of such discharge, and as far as practicable from sources of ignition.

b. In such a manner as to minimize the possibility of impingement of escaping gas upon a container, vehicle parts, or on other vehicles in adjacent lines of traffic. For engine fuel containers, the relief valve discharge shall be vented upward within 45° of the vertical to accomplish this.

(3) Safety relief valve discharge lines, if used, shall be metallic (other than aluminum) and shall be sized, located and secured so as to permit sufficient safety relief valve discharge capacity. Flexible metal hose or tubing used shall be able to withstand the pressure from the relief valve vapor discharge when the relief valve is in full open position.

(4) On vehicles used outdoors or in industrial locations, means shall be provided (such as loose fitting caps) to minimize the possibility of the entrance of water or dirt into either the relief valve or its discharge piping. The protecting means shall remain in place except when the relief valve operates. In this event, it shall permit the relief valve to operate at sufficient capacity.

(b) The filling, withdrawal and equalizing connections of containers shall be equipped in compliance with 2220 through 2222 (see "Used as Fuel on Vehicles", Column 5 of Table 2-3).

(c) Main shutoff valves on container for liquid and vapor shall be readily accessible.

(d) Containers to be filled volumetrically shall be equipped with liquid level gaging devices as provided in 223, except that variable gages requiring the venting of gas to the atmosphere shall not be used on industrial trucks (including forklift trucks). Portable containers may be designed, constructed and fitted for filling in either the vertical or horizontal position, or if of the portable universal type (see 2231(c)(2)), in either position. The container shall be in the appropriate position when filled or, if of the portable universal type, may be loaded in either position, provided:

(1) The fixed level gage indicates correctly the maximum permitted filling level in either position.

(2) The safety relief valves are located in, or connected to, the vapor space in either position.

(e) All container inlets and outlets, except safety relief valves and gaging devices, shall be labeled to designate whether they communicate with the vapor or liquid space. Labels may be on valves.

(f) Containers from which only vapor is to be withdrawn shall be installed and equipped with suitable connections to minimize the possibility of the accidental withdrawal of liquid.

3815. Regulators, other than those used in engine fuel systems, shall comply with 240 and 247 and shall be installed in accordance with 314. If in an enclosed space, the regulator relief valve and the space above the regulator and relief valve diaphragms shall be vented to the outside air. Such venting is not required if regulator is located in a recess or cabinet as provided for in 3811.

3816. Piping shall comply with Section 23 as to material and design and shall be installed in accordance with 316, except that steel tubing shall have a minimum wall thickness of 0.049 inches. Paragraphs 3816(a) through (j) shall also apply to piping systems on vehicles covered by Section 38.

(a) A flexible connector or a tubing loop shall be installed between the regulator outlet and the piping system to protect against expansion, contraction, jarring and vibration strains.

(b) In the case of removable containers, a flexible connection shall be installed between the container and the gas piping system or regulator.

(c) Flexible connectors shall comply with 235 and be installed in accordance with 3167(a). Flexible connectors of more than 36 inches overall length, or fuel lines of essentially all hose, shall be used only with the approval of one of the authorities listed in 1200.

(d) The piping system shall be designed, installed, supported and secured in such a manner as to minimize the possibility of damage due to vibration, strains or wear, and to preclude any working loose while in transit.

(e) Piping shall be installed in a protected location, and if outside, under the vehicle and below any insulation or false bottom, fastenings and protection shall be such as to prevent abrasion or damage due to vibration. At points where piping passes through structural members or floors, a rubber grommet or equivalent shall be installed to prevent chafing.

(f) Gas piping shall be installed to enter the vehicle through the floor directly beneath, or adjacent to, the appliance served. If a branch line is required, the tee connection shall be in the main gas line under the floor and outside the vehicle.

(g) Exposed parts of the piping system shall either be of corrosion-resistant material or adequately protected against exterior corrosion.

(h) Hydrostatic relief valves, complying with 2360, shall be installed in isolated sections of liquid piping as provided in 317.

(i) Piping systems, including hose, shall be tested and proven free of leaks in accordance with 318.

(j) There shall be no fuel connection between a tractor and trailer or other vehicle units.

382. Equipment Installation

3820. Equipment for installation on vehicles shall comply with Section 24 as to design and construction, and shall be installed in accordance with 319, and with the following:

(a) Installation shall be made in accordance with the manufacturer's recommendations and, in the case of listed or approved equipment, as provided in the listing or approval.

(b) Equipment installed on vehicles shall be considered as part of the LP-Gas system on the vehicle and shall be protected against vehicular damage as provided for container appurtenances and connections in 3812(c).

383. Appliance Installation

3830. The term "appliances" as used in this subsection shall include any commercial or industrial gas consuming device except engines. The installation of that part of the LP-Gas system on the vehicle designed to accept LP-Gas from the container withdrawal valve, and to deliver a suitable gas-air mixture to the engine, shall comply with Section 35. (See 3801(c)).

3831. All gas consuming devices (appliances), other than engines, installed on vehicles shall be approved as provided in 251, shall comply with 252, and shall be installed as follows:

(a) Whenever the device or appliance is of a type designed to be in operation while the vehicle is in transit, such as a cargo heater or cooler, suitable means to stop the flow of gas in the event of a line break, such as an excess flow valve, shall be installed. Excess flow valves shall comply with 2342 and 2222(b).

(b) All gas-fired heating appliances shall be equipped with safety shutoffs in accordance with 2524(a) except those covered in 3317(b).

(c) For installations on vehicles intended for human occupancy, all gas-fired heating appliances, except ranges and illuminating appliances, shall be designed or installed to provide for a complete separation of the combustion system from the atmosphere inside the vehicle. Combustion air inlets and flue gas outlets shall be listed or certified as components of the appliance.

(d) For installations on vehicles not intended for human occupancy, unvented type gas-fired heating appliances may be used to protect the cargo. Provision shall be made to provide air for combustion (see 3831(f)) and to dispose of the products of combustion to the outside.

(e) Appliances installed within vehicles shall comply with the following:

(1) If in the cargo space, they shall be located so as to be readily accessible whether the vehicle is loaded or empty.

(2) Appliances shall be so constructed or otherwise protected as to minimize possible damage or impaired operation due to cargo shifting or handling.

(3) Appliances shall be located so that a fire at any appliance will not block egress of persons from the vehicle.

(f) Provision shall be made in all appliance installations to insure an adequate supply of outside air for combustion.

(g) A permanent caution plate shall be provided, affixed either to the appliance, or to the vehicle, outside of any enclosure, and adjacent to the container(s), including the following items:

Caution

1. Be sure all appliance valves are closed before opening container valve.
2. Connections at the appliances, regulators and containers shall be checked periodically for leaks with soapy water or its equivalent.
3. Never use a match or flame to check for leaks.
4. Container valves shall be closed when equipment is not in use.

384. General Precautions

3840. Containers on vehicles shall be filled or refilled as provided by 4031. See 2102 for requalification requirements for continued use or reinstallation.

3841. Mobile units containing hotplates and other cooking equipment, including mobile kitchens and catering vehicles, shall be provided with at least one approved portable fire extinguisher rated in accordance with the Standard for Installation of Portable Fire Extinguishers, NFPA No. 10, at not less than 10-B, C.

39. FIRE PROTECTION

390. Application

3900. This section includes provisions for fire protection to augment the leak control and ignition source control provisions in this standard.

391. General

3910. The wide range in size, arrangement and location of LP-Gas installations covered by this standard precludes the inclusion of detailed fire protection provisions completely applicable to all installations. Provisions in this section are subject to verification or modification through analysis of local conditions.

3911. The planning for effective measures for control of inadvertent LP-Gas release or fire shall be coordinated with local

emergency handling agencies, such as fire and police departments. Such measures require specialized knowledge and training not commonly present in the training programs of emergency handling agencies.[1] Planning shall consider the safety of emergency personnel.

3912. Except as provided in 3913 or 3914, fire protection shall be provided for installations having storage containers with an aggregate water capacity of more than 4000 gallons subject to exposure from a single fire. The mode of such protection shall be arrived at through competent fire safety analysis of local conditions of hazard within the container site, exposure to or from other properties, water supply, the probable effectiveness of plant fire brigades, and the time of response and probable effectiveness of fire departments.

(a) The first consideration in such an analysis shall consist of the use of water applied by hose streams by the fire brigade or fire department for the effective control of hazardous leakage or fire exposing storage tanks, cargo vehicles or railroad tank cars which may be present.[2]

3913. If the analysis specified in 3912 indicates a serious hazard does not exist, the fire protection provisions of 3912 need not apply.

3914. If the analysis specified in 3912 indicates that a serious hazard exists and the provisions of 3912 cannot be met, special protection (see Definition) shall be provided in accordance with 392.

3915. Suitable roadways or other means of access for emergency equipment, such as fire department apparatus, shall be provided.

3916. Each industrial plant, distributing plant and distributing point, shall be provided with at least one listed portable extinguisher having a minimum rating of 10 B, C (see NFPA No. 10, Installation of Portable Fire Extinguishers, for explanation of ratings).

3917. LP-Gas fires shall not normally be extinguished until the source of the burning gas has been shut off or can be shut off.

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1. The National Fire Protection Association, American Petroleum Institute and National LP-Gas Association publish material, including visual aids, useful in such planning.

2. Experience has indicated that hose stream application of water in adequate quantities as soon as possible after the initiation of flame contact is an effective way to prevent container failure from fire exposure. The majority of large containers exposed to sufficient fire to result in container failure have failed in from 10 to 30 minutes after the start of the fire when water was not applied. Water in the form of a spray can also be used to control unignited gas leakage.

3918. Emergency controls shall be conspicuously marked and the controls shall be located so as to be readily accessible in emergencies.

392. Special Protection

3920. If insulation is used,[1] it shall be capable of limiting the container temperature to not over 800°F for a minimum of 50 minutes as determined by test with insulation applied to a steel plate and subjected to a test flame providing a heat flux of 70,000 Btu's per per hour per square foot substantially over the area of the test plate. The insulation system shall be inherently resistant to weathering and the action of hose streams.[2]

3921. If mounding is utilized, the provisions of 3921(a) and (b) shall apply:

(a) Mounding material shall be earth or sand and shall provide minimum thickness of cover for the container of at least 1 foot.

(b) Unless inherently resistant to erosion, a suitable protective cover shall be provided.

3922. If burial is utilized, the provisions of 3126 shall constitute adequate protection.

3923. If water spray fixed systems are used, they shall comply with NFPA No. 15, Water Spray Fixed Systems for Fire Protection. Such systems shall be automatically actuated by fire responsive devices and also have a capability for manual actuation.

3924. If monitor nozzles are used, they shall be located and arranged so that all container surfaces likely to be exposed to fire will be wetted. Such systems shall otherwise comply with NFPA No. 15, Water Spray Fixed Systems for Fire Protection, and shall be automatically actuated by fire responsive devices and also have a capability for manual actuation.

1. For LP-Gas fixed storage facilities of 60,000 gallons water capacity or less, a competent fire safety analysis (see 3912 and 3914) could indicate that applied insulating coatings are quite often the most practical solution for special protection.

2. It is recommended that insulation systems be evaluated on the basis of experience or listings by a nationally recognized testing laboratory.

CHAPTER 4

LP-GAS LIQUID TRANSFER

40. GENERAL PROVISIONS

400. Application

4000. This chapter covers transfers of liquid LP-Gas from one container to another whenever this transfer involves connections and disconnections in the transfer system, or the venting of LP-Gas to the atmosphere. The methods for determining the quantity of LP-Gas permitted in containers and the locations of, and safety requirements for, transfer operations also are included.

4001. The "point of transfer" shall be considered to be the location where connections and disconnections are made or where LP-Gas is vented to the atmosphere in the course of transfer operations.

4002. Provisions for ignition source control at transfer locations are covered in Section 37. Fire protection shall be in accordance with Section 39.

401. General Transfer Operations, Locations and Precautions

4010. Liquid shall be transferred into containers only outdoors or in structures especially designed for this purpose. Such structures constructed or converted for container filling after December 31, 1972 shall comply with Chapter 7. The transfer of liquid into containers on the roofs of structures is prohibited.

4011. Transfer hoses larger than ½-inch internal diameter shall not be used for making connections to individual containers being filled indoors.

4012. Tank trucks or transports unloading into storage containers shall be at least 10 feet from the container and so positioned that the shutoff valves on both the truck and the container are readily accessible. In the case of distributing points, such as LP-Gas service stations, the truck or transport shall not be parked on a public way.

4013. During the time the tank cars are on sidings for loading or unloading, the following shall apply:

(a) A caution sign, such as STOP. TANK CAR CONNECTED, shall be placed at the active end(s) of the siding while car is connected as required by DOT Regulations.

(b) A wheel at each end of car shall be blocked on the rails.

402. Transfer Personnel

4020. Transfer operations shall be conducted by competent personnel meeting the provisions of 1500. At least one qualified person shall remain at or near the transfer operation from the time connections are made until the transfer is completed, shutoff valves are closed, and lines are disconnected.

4021. Transfer personnel shall exercise precaution to assure that the LP-gases transferred are those for which the transfer system and the containers to be filled are designed.

403. Containers to be Filled

4030. Containers shall be filled only by the owner or upon his authorization.

4031. Containers shall be filled only after determination that they comply with the design, fabrication, inspection, marking and requalification provisions of this Standard. (See 2101, 2102 and Appendices B and C.)

4032. DOT specification cylinders authorized as "single trip," "nonrefillable," or "disposable" containers shall not be refilled with LP-Gas.

4033. Containers into which LP-Gas is to be transferred shall comply with the following as to service or design pressure in relation to the vapor pressure of the LP-Gas:

(a) For DOT specification cylinders, the service pressure marked on the container shall not be less than 80 percent of the vapor pressure of the LP-Gas at 130 F. For example, if the vapor pressure of a commercial propane is 300 psig at 130 F, the service pressure must be at least 80 percent of 300; or 240 psig.

(b) For ASME containers, the minimum design pressure (or its equivalent, see 2111), shall comply with Table 2-1 in relation to the vapor pressure of the LP-Gas.

404. Venting LP-Gas to the Atmosphere

4040. LP-Gas in either liquid or vapor form, normally shall not be vented to the atmosphere except under the following conditions:

(a) Venting for the operation of fixed liquid level, rotary or slip tube gages, provided the maximum flow does not exceed that from a No. 54 drill orifice.

(b) Venting the LP-Gas between shutoff valves before disconnecting the liquid loading line from the container. When necessary, suitable bleeder valves shall be used.

(c) LP-Gas may be vented for the purposes described in 4040(a) and (b) within structures designed for container filling as provided in 4010 and Chapter 7.

(d) Venting vapor from listed liquid transfer pumps using such vapor as a source of energy, provided the rate of discharge does not exceed that from a No. 31 drill size opening. (See 4221 as to location of such transfer operations.)

4041. Venting of gas from containers for purging or for other purposes shall be accomplished as follows:

(a) If indoors, containers may be vented only in structures designed and constructed for container filling in accordance with 4010 and Chapter 7 and with the following provisions:

(1) Piping shall be provided to carry the vented product outside and to a point at least 3 feet above the highest point of any building within 25 feet.

(2) Only vapors shall be exhausted to the atmosphere.

(3) If a vent manifold is used to allow for the venting of more than one container at a time, each connection to the vent manifold shall be equipped with a back flow check valve.

(b) When out of doors, container venting shall be done under conditions that will result in rapid dispersion of the product being released. Consideration shall be given to such factors as distance to buildings, terrain, wind direction and velocity, and use of a vent stack so that a flammable mixture will not reach a point of ignition.

(c) If conditions are such that venting into the atmosphere cannot be accomplished safely, LP-Gas may be burned off providing such burning is done under controlled conditions remote from combustibles or a hazardous atmosphere.

4042. The procedure to be followed for the disposal of LP-Gas in an emergency will be dictated by the conditions present, requiring individual judgment in each case and using, where practical, the provisions of this standard.

405. General Arrangement and Operation of Transfer Systems

4050. Liquid transfer may be accomplished by pressure differential, by gravity or by the use of pumps or compressors complying with Section 24.

4051. Compressors used for liquid transfer normally shall take suction from the vapor space of the container being filled and discharge into the vapor space of the container from which the withdrawal is being made.

4052. Transfer systems using positive displacement pumps shall include a recirculating device to limit the differential pressure on the pump under normal operating conditions, so that the total pressure will not exceed the maximum pressure rating of the pump. (See 2411 and 3190.) Manual shutoff valves in recirculating systems shall be kept open during operating periods.

4053. When hose is to be used for liquid transfer, a shutoff valve at the discharge end, so that the hose normally contains liquid, is recommended. Transfer hose thus equipped (called "wet hose" by the industry) shall be protected against excessive hydrostatic pressure by the use of hydrostatic relief valves. (See 317.)

4054. The provisions of 3168 shall apply.

4055. When a hose or swivel type piping is used for loading or unloading railroad tank cars, an emergency shutoff valve complying with 2343 shall be used at the tank car end of the hose or swivel type piping.

406. Control of Ignition Sources During Transfer

4060. Sources of ignition shall be carefully controlled during transfer operations, while connections or disconnections are made, or while LP-Gas is being vented to the atmosphere. In addition to the provisions of Section 37, the following shall apply:

(a) Internal combustion engines within 15 feet of a point of transfer shall be shut down while such transfer operations are in progress, except as follows:

(1) Engines of LP-Gas cargo vehicles constructed and operated in compliance with Chapter 6 while such engines are driving transfer pumps or compressors on these vehicles to load containers as provided in 4210.

(2) Engines installed in buildings as provided in 352.

(b) Smoking, open flames, metal cutting or welding, portable electrical tools and extension lights capable of igniting LP-Gas shall not be permitted within 15 feet of a point of transfer while filling operations are in progress. Care shall be taken to assure that materials which have been heated have cooled before the transfer is started.

(c) Sources of ignition, such as pilot lights, burners, electrical appliances, and engines, located on the vehicle being refueled shall be turned off during the filling of any LP-Gas container on the vehicle.

4061. Transfers to containers serving agricultural or industrial equipment requiring refueling in the field shall comply with the following:

(a) Air moving equipment, such as large blowers on crop driers or on space heaters, shall be shut down while containers are being refilled, unless the point of transfer is at least 50 feet from the air intake of the blower.

(b) Equipment employing open flames, or equipment with integral containers such as flame cultivators, weed burners, tractors, large blower type space heaters or tar kettles shall be shut down while refueling.

41. QUANTITY OF LP-GAS IN CONTAINERS

410. Application

4100. This section includes provisions covering the maximum quantity of LP-Gas which may be filled into containers and the methods of verifying this quantity.

411. Basis for Determining Container LP-Gas Capacity

4110. The maximum quantity of LP-Gas which may be put into a container is based upon 4111, 4112 and 4113.

4111. Portable containers built to DOT cylinder specifications and other aboveground containers with water capacities of 1,200 gallons or less, shall not be filled to the extent that they become liquid full even if the liquid temperature increases to 130 F.

4112. Other aboveground uninsulated containers, including those built to DOT portable or cargo tank specifications with water capacities in excess of 1,200 gallons, shall not be filled to the extent that they become liquid full even if the liquid temperature increases to 115 F.

4113. Underground containers shall not be filled to the extent that they become liquid full even if the liquid temperature increases to 105 F.

412. Maximum Quantities to be Filled into Containers

4120. The maximum quantities of liquid LP-Gas which may be put into containers to meet the provisions of 411 shall be as specified in 4121 and 4122. The method of determining compliance shall be in accordance with 4123.

4121. The maximum quantity of LP-Gas to be put into a container shall be based on the weight of LP-Gas in relation to the weight of water that the container would hold when liquid full of water at 60 F. Maximum permitted filling densities, expressed in percent of water weight capacity (WWC) of the container to be filled, shall be as shown in Columns 2, 4 and 6 of Table 4-1 for the specific gravity of the particular LP-Gas, the size container and the condition under which installed.

NOTE: Containers installed partially underground (see 3127) are considered as aboveground containers.

Table 4-1
MAXIMUM PERMITTED FILLING DENSITY

Column 1	Col. 2	Col. 3	Col. 4	Col. 5	Col. 6	Col. 7
Specific Gravity at 60 F (15.6 C)	Aboveground Containers				All Underground Containers	
	0 to 1,200 gal.[1]		Over 1,200 gal.[1]			
	% of WWC[2]	Vol. % at 60 F	% of WWC[2]	Vol. % at 60 F	% of WWC[2]	Vol. % at 60 F
.496 — .503	41	82.0	44	88.0	45	90.0
.504 — .510	42	82.6	45	88.5	46	90.5
.511 — .519	43	83.5	46	89.4	47	91.3
.520 — .527	44	84.3	47	90.0	48	91.8
.528 — .536	45	84.7	48	90.3	49	92.2
.537 — .544	46	85.2	49	90.7	50	92.5
.545 — .552	47	85.6	50	91.2	51	93.0
.553 — .560	48	86.4	51	91.8	52	93.6
.561 — .568	49	87.0	52	92.3	53	94.1
.569 — .576	50	87.5	53	92.7	54	94.4
.577 — .584	51	87.9	54	93.1	55	94.8
.585 — .592	52	88.3	55	93.5	56	95.1
.593 — .600	53	88.9	56	94.0	57	95.6

[1]Total Water Capacity, U. S. Gallons (1000 Imperial Gallons, 4550 Liters)
[2]WWC — Water Weight Capacity

4122. If quantity is determined by volume, this volume, when corrected to the base temperature of 60 F (15.6 C) by use of the Correction Factor Table of Appendix E and converted to weight by use of the applicable specific gravity, shall result in a computed weight complying with the water weight percentages shown in Columns 2, 4 and 6 of Table 4-1. Equivalent volumetric percentages at 60 F are shown in Columns 3, 5 and 7 of Table 4-1.

4123. Determination that the quantity of LP-Gas put into a container complies with Table 4-1 may be either by weight or by volume in accordance with 4124 and 4125.

4124. The weight method may be used if the container is designed and equipped to be filled by weight, and complies with 2152, and with 4124(a), (b) or (c):

(a) DOT specification cylinders of less than 200 lbs. water capacity which are not subject to DOT jurisdiction (such as, but not limited to, motor fuel containers on vehicles not in interstate commerce or cylinders filled at the installation) may be filled either by weight or by volume. (See DOT regulations on cylinder filling.)

(b) DOT specification cylinders of 200 pounds water capacity or more, may be filled by weight or by volume. (See DOT regulations requiring a representative number of volumetrically filled cylinders to be check weighed to verify accuracy of content.)

(c) ASME containers complying with 2101 and 2111 may be filled either by weight or by volume.

4125. The volumetric method may be used for containers designed and equipped to be filled by volume and in accordance with 4125(a) and 4125(b):

(a) A maximum fixed liquid level gage may be used, provided the liquid level indicated by this gage has been computed on the basis of not filling the container with a quantity greater than the maximum permitted filling density on a weight basis as shown in Column 2, 4 or 6 of Table 4-1 when liquid at the specific gravity of that to be placed in the container is at 40 F for aboveground, or 50 F for underground, containers. See E-22 and Table E-2 in Appendix E for methods of making such computations.

(b) A variable gage of the rotary, slip tube or float type may be used, provided the maximum filling level indicated by this gage is corrected for the temperature of the liquid in the container. The fixed maximum liquid level gage (required on all containers fabricated after December 31, 1965, which are to be filled volumetrically) may be used to check the accuracy of variable gages. In the case of containers of 2,000 gallons water capacity or less to be filled at consumer sites, fabricated after December 31, 1965 (and mandatorily equipped with a maximum fixed liquid level gage(s)), filling by variable gage shall comply with the following:

(1) The variable gage shall have been calibrated for accuracy by checking against the reading of the fixed maximum liquid level gage.

(2) If the container is to be filled beyond the level indicated by the fixed maximum liquid level gage complying with 4125(a), the reading of the variable gage, adjusted as indicated by the calibration, shall be corrected for the LP-Gas liquid temperature in accordance with Table E-2.

4126. Portable containers with water capacities greater than 1,000 pounds, such as portable tank containers built to DOT Specifications MC-330, MC-331 or DOT-51, may be loaded either by weight or by volume, provided they are appropriately equipped.

4127. Containers to be filled volumetrically by a variable liquid level gage, corrected for temperature as provided by 4125(a) or (b), shall have a provision for determining the liquid temperature. (See Appendix E-101 for method of establishing this temperature.) Containers may be filled without temperature correction by maximum liquid level gage in accordance with 4125(a).

42. TRANSFER LOCATIONS AND PROCEDURES

420. Application

4200. This section includes provisions covering the location of, and the procedures for, liquid transfer operations whether conducted indoors or outdoors.

421. Consumer Site Filling of Permanently Installed Containers

4210. Containers permanently located and installed outdoors in accordance with Section 31, and equipped with appurtenances for filling at, or adjacent to, the container, may be filled at that location, provided that a cargo vehicle is used for the delivery which complies with Chapter 6 as to construction and method of operation.

4211. If the point of transfer is not located at the container, it shall be located in accordance with Table 4-2.

422. Consumer Site and Distributing Point Filling of Portable and Other than Permanently Installed Containers

4220. This subsection includes provisions for filling of portable containers and containers not permanently installed in accordance with Section 31, including containers mounted on vehicles (including recreational vehicles) and industrial and agricultural equipment, on the premises of the consumer or at a distributing point (see definition).

4221. The point of transfer or the nearest part of a structure housing transfer operations, whichever is closer, shall be located in accordance with Table 4-2 with respect to various types of exposures.

(a) If LP-Gas is vented to the atmosphere under the conditions stipulated in 4040(d), the distances in Table 4-2 shall be doubled.

(b) If the point of transfer is housed in a structure complying with Chapter 7, the distances in Table 4-2 may be reduced provided either the exposing wall(s) or the exposed wall(s) complies with 7200(a).

Table 4-2[1]

DISTANCE BETWEEN POINT OF TRANSFER AND EXPOSURES

Part	Exposure	Min. Horizontal Distance, Feet
1.	Buildings[2] with fire resistive walls[3]	10
2.	Buildings[2] with other than fire resistive walls	25
3.	Building wall openings or pits at or below the level of the point of transfer	25
4.	Line of adjoining property which can be built upon	25
5.	Outdoor places of public assembly, including school yards, athletic fields and playgrounds	50
6.	Public ways, including public streets, highways, thoroughfares and sidewalks	
	(a) From points of transfer in Distributing Points	10
	(b) From points of transfer in Distributing Plants	25
7.	Driveways	5
8.	Mainline railroad track centerlines	25
9.	Containers[4]	10

Note 1: Table 4-2 is not applicable to the transfer operations covered in 4210.

Note 2: "Buildings" include structures such as mobile homes, recreational vehicles, modular homes, tents and box trailers at construction sites.

Note 3: Walls constructed of noncombustible materials having, as erected, a fire resistance of at least one hour as determined by NFPA No. 251, Standard Methods of Fire Tests of Building Construction and Materials.

Note 4: Not applicable to filling connections at the storage container or to dispensing units of 2000 gallons water capacity or less when used for filling containers not mounted upon vehicles.

CHAPTER 5

STORAGE OF PORTABLE CONTAINERS AWAITING USE OR RESALE

50. SCOPE

500. Application

5000. The provisions of this chapter are applicable to the storage of portable containers of 1,000 pounds water capacity, or less, whether filled, partially filled or empty (if they have been in LP-Gas service) as follows:

(a) At consumer sites or distributing points, but not connected for use.

(b) In storage for resale by dealer or reseller.

5001. The provisions of this chapter do not apply to:

(a) Containers stored at distributing plants.

51. GENERAL PROVISIONS

510. General Location of Containers

5100. Containers in storage shall be so located as to minimize exposure to excessive temperature rise, physical damage or tampering.

5101. Containers stored in buildings in accordance with Section 52 shall not be located near exits, stairways, or in areas normally used, or intended to be used for the safe egress of people.

5102. Empty containers which have been in LP-Gas service shall preferably be stored in the open. If stored inside, they shall be considered as full containers for the purposes of determining the maximum quantities of LP-Gas permitted in 5200, 5210 and 5220.

5103. Containers not connected for use shall not be stored on roofs.

511. Protection of Valves on Containers in Storage

5110. Container valves shall be protected as required by 2130. Screw-on type caps or collars shall be securely in place on all containers stored regardless of whether they are full, partially full or empty, and container outlet valves shall be closed or plugged.

52. STORAGE WITHIN BUILDINGS

520. Storage within Buildings Frequented by the Public

5200. DOT specification cylinders with a maximum water capacity of 2½ pounds, used with completely self-contained hand torches and similar applications, may be stored or displayed in a building frequented by the public. The quantity of LP-Gas shall not exceed 200 pounds except as provided in 522.

521. Storage within Buildings Not Frequented by the Public (Such as Industrial Buildings)

5210. The quantity of LP-Gas stored shall not exceed 300 pounds (approximately 2,550 cubic feet in vapor form) except as provided in 522.

5211. Containers carried as a part of the service equipment on highway mobile vehicles are not to be considered in the total storage capacity in 5210 provided such vehicles are stored in private garages and carry only one LP-Gas container with an LP-Gas capacity of 100 pounds or less per vehicle. Container valves shall be closed.

522. Storage within Special Buildings or Rooms

5220. The maximum quantity of LP-Gas which may be stored in special buildings or rooms shall be 10,000 pounds.

5221. Special buildings or rooms for storing LP-Gas containers shall not be located adjoining the line of property occupied by schools, churches, hospitals, athletic fields or other points of public gathering.

5222. The construction of all such special buildings, and rooms within, or attached to, other buildings, shall comply with Chapter 7 and the following:

(a) Adequate vents, to the outside only, shall be provided at both top and bottom, located at least 5 feet away from any building opening.

(b) The entire area shall be classified for purposes of ignition source control in accordance with Section 37.

53. STORAGE OUTSIDE OF BUILDINGS

530. Location of Storage Outside of Buildings

5300. Storage outside of buildings, for containers awaiting use or resale, shall be located in accordance with Table 5-1 with respect to:

(a) Nearest important building or group of buildings.

(b) Line of adjoining property which may be built upon.

(c) Busy thoroughfares or sidewalks.

(d) Line of adjoining property occupied by schools, churches, hospitals, athletic fields or other points of public gathering.

Table 5-1

Quantity of LP-Gas Stored	Distance to: (a) and (b)	(c) and (d)
500 lbs. or less	0	0
501 to 2,500 lbs.	0	10 ft.
2,501 to 6,000 lbs.	10 ft.	10 ft.
6,001 to 10,000 lbs.	20 ft.	20 ft.
Over 10,000 lbs.	25 ft.	25 ft.

531. Protection of Containers

5310. Containers shall be stored within a suitable enclosure or otherwise protected against tampering.

532. Alternate Location and Protection of Storage

5320. When the provisions of 5300 and 5310 are impractical at construction sites, or at buildings or structures undergoing major renovation or repairs, the storage of containers shall be acceptable to the authority having jurisdiction.

54. FIRE PROTECTION

540. Fire Extinguisher Requirements

5400. Storage locations, other than supply depots at separate locations apart from those of the dealer, reseller or user's establishments, shall be provided with at least one approved portable fire extinguisher, having a minimum rating of 10-B,C. Ratings shall be in accordance with the Standard for the Installation of Portable Fire Extinguishers, NFPA No. 10.

CHAPTER 6

TRUCK TRANSPORTATION OF LP-GAS

60. SCOPE

600. Application

6000. This chapter includes provisions applying to containers, container appurtenances, piping, valves, equipment and vehicles used for the highway transportation of LP-Gas as cargo, as follows:

(a) Transportation of filled portable containers delivered as "packages," including the equipment for holding such portable containers in place during transportation.

(b) Transportation in cargo vehicles, whether fabricated by mounting cargo tanks on conventional truck or trailer chassis, or constructed as integral cargo units in which the container constitutes in whole, or in part, the stress member of the vehicle frame. Transfer equipment and piping, and the protection of such equipment and the container appurtenances against overturn, collision or other vehicular accidents are also included.

6001. The provisions of this chapter are not applicable to the transportation of LP-Gas on vehicles incident to its use on these vehicles as covered in 353, 354, 355 and Section 38.

6002. Much truck transportation of LP-Gas is interstate commerce and subject to regulation by the U. S. Department of Transportation. Many of the provisions of this chapter are identical or similar to DOT Regulations and are intended to extend these provisions to areas not subject to DOT Regulation. Vehicles and procedures under the jurisdiction of DOT shall comply with DOT Regulations.

6003. If LP-Gas is used for engine fuel, the supply piping and regulation, vaporizing, gas-air mixing and carburetion equipment, shall be designed, constructed and installed in accordance with Section 35. Fuel systems (including fuel containers) shall be constructed and installed in accordance with Section 38. Fuel may be used from the cargo tank of tank trucks, but not from cargo tanks on trailers or semitrailers.

6004. No artificial light other than electrical shall be used with the vehicles covered by this chapter. Wiring used shall have adequate mechanical strength and current-carrying capacity with suitable overcurrent protection (fuses or automatic circuit breakers) and shall be properly insulated and protected against physical damage.

61. TRANSPORTATION IN PORTABLE CONTAINERS

610. Application

6100. This section applies to the vehicular transportation of portable containers filled with LP-Gas delivered as "packages," including containers built to DOT Cylinder specifications and of other portable containers (such as DOT portable tank containers and skid tanks). The design and construction of these containers is covered in Chapter 2.

611. Transportation of DOT Cylinder Specification or Equivalent Portable ASME Containers

6110. Portable containers of 1,000 pounds or less water capacity, when filled with LP-Gas, shall be transported in accordance with 6111 through 6117.

6111. Containers shall be constructed as provided in Section 21 and equipped in accordance with Section 22 for transportation as portable containers.

6112. The quantity of LP-Gas placed into containers shall be in accordance with Chapter 4.

6113. Valves of containers shall be protected in accordance with 2130. Screw-on type protecting caps or collars shall be secured in place.

6114. Containers and their appurtenances shall be determined to be leak-free before being loaded into vehicles. Containers shall be loaded into vehicles with substantially flat floors or equipped with suitable racks for holding containers. Containers shall be securely fastened in position to minimize the possibility of movement, tipping over or physical damage.

6115. Containers in excess of 200 pounds water capacity shall be transported with the relief valves of containers in direct communication with the vapor space.

6116. Containers not exceeding 200 pounds water capacity may be transported in other than the upright position.

6117. Trucks or trailers carrying more than 1,000 pounds of LP-Gas shall be marked as required by DOT regulations and/or state law.

612. Transportation of Portable Containers of More than 1,000 Pounds Water Capacity

6120. Portable containers of more than 1,000 pounds water capacity when filled with LP-Gas shall be transported in compliance with 6121 through 6127.

6121. Containers shall be constructed in accordance with Section 21 and equipped in accordance with Section 22 for portable use, or shall comply with DOT portable tank container specifications for LP-Gas service.

6122. The quantity of LP-Gas put into containers shall be in accordance with Chapter 4.

6123. Valves and other container appurtenances shall be protected in accordance with 2131.

6124. Containers and their appurtenances shall be determined to be leak-free before being loaded into vehicles. Containers shall be loaded onto a flat vehicle floor or platform, or onto a suitable vehicle frame. In either case, containers shall be securely blocked or held down to minimize movement, relative to each other or to the supporting structure, while in transit.

6125. Containers shall be transported with relief valves in direct communication with the vapor space.

6126. Trucks or trailers carrying more than 1,000 pounds of LP-Gas shall be marked as required by DOT regulations and/or state law.

6127. When portable containers complying with 6120 through 6125 are permanently or semipermanently mounted on vehicles to serve as cargo tanks, so that the assembled vehicular unit can be used for making liquid deliveries to other containers at points of use, the provisions of Section 62 shall apply.

613. Fire Extinguishers

6130. Each truck or trailer transporting portable containers as provided by 611 or 612 shall be equipped with at least one fire extinguisher having a 10-B, C rating. Ratings shall be in accordance with NFPA No. 10, Standard for the Installation of Portable Fire Extinguishers.

62. TRANSPORTATION IN CARGO VEHICLES

620. Application

6200. This section includes provisions for cargo vehicles used for the transportation of LP-Gas as liquid cargo, normally loaded into the cargo container at the distributing or manufacturing point, and transferred into other containers at the point of delivery. Transfer may be made by a pump or compressor mounted on the vehicle or by a transfer means at the delivery point.

621. Containers Mounted on, or a Part of, Cargo Vehicles

6210. Containers mounted on, or comprising in whole, or in part, the stress member used in lieu of a frame for cargo vehicles, shall comply with DOT cargo tank specifications for LP-Gas service. Such containers shall also comply with Section 21, be equipped with appurtenances as provided in Section 22 for cargo service, and comply with 6210(a) through (j):

(a) Safety relief valves shall be in accordance with DOT regulations, shall comply with 2125, 2212 and 2213, and be installed in accordance with 3132.

(b) Filling connections shall be equipped with appurtenances in accordance with 2221 and Table 2-3, Column 7, for cargo containers.

(c) Container liquid discharge openings except those for engine fuel lines shall be equipped with remotely controlled internal shutoff valves which shall remain closed except during liquid transfer operations in accordance with DOT regulations. At least two control stations, both mechanically and thermally actuated, shall be located at opposite ends of the container and diagonally across from each other, to provide closure for the internal valves for containers in excess of 3,500 gallons water capacity. The thermal control mechanism shall have a fusible element with a melting point not over 220 F or less than 208 F. Only one remote control station need be provided for cargo units of 3,500 gallons water capacity or less and the actuating means may be mechanical. Control stations shall be readily accessible to personnel on the roadway surface alongside of the vehicle.

(d) Liquid hose of 1½ inch (nominal size) and larger size and vapor hose of 1¼ inch (nominal size) and larger size shall be protected with an emergency shutoff valve complying with 2343, except that:

(1) If the internal valve specified in 6210(c) meets the provisions of 2343 and 3168(a)(1), an emergency shutoff valve shall not be required in the cargo container piping.

(2) A back flow check valve may be used in the cargo container piping or container in lieu of an emergency shutoff valve if the flow is only into the cargo container.

(e) Cargo containers, except those filled by weight, shall be equipped with liquid level gaging devices in accordance with DOT regulations and complying with 2230 through 2233. Gaging devices used to determine the maximum loading level in cargo containers over 1200 gallons of water capacity shall be as near the midpoints (front-to-rear and side-to-side) of the container as practicable. When the gage is located at other than the midpoint, the vehicle shall be substantially level when gaged. If a variable gage (rotary or slip tube) is used for loading, a fixed level gage reading within the limits of 85-to-90 percent of container water capacity shall be used as a means of checking the accuracy of the variable gage. The container may be equipped with several fixed liquid level gages, positioned at different liquid levels, provided the loading percentages of container capacity indicated by each is marked on the container adjacent to the gage in accordance with 2231(d).

(f) Each cargo container, regardless of water capacity, shall be equipped with a pressure gage in accordance with 224.

(g) Containers shall be provided with opening(s) to provide complete drainage.

(h) Container openings not equipped with safety relief valves, loading connections, liquid discharge connections, liquid level gages, pressure gages, or used for thermometer wells, shall be equipped with appurtenances in accordance with 2250.

(i) Manually operated shutoff valves on vapor openings larger than 1¼-inch IPS shall be closed except during liquid transfer operations.

(j) Container inlets and outlets, except those used for safety relief valves, gaging devices and pressure gages, shall be labeled to indicate whether they communicate with the vapor or liquid space when the container is filled to maximum filling density. Labels may be on valves.

(k) Container appurtenances shall be protected against damage from collision with other vehicles or objects, jackknifing or overturning, in accordance with DOT regulations and 2131. The housing(s) around container fittings and appurtenances shall be provided with a weather cover(s) if necessary to insure proper operation of valves and safety devices. (See 2125 as to protection of relief valve enclosures against corrosion.)

6211. Cargo containers designed to be mounted on conventional vehicle chassis (see 6210) shall be mounted in accordance with DOT cargo tank specifications. The cargo container and chassis shall be metallically connected.

6212. Portable containers designed to be used in accordance with the provisions of 612 for transportation as package units, when used as cargo containers for liquid delivery, either temporarily or permanently, in lieu of containers designed for such service (as provided for by Section 62), shall be mounted and equipped as provided in 6210 and 6211.

622. Piping (Including Hose), Fittings and Valves

6220. Pipe, tubing, pipe and tubing fittings, valves, hose and flexible connectors shall comply with Section 23, with the provisions of DOT cargo tank specifications for LP-Gas, and shall be suitable for the working pressure specified in 6221. In addition, 6220(a) through (e) shall apply:

(a) Pipe shall be wrought iron, steel, brass or copper in accordance with 2310(a), (b), (c) or (d).

(b) Tubing shall be steel, brass or copper in accordance with 2320(a), (b), or (c).

(c) Pipe and tubing fittings shall be steel, brass, copper, malleable iron or ductile (nodular) iron suitable for use with the pipe or tubing used as specified in 6220(a) or (b).

(d) Pipe joints may be threaded, flanged, welded or brazed. Fittings when used shall comply with 6220(c).

(1) When joints are threaded, or threaded and back welded, pipe and nipples shall be Schedule 80 or heavier. Copper or brass pipe and nipples shall be of equivalent strength.

(2) When joints are welded or brazed, the pipe and nipples shall be Schedule 40 or heavier. Fittings or flanges shall be suitable for the service (see 6221).

(3) Brazed joints shall be made with a brazing material having a melting point exceeding 1,000 degrees F.

(e) Tubing joints shall be brazed, using a brazing material having a melting point of at least 1,000 degrees F.

6221. Pipe, tubing, pipe and tubing fittings, valves, hose and flexible connectors, and complete cargo vehicle piping systems including connections to equipment (see 623), after assembly, shall comply with 6221(a) and (b):

(a) Piping used at pressures higher than container pressure, such as on the discharge side of liquid transfer pumps, shall be adequate for a working pressure of at least 350 psig.

(b) All other liquid or vapor piping shall be adequate for a working pressure of at least 250 psig.

6222. Valves, including shutoff valves, excess-flow valves, backflow check valves and remotely controlled valves, used in piping shall comply with the applicable provisions of DOT cargo tank specifications for LP-Gas service, and with 234, provided, however, that their minimum design pressure shall comply with 6221. Excess-flow valves (or equivalent automatic devices) which will prevent the uncontrolled discharge of LP-Gas in the event of a failure in either the fixed or flexible parts of the piping system, shall be installed as follows:

(a) Where piping branches, restrictions, or reductions in piping size decrease the flow rate to less than that of the excess-flow valve protecting the piping up to that point, additional excess-flow valves shall be installed, having flow rates less than the piping or hose downstream.

6223. Hose, hose connections and flexible connectors, shall comply with 235 and 6221. Flexible connectors used in the piping system to compensate for stresses and vibration, shall be limited to 3 feet in overall length. Flexible connectors on existing LP-Gas cargo units replaced after December 1, 1967, shall comply with 235.

(a) Flexible connectors assembled from rubber hose and couplings installed after December 31, 1974, shall be permanently marked to indicate the date of assembly of the flexible connector and the flexible portion of the connector shall be replaced within six years of the indicated date of assembly of the connector.

(b) The rubber hose portion of flexible connectors shall be replaced whenever a cargo unit is remounted on a different chassis, or whenever the cargo unit is repiped, if such repiping encompasses that portion of piping in which the connector is located, unless the remounting and/or repiping is performed within one year of the date of assembly of the connector.

6224. Hydrostatic relief valves complying with 2360 shall be installed in each section of piping which can be isolated by valves in accordance with 317.

6225. Piping, valves, hose, flexible connectors, and complete cargo vehicle piping systems, including connections to equipment (see 623), shall be tested and proven free of leaks after assembly at not less than the container design pressure (see 3180).

623. Equipment

6230. LP-Gas equipment, such as pumps, compressors, meters, dispensers, regulators and strainers, shall comply with Section 24 as to design and construction and shall be installed in accordance with

the applicable provisions of 319. Equipment on vehicles shall be securely mounted in place and connected into the piping system in accordance with the manufacturer's instructions, taking into account the greater (than for stationary service) jarring and vibration problems incident to vehicular use.

6231. Pumps or compressors used for LP-Gas transfer may be mounted on tank trucks, trailers, semitrailers or tractors, and may be driven by the truck or tractor motor power takeoff, by a separate internal combustion engine, or by hand, mechanical, hydraulic or electrical means. If an electric drive is used, obtaining energy from the electrical installation at the delivery point, the installation on the vehicle (and at the delivery point) shall comply with 371.

6232. The installation of compressors shall comply with the applicable provisions of 3191 and with 6230.

6233. The installation of liquid meters shall be in accordance with 3194(a). If venting of LP-Gas to the air is necessary, provision shall be made to vent it at a safe location.

6234. When wet hose is carried connected to the truck liquid pump discharge piping, an automatic device, such as a differential regulator, shall be installed between the pump discharge and the hose connection to prevent liquid discharge when the pump is not operating. When a meter or dispenser is used, this device shall be installed between the meter outlet and the hose connection. An excess-flow valve may also be used but shall not be the exclusive means of complying with this provision.

624. Protection of Container Appurtenances, Piping System and Equipment

6240. Container appurtenances, piping and equipment comprising the complete LP-Gas system on the cargo vehicle, shall be securely mounted in position (see 6210 and 6211 for container mounting), shall be protected against damage to the extent it is practical, and in accordance with DOT regulations as follows:

(a) Damage from collision with other objects or vehicles, jackknifing, or overturning which might be caused by operation of the vehicle.

(b) Damage to which vehicle might be exposed while parked.

6241. In locating and mounting the containers, piping and equipment comprising the complete LP-Gas system on the cargo vehicle, 6241(a) through (d) shall apply:

(a) LP-Gas system components shall be installed with as much road clearance as practicable, but not less than the minimum road clearance of the vehicle under maximum spring deflection.

(b) Mounting shall be such (see 6210 and 6211 for container mounting) as to prevent components from jarring loose, slipping or rotating.

(c) Container appurtenances, shutoff valves, piping and equipment shall be adequately protected against damage due to accidental contact with stationary objects, from loose objects thrown up from the ground or from damage due to overturn or other vehicular accidents. Provision for this protection may be made by location on the vehicle with parts of the vehicle furnishing the protection.

(d) Such protection against weather and tampering as may be necessary to insure safe operations shall be provided.

625. Painting and Marking Liquid Cargo Vehicles

6250. At least the upper two-thirds of the shells and heads of cargo containers shall be painted a light reflecting color, except for lettering. Marking and lettering shall conform with DOT regulations and/or state requirements.

626. Fire Extinguishers

6260. Each tank truck or tractor shall be provided with at least one approved portable fire extinguisher having at least a 10-B, C rating. Two extinguishers, each having at least a 5-B, C rating may be used as an alternative. Ratings shall be in accordance with NFPA No. 10, Standard for the Installation of Portable Fire Extinguishers.

627. Chock Blocks for Liquid Cargo Vehicles

6270. Each tank truck and trailer shall carry chock blocks which shall be used to prevent rolling of the vehicle whenever it is being loaded or unloaded, or is parked.

628. Exhaust Systems

6280. The exhaust system, including the muffler and exhaust piping, shall have ample clearance from the fuel system and combustible materials. The truck exhaust discharge shall be directed away from the cargo container(s) and to the outside of the frame and any skirting.

6281. A muffler cutout is prohibited.

629. Smoking Prohibition

6290. Truck drivers and their helpers shall not smoke, or allow smoking, around the vehicle on the road, while making liquid transfers, or making repairs to the truck or trailer.

63. TRAILERS, SEMITRAILERS, MOVABLE FUEL STORAGE TENDERS OR FARM CARTS

630. Application

6300. This section applies to all cargo vehicles, other than trucks, which may be parked at locations away from distributing points.

631. Trailers or Semitrailers Comprising Parts of Section 62 Vehicles

6310. When parked, cargo tank trailers or semitrailers covered by Section 62 shall be positioned so that the safety relief valves shall communicate with the vapor space of the container.

632. Trailers, Including Movable Storage Tenders or Farm Carts

6320. Trailers, including fuel storage tenders or farm carts shall comply with 6321 through 6325. If normally used over public ways they shall comply with applicable state regulations.

6321. Cargo containers mounted on such vehicles shall be constructed in accordance with Section 21, and equipped with appurtenances as provided in Section 22. Container mounting shall be adequate for the service involved.

6322. Threaded piping shall not be less than Schedule 80 and fittings shall be designed for not less than 250 psig.

6323. Piping, hoses and equipment, including valves, fittings, safety relief valves and container accessories, shall be adequately protected against collision or upset.

6324. Parked vehicles shall be so positioned that container safety relief valves communicate with the vapor space.

6325. Such cargo units shall not be filled on a public way.

64. TRANSPORTATION OF STATIONARY CONTAINERS TO AND FROM POINT OF INSTALLATION

640. Application

6400. This section applies to the transportation of containers designed for stationary service at the point of use and secured to the vehicle only for transportation. Such containers may be transported partially filled with LP-Gas.

641. Transportation of Containers

6410. Containers of 125 gallons or more water capacity shall contain no more than 5 percent of their water capacity in liquid form during transportation except with the approval of the authority having jurisdiction.

6411. Containers shall be safely secured to minimize movement relative to each other or to the carrying vehicle while in transit, giving consideration to the sudden stops, starts and changes of direction normal to vehicular operation.

6412. Valves, regulators and other container appurtenances shall be adequately protected against physical damage during transportation.

6413. Safety relief valves shall be in direct communication with the vapor space of the container.

6414. Lifting lugs on containers shall not be used as the sole means of lifting such containers.

65. PARKING AND GARAGING VEHICLES USED TO CARRY LP-GAS CARGO

650. Application

6500. This section applies to the parking (except parking associated with a liquid transfer operation) and garaging of vehicles used for the transportation of LP-Gas. Such vehicles include those used to carry portable containers (See Section 61) and those used to carry LP-Gas in cargo tanks (cargo vehicles, See Section 62).

651. Parking

6510. Vehicles carrying or containing LP-Gas parked out-of-doors shall comply with the following:

(a) Vehicles, except in an emergency and except as provided in 6510(b), shall not be left unattended on any street, highway, avenue or alley, provided that this shall not prevent a driver from

the necessary absence from the vehicle in connection with his normal duties, nor shall it prevent stops for meals or rest stops during the day or at night.

(b) Vehicles shall not be parked in congested areas. Such vehicles may be parked off the street in uncongested areas if at least 50 feet from any building used for assembly, institutional, or multiple residential occupancy. This shall not prohibit the parking of vehicles carrying portable containers or cargo vehicles of 3500 gallons water capacity or less on streets adjacent to the driver's residence in uncongested residential areas, provided such points of parking are at least 50 feet from a building used for assembly, institutional or multiple residential occupancy.

6511. Vehicles parked indoors shall comply with the following:

(a) Cargo vehicles parked in any public garage or building shall have LP-Gas liquid removed from the cargo container, piping, pump, meter, hoses and related equipment and the pressure in the delivery hose and related equipment reduced to approximately atmospheric, and all valves closed before being moved inside. Delivery hose or valve outlets shall be plugged or capped before the vehicle is moved inside.

(b) Vehicles used to carry portable containers shall not be moved into any public garage or building for parking until all portable containers have been removed from the vehicle.

(c) Vehicles carrying or containing LP-Gas are permitted to be parked in buildings complying with Chapter 7 and located on premises owned or under the control of the operator of such vehicles, provided:

(1) The public is excluded from such buildings.

(2) There is adequate floor level ventilation in all parts of the building where these vehicles are parked.

(3) Leaks in the vehicle LP-Gas systems are repaired before the vehicle is moved inside.

(4) Primary shutoff valves on cargo tanks and other LP-Gas containers on the vehicle (except propulsion engine fuel containers) are closed and delivery hose outlets plugged or capped to contain system pressure before the vehicle is moved inside. Primary shutoff valves on LP-Gas propulsion engine fuel containers shall be closed when the vehicle is parked.

(5) No LP-Gas container is located near a source of heat or within the direct path of hot air being blown from a blower-type heater.