

form prescribed by the official U.S. Pharmacopeia.

(2) The manufacture of explosives as defined in paragraph (a)(3) of this section shall also meet the requirements contained in §1910.119.

(3) The manufacture of pyrotechnics as defined in paragraph (a)(10) of this section shall also meet the requirements contained in §1910.119.

[39 FR 23502, June 27, 1974, as amended at 43 FR 49747, Oct. 24, 1978; 45 FR 60704, Sept. 12, 1980; 53 FR 12122, Apr. 12, 1988; 57 FR 6403, Feb. 24, 1992; 58 FR 35309, June 30, 1993; 61 FR 9237, Mar. 7, 1996; 63 FR 33466, June 18, 1998]

§ 1910.110 Storage and handling of liquefied petroleum gases.

(a) *Definitions applicable to this section.* As used in this section:

(1) API-ASME container—A container constructed in accordance with the requirements of paragraph (b)(3)(iii) of this section.

(2) ASME container—A container constructed in accordance with the requirements of paragraph (b)(3)(i) of this section.

(3) Container assembly—An assembly consisting essentially of the container and fittings for all container openings, including shutoff valves, excess flow valves, liquid-level gaging devices, safety relief devices, and protective housing.

(4) Containers—All vessels, such as tanks, cylinders, or drums, used for transportation or storing liquefied petroleum gases.

(5) DOT—Department of Transportation.

(6) DOT container—A container constructed in accordance with the applicable requirements of 49 CFR chapter I.

(7) “Liquefied petroleum gases”—“LPG” and “LP-Gas”—Any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them; propane, propylene, butanes (normal butane or iso-butane), and butylenes.

(8) 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 of usage to another. They are basically nonhighway vehicles, but may occasionally be moved over public roads or highways. They are used as a fuel

supply for farm tractors, construction machinery and similar equipment.

(9) P.S.I.G.—pounds per square inch gauge.

(10) P.S.I.A.—pounds per square inch absolute.

(11) Systems—an assembly of equipment consisting essentially of the container or containers, major devices such as vaporizers, safety relief valves, excess flow valves, regulators, and piping connecting such parts.

(12) Vaporizer-burner—an integral vaporizer-burner unit, dependent upon the heat generated by the burner as the source of heat to vaporize the liquid used for dehydrators or dryers.

(13) Ventilation, adequate—when specified for the prevention of fire during normal operation, ventilation shall be considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit.

(14) Approved—unless otherwise indicated, listing or approval by a nationally recognized testing laboratory. Refer to §1910.7 for definition of nationally recognized testing laboratory.

(15) Listed—see “approved” in §1910.110(14).

(16) DOT Specifications—regulations of the Department of Transportation published in 49 CFR chapter I.

(17)–(18) [Reserved]

(19) DOT cylinders—cylinders meeting the requirements of 49 CFR chapter I.

(b) *Basic rules*—(1) *Odorizing gases.* (i) All liquefied petroleum gases shall be effectively odorized by an approved agent of such character as to indicate positively, by distinct odor, the presence of gas down to concentration in air of not over one-fifth the lower limit of flammability. Odorization, however, is not required if harmful in the use of further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

(ii) The odorization requirement of paragraph (b)(1)(i) of this section shall be considered to be met by the use of 1.0 pounds of ethyl mercaptan, 1.0 pounds of thiophane or 1.4 pounds of amyl mercaptan per 10,000 gallons of LP-Gas. However, this listing of

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odorants and quantities shall not exclude the use of other odorants that meet the odorization requirements of paragraph (b)(1)(i) of this section.

(2) *Approval of equipment and systems.*

(i) Each system utilizing DOT containers in accordance with 49 CFR part 178 shall have its container valves, connectors, manifold valve assemblies, and regulators approved.

(ii) Each system for domestic or commercial use utilizing containers of 2,000 gallons or less water capacity, other than those constructed in accordance with 49 CFR part 178, shall consist of a container assembly and one or more regulators, and may include other parts. The system as a unit or the container assembly as a unit, and the regulator or regulators, shall be individually listed.

(iii) In systems utilizing containers of over 2,000 gallons water capacity, each regulator, container valve, excess flow valve, gaging device, and relief valve installed on or at the container, shall have its correctness as to design, construction, and performance determined by listing by a nationally recognized testing laboratory. Refer to §1910.7 for definition of nationally recognized testing laboratory.

(3) *Requirements for construction and original test of containers.* (i) Containers used with systems embodied in paragraphs (d), (e), (g), and (h) of this section, except as provided in paragraphs (e)(3)(iii) and (g)(2)(i) of this section, shall be designed, constructed, and tested in accordance with the Rules for Construction of Unfired Pressure Vessels, section VIII, Division 1, American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, 1968 edition, which is incorporated by reference as specified in §1910.6.

(ii) Containers constructed according to the 1949 and earlier editions of the ASME Code do not have to comply with paragraphs U-2 through U-10 and U-19 thereof. Containers constructed according to paragraph U-70 in the 1949 and earlier editions are not authorized.

(iii) Containers designed, constructed, and tested prior to July 1, 1961, according to the Code for Unfired Pressure Vessels for Petroleum Liquids and Gases, 1951 edition with 1954 Ad-

denda, of the American Petroleum Institute and the American Society of Mechanical Engineers, which is incorporated by reference as specified in §1910.6, shall be considered in conformance. Containers constructed according to API-ASME Code do not have to comply with section I or with appendix to section I. Paragraphs W-601 to W-606 inclusive in the 1943 and earlier editions do not apply.

(iv) The provisions of paragraph (b)(3)(i) of this section shall not be construed as prohibiting the continued use or reinstallation of containers constructed and maintained in accordance with the standard for the Storage and Handling of Liquefied Petroleum Gases NFPA No. 58 in effect at the time of fabrication.

(v) Containers used with systems embodied in paragraph (b), (d)(3)(iii), and (f) of this section, shall be constructed, tested, and stamped in accordance with DOT specifications effective at the date of their manufacture.

(4) *Welding of containers.* (i) Welding to the shell, head, or any other part of the container subject to internal pressure, shall be done in compliance with the code under which the tank was fabricated. Other welding is permitted only on saddle plates, lugs, or brackets attached to the container by the tank manufacturer.

(ii) Where repair or modification involving welding of DOT containers is required, the container shall be returned to a qualified manufacturer making containers of the same type, and the repair or modification made in compliance with DOT regulations.

(5) *Markings on containers.* (i) Each container covered in paragraph (b)(3)(i) of this section, except as provided in paragraph (b)(3)(iv) of this section shall be marked as specified in the following:

(a) With a marking identifying compliance with, and other markings required by, the rules of the reference under which the container is constructed; or with the stamp and other markings required by the National Board of Boiler and Pressure Vessel Inspectors.

(b) With notation as to whether the container is designed for underground or aboveground installation or both. If intended for both and different style

hoods are provided, the marking shall indicate the proper hood for each type of installation.

(c) With the name and address of the supplier of the container, or with the trade name of the container.

(d) With the water capacity of the container in pounds or gallons, U.S. Standard.

(e) With the pressure in p.s.i.g., for which the container is designed.

(f) With the wording "This container shall not contain a product having a vapor pressure in excess of ___ p.s.i.g. at 100 °F.," see subparagraph (14)(viii) of this paragraph.

(g) With the tare weight in pounds or other identified unit of weight for containers with a water capacity of 300 pounds or less.

(h) With marking indicating the maximum level to which the container may be filled with liquid at temperatures between 20 °F. and 130 °F., except on containers provided with fixed maximum level indicators or which are filled by weighing. Markings shall be increments of not more than 20 °F. This marking may be located on the liquid level gaging device.

(i) With the outside surface area in square feet.

(ii) Markings specified shall be on a metal nameplate attached to the container and located in such a manner as to remain visible after the container is installed.

(iii) When LP-Gas and one or more other gases are stored or used in the same area, the containers shall be marked to identify their content. Marking shall conform to the marking requirements set forth in §1910.253(b)(1)(ii).

(6) *Location of containers and regulating equipment.* (i) Containers, and first stage regulating equipment if used, shall be located outside of buildings, except under one or more of the following:

(a) In buildings used exclusively for container charging, vaporization pressure reduction, gas mixing, gas manufacturing, or distribution.

(b) When portable use is necessary and in accordance with paragraph (c)(5) of this section.

(c) LP-Gas fueled stationary or portable engines in accordance with paragraph (e) (11) or (12) of this section.

(d) LP-Gas fueled industrial trucks used in accordance with paragraph (e)(13) of this section.

(e) LP-Gas fueled vehicles garaged in accordance with paragraph (e)(14) of this section.

(f) Containers awaiting use or resale when stored in accordance with paragraph (f) of this section.

(ii) Each individual container shall be located with respect to the nearest important building or group of buildings in accordance with Table H-23.

TABLE H-23

Water capacity per container	Minimum distances		
	Containers		Between above-ground containers
	Under-ground	Above-ground	
Less than 125 gals. ¹ ..	10 feet	None	None.
125 to 250 gals	10 feet	10 feet	None.
251 to 500 gals	10 feet	10 feet	3 feet.
501 to 2,000 gals	25 feet ² ..	25 feet ² ..	3 feet.
2,001 to 30,000 gals ...	50 feet	50 feet	5 feet.
30,001 to 70,000 gals	50 feet	75 feet. ³	
70,001 to 90,000 gals	50 feet	100 feet. ³	

¹ If the aggregate water capacity of a multi-container installation at a consumer site is 501 gallons or greater, 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 installation is made, each installation shall be separated from another installation by at least 25 feet. Do not apply the MINIMUM DISTANCES BETWEEN ABOVE-GROUND CONTAINERS to such installations.

² The above distance requirements may be reduced to not less than 10 feet for a single container of 1,200 gallons water capacity or less, providing such a container is at least 25 feet from any other LP-Gas container of more than 125 gallons water capacity.

³ 1/4 of sum of diameters of adjacent containers.

(iii) Containers installed for use shall not be stacked one above the other.

(iv) [Reserved]

(v) In the case of buildings devoted exclusively to gas manufacturing and distributing operations, the distances required by Table H-23 may be reduced provided that in no case shall containers of water capacity exceeding 500 gallons be located closer than 10 feet to such gas manufacturing and distributing buildings.

(vi) Readily ignitable material such as weeds and long dry grass shall be removed within 10 feet of any container.

(vii) The minimum separation between liquefied petroleum gas containers and flammable liquid tanks

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shall be 20 feet, and the minimum separation between a container and the centerline of the dike shall be 10 feet. The foregoing provision shall not apply when LP-Gas containers of 125 gallons or less capacity are installed adjacent to Class III flammable liquid tanks of 275 gallons or less capacity.

(viii) Suitable means shall be taken to prevent the accumulation of flammable liquids under adjacent liquified petroleum gas containers, such as by diking, diversion curbs, or grading.

(ix) When dikes are used with flammable liquid tanks, no liquefied petroleum gas containers shall be located within the diked area.

(7) *Container valves and container accessories.* (i) Valves, fittings, and accessories connected directly to the container including primary shutoff valves, shall have a rated working pressure of at least 250 p.s.i.g. and shall be of material and design suitable for LP-Gas service. Cast iron shall not be used for container valves, fittings, and accessories. This does not prohibit the use of container valves made of malleable or nodular iron.

(ii) Connections to containers, except safety relief connections, liquid level gaging devices, and plugged openings, shall have shutoff valves located as close to the container as practicable.

(iii) Excess flow valves, where required shall close automatically at the rated flows of vapor or liquid as specified by the manufacturer. The connections or line including valves, fittings, etc., being protected by an excess flow valve shall have a greater capacity than the rated flow of the excess flow valve.

(iv) Liquid level gaging devices which are so constructed that outward flow of container contents shall not exceed that passed by a No. 54 drill size opening, need not be equipped with excess flow valves.

(v) Openings from container or through fittings attached directly on container to which pressure gage connection is made, need not be equipped with shutoff or excess flow valves if such openings are restricted to not larger than No. 54 drill size opening.

(vi) Except as provided in paragraph (c)(5)(i)(b) of this section, excess flow and back pressure check valves where

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required by this section shall be located inside of the container or at a point outside where the line enters the container; in the latter case, installation shall be made in such manner that any undue strain beyond the excess flow or back pressure check valve will not cause breakage between the container and such valve.

(vii) Excess flow valves shall be designed with a bypass, not to exceed a No. 60 drill size opening to allow equalization of pressures.

(viii) Containers of more than 30 gallons water capacity and less than 2,000 gallons water capacity, filled on a volumetric basis, and manufactured after December 1, 1963, shall be equipped for filling into the vapor space.

(8) *Piping—including pipe, tubing, and fittings.* (i) Pipe, except as provided in paragraphs (e)(6)(i) and (g)(10)(iii), of this section shall be wrought iron or steel (black or galvanized), brass, copper, or aluminum alloy. Aluminum alloy pipe shall be at least Schedule 40 in accordance with the specifications for Aluminum Alloy Pipe, American National Standards Institute (ANSI) H38.7-1969 (ASTM, B241-69), which is incorporated by reference as specified in § 1910.6, except that the use of alloy 5456 is prohibited and shall be suitably marked at each end of each length indicating compliance with American National Standard Institute Specifications. Aluminum Alloy pipe shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by such liquids as water (except rain water), detergents, sewage, or leaking from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum nominal pipe size for aluminum pipe shall be three-fourths inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy pipe shall not be installed within 6 inches of the ground.

(a) Vapor piping with operating pressures not exceeding 125 p.s.i.g. shall be suitable for a working pressure of at least 125 p.s.i.g. Pipe shall be at least Schedule 40 (ASTM A-53-69, Grade B

Electric Resistance Welded and Electric Flash Welded Pipe, which is incorporated by reference as specified in §1910.6, or equal).

(b) Vapor piping with operating pressures over 125 p.s.i.g. and all liquid piping shall be suitable for a working pressure of at least 250 p.s.i.g. Pipe shall be at least Schedule 80 if joints are threaded or threaded and back welded. At least Schedule 40 (ASTM A-53-69 Grade B Electric Resistance Welded and Electric Flash Welded Pipe or equal) shall be used if joints are welded, or welded and flanged.

(ii) Tubing shall be seamless and of copper, brass, steel, or aluminum alloy. Copper tubing shall be of type K or L or equivalent as covered in the Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B88-69), which is incorporated by reference as specified in §1910.6. Aluminum alloy tubing shall be of Type A or B or equivalent as covered in Specification ASTM B210-68 (which is incorporated by reference as specified in §1910.6) and shall be suitably marked every 18 inches indicating compliance with ASTM Specifications. The minimum nominal wall thickness of copper tubing and aluminum alloy tubing shall be as specified in Table H-24 and Table H-25.

Aluminum alloy tubing shall be protected against external corrosion when it is in contact with dissimilar metals other than galvanized steel, or its location is subject to repeated wetting by liquids such as water (except rainwater), detergents, sewage, or leakage from other piping, or it passes through flooring, plaster, masonry, or insulation. Galvanized sheet steel or pipe, galvanized inside and out, may be considered suitable protection. The maximum outside diameter for aluminum alloy tubing shall be three-fourths inch and shall not be used for pressures exceeding 20 p.s.i.g. Aluminum alloy tubing shall not be installed within 6 inches of the ground.

TABLE H-24—WALL THICKNESS OF COPPER TUBING¹

Standard size (inches)	Nominal outside diameter (inches)	Nominal wall thickness (inches)	
		Type K	Type L
1/4	0.375	0.035	0.030

TABLE H-24—WALL THICKNESS OF COPPER TUBING¹—Continued

Standard size (inches)	Nominal outside diameter (inches)	Nominal wall thickness (inches)	
		Type K	Type L
3/8	0.500	0.049	0.035
1/2	0.625	0.049	0.040
5/8	0.750	0.049	0.042
3/4	0.875	0.065	0.045
1	1.125	0.065	0.050
1 1/4	1.375	0.065	0.055
1 1/2	1.625	0.072	0.060
2	2.125	0.083	0.070

¹Based on data in Specification for Seamless Copper Water Tube, ANSI H23.1-1970 (ASTM B-88-69).

NOTE: The standard size by which tube is designated is 1/8 inch smaller than its nominal outside diameter.

TABLE H-25—WALL THICKNESS OF ALUMINUM ALLOY TUBING¹

Outside diameter (inches)	Nominal wall thickness (inches)	
	Type A	Type B
3/8	0.035	0.049
1/2	0.035	0.049
5/8	0.042	0.049
3/4	0.049	0.058

¹Based on data in Standard Specification for Aluminum-Alloy Drawn Seamless Coiled Tubes for Special Purpose Applications, ASTM B210-68.

(iii) In systems where the gas in liquid form without pressure reduction enters the building, only heavy walled seamless brass or copper tubing with an internal diameter not greater than three thirty-seconds inch, and a wall thickness of not less than three sixty-fourths inch shall be used. This requirement shall not apply to research and experimental laboratories, buildings, or separate fire divisions of buildings used exclusively for housing internal combustion engines, and to commercial gas plants or bulk stations where containers are charged, nor to industrial vaporizer buildings, nor to buildings, structures, or equipment under construction or undergoing major renovation.

(iv) Pipe joints may be screwed, flanged, welded, soldered, or brazed with a material having a melting point exceeding 1,000 °F. Joints on seamless copper, brass, steel, or aluminum alloy gas tubing shall be made by means of approved gas tubing fittings, or soldered or brazed with a material having a melting point exceeding 1,000 °F.

(v) For operating pressures of 125 p.s.i.g. or less, fittings shall be designed for a pressure of at least 125

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p.s.i.g. For operating pressures above 125 p.s.i.g., fittings shall be designed for a minimum of 250 p.s.i.g.

(vi) The use of threaded cast iron pipe fittings such as ells, tees, crosses, couplings, and unions is prohibited. Aluminum alloy fittings shall be used with aluminum alloy pipe and tubing. Insulated fittings shall be used where aluminum alloy pipe or tubing connects with a dissimilar metal.

(vii) Strainers, regulators, meters, compressors, pumps, etc., are not to be considered as pipe fittings. This does not prohibit the use of malleable, nodular, or higher strength gray iron for such equipment.

(viii) All materials such as valve seats, packing, gaskets, diaphragms, etc., shall be of such quality as to be resistant to the action of liquefied petroleum gas under the service conditions to which they are subjected.

(ix) All piping, tubing, or hose shall be tested after assembly and proved free from leaks at not less than normal operating pressures. After installation, piping and tubing of all domestic and commercial systems shall be tested and proved free of leaks using a manometer or equivalent device that will indicate a drop in pressure. Test shall not be made with a flame.

(x) Provision shall be made to compensate for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(xi) Piping outside buildings may be buried, above ground, or both, but shall be well supported and protected against physical damage. Where soil conditions warrant, all piping shall be protected against corrosion. Where condensation may occur, the piping shall be pitched back to the container, or suitable means shall be provided for revaporization of the condensate.

(9) *Hose specifications.* (i) Hose shall be fabricated of materials that are resistant to the action of LP-Gas in the liquid and vapor phases. If wire braid is used for reinforcing the hose, it shall be of corrosion-resistant material such as stainless steel.

(ii) Hose subject to container pressure shall be marked "LP-Gas" or "LPG" at not greater than 10-foot intervals.

(iii) Hose subject to container pressure shall be designed for a bursting pressure of not less than 1,250 p.s.i.g.

(iv) Hose subject to container pressure shall have its correctness as to design construction and performance determined by being listed (see § 1910.110(a)(15)).

(v) Hose connections subject to container pressure shall be capable of withstanding, without leakage, a test pressure of not less than 500 p.s.i.g.

(vi) Hose and hose connections on the low-pressure side of the regulator or reducing valve shall be designed for a bursting pressure of not less than 125 p.s.i.g. or five times the set pressure of the relief devices protecting that portion of the system, whichever is higher.

(vii) Hose may be used on the low-pressure side of regulators to connect to other than domestic and commercial gas appliances under the following conditions:

(a) The appliances connected with hose shall be portable and need a flexible connection.

(b) For use inside buildings the hose shall be of minimum practical length, but shall not exceed 6 feet except as provided in paragraph (c)(5)(i)(g) of this section and shall not extend from one room to another, nor pass through any walls, partitions, ceilings, or floors. Such hose shall not be concealed from view or used in a concealed location. For use outside of buildings, the hose may exceed this length but shall be kept as short as practical.

(c) The hose shall be approved and shall not be used where it is likely to be subjected to temperatures above 125 °F. The hose shall be securely connected to the appliance and the use of rubber slip ends shall not be permitted.

(d) The shutoff valve for an appliance connected by hose shall be in the metal pipe or tubing and not at the appliance end of the hose. When shutoff valves are installed close to each other, precautions shall be taken to prevent operation of the wrong valve.

(e) Hose used for connecting to wall outlets shall be protected from physical damage.

(10) *Safety devices.* (i) Every container except those constructed in accordance with DOT specifications and every vaporizer (except motor fuel vaporizers

and except vaporizers described in paragraph (b)(11)(ii)(c) of this section and paragraph (d)(4)(v)(a) of this section) whether heated by artificial means or not, shall be provided with one or more safety relief valves of spring-loaded or equivalent type. These valves shall be arranged to afford free vent to the outer air with discharge not less than 5 feet horizontally away from any opening into the building which is below such discharge. The rate of discharge shall be in accordance with the requirements of paragraph (b)(10)(ii) or (b)(10)(iii) of this section in the case of vaporizers.

(ii) Minimum required rate of discharge in cubic feet per minute of air at 120 percent of the maximum permitted start to discharge pressure for safety relief valves to be used on containers other than those constructed in accordance with DOT specification shall be as follows:

Surface area (sq. ft.)	Flow rate CFM air
20 or less	626
25	751
30	872
35	990
40	1,100
45	1,220
50	1,330
55	1,430
60	1,540
65	1,640
70	1,750
75	1,850
80	1,950
85	2,050
90	2,150
95	2,240
100	2,340
105	2,440
110	2,530
115	2,630
120	2,720
125	2,810
130	2,900
135	2,990
140	3,080
145	3,170
150	3,260
155	3,350
160	3,440
165	3,530
170	3,620
175	3,700
180	3,790
185	3,880
190	3,960
195	4,050
200	4,130
210	4,300
220	4,470
230	4,630
240	4,800
250	4,960

Surface area (sq. ft.)	Flow rate CFM air
260	5,130
270	5,290
280	5,450
290	5,610
300	5,760
310	5,920
320	6,080
330	6,230
340	6,390
350	6,540
360	6,690
370	6,840
380	7,000
390	7,150
400	7,300
450	8,040
500	8,760
550	9,470
600	10,170
650	10,860
700	11,550
750	12,220
800	12,880
850	13,540
900	14,190
950	14,830
1,000	15,470
1,050	16,100
1,100	16,720
1,150	17,350
1,200	17,960
1,250	18,570
1,300	19,180
1,350	19,780
1,400	20,380
1,450	20,980
1,500	21,570
1,550	22,160
1,600	22,740
1,650	23,320
1,700	23,900
1,750	24,470
1,800	25,050
1,850	25,620
1,900	26,180
1,950	26,750
2,000	27,310

Surface area=total outside surface area of container in square feet.

When the surface area is not stamped on the nameplate or when the marking is not legible, the area can be calculated by using one of the following formulas:

(1) Cylindrical container with hemispherical heads:

$$\text{Area} = \text{Overall length} \times \text{outside diameter} \times 3.1416.$$

(2) Cylindrical container with other than hemispherical heads:

$$\text{Area} = (\text{Overall length} + 0.3 \text{ outside diameter}) \times \text{outside diameter} \times 3.1416.$$

NOTE: This formula is not exact, but will give results within the limits of practical accuracy for the sole purpose of sizing relief valves.

(3) Spherical container:

$$\text{Area} = \text{Outside diameter squared} \times 3.1416.$$

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Flow Rate-CFM Air=Required flow capacity in cubic feet per minute of air at standard conditions, 60 F. and atmospheric pressure (14.7 p.s.i.a.).

The rate of discharge may be interpolated for intermediate values of surface area. For containers with total outside surface area greater than 2,000 square feet, the required flow rate can be calculated using the formula, Flow Rate-CFM Air=53.632 A^{0.82}.

A=total outside surface area of the container in square feet.

Valves not marked "Air" have flow rate marking in cubic feet per minute of liquefied petroleum gas. These can be converted to ratings in cubic feet per minute of air by multiplying the liquefied petroleum gas ratings by factors listed below. Air flow ratings can be converted to ratings in cubic feet per minute of liquefied petroleum gas by dividing the air ratings by the factors listed below.

AIR CONVERSION FACTORS

Container type	100	125	150	175	200
Air conversion factor	1.162	1.142	1.113	1.078	1.010

(iii) Minimum Required Rate of Discharge for Safety Relief Valves for Liquefied Petroleum Gas Vaporizers (Steam Heated, Water Heated, and Direct Fired).

The minimum required rate of discharge for safety relief valves shall be determined as follows:

(a) Obtain the total surface area by adding the surface area of vaporizer shell in square feet directly in contact with LP-Gas and the heat exchanged surface area in square feet directly in contact with LP-Gas.

(b) Obtain the minimum required rate of discharge in cubic feet of air per minute, at 60 °F. and 14.7 p.s.i.a. from paragraph (b)(10)(ii) of this section, for this total surface area.

(iv) Container and vaporizer safety relief valves shall be set to start-to-discharge, with relation to the design pressure of the container, in accordance with Table H-26.

(v) Safety relief devices used with systems employing containers other than those constructed according to DOT specifications shall be so constructed as to discharge at not less than the rates shown in paragraph (b)(10)(ii) of this section, before the pressure is in excess of 120 percent of the maximum (not including the 10 percent referred to in paragraph (b)(10)(iv)

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of this section) permitted start to discharge pressure setting of the device.

TABLE H-26

Containers	Minimum (percent)	Maximum (percent)
ASME Code; Par. U-68, U-69—1949 and earlier editions	110	125
ASME Code; Par. U-200, U-201—1949 edition	88	100
ASME Code—1950, 1952, 1956, 1959, 1962, 1965 and 1968 (Division I) editions	88	100
API—ASME Code—all editions	88	100
DOT—As prescribed in 49 CFR Chapter I.		

¹Manufacturers of safety relief valves are allowed a plus tolerance not exceeding 10 percent of the set pressure marked on the valve.

(vi) In certain locations sufficiently sustained high temperatures prevail which require the use of a lower vapor pressure product to be stored or the use of a higher designed pressure vessel in order to prevent the safety valves opening as the result of these temperatures. As an alternative the tanks may be protected by cooling devices such as by spraying, by shading, or other effective means.

(vii) Safety relief valves shall be arranged so that the possibility of tampering will be minimized. If pressure setting or adjustment is external, the relief valves shall be provided with approved means for sealing adjustment.

(viii) Shutoff valves shall not be installed between the safety relief devices and the container, or the equipment or piping to which the safety relief device is connected except that a shutoff valve may be used where the arrangement of this valve is such that full required capacity flow through the safety relief device is always afforded.

(ix) Safety relief valves shall have direct communication with the vapor space of the container at all times.

(x) Each container safety relief valve used with systems covered by paragraphs (d), (e), (g), and (h) of this section, except as provided in paragraph (e)(3)(iii) of this section shall be plainly and permanently marked with the following: "Container Type" of the pressure vessel on which the valve is designed to be installed; the pressure in p.s.i.g. at which the valve is set to discharge; the actual rate of discharge of the valve in cubic feet per minute of air at 60 °F. and 14.7 p.s.i.a.; and the

manufacturer's name and catalog number, for example: T200-250-4050 AIR—indicating that the valve is suitable for use on a Type 200 container, that it is set to start to discharge at 250 p.s.i.g.; and that its rate of discharge is 4,050 cubic feet per minute of air as determined in subdivision (ii) of this subparagraph.

(xi) Safety relief valve assemblies, including their connections, shall be of sufficient size so as to provide the rate of flow required for the container on which they are installed.

(xii) A hydrostatic relief valve shall be installed between each pair of shut-off valves on liquefied petroleum gas liquid piping so as to relieve into a safe atmosphere. The start-to-discharge pressure setting of such relief valves shall not be in excess of 500 p.s.i.g. The minimum setting on relief valves installed in piping connected to other than DOT containers shall not be lower than 140 percent of the container relief valve setting and in piping connected to DOT containers not lower than 400 p.s.i.g. The start-to-discharge pressure setting of such a relief valve, if installed on the discharge side of a pump, shall be greater than the maximum pressure permitted by the recirculation device in the system.

(xiii) The discharge from any safety relief device shall not terminate in or beneath any building, except relief devices covered by paragraphs (b)(6)(i) (a) through (e) of this section, or paragraphs (c) (4)(i) or (5) of this section.

(xiv) Container safety relief devices and regulator relief vents shall be located not less than five (5) feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(11) *Vaporizer and housing.* (i) Indirect fired vaporizers utilizing steam, water, or other heating medium shall be constructed and installed as follows:

(a) Vaporizers shall be constructed in accordance with the requirements of paragraph (b)(3) (i)–(iii) of this section and shall be permanently marked as follows:

(1) With the code marking signifying the specifications to which the vaporizer is constructed.

(2) With the allowable working pressure and temperature for which the vaporizer is designed.

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

(4) With the name or symbol of the manufacturer.

(b) Vaporizers having an inside diameter of 6 inches or less exempted by the ASME Unfired Pressure Vessel Code, Section VIII of the ASME Boiler and Pressure Vessel Code—1968 shall have a design pressure not less than 250 p.s.i.g. and need not be permanently marked.

(c) Heating or cooling coils shall not be installed inside a storage container.

(d) Vaporizers may be installed in buildings, rooms, sheds, or lean-tos used exclusively for gas manufacturing or distribution, or in other structures of light, noncombustible construction or equivalent, well ventilated near the floor line and roof.

When vaporizing and/or mixing equipment is located in a structure or building not used exclusively for gas manufacturing or distribution, either attached to or within such a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipe or conduit passing through it. Such structure or room shall be provided with adequate ventilation and shall have a roof or at least one exterior wall of lightweight construction.

(e) Vaporizers shall have, at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with paragraph (b)(10)(iii) of this section, except as provided in paragraph (d)(4)(v)(a), of this section.

(f) The heating medium lines into and leaving the vaporizer shall be provided with suitable means for preventing the flow of gas into the heat systems in the event of tube rupture in the vaporizer. Vaporizers shall be provided with suitable automatic means to prevent liquid passing through the vaporizers to the gas discharge piping.

(g) The device that supplies the necessary heat for producing steam, hot water, or other heating medium may

be installed in a building, compartment, room, or lean-to which shall be ventilated near the floorline and roof to the outside. The device location shall be separated from all compartments or rooms containing liquefied petroleum gas vaporizers, pumps, and central gas mixing devices by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. This requirement does not apply to the domestic water heaters which may supply heat for a vaporizer in a domestic system.

(h) Gas-fired heating systems supplying heat exclusively for vaporization purposes shall be equipped with automatic safety devices to shut off the flow of gas to main burners, if the pilot light should fail.

(i) Vaporizers may be an integral part of a fuel storage container directly connected to the liquid section or gas section or both.

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

(k) Vaporizer houses shall not have unprotected drains to sewers or sump pits.

(ii) Atmospheric vaporizers employing heat from the ground or surrounding air shall be installed as follows:

(a) Buried underground, or

(b) Located inside the building close to a point at which pipe enters the building provided the capacity of the unit does not exceed 1 quart.

(c) Vaporizers of less than 1 quart capacity heated by the ground or surrounding air, need not be equipped with safety relief valves provided that adequate tests demonstrate that the assembly is safe without safety relief valves.

(iii) Direct gas-fired vaporizers shall be constructed, marked, and installed as follows:

(a)(1) In accordance with the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code—1968 that are applicable to the maximum working conditions for which the vaporizer is designed.

(2) With the name of the manufacturer; rated BTU input to the burner; the area of the heat exchange surface

in square feet; the outside surface of the vaporizer in square feet; and the maximum vaporizing capacity in gallons per hour.

(b)(1) Vaporizers may be connected to the liquid section or the gas section of the storage container, or both; but in any case there shall be at the container a manually operated valve in each connection to permit completely shutting off when desired, of all flow of gas or liquid from container to vaporizer.

(2) Vaporizers with capacity not exceeding 35 gallons per hour shall be located at least 5 feet from container shutoff valves. Vaporizers having capacity of more than 35 gallons but not exceeding 100 gallons per hour shall be located at least 10 feet from the container shutoff valves. Vaporizers having a capacity greater than 100 gallons per hour shall be located at least 15 feet from container shutoff valves.

(c) Vaporizers may be installed in buildings, rooms, housings, sheds, or lean-tos used exclusively for vaporizing or mixing of liquefied petroleum gas. Vaporizing housing structures shall be of noncombustible construction, well ventilated near the floorline and the highest point of the roof. When vaporizer and/or mixing equipment is located in a structure or room attached to or within a building, such structure or room shall be separated from the remainder of the building by a wall designed to withstand a static pressure of at least 100 pounds per square foot. This wall shall have no openings or pipes or conduit passing through it. Such structure or room shall be provided with adequate ventilation, and shall have a roof or at least one exterior wall of lightweight construction.

(d) Vaporizers shall have at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with paragraph (b)(10)(iii) of this section. The relief valve shall be so located as not to be subjected to temperatures in excess of 140 °F.

(e) Vaporizers shall be provided with suitable automatic means to prevent liquid passing from the vaporizer to the gas discharge piping of the vaporizer.

(f) Vaporizers shall be provided with means for manually turning off the gas to the main burner and pilot.

(g) Vaporizers shall be equipped with automatic safety devices to shut off the flow of gas to main burners if the pilot light should fail. When the flow through the pilot exceeds 2,000 B.t.u. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(h) Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fire vaporizer shall be separated from the open flame by a substantially airtight noncombustible partition or partitions.

(i) Except as provided in (c) of this subdivision, the following minimum distances shall be maintained between direct fired vaporizers and the nearest important building or group of buildings:

Ten feet for vaporizers having a capacity of 15 gallons per hour or less vaporizing capacity.

Twenty-five feet for vaporizers having a vaporizing capacity of 16 to 100 gallons per hour.

Fifty feet for vaporizers having a vaporizing capacity exceeding 100 gallons per hour.

(j) Direct fired vaporizers shall not raise the product pressure above the design pressure of the vaporizer equipment nor shall they raise the product pressure within the storage container above the pressure shown in the second column of Table H-31.

(k) Vaporizers shall not be provided with fusible plugs.

(l) Vaporizers shall not have unprotected drains to sewers or sump pits.

(iv) Direct gas-fired tank heaters shall be constructed and installed as follows:

(a) Direct gas-fired tank heaters, and tanks to which they are applied, shall only be installed above ground.

(b) Tank heaters shall be permanently marked with the name of the manufacturer, the rated B.t.u. input to the burner, and the maximum vaporizing capacity in gallons per hour.

(c) Tank heaters may be an integral part of a fuel storage container directly connected to the container liquid section, or vapor section, or both.

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

(e) Tank heaters shall be equipped with an automatic safety device to shut off the flow of gas to main burners, if the pilot light should fail. When flow through pilot exceeds 2,000 B.t.u. per hour, the pilot also shall be equipped with an automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

(f) Pressure regulating and pressure 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.

(g) The following minimum distances shall be maintained between a storage tank heated by a direct fired tank heater and the nearest important building or group of buildings:

Ten feet for storage containers of less than 500 gallons water capacity.

Twenty-five feet for storage containers of 500 to 1,200 gallons water capacity.

Fifty feet for storage containers of over 1,200 gallons water capacity.

(h) No direct fired tank heater shall raise the product pressure within the storage container over 75 percent of the pressure set out in the second column of Table H-31.

(v) The vaporizer section of vaporizer-burners used for dehydrators or dryers shall be located outside of buildings; they shall be constructed and installed as follows:

(a) Vaporizer-burners shall have a minimum design pressure of 250 p.s.i.g. with a factor of safety of five.

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

(c) Minimum distances between storage containers and vaporizer-burners shall be as follows:

Water capacity per container (gallons)	Minimum distances (feet)
Less than 501	10
501 to 2,000	25
Over 2,000	50

(d) The vaporizer section of vaporizer-burners shall be protected by a hydrostatic relief valve. The relief valve shall be located so as not to be subjected to temperatures in excess of 140

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°F. The start-to-discharge pressure setting shall be such as to protect the components involved, but not less than 250 p.s.i.g. The discharge shall be directed upward and away from component parts of the equipment and away from operating personnel.

(e) Vaporizer-burners shall be provided with means for manually turning off the gas to the main burner and pilot.

(f) Vaporizer-burners shall be equipped with automatic safety devices to shut off the flow of gas to the main burner and pilot in the event the pilot is extinguished.

(g) Pressure regulating and control equipment shall be located or protected so that the temperatures surrounding this equipment shall not exceed 140 °F. except that equipment components may be used at higher temperatures if designed to withstand such temperatures.

(h) Pressure regulating and control equipment when located downstream of the vaporizer shall be designed to withstand the maximum discharge temperature of the vapor.

(i) The vaporizer section of vaporizer-burners shall not be provided with fusible plugs.

(j) Vaporizer coils or jackets shall be made of ferrous metal or high temperature alloys.

(k) Equipment utilizing vaporizer-burners shall be equipped with automatic shutoff devices upstream and downstream of the vaporizer section connected so as to operate in the event of excessive temperature, flame failure, and, if applicable, insufficient airflow.

(12) *Filling densities.* (i) The “filling density” is defined as the percent ratio of the weight of the gas in a container to the weight of water the container will hold at 60 °F. All containers shall be filled according to the filling densities shown in Table H-27.

TABLE H-27—MAXIMUM PERMITTED FILLING DENSITY—Continued

Specific gravity at 60 °F. (15.6 °C.)	Above ground containers		Under ground containers, all capacities
	0 to 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap.	Over 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap.	
0 .496-0 .503	41	44	45
.504- .510	42	45	46
.511- .519	43	46	47
.520- .527	44	47	48
.528- .536	45	48	49
.537- .544	46	49	50
.545- .552	47	50	51
.553- .560	48	51	52
.561- .568	49	52	53
.569- .576	50	53	54
.577- .584	51	54	55
.585- .592	52	55	56
.593- .600	53	56	57

(ii) Except as provided in paragraph (b)(12)(iii) of this section, any container including mobile cargo tanks and portable tank containers regardless of size or construction, shipped under DOT jurisdiction or constructed in accordance with 49 CFR chapter I Specifications shall be charged according to 49 CFR chapter I requirements.

(iii) Portable containers not subject to DOT jurisdiction (such as, but not limited to, motor fuel containers on industrial and lift trucks, and farm tractors covered in paragraph (e) of this section, or containers recharged at the installation) may be filled either by weight, or by volume using a fixed length dip tube gaging device.

(13) *LP-Gas in buildings.* (i) Vapor shall be piped into buildings at pressures in excess of 20 p.s.i.g. only if the buildings or separate areas thereof, (a) are constructed in accordance with this section; (b) are used exclusively to house equipment for vaporization, pressure reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; (c) buildings, structures, or equipment under construction or undergoing major renovation.

(ii) Liquid may be permitted in buildings as follows:

(a) Buildings, or separate areas of buildings, used exclusively to house equipment for vaporization, pressure

TABLE H-27—MAXIMUM PERMITTED FILLING DENSITY

Specific gravity at 60 °F. (15.6 °C.)	Above ground containers		Under ground containers, all capacities
	0 to 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap.	Over 1,200 U.S. gals. (1,000 imp. gal., 4,550 liters) total water cap.	
	Percent	Percent	Percent

reduction, gas mixing, gas manufacturing, or distribution, or to house internal combustion engines, industrial processes, research and experimental laboratories, or equipment and processes using such gas and having similar hazard; and when such buildings, or separate areas thereof are constructed in accordance with this section.

(b) Buildings, structures, or equipment under construction or undergoing major renovation provided the temporary piping meets the following conditions:

(1) Liquid piping inside the building shall conform to the requirements of paragraph (b)(8) of this section, and shall not exceed three-fourths iron pipe size. Copper tubing with an outside diameter of three-fourths inch or less may be used provided it conforms to Type K of Specifications for Seamless Water Tube, ANSI H23.1-1970 (ASTM B88-69) (see Table H-24). All such piping shall be protected against construction hazards. Liquid piping inside buildings shall be kept to a minimum. Such piping shall be securely fastened to walls or other surfaces so as to provide adequate protection from breakage and so located as to subject the liquid line to lowest ambient temperatures.

(2) A shutoff valve shall be installed in each intermediate branch line where it takes off the main line and shall be readily accessible. A shutoff valve shall also be placed at the appliance end of the intermediate branch line. Such shutoff valve shall be upstream of any flexible connector used with the appliance.

(3) Suitable excess flow valves shall be installed in the container outlet line supplying liquid LP-Gas to the building. A suitable excess flow valve shall be installed immediately downstream of each shutoff valve. Suitable excess flow valves shall be installed where piping size is reduced and shall be sized for the reduced size piping.

(4) Hydrostatic relief valves shall be installed in accordance with paragraph (b)(10)(xii) of this section.

(5) The use of hose to carry liquid between the container and the building or at any point in the liquid line, except at the appliance connector, shall be prohibited.

(6) Where flexible connectors are necessary for appliance installation, such connectors shall be as short as practicable and shall comply with paragraph (b)(8)(ii) or (9) of this section.

(7) Release of fuel when any section of piping or appliances is disconnected shall be minimized by either of the following methods:

(i) Using an approved automatic quick-closing coupling (a type closing in both directions when coupled in the fuel line), or

(ii) Closing the valve nearest to the appliance and allowing the appliance to operate until the fuel in the line is consumed.

(iii) Portable containers shall not be taken into buildings except as provided in paragraph (b)(6)(i) of this section.

(14) *Transfer of liquids.* The employer shall assure that (i) at least one attendant shall remain close to the transfer connection from the time the connections are first made until they are finally disconnected, during the transfer of the product.

(ii) Containers shall be filled or used only upon authorization of the owner.

(iii) Containers manufactured in accordance with specifications of 49 CFR part 178 and authorized by 49 CFR chapter 1 as a "single trip" or "non-refillable container" shall not be refilled or reused in LP-Gas service.

(iv) Gas or liquid shall not be vented to the atmosphere to assist in transferring contents of one container to another, except as provided in paragraph (e)(5)(iv) of this section and except that this shall not preclude the use of listed pump utilizing LP-Gas in the vapor phase as a source of energy and venting such gas to the atmosphere at a rate not to exceed that from a No. 31 drill size opening and provided that such venting and liquid transfer shall be located not less than 50 feet from the nearest important building.

(v) Filling of fuel containers for industrial trucks or motor vehicles from industrial bulk storage containers shall be performed not less than 10 feet from the nearest important masonry-walled building or not less than 25 feet from the nearest important building or other construction and, in any event, not less than 25 feet from any building opening.

(vi) Filling of portable containers, containers mounted on skids, fuel containers on farm tractors, or similar applications, from storage containers used in domestic or commercial service, shall be performed not less than 50 feet from the nearest important building.

(vii) The filling connection and the vent from the liquid level gages in containers, filled at point of installation, shall not be less than 10 feet in any direction from air openings into sealed combustion system appliances or mechanical ventilation air intakes.

(viii) Fuel supply containers shall be gaged and charged only in the open air or in buildings especially provided for that purpose.

(ix) The maximum vapor pressure of the product at 100 °F. which may be transferred into a container shall be in accordance with paragraphs (d)(2) and (e)(3) of this section. (For DOT containers use DOT requirements.)

(x) Marketers and users shall exercise precaution to assure that only those gases for which the system is designed, examined, and listed, are employed in its operation, particularly with regard to pressures.

(xi) Pumps or compressors shall be designed for use with LP-Gas. When compressors are used they shall normally take suction from the vapor space of the container being filled and discharge to the vapor space of the container being emptied.

(xii) Pumping systems, when equipped with a positive displacement pump, shall include a recirculating device which shall limit the differential pressure on the pump under normal operating conditions to the maximum differential pressure rating of the pump. The discharge of the pumping system shall be protected so that pressure does not exceed 350 p.s.i.g. If a recirculation system discharges into the supply tank and contains a manual shutoff valve, an adequate secondary safety recirculation system shall be incorporated which shall have no means of rendering it inoperative. Manual shutoff valves in recirculation systems shall be kept open except during an emergency or when repairs are being made to the system.

(xiii) When necessary, unloading piping or hoses shall be provided with suitable bleeder valves for relieving pressure before disconnection.

(xiv) Agricultural air moving equipment, including crop dryers, shall be shut down when supply containers are being filled unless the air intakes and sources of ignition on the equipment are located 50 feet or more from the container.

(xv) Agricultural equipment employing open flames or equipment with integral containers, such as flame cultivators, weed burners, and, in addition, tractors, shall be shut down during refueling.

(15) *Tank car or transport truck loading or unloading points and operations.* (i) The track of tank car siding shall be relatively level.

(ii) A "Tank Car Connected" sign, as covered by DOT rules, shall be installed at the active end or ends of the siding while the tank car is connected.

(iii) While cars are on sidetrack for loading or unloading, the wheels at both ends shall be blocked on the rails.

(iv) The employer shall insure that an employee is in attendance at all times while the tank car, cars, or trucks are being loaded or unloaded.

(v) A backflow check valve, excess-flow valve, or a shutoff valve with means of remote closing, to protect against uncontrolled discharge of LP-Gas from storage tank piping shall be installed close to the point where the liquid piping and hose or swing joint pipe is connected.

(vi) Where practical, the distance of the unloading or loading point shall conform to the distances in subparagraph (6)(ii) of this paragraph.

(16) *Instructions.* Personnel performing installation, removal, operation, and maintenance work shall be properly trained in such function.

(17) *Electrical equipment and other sources of ignition.* (i) Electrical equipment and wiring shall be of a type specified by and shall be installed in accordance with subpart S of this part, for ordinary locations except that fixed electrical equipment in classified areas shall comply with subparagraph (18) of this paragraph.

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

(iii) Liquefied petroleum gas storage containers do not require lightning protection.

(iv) 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.

(v) Open flames (except as provided for in paragraph (b)(11) of this section), cutting or welding, portable electric tools, and extension lights capable of igniting LP-Gas, shall not be permitted within classified areas specified in Table H-28 unless the LP-Gas facilities have been freed of all liquid and vapor, or special precautions observed under carefully controlled conditions.

TABLE H-28

Part	Location	Extent of classified area ¹	Equipment shall be suitable for 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 H-28.	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. 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 H-1).	Division 1. Division 2.
C	Gage vent openings other than those on DOT cylinders.	Within 5 feet in all directions from point of discharge Beyond 5 feet but within 15 feet in all directions from point of discharge.	Division 1. Division 2.
D	Relief valve discharge other than those on DOT cylinders.	Within direct path of discharge Within 5 feet in all directions from point of discharge Beyond 5 feet but within 15 feet in all directions from point of discharge except within the direct path of discharge.	Division 1. Division 1. Division 2.
E	Pumps, compressors, gas-air mixers and vaporizers other than direct fired. Indoors without ventilation Entire room and any adjacent room not separated by a gas-tight partition. 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 1. Division 2.
	Indoors with adequate ventilation ⁴ . Outdoors in open air at or abovegrade.	Entire room and any adjacent room not separated by a gas-tight partition. 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 H-1.	Division 2. 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. Up to 18 inches abovegrade within 20 ft. horizontally from any edge of enclosure.	Division 1. Division 2.
G	Pits or trenches containing or located beneath LP-Gas valves, pumps, compressors, regulators, and similar equipment. Without mechanical ventilation	NOTE: For pits within this area, see part F of this table.. Entire pit or trench Entire room and any adjacent room not separated by a gas-tight partition. Within 15 feet in all directions from pit or trench when located outdoors.	Division 1. Division 1. Division 2.
	With adequate mechanical ventilation.	Entire pit or trench Entire room and any adjacent room not separated by a gas-tight partition.	Division 2. Division 2.

TABLE H-28—Continued

Part	Location	Extent of classified area ¹	Equipment shall be suitable for Class 1, Group D 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.
	Pipelines and connections containing operational bleeds, drips, vents or drains.	Within 5 ft. in all directions from point of discharge	Division 1.
J	Container filling:	Beyond 5 ft. from point of discharge, same as part E of this table.	
	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.
	Outdoors in open air	Beyond 5 feet and entire room	Division 2.
		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 H-1).	Division 2.

¹ The classified area shall not extend beyond an unpierced wall, roof, or solid vaportight partition.
² See subpart S of this part.
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.
⁴ Ventilation, either natural or mechanical, is considered adequate when the concentration of the gas in a gas-air mixture does not exceed 25 percent of the lower flammable limit under normal operating conditions.

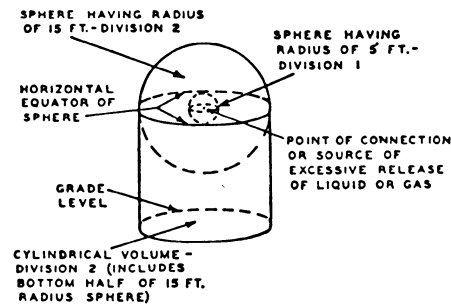


FIGURE H-1

(18) *Fixed electrical equipment in classified areas.* Fixed electrical equipment and wiring installed within classified areas specified in Table H-28 shall comply with Table H-28 and shall be installed in accordance with subpart S of this part. This provision does not apply to fixed electrical equipment at residential or commercial installations of LP-Gas systems or to systems covered by paragraph (e) or (g) of this section.

(19) *Liquid-level gaging device.* (i) Each container manufactured after December 31, 1965, and filled on a volumetric basis shall be equipped with a fixed liquid-level gage to indicate the maximum permitted filling level as pro-

vided in paragraph (b)(19)(v) of this section. Each container manufactured after December 31, 1969, shall have permanently attached to the container adjacent to the fixed level gage a marking showing the percentage full that will be shown by that gage. When a variable liquid-level gage is also provided, the fixed liquid-level gage will also serve as a means for checking the variable gage. These gages shall be used in charging containers as required in paragraph (b)(12) of this section.

(ii) All variable gaging devices shall be arranged so that the maximum liquid level for butane, for a 50-50 mixture of butane and propane, and for propane, to which the container may be charged is readily determinable. The markings indicating the various liquid levels from empty to full shall be on the system nameplate or gaging device or part may be on the system nameplate and part on the gaging device. Dials of magnetic or rotary gages shall show whether they are for cylindrical or spherical containers and whether for aboveground or underground service. The dials of gages intended for use only on aboveground containers of over 1,200 gallons water capacity shall be so marked.

(iii) Gaging devices that require bleeding of the product to the atmosphere, such as the rotary tube, fixed tube, and slip tube, shall be designed so that the bleed valve maximum opening is not larger than a No. 54 drill size, unless provided with excess flow valve.

(iv) Gaging devices shall have a design working pressure of at least 250 p.s.i.g.

(v) Length of tube or position of fixed liquid-level gage shall be designed to indicate the maximum level to which the container may be filled for the product contained. This level shall be based on the volume of the product at 40 °F. at its maximum permitted filling density for aboveground containers and at 50 °F. for underground containers. The employer shall calculate the filling point for which the fixed liquid level gage shall be designed according to the method in this subdivision.

(a) It is impossible to set out in a table the length of a fixed dip tube for various capacity tanks because of the varying tank diameters and lengths and because the tank may be installed either in a vertical or horizontal position. Knowing the maximum permitted filling volume in gallons, however, the length of the fixed tube can be determined by the use of a strapping table obtained from the container manufacturer. The length of the fixed tube should be such that when its lower end touches the surface of the liquid in the container, the contents of the container will be the maximum permitted volume as determined by the following formula:

$$[(\text{Water capacity (gals.) of container} \times \text{filling density}^{**}) \div (\text{Specific gravity of LP-Gas} \times \text{volume correction factor} \times 100)] = \text{Maximum volume of LP-Gas}$$

*Measured at 60 °F.

**From subparagraph (12) of this paragraph "Filling Densities."

For aboveground containers the liquid temperature is assumed to be 40 °F. and for underground containers the liquid temperature is assumed to be 50 °F. To correct the liquid volumes at these temperatures to 60 °F. the following factors shall be used.

(b) Formula for determining maximum volume of liquefied petroleum gas for which a fixed length of dip tube shall be set:

TABLE H-29—VOLUME CORRECTION FACTORS

Specific gravity	Aboveground	Underground
0.500	1.033	1.017
.510	1.031	1.016
.520	1.029	1.015
.530	1.028	1.014
.540	1.026	1.013
.550	1.025	1.013
.560	1.024	1.012
.570	1.023	1.011
.580	1.021	1.011
.590	1.020	1.010

(c) The maximum volume of LP-Gas which can be placed in a container when determining the length of the dip tube expressed as a percentage of total water content of the container is calculated by the following formula.

(d) The maximum weight of LP-Gas which may be placed in a container for determining the length of a fixed dip tube is determined by multiplying the maximum volume of liquefied petroleum gas obtained by the formula in paragraph (b)(19)(b) of this section by the pounds of liquefied petroleum gas in a gallon at 40 °F. for aboveground and at 50 °F. for underground containers. For example, typical pounds per gallon are specified below:

Example: Assume a 100-gallon total water capacity tank for aboveground storage of propane having a specific gravity of 0.510 of 60 °F.

$$[(100 \text{ (gals.)} \times 42 \text{ (filling density from subparagraph (12) of this paragraph)}) \div (0.510 \times 1.031 \text{ (correction factor from Table H-29)} \times 100)] = (4200 \div 52.6)$$

(4200 ÷ 52.6) = 79.8 gallons propane, the maximum amount permitted to be placed in a 100-gallon total water capacity aboveground container equipped with a fixed dip tube.

$$[(\text{Maximum volume of LP-Gas (from formula in subdivision (b) of this subdivision)} \times 100) \div \text{Total water content of container in gallons}] = \text{Maximum percent of LP-Gas}$$

	Above-ground, pounds per gallon	Under-ground, pounds per gallon
Propane	4.37	4.31
N Butane	4.97	4.92

(vi) Fixed liquid-level gages used on containers other than DOT containers shall be stamped on the exterior of the gage with the letters "DT" followed by the vertical distance (expressed in inches and carried out to one decimal

place) from the top of container to the end of the dip tube or to the centerline of the gage when it is located at the maximum permitted filling level. For portable containers that may be filled in the horizontal and/or vertical position the letters "DT" shall be followed by "V" with the vertical distance from the top of the container to the end of the dip tube for vertical filling and with "H" followed by the proper distance for horizontal filling. For DOT containers the stamping shall be placed both on the exterior of the gage and on the container. On above-ground or cargo containers where the gages are positioned at specific levels, the marking may be specified in percent of total tank contents and the marking shall be stamped on the container.

(vii) Gage glasses of the columnar type shall be restricted to charging plants where the fuel is withdrawn in the liquid phase only. They shall be equipped with valves having metallic handwheels, with excess flow valves, and with extra-heavy glass adequately protected with a metal housing applied by the gage manufacturer. They shall be shielded against the direct rays of the sun. Gage glasses of the columnar type are prohibited on tank trucks, and on motor fuel tanks, and on containers used in domestic, commercial, and industrial installations.

(viii) Gaging devices of the float, or equivalent type which do not require flow for their operation and having connections extending to a point outside the container do not have to be equipped with excess flow valves provided the piping and fittings are adequately designed to withstand the container pressure and are properly protected against physical damage and breakage.

(20) *Requirements for appliances.* (i) Except as provided in paragraph (b)(20)(ii) of this section, new commercial and industrial gas consuming appliances shall be approved.

(ii) Any appliance that was originally manufactured for operation with a gaseous fuel other than LP-Gas and is in good condition may be used with LP-Gas only after it is properly converted, adapted, and tested for performance with LP-Gas before the appliance is placed in use.

(iii) Unattended heaters used inside buildings for the purpose of animal or poultry production or care shall be equipped with an approved automatic device designed to shut off the flow of gas to the main burners, and pilot if used, in the event of flame extinguishment.

(iv) All commercial, industrial, and agricultural appliances or equipment shall be installed in accordance with the requirements of this section and in accordance with the following NFPA consensus standards, which are incorporated by reference as specified in § 1910.6:

(a) Domestic and commercial appliances—NFPA 54-1969, Standard for the Installation of Gas Appliances and Gas Piping.

(b) Industrial appliances—NFPA 54A-1969, Standard for the Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises.

(c) Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines—NFPA 37-1970.

(d) Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment, NFPA 96-1970.

(c) *Cylinder systems*—(1) *Application.* This paragraph applies specifically to systems utilizing containers constructed in accordance with DOT Specifications. All requirements of paragraph (b) of this section apply to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) *Marking of containers.* Containers shall be marked in accordance with DOT regulations. Additional markings not in conflict with DOT regulations may be used.

(3) *Description of a system.* A system shall include the container base or bracket, containers, container valves, connectors, manifold valve assembly, regulators, and relief valves.

(4) *Containers and regulating equipment installed outside of buildings or structures.* (i) Containers shall not be buried below ground. However, this shall not prohibit the installation in a compartment or recess below grade level such as a niche in a slope or terrace wall which is used for no other

purpose, providing that the container and regulating equipment are not in contact with the ground and the compartment or recess is drained and ventilated horizontally to the outside air from its lowest level, with the outlet at least 3 feet away from any building opening which is below the level of such outlet.

Except as provided in paragraph (b)(10)(xiii) of this section, the discharge from safety relief devices shall be located not less than 3 feet horizontally away from any building opening which is below the level of such discharge and shall not terminate beneath any building unless such space is well ventilated to the outside and is not enclosed on more than two sides.

(ii) Containers shall be set upon 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.

(5) *Containers and equipment used inside of buildings or structures.* (i) When operational requirements make portable use of containers necessary and their location outside of buildings or structure is impracticable, containers and equipment are permitted to be used inside of buildings or structures in accordance with (a) through (l) of this subdivision, and, in addition, such other provisions of this subparagraph as are applicable to the particular use or occupancy.

(a) Containers in use shall mean connected for use.

(b) Systems utilizing containers having a water capacity greater than 2½ pounds (nominal 1 pound LP-Gas capacity) shall be equipped with excess flow valves. Such excess flow valves shall be either integral with the container valves or in the connections to the container valve outlets. In either case, an excess flow valve shall be installed in such a manner that any undue strain beyond the excess flow valve will not cause breakage between the container and the excess flow valve. The installation of excess flow valves shall take into account the type of valve protection provided.

(c) Regulators, if used, shall be either directly connected to the container valves or to manifolds connected to the container valves. The regulator shall

be suitable for use with LP-Gas. Manifolds and fittings connecting containers to pressure regulator inlets shall be designed for at least 250 p.s.i.g. service pressure.

(d) Valves on containers having a water capacity greater than 50 pounds (nominal 20 pounds LP-Gas capacity) shall be protected while in use.

(e) Containers shall be marked in accordance with paragraph (b)(5)(iii) of this section and paragraph (c)(2) of this section.

(f) Pipe or tubing shall conform to paragraph (b)(8) of this section except that aluminum pipe or tubing shall not be used.

(g)(1) Hose shall be designed for a working pressure of at least 250 p.s.i.g. Hose and hose connections shall have their correctness as to design, construction and performance determined by listing by a nationally recognized testing laboratory. The hose length may exceed the length specified in paragraph (b)(9)(vii)(b) of this section, but shall be as short as practicable. Refer to § 1910.7 for definition of nationally recognized testing laboratory.

(2) Hose shall be long enough to permit compliance with spacing provisions of this subparagraph without kinking or straining or causing hose to be so close to a burner as to be damaged by heat.

(h) 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. Such heaters having inputs above 50,000 B.t.u. manufactured on or after May 17, 1967, and such heaters having inputs above 100,000 B.t.u. manufactured before May 17, 1967, 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 electric ignition system.

The provisions of this paragraph (h) do not apply to tar kettle burners, torches, melting pots, nor do they apply to portable heaters under 7,500 B.t.u.h. input when used with containers having a maximum water capacity of 2½ pounds. Container valves, connectors,

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regulators, manifolds, piping, and tubing shall not be used as structural supports for heaters.

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

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

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

(l) Containers, including the valve protective devices, shall be installed so as to minimize the probability of impingement of discharge of safety relief devices upon containers.

(ii) Containers having a maximum water capacity of 2½ pounds (nominal 1 pound LP-Gas capacity) are permitted to be used inside of buildings as part of approved self-contained hand torch assemblies or similar appliances.

(iii) Containers having a maximum water capacity of 12 pounds (nominal 5 pounds LP-Gas capacity) are permitted to be used temporarily inside of buildings for public exhibition or demonstration purposes, including use for classroom demonstrations.

(iv) [Reserved]

(v) Containers are permitted to be used in buildings or structures under construction or undergoing major renovation when such buildings or structures are not occupied by the public, as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(b) For temporary heating such as curing concrete, drying plaster and similar applications, heaters (other than integral heater-container units) shall be located at least 6 feet from any LP-Gas container. This shall not prohibit the use of heaters specifically designed for attachment to the container

or to a supporting standard, provided they are designed and installed so as to prevent direct or radiant heat application from the heater onto the container. Blower and radiant type heaters shall not be directed toward any LP-Gas container within 20 feet.

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

(d) When heaters are connected to containers for use in an unpartitioned area on the same floor, the total water capacity of containers manifolded together for connection to a heater or heaters shall not be greater than 735 pounds (nominal 300 pounds LP-Gas capacity). Such manifolds shall be separated by at least 20 feet.

(e) On floors on which heaters are not connected for use, containers are permitted to be manifolded together for connection to a heater or heaters on another floor, *Provided*:

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

(2) Where more than one manifold having a total water capacity greater than 735 pounds (nominal 300 pounds LP-Gas capacity) are located in the same unpartitioned area, they shall be separated by at least 50 feet.

(f) Storage of containers awaiting use shall be in accordance with paragraph (f) of this section.

(vi) Containers are permitted to be used in industrial occupancies for processing, research, or experimental purposes as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity).

(b) Containers connected to a manifold shall have a total water capacity not greater than 735 pounds (nominal 300 pounds LP-Gas capacity) and not more than one such manifold may be located in the same room unless separated at least 20 feet from a similar unit.

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

(vii)(a) Containers are permitted to be used in industrial occupancies with essentially noncombustible contents where portable equipment for space heating is essential and where a permanent heating installation is not practical, as follows:

(b) Containers and heaters shall comply with and be used in accordance with paragraph (c)(5)(v) of this section.

(viii) Containers are permitted to be used in buildings for temporary emergency heating purposes, if necessary to prevent damage to the buildings or contents, when the permanent heating system is temporarily out of service, as follows:

(a) Containers and heaters shall comply with and be used in accordance with paragraph (c)(5)(v) of this section.

(b) The temporary heating equipment shall not be left unattended.

(ix) Containers are permitted to be used temporarily in buildings for training purposes related in installation and use of LP-Gas systems, as follows:

(a) The maximum water capacity of individual containers shall be 245 pounds (nominal 100 pounds LP-Gas capacity), but the maximum quantity of LP-Gas that may be placed in each container shall be 20 pounds.

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

(6) *Container valves and accessories.* (i) Valves in the assembly of multiple container systems shall be arranged so that replacement of containers can be made without shutting off the flow of gas in the system.

NOTE: This provision is not to be construed as requiring an automatic changeover device.

(ii) Regulators and low-pressure relief devices shall be rigidly attached to the cylinder valves, cylinders, supporting standards, the building walls or otherwise rigidly secured and shall be so installed or protected that the elements (sleet, snow, or ice) will not affect their operation.

(iii) Valves and connections to the containers shall be protected while in

transit, in storage, and while being moved into final utilization, as follows:

(a) By setting into the recess of the container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(b) By ventilated cap or collar, fastened to the container capable of withstanding a blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to the valve or other connection.

(iv) When containers are not connected to the system, the outlet valves shall be kept tightly closed or plugged, even though containers are considered empty.

(v) Containers having a water capacity in excess of 50 pounds (approximately 21 pounds LP-Gas capacity), recharged at the installation, shall be provided with excess flow or backflow check valves to prevent the discharge of container contents in case of failure of the filling or equalizing connection.

(7) *Safety devices.* (i) Containers shall be provided with safety devices as required by DOT regulations.

(ii) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

TABLE H-30

Regulator delivery pressure	Relief valve start-to-discharge pressure setting (percent of regulator delivery pressure)	
	Minimum	Maximum
1 p.s.i.g. or less	200	300
Above 1 p.s.i.g. but not over 3 p.s.i.g.	140	200
Above 3 p.s.i.g.	125	200

(iii) When a regulator or pressure relief valve is used inside a building for other than purposes specified in paragraphs (b)(6)(i) (a)-(g) of this section, the relief valve and the space 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 which is below such discharge. These provisions do not

apply to individual appliance regulators when protection is otherwise provided nor to paragraph (c)(5) of this section and paragraph (b)(10)(xiii) of this section. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.

(8) *Reinstallation of containers.* Containers shall not be reinstalled unless they are requalified in accordance with DOT regulations.

(9) *Permissible product.* A product shall not be placed in a container marked with a service pressure less than four-fifths of the maximum vapor pressure of product at 130 °F.

(d) *Systems utilizing containers other than DOT containers—(1) Application.* This paragraph applies specifically to systems utilizing storage containers other than those constructed in accordance with DOT specifications. Paragraph (b) of this section applies to this paragraph unless otherwise noted in paragraph (b) of this section.

(2) *Design pressure and classification of storage containers.* Storage containers shall be designed and classified in accordance with Table H-31.

TABLE H-31

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100 °F. (37.8 °C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code ³
180	180	180	100
100	100	100	125
125	125	125	156
150	150	150	187
175	175	175	219
² 200	215	200	250

¹New storage containers of the 80 type have not been authorized since Dec. 31, 1947.

²Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100% of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125% of the container type designation when constructed under: (1) the 1949 ASME Code (Par. U-200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

³Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(3) *Container valves and accessories, filler pipes, and discharge pipes.* (i) The filling pipe inlet terminal shall not be

located inside a building. For containers with a water capacity of 125 gallons or more, such terminals shall be located not less than 10 feet from any building (see paragraph (b)(6)(ii) of this section), and preferably not less than 5 feet from any driveway, and shall be located in a protective housing built for the purpose.

(ii) The filling connection shall be fitted with one of the following:

(a) Combination back-pressure check valve and excess flow valve.

(b) One double or two single back-pressure check valves.

(c) A positive shutoff valve, in conjunction with either:

(1) An internal back-pressure valve, or

(2) An internal excess flow valve.

(iii) All openings in a container shall be equipped with approved automatic excess flow valves except in the following: Filling connections as provided in paragraph (d)(3)(ii) of this section; safety relief connections, liquid-level gaging devices as provided in paragraphs (b)(7)(iv), (19)(iii), and (19)(viii) of this section; pressure gage connections as provided in paragraph (b)(7)(v) of this section, as provided in paragraphs (d) (iv), (vi), and (vii) of this section.

(iv) An excess flow valve is not required in the withdrawal service line providing the following are complied with:

(a) Such systems' total water capacity does not exceed 2,000 U.S. gallons.

(b) The discharge from the service outlet is controlled by a suitable manually operated shutoff valve which is:

(1) Threaded directly into the service outlet of the container; or

(2) Is an integral part of a substantial fitting threaded into or on the service outlet of the container; or

(3) Threaded directly into a substantial fitting threaded into or on the service outlet of the container.

(c) The shutoff valve is equipped with an attached handwheel or the equivalent.

(d) The controlling orifice between the contents of the container and the outlet of the shutoff valve does not exceed five-sixteenths inch in diameter for vapor withdrawal systems and one-

eighth inch in diameter for liquid withdrawal systems.

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

(v) All 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, and on any container used to supply fuel directly to an internal combustion engine, shall be labeled to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(vi) In lieu of an excess flow valve openings may be fitted with a quick-closing internal valve which, except during operating periods shall remain closed. The internal mechanism for such valves may be provided with a secondary control which shall be equipped with a fusible plug (not over 220 °F. melting point) which will cause the internal valve to close automatically in case of fire.

(vii) Not more than two plugged openings shall be permitted on a container of 2,000 gallons or less water capacity.

(viii) Containers of 125 gallons water capacity or more manufactured after July 1, 1961, shall be provided with an approved device for liquid evacuation, the size of which shall be three-fourths inch National Pipe Thread minimum. A plugged opening will not satisfy this requirement.

(4) *Safety devices.* (i) All safety devices shall comply with the following:

(a) All container safety relief devices shall be located on the containers and shall have direct communication with the vapor or space of the container.

(b) In industrial and gas manufacturing plants, discharge pipe from safety relief valves on pipe lines within a building shall discharge vertically upward and shall be piped to a point outside a building.

(c) Safety relief device discharge terminals shall be so located as to provide

protection against physical damage and such discharge pipes shall be fitted with loose raincaps. Return bends and restrictive pipefittings shall not be permitted.

(d) If desired, discharge lines from two or more safety relief devices located on the same unit, or similar lines from two or more different units, may be run into a common discharge header, provided that the cross-sectional area of such header be at least equal to the sum of the cross-sectional area of the individual discharge lines, and that the setting of safety relief valves are the same.

(e) Each storage container of over 2,000 gallons water capacity shall be provided with a suitable pressure gage.

(f) A final stage regulator of an LP-Gas system (excluding any appliance regulator) shall be equipped on the low-pressure side with a relief valve which is set to start to discharge within the limits specified in Table H-30.

(g) When a regulator or pressure relief valve is installed inside a building, the relief valve and the space 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 opening into the building which is below such discharge. (These provisions do not apply to individual appliance regulators when protection is otherwise provided. In buildings devoted exclusively to gas distribution purposes, the space above the diaphragm need not be vented to the outside.)

(ii) Safety devices for aboveground containers shall be provided as follows:

(a) Containers of 1,200 gallons water capacity or less which may contain liquid fuel when installed above ground shall have the rate of discharge required by paragraph (b)(10)(ii) of this section provided by a spring-loaded relief valve or valves. In addition to the required spring-loaded relief valve(s), suitable fuse plug(s) may be used provided the total discharge area of the fuse plug(s) for each container does not exceed 0.25 square inch.

(b) The fusible metal of the fuse plugs shall have a yield temperature of 208

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°F. minimum and 220 °F. maximum. Relief valves and fuse plugs shall have direct communication with the vapor space of the container.

(c) On a container having a water capacity greater than 125 gallons, but not over 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made for draining condensate which may accumulate in the relief valve or its discharge pipe.

(d) On containers of 125 gallons water capacity or less, the discharge from safety relief devices shall be located not less than 5 feet horizontally away from any opening into the building below the level of such discharge.

(e) On a container having a water capacity greater than 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 7 feet above the container, and unobstructed to the open air in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. Suitable provision shall be made so that any liquid or condensate that may accumulate inside of the safety relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of product escaping from the drain.

(iii) On all containers which are installed underground and which contain no liquid fuel until buried and covered, the rate of discharge of the spring-loaded relief valve installed thereon may be reduced to a minimum of 30 percent of the rate of discharge specified in paragraph (b)(10)(ii) of this section. Containers so protected shall not be uncovered after installation until the liquid fuel has been removed therefrom. Containers which may contain liquid fuel before being installed under ground and before being completely covered with earth are to be considered aboveground

containers when determining the rate of discharge requirement of the relief valves.

(iv) On underground containers of more than 2,000 gallons water capacity, the discharge from safety relief devices shall be piped vertically and directly upward to a point at least 7 feet above the ground.

Where there is a probability of the manhole or housing becoming flooded, the discharge from regulator vent lines shall be above the highest probable water level. All manholes or housings shall be provided with ventilated louvers or their equivalent, the area of such openings equaling or exceeding the combined discharge areas of the safety relief valves and other vent lines which discharge their content into the manhole housing.

(v) Safety devices for vaporizers shall be provided as follows:

(a) Vaporizers of less than 1 quart total capacity, heated by the ground or the surrounding air, need not be equipped with safety relief valves provided that adequate tests certified by any of the authorities referred to in paragraph (b)(2) of this section, demonstrate that the assembly is safe without safety relief valves.

(b) No vaporizer shall be equipped with fusible plugs.

(c) In industrial and gas manufacturing plants, safety relief valves on vaporizers within a building shall be piped to a point outside the building and be discharged upward.

(5) *Reinstallation of containers.* Containers may be reinstalled if they do not show any evidence of harmful external corrosion or other damage. Where containers are reinstalled underground, the corrosion resistant coating shall be put in good condition (see paragraph (c)(7)(vi) of this section). Where containers are reinstalled above ground, the safety devices and gaging devices shall comply with paragraph (c)(4) of this section and paragraph (b)(19) of this section respectively for aboveground containers.

(6) *Capacity of containers.* A storage container shall not exceed 90,000 gallons water capacity.

(7) *Installation of storage containers.* (i) Containers installed above ground, except as provided in paragraph (c)(7)(vii)

of this section, shall be provided with substantial masonry or noncombustible structural supports on firm masonry foundation.

(ii) Aboveground containers shall be supported as follows:

(a) Horizontal containers shall be mounted on saddles in such a manner as to permit expansion and contraction. Structural metal supports may be employed when they are protected against fire in an approved manner. Suitable means of preventing corrosion shall be provided on that portion of the container in contact with the foundations or saddles.

(b) Containers of 2,000 gallons water capacity or less may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container shell to the concrete pad, footing, or the ground does not exceed 24 inches.

(iii) Any container may be installed with nonfireproofed ferrous metal supports if mounted on concrete pads or footings, and if the distance from the outside bottom of the container to the ground does not exceed 5 feet, provided the container is in an isolated location.

(iv) Containers may be partially buried providing the following requirements are met:

(a) The portion of the container below the surface and for a vertical distance not less than 3 inches above the surface of the ground is protected to resist corrosion, and the container is protected against settling and corrosion as required for fully buried containers.

(b) Spacing requirements shall be as specified for underground tanks in paragraph (b)(6)(ii) of this section.

(c) Relief valve capacity shall be as required for aboveground containers.

(d) Container is located so as not to be subject to vehicular damage, or is adequately protected against such damage.

(e) Filling densities shall be as required for above-ground containers.

(v) Containers buried underground shall be placed so that the top of the container is not less than 6 inches below grade. Where an underground container might be subject to abrasive action or physical damage due to ve-

hicular traffic or other causes, then it shall be:

(a) Placed not less than 2 feet below grade, or

(b) Otherwise protected against such physical damage.

It will not be necessary to cover the portion of the container to which manhole and other connections are affixed; however, where necessary, protection shall be provided against vehicular damage. When necessary to prevent floating, containers shall be securely anchored or weighted.

(vi)(a) Containers shall be given a protective coating before being placed under ground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to prevent damage to the coating. Any damage to the coating shall be repaired before backfilling.

(b) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place.

(vii) Containers with foundations attached (portable or semiportable containers with suitable steel "runners" or "skids" and popularly known in the industry as "skid tanks") shall be designed, installed, and used in accordance with these rules subject to the following provisions:

(a) If they are to be used at a given general location for a temporary period not to exceed 6 months they need not have fire-resisting foundations or saddles but shall have adequate ferrous metal supports.

(b) They shall not be located with the outside bottom of the container shell more than 5 feet above the surface of the ground unless fire-resisting supports are provided.

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

(d) Flanges, nozzles, valves, fittings, and the like, having communication with the interior of the container, shall be protected against physical damage.

(e) When not permanently located on fire-resisting foundations, piping connections shall be sufficiently flexible to minimize the possibility of breakage

or leakage of connections if the container settles, moves, or is otherwise displaced.

(f) Skids, or lugs for attachment of skids, shall be secured to the container in accordance with the code or rules under which the container is designed and built (with a minimum factor of safety of four) to withstand loading in any direction equal to four times the weight of the container and attachments when filled to the maximum permissible loaded weight.

(viii) Field welding where necessary shall be made only on saddle plates or brackets which were applied by the manufacturer of the tank.

(ix) For aboveground containers, secure anchorage or adequate pier height shall be provided against possible container flotation wherever sufficiently high floodwater might occur.

(x) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers, and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100 °F. The use of nonmetallic hose is prohibited for permanently interconnecting such containers.

(xi) Container assemblies listed for interchangeable installation above ground or under ground shall conform to the requirements for aboveground installations with respect to safety relief capacity and filling density. For installation above ground all other requirements for aboveground installations shall apply. For installation under ground all other requirements for underground installations shall apply.

(8) *Protection of container accessories.*
(i) Valves, regulating, gaging, and other container accessory equipment shall be protected against tampering and physical damage. Such accessories shall also be so protected during the transit of containers intended for installation underground.

(ii) On underground or combination aboveground-underground containers, the service valve handwheel, the terminal for connecting the hose, and the

opening through which there can be a flow from safety relief valves shall be at least 4 inches above the container and this opening shall be located in the dome or housing. Underground systems shall be so installed that all the above openings, including the regulator vent, are located above the normal maximum water table.

(iii) All connections to underground containers shall be located within a substantial dome, housing, or manhole and with access thereto protected by a substantial cover.

(9) *Drips for condensed gas.* Where vaporized gas on the low-pressure side of the system may condense to a liquid at normal operating temperatures and pressures, suitable means shall be provided for revaporization of the condensate.

(10) *Damage from vehicles.* When damage to LP-Gas systems from vehicular traffic is a possibility, precautions against such damage shall be taken.

(11) *Drains.* No drains or blowoff lines shall be directed into or in proximity to sewer systems used for other purposes.

(12) *General provisions applicable to systems in industrial plants (of 2,000 gallons water capacity and more) and to bulk filling plants.* (i) When standard watch service is provided, it shall be extended to the LP-Gas installation and personnel properly trained.

(ii) If loading and unloading are normally done during other than daylight hours, adequate lights shall be provided to illuminate storage containers, control valves, and other equipment.

(iii) Suitable roadways or means of access for extinguishing equipment such as wheeled extinguishers or fire department apparatus shall be provided.

(iv) To minimize trespassing or tampering, the area which includes container appurtenances, pumping equipment, loading and unloading facilities, and cylinder-filling facilities shall be enclosed with at least a 6-foot-high industrial type fence unless otherwise adequately protected. There shall be at least two means of emergency access.

(13) *Container-charging plants.* (i) The container-charging room shall be located not less than:

(a) Ten feet from bulk storage containers.

(b) [Reserved]

(ii) Tank truck filling station outlets shall be located not less than:

(a) [Reserved]

(b) Ten feet from pumps and compressors if housed in one or more separate buildings.

(iii) The pumps or compressors may be located in the container-charging room or building, in a separate building, or outside of buildings. When housed in a separate building, such building (a small noncombustible weather cover is not to be construed as a building) shall be located not less than:

(a) Ten feet from bulk storage tanks.

(b) [Reserved]

(c) Twenty-five feet from sources of ignition.

(iv) When a part of the container-charging building is to be used for a boiler room or where open flames or similar sources of ignition exist or are employed, the space to be so occupied shall be separated from container charging room by a partition wall or walls of fire-resistant construction continuous from floor to roof or ceiling. Such separation walls shall be without openings and shall be joined to the floor, other walls, and ceiling or roof in a manner to effect a permanent gas-tight joint.

(v) Electrical equipment and installations shall conform with paragraphs (b) (17) and (18) of this section.

(14) *Fire protection.* (i) Each bulk plant shall be provided with at least one approved portable fire extinguisher having a minimum rating of 12-B, C.

(ii) In industrial installations involving containers of 150,000 gallons aggregate water capacity or more, provision shall be made for an adequate supply of water at the container site for fire protection in the container area, unless other adequate means for fire control are provided. Water hydrants shall be readily accessible and so spaced as to provide water protection for all containers. Sufficient lengths of firehose shall be provided at each hydrant location on a hose cart, or other means provided to facilitate easy movement of the hose in the container area. It is desirable to equip the outlet of each

hose line with a combination fog nozzle. A shelter shall be provided to protect the hose and its conveyer from the weather.

(15) [Reserved]

(16) *Lighting.* Electrical equipment and installations shall conform to paragraphs (b) (17) and (18) of this section.

(17) *Vaporizers for internal combustion engines.* The provisions of paragraph (e)(8) of this section shall apply.

(18) *Gas regulating and mixing equipment for internal combustion engines.* The provisions of paragraph (e)(9) of this section shall apply.

(e) *Liquefied petroleum gas as a motor fuel—(1) Application.* (i) This paragraph applies to internal combustion engines, fuel containers, and pertinent equipment for the use of liquefied petroleum gases as a motor fuel on easily movable, readily portable units including self-propelled vehicles.

(ii) Fuel containers and pertinent equipment for internal combustion engines using liquefied petroleum gas where installation is of the stationary type are covered by paragraph (d) of this section. This paragraph does not apply to containers for transportation of liquefied petroleum gases nor to marine fuel use. All requirements of paragraph (b) of this section apply to this paragraph, unless otherwise noted in paragraph (b) of this section.

(2) *General.* (i) Fuel may be used from the cargo tank of a truck while in transit, but not from cargo tanks on trailers or semitrailers. The use of fuel from the cargo tanks to operate stationary engines is permitted providing wheels are securely blocked.

(ii) Passenger-carrying vehicles shall not be fueled while passengers are on board.

(iii) Industrial trucks (including lift trucks) equipped with permanently mounted fuel containers shall be charged outdoors. Charging equipment shall comply with the provisions of paragraph (h) of this section.

(iv) LP-Gas fueled industrial trucks shall comply with the Standard for Type Designations, Areas of Use, Maintenance and Operation of Powered Industrial Trucks, NFPA 505-1969, which is incorporated by reference as specified in § 1910.6.

(v) Engines on vehicles shall be shut down while fueling if the fueling operation involves venting to the atmosphere.

(3) *Design pressure and classification of fuel containers.* (i) Except as covered in paragraphs (e)(3) (ii) and (iii) of this section, containers shall be in accordance with Table H-32.

(ii) Fuel containers for use in industrial trucks (including lift trucks) shall be either DOT containers authorized for LP-Gas service having a minimum service pressure of 240 p.s.i.g. or minimum Container Type 250. Under 1950 and later ASME codes, this means a 312.5-p.s.i.g. design pressure container.

TABLE H-32

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100 °F. (37.8 °C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code ²
¹ 200	215Z	200	250

¹ Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100% of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125% of the container type designation when constructed under: (1) the 1949 ASME Code (Par. U-200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

² Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(iii) Containers manufactured and maintained under DOT specifications and regulations may be used as fuel containers. When so used they shall conform to all requirements of this paragraph.

(iv) All container inlets and outlets except safety relief valves and gaging devices shall be labeled to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(4) *Installation of fuel containers.* (i) Containers shall be located in a place and in a manner to minimize the possibility of damage to the container. Containers located in the rear of trucks and buses, when protected by substantial bumpers, will be considered in conformance with this requirement. Fuel

containers on passenger-carrying vehicles shall be installed as far from the engine as is practicable, and the passenger space and any space containing radio equipment shall be sealed from the container space to prevent direct seepage of gas to these spaces. The container compartment shall be vented to the outside. In case the fuel container is mounted near the engine or the exhaust system, the container shall be shielded against direct heat radiation.

(ii) Containers shall be installed with as much clearance as practicable but never less than the minimum road clearance of the vehicle under maximum spring deflection. This minimum clearance shall be to the bottom of the container or to the lowest fitting on the container or housing, whichever is lower.

(iii) Permanent and removable fuel containers shall be securely mounted to prevent jarring loose, slipping, or rotating, and the fastenings shall be designed and constructed to withstand static loading in any direction equal to twice the weight of the tank and attachments when filled with fuel using a safety factor of not less than four based on the ultimate strength of the material to be used. Field welding, when necessary, shall be made only on saddle plates, lugs or brackets, originally attached to the container by the tank manufacturer.

(iv) Fuel containers on buses shall be permanently installed.

(v) Containers from which vapor only is to be withdrawn shall be installed and equipped with suitable connections to minimize the accidental withdrawal of liquid.

(5) *Valves and accessories.* (i) Container valves and accessories shall have a rated working pressure of at least 250 p.s.i.g., and shall be of a type suitable for liquefied petroleum gas service.

(ii) The filling connection shall be fitted with an approved double back-pressure check valve, or a positive shutoff in conjunction with an internal back-pressure check valve. On a removable container the filler valve may be a hand operated shutoff valve with an internal excess flow valve. Main shutoff valves on the container on liquid and vapor lines must be readily accessible.

(iii) With the exceptions of paragraph (e)(5)(iv)(c) of this section, filling connections equipped with approved automatic back-pressure check valves, and safety relief valves, all connections to containers having openings for the flow of gas in excess of a No. 54 drill size shall be equipped with approved automatic excess flow valves to prevent discharge of content in case connections are broken.

(iv) Liquid-level gaging devices:

(a) Variable liquid-level gages which require the venting of fuel to the atmosphere shall not be used on fuel containers of industrial trucks (including lift trucks).

(b) On portable containers that may be filled in the vertical and/or horizontal position, the fixed liquid-level gage must indicate maximum permitted filling level for both vertical and horizontal filling with the container oriented to place the safety relief valve in communication with the vapor space.

(c) In the case of containers used solely in farm tractor service, and charged at a point at least 50 feet from any important building, the fixed liquid-level gaging device may be so constructed that the outward flow of container content exceeds that passed by a No. 54 drill size opening, but in no case shall the flow exceed that passed by a No. 31 drill-size opening. An excess flow valve is not required. Fittings equipped with such restricted drill size opening and container on which they are used shall be marked to indicate the size of the opening.

(d) All valves and connections on containers shall be adequately protected to prevent damage due to accidental contact with stationary objects or from loose objects thrown up from the road, and all valves shall be safeguarded against damage due to collision, overturning or other accident. For farm tractors where parts of the vehicle provide such protection to valves and fittings, the foregoing requirements shall be considered fulfilled. However, on removable type containers the protection for the fittings shall be permanently attached to the container.

(e) When removable fuel containers are used, means shall be provided in

the fuel system to minimize the escape of fuel when the containers are exchanged. This may be accomplished by either of the following methods:

(1) Using an approved automatic quick-closing coupling (a type closing in both directions when uncoupled) in the fuel line, or

(2) Closing the valve at the fuel container and allowing the engine to run until the fuel in the line is consumed.

(6) *Piping—including pipe, tubing, and fittings.* (i) Pipe from fuel container to first-stage regulator shall be not less than schedule 80 wrought iron or steel (black or galvanized), brass or copper; or seamless copper, brass, or steel tubing. Steel tubing shall have a minimum wall thickness of 0.049 inch. Steel pipe or tubing shall be adequately protected against exterior corrosion. Copper tubing shall be types K or L or equivalent having a minimum wall thickness of 0.032 inch. Approved flexible connections may be used between container and regulator or between regulator and gas-air mixer within the limits of approval. The use of aluminum pipe or tubing is prohibited. In the case of removable containers an approved flexible connection shall be used between the container and the fuel line.

(ii) All piping shall be installed, braced, and supported so as to reduce to a minimum the possibility of vibration strains or wear.

(7) *Safety devices.* (i) Spring-loaded internal type safety relief valves shall be used on all motor fuel containers.

(ii) The discharge outlet from safety relief valves shall be located on the outside of enclosed spaces and as far as practicable from possible sources of ignition, and vented upward within 45 degrees of the vertical in such a manner as to prevent impingement of escaping gas upon containers, or parts of vehicles, or on vehicles in adjacent lines of traffic. A rain cap or other protector shall be used to keep water and dirt from collecting in the valve.

(iii) When a discharge line from the container safety relief valve is used, the line shall be metallic, other than aluminum, and shall be sized, located, and maintained so as not to restrict the required flow of gas from the safety relief valve. Such discharge line shall

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be able to withstand the pressure resulting from the discharge of vapor when the safety relief valve is in the full open position. When flexibility is necessary, flexible metal hose or tubing shall be used.

(iv) Portable containers equipped for volumetric filling may be filled in either the vertical or horizontal position only when oriented to place the safety relief valve in communication with the vapor space.

(v) Paragraph (b)(10)(xii) of this section for hydrostatic relief valves shall apply.

(8) *Vaporizers.* (i) Vaporizers and any part thereof and other devices that may be subjected to container pressure shall have a design pressure of at least 250 p.s.i.g.

(ii) Each vaporizer shall have a valve or suitable plug which will permit substantially complete draining of the vaporizer. It shall be located at or near the lowest portion of the section occupied by the water or other heating medium.

(iii) Vaporizers shall be securely fastened so as to minimize the possibility of becoming loosened.

(iv) Each vaporizer shall be permanently marked at a visible point as follows:

(a) With the design pressure of the fuel-containing portion in p.s.i.g.

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

(v) Devices to supply heat directly to a fuel container shall be equipped with an automatic device to cut off the supply of heat before the pressure inside the fuel container reaches 80 percent of the start to discharge pressure setting of the safety relief device on the fuel container.

(vi) Engine exhaust gases may be used as a direct source of heat supply for the vaporization of fuel if the materials of construction of those parts of the vaporizer in contact with exhaust gases are resistant to the corrosive action of exhaust gases and the vaporizer system is designed to prevent excessive pressures.

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

(9) *Gas regulating and mixing equipment.* (i) Approved automatic pressure

reducing equipment shall be installed in a secure manner between the fuel supply container and gas-air mixer for the purpose of reducing the pressure of the fuel delivered to the gas-air mixer.

(ii) 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 flow of fuel to the mixer when the ignition is off and the engine is not running. In the case of industrial trucks and engines operating in buildings other than those used exclusively to house engines, the automatic shutoff valve shall be designed to operate if the engine should stop. Atmospheric type regulators (zero governors) shall be considered adequate as an automatic shutoff valve only in cases of outdoor operation such as farm tractors, construction equipment, irrigation pump engines, and other outdoor stationary engine installations.

(iii) The source of the air for combustion shall be completely isolated from the passenger compartment, ventilating system, or air-conditioning system.

(10) [Reserved]

(11) *Stationary engines in buildings.* Stationary engines and gas turbines installed in buildings, including portable engines used instead of or to supplement stationary engines, shall comply with the Standard for the Institution and Use of Stationary Combustion Engines and Gas Turbines, NFPA 37-1970, and the appropriate provisions of paragraphs (b), (c), and (d) of this section.

(12) *Portable engines in buildings.* (i) Portable engines may be used in buildings only for emergency use, except as provided by subparagraph (11) of this paragraph.

(ii) Exhaust gases shall be discharged to outside the building or to an area where they will not constitute a hazard.

(iii) Provision shall be made to supply sufficient air for combustion and cooling.

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

(v) The capacity of LP-Gas containers used with such engines shall comply with the applicable occupancy provision of paragraph (c)(5) of this section.

(13) *Industrial trucks inside buildings.*

(i) LP-Gas-fueled industrial trucks are permitted to be used in buildings and structures.

(ii) No more than two LP-Gas containers shall be used on an industrial truck for motor fuel purposes.

(iii)-(iv) [Reserved]

(v) Industrial trucks shall not be parked and left unattended in areas of possible excessive heat or sources of ignition.

(14) *Garaging LP-Gas-fueled vehicles.*

(i) LP-Gas-fueled vehicles may be stored or serviced inside garages provided there are no leaks in the fuel system and the fuel tanks are not filled beyond the maximum filling capacity specified in paragraph (b)(12)(i) of this section.

(ii) LP-Gas-fueled vehicles being repaired in garages shall have the container shutoff valve closed except when fuel is required for engine operation.

(iii) Such vehicles shall not be parked near sources of heat, open flames, or similar sources of ignition or near open pits unless such pits are adequately ventilated.

(f) *Storage of containers awaiting use or resale—(1) Application.* This paragraph shall apply to the storage of portable containers not in excess of 1,000 pounds water capacity, filled or partially filled, at user location but not connected for use, or in storage for resale by dealers or resellers. This paragraph shall not apply to containers stored at charging plants or at plants devoted primarily to the storage and distribution of LP-Gas or other petroleum products.

(2) *General.* (i) Containers in storage shall be located so as to minimize exposure to excessive temperature rise, physical damage, or tampering by unauthorized persons.

(ii) Containers when stored inside shall not be located near exits, stairways, or in areas normally used or intended for the safe exit of people.

(iii) Container valves shall be protected while in storage as follows:

(a) By setting into recess of container to prevent the possibility of their being struck if the container is dropped upon a flat surface, or

(b) By ventilated cap or collar, fastened to container capable of withstanding blow from any direction equivalent to that of a 30-pound weight dropped 4 feet. Construction must be such that a blow will not be transmitted to a valve or other connection.

(iv) The outlet valves of containers in storage shall be closed.

(v) Empty containers which have been in LP-Gas service when stored inside, shall be considered as full containers for the purpose of determining the maximum quantity of LP-Gas permitted by this paragraph.

(3) [Reserved]

(4) *Storage within buildings not frequented by the public (such as industrial buildings).* (i) The quantity of LP-Gas stored shall not exceed 300 pounds (approximately 2,550 cubic feet in vapor form) except as provided in subparagraph (5) of this paragraph.

(ii) Containers carried as a part of service equipment on highway mobile vehicles are not to be considered in the total storage capacity in subdivision (i) of this subparagraph provided such vehicles are stored in private garages, and are limited to one container per vehicle with an LP-Gas capacity of not more than 100 pounds. All container valves shall be closed.

(5) *Storage within special buildings or rooms.* (i) The quantity of LP-Gas stored in special buildings or rooms shall not exceed 10,000 pounds.

(ii) The walls, floors, and ceilings of container storage rooms that are within or adjacent to other parts of the building shall be constructed of material having at least a 2-hour fire resistance rating.

(iii) A portion of the exterior walls or roof having an area not less than 10 percent of that of the combined area of the enclosing walls and roof shall be of explosion relieving construction.

(iv) Each opening from such storage rooms to other parts of the building shall be protected by a 1½ hour (B) fire door listed by a nationally recognized testing laboratory. Refer to §1910.7 for definition of nationally recognized testing laboratory.

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(v) Such rooms shall have no open flames for heating or lighting.

(vi) Such rooms shall be adequately ventilated both top and bottom to the outside only. The openings from such vents shall be at least 5 feet away from any other opening into any building.

(vii) The floors of such rooms shall not be below ground level. Any space below the floor shall be of solid fill or properly ventilated to the open air.

(viii) Such storage rooms shall not be located adjoining the line of property occupied by schools, churches, hospitals, athletic fields or other points of public gathering.

(ix) Fixed electrical equipment shall be installed in accordance with paragraph (b)(18) of this section.

(6) *Storage outside of buildings.* (i) Storage outside of buildings, for containers awaiting use or resale, shall be located in accordance with Table H-33 with respect to:

(a) The nearest important building or group of buildings;

(b) [Reserved]

(c) Busy thoroughfares;

TABLE H-33

Quantity of LP-Gas Stored	Distance
500 pounds or less	0
501 to 2,500 pounds	10
2,501 to 6,000 pounds	10 feet
6,001 to 10,000 pounds	20 feet
Over 10,000 pounds	25 feet

¹ Container or containers shall be at least 10 feet from any building on adjoining property, any sidewalk, or any of the exposures described in § 1910.110(f)(6)(i) (c) or (d) of this paragraph.

(ii) Containers shall be in a suitable enclosure or otherwise protected against tampering.

(7) *Fire protection.* Storage locations other than supply depots separated and located apart from dealer, reseller, or user establishments shall be provided with at least one approved portable fire extinguisher having a minimum rating of 8-B, C.

(g) [Reserved]

(h) *Liquefied petroleum gas service stations—(1) Application.* This paragraph applies to storage containers, and dispensing devices, and pertinent equipment in service stations where LP-Gas is stored and is dispensed into fuel tanks of motor vehicles. See paragraph (e) of this section for requirements covering use of LP-Gas as a motor fuel. All

requirements of paragraph (b) of this section apply to this paragraph unless otherwise noted.

(2) *Design pressure and classification of storage containers.* Storage containers shall be designed and classified in accordance with Table H-34.

TABLE H-34

Container type	For gases with vapor press. Not to exceed lb. per sq. in. gage at 100 °F. (37.8 °C.)	Minimum design pressure of container, lb. per sq. in. gage	
		1949 and earlier editions of ASME Code (Par. U-68, U-69)	1949 edition of ASME Code (Par. U-200, U-201); 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of ASME Code; All editions of API-ASME Code ²
¹ 200	215	200	250

¹ Container type may be increased by increments of 25. The minimum design pressure of containers shall be 100 percent of the container type designation when constructed under 1949 or earlier editions of the ASME Code (Par. U-68 and U-69). The minimum design pressure of containers shall be 125 percent of the container type designation when constructed under: (1) The 1949 ASME Code (Paragraphs U-200 and U-201), (2) 1950, 1952, 1956, 1959, 1962, 1965, and 1968 (Division 1) editions of the ASME Code, and (3) all editions of the API-ASME Code.

² Construction of containers under the API-ASME Code is not authorized after July 1, 1961.

(3) *Container valves and accessories.* (i) A filling connection on the container shall be fitted with one of the following:

(a) A combination back-pressure check and excess flow valve.

(b) One double or two single back-pressure valves.

(c) A positive shutoff valve, in conjunction with either,

(1) An internal back-pressure valve, or

(2) On internal excess flow valve.

In lieu of an excess flow valve, filling connections may be fitted with a quick-closing internal valve, which shall remain closed except during operating periods. The mechanism for such valves may be provided with a secondary control which will cause it to close automatically in case of fire. When a fusible plug is used its melting point shall not exceed 220 °F.

(ii) A filling pipe inlet terminal not on the container shall be fitted with a positive shutoff valve in conjunction with either;

(a) A back pressure check valve, or

(b) An excess flow check valve.

(iii) All openings in the container except those listed below shall be

equipped with approved excess flow check valves:

(a) Filling connections as provided in subdivision (i) of this subparagraph.

(b) Safety relief connections as provided in paragraph (b)(7)(ii) of this section.

(c) Liquid-level gaging devices as provided in paragraphs (b)(7)(iv) and (19)(iv) of this section.

(d) Pressure gage connections as provided in paragraph (b)(7)(v) of this section.

(iv) All container inlets and outlets except those listed below shall be labeled to designate whether they connect with vapor or liquid (labels may be on valves):

- (a) Safety relief valves.
- (b) Liquid-level gaging devices.
- (c) Pressure gages.

(v) Each storage container shall be provided with a suitable pressure gage.

(4) *Safety-relief valves.* (i) All safety-relief devices shall be installed as follows:

(a) On the container and directly connected with the vapor space.

(b) Safety-relief valves and discharge piping shall be protected against physical damage. The outlet shall be provided with loose-fitting rain caps. There shall be no return bends or restrictions in the discharge piping.

(c) The discharge from two or more safety relief valves having the same pressure settings may be run into a common discharge header. The cross-sectional area of such header shall be at least equal to the sum of the cross-sectional areas of the individual discharges.

(d) Discharge from any safety relief device shall not terminate in any building nor beneath any building.

(ii) Aboveground containers shall be provided with safety relief valves as follows:

(a) The rate of discharge, which may be provided by one or more valves, shall be not less than that specified in paragraph (b)(10)(ii) of this section.

(b) The discharge from safety relief valves shall be vented to the open air unobstructed and vertically upwards in such a manner as to prevent any impingement of escaping gas upon the container; loose-fitting rain caps shall be used. On a container having a water

capacity greater than 2,000 gallons, the discharge from the safety relief valves shall be vented away from the container vertically upwards to a point at least 7 feet above the container. Suitable provisions shall be made so that any liquid or condensate that may accumulate inside of the relief valve or its discharge pipe will not render the valve inoperative. If a drain is used, a means shall be provided to protect the container, adjacent containers, piping, or equipment against impingement of flame resulting from ignition of the product escaping from the drain.

(iii) Underground containers shall be provided with safety relief valves as follows:

(a) The discharge from safety-relief valves shall be piped vertically upward to a point at least 10 feet above the ground. The discharge lines or pipes shall be adequately supported and protected against physical damage.

(b) [Reserved]

(c) If no liquid is put into a container until after it is buried and covered, the rate of discharge of the relief valves may be reduced to not less than 30 percent of the rate shown in paragraph (b)(10)(ii) of this section. If liquid fuel is present during installation of containers, the rate of discharge shall be the same as for aboveground containers. Such containers shall not be uncovered until emptied of liquid fuel.

(5) *Capacity of liquid containers.* Individual liquid storage containers shall not exceed 30,000 gallons water capacity.

(6) *Installation of storage containers.*

(i)(a) Each storage container used exclusively in service station operation shall comply with the following table which specifies minimum distances to a building and groups of buildings.

Water capacity per container (gallons)	Minimum distances	
	Above-ground and under-ground (feet)	Between above-ground containers (feet)
Up to 2,000	25	3
Over 2,000	50	5

NOTE: The above distances may be reduced to not less than 10 feet for service station buildings of other than wood frame construction.

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(b) Readily ignitable material including weeds and long dry grass, shall be removed within 10 feet of containers.

(c) The minimum separation between LP-Gas containers and flammable liquid tanks shall be 20 feet and the minimum separation between a container and the centerline of the dike shall be 10 feet.

(d) LP-Gas containers located near flammable liquid containers shall be protected against the flow or accumulation of flammable liquids by diking, diversion curbs, or grading.

(e) LP-Gas containers shall not be located within diked areas for flammable liquid containers.

(f) Field welding is permitted only on saddle plates or brackets which were applied by the container manufacturer.

(g) When permanently installed containers are interconnected, provision shall be made to compensate for expansion, contraction, vibration, and settling of containers and interconnecting piping. Where flexible connections are used, they shall be of an approved type and shall be designed for a bursting pressure of not less than five times the vapor pressure of the product at 100 °F. The use of nonmetallic hose is prohibited for interconnecting such containers.

(h) Where high water table or flood conditions may be encountered protection against container flotation shall be provided.

(ii) Aboveground containers shall be installed in accordance with this subdivision.

(a) Containers may be installed horizontally or vertically.

(b) Containers shall be protected by crash rails or guards to prevent physical damage unless they are so protected by virtue of their location. Vehicles shall not be serviced within 10 feet of containers.

(c) Container foundations shall be of substantial masonry or other non-combustible material. Containers shall be mounted on saddles which shall permit expansion and contraction, and shall provide against the excessive concentration of stresses. Corrosion protection shall be provided for tank-mounting areas. Structural metal container supports shall be protected against fire. This protection is not re-

quired on prefabricated storage and pump assemblies, mounted on a common base, with container bottom not more than 24 inches above ground and whose water capacity is 2,000 gallons or less if the piping connected to the storage and pump assembly is sufficiently flexible to minimize the possibility of breakage or leakage in the event of failure of the container supports.

(iii) Underground containers shall be installed in accordance with this subdivision.

(a) Containers shall be given a protective coating before being placed under ground. This coating shall be equivalent to hot-dip galvanizing or to two coatings of red lead followed by a heavy coating of coal tar or asphalt. In lowering the container into place, care shall be exercised to minimize abrasion or other damage to the coating. Damage to the coating shall be repaired before back-filling.

(b) Containers shall be set on a firm foundation (firm earth may be used) and surrounded with earth or sand firmly tamped in place. Backfill should be free of rocks or other abrasive materials.

(c) A minimum of 2 feet of earth cover shall be provided. Where ground conditions make compliance with this requirement impractical, equivalent protection against physical damage shall be provided. The portion of the container to which manhole and other connections are attached need not be covered. If the location is subjected to vehicular traffic, containers shall be protected by a concrete slab or other cover adequate to prevent the weight of a loaded vehicle imposing concentrated direct loads on the container shell.

(7) *Protection of container fittings.* Valves, regulators, gages, and other container fittings shall be protected against tampering and physical damage.

(8) *Transport truck unloading point.* (i) During unloading, the transport truck shall not be parked on public thoroughfares and shall be at least 5 feet from storage containers, and shall be positioned so that shutoff valves are readily accessible.

(ii) The filling pipe inlet terminal shall not be located within a building

nor within 10 feet of any building or driveway. It shall be protected against physical damage.

(9) *Piping, valves, and fittings.* (i) Piping may be underground, above ground, or a combination of both. It shall be well supported and protected against physical damage and corrosion.

(ii) Piping laid beneath driveways shall be installed to prevent physical damage by vehicles.

(iii) Piping shall be wrought iron or steel (black or galvanized), brass or copper pipe; or seamless copper, brass, or steel tubing and shall be suitable for a minimum pressure of 250 p.s.i.g. Pipe joints may be screwed, flanged, brazed, or welded. The use of aluminum alloy piping or tubing is prohibited.

(iv) All shutoff valves (liquid or gas) shall be suitable for liquefied petroleum gas service and designed for not less than the maximum pressure to which they may be subjected. Valves which may be subjected to container pressure shall have a rated working pressure of at least 250 p.s.i.g.

(v) All materials used for valve seats, packing, gaskets, diaphragms, etc., shall be resistant to the action of LP-Gas.

(vi) Fittings shall be steel, malleable iron, or brass having a minimum working pressure of 250 p.s.i.g. Cast iron pipe fittings, such as ells, tees, and unions shall not be used.

(vii) All piping shall be tested after assembly and proved free from leaks at not less than normal operating pressures.

(viii) Provision shall be made for expansion, contraction, jarring, and vibration, and for settling. This may be accomplished by flexible connections.

(10) *Pumps and accessories.* All pumps and accessory equipment shall be suitable for LP-Gas service, and designed for not less than the maximum pressure to which they may be subjected. Accessories shall have a minimum rated working pressure of 250 p.s.i.g. Positive displacement pumps shall be equipped with suitable pressure actuated bypass valves permitting flow from pump discharge to storage container or pump suction.

(11) *Dispensing devices.* (i) Meters, vapor separators, valves, and fittings in the dispenser shall be suitable for

LP-Gas service and shall be designed for a minimum working pressure of 250 p.s.i.g.

(ii) Provisions shall be made for venting LP-Gas contained in a dispensing device to a safe location.

(iii) Pumps used to transfer LP-Gas shall be equipped to allow control of the flow and to prevent leakage or accidental discharge. Means shall be provided outside the dispensing device to readily shut off the power in the event of fire or accident.

(iv) A manual shutoff valve and an excess flow check valve shall be installed downstream of the pump and ahead of the dispenser inlet.

(v)(a) Dispensing hose shall be resistant to the action of LP-Gas in the liquid phase and designed for a minimum bursting pressure of 1,250 p.s.i.g.

(b) An excess flow check valve or automatic shutoff valve shall be installed at the terminus of the liquid line at the point of attachment of the dispensing hose.

(vi)(a) LP-Gas dispensing devices shall be located not less than 10 feet from aboveground storage containers greater than 2,000 gallons water capacity. The dispensing devices shall not be less than 20 feet from any building (not including canopies), basement, cellar, pit, or line of adjoining property which may be built upon and not less than 10 feet from sidewalks, streets, or thoroughfares. No drains or blowoff lines shall be directed into or in proximity to the sewer systems used for other purposes.

(b) LP-Gas dispensing devices shall be installed on a concrete foundation or as part of a complete storage and dispensing assembly mounted on a common base, and shall be adequately protected from physical damage.

(c) LP-Gas dispensing devices shall not be installed within a building except that they may be located under a weather shelter or canopy provided this area is not enclosed on more than two sides. If the enclosing sides are adjacent to each other, the area shall be properly ventilated.

(vii) The dispensing of LP-Gas into the fuel container of a vehicle shall be performed by a competent attendant

who shall remain at the LP-Gas dispenser during the entire transfer operation.

(12) *Additional rules.* There shall be no smoking on the driveway of service stations in the dispensing areas or transport truck unloading areas. Conspicuous signs prohibiting smoking shall be posted within sight of the customer being served. Letters on such signs shall be not less than 4 inches high. The motors of all vehicles being fueled shall be shut off during the fueling operations.

(13) *Electrical.* Electrical equipment and installations shall conform to paragraphs (b) (17) and (18) of this section.

(14) *Fire protection.* Each service station shall be provided with at least one approved portable fire extinguisher having at least an 8-B, C, rating.

(i) *Scope—(1) Application.* (i) Paragraph (b) of this section applies to installations made in accordance with the requirements of paragraphs (c), (d), (e), (g), and (h) of this section, except as noted in each of those paragraphs.

(ii) Paragraphs (c) through (h) of this section apply as provided in each of those paragraphs.

(2) *Inapplicability.* This section does not apply to:

(i) Marine and pipeline terminals, natural gas processing plants, refineries, or tank farms other than those at industrial sites.

(ii) LP-Gas refrigerated storage systems;

(iii) LP-Gas when used with oxygen. The requirements of §1910.253 shall apply to such use;

(iv) LP-Gas when used in utility gas plants. The National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases at Utility Gas Plants, NFPA No. 59-1968, shall apply to such use;

(v) Low-pressure (not in excess of one-half pound per square inch or 14 inches water column) LP-Gas piping systems, and the installation and operation of residential and commercial appliances including their inlet connections, supplied through such systems. For such systems, the National Fire Protection Association Standard for the Installation of Gas Appliances and Gas Piping, NFPA 54-1969 shall apply.

(3) *Retroactivity.* Unless otherwise stated, it is not intended that the provisions of this section be retroactive.

(i) Existing plants, appliances, equipment, buildings, structures, and installations for the storage, handling or use of LP-Gas, which were in compliance with the current provisions of the National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases NFPA No. 58, at the time of manufacture or installation may be continued in use, if such continued use does not constitute a recognized hazard that is causing or is likely to cause death or serious physical harm to employees.

(ii) Stocks of equipment and appliances on hand in such locations as manufacturers' storage, distribution warehouses, and dealers' storage and showrooms, which were in compliance with the current provisions of the National Fire Protection Association Standard for the Storage and Handling of Liquefied Petroleum Gases, NFPA No. 58, at the time of manufacture, may be placed in service, if such use does not constitute a recognized hazard that is causing or is likely to cause death or serious physical harm to employees.

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§ 1910.111 Storage and handling of anhydrous ammonia.

(a) *General—(1) Scope.* (i) This standard is intended to apply to the design, construction, location, installation, and operation of anhydrous ammonia systems including refrigerated ammonia storage systems.

(ii) This standard does not apply to:

(a) Ammonia manufacturing plants.

(b) Refrigeration plants where ammonia is used solely as a refrigerant.

(2) *Definitions.* As used in this section.

(i) *Appurtenances.* All devices such as pumps, compressors, safety relief devices, liquid-level gaging devices, valves and pressure gages.