

5.21.9 Vaporizer Pressure Relief Valve.

5.21.9.1 The minimum rate of discharge in cubic feet of air per minute for pressure relief valves for LP-Gas vaporizers, either of the indirect type or direct-fired type, shall comply with 5.21.9.2 through 5.21.9.4.

5.21.9.2 Based on conservative heat transfer calculations (assuming that the vaporizing chamber is liquid full), the maximum vapor generating capacity (rate) shall be determined when maximum heat is available. That vapor rate shall be converted to an equivalent air rate.

5.21.9.3 If the vaporizer is direct fired or if a substantial exterior surface is in contact with the LP-Gas, the sum of the vaporizer surface and the LP-Gas wetted exterior surface shall be used in conjunction with Table 5.7.2.6 to determine the required relief valve capacity.

5.21.9.4 The minimum rate of discharge in cubic feet of air per minute for pressure relief valves for LP-Gas vaporizers, of either the indirect type or direct-fired type, shall be at least 150 percent of the rated vaporizing capacity.

5.22 Vehicle Fuel Dispensers.

5.22.1 The dispenser shall have a maximum design pressure rating equal to or greater than the maximum discharge pressure from the pump and bypass valve, if provided.

5.22.2 The maximum design pressure and all equipment downstream from the pump shall be in accordance with Table 5.17.2.1.

Chapter 6 Installation of LP-Gas Systems

6.1 Scope.

6.1.1* Application. This chapter applies to the following:

- (1) Location and field installation of LP-Gas systems that use components, subassemblies, container assemblies, and container systems that are fabricated in accordance with Chapter 5
- (2) Location of containers and liquid transfer systems
- (3) Installation of container appurtenances and regulators
- (4) Installation of piping (including flexible connectors and hose), hydrostatic relief valves, and piping service limitations
- (5) Installation of equipment
- (6) Testing of piping systems

6.1.2 Nonapplication. This chapter does not apply to the following:

- (1) Refrigerated containers
- (2) Installation of systems used in the highway transportation of LP-Gas

6.1.3* Additional Features. For any purpose or application addressed within the scope of this chapter, if the requirements of the chapter are met, any or all additional features or components of equipment not prohibited by the chapter shall be permitted to be used.

6.2 Location of Containers.

6.2.1 LP-Gas containers shall be located outside of buildings unless they are specifically allowed to be located inside of buildings.

6.2.2 LP-Gas containers shall be allowed in buildings only for the following applications:

- (1) Cylinders as specifically provided for in Section 6.20

- (2) Containers of less than 125 gal (0.5 m³) water capacity for the purposes of being filled in buildings or structures complying with Chapter 10
- (3) Containers on LP-Gas vehicles complying with, and parked or garaged in accordance with, Chapter 9
- (4) Containers used with LP-Gas portable engine fuel systems complying with 11.15.1
- (5) Containers used with LP-Gas stationary engine fuel systems complying with 6.26
- (6) Containers used with LP-Gas-fueled industrial trucks complying with 11.13.4
- (7) Containers on LP-Gas-fueled vehicles garaged in accordance with Section 11.16
- (8) Cylinders awaiting use, resale, or exchange when stored in accordance with Chapter 8

6.3 Container Separation Distances.

6.3.1 Aboveground Containers.

6.3.1.1* Containers installed outside of buildings, whether of the portable type replaced on a cylinder exchange basis or permanently installed and refilled at the installation, shall be located with respect to the adjacent containers, important building, group of buildings, or line of adjoining property that can be built upon, in accordance with Table 6.3.1.1, Table 6.4.1.2, 6.3.1.2 through 6.3.1.3, 6.3.3, 6.3.4.1 through 6.3.4.4, and 6.4.4.6 through 6.4.4.11.

6.3.1.2 When the provisions of 6.28.3 through 6.28.5 are met, the minimum distance from an ASME container to a building shall be reduced by one-half for ASME containers of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity.

6.3.1.3 The 25 ft (7.6 m) minimum distance from aboveground ASME containers of 501 gal through 2000 gal (1.9 m³ through 7.6 m³) water capacity to buildings, a group of buildings, or the line of adjoining property that can be built upon shall be reduced to 10 ft (3 m) for a single ASME container of 1200 gal (4.5 m³) or less water capacity where such container is at least 25 ft (7.6 m) from any other LP-Gas container of more than 125 gal (0.5 m³) water capacity.

6.3.2 Underground or Mounded ASME Containers.

6.3.2.1 Minimum distances for underground or mounded ASME containers of 2001 gal through 30,000 gal (7.6 m³ through 114 m³) water capacity, incorporating all the provisions of Section 6.28, shall be reduced to 10 ft (3 m).

6.3.2.2 Distances for all underground and mounded ASME containers shall be measured from the container surface.

6.3.2.3 No part of an underground or mounded ASME container shall be less than 10 ft (3 m) from a building or line of adjoining property that can be built upon.

6.3.3 Minimum Separation Distances for ASME Containers.

6.3.3.1 The minimum separation distances specified in Table 6.3.1.1 between containers and buildings of other than woodframe construction devoted exclusively to gas manufacturing and distribution operations shall be reduced to 10 ft (3 m).

6.3.3.2 If the aggregate water capacity of a multicontainer installation is 501 gal (1.9 m³) or more and the installation is comprised of individual containers, each with a water capacity of less than 125 gal (0.5 m³), the minimum distance shall comply with Table 6.3.1.1 and 6.3.3.2(A) through 6.3.3.2(C).

(A) The aggregate capacity shall be used rather than the capacity per container.

Table 6.3.1.1 Separation Distances Between Containers, Important Buildings, and Line of Adjoining Property That Can Be Built Upon

Water Capacity per Container		Minimum Distances							
		Mounded or Underground Containers ^a		Aboveground Containers		Between Containers ^b			
		gal	m ³	ft	m	ft	m	ft	m
<125 ^c	<0.5 ^c	10	3	0 ^d	0 ^d	0	0		
125-250	0.5-1.0	10	3	10	3	0	0		
251-500	>1.0-1.9	10	3	10	3	3	1		
501-2,000	>1.9-7.6	10	3	25 ^e	7.6	3	1		
2,001-30,000	>7.6-114	50	15	50	15	5	1.5		
30,001-70,000	>114-265	50	15	75	23				
70,001-90,000	>265-341	50	15	100	30	¼ of sum of			
90,001-120,000	>341-454	50	15	125	38	diameters of			
120,001-200,000	>454-757	50	15	200	61	adjacent			
200,001-1,000,000	>757-3,785	50	15	300	91	containers			
>1,000,000	>3,785	50	15	400	122				

^aSee 6.3.2.1.

^bSee 6.3.4.5.

^cSee 6.3.4.4.

^dSee 6.3.4.1, 6.3.4.2, 6.3.4.3, and 6.3.4.4.

^eSee 6.3.1.3.

(B) If more than one such installation is made, each installation shall be separated from any other installation by at least 25 ft (7.6 m).

(C) The minimum distances between containers shall not be applied to installations covered by 6.3.3.2.

6.3.4 Separation Distance Between Container Pressure Relief Valve and Building Openings.

6.3.4.1 Cylinders shall not be located and installed underneath any building unless the space is open to the atmosphere for 50 percent of its perimeter or more.

6.3.4.2 ASME containers of less than 125 gal (0.5 m³) water capacity shall be located and installed so that the discharge from pressure relief devices shall not terminate in or beneath any building.

6.3.4.3^o The distance measured horizontally from the point of discharge of a container pressure relief valve to any building opening below the level of such discharge shall be in accordance with Table 6.3.4.3.

6.3.4.4 The distance measured in any direction from the point of discharge of a container pressure relief valve, vent of a fixed maximum liquid level gauge on a container, and the container filling connection to exterior sources of ignition, openings into direct-vent (sealed combustion system) appliances, and mechanical ventilation air intakes shall be in accordance with Table 6.3.4.3.

6.3.4.5 Access at the ends or sides of individual underground containers having a water capacity of 125 gal (0.5 m³) or more shall be provided in multicontainer installations to facilitate working with cranes or hoists.

Table 6.3.4.3 Separation Distance Between Container Pressure Relief Valve and Building Openings

Container Type	Exchange or Filled on Site at Point of Use	Distance Horizontally from Relief Valve Discharge to Opening Below Discharge		Discharge from Relief Valve, Vent Discharge, and Filling Connection to Exterior Source of Ignition, Openings into Direct-Vent Appliances, and Mechanical Ventilation Air Intakes	
		ft	m	ft	m
Cylinder	Exchange	3	0.9	5	1.5
Cylinder	Filled on site at the point of use	3	0.9	10	3.0
ASME	Filled on site at the point of use	5	1.5	10	3.0



6.4 Other Container Location Requirements.

6.4.1 ASME Multicontainer Requirements.

6.4.1.1 Where storage containers having an aggregate water capacity of more than 4000 gal (15.2 m³) are located in heavily populated or congested areas, the siting provisions of 6.3.1.1 and Table 6.3.1.1 shall be permitted to be modified as indicated by the fire safety analysis described in 6.27.3.

6.4.1.2 Aboveground multicontainer installations comprised of ASME containers having an individual water capacity of 12,000 gal (45 m³) or more and installed for use in a single location shall be limited to the number of containers in one group, with each group separated from the next group in accordance with the degree of fire protection provided in Table 6.4.1.2.

Table 6.4.1.2 Maximum Number of Containers in a Group and Their Separation Distances

Fire Protection Provided by	Maximum Number of Containers in One Group	Minimum Separation Between Groups	
		ft	m
Hose streams only (see 6.4.1.2 and 6.27.3.1)	6	50	15
Fixed monitor nozzles per 6.27.6.3	6	25	7.6
Fixed water spray per 6.27.6.1	9	25	7.6
Insulation per 6.27.5.1	9	25	7.6

6.4.1.3 Where the provisions of 6.28.3 and 6.28.4 are met, the minimum separation distance between groups of ASME containers protected by hose stream only shall be one-half the distances required in Table 6.4.1.2.

6.4.2 Underground and Mounded ASME Containers.

6.4.2.1 Underground or mounded ASME containers shall be located in accordance with 6.4.2.2 and 6.4.2.3.

6.4.2.2 Underground or mounded containers shall be located outside of any buildings.

6.4.2.3 Buildings shall not be constructed over any underground or mounded containers.

6.4.3 General Requirements.

6.4.3.1 The sides of adjacent containers shall be separated in accordance with Table 6.3.1.1 but shall not be separated by less than 3 ft (1 m).

6.4.3.2 Where containers are installed parallel with ends in line, the number of containers in one group shall not be limited.

6.4.3.3 Where more than one row of containers is installed, the adjacent ends of the containers in each row shall be separated by not less than 10 ft (3 m).

6.4.4 Additional Container Installation Requirements.

6.4.4.1 Additional container installation requirements shall comply with 6.4.4.2 through 6.4.4.14 and 6.4.5.

6.4.4.2 Containers shall not be stacked one above the other.

6.4.4.3* Combustible materials shall not accumulate or be stored within 10 ft (3 m) of a container.

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

6.4.4.5 LP-Gas containers shall be located at least 10 ft (3 m) from the centerline of the wall of diked areas containing flammable or combustible liquids.

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

6.4.4.7 The requirements of 6.4.4.6 shall not apply where LP-Gas containers of 125 gal (0.5 m³) or less water capacity are installed adjacent to fuel oil supply tanks of 660 gal (2.5 m³) or less capacity.

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

6.4.4.9* The minimum separation between LP-Gas containers and oxygen or gaseous hydrogen containers shall be in accordance with NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.

6.4.4.10 Where protective structures having a minimum fire resistance rating of 2 hours interrupt the line of sight between uninsulated portions of the oxygen or hydrogen containers and the LP-Gas containers, no minimum distance shall apply.

6.4.4.11 The minimum separation between LP-Gas containers and liquefied hydrogen containers shall be in accordance with NFPA 55, *Compressed Gases and Cryogenic Fluids Code*.

6.4.4.12 Where LP-Gas cylinders are to be stored or used in the same area with other compressed gases, the cylinders shall be marked to identify their content in accordance with ANSI/CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*.

6.4.4.13 An aboveground LP-Gas container and any of its parts shall not be located within 6 ft (1.8 m) of a vertical plane beneath overhead electric power lines that are over 600 volts, nominal.

6.4.4.14* Refrigerated LP-Gas containers shall be located within an impoundment in accordance with Section 12.5.

6.4.5* Structure Requirements.

6.4.5.1 Structures such as fire walls, fences, earth or concrete barriers, and other similar structures shall not be permitted around or over installed nonrefrigerated containers unless specifically allowed.

6.4.5.2 Structures partially enclosing containers shall be permitted if designed in accordance with a sound fire protection analysis.

6.4.5.3 Structures used to prevent flammable or combustible liquid accumulation or flow shall be permitted in accordance with 6.4.4.4.

6.4.5.4 Structures between LP-Gas containers and gaseous hydrogen containers shall be permitted in accordance with 6.4.4.10.

6.4.5.5 Structures such as fences shall be permitted in accordance with 6.19.4.

6.5 Location of Transfer Operations.

6.5.1 Transfer of Liquids.

6.5.1.1* Liquid shall be transferred into containers, including containers mounted on vehicles, only outdoors or in structures specially designed for such purpose.

6.5.1.2 The transfer of liquid into containers mounted on vehicles shall not take place within a building but shall be permitted to take place under a weather shelter or canopy. (See 6.25.3.3.)

6.5.1.3 Structures housing transfer operations or converted for such use after December 31, 1972, shall comply with Chapter 10.

6.5.1.4 The transfer of liquid into containers on the roofs of structures shall be permitted, provided that the installation conforms to the requirements specified in 6.6.7 and 6.20.11.

6.5.1.5 The transfer hose shall not be routed in or through any buildings except those specified in 6.5.1.3.

6.5.1.6 Filling of containers located outdoors in stationary installations in accordance with Section 6.3 shall be permitted to be filled at that location.

6.5.2 Container Point of Transfer Location Requirements.

6.5.2.1 If the point of transfer of containers located outdoors in stationary installations is not located at the container, it shall be located in accordance with Table 6.5.2.1.

6.5.2.2 Containers not located in stationary installations shall be filled at a location determined by the point of transfer in accordance with Table 6.5.2.1.

6.5.3 Separation Distance from Point of Transfer.

6.5.3.1 If the point of transfer is a component of a system covered by Section 6.24 or Chapter 11, the requirements of parts A, B, and C of Table 6.5.2.1 shall not apply to the structure containing the point of transfer.

6.5.3.2 If LP-Gas is vented to the atmosphere under the conditions stipulated in 7.3.1(5), the distances in Table 6.5.2.1 shall be doubled.

6.5.3.3 If the point of transfer is housed in a structure complying with Chapter 10, and the common walls comply with 10.2.1, separation distances in Table 6.5.2.1 shall not be required where the common walls comply with 10.3.1.3.

6.5.3.4 The distances in Table 6.5.2.1, parts B, C, D, E, F(2), and J, shall be reduced by one-half where the system incorporates the provisions of low emission transfer as provided in 6.28.5.

Table 6.5.2.1 Distance Between Point of Transfer and Exposures

Part	Exposure	Minimum Horizontal Distance	
		ft	m
A	Buildings, ^a mobile homes, recreational vehicles, and modular homes with at least 1-hour fire-rated walls ^b	10 ^c	3.1
B	Buildings ^a with other than at least 1-hour fire-rated walls ^b	25 ^c	7.6 ^c
C	Building wall openings or pits at or below the level of the point of transfer	25 ^c	7.6 ^c
D	Line of adjoining property that can be built upon	25 ^c	7.6 ^c
E	Outdoor places of public assembly, including schoolyards, athletic fields, and playgrounds	50 ^c	15 ^c
F	Public ways, including public streets, highways, thoroughfares, and sidewalks		
	(1) From points of transfer in LP-Gas dispensing stations and at vehicle fuel dispensers	10	3.1
	(2) From other points of transfer	25 ^c	7.6 ^c
G	Driveways ^d	5	1.5
H	Mainline railroad track centerlines	25	7.6
I	Containers ^e other than those being filled	10	3.1
J	Flammable and Class II combustible liquid ^f dispensers and the fill connections of containers	10 ^c	3.1 ^c
K	Flammable and Class II combustible liquid aboveground containers and filling connections of underground containers	20	6.1

^aFor the purpose of the table, buildings also include structures such as tents and box trailers at construction sites.

^bSee ASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials*, or ANSI/UL 263, *Standard for Fire Tests for Building Construction and Materials*.

^cSee 6.5.3.4.

^dNot applicable to driveways and points of transfer at vehicle fuel dispensers.

^eNot applicable to filling connections at the storage container or to dispensing vehicle fuel dispenser units of 4000 gal (15.2 m³) water capacity or less when used for filling containers not mounted on vehicles.

^fNFPA 30, *Flammable and Combustible Liquids Code*, defines these as follows: Flammable liquids include those having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psia (276 kPa) at 100°F (37.8°C). Class II combustible liquids include those having a flash point at or above 100°F (37.8°C) and below 140°F (60°C).



6.6 Installation of Containers.

6.6.1 General Requirements.

6.6.1.1 Containers shall be positioned so that the pressure relief valve is in direct communication with the vapor space of the container.

6.6.1.2 LP-Gas containers or systems of which they are a part that are installed within 10 ft (3 m) of public vehicular thoroughfares shall be provided with a means of vehicular barrier protection.

6.6.1.3 Field welding on containers shall be limited to non-pressure parts such as saddle plates, wear plates, or brackets installed by the container manufacturer.

6.6.1.4* Aboveground containers shall be painted.

6.6.1.5 Containers shall be installed so that all container operating appurtenances are accessible.

6.6.1.6 Where necessary to prevent flotation due to possible high flood waters around aboveground or mounded containers, or high water table for those underground and partially underground, containers shall be securely anchored.

6.6.2 Installation of Cylinders.

6.6.2.1 Cylinders shall be installed only aboveground and shall be set upon a firm foundation or otherwise be firmly secured. (See 6.6.2.2.)

6.6.2.2 The cylinder shall not be in contact with the soil.

6.6.2.3 Flexibility shall be provided in the connecting piping. (See 6.6.2.4.)

6.6.2.4 Where flexible connectors are used, they shall comply with 6.9.6.

6.6.3 Installation of Horizontal Aboveground ASME Containers.

6.6.3.1 Horizontal ASME containers designed for permanent installation in stationary aboveground service shall be placed on masonry or other noncombustible structural supports located on concrete or masonry foundations with the container supports.

(A) Where saddles are used to support the container, they shall allow for expansion and contraction and prevent an excessive concentration of stresses.

(B) Where structural steel supports are used, they shall comply with 6.6.3.3.

(C) Containers of more than 2000 gal (7.6 m³) water capacity shall be provided with concrete or masonry foundations formed to fit the container contour or, if furnished with saddles in compliance with Table 6.6.3.3(A), shall be placed on flat-topped foundations.

(D) Containers of 2000 gal (7.6 m³) water capacity or less shall be installed either on concrete or masonry foundations formed to fit the container contour or in accordance with 6.6.3.1(E).

(E) Containers of 2000 gal (7.6 m³) water capacity or less and equipped with attached supports complying with Table 6.6.3.3(A) shall be installed on a fire-resistive foundation if the bottoms of the horizontal members of the container saddles, runners, or skids are more than 12 in. (300 mm) above grade.

(F) Containers of 2000 gal (7.6 m³) water capacity or less shall not be mounted with the outside bottom of the container shell more than 5 ft (1.5 m) above the surface of the ground.

(G) Containers of 4000 gal (15.2 m³) water capacity or less installed with combined container-pump assemblies on a common base complying with Table 6.6.3.3(A) shall be placed either on paved surfaces or on concrete pads at ground level within 4 in. (100 mm) of ground level.

6.6.3.2 ASME containers that have liquid interconnections shall be installed so that the maximum permitted filling level of each container is at the same elevation.

6.6.3.3 Support of horizontal ASME containers shall comply with 6.6.3.3(A) through 6.6.3.3(D).

(A) Horizontal ASME containers with attached supports and designed for permanent installation in stationary service shall be installed in accordance with Table 6.6.3.3(A).

Table 6.6.3.3(A) Installation of Permanently Installed Horizontal ASME Containers with Attached Supports

Container Size		Attached Support	Height of Container Bottom
gal	m ³		
≥4000	≥15.2	Non-fireproofed steel on flat-topped concrete foundations	6 in. (150 mm) maximum above concrete foundations
≤4000	≤15.2	Non-fireproofed steel on masonry or concrete foundations more than 12 in. (300 mm) above the ground	2 in. to 12 in. (51 mm to 300 mm) above concrete foundation
≤4000	≤15.2	Non-fireproofed steel on paved surfaces or concrete pads within 4 in. (100 mm) of the ground	24 in. (610 mm) maximum above paved surface or top of concrete pads
≤4000	≤15.2	Foundations or supports for horizontal LP-Gas containers per 6.6.3.3(B)	24 in. (610 mm) maximum above paved surface

