NFPA 59



STANDARDS

for the

# Storage and Handling of LIQUEFIED PETROLEUM GASES AT UTILITY GAS PLANTS

## 1949

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NATIONAL FIRE PROTECTION ASSOCIATION

International

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# National Fire Protection Association

INTERNATIONAL

Executive Office: 60 Batterymarch St., Boston 10, Mass.

The National Fire Protection Association was organized in 1896 to promote the science and improve the methods of fire protection and prevention, to obtain and circulate information on these subjects and to secure the cooperation of its members in establishing proper safeguards against loss of life and property by fire. Its membership includes over a hundred and seventy-five national and regional societies and associations and over thirteen thousand individuals, corporations, and organizations.

This pamphlet is one of a large number of publications on fire safety issued by the Association. The standards, prepared by the technical committees of the National Fire Protection Association and adopted in the annual meetings of the Association, are intended to prescribe reasonable measures for minimizing fire losses. All interests concerned have opportunity through the National Fire Protection Association to participate in the development of the standards and to secure impartial consideration of matters affecting them.

# Liquefied Petroleum Gases at Utility Gas Plants.

Public utilities have been concerned about the shortage and steadily increasing demands for gas. To meet the problem, the utilities have increasingly turned to liquefied petroleum gas as a stand-by means to meet peak load requirements. The NFPA Standards on Liquefied Petroleum Gases (NFPA No. 58), as prepared by the Committee on Gases and published herein and in NFPA-NBFU pamphlets No. 58 were used as a general guide until these separate standards were adopted in 1949.

To facilitate the preparation of these standards, the cooperation of the American Gas Association was secured. This resulted in the formation of a special committee under the sponsorship of the American Gas Association, made up of utility engineers, specialists in gas plant construction, and engineers of the liquefied petroleum gas industry. The standard is thus the result of the joint efforts of the AGA Committee and the NFPA Committee on Gases (for personnel see page 135).

The committee submitted these standards for tentative adoption at the 1948 annual meeting of the Association. At this time they were tentatively adopted and referred back to the committee for minor revisions with authority granted to submit the revised text to the NFPA Board of Directors for final approval in the name of the Association. The Board, acting in accordance with these instructions, adopted the standard at its meeting on January 27, 1949.

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## Standards for the Storage and Handling of LIQUEFIED PETROLEUM GASES AT UTILITY GAS PLANTS

**Introduction.**

The term "liquefied petroleum gases" as used in these standards shall mean and include any material which is composed predominantly of any of the following hydrocarbons, or mixtures of them; propane, propylene, butanes (normal butane or isobutane), and butylenes.

In the interest of safety it is important that employees understand the properties of these gases, and that they be thoroughly trained in safe practices for handling, distribution and operation.

Under moderate pressure the gases liquefy, but upon relief of the pressure are readily converted into the gaseous phase. Advantage of this characteristic is taken by the industry, and for convenience the gases are shipped and stored under pressure as liquids. When in the gaseous state, these gases present a hazard comparable to any flammable natural or manufactured gas, except that being heavier than air, ventilation requires added attention. The range of combustibility is considerably narrower and lower than that of natural and manufactured gas.

In the case of pure product at atmospheric pressure and below 31° F., normal butane is a liquid. Propane is a liquid at atmospheric pressure at temperatures below minus 44° F. and normally does not present a flammable liquid hazard.

Rapid vaporization takes place at temperatures above the boiling points (normal butane about 30°F.; propane about minus 44°F.). At temperatures above these, it is self-evident that the escape of this material will be as gases. Only large volume release permits liquids to escape. Normal storage of these gases is as a liquid under pressure.

**Application of Rules.**

(a) The following standards are intended to apply to utility gas companies for the design, construc-

tion, location, installation, and operation of liquefied petroleum gas systems.

(b) When operations involving bottling or transportation of LP-Gas in liquid form are carried out on the same property, these operations shall conform to the appropriate rules in the NFPA Standard on Liquefied Petroleum Gases as published in National Fire Codes, Vol. I, and Pamphlet 58 of the National Board of Fire Underwriters.

(c) Installations having an aggregate water capacity not exceeding 1200 gallons shall conform to the appropriate rules in the NFPA Standard on Liquefied Petroleum Gases, as published in National Fire Codes, Vol. I, and Pamphlet 58 of the National Board of Fire Underwriters.

(d) When reference is made to gas in these standards it shall refer to liquefied petroleum gases in either the liquid or gaseous state.

(e) The term "containers" includes all vessels such as tanks, cylinders or drums used for storing liquefied petroleum gases.

(f) The term "systems" as used in these standards refers to an assembly of equipment consisting essentially of LP-Gas unloading equipment, container or containers, major devices such as vaporizers, relief valves, excess flow valves, regulators, etc., and interconnecting piping. Such systems shall include any unloading equipment, storage equipment or interconnecting piping up to the outlet of the first stage regulator, vaporizer or mixing device, which ever is the last unit before the LP-Gas enters other plant equipment or distribution lines.

**1. Odorizing Gases.**

(a) All liquefied petroleum gases shall be effectively odorized by an approved agent of such character as to indicate positively, by a distinctive odor, the presence of gas down to concentration in air of not over one-fifth the lower limit of combustibility; provided, however, that odorization is not required if harmful in the use or further processing of the liquefied petroleum gas, or if odorization will serve no useful purpose as a warning agent in such use or further processing.

NOTE: The lower limits of combustibility of the more commonly used liquefied petroleum gases are: Propane, approximately 2 per cent; Butane, approximately 1½ per cent. These figures represent volumetric percentages of gas in a gas-air mixture in each case.

**2. Testing and Listing of Equipment.**

In systems utilizing containers of over 1,200 gallons water capacity, each container valve, excess flow valve, gauging device and relief valve directly connected on the LP-Gas container shall have its correctness as to design, construction, and performance determined by:

(1) Testing and Listing by Underwriters' Laboratories, Inc., or,

(2) Testing and Listing by a nationally recognized agency for LP-Gas use, or,

(3) The enforcing authority having jurisdiction.

**3. Requirement for Construction and Original Test of Containers.**

(a) Containers shall be constructed and tested in accordance with the Unfired Pressure Vessel Code of the American Society of Mechanical Engineers, except that construction under Paragraph U-70 is not authorized; or in accordance with the Unfired Pressure Vessel Code, joint standard of the American Petroleum Institute and the American Society of Mechanical Engineers; or in accordance with the rules of the authority under which the containers are installed, provided such rules are in substantial conformity with the rules of the A.S.M.E. Code or the A.P.I.-A.S.M.E. Code, except that compliance with the following shall not be required; Paragraph U-2 to U-10 inclusive and U-19 of the aforesaid A.S.M.E. Code; Paragraph W-601 to W-606 inclusive and Section I and appendix to Section I of the aforesaid A.P.I.-A.S.M.E. Code.

**4. Design Working Pressure and Classification of Storage Containers.**

(a) Storage containers shall be designed and classified as follows:

| "Container Type" | For Gases with Vapor Pressure Not to Exceed the Following at 100°F. | Minimum Design Working Pressure of Containers by: A.S.M.E. Code U-68 U-69 | A.S.M.E. Code U-200 U-201 | A.P.I.-A.S.M.E. Code |
|---|---|---|---|---|
| 100 | 100 psig | 100 psig | 113 psig | 125 psig |
| 125 | 125 | 125 | 141 | 156 |
| 150 | 150 | 150 | 169 | 187 |
| 175 | 175 | 175 | 197 | 219 |
| 200 | 200 | 200 | 225 | 250 |

(b) The shell or head thickness of any container shall not be less than 3/16 inch.

NOTE: Because of low soil temperature usually encountered, and the insulating effect of the earth, the average vapor pressure of products stored in underground containers will be materially lower than when stored aboveground. This reduction in actual operating pressure therefore provides a substantial corrosion allowance for these containers when installed underground.

**5. Capacity of Liquid Containers.**

(a) No liquid storage container shall exceed 30,000 standard U. S. gallons capacity.

**6. Markings on Containers.**

(a) Each container shall be marked as specified in the following:

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

Underground: Container and an accessible nameplate.

Aboveground: Container.

2. With notation as to whether system is designed for underground or aboveground installation.

Underground: Container and an accessible nameplate.

Aboveground: Container.

3. With the water capacity of the container in pounds or gallons, U. S. Standard.

Underground: Container and an accessible nameplate.

Aboveground: Container.

4. With the pressure in pounds per square inch for which the container is designed.

Underground: Container and an accessible nameplate.

Aboveground: Container.

5. With the wording "This container shall not contain a product having a vapor pressure in excess of——lbs. per sq. in. gauge at 100° F." See Sec. 4.

Underground and aboveground: A nameplate or tag on filler connection.

6. With the over-all length and outside diameter of the container in inches.

Underground: An accessible nameplate.

Aboveground: No requirement.

7. 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. Markings shall be in increments of 20°F.

Aboveground and underground: System nameplate or on liquid level gauging device.

**7. Location of Containers.**

(a) Containers shall be located outside of buildings other than those especially provided for this purpose. Each individual container shall be located at least 50 feet away from the nearest important building, or group of buildings, or line of adjacent property which may be built on, except as provided in paragraph (b). Except as herein provided, each individual container in a group shall be separated by 5 feet.

1. When the number of containers exceeds ten, they shall be segregated into groups not exceeding ten containers in each group.

2. The groups described in Sec. 7(a) 1, shall be separated from each other by at least 25 feet.

(b) Installations consisting of 6 or more containers and their loading stations should preferably

be located 100 feet or more from buildings occupied for generation, compression or purification of coal or water gas, or for natural gas compressor buildings, or from outdoor installations essential to the maintenance of operation in such buildings, and should be 100 feet or more from aboveground storage of oils or tars and from any building of such construction or occupancy as to constitute a material hazard of exposure to the containers in the event of fire or explosion in said buildings. If the storage containers by necessity are located closer than 50 feet to any such buildings or installations, then the latter shall be protected by blank walls adjacent to such storage containers and by other appropriate means against the entry of escaped liquefied petroleum gas, or of drainage from the storage container area and its loading points, all in such a manner as may be required and approved by the inspection department having jurisdiction. The inspection department in addition, may require the provision and maintenance of special gas detecting alarm devices, gas barriers and fire extinguishing equipment in the storage container area. Any large aboveground storage of fuel oil, gas oil or tar within 150 feet of the storage container area shall be protected by standard dikes.

(c) The ground within 10 feet of any container shall be kept clear of readily ignitable material such as weeds and long dry grass.

(d) In cases where containers are to be installed in heavily populated or congested areas, the inspection department having jurisdiction shall determine restrictions of individual tank capacity, total storage, distance to line of adjoining property which may be built on and other reasonable protective methods.

**8. Container Valves and Accessories, Filler Pipes, Discharge Pipes and Manifolds.**

(a) All shut-off valves and accessory equipment (liquid or gas) shall be suitable for use with liquefied petroleum gas, 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 pounds per square inch gauge.

(b) All connections to containers, except safety relief connections and gauging devices shall have shut-off valves located as close to the container as practicable.

(c) Excess flow valves where required by these standards shall close automatically at those 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.

(d) The filling connection shall be fitted with an approved positive shut-off valve in conjunction with either an internal back pressure valve or an internal excess flow valve.

(e) Except as provided in Sec. 13(c), 8(f) and 8(g) all liquid and vapor connections on containers except safety relief connections shall be equipped with approved automatic excess flow valves or back pressure check valves.

(f) Liquid level gauging 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.

(g) Openings from tank or through fittings attached directly on tank to which pressure gauge connection is made need not be equipped with excess flow valve if such openings are protected by not larger than No. 54 drill size opening.

(h) Excess flow and back pressure check valves where required by these standards 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.

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

(j) Cast iron valves shall be prohibited on LP-Gas container connections and in piping carrying liquid LP-Gas.

(k) The filling pipe inlet terminal shall not be located inside a building. Such terminals shall be located not less than 10 feet from any building and preferably not less than 5 feet from any driveway, and shall be properly supported and protected from mechanical damage.

(l) Containers manifolded together:

1. Liquid connections between container and manifold should be provided with adequate means for contraction and expansion.

2. It is desirable that liquid manifold connections be located at non-adjacent ends of parallel rows of containers.

(m) All inlet and outlet connections except safety relief valves, liquid level gauging devices and pressure gauges on containers of 1200 gallons water capacity or more, and on any container used to supply fuel directly to an internal combustion engine, shall be labeled or color coded to designate whether they communicate with vapor or liquid space. Labels may be on valves.

(n) Each storage container of 1200 gallons water capacity or over shall be provided with a suitable pressure gauge.

**9. Piping, Tubing and Fittings.**

(a) Piping or tubing shall be wrought iron, steel, brass or copper pipe; or, except as hereinafter provided, seamless copper, brass, steel or other approved gas tubing. All piping or tubing shall be suitable for the working pressure to which it may be subjected. Copper tubing may be of the standard grade K or L. Aluminum tubing shall not be used in exterior locations or where it passes through masonry or plaster walls, insulation or in contact with concrete.

(b) Pipe joints may be screwed, flanged, welded, or brazed. Where fittings are used they shall have a working pressure of at least 125 pounds in systems where the operating pressure is 125 pounds per square inch gauge or less. Extra heavy fittings shall be used for pressure exceeding 125 pounds per square

inch. Cast iron fittings shall be prohibited on LP-Gas container connections and in piping carrying liquid LP-Gases. Joints on seamless copper, brass, steel, or non-ferrous gas tubing shall be made by means of approved gas tubing fittings or brazed or soldered with solders having a melting point exceeding 1000° F.

(c) Valve seat material, packing, gaskets, etc., shall be of such quality as to be resistant to the action of liquefied petroleum gas in the liquid phase.

(d) All piping, tubing, fittings and the valves shall be tested after assembly and proved free from leaks at not less than normal operating pressures. Test shall not be made with a flame.

(e) Provision shall be made for expansion, contraction, jarring and vibration, and for settling.

(f) Piping outside buildings may be buried, above ground, or both, but shall be well supported and protected against mechanical injury.

**10. Hose Specifications.**

(a) Hose shall be fabricated of materials that are resistant to the action of liquefied petroleum gas.

(b) Hose subject to container pressure shall be designed for a bursting pressure of not less than five times the pressure for which the container was designed. Hose connections when made shall be capable of withstanding a test pressure of twice the pressure for which the container is designed.

(c) Hose and hose connections located on the low pressure side of regulators or reducing valves shall be designed for a bursting pressure of not less than 125 pounds per square inch but not less than five times the pressure setting of the safety relief devices protecting that portion of the system. All connections shall be so designed that there will be no leakage when connected.

**11. Safety Devices.**

(a) Every container and every vaporizer, 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 any building which is below such discharge. The rate of the discharge shall be in accordance with the provisions of Appendix A, or Appendix B in the case of vaporizers.

(b) Container safety relief valves shall be set to start to discharge as follows, with relation to the design working pressure:

| Containers | Minimum | Maximum |
|---|---|---|
| A.S.M.E.-U-68, U-69 ..... | 100% | 125% |
| A.S.M.E.-U-200, U-201 ..... | 90 | 100 |
| A.P.I.-A.S.M.E. ..... | 80 | 100 |

(c) Safety relief devices shall be so constructed as to discharge at not less than the rates shown in Appendix A, before the pressure is in excess of 120 per cent of the maximum permitted start to discharge pressure setting of the devices.

NOTE: On containers with working pressure above the 200 lb. type container as set out in section 4(a) the Safety Relief Valve minimum requirements for 200 type containers may be used.

(d) In certain locations sufficiently sustained sun temperatures prevail which will 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 a 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.

(e) Safety relief valves shall be so arranged 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.

(f) No shut-off valves shall be installed between the safety relief valves and the container except that a shut-off valve may be used where the arrangement of this valve is such as always to afford full required capacity flow through the relief valves.

NOTE: The above exception is made to cover such cases as a three-way valve installed under two safety relief valves, each of which has the required rate of discharge and is so installed as to allow either of the safety relief valves to be closed off but does not allow both safety valves to be closed off at the same time. Another exception to this may be where two separate relief valves are installed with individual shut-off valves. In this case the two

shut-off valve stems shall be mechanically inter-connected in a manner which will allow full required flow of one relief valve at all times.

(g) Safety relief valves shall have direct communication with the vapor space of the container.

(h) Each container safety relief valve shall be plainly and permanently marked with the "Container Type," with the pressure vessel code designation for which the valve is designed, with the pressure in pounds per square inch gauge at which the valve is set to start to discharge, with the actual rate of discharge of the valve at its full open position in cubic feet per minute of LP-Gas at 60° F. and atmospheric pressure, and with the manufacturer's name and catalogue number; for example, T200—U-69—240-26,000 indicating that the valve is suitable for use on a Type 200 container of U-69 ASME Code Construction; that it is set to start to discharge at 240 pounds per square inch gauge, and that its rate of discharge at full open position (See Sec. 11(b) and (c) is 26,000 cubic feet per minute of LP-Gas as determined in Appendix A.

NOTE: Frequent testing of safety relief valves, as would be required where there is a probable increase or decrease of the releasing pressure of the valve due to clogging, sticking, corrosion or exposure to elevated temperatures, is not necessary for such valves on liquefied petroleum gas containers for the following reasons:

The gases are so-called "sweet gases," i.e., they have no corrosive effect on the metal of the container or valve; the valves are constructed of materials not readily subject to corrosion and are installed in pressure vessels so as to be protected against the weather. Further, the temperature variations are not sufficient to bring about any permanent set of the valve springs.

It is recognized, however, that like all mechanical devices, these valves cannot be expected to remain in reliable operative condition forever, hence it is suggested that in the case of containers exceeding 1,200 gallons water capacity, they be tested at approximately 5 year intervals. When valve is of type necessitating removal for testing, container must first be emptied.

(i) Connections to which relief valves are attached, such as couplings, flanges, nozzles, and discharge lines for venting, shall have their internal dimensions such that the net relief area of the valve is not restricted.

(j) A safety relief valve shall be installed between each pair of shut-off valves on LP-Gas liquid piping so as to relieve into a safe atmosphere. It is recommended that the start to discharge pressure of such

relief valves be not less than 240 pounds per square inch gauge and not in excess of 400 pounds per square inch gauge.

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

(l) All safety devices shall comply with the following:

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

2. Discharge pipe from safety relief valves within a building shall be piped to a point outside and shall discharge vertically upward.

3. Safety relief discharge terminals shall be so located as to provide protection against mechanical injury and such discharge pipes shall be fitted with loose raincaps. Return bends and restrictive pipe fittings shall not be permitted.

4. 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, except those located on storage containers, 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 is the same.

5. Each storage container of 1200 gallons water capacity or over shall be provided with a suitable pressure gauge.

6. When the discharge pressure from the final stage regulator is not more than 5 pounds, the low pressure side shall be equipped with a relief valve, set to relieve at not less than two times, and not more than three times, but not more than 5 pounds in excess of the discharge pressure. When the discharge pressure is more than 5 pounds, the relief valve shall be set to not less than 1½ times and not more than three times the discharging pressure. 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 5 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, when there is no probability of gas accumulation, the space above the diaphragm need not be vented to the outside.

(m) ABOVEGROUND CONTAINERS. Safety devices for aboveground containers shall be provided as follows:

1. The discharge from safety relief valves shall be vented, away from the container upward at least 7 feet 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. Size of discharge lines from safety relief valves shall not be smaller than the nominal size of the relief valve outlet connection. Suitable provision shall be made for draining water which may accumulate in the discharge pipe.

(n) UNDERGROUND CONTAINERS. Safety devices for underground containers shall be provided as follows:

1. On underground containers of more than 1200 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.

2. On underground installations where there is a probability of the manhole or housing becoming flooded, the discharge from vent lines should be above the possible water level. All manholes or housings shall be provided with ventilated louvers or their equivalent.

**12. Vaporizing and Housing.**

(a) Indirect fired vaporizers utilizing steam, water or other heated medium shall be constructed and installed as follows:

1. Vaporizers constructed in accordance with the requirements of the ASME Unfired Pressure

Vessel Code shall be permanently marked as follows:

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

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

With the outside surface and the inside heat exchange surface expressed in square feet.

With the name or symbol of the manufacturer.

2. Vaporizers having an inside diameter of 6 inches or less exempted by paragraph U-1(a) of the ASME Unfired Pressure Vessel Code shall have a design working pressure not less than 250 pounds per square inch gauge and need not be permanently marked.

3. Heating or cooling coils shall not be installed inside of a storage container.

4. Vaporizers may be installed in buildings, rooms, sheds, or lean-tos, other than those in which open flames or fires may exist. Vaporizers shall not be installed in the same room with units furnishing air other than for an LP-Gas mixing device. Such structures shall be of light fire resistive construction or equivalent, well ventilated near the floor line and roof.

5. Vaporizers shall have at or near the discharge, a safety relief valve providing an effective rate of discharge in accordance with Appendix B.

6. Vaporizers shall be provided with suitable automatic means to prevent liquid passing from the vaporizers to the gas discharge piping.

7. The device that supplies the necessary heat for producing steam, hot water, or other heating medium shall be separated from all compartments or rooms containing liquefied petroleum gas vaporizers, pumps, and central gas mixing devices by a wall of substantially fire resistant material and vapor tight construction.

8. Vaporizers shall not be equipped with fusible plugs.

9. Vaporizer houses shall not have drains to sewers or sump pits.

(b) Direct gas fired vaporizers shall be constructed and installed as follows:

1. Vaporizer shall be constructed and marked in accordance with the requirements of the ASME Code that are applicable to the maximum working conditions for which the vaporizer is designed.

(a). Each vaporizer shall be marked to show the name of the manufacturer; rated British thermal unit input to 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.

2. 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 complete shutting off when desired, of all flow of gas or liquid from container to vaporizer.

(a). Vaporizers with capacity not exceeding 35 gallons per hour shall be located at least 5 feet from container shut-off 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 shut-off valves. Vaporizers having a capacity greater than 100 gallons per hour shall be located at least 15 feet from container shut-off valves.

3. Vaporizers may be installed in buildings, rooms, housings, sheds, or lean-tos used exclusively for gas manufacturing or distribution. Such structures shall be of non-combustible construction or equivalent, and well ventilated near the floor line and roof.

4. Vaporizers shall have at or near the discharge, a safety relief valve providing an effective rate of discharge to safeguard against rupture of the vaporizer. Relief valve shall be so located as not to be subjected to temperatures in excess of 140° F. See Section 11(a) for venting of relief valve.

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

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

7. Vaporizers shall be equipped with automatic safety devices to shut off the flow of gas to main burners, if pilot flame or spark should fail. When flow through the pilot exceeds 2000 British thermal units per hour, the pilot also shall be equipped with automatic safety device to shut off the flow of gas to the pilot should the pilot flame be extinguished.

8. Pressure regulating and pressure reducing equipment if located within 10 feet of a direct fired vaporizer shall be separated from the open flame by a susbtantially air tight non-combustible partition or partitions.

9. Except as provided in Sec. 12(b)3 the following minimum distances shall be maintained between the nearest important building or group of buildings and direct fired vaporizers; 10 feet for vaporizer not exceeding 15 gallons per hour vaporizing capacity; 25 feet for vaporizers having a capacity of 16 to 100 gallons per hour; 50 feet for vaporizers having a capacity exceeding 100 gallons per hour. No direct fired vaporizer shall be located closer than 50 feet to line of adjoining property which may be built on.

10. No direct fired vaporizer shall raise the product pressure within the storage container over the pressure set out in the second column of the table in Sec. 4(a).

11. No direct fired vaporizer shall be connected to a container that has a storage capacity in gallons, less than 10 times the hourly capacity of the vaporizer in gallons.

12. Vaporizer shall not be provided with fusible plugs for pressure relief.

13. Vaporizer shall not have drains to sewers or sump pits.

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

1. Direct gas fired tank heaters, and tanks to which they are applied, shall only be installed aboveground.

2. Tank heaters shall be permanently marked with the name of the manufacturer, the rated British thermal unit input to the burner, and the maximum vaporizing capacity in gallons per hour.

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

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

5. Tank heaters shall be equipped with an automatic safety device to shut off the flow of gas to main burners, if pilot light should fail. When flow through pilot exceeds 2000 British thermal units 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.

6. 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 air tight non-combustible partition or partitions.

7. No direct fired tank heater shall be located closer than 50 feet to line of adjoining property which may be built upon.

8. No direct fired tank heater shall raise the product pressure within the storage container over the pressure set out in the second column of the table in Section 4(a).

9. No direct fired tank heater shall be connected to a container that has a storage capacity in gallons, less than ten times the hourly vaporizing capacity of the tank heater in gallons.

**13. Liquid Level Gauging Device.**

(a) Each container shall be equipped with a liquid level gauging device of approved design, for example, a rotary gauge, slip tube, an automatic outage tank, magnetic or fixed tube device. When float type or pressure differential type gauges are used, containers shall also be provided with a fixed dip tube, slip tube, rotary gauge or similar device.

(b) All gauging devices shall be arranged so that the maximum liquid level for butane, 50-50 mixture

of butane and propane, and propane, to which the container may be filled is readily determinable.

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

(d) Gauging devices shall have a design working pressure of at least 250 pounds per square inch gauge.

(e) Length of fixed tube device 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 above-ground containers and at 50°F. for buried containers. Refer to Appendix D for calculating filling point for which tube shall be designed.

(f) Gauge glasses of the columnar type shall not be permitted.

**14. Filling Densities.**

(a) The "filling density" is defined as the per cent ratio of the weight of the gas in a container to the weight of water the container will hold at 60°F. The filling densities for storage containers shall not exceed the ratios following:

## MAXIMUM PERMITTED FILLING DENSITY

| LP-Gas Specific Gravity at 60°F. | Aboveground Containers Over 1200 Gallons: Per Cent Ratio Gas Capacity to Water Capacity | Aboveground Containers Over 1200 Gallons: Maximum LP-Gas Content at 60°F. Volume Per Cent | Underground Containers All Capacities: Per Cent Ratio Gas Capacity to Water Capacity | Underground Containers All Capacities: Maximum LP-Gas Content at 60°F. Volume Per Cent |
|---|---|---|---|---|
| .473-.480 | 41% | 86.10% | 42% | 88.10% |
| .481-.488 | 42 | 86.65 | 43 | 88.75 |
| .489-.495 | 43 | 87.45 | 44 | 89.45 |
| .496-.503 | 44 | 88.05 | 45 | 90.05 |
| .504-.510 | 45 | 88.85 | 46 | 90.80 |
| .511-.519 | 46 | 89.35 | 47 | 91.25 |
| .520-.527 | 47 | 89.80 | 48 | 91.70 |
| .528-.536 | 48 | 90.20 | 49 | 92.10 |
| .537-.544 | 49 | 90.65 | 50 | 92.50 |
| .545-.552 | 50 | 91.10 | 51 | 92.90 |
| .553-.560 | 51 | 91.65 | 52 | 93.45 |
| .561-.568 | 52 | 92.10 | 53 | 93.90 |
| .569-.576 | 53 | 92.50 | 54 | 94.30 |
| .577-.584 | 54 | 93.05 | 55 | 94.75 |
| .585-.592 | 55 | 93.45 | 56 | 95.15 |
| .593-.600 | 56 | 93.85 | 57 | 95.55 |
| .601-.608 | 57 | 94.25 | 58 | 95.90 |
| .609-.617 | 58 | 94.65 | 59 | 96.25 |
| .618-.626 | 59 | 94.95 | 60 | 96.55 |
| .627-.634 | 60 | 95.20 | 61 | 96.75 |

**15. Transfer of Liquids from Tank Cars or Tank Trucks.**

(a) 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 product.

(b) The maximum vapor pressure of the product at 100°F. which may be transferred into a container shall be in accordance with Sec. 4(a).

(c) Precaution shall be exercised 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.

(d) Where needed unloading piping or hoses shall be provided with suitable bleeder valves for relieving pressure before disconnection.

(e) All transfer of liquefied petroleum gas shall be by means of approved pumps or compressors. 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. When low temperatures so reduce the vapor pressure that this proceedure will not function, the compressor may take suction directly from the air and discharge through a suitable moisture removing medium to the container being emptied.

**16. Tank Car Loading and Unloading Point.**

(a) The track of tank car siding shall be relatively level.

(b) A TANK CAR CONNECTED sign, as covered by I.C.C. (Interstate Commerce Commission) rules, shall be installed at the active end or ends of the siding while the tank car is connected for unloading.

(c) While cars are on side-track for unloading, the wheels at both ends shall be blocked on the rail.

(d) A man shall be in attendance at all times while the tank car or cars are being unloaded.

(e) The pipe line to which the tank car unloading hoses are connected shall be equipped with a back flow check valve to prevent discharge of the LP-Gas from the receiving container and line in case of line hose and fittings rupture.

(f) The tank car unloading point should be located with due safety consideration to the following:

1. Proximity to railroad and highway traffic.
2. The distance of such unloading point from adjacent property.
3. With respect to buildings on installer's property.
4. Nature of occupancy.
5. Topography.
6. Type of construction of buildings.
7. Number of tank cars that may be safely unloaded at one time.
8. Frequency of unloading.

(g) Where practical, the distance of the tank car unloading point should conform to the distance in Sec. 7(a) except that lesser distances may be used, keeping in mind the above items and upon approval of the inspection department having jurisdiction.

**17. Electrical Connections and Open Flames.**

(a) In vaporizer houses, gas mixing rooms and similar locations, all electrical installations shall be in strict accordance with the requirements of the National Electrical Code for Class I, Group D hazardous locations.

(b) In vaporizer houses, gas mixing rooms and similar locations, open flames or other sources of ignition shall not be permitted.

## CONTAINERS AND EQUIPMENT.

**18. Pumps and Compressors.**

Each pump and compressor shall be marked with its maximum working pressure and shall be of a type suitable for the LP-Gas service intended.

**19. Installation of Storage Containers.**

(a) Containers installed aboveground shall be provided with substantial masonry or noncombustible structural supports on firm masonry foundations.

(b) Aboveground containers shall be supported as follows:

1. Horizontal containers shall be mounted on saddles in such a manner as to permit expansion and contraction. Only two saddles shall be used. Every container shall be so supported as to prevent the concentration of excessive loads on the supporting portion of the shell. 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.

(c) Field welding where necessary shall be made only on saddle plates or brackets which were applied by manufacturer of container, except as provided by the code under which the container was fabricated.