# UL 644

## STANDARD FOR SAFETY

Container Assemblies for LP-Gas

UL Standard for Safety for Container Assemblies for LP-Gas, UL 644

Ninth Edition, Dated June 6, 2014

***Summary of Topics***

***This revision of ANSI/UL 644 dated November 12, 2019 is being issued to update the title page to reflect the most recent designation as a Reaffirmed American National Standard (ANS). No technical changes have been made.***

Text that has been changed in any manner or impacted by UL's electronic publishing system is marked with a vertical line in the margin.

The requirements are substantially in accordance with Proposal(s) on this subject dated July 26, 2019.

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**UL 644**

# Standard for Container Assemblies for LP-Gas

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**Ninth Edition**

**June 6, 2014**

This ANSI/UL Standard for Safety consists of the Ninth Edition including revisions through November 12, 2019.

The most recent designation of ANSI/UL 644 as a Reaffirmed American National Standard (ANS) occurred on November 12, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

The Department of Defense (DoD) has adopted UL 644 on February 10, 1976. The publication of revised pages or a new edition of this Standard will not invalidate the DoD adoption.

Comments or proposals for revisions on any part of the Standard may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at https://csds.ul.com.

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## INTRODUCTION

### 1 Scope

1.1 These requirements cover aboveground, underground, and interchangeable (aboveground or underground) stationary container assemblies for liquefied petroleum gases which include any material having a vapor pressure not exceeding that allowed for commercial propane composed predominately of the following hydrocarbons, either by themselves or as mixtures: propane, propylene, butane (normal butane or isobutane), and butylenes. These container assemblies are provided with tanks constructed under the appropriate provisions of the current edition of the Boiler and Pressure Vessel Code of the American Society of Mechanical Engineers (ASME).

1.2 Container assemblies covered by these requirements are those using fuel storage tanks having a water capacity of 4000 gallons (15.14 $m^3$) or less and designed and used only for delivery of fuel in the gaseous phase, but they may also incorporate a liquid take-off in addition to a vapor take-off. This standard does not cover liquid supply to systems or liquid withdrawal from these or any other containers.

1.3 Container assembly installations are intended to be made in accordance with the Liquefied Petroleum Gas Code (National Fire Protection Association); NFPA 58. They are not intended for use in chemical, petrochemical, petroleum, or utility power plants; nor pipeline or marine terminals; nor related storage facilities at such plants or terminals.

### 2 Components

2.1 Except as indicated in 2.2, a component of a product covered by this standard shall comply with the requirements for that component. See Appendix A for a list of standards covering components generally used in the products covered by this standard.

2.2 A component is not required to comply with a specific requirement that:

a) Involves a feature or characteristic not required in the application of the component in the product covered by this standard, or

b) Is superseded by a requirement in this standard.

2.3 A component shall be used in accordance with its rating established for the intended conditions of use.

2.4 Specific components are incomplete in construction features or restricted in performance capabilities. Such components are intended for use only under limited conditions, such as certain temperatures not exceeding specified limits, and shall be used only under those specific conditions.

### 3 Units of Measurement

3.1 Values stated without parentheses are the requirement. Values in parentheses are explanatory or approximate information.

### 4 Undated References

4.1 Any undated reference to a code or standard appearing in the requirements of this standard shall be interpreted as referring to the latest edition of that code or standard.

## 5 Glossary

5.1 For the purpose of this standard the following definitions apply.

5.2 CONTAINER ASSEMBLY – An assembly consisting of a certified ASME Code container provided with fittings for all tank openings including a filler valve, a safety-relief valve, a service-line shutoff valve, excess flow valves, a liquid-level gauging device, and a protective housing. It may include a pressure regulator or a liquid withdrawal valve. When necessary, a copper tubing pigtail is provided for making a connection between the outlet of the service-line shutoff valve and the regulator. A vapor-return valve, a pressure gauge, and a copper tubing connector for making connection between the outlet of the regulator and the fuel service piping may be included in the assembly. Several or all of the parts may be incorporated in the assembly of a multiple-head unit.

5.3 INTERCHANGEABLE CONTAINER ASSEMBLY – A container assembly conforming to the requirements for aboveground installation with respect to safety-relief valve capacity and filling density, and to all other requirements for aboveground and underground installation, so as to permit its installation in either location without modification.

## CONSTRUCTION

## 6 Containers

6.1 These container assemblies are provided with tanks constructed under the appropriate provision of the current edition of ASME Boiler and Pressure Vessel Code. The minimum design pressure shall be in accordance with Table 6.1.

*Exception: UG 125-136 of the ASME Code does not apply. See Safety-Relief Valves, Section 8.*

**Table 6.1**
**Design pressure of containers**

| Vapor pressure of gas at 100°F (37.7°C) up to: | | Minimum design pressure of container, | |
|---|---|---|---|
| psig | (kPa) | psig | (kPa) |
| 80 | 551 | 100 | 689 |
| 100 | 689 | 125 | 862 |
| 125 | 862 | 156 | 1076 |
| 150 | 1034 | 187 | 1289 |
| 175 | 1207 | 219 | 1510 |
| 215 | 1482 | 250 | 1724 |

6.2 A container having a water capacity of 125 gallons (0.47 $m^3$) or greater shall be provided with an opening for an actuated liquid withdrawal excess-flow valve which shall be no smaller than 3/4-inch nominal pipe size. See Table 6.2.

**Table 6.2**
**Dimensions of welded and seamless wrought steel pipe**

| Size – nominal, inches | Outside diameter, | | Identification | | Wall thickness, | |
|---|---|---|---|---|---|---|
| | inches | (mm) | Extra strong standard type | Schedule no. | inch | (mm) |
| 1/2 | 0.840 | 21.34 | STD | 40 | 0.109 | 2.77 |
| | | | XS | 80 | 0.147 | 3.73 |
| 3/4 | 1.050 | 26.67 | STD | 40 | 0.113 | 2.87 |
| | | | XS | 80 | 0.154 | 3.91 |
| 1 | 1.315 | 33.40 | STD | 40 | 0.133 | 3.38 |
| | | | XS | 80 | 0.179 | 4.55 |
| 1-1/4 | 1.660 | 42.16 | STD | 40 | 0.140 | 3.56 |
| | | | XS | 80 | 0.191 | 4.85 |
| 1-1/2 | 1.900 | 48.26 | STD | 40 | 0.145 | 3.68 |
| | | | XS | 80 | 0.200 | 5.08 |
| 2 | 2.375 | 60.33 | STD | 40 | 0.154 | 3.91 |
| | | | XS | 80 | 0.218 | 5.54 |
| 2-1/2 | 2.875 | 73.03 | STD | 40 | 0.203 | 5.16 |
| | | | XS | 80 | 0.276 | 7.01 |

NOTE – The dimensions referred to in this table are taken from The Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10M.

6.3 All openings in a container shall be safeguarded by internal valves, or positive shutoff valves and either automatic excess-flow valves, or back-pressure check valves, except for the following:

a) Plugged openings,

b) Safety-relief valve connections,

c) Liquid-level gauge connections as specified,

d) Pressure gauge connections as specified,

e) Service-line shutoff valve connections, as specified,

f) Multiple-head unit connections if the proper safeguards are incorporated at each opening in the head assembly, and

g) Double backflow check filler valves.

6.4 A container shall not be constructed with more than two plugged openings. Such openings shall be not larger than 2-inch nominal pipe size and shall be closed by steel pipe plugs before the container assembly is shipped.

6.5 An opening in a container for connection of a valve or other accessory, except for a bolt-on type of liquid-level gauge connection, shall be threaded in accordance with the Standard for Pipe Threads, General Purpose, ANSI/ASME B1.20.1.

6.6 Conformance to 6.5 may be provided by a joint of other design if equivalent in strength and resistance to leakage.

6.7 A riser pipe shall be equivalent in strength to Schedule 80 pipe (Table 6.2), and shall be welded directly to the container.

6.8 Each container shall be provided with lifting lugs which will support the empty weight of the container plus 5 percent liquid volume.

6.9 A container for aboveground or interchangeable installation shall be constructed with ferrous metal supports for mounting on a foundation. The bottom of such supports shall be not less than 2 inches (51 mm) nor more than 24 inches (610 mm) below the outside bottom of the container shell.

6.10 The supports shall be drilled or be otherwise arranged to permit anchoring by screws or bolts.

6.11 The supporting base or legs of a spherical aboveground container shall terminate on a diameter of not less than 50 percent of the container diameter. A cylindrical base shall permit ventilation beneath the container. Ventilation passages shall be equivalent to at least four equally spaced 1-inch (25.4-mm) diameter holes.

6.12 A container designed for underground or interchangeable installation and constructed of uncoated metal shall incorporate provisions for cathodic protection and shall be coated with a material recommended for the service that is applied in accordance with the coating manufacturer's instructions.

## 7 Protective Housings

7.1 A container assembly shall be provided with a sheet-metal housing for protection of the valves, regulator, and other parts. The housing shall be secured to the container before shipment unless the accessories are protected from damage during transit by other means.

7.2 Sheet metal used in construction of a housing for an underground or interchangeable container shall be equivalent in strength to 0.053 inch (1.35 mm) minimum thickness sheet steel for the body, and 0.067 inch (1.70 mm) minimum thickness for the cover.

7.3 Sheet metal used in the construction of a housing for an aboveground container shall be equivalent in strength to 0.042 inch (1.07 mm) minimum thickness sheet metal.

7.4 A housing on an interchangeable and on an underground container shall be provided with a cover hinged to the body. A one-piece housing permitted on aboveground containers only shall be hinged in place.

7.5 A hinged housing or a housing cover shall be provided.

7.6 An underground or an interchangeable container housing cover shall be provided with ventilation openings, the area of such openings equaling or exceeding the combined discharge areas of the safety-relief valve and other vents which discharge their contents into the housing.

7.7 A housing for an aboveground or for an interchangeable container having a water capacity greater than 125 gallons (0.47 $m^3$) shall be designed to permit venting of the relief valve in accordance with 8.10 and 8.11.

## 8 Safety-Relief Valves

8.1 A container shall be provided with one or more spring-loaded safety-relief valves to safeguard against excessive pressure.

8.2 A safety-relief valve shall be set as indicated in Table 8.1 with relation to the minimum design pressure of the container.

## Table 8.1
## Safety-relief valve pressure setting

| Minimum design pressure of container, | | Set pressure, | |
|---|---|---|---|
| psig | (kPa) | psig | (kPa) |
| 100 | 689 | 100 | 689 |
| 125 | 862 | 125 | 862 |
| 156 | 1076 | 156 | 1076 |
| 187 | 1289 | 187 | 1289 |
| 219 | 1510 | 219 | 1510 |
| 250 | 1724 | 250 | 1724 |

8.3 For an aboveground or for an interchangeable container the air-discharge capacity of a safety-relief valve shall be not less than that specified in Table 8.2, based on the total outside surface area of the container in square feet ($m^2$).



## Table 8.2
## Safety relief valve discharge rate or capacity

| Minimum required safety-relief valve discharge rate for container assemblies in cubic feet per minute of air at 120 percent of the maximum permitted set pressure. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface area square feet[a] | (Square meters) | Flow rate, cubic feet per minute, air[b,c] | (Cubic meters per second) | Surface area, square feet[a] | (Square meters) | Flow rate, cubic feet per minute, air[b,c] | (Cubic meters per second) |
| 20 or less | 1.8 | 626 | 0.3 | 170 | 15.8 | 3620 | 1.7 |
| 25 | 2.3 | 751 | 0.3 | 175 | 16.2 | 3700 | 1.7 |
| 30 | 2.8 | 872 | 0.4 | 180 | 16.7 | 3790 | 1.8 |
| 35 | 3.2 | 990 | 0.5 | 185 | 17.2 | 3880 | 1.8 |
| 40 | 3.7 | 1100 | 0.5 | 190 | 17.6 | 3960 | 1.9 |
| 45 | 4.2 | 1220 | 0.6 | 195 | 18.1 | 4050 | 1.9 |
| 50 | 4.6 | 1330 | 0.6 | 200 | 18.6 | 4130 | 1.9 |
| 55 | 5.1 | 1430 | 0.7 | 210 | 19.5 | 4300 | 2.0 |
| 60 | 5.6 | 1540 | 0.7 | 220 | 20.4 | 4470 | 2.1 |
| 65 | 6.0 | 1640 | 0.8 | 230 | 21.4 | 4630 | 2.2 |
| 70 | 6.5 | 1750 | 0.8 | 240 | 22.3 | 4800 | 2.3 |
| 75 | 7.0 | 1850 | 0.9 | 250 | 23.2 | 4960 | 2.3 |
| 80 | 7.4 | 1950 | 0.9 | 260 | 24.1 | 5130 | 2.4 |
| 85 | 7.9 | 2050 | 1.0 | 270 | 25.1 | 5290 | 2.5 |
| 90 | 8.4 | 2150 | 1.0 | 280 | 26.0 | 5450 | 2.6 |
| 95 | 8.8 | 2240 | 1.0 | 290 | 26.9 | 5610 | 2.6 |
| 100 | 9.3 | 2340 | 1.1 | 300 | 27.9 | 5760 | 2.7 |
| 105 | 9.7 | 2440 | 1.1 | 310 | 28.8 | 5920 | 2.8 |
| 110 | 10.2 | 2530 | 1.2 | 320 | 29.7 | 6080 | 2.9 |
| 115 | 10.7 | 2630 | 1.2 | 330 | 30.6 | 6230 | 2.9 |
| 120 | 11.1 | 2720 | 1.3 | 340 | 31.6 | 6390 | 3.0 |
| 125 | 11.6 | 2810 | 1.3 | 350 | 32.5 | 6540 | 3.1 |
| 130 | 12.1 | 2900 | 1.4 | 360 | 33.4 | 6690 | 3.1 |
| 135 | 12.5 | 2990 | 1.4 | 370 | 34.4 | 6840 | 3.2 |

Table 8.2 Continued on Next Page

**Table 8.2 Continued**

| Minimum required safety-relief valve discharge rate for container assemblies in cubic feet per minute of air at 120 percent of the maximum permitted set pressure. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Surface area square feet[a] | (Square meters) | Flow rate, cubic feet per minute, air[b,c] | (Cubic meters per second) | Surface area, square feet[a] | (Square meters) | Flow rate, cubic feet per minute, air[b,c] | (Cubic meters per second) |
| 140 | 13.0 | 3080 | 1.4 | 380 | 35.3 | 7000 | 3.3 |
| 145 | 13.5 | 3170 | 1.5 | 390 | 36.2 | 7150 | 3.4 |
| 150 | 13.9 | 3260 | 1.5 | 400 | 37.2 | 7300 | 3.4 |
| 155 | 14.4 | 3350 | 1.6 | 450 | 41.9 | 8040 | 3.8 |
| 160 | 14.8 | 3440 | 1.6 | 500 | 46.4 | 8760 | 4.1 |
| 165 | 15.3 | 3530 | 1.7 | | | | |

[a]

1. Surface area-total outside surface area of container in square feet, can be calculated as follows:

a) Cylindrical container with hemispheric heads.
Area = Overall length × outside diameter × 3.1416.

b) Cylindrical container with other than hemispheric heads.
Area = (Overall length + 0.3 outside diameter) × outside diameter × 3.1416.

c) Spherical container.
Area = Outside diameter squared × 3.1416.

2. Square feet ($ft^2$) × 0.0929 = square meters ($m^2$).

[b]

1. Flow rate cubic feet per minute of air = cubic feet of air required at standard conditions 15.6°C (60°F) and pressure of 14.7 pounds per square inch absolute.

2. Cubic feet per minute ($ft^3$/minute) × 0.000472 = cubic meters per second ($m^3$/s).

[c] The rate of safety-relief valve discharge may be interpolated for intermediate values of surface area.



8.4 For an underground container the air-discharge capacity of a safety-relief valve may be reduced to not less than 30 percent of that specified in Table 8.2, based on the total outside surface area of the container in square feet ($m^2$).

8.5 A safety-relief valve shall have direct communication with the vapor space of the container. No shutoff valve shall be installed between the container and the safety-relief valve.

8.6 If a safety-relief valve is:

a) Installed in a multiple-head unit or manifold other than that with which the valve was flow-tested and rated;

b) Used with a vapor tube;

c) Mounted in a fitting in such manner as to introduce restriction to flow ahead of the valve inlet; or

d) Mounted so that the flow is restricted on the discharge side by the use of vent piping or fittings;

The assigned flow rate does not apply and it is necessary to conduct flow tests under such conditions of installation to determine if the discharge rate of the valve is still adequate for the application consistent with Table 8.2.

8.7 A safety-relief valve for an underground or for an interchangeable container assembly shall be protected against physical damage by locating it within the protective housing.

8.8 A safety-relief valve for an aboveground container, except as indicated in 8.9, shall be protected against physical damage by locating it within the housing, or by a steel collar surrounding the valve and welded to the container.

8.9 An internal-spring type safety-relief valve is not required to be protected against physical damage if it is located in the top of a horizontal cylindrical aboveground container at least 12 inches (305 mm) from the end of the shell, and if the top of the valve is not more than 3 inches (72 mm) above the container.

8.10 On an aboveground or on an interchangeable container having a water capacity of 125 gallons (0.47 $m^3$) or more, the discharge from a safety-relief valve shall be vented vertically upward and unobstructed to the open air to prevent impingement of escaping gas on the container. If a valve is located within the housing, it shall be piped, or otherwise vented directly to the outside. Vent pipes or extensions shall terminate above the top of the housing.

8.11 A safety-relief valve vent opening in the top of a housing of an aboveground or of an interchangeable container assembly shall have a diameter not less than the outside diameter of the discharge end of the valve or vent pipe, and the opening shall be centered with relation to the valve.

8.12 A loose-fitting rain cap designed to prevent the entrance of rain, snow, or sleet, and its displacement and possible loss, shall be provided as part of:

a) A safety-relief valve located outside of a housing;

b) A safety-relief valve located within a housing with a vent pipe terminating outside of the housing, and

c) A safety-relief valve located within a housing, and not provided with a vent pipe, for a container having a water capacity of less than 125 gallons (0.47 $m^3$).

## 9 Excess-Flow Valves

9.1 An excess-flow check valve in combination with a vapor-return valve shall operate at a pressure differential of not more than 20 pounds per square inch gauge (psig) (138 kPa). All other excess-flow valves shall operate at a pressure differential of not more than 15 psig (103 kPa).

## 10 Liquid-Level Gauging Devices

10.1 A container assembly shall be provided with a fixed liquid-level gauging device to indicate the maximum permissible filling level of the container during a filling operation. A variable type liquid-level gauge may be provided in addition to the fixed-tube type.

10.2 The dip tube of a fixed-tube type gauge shall be of such length that it indicates the maximum level to which a container can be filled at a temperature of 40° F (4° C) for an aboveground or for an interchangeable container, and 50° F (10° C) for an underground container, based on the maximum permitted filling density.

10.3 For gauges where the tube is not welded in place, a permanent marking shall be provided adjacent to the fixed-tube type gauge or on the container nameplate, consisting of the following: Letters "DT" followed by the vertical distance expressed in inches and carried to one decimal place (or in whole mm) measured from the top center of the container boss or coupling into which the gauge is installed, to the maximum permitted filling level.

10.4 The "percentage full" that will be indicated by the fixed-tube type gauge shall be included as a permanent marking attached to the container adjacent to the gauge, or on the container nameplate.

10.5 Variable liquid level gauges shall be so marked that the maximum liquid level, in inches or percent of capacity of the container in which they are to be installed, is readily determinable. These markings shall indicate the maximum liquid level for propane, for 50 – 50 butane-propane mixture, and for butane at liquid temperatures from 20 – 130°F (minus 7 – 54°C) in increments not greater than 20°F (11°C).

10.6 A float or a rotary-type gauge shall be marked to indicate whether it is designed for a cylindrical or a spherical container, and whether for aboveground or underground service.

10.7 A float or a rotary-type liquid level gauge for use with an interchangeable container shall be of the type suitable for use on an aboveground container.

10.8 A dial of a magnetic float or of a rotary tube-type gauge for use only on aboveground containers of over 1200 gallons (4.54 $m^3$) water capacity shall be so marked.

10.9 A gauging device that requires bleeding of the product to the atmosphere, such as a rotary-tube, fixed-tube, or slip-tube type, shall be so designed that the bleed opening of the bleed valve is not larger than a No. 54 drill size (0.055 inch) (1.40 mm).

## 11 Filler Valves and Vapor-Return Valves

11.1 A container assembly shall be provided with a double backflow check filler valve. This valve is required, but is not prohibited from being a part of a multipurpose valve.

11.2 A filler valve shall be arranged to permit filling into the vapor space.

11.3 A vapor-return connection shall be constructed with an internal back-pressure check valve and an excess-flow valve, or with a positive manual shutoff valve and an internal excess-flow valve.

11.4 A filler connection and a vapor-return connection shall be provided with a threaded cap or plug designed to provide a gas-tight closure when the valve is not in use.

## 12 Service Line Shutoff Valves

12.1 A service line outlet of a container assembly shall be controlled by a manually operated shutoff valve with an attached handwheel.

12.2 A service line shutoff valve shall be connected directly into the service outlet in the container, or directly into a fitting, such as a multiple-head unit, which in turn is mounted on the container, unless it is an integral part of the head unit.

12.3 Unless the shutoff valve is provided with an excess-flow check valve, the controlling orifice in the valve shall not exceed 5/16 inch (7.9 mm) in diameter for vapor withdrawal.

## 13 Regulators

13.1 A container assembly shall be equipped with a mounting bracket or equivalent means for mounting of a regulator.