UL 2227

STANDARD FOR SAFETY

Overfilling Prevention Devices

UL Standard for Safety for Overfilling Prevention Devices, UL 2227

Second Edition, Dated February 16, 2007

Summary of Topics

This revision of ANSI/UL 2227 dated November 12, 2019 includes revising the Moist Ammonia Test with respect to brass containing parts.

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

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UL 2227

Standard for Overfilling Prevention Devices

First Edition – November, 1999

Second Edition

February 16, 2007

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

The most recent designation of ANSI/UL 2227 as an American National Standard (ANSI) occurred on November 12, 2019. ANSI approval for a standard does not include the Cover Page, Transmittal Pages, and Title Page.

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 devices for use on stationary containers or portable LP-Gas containers that consist of a shutoff mechanism that works in conjunction with a liquid level sensing device that shuts off the incoming flow of LP-Gas during a refilling operation when the liquid level reaches a predetermined point. The sensing mechanism may be a float, dip tube, or other type of sensor that is intended to cause operation of the shutoff mechanism. An overfilling prevention device may be a separate component intended for installation on cylinder or fill valves designed for such purposes, or may be incorporated into the design of a cylinder or fill valve assembly. Overfilling prevention devices may be designed for use in automotive applications.

1.2 Overfilling prevention devices covered by these requirements are for use in applications covered by the following standards:

a) Liquefied Petroleum Gas Code, NFPA No. 58.

b) Outdoor Cooking Gas Appliances, ANSI Z21.58/CGA 1.6-M95.

c) Standard on Recreational Vehicles, RVIA A119.2.

2 General

2.1 Components

2.1.1 Except as indicated in 2.1.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.1.2 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.

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

2.1.4 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.

2.2 Undated references

2.2.1 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.

2.3 Units of measurement

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

3 Service Pressure Rating

3.1 The service pressure rating shall not be less than 250 psig (1.7 MPa) for ASME pressure vessels and 240 psig (1.7 MPa) for cylinders.

3.2 The devices covered by these requirements are intended for use at temperatures within the range of minus 40 to plus 130°F (minus 40 to plus 55°C).

4 Glossary

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

4.2 CONTAINER – A pressure vessel including cylinders, tanks, and portable tanks used for transporting or storing of LP-Gas.

4.3 CYLINDER – A portable container that complies with the specification for cylinders constructed under subpart C of Part 178 of the DOT Regulations and similar specifications of the TC regulations.

4.4 PRESSURE CONFINING COMPONENTS – Components of an overfilling prevention device that prevent the release of LP-Gas to the atmosphere from the container.

CONSTRUCTION

5 General

5.1 An overfilling prevention device shall include all of the components required for its normal function and installation, and shall be furnished as a single unit or as part of a valve/OPD assembly.

5.2 When an overfilling prevention device is of a design which requires the use of special pipe flanges, gaskets, bolts, or other special fittings or parts for making a proper installation, such parts shall be furnished by the manufacturer with each overfilling prevention device.

5.3 A seat disc shall be attached to its poppet or holder, or be otherwise assembled so as to prevent it from becoming dislocated under service conditions. The means to secure the disc shall not rely on cement or adhesive.

5.4 A brazing material used for joining pressure confining components of an overfilling prevention device for LP-Gas shall have a melting point (solidus temperature) not less than 1000°F (538°C).

5.5 Pipe threads shall be in accordance with the Standard for Pipe Threads, General Purpose (Inch), ANSI/ASME B1.20.1, FED-STD-H28/7, Screw-Thread Standards for Federal Services, Section 7, Pipe Threads, General Purpose, or FED-STD-H28/8 Screw-Thread Standards for Federal Services, Section 8, Dryseal Pipe Threads.

5.6 An overfilling prevention device intended for installation on a cylinder valve shall be provided only on such valves for which it is designed. This assembly shall be constructed and marked in accordance with the Standard for Cylinder Valves, UL 1769.

5.7 An overfilling prevention device which is incorporated into the design of a cylinder valve shall also comply with the Standard for Cylinder Valves, UL 1769.

5.8 Filler valves used in the assembly of overfill prevention devices shall comply with the Standard for Valves for Anhydrous Ammonia and LP-Gas (Other than Safety Relief), UL 125.

5.9 An automotive overfilling prevention device that is provided with threads for direct connection to a filler valve shall have sufficient strength and durability to prevent the filler valve from separating from the liquid level control valve body. See the Breakoff Test, Section 21.

5.10 A float shall be secured to its corresponding lever, rod, or other part of the mechanism by a method that prevents the float from becoming detached under service conditions. See the Float Pull Test, Section 20.

5.11 A float-operated liquid level control valve shall be provided with a means to maintain proper float orientation during the life of the device.

5.12 The operating parts of an automotive overfilling prevention device shall be protected against freezing rain, road dirt, salt and other foreign matter. The protective means shall not rely on cement or adhesives for securement.

5.13 An OPD design shall be such that liquid propane cannot be withdrawn from the cylinder with propane temperature starting at 40°F and rising to 85°F. This shall be demonstrated by design calculation for each OPD design for each size and design of cylinder for which the OPD may be used, using the lowest potential liquid propane pickup point on the OPD and then comparing it to propane liquid level at 85° F starting from the 83 percent fill at 40° F or submit product for testing as defined in the Liquid Withdrawal Test, Section 13.

6 Materials

6.1 Pressure-confining components of an overfilling prevention device or operating parts, when failure of the part allows leakage or hazardous operation, shall have sufficient strength and durability to furnish reliable service of the parts and of the assembly.

6.2 To conform to the requirement of 6.1, a material (except a disc or soft seat, a seal ring, a diaphragm, or a gasket) is to have a melting point (solidus temperature) of not less than 950°F (510°C) and a tensile strength of not less than 10,000 psig (68.9 MPa) at 400°F (204°C).

6.3 Nonductile cast iron (regular gray iron) shall not be used for bodies or closures for overfilling prevention devices. This does not prohibit the use of nodular iron.

6.4 A part in contact with the liquid to be handled shall be resistant to the action of such liquid.

6.5 With reference to the requirement in 6.4, elastomeric materials shall be subjected to:

a) The Accelerated Aging Test, Section 23;

b) The LP-Gas Compatibility Test, Section 24; and

c) The Low Temperature Test, Section 26.

Polymeric materials shall be subjected to the Accelerated Aging Test, Section 23, and the LP-Gas Compatibility Test, Section 24.

Exception: Acetal polymers, chlorotrifluorethylene polymers, tetrafluorethylene, fluorinated ethylene propylene polymers and polyamides of composition polyhexamethylene adipamide or polycaproamide polymers (nylon 6, 6/6 or 6/16) shall only be subjected to the Accelerated Aging Test, Section 23.

6.6 When corrosion of a part interferes with the proper function of an overfilling prevention device, the part shall be of a corrosion-resistant material or be provided with a corrosion-resistant protective coating.

6.7 A protective coating shall provide resistance against corrosion to a degree not less than that provided by the protective coatings specified in 6.8.

6.8 Cadmium plating shall have a thickness of not less than 0.0003 inch (0.008 mm), and zinc plating shall have a thickness of not less than 0.0005 inch (0.013 mm), except on parts where threads constitute the major portion of the area, in which case the thickness of the cadmium or zinc plating shall not be less than 0.00015 inch (0.0038 mm).

6.9 When warping of a casting affects the tightness of liquid-confining joints or the necessary fit of parts, the casting shall be stress relieved to reduce to a minimum the possibility of warping.

6.10 A part made of drawn brass or machined from a brass rod incorporating internal threads made of a copper alloy containing more than 15 percent zinc shall be capable of withstanding, without cracking, the Moist Ammonia Test, Section 22.

6.11 Nonmetallic float materials shall be resistant to the action of commercial propane when tested in accordance with the Commercial Propane Compatibility Test, Section 25.

7 Springs

7.1 A spring shall be guided and arranged to minimize binding, buckling, or other interference with its free movement. When required, ends of a spring shall be closed and squared. Springs shall be constructed of corrosion resistant materials (e.g., stainless steel, plated, etc.).

PERFORMANCE

8 General

8.1 Unless specifically noted otherwise, three representative samples of each size and type of overfilling prevention device are to be subjected to the tests described in these requirements. Additional samples of parts constructed of nonmetallic materials, such as seal materials and seat discs, are required for physical and chemical tests.

8.2 Unless otherwise specified, leakage tests are to use a source of aerostatic pressure such as air or nitrogen.

8.3 Water, or another liquid, is suitable for developing the required pressure in a hydrostatic pressure test.

8.4 All leakage and hydrostatic pressure strength tests are to be maintained for at least 1 minute.

8.5 Unless otherwise specified, all tests are to be performed at room temperature [nominal 70°F (21.1°C) ±10°F (5°C)].

8.6 LP-Gas used in the Operation Test, Section 12, shall be commercial propane having a minimum propane content of 85 percent by volume.

9 Deformation Test

9.1 Threaded joints, when used in pressure-confining components in an overfilling prevention device, shall not leak, and there shall be no evidence of loosening of joints, distortion, or other damage resulting from the stress imposed on female pipe-threaded sections when tested in accordance with these requirements.

9.2 The sample used in this test is to be rigidly anchored or otherwise supported. A length of Schedule 80 pipe is to be connected to each female pipe threaded section of the body, the male threads having first been lubricated with SAE No. 10 machine oil. Each pipe is then to be tightened to the torque specified in Table 9.1.

9.3 After the torque has been applied to each connected pipe, the test sample is to be subjected to the External Leakage Test, Section 10. When leakage is noted at the threaded joint between the pipe and the body, the joint is to be remade using a pipe joint sealing compound and the sample retested for external leakage.

Table 9.1
Torque requirements for pipe connections

Nominal pipe size, inches	Torque,	
	Pound-inches	N·m
1/8	150	17
1/4	250	28
3/8	450	51
1/2	800	90
3/4	1000	113
1	1200	136
1-1/4	1450	164
1-1/2	1550	175
2	1650	186
2-1/2	1750	198
3	1800	203
4	1900	214

9.4 Upon removal of the pipe from the test sample, the assembly is to be examined for loosening of body joints.

10 External Leakage Test

10.1 There shall be no external leakage of pressure-confining components or parts of the device which, in the event of failure, would allow external leakage.

10.2 Each sample is subjected to aerostatic pressure between 0 and 375 psig (0 and 2.6 MPa), or 0 and 1-1/2 times the maximum rated pressure, whichever is greater, applied to that portion of the device which, in the event of failure, would allow external leakage. All other openings or portions of the valve are closed. When the pressure-confining components used on the device are provided with pipe threaded joints, the Deformation Test, Section 9, shall be conducted prior to this test.

10.3 During this test, the sample is to be connected to a source of aerostatic pressure. A positive shutoff valve and a suitable pressure measurement instrument are to be installed in the pressure supply piping. The pressure gauge is to be installed between the shutoff valve and the sample under test. While under the applied test pressure, the sample is to be submerged in water to detect leakage, or all joints and body casting surfaces are to be leak tested with soap and water or another leak detection solution or any other equally sensitive method.

11 Seat Leakage Test

11.1 The following tests for seat leakage of the overfilling prevention device are to be conducted on samples which have previously been subjected to the Deformation Test, Section 9, and the External Leakage Test, Section 10, as applicable.

11.2 Water at any pressure to generate flow shall be applied to the normal inlet of the device and the liquid sensing mechanism is to be mechanically or otherwise operated so that the shutoff mechanism closes. The water pressure is increased after the mechanism has closed to 75 psig (0.5 MPa). A determination is to be made regarding whether the seat closes completely or the design is such as to allow aerostatic leakage. The maximum leakage rate of the device shall not exceed a water leakage flow rate of 101 ml/minute. The test is to be repeated at a pressure after closure of 150 psig (1.03 MPa). The maximum leakage rate of the device shall not exceed a water leakage flow rate of 202 ml/minute.

11.3 Seat leakage tests are conducted with the inlet of the sample connected to a source of pressurized water, the overfilling prevention device in the closed position, and with the outlet open. A positive shutoff valve and a suitable pressure measurement instrument are to be installed in the pressure supply piping. The pressure gauge is to be installed between the shutoff valve and the sample under test.

11.4 The leakage rate is to be determined by collecting the water that has leaked through the device into a graduated cylinder. The test period shall be at least two minutes and the time of the test shall be recorded. The flow rate shall be measured in milliliters per minute of water.

11.5 Instead of the method described in 11.4, it is not prohibited that leakage be measured by a flowmeter installed on the inlet side of the overfilling prevention device under test. The flowmeter shall be capable of indicating – with an accuracy of at least 3 percent – the maximum leakage flow rates.

12 Operation Test

12.1 An overfilling prevention device shall control the amount of propane filled within the percent of the volume of the container as noted in (a) or (b) below, when tested as described in 12.2 – 12.4.

a) 77 – 83 percent for DOT cylinders and stationary ASME containers.

b) 70 – 80 percent for ASME containers used only for engine fuel or mobile service.

c) Deleted

12.2 Three samples of the overfilling prevention device are to be installed on valves as recommended by the manufacturer, as appropriate, and are to be individually installed into a representative DOT container as intended in service or ASME container as noted in Table 12.1 and connected to a fuel transfer valve. LP-Gas shall be allowed to flow into the container through each sample until the overfilling prevention device functions.

Table 12.1
Container test size

Size of Container on which OPD is Used	Container Type and Size for Test
ASME stationary container	Smallest size to be used
ASME containers used only for engine fuel or mobile service	Smallest size to be used

12.3 Two trials are to be conducted at an approximate pump differential pressure of 75 ±5 psig (0.5 ±0.03 MPa). At the end of each trial, the weight of liquid shall be determined and recorded. This shall be done by

weighing the filled container and subtracting the empty weight of the container. The transfer tank's fluid temperature during this test shall be recorded and the specific gravity determined based on this temperature in accordance with the liquid volume correction factor table in the Liquefied Petroleum Gas Code, NFPA 58. All trials for a single sample shall be averaged and the average shall be in accordance with 12.1(a). No single trial shall exceed 85 percent full.

12.4 The percent volume of the liquid in the container shall be calculated by dividing the weight of the liquid by the water capacity of the container divided by the specific gravity of the propane.

13 Liquid Withdrawal Test

13.1 An overfilling prevention device shall not be capable of withdrawing liquid from the cylinder when the temperature of the propane is elevated to 85°F (29.5°C).

13.2 The three samples of the overfilling prevention device each shall be used and installed in a representative container as recommended by the OPD manufacturer. If the OPD design can be used in multiple cylinder sizes and designs, the one cylinder size and design that has the OPD at the lowest vapor withdrawal point is required to be subjected to this test. The cylinders shall be filled at a liquid propane temperature of 40°F until OPD activation. The cylinder shall then be subjected to an 85°F (29.5°C) water bath for a period of 6 hours to assure saturation temperature of the propane. The outlet connection of the cylinder valve shall be coupled to the appliance (female) side of the connection. The cylinder valve shall be opened one half turn and no liquid propane shall be discharged from the cylinder.

14 Positive Shutoff Test

14.1 After the device initially shuts off, it shall not reopen to grant an increase of more than 2 percent when tested as described in 14.2 and 14.3.

Exception: This test is allowed to be conducted using liquid propane at the pressures indicated in 14.2 and 14.3.

14.2 Each sample shall be installed into a simulated container. The device shall be connected to a hydrostatic pressure source and water shall flow into the container at a flowing pressure not greater than 15 psig (101 kPa), until the overfilling prevention device functions. At this point, the pressure to the sample is to be reduced to 0 psig and the weight of water filled is to be determined and recorded. The fill valve may be disconnected or any other equivalent means to reduce the pressure to 0 psig may be used. During this initial step the fixed maximum liquid level gauge (FMLLG) (bleed valve) is to be open during filling but when the OPD sample closes, the FMLLG shall also be closed and remain closed for the remaining steps of the test. The device is then to be subjected to a hydrostatic pressure of 15 psig for a period of 30 seconds. Three trials are to be conducted and the pressure is to be reduced to 0 psig between trials. After the three trials, the weight of liquid is to be determined and compared to the value after the overfilling prevention device initially operated.

14.3 The test is to be repeated at a pressure of 125 psig (862 kPa).

15 Endurance Test

15.1 An overfilling prevention device shall be operative and capable of conforming to the applicable leakage test requirements of Sections 10 and 11 after being subjected to 10,000 cycles of opening and closing.

15.2 One sample that has previously been subjected to the Deformation Test, Section 9, the External Leakage Test, Section 10, and the Seat Leakage Test, Section 11, as applicable, is to be used for this test.

15.3 When the overfilling prevention device incorporates non-metallic parts, the failure of which results in seat leakage or malfunction of the shutoff mechanism such as body seating areas, seats, levers, rods, pins and the like , two samples shall be tested after being conditioned as follows:

a) One sample is to be exposed to n-hexane liquid for a period of 60 days.

b) The second sample is to be exposed to an air-oven aging for 60 days at 189°F (87°C) followed by a 70-hour n-hexane immersion at room temperature.

15.4 The inlet shall be connected to a source of aerostatic pressure maintained at 100 psig (0.7 MPa). The test is to be conducted at a rate not faster than 10 cycles per minute. One cycle consists of the following steps:

a) With the liquid level sensing device in a position so as to open the seat of the shutoff mechanism, aerostatic pressure is allowed to flow through the device.

b) The sensing device is operated so as to activate the shutoff mechanism.

c) At this point the aerostatic pressure is shutoff.

d) The liquid level sensing device is then be operated so as to open the shutoff mechanism.

e) The air pressure will again be allowed to flow through the valve.

15.5 The appropriate tests for leakage, as described under the External Leakage Test, Section 10, and the Seat Leakage Test, Section 11, are to be conducted immediately following this test. When the construction is such to allow for seat leakage, the leakage rate must not increase more than 125 percent of the value previously obtained during the seat leakage test after the endurance test.

16 Vibration Test

16.1 One sample that has been subjected to the Seat Leakage Test, Section 11, shall be operational when tested as specified in 16.2.

16.2 When the overfilling prevention device incorporates non-metallic parts, the failure of which results in leakage or malfunction of the shutoff mechanism such as seats, levers, rods or floats, two samples shall be tested after being conditioned as follows:

a) One sample is to be exposed to n-hexane liquid for a period of 60 days.

b) The second sample is to be exposed to an air-oven aging for 60 days at 189°F (87°C) followed by a 70-hour n-hexane immersion.

16.3 Each sample is to be mounted on a vibration table in a typical operating position. When the device is capable of being installed in more than one position, additional samples are not prohibited from being used to cover all mounting positions. When the overfilling prevention device is intended for non-automotive applications, the sample shall be subjected to a vibration of 1/4-inch displacement at a frequency of 17 hertz for 48 hours. For overfilling prevention devices intended for automotive applications, the sample shall be subjected to a vibration of 1/4-inch displacement at a frequency of 17 hertz for 200 hours.

16.4 The appropriate tests for seat leakage, as described under Seat Leakage Test, Section 11, and Float Pull Test, if appropriate, are to be conducted immediately following this test.

17 Hydrostatic Strength Test

17.1 The device while in the closed position shall be capable of withstanding without rupture a hydrostatic pressure of 625 psig (3.6 MPa).

Exception: For pressure-confining components and any parts of an overfilling prevention device that, in the event of failure, results in external leakage from the container, the test pressure shall be 1250 psig (8.6 MPa) or 5 times the rated service pressure, whichever is the greater.

17.2 Three samples are to be connected to a source of hydrostatic pressure. A positive shutoff valve and a suitable pressure measuring instrument are to be installed in the hydrostatic pressure supply piping. The pressure measuring instrument is to be installed in the piping between the shutoff valve and the sample under test.

18 Surge Pressure Test

18.1 The body shall not rupture when tested as specified in 18.2.

18.2 Water at a pressure of 250 psig (1.7 MPa) is to be applied to the normal inlet of the device and the liquid sensing mechanism is to be mechanically or otherwise operated so that the shutoff mechanism closes. The pressure is then to be reduced to 0 psig. This test is to be conducted 10 times.

19 Float Crush Test

19.1 Two samples of the floats shall withstand an external hydrostatic pressure of 750 psig (5.2 MPa) without damage or distortion when tested as specified in 19.2.

19.2 Each float is to be inserted into a vessel of appropriate size and strength constructed of pipe and pipe fittings. The vessel is to be connected to a source of hydrostatic pressure. A pressure-measuring instrument is to be installed in the pressure supply piping. The vessel is to be completely filled with liquid to expel all air. The pressure is then to be slowly increased to 750 psig (5.2 MPa).

19.3 Following this test, the floats are to be removed from the vessel and examined for evidence of distortion.

20 Float Pull Test

20.1 The means of securement of a float to the lever on a float operated overfilling prevention device shall withstand a longitudinal pull-force of 50 pounds (22 kilograms) when tested as described in 20.2.

20.2 Two samples of the float assembly, one in the as-received condition and one that has been subjected to the Vibration Test, Section 16, are to be tested. If two conditioned samples are subjected to the Vibration Test in accordance with 16.2, both conditioned samples shall be subjected to this test. The lever of the float assembly is to be rigidly anchored and an axial load of 50 pounds (22 kilograms) is to be applied to the float at a rate not in excess of 600 pounds per minute.

21 Breakoff Test

21.1 An automotive overfilling prevention device shall comply with the requirements of the External Leakage Test, Section 10, after being subjected to the test specified in 21.2.

21.2 Three samples are to be used. A filler valve intended for use with the sample shall be installed in accordance with the manufacturer's instructions. A length of pipe attached to a coupling is to be connected