



Underwriters Laboratories Inc.®

An independent, not-for-profit organization testing for public safety

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Revision pages for

Standard for

Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures

UL 1316, Second Edition

Attached to this transmittal notice is a revision of the Second edition of UL 1316.

A CHANGE ON A PAGE DATED APRIL 2, 1996 IS INDICATED BY A SMALL PRINT NOTE FOLLOWING THE AFFECTED ITEM, PRECEDED AND FOLLOWED BY AN ASTERISK.

THIS REVISION IS BEING ISSUED TO PROVIDE EDITORIAL CLARIFICATION OF THE REQUIREMENTS.

THESE REQUIREMENTS ARE NOW IN EFFECT.

Attention is directed to the note on the title page of this standard outlining the procedure to be followed to retain the approved text of ANSI/UL 1316-1993.

Revised and/or additional pages may be issued from time to time.

With the inclusion of the accompanying material, the standard consists of pages dated as shown in the following checklist:

Page	Date
1	January 7, 1994 (Reprinted April 2, 1996)
2	—
3, 4	January 7, 1994
5 – 7	April 2, 1996
8	January 7, 1994
9 – 13	April 2, 1996
14	January 7, 1994
15, 16	April 2, 1996

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UL 1316

Standard for

**Glass-Fiber-Reinforced Plastic Underground
Storage Tanks for Petroleum Products, Alcohols, and
Alcohol-Gasoline Mixtures**

The First edition was titled Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products.

First Edition – July 1, 1983

Second Edition

January 7, 1994

Approval as an American National Standard (ANSI) covers the numbered paragraphs on pages dated January 7, 1994. These pages should not be discarded when revised or additional pages are issued if it is desired to retain the ANSI approved text.

An effective date included as a note immediately following certain requirements is one established by Underwriters Laboratories Inc.

Approved as ANSI/UL 1316-1986, February 28, 1986
Approved as ANSI/UL 1316-1993, August 18, 1993

Revisions of this standard will be made by issuing revised or additional pages bearing their date of issue. A UL Standard is current only if it incorporates the most recently adopted revisions, all of which are itemized on the transmittal notice that accompanies the latest published set of revision pages.

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INTRODUCTION

1 Scope

1.1 These requirements cover spherical or horizontal cylindrical, atmospheric-type tanks of glass-fiber-reinforced plastic (FRP) that are intended for the underground storage of petroleum-based flammable and combustible liquids, alcohols, and alcohol-blended fuels.

1.2 These requirements cover tanks of either single- or double-wall construction. A double-wall tank is a tank within a tank, capable of being provided with means to detect a leak in either tank.

1.3 These tanks are completely assembled and tested for leakage before shipment.

1.4 These tanks are intended for installation and use in accordance with the Standard for the Installation of Oil-Burning Equipment, NFPA 31, the Flammable and Combustible Liquids Code, NFPA 30; and the manufacturer's instructions.

1.5 These requirements do not cover optional accessories for these tanks, such as heating coils or hotwells; nor do they cover compartmented tanks.

1.6 A product that contains features, characteristics, components, materials, or systems new or different from those covered by the requirements in this standard, and that involves a risk of fire, electric shock, or injury to persons shall be evaluated using the appropriate additional component and end-product requirements as determined necessary to maintain the acceptable level of safety as originally anticipated by the intent of this standard. A product whose features, characteristics, components, materials, or systems conflict with specific requirements or provisions of this standard cannot be judged to comply with this standard. Where considered appropriate, revision of requirements shall be proposed and adopted in conformance with the methods employed for development, revision, and implementation of this standard.

1.6 revised April 2, 1996

2 General

2.1 Units of measurement

2.1.1 When a value for measurement is followed by a value in other units in parentheses, the second unit is only approximate. The first stated value is the requirement.

2.1.1 revised April 2, 1996

2.2 Components

2.2.1 Except as indicated in 2.2.2, a component of a product covered by this standard shall comply with the requirements for that component.

2.2.2 A component of a product covered by this standard shall comply with the requirements for that component and shall be used in accordance with its approved rating and other limitations of use. 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 a product covered by this standard, or
- b) Is superseded by a requirement in this standard.

2.2.2 revised April 2, 1996

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

2.2.4 Specific components are approved as being 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 for which they have been approved.

2.2.4 revised April 2, 1996

2.3 Undated references

2.3.1 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.

CONSTRUCTION

3 General

3.1 A tank shall be provided with one or more lugs for lifting that are attached to the tank or can be attached to a fitting on the tank. Also, see Strength of Lifting Fittings Tests, Section 10.

3.2 A tank shall be capable of being anchored.

4 Pipe Connections

4.1 A fitting for pipe connection shall be a standard threaded pipe coupling (see the Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10-1985), a threaded flange, a standard half pipe nipple, or a bolted and gasketed flanged connection. The connection shall be bonded directly to the tank.

4.2 All openings in a tank shall be located in the top. They shall be located on the longitudinal centerline of the top when the tank is cylindrical. When the tank is spherical, the openings shall be located on the vertical centerline of the tank.

Exception: When the application of a tank is such that openings in the top for pipe connection are required to be grouped, the openings shall be located not more than 12 inches (305 mm) from the longitudinal centerline of the top of a cylindrical tank or the vertical centerline of a spherical tank. This exception applies when the upper end of each pipe coupling or other fitting for pipe connection terminates above the top of the shell.

4.2 revised April 2, 1996

4.3 An opening in a tank shall be closed with a wooden plug, metal cover, or the equivalent, to protect the threads or flange face and exclude foreign matter while the tank is in storage or in transit.

4.4 A tank shall have a fitting of a size not less than that specified in Table 4.1 for attachment of a vent pipe.

4.5 An opening for connection of a vent pipe in a manhole cover shall be grouped with at least one other opening.

Table 4.1
Size of vent-pipe fitting

Tank capacity		Nominal pipe size, Inches ^a
U.S. gallons	Liters	
0 – 500	0 – 1,893	1-1/4
501 – 3,000	1,896 – 11,356	1-1/2
3,001 – 10,000	11,360 – 37,854	2
10,001 – 20,000	37,858 – 75,708	2-1/2
20,001 – 35,000	75,712 – 132,489	3
35,001 – 50,000	132,493 – 189,270	4

^aNominal pipe size specifications are in accordance with the Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10-1985.

5 Manholes

5.1 A manhole, when provided in a tank, shall be located above the highest normal liquid level and shall be of the bolted-cover type.

5.1 revised April 2, 1996

5.2 A manhole-cover joint shall be provided with a gasket at least 1/8 inch (3.2 mm) thick of material approved for use with the liquid to be stored.

5.2 revised April 2, 1996

6 Deflection Plates

6.1 A tank shall have a deflection plate of steel at least 0.053 inch (1.35 mm) thick or aluminum at least 1/8 inch (3.2 mm) thick. The deflector plate shall be at least 9 inches (229 mm) wide, and at least 1 square foot (0.009 m²) in area under:

- a) Each opening, or
- b) One opening that is marked as specified in 20.5.

PERFORMANCE

7 General

7.1 One sample of a tank is to be subjected to each of the tests described in Sections 8 – 13. However, the same sample is not required to be subjected to all tests. Each diameter of a line of cylindrical tanks shall be investigated. When a manufacturer produces a line of cylindrical tanks that differ only in shell length, the longest tank shall be tested as representative of the entire line. For a line of spherical tanks that differ only in diameter, only the largest diameter tank is required to be tested.

7.1 revised April 2, 1996

7.2 For a double-wall tank, tests are first to be conducted on the primary containment (inner) tank. Upon successful completion of the tests, the complete tank assembly shall be subjected to the following tests:

- a) The Water-Load Test, Section 11, conducted with the annulus empty, followed by the Leakage Test, Section 8;
- b) The Strength of Lifting Fittings Tests, Section 10;
- c) The Internal Pressure Test, Section 13, first with the inner tank at test pressure and the annulus vented to the atmosphere, and then with both the inner tank and the annulus at test pressure;
- d) The Annulus Proof-Pressure Test, Section 16.

8 Leakage Test

8.1 A tank, including fittings, shall be tested as described in 8.2 and shall not leak.

8.2 The tank is to be pressurized for 5 minutes to the applicable value specified in Table 8.1, and the entire surface is to be brushed or sprayed with a leak-detection fluid. Continuous formation of bubbles at any location on the tank surface is evidence of leakage.

Table 8.1
Leakage-test pressure

Maximum diameter of tank feet (m)	Applied pressure Psi (kPa)
10 (3.0 or less)	5 (34)
More than 10	3 (21)

9 Strength of Pipe Fittings Tests

9.1 Torque

9.1.1 A length of pipe shall be threaded into a fitting for pipe connection and shall be tightened to the torque specified in Table 9.1. The fitting shall not crack or split and the threads shall not strip.

Table 9.1
Torques on pipe fittings

Nominal pipe size Inches ^a	Torques, pounds-inches (N·m)	
3/4	2000	(226)
1	2400	(271)
1-1/4	2900	(328)
1-1/2	3100	(350)
2	3300	(373)
2-1/2	3500	(395)
3	3600	(407)
3-1/2	3700	(418)
4	3800	(429)
6	4200	(475)
8	4600	(520)

^aNominal pipe size specifications are in accordance with the Standard for Welded and Seamless Wrought Steel Pipe, ANSI/ASME B36.10-1985.

Table 9.1 revised April 2, 1996

9.2 Bending moment

9.2.1 The bond between a fitting for pipe connection and the tank shall not be damaged as a result of being subjected to a bending moment as described in 9.2.2.

9.2.2 A 4-foot (1.2-m) length of Schedule 40 steel pipe is to be threaded into the fitting. A force is then to be applied to the top of the pipe. For a cylindrical tank, the force is first to be applied parallel to the longitudinal axis of the tank, and then transverse to the longitudinal axis of the tank. For a spherical tank, the force is first to be applied in any one direction and then perpendicular to the direction in which the force was first applied. The applied force is to be increased so that the bending moment is increased from zero to 2000 pound-feet (2712 N·m) in 250 pound-feet (339 N·m) increments. If the Schedule 40 pipe bends before the required bending moment is reached, the test is to be stopped and the fitting is to be examined for compliance with the requirements specified in 9.2.1.

9.3 Leakage

9.3.1 After each of the tests specified in 9.1.1 and 9.2.1, the tank is to be subjected to the Leakage Test, Section 8.

10 Strength of Lifting Fittings Tests

10.1 A fitting intended to be used to lift and move a tank shall be subjected for 1 second to a load equal to twice that imposed by lifting the empty tank. When more than one fitting is provided on a tank, the load is to be divided between the fittings in proportion to the loads to which they are subjected by lifting the tank as intended. The fitting shall not be damaged or damage the tank.

10.1 revised April 2, 1996

10.2 Following the test described in 10.1, the tank is to be subjected to the Leakage Test, Section 8.

11 Water-Load Test

11.1 A tank shall be:

- a) Placed in a sand bed so that one-eighth of the tank diameter is buried, and
- b) Filled to capacity with water for 1 hour.

The tank shall not be damaged.

11.1 revised April 2, 1996

12 External Pressure Test

12.1 A tank shall be tested as described in 12.2. The tank shall not implode or otherwise be damaged.

12.2 The empty tank is to be installed in a test pit using the specified anchoring system and the specified backfill procedure. The pit is then to be filled with water to such a level that the tank is submerged to its maximum specified burial depth. The tank is to remain submerged for 24 hours. While the tank is still submerged, it is to be subjected for 1 minute to a partial internal vacuum so that the internal pressure on the tank is 5.3 inches of mercury (17.9 kPa) less than the external pressure imposed by the hydrostatic head.

12.2 revised April 2, 1996

13 Internal Pressure Test

13.1 A tank shall withstand without rupture for 1 minute an internal pressure as specified in Table 13.1.

Table 13.1
Internal pressure test

Maximum diameter of tank feet (m)	Applied pressure, Psi (kPa)
10 (3.0) or less	25 (172)
More than 10	15 (103)

14 Physical Properties of Materials Tests

14.1 General

14.1.1 Coupons cut directly from a representative tank laminate are to be used for the tests described in 14.1.2 – 14.6.2. The coupons are to measure at least 7.5 by 9 inches (190 by 229 mm) and are to be cut to minimize the amount of curvature; that is, the 7.5 inch dimension is to be parallel to the cylinder circumference. Each coupon is then to be cut to provide two smaller coupons; the first is to measure 2.5 by 9 inches (64 by 229 mm) and the second 5 by 9 inches (127 by 229 mm). Each of these coupons is to be marked for identification. The 2.5 by 9 inch coupons are to be used for tests in the as-received condition and the 5 by 9 inch coupons are to be tested after conditioning.

14.1.1 revised April 2, 1996

14.2 Air-oven aging

14.2.1 Specimens from coupons conditioned as described in 14.2.2 are to be subjected to the tests specified in 14.3.1 and 14.3.2. The flexural properties and impact strength of the conditioned specimens shall be at least 80 percent of the flexural properties and impact strength of specimens from the unconditioned coupons.

14.2.2 One coupon is to be conditioned for 30, one for 90, and one for 180 days, in an air-circulating oven at a temperature of 70°C (158°F).

14.3 Physical properties

14.3.1 Specimens are to be subjected to the flexural modulus and fiber strength tests described in Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials, ANSI/ASTM D790-91, using a crosshead speed of 0.1 inch per minute (2.5 mm/minute) and with the inside surface facing down. Five specimens are to be cut from each coupon, parallel to the longest dimension of the coupon.

14.3.2 Specimens are to be subjected to the Izod impact-strength test described in Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials, ASTM D256-90b. Five specimens are to be cut from each coupon, parallel to the longest dimension of the coupon.

14.4 Immersion

14.4.1 Coupons conditioned as described in 14.4.3 – 14.4.5 are to be subjected to the tests specified in 14.3.1 and 14.3.2. The flexural properties and impact strength of specimens from a coupon that has been immersed for 180 days in a Type A liquid shall be at least 50 percent of the flexural properties and impact strength of specimens from the unconditioned coupons (see 14.4.5), and the coupon shall show no evidence of blistering, softening, crazing, cracking, or other damage that impairs the performance of the tank. The flexural properties and impact strength of specimens from a coupon that has been immersed for 180 days in a Type B liquid shall be at least 30 percent of the flexural properties and impact strength of specimens from the unconditioned coupon.

14.4.1 revised April 2, 1996

14.4.2 An immersion test liquid is classed as either Type A or Type B according to the following:

- a) Type A liquids represent either an actual product to be stored or an outside soil condition.
- b) Type B liquids are more severe than expected conditions.

14.4.3 Coupons are to be immersed in liquids in accordance with Table 14.1 for 30, 90, and 180 days.

14.4.4 The liquids are to be maintained at 38°C (100°F) during the tests. The edges of all samples for immersion are to be coated with the same resin used to fabricate the coupons. For the tests specified in 14.3.1 and 14.3.2, specimens are to be cut from the coupons after having been subjected to the immersion conditioning.

14.4.5 After immersion, specimens cut from each of the coupon from each immersion group are to be tested separately as specified in 14.3.1 and 14.3.2, as applicable (see Table 14.1). The results of the tests are to be evaluated according to 14.4.1 and, in addition, the results from immersion in each of the Type A liquids are to be extrapolated (using regression analysis techniques) to obtain 270-day retention values. The extrapolated strength shall be not less than 50 percent of the strength of unconditioned samples. When the extrapolated value is less than 50 percent for a particular liquid, an additional coupon is to be immersed in that liquid for a total of 270 days as described in 14.4.4, and these specimens are then to be tested as described in paragraphs 14.3.1 and 14.3.2. The flexural properties and impact strength of the specimens shall be not less than 50 percent of the flexural properties and impact strength of unconditioned specimens.

14.4.5 revised April 2, 1996