UL 1713

STANDARD FOR SAFETY

Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service

UL Standard for Safety for Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service, UL 1713

Fourth Edition, Dated May 8, 2017

Summary of Topics

This new edition of UL 1713 was issued to incorporate the requirements for the Transition from Carbon Arc to Xenon Arc and other miscellaneous editorial updates.

The new/revised requirements are substantially in accordance with Proposal(s) on this subject dated March 17, 2017.

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Standard for Pressure Pipe and Couplings, Glass Fiber-Reinforced, for Underground Fire Service

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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 glass-fiber-reinforced, thermosetting-resin pipe (RTRP) and glass-fiber-reinforced, plastic-mortar pipe (RPMP), and their couplings. The pipe is for use in underground fire service systems and connections to such systems.

1.2 Pipe covered by these requirements is designated as Class 100, 150, 200, 250, or greater for rated working pressures of 100, 150, 200, 250 psig (0.69, 1.03, 1.38, and 1.72 MPa), or higher, respectively, and has a nominal inside diameter of 4 to 60 inches.

1.3 Requirements for the installation and use of RTRP and RPMP pressure pipe and couplings are specified in the Standard for the Installation of Private Fire Service Mains and their Appurtenances, ANSI/NFPA No. 24, and the Standard Practice for Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin Pipe), ASTM D3839.

2 Units of Measurement

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

3 Undated Reference

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.

4 Glossary

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

4.2 EPOXY RESIN (THERMOSETTING) – A polymer containing two or more three-membered rings consisting of one oxygen and two carbon atoms, which is cured by cross-linking with an amine or anhydride hardener with or without heat, catalyst, or both.

4.3 GLASS FIBERS (STRUCTURAL WALL) – A commercial grade of E glass filaments the binder and sizing of which is compatible with the impregnating resin.

4.4 LINER – A filled or unfilled thermoplastic- or thermosetting-resin layer, nonreinforced or reinforced, forming the interior surface of the pipe.

4.5 PRESSURE CLASS – The working pressure of a specified pipe for water service at a specified maximum operating temperature.

4.6 POLYESTER RESIN (THERMOSETTING) – A polymer with two or more ester groups and containing ethylenic unsaturation, dissolved in a reactive diluent with vinyl unsaturation, that is cured by cross-linking by means of a free-radical initiated curing mechanism, such as peroxide catalyst and heat.

4.7 RPMP – A tubular product containing glass-fiber reinforcement and aggregate embedded in or surrounded by cured, thermosetting epoxy or polyester resin. The composite structure may contain granular or platelet fillers, thixotropes, pigments, or dyes. Liner and coating materials include thermoplastic or thermosetting resins.

4.8 RTRP – A tubular product containing glass-fiber reinforcement embedded in or surrounded by cured, thermosetting epoxy or polyester resin. The composite structure may contain thixotropes, pigments, or dyes, while it does not include granular or platelet fillers. Liner and coating materials include thermoplastic or thermosetting resins.

4.9 RESIN – Any of a class of solid or pseudosolid organic materials, often of high molecular weight, with no definite melting point. The term is used to designate any polymer that is a basic material for plastics.

4.10 THERMOPLASTIC RESIN – A plastic that is repeatedly softened by heating and hardened by cooling and that in the softened state is fuseible or shaped by flow.

4.11 THERMOSETTING RESIN – A plastic that, after having been cured by heat or other means, is substantially infusible and insoluble.

CONSTRUCTION

5 Materials

5.1 Grade E glass, as specified in the Standard Specification for Glass Fiber Strands, ASTM D578, shall be used as the glass-fiber reinforcement material in the structural wall of RTRP and RPMP pipe and couplings.

6 Pipe Joints

6.1 A joint shall be of the gasketed bell-and-spigot type, adhesive-bonded type, or mechanical type. See 6.2 and 15.1.1.

6.2 A mechanical joint is not prohibited from being flanged, threaded, compression couplings, or proprietary joints.

7 Sealing Gaskets

7.1 A sealing gasket shall be made of a vulcanized natural rubber or a synthetic-rubber compound and shall have uniform dimensions and sufficient thickness to provide a compression seal. See Elastomeric Parts Test, Section 9.

PERFORMANCE

8 General

8.1 Representative samples of each class and size of pipe and couplings shall be subjected to the tests specified in Sections 9 – 15.

9 Elastomeric Parts Tests

9.1 An elastomeric part used to provide a seal shall have the following properties when tested as specified in the Standard for Gaskets and Seals, UL 157:

a) Minimum tensile strength – 2000 pounds per square inch (psi) (13.8 MPa).

b) Minimum ultimate elongation – 300 percent [1 to 4 inches (25.4 to 102 mm)].

c) Permanent set of 3/16 inch (4.8 mm) when 1 inch (25.4 mm) marks are stretched to 3 inches (76.2 mm), held for 2 minutes and measured 2 minutes after release.

d) Those properties relating to minimum tensile strength and elongation after oven aging; and hardness after oven aging, all as specified in UL 157. The maximum service temperature used to determine the oven time and temperature for oven aging is 60°C (140°F).

10 Hydrostatic Pressure Test

10.1 Pipe and couplings (if provided) shall withstand for 5 seconds without rupture or weepage an internal hydrostatic pressure of four times the rated working pressure based on the minimum wall thickness of the pipe.

10.2 Three samples of each pressure class and size of pipe and couplings are to be prepared for hydrostatic pressure for short-time rupture strength in compliance with the Standard Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings, ANSI/ASTM D1599. The minimum wall thickness, average wall thickness (minimum of six points), outside diameter, and length of the samples are to be measured and recorded. The test pressure is to be determined based on the calculated hoop stress for the minimum wall thickness and minimum test pressure (four times rated working pressure) using the measured minimum wall thickness. For sizes up to and including 8 inches (203 mm), the sample length (between end caps) is to be at least five times the nominal diameter, and for larger sizes, the length is to be at least three times the nominal diameter.

10.3 The ends of the sample are to be sealed with gaskets or end caps. The sample is then to be connected to the hydrostatic-pressure testing equipment and all air is to be expelled from the pipe or fitting. The internal water pressure is to be increased at a uniform rate until the calculated test pressure has been attained. The calculated test pressure is to be held for 5 seconds. The pressure then is to be increased until rupture or weepage occurs. See 17.1. The rate at which the pressure is increased is to be adjusted within the range of 50 – 30 psig (345 – 207 kPa) per second so that rupture or weepage occurs in not less than 60 seconds after the initial application of pressure.

11 Leakage Test for Joints

11.1 Pipe joints having maximum clearances and joints having minimum clearances between the pipe spigot and pipe bell or coupling, with clearances determined by the manufacturer's tolerances, shall not leak and shall not exhibit damage that impairs the intended operation when subjected to a hydrostatic pressure of twice the rated pressure.

11.2 Pipe to be used in each test is to be representative of each class and size. At least one joint is to be machined to the maximum clearance allowed by the manufacturer's tolerances. A test line is to be assembled of at least five lengths of pipe with couplings and sealing gaskets, in compliance with the manufacturer's installation instructions. At least two joints, including the maximum clearance joint, are to be deflected to the maximum deflection rated by the manufacturer. The ends of the test line are to be restrained to confine longitudinal separation at the joints. Four tests of single joints are capable of being conducted in lieu of the test on a single line.

11.3 The test line is to be connected to the hydrostatic pressure testing equipment and all air is to be expelled from the system. The water pressure is to be increased in 50 psig (345 kPa) increments until twice the rated pressure is attained. At each increment of pressure increase, measurements are to be made of distortion at each joint, protrusion of gasket material (if any) or other factors that cause leakage after continued use of the pipe in service. During the test, the pressure is not to be increased to the next increment until the line and connections have become stable, as evidenced by no further movement of gasket material.

11.4 After the test pressure has been increased to twice the rated pressure, the test pressure is to be decreased to 0 psig, while observations are made for leakage. Then, the pressure is again to be slowly increased to twice the rated pressure while observations are made for leakage.

12 Assembly Test

12.1 Pipe joints made with minimum clearances between the pipe spigot and bell or coupling, determined in accordance with the manufacturer's tolerances, shall, when assembled as specified in 12.2, exhibit no damage to gaskets, pipe, or coupling sections. Cut or torn gasket materials and chipped or broken pipe or coupling sections do not comply with the requirement.

12.2 Representative samples of each class and size of pipe and couplings are to be machined as required. Two pipe sections are to be joined together in accordance with the manufacturer's instructions, using a nonmineral base lubricant, or the equivalent, and installation tools such as pike bars and jack and chain .

13 Stiffness Test

13.1 The pipe shall exhibit, without structural damage (see 13.3), the minimum pipe stiffness (PS), at 5 percent deflection of the measured inside diameter, specified for the applicable size in Table 13.1. The pipe stiffness is to be calculated using the following formula:

$$PS = \frac{F}{\Delta y}$$

in which:

PS is the pipe stiffness;

F is the load per unit length in pounds per inch; and

Δy is the measured change of the inside diameter in the direction of load application, in inches.

Table 13.1
Minimum ring stiffness requirements

Nominal diameter		Minimum ring stiffness (F/Δy) at 5-percent deflection	
Inches	(mm)	psi	(kPa)
4 to 8	(102 to 203)	35	(241)
10	(254)	20	(138)
12 to 60	(305 to 1524)	10	(69)

13.2 The minimum ring stiffness (F/Δy) is to be determined at 5-percent deflection using the apparatus and procedure specified in the Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading, ANSI/ASTM D2412 with the following modifications:

a) The wall thickness is to be measured to the nearest 0.01 inch (0.25 mm).

b) The sample taken from the pipe barrel is to be loaded to 5 percent deflection, the load is to be recorded, and the sample is to be examined for evidence of crazing or cracking.

13.3 At 5-percent deflection, there shall be no visual evidence (unaided eye) of cracking or crazing of the sample. At 15-percent deflection, there shall be no visual indication (unaided eye) of structural damage of the pipe wall evidenced by interlaminar separation, breaking of the glass fiber reinforcement, cracking, or buckling of the pipe wall. For the purposes of this test, the pipe wall is the pipe barrel, and does not include stiffening ribs.

14 Long-Term Hydrostatic-Pressure Test

14.1 Each class of pipe shall not rupture, permanently distort, or leak:

a) At the test pressures based on two times the long-term hydrostatic design pressure data (see Procedure B of the Standard Practice for Obtaining Hydrostatic or Pressure Design Basis for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Fittings, ANSI/ASTM D2992); or

b) When subjected to two times the long-term hydrostatic design pressure test method as specified in the [see Standard Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe, ANSI/ASTM D3517]. Procedure A data of ANSI/ASTM D2992 is capable of being used in lieu of Procedure B data.

15 Exposure Tests

15.1 General

15.1.1 After being subjected to the test exposures specified in 15.1.2, the apparent tensile strength and minimum ring stiffness (see 13.1) of sample pipe rings and tensile strength of adhesive bonding shall not be reduced by more than 30 percent.

15.1.2 The exterior surface of pipe ring samples and adhesive bond samples (when used) are to be subjected to the following exposures:

a) Solutions specified in 15.3.1, for 30 and 180 days.

b) Air-oven aging specified in 15.4.1 for 30 and 180 days.

c) Accelerated light and water apparatus as specified in 15.5.

15.2 Test method

15.2.1 Samples of the pipe rings for determination of the apparent tensile strength (split disc) are to be prepared and tested in accordance with the Standard Test Method for Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method, ASTM D2290.

15.2.2 Samples of pipe rings for determination of stiffness are to be tested as specified in 13.2.

15.2.3 Samples of adhesive bonded pipe sections are to be prepared and tested in accordance with the Standard Specification for Reinforced Epoxy Resin Gas Pressure Pipe and Fittings, ASTM D2517).

15.3 Test solutions

15.3.1 Samples are to be submerged for 30 and 180 days in the following solutions maintained at a temperature of 37.8°C (100.0°F):

a) Saturated solution of sodium chloride;

b) Five-percent hydrochloric acid;

c) Distilled water with hydrochloric acid added to provide a pH of 3;

d) Distilled water with sodium hydroxide added to provide a pH of 12;

e) Distilled water;

f) Distilled water with sulfuric acid added to provide a pH of 3; and

g) Solution of sodium carbonate and sodium bicarbonate to provide a pH of 10.

15.4 Air oven aging

15.4.1 Pipe ring samples and adhesive bonded samples are to be subjected to air-oven aging for 30 and 180 days at 70°C (158°F). The samples are to cool for 24 hours at 23°C (73°F) and 50-percent relative humidity prior to physical testing.

15.5 Light and water exposure

15.5.1 Pipe ring samples and adhesive bonded samples are to be subjected for 360 hours to exposure in an accelerated light and water exposure apparatus, as specified in 15.5.2 and 15.5.3.

15.5.2 The apparatus used is to provide ultraviolet light from two enclosed carbon arcs formed between vertical electrodes 1/2-inch (12.7-mm) in diameter, located at the center of a revolvable vertical metal cylinder 31 inches (787 mm) in diameter and 17-3/4 inches (451 mm) high. The arcs are to operate with approximately 15 to 17 amperes ac and the potential across the arcs is to be approximately 120 to 145 volts. The arcs are to be enclosed by clear globes of No. 9200-PX Pyrex glass.

15.5.3 The samples are to be vertically mounted on the inside of the cylinder, facing the arcs, and the cylinder is to be rotated about the arcs at one revolution per minute. A system of nozzles is to be provided so that each sample is sprayed in turn with water as the cylinder revolves. During each 20-minute operating cycle, each sample is to be exposed to light from the arcs for 17 minutes and to water spray with light for 3 minutes. The temperature within the cylinder while the apparatus is in operation is to be 63 ±5°C (145 ±9°F).

15.5.4 As an alternate to the test in sections 15.5.1-15.5.3, the test samples are to be exposed for 500 hours to light and water in accordance with 15.5.5.

15.5.5 Specimens are to be exposed to ultraviolet light and waterspray by using a Xenon-arc lamp in accordance with the Standard Practice for Exposing Nonmetallic Materials in Accelerated Test Devices That Use Laboratory Light Sources, ASTM G151, and the Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-metallic Materials, ASTM G155. The spectral power distribution of the xenon lamp shall conform to the requirement in Table 1 in ASTM G155 for a xenon lamp with daylight filters. A programmed cycle of 120 minutes consisting of a 102-minute light exposure and an 18-minute exposure to water spray with light shall be used. The apparatus shall operate with a spectral irradiance of 0.35 W/m^2 nm at 340 nm and a black-panel temperature of 63 ± 3°C (145.4 ± 5.4°F).

MANUFACTURING AND PRODUCTION TESTS

16 General

16.1 The manufacturer shall conduct the necessary control, inspection, and tests. The program shall include the Production-Line Hydrostatic-Pressure Tests, Section 17.

17 Production-Line Hydrostatic-Pressure Tests

17.1 Each length of pipe and each coupling shall be hydrostatically tested at an internal pressure of two times the rated pressure:

a) For 30 seconds if weepage occurred when the product was tested to the strength as specified in 10.2 and 10.3; or

b) For 5 seconds if the product ruptured when tested to the limit of strength. Any pipe or coupling showing leakage or other defect that impairs the intended performance of the product is to be rejected.

17.2 The test sample is to be connected to the hydrostatic-pressure testing equipment with gaskets that seal the ends of the pipe or coupling. All air is to be expelled from the sample, and the internal water pressure is to be applied at a uniform rate of not less than 100 psig (689 kPa) per second until the specified pressure is attained. The specified pressure is to be maintained for not less than 30 seconds. Couplings are to be tested using a bladder-type tester.

17.3 The apparatus for conducting hydrostatic pressure tests is to be equipped with an instrument to record the pressure to which each length of pipe or coupling was subjected.

17.4 The manufacturer shall keep records of the results of the hydrostatic-pressure tests. Each record shall identify each test as to class, size, test pressure, date, and shift of manufacture.