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An American National Standard

Standard Specification for Plastic Mechanical Fittings for Use on Outside Diameter Controlled Polyethylene Gas Distribution Pipe and Tubing[1]

This standard is issued under the fixed designation F 1924; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

ε[1] NOTE—Section 10 was editorially updated in December 2002.

1. Scope

1.1 This specification describes requirements and test methods for the qualification of plastic bodied mechanical fittings for use with outside diameter controlled polyethylene (PE) gas distribution pipe, nominal 2 pipe size (IPS) and smaller complying with Specification D 2513. In addition, it specifies general requirements of the material from which these fittings are made.

1.2 The test methods described in this specification are not intended to be used as routine quality control tests.

1.3 This specification covers the types of mechanical fittings described in 3.2.1.

1.4 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.6 The text of this specification references notes and footnotes, which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this specification.

2. Referenced Documents

2.1 *ASTM Standards:*

D 638 Test Method for Tensile Properties of Plastics[2]

D 1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure[3]

D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]

D 2513 Specification for Thermoplastic Gas Pressure Pipe, Tubing, and Fittings[3]

D 2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials[3]

F 412 Terminology Relating to Plastic Piping Systems[3]

F 1588 Test Method for Constant Tensile Load Joint Test (CTLJT)[3]

2.2 *ASME Standard:*

ASME B31.8 Gas Transmission and Distribution Piping Systems[4]

2.3 *Federal Standard:*

CFR, Title 49, Part 192 Pipeline Safety Regulations[5]

2.4 *Plastics Pipe Institute Standard:*

PPI TR-4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Pipe and Fittings Compounds[6]

3. Terminology

3.1 *Definitions*—Definitions of terms used in this specification are in accordance with Terminology F 412 unless otherwise specified. Abbreviations are in accordance with Terminology D 1600 unless otherwise specified.

3.1.1 The Gas Industry terminology used in this specification is in accordance with ASME B31.8 or CFR, Title 49, Part 192 unless otherwise indicated.

3.1.2 The term "pipe" used herein refers to both "pipe" and "tubing" unless specifically stated otherwise. The term "fitting" refers to a mechanical connecting device as described in 3.1.4 and 3.1.6.

3.1.3 *joint, n*—the location at which two pieces of pipe, or a pipe and a fitting are connected together, for example, an installed coupling has two joints.

3.1.4 *joint, mechanical, n*— a connection between piping components employing physical force to develop a seal or produce alignment.

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[2] *Annual Book of ASTM Standards*, Vol 08.01.

[3] *Annual Book of ASTM Standards*, Vol 08.04.

[4] Available from American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016–5990.

[5] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

[6] Available from Plastics Pipe Institute, 1801 K Street NW, Suite 600K, Washington, DC 20402.

3.1.5 *long-term strength (LTS), n*—the estimated tensile stress that when applied continuously will cause failure at 100 000 h. This is the intercept of the stress regression line with the 100 000 h coordinate.

3.1.6 *mechanical fitting, n*—fitting for making a mechanical joint to provide for pressure integrity, leak tightness, and depending on category, as defined in this specification, resistance to end loads.

3.1.6.1 *category 1 mechanical fitting, n*—fitting for assembling pipes, which includes a compression zone(s) to provide for pressure integrity, leak tightness, and resistance to end loads sufficient to cause no less than 25 % elongation of the PE piping as described in this specification.

3.1.6.2 *category 2 mechanical fitting, n*—fitting for assembling pipes, which includes a compression zone(s) to provide for pressure integrity and leak tightness only. Category 2 fittings do not provide for resistance to end loads.

3.1.7 *MAOP, n*—the Maximum Allowable Operating Pressure of the fuel gas piping system, in psig, as determined in accordance with CFR, Title 49, Part 192.121 and as represented in the following:

$$MAOP = P = 2 \times S/(R-1) \times f_D \quad (1)$$

where:

S = the PE material's HDB as published in PPI TR-4.
R = the pipe's dimension ratio determined by dividing the pipe's specified nominal outside diameter by the pipes specified nominal wall thickness; and,
f_D = the design (derating) factor for thermoplastic fuel gas piping as set by the authority having jurisdiction. In the United States the design factor is cited in CFR, Title 49 Part 192.121.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *Types of Mechanical Fittings:*

3.2.2 *in-line fitting, n*—mechanical fitting used to make a mechanical joint where the bore axis of the compression and sealing zones of the fitting is essentially the same as the connected piping, for example, couplings, ells, and tees.

3.2.3 *mechanical saddle fitting, n*—mechanical fitting used to make a mechanical joint that allows a lateral connection to an existing main in which a portion of the fitting is contoured to match the O.D. of the pipe to which it is attached. Herein referred to as the *saddle fitting mating pipe.*

4. Materials and Manufacture Requirements

4.1 Plastic pressure containing materials subject to continuous stress, either hoop or axial, shall have an ASTM material specification, and the materials long-term strength, such as the long-term hydrostatic strength, determined in accordance with Test Method D 2837, excepting that failure data can be obtained from specimens such as the following: tensile bars, plane strain, or actual fitting samples. A material listing in PPI TR-4 document is evidence of compliance with this paragraph for third party certifying and listing agencies.

4.2 The physical properties of each material used to produce the fitting shall be available from the fitting manufacturer upon request.

4.3 Specifications outlining all the physical properties and effects of environmental conditions for materials of manufacture shall be available from the fitting manufacturer upon request.

NOTE 1—Materials in long-term contact with natural gas of line quality and LP gas vapor should be demonstrated not to adversely affect the performance of the fitting.

NOTE 2—Materials should have a demonstrated resistance to environmental stress cracking when exposed, under stress, to chemical compounds encountered in, or external to gas piping systems, and a demonstrated resistance to bacteriological decomposition. Such compounds include, but are not limited to, ice thawing chemicals, fertilizers, insecticides, herbicides, leak detection fluids, acids, bases and antifreeze solutions used to thaw frozen lines. The effects of liquid environments, such as antifreeze agents, odorants, and hydrocarbons are known to be deleterious to some plastics, particularly when under service conditions.

5. Dimensions

5.1 The dimensions and tolerances shall be determined by the manufacturer.

6. Qualification Requirements

6.1 *General*—Unless otherwise specified, each nominal size of fitting shall be tested. Testing of the thickest wall pipe that the fitting is designed to be used with qualifies the use of that fitting with pipe of lesser wall thickness.

6.1.1 Mechanical joint qualifications shall be performed on assembled joints using the fitting manufacturer's joining procedure. All mechanical fittings offered by the manufacturer shall be capable of meeting the requirements of this standard when connecting polyethylene gas piping complying with Specification D 2513. To verify the structural integrity of the fitting body, representative samples shall be subjected to the requirements of 6.2.1. It is not the intent of this specification to require testing of all fitting configurations, that is, tees, ells, etc., but each mechanical joint design in each size.

6.1.2 All mechanical fittings described in 3.2.1 shall have an internal pipe reinforcing tubular insert stiffener that extends at least under the seal and gripping device, where used. The saddle portion of saddle-type fittings do not require an internal tubular stiffener due to the nature of the connection.

6.2 *Performance Requirements*:

6.2.1 *Elevated Temperature Sustained Pressure*—The fitting, joint or pipe in the area affected by the fitting shall not fail as defined in Test Method D 1598, when tested in accordance with 7.2. The fitting or joint meets this requirement when tested in accordance with any one of the three conditions (A, B, or C) listed in 7.2.

6.2.2 *Tensile Strength*—The pipe joint shall accommodate the tensile loadings when tested in accordance with 7.3.

6.2.2.1 *In-Line Fittings, Category 1*—The joint shall provide resistance to a force on the pipe joint equal to or greater than that which will cause no less than 25 % elongation of pipe, or the pipe fails outside the joint area when tested in accordance with 7.3.

6.2.2.2 *In-Line Fittings, Category 2*—A joint design that provides a seal only. A mechanical joint designed for this category excludes any provisions in the design of the joint to resist any axial pullout forces; therefore, tensile tests are not required.

6.2.2.3 *Mechanical Saddle Fittings*—The joint between the saddle and mating pipe shall not fail by rotation or leakage when tested in accordance with 7.6.

6.2.2.4 Joint restraint capabilities less than as defined above shall constitute failure of the test.

6.2.3 *Temperature Cycling Test*—The mechanical joint shall provide a pressure seal after 10 cycles of the temperature cycling test when tested in accordance with 7.4.

6.2.4 *Constant Tensile Load Joint Test*— The joint shall not fail by leakage or pullout when loaded to an axial tensile stress of 1320 psi (9.1 MPa) and tested in accordance with 7.5.

7. Test Methods

7.1 *General*—The test methods in this specification cover mechanical joint designs. Test methods that are applicable from other specifications will be referenced in the section pertaining to that particular test.

7.1.1 *Conditioning*—Unless otherwise specified, condition the specimens (pipe and fittings) prior to joining at 73.4 ± 3.6° F (23 ± 2° C) for not less than 16 h.

7.1.2 *Test Conditions*—Conduct the tests at the standard laboratory temperature of 73.4 ± 3.6° F (23 ± 2° C) unless otherwise specified.

7.1.3 *Test Specimens*—Test joints shall be prepared with the appropriate size PE pipe, complying with the dimensional requirements of Specification D 2513, in accordance with the manufacturer's joining procedures.

7.2 *Elevated Temperature Sustained Pressure Test*:

7.2.1 The apparatus and report shall be as specified in Test Method D 1598. Test six joints assembled in accordance with 6.1.1.

7.2.2 The assembled joints shall be tested in accordance with Test Method D 1598 with the exception that it is not required that 12 in. or five times the nominal outside diameter of the pipe used in conducting the test be placed on each side of the fitting being tested. The test shall be conducted at one of the time/temperature/hoop stress combinations shown in Table 1 with the test pressure calculated using Eq 2. If ductile failure occurs in the pipe at 176°F (80°C)/670 psi (4.6 MPa) hoop stress, retest at 176°F (80°C)/580 psi (4.0 MPa) hoop stress.

$$P = \frac{2S}{DR - 1} \tag{2}$$

where:

P = test pressure, psig,
S = hoop stress from Table 1, and
DR = dimension ratio (OD/wall).

7.2.3 Failure of two of the six specimens tested shall constitute failure in the test. Failure of one of the six specimens tested is cause for retest of six additional specimens. Failure of one of the six specimens in retest shall constitute failure of the test. Evidence of failure of the pipe shall be as defined in Test Method D 1598.

TABLE 1 Elevated Temperature Sustained Pressure Test Conditions

Condition	Minimum Time	Temperature	Pipe Hoop Stress, S
A	3 000 h	140±3.6°F (60± 2°C)	1 000 psi (6.8 MPa)
B	1 000 h	176±3.6°F (80± 2°C)	580 psi (4.0 MPa)
C	170 h	176±3.6°F (80± 2°C)	670 psi (4.6 MPa)

7.3 *Tensile Strength Test*:

7.3.1 Test specimens shall be prepared so that the minimum length of unreinforced pipe is equal to five times the nominal outside diameter of the pipe being tested. It is permissible to test multiple joints together provided the minimum length of unreinforced pipe (as stated above) exists on at least one joint.

7.3.2 In-line fittings shall be tested with the apparatus and reported as specified in Test Method D 638. Test six joints.

7.3.3 The test shall be conducted at 73.4 ± 3.6°F (23 ± 2°C).

7.3.4 The speed of the testing shall be 0.2 in. (5 mm)/min± 25 %.

7.3.5 Failure of two of the six specimens tested shall constitute failure of the test. Failure of one of the six specimens tested is cause for retest of six additional specimens. Failure of one of the six specimens in retest shall constitute failure of the test.

7.4 *Temperature Cycling Test*:

7.4.1 Tests shall be conducted on six of the smallest and six of the largest nominal pipe sizes of each mechanical joint design and assembled in accordance with 6.1.1.

7.4.2 Leak test specimens at ambient at 7 ± 3 psig and a minimum of 1.5 × MAOP.

7.4.3 Cool specimens to a temperature of −20 ± 3.6°F (−29 ± 2°C) and maintain for a minimum of 2.5 h.

7.4.4 Condition specimens to a temperature of 140 ± 3.6°F (60 ± 2°C) and maintain for a minimum of 2.5 h.

7.4.5 Repeat 7.4.3 and 7.4.4 for a total of 10 cycles.

7.4.6 Pressurize 50 % of the speciments of each size at 7 ± 3 psig and the remaining 50 % of each size at 1.5× MAOP of the piping material and SDR that the fittings are designed to be used with. Leak test first at 140 ± 3.6°F (60 ± 2°C) and then at −20 ± 3.6°F (−29 ± 2°C).

NOTE 3—If immersion is used for leak testing, and the design of the joint is such that air can be trapped within the joint assembly, allow adequate time for all air trapped within the joint to escape prior to observing for leaks.

7.5 *Constant Tensile Load Joint Test (In-Line Joints Only)*:

7.5.1 One specimen of each nominal pipe size shall be tested in accordance with Test Method F 1588 for a minimum of 1000 h at an internal pressure between 4 psig (27.6 kPa) and the pipe MAOP.

7.5.2 Failure of the specimen shall constitute failure of the test.

7.6 *Rotation Test (Mechanical Saddle Fittings Only)*:

7.6.1 Test shall be conducted on six of the smallest and six of the largest nominal pipe sizes of each mechanical joint design and assembly assembled in accordance with 6.1.1.

7.6.2 The test shall be conducted at 73.4 ± 3.6°F (23 ± 2°C).

7.6.3 Saddle fittings shall be assembled onto the mating pipe so that the minimum length of unreinforced pipe is equal to five times the nominal diameter of the pipe to which the saddle is being installed.

7.6.4 Following the manufacturer's recommended procedure for installing saddle fittings, tap the mating pipe and remove the saddle fitting cutter.

7.6.5 Alignment marks shall be placed on both the saddle fitting and the mating pipe to identify the original position of the assembly.

7.6.6 Either the saddle fitting, or the mating pipe, shall be restrained in a manner that does not affect the saddle fitting joint.

7.6.7 A torque shall be applied to the unrestrained component of the assembly and a torsion load applied about the centerline of the mating pipe.

7.6.8 The saddle fitting assembly shall be capable of withstanding the torsion loads indicated in Table 2 without the saddle fitting rotating relative to the mating pipe or adversely affecting the integrity of the joint.

7.6.9 Following rotation testing, leak test in accordance with the following. Pressurize each saddle tee joint at 7 ± 3 psig (48.3 ± 20.7 kPa) and at a minimum of 1.5 × MAOP of the pipe on which they are being tested.

7.6.10 Observe the joint for leakage for 2 to 3 min at each pressure.

7.6.11 The joint shall be bubble tight when tested with leak detection soap, liquid immersion, or other equivalent methods.

7.6.12 Failure of any of the six samples tested shall constitute failure of the test.

NOTE 4—The rotation test is intended to qualify only the joint between the saddle fitting and the mating pipe, not the lateral connection coming from the saddle fitting. It is the intent of this specification that the lateral connection joint design will be qualified by virtue of utilizing a design similar to an in-line fitting and capable of meeting the requirements for in-line fittings contained within this specification.

TABLE 2 Rotation Test Torsion Load Requirements

Main Pipe Size	Minimum Torsion Load
NPS 1¼	30 ft-lbf (40.7 N · m)
NPS 2 and larger	50 ft-lbf (67.8 N · m)

8. Product Instructions

8.1 Qualified installation instructions shall be available from the manufacturer and supplied with the fitting.

9. Product Marking

9.1 Fittings shall be marked with the following:

9.1.1 The designation ASTM F 1924.

9.1.2 Two or three letter coded plastic material identification, in accordance with PPI TR-4 or the equivalent.

9.1.3 Date or lot code identification.

9.1.4 Manufacturer's name or trademark.

9.1.5 Size, followed by "IPS" or "CTS" designation, and SDR or wall thickness range.

9.1.6 The word "gas", or if space does not permit, the letter "G".

9.1.7 Category 1 or Category 2 abbreviation is permitted as CAT1 or CAT2.

9.1.8 All required markings shall be legible and so applied as to remain legible under normal handling and installation practices. If indentation is used, it shall be demonstrated that these marks have no affect on the long term strength of the fitting.

9.1.9 Fittings manufactured from materials listed in Specification D 2513 and intended for use with natural gas at elevated temperatures greater than 73°F (23°C) shall be marked with additional code letters from Table 4 of Specification D 2513 the first code letter to identify the temperature of the pressure rating, and a second code letter to identify HDB at the highest recommended temperature.

10. Quality Assurance

10.1 When the product is marked with this designation, F 1924, the manufacturer affirms that the product is manufactured inspected, sampled and tested in accordance with this specification and has been found to meet the requirements of this specification.

11. Keywords

11.1 gas; mechanical saddle fitting; plastic mechanical fitting; polyethylene pipe; rotation test; temperature cycling test