



Designation: D5677 – 17 (Reapproved 2023)

# Standard Specification for Fiberglass (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe and Pipe Fittings, Adhesive Bonded Joint Type, for Aviation Jet Turbine Fuel Lines<sup>1</sup>

This standard is issued under the fixed designation D5677; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers a reinforced plastic pipe and fittings system made from epoxy resin and glass-fiber reinforcement, together with adhesive for joint assembly, intended for service up to 150°F (65.6°C) and 150-psig (1034-kPa) operating pressure and surges up to 275 psig (1896 kPa) in aviation jet turbine fuel lines installed below ground.

1.2 The dimensionless designator NPS has been substituted in this specification for such traditional terms as *nominal diameter*, *size*, and *nominal size*.

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

1.4 The following safety hazards caveat pertains only to the test method portion, Section 9, 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—There is no known ISO equivalent to this standard.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.23 on Reinforced Thermosetting Resin Piping Systems and Chemical Equipment.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

D381 Test Method for Gum Content in Fuels by Jet Evaporation

D883 Terminology Relating to Plastics

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D1600 Terminology for Abbreviated Terms Relating to Plastics

D1655 Specification for Aviation Turbine Fuels

D2310 Classification for Machine-Made “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe (Withdrawn 2017)<sup>3</sup>

D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

D3241 Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels

D3567 Practice for Determining Dimensions of “Fiberglass” (Glass-Fiber-Reinforced Thermosetting Resin) Pipe and Fittings

D3951 Practice for Commercial Packaging

D5685 Specification for “Fiberglass” (Glass-Fiber-Reinforced Thermosetting-Resin) Pressure Pipe Fittings

F412 Terminology Relating to Plastic Piping Systems

F1173 Specification for Thermosetting Resin Fiberglass Pipe Systems to Be Used for Marine Applications

### 2.2 Military Specification:

MIL-T-5624 Turbine Fuel, Aviation, Grades JP-4, JP-5 and JP-5/JP-8 ST<sup>4</sup>

### 2.3 ANSI Standard:

B16.5 Steel Pipe Flanges and Flanged Fittings<sup>5</sup>

## 3. Terminology

3.1 *Definitions*—Definitions are in accordance with Terminologies D883 and F412, and abbreviations are in accordance with Terminology D1600, unless otherwise indicated.

<sup>3</sup> The last approved version of this historical standard is referenced on www.astm.org.

<sup>4</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

<sup>5</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

\*A Summary of Changes section appears at the end of this standard

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *conductive*—a pipe or fitting that meets the requirements for conductivity listed in Section 6 of Specification **F1173**.

### 3.3 Abbreviations:

3.3.1 *RTRP, n*—reinforced thermosetting resin pipe.

## 4. Classification

### 4.1 General:

4.1.1 Pipe meeting this specification is classified by type, grade, and class similar to Classification **D2310**.

4.1.2 Fittings meeting this specification are also classified by type (method of manufacture) and grades (generic type of resin).

### 4.2 Pipe:

4.2.1 Type I Filament-Wound Pipe Nonconductive

4.2.2 Type Ia Filament-Wound Pipe Conductive

4.2.3 Type II Centrifugally Cast Pipe

### 4.3 Fittings:

4.3.1 Type I Filament-Wound Fittings Nonconductive

4.3.2 Type Ia Filament Wound Fittings Conductive

4.3.3 Type II Molded Fittings Nonconductive

### 4.4 Grade:

4.4.1 Grade 1 Glass-Fiber-Reinforced Epoxy Resin (Pipe and Fittings)

### 4.5 Classes (Pipe Only):

4.5.1 Class A No Liner

4.5.2 Class C Epoxy Resin Liner Nonreinforced

4.5.3 Class F Epoxy Resin Liner Reinforced

## 5. Materials and Manufacture

5.1 *General*—The fiberglass pipe shall be round and straight, and the pipe and fittings shall be of uniform density, resin content, and surface finish. All pipe ends shall be cut at right angles to the axis of the pipe and any sharp edges removed. The bore of the pipe and fittings shall have a smooth, uniform surface with no exposed fibers and is permitted to

contain a liner. The liner, if used, shall be composed of an epoxy resin formulation and is permitted to contain a reinforcement.

5.2 *Material*—The pipe and fittings shall be made from epoxy resins and glass-fiber reinforcement of commercial first quality. Fillers, colorants, and other materials are permitted to be added, provided the pipe and fittings meet all the requirements of this specification. Epoxy pipe shall be joined only with epoxy fittings.

5.3 *Adhesive*—Adhesive for joint assembly shall be a material suitable for providing a seal between the pipe and fittings in continuous service up to 150°F (65°C) and 150 psig (1034 kPa) with surges to 275 psig (1896 kPa). The adhesive shall be supplied as a kit which includes containers of all components in the amounts needed for each adhesive mixture. Instructions for use shall be marked on each container or listed on an instruction sheet included in each adhesive kit. When specified in the contract or purchase order, adhesive kits shall be furnished in a sufficient quantity for the particular procurement of pipe and fittings.

## 6. Dimensions

6.1 *Pipe*—The pipe shall be 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24-in. (25, 40, 50, 80, 100, 125, 150, 200, 250, 300, 350, 400, 450, 500, 550, and 600-mm) nominal sizes as specified and shall have the dimensions and tolerances shown in **Table 1** unless otherwise agreed upon by the purchaser and seller.

6.1.1 *Length*—Unless other lengths are specified on the purchase order, the length of the pipe shall be 20 ft (6.1 m), 30 ft (9.2 m), or 40 ft (12.2 m) with a plus tolerance of 2 ft (0.6 m) and a minus tolerance of 5 ft (1.5 m).

6.1.2 *Wall Thickness*—The minimum wall thickness of the pipe shall be not less than 87.5 % of the average wall thickness of the pipe as measured in Section 8 and tested in Section 9.

6.1.3 *Fittings*—Fittings shall be 1, 1.5, 2, 3, 4, 5, 6, 8, 10, 12, 14, 16, 18, 20, 22, and 24-in. (25, 40, 50, 80, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, and 600-mm) nominal sizes,

**TABLE 1 Dimensions of Pipe**

NOTE 1—Nominal pipe diameters of 14 in. (350 mm), 16 in. (400 mm), 18 in. (450 mm), 20 in. (500 mm), 22 in. (550 mm), and 24 (600 mm) are available and approved with outside diameters or inside diameters as specified in **Table 1**.

Nominal Pipe Diameter		Outside Diameter		Tolerance, Type I and Type Ia		Tolerance, Type II	
in.	(mm)	in.	(mm)	in.	(mm)	in.	(mm)
1	(25)	1.315	(33.40)	+0.060 –0.016	(+1.52 –0.41)	±0.009	(±0.229)
1.5	(40)	1.900	(48.26)	+0.060 –0.018	(+1.52 –0.46)	±0.009	(±0.229)
2	(50)	2.375	(60.32)	+0.060 –0.018	(+1.52 –0.46)	±0.012	(±0.30)
3	(75)	3.500	(88.90)	±0.060 –0.018	(+1.52 –0.46)	±0.012	(±0.30)
4	(100)	4.500	(114.30)	±0.060 –0.018	(+1.52 –0.46)	±0.015	(±0.38)
5	(125)	5.563	(141.30)	±0.060 –0.028	(+1.68 –0.71)	±0.025	(±0.64)
6	(150)	6.625	(168.28)	±0.066 –0.028	(+1.68 –0.71)	±0.025	(±0.64)
8	(200)	8.625	(219.08)	±0.086 –0.040	(+2.28 –1.02)	±0.025	(±0.64)
10	(250)	10.750	(273.05)	±0.108 –0.048	(+2.74 –1.22)	±0.025	(±0.64)
12	(300)	12.750	(323.05)	±0.128 –0.056	(+3.25 –1.42)	±0.025	(±0.64)
14	(350)	14.000	(355.60)	±0.145 –0.064	(+3.68 –1.63)	±0.035	(±0.89)
16	(400)	16.000	(406.40)	±0.165 –0.074	(+4.19 –1.88)	±0.035	(±0.89)
18	(450)	18.000	(457.20)		±6.35		
20	(500)	20.000	(508.00)		±0.250		
22	(550)	22.000	(558.80)		±0.250		
24	(600)	24.000	(609.60)		±0.250		

as specified, and shall have dimensions suitable for joining to the pipe and enabling the pipe and fitting joint to meet the requirements of this specification. For purposes of this specification, fittings shall include couplings and flanges.

6.1.4 *Flanges*—Flanges shall conform to the bolt hole sizes and pattern for 150-lb steel flanges in accordance with ANSI B16.5.

## 7. Performance Requirements

7.1 *Joint Strength*—Pipe, fittings, adhesive, and joints shall show no porosity or other evidence of failure when tested in accordance with 9.2.2.

7.2 *Hydrostatic Strength*—Pipe, fittings, adhesive, and joints shall withstand a hydrostatic pressure of 300 psi (2068 kPa) without any indication of porosity, delamination, splitting, or other evidence of failure when tested in accordance with 9.2.3.

7.3 *Impact Resistance*—Pipe and fittings shall show no porosity or visual evidence of damage that would affect serviceability when tested in accordance with 9.2.4.

7.4 *Boil Resistance*—Pipe and fittings shall show no evidence of delamination or other impairment and shall have a weight gain no greater than 1.0 % when tested in accordance with 9.2.5.

7.5 *External Load Resistance*—When tested as specified in 9.2.6, the pipe shall show no visual evidence of cracking, crazing, or other damage that could allow leakage of fuel through the pipe wall at 5 % deflection and no visual evidence of delamination, rupture, or other structural damage at 10 % deflection.

### 7.6 *Degradation Resistance:*

7.6.1 *Pipe and Fittings*—Pipe and fittings exposed to JP-5 and JP-5/JP-8 ST fuels, or Jet A and Jet A-1, in accordance with 9.2.7, shall exhibit no visual evidence of deterioration as a result of exposure to the fuels and shall have short-time rupture strengths of not less than 90 % of the short-time rupture strengths of unexposed pipe and fittings when tested in accordance with 9.2.7.1.

7.6.2 *Fuels*—JP-5 and JP-5/JP-8 ST, or Jet A and Jet A-1 fuels contained within pipe and fittings in accordance with 4.2 and 4.3, shall not vary from control samples of the fuels in thermal stability and existent gum properties when tested, as specified, in accordance with 9.2.7.2.

7.6.3 *Hydrostatic Proof Test*—Pipe and fittings shall withstand a hydrostatic pressure of 275 psi (1551 kPa) without any indication of porosity when tested in accordance with 9.2.8.

## 8. Workmanship

8.1 *Pipe and Fittings*—The pipe and fittings shall be free from all defects including delaminations, cracks, indentations, bubbles, pinholes, porosity, and resin-rich and resin-starved areas which, due to their nature, degree, or extent, detrimentally affect the strength and serviceability of the pipe and fittings. The liner, if used in the pipe or fittings, shall be free of cracks, chips, or other damage.

### 8.2 *Examination:*

8.2.1 *Sampling*—A sufficient quantity of pipe, fittings, and adhesive kits, in accordance with accepted statistical practice

and as agreed upon between the purchaser and the seller, shall be selected from each lot or shipment and examined to determine conformance with this specification. In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate.

8.2.2 *Pipe and Fittings*—Sample pipe and fittings selected shall be examined for the following defects: incorrect dimensions; ends of pipe not cut at right angles to the axis; exposed fibers or nonuniform surface on bore of pipe or fittings; cracked or chipped liner (if used); bubbles, pinholes, delaminations, cracks, indentations, resin-rich or resin-starved areas in the outer wall that will affect the strength and performance of the product; and incorrect or missing identification marking. Any sample pipe or fitting having one or more of the defects listed shall be considered a defective unit.

8.2.3 *Dimensions*—Pipe and fitting dimensions shall be determined in accordance with the applicable sections of Practice D3567.

8.2.4 *Adhesive*—Sample adhesive kits selected shall be examined for missing adhesive components and instructions for use, and missing or incorrect identification marking. Any sample adhesive kit having one or more of the defects listed shall be considered a defective unit.

## 9. Test Methods

9.1 *Sampling*—All pipe and fittings shall be tested to determine conformance to the hydrostatic proof test requirements of 7.6.3 unless otherwise agreed upon by the purchaser and the seller. The rate of sampling for the destructive tests specified in 9.2.2 to 9.2.6 (joint strength, impact resistance, boil resistance, beam strength, and cycling resistance) other tests listed shall be in accordance with the accepted statistical practice unless otherwise agreed upon between the purchaser and the seller. In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate. 7-172023

9.2 *Tests*—Sample pipe, fittings, and adhesive kits selected shall be subjected to the tests in accordance with 9.2 through 9.2.8. Any sample failing to pass any of these tests shall be considered a defective unit.

9.2.1 *Test Conditions*—Unless otherwise specified in the test method, test specimens shall be conditioned for not less than 48 h in a room maintained at 60 to 90°F (15 to 32°C) and tested at the same temperature range. Unless otherwise specified, the test pressure in the individual test methods shall have a tolerance of +10 –0 psig (68.9 kPa) and –0 psig (0 kPa).

9.2.2 *Joint Strength*—Joint assemblies containing the pipe, fittings, and adhesive shall be fabricated. The adhesive shall be applied and cured as under field conditions in accordance with the manufacturer's printed instructions. The completed test section shall be either an assembly containing the pipe and each kind of fitting to be furnished under a contract, or simply one fitting joined between two pieces of pipe. When a section containing just one fitting is used, then similar test sections containing the other kinds of fittings to be furnished must also be tested. If the test section containing the one fitting is used, the longest end-to-end dimension shall be 18 in. (457 mm) or seven times the outside diameter of the pipe, whichever is greater, but no longer than 84 in. (2.1 m). If the test section