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Standard Specification for Polyvinylidene Fluoride (PVDF) Corrosive Waste Drainage Systems[1]

This standard is issued under the fixed designation F 1673; 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.

1. Scope

1.1 This specification covers requirements for polyvinylidene drainage systems for corrosive applications. Requirements for material, pipe and fittings are included. Polyvinylidene fluoride includes emulsion/suspension polymerization and copolymers of vinylidene fluoride/hexafluoropropylene produced by either method.

1.2 These requirements apply to Schedule 40 and 80 IPS and SDR 21 pipe sizes. Pipe and fittings are to be joined by heat fusion or mechanical methods using the equipment supplied by the manufacturers.

1.3 This specification is not intended to provide for interchangeability between plastic pipe and fittings from different manufacturers, but it does allow for transition fittings for joining one manufacturer's product to another's product, provided the joining technique used is other than heat fusion.

1.4 This specification is not for polyvinylidene pressure systems.

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

1.6 Notes and appendixes are not a mandatory part of this specification.

1.7 The following safety hazard caveat pertains only to the test method portion, Section 8, 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 543 Test Method for Resistance of Plastics to Chemical Reagents[2]
D 570 Test Method for Water Absorption of Plastics[2]
D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]
D 883 Terminology Relating to Plastics[2]
D 1599 Test Method for Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings[3]
D 1600 Terminology for Abbreviated Terms Relating to Plastics[2]
D 2122 Method for Determining Dimensions of Thermoplastic Pipe and Fittings[3]
D 2321 Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe[3]
D 2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading[3]
D 2444 Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)[3]
D 2657 Practice for Heat Joining of Polyolefin Pipe and Fittings[3]
D 3222 Specification for Unmodified Poly(Vinylidene Fluoride) (PVDF) Molding, Extrusion, and Coating Materials[4]
D 3311 Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns[3]
F 412 Terminology Relating to Plastic Piping Systems[3]
F 1290 Practice for Electrofusion Joining Polyolefin Pipe and Fittings[3]
F 1498 Specification for Taper Pipe Threads (60°) and Thermoplastic Pipe and Fittings[3]

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment[5]

2.3 *Military Standard:*

MIL-STD 129 Marking for Shipment and Storage[5]

2.4 *Other Standard: Uniform Plumbing Code*[6]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions used in this specification are in accordance with the definitions given in Terminologies D 833 and F 412 and abbreviations are in accordance with Terminology D 1600, unless otherwise indicated.

3.1.2 The plumbing terminology used in this specification is in accordance with the definitions given in the *Uniform*

[1] This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.63 on DWV.
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[2] *Annual Book of ASTM Standards*, Vol 08.01.

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

[4] *Annual Book of ASTM Standards*, Vol 08.02.

[5] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

[6] Available from the International Association of Plumbing and Mechanical Officials, 20001 Walnut Drive South, Walnut, CA 91789-2825.

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Plumbing Code, unless otherwise indicated.

4. Classification

4.1 *General*—This specification covers PVDF pipe and fittings made from PVDF or VF/HFP copolymers in Schedule 40 and 80 IPS sizes and in SDR 21.

4.2 This specification also includes molded fittings and the larger sizes (8, 10, 12 in.) of fabricated fittings.

4.3 This specification covers PVDF pipe (SDR 21) made from PVDF defined by a hydrostatic design stress of 2300 psi (15.85 MPa).

5. Materials and Manufacture

5.1 Polyvinylidene fluoride (PVDF) material for pipe or fittings shall conform to the requirements of Type I or Type II PVDF as defined in Specification D 3222.

5.2 The PVDF material may contain pigment and fillers not detrimental to the pipe and fittings, provided the pipe and fittings produced meet the requirements of this specification.

5.3 *Rework Material*—Clean rework material, generated from the manufacturer's pipe and fittings products may be used by the same manufacturer, provided that the pipe or fittings produced meet the requirements of this specification.

6. Requirements

6.1 *Dimensions and Tolerances—Pipe and Fittings*:

6.1.1 *Pipe*:

6.1.1.1 Dimensions and tolerances for pipe shown in Table 1 and Table 2 shall be measured in accordance with Method D 2122. The tolerance for out-of-roundness shall apply only to pipe prior to shipment.

6.1.1.2 *Toe-In*—The outside diameter, when measured in accordance with Method D 2122, shall meet the requirements of Table 1 and Table 2 at any point within 1.5 pipe diameters or 11.8 in. (300 mm), whichever is less, to the cut end of the pipe length.

6.1.2 *Fittings*:

6.1.2.1 The minimum wall thickness of the body all fittings shall not be less than the corresponding Schedule 40 pipe size and shall be measured in accordance with Method D 2122.

6.1.2.2 Spigot ends of fittings shall conform to the diameter and out-of-roundness requirements for pipe.

6.1.2.3 Socket ends of fittings shall conform to the dimensional requirements for size and tolerances as provided by the manufacturer.

TABLE 1 Outside Diameters and Tolerances for PVDF Pipe Schedules 40 and 80 and SDR 21, in. (mm)

Nominal Pipe Size	Average Outside Diameter	Tolerance	Out-of-Roundness (Maximum Diameter Minus Minimum Diameter)
1 ¼	1.660 (42.16)	±0.005 (±0.13)	0.050 (1.28)
1 ½	1.900 (48.26)	±0.006 (±0.15)	0.060 (1.52)
2	2.375 (60.32)	±0.006 (±0.15)	0.070 (1.78)
3	3.500 (88.90)	±0.008 (±0.20)	0.080 (2.04)
4	4.500 (114.30)	±0.009 (±0.23)	0.100 (2.54)
6	6.625 (168.28)	±0.011 (±0.28)	0.100 (2.54)
8	8.625 (219.08)	±0.015 (±0.38)	0.150 (3.80)
10	10.750 (273.05)	±0.015 (±0.38)	0.150 (3.80)
12	12.750 (323.85)	±0.015 (±0.38)	0.150 (3.80)

6.1.2.4 The average minimum diameters of waterways of fittings, excluding adapters, shall be as specified in Table 3.

6.1.2.5 Taper pipe threads in any fittings shall be as specified in Specification F 1498. The tolerance shall be 1½ large or small turns from the basic thread dimension and gaged in accordance with 8.7.

6.1.2.6 The patterns, dimensions, and laying lengths of molded fittings, including adaptors, shall meet the requirements of Specification D 3311, or shall be of a proven design and allow a smooth transition of fluid flow from one direction to another.

6.1.2.7 Cleanouts, cleanout plugs, and caps as commonly used in the manufacturer's laboratory drainage system, shall have a thread size and depth sufficient to ensure that the minimum waterway sizes are maintained.

6.1.2.8 *Traps*—All traps shall have a minimum water seal of 2 in.

6.2 *Chemical Resistance*—Pipe and fittings material shall be evaluated in accordance with Test Method D 543, Procedures I and II, using the chemicals listed in 8.3. The weight change shall not exceed 2 %, nor shall the apparent tensile strength change by more than 10 %. In cases where there is a change in the apparent tensile strength greater than 10 %, a further evaluation shall be made after removal from the chemical and conditioning for 72 h. If there is a minimum of 50 % recovery of tensile strength after 72 h, and that figure is within ±10 % of the original tensile strength, the specimen shall be considered acceptable.

6.3 *Water Absorption*—Pipe and fitting materials shall not change in weight more than 0.50 % when tested in accordance with 8.4.

6.4 *System Integrity*:

6.4.1 Fused joints and associated pipe shall withstand a pressure of 50 psi (345 kPa) without leaking when tested in accordance with 8.5.1.

6.4.2 Mechanical joints shall withstand a pressure of 14.5 psi (100 kPa) without leaking when tested in accordance with 8.5.2.

NOTE 1—Mechanical joints include transition, compression, threaded, and other type mechanical joints.

6.4.3 Mechanical joints shall incorporate a positive mechanical system for axial restraint in addition to any restraint provided by friction.

6.4.4 Mechanical joints shall show no evidence of separation at the joint under Force *P* when tested in accordance with 8.6.1, nor shall they leak or show any other damage when tested in accordance with 8.6.2. Two fittings shall be tested and both shall pass.

6.5 All stainless steel parts shall be made of corrosion-resistant steel, containing not less than 16 % chromium and not less than 6 % nickel by weight.

6.6 *Sealing Rings*—Sealing rings shall be made from a material with a chemical resistance similar to PVDF.

6.7 *Flattening*—There shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 8.8.1.

6.8 *Impact Resistance*—The impact resistance testing shall be in accordance with 8.9.

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TABLE 2 Wall Thicknesses and Tolerances for PVDF Pipe Schedules 40 and 80 and SDR 21, in. (mm)

Note 1— For fittings, the wall thickness is a minimum value, except that a 10 % variation resulting from core shift is allowable. In such a case, the average of the two opposite wall thickness' shall equal or exceed the value shown in the Schedule 40 table.

Nominal Pipe Sizes	Schedule 40		Schedule 80		SDR 21, 150 psi	
	Minimum	Tolerance	Minimum	Tolerance	Minimum	Tolerance
1 ¼	0.140 (3.56)	+0.020 (+0.51)	0.191 (4.85)	+0.023 (+0.58)	0.062 (1.57)	+0.020 (+0.51)
1 ½	0.145 (3.68)	+0.020 (+0.51)	0.200 (5.08)	+0.024 (+0.61)	0.062 (1.57)	+0.020 (+0.51)
2	0.154 (3.91)	+0.020 (+0.51)	0.218 (5.54)	+0.026 (+0.66)	0.077 (1.96)	+0.020 (+0.51)
3	0.216 (5.49)	+0.026 (+0.66)	0.300 (7.62)	+0.036 (+0.91)	0.114 (2.90)	+0.026 (+0.66)
4	0.237 (6.02)	+0.028 (+0.71)	0.337 (8.56)	+0.040 (+1.02)	0.147 (3.73)	+0.028 (+0.71)
6	0.280 (7.11)	+0.034 (+0.86)	0.432 (10.97)	+0.052 (+1.32)	0.216 (5.49)	+0.034 (+0.86)
8	0.322 (8.18)	+0.039 (+0.99)	0.500 (12.70)	+0.060 (+1.52)	0.281 (7.14)	+0.039 (+0.99)
10	0.365 (9.27)	+0.044 (+1.12)	0.593 (15.06)	+0.071 (+1.80)	0.350 (8.90)	+0.044 (+1.12)
12	0.406 (10.31)	+0.049 (+1.24)	0.687 (17.45)	+0.082 (+2.08)	0.415 (10.54)	+0.049 (+1.24)

TABLE 3 Average Waterway Diameter, in. (mm)

Nominal Pipe Size	Unthreaded Fittings	Under Half Thread of Male Adapters	
	Minimum	Minimum	Maximum
1 ¼	1.227 (31.17)	1.220 (30.99)	1.280 (32.51)
1 ½	1.446 (36.73)	1.458 (37.03)	1.501 (38.13)
2	1.881 (47.78)	1.915 (48.64)	1.946 (49.43)
3	2.820 (71.63)	2.849 (72.36)	2.983 (75.77)
4	3.737 (94.92)	3.806 (96.67)	3.972 (100.89)
6	5.646 (143.41)	5.851 (148.62)	6.008 (152.53)
8	7.490 (190.25)	. . .	. . .
10	9.407 (238.94)	. . .	. . .
12	11.197 (284.40)	. . .	. . .

7. Workmanship, Finish, and Appearance

7.1 The manufacture of pipe and fittings shall be in accordance with good commercial practice, so as to produce fittings meeting the requirements of this specification. Fittings and pipe shall be homogenous throughout and free from visible cracks, holes, foreign inclusions, or injurious defects. The fittings and pipe shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

8. Test Methods

8.1 *Conditioning*—When required, condition the test specimens at 73.4 ± 3.6°F (23 ± 2°C) and 50± 5 % relative humidity, for not less than 40 h prior to the test in accordance with Procedure A of Practice D 618.

8.2 *Test Conditions*—Conduct the test in a standard laboratory atmosphere of 73.4 ± 3.6°F (23 ± 2°C) and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

8.3 *Chemical Resistance*—Determine the resistance to the following chemicals using the material quantification method in Test Method D 543.

Chemical	Percent in Water
Acetic acid	5 by volume
Acetone	5 by volume
Methyl alcohol	100
Ammonia hydroxide	10 by volume
Nitric acid	40 by volume
Sodium hydroxide	10 by weight
Sulfuric acid	20 by volume
Hydrochloric acid	20 by volume

8.4 *Water Absorption*—Three cleanly cut specimens measuring approximately 2 by 3 in. (50 by 75 mm) and having smooth edges shall be weighed to the nearest 0.001 g and immersed in distilled water at 73.4 ± 1.8°F (23 ± 1°C) for 24 h + ½−0 h, in accordance with Test Method D 570. The specimens shall be removed, wiped dry with a clean, dry cloth, and reweighed immediately. The average percent gain in weight shall be calculated to the nearest 0.01 % on the basis of the initial mass. Weight change shall be less than 0.50 % (material qualification only).

8.5 *Joint Tests—Hydrostatic Pressure Tests*:

8.5.1 *Fused Joint Pressure Test*—Six specimens of pipe, each five times the nominal diameter or a maximum of 18 in. (450 mm) in length, shall be selected at random for each size of piping and each type of system being considered. Three suitable couplings shall also be selected at random. Three joined specimens shall be prepared by joining two pipe specimens with one coupling, using the equipment and instructions supplied by the manufacturer of the system. Fill each specimen with water at 73.4 ± 3.6°F (23± 2°C) and cap, taking care to exclude all air from the system. Fix one end of the specimen to a pressurizing apparatus, and support the free end if necessary. Pressurize each specimen to 50 psi (345 kPa) for a minimum of 5 min and inspect for leaks. None of the three specimens shall leak.

8.5.1.1 This is a laboratory performance test only and is not for field use.

8.5.2 *Mechanical Joint Pressure Test*—The pressure test on mechanical joints shall be carried out on test specimens prepared in a manner similar to that described in 8.5.1, except use appropriate pipe specimens where the joint is intended to join pipes of similar or dissimilar material and sizes. Pressurize the assembly to 14.5 psi (100 kPa) for a period of 24 h +15, −0.0 min and inspect for signs of leakage. Apply this test to each size and type of joint being considered.

8.5.2.1 This is a laboratory performance test only and is not for field use.

8.6 *Mechanical Joint Pullout Test*:

8.6.1 Join two sections of pipe by a coupling, with the positive mechanical axial restraint system removed or deactivated. Mount the assembly with the outer ends of the pipe sections fastened in the clamps of a tensile testing machine. Pull the two pipe sections apart at a rate of approximately 1 in./min (25 mm/min) until at least one pipe section has separated from the coupling. Record the maximum force, *F*, applied.

8.6.2 Using the setup described in 8.6.1, subject a complete