



# Standard Specification for Perfluoro (Ethylene-Propylene) Copolymer (FEP) Plastic-Lined Ferrous Metal Pipe and Fittings<sup>1</sup>

This standard is issued under the fixed designation F 546; 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 factory-made perfluoro (ethylene-propylene) copolymer (FEP) plastic-lined ferrous metal pipe and fittings, primarily intended for conveying corrosive liquids and gases. Requirements for materials, workmanship, dimensions, design, construction, working pressures and temperatures, test methods, and markings are included.

NOTE 1—The values given in parentheses are provided for information purposes only.

NOTE 2—This specification does not include products coated with FEP nor does it define the suitability of FEP-lined components in chemical environments.

1.2 The ferrous piping products shall meet the requirements of the relevant specification listed in 1.2.1 through 1.2.3. Nominal sizes from 1 through 12 in. in 150 and 300 psi (1.0 to 2.0 MPa) ratings are covered.

NOTE 3—The FEP sealing faces may prevent achievement of the full pressure rating of the ferrous housings. For pressure limitations, the manufacturer should be consulted.

### 1.2.1 For Ferrous Pipe:

Title of Specification	ASTM Designation
Pipe, Steel, Black, and Hot-Dipped, Zinc-Coated Welded and Seamless	A 53
Seamless Carbon Steel Pipe and High-Temperature Service	A 106
Electric-Resistance-Welded Steel Pipe	A 135
Electric-Welded Low-Carbon Steel Pipe for the Chemical Industry	A 587
Seamless and Welded Austenitic Stainless Steel Pipe	A 312

### 1.2.2 For Ferrous Flanges:

Title of Specification	ASTM Designation
Forgings, Carbon Steel, for Piping Components	A 105
Forged or Rolled Steel Pipe Flanges, Forged Fittings and Valves and Parts for General Service	A 181
Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service	A 182
Carbon-Steel Castings Suitable for Fusion Welding for High-Temperature Service	A 216

Ferritic Ductile Iron for Pressure Retaining Castings for Use at Elevated Temperatures	A 395
Ductile Iron Castings	A 536

### 1.2.3 For Ferrous Fittings:

Title of Specification	ASTM Designation
Forgings, Carbon Steel, for Piping Components	A 105
Forged or Rolled Steel Pipe Flanges, Forged Fittings, and Valves and Parts for General Service	A 181
Carbon Steel Castings Suitable for Fusion Welding for High-Temperature Service	A 216
Piping Fittings Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures	A 234
Austenitic Steel Castings for High-Temperature Service	A 351
Alloy Steel Castings Specially Heat-Treated for Pressure Containing Parts Suitable for High-Temperature Service	A 389
Ductile Iron Castings	A 536
Ferritic Ductile Iron for Pressure Retaining Castings for Use at Elevated Temperatures	A 395
Ductile Iron for Pressure Containing Castings for Use at Elevated Temperatures	A 403

1.3 The FEP-lined flanged pipe and fitting assemblies are recommended for use from -20 to 300°F (-29 to 149°C). Use in specific aggressive environments may alter the above temperature range.

NOTE 4—Successful use has been reported over a range from -20 to 400°F (-29 to 204°C).

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 1600 Terminology for Abbreviated Terms Relating to Plastics<sup>2</sup>
- D 2116 Specification for FEP-Fluorocarbon Molding and Extrusion Materials<sup>3</sup>
- F 412 Terminology Relating to Plastic Piping Systems<sup>4</sup>

### 2.2 ANSI Standard

- B 16.5 Steel Pipe Flanges and Flanged Fittings<sup>5</sup>

## 3. Terminology

3.1 Definitions are in accordance with Terminology F 412, and abbreviations are in accordance with Terminology D 1600 unless otherwise specified.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F-17 on Plastic Piping Systems, and is the direct responsibility of Subcommittee F 17.11 on Composite.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>4</sup> Annual Book of ASTM Standards, Vol 08.04.

<sup>5</sup> Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.

3.2 The abbreviation for perfluoro (ethylene-propylene) co-polymer is FEP.

**4. Materials**

**4.1 Lining:**

4.1.1 *Material*—The lining shall be made from FEP resins conforming to the requirements of Type III materials as defined in Specification D 2116, except that a maximum of 1 % by weight of additives or colorants, or both, is permissible. Organic colorants, if used, shall be identified in the manufacturer’s specification.

4.1.2 *Mechanical Properties*—The minimum tensile strength and minimum elongation at yield when tested in accordance with the requirements of Specification D 2116, shall be 3000 psi (20.7 MPa) and 250 % respectively. The minimum values for tensile strength and elongation shall apply to both the longitudinal and circumferential directions.

4.1.3 *Flow Rate*—FEP resins used to manufacture the liner and molded fittings shall have a maximum flow rate of 1.6 g/10 min when tested in accordance with Specification D 2116.

**4.2 Ferrous Pipe and Fittings:**

4.2.1 The mechanical properties of the pipes and fittings shall conform to the requirements of the appropriate specification of 1.2 except as they are influenced by accepted methods of processing in the industry, for example, Van Stone flaring, bending, swaging, and welding. The carbon steel pipe and wrought fittings shall be welded or seamless steel, Schedule 40 or Schedule 80, except that Schedule 30 pipe may be used in 8, 10, and 12-in. nominal size. Schedule 20 may also be used for 12-in. nominal size with the agreement of the purchaser.

4.2.2 *Finish*—The interior surfaces of all housing shall be clean and free of mold burrs, rust, scale, or other protrusions, which may adversely affect the integrity or performance of the lining.

**4.3 Back-Up Gaskets:**

4.3.1 *General*—Back-up gaskets shall be used to cover the pipe end and gasket face of threaded or slip-on flanges unless a full radius is provided at the end of the pipe and flange. Gaskets may also be required on fittings to provide accommodation and/or elimination of sharp corners which could damage the lining.

4.3.2 *Material*—Plain gaskets meeting the temperature requirements, or perforated metallic gaskets, may be used.

**5. Finish**

5.1 The outside surface of all lined pipe and fittings, other than stainless steel, shall be coated with a corrosion-resistant primer over a properly prepared surface.

**6. Requirements**

**6.1 Dimensions:**

6.1.1 *Housings*—Housing installation dimensions are as required in the applicable material specification listed in 1.2.

6.1.2 *Wall Thickness*—Fitting linings shall have a minimum wall thickness of 3/32 in. (2.38 mm), and shall have a uniform face thickness of not less than 3/32 in. (2.38 mm). Pipe linings shall have a minimum wall thickness of 0.050 in. (1.27 mm), and the flared radius and gasket faces shall have a uniform thickness not less than 80 % of the wall thickness.

6.1.3 *FEP Face Diameter*—The outside diameter of the FEP covering the gasket face of the flange or the full face of the lap-joint stub end shall not be less than the diameter specified in Table 1 and they shall be concentric within 1/16 in. (1.6 mm).

6.1.4 *Tolerances*—Tolerances for pipe, flanges, and fittings shall be as specified in Table 2. Bolt holes in both flanges on a fixed-flange spool shall straddle the same center line to facilitate alignment. Finished lined (plastic face to plastic face) fabricated fittings shall conform to the nominal face-to-face, etc. as specified in ANSI B 16.5 with the applicable tolerances.

**6.2 Flange Construction:**

6.2.1 Screw-type flanges shall be secured in position to prevent inadvertent turning of the flange.

6.2.2 Socket-type flanges shall be fully back-welded to the pipe housing and the inside surfaces of the socket flanges shall be welded and ground smooth.

6.2.3 Slip-on flanges shall be fully backwelded.

NOTE 5—No welding shall be done on lined components.

6.2.4 Lap-end (or Van Stone) flanged ends may be manufactured by standard forming techniques or by using fully welded stub ends or collars. Lap-joints shall not contain any cracks or buckles.

NOTE 6—The use of lap-joint flanges in a piping system may simplify alignment.

6.3 *Venting*—Each pipe and fittings shall be provided with a venting system that will release any gases between the liner and the housing (this system will also indicate any leakage through the linear). Two systems that provide adequate venting are a series of 1/16 to 3/32 in. (1.6 to 4-mm) diameter holes in the housings or a helical groove system inside the housing that connects flange vents.

NOTE 7—Vent holes should not be plugged with paint, cement, etc., since this negates the intended purpose listed in 6.3.

**6.4 Workmanship:**

6.4.1 Pipe and fitting linings shall show no evidence of pinholes, porosity, or cracks when inspected in accordance with 6.5.2. The linings shall fit snugly inside the pipe and fitting housings. Any bulges or other obvious indication of poor contact with the housing shall be cause for rejection.

6.4.2 The gasket face of the FEP linings shall be free of surface defects that could impair sealing effectiveness. Scratches, dents, nicks, or tool marks on the gasket surface shall not be deeper than 10 % of the wall thickness.

**6.5 Performance:**

6.5.1 *Qualification*—FEP-lined pipe and fittings must be

**TABLE 1 FEP Face Diameter**

Nominal Pipe Size, in.	Minimum FEP Face Diameter, in.
1	1 7/8 (48)
1.5	2 1/16(68)
2	3 7/16 (87)
3	4 5/8(117)
4	5 15/16 (151)
6	8 (203)
8	10 1/16(256)
10	12 1/4 (311)
12	14 3/8 (365)