



Designation: D 2116 – 97

Standard Specification for FEP-Fluorocarbon Molding and Extrusion Materials ¹

This standard is issued under the fixed designation D 2116; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

1.1 This specification covers melt processable molding and extrusion materials of FEP-fluorocarbon resin. This specification does not cover recycled FEP materials. These FEP resins are copolymers of tetrafluoroethylene and hexafluoropropylene or modified FEP-fluorocarbon resins containing not more than 2 % by weight of other fluoromonomers.

1.2 The values stated in SI units as detailed in Practice E 380E 380 are to be regarded as the standard and the principles of Practice E 380E 380 incorporated herein.

NOTE 1—Although this specification and ISO 12086-1 and ISO 12086-2 differ in approach or detail, data obtained using either are technically equivalent.

1.3 The following precautionary caveat pertains only to the test methods portion, Section 11, 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 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials²
- D 618 Practice for Conditioning Plastics for Testing³
- D 638 Test Method for Tensile Properties of Plastics³
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement³
- D 883 Terminology Relating to Plastics³
- D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer³
- D 1600 Terminology for Abbreviated Terms Relating to Plastics³

- D 1898 Practice for Sampling of Plastics³
- D 3295 Specification for PTFE Tubing⁴
- D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis⁴
- D 3892 Practice for Packaging/Packing of Plastics⁴
- E 380 Practice for Use of the International System of Units (SI) (the Modernized Metric System)⁵
- E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁵
- 2.2 ISO Standards:⁶
 - ISO 12086-1:1995 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 1
 - ISO 12086-2:1995 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2

3. Terminology

3.1 Definitions:

3.1.1 *General*—The definitions given in Terminology D 883D 883 are applicable to this specification.

3.2 Abbreviated Terms:

3.2.1 *General*—The abbreviated terms given in Terminology D 1600D 1600 are applicable to this specification.

4. Classification

4.1 This specification covers four types of FEP-fluorocarbon resin supplied in pellet form classified according to their melt flow rate.

4.2 A one-line system may be used to specify materials covered by this specification. The system uses predefined cells to refer to specific aspects of this specification, illustrated as follows:

Specification			
Standard Number	Type		Special notes
Block	:	:	:
:	:	:	:

Example: Specification D 2116 – 95, I

¹ This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials (Section D20.15.12).

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² Annual Book of ASTM Standards, Vol 10.01.

³ Annual Book of ASTM Standards, Vol 08.01.

⁴ Annual Book of ASTM Standards, Vol 08.02.

⁵ Annual Book of ASTM Standards, Vol 14.02.

⁶ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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

For this example, the line callout would be Specification D 2116 – 95,I and would specify an FEP-fluorocarbon resin that has all of the properties listed for that type, grade, and class in the appropriate specified properties or tables, or both, in the specification identified. A comma is used as the separator between the standard number and the type.⁷ A provision for special notes is included so that other information can be provided when required. An example would be in Specification D 3295D 3295 where dimensions and tolerances are specified for each AWG size within type and class. When special notes are used, they should be preceded by a comma.

5. General Requirements

5.1 The materials shall be of uniform composition and so prepared as to conform to the requirements of this specification.

5.2 The material described in this specification shall be free of foreign matter to such a contamination level as may be agreed upon between the purchaser and the seller.

6. Detail Requirements

6.1 The average test result of the lot shall conform to the requirements prescribed in Table 1 and Table 2 when tested by

TABLE 1 Detail Requirements for Test on Molding Materials

	Type I	Type II	Type III	Type IV
Melt flow rate, g/10 min:				
Load, 5000 g:				
Min	4.0	>12.0	0.8	2.0
Max	12.0	...	2.0	3.9

TABLE 2 Detail Requirements for Molded Test Specimens

	Type I	Type II	Type III	Type IV
Specific gravity 23/23°C (73/73°F)				
Min	2.12	2.12	2.12	2.12
Max	2.17	2.17	2.17	2.17
Melting point, °C	260 ± 20	260 ± 20	260 ± 20	260 ± 20
Tensile strength, 23°C (73°F), min:				
MPa	17.3	14.5	20.7	18.7
psi	2500	2100	3000	2700
Elongation, 23°C (73°F), min, %	275	240	275	275
Dielectric constant, max:				
At 10 ³ Hz	2.15	2.15	2.15	2.15
At 10 ⁶ Hz	2.15	2.15	2.15	2.15
Dissipation factor, max:				
At 10 ³ Hz	0.0003	0.0003	0.0003	0.0003
At 10 ⁶ Hz	0.0007	0.0009	0.0007	0.0007

the procedures specified herein. Table 2 lists those tests requiring a specimen molded as described in Section 8.

7. Sampling

7.1 Unless otherwise agreed upon between the purchaser and the seller the materials shall be sampled in accordance with Practice D 1898D 1898. Adequate statistical sampling shall be considered an acceptable alternative.

8. Test Specimens

8.1 Prepare a molded sheet 1.5 ± 0.3 mm (0.060 ± 0.010 in.) thick. Use a picture-frame-type chase having a suitable blanked-out section and thickness to produce the desired sheet. Use clean aluminum foil, 0.13 to 0.18 mm (0.005 to 0.007 in.) thick, in contact with the resin. A high-temperature mold release agent may be sprayed on the aluminum foil to help prevent the foil from sticking to the sheet. Use steel molding plates at least 1.0 mm (0.040 in.) thick and of an area adequate to cover the chase.

8.2 Lay down and smoothly cover one plate with a sheet of aluminum foil. Place the mold chase on top of this assembly. Place within the mold chase sufficient molding material to produce the required sheet in such a manner that the polymer charge is a mound in the middle of the chase. Place a second sheet of aluminum foil on top of the granules and add the top mold plate. Place the assembly in a compression molding press having platens that have been heated to 372 ± 5°C (702 ± 9°F).

8.3 Bring the platens to incipient contact with the mold assembly. Hold for 2 to 4 min without pressure. Apply approximately 1 MPa (145 psi) and hold for 1 to 1.5 min. Then apply 2 to 4 MPa (290 to 580 psi) and hold for 1 to 1.5 min. Maintain the press at 372 ± 5°C (702 ± 9°F) during these steps. Remove the assembly from the press and place between two 20 ± 7-mm (0.75 ± 0.25-in.) steel plates whose temperature is less than 40°C (104°F).

8.4 When the sheet is cool enough to touch (about 50 to 60°C (122 to 140°F)), remove aluminum foil from the sheet. (If the sheet is allowed to cool to room temperature, the aluminum

foil cannot be pulled free.)

9. Conditioning

9.1 For tests of specific gravity and tensile properties, condition the molded test specimens in accordance with Procedure A of Practice D 618D 618 for a period of at least 4 h prior to test. The other tests require no conditioning.

9.2 Conduct tests at the Standard Laboratory Temperature of 23 ± 2°C (73.4 ± 3.6°F) for determination of specific gravity and tensile properties only. Since this resin does not absorb water, the maintenance of constant humidity during testing is

⁷ See the ASTM Form and Style Manual, available from ASTM Headquarters.