



Designation: D2116 – 07

# Standard Specification for FEP-Fluorocarbon Molding and Extrusion Materials<sup>1</sup>

This standard is issued under the fixed designation D2116; 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.

*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 IEEE/ASTM SI-10<sup>3</sup> are to be regarded as the standard. The values given in parentheses are for information only.

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:<sup>2</sup>

- D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation
- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D883 Terminology Relating to Plastics
- D1238 Test Method for Melt Flow Rates of Thermoplastics

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

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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.

by Extrusion Plastometer

- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D3295 Specification for PTFE Tubing, Miniature Beading and Spiral Cut Tubing
- D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry
- D3892 Practice for Packaging/Packing of Plastics
- E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method
- IEEE/ASTM SI-10 Use of the International System of Units (SI): The Modern Metric System<sup>3</sup>

2.2 ISO Standards:<sup>4</sup>

- ISO 12086-1 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 1
- ISO 12086-2 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2

## 3. Terminology

3.1 Definitions:

- 3.1.1 *General*—The definitions given in Terminology D883 are applicable to this specification.
- 3.1.2 *lot, n*—one production run or a uniform blend of two or more production runs.

3.2 *Abbreviated Terms*:

- 3.2.1 *General*—The abbreviated terms given in Terminology D1600 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 shall 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:

<sup>3</sup> Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428–2959.

<sup>4</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.

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

Example: Specification D2116 – XX,

I

For this example, the line callout would be Specification D2116 – XX, 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.<sup>5</sup> A provision for special notes is included so that other information can be provided when required. When special notes are used, precede them with 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 is 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 <sup>3</sup> Hz	2.15	2.15	2.15	2.15
At 10 <sup>6</sup> Hz	2.15	2.15	2.15	2.15
Dissipation factor, max:				
At 10 <sup>3</sup> Hz	0.0003	0.0003	0.0003	0.0003
At 10 <sup>6</sup> 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.

<sup>5</sup> See the ASTM *Form and Style Manual*, available from ASTM Headquarters.

## 7. Sampling

7.1 Sampling shall be statistically adequate to satisfy requirements of **13.1.1**.

## 8. Test Specimens

8.1 Prepare a molded sheet  $1.5 \pm 0.3$  mm ( $0.060 \pm 0.010$  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 shall 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  $372 \pm 5^\circ\text{C}$  ( $702 \pm 9^\circ\text{F}$ ).

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  $372 \pm 5^\circ\text{C}$  ( $702 \pm 9^\circ\text{F}$ ) during these steps. Remove the assembly from the press and place between two  $20 \pm 7$ -mm ( $0.75 \pm 0.25$ -in.) steel plates whose temperature is less than  $40^\circ\text{C}$  ( $104^\circ\text{F}$ ).

8.4 When the sheet is cool enough to touch (about  $50$  to  $60^\circ\text{C}$  ( $122$  to  $140^\circ\text{F}$ )), remove aluminum foil from the sheet. (If the sheet is allowed to cool to room temperature, the aluminum foil cannot be pulled free.)