



Standard Specification for Perfluoroalkoxy (PFA)-Fluorocarbon Resin Molding and Extrusion Materials¹

This standard is issued under the fixed designation D 3307; 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 PFA-perfluoro(alkoxy alkane) fluorocarbon resin. The materials are copolymers of TFE-fluorocarbon resins containing perfluoroalkoxy side chains.

1.2 This specification does not cover recycled plastics.²

1.3 The tests involved are intended to provide information for identifying the materials covered. It is not the function of this specification to provide engineering data for design purposes. Specimens prepared by injection molding or extrusion could yield test results that may vary from the values in this specification.

1.4 The values stated in SI units³ are to be regarded as the standard. The values given in parentheses are for information only.

1.5 The following precautionary caveat pertains only to the test methods portions, Sections 8 and 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 and health practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—This specification, ISO 12086–1(1995), and ISO 12086–2(1995) differ in approach or detail. Data obtained using either may not be technically equivalent.

2. Referenced Documents

2.1 ASTM Standards:

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials⁴

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing⁵

D 638 Test Method for Tensile Properties of Plastics⁵

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

Current edition approved Sept. 10, 2000. Published November 2000. Originally published as D 3307 – 74. Last previous edition D 3307 – 98.

² As defined in Guide D 5033.

³ As defined in IEEE/ASTM SI 10.

⁴ Annual Book of ASTM Standards, Vol 10.01.

⁵ Annual Book of ASTM Standards, Vol 08.01.

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement⁵

D 883 Terminology Relating to Plastics⁵

D 1238 Test Method for Flow Rates of Thermoplastics by Extrusion Plastometer⁵

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique⁵

D 1600 Terminology for Abbreviated Terms Relating to Plastics⁵

D 3892 Practice for Packaging/Packing of Plastics⁶

D 4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry⁷

D 5033 Guide for the Development of Standards Relating to the Proper Use of Recycled Plastics⁷

E 177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods⁸

E 691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method⁸

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System⁸

2.2 ISO Standards:

ISO 12086–1 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 1⁹

ISO 12086–2 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2⁹

3. Terminology

3.1 **Definitions**—Definitions are in accordance with Terminology D 883.

3.1.1 **lot, n**—one production run or a uniform blend of two or more productions runs.

4. Classification

4.1 This specification covers six types of PFA-fluorocarbon resins supplied in pellet form for molding and extrusion.

4.2 A one-line system may be used to specify materials covered by this specification. The system uses predefined cells

⁶ Annual Book of ASTM Standards, Vol 08.02.

⁷ Annual Book of ASTM Standards, Vol 08.03.

⁸ Annual Book of ASTM Standards, Vol 14.02.

⁹ Available from the American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

to refer to specific aspects of this specification, as illustrated as follows:

Specification					
Standard Number	: Type	: Grade	: Class	:	Special Notes
Block	:	:	:	:	
:	:	:	:	:	
Example: Specification D 3307 – 98, I					

In this standard, the only specifications are type; no grade or class is required. A comma is used as the separator between the standard number and the type. Separators are not needed between the type, grade, and class.¹⁰ Provision for special notes is included so that other information can be provided when required. An example would be in Specification D 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 materials 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 materials covered by this specification shall conform to the requirements prescribed in Table 1 and Table 2 when tested by the procedures specified herein. Table 2 lists those tests requiring a specimen molded as described in 9.1.

7. Sampling

7.1 Sampling shall be statistically adequate to satisfy the requirements of 10.4.

8. Number of Tests

8.1 One set of test specimens as prescribed in Section 9 shall be considered sufficient for testing each sample. The average result of the specimens tested shall conform to the requirements of this specification.

9. Test Methods

9.1 Test Specimens:

9.1.1 Prepare a molded sheet 1.5 ± 0.25 -mm (0.060 $\pm$ 0.010-in.) thick. Use a picture-frame-type chase having a

¹⁰ See ASTM Form and Style Manual.

TABLE 2 Detailed Requirements for Molded Specimens

	Type I	Type II	Type III	Type IV	Type V	Type VI
Specific gravity, 23°C (73.4°F): ^A						
min	2.12	2.12	2.12	2.12	2.12	2.12
max	2.17	2.17	2.17	2.17	2.17	2.17
Tensile strength, min, 23°C (73.4°F): ^B						
MPa	20.68	25	20.68	22.75	25.51	22.75
psi	3000	3625	3000	3300	3700	3300
Elongation, 23°C (73.4°F), min, % ^B	275	300	275	275	260	275
Dielectric constant, max: ^C						
10 ² Hz	2.2	2.2	2.2	2.2	2.2	2.2
10 ⁶ Hz	2.2	2.2	2.2	2.2	2.2	2.2
Dissipation factor, max: ^C						
10 ²	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
10 ⁶	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005

^ASee 9.5 of this specification.

^BSee 9.6 of this specification.

^CSee 9.7 of this specification.

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.

9.1.2 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 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 $380 \pm 5^\circ\text{C}$ ($716 \pm 10^\circ\text{F}$).

9.1.3 Bring the press 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 $380 \pm 5^\circ\text{C}$ ($716 \pm 10^\circ\text{F}$) 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).

9.1.4 When the sheet is cool enough to touch (about 50 to 60°C (122 to 140°F)), remove the aluminum foil from the sheet. (If the sheet is allowed to cool to room temperature, the aluminum foil cannot be pulled free.)

9.2 Conditioning:

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

9.2.2 Conduct tests at the Standard Laboratory Temperature of $23 \pm 2^\circ\text{C}$ ($73.4 \pm 3.6^\circ\text{F}$) for determination of specific gravity, tensile properties, and electrical properties only. Since the resin does not absorb water, the maintenance of constant humidity during testing is not necessary. Conduct tests for melt flow rate and melting endotherm under ordinary laboratory conditions.

9.3 Melt Flow Rate—Determine the melt flow rate in

TABLE 1 Detail Requirements for Test on Molding and Extrusion Materials

	Type I	Type II	Type III	Type IV	Type V	Type VI
Melt flow, ^A g/10min:						
min	>7	1	>3	>10	1	>3
max	18	3	7	30	3	10
Melting endotherm peak, ^B min, °C	300	300	300	285	285	285

^ASee 9.3 of this specification.

^BSee 9.4 of this specification.