Designation: D3307 – 16

Standard Specification for Perfluoroalkoxy (PFA) Resin Molding and Extrusion Materials[1]

This standard is issued under the fixed designation D3307; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers melt processable molding and extrusion materials of Perfluoroalkoxy (PFA) resin. The materials are copolymers of tetrafluoroethylene and perfluoroalkoxy.

1.2 This specification is intended to provide a means for calling out plastic materials used in the fabrication of end items or parts. It is not intended for the selection of materials. Material selection should be made by those having expertise in the plastics field after careful consideration of the design and the performance required of the part, the environment to which it will be exposed, the fabrication process to be employed, the costs involved, and the inherent properties of the material other than those covered by this specification.

1.3 This specification does not cover recycled plastics.

1.4 The values stated in SI units[2] are to be regarded as 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(2006), and ISO 12086–2(2006) differ in approach or detail. Data obtained using either may not be technically equivalent.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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 by Extrusion Plastometer
D1600 Terminology for Abbreviated Terms Relating to Plastics
D1708 Test Method for Tensile Properties of Plastics by Use of Microtensile Specimens
D3892 Practice for Packaging/Packing of Plastics
D4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry
E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods
IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.2 *ISO Standards:*[4]

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*—Definitions are in accordance with Terminologies D883 and D1600.

[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).

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[2] As defined in IEEE/ASTM SI-10.

[3] 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.

[4] 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**

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 18 types of PFA-fluorocarbon resins supplied in pellet form classified according to their melting points. The resins of each type are divided into two to four grades according to their melt flow rates.

4.2 A one-line system is 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 Block	Type	Grade	Class	Special Notes
Example: Specification D3307 – 06,	I			

In this standard, the specifications are type and grade. A comma is used as the separator between the standard number and the type, and a separator is not needed between the type and grade.[5]

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 at the best commercially practical level.

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 1.50 ± 0.25-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 sprayed on the aluminum foil helps to 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 a sheet of aluminum foil down to smoothly cover one plate. 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 ± 5°C (716 ± 10°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 ± 5°C (716 ± 10°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 D618 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 ± 2°C (73.4 ± 3.6°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 accordance with Test Method D1238, Test Method A or B, with a temperature of 372 ± 1°C and using a total load, including piston, of 5000 g. The same requirements apply for the use of corrosion-resistant alloy for the barrel lining, orifice, and piston tip.

9.4 *Melting Endotherm Peak Temperature:*

9.4.1 Use differential scanning calorimetry (DSC) as described in Test Method D4591 for this determination. For specification purposes, the test shall be run on a 10 ± 2-mg specimen cut from a pellet of the resin as sold or received. The heating rate shall be run at 10 ± 1°C (18 ± 1.8°F)/min to 350°C (626°F). Two peaks during the initial melting test are observed occasionally. In this case, the peak temperatures shall be reported as T_l for the lower temperature and T_u for the upper temperature. The peak temperature of the peak largest in height shall be reported as the melting point if a single value is required. If a peak temperature is difficult to discern from the curves, that is, if the peak is rounded rather than pointed, straight lines shall be drawn tangent to the sides of the peak.

[5] See *ASTM Form and Style Manual.*

TABLE 1 Detail Requirements for Test on Molding and Extrusion Materials

	Type I	Type II	Type III	Type IV	Type V	Type VI	Type VII	Type VIII	Type IX	Type X	Type XI	Type XII	Type XIII	Type XIV	Type XV	Type XVI	Type XVII	Type XVIII
Melt flow,[A] g/10min:																		
min	>7	1	>3	>10	1	>3	10	2	>24	1	≥4	≥8	≥18	≥63	1	>2.5	>5	>9
max	19	3	7	30	3	10	17	5	≤50	4	8	18	40	81	2.5	5	9	13
Melting endotherm peak temperature,[B] min, °C	300	300	300	285	285	285	280	280	300	265	265	265	265	290	311	311	311	311

[A] See 9.3 of this specification.
[B] See 9.4 of this specification.