Designation: D7472 – 09 (Reapproved 2014)

Standard Specification for EFEP-Fluoropolymer Molding and Extrusion Materials[1]

This standard is issued under the fixed designation D7472; 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 melt processible molding and extrusion materials of EFEP-fluoropolymer. The EFEP resin is a copolymer of ethylene, tetrafluoroethylene, and hexafluoropropylene.

1.2 This specification does not cover blended materials and does not cover recycled materials.

1.3 The values stated in SI units as detailed in IEEE/ASTM SI-10 are to be regarded as the standard. The values given in parentheses are for information only.

1.4 The following safety hazards caveat pertains only to the test method 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.*

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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

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

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

IEEE/ASTM SI-10 Use of the International System of Units (SI): The Modem Metric System

2.2 *ISO Standards:*[3]

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 *General*—The terminology given in Terminology D883 is applicable to this specification.

3.2 *Definitions:*

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

3.4 *General*—The abbreviated terms given in Terminology D1600 are applicable to this specification.

4. Classification

4.1 This specification covers two types of fluoropolymer supplied in pellet form classified according to their melting points. The resins of each type are divided into one to two grades in accordance with their melt flow rate.

4.2 An 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, as illustrated as follows:

Specification _____
Standard Number : Type : Grade : Special
Block : : : Notes
: : : :

Example: Specification D7472 - 09, I2

For this example, the line callout shall be, Specification D7472 – 09, I2 and shall specify a fluoropolymer that has all of the properties listed for that type and grade in the appropriate

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[2] 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.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

TABLE 1 Specific Gravity, Melting Point, and Flow Rate Requirements

Type	I		II
Grade	1	2	1
Specific gravity,			
min:	1.71	1.71	1.71
max:	1.77	1.77	1.77
Melting point, °C,			
min:	155	155	190
max:	170	170	200
Flow rate, g/10 min,			
min:	25.0	3.0	20.0
max:	50.0	8.0	30.0

specified properties, or tables, or both, in the specification identified. A comma is used as the separator between the standard number and the type. Separators are not needed between the type and grade.[4]

5. General Requirements

5.1 The material 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 shall be agreed upon between the purchaser and the seller.

6. Performance Requirements

6.1 The average test result of the lot shall conform to the requirements prescribed in Tables 1 and 2 when tested by the procedures specified herein. Table 2 lists those tests requiring a specimen molded as described in Section 8.

7. Sampling

7.1 The materials shall be sampled in accordance with an adequate statistical sampling program.

8. Specimen Preparation

8.1 Prepare a molded sheet 1.5 ± 0.3 mm (0.06 ± 0.01 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. Spraying a high-temperature mold release agent on the aluminum foil will help prevent the foil from sticking to the sheet. Use steel molding plates at least 1.0 mm (0.040 in.) thick and have 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 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 265 ± 5°C (509 ± 9°F).

8.3 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 265 ± 5°C (509 ± 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.)

[4] See the ASTM Form and Style Manual, available from ASTM Headquarters.

TABLE 2 Detail Requirements for Molded Test Specimens for All Resins in This Specification

Type	I		II
Grade	1	2	1
Tensile strength, min, psi:	5800	4300	4300
Elongation, min, %:	370	370	370
Dielectric constant,			
10^3 Hz, max:	2.6	2.6	2.6
10^6 Hz, max:	2.6	2.6	2.6
Dissipation factor,			
10^3 Hz, max:	0.001	0.001	0.001
10^6 Hz, max:	0.01	0.01	0.01

9. Conditioning

9.1 For tests of specific gravity and tensile 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 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 not necessary. Conduct tests for melt flow rate and melting point under ordinary laboratory conditions.

10. Packaging and Package Marking

10.1 *Packaging*—The material shall be packaged in standard commercial containers so constructed as to ensure acceptance by common or other carriers for safe transportation to the point of delivery unless otherwise specified in the contract or order.

10.2 *Marking*—Shipping containers shall be marked with the name of the material, type, grade, and quantity therein.

10.3 All packing, packaging, and marking provisions of Practice D3892 shall apply to this specification.

11. Test Methods

11.1 *Melt Flow Rate:*

11.1.1 *Principle of Test Method*—The melt flow rate shall be determined at 265 ± 1°C using Procedure A or B described in Test Method D1238. The extrusion plastometer to be used is

described in Test Method D1238 modified by use of corrosion resistant alloy for the barrel lining, orifice, piston tip, and orifice securing device. Use pellets or pieces of approximately the same size cut from molded or extruded forms. Strips about 6 mm (¼ in.) by 76 mm (3 in.) long also load readily into the barrel. Refer to Table 2 or Table 3 of Test Method D1238 for the amount of charge which shall be adjusted accordingly with melt density of EFEP being used. Usually the charge amount is 5 to 15 g. Flow rate shall be measured using a load of 5000 g. Collect five successive cuts for the manual method.

11.1.2 *Precision and Bias*—Precision and bias for this test method are to be determined by round-robin testing.

11.2 *Specific Gravity*—Determine the specific gravity of a specimen approximately 25 by 38 mm (1 by 1.5 in.) blanked or cut from the molded plaque (see Section 8) in accordance with the procedures described in Test Methods D792. Add two drops of a wetting agent to the water in order to reduce the surface tension and ensure complete wetting of the specimen.

11.3 *Melting Point:*

11.3.1 *Melting Characteristics by Thermal Analysis*—Use differential scanning calorimetry (DSC) as described in Test Method D3418 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 265°C (509°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. The temperature corresponding to the point where these lines intersect beyond the peak shall be taken as the peak temperature.

11.4 *Tensile Properties:*

11.4.1 Cut five specimens with the microtensile die shown in Figure 1 of Test Method D1708. The die shall be of the steel-rule or solid metal type of curvature of 5 ±0.5-mm (0.2 ± 0.02-in.) type. Determine the tensile properties in accordance with the procedures described in Test Method D638 except that the specimens used shall be as detailed above, the initial jaw separation shall be 22.2 ± 0.13 mm (0.875 ± 0.005 in.), and the speed of testing shall be 50 ± 5 mm/min (2 ± 0.2 in./min). Clamp the specimens with essentially equal lengths in each jaw. Determine the elongation from the chart, expressing it as a percentage of the initial jaw separation.

11.5 *Dielectric Constant and Dissipation Factor*—Determine dielectric constant and dissipation factor in accordance with Test Methods D150. Testing shall be done at 10^3 Hz and 10^6 Hz.

12. Number of Tests

12.1 One set of test specimens as prescribed in Section 11 shall be considered sufficient for testing each sample. The average result of the samples tested shall conform to the requirements of this specification.

13. Certification and Inspection

13.1 Inspection and certification of the material supplied with reference to this specification shall be for conformance to the requirements specified herein.

13.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of melt flow rate and melting point.

13.3 Periodic-check inspection with reference to a specification shall consist of the tests for all requirements of the material under the specification. Inspection frequency shall be adequate to ensure the material is certifiable in accordance with 13.4.

13.4 Certification shall be that the material was manufactured by a process in statistical control, sampled, tested and that the average values for the lot meet the requirements of the specification.

13.5 *Reports*—When specified in the purchase order or contract, a report of the test results shall be furnished. The report shall consist of results of the lot-acceptance inspection for the shipment.

14. Keywords

14.1 copolymer of ethylene, tetrafluoroethylene, and hexafluoropropylene ; EFEP copolymer; ETFE copolymer; ethylene copolymer; ethylene-tetrafluoroethylene copolymer; fluoropolymer; tetrafluoroethylene copolymer; TFE copolymer