Designation: D6040 – 12

Standard Guide to Standard Test Methods for Unsintered Polytetrafluoroethylene (PTFE) Extruded Film or Tape[1]

This standard is issued under the fixed designation D6040; 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 guide identifies test methods to use in evaluating unsintered extruded films or tapes manufactured from polytetrafluoroethylene.

1.2 The values stated in SI units as detailed in IEEE/ASTM SI 10, are to be regarded as standard.

1.3 *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 test method is equivalent to ISO 12086-2:2006 in the measurement of tensile properties, specific gravity, and dielectric constant. These are in ISO 12086-2:2006, sections 8.2.2, 10.6 and 8.1.1. It is not equivalent to ISO 12086-2:2006 in any other measurement or section..

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D257 Test Methods for DC Resistance or Conductance of Insulating Materials

D374 Test Methods for Thickness of Solid Electrical Insulation

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D883 Terminology Relating to Plastics

D1711 Terminology Relating to Electrical Insulation

D3776 Test Methods for Mass Per Unit Area (Weight) of Fabric

F335 Terminology Relating to Electrostatic Imaging

F412 Terminology Relating to Plastic Piping Systems

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

2.2 *ISO Standard:*

ISO 12086-2:2006 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2: Preparation of Test Specimens and Determination of Properties[3]

3. Terminology

3.1 *Definitions:*

3.1.1 Definitions are in accordance with Test Methods D257 and Terminologies D883 and D1711, unless otherwise specified.

3.1.2 *apparent density, n*—the weight per unit volume of a material including voids inherent in the material as tested, see Terminology F412.

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *film, n*—full-width material received as finished film.

3.2.2 *tape, n*—material that has been slit from the finished film.

3.2.3 *volume resistivity, n*—the volume resistance (in ohm-centimetres) between opposite faces of a material where the values are obtained by the measure of resistance to electrical current between electrodes placed in contact with the opposing surfaces of the sample (see Terminology F335).

4. Test Specimens

4.1 The number of test specimens shall be in accordance with the requirements of the individual test methods.

5. Conditioning

5.1 Condition the tape for 4 h and conduct tests at the standard laboratory temperature of 23 ± 2°C [73.4 ± 3.6°F],

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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.

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

unless otherwise specified in the test methods or required in a specification. Since the tape or film does not absorb water, the maintenance of constant humidity during testing is not important.

6. Width

6.1 Determine width measurements using a steel scale having divisions at a minimum of 0.5-mm [1⁄64-in.] intervals.

6.2 Test at least one specimen from each lot.

6.3 Each test specimen shall be approximately 450 mm [18 in.] in length. Place the specimens on a hard smooth surface. Measure the width perpendicular to the edge of the steel scale, at three approximately equally spaced points along the length.

6.4 Report the average width in millimetres [or inches] plus the maximum and minimum values if they are required by a specification.

7. Thickness

7.1 Measure thickness of the tape and film in accordance with Test Methods D374. Test Method D shall be the preferred method. The force on the foot shall not exceed 300 g. Test Method B shall not be used as the film is compressible, and there is no restraint on how much compression is used.

NOTE 2—Alternate methods and equipment are permitted based on documented agreement between producer and buyer.

7.2 *Report:*

7.2.1 Report the average thickness to the nearest 0.0025 mm [0.0001 in.] plus the maximum and minimum, if specified.

7.2.2 Report the test method from Test Methods D374 if other than Test Method D is used.

8. Tensile Properties

8.1 Determine tensile strength and elongation in accordance with Test Methods D882. Calculate tensile strength and percentage elongation from the values at the maximum load.

NOTE 3—Unsintered PTFE does not exhibit a clean break as is normal for most thin plastic sheeting.

NOTE 4—In some industries elongation at material rupture is important to process control. In such cases it is permissible to include this information as well when agreed to between producer and buyer.

8.2 Randomly select five specimens per lot and test.

8.3 *Report:*

8.3.1 Report the average tensile strength and the minimum and maximum values in megapascals (MPa) (pound-force per square inch (psi)).

8.3.2 Report the average percentage elongation at maximum load and the minimum and maximum values.

9. Specific Gravity (Relative Density)

9.1 Determine specific gravity in accordance with Test Method A of Test Methods D792. Other equipment shown to give comparable results may be used.

NOTE 5—Test Methods D792 can generally be used as PTFE film or tape typically exhibits hydrophobic characteristics.

NOTE 6—Especially useful for this test, has been the electronic densimeter, Model ED-120 T.[4]

NOTE 7—A volume method (apparent density) may be used providing that the testing error is held to less than one third of the total allowable variance. Calculate the density as follows:

$$D = W_g / V \quad (1)$$

where:

D = apparent density of the specimen, g/cm^3,
W_g = weight of specimen, g, and
V = volume of specimen, cm^3.

9.2 Test one specimen for each lot.

10. Residual Extrusion Aids or Other Volatile Components

10.1 Determine the percentage of volatile material using a minimum 35-gram sample and test temperature 218 ± 5°C (425 ± 10°F), and test for 1.5 hours. Allow sample to cool for a minimum of 30 minutes in an environment that prevents condensation. Calculate the loss using the pre and post-heated sample weights and a 0.0001 gram analytical balance.

NOTE 8—Commercially available equipment designed to perform volatile testing is acceptable in place of this test method.

10.2 Test one specimen for each lot.

11. Dielectric Constant

11.1 This test method covers the determination of relative permittivity of electrical insulating materials and should be performed in accordance with Test Methods D150 using a microelectrode system at a frequency of 1 MHz.

NOTE 9—The results are offered as proof of consistency of lot to lot of material that usually is to be processed further. The processing may result in significant change in the dielectric constant. The test results, therefore, are used primarily to ensure product uniformity of the film or tape as received.

11.2 Test one specimen per lot.

12. Volume Resistivity

12.1 Perform the test in accordance with Test Methods D257.

NOTE 10—The results are offered as proof of consistency of lot to lot of material that usually is to be processed further. The processing may result in significant change in the dielectric constant. The test results, therefore, are used primarily to ensure product uniformity of the film or tape as received.

12.2 Randomly select one specimen per lot and test.

13. Dielectric Breakdown Voltage

13.1 Determine the dielectric breakdown voltage in accordance with Test Method A, Short Time Test of Test Methods D149.

13.2 Randomly select five specimens per lot and test.

[4] The sole source of supply of the apparatus known to the committee at this time is Testing Machines, Inc., 400 Bayview Avenue, Amityville, NY 11701. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.

13.3 The voltage rate of rise shall be 500 V/s.

13.4 Perform the test in air at standard laboratory conditions unless otherwise specified.

13.5 Use Type 3 electrodes as described in Table 1 of Test Method D149 shall be used.

13.6 Give special attention to the hazards listed in Test Methods D149.

NOTE 11—Dielectric breakdown voltage may not be applicable to some tapes due to width constraints.

14. Unit Weight

14.1 Determine unit weight in accordance with Test Methods D3776.

14.2 Randomly select one specimen per lot and test.

15. Keywords

15.1 dielectric breakdown voltage; dielectric constant; elongation; lubricated PTFE; paste extruded PTFE; PTFE; specific gravity; tensile properties; unsintered PTFE; virgin; volatiles; volume resistivity

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue, D6040 - 06, that may impact the use of this standard. (August 1, 2012)

(1) Removed reference to withdrawn standard D2288 from 2.1.
(2) Revised wording in 10.1 and added Note 8.
(3) Added Note 2, and re-numbered subsequent notes.
(4) Corrected spelling of hydrophobic in revised Note 5.