Designation: D 6040 – 01

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

This standard is issued under the fixed designation D 6040; 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—There is no ISO standard that covers all of the information included in this guide. A few of these test methods are mentioned in ISO 12086-2:1995.

2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies[2]

D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation[2]

D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials[2]

D 374 Test Methods for Thickness of Solid Electrical Insulation[2]

D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement[3]

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting[3]

D 883 Terminology Relating to Plastics[3]

D 1711 Terminology Relating to Electrical Insulation[2]

D 2288 Test Method for Weight Loss of Plasticizers on Heating[2]

D 3776 Test Methods for Mass per Unit Area (Weight) of Fabric[4]

F 335 Terminology Related to Electrostatic Copying[5]

F 412 Terminology Related to Plastic Piping Systems[6]

IEEE/ASTM SI 10 Standard for Use of the International System of Units (SI): The Modern Metric System[7]

2.2 *ISO Standard:*

ISO 12086-2:1995 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2: Preparation of Test Specimens and Determination of Properties[8]

3. Terminology

3.1 *Definitions:* Definitions are in accordance with Test Methods D 257 and Terminologies D 883 and D 1711, unless otherwise specified.

3.1.1 *apparent density*, *n*—the weight per unit volume of a material including voids inherent in the material as tested, see Terminology F 412.

3.1.2 *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 F 335).

[1] This guide is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials.

Current edition approved August 10, 2001. Published October 2001. Originally published as D 6040 – 96. Last previous edition D 6040 – 96.

[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 07.02.

[5] *Annual Book of ASTM Standards*, Vol 15.09.

[6] *Annual Book of ASTM Standards*, Vol 08.04.

[7] Available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

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

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

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), 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 D 374. 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.

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 D 374 if other than Test Method D is used.

8. Tensile Properties

8.1 Determine tensile strength and elongation in accordance with Test Method A of Test Methods D 882. Calculate tensile strength and percentage elongation from the values at the maximum load.

NOTE 2—Unsintered PTFE does not exhibit a clean break as is normal for most thin plastic sheeting.

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. Apparent Density

9.1 Determine apparent density in accordance with Test Method A of Test Methods D 792. Other equipment shown to give comparable results may be used.

NOTE 3—Test Methods D 792 can be used due to the inability of water to penetrate the film or tape.

NOTE 4—Especially useful for this test, has been the electronic densimeter, Model ED-120 T.[9]

NOTE 5—A volume method 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 in accordance with Test Method D 2288 except that the test temperature shall be 260 ± 5°C (500 ± 10°F), and test for 1 h.

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 D 150 using a microelectrode system at a frequency of 1 MHz.

NOTE 6—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 D 257.

NOTE 7—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 D 149.

13.2 Randomly select five specimens per lot and test.

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 D 149 shall be used.

13.6 Give special attention to the hazards listed in Test Methods D 149.

[9] Available from Testing Machines, Inc., 400 Bayview Avenue, Amityville, NY 11701.

NOTE 8—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 D 3776.

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

This section identifies the location of selected changes to this test method. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this test method. This section may also include descriptions of the changes or reasons for the changes, or both.

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(*1*) Revised 1.2 to include reference to IEEE/ASTM SI 10.

(*2*) Added IEEE/ASTM SI 10 to 2.1.

(*3*) Moved definition of the term "lot" from 3.2.2 to 3.1.2 and changed the definition to the standard one used in D20.15.

(*4*) Renumbered 3.2.1 to 3.2.3 to accomodate removal of "lot."