Designation: D2305 – 18

Standard Test Methods for Polymeric Films Used for Electrical Insulation[1]

This standard is issued under the fixed designation D2305; 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 These test methods cover the testing of homogeneous organic polymer films not over 2.4 mm (95 mils) thick that are to be used for electrical insulation.

1.2 These test methods are not necessarily applicable to testing films in combinations with a coating, another film, or with other types of substrate, such as fabrics or papers.

1.3 The values stated in SI units are the standard. The values in parentheses are provided for information only.

1.4 The procedures appear in the following sections:

Procedure	Sections
Conditioning	6 and 7
Dielectric Breakdown Voltage & Dielectric Strength	21 to 26
Extractables	65 to 70
Heat-Seal Strength	59 to 64
Permittivity and Dissipation Factor	42 to 47
Resistance Method for Measuring the Tendency to Corrode Metals	38 to 41
Sampling	5
Shrinkage	48 to 53
Strain Relief	13 to 20
Surface Resistivity	27 to 31
Tensile Properties	12
Thickness	8 to 11
Volume Resistivity	32 to 37
Water Absorption	53 to 58

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

NOTE 1—These test methods are similar to IEC 60674–2.

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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 (Metric) D0374_D0374M

D570 Test Method for Water Absorption of Plastics

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D883 Terminology Relating to Plastics

D1000 Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

D1531 Test Methods for Relative Permittivity (Dielectric Constant) and Dissipation Factor by Fluid Displacement Procedures (Withdrawn 2012)[3]

D1676 Test Methods for Film-Insulated Magnet Wire

D1711 Terminology Relating to Electrical Insulation

D5032 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions

D6054 Practice for Conditioning Electrical Insulating Materials for Testing (Withdrawn 2012)[3]

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *IEC Standard:*

Publication 60674–2 Specification for Plastic Films for Electrical Purposes[4]

3. Terminology

3.1 *Definitions:*

[1] These test methods are under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and are the direct responsibility of Subcommittee D09.07 on Electrical Insulating Materials.

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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] The last approved version of this historical standard is referenced on www.astm.org.

[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 Definitions are in accordance with Terminologies D1711 and D883 unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *sheet, n*—material greater than 75 mm in width.

3.2.2 *strain relief, n*—relaxation at a specified elevated temperature of induced strains.

3.2.3 *strip, n*—material 75 mm or less in width.

4. Hazards

4.1 *High Voltage:*

4.1.1 Lethal voltages are a potential hazard during the performance of this test. It is essential that the test apparatus, and all associated equipment electrically connected to it, be properly designed and installed for safe operation.

4.1.2 Solidly ground all electrically conductive parts which it is possible for a person to contact during the test.

4.1.3 Provide means for use at the completion of any test to ground any parts which were at high voltage during the test or have the potential for acquiring an induced charge during the test or retaining a charge even after disconnection of the voltage source.

4.1.4 Thoroughly instruct all operators as to the correct procedures for performing tests safely.

4.1.5 When making high voltage tests, particularly in compressed gas or in oil, it is possible for the energy released at breakdown to be sufficient to result in fire, explosion, or rupture of the test chamber. Design test equipment, test chambers, and test specimens so as to minimize the possibility of such occurrences and to eliminate the possibility of personal injury. If the potential for fire exists, have fire suppression equipment available. See section

5. Sampling

5.1 Remove the outer three or more layers down from the roll or stack of material before sampling.

5.2 If the film is known or suspected to be anisotropic for a given property, prepare and mark each test specimen to indicate the axis of maximum orientation. The axis parallel to the direction of extrusion, or casting, is conventionally described as the machine direction and is abbreviated MD. The axis that is normal to both the MD axis and the thickness axis is conventionally described as the transverse direction and is abbreviated TD.

5.3 Prepare test specimens suitable for each test from samples that have been cut across the entire width of the sampled material. If the width of strip material is too small to permit preparation of specimens of the required dimensions, then it is acceptable to prepare specimens from samples taken from mill rolls prior to slitting to the furnished width.

CONDITIONING

6. Significance and Use

6.1 Many electrical and physical properties of films vary significantly with changes in temperature and humidity. Properties of thin plastic films can change very rapidly; therefore, the specimen needs to be in the stated conditioning environment when the test is being performed. When the test is performed in a different environment, note these conditions and the time of exposure to this new environment.

7. Procedure

7.1 Unless otherwise specified in the individual test methods, test the specimens in the Standard Laboratory Atmosphere 23 ± 2°C, 50 ± 10 % R.H.

THICKNESS

8. Significance and Use

8.1 The determination of film thickness is frequently necessary to ensure (*1*) the satisfactory production of electrical equipment, and (*2*) the maintenance of desired electrical properties of the film during the use of the electrical equipment. Some properties, such as dielectric strengths, vary with the thickness of the material; other properties, such as permittivity, cannot be calculated without a proper determination of thickness unless special techniques are used.

9. Procedure

9.1 Use Method C of Test Methods D374 for this measurement, with the apparatus modified as follows: Use a presser foot of 6.25 ± 0.05 mm (250 ± 1 mil) diameter, and an anvil surface, upon which the specimen rests, of at least 50-mm (2-in.) diameter. Apply a force of 0.84 ± 0.2 N (3 ± 0.75) ozf to the specimen. Take ten measurements, equally spaced throughout the specimen.

10. Report

10.1 Report the average, maximum, and minimum thicknesses to the nearest 0.5 µm (0.02 mil) for specimens thinner than 50 µm (2 mils) and to the nearest 1 µm (0.04 mil) for specimens 50 µm (2 mils) or more in thickness.

11. Precision and Bias

11.1 *Precision*—A formal round robin test in accordance with Practice E691 has not been conducted. Persons familiar with this method have determined that two test results can be expected (with a probability of 95 %) to agree within 3 %. Each test result is the average of 10 thickness readings taken on a single sample of polyimide film in one laboratory in which a multiple number of operators used the same apparatus.

11.2 *Bias*—This test method has no bias because the value for thickness is determined solely in terms of this test method.

TENSILE PROPERTIES

12. Procedure

12.1 Use Method A of Test Methods D882. Report data only for the specific tests required by a specification.

12.2 Prepare five specimens in each of the two principal directions, each 12 by 200 mm (0.5 by 8 in.).