



Designation: D5047 – 17

# Standard Specification for Polyethylene Terephthalate Film and Sheeting<sup>1</sup>

This standard is issued under the fixed designation D5047; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers requirements for biaxially oriented polyethylene terephthalate film and sheeting in thicknesses from 1.5  $\mu\text{m}$  (0.06 mil) to 355  $\mu\text{m}$  (14.0 mil). For this specification, polyethylene terephthalate film and sheeting shall be defined as the material derived from terephthalic acid and ethylene glycol and shall consist of at least 90 % polyethylene terephthalate homopolymer. This specification does not apply to coated, coextruded, tinted, pigmented, or metallized film or sheeting.

1.2 Polyethylene terephthalate materials, being thermoplastic, are reprocessible and recyclable.<sup>2</sup> This specification allows for the use of those polyethylene terephthalate plastic materials, provided that any specific requirements as governed by the producer and end user are met.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

NOTE 1—There is no known ISO equivalent to this specification.

NOTE 2—Film is defined as sheeting having a thickness of  $\leq 250$  microns (0.010 in.).

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

- 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

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film, Sheeting, and Molded Products.

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<sup>2</sup> See Guide D7209 for information and definitions related to recycled plastics.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- D774/D774M Test Method for Bursting Strength of Paper (Withdrawn 2010)<sup>4</sup>
- D882 Test Method for Tensile Properties of Thin Plastic Sheeting
- D883 Terminology Relating to Plastics
- D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D1894 Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting
- D1922 Test Method for Propagation Tear Resistance of Plastic Film and Thin Sheeting by Pendulum Method
- D2176 Test Method for Folding Endurance of Paper and Plastics Film by the M.I.T. Tester
- D2275 Test Method for Voltage Endurance of Solid Electrical Insulating Materials Subjected to Partial Discharges (Corona) on the Surface
- D2305 Test Methods for Polymeric Films Used for Electrical Insulation
- D3417 Test Method for Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry (DSC) (Withdrawn 2004)<sup>4</sup>
- D3892 Practice for Packaging/Packing of Plastics
- D3985 Test Method for Oxygen Gas Transmission Rate Through Plastic Film and Sheeting Using a Coulometric Sensor
- D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens
- D6988 Guide for Determination of Thickness of Plastic Film Test Specimens
- D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)<sup>4</sup>
- E96/E96M Test Methods for Water Vapor Transmission of Materials

## 3. Terminology

3.1 *Definitions*—Unless otherwise indicated, the terminology used in this specification is in accordance with Terminology D883.

<sup>4</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

### 3.2 Description of Term Specific to This Standard:

3.2.1 *polyethylene terephthalate film and sheeting*—material derived from terephthalic acid and ethylene glycol and consisting of at least 90 % polyethylene terephthalate homopolymer.

## 4. Ordering Information

4.1 Product shall be specified based on the appropriate properties from **Table 1** and include the following information in the purchase contract:

- 4.1.1 Title, number, and date of this specification,
- 4.1.2 Length and width of sheets (see **5.1**),
- 4.1.3 Thickness of sheets (see **5.1**), and
- 4.1.4 Requirements for packaging, packing, and marking (see **10.1**).

## 5. General Requirements

5.1 The nominal thickness, width, and roll length including allowable splices per roll shall be established by mutual agreement between the purchaser and the seller.

5.2 Typical properties are shown in **Table 1**. Specification of properties shall be by agreement between the purchaser and the seller.

## 6. Detail Requirements

6.1 *Form*—The film or sheeting shall be furnished flat or in rolls in the dimensions specified.

6.2 *Thickness*—The thickness shall be within  $\pm 18\%$  of nominal for film 19  $\mu\text{m}$  (0.75 mil) or under and within  $\pm 14\%$  of nominal for film or sheeting over 19  $\mu\text{m}$ . Thickness shall be tested in accordance with Test Methods **D5947** or Guide **D6988**, depending on the thickness.

6.3 *Width*—The width shall be within  $\pm 1.6\text{ mm}$  ( $\frac{1}{16}$  in.) of width ordered on rolls or flat sheets up to 1 m (40 in.) wide and within  $\pm 3.2\text{ mm}$  ( $\frac{1}{8}$  in.) on rolls or sheets over 1 m wide.

6.4 *Weight*—The weight shall be within  $\pm 10\%$  of weight ordered for orders up to 1100 kg (2500 lb) and within  $\pm 5\%$  for orders over 1100 kg.

6.5 *Workmanship*—Quality of film or sheet with regard to gels, streaks, pinholes, particles of foreign matter, undispersed raw materials, holes, tears, and blisters shall be mutually established by the purchaser and the seller.

## 7. Sampling

7.1 Sampling shall be statistically adequate to show that the product was manufactured by a process in statistical control, sampled, tested, and inspected in accordance with this specification, and that average values for the lot meet the requirements of this specification. A lot of product is construed as a unit of manufacture as prepared for shipment, and may consist of two or more “production runs” or batches.

**TABLE 1 Typical Properties**

NOTE 1—Values in the table are given as examples only. These properties are highly dependent on characteristics of the particular material under examination, including molecular weight, degree of orientation, crystallinity, and so forth.

Property	Typical Value	Test Condition	ASTM Test Method
Ultimate tensile strength (MD)	170 MPa (25 000 psi)	25°C	<b>D882</b>
Ultimate elongation (MD)	120 %	25°C	<b>D882</b>
Tensile modulus (MD)	3800 MPa (550 000 psi)	25°C	<b>D882</b>
Folding endurance (MIT)	100 000 cycles	25°C	<b>D2176</b> (1-kg load)
Tear strength—propagating (Elmendorf)	20 g/25 m	25°C	<b>D1922</b>
Tear strength—initial (Graves)	800 g/25 m	25°C	<b>D1004</b>
Bursting strength (Mullen)	0.45 MPa (66 psi)	25°C	<b>D774/D774M</b>
Density	1.395 g/cm <sup>3</sup>	25°C	<b>D1505</b>
Coefficient of friction (kinetic) (film-to-film)	0.45		<b>D1894</b>
Oxygen transmission	93 cm <sup>3</sup> /m/24 h	25°C	<b>D3985</b>
Water vapor transmission	28 g/m/24 h		<b>E96/E96M</b>
Melting point	250°C		<b>D3417</b>
Strain relief	1.5 %	30 min at 150°C	<b>D2305</b>
Dielectric strength—short term (25- $\mu\text{m}$ film)	14 000 V/25 m	25°C-DC (500 V/s)	<b>D2305</b>
	7500 V/25 m	25°C-60 Hz	<b>D149 and D2305</b>
	5000 V/25 m	150°C-60 Hz	
Dielectric constant	3.30	25°C-60 Hz	<b>D150</b>
	3.25	25°C-1 KHz	
	3.0	25°C-1 MHz	
	2.8	25°C-1 GNz	
	3.7	150°C-60 Hz	
Dissipation factor	0.0025	25°C-60 Hz	<b>D150</b>
	0.0050	25°C-1 KHz	
	0.016	25°C-1 MHz	
	0.003	25°C-GHz	
	0.0040	15°C-60 Hz	
Volume resistivity	10 <sup>18</sup> ohm-cm	25°C	<b>D257 and D2305</b>
	10 <sup>13</sup> ohm-cm	150°C	
Surface resistivity	10 <sup>16</sup> ohm/sq	23°C-30 % RH	<b>D257</b>
	10 <sup>12</sup> ohms/sq	23°C-80 % RH	
Insulation resistance	10 <sup>12</sup> ohms	35°C-90 % RH	<b>D257 and D2305</b>
Corona resistance (75 $\mu\text{m}$ )	30 h (single sheet)	3000 VAC, 60 Hz	<b>D2275</b>

## 8. Testing

8.1 The film or sheet shall be tested as appropriate to establish conformance to critical requirements based on the intended application and as agreed upon between the purchaser and the seller.

## 9. Certification and Inspection

9.1 The requirements for certification and lot acceptance of the film or sheet shall be agreed upon between the purchaser and the seller.

9.2 Periodic check inspection shall consist of the tests agreed upon between the purchaser and the seller.

9.3 A report of the test results shall be furnished at a frequency agreed upon between the purchaser and the seller when specified in a purchase order or contract.

## 10. Packaging, Packing, and Marking

10.1 Provisions of Practice **D3892** apply for packaging, packing, and marking of plastic materials.

## 11. Keywords

11.1 film; polyethylene terephthalate; sheeting

## SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue, D5047 - 09, that may impact the use of this standard. (March 1, 2017)

(1) Addressed permissive language in **7.1**.

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