Designation: D4801 – 08 (Reapproved 2016)

Standard Specification for Polyethylene Sheeting in Thickness of 0.25 mm (0.010 in.) and Greater[1]

This standard is issued under the fixed designation D4801; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope

1.1 This specification covers requirements for extruded (cast or blown) and compression-molded sheeting made from low-, medium- and high-density polyethylenes and copolymers in thickness of 0.25 mm (0.010 in.) and greater. Depending on the functional requirements, sheeting conforming to this specification is used in applications such as chemical tank linings, spacers in electrical equipment, thermoforming into such items as trays, pallets, and shipping containers, and as machine-shop stock.

1.2 Polyethylene materials, being thermoplastics, are reprocessable and recyclable (see Guides D5033 and D7209). This specification allows for the use of those polyethylene 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.

1.4 The following precautionary caveat pertains only to the test methods 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—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D1505 Test Method for Density of Plastics by the Density-Gradient Technique

D2103 Specification for Polyethylene Film and Sheeting

D3892 Practice for Packaging/Packing of Plastics

D4976 Specification for Polyethylene Plastics Molding and Extrusion Materials

D5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics (Withdrawn 2007)[3]

D5947 Test Methods for Physical Dimensions of Solid Plastics Specimens

D7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)[3]

2.2 *Military Standard:*[4]

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

2.3 *Federal Standard:*[4]

Fed. Std. No. 406A Plastics: Methods of Testing (Method 6051, Warpage)

3. Terminology

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

4. Classification

4.1 The polyethylene sheeting in accordance with this specification is classified by special types as follows:

[1] 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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[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 Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

4.1.1 *Type I*—General purpose, natural and colors.
4.1.2 *Type II*—Dielectric, natural and colors.
4.1.3 *Type III*—Weather-resistant, black.

5. Ordering Information

5.1 As appropriate, the following information shall be included in the purchase contract.
5.1.1 Title, number, and date of this specification.
5.1.2 Classification in accordance with the appropriate cell call-out as found in Specification D4976.
5.1.3 Length and width of sheets (see 7.5 and 7.6).
5.1.4 Thickness of sheets (see 7.5).
5.1.5 Color (see 7.7).
5.1.6 Requirements for packaging, packing, and marking (see 13.1).

6. Materials and Manufacture

6.1 *Materials*—The sheeting shall be manufactured from polyethylene thermoplastic material of the special grade specified in 5.1.2. The supplier shall furnish, for the material used, data for the classification properties.

6.2 *Manufacture*—Sheeting shall be formed by extrusion and roll polishing, or compression.

7. Detail Requirements

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

7.2 *Tensile Stress at Yield and Nominal Strain at Break*—Sheeting shall conform to the values shown for the appropriate cell classification as found in Specification D4976.

7.3 *Shrinkage*—The sheeting, when tested as specified in 11.3, shall conform to the requirements as determined between the user and the supplier.

7.4 *Warpage and Twist*—The sheeting, when tested as specified in 11.4, shall conform to the requirements as determined between the user and the supplier.

7.5 *Dimensions*—Sheeting shall be supplied in the width, length (or weight), and thickness as specified between the user and the supplier, except that is permissible for a maximum of 4 % of the sheet in a shipment to be trimmed 55-mm (2-in.) undersize or half-size. Such trimmed sheet shall be packed separately from full-sized sheet. The thickness shall be tested in accordance with 11.5. Thickness tolerances are shown in Table 1.

7.6 *Length or Weight and Diameter of Rolls*—Sheeting in rolls shall be supplied with either the length or weight specified, except that one roll in a shipment shall be permitted to have the lesser length or weight required to make the total length or weight of the shipment equal to the quantity ordered. Specify the diameter of the roll.

TABLE 1 Thickness Tolerances

Nominal Thickness, mm (in.)	Thickness Tolerance, Percent of Nominal
0.254 to 1.78 (0.010 to 0.070), incl	±10
Greater than 1.78 (0.070)	±5

7.7 *Color*—The sheeting shall be of the color specified by the user.

7.8 *Grade*—The sheeting shall be of the grade specified by the user.

7.9 *Workmanship*—The sheeting shall have a smooth finish and shall be free of cracks, blisters, bubbles, discolorations, craze, surface scratches that form definite indentations, and other defects that could affect appearance or serviceability.
7.9.1 *Dimensional Defects*—The sheeting shall show none of the defects described in Table 2.
7.9.2 *Defects in Color, Appearance, and Workmanship*—The sheeting shall show none of the defects described in Table 3.

8. Sampling

8.1 The materials shall be sampled in accordance with the sampling procedure prescribed in Practice D1898. Adequate statistical sampling shall be considered an acceptable alternative. A lot of material shall be considered as a unit of manufacture as prepared for shipment, and shall be permitted to consist of a blend of two or more production runs or batches.

9. Testing

9.1 Test the sheeting for the applicable characteristics listed in 7.2, 7.3, and 7.4 and Table 1 and Table 2 in accordance with the test methods specified herein, for each lot submitted for inspection.

10. Conditioning

10.1 Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) for not less than 40 h prior to test in accordance with Specification D4976 or as otherwise specified by agreement. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F).

10.2 In addition, for films containing hydrophilic fillers, co-monomers, pigments or other modifiers, conditioning and testing shall be done at 50 ± 10 % relative humidity. In cases of disagreement, the tolerance shall be ±5 % relative humidity.

TABLE 2 Examination of the Sheeting for Defects in Dimensions

Examine	Defects
Length and width (sheet)	not of the length and width specified varies by more than +3.2, –0 mm (+⅛, –0 in.) varies by more than ±13 mm (±½ in.) from true rectangles
Width (sheeting)	not of the width specified varies by more than +13, –0 mm (+½, –0 in.)
Length or weight of rolls (sheeting)	not of the length or weight specified varies by more than +3, –1 %
Diameter of rolls (sheeting)	not of the diameter specified
Cores (sheeting)	not having lengths equal to the nominal width of the sheeting, +13, –0 mm (+½, –0 in.) not having inside diameters as specified varies by more than +3.2, –0 mm (+⅛, –0 in.) for a 76-mm (3-in.) diameter hole unless otherwise specified

TABLE 3 Examination of Sheeting for Defects in Color, Appearance, and Workmanship

Examine	Defects
Appearance	not uniform texture, finish, or color
	any pits, blisters, cracks, dents, waviness, heat marks, or scratches
Workmanship	surface not polished and straight
	edges not smooth and straight
	any delaminations or porosity on edges

11. Test Methods

11.1 Conduct the tests at 23 ± 2°C (73.4 ± 3.6°F) in accordance with Specification D4976 or as otherwise specified by agreement. In cases of disagreement, the tolerances shall be ± 1°C (±1.8°F)

11.2 *Tensile Stress at Yield and Nominal Strain at Break*—Test in accordance with Test Method D638. Determine tensile stress at yield and nominal strain at break.

11.2.1 *Test Specimens*—Prepare test specimens by die cutting or machining. In extruded sheet, properties are dependent on the sampling direction; therefore, test specimens shall be cut and tested in the extrusion direction or in both the extrusion and transverse directions if agreed upon between the supplier and the user.

11.3 *Shrinkage*—Test in accordance with Test Method D1204, using a minimum oven time of 30 min, and an oven temperature of 130 ± 2°C (266 ± 3.6°F) for Group 1 and 2, Classes 1 and 2 Polyethylene (Specification D4976) and of 140 ± 2°C (284 ± 3.6°F) for Group 2, Classes 3 and 4 Polyethylene (Specification D4976). If previous tests on the same grade and nominal thickness of sheeting have shown that the use of talc or paper is unnecessary to provide free shrinkage, these refinements can be omitted.

11.4 *Warpage and Twist*—Determine warpage or twist using two sheets tested in accordance with Method 6051 of Fed. Std. No. 406A except for the following: a straightedge 1-m (36-in.) long shall be used. Move the straightedge over the sheet and rotate it along the sheet length about an axis perpendicular to the plane of the sheet without permitting an end of the straightedge to extend beyond the edge of the sheet. Measure and report the maximum distance from the sheet to the straightedge. Make the measurement with the sheet lying with its surface of maximum convexity in contact with a horizontal flat surface. The straightedge shall be light in weight and no pressure shall be exerted on it that might tend to reduce the warpage or twist during the measurement.

11.4.1 *Calculation*—Calculate the warpage or twist as follows:

$$W = \frac{D \times 100}{L} \quad (1)$$

where:

W = warpage or twist, %
D = maximum deviation, mm (in.), and
L = length of the sheet along the straightedge, mm (in.)

11.4.2 *Precision*—No data are available for a precision statement.

11.5 *Thickness*—The thickness of the sheeting covered in this specification shall meet the tolerances given in Table 1 when tested as follows: Determine the thickness by the method described in 11.5.1 – 11.5.4. In cases of disagreement use the Arbitration Method given in the test method section of Specification D2103.

11.5.1 Because of the wide range of materials included in the scope of this specification it is not possible to specify a universal instrument geometry or method. The selection of a specific method and instrument for measurement is influenced by the characteristics of the material and needs to be considered by the user of this specification.

11.5.2 *Apparatus*—An instrument as described in Test Method D5947 that is suitable for the material and specimen geometry being tested.

11.5.3 *Test Specimens*—Prepare test specimens, approximately 5 by 5 cm (2 by 2 in.) in area, taken randomly across the width of the roll. Take at least one set of test specimens from each roll being tested. In the case of sheet stock, a statistically valid sampling plan shall be used. Five specimens are recommended for sheeting of widths of five feet or less and ten specimens are recommended for sheeting greater than five feet in width.

NOTE 2—Care must be taken in choosing the size of the specimen in relation to the anvil to assure that the weight of the specimen overhanging the anvil does not overcome the weight applied to the presser foot, which will result in erroneous readings. If it is necessary to use a larger specimen, a heavier weight should be used.

11.5.4 *Procedure*—A procedure, suitable for the material and specimen geometry being tested, as described in Test Method D5947 shall be used. The surfaces of the anvil, the presser foot spindle, and the specimens shall be clean and dry. Take one measurement on each specimen. Average the measurements of all the specimens of a sample to obtain the thickness of the sample.

12. Certification and Inspection

12.1 Certification and lot acceptance of the material shall be agreed upon between the supplier and the user, or as a part of the purchase contract.

12.2 Periodic check inspection shall consist of the tests agreed upon between the supplier and the user.

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

13. Packaging, Packing, and Marking

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

14. Keywords

14.1 dielectric sheet; general purpose sheet; polyethylene; recycled plastics; sheeting; sheeting specification; thick gage; thick sheet; thickness >25 mil; weather-resistant sheet

SUPPLEMENTARY REQUIREMENTS

S1. QUALITY ASSURANCE PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT

These requirements apply *only* to Federal/Military procurement, not domestic sales or transfers.

S1.1 Unless otherwise specified in a purchase order or contact, sampling for inspection and testing shall be in accordance with the recommendations of Practice D1898.

S1.2 Selection of Acceptable Quality Level (AQL) and of Inspection Level (IL) shall be made, with consideration of the specific use requirements. This is discussed in Practice D1898 in the sections "Means and Standard Deviations," and "Comparison of Sampling Plans," with reference to MIL-STD-105.

S1.3 In the absence of contrary requirements, the following values shall apply:

	IL	AQL
Defects in material and workmanship	II	2.5
Defects of preparation for delivery	S-2	2.5
Testing (products)	S-1	1.5
Testing (polymer, unfabricated)	S-1[A]	...

[A] Samples shall be drawn from the required number of units, and pooled for preparation of molded samples for mechanical properties evaluation.

ADDITIONAL SUPPLEMENTARY REQUIREMENTS

S2. PACKAGING PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT

S2.1 All packing, packaging, and marking provisions of Practice D3892 shall apply to this specification.

APPENDIX

(Nonmandatory Information)

X1. ALTERNATIVE TECHNIQUES FOR DETERMINATION OF AVERAGE THICKNESS

X1.1 *Thickness*—This method for thickness determination is to be used as a referee method for average thickness and is especially suitable for use in determining the average thickness for embossed film and sheeting. For routine testing or specification, standard dead weight methods shall be used.

X1.1.1 *Apparatus*—The apparatus shall consist of the following:

(1) Analytical Balance, equipped with pan straddle or other stationary support, sensitive to 0.0005 g,

(2) Class S Weights,

(3) Beaker, 250-mL,

(4) Fine Thread or Wire, nonabsorbent,

(5) Thermometer, 0 to 100°C, graduated in 1°C divisions,

(6) Die or Template, for cutting test specimens, 10 by 10 cm, with dimensional tolerance of ±0.01 cm/side, and

(7) Sharp knife or Razor.

X1.1.2 *Test Specimens*—Test five 10 by 10-cm specimens taken uniformly across the width of the sheet.

X1.1.3 *Procedure*—By means of the die or template and the sharp knife or razor, cut five specimens from the sample of material. Weigh each specimen to the nearest 0.5 mg on the analytical balance. Record the weight as W. Determine the density of each specimen in accordance with Method A of Test Methods D792 or Test Method D1505, and record as D. Use of a wetting agent is recommended.

X1.1.4 *Calculation*—Calculate the average thickness of each test specimen, using the following formula, and average the five values:

$$T = 394W/100D = 3.94W/D \quad \text{(X1.1)}$$

where:

T = average thickness of test specimen, mils,
W = weight of test specimen, g,
D = density of test specimen, g/cm^3,
394 = conversion factor, cm to mils, and
100 = area of specimen, cm^2.

X1.2 *Average Thickness Based on Yield per Roll*—Calculate the average thickness based on yield per roll as follows:

$$\text{average thickness, mils} = \frac{2307 \times \text{net weight (lb)}}{\text{density} \times \text{length (ft)} \times \text{width (in.)}} \quad \text{(X1.2)}$$