



# Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications<sup>1</sup>

This standard is issued under the fixed designation D 4397; 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 specification covers polyethylene sheeting, 250 μm (0.010 in. or 10 mils) or less in thickness, intended for construction, industrial, and agricultural applications.

1.2 The values stated in SI units are to be regarded as the standard.

1.3 The following precautionary statement pertains only to the test methods portion, Section 8 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 specification.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 374 Test Methods for Thickness of Solid Electrical Insulation<sup>2</sup>
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>3</sup>
- D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting<sup>3</sup>
- D 883 Terminology Relating to Plastics<sup>3</sup>
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique<sup>3</sup>
- D 1709 Test Method for Impact Resistance of Polyethylene Film by the Free Falling Dart Method<sup>3</sup>
- D 1898 Practice for Sampling of Plastics<sup>3</sup>
- D 2103 Specification for Polyethylene Film and Sheeting<sup>3</sup>
- D 3892 Practice for Packaging/Packing of Plastics<sup>4</sup>
- E 96 Test Methods for Water Vapor Transmission of Materials<sup>5</sup>
- E 1347 Test Method for Color and Color-Difference Mea-

surement by Tristimulus (Filter) Colorimetry<sup>6</sup>

F 88 Test Methods for Seal Strength of Flexible Barrier Materials<sup>7</sup>

### 2.2 Military Standard:

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes<sup>8</sup>

## 3. Terminology

3.1 *Definitions*—The plastics terminology used in this specification is in accordance with the definitions given in Terminology D 883.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *nominal length*—the length of sheeting in any roll, as specified on product labels, invoices, sales literature, and the like.

3.2.2 *nominal net weight*—the weight of sheeting in any roll, as specified on product labels, invoices, sales literature, and the like.

3.2.3 *nominal thickness*—the thickness of sheeting in any roll, as specified on product labels, invoices, sales literature, and the like.

3.2.4 *nominal width*—the width of sheeting in any rolls, as specified on product labels, invoices, sales literature, and the like.

## 4. Materials

4.1 The sheeting shall be made from polyethylene or modified polyethylene, such as an ethylene copolymer consisting of a major portion of ethylene in combination with a minor portion of some other monomer, or a mixture of polyethylene with a lesser amount of other polymers.

NOTE 2—Polyethylene sheeting is made in a variety of colors, opacities, translucencies, and dimensions. It is recommended that manufacturers be consulted on the varieties available.

## 5. General Requirements

5.1 *Appearance*—The sheeting shall have appearance qualities conforming with those produced by good commercial

<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 and Sheeting.

Current edition approved November 10, 2002. Published January 2003. Originally approved in 1984. Last previous edition approved in 2000 as D 4397 – 00.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 08.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 06.01.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>8</sup> Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

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

practices. It shall be as free as is commercially possible of gels, streaks, pinholes, particles of foreign matter, and undispersed raw material. There shall be no other visible defects such as blocking, holes, tears, or blisters. The edges shall be free of nicks and cuts visible to the unaided eye.

5.2 Dimensions:

5.2.1 Size—The nominal thickness, width, and length of the sheeting in each roll shall be agreed upon between the buyer and the seller.

5.2.2 Tolerances:

5.2.2.1 Thickness—The thickness at any point, when measured in accordance with 8.5, shall not be less than 80 % of the nominal thickness.

5.2.2.2 Width—The tolerance for widths of 0.3 m (1 ft) or more, shall be 3.2 mm (1/8 in.) per foot of nominal width. For all widths less than 0.3 m (1 ft), the tolerance shall be 3.2 mm (1/8 in.). Width to be measured in accordance with 8.6.

5.2.2.3 Length—The length of sheeting per roll, when measured in accordance with 8.6, shall be within + 3 % to – 1 % of the length specified.

5.2.3 Minimum Net Weight—The actual net weight of each roll shall be not less than the nominal net weight, when determined in accordance with the formula established in 8.7. The nominal net weight shall, in turn, be the labeled net weight.

6. Detail Requirements

6.1 Color and Finish—The sheeting may be natural, (essentially colorless), color tinted, translucent, or opaque. The surface finish may be plain, printed, or otherwise treated as agreed upon between the buyer and the seller.

6.2 Impact Resistance—The average impact resistance shall be not less than the resistance specified in Table 1, when tested in accordance with 8.8.

6.3 Mechanical Properties—The average tensile strength and elongation at break for all thicknesses of sheeting shall be as specified in Table 2, when tested in accordance with 8.9.

6.4 Reflectance—The daylight reflectance of white opaque sheeting, intended for use in curing concrete, shall be not less than 70 %, when determined in accordance with 8.10.

6.5 Luminous Transmittance—Black sheeting intended for exclusion of light and for maximum resistance to weathering shall have an average luminous transmittance not greater than 1 %, when determined in accordance with 8.11. This low level of luminous transmittance indicates a high degree of opacity.

TABLE 1 Dart Drop Impact Resistance<sup>A</sup>

Nominal Thickness, μm (mils)	Dart Drop Impact Resistance, min, g
25 (1.0)	40
38 (1.5)	65
50 (2.0)	85
75 (3.0)	125
100 (4.0)	165
125 (5.0)	205
150 (6.0)	260
175 (7.0)	315
200 (8.0)	370
225 (9.0)	420
250 (10.0)	475

<sup>A</sup> Values for nominal thickness other than those listed shall be determined by arithmetical interpolation.

TABLE 2 Mechanical Properties

	Lengthwise Direction	Crosswise Direction
Tensile strength, min, MPa (psi)	11.7 (1700)	8.3 (1200)
Elongation, min, % <sup>A</sup>	225	350

<sup>A</sup> For films of nominal thickness of <2 mils (<50 μm), minimum % to be 200 and 325, respectively (LD/CD).

6.6 Water Vapor Transmission Rate (WVTR)—The average water vapor transmission shall not be greater than 22.0 g/m<sup>2</sup> (1.40 g/100 in.<sup>2</sup>) per 24 h for sheeting 25 μm (1 mil) in thickness, when determined in accordance with 8.12. The water vapor transmission rate is inversely proportional to the thickness. Maximum limits for rate of water transmission as a function of thickness are given in Table 3. Equivalent maximum limits in terms of permeance are given in Table 4. It should be noted that the WVTR requirement is not necessary for all applications (such as pallet wrap). However, Table 3 and Table 4 may be used for those cases where the WVTR is an important consideration.

7. Sampling

7.1 Samples for test purposes shall be taken from rolls, selected at random from the total number of rolls in each shipment or lot, in accordance with Table 5.

7.2 The samples for testing shall be full width and shall be cut at least three full turns, but not less than 1.5 m (5 ft), from either end of the sheeting on each roll. Normally about 2 m<sup>2</sup> (20 ft<sup>2</sup>) of sheeting is needed to carry out all the tests. All the tests shall be made on each sample roll. Rolls damaged in shipment shall not be selected for testing.

7.3 The specimens to be used for a particular test shall be cut from different parts of the sheeting sample (that is, they shall not be cut adjacent to one another), unless otherwise specified in the test.

8. Test Methods

8.1 General—The tests given herein are intended primarily for use as production tests in conjunction with manufacturing processes and inspection methods to insure conformity of sheeting with the requirements of this specification.

8.2 Production Inspection and Testing— During the process of manufacture, the manufacturer shall make inspections and

TABLE 3 Specification for Water Vapor Transmission Rate (WVTR)<sup>A</sup>

WVTR (g/24-h·m <sup>2</sup> ) max	Nominal Thickness		WVTR (g/24-h·100-in. <sup>2</sup> ) max
	μm	(mils)	
22.0	25	(1)	1.40
11.0	50	(2)	0.70
7.3	75	(3)	0.47
5.5	100	(4)	0.35
4.4	125	(5)	0.28
3.7	150	(6)	0.23
3.1	175	(7)	0.20
2.8	200	(8)	0.18
2.4	225	(9)	0.16
2.2	250	(10)	0.14

<sup>A</sup> Values for nominal thickness other than those listed shall be determined by arithmetical interpolation.

**TABLE 4 Specification for Permeance<sup>A</sup>**

Permeance <sup>B</sup> (metric perms), max	Nominal Thickness		Permeance <sup>C</sup> (perms), max
	µm	(mils)	
0.50	25	(1)	0.76
0.25	50	(2)	0.38
0.17	75	(3)	0.25
0.12	100	(4)	0.19
0.10	125	(5)	0.15
0.084	150	(6)	0.13
0.070	175	(7)	0.11
0.063	200	(8)	0.096
0.054	225	(9)	0.082
0.050	250	(10)	0.076

<sup>A</sup> Values for nominal thickness other than those listed shall be determined by arithmetical interpolation.

<sup>B</sup> Permeance in metric perms is found by dividing WVTR, g/24-h·m<sup>2</sup>, by the pressure difference of water vapor, µm Hg, at the test temperature.

<sup>C</sup> Permeance in perms is found by dividing WVTR, grains/h·ft<sup>2</sup>, by the pressure difference of water vapor, in. Hg at the test temperature. To convert WVTR from g/h·100 in. <sup>2</sup> to grains/h·ft<sup>2</sup>, multiply by 0.926.

**TABLE 5 Sampling for Test Procedures**

Rolls in Shipment or Lot	Rolls Sampled
2 to 9	1
10 to 15	2
16 to 40	3
41 to 65	5
66 to 110	7
111 to 180	10
181 to 300	15
301 to 500	25
501 to 800	35
801 to 1300	50

tests in accordance with methods described by this specification. The manufacturer shall keep such essential records and other information to document his claim that the requirements of this specification are met with a high degree of assurance.

**8.3 Inspection**—The samples of sheeting shall be visually inspected to determine conformance of the sheeting with the requirements of 5.1.

**8.4 Conditioning**—The test specimens shall be conditioned in accordance with Procedure A of Practice D 618 and shall be tested under these conditions for referee tests or in the case of disputes. Otherwise, storage at room temperature should be adequate.

**8.5 Thickness**—The thickness should be determined using Method C of Test Methods D 374.

NOTE 3—Standard commercial apparatus with foot sizes from approximately 5 to 10 mm ( $\frac{3}{16}$  to  $\frac{3}{8}$  in.) in diameter and effective pressure on the foot from 0.02 to 0.17 MPa (3 to 25 psi) give essentially the same value.<sup>9</sup>

**8.6 Length and Width**—Measurements shall be made with a calibrated 30-m (100-ft) steel tape graduated at intervals of 1 mm ( $\frac{1}{16}$  in.). The roll shall be extended to its full length on a flat surface and all creases and buckles removed, insofar as practical, without applying stresses that cause any significant flow. Measurements of length shall be rounded to the nearest

centimetre (inches). Width shall be measured to the nearest 1 mm ( $\frac{1}{16}$  in.) at not less than 10 locations uniformly distributed along the length of the roll, and the results shall be averaged.

**8.7 Weight**—The actual net weight of each roll shall be determined to the nearest 50 g (1 oz or 0.1 lb) on suitably calibrated equipment. The nominal net weight shall be calculated as follows:

$$W = T \times A \times D \times k \quad (1)$$

where:

$W$  = nominal, kg (lb),

$T$  = nominal thickness, mm (in.),

$A$  = nominal length times nominal width, mm (in.),

$D$  = density of the film as determined by Test Method D 1505, g/cm<sup>3</sup>, and

$k$  = 10<sup>-6</sup> for converting g/cm<sup>3</sup> to kg/mm<sup>3</sup> (= 0.03613 for converting g/cm<sup>3</sup> to lb/in.<sup>3</sup>).

**8.8 Impact Resistance**—The impact resistance shall be determined in accordance with Test Method D 1709, using Method A for sheeting up to 250 µm (10 mils) in thickness. (See Table 1.)

**8.9 Tensile Properties**—The tensile properties of polyethylene sheeting shall be determined in accordance with Method A of Test Methods D 882, using ten specimens for each direction. The thickness of the specimens shall be measured in accordance with 8.5.

**8.10 Reflectance**—Determine the daylight reflectance of the specimens in accordance with Test Method E 1347.

NOTE 4—Daylight reflectance is total luminous reflectance factor, CIE tristimulus value Y for CIE 1931 (2°) standard observer and CIE standard illuminant C or D65.

**8.11 Luminous Transmittance**—The luminous transmittance shall be determined in accordance with Specification D 2103, using five test specimens.

**8.12 Water Vapor Transmission**—The water vapor transmission rate shall be determined in accordance with Method E of Test Methods E 96, using four specimens.

**8.13 Heat Sealability**—Measure heat sealability in accordance with Test Methods F 88, Test Method B, Dynamic Load Test.

## 9. Packaging and Marking

**9.1 Marking**—Each package or roll shall be marked with the nominal width, length, area in square feet or square metres, thickness of the sheeting, and the nominal net weight of the package or roll.

**9.2 Conformance Statements**—In order that purchasers may identify product complying with all requirements of this specification, producers choosing to produce said product in conformance with this specification may include a statement in conjunction with their name and address on labels, invoices, sales literature, and the like. The following statement is suggested when sufficient space is available:

This sheeting conforms to all of the requirements established in ASTM Specification D 4397, Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications. Full responsibility for the conformance of this product is assumed by (name and address of producer or distributor).

<sup>9</sup> Available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402. Types of thickness measuring gages are described in National Institute for Standards and Technology Circular 585, The Measurement of Thickness, issued January 20, 1958. Names of manufacturers are also given.

9.2.1 The following abbreviated statement is suggested when available space on labels is insufficient for the full statement:

Conforms to ASTM D 4397 (name and address of producer or distributor).

9.3 All packing, packaging, and marking provisions of Practice D 3892 shall apply to this specification.

**10. Keywords**

10.1 film; polyethylene; recycling; sheeting

**QUALITY ASSURANCE PROVISIONS FOR GOVERNMENT/MILITARY PROCUREMENT**

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

S1. Sampling for inspection and testing shall be carried out in accordance with the recommendations of Practice D 1898.

S2. 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 Sections 7 and 8 of the above document, with reference to Military Standard MIL-STD-105.

S3. In the absence of contrary requirements, the following values shall apply:

	IL	AQL	
Defects of appearance 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 <sup>A</sup>	—	

<sup>A</sup> Samples shall be drawn from the required number of units and pooled for preparation of molded samples for mechanical properties evaluation.

**SUMMARY OF CHANGES**

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

*D 4397–02:*

(I) Deleted reference to Test Method E 97 (withdrawn) and replaced with reference to Test Method E 1347. Applicable clauses were changed to reflect this referenced document change.

*D 4397–00:*

(I) Revised 5.2.2.2, 8.5, 8.7, and Footnote A of Tables 3 and 4.

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).*