Designation: D 3981 – 95

Standard Specification for Polyethylene Films Made from Medium-Density Polyethylene for General Use and Packaging Applications[1]

This standard is issued under the fixed designation D 3981; 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 unpigmented, unsupported, sheet or tubular, medium-density polyethylene films (here-after referred to as film or films) from resins having densities in the range from 926.0 to 938.0 kg/m^3 (0.926 to 0.938 g/cm^3), inclusive, as measured on molded plaques.

1.2 This specification is applicable to homopolymer polyethylene but is not restricted to it.

1.3 This specification is also applicable to films made from copolymer polyethylene commonly referred to in industry as low-pressure polyethylene.

1.4 This specification is also applicable to films made from blends of homopolymers and copolymers, including ethylene/vinyl-acetate copolymers.

1.5 This specification allows for the use of recycled polyethylene film or resin as feedstock, in whole or in part, as long as all the requirements of this specification are met and as long as any specific requirements as governed by the producer and end user are also met (see Note 1).

NOTE 1—Guide D 5033 contains terminology and definitions relating to recycled plastics.

1.6 While much of the content of this specification may also be applied to colored or pigmented films, special care must be exercised. This specification does not address specific problems associated with coloring, such as, quantity and quality of pigment dispersion, optical properties, and increase in density. These and other areas must be taken into account by mutual agreement between the supplier and the purchaser.

1.7 The thickness of the films covered by this specification range from 25 to 100 µm (0.001 to 0.004 in.), inclusive. The maximum width of the sheet or lay-flat is 3.05 m (120 in.).

1.8 This specification does not cover oriented heat-shrinkable films.

1.9 This specification defines the levels of the various physical properties from which specifications for specific films may be described. The levels of physical properties required by a film for a given application are selected from Section 6 and the corresponding tables. However, Sections 2-5 relating to tolerances shall apply without change to all film falling within the scope indicated by the title and 1.1-1.4.

1.10 This specification covers dimensional tolerances, classification, intrinsic quality requirements, and test methods. The dimensional tolerances include thickness, width, and length or yield. Classification defines types, classes, surfaces, and finishes. The intrinsic quality requirements include density, workmanship, impact strength, tensile strength, heat sealability, and odor, as well as the classification properties for stiffness, coefficient of friction, optical properties, and surface treatment. A sampling method is included.

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

1.12 The following precautionary caveat 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 2—There is no similar or equivalent ISO standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing[2]

D 882 Test Methods for Tensile Properties of Thin Plastic Sheeting[2]

D 883 Terminology Relating to Plastics[2]

D 1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics[2]

D 1248 Specification for Polyethylene Plastics Molding and Extrusion Materials[2]

D 1505 Test Method for Density of Plastics by the DensityGradient Technique[2]

D 1709 Test Methods for Impact Resistance of Polyethylene Film by the Free Falling Dart Method[2]

[1] This specification is under the jurisdiction of ASTM Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.19 on Film and Sheeting.

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References to film density in the previous edition were replaced with references to resin density and the separate sections on inspection and certification were revised and combined in this edition.

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

D 1894 Test Method for Static and Kinetic Coefficients of Friction of Plastic Film and Sheeting[2]
D 1898 Practice for Sampling of Plastics[2]
D 2103 Specification for Polyethylene Film and Sheeting[2]
D 2457 Test Method for Specular Gloss of Plastics Films[3]
D 2578 Test Method for Wetting Tension of Polyethylene and Polypropylene Films[3]
D 3892 Practice for Packaging/Packing of Plastics[3]
D 4321 Test Method for Package Yield of Plastic Film[3]
D 5033 Guide for the Development of Standards Relating to the Proper Use of Recycled Plastics[4]
E 462 Test Method for Odor and Taste Transfer from Packaging Film[5]
F 88 Test Methods for Seal Strength of Flexible Barrier Materials[6]

NOTE 3—Relevant government regulations also apply to this specification.

NOTE 4—If this product is intended for packaging foods, medicines, drugs, and cosmetics it is subject to applicable regulations of the Food and Drug Administration or the Department of Agriculture and must comply with such regulations. If it is necessary to comply with regulations of other government agencies, such as the Consumer Product Safety Commission, Environmental Protection Agency, Department of Transportation, Federal Trade Commission, etc., such compliance should be arranged between the purchaser and the seller prior to placing an order.

3. Terminology

3.1 Unless otherwise indicated the terminology used in this specification is in accordance with definitions given in Terminology D 883.

4. Classification

4.1 The medium-density film is, by this specification, classified by Types: 0, 1, 2, and 3; Surfaces: 0, 1, 2, and 3; Classes: 0, 1, 2, and 3; and Finishes: 1, 2, 3, and 4. These classifications are described in detail in 6.1.

5. Materials

5.1 The film shall be made from a homopolymer polyethylene, copolymer polyethylene (see Note 5), or blends of homopolymers or copolymers, or both, so that it meets the density and other film requirements listed herein.

NOTE 5—From a polyethylene, polyethylene plastic, or an ethylene plastic as defined in Terminology D 883.

5.2 The film shall be made from resins having a density between 926.0 and 938.0 kg/m^3 (0.926 and 0.938 g/cm^3), inclusive.

5.3 The film shall be natural in color (essentially colorless) unless a color has been agreed upon between the supplier and the purchaser. If colored, the quality and uniformity of coloring shall be by agreement between the supplier and the purchaser. Also, if added colorants or pigments are used in an amount such that some film properties are affected, this should be taken into account by mutual agreement between the supplier and the purchaser.

[3] *Annual Book of ASTM Standards*, Vol 08.02.
[4] *Annual Book of ASTM Standards*, Vol 08.03.
[5] *Annual Book of ASTM Standards*, Vol 15.07.
[6] *Annual Book of ASTM Standards*, Vol 15.09.

6. Physical Requirements

6.1 *Classification Properties*:

6.1.1 *Type*—The 1 % secant modulus for all thicknesses of film shall be as specified in Table 1 for Types 0, 1, 2, and 3.

6.1.2 *Surface*—The kinetic coefficient of friction shall be as specified in Table 2 for Surfaces 0, 1, 2, and 3.

6.1.3 *Class*—The optical properties shall be as specified in Table 3 of Classes 0, 1, 2, and 3. The three optical properties of clarity, gloss, and haze do not always correlate. The particular property of most importance for the specific application shall be established and the value for this property shall then govern, in case of any inconsistency.

6.1.4 *Finish*—The surface treatment level of the film shall be as specified in Table 4 for Finishes 1, 2, 3, and 4.

6.2 *Other Physical Properties*:

6.2.1 *Impact Resistance*—Impact resistance of the film shall be established by mutual agreement between the supplier and the purchaser if this property is required.

NOTE 6—Dart-impact resistance of medium-density polyethylene films can be substantially less than that of low-density polyethylene films.

6.2.2 *Tensile Properties*—The tensile strength and elongation at break for all thicknesses shall be as specified in Table 5.

6.2.3 *Heat Sealability*—The minimum ratio of heat-seal strength to the film strength in the two principal directions shall be as specified in Table 6.

6.2.4 *Odor*—The odor level of the film shall average no more than a 3.5 rating level.

7. Dimensions

7.1 *Size*—The nominal thickness, width, length per roll or roll diameter, and yield of the film shall be established by mutual agreement between the purchaser and the supplier.

7.2 *Thickness Tolerance*—The average thickness and the thickness variation across the film shall be within the tolerances given in Table 7.

7.3 *Width Tolerance*—The width shall be within the tolerances given in Table 8.

7.4 *Yield Tolerance*—The deviation of the actual yield from nominal yield shall be within the tolerances given in Table 9.

7.5 *Flatness*—The flatness of the film shall be within limits as mutually agreed upon between the purchaser and the supplier.

8. Workmanship, Finish, and Appearance

8.1 *Film*—The film shall have workmanship qualities conforming to good commercial practice. The quality of film with regard to gels, streaks, pinholes, particles of foreign matter, undispersed raw materials, holes, tears, and blisters shall be mutually established between the purchaser and the supplier.

8.2 *Roll Formation*:

TABLE 1 Classification for Type

Type	1 % Secant Modulus, MPa (psi)
0	170 (25 000) or less
1	>170 to 240 (25 000 to 35 000)
2	>240 to 345 (35 000 to 50 000)
3	345 (50 000)