Designation: D4635 – 16

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

This standard is issued under the fixed designation D4635; 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, low-density polyethylene and linear low-density polyethylene films (hereafter referred to as film or films) with densities ranging from 0.910-0.925 g/cm^3 per Specification D4976.

NOTE 1—The density of a film will not necessarily be equal to the density of a molded plaque from the same resin.

NOTE 2—Blends of ethylene/vinyl acetate (EVA) with low-density polyethylene may have densities up to 0.929 g/cm^3.

1.2 This specification is applicable to homopolymer polyethylene, but is not restricted to it. It is applicable to films made from polyethylene copolymers, and also applicable to films made from blends of homopolymers and copolymers, including ethylene/vinyl acetate copolymers.

1.3 The thickness of the films covered by this specification is 101.6 µm or less (0.004 in. or less), inclusive. The maximum width of the sheet or layflat is 3.30 m (130 in.).

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

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 of 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 3.)

NOTE 3—Guide D7209 describes terminology and definitions related to recycled plastics.

1.6 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. 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.

1.7 This specification covers dimensional tolerances, classifications, 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, tensile strength, heat sealability, and odor, as well as the classification properties for impact strength, coefficient of friction, optical properties, and surface treatment. A sampling method is included.

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

1.9 The following precautionary caveat pertains only to the test methods portion, Section 10, 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 4—There is no known ISO equivalent to this standard.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D618 Practice for Conditioning Plastics for Testing

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

D882 Test Method for Tensile Properties of Thin Plastic Sheeting

D883 Terminology Relating to Plastics

D1003 Test Method for Haze and Luminous Transmittance of Transparent Plastics

D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

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

[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.

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

D1709 Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method
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
D1938 Test Method for Tear-Propagation Resistance (Trouser Tear) of Plastic Film and Thin Sheeting by a Single-Tear Method
D2103 Specification for Polyethylene Film and Sheeting
D2457 Test Method for Specular Gloss of Plastic Films and Solid Plastics
D2578 Test Method for Wetting Tension of Polyethylene and Polypropylene Films
D4321 Test Method for Package Yield of Plastic Film
D4703 Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets
D4976 Specification for Polyethylene Plastics Molding and Extrusion Materials
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)[3]
E96/E96M Test Methods for Water Vapor Transmission of Materials
E1870 Test Method for Odor and Taste Transfer from Polymeric Packaging Film
F1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
F88 Test Method for Seal Strength of Flexible Barrier Materials

NOTE 5—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, or others, such compliance should be arranged between the buyer and the seller prior to placing an order.

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 low-density polyethylene film is, by this specification, classified by Types 1, 2, and 3; Surfaces 1, 2, and 3; Classes 1, 2, 3, and 4; 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 an ethylene homopolymer, ethylene copolymers, or blends of homopolymers or copolymers, or homopolymer and copolymer, so that it meets the density and other film requirements listed herein.

5.2 The film shall be made from resins having densities between 0.910 and 0.925 g/cm^3 (910.0 and 925.0 kg/m^3), inclusive. This is the range of standard densities in the definition of low-density polyethylene (see Terminology D883). Standard density refers to the density of the material molded to a thickness of 1.9 mm (0.075 in.) using Procedure C of Annex A1 of Practice D4703 (see Note 1).

5.3 The film shall be natural in color (essentially colorless).

6. Physical Requirements

6.1 *Classification Properties:*

6.1.1 *Type*—The dart drop impact for all thickness of film shall be as specified in Table 1 for Types 1, 2, and 3.

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

6.1.3 *Class*—The optical properties shall be as specified in Table 3 for Classes 1, 2, and 3. The optical properties of 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 Properties:*

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

6.2.2 *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.

6.2.3 *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 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.

TABLE 1 Classification for Type

Film Thickness		Drop Dart (g, min)[A]		
		Type 1	Type 2	Type 3
<25.4 µm	(<0.001 in.)	not specified	not specified	not specified
25.4 µm	(0.001 in.)	40	75	105
38 µm	(0.0015 in.)	65	105	140
51 µm	(0.002 in.)	85	135	175
76.2 µm	(0.003 in.)	125	195	245
101.6 µm	(0.004 in.)	165	255	315

[A] Impact limits for thickness not covered in this table will be determined by linear interpolation between successive values in this table.

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

TABLE 2 Classification for Surface

Surface	Coefficient of Friction
1	>0.5
2	>0.2 to 0.5
3	0.2 or less

TABLE 3 Optical Properties for Classes

Class	Gloss Units	Haze, %
1	30 or less	>25
2	>30 to 50	>10 to 25
3	>50 to 70	>5 to 10
4	>70	0 to 5

TABLE 4 Classification for Finish

Finish	Wetting Tension, mN/m (dynes/cm)
1	32, 33, 34
2	35, 36, 37
3	38, 39, 40
4	41 and over

TABLE 5 Tensile Properties

Property	Units	Machine Direction	Transverse Direction
Tensile Strength, min	MPa (psi)	11.7 (1697)	8.3 (1204)
Tensile Elongation, min	%	225	350

TABLE 6 Heat Sealability[A]

Finish of Contact Surfaces[B]	Heat Sealability, min
2 to 2	0.60
1 to 2	0.60
1 to 1	0.75

[A] Heat sealability is the ratio of the tensile strength of the heat-sealed specimen to the tensile strength of the original film specimen.
[B] Heat sealability is not applicable to films with finish greater than two; this does not infer that films with finishes greater than two cannot be sealed.

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

7.6 Dimension tolerances for "J-Sheeting" lip and gusset depth shall be established by mutual agreement 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, scratches, wrinkles, wind chatter, undispersed raw materials, holes, tears, and blisters shall be mutually established by the purchaser and the supplier.

8.2 *Roll Formation:*

8.2.1 The diameter of cores upon which film is wound shall be established by mutual agreement between the purchaser and the supplier.

8.2.2 Cores upon which film is wound must not be recessed at either edge of the roll, but shall be allowed to extend up to 6.35 mm (¼ in.) beyond either edge of the roll or as established by mutual agreement between the purchaser and the supplier.

8.2.3 Rolls with cores that are crushed and are not able to be mounted on the purchaser's equipment are to be considered rejects.

8.2.4 Ridges and soft spots that result in bagginess and looseness of the unwound film are unacceptable and shall be rejected by the purchaser on a roll-to-roll basis if the conditions contribute to poor performance of the film in end-use application.

8.2.5 The edges of the roll must be free of nicks and cuts, and the general condition of roll edges must not interfere with the unwinding of the rolls.

8.2.6 The type and number of splices, flaggings of splices, or breaks (if unspliced) in rolls of more than one piece shall be established by mutual agreement between the supplier and the purchaser.

9. Sampling

9.1 Statistically based sampling plans which are appropriate for each particular product or quantity may be used to obtain samples for use in determining compliance with this specification.

9.2 For the purposes of developing supplier-purchaser specifications, a lot size generally refers to the number of rolls in a lot. Sampling units are those rolls selected by random numbers from the lot. A unit sample is the sample of film taken from the roll. Care must be exercised in taking unit samples. Unwind and then discard several turns from the roll and then take more than enough sample to run all specified tests. Keep the sample from becoming soiled. Ensure that the sample is not folded or creased excessively.

10. Test Methods

10.1 *Conditioning*—Condition the test specimens at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity for not less than 40 h prior to test in accordance with Procedure A of Practice D618 unless otherwise specified by agreement or the relevant ASTM material specification. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±5 % relative humidity.

10.2 *Test Conditions*—Conduct the tests at 23 ± 2°C (73.4 ± 3.6°F) and 50 ± 10 % relative humidity unless otherwise specified by agreement or the relevant ASTM material specification. In cases of disagreement, the tolerances shall be ±1°C (±1.8°F) and ±5 % relative humidity.

10.3 *Width*—Measure width with a metal rule capable of measuring to an accuracy of ±1.59 mm (1⁄16 in.).

10.4 *Thickness*—Measure thickness in accordance with Guide D6988.

10.5 *Yield*—See Test Method D4321.

10.6 *Flatness*—Measure flatness using a method mutually agreed upon between the purchaser and the supplier.

10.7 *Density*—The density of resins from which the film is made shall be measured in accordance with Test Method D1505 or Test Method D792.

TABLE 7 Tolerance, Percent from Nominal Thickness[A]

Film Width		Nominal Thickness		Across Film[B] % Tolerance
1270 mm or less	(50 in. or less)	25.4 to 101.6 μm	(0.001 to 0.004 in.)	±20
>1270 to 3300 mm	(>50 to 130 in.)	25.4 to 101.6 μm	(0.001 to 0.004 in.)	±25

[A] Use Table 9 as the controlling table for average gage in terms of yield. For minimum gage requirements, order film specifying nominal gage greater than the required minimum by at least the percent tolerance set above.
[B] No single measurement shall differ from the nominal gage by more than the tolerance listed in this table.

TABLE 8 Width Tolerances[A]

Film Widths	Sheeting	Layflat Tubing
381 mm (15 in.) or less	–0, +4.76 mm (3⁄16 in.)	–0, +4.76 mm (3⁄16 in.)
>381 to 762 mm (15 to 30 in.)	–0, +6.35 mm (1⁄4 in.)	–0, +9.53 mm (3⁄8 in.)
>762 to 1524 mm (30 to 60 in.)	–0, +9.53 mm (3⁄8 in.)	–0, +15.87 mm (5⁄8 in.)
>1524 mm to 3300 mm (60 to 130 in.)	–0, +12.7 mm (1⁄2 in.)	–0, +25.4 mm (1 in.)

[A] Across sheet or layflat tubing.

TABLE 9 Deviation,[A] Actual Yield from Nominal Yield

Quantity	Tolerances
Any one roll	±10 %
500 kg (1100 lb) or less	±10 %
>500 to 1000 kg (1100 to 2200 lb)	±5 %
Over 1000 kg (2200 lb)	±3 %

[A] Negative deviation generally infers that the average gage is greater than nominal. Positive deviation generally infers that the average gage is less than nominal.

10.8 *Coefficient of Friction*—The static and kinetic coefficients of friction shall be measured in accordance with Test Method D1894. The test shall be conducted film to film, in both the machine direction and transverse direction.

10.9 *Optical Properties:*

10.9.1 *Clarity*—Measure clarity of the film by visual or instrumented means, as agreed upon between the purchaser and the supplier.

10.9.2 *Gloss*—Measure gloss of the film in accordance with Test Method D2457, using a 45° gloss head.

10.9.3 *Haze*—Measure haze in accordance with Test Method D1003.

10.10 *Wetting Tension*—Measure wetting tension in accordance with Test Method D2578.

10.11 *Impact Resistance*—Measure impact resistance in accordance with Test Methods D1709, except that Test Method A shall be used for all gages of film.

10.12 *Tensile Properties*—Measure tensile strength and elongation at break in accordance with Test Method D882.

10.13 *Heat Sealability*—Measure heat sealability in accordance with Test Methods F88, Test Method B, Dynamic Load Test.

10.14 *Odor*—Measure odor level in accordance with Test Method E1870, low to moderate scale.

10.15 *Tear Resistance*—Measure tear resistance in accordance with Test Method D1922 or Test Method D1938, as agreed upon between the purchaser and the supplier.

11. Inspection and Certification

11.1 Inspection and certification of the material supplied under this specification shall be for conformance to the requirements specified herein.

11.2 Lot-acceptance inspection shall be the basis on which acceptance or rejection of the lot is made. The lot-acceptance inspection shall consist of those tests that ensure process control during manufacture as well as those necessary to ensure certification in accordance with 11.4.

11.3 Periodic check inspection shall consist of the tests specified for all requirements of the material under this specification. Inspection frequency shall be adequate to ensure that the material is certifiable in accordance with 11.4.

11.4 Certification shall be that the material was manufactured, sampled, tested, and inspected in accordance with this specification and that average values meet the requirements at a confidence level of 95 %.

11.5 A report of the test results shall be furnished when requested. The report shall consist of results of the lot-acceptance inspection for the shipment and results of the most recent periodic-check inspection.

12. Packaging and Package Marking

12.1 *Packaging*—The film shall be packaged in standard commercial containers, so constructed as to ensure acceptance by common or other carriers for transportation to the point of delivery, unless otherwise specified in the contract or order.

12.2 *Labels and Literature*—So that purchasers may know that the film has been manufactured in compliance with this specification, it is suggested that the supplier include an appropriate statement to this effect on labels, invoices, or another place.

12.3 Identification of the film shall include:

12.3.1 *Manufacturer's Name,*

12.3.2 *Type,*

12.3.3 *Surface,*

12.3.4 *Class,*

12.3.5 *Finish* (if treated, the treated side of the film shall be clearly identified), and

12.3.6 Reference to this specification number.

13. Keywords

13.1 film; general use; low-density; packaging; polyethylene; recycled plastics

SUMMARY OF CHANGES

Committee D20 has identified the location of selected changes to this standard since the last issue (D4635 - 08a) that may impact the use of this standard. (April 1, 2016)

(1) Revised title of this standard.
(2) Revised 1.1.
(3) Added several test standards to Referenced Documents.
(4) Adjusted metric units and English units to be equivalent throughout the standard.
(5) Revised Testing and Conditioning.
(6) Added 8.2.3.
(7) Adjust Table 8.