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Standard Specification for Thermoplastic Polyolefin Based Sheet Roofing¹

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1. Scope

1.1 This specification covers flexible sheet made from thermoplastic polyolefin (TPO) as the principal polymer, intended for use in single-ply roofing membranes exposed to the weather. The sheet shall contain reinforcing fabrics or scrim.

1.2 The tests and property limits used to characterize the sheet are values intended to ensure minimum quality for the intended purpose. In-place roof system design criteria, such as fire resistance, field seaming strength, material compatibility, and uplift resistance, among others, are factors which should be considered but are beyond the scope of this specification.

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

1.4 *This standard may involve hazardous materials, operations, and equipment. 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 requirements prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D 471 Test Method for Rubber Property Effect of Liquids

D 573 Test Method for Rubber Deterioration in an Air Oven

D 751 Test Methods for Coated Fabrics

D 1149 Test Methods for Rubber Deterioration Cracking in an Ozone Controlled Environment

D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D 2137 Test Methods for Rubber Property Brittleness Point of Flexible Polymers and Coated Fabrics

D 5538 Practice for Thermoplastic Elastomers Terminology and Abbreviations

G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Materials and Manufacture

3.1 The sheet shall be formulated from ethylene and higher alpha-olefin polymers, copolymers, and mixtures thereof, in amounts greater than 50 %, by weight of the total polymer content suitably compounded to satisfy the physical requirements in the specification (see Practice D 5538).

3.2 The sheet shall be capable of being heat welded, fused, or adhesively bonded to itself for making watertight field splices and repairs, and the supplier or fabricator shall recommend suitable methods and materials.

3.3 Sheet shall be reinforced with fabric or scrim.

4. Physical Properties and Tolerances

4.1 Each sheet specimen shall meet or exceed the physical requirements prescribed in Table 1.

4.2 The tolerance for time conditions (aging, weathering, and so forth) is ± 15 min or ± 1 % of the period, whichever is greater, unless otherwise specified.

4.3 The tolerance for temperature conditions (aging, weathering, and so forth) is $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$) of the specified temperature, unless otherwise specified.

5. Dimensions and Permissible Variations

5.1 The width and length of the sheet shall be agreed upon between the purchaser and the supplier.

¹ This specification is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.18 on Nonbituminous Organic Roof Coverings.

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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.

TABLE 1 Physical Requirements for TPO Sheet

Thickness, min, mm (in.)	
Sheet-overall	1.0 (0.039)
Coating over fabric or scrim, weathering side only	0.305 (0.012)
Breaking strength, min, N (lbf)	976 (220)
Elongation at reinforcement break, min, %	15
Tearing strength, min, N (lbf)	245 (55)
Brittleness point, max, °C (°F)	-40 (-40)
Ozone resistance, no cracks	Pass
Properties after heat aging: (retained values)	
Breaking strength, % min	90
Elongation at reinforcement break, % min	90
Tearing strength, % min	60
Weight change (mass), max %	±1
Linear dimensional change, max, %	±1
Water absorption, max, mass %	±3.0 ^A
Factory seam strength, min, N (lbf)	290 (66)
Weather resistance: (retained values)	
<u>Weather resistance:</u>	
Visual inspection	Pass

^A Test performed on top coating material only. (Use Test Method D 471, ~~Testing One Surface Only Section~~, Procedure for Change in Mass.)

5.1.1 The width and length tolerance shall be +3 %, -0 %.

5.1.2 The thickness tolerance shall be +15 %, -10 % of thickness agreed upon by the purchaser and supplier, but in no case shall it be less than the minimum in Table 1.

6. Workmanship, Finish, and Appearance

6.1 The sheet, including factory seams, if present, shall be watertight and free of pinholes, particles of foreign matter, protruding fibers or reinforcement, undispersed raw material, nicks and cuts, voids, thin areas, delaminations or other manufacturing defects that might adversely affect serviceability.

6.2 Edges of the sheets shall be capable of being seamed to one another without fishmouthing.

7. Test Methods

7.1 *Dimensions*—Test Methods D 751, after permitting the sheet to relax at 23°C (73°F) for 1 h.

7.2 *Thickness, Sheet Overall*—Refer to Test Methods D 751 for Type I.

7.3 *Thickness of Coating Over Scrim (Reinforcing Fabric)*—Optical Method described in Annex A1.

7.4 *Breaking Strength*—Test Methods D 751, Grab Method.

7.5 *Elongation at Break*—Test Methods D 751, Grab Method.

7.6 *Tearing Strength*—Test Methods D 751, 2 in./min jaw speed. (8 by 8 in. sample size).

7.7 *Brittleness Point*—Test Methods D 2137, Method B.

7.8 *Ozone Resistance*—Test Method D 1149. Inspect at 7× magnification on specimens exposed to 100 mPa (1×10^{-5} psi) ozone in air at 40°C (104°F). Specimens shall be wrapped around a 75-mm (3-in.) diameter mandrel for 166 h exposure. Specimen shall be wrapped around the same size mandrel for inspection. The required specimen width is 25 mm (1.0 in.).

7.9 *Heat Aging*—Test Method D 573. Age sheet specimens for 670 h at 116°C (240°F). Specimens are then cut from the aged sheet for testing of breaking strength, elongation, and so forth.

7.10 *Linear Dimensional Change*—Test Method D 1204. Age specimen for 6 h at 70°C (158°F) or 1 h at 100°C (212°F).

7.11 *Water Absorption*—Test Method D 471 for 166 h at 70°C (158°F). Test performed on top coating material only. (Use Test Method D 471, ~~Testing One Surface Only Section~~, Procedure for Change in Mass.)

7.12 *Factory Seam Strength*—Test Methods D 751, Grab Method. Modify procedure by cutting a 25 mm (1.0 in.) wide by 300 mm (12 in.) long sample across the lap seam. Place in jaws approximately 50 mm (2.0 in.) from edges of the overlap area and test at a jaw separation rate of 5 cm/min (2 in./min).

7.13 *Weather Resistance*—Accelerated weathering tests shall be performed using Practice G 155.

7.13.1 *Practice G 151 and G 155*—Xenon-arc apparatus shall be operated in accordance with the following conditions:

Filter Type	Daylight
Irradiance	0.35 to 0.70 W/(m ² · nm) at 340 nm. The maximum allowable operational fluctuation of the irradiance setting is ±0.02 W/(m ² · nm).
Cycle	690 min light, 30 min light plus water spray on the front surface
Uninsulated Black Panel Temperature	80°C. The maximum allowable operational fluctuation is ±2.5°C.