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Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane¹

This standard is issued under the fixed designation D 4637; 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 Department of Defense.

1. Scope

1.1 This specification covers flexible sheet made from ethylene-propylene-diene terpolymer (EPDM) intended for use in single-ply roofing membranes exposed to the weather. The tests and property limits used to characterize the sheet are values to ensure minimum quality for the intended use. The sheet may be non-reinforced, fabric- or scrim-reinforced, or fabric-backed vulcanized rubber sheet.

1.2 In-place roof system design criteria, such as fire resistance, field seaming strength, material compatibility, and uplift resistance, among others, are factors that must 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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D 413 Test Methods for Rubber Property—Adhesion to Flexible Substrate

D 471 Test Method for Rubber Property—Effect of Liquids

D 518 Test Method for Rubber Deterioration—Surface Cracking

D 573 Test Method for Rubber—Deterioration in an Air Oven

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D 751 Test Methods for Coated Fabrics

D 816 Test Methods for Rubber Cements

~~D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber~~ 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 5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens

D 5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens

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. Classification

3.1 Types describe the sheet construction:

3.1.1 *Type I*—Non-reinforced.

3.1.2 *Type II*—Scrim (or fabric) internally reinforced.

3.1.3 *Type III*—Fabric backed.

4. Materials and Manufacture

4.1 The sheet shall be formulated from EPDM polymers and other compounding ingredients. EPDM shall be the principal

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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.

polymer used in the sheet and shall be greater than 95 % of the total polymer content.

4.2 To make seams and repairs, the sheet shall be capable of being bonded watertight to itself and the supplier or fabricator shall recommend suitable methods.

5. Physical Properties and Tolerances

5.1 The sheet shall conform to the physical requirements prescribed in Table 1.

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

5.3 Tolerances for temperature shall be $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$).

6. Dimensions

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

6.1.1 The width and length tolerance shall be +3 %, –0 %.

6.2 The thickness tolerance shall be +15 %, –10 % of the thickness agreed upon between the purchaser and supplier, but in no case shall the thickness be less than the minimum listed in Table 1.

7. Workmanship, Finish, and Appearance

7.1 The sheet, including the full width of factory seams if present, shall be fully adhered, watertight, and visibly free of pinholes, particles of foreign matter, undispersed raw material, or other manufacturing defects that might affect serviceability. If the number of irregularities in the form of pockmarks (see Note 1) appear excessive on the sheet (or portion thereof), then its rejection shall be negotiated between involved parties.

7.2 Edges of the sheets shall be straight and flat so that they may be seamed to one another without fishmouthing.

NOTE 1—Pockmarks are oblong depressions, cavities, or craters on the surface of the sheet that have an approximate surface dimension of 3.2 by 1.6 mm ($\frac{1}{8}$ by $\frac{1}{16}$ in.), and have a maximum depth approaching one half of the sheet thickness.

8. Test Methods

8.1 *Dimensions*—Test Methods D 751, after permitting the sheet to relax at $23 \pm 2^\circ\text{C}$ ($73.4 \pm 4^\circ\text{F}$) for 1 h ± 15 min.

8.2 *Thickness, Sheet Overall*—From across the full width of the unbuffed sheet, take three samples, 300 by 300 mm (1 by 1 ft). Measure the thickness of each corner. On fabric backed (Type III) the coating thickness can be measured after cutting or buffing fabric from the rubber. Refer to Test Method D 412 for Type I sheet and Test Method D 751 for Type II and Type III sheet.

8.3 *Thickness of Coating Over Scrim (Reinforcing Fabric)*—Optical Method, see Annex A1.

TABLE 1 Physical Requirements for EPDM Sheet

Type	I	II	III
Thickness, min, mm (in.):			
Sheet-overall	1.016 (0.040)	1.016 (0.040)	...
Coating over scrim or fabric	...	0.38 (0.015)	0.76 (0.030)
Breaking strength, min, N (lbf)	...	400 (90)	400 (90)
Tensile strength, min, MPa (psi)	9.0 (1305)	...	...
Dynamic Puncture Resistance, Type I at 5 J, Type II at 10 J	pass	pass	...
Static Puncture Resistance, Type I at 20 kg (44.1 lbf), Type II at 25 kg (55.1 lbf)	pass	pass	...
Elongation, ultimate, min, %	300	250 ^A	300 ^A
Elongation @ fabric break, ultimate, min, %			
Machine direction		15	
Cross direction		15	
Tensile set, max, %	10	...	...
Tear resistance, min, kN/m (lbf/in.)	26.27 (150)	...	...
Tearing strength, min, N (lbf)	...	45 (10)	45 (10)
Brittleness point, max, °C (°F)	–45 (–49)	–45 (–49)	–45 (–49)
Ozone resistance, no cracks	pass	pass	pass
Heat aging:			
Breaking strength, min, N (lbf)	...	356 (80)	356 (80)
Tensile strength, min, MPa (psi)	8.3 (1205)	...	...
Elongation, ultimate, min, %	200	200 ^A	200 ^A
Tear resistance, min, kN/m (lbf/in.)	21.9 (125)	...	...
Linear dimensional change, max, %	± 1	± 1	± 1
Water absorption, max, mass %	+ 8, – 2	+ 8, – 2 ^A	± 8 , – 2 ^A
Factory seam strength, min, kN/m (lbf/in.)		8.8 (50) or sheet failure	
Weather resistance:			
Visual inspection	pass	pass	pass
Visual inspection	<u>no cracks or crazing</u>	<u>no cracks or crazing</u>	<u>no cracks or crazing</u>
PRFSE, min, %	30	...	...
Elongation, ultimate, min, %	200	...	...
Fabric adhesion, min, N/m (lbf/in.)	...	...	525 (3)

^A Specimens to be prepared from coating rubber compound, vulcanized in a similar method to the reinforced products.

- 8.4 *Breaking Strength*—Test Methods D 751, Grab Method.
- 8.5 *Tensile Strength*— Test Methods D 412, Die C.
- 8.6 *Dynamic Puncture Resistance*—Test Method D 5635, at an energy of 5 J min at 23 ± 2°C (73.4 ± 4°F) for Type I and an energy of 10 J min for Type II.
- 8.7 *Static Puncture Resistance*—Test Method D 5602, at a load of 20 kg (44.1 lbf) min for Type I and a load of 25 kg (55.1 lbf) min for Type II at 23 ± 2°C (73.4 ± 4°F).
- 8.8 *Elongation, Ultimate*—Test Methods D 412, Die C.
- 8.9 *Elongation at Fabric Break, Ultimate*—Test Method D 751, Grab Method, 50 mm (2 in.) per minute jaw separation rate.
- 8.10 *Tensile Set*— Test Methods D 412, Method A, Die C, 50 % elongation.
- 8.11 *Tear Resistance*— Test Method D 624, Die C.
- 8.12 *Tearing Strength*— Test Methods D 751, B-Tongue Tear.
- 8.13 *Brittleness Point*—Test Methods D 2137.
- 8.14 *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 ± 2°C (104 ± 4°F). Elongate Type I specimens 50 % for 166 ± 1.66 h exposure. Type II and Type III specimens must be wrapped around a 75 mm (3 in.) diameter mandrel for 166 ± 1.66 h exposure. The required specimen width is 25 mm (1 in.).
- 8.15 *Heat Aging*—Test Method D 573. Age black sheet at 116 ± 2°C (240 ± 4°F) for 670 ± 6.7 h and non-black sheet for 166 ± 1.66 h. Specimens are then cut from the aged sheet for testing of tensile strength, elongation, and so forth.
- 8.16 *Linear Dimensional Change*—Test Method D 1204.
- 8.17 *Water Absorption*— Test Method D 471, at 70 ± 2°C (158 ± 4°F) for 166 ± 1.66 h.
- 8.18 *Factory Seam Strength*—Methods D 816, Method B. Modify procedure by cutting a 25-mm (1-in.) wide by 300-mm (12-in.) long sample across the lap seam. Place in jaws approximately 50 mm (2 in.) from edges of the overlap area and test at 50 mm (2 in.)/min.
- 8.19 *Fabric Adhesion*— Test Method D 413. Perform test on strip specimen-Type A, using 180° peel.
- 8.20 *Weather Resistance*—Accelerated weathering tests shall be performed in accordance with Practices G 151 and G 155. These tests are performed on the intact sheet with the weathering side facing the lamps. Mount specimens for exposure under no strain. After exposure the specimens shall be removed and inspected immediately for cracks and crazing at 10 % strain in the bent loop configuration in accordance with Test Method D 518 under 7× magnification. A specimen is rated “pass” if no cracks or crazing are observed. In addition, for Type I sheet, determine tensile strength and ultimate elongation after weather exposure. Calculate the specimen percent retained fractional strain energy (PRFSE):

$$PRFSE = \frac{(Tensile\ Strength \times Elongation)_{aged}}{(Tensile\ Strength \times Elongation)_{original}} \times 100$$

8.21 *Weather Resistance*—Practices G 151 and G 155 Xenon-Arc shall be operated in accordance with the following conditions:

Filter type:

<u>Filter Type</u>	Daylight filter Irradiance:
<u>Irradiance</u>	0.35 to 0.70 W/(m ² .nm) at 340 nm (42 to 84 W/(m ² .nm) at 300 to 400 nm)
<u>Irradiance</u>	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) at 300 to 400 nm)
Cycle:	600 min ± 15 min light, 30 min light —plus water spray
Uninsulated black panel temp:	80 ± 2°C (176 ± 4°F)
Relative humidity:	50 ± 5 %