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

This standard is issued under the fixed designation D4637/D4637M; 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.~~

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

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

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers Tension

D413 Test Methods for Rubber Property Adhesion to Flexible Substrate

D471 Test Method for Rubber Property Effect of Liquids

D518 Test Method for Rubber Deterioration Surface Cracking

D573 Test Method for Rubber Deterioration in an Air Oven

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D751 Test Methods for Coated Fabrics

D816 Test Methods for Rubber Cements

D1149 Test Methods for Rubber Deterioration Cracking in an Ozone Controlled Environment

D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature

D2137 Test Methods for Rubber Property Brittleness Point of Flexible Polymers and Coated Fabrics

D5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens

D5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens

D6382 Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material

G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources

G155 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.

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.

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 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 $\pm 2^\circ\text{C}$ ($\pm 4^\circ\text{F}$), $[\pm 4^\circ\text{F}]$.

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,

TABLE 1 Physical Requirements for EPDM Sheet

Type	I	II	III
Thickness, min, mm (in.):			
Thickness, min, mm [in.]:			
—Sheet overall	1.016 (0.040)	1.016 (0.040)	...
—Sheet overall	1.016 [0.040]	1.016 [0.040]	...
—Coating over scrim or fabric	...	0.38 (0.015)	0.76 (0.030)
—Coating over scrim or fabric	...	0.38 [0.015]	0.76 [0.030]
Breaking strength, min, N (lbf)	...	400 (90)	400 (90)
Breaking strength, min, N [lbf]	...	400 [90]	400 [90]
Tensile strength, min, MPa (psi)	9.0 (1305)	...	...
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	...
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)	...	...
Tear resistance, min, kN/m [lbf/in.]	26.27 [150]	...	...
Tearing strength, min, N (lbf)	...	45 (10)	45 (10)
Tearing strength, min, N [lbf]	...	45 [10]	45 [10]
Brittleness point, max, °C (°F)	–45 (–49)	–45 (–49)	–45 (–49)
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)
—Breaking strength, min, N [lbf]	...	356 [80]	356 [80]
—Tensile strength, min, MPa (psi)	8.3 (1205)	...	...
—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)	...	...
—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	$\pm 8, - 2^A$
Factory seam strength, min, kN/m (lbf/in.)		8.8 (50) or sheet failure	
Factory seam strength, min, kN/m [lbf/in.]		8.8 [50] or sheet failure	
Weather resistance:			
—Visual inspection	no cracks or crazing	no cracks or crazing	no cracks or crazing
—PRFSE, min, %	30	...	...
—Elongation, ultimate, min, %	200	...	...
Fabric adhesion, min, N/m (lbf/in.)	...	...	525 (3)
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.

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 D751, after permitting the sheet to relax at $23 \pm 2^\circ\text{C}$ ($73.4[73.4 \pm 4^\circ\text{F}]4^\circ\text{F}$) for $1 \text{ h} \pm 15 \text{ min}$.

8.2 *Thickness, Sheet Overall*—From across the full width of the unbuffered sheet, take three samples, 300 by 300 mm (± 1 by 1 ft)-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 D412 for Type I sheet and Test Method D751 for Type II and Type III sheet.

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

8.4 *Breaking Strength*—Test Methods D751, Grab Method.

8.5 *Tensile Strength*—Test Methods D412, Die C.

8.6 *Dynamic Puncture Resistance*—Test Method D5635, at an energy of 5 J min at $23 \pm 2^\circ\text{C}$ ($73.4[73.4 \pm 4^\circ\text{F}]4^\circ\text{F}$) for Type I and an energy of 10 J min for Type II.

8.7 *Static Puncture Resistance*—Test Method D5602, at a load of 20 kg (44.1 lbf)[44.1 lbf] min for Type I and a load of 25 kg (55.1 lbf)[55.1 lbf] min for Type II at $23 \pm 2^\circ\text{C}$ ($73.4[73.4 \pm 4^\circ\text{F}]4^\circ\text{F}$).

8.8 *Elongation, Ultimate*—Test Methods D412, Die C.

8.9 *Elongation at Fabric Break, Ultimate*—Test Method D751, Grab Method, 50 mm (2 in.)[2 in.] per minute jaw separation rate.

8.10 *Tensile Set*—Test Methods D412, Method A, Die C, 50 % elongation.

8.11 *Tear Resistance*—Test Method D624, Die C.

8.12 *Tearing Strength*—Test Methods D751, B-Tongue Tear.

8.13 *Brittleness Point*—Test Methods D2137.

8.14 *Ozone Resistance*—Test Method D1149. Inspect at $7\times$ magnification on specimens exposed to 100 mPa (± 10)[1×10^{-5} psi] ozone in air at $40 \pm 2^\circ\text{C}$ (104)[$104 \pm 4^\circ\text{F}$]: 4°F). Elongate Type I specimens 50 % for $166 \pm 1.66 \text{ h}$ exposure. Type II and Type III specimens must be wrapped around a 75 mm (3 in.)[3 in.] diameter mandrel for $166 \pm 1.66 \text{ h}$ exposure. The required specimen width is 25 mm (1 in.)[1 in.].

8.15 *Heat Aging*—Test Method D573. Age black sheet at $116 \pm 2^\circ\text{C}$ (240)[$240 \pm 4^\circ\text{F}$]: 4°F) for $670 \pm 6.7 \text{ h}$ and non-black sheet for $166 \pm 1.66 \text{ h}$. Specimens are then cut from the aged sheet for testing of tensile strength, elongation, and so forth.

8.16 *Linear Dimensional Change*—Test Method D1204.

8.17 *Water Absorption*—Test Method D471, at $70 \pm 2^\circ\text{C}$ (158)[$158 \pm 4^\circ\text{F}$]: 4°F) for $166 \pm 1.66 \text{ h}$.

8.18 *Factory Seam Strength*—Methods D816, Method B. Modify procedure by cutting a 25-mm (1 in.)[1 in.] wide by 300-mm (12 in.)[12 in.] long sample across the lap seam. Place in jaws approximately 50 mm (2 in.)[2 in.] from edges of the overlap area and test at 50 mm (2 in.)/min. [2 in.]/min.

8.19 *Fabric Adhesion*—Test Method D413. Perform test on strip specimen-Type A, using 180° peel.

8.20 *Weather Resistance*—Accelerated weathering tests shall be performed in accordance with Practices G151 and G155. 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 D518 under $7\times$ 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 = (Tensile Strength \times Elongation) aged / (Tensile Strength \times Elongation) original $\times 100$

8.21 *Weather Resistance*—Practices G151 and G155 Xenon-Arc shall be operated in accordance with the following conditions:

Filter Type	Daylight filter
Irradiance	0.35 to 0.70 W/(m ² ·nm) at 340 nm. The maximum allowable operational fluctuation of the irradiance setting is $\pm 0.02 \text{ W}/(\text{m}^2 \cdot \text{nm})$. (42 to 84 W/m ² at 300 to 400 nm. The maximum allowable operational fluctuation of the irradiance setting is $\pm 2.5 \text{ W}/\text{m}^2$.)
Cycle	690 \pm 15 min light, 30 min light, plus water spray on the front surface.
Uninsulated- -Black Panel -Temperature	80°C (176°F) during the dry period. The maximum allowable operational fluctuation is $\pm 2.5^\circ\text{C}$ ($\pm 5^\circ\text{F}$).