Designation: D 4637 – 03

Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane[1]

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

1.3 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.

1.4 *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:*

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension[2]

D 413 Test Methods for Rubber Property-Adhesion to Flexible Substrate[2]

D 471 Test Method for Rubber Property—Effect of Liquids[2]

D 518 Test Method for Rubber Deterioration-Surface Cracking[2]

D 573 Test Method for Rubber-Deterioration in an Air Oven[2]

D 624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers[2]

D 751 Test Methods for Coated Fabrics[3]

D 816 Test Methods for Rubber Cements[2]

D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber[2]

D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature[4]

D 2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics[2]

D 5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens[5]

D 5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens[5]

G 151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources[6]

G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials[6]

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 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.

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[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] *Annual Book of ASTM Standards,* Vol 09.01.

[3] *Annual Book of ASTM Standards,* Vol 09.02.

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

[5] *Annual Book of ASTM Standards,* Vol 04.04.

[6] *Annual Book of ASTM Standards,* Vol 14.04.

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 10J, Type II at at 20J	pass	pass	
Static Puncture Resistance, Type I at 20kg (44.1 lbf), Type II at 25kg (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
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.

5.3 Tolerances for temperature shall be ±2°C (±4°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 (⅛ by 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 ± 2°C (73.4 ± 4°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.

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 10J min at 23 ± 2°C (73.4 ± 4°F) for Type I and an energy of 20J 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 h ± 1.66 h exposure. Type II and Type III specimens must be wrapped around a 75 mm (3 in.)

diameter mandrel for 166 h ± 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:	Daylight filter
Irradiance:	0.35 to 0.70 W/(m^2.nm) at 340 nm (42 to 84 W/(m^2.nm) at 300 to 400 nm)
Cycle:	690 min ± 15 min light, 30 min light plus water spray
Uninsulated black panel temp:	80 ± 2°C (176 ± 4°F)
Relative humidity:	50 ± 5 %
Spray water:	Deionized
Specimen rotation (if required):	Every 315 KJ/(m^2.nm) at 340 nm (37.8 MJ/(m^2.nm) at 300 to 400 nm)
Exposure duration:	White-2520 KJ/(m^2.nm) at 340 nm (302.4 MJ/(m^2.nm) at 300 to 400 nm) Black-5040 KJ/(m^2.nm) at 340 nm (604.8 MJ/(m^2.nm) at 300 to 400 nm)

9. Inspection and Special Testing

9.1 The manufacturer shall inspect and test production to ensure compliance of the product with this specification.

10. Rejection and Resubmittal

10.1 Failure to conform to any one of the requirements prescribed in this specification shall constitute grounds for rejection. Rejection shall be reported to the producer or supplier promptly and in writing. The seller shall have the right to reinspect the rejected shipment and resubmit the lot after removal of those packages not conforming to the specified requirements.

11. Product Marking

11.1 The sheet shall be identified on the side intended to be exposed to the weather with this ASTM designation number (Specification D 4637) and ASTM type, the name of the manufacturer or supplier, or the generic sheet type. The type and size of the identification is at the manufacturer's option. Such identification shall occur at intervals not to exceed 4 m (13 ft) in the long direction of the sheet and not be located near an intended seam area. The identification shall be applied in such a manner as to be legible at least five years from installation. Identification shall not be required when so specified by the purchaser.

12. Packaging and Package Marking

12.1 The material shall be rolled on a substantial core and packaged in a standard commercial manner, unless otherwise specified in the contract or order.

12.2 Shipping containers shall be marked with the name of the material, the stock and lot numbers, the ASTM designation number and type, the size and quantity as defined by the contract or order under which shipment is made and the name of the manufacturer or supplier.

13. Keywords

13.1 EPDM; roofing; rubber sheet; single-ply membrane; vulcanized rubber

ANNEX

(Mandatory Information)

A1. OPTICAL METHOD FOR MEASUREMENT OF THICKNESS OF COATING OVER SCRIM (REINFORCING FABRIC) FOR TYPE II SHEET

A1.1 *Scope*—This is a method for measuring the thickness of the coating over the reinforcing fabric.

A1.2 *Measurement Method Principle*—The thickness of coating material over reinforcing fabric can be observed with a standard reflectance microscope. Measurement is made with a calibrated eyepiece.

A1.3 *Apparatus:*

A1.3.1 *Microscope*, 60× with reticle.

A1.3.2 *Light Source*—If light source on the microscope is not adequate, a small tensor lamp can also be used.

A1.3.3 *Stage Micrometer*, 0.0254-mm (0.001-in.) divisions.

A1.4 *Procedure:*

A1.4.1 *Calibration*:

A1.4.1.1 Place a standard reflectance stage micrometer in place of the specimen.

A1.4.1.2 Turn on microscope light source.

A1.4.1.3 Position the reticle eyepiece and the micrometer such that the scales are superimposed. Focus the reticle by turning the eyepiece. Focus the specimen and reticle by turning the vertical adjustment knob.

A1.4.1.4 Locate a point at which both scales line up. Count the number of micrometer divisions away. Measure to the nearest 0.0125 mm (0.5 mil). The calibration may be optimized in increasing the number of divisions measured.

A1.4.1.5 Repeat the calibration three times and average the results.

A1.4.2 *Specimen Analysis*:

A1.4.2.1 Carefully center a sharp single edge razor or equivalent over the fiber intersections along the x – x line.

A1.4.2.2 Make a clean bias cut completely through the liner.

A1.4.2.3 Remove the razor cut section and mount in common putty with the cut surface facing upward.

A1.4.2.4 Observe the cut surface with the eyepiece reticle. Measure the thickness of the coating on either side of the thread intersection by counting the number of reticle divisions (to the nearest one-half division).

A1.4.2.5 Sample two or three areas of the coatings and average the results.

A1.5 *Calculation:*

A1.5.1 *Calibration*:

A1.5.1.1 A calibration example follows:

In this example, 4.5 micrometer divisions (MD) are equal to 4 reticle divisions (RD).

$$4\ (\text{RD}) = 4.5\ (\text{MD}) \tag{A1.1}$$

$$1\ (\text{RD}) = 4.5/4\ (\text{MD}) \tag{A1.2}$$

$$1\ (\text{RD}) = 1.125\ (\text{MD}) \tag{A1.3}$$

One micrometer division is equal to 0.0254 mm (1 mil), therefore:

$$1\ \text{RD} = 0.0286\ \text{mm}\ (1.125\ \text{mils}) \tag{A1.4}$$

This calculated value (0.0286 mm (1.125 mils) in the sample) is the calibration factor.

A1.5.2 *Specimens*—Multiply the number of reticle divisions by the calibration factor. Report results to the nearest 0.0127 mm (0.5 mil).

A1.6 *Precision*—Measurements are accurate to ±0.0127 mm (±0.5 mil) when the thickness is about 0.5 mm (20 mils).