



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 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D518 Test Method for Rubber Deterioration—Surface Cracking (Withdrawn 2007)³

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 Sheeting 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

D7635/D7635M Test Method for Measurement of Thickness of Coatings Over Fabric Reinforcement

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.

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.

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.

Current edition approved Jan. 1, 2012. Published January 2012. Originally approved in 1987. Last previous edition approved in 2010 as D4637 – 10. DOI: 10.1520/D4637_D4637M-12.

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

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 **D751**, 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 **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)*—Follow preparation procedures as specified in Test Method **D7635/D7635M**. The thickness measurements shall be conducted as described in the test method on the coating on the side intended to be exposed to the weather.

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 $23 \pm 2^\circ\text{C}$ [$73.4 \pm 4^\circ\text{F}$] for Type I and an energy of 10 J min for Type II.

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 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 | $\pm 8, - 2^A$ |
| 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] |

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

8.7 *Static Puncture Resistance*—Test Method **D5602**, 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 $23 \pm 2^\circ\text{C}$ [$73.4 \pm 4^\circ\text{F}$].

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.] 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× magnification on specimens exposed to 100 mPa [1×10^{-5} psi] ozone in air at $40 \pm 2^\circ\text{C}$ [$104 \pm 4^\circ\text{F}$]. 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 *Dark Oven Heat Exposure*—Test Method **D573**. Expose black sheet to dark oven heat at $116 \pm 2^\circ\text{C}$ [$240 \pm 4^\circ\text{F}$] for 670 ± 6.7 h and non-black sheet for 166 ± 1.66 h. Sample that has been exposed to dark oven heat is then used for testing of breaking strength, tensile strength, elongation, tear resistance, and linear dimensional change. (Linear dimensional change tests sample before and after exposure to dark oven heat.)

8.15.1 *Breaking Strength*—Test Method **D751**, Grab Method.

8.15.2 *Tensile Strength*—Test Method **D412**, Die C.

8.15.3 *Elongation, Ultimate*—Test Method **D412**, Die C.

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

8.15.5 *Linear Dimensional Change*—Test Method **D1204**.

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

8.17 *Factory Seam Strength*—Methods **D816**, 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.

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

8.19 *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× 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):

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

8.20 *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 ± 0.02 W/(m ² ·nm). (42 to 84 W/m ² at 300 to 400 nm. The maximum allowable operational fluctuation of the irradiance setting is ± 2.5 W/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 $\pm 2.5^\circ\text{C}$ [$\pm 5^\circ\text{F}$]. |
| Chamber Air Temperature (where applicable) | 50°C. The maximum allowable operational fluctuation is $\pm 2^\circ\text{C}$. |
| Relative Humidity | 50 %. The maximum allowable operational fluctuation is ± 5 %. |
| Spray Water | Refer to Practice G155 , Section 6.6.1. |
| Specimen Repositioning (if required) | Refer to Practice G155 , Section 9.5. Every 315 KJ/(m ² ·nm) at 340 nm (37.8 MJ/m ² at 300 to 400 nm.). |
| Exposure duration | White—2520 KJ/(m ² ·nm) at 340 nm (302.4 MJ/m ² at 300 to 400 nm.) Black—5040 KJ/(m ² ·nm) at 340 nm (604.8 MJ/m ² at 300 to 400 nm.) |

NOTE 2—If the operational fluctuations are greater than the maximum allowable after the equipment has stabilized, discontinue the test and correct the cause of the problem before continuing.

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 D4637) 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. PROCEDURE TO MEASURE THE GLASS TRANSITION TEMPERATURE (T_g) BY DYNAMIC MECHANICAL ANALYSIS

A1.1 Follow the test procedure, test conditions, and test reporting specified in Practice **D6382** (Sections 6, 7, and 8).

A1.2 Report data for EPDM sample prior to heat aging (as specified in ASTM D4637, Section 8.15 on Heat Aging) and after heat-aging (as specified in ASTM D4637, Section 8.15 on Heat Aging).

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