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

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1. Scope

1.1 This specification covers non-reinforced, fabric- or scrim-reinforced and fabric-backed vulcanized rubber sheet made from ethylene-propylene-diene terpolymer (EPDM), intended for use in single-ply roof membranes.

1.2 The test methods and property limits used to characterize these sheets are specific for each classification and are minimum values to make the product fit for its intended purpose.

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 The following precautionary caveat pertains to the test methods portion only, Section 8, of this specification: *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 Rubber Properties in 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 Rubber Property—Tear Resistance[2]

D 751 Test Methods for Coated Fabrics[3]

D 816 Methods of Testing 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]

G 26 Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials[5]

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 the EPDM polymers and other compounding ingredients. The principal polymer used in the sheet shall be greater than 95 % EPDM.

4.2 The sheet shall be capable of being bonded to itself for making watertight field splices and repairs, and the manufacturer or fabricator shall recommend suitable bonding methods and materials.

5. Physical Properties

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

5.2 Other requirements shall be agreed upon between the purchaser and the supplier.[6]

6. Dimensions and Permissible Variations

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 Sheet thicknesses greater than the minimum shall be agreed upon between the purchaser and the supplier.

6.2.1 The thickness tolerance shall be + 15 %, − 10 % of the specified thickness, 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 factory seams if present, shall be watertight and visually free of pinholes, particles of foreign

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[1] This specification is under the jurisdiction of ASTM Committee D-8 on Roofing, Waterproofing, and Bituminous Materials 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 14.02.

[6] Performance requirements and application specifications are being investigated by other ASTM D-8 Task Groups and will be covered by separate specifications.

TABLE 1 Physical Requirements for EPDM Sheet

Type	I	II	III
Thickness, min, in. (mm):			
Sheet-overall	0.040 (1.016)	0.040 (1.016)	...
Coating over scrim or fabric	...	0.015 (0.381)	0.030 (0.762)
Breaking strength, min, lbf (N)	...	90 (400)	90 (400)
Tensile strength, min, psi (MPa)	1305 (9.0)	...	...
Elongation, ultimate, min,%	300	250[A]	300[A]
Tensile set, max, %	10	...	...
Tear resistance, min, lbf/in. (kN/m)	150 (26.27)	...	...
Tearing strength, min, lbf (N)	...	10 (45)	10 (45)
Brittleness point, max, °F (°C)	−49 (−45)	−49 (−45)	−49 (−45)
Ozone resistance, no cracks	pass	pass	pass
Heat aging:			
Breaking strength, min, lbf (N)	...	80 (356)	80 (356)
Tensile strength, min, psi (MPa)	1205 (8.3)	...	...
Elongation, ultimate, min,%	200	200[A]	200[A]
Tear resistance, min, lbf/in. (kN/m)	125 (21.9)	...	...
Linear dimensional change, max, %	±1	±1	±1
Water absorption, max, mass %	+ 8, − 2	+ 8, − 2[A]	±8, − 2[A]
Factory seam strength, min, lbf/in. (kN/m)		50 (8.8) or sheet failure	
Weather resistance:			
Visual inspection	pass	pass	pass
PRFSE, min, %	30	...	...
Elongation, ultimate, min, %	200	...	...
Fabric adhesion, min, lbf/in. (N/m)	...	...	3 (525)

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

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 a sheet (or portion thereof), then its rejection should 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 ⅛ by 1⁄16in. (3.2 by 1.6 mm), and have a maximum depth approaching one half of the coating thickness.

8. Test Methods

8.1 *Dimensions*—Test Methods D 751, after permitting the sheet to relax at 73.4 ± 3.6°F (23 ± 2°C) for 1 h ± 15 min.

8.2 *Thickness, Sheet Overall*—From across the full width of the unbuffed sheet, take three samples, 1 by 1 ft (300 by 300 mm).[2] Measure the thickness of each corner. Ten readings out of twelve shall be equal to or above the minimum specified. 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 *Elongation, Ultimate*—Test Methods D 412, Die C.

8.7 *Tensile Set*—Test Methods D 412, Method A, Die C, 50 % elongation.

8.8 *Tear Resistance*—Test Method D 624, Die C.

8.9 *Tearing Strength*—Test Methods D 751, B-Tongue Tear.

8.10 *Brittleness Point*—Test Methods D 2137.

8.11 *Ozone Resistance*—Test Method D 1149. Inspect at 7× magnification on specimens exposed to 100 mPa (1×10^{-5} psi) ozone in air at 104 ± 4°F (40 ± 2°C). Elongate Type I specimens 50 % for 166 h ± 1.66 h exposure. Type II and Type III specimens must be wrapped around a 3 in. (76 mm) diameter mandrel for 166 h ± 1.66 h exposure. The required specimen width is 1 in. (25 mm).

8.12 *Heat Aging*—Test Method D 573. Age black sheet at 240± 4°F (116 ± 2°C) for 670 h ± 6.7 h and non-black sheet for 166 h ± 1.66 h. Specimens are then cut from the aged sheet for testing of tensile strength, elongation, and so forth.

8.13 *Linear Dimensional Change*—Test Method D 1204.

8.14 *Water Absorption*—Test Method D 471, at 158 ± 4°F (70 ± 2°C) for 166 h ± 1.66 h.

8.15 *Factory Seam Strength*—Methods D 816, Method B. Modify procedure by cutting a 1-in. (25.4-mm) wide by 12-in. (304.8-mm) long sample across the lap seam. Place in jaws approximately 2-in. (50.8 mm) from edges of the overlap area and test at 2 in. (50.8 mm)/min.

8.16 *Fabric Adhesion*—Test Method D 413. Perform test on strip specimen-Type A, using 180° peel.

8.17 *Weather Resistance*—Accelerated weathering tests shall be performewd in accordance with Practice G 26. 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):

$$PRFSE = \frac{(Tensile\ Strength \times Elongation)\ aged}{(Tensile\ Strength \times Elongation)\ original} \times 100 \qquad (1)$$

8.18 *Weather Resistance*—Practice G 26 Xenon-Arc shall be operated to the following conditions:

Filter type:[7]	Simulate natural sunlight
Irradiance:	0.35 to 0.70 W/m^2 at 340 nm (42 to 84 W/m^2 at 300 to 400 nm)
Cycle:	690 min ± 15 min light, 30 min light plus water spray
Black panel temp:	176 ± 5.4°F (80± 3°C)
Relative humidity:	50 ± 5 %
Spray water:	Deionized
Spray nozzle:[7]	Standard
Specimen rotation (if required):	Every 315 KJ/m^2 at 340 nm (37.8 MJ/m^2 at 300 to 400 nm)
Exposure duration:	White-2520 KJ/m^2 at 340 nm (302.4 MJ/m^2 at 300 to 400 nm)
	Black-5040 KJ/m^2 at 340 nm (604.8 MJ/m^2 at 300 to 400 nm)

9. Inspection and Special Testing

9.1 The manufacturer shall inspect production as a means of quality control.

9.2 The purchaser may, in the contract, order special tests which the supplier shall be required to make beyond those in Table 1.

9.3 If the results of any tests do not conform to the requirements of this specification, retesting to determine conformity shall be performed as agreed upon between involved parties.

10. Rejection and Rehearing

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.

[7] Available from Atlas Electric Devices, 4114 North Ravenswood Avenue, Chicago, IL 60613. Air cooled-3 piece suprax filter, standard spray nozzles; water cooled-borosilicate inner and outer filters, F80 Spray Nozzles, have been found suitable for this purpose.

11. Certification

11.1 Upon request of the purchaser, a manufacturer's certification that the material was manufactured in accordance with and meets the requirements outlined in this specification, together with a report of test results, shall be furnished at the time of shipment.

12. Product Marking

12.1 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 13 ft (4 m) 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.

13. Packaging and Package Marking

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

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

14. Keywords

14.1 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*, 0.001-in. (0.0254-mm) 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 0.5 mil (0.0125 mm). 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 1 mil (0.0254 mm), therefore:

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

This calculated value (1.125 mils (0.0286 mm) 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 0.5 mil (0.0127 mm).

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