



Standard Specification for Reinforced Non-Vulcanized Polymeric Sheet Used in Roofing Membrane¹

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^{ε1} NOTE—Table 1 was corrected editorially in May 1996.

1. Scope

1.1 This specification covers reinforced non-vulcanized polymeric sheet made from chlorosulfonated polyethylene (CSM)² and poly-isobutylene (PIB) intended for use as a single-ply roof membrane exposed to the weather. The sheet shall be reinforced with fiber or fabric.

1.1.1 The polymers used in these sheets have thermoplastic characteristics at time of installation. The chlorosulfonated polyethylene will vulcanize in place under ambient conditions on a roof.

1.2 The tests and property limits used to characterize these sheets are minimum values specific for each classification.

1.2.1 In-place roof systems design criteria such as fire resistance, field seaming strength, impact/puncture resistance, material compatibility, and uplift resistance, among others, are factors that must be considered, but are beyond the scope of this specification.

1.3 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 Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension³
- D 413 Test Methods for Rubber Property—Adhesion to Flexible Substrate³
- D 471 Test Method for Rubber Property—Effect of Liquids³

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² The terms CSPE for chlorosulfonated polyethylene is commonly used in the roofing industry. In accordance with Practice D 1418, some documents use CSPE as an abbreviation for CSM.

³ *Annual Book of ASTM Standards*, Vol 09.01.

- D 518 Test Method for Rubber Deterioration—Surface Cracking³
- D 751 Test Methods for Coated Fabrics⁴
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting⁵
- D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber³
- D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature⁵
- D 1418 Practice for Rubber and Rubber Latices—Nomenclature³
- D 2136 Test Method for Coated Fabrics—Low Temperature Bend Test³
- G 26 Practice for Operating Light-Exposure Apparatus (Xenon Arc-Type) With and Without Water for Exposure on Nonmetallic Materials⁶
- G 53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials⁶

3. Classification

3.1 The following types are used to identify the principal polymeric component of the coating portion of the sheet:

- 3.1.1 *Type I*—Chlorosulfonated polyethylene (CSM), and
- 3.1.2 *Type II*—Polyisobutylene (PIB).

3.2 The following grades describe the sheet construction:

- 3.2.1 *Grade 1*—Backed with fibers, and
- 3.2.2 *Grade 2*—Internally reinforced with fabric.

3.3 A general description of reinforcing/backing material including the type of fiber used and the weight per unit area of the reinforcing or backing material shall be provided, upon request.

4. Materials and Manufacture

4.1 The coating shall be formulated from the appropriate polymers, as listed in 3.1, and other compounding ingredients. The principal polymer used in the coating shall be one of those

⁴ *Annual Book of ASTM Standards*, Vol 09.02.

⁵ *Annual Book of ASTM Standards*, Vol 08.01.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 1 Physical Properties of the Backed or Reinforced Sheet

Type (Polymer) Grade (Reinforcement)	I (CSM) 2	II (PIB) 1
Property		
Thickness, min, in. (mm)	0.040 (1.02)	0.080 (2.0)
Breaking strength, min, lbf (N)	210 (935) (fabric)	160 (710)
Elongation, min, %	16.5 (fabric)	35
Tearing strength, min, lbf (N)	68 (300)	20 (89)
Low temperature bend	pass	pass
Linear dimensional change, max, %	2	0.5
Fabric adhesion, min, lbf/in., width (N/m)	NA ^{A,B}	20 (3500)
Ply adhesion, min, lbf/in. (N/m)	7.5 (1310)	NA ^B
Hydrostatic resistance, min, psi (kPa)	330 (2270)	175 (1200)
Ozone resistance, no cracks	pass	pass
Weather resistance, no cracks or crazing	pass	pass

^AInternal delamination of backing occurs prior to failure at bond between backing and coating.

^BNA = not applicable.

listed in 3.1 and shall be a minimum of 90 % for Type I and 75 % for Type II in relation to the total polymer present.

4.2 The sheet construction shall be as listed in 3.2.

4.3 The sheet shall be capable of being bonded to itself to make watertight field splices and repairs. The manufacturer or supplier shall recommend bonding methods and materials.

5. Physical Properties

5.1 Table 1 contains physical property requirements that shall be met when using the indicated class of reinforcement. (The values shown were obtained from sheets made with coatings having the properties described in Table 2.)

5.2 Table 2 contains property values for the coating portion on the weather side of the sheet. (When requested, the manufacturer shall provide a sample of the coating used on the weathering side of the supplied sheet at the thickness applied during manufacture, for testing purposes.) See 8.2.

5.3 Other requirements shall be agreed upon between the purchaser and the supplier.

6. Dimensions, Mass, 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 thickness specified greater than the minimum shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

6.2.1 The thickness tolerance shall be + 15, - 10 % of the specified nominal thickness. In no case shall the total sheet thickness be less than the minimum listed in Table 1. The minimum thickness of coating on Grade 1 sheets (backed with fibers) shall not be less than 0.020 in. (0.51 mm). The minimum thickness of coating on the weather side of Grade 2

TABLE 2 Physical Properties of the Coating Portion on the Weather Side of the Sheet, (No Backing or Internal Reinforcement)

Type	I (CSM)	II (PIB)
Property		
Tensile strength, min, psi (MPa)	735 (5.1)	680 (4.7)
Elongation, min, %	250	470
Tear resistance, min, lbf/in. (kN/m)	195 (34.0)	100 (15.8)
Ozone resistance, no cracks	Pass	Pass
Water absorption, max, mass, %	10	0.2

sheets (internally reinforced with fabric) shall not be less than 0.011 in. (0.28 mm). (See Annex A1 for method of thickness measurement for coating on weather side of sheet.)

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 matter, undispersed raw material, or other manufacturing defects that might affect serviceability. If irregularities in the form of pock marks, (See Note) appear on a sheet (or portion thereof) then its rejection shall be negotiated between involved parties.

7.2 On Grade 2 sheet, the weather side of the sheet shall be identified as agreed upon between involved parties, and so that it is apparent to the applicator.

7.3 Edges of the sheet shall be straight and flat to permit seaming to one another without fishmouthing.

NOTE 1—Pock marks are oblong depressions, cavities, or craters on the surface coating of the sheet that have approximate surface dimension of 1/8 by 1/16 in., (3.2 by 1.6 mm) and have a maximum depth approaching one half of the coating thickness.

8. Test Methods

8.1 *Backed or Reinforced Sheet, (See Table 1):*

8.1.1 *Dimensions*—In accordance with Test Methods D 751, after unrolling or unfolding and permitting the sheet to relax at 73 ± 4°F (23 ± 2°C) for 1 h minimum.

8.1.2 *Breaking Strength and Elongation*—In accordance with Test Methods D 751, grab method.

8.1.3 *Tearing Strength*—In accordance with Test Methods D 751, tongue tear method, 8 in. (200 mm) minimum by 8 in. (200 mm) minimum specimen size.

8.1.4 *Low-Temperature Bend*—In accordance with Test Method D 2136 at - 40 ± 4°F (- 40 ± 2°C).

8.1.5 *Linear Dimensional Change*—In accordance with Test Method D 1204, 1 h minimum at 212 ± 4°F (100 ± 2°C).

8.1.6 *Fabric Adhesion*—In accordance with Test Methods D 751; 12 in./min. (5.0 mm/s) jaw speed.

8.1.7 *Ply Adhesion*—In accordance with Test Methods D 413, Machine Method, Type A specimens; 2 in./min. (0.85 mm/s) jaw speed.

8.1.8 *Hydrostatic Resistance*—In accordance with Test Methods D 751, Method A.

8.1.9 *Ozone Resistance*—In accordance with Test Method

D 1149, Method B (bent loop) exposure of Test Method D 518; inspect at 7× magnification after exposure to 50 ± 5 ppm ozone at $104 \pm 4^\circ\text{F}$ ($40 \pm 2^\circ\text{C}$) for 70 h minimum.

8.1.10 *Weather Resistance*—Accelerated weathering test shall be performed by Practice G 26 or Practice G 53.

8.1.10.1 *Practice G 26*—Xenon arc apparatus Type BH or E, shall be operated in accordance with the following conditions:

filter type: borosilicate inner and outer or equivalent;
 exposure: 0.35 W/m at 340 nm;
 cycle: 690 min light, 30 min light and water spray;
 black panel temperature: $80 \pm 3^\circ\text{C}$;
 relative humidity: $50 \pm 5\%$;
 spray water: deionized;
 spray nozzle: F-80;
 specimen rotation: every 250 h; and
 exposure time: 2000 h.

Mount specimens for exposure under no strain.

Minimum specimen size is 2.75 in. (70 mm) wide by 8.0 in. (200 mm) long. After exposure, remove and wrap the specimens around a 3.0 in. (75 mm) mandrel and inspect for cracks and crazing under 7× magnification.

8.1.10.2 *Practice G 53*—Fluorescent/UV condensation exposure apparatus shall be operated in accordance with the following conditions:

fluorescent lamp: UVA-340;
 cycle: 20 h light at $80 \pm 3^\circ\text{C}$;
 4 h condensation at $80 \pm 2^\circ\text{C}$;
 specimen rotation: every 168 h; and
 exposure time: 2000 h.

Mount specimens for exposure under no strain. Minimum specimen size is 3.0 in. (75 mm) wide by 6.0 in. (150 mm) long. After exposure, remove and wrap the specimens around a 3.0 in (75 mm) mandrel and inspect for cracks and crazing under 7× magnification.

8.2 *Coating Portion on Weather Side of Supplied Sheet, (See Table 2):*

8.2.1 *Tensile Strength and Elongation*—In accordance with Test Method D 412, Method A, Die C.

8.2.2 *Tear Resistance*—In accordance with Test Method D 1004; specimens tested shall be at the applied thickness on the supplied sheet. Because the results are directly dependent

on thickness, the data is reported in lbf/in. (N/m).

8.2.3 *Ozone Resistance*—In accordance with Test Method D 1149; inspect at 7× magnification. Specimens strained 50 % while exposed to 100 MPa (pphm) ozone at $104 \pm 4^\circ\text{F}$ ($40 \pm 2^\circ\text{C}$) for 166 h.

8.2.4 *Water Absorption*—In accordance with Test Method D 471, Sections 8 and 9, at $122 \pm 4^\circ\text{F}$ ($50 \pm 2^\circ\text{C}$) for 166 h.

9. Inspection

9.1 Inspection of the material shall be agreed upon between involved parties.

10. Rejection and Resubmittal

10.1 Failure to conform to any one of the requirements prescribed in this specification shall constitute grounds for rejection. 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 (D 5019) 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 a minimum of one time per roll and not be located near an intended seam area. The identification shall be applied in such a manner as to be legible at least 5 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, so as to be acceptable by common or other carriers for safe transportation to the point of delivery, unless otherwise specified. Date of manufacture, ASTM designation, type, and grade shall be included.

ANNEX

(Mandatory Information)

A1. OPTICAL METHOD FOR MEASUREMENT OF THICKNESS OF COATING

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

A1.2 *Measurement Method:*

A1.2.1 *Principle*—The thickness of coating material over fiber, fabric, or scrim can be observed with a standard reflectance microscope. Measurement is made with a calibrated eyepiece.

A1.2.2 *Apparatus:*

A1.2.2.1 *Microscope*, 60X with reticle.

A1.2.2.2 *Light Source*—If light source on the microscope is not adequate, use a small high-intensity lamp.

A1.2.2.3 *Stage Micrometer*, 0.0254-mm (0.001-in.) divisions.

A1.2.3 *Calibration Procedure:*

A1.2.3.1 Place a standard reflectance stage micrometer in place of the specimen.

A1.2.3.2 Turn on microscope light source.

A1.2.3.3 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 verticle adjustment knob.

A1.2.3.4 Locate a point at which both scales line up. Count the number of micrometer divisions away. Measure to the

nearest 0.0125 mm (0.0005 in. or 0.5 mil). The calibration may be optimized by increasing the number of divisions measured.

A1.2.3.5 Repeat the calibration three times and average the results. A calibration example is given below:

If four reticle divisions (RD) are found equal to 4.5 micrometer divisions (MD), then:

$$1 \text{ (RD)} = 4.5/4 \text{ (MD)} \text{ or } 1 \text{ (RD)} = 1.125 \text{ (MD)} \quad (\text{A1.1})$$

Since 1 micrometer division is also equal to 25.4 μm (0.001 in. or 1.0 mil), therefore:

$$1 \text{ RD} = 28.6 \mu\text{m} \text{ (0.001125 in. or 1.125 mils)} \text{ or the calibration factor.} \quad (\text{A1.2})$$

A1.2.4 Specimen Analysis:

A1.2.4.1 Carefully center a sharp single edge razor or equivalent over the fiber intersections along the x - x axis.

A1.2.4.2 Make a clean bias cut completely through the sheet.

A1.2.4.3 Remove the razor-cut section and mount in common putty with the cut surface facing upward.

A1.2.4.4 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).

A1.2.4.5 Sample three areas of the coatings and average the results.

A1.3 *Calculation and Report*—Multiply the number of reticle divisions representing the thickness of the coating the by calibration factor. Report the average results from three areas of the coating to the nearest 12.7 μm (0.0005 in. or 0.5 mils).

A1.4 Precision and Bias:

A1.4.1 *Precision*—Measurements are accurate to $\pm 12.7 \mu\text{m}$ (0.005 in. or 0.5 mils) when the thickness is about 0.5 mm (0.020 in. or 20 mils).

A1.4.2 *Bias*—Since there is no accepted reference material suitable for determining the bias for measuring coating thickness, no statement on bias is being made.

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