Designation: D 5019 – 05

Standard Specification for Reinforced CSM (Chlorosulfonated Polyethylene) Sheet Used in Single-Ply Roof Membrane[1]

This standard is issued under the fixed designation D 5019; 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.

1. Scope

1.1 This specification covers reinforced non-vulcanized polymeric sheet made from chlorosulfonated polyethylene (CSM)[2] 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.

1.2 The tests and property limits used to characterize these sheets are minimum values.

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

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:* [3]

D 412 Test Methods for Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers—Tension
D 413 Test Methods for Rubber Property—Adhesion to Flexible Substrate
D 471 Test Method for Rubber Property—Effect of Liquids
D 518 Test Method for Rubber Deterioration—Surface Cracking
D 751 Test Methods for Coated Fabrics
D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting
D 1149 Test Method for Rubber Deterioration—Surface Ozone Cracking in a Chamber
D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
D 2136 Test Method for Coated Fabrics—Low Temperature Bend Test
G 154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
G 155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Classification

3.1 The following type is used to identify the principal polymeric component of the coating portion of the sheet:

3.1.1 *Type I*—Chlorosulfonated polyethylene (CSM).

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 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 CSM and other compounding ingredients. The CSM used in the coating shall be a minimum of 90 % in relation to the total polymer present.

4.2 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.

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[2] The term CSPE for chlorosulfonated polyethylene is commonly used in the roofing industry.

[3] 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.

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.

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 0.50 mm (0.020 in.). The minimum thickness of coating on the weather side of Grade 2 sheets (internally reinforced with fabric) shall not be less than 0.28 mm (0.011 in.). (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.

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.

8. Test Methods

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

TABLE 1 Physical Properties of the Backed or Reinforced Sheet

Type (Polymer) Grade (Reinforcement)	I (CSM) 2
Property Thickness, min, mm (in.)	1.02 (0.040)
Breaking strength, strip, min, N (lbf)	935 (210) (fabric)
Elongation, min, %	16.5 (fabric)
Tearing strength, min, N (lbf)	300 (68)
Low temperature bend	pass
Linear dimensional change, max, %	2
Ply adhesion, min, N/m (lbf/in.)	1310 (7.5)
Hydrostatic resistance, min, kPa (psi)	2270 (330)
Ozone resistance, no cracks (7× magnification)	pass
Weather resistance, no cracks or crazing (7× magnification)	pass

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

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

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

8.1.2 *Breaking Strength and Elongation*—In accordance with Test Methods D 751, cut strip test method. Ensure the nominal number of reinforcing strands per unit width are included in each test specimen.

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

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

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

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

8.1.7 *Ply Adhesion*—In accordance with Test Methods D 413, machine method, Type A specimens; 0.85 mm/s (2 in./min) 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 pphm ozone at 40 ± 2°C (104 ± 4°F) for 70 h minimum.

8.1.10 *Weather Resistance*—Accelerated weathering test shall be performed by Practices G 154 or G 155.

8.1.10.1 *Practice G 154*—2000 h fluorescent lamp UVA-340, Cycle 20 h UV at 80 ± 3°C (uninsulated black panel temperature), 4 h condensation at 50 ± 3°C (uninsulated black panel temperature). If irradiance is controlled, set-point shall be 0.68 ± 0.03 W/(m^2·nm) at 340 nm.

8.1.10.2 *Practice G 155*—2000 h xenon arc light exposure using daylight filter 0.35 ± 0.02 W/(m^2·nm) at 340 nm; 690 min light exposure, 30 min light and deionized water spray; uninsulated black panel temperature: 80 ± 3°C; relative humidity 50 ± 5 %. For equipment that allows temperature control, chamber air shall be 48 ± 3°C.

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 N/m (lbf/in.).

8.2.3 *Ozone Resistance*—In accordance with Test Method D 1149. Specimens strained 50 % while exposed to 100 MPa (pphm) ozone at 40 ± 2°C (104 ± 4°F) for 166 h.

8.2.4 *Water Absorption*—In accordance with Test Method D 471, Sections 8 and 9, at 50 ± 2°C (122 ± 4°F) 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 at intervals not to exceed 3 m (9 ft, 10 in.) in the long direction. 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.

13. Keywords

13.1 CSM (chlorosulfonated polyethylene); CSPE (chlorosulfonated polyethylene); flexible sheet; reinforcing fabrics; single-ply roof membrane

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:

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

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

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

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 ±12.7 μm (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.