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Standard Specification for Poly(Vinyl Chloride) Sheet Roofing[1]

This standard is issued under the fixed designation D4434/D4434M; 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 U.S. Department of Defense.

1. Scope

1.1 This specification covers flexible sheet made from poly(vinyl chloride) resin as the primary polymer intended for use in single-ply roofing membranes exposed to the weather. The sheet shall contain reinforcing fibers or reinforcing fabrics.

1.2 The tests and property limits used to characterize the sheet are values intended to ensure minimum quality for the intended purpose. In-place roof system design criteria, such as fire resistance, material compatibility, wind uplift resistance, in-situ shrinkage, 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~~nonconformance 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 limitation prior to use.*~~

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D570 Test Method for Water Absorption of Plastics
D638 Test Method for Tensile Properties of Plastics
D751 Test Methods for Coated Fabrics
D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

[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] 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.

D2136 Test Method for Coated Fabrics—Low-Temperature Bend Test
D3045 Practice for Heat Aging of Plastics Without Load
~~D5602~~D5602/D5602M Test Method for Static Puncture Resistance of Roofing Membrane Specimens
~~D5635~~D5635/D5635M Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens
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
G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Classification

3.1 *Type II*—Reinforced sheet in which fibers are incorporated into a production process, for example as a carrier, without appreciably affecting such physical property characteristics of the finished product as tensile strength or ultimate elongation, but may provide other desirable characteristics, such as dimensional stability.

3.2 *Type III*—Sheet that is internally reinforced with fabric and which may also have a fabric backing.

3.3 *Type IV*—Sheet that is internally reinforced with fabric and which may also have a fabric backing with minimum thickness of 0.91 mm [0.036 in.].

4. Materials and Manufacture

4.1 The sheet shall consist of poly(vinyl chloride) resin in amounts greater than 50 % of the total polymer content suitably compounded with plasticizers, stabilizers, fillers, pigments, and other ingredients to satisfy the physical property requirements and accelerated durability tests.

4.2 To make seams and repairs, the sheet shall be capable of being bonded watertight to itself during the design service life of the sheets. The manufacturer shall recommend a suitable method. Design service life is defined as the designated time period of intended system performance.

5. Physical Requirements

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

TABLE 1 Physical Requirements for Poly(Vinyl Chloride) Sheet

Property	Type II	Type III	Type IV
Overall thickness of PVC sheet, min, mm [in.]	1.14 [0.045]	1.14 [0.045]	0.91 [0.036]
Thickness over scrim, min. mm [in.][A]	0.40 [0.016]	0.40 [0.016]	0.40 [0.016]
Breaking strength, min, N [lbf/in.]	245 [55]	890 [200]	1223 [275]
Elongation at break, min, %:			
Machine direction	250	15[B]	25[B]
Cross-machine direction	220	15[B]	25[B]
Seam strength, min, % of tensile or breaking strength	75	75	75
Retention of properties after heat aging:			
Tensile strength, min, % of original	90	...	...
Breaking strength, min, % of original	...	90	90
Elongation, min, % of original	90	90	90
Tear resistance, min, N [lbf]	45.0 [10.0]	...	...
Tearing strength, min, N [lbf]	...	200 [45.0]	400 [90.0]
Low temperature bend	pass	pass	pass
Accelerated weathering test:			
Cracking (7× magnification)	none	none	none
Crazing (7× magnification)	none	none	none
Linear dimensional change, max, %	0.1	0.5	0.5
Change in weight after immersion in water, max, %	±3.0	±3.0	±3.0
Static Puncture Resistance	pass	pass	pass
Dynamic Puncture Resistance	pass[C]	pass[C]	pass[C]

[A] Above the cross points of any fabric or fiber and the surface exposed to the weather.
[B] For reinforcing fabric only; elongation of PVC material shall be the same as Type II.
[C] For Type II products, dynamic puncture shall be evaluated at an energy level of 10 J min. For Type III products, dynamic puncture shall be evaluated at an energy level of 20 J min.

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 The tolerance for temperature conditions (aging, weathering, and so forth) is ~~±2°C [±4°F]~~±2 °C [±4 °F] of the specified temperature, unless otherwise specified.

6. Dimensions

6.1 The width and length of the sheet shall be agreed upon between the purchaser and the supplier as part of the purchase contract. The width and length tolerance shall be +3 %, −0 % after permitting the sheet to relax for 1 h at 21 ± ~~3°C~~3 °C [70 ± ~~5°F]~~.5 °F].

6.2 The thickness tolerance shall be ±10 % of the thickness agreed upon by the purchaser and supplier, but in no case shall the thickness be less than the minimum in Table 1.

6.3 The sheet shall have a minimum coating or laminant thickness of 0.40 mm [0.016 in.] above the cross points of any fabric or fiber and the surface exposed to the weather.

7. Workmanship, Finish, and Appearance

7.1 The sheet and any factory seams shall be watertight. It shall be visually free of pinholes, particles of foreign matter, undispersed raw material, protruding fibers or reinforcement, or other manufacturing defects that might affect serviceability.

7.2 The sheet shall be visually free of nicks and cuts, voids, thin areas, delaminations, or other defects.

7.3 The sheet shall lay straight and flat to permit seaming without fishmouths.

8. Test Methods

8.1 *Conditioning*—Condition the test specimens in accordance with the individual test methods.

8.2 *Overall Thickness*—Test Method D638 for Type II and Test ~~Method~~Methods D751 for Type II, Type III, and Type IV.

8.3 *Thickness of Coating Over Scrim (Reinforcing Fabric)*—Test Method D7635/D7635M—Follow preparation test methods 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, Procedure B—1 in. strip for Type II and Procedure A for ~~Type~~Types III and IV.

8.5 *Elongation at Break*—Test ~~Method~~Methods D751, Procedure B—1 in. strip for Type II and Procedure A for ~~Type~~Types III and IV.

8.6 *Seam Strength*—Test ~~Method~~Methods D751, Procedure B—1 in. strip for Type II and Procedure A for ~~Type~~Types III and IV. All testing shall be performed on seamed specimens with the passing criteria specified as a percent of either unseamed sample tensile strength at break or unseamed sample breaking strength, dependent on type.

8.7 *Heat Aging*—Practice D3045 at 80 ± ~~1°C~~1 °C [176 ± ~~2°F]~~2 °F] for 56 days ± 1 h.

8.8 *Tear Resistance*—Test Method D1004, for Type II.

8.9 *Tearing Strength*—Test Methods D751, B-Tongue Tear Method, for Type III and Type IV. Specimen size shall be 200 ~~×~~by 200 mm [8 ~~×~~by 8 in.].

8.10 ~~*Low Temperature*~~ *Low-Temperature Bend Test*—Test Method D2136, at ~~−40°C [−40°F].~~−40 °C [−40 °F].

8.11 *Accelerated Weathering*—Perform accelerated weathering for 5000 h using the exposure described either in 8.11.1 or 8.11.2. Choice of apparatus and exposure conditions selected shall be by mutual agreement among the interested parties. The two different types of exposures may produce different test results. Therefore, they cannot be used interchangeably without supporting data that demonstrates equivalency of the procedures for the materials tested. Refer to Practice G151 for cautionary guidance regarding laboratory weathering.

8.11.1 *Xenon Arc Light Exposure*—Practice G155 apparatus shall be operated in accordance with the following conditions:

Filter Type	Daylight
Irradiance Set Point	0.35 W/(m^2·nm) at 340 nm. The maximum allowable operational fluctuation of the irradiance setting is (±0.02 W/(m^2·nm)).
Cycle	102 min light, 18 min light plus water spray on the front surface.
~~Black Panel Temperature, uninsulated~~	~~63°C [145°F] during the dry period. The maximum allowable operational fluctuation is ±2.5°C [±5°F].~~
Black Panel Temperature, uninsulated	63 °C [145 °F] during the dry period. The maximum allowable operational fluctuation is ±2.5 °C [±5 °F].
Relative Humidity	30 %. The maximum allowable operational fluctuation is ±5 %.
~~Chamber Air Temperature (where applicable)~~	~~44°C [111°F]. The maximum allowable operational fluctuation is ±2°C [3.6°F].~~
Chamber Air Temperature (where applicable)	44 °C [111 °F]. The maximum allowable operational fluctuation is ±2 °C [3.6 °F].
~~Spray Water~~	~~Deionized. Refer to Practice G155, Section 6.6.1. Typical water temperature used for specimen spray is 21 ± 5°C [70 ± 9°F], but if ambient temperature is low and holding tank is not used to store purified water, the water temperature can be below the typical range.~~
Spray Water	Deionized. Refer to Practice G155, Section 6.6.1. Typical water temperature used for specimen spray is 21 ± 5 °C [70 ± 9 °F], but if ambient temperature is low and holding tank is not used to store purified water, the water temperature can be below the typical range.
~~Irradiance Uniformity~~	~~Refer to Practice G155.~~
Irradiance Uniformity	Refer to Practice G155.

8.11.2 *Fluorescent UV/Condensation Exposure*—Practice G154 apparatus shall be operated in accordance with the following conditions: Using fluorescent ~~UVA –340~~ UVA-340 lamps. ~~Irradiance~~Irradiance level shall be 0.68 W/(m^2·nm) at 340 nm. The maximum allowable operational fluctuation of the irradiance setting is ±0.02 W/(m^2·nm). Cycle 8 h light at ~~60°C [145°F],~~60 °C