



Designation: D 4434 – 96

Standard Specification for Poly(Vinyl Chloride) Sheet Roofing¹

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

2. Referenced Documents

2.1 ASTM Standards:

- D 570 Test Method for Water Absorption of Plastics²
- D 638 Test Method for Tensile Properties of Plastics²
- D 751 Test Methods for Coated Fabrics³
- D 1004 Test Method for Initial Tear Resistance of Plastic Film and Sheeting²
- D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature²
- D 2136 Test Method for Coated Fabrics—Low Temperature Bend Test⁴
- D 3045 Practice for Heat Aging of Plastics Without Load⁵
- D 5602 Test Method for Static Puncture Resistance of Roofing Membrane Samples⁶
- D 5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Samples⁶
- G 26 Practice for Operating Light-Exposure Apparatus

(Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials⁷

G 53 Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV/Condensation Type) for Exposure of Nonmetallic Materials⁷

3. Classification

3.1 Type II:

3.1.1 *Grade 1*—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.

3.1.2 *Grade 2*—Externally reinforced sheet utilizing a fabric backing.

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.

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

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² *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 09.02.

⁴ *Annual Book of ASTM Standards*, Vol 09.01.

⁵ *Annual Book of ASTM Standards*, Vol 08.02.

⁶ *Annual Book of ASTM Standards*, Vol 04.04.

⁷ *Annual Book of ASTM Standards*, Vol 14.02.

TABLE 1 Physical Requirements for Poly(Vinyl Chloride) Sheet

Property	Type II		Type III	Type IV
	Grade 1	Grade 2		
Overall thickness of PVC sheet, min, mm (in.)	1.14 (0.045)	1.14 (0.045)	1.14 (0.045)	0.91 (0.036)
Tensile strength at break, min, MPa (psi):				
Machine direction	10.4 (1500)	...	...	...
Cross-machine direction	10.4 (1500)	...	...	...
Breaking strength, min, kN/m (lbf/in.)	...	35 (200)	35 (200)	48 (275)
Elongation at break, min, %:				
Machine direction	250	15	15 ^A	25 ^A
Cross-machine direction	220	15	15 ^A	25 ^A
Seam strength, min, % of tensile or breaking strength	75	75	75	75
Retention of properties after heat aging:				
Tensile strength, min, % of original	90	...	...	...
Breaking strength, min, % of original	...	90	90	90
Elongation, min, % of original	90	90	90	90
Tear resistance, min, N (lbf)	45.0 (10.0)	...	...	...
Tearing strength, min, N (lbf)	...	200 (45.0)	200 (45.0)	400 (90.0)
Low temperature bend	pass	pass	pass	pass
Accelerated weathering test:				
Cracking (7× magnification)	none	none	none	none
Crazing (7× magnification)	none	none	none	none
Linear dimensional change, max, %	0.1	0.1	0.5	0.5
Change in weight after immersion in water, max, %	±3.0	±3.0	±3.0	±3.0
Static Puncture Resistance	pass	pass	pass	pass
Dynamic Puncture Resistance	pass ^B	pass ^B	pass ^B	pass ^B

^A For reinforcing fabric only; elongation of PVC material shall be the same as Type II, Grade 1.

^B For Type II, Grade 1 products dynamic puncture shall be evaluated at an energy level of 10 J min. For Type II, Grade 2 and Type III products dynamic puncture shall be evaluated at an energy level of 20 J min.

contract. The width and length tolerance shall be + 3 %, – 0 % after permitting the sheet to relax for 1 h at 21 ± 3°C (70 ± 5°F).

6.2 The thickness and thickness tolerance shall be agreed upon between the purchaser and the supplier as part of the purchase contract subject to the requirements specified in Table 1.

6.3 Type II, Type III, and Type IV 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 Edges of the sheet shall be straight and flat to permit seaming to the adjacent sheet 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 D 638 for Type II, Grade 1 and Test Method D 751 for Type II, Grade 2, Type III, and Type IV. Unless otherwise noted, all thicknesses shall have tolerances of + 10 %, – 10 % of the specified nominal thickness.

8.3 *Tensile Strength at Break*—Test Method D 638 for Type II, Grade 1.

8.4 *Breaking Strength*—Test Methods D 751, A—Grab Method, for Type II, Grade 2, Type III and Type IV.

8.5 *Elongation at Break*—Test Method D 638 for Type II, Grade 1 and Test Methods D 751, A—Grab Method, for Type II, Grade 2, Type III and Type IV.

8.6 *Seam Strength*—Test Method D 638 for Type II, Grade 1 and Test Methods D 751, A—Grab Method, for Type II, Grade 2, Type III and Type 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 D 3045 at 80 ± 1°C (176 ± 2°F) for 56 days ± 1 h.

8.8 *Tear Resistance*—Test Method D 1004, for Type II, Grade 1.

8.9 *Tearing Strength*—Test Methods D 751, B—Tongue Tear Method, for Type II, Grade 2, Type III, and Type IV. Specimen size shall be 200 mm × 200 mm (8 in. by 8 in.).

8.10 *Low Temperature Bend Test*—Test Method D 2136, at – 40°C (– 40°F).

8.11 *Accelerated Weathering Test*—Perform accelerated weathering test for 5000 h. The following test procedures shall be permitted:

8.11.1 *Xenon Arc Light Exposure*—Practice G 26 with controlled humidity (Type B, BH or E), using natural sunlight filter (inner/outer borosilicate or equivalent); deionized water; 102 min light exposure, 18 min light and spray; black panel temperature (63 ± 3°C) (black standard thermometer 70 ± 3°C) relative humidity (30 ± 5 %). The intensity appropriate for this test shall be 0.35 W/m² at 340 nm.

8.11.2 *Fluorescent UV/Condensation Exposure*—Practice G 53 Type UVA-340; 8 h light exposure; 4 h condensation; black panel temperature (63 ± 3°C); condensation temperature 50°C.

8.12 *Linear Dimensional Change*—Test Method D 1204, 6 h at 80 ± 1°C (176 ± 2°F).