



Standard Specification for Liquid-Applied, Single-Pack, Moisture-Triggered, Aliphatic Polyurethane Roofing Membrane¹

This standard is issued under the fixed designation D7311/D7311M; 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 in-situ applied, single-pack, moisture-triggered, aliphatic polyurethanes intended to form an elastomeric single-ply membrane, once cured. The cured membrane may or may not contain a reinforcing material.

1.2 Single-pack, moisture-triggered, aliphatic polyurethanes are characterized by their ability to use moisture to trigger the curing process only.

1.3 The tests and property limits used to characterize the liquid material and cured membrane are values intended to ensure minimum quality. In-place roof system design criteria such as fire resistance, material compatibility, and uplift resistance, among others, are factors that shall be considered but are beyond the scope of this specification.

1.4 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 with the standard.

1.5 *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:²

C717 Terminology of Building Seals and Sealants

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.

Current edition approved Aug. 1, 2010. Published September 2010. Originally approved in 2007. Last previous edition approved in 2007 as D7311 – 07. DOI: 10.1520/D7311_D7311M-10.

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.

C578 Specification for Rigid, Cellular Polystyrene Thermal Insulation

D412 Test Methods for Vulcanized Rubber and Thermoplastic Elastomers—Tension

D522 Test Methods for Mandrel Bend Test of Attached Organic Coatings

D624 Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

D1079 Terminology Relating to Roofing and Waterproofing

D2240 Test Method for Rubber Property—Durometer Hardness

D5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens

D5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens

E96/E96M Test Methods for Water Vapor Transmission of Materials

G154 Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

3. Terminology

3.1 The following definitions have been developed specifically for the purposes of this specification. For general terminology, see Terminologies **D1079** and **C717**.

3.2 *Definitions of Terms Specific to This Standard:*

3.3 *aliphatic polyurethane*—polyurethane is made by polyaddition of aliphatic di- or polyfunctional hydroxyl group containing compounds and of aliphatic polyfunctional prepolymers.

3.4 *liquid-applied*—a material or a combination of materials that can be poured, spread, or sprayed.

3.5 *moisture-triggered*—the mechanism by which moisture activates a latent hardener contained within the material.

3.6 *single-pack*—a material that is capable of being delivered in one package, and applied without further additions.

4. Materials and Manufacture

4.1 The membrane shall be formulated from the principle polymers and related formula ingredients.

4.2 The product, as manufactured, shall be in liquid form for application by brush, roller, or spray equipment.

4.3 Freshly applied material shall be capable of being bonded to cured material for making watertight field repairs. Supplier shall recommend suitable methods for surface preparation necessary to achieve adhesion.

5. Physical Properties

5.1 The cured film shall comply with the physical property requirements in **Table 1**.

6. Specimen Preparation

6.1 Films are prepared by draw-down bar, on siliconized release board, at a wet film thickness (WFT) necessary to yield a dry film thickness (DFT) of 0.8 mm [0.032 in./32 mil]. The film is allowed to cure at $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] and $50 \pm 5\%$ relative humidity for 24 ± 2 h. This is followed by 24 h at $60 \pm 2^\circ\text{C}$ [$140 \pm 3.6^\circ\text{F}$] oven curing and minimum 2 h cooling.

6.1.1 The thickness tolerance for sample preparation shall be $+15\%$, -10% of that shown in **6.1**.

6.1.2 Samples shall be prepared equal to the width of a 12.5 cm [5 in.] draw-down bar by 30.5 cm [12 in.] in length. Cured films should be inspected for imperfections (for example, pinholes) and any such areas rejected. If necessary, recast the films. Trim 1.75 cm [0.69 in.] off each edge of the cured film. Test work is carried out on the remaining 9 by 27 cm [3.54 by 10.63 in.] cured film.

7. Test Methods

7.1 *Elongation and Tensile (Tension) Strengths (Test Method D412):*

7.1.1 Test conditions $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] at $50 \pm 5\%$ relative humidity.

7.1.2 Dumbbell specimens are Type IV, Die C.

7.1.3 Test type or functional equivalent:

7.1.3.1 Cross head speed.

7.1.3.2 Dumbbell specimens 50 mm/min [1.95 in./min].

7.1.4 Results expressed are at break.

7.2 *Accelerated Weathering (Practice G154):*

7.2.1 Cycle employed—using type 313 lamps (UV-B).

4 h UV at 60°C [140°F] uninsulated black panel temperature	} 5000 h
4 h condensation at 50°C [122°F]	
uninsulated black panel temperature	
Major irradiance between 290 and 340 nm	
Irradiance level = $0.74 \text{ W}/(\text{m}^2 \cdot \text{nm})$ at wavelength of 310 nm	

NOTE 1—Refer to Practice **G154**, Table X2.3, for maximum allowable operational fluctuations of the temperature and irradiance set points. If the

fluctuation is greater than the maximum allowable deviation for the set point at the control sensor during equilibrium operation, the test must be discontinued until the problem is solved.

NOTE 2—Refer to Practice **G154**, Table X2.1, Note X2.7, for information on the change in historical irradiance set point. The higher set point does not change the irradiance in the device of one manufacturer that required modification of the radiometer calibration, but increases the irradiance in equipment that did not require modification. Users should consult the manufacturer of their device for clarification if in doubt.

7.3 *Water Vapor Transmission (Test Method E96/E96M):*

7.3.1 Test to constant transmission at 32.2°C [90°F] and 54% relative humidity using Procedure C.

7.3.2 The results may be expressed as water vapor transmission, permeance, or permeability in accordance with Test Method **E96/E96M**.

7.4 *Flexibility—Mandrel Bend (Test Method D522):*

7.4.1 Method B with 304.8 by 101.6 mm [12 by 4 in.].

7.4.2 Test carried out at $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{C}$] and $50 \pm 5\%$ relative humidity.

7.4.3 Result in **Table 1** is for 3.2 mm [$1/8$ -in.] cylindrical mandrel.

7.5 *Tear Resistance (Test Method D624):*

7.5.1 Test samples are ‘trouser shapes’—Die ‘C’.

7.5.2 Tear rate is 50 mm/min [1.97 in./min].

7.5.3 Test carried out at $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{C}$] and $50 \pm 5\%$ relative humidity.

7.6 *Indentation Hardness (Test Method D2240):*

7.6.1 Test carried out at $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{C}$] and $50 \pm 5\%$ relative humidity.

7.6.2 Test material may be wet applied/adhered to a panel of harder material (for example, aluminium), or as a cured sheet placed on a harder surface such as aluminium.

7.7 *Dynamic Puncture Resistance (Test Method D5635):*

7.7.1 Test conditions $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] and $50 \pm 5\%$ relative humidity.

7.7.2 Test may be carried out in compliance with protocol PA 114, Appendix 1, such as indicated by Miami Dade Authority, in which case the sample is conditioned at $25 \pm 2^\circ\text{C}$ [$77 \pm 3^\circ\text{F}$] and $50 \pm 5\%$ relative humidity. The test procedure is then followed in compliance with Test Method **D5635**.

7.7.3 Substrate is Type IX, Rigid, Cellular Polystyrene conforming to Specification **C578**.

7.7.4 Test result is recorded as the load at which no puncture occurs but above which the specimen is punctured.

7.8 *Static Puncture Resistance (Test Method D5602):*

7.8.1 Test conditions $23 \pm 2^\circ\text{C}$ [$73.4 \pm 3.6^\circ\text{F}$] and $50 \pm 5\%$ relative humidity.

TABLE 1 Film Physical Property Requirements for Moisture-Triggered Aliphatic Polyurethane Roofing Membranes

Physical Properties	ASTM	Requirements
Tensile strength (tension)	D412	min 1.86 MPa [270 lb/in. ²]
Elongation	D412	min 200 %
Accelerated weathering FL/UV — 5000 h	G154	No cracking or checking
Water vapor transmission permeability/permeance	E96/E96M	Max 8.52 g/m ² /day [0.033 perm-in.]
Flexibility—mandrel bend	D522	Pass—no cracking or flaking
Tear resistance	D624	Min 5.8 kN/m [33 lbf/in.]
Indentation hardness	D2240	82 durometer units [± 5 units]
Dynamic puncture resistance	D5635	Min 15 J [357 ft.poundals]
Static puncture resistance	D5602	Min 20.7ow kg [45.5 lb]



7.8.2 Test may be carried out in compliance with protocol PA 114, Appendix 1, such as indicated by Miami Dade Authority, in which case the sample is conditioned at $25 \pm 2^{\circ}\text{C}$ [$77 \pm 3^{\circ}\text{F}$] and $50 \pm 5\%$ relative humidity. The test procedure is then followed in compliance with Test Method D5635.

7.8.3 Substrate is Type IX, Rigid, Cellular Polystyrene conforming to Specification C578.

7.8.4 Test result is recorded as the load at which a puncture occurs but above which the specimen is punctured.

8. Packaging and Package Marking

8.1 The material shall be packaged in a standard commercial manner, unless otherwise specified, so as to be acceptable by commercial or other carriers for safe transportation to the point of delivery.

8.2 Shipping containers shall be marked with:

8.2.1 The name of the material,

8.2.2 Product code,

8.2.3 ASTM designation,

8.2.4 Size or quantity, and

8.2.5 Name of manufacturer or supplier.

9. Inspection

9.1 Inspection shall be determined by and as agreed between the purchaser and the supplier.

10. Rejection and Resubmittal

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 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. Purchaser shall apply same test methods, as applied to rejected shipment, to resubmitted material to ensure compliance with specification.

11. Keywords

11.1 aliphatic polyurethane; elastomeric polyurethane; moisture trigger polyurethane; roof waterproofing; single-pack

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the ASTM website (www.astm.org/COPYRIGHT/).