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Standard Guide for Low-Slope Insulated Roof Membrane Assembly Performance[1]

This standard is issued under the fixed designation D6630/D6630M; 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 guide lists test methods intended to establish a minimum level of performance for insulated roof membrane assemblies, and lists pertinent design guidelines and installation methods in a unified manner. Material tests and evaluations are included with and without roof insulation.

1.2 It is not possible to establish a precise correlation between laboratory tests on roof assemblies and natural weathering due to variations in geographical climate, design, material, and installation.

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 nonconformance with the standard.

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]

D95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

D450/D450M Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing

D1079 Terminology Relating to Roofing and Waterproofing

D2523/D2523M Practice for Testing Load-Strain Properties of Roofing Membranes

D4434/D4434M Specification for Poly(Vinyl Chloride) Sheet Roofing

D4637/D4637M Specification for EPDM Sheet Used in Single-Ply Roof Membrane

D4798/D4798M Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)

D4799/D4799M Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Fluorescent UV, Water Spray, and Condensation Method)

D5019 Specification for Reinforced CSM (Chlorosulfonated Polyethylene) Sheet Used in Single-Ply Roof Membrane (Withdrawn 2011)[3]

D5147/D5147M Test Methods for Sampling and Testing Modified Bituminous Sheet Material

D5601 Test Method for Tearing Resistance of Roofing and Waterproofing Materials and Membranes (Withdrawn 2002)[3]

D5602/D5602M Test Method for Static Puncture Resistance of Roofing Membrane Specimens

D5635/D5635M Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens

D5849/D5849M Test Method for Evaluating Resistance of Modified Bituminous Roofing Membrane to Cyclic Fatigue (Joint Displacement)

D6754/D6754M Specification for Ketone Ethylene Ester Based Sheet Roofing

D6878/D6878M Specification for Thermoplastic Polyolefin-Based Sheet Roofing

E96/E96M Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials

E631 Terminology of Building Constructions

[1] This guide is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.20 on Roofing Membrane Systems.

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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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

2.2 *ASCE Standard:*[4]

ASCE-7 Minimum Design Loads for Buildings and Other Structures

2.3 *ANSI/SPRI Standard:*[5]

ANSI/SPRI RP-4 Wind Design Guide for Ballasted Single Ply Roof Systems

3. Terminology

3.1 For terminology used in this standard, refer to Terminologies D1079 and E631.

3.2 *roof assemblies*—the weathering or waterproofing material, whether film, flexible membrane, semi-flexible membrane, factory or field manufactured; the underlying substrate including insulation (if used) above or below the membrane, or both; supporting deck structure and method of attachment of the entire assembly. Low-slope roof assemblies may be up to 25 % slope. Some roof assemblies may accommodate higher slopes.

3.3 *performance*—the ability of the roof system as designed, manufactured, and installed to provide adequate levels of expected service life in terms of watertightness, thermal protection, and condensation control, while being maintainable. Live loading of the roof system may also occur.

4. Significance and Use

4.1 A roof assembly must work as a system. Any component of the roof assembly demonstrating an inherent weakness or inability to perform will diminish the roof system performance and service life expected. This guide lists minimum performance attributes required of low-slope roof assemblies. Products not previously used as roof membrane materials require additional tests beyond the scope of this document. This guide is not intended for use on in-service roofing materials. Roof membranes and other components should conform to ASTM product standards, if available.

5. Roof Design Classifications

5.1 *Type of Construction:*

Class	Construction
I New	New
II Replace	Remove existing roof membrane (and existing insulation, if necessary) and replace
III Re-cover	Re-cover existing roof membrane

5.2 *Methods of Attachment:*

Roof Membrane Configuration	Method of Attachment
Method A Adhered	Uses a variety of adhesives including hot and cold applied.
Method B Loose laid ballasted	Uses aggregate ballast or pavers. Structure needs capacity to carry ballast dead load.
Method LD Loose laid air pressure equalization valves	Uses air pressure equalization valve with loose laid membrane tightly sealed at edge. Needs airtight deck.
Method M Partially attached/ mechanically fastened	Uses a variety of fasteners and attachment schemes that anchor membrane to roof deck for uplift resistance.
Method P Protected membrane	Uses aggregate ballast, pavers, or other dead load devices for wind uplift resistance of extruded polystyrene.

6. Roof Material Attributes

6.1 The roof membrane and insulated roof system shall be tested according to the procedures in Table 1. In addition, the roof membrane shall meet specific test requirements where identified.

7. Design of Roofing Assembly

7.1 The roofing system may consist of the following functional layers from the bottom to the top:

7.1.1 Structural deck;

7.1.2 Air retarder;

7.1.3 Vapor retarder;

7.1.4 Thermal insulation; and

7.1.5 Roofing membrane

7.2 The following paragraphs list the minimum design requirements for each functional layer of the roof assembly. These may exceed the requirements of the local building code.

7.2.1 *Structural Deck*—The structural deck shall have the capacity to support the full design load, including dead load, live loads, and environmental loads anticipated or mandated by code. The dead load of the roof system shall be included as part of the design load. Deck deflection should be limited to L/240 under full design load. Ponding due to deck deflection should not occur. Provide overflow drains or scuppers when interior drains are used. The live load capacity shall not be less than 98 Kg/m^2 [20 psf] and should have adequate capacity to resist construction loads.

7.2.2 *Air Retarder*—Air retarders are used to retard the flow of air from the interior into the roof system. When air retarders are used properly, they reduce the effects from wind on some roofing systems. With care, the vapor retarder and air retarder functions may be provided by the same materials.

7.2.3 *Vapor Retarder*—The vapor retarder retards the transfer of the moist-warm interior vapor into the roofing system. A vapor retarder should be used on the warm side of the system over moist occupancies, and at locations where the quantity of moisture accumulated in the winter exceeds the moisture capacity of the materials in the system.

7.2.4 *Thermal Insulation*—Thermal insulation must be used wherever a building is heated or cooled, except industrial facilities where excess process heat needs to be dissipated. Where used, it should be installed in two or more layers with offset joints. Tapered insulation can be used where necessary to provide a positive slope to the drains. Provide sump areas at all roof drains to assist drainage. The insulation selected must be compatible with the membrane system selected and have the

[4] Available from American Society of Civil Engineers (ASCE), 1801 Alexander Bell Dr., Reston, VA 20191, http://www.asce.org.

[5] Available from American National Standards Institute and Single Ply Roofing Institute, 200 Reservoir St., Suite 309A, Needham, MA 02194.

TABLE 1 Roof Material Attributes

Property	Criteria
A. Static indentation resistance Use Test Method D5602/D5602M. Tested at –18 °C, 23 °C, 70 °C [0 °F, 73 °F, 158 °F]. Test membrane with specified insulation system over rigid concrete support. Concrete to have 50 mm [2 in.] minimum thickness with minimum compressive strength of 17.2 MPa [2500 psi]. If no insulation is used, report none.	Report static puncture resistance per Section 11 of Test Method D5602/D5602M for each test temperature.
B. Dynamic indentation resistance Use Test Method D5635/D5635M. Tested at –18 °C, 23 °C, 70 °C [0 °F, 73 °F, 158 °F]. Test membrane with specified insulation system over rigid concrete support. Concrete to have compressive strength of 17.2 MPa [2500 psi]. If no insulation is used, report none.	Report dynamic puncture resistance per Section 12 of Test Method D5635/D5635M for each test temperature.
C. Cyclical fatigue—membrane only Use Test Condition 3 of Test Method D5849/D5849M at 0 °C [32 °F].	Run 500 cycles. Report results per Section 11 of Test Method D5849/D5849M. If less than 500 cycles, report cycles achieved and failure mode.
D. Heat conditioning Use this sequence of tests on new roof membranes intended for exposure (smooth or granule surfaced, plain or reinforced).[A] Membrane materials without existing ASTM material standards should follow the test conditions cited below based on color. Membrane materials with existing ASTM material standards should use the heat conditioning test called for.	
1. For black membrane materials—28 days at 80 °C [176 °F]	Report change in tensile strength and elongation. Report changes in sample dimension and thickness.
2. For gray membrane materials—28 days at 70 °C [158 °F]	Report change in tensile strength and elongation. Report changes in sample dimension and thickness.
3. For white membrane materials—28 days at 60 °C [140 °F]	Report change in tensile strength and elongation. Report changes in sample dimension and thickness.
E. UV radiation—membrane only[B] 1. For unsurfaced membranes, use Practices D4798/D4798M or D4799/D4799M for a minimum of 4000 h. Report test cycle employed and number of test cycles completed, along with the level of irradiation used for D4798/D4798M; report test cycle employed and number of cycles completed along with fluorescent lamps used for D4799/D4799M. 2. 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. 3. The duration of the UV radiation shall be sufficiently long enough to differentiate a material that weathers poorly from one that has acceptable weathering performance.	1. <5.5 °C [10 °F] change in low temperature flex. 2. Report change in tensile strength and elongation. 3. No cracks. 4. Report visual appearance and note color change, if any.
F. Water exposure—membrane only 1. Run 45 cycles of immersion in water at 23 °C and 50 °C ± 2 °C [73 °F and 122 °F ± 4 °F] for 24 h followed by dark oven heat aging at 70 °C [158 °F] for 24 h. Determine moisture content according to Test Method D95 for membrane at start of test and after 45th cycle.	1. <1 % change in weight. 2. Report visual appearance and note color change, if any.
G. Moisture permeance—membrane only 1. Determine according to Test Methods E96/E96M. Use Procedure B or BW at 23 °C [73 °F]	1. <0.10 perms. 2. Report conditioning, procedure and test temperature used and results.
H. Tear resistance—membrane only 1. Conduct tear resistance test at –18 °C, 23 °C, and 70 °C ± 2 °C [0 °F, 73 °F, and 158 °F ± 4 °F] per Test Method D5601.	1. Report tear resistance per Section 7 of Test Method D5601 for each temperature tested.
I. Tensile strength, elongation, strain energy Membrane only per Practice D2523/D2523M; Specifications D4434/D4434M, D4637/D4637M, or D5019; or Test Method D5147/D5147M. Include testing of lap seams where called for in the standards.	Report values of tensile strength, elongation and/or strain energy per standard used.

[A] The tests listed in Table 1 do not apply to any adhered aggregate roof membrane assembly which uses coal tar pitch material meeting Specification D450/D450M.
[B] If a material that is known to weather poorly does not show deterioration when exposed for the specified duration, the latter is insufficient.

heat, moisture stability, and compressive resistance needed for the application selected.

7.2.5 *Roofing Membrane*—The roofing membrane may be single-ply or multi-ply, depending on the materials involved. Where applicable, the properties of the roof membrane shall meet or exceed the minimum values shown in Table 1 before and after artificial weathering, heat conditioning, water immersion, and fatigue cycling.

7.3 *Roof System Design:*

7.3.1 The membrane material selected for use shall pass the tests outlined in Section 6, modified to reflect the weather extremes anticipated for the locality of use, including wind.

7.3.2 All classes of roof construction should have a positive slope to drain (2 % minimum for new construction, other than coal-tar roof assemblies and 1 % minimum for new construction for coal tar roof assemblies).