



Designation: D 6630 – 01

## Standard Guide for Low Slope Insulated Roof Membrane Assembly Performance<sup>1</sup>

This standard is issued under the fixed designation D 6630; 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 *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 requirements prior to use.*

### 2. Referenced Documents

#### 2.1 ASTM Standards:

- D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation<sup>2</sup>
- D 2523 Practice for Testing Load-Strain Properties of Roofing Membranes<sup>3</sup>
- D 4434 Specification for Poly(Vinyl Chloride) Sheet Roofing<sup>3</sup>
- D 4637 Specification for Vulcanized Rubber Sheet Used in Single-Ply Roof Membrane<sup>3</sup>
- D 4798 Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)<sup>3</sup>
- D 4799 Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Fluorescent UV and Condensation Method)<sup>3</sup>
- D 5019 Specification for Reinforced Non-Vulcanized Polymeric Sheet Used in Roofing Membrane<sup>3</sup>
- D 5147 Test Methods for Sampling and Testing Modified Bituminous Sheet Material<sup>3</sup>

D 5601 Test Method for Tearing Resistance of Roofing and Waterproofing Materials and Membranes<sup>3</sup>

D 5602 Test Method for Static Puncture Resistance of Roofing Membrane Specimens<sup>3</sup>

D 5635 Test Method for Dynamic Puncture Resistance of Roofing Membrane Specimens<sup>3</sup>

D 5849 Test Method for Evaluating Resistance of Modified, Bituminous Roofing Membranes to Cyclic Joint Displacement<sup>3</sup>

E 96 Test Methods for Water Vapor Transmission of Materials<sup>4</sup>

#### 2.2 ASCE Standard:

ASCE-7 Minimum Design Loads for Buildings and Other Structures<sup>5</sup>

#### 2.3 ANSI/SPRI Standard:

ANSI/SPRI RP-4 Wind Design Guide for Ballasted Single Ply Roof Systems<sup>6</sup>

### 3. Terminology

3.1 *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.

3.2 *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

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 05.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 04.04.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 04.06.

<sup>5</sup> Available from American Society of Civil Engineering, 1801 Alexander Bell Drive, Reston, VA 20191-4400.

<sup>6</sup> Available from American National Standards Institute and Single Ply Roofing Institute, 200 Reservoir St., Suite 309A, Needham, MA 02194.

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

**TABLE 1 Roof Material Attributes**

| Property                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Criteria                                                                                                                                                                                                                                                                                                                   |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A. Static indentation resistance</b><br>Use Test Method D 5602.<br>Tested at $-18^{\circ}\text{C}$ , $23^{\circ}\text{C}$ , $70^{\circ}\text{C}$ ( $0^{\circ}\text{F}$ , $73^{\circ}\text{F}$ , $158^{\circ}\text{F}$ ).<br>Test membrane with specified insulation system over rigid concrete support.<br>Concrete to have 50 mm (2 in.) minimum thickness with minimum compressive strength of 17.2 MPa (2 500 psi). If no insulation is used, report none.                                                                                                                                                                                                                                                                                                                                     | Report static puncture resistance per Section 11 of Test Method D 5602 for each test temperature.                                                                                                                                                                                                                          |
| <b>B. Dynamic indentation resistance</b><br>Use Test Method D 5635.<br>Tested at $-18^{\circ}\text{C}$ , $23^{\circ}\text{C}$ , $70^{\circ}\text{C}$ ( $0^{\circ}\text{F}$ , $73^{\circ}\text{F}$ , $158^{\circ}\text{F}$ ).<br>Test membrane with specified insulation system over rigid concrete support.<br>Concrete to have compressive strength of 17.2 MPa (2 500 psi). If no insulation is used, report none.                                                                                                                                                                                                                                                                                                                                                                                 | Report dynamic puncture resistance per Section 12 of Test Method D 5635 for each test temperature.                                                                                                                                                                                                                         |
| <b>C. Cyclical fatigue—membrane only</b><br>Use Test Condition 3 of Test Method D 5849 at $0^{\circ}\text{C}$ ( $32^{\circ}\text{F}$ ).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Run 500 cycles. Report results per Section 11 of Test Method D 5849. If less than 500 cycles, report cycles achieved and failure mode.                                                                                                                                                                                     |
| <b>D. Heat conditioning</b><br>Use this sequence of tests on new roof membranes intended for exposure (smooth or granule surfaced, plain or reinforced).<br>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. <ol style="list-style-type: none"> <li>For black membrane materials—28 days at <math>80^{\circ}\text{C}</math> (<math>176^{\circ}\text{F}</math>)</li> <li>For gray membrane materials—28 days at <math>70^{\circ}\text{C}</math> (<math>158^{\circ}\text{F}</math>)</li> <li>For white membrane materials—28 days at <math>60^{\circ}\text{C}</math> (<math>140^{\circ}\text{F}</math>)</li> </ol> | Report change in tensile strength and elongation.<br>Report changes in sample dimension and thickness.<br>Report change in tensile strength and elongation.<br>Report changes in sample dimension and thickness.<br>Report change in tensile strength and elongation.<br>Report changes in sample dimension and thickness. |
| <b>E. UV radiation—membrane only</b> <ol style="list-style-type: none"> <li>For unsurfaced membranes, use Test Method D 4798 or D 4799. Follow test criteria and exposure for each material standard listed; minimum 4 000 h with condensation cycle, or minimum irradiance called for in ASTM material standards.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <ol style="list-style-type: none"> <li><math>&lt;5.5^{\circ}\text{C}</math> (<math>10^{\circ}\text{F}</math>) change in low temperature flex.</li> <li>Report change in tensile strength and elongation.</li> <li>No cracks.</li> <li>Report visual appearance and note color change, if any.</li> </ol>                   |
| <b>F. Water exposure—membrane only</b> <ol style="list-style-type: none"> <li>Run 45 cycles of immersion in water at <math>23^{\circ}\text{C}</math> and <math>50^{\circ}\text{C}</math> (<math>\pm 2^{\circ}\text{C}</math>) (<math>73^{\circ}\text{F}</math> and <math>122^{\circ}\text{F}</math> <math>\pm 4^{\circ}\text{F}</math>) for 24 h followed by dark oven heat aging at <math>70^{\circ}\text{C}</math> (<math>158^{\circ}\text{F}</math>) for 24 h. Determine moisture content according to Test Method D 95 for membrane at start of test and after 45th cycle.</li> </ol>                                                                                                                                                                                                            | <ol style="list-style-type: none"> <li><math>&lt;1\%</math> change in weight.</li> <li>Report visual appearance and note color change, if any.</li> </ol>                                                                                                                                                                  |
| <b>G. Moisture permeance—membrane only</b> <ol style="list-style-type: none"> <li>Determine according to Test Methods E 96.<br/>Use Procedure B or BW at <math>23^{\circ}\text{C}</math> (<math>73^{\circ}\text{F}</math>)</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <ol style="list-style-type: none"> <li><math>&lt;0.10</math> perms.</li> <li>Report conditioning, procedure and test temperature used and results.</li> </ol>                                                                                                                                                              |
| <b>H. Tear resistance—membrane only</b> <ol style="list-style-type: none"> <li>Conduct tear resistance test at <math>-18^{\circ}\text{C}</math>, <math>23^{\circ}\text{C}</math> and <math>70^{\circ}\text{C}</math> (<math>\pm 2^{\circ}\text{C}</math>) (<math>0^{\circ}\text{F}</math>, <math>73^{\circ}\text{F}</math> and <math>158^{\circ}\text{F}</math> <math>\pm 4^{\circ}\text{F}</math>) per Test Method D 5601.</li> </ol>                                                                                                                                                                                                                                                                                                                                                               | <ol style="list-style-type: none"> <li>Report tear resistance per Section 7 of Test Method D 5601 for each temperature tested.</li> </ol>                                                                                                                                                                                  |
| <b>I. Tensile strength, elongation, strain energy</b><br>Membrane only per Practice D 2523; Specifications D 4434, D 4637, or D 5019; or Test Method D 5147. Include testing of lap seams where called for in the standards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Report values of tensile strength, elongation and/or strain energy per standard used.                                                                                                                                                                                                                                      |