Designation: D 5147 – 02

Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material[1]

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1. Scope

1.1 These test methods cover procedures for sampling and testing prefabricated, reinforced, polymer-modified bituminous sheet materials designed for single- or multiple-ply application in roofing and waterproofing membranes. These products may use various surfacing materials on one side.

1.2 These test methods appear in the following order:

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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 limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 95 Test Method for Water in Petroleum Products and Bituminous Materials by Distillation[2]

D 228 Test Methods for Sampling, Testing, and Analysis of Asphalt Roll Roofing, Cap Sheets, and Shingles Used in Roofing and Waterproofing[3]

D 573 Test Method for Rubber—Deterioration in an Air Oven[4]

D 751 Test Methods for Coated Fabrics[5]

D 1079 Terminology Relating to Roofing, Waterproofing, and Bituminous Materials[3]

D 1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature[6]

D 4073 Test Method for Tensile-Tear Strength of Bituminous Roofing Membranes[3]

D 4798 Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)[3]

D 4977 Test Method for Granule Adhesion to Mineral Surfaced Roofing by Abrasion[3]

3. Sampling

3.1 From each shipment or fraction thereof, select at random a number of rolls equal to one half the cube root of the total number of rolls in the lot. If the calculated number is fractional, express it as the next highest whole number. For convenience, a table showing the number of rolls to be selected from the lots of various sizes is given in Test Methods D 228. When mutually agreed upon by the concerned parties, other sampling frequencies may be used and reported within the framework of these procedures. The minimum sample shall consist of five rolls. The rolls so selected constitute the representative sample used for all subsequent observations and tests pertaining to the lot of material being examined.

4. Conditioning

4.1 Unless otherwise specified, condition test specimens for a minimum of 4 h at 23 ± 3°C (73.4 ± 3.6°F) and 50 ± 5 % relative humidity before testing.

5. Thickness

5.1 Sheet materials shall be checked at five points across the roll width, to include the weathering surface. Measurements shall taken in accordance with Test Methods D 751, Section 9 except as follows: Lay the sheet out smooth on a horizontal surface and take measurements at two points, each being 150 ± 15 mm (6 ± 0.5 in.) from each edge, and at three points equally spaced between these two points. Compute the average thickness and the standard deviation of the thicknesses based

[1] These test methods are under the jurisdiction of ASTM Committee D08 on Roofing, Waterproofing, and Bituminous Materials and are the direct responsibility of Subcommittee D08.04 on Felts and Fabrics.

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[2] *Annual Book of ASTM Standards*, Vol 05.01.

[3] *Annual Book of ASTM Standards*, Vol 04.04.

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

[5] *Annual Book of ASTM Standards*, Vol 09.02.

[6] *Annual Book of ASTM Standards*, Vol 08.03.

on the total number of point measurements from all of the rolls taken in accordance with 1.2 of these test methods.

5.2 Using the samples measured in 5.1, take five measurements along the selvage edge, each being 150 ± 15 mm (6 ± 0.5 in.) apart. The presser foot shall be positioned midway between the surfacing and sheet edge or midway between the laying line and sheet edge, in the case of smooth products.

5.3 Report the individual point measurements, average, and estimated standard deviation. Refer to the measurements taken in 5.1 as sheet thickness and the measurements taken in 5.2 as selvage thickness.

6. Load Strain Properties

6.1 This test method covers the determination of the load strain (tensile elongation and strain energy) properties of polymer-modified bituminous sheets.

6.1.1 *Specimens*—Prepare five specimens from each sample roll in both the longitudinal and transverse directions for each temperature to be tested. Specimens shall be 25 mm (1.0 in.) wide by a minimum of 150 mm (6.0 in.) long for sheet materials having an ultimate elongation of 75 % or less at −18°C (0°F). Specimens shall be 12.5 mm (0.5 in.) wide by a minimum of 100 mm (4.0 in.) long for materials having an ultimate elongation of greater than 75 % at −18°C (0°F).

6.1.2 *Procedure*:

6.1.2.1 Condition each specimen at least 2 h at the selected test temperature. If conditioning is done outside the machine clamps, allow the specimen to equilibrate at the testing temperature for at least 15 min before the testing force is applied.

6.1.2.2 Test specimens at both 23 ± 3°C (73.4 ± 3.6°F) and −18 ± 3°C (0 ± 3.6°F).

6.1.2.3 Use a constant rate of elongation (CRE) tension testing machine, preferably with automatic load and strain recording equipment, and clamps that permit a uniform clamping pressure on the specimen without slipping. The initial clamp separation shall be 75 ± 2 mm (3.0 ± 0.125 in.) for sheet materials having an ultimate elongation of 75 % or less at −18°C (0°F), and 50 ± 2 mm (2.0 ± 0.125 in.) for sheet materials having an ultimate elongation greater than 75 % at −18°C (0°F).

6.1.2.4 Maintain a rate of separation of 50 mm/min ±3 % (2.0 in./min ±3 %) for specimens tested at 23 ± 3°C (73.4 ± 3.6°F) and a rate of separation of 2.0 mm/min ±3 % (0.08 in./min ±3 %) for specimens tested at −18 ± 3°C (0 ± 3.6°F).

6.1.2.5 Record the percent elongation of each specimen at specimen break and also at peak load using an extensiometer, or calculate the percent elongation at specimen break and also at peak load from the chart of the stress versus time knowing the speed of the chart drive and the jaw separation rate.

6.1.2.6 Record the breaking load and peak load of each specimen.

6.1.3 *Calculation*:

6.1.3.1 Determine the percent elongation at break obtained from the extensiometer in accordance with the manufacturer's instructions, or read directly, calculate the percent elongation determined from the chart, without an extensiometer, as follows:

$$\text{Percent elongation} = \frac{a - b}{b} \times 100 \text{ at break} \quad (1)$$

where:

a = jaw separation at specimen break,

$$= \frac{\text{maximum extension on chart} \times \text{jaw separation rate}}{\text{chart speed}}$$

and

b = initial jaw separation.

6.1.3.2 Determine the average percent elongation at break in each direction and the standard deviation of percent elongation at break in each direction based on the total number of measurements taken.

6.1.3.3 Calculate the percent elongation at peak load obtained from the extensiometer in accordance with the manufacturer's instructions, or read directly, calculate the strain at peak load determined from the chart, without an extensiometer, as follows:

$$\text{percent elongation} = \frac{c - d}{b} \times 100 \text{ at peak load} \quad (2)$$

where:

c = jaw separation at maximum load,

$$= \frac{\text{maximum extension on chart} \times \text{jaw separation rate}}{\text{chart speed}}$$

and

b = initial jaw separation.

6.1.3.4 Calculate the average percent elongation at peak load in each direction and the standard deviation of percent elongation at peak load in each direction based on the total number of measurements taken.

6.1.3.5 Calculate the average breaking load in each direction and the standard deviation of the breaking loads in each direction based on the total number of measurements taken.

6.1.3.6 Calculate the average peak load in each direction and the standard deviation of the peak loads in each direction based on the total number of measurements taken.

6.1.3.7 If the load elongation curve is not available, estimate the strain energy. The strain energy should be reported as either measured or estimated.[7]

6.1.3.8 Calculate the average strain energy at peak load and at break in each direction and the standard deviation of the strain energies in each direction based on the total number of measurements taken.

6.1.4 *Report*:

6.1.4.1 For each specimen in each direction, record the temperature of the test, specimen size, and individual measurements of peak load in kN/m (lbf/in.), percent elongation at peak load, breaking load in kN/m (lbf/in.), percent elongation at break, method of determining elongation, strain energy in

[7] The estimation technique requires knowledge of the maximum tensile strength and elongation values of the test specimen. This technique can only be used for fibrous glass-reinforced specimens. If the values generated by this technique are in question, verification must be made by analysis of the load-elongation curve. Strain energy for fibrous glass-reinforced specimens is estimated by:

$$se = \frac{[1/2 \times \text{peak load [kN (lbf)]} \times \text{elongation [mm (in.)]}]}{25 \text{ mm (1 in.)} \times \text{gage length [mm (in.)]}}$$

where 25 mm (1 in.) = sample width.

Strain energy represented as the area under the load-elongation curve may also be calculated by direct computer integration or analog techniques such as, the trapezoidal rule, use of planimeter, or gravimetrical analysis.