Designation: D7051 – 05 (Reapproved 2013)

Standard Test Method for Cyclic Thermal Shock of SBS-Modified Bituminous Roofing Sheets with Factory-Applied Metal Surface[1]

This standard is issued under the fixed designation D7051; 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 test method covers the measurement of movement due to cyclic thermal exposure of SBS (styrene-butadiene-styrene)-modified bituminous sheets with a factory-applied metal foil surface.

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

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:*[2]

C552 Specification for Cellular Glass Thermal Insulation

D41 Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

D312 Specification for Asphalt Used in Roofing

D5147 Test Methods for Sampling and Testing Modified Bituminous Sheet Material

3. Summary of Test Method

3.1 This test consists of exposing two specimens of 2000 ± 5 by 90 ± 5 mm (78.7 ± 0.2 by 3.5 ± 0.2 in.) to cycles of temperature produced by infrared radiation. The variation in the specimen length dimension is measured in relation to the number of cycles and temperature variation. This test applies to metal foil surfaced SBS-modified bitumen roofing sheets.

4. Significance and Use

4.1 This test method is used to determine the dimensional changes and physical stability of the product upon exposure to specified cyclic thermal conditions. It is also useful in determining the integrity of the bond between the metal foil and the SBS-modified bituminous compound.

5. Apparatus

5.1 The apparatus and test assembly as shown in Figs. 1-4 consists of the following components.

5.2 A hollow metal, rigid support or base on which the test sample is mounted, hereafter referred to as the shock table. The base shall be 2110 ± 25 mm long by 280 ± 25 mm wide by 125 ± 13 mm tall (83 ± 1.0 in. long by 11 ± 1.0 in. wide by 5 ± 0.5 in. tall). The shock table shall have water inlet and outlet attachments mounted such that the support is always full of circulating water. This is done to avoid expansion or contraction of the shock table during the test.

NOTE 1—The support can be easily constructed by welding two pieces of wide channel iron together with the addition of end plates.

5.3 Mounting brackets for the measuring devices shall be attached to the shock table such that the measuring device is level with and facing the metal reference tabs attached to the foil surface of the specimens (see 6.4).

5.4 Linear transducers, or dial indicators, accurate to 10 µm (0.4 mil) shall be used to measure the change in distance between the adhered metal reference tab and the mounted indicator.

5.5 Six or more 250 W infrared heating lamps are mounted above the support equally spaced across the 2000 mm (79 in.) test length.

NOTE 2—The number of lamps is not critical as long as the temperature is accurate and consistent.

5.6 Sheet metal panels, or other suitable protection, shall be mounted on the sides and ends of the hollow support to reduce drafts and temperature fluctuations during the test. The panels should be easily removed to allow for daily observations of the test assembly.

5.7 A regulating system shall be used to maintain the timing of the heating and cooling cycles. Temperature may be maintained automatically or manually, but the temperature shall be measured using thermocouples.

[1] This test method is under the jurisdiction of ASTM Committee D08 on Roofing and Waterproofing and is the direct responsibility of Subcommittee D08.04 on Felts, Fabrics and Bituminous Sheet Materials.

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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.

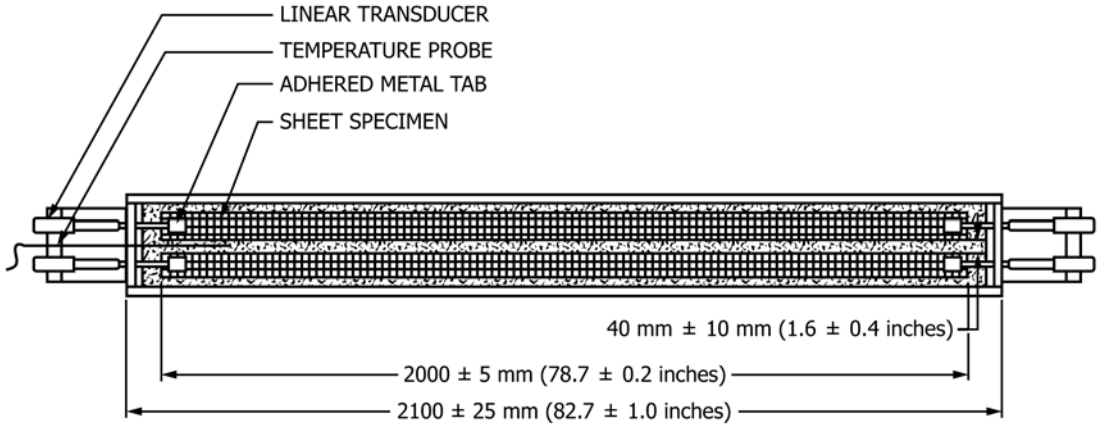

FIG. 1 Shock Table—Top View

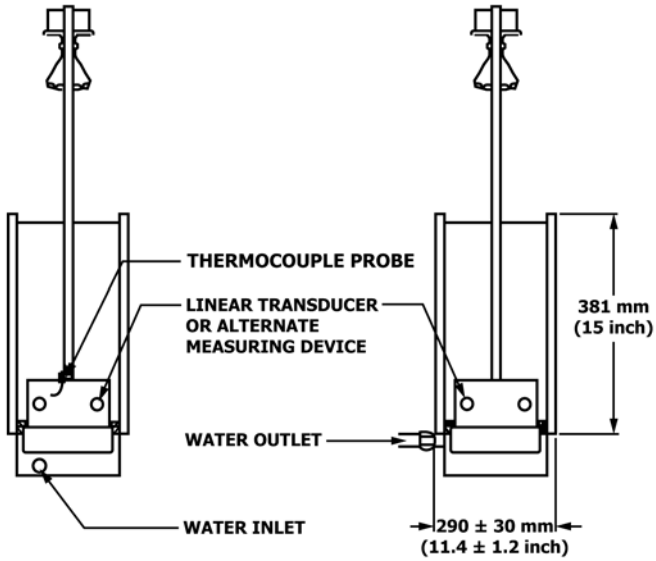

FIG. 2 Shock Table—End Views

6. Preparation of Apparatus

6.1 The top surface of the shock table shall be primed with Specification D41 asphalt primer and allowed to dry. Specification C552 Type IV, board cellular glass thermal insulation 38 mm (1.5 in.) thick shall be cut to fit the shock table. The cellular glass insulation shall then be bonded to the primed metal base with Specification D312 Type IV asphalt.

6.2 Place the thermocouples on the insulation surface and, with side shields in position, adjust the height of the infrared heating lamps until the test temperature is attained. This will serve as the initial lamp height. Remove the thermocouples.

6.3 Test specimens of the SBS metal foil surfaced SBS-modified bitumen sheets are bonded directly to the cellular glass insulation using a pour and roll method with an Specification D312 Type IV asphalt applied at 218 ± 14°C (425 ± 25°F). The specimens are applied parallel to each other, and shall be separated by a distance of 40 ± 10 mm (1.6 ± 0.4 in.). If polyolefin film backing exists, it shall be carefully melted away, and dusted with a parting agent before applying the specimens with asphalt.

6.4 Metal reference tabs, minimum 0.5 mm (28 ga) thick, shall be attached to the foil surface at both ends of each specimen, and shall be used as the reference points. The metal reference tabs shall be bent at a 90° angle, and shall be adhered using a two-component epoxy adhesive. See Figs. 1-3 for metal tab shape and placement.

6.5 After adhering the metal reference tabs, paint the foil surface of the specimens using flat black spray paint. The paint provides for consistent surface temperature regardless of the metal foil type. Avoid painting the index tabs.

7. Conditioning

7.1 Condition test specimens according to Test Methods D5147.

8. Procedure

8.1 Linear transducers or dial indicators shall be mounted to the metal base facing the metal reference tabs that are adhered to the test specimens. See Figs. 1-4. The change in dimensional movement shall be measured between these two reference points.

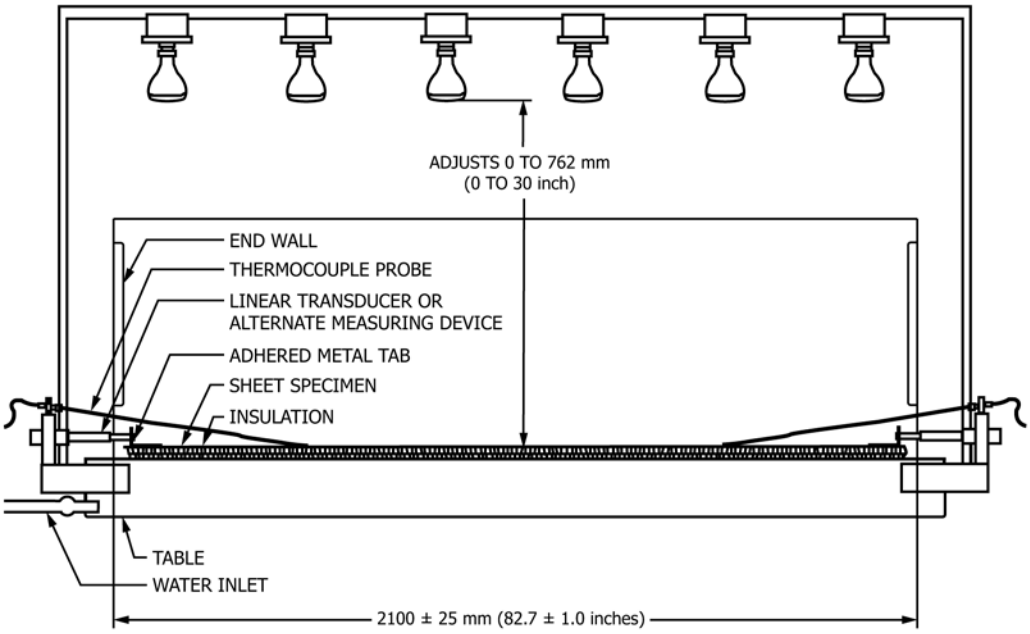

FIG. 3 Shock Table—Side View

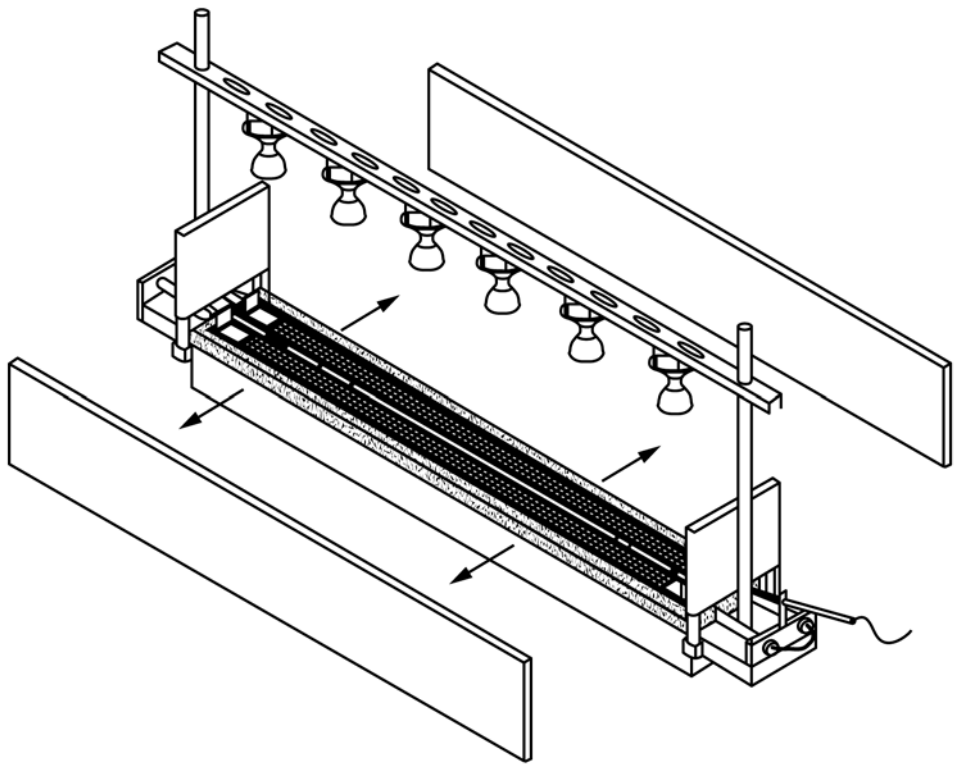

FIG. 4 Shock Table—ISO View

8.2 Position a minimum of two thermocouples on the surface of the specimens. The average temperature from the thermocouples shall be used to control the surface temperature of specimens at 73 ± 5°C (163 ± 9°F). Prior to the first heating cycle measure and record the initial gap setting between the reference points, and use this as the zero point. During the last ten minutes of each cooling and heating period, measure and record the change in dimension (mm) at each end of the test specimens.

8.3 Each cycle shall include one heating and one cooling period, and shall be a minimum of 6 h. The cooling period shall be permitted to be extended to allow for non-monitored periods such as at night or weekends when non-automated systems are in use.

8.3.1 *Heating Period*—4 h ± 10 min of heating at 73 ± 5°C (163 ± 9°F).

8.3.2 *Cooling Period*—2 h ± 10 min of cooling at 23 ± 3°C (73 ± 5°F).

8.4 Subject the specimens to 30 cycles.

NOTE 3—Non-automated systems shall be permitted to be used when automated systems are not available.

9. Calculation or Interpretation of Results

9.1 Calculate the percent dimensional change for each specimen after each heating and cooling period. From the data collected in 8.2, add the changes in dimension (mm) at both ends of the specimen. This is ΔL. Divide this value by the initial specimen length (L_o) and multiply by 100.

$$(\Delta L/L_o) \times 100 = \%\ \text{dimensional change per half cycle}$$

9.2 Plot the percent change in dimension after each half cycle (after each heating period and cooling period) for both specimens. See Fig. 5 for an example graph showing the number of cycles on the *X*-axis and the percent (%) dimensional change on the *Y*-axis. Examine the specimens daily for wrinkling, buckling, or disbonding from the insulation substrate, or delamination of the foil surfacing from the SBS-modified bitumen compound. If any of these conditions are observed, the test shall be terminated. Daily examination shall be permitted to be suspended to allow for non-monitored periods as described in 8.3.

10. Report

10.1 Report the percent dimensional change for each specimen at the end of 30 cycles. Include the plot described in 9.2 in the report. Report any wrinkling, buckling, or disbonding of individual specimens from the insulation substrate, or delamination of the foil surfacing from the SBS-modified bitumen compound, and the cycle number the observation was made.

11. Precision and Bias

11.1 At the present time, there is no basis for statements concerning the precision and bias of test results obtained from either within-laboratory or between-laboratory testing.

12. Keywords

12.1 cyclic thermal shock; foil faced; modified bitumen; SBS-modified bituminous sheets; styrene-butadiene-styrene

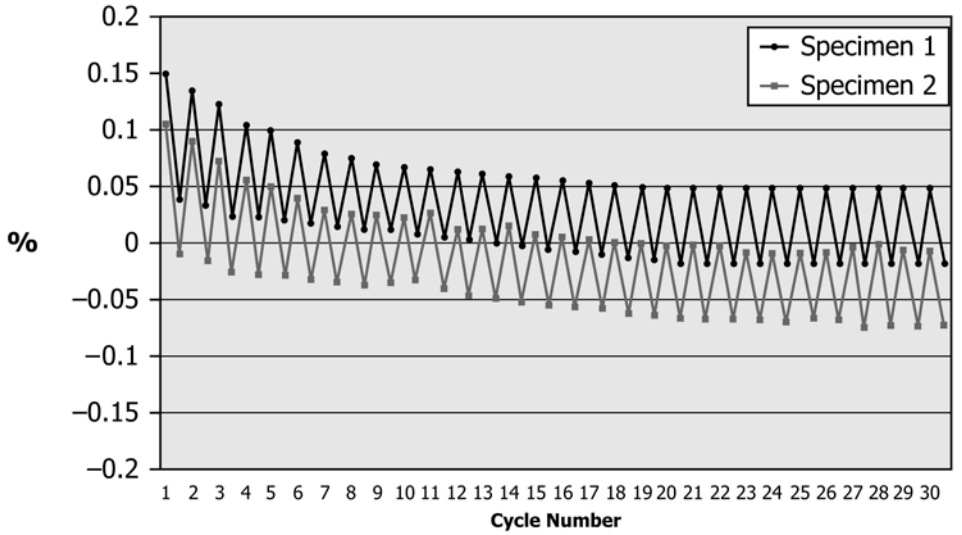

FIG. 5 Cyclic Thermal Shock Test (Sample Graph)