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Standard Practice for Dynamic Mechanical Analysis and Thermogravimetry of Roofing and Waterproofing Membrane Material[1]

This standard is issued under the fixed designation D6382/D6382M; 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.

~~ε^1 NOTE—Units information was editorially revised in February 2011.~~

1. Scope

1.1 This practice covers test procedures and conditions that are applicable when Test Methods D5023, D5024, D5026, D5279, and D5418 are used for conducting dynamic mechanical analysis of roofing and waterproofing membrane material in three-point bending, compression, tension, torsion, and dual cantilever modes, respectively. The specific method is selected by the analyst and depends on the membrane material and the operating principles of the individual instrument used for the analysis.

1.2 This practice covers test procedures and conditions that are applicable when Test Method E1131 is used for conducting thermogravimetry of roofing and waterproofing membrane material.

1.3 Membrane materials include bituminous built-up roofing, polymer-modified bitumen sheets, vulcanized rubbers, non-vulcanized polymeric sheets, and thermoplastics. The membrane materials can be either nonreinforced or reinforced.

1.4 This practice is applicable to new membrane materials received from the supplier, those exposed artificially in the laboratory or outdoors on an exposure rack, and those sampled from field installations.

1.5 This practice contains notes which are explanatory and are not part of the mandatory requirements of this practice.

1.6 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.

1.7 *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.*

1.8 *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.*

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2. Referenced Documents

2.1 *ASTM Standards:*[2]

D1079 Terminology Relating to Roofing and Waterproofing
D4092 Terminology for Plastics: Dynamic Mechanical Properties
D5023 Test Method for Plastics: Dynamic Mechanical Properties: In Flexure (Three-Point Bending)
D5024 Test Method for Plastics: Dynamic Mechanical Properties: In Compression
D5026 Test Method for Plastics: Dynamic Mechanical Properties: In Tension
D5279 Test Method for Plastics: Dynamic Mechanical Properties: In Torsion
D5418 Test Method for Plastics: Dynamic Mechanical Properties: In Flexure (Dual Cantilever Beam)
E473 Terminology Relating to Thermal Analysis and Rheology

[1] This practice 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.

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E1131 Test Method for Compositional Analysis by Thermogravimetry
E1142 Terminology Relating to Thermophysical Properties

3. Terminology

3.1 *Definitions*—For definitions of terms used in this practice, refer to Terminologies E473, D1079, D4092, and E1142.

4. Summary of Practice

4.1 In conducting a dynamic mechanical analysis, the roofing or waterproofing membrane specimen is placed in a test chamber and subjected to a controlled, increasing temperature program. The temperature range can be from well-below (for example, −80°C) to somewhat (for example, 50°C) above room temperature. The glass transition temperature, storage modulus, loss modulus, and damping factor of the specimen are measured.

4.2 In conducting a thermogravimetry analysis, the roofing or waterproofing membrane specimen is placed in a test chamber and subjected to a controlled, increasing temperature program. The temperature range can be from about room temperature (for example, 20 to 40°C) to well-above room temperature (for example, 900°C), and the atmosphere of the chamber is controlled through the use of inert gas such as nitrogen or reactive gas such as air. The percent mass loss of the specimen is determined as a function of temperature.

5. Significance and Use

5.1 Dynamic mechanical analysis provides a measure of the rheological properties of roofing and waterproofing membrane materials.

5.2 Thermogravimetry is used to characterize the thermal stability of roofing and waterproofing membrane materials under the specific temperature program and gaseous atmosphere conditions selected for the analysis.

5.3 Both dynamic mechanical analysis and thermogravimetry are used to evaluate the effect of either laboratory-simulated or in-service exposure on roofing and waterproofing membrane materials.

5.4 Both dynamic mechanical analysis and thermogravimetry can be applied to asphalt shingles. However, their application to asphalt shingles is beyond the scope of this practice, which is limited to low-slope membrane materials at this time.

5.5 This practice can be useful in the development of performance criteria for roofing and waterproofing membrane materials.

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DYNAMIC MECHANICAL ANALYSIS

6. Test Procedure

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6.1 Select the specific test method (that is, Test Method D5023, D5024, D5026, D5279, or D5418) depending on the available instrument and specific type of roofing or waterproofing membrane material to be analyzed. If questions arise, consult the individual manufacturer's literature on instrument operation.

6.2 Prepare a specimen, appropriately sized for the specific instrument, cut in either the machine or cross machine direction of the membrane material.

6.3 Remove granules, if present on the surface of the membrane material, taking care to avoid damage to the specimen.

NOTE 1—Tweezers or a razor-edged laboratory knife have been found to be suitable for this purpose.

6.4 Remove dirt and bonding adhesive to the extent possible, if present on the surface of membrane materials sampled after outdoor exposure or from field installations (see Note 2), taking care to avoid damage to the specimen. Use of solvents other than water is not permissible. If water is used, dry the sample overnight at 23 ± 2°C [74 ± 4°F] before analysis.

NOTE 2—In some cases where dirt or bonding adhesive is well adhered to the membrane material, it may not be possible to completely remove it. In such cases, the decision to conduct the analysis is left to the analyst. If the analysis is conducted, the presence of dirt or bonding adhesive on the specimen is included in the report.

7. Test Conditions

7.1 Conduct the dynamic mechanical analysis using the following conditions and parameters:

7.1.1 *Preconditioning*—Precondition the specimen in an oven for 1 h at 80 ± 2°C [176 ± 4°F] to provide a consistent thermal history prior to analysis. Then allow the preconditioned specimen to cool to 23 ± 2°C [74 ± 4 °F] in a desiccator. Store the preconditioned specimen in the desiccator at 23 ± 2°C [74 ± 4°F] until conducting the analysis.

7.1.2 *Temperature Range*—The temperature range shall be −80 to 50°C [−112 to 122°F], with an allowed variation of ±2°C [±4°F].

7.1.3 *Low Temperature ~~Stabilization —~~Stabilization*—The specimen shall remain at −80°C [−112°F] for 5 min before beginning an analysis.

7.1.4 *Heating Rate*—The heating rate shall be 2°C/min [4°F/min].