Designation: D8237 − 18

Standard Test Method for Determining Fatigue Failure of Asphalt-Aggregate Mixtures With the Four-Point Beam Fatigue Device[1]

This standard is issued under the fixed designation D8237; 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 provides a procedure for determining a fatigue curve that is developed using three or more strain levels. The resulting data can be used in the fatigue models for mechanistic-empirical pavement design (that is, Pavement ME). Failure points are determined for estimating the fatigue life of 380 mm long by 50 mm thick by 63 mm in breadth (width) asphalt mixture beam (rectangular prism) specimens sawed from laboratory or field-compacted asphalt mixture, which are subjected to repeated flexural bending.

1.2 The largest nominal maximum aggregate size (NMAS) recommended for beams 50 mm thick is 19 mm. Beams made with an NMAS greater than 19 mm might significantly interfere with the material response, thereby affecting the repeatability of the test.

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

1.4 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard, with the exception of degrees (°) where angle is specified in accordance with IEEE/ASTM SI 10.

1.5 *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.*

1.6 *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]

D8 Terminology Relating to Materials for Roads and Pavements
D75/D75M Practice for Sampling Aggregates
D140/D140M Practice for Sampling Asphalt Materials
D979/D979M Practice for Sampling Bituminous Paving Mixtures
D2041/D2041M Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
D2726/D2726M Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
D3203/D3203M Test Method for Percent Air Voids in Compacted Asphalt Mixtures
D3549/D3549M Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens
D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
D5361/D5361M Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
D7981 Practice for Compaction of Prismatic Asphalt Specimens by Means of the Shear Box Compactor
D8079 Practice for Preparation of Compacted Slab Asphalt Mix Samples Using a Segmented Rolling Compactor
E4 Practices for Force Verification of Testing Machines
E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
E2309/E2309M Practices for Verification of Displacement Measuring Systems and Devices Used in Material Testing Machines

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.26 on Fundamental/Mechanistic Tests.

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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.

IEEE/ASTM SI 10 American National Standard for Metric Practice

2.2 *AASHTO Standard:*[3]

R 30 Standard Practice for Mixture Conditioning of Hot-Mix Asphalt (HMA)

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 $\sigma_{p\text{-}p}$, *n*—peak-to-peak stress amplitude at load cycle *i*.

3.1.2 σ_t, *n*—maximum tensile stress at the fiber of the beam.

3.1.3 $\varepsilon_{p\text{-}p}$, *n*—peak-to-peak tensile strain at load cycle *i*.

3.1.4 ε_t, *n*—maximum tensile strain at the bottom fiber of the beam.

3.1.5 $\delta_{p\text{-}p}$, *n*—peak-to-peak displacement as determined in Fig. 1.

3.1.6 *S, n*—flexural beam stiffness, which is the stress divided by the strain.

3.1.7 S_i, *n*—the initial beam stiffness determined at 50 load cycles.

3.1.8 *failure point, n*—the number of cycles to failure, N_f, which corresponds to the maximum or peak normalized beam stiffness × normalized cycles when plotted versus number of cycles (9.9).

3.1.9 *normalized stiffness × normalized cycles, n*—see Rowe and Bouldin (**1**).[4]

3.2 For definitions of other terms used in this standard, refer to Terminology D8.

4. Summary of Test Method

4.1 The four-point flexural bending test method is conducted on compacted beam specimens to evaluate the fatigue properties of viscoelastic asphalt mixtures using a fixed reference point bending beam fixture. A cyclic sinusoidal loading pattern is initiated having no rest periods from the start location. A fully executed peak-to-peak displacement ($\delta_{p\text{-}p}$) at the articulating H-frame third points of the beam is induced. The outer third points are held in an articulating fixed position about the neutral axis of the beam. The frequency rate has a default frequency of 10 Hertz (Hz) and a test temperature of 20 °C. This produces a constant bending moment over the center third (L/3, length between outside clamps divided by 3) span of 119 mm ± 0.5 mm (distance may vary between manufacturers; check with manufacturers specifications) between the H-frame contact points on the beam specimen. The level of desired strain is pre-calculated and an input value for the equipment peak-to-peak deflection. The peak-to-peak deflection at mid-length position (L/2, length between outside frames divided by 2) of a beam specimen is regulated by the closed-loop control system measured from the mid-height position (neutral axis). The peak-to-peak deflection is measured relative to a fixed reference point located at the outer articulating fixed position.

NOTE 1—Caution should be applied when using frequencies above 10 Hz, Pronk (**2**).

5. Significance and Use

5.1 The laboratory fatigue life determined by this standard for beam specimens has been used to estimate the fatigue life

[3] Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

[4] The boldface numbers in parentheses refer to a list of references at the end of this standard.

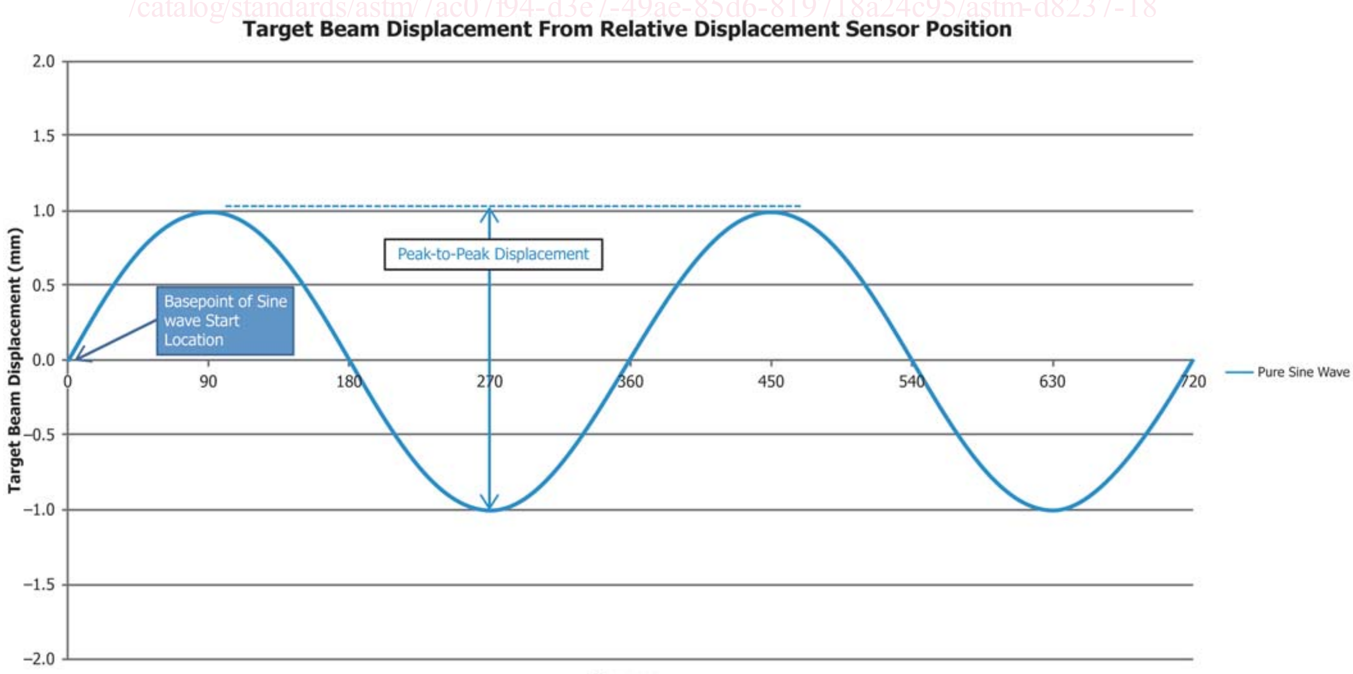

FIG. 1 Illustration of Actuator Response of Repeated Sinusoidal Peak-to-Peak Defection