Standard Method of Test for

Determining the Damage Characteristic Curve and Failure Criterion Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT) Cyclic Fatigue Test

AASHTO Designation: TP 133-19[1]

Technical Subcommittee: 2d, Proportioning of Asphalt–Aggregate Mixtures

Release: Group 3 (July)

AASHTO

American Association of State Highway and Transportation Officials
444 North Capitol Street N.W., Suite 249
Washington, D.C. 20001

Standard Method of Test for

Determining the Damage Characteristic Curve and Failure Criterion Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT) Cyclic Fatigue Test

AASHTO Designation: TP 133-19[1]

Technical Subcommittee: 2d, Proportioning of Asphalt–Aggregate Mixtures

Release: Group 3 (July)

AASHTO

1. SCOPE

1.1. This test method covers procedures for preparing and testing both laboratory-compacted and field-cored asphalt mixture specimens to determine the damage characteristic curve and fatigue analysis parameters via the direct tension cyclic fatigue test using the asphalt mixture performance tester (AMPT).

1.2. This standard is intended for dense-graded mixtures with nominal maximum aggregate size up to 19.0 mm (0.98 in.). Mixtures with a nominal maximum aggregate size greater than 19.0 mm (0.98 in.) should be tested following TP 107.

1.3. *This standard may involve hazardous material, operations, and equipment. This standard does not purport to address all safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to use.*

2. REFERENCED STANDARDS

2.1. *AASHTO Standards*:

- PP 99, Preparation of Small Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC) and Field Cores
- R 30, Mixture Conditioning of Hot Mix Asphalt (HMA)
- R 62, Developing Dynamic Modulus Master Curves for Asphalt Mixtures
- R 84, Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)
- T 378, Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)
- TP 107, Determining the Damage Characteristic Curve of Asphalt Mixtures from Direct Tension Cyclic Fatigue Tests

- TP 132, Determining the Dynamic Modulus for Asphalt Mixtures Using Small Specimens in the Asphalt Mixture Performance Tester (AMPT)

2.2. *ASTM Standard*:

- E4, Standard Practices for Force Verification of Testing Machines

2.3. *Federal Highway Administration*:

- Kim, Y. R., et al. *Development of Asphalt Mixture Performance Related Specifications*, Final Report, FHWA Project No. DTFH61-08-H-00005, 2018.

2.4. *NCHRP Report*:

- *National Cooperative Highway Research Report 629: Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester,* Appendix E, Final Version of the SPT Equipment Specifications. NCHRP, Transportation Research Board, 2008.

2.5. *Other Document*:

- Li, X. and N. H. Gibson. "Using Small Specimens for AMPT Dynamic Modulus and Fatigue Tests," *Asphalt Paving Technology*, Journal of the Association of Asphalt Paving Technologists, Vol. 82, pp. 579–615, 2013.

3. TERMINOLOGY

3.1. *alpha term* (α)—value corresponding to the slope of the relaxation modulus master curve which is used in the accumulation of damage with time.

3.2. *complex modulus* (E^*)—complex number that defines the relationship between stress and strain for a linear viscoelastic material.

3.3. *cyclic pseudo secant modulus* (C^*)—secant modulus in stress–pseudo strain space for a single cycle. This pseudo modulus differs from C because it is computed using a steady-state assumption and is used only with cycle-based data.

3.4. *damage* (S)—internal state variable that quantifies microstructural changes in asphalt concrete.

3.5. *damage characteristic curve* (C versus S curve)—curve formed when plotting the damage on the x-axis and the pseudo secant modulus on the y-axis. It defines the unique relationship between the structural integrity and amount of damage in a given mixture.

3.6. *dynamic modulus* ($|E^*|$)—norm of the E^*, which is calculated by dividing the peak-to-peak stress by the peak-to-peak axial strain measured during the steady-state period.

3.7. *dynamic modulus ratio* (*DMR*)—ratio between the dynamic modulus fingerprint and the dynamic modulus value from a master curve construction, both evaluated at the same temperature and frequency condition. This value is also used to characterize specimen-to-specimen variability.

3.8. *failures:*

3.8.1. *end failure*—specimen failure in which the macrocrack develops outside the range of one or more axial deformation sensors. Several example end failure locations are shown in Figure 1.