
Standard Method of Test for

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

AASHTO Designation: TP 132-23¹

Technically Revised: 2023

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



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. This standard describes test methods for measuring the dynamic modulus for asphalt mixtures using the asphalt mixture performance tester (AMPT). This practice is intended for dense-graded mixtures with nominal-maximum aggregate sizes up to 19.0 mm (0.75 in.).
- 1.2. *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.*
- 1.3. *The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED STANDARDS

- 2.1. AASHTO Standards:
 - < PP 99, Preparation of Small Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC) or Field Cores
 - < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.2. National Cooperative Highway Research Program:
 - < NCHRP. Final Version of the SPT Equipment Specifications. Appendix E in *National Cooperative Highway Research Report 629: Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester*. National Cooperative Highway Research Program, Transportation Research Board, National Research Council, Washington, DC, October 16, 2007. Available from <https://doi.org/10.17226/14200>
- 2.3. Other Document:

< Diefenderfer, B. K. and S. D. Diefenderfer. *Asphalt Mixture Performance Characterization Using Small-Scale Cylindrical Specimens*. Final Report VTRC Report 15-R26. Virginia Center for Transportation Innovation and Research, 530 Edgemont Road, Charlottesville, VA, June 2015. Available from <http://vtrc.viriniadot.org/%5C/PubDetails.aspx?PubNo=15-R26>

3. TERMINOLOGY

- 3.1. *dynamic modulus*, $|E^*|$ —the absolute value of the complex modulus calculated by dividing the peak-to-peak stress by the peak-to-peak strain for a material subjected to a sinusoidal loading.
- 3.2. *phase angle*, δ —the angle in degrees between a sinusoidally applied stress and the resulting strain in a controlled stress test.
- 3.3. *test specimen*—a 38-mm (1.50-in.) diameter by 110-mm (4.33-in.) tall cylindrical specimen cored and sawed from either an SGC specimen or field core.

4. SUMMARY OF METHOD

- 4.1. This test method describes the procedure for measuring the dynamic modulus of asphalt mixtures. A test specimen at a specific test temperature is subjected to a controlled sinusoidal (haversine) compressive stress of various frequencies. The applied stresses and resulting axial strains are measured as a function of time and used to calculate the dynamic modulus and phase angle.

5. SIGNIFICANCE AND USE

- 5.1. The dynamic modulus is a performance-related property that can be used for mixture evaluation, mechanistic analysis of asphalt pavements, and mechanistic–empirical pavement design.

6. APPARATUS

- 6.1. *Specimen Fabrication Equipment*—For fabricating dynamic modulus test specimens as described in PP 99.
- 6.2. *Dynamic Modulus Test System*—Meeting the requirements of the equipment specification for the Simple Performance Test (SPT) System, Version 3.0, except for the following provisions:
 - 6.2.1. In the referenced equipment specification, Sections 10.7 and 11.3 shall require a temperature sensor range of 0 to 75°C (32 to 167°F).
 - 6.2.2. Section 11.1 shall require a temperature control range from 4 to 70°C (39 to 158°F).
- 6.3. *38-mm Specimen Dynamic Modulus Platens*—Platens meeting the requirements of the equipment specification for the Simple Performance Test (SPT) system, Version 3.0, except the following provisions:
 - 6.3.1. The lower platen loading surface diameter shall be not less than 42 mm and not more than 45 mm.
 - 6.3.2. The upper platen diameter shall be not less than 42 mm and not more than 45 mm.
- 6.4. *Conditioning Chamber*—An environmental chamber for conditioning the test specimens to the desired testing temperature. The environmental chamber shall be capable of controlling the temperature of the specimen over a temperature range from 4 to 70°C (39 to 158°F) to an accuracy

of $\pm 0.5^{\circ}\text{C}$ (0.9°F). The chamber shall be large enough to accommodate the number of specimens to be tested plus a “dummy” specimen with a temperature sensor mounted in the center for temperature verification.

- 6.5. *Friction Reducers*—Either a single 0.25-mm (0.01-in.) thick PTFE sheet or two 0.3-mm (0.011-in.) thick latex membranes stacked on top of each other (i.e., a double latex, non-greased membrane), to be used as a friction reducer between the specimen and the loading platens in the dynamic modulus test. Double latex, non-greased membranes are only allowed to be used for nine frequency sweeps/ (I.e., three specimens, each tested for one frequency sweep, 10, 1, and 0.1 Hz, and at three temperatures is $3 \times 1 \times 3 = 9$ frequency sweeps.) PTFE sheets can be used until they either are visibly torn or become visibly worn.

Note 1—Greased double latex type friction reducers are not recommended for small specimen testing due to the specimens occasionally sliding out from between the loading platens, which damages the specimen and may damage the testing equipment.

7. HAZARDS

- 7.1. This practice and associated standards involve handling of hot asphalt binder, aggregates, and asphalt mixtures. It also includes the use of sawing and coring machinery and servo-hydraulic testing equipment. Use standard safety precautions, equipment, clothing, and personal protection equipment when handling hot materials and operating machinery.

8. STANDARDIZATION

- 8.1. *Verification with Proving Ring:*

- 8.1.1. Verify the normal operation of the AMPT weekly or at the beginning of a new testing program using the manufacturer-provided proving ring and following the manufacturer’s use instructions. Perform a dynamic modulus test on the proving ring using a target strain of 100 microstrain at 1.0 Hz. The dynamic modulus of the proving ring should be within ± 3 percent of the value obtained on the proving ring for the same testing conditions during the last calibration.

- 8.2. *Calibration:*

- 8.2.1. *The following systems on the AMPT shall be calibrated annually, when the AMPT system is moved, or when any of its components are changed:*

- 8.2.1.1. Load measuring system;
- 8.2.1.2. Actuator displacement measuring system;
- 8.2.1.3. Specimen-mounted deformation measuring system;
- 8.2.1.4. Confining pressure measuring system; and
- 8.2.1.5. Temperature measuring system.

- 8.2.2. Methods for calibration of each of these systems are included in Annex A.