
Standard Method of Test for

**Determining the Dynamic Modulus
and Flow Number for Asphalt
Mixtures Using the Asphalt Mixture
Performance Tester (AMPT)**

AASHTO Designation: T 378-17 (2021)¹

Adopted with Revisions: 2017

Reviewed but Not Updated: 2021

Editorially Revised: 2021

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



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Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)

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1. SCOPE

- 1.1. This standard describes test methods for measuring the dynamic modulus and flow number for asphalt mixtures using the Asphalt Mixture Performance Tester (AMPT). This practice is intended for dense- and gap-graded mixtures with nominal-maximum aggregate sizes up to 37.5 mm.
- 1.2. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety concerns 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.*
- 1.3. *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.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - R 83, Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC)
- 2.2. *Other Publication:*
- Equipment Specification for the Simple Performance Test System, Version 3.0, Prepared for National Cooperative Highway Research Program (NCHRP), October 16, 2007

3. TERMINOLOGY

3.1. Definitions:

- 3.1.1. *confining pressure*—the stress applied to all surfaces in a confined test.
- 3.1.2. *deviatoric stress*—the difference between the total axial stress and the confining pressure in a confined test.
- 3.1.3. *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.
- 3.1.4. *flow number*—the number of load cycles corresponding to the minimum rate of change of permanent axial strain during a repeated-load test.
- 3.1.5. *phase angle*, δ —the angle in degrees between a sinusoidally applied stress and the resulting strain in a controlled stress test.
- 3.1.6. *permanent deformation*—the nonrecovered deformation in a repeated-load test.

4. SUMMARY OF METHOD

- 4.1. This test method describes procedures for measuring the dynamic modulus and flow number for asphalt mixtures.
- 4.2. In the dynamic modulus procedure, a specimen at a specific test temperature is subjected to a controlled sinusoidal (haversine) compressive stress of various frequencies. The test may be conducted with or without confining pressure. The applied stresses and resulting axial strains are measured as a function of time and used to calculate the dynamic modulus and phase angle.
- 4.3. In the flow number procedure, a specimen at a specific test temperature is subjected to a repeated haversine axial compressive load pulse of 0.1 s every 1.0 s. The test may be conducted with or without confining pressure. The resulting permanent axial strains are measured as a function of the load cycles and numerically differentiated to calculate the flow number. The flow number is defined as the number of load cycles corresponding to the minimum rate of change of permanent axial strain.

5. SIGNIFICANCE AND USE

- 5.1. The dynamic modulus is a performance-related property that can be used for mixture evaluation and for characterizing the stiffness of asphalt mixtures for mechanistic-empirical pavement design.
- 5.2. The flow number is a property related to the resistance of asphalt mixtures to permanent deformation. It can be used to evaluate and design asphalt mixtures with specific resistance to permanent deformation.

6. APPARATUS

- 6.1. *Specimen Fabrication Equipment*—For fabricating dynamic modulus test specimens as described in R 83.