
Standard Practice for Developing Dynamic Modulus Master Curves for Asphalt Mixtures Using the Indirect Tension Testing Method

AASHTO Designation: PP 96-18 (2024)¹

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



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1. SCOPE

- 1.1. This practice describes testing and analysis for developing a dynamic modulus master curve for asphalt concrete using a servo-hydraulic closed loop testing machine. This practice is intended for dense- and gap- graded mixtures with nominal maximum aggregate sizes up to 25 mm.
- 1.2. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the 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 its use.*

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
 - PP 95, Preparation of Indirect Tension Performance Test Specimens
 - TP 131, Determining the Dynamic Modulus of Asphalt Mixtures Using the Indirect Tension Test
- 2.2. *Other Publications:*
 - Applied Research Associates, Inc., ERES Consultants Division. *Guide for Mechanistic-Empirical Design of New and Rehabilitated Pavement Structures*. Final Report Prepared for the National Cooperative Highway Research Program (NCHRP), March 2004. Available from https://onlinepubs.trb.org/onlinepubs/archive/mepdg/2appendices_rr.pdf
 - Kim, Y. R., Y. Seo, M. King, and M. Momen. Dynamic Modulus Testing of Asphalt Concrete in Indirect Tension Mode. In *Transportation Research Record: Journal of the Transportation Research Board, No. 1891*, Transportation Research Board, National Research Council, Washington, DC, 2004.
 - NCHRP. 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. *Dynamic Modulus Master Curve*—a composite curve constructed at a reference temperature by shifting dynamic modulus data from various temperatures along the log frequency axis.

- 3.2. *Indirect Tension (IDT)*—a method of loading a material by applying a compressive force on a cylindrical specimen in one direction, which results in a tensile strain in the perpendicular direction due to the Poisson’s effect.
- 3.3. *Reduced Frequency*—the computed frequency at the reference temperature equivalent to the actual loading frequency at the test temperature.
- 3.4. *Reference Temperature*—the temperature at which the master curve is constructed.
- 3.5. *Shift Factor*—shift in frequency associated with a shift from a test temperature to the reference temperature.

4. SUMMARY OF PRACTICE

- 4.1. This practice describes the testing and analysis needed to develop a dynamic modulus master curve for asphalt mixtures from indirect tension specimens, specifically from field cores. It involves collecting dynamic modulus test data at specified temperatures and loading frequencies, determining time-temperature shift factors from individual temperature data, and finally fitting the test data to obtain a continuous function describing the dynamic modulus as a function of reduced frequency.

5. SIGNIFICANCE AND USE

- 5.1. Dynamic modulus master curves can be used for mixture evaluation and for characterizing the modulus of asphalt concrete for mechanistic-empirical pavement design.

6. APPARATUS

- 6.1. *Specimen Fabrication Equipment*—equipment for fabricating dynamic modulus test specimens as described in PP 95, *Preparation of Indirect Tension Performance Test Specimens*.
- 6.2. *Dynamic Modulus Test System*—a dynamic test system meeting the requirements of Equipment Specification for the Simple Performance Test System, Version 3.0.
- 6.3. *Specimen Deformation Measurement Devices*—The specimen deformation measurement devices shall consist of four displacement transducers with a range of at least 0.25 mm, and a minimum resolution throughout the range of 0.10 μm .
- 6.4. *Analysis Software*—software capable of performing numerical optimization of non-linear equations.

Note 1—The Solver Tool included in Microsoft Excel® is capable of performing the numerical optimization required by this practice.

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, and clothing when handling hot materials and operating machinery.