
Standard Test Method for

Determining the Dynamic Modulus of Asphalt Mixtures Using the Indirect Tension Test

AASHTO Designation: TP 131-18 (2024)¹

First Published: 2018

Reviewed but Not Updated: 2024

Editorially Revised: 2021

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



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004**

Standard Test Method for Determining the Dynamic Modulus of Asphalt Mixtures Using the Indirect Tension Test

AASHTO Designation: TP 131-18 (2024)¹

AASHTO

First Published: 2018

Reviewed but Not Updated: 2024

Editorially Revised: 2021

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

1. SCOPE

- 1.1. This standard describes the test method for measuring the dynamic modulus of asphalt mixtures using the indirect tension test. This test 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.*
- 1.3. *The quality of the results produced by this standard is 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 DOCUMENTS

- 2.1. *AASHTO Standards:*
- PP 95, Preparation of Indirect Tension Performance Test Specimens
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- 2.2. *Other Publications:*
- Equipment Specification for the Simple Performance Test System, Version 3.0, Prepared for National Cooperative Highway Research Program (NCHRP), October 16, 2007.
 - Chapra, S. C. and R. P. Canale. *Numerical Methods for Engineers*, McGraw–Hill, 2009.
 - Kim, Y. R., Y. Seo, M. King, and M. Momen. Dynamic Modulus Testing of Asphalt Concrete in Indirect Tension Mode. In *Transportation Research Record No. 1891*, Transportation Research Board, National Research Council, Washington, DC, 2004.

3. TERMINOLOGY

- 3.1. *dynamic modulus*—A linear viscoelastic material property that describes the stiffness of asphalt mixture at different frequencies and temperatures.

- 3.2. *phase angle*— δ , the angle in degrees between a sinusoidal applied stress and the resulting strain in the same direction (vertical or horizontal).
- 3.3. *Poisson's ratio*—The ratio of the strain transverse to the loading direction (horizontal strain), divided by the axial strain (vertical strain).
- 3.4. *permanent deformation*—Non-recovered deformation in a repeated load test.
- 3.5. *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 stress and strain in the perpendicular direction due to the Poisson's effect.
- 3.6. *LVDT Components*:
- 3.6.1. *rod*—thin, stainless steel bar that holds the LVDT core.
- 3.6.2. *core*—magnetic component of LVDT that attaches to rod.
- 3.6.3. *head*—component that surrounds the core to measure the displacement.
- 3.6.4. *target*—component glued to the specimen to hold the LVDT rod and head away from the surface of the specimen.

4. SUMMARY OF THE TEST METHODS

- 4.1. This test method describes procedures for measuring the dynamic modulus from the indirect tension test for asphalt mixtures.
- 4.2. In the dynamic modulus procedure, an asphalt mixtures specimen, at a specific test temperature, is subjected to controlled sinusoidal (haversine) compressive stress in the vertical axis at various frequencies. The applied stresses and resulting axial and transverse strains are measured as a function of time and used to calculate the dynamic modulus, phase angle, and Poisson's ratio.

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.

6. APPARATUS

- 6.1. *Specimen Fabrication Equipment*—Equipment for fabricating dynamic modulus test specimens as described in PP 95.
- 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. A servo-hydraulic testing machine capable of producing a controlled haversine compressive loading shall be used. The testing machine should have a capability of applying a sinusoidal load over a range of frequencies from 0.1 to 25 Hz and load level up to 25.0 kN. For sinusoidal loads, the standard error of the applied load shall be less than 5 percent.
- 6.3. *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 -10° to 35°C to an accuracy of $\pm 0.5^{\circ}\text{C}$. The chamber shall be large enough to accommodate the load guide device and a dummy specimen with a temperature sensor mounted in the center for temperature verification.

- 6.4. *Load Guide Device (LGD)*—The loading device should be capable of testing 150 ± 9 mm diameter specimens of thicknesses of 38 to 50 mm. An example of the load guide device is shown in Figure 1.
- 6.4.1. The device should be compact enough to be used within the environmental chamber. It should have a fixed bottom loading plate and a moving upper loading plate. The movement of the upper plate should be guided by two columns, one on each side of the specimen and equidistant from the loading axis and the loading strips, to ensure it has minimal translational or rotational motion during loading of the specimen. The guide columns shall have a frictionless bearing surface that shall be kept well lubricated. The surface of the guide columns shall be frequently inspected for any grooves caused due to friction.
- 6.4.2. Alignment of the device, within the loading system, shall be achieved so that such friction is limited to the minimum possible extent. The upper plate shall be rigid enough to prevent any deflections during loading. If heavyweight plates are used to achieve rigidity, the testing should be able to counteract all the weight, such that no more than 8.9 N of load is transferred to the specimen when the load is not being applied. It is recommended that high-strength material be used to achieve rigidity and keep the weight small. The loading strips preferably shall be perpendicular to the line connecting the two guide columns, so that visual alignment of the sample in the device is easier.

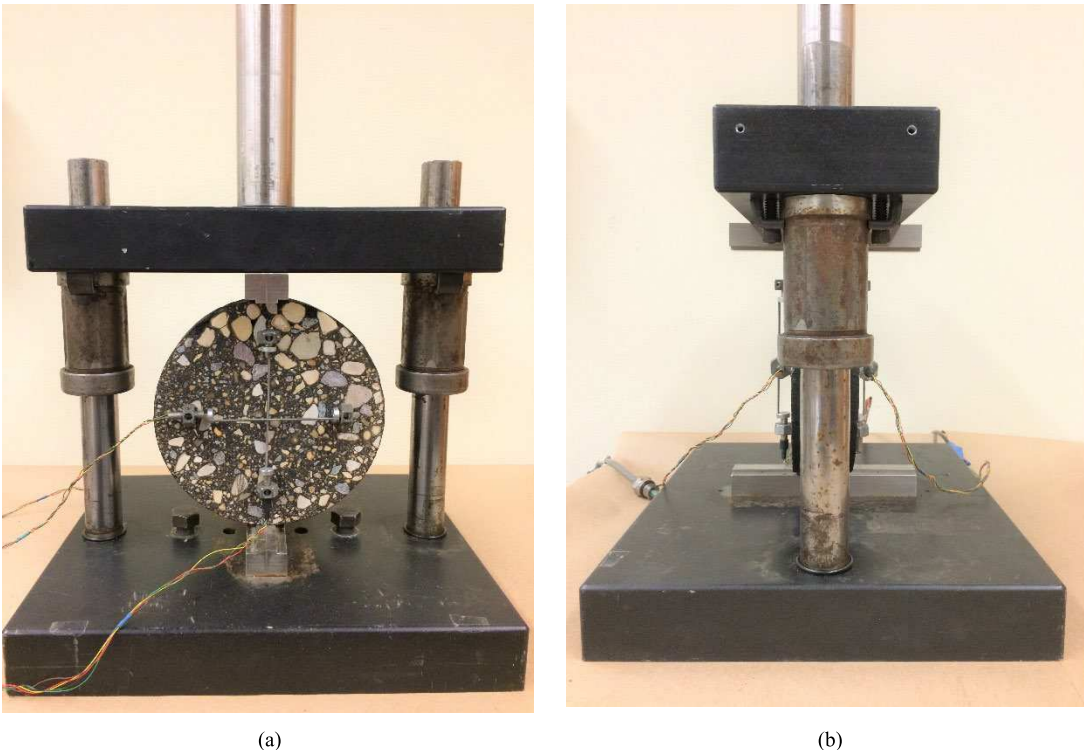
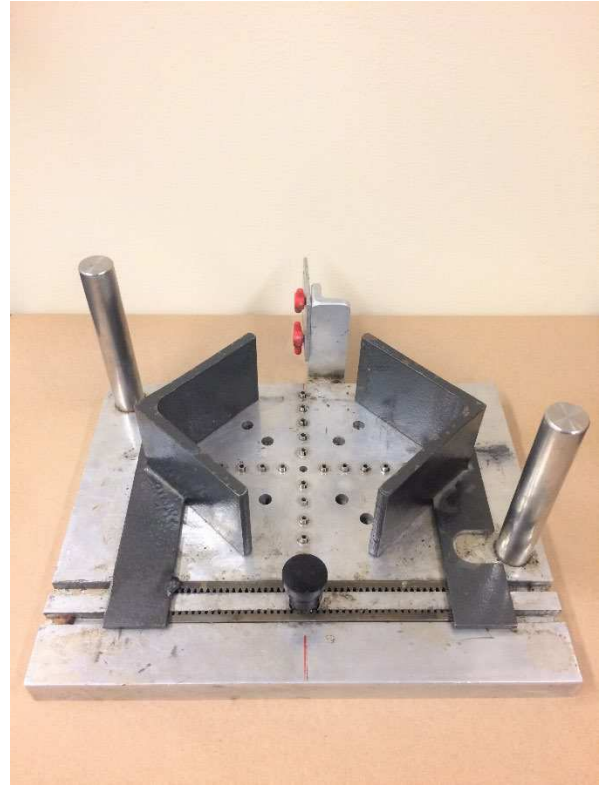


Figure 1—Two Post Load Guide Device with Specimen Prepared for Testing: (a) Front View and (b) Side View

- 6.5. *Loading Strips*—Steel loading strips, with concave sample contact surfaces, are required to apply load to the test specimens.
- 6.5.1. The loading strips shall be machined to the radius of curvature of 150 ± 0.15 mm. The contact arc of the loading strip shall be between 12.5 mm and 19 mm. The outer edges of the curved surface shall be filed lightly to remove sharp edges that might cut the specimen during testing. Thin lines should be drawn along the length of the strip at its center, to help in alignment.
- 6.6. *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 .
- 6.7. *LVDT Target Alignment Device*—An alignment device shall be used to position and place the vertical and horizontal LVDT targets and hold them there until the glue cures. An example LVDT target alignment device is shown in Figure 2, and its schematic views with pertinent dimensions are presented in Figure 3.
- 6.7.1. The device shall be easily removable, without disturbing the LVDT targets or the specimen once the glue cures. The device shall preferably have the capability to mount the LVDT targets at different gauge lengths. The LVDT heads and rods shall be close, but not touching, the surface of the specimen to minimize possible damage due to bulging of the specimen under loading. To ensure uniform test results, a height of 5 mm from the surface of the specimen is recommended.



(a)



(b)



(c)



(d)

Figure 2—Example Alignment Device (a) Assembled, (b) Base with Sliding Holder, (c) Bottom of Top Plate with Cross for Alignment of LVDT Holders, and (d) Top of Top Plate