
Standard Method of Test for

**Determining the Creep Compliance
and Strength of Hot Mix Asphalt
(HMA) Using the Indirect Tensile
Test Device**

AASHTO Designation: T 322-07 (2020)

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

Release: Group 3 (July)



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

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1. SCOPE

- 1.1. This standard provides procedures for determining the tensile creep compliance at different loading times, tensile strength, and Poisson's ratio of hot mix asphalt (HMA) using indirect loading techniques.
- 1.2. The procedures described in this standard provide the data required to conduct the thermal cracking analysis. These procedures apply to test specimens having a maximum aggregate size of 38 mm or less. Specimens shall be 38 to 50 mm high and 150 ± 9 mm in diameter.
- 1.3. *This test 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.*

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- PP 3, Hot Mix Asphalt (HMA) Specimens by Means of the Rolling Wheel Compactor¹
 - T 166, Bulk Specific Gravity (G_{mb}) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
 - T 269, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
 - T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
 - T 320, Determining the Permanent Shear Strain and Stiffness of Asphalt Mixtures Using the Superpave Shear Tester (SST)
- 2.2. *ASTM Standards:*
- D3549/D3549M, Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
 - D4123, Standard Test Method for Indirect Tension Test for Resilient Modulus of Bituminous Mixtures (withdrawn 2003; no replacement)

3. TERMINOLOGY

- 3.1. *Definitions:*
- 3.1.1. *creep*—the time-dependent part of strain resulting from stress.
- 3.1.2. *creep compliance*—the time-dependent strain divided by the applied stress.
- 3.1.3. *tensile strength*—the strength shown by a specimen subjected to tension, as distinct from torsion, compression, or shear.
- 3.1.4. *Poisson's ratio (ν)*—the absolute value of the ratio of transverse strain to the corresponding axial strain resulting from uniformly distributed axial stress below the proportional limit of the material.

4. SUMMARY OF METHOD

- 4.1. This standard describes the procedure for determining the tensile creep and tensile strength to be determined on the same specimen for thermal cracking analyses.
- 4.2. The tensile creep is determined by applying a static load of fixed magnitude along the diametral axis of a specimen. The horizontal and vertical deformations measured near the center of the specimen are used to calculate a tensile creep compliance as a function of time. Loads are selected to keep horizontal strains in the linear viscoelastic range (typically below a horizontal strain of 500×10^{-6} mm/mm) during the creep test. By measuring both horizontal and vertical deformations in regions where the stresses are relatively constant and away from the localized nonlinear effects induced by the steel loading strips, Poisson's ratio can be more accurately determined. Creep compliance is sensitive to Poisson's ratio measurements.
- 4.3. The tensile strength is determined immediately after determining the tensile creep or separately by applying a constant rate of vertical deformation (or ram movement) to failure.

5. SIGNIFICANCE AND USE

- 5.1. Tensile creep and tensile strength test data are required for Superpave mixtures to determine the master relaxation modulus curve and fracture parameters. This information is used to calculate the thermal cracking of HMA. The master relaxation modulus curve controls thermal crack development, while the fracture parameter defines a mixture's resistance to fracture.
- 5.2. The values of creep compliance, tensile strength, and Poisson's ratio determined with this method can be used in linear viscoelastic analysis to calculate the low temperature thermal cracking potential of asphalt concrete.
- 5.3. Tensile creep data may be used to evaluate the relative quality of materials.
- 5.4. This procedure is applicable to newly prepared mixtures, reheated, and recompacted mixtures. Reheated and recompacted mixtures will have lower creep compliance values than newly prepared mixtures when measured under these specific loading conditions and temperatures.
- 5.5. This procedure is applicable for mixtures with a maximum aggregate size of 38 mm or less.

6. APPARATUS

- 6.1. *Indirect Tensile Test System*—The indirect tensile test system shall consist of an axial loading device, a load-measuring device, specimen deformation measurement devices, an environmental chamber, and a control and data acquisition system.
- 6.1.1. *Axial Loading Device*—The loading device shall be capable of providing a fixed or constant load of 100 kN with a resolution of at least 20 N and constant rate of ram displacement of at least 12 mm/min.
- 6.1.2. *Load-Measuring Device*—The load-measuring device shall consist of an electronic load cell, designed for placement between the loading platen and piston, with a sensitivity of 20 N and a minimum capacity of 100 kN.
- 6.1.3. *Specimen Deformation Measurement Devices*—The specimen deformation measurement devices shall consist of four displacement transducers with a range of at least 25 mm, reducible to 0.25 mm through software, and a minimum resolution throughout the range of 0.10 μm .
- 6.1.4. *Environmental Chamber*—The environmental chamber shall be equipped with temperature conditioners and controls capable of generating test temperatures between -30 and $+10^{\circ}\text{C}$ inside the chamber and maintaining the desired test temperature to within $\pm 0.5^{\circ}\text{C}$. The internal dimensions of the environmental chamber shall be sufficient to hold a minimum of three test specimens for a period of 12 h prior to testing.
- 6.1.5. *Control and Data Acquisition System*—Specimen behavior in the creep compliance test is evaluated from time records of applied load and specimen deformation. These parameters shall be recorded on an analog to digital data acquisition device.
- 6.1.5.1. When determining the 100-s tensile creep for Superpave, digital data acquisition devices shall provide a sampling frequency of 10 Hz for the first 10 s and 1 Hz for the next 90 s. When determining the 1000-s tensile creep, digital data acquisition devices shall provide a sampling frequency of 10 Hz for the first 10 s, 1 Hz for the next 90 s, and 0.1 Hz for the rest of 900 s. When determining the tensile strength test, digital data acquisition devices shall provide a sampling frequency of 20 Hz through the entire test. A 16-bit A/D board is normally required to obtain the resolution needed when determining the tensile creep and the range needed when determining the tensile strength.
- 6.1.6. *Gauge Points*—Eight brass gauge points having a diameter of 8 mm and a height of 3.2 mm are required per specimen.
- 6.1.7. *Mounting Template*—A mounting template that has been used successfully for placing and mounting the brass gauge points to each side of the test specimen (four per side) is illustrated in Figure 1, which shows an example of a template for use with specimens 150-mm in diameter specimens. Other similar and comparable systems such as those used in T 320 can be used.
- 6.1.8. *Test Specimen Loading Frame*—The specimen load frame shall be as described in ASTM D4123 and capable of delivering test loads coincident with the vertical diametral plane of the test specimen and with less than 20 N frictional resistance in guides and/or bearings. Often a smaller guide frame with special alignment capabilities is used in conjunction with the larger loading frame to accomplish this. The frame may be configured with two support columns or four support columns (Figure 2).