
Standard Method of Test for

Determining the Fatigue Life of Compacted Asphalt Mixtures Subjected to Repeated Flexural Bending

AASHTO Designation: T 321-22

Technically Revised: 2022

**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 provides procedures for determining the fatigue life and fatigue energy of 380 mm long by 50 mm thick by 63 mm wide asphalt mixture beam specimens sawed from laboratory- or field-compacted asphalt mixtures and subjected to repeated flexural bending until failure.
- 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 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.*
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2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- < M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - < PP 3, Preparing Hot Mix Asphalt (HMA) Specimens by Means of the Rolling Wheel Compactor¹
 - < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - < R 66, Sampling Asphalt Materials
 - < R 90, Sampling Aggregate Products
 - < R 97, Sampling Asphalt Mixtures
 - < T 247, Preparation of Test Specimens of Hot Mix Asphalt (HMA) by Means of California Kneading Compactor
 - < T 269, Percent Air Voids in Compacted Dense and Open Asphalt Mixtures
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TS-2d

T 321-1

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- 2.2. *ASTM Standards:*
- < D3549/D3549M, Standard Test Method for Thickness or Height of Compacted Asphalt Mixture Specimens
 - < D5361/D5361M, Standard Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
 - < E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
 - < E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
 - < E879, Standard Specification for Thermistor Sensors for General Purpose and Laboratory Temperature Measurements
 - < E1137/E1137M, Standard Specification for Industrial Platinum Resistance Thermometers
- 2.3. *International Electrotechnical Commission Standard:*
- < IEC 60751: 2008 Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

3. TERMINOLOGY

- 3.1. *Definition:*
- 3.1.1. *failure point*—the load cycle at which a peak occurs in the plot of stiffness multiplied by load cycles versus load cycles, which is indicative of the formation of a crack in the specimen.

4. SIGNIFICANCE AND USE

- 4.1. The fatigue life and failure energy determined by this standard can be used to estimate the fatigue life of asphalt mixture pavement layers under repeated traffic loading. The performance of asphalt mixtures can be more accurately predicted when these properties are known.

5. APPARATUS

- 5.1. *Test System*—The test system shall consist of a loading device, an environmental chamber (optional), and a control and data acquisition system. The test system shall meet the minimum requirements specified in Table 1.

Table 1—Test System Minimum Requirements

Load measurement and control	Range:	0 to 5 kN
	Resolution:	2 N
	Accuracy:	5 N
Displacement measurement and control	Range:	0 to 5 mm
	Resolution:	2 μm
	Accuracy:	5 μm
Frequency measurement and control	Range:	5 to 10 Hz
	Resolution:	0.005 Hz
	Accuracy:	0.01 Hz
Temperature measurement and control	Range:	−10 to 25°C
	Resolution:	0.25°C
	Accuracy:	±0.5°C

- 5.1.1. *Loading Device*—The test system shall include a closed-loop, computer-controlled loading component that, during each load cycle in response to commands from the data processing and control component, adjusts and applies a load such that the specimen experiences a constant level of strain during each load cycle. The loading device shall be capable of (1) providing repeated sinusoidal loading at a frequency range of 5 to 10 Hz; (2) subjecting specimens to four-point bending with free rotation and horizontal translation at all load and reaction points; and (3) forcing the specimen back to its original position (i.e., zero deflection) at the end of each load pulse. (Figure 1 illustrates the loading conditions.)
- 5.1.2. *Environmental Chamber (Optional)*—The environmental chamber shall enclose the entire specimen and maintain the specimen at the test temperature $\pm 0.5^{\circ}\text{C}$ during testing. An environmental chamber is not required if the temperature of the surrounding environment can be maintained within the specified limits. Thermometers for measuring the temperature within the chamber shall meet the requirements of M 339M/M 339 with a temperature range of at least -15 to 30°C , and an accuracy of $\pm 0.13^{\circ}\text{C}$ (see Note 1).
- Note 1**—Thermometer types suitable for use include ASTM E879 thermistor thermometer, Special order; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometer, Special order; or IEC 60751: 2008 Pt-100 RTD platinum resistance thermometer, Special order.
- 5.1.3. *Control and Data Acquisition System*—During each load cycle, the control and data acquisition system shall be capable of measuring the deflection of the beam specimen, computing the strain in the specimen, and adjusting the load applied by the loading device such that the specimen experiences a constant level of strain on each load cycle. In addition, it shall be capable of recording load cycles, applied loads, and beam deflections and computing and recording the maximum tensile stress, maximum tensile strain, phase angle, stiffness, dissipated energy, and cumulative dissipated energy at load cycle intervals specified by the user.
- 5.2. *Miscellaneous Apparatus and Materials*—A suitable saw for cutting the beams and a mechanism for setting proper clamp spacing. For loading devices that require a glued nut for deformation measurement, a screw, nut (suggested size M 8 by 1) and block assembly for referencing the linear variable differential transducer (LVDT) to the neutral axis of the specimen, and epoxy for attaching a target to the specimen at the neutral axis are also needed.