
Standard Method of Test for Estimating Fatigue Resistance of Asphalt Binders Using the Linear Amplitude Sweep

AASHTO Designation: TP 101-12 (2018)¹

Technical Subcommittee: 2b, Liquid Asphalt

Release: Group 3 (July)



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1. SCOPE

- 1.1. This test method covers the determination of an asphalt binder's resistance to fatigue damage by means of cyclic loading employing systematic, linearly increasing load amplitudes. The amplitude sweep is conducted using the Dynamic Shear Rheometer (DSR) at the intermediate pavement temperature determined from the performance grade (PG) of the asphalt binder according to M 320. The test method can be used with binder aged using T 240 (RTFOT) and R 28 (PAV) to simulate the aging for in-service asphalt pavements.
- 1.2. The values stated in SI units are to be regarded as the standard.
- 1.3. *This standard does not purport to address all of the safety concerns, if any, 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:*
- M 320, Performance-Graded Asphalt Binder
 - R 28, Accelerated Aging of Asphalt Binder Using a Pressurized Aging Vessel (PAV)
 - T 240, Effect of Heat and Air on a Moving Film of Asphalt Binder (Rolling Thin-Film Oven Test)
 - T 315, Determining the Rheological Properties of Asphalt Binder Using a Dynamic Shear Rheometer (DSR)
- 2.2. *ASTM Standard:*
- D8, Standard Terminology Relating to Materials for Roads and Pavements

3. TERMINOLOGY

- 3.1. *Definitions:*
- 3.1.1. Definitions of terms used in this test method may be found in ASTM D8, determined from common English usage, or combinations of both.

4. SUMMARY OF TEST METHOD

- 4.1. Asphalt binder is first aged using T 240 (RTFOT) to represent short-term aging of asphalt pavements. The binder may be further aged using R 28 (PAV) prior to testing in order to simulate long-term aging of asphalt pavements. A sample is prepared according to T 315 (DSR) using the 8-mm parallel plate geometry with a 2-mm gap setting. The sample is tested in shear using a frequency sweep to determine its rheological properties. The sample is then tested using a series of oscillatory load cycles at systematically increasing amplitudes at a constant frequency to cause accelerated fatigue damage. The continuum damage approach is used to calculate the fatigue resistance from the rheological properties and amplitude sweep results.

5. SIGNIFICANCE AND USE

- 5.1. This method is intended to evaluate the ability of an asphalt binder to resist fatigue damage by employing cyclic loading at increasing amplitudes in order to accelerate damage. The characteristics of the rate of damage accumulation in the material can be used to indicate the fatigue performance of the asphalt binder given pavement structural conditions and/or expected amount of traffic loading using predictive modeling techniques.

6. APPARATUS

- 6.1. Use the apparatus as specified in T 315.

7. PROCEDURE

- 7.1. Condition the asphalt binder in accordance with T 240 (RTFOT) for short-term performance, or condition the asphalt binder in accordance with T 240 (RTFOT) followed by R 28 (PAV) for long-term performance.
- 7.2. *Sample Preparation*—The sample for the Amplitude Sweep is prepared following T 315 for 8-mm plates. The temperature control also follows the T 315 requirements.
- 7.2.1. This test may be performed on the same sample that was previously used to determine the rheological properties in the DSR on PAV residue as specified in M 320.
- 7.3. *Test Protocol*—Two types of testing are performed in succession. The first test, a frequency sweep, is designed to obtain information on the rheological properties, and the second test, an amplitude sweep, is intended to measure the damage characteristics of the material.
- 7.3.1. *Determination of “Alpha” Parameter*—In order to perform the damage analysis, information regarding the undamaged material properties (represented by the parameter α) must be determined. The frequency sweep procedure outlined in Section 7.3.1.1 is used to determine the alpha parameter.
- 7.3.1.1. *Frequency Sweep*—Frequency sweep test data are used to determine the damage analysis “alpha” parameter. The frequency sweep test is performed at the selected temperature and applies oscillatory shear loading at constant amplitude over a range of loading frequencies. For this test method, the frequency sweep test is selected from the DSR manufacturer’s controller software, employing an applied load of 0.1 percent strain over a range of frequencies from 0.2 to 30 Hz. Data are sampled at the following 12 unique frequencies (all in Hz):

0.2 0.4 0.6 0.8 1.0 2.0 4.0 6.0 8.0 10 20 30