
Standard Method of Test for

Rutting and Fatigue Resistance of Asphalt Mixtures Using Incremental Repeated Load Permanent Deformation (iRLPD)

AASHTO Designation: TP 116-22¹

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 describes a test method for measuring the resistance of asphalt mixtures to rutting and fatigue cracking using minimum strain rates (m^*) from an incremental repeated load permanent deformation (iRLPD) test conducted by means of a dynamic testing system (DTS). This practice is intended for dense- and gap-graded mixtures with nominal maximum aggregate sizes to 37.5 mm.
- 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 its 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.*

2. REFERENCED DOCUMENTS

- 2.1. *AASHTO Standards:*
- < M 339M/M 339, Thermometers Used in the Testing of Construction Materials
 - < R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
 - < R 29, Grading or Verifying the Performance Grade (PG) of an Asphalt Binder
 - < R 30, Laboratory Conditioning of Asphalt Mixtures
 - < R 83, Preparation of Cylindrical Performance Test Specimens Using the Superpave Gyratory Compactor (SGC)
 - < T 312, Preparing and Determining the Density of Asphalt Mixture Specimens by Means of the Superpave Gyratory Compactor
 - < T 378, Determining the Dynamic Modulus and Flow Number for Asphalt Mixtures Using the Asphalt Mixture Performance Tester (AMPT)

- 2.2. *ASTM Standards:*
- < 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
- 2.4. *Other Document:*
- < TRB. Equipment Specification for the Simple Performance Test System, Version 3.0. In Appendix F of *National Cooperative Highway Research Report 629: Ruggedness Testing of the Dynamic Modulus and Flow Number Tests with the Simple Performance Tester*. National Cooperative Highway Research Program, Transportation Research Board, Washington, DC, 2008.

3. TERMINOLOGY

- 3.1. *Definitions:*
- 3.1.1. *confining pressure*—stress applied to all surfaces in a confined test.
- 3.1.2. *contact stress*—the constant axial stress applied to hold the specimen in place.
- 3.1.3. *deviator stress*—difference between the total axial stress and the confining pressure in a confined test.
loading increment—500 cycles of a repeated load.
- 3.1.4. *loading increment*—500 cycles of a repeated load in the rutting test and 100 cycles of a repeated load in the fatigue test.
- 3.1.5. *minimum strain rate (m^*)*—the lowest permanent strain per cycle in a loading increment, which is the permanent strain due to the last cycle of a loading increment.
- 3.1.6. *permanent deformation*—non-recovered deformation in a repeated load test.
- 3.1.7. *repeated load cycle*—loading of 0.1 s followed by 0.9-s rest period.
- 3.1.8. *secondary stage*—the loading cycles where the permanent axial strain rate is stable.
- 3.1.9. *strain rate*—the permanent axial strain due to one repeated load cycle.
- 3.1.10. *strain acceleration*—the rate of change of the strain rate.

4. SUMMARY OF THE TEST METHOD

- 4.1. This test method describes procedures for evaluating resistance of asphalt mixtures to rutting and fatigue cracking by measuring the minimum strain rate (m^*) at the critical temperature and various load levels using the iRLPD method.
- 4.2. The iRLPD test is conducted at one test temperature and in several increments. The deviator load is held constant during each increment and is increased for each subsequent increment. The load pulse is 0.1 s every 1.0 s. Permanent axial strains due to each load cycle (permanent strain rate) are

measured by the actuator. The minimum strain rate for each increment is defined as the permanent axial strain due to the last cycle.

- 4.3. There are two methods of conducting the rutting test.
- 4.3.1. Method A is conducted on a 150-mm (6.0-in.) diameter by 115-mm (4.5-in.) high volumetric specimen without applying confinement, in one increment of 500 cycles.
- 4.3.2. Method B is conducted on a 100-mm (4.0-in.) diameter by 150-mm (6.0-in.) high cylinder with 69-kPa (10-psi) confinement, in four increments of 500 cycles each.
- 4.3.3. The increments of the rutting test always remain in the secondary stage of deformation and never reach tertiary flow.
- 4.4. The fatigue test is conducted in twelve increments of 100 cycles each using an indirect-tensile (IDT) setup on a 150-mm (6.0-in.) diameter by 50-mm (2.0-in.) high disk. The fatigue test is always carried to failure.

5. SIGNIFICANCE AND USE

- 5.1. The minimum strain rate (m^*) is the permanent deformation property of asphalt mixtures and represents the unit rutting damage at high temperature or fatigue resistance at intermediate temperature due to a repeated heavy-axle load.
- 5.2. For the rutting tests, the minimum strain rate (m^*) represents the rutting damage due to a single heavy-axle load at a specific temperature and tire pressure. The m^* is used for performance grading of mixtures, mix design verification, material characterization, and rutting performance evaluation.
- 5.3. The fatigue test simulates field conditions by applying the same loading magnitude and loading pattern as in the field. The specimen, at its intermediate temperature, is incrementally loaded using a repeated load until it reaches failure. The m^* from the fatigue test is well correlated with field fatigue performance.

6. APPARATUS

- 6.1. *Specimen Fabrication Equipment*—Equipment for fabricating iRLPD test specimens as described in T 312 and R 83.
- 6.2. *Dynamic Testing System (DTS)*—A dynamic test system capable of applying up to 20 kN (4500 lbf) of repeated load (0.1 s load/0.9 s unload). The DTS shall have a temperature-controlled testing chamber capable of controlling the temperature of the specimen over a temperature range from 4 to 70°C (39 to 158°F) to an accuracy of $\pm 0.5^\circ\text{C}$ (1°F) and preferably capable of holding the test replicates and a dummy specimen with a temperature sensor mounted in the center for temperature verification. For a confined test (rutting Method B), the DTS shall be capable of applying 69 kPa (10 psi) of confining pressure.
- 6.3. *Conditioning Chamber*—An environmental chamber for conditioning the test specimens to the desired testing temperature, in case the testing chamber cannot hold more than the test specimen. The environmental chamber shall be capable of controlling the temperature of the specimen over a temperature range from 4 to 70°C (39 to 158°F) to an accuracy of $\pm 0.5^\circ\text{C}$ (1°F). The chamber shall be large enough to accommodate the number of specimens to be tested plus a dummy specimen with a temperature sensor mounted in the center for temperature verification. The thermometer for