
Standard Test Method for

**Evaluating Rutting and Moisture
Resistance of Paving Materials via
Loaded Wheel Tracking with a
Rubber Tire**

AASHTO Designation: TP 145-24¹

First Published: 2024

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



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Evaluating Rutting and Moisture Resistance of Paving Materials via Loaded Wheel Tracking with a Rubber Tire

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1. SCOPE

- 1.1. This standard test method describes a procedure for asphalt or other paving materials to be tested for rutting and moisture damage resistance with a loaded rubber tire in a laboratory. One test protocol, referred to as Method A, is performed without water to measure rutting resistance, and a second test protocol, referred to as Method B, submerges specimens in water but tests in otherwise identical conditions to Method A. The difference between the measured Method A and measured Method B rutting profile curves isolates the effects of moisture from other variables due to loaded wheel tracking.
- 1.2. This standard test method is applicable to compacted paving materials to be used as a lift or lifts of a pavement system.
- 1.3. The values stated in SI units are to be regarded as the standard.
- 1.4. *This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all 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.*
- 1.5. *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:*
 - M 339/M 339M, Thermometers Used in the Testing of Construction Materials
 - R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories

- R 97, Sampling Asphalt Mixtures
- T 166, Bulk Specific Gravity (G_{mb}) of Compacted Asphalt Mixtures Using Saturated Surface-Dry Specimens
- T 209, Theoretical Maximum Specific Gravity (G_{mm}) and Density of Asphalt Mixtures
- 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 324, Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures
- T 331 Bulk Specific Gravity (G_{mb}) and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method

2.2. *ASTM Standards:*

- D6027, Standard Test Method for Calibrating Linear Displacement Transducers for Geotechnical Purposes, Method A
- E1, Standard Specification for ASTM Liquid-in-Glass Thermometers
- E230/E230M, Standard Specification for Temperature-Electromotive Force (emf) Tables for Standardized Thermocouples
- 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 Standards:*

- IEC 600584-1: 2013, Thermocouples - Part 1: EMF Specifications and Tolerances
- IEC 60751: 2008, Industrial Platinum Resistance Thermometers and Platinum Temperature Sensors

2.4. *Other Documents:*

- Doyle, J. D. and I. L. Howard. Rutting and Moisture Damage Resistance of High Reclaimed Asphalt Pavement Warm Mixed Asphalt: Loaded Wheel Tracking vs. Conventional Methods. *Road Materials and Pavement Design*, Special Issue from 88th Association of Asphalt Paving Technologists' Annual Meeting, Vol. 14, No. S2, 2013, pp. 148–172. Available from <https://doi.org/10.1080/14680629.2013.812841>
- Cox, B. C., A. S. Carey, J. V. Lewis, and I. L. Howard. Twenty-Five Years of Rubber Tire Wheel Tracking of Asphalt Pavements in a Laboratory. In *Transportation Research Record* 2676, Vol. 11, 2022, pp. 74–92. Available from <https://doi.org/10.1177/03611981221091558>
- Howard, I.L., Lewis, J.V., Carey, A.S., and Cox, B.C. Laboratory Wheel Tracking of Asphalt with Rubber Tires or Rubber Hoses. In *Transportation Research Record* 2677, Vol. 10, 2023. Available from <https://doi.org/10.1177/03611981231161599>

3. SUMMARY OF METHOD

- 3.1. Circular specimens (Superpave gyratory compacted or field cores) are vertically sawn, placed end to end, confined in a mold, and laboratory tested in a temperature-controlled environment with repeated passes of a loaded rubber tire. In a default case, gyratory compacted specimens are not conditioned in the laboratory or aged in the field prior to testing, and field cores are tested with only the aging received in the field prior to testing. The rubber tire is inflated and loaded in a manner to produce a gross contact pressure of 620 to 655 kPa (90 to 95 psi). Testing is performed without water (Method A) or with water (Method B). A user can elect to perform only Method A, only Method B, or both methods. Either method produces a rut depth versus rubber tire passes curve for up to 20,000 passes, and this curve is used to calculate key parameters that are reported as test outputs.

- 3.1.1. Method A provides information about a mixture's rut resistance in the presence of 1) a loaded rubber tire; and 2) an elevated, thermally controlled environment. Method A provides information on dry rutting resistance but no information on moisture resistance.
- 3.1.2. Method B provides information about a mixture's rut resistance in the presence of 1) a loaded rubber tire; 2) an elevated, thermally controlled environment; and 3) water submersion. Method B provides information about a mixture's rut resistance in the presence of multiple rutting tendencies but does not allow for isolation of any one rutting mechanism.
- 3.1.3. Method A and Method B, when used in conjunction, can isolate the effects of moisture by taking the difference in their respective rut depth versus rubber tire passes curves.

4. APPARATUS

- 4.1. *Rubber Tire Wheel Tracking (RTrack) Device*—An electrically powered machine and associated software capable of performing wheel tracking experiments that conform to the following parameters.
 - 4.1.1. The RTrack device shall accommodate a rubber tire and stainless steel rim conforming to the requirements in Section 4.2.
 - 4.1.2. The RTrack device shall be capable of reciprocating the rubber tire across the specimens at a speed of 52 ± 2 passes/minute, with position varying sinusoidally over time. The maximum travel speed, reached at the midpoint of the device's stroke length, should not exceed 0.31 ± 0.02 m/s (1 ± 0.066 ft/s).

Note 1—For a typical device with a stroke length of 0.23 m (0.75 ft), a reciprocating sinusoidal wheel speed of 52 passes/minute equates to an average travel speed of 0.20 m/s (0.66 ft/s) and a maximum travel speed of 0.31 m/s (1.02 ft/s) at the midpoint of the stroke length. Potential future work may evaluate devices that travel at a linear rate of speed in contrast to sinusoidal, alongside travel speed requirements.
 - 4.1.3. The RTrack device shall be capable of applying a continuous vertical load to the rubber tire and metal rim to within ± 10 N (± 2 lb) over a range of 1735 to 1825 N (390 to 410 lb).
 - 4.1.4. The RTrack device shall apply 20,000 passes (10,000 cycles) of the loaded rubber tire and record rut depth measurements as a function of passes applied. The device shall take rut depth measurements with electronic instrumentation such as linear displacement transducers (LDTs) that have a precision of 0.15 mm (0.006 in.) and a minimum range of 20 mm (0.8 in.). The device shall be capable of measuring rut depth at a minimum of 11 evenly spaced locations along the track length ranging from -114 (-4.5) to +114 (+4.5) mm (in.) with zero being the midpoint of the track. The device shall be capable of reporting rut depth measurements at least once every 20 passes during testing.
 - 4.1.5. The RTrack device shall include a temperature control system to regulate temperature around specimens during test conditioning and testing. The system shall be capable of controlling air temperature for dry testing and water temperature for wet testing within $\pm 1.0^\circ\text{C}$ ($\pm 1.8^\circ\text{F}$) over a range of at least 40 to 70°C (104 to 158°F). Mechanical circulating systems shall be used to aid in temperature stabilization and uniformity. Thermometers for measuring air and water temperature shall meet the requirements of M 339M/M 339 with a temperature range of at least 35 to 75°C (95 to 167°F) and an accuracy of $\pm 0.25^\circ\text{C}$ ($\pm 0.45^\circ\text{F}$) (see Note 2).

Note 2—Thermometer types suitable for use include ASTM E1 mercury thermometers; ASTM E879 thermistor thermometers; ASTM E1137/E1137M Pt-100 RTD platinum resistance thermometers, Class A; and IEC 60751: 2008 Pt-100 RTD platinum resistance thermometers, Class AA.