
Standard Method of Test for Frictional Properties of Paved Surfaces Using a Full-Scale Tire

AASHTO Designation: T 242-18 (2022)¹

Technically Revised: 2018

Reviewed but Not Updated: 2022

Editorially Revised: 2021

Technical Subcommittee: 5a, Pavement Measurement

ASTM Designation: [E274/E274M-15\(2020\)](#)



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

Standard Method of Test for

Frictional Properties of Paved Surfaces Using a Full-Scale Tire

AASHTO Designation: T 242-18 (2022)¹

AASHTO

Technically Revised: 2018

Reviewed but Not Updated: 2022

Editorially Revised: 2021

Technical Subcommittee: 5a, Pavement Measurement

ASTM Designation: [E274/E274M-15\(2020\)](#)

1. SCOPE

- 1.1. This method covers the measurement of the frictional properties of paved surfaces with a specified full-scale automotive tire.
- 1.2. This method utilizes a measurement representing the steady-state friction force on a locked test wheel as it is dragged over a wetted-pavement surface under constant load and at a constant speed while its major plane is parallel to its direction of motion and perpendicular to the pavement.
- 1.3. The values measured represent the frictional properties obtained with the equipment and procedures stated herein and do not necessarily agree or correlate directly with those obtained by other pavement friction measuring methods. The values are intended for use in comparing certain frictional properties of a pavement relative to those of other pavements or for evaluating changes in these frictional properties of a pavement with the passage of time. The values are insufficient to determine the distance required to stop a vehicle on either a wet or a dry pavement. They are also insufficient for determining the speed at which control of a vehicle would be lost, because peak and side-force friction are also required for these determinations.
- 1.4. The values stated in SI units are to be regarded as the standard.
- 1.5. *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 standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*
- 1.6. *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 261](#), Rib-Tread Standard Tire for Special-Purpose Pavement Frictional-Property Tests

- [M 286](#), Smooth-Tread Standard Tire for Special-Purpose Pavement Frictional-Property Tests
- [R 18](#), Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- [T 282](#), Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)

2.2. *ASTM Standards:*

- [E178](#), Standard Practice for Dealing with Outlying Observations
- [E501](#), Standard Specification for Standard Rib Tire for Pavement Skid-Resistance Tests
- [E1136](#), Standard Specification for P195/75R14 Radial Standard Reference Test Tire
- [F457](#), Standard Test Method for Speed and Distance Calibration of Fifth Wheel Equipped with Either Analog or Digital Instrumentation

3. SUMMARY OF METHOD

- 3.1. The test apparatus consists of an automotive vehicle with one or more test wheels incorporated into it or forming part of a suitable trailer towed by a vehicle. The apparatus contains a transducer, instrumentation, a water supply and proper dispensing system, and actuation controls for the brake of the test wheel. The test wheel is equipped with a standard pavement test tire, as specified in [M 261](#) or [M 286](#).
- 3.2. The test apparatus is brought to the desired test speed. Water is delivered ahead of the test tire and the braking system is actuated to lock the test tire. The resulting friction force acting between the test tire and the pavement surface (or some other quantity that is directly related to this force) and the speed of the test vehicle are recorded with the aid of suitable instrumentation.
- 3.3. Frictional properties of the paved surface are determined from the resulting force or torque recorded and reported as friction numbers (FN), which are determined from the force required to slide the locked test tire at a stated speed, divided by the effective wheel load and multiplied by 100.

4. APPARATUS

- 4.1. *Vehicle*—The vehicle with one test tire locked shall be capable of maintaining test speeds of 65 to 100 km/h (40 to 60 mph) within ± 1.5 km/h (± 1.0 mph) during a test on a level pavement having an FN of 50.
- 4.2. *Braking System*—The test wheel shall be equipped with a suitable brake. The brake system shall be capable of locking the wheel at the condition specified in Section 4.1 and maintaining the locked-wheel condition throughout the test.
- 4.3. *Wheel Load*—The apparatus shall be of such a design as to provide an equal static load of 4800 ± 65 N (1085 ± 15 lbf) to each test wheel and, on detachable trailers, a static download of 450 to 900 N (100 to 200 lbf) at the hitch point.
- 4.4. *Tire and Rim*—The test tire shall be one of the standard tires for the pavement test, as specified in [M 261](#) or [M 286](#), and it shall be mounted on a suitable 15-by-6-in. rim. Since all rims do not have the same offset from the hub, replacement rims must be of the same offset to ensure consistent alignment of the tire with the water path. The data from the two tires are not interchangeable. Alternative testing for special purposes may be performed with other tires, such as [ASTM E1136](#).
- 4.5. *Instrumentation:*

- 4.5.1. *General Requirements for Measuring System*—The instrumentation system shall conform to the following overall requirements at ambient temperatures between 4 and 40°C (40 and 100°F):
- 4.5.1.1. *Overall System Accuracy*— $\pm 1\frac{1}{2}$ percent of applied load from 900 N (200 lbf) to full scale; for example, at 900 N (200 lbf), applied calibration force of the system output shall be determinable within ± 14 N (± 3 lbf).
- 4.5.1.2. *Time Stability of Calibration*—10-h minimum.
- 4.5.1.3. The exposed portions of the system shall tolerate 100 percent relative humidity (rain or spray) and all other adverse conditions, such as dust, shock, and vibrations, which may be encountered in highway operations.
- 4.5.2. *Force-Measuring Transducer*—The tire force-measuring transducer shall be of such design as to measure the tire-road interface force with minimum inertial effects. Transducers are recommended to provide an output directly proportional to force with hysteresis less than 1 percent of the applied load, nonlinearity less than 1 percent of the applied load up to the maximum expected loading, and sensitivity to any expected cross-axis loading or torque loading less than 1 percent of the applied load. The force transducer shall be mounted in such a manner as to experience less than 1-degree angular rotation with respect to its measuring plane at the maximum expected loading.
- 4.5.3. *Torque-Measuring Transducer*—Torque transducers provide an output directly proportional to torque with hysteresis less than 1 percent of the applied load and nonlinearity up to the maximum expected loading less than 1 percent of the applied load. It should have sensitivity to any cross-axis loading less than 1 percent of the applied load.
- 4.5.4. *Additional Transducers*—Force transducers for measuring quantities such as vertical load, etc., shall meet the recommendations stated in Section 4.5.2.
- 4.5.5. *Vehicle Speed-Measuring Transducers*—Transducers such as fifth-wheel or free-rolling wheel-coupled tachometers shall provide speed resolution and accuracy of ± 1.5 percent of the indicated speed or ± 1.0 km/h (± 0.5 mph), whichever is greater. Output shall be directly viewable by the driver and shall be simultaneously recorded. Fifth-wheel systems shall conform to [ASTM F457](#).
- 4.6. *Signal Conditioning and Recorder System:*
- 4.6.1. Transducers that measure parameters sensitive to inertial loading shall be designed or located in such a manner as to minimize this effect. If the foregoing is not practical, data correction must be made for these effects if they exceed 2 percent of the actual data during expected operation. All signal conditioning and recording equipment shall provide linear output and shall allow data reading resolution to meet the requirements of Section 4.5.1. All systems, except the smoothing filter recommended in Section 4.6.2, shall provide a minimum bandwidth of at least 0 to 20 Hz (flat within ± 1 percent).
- 4.6.2. It is recommended that an electronic filter, typically between 4.8 Hz/–3dB/4-pole Bessel-type and a 10 Hz/–3dB/8-pole Butterworth filter, selected from the types described in Reference 1 (see Section 13.1) be installed in the signal conditioning circuit preceding the electronic divider and integration calculation of FN as described in Section 9.4.
- 4.6.3. All strain-gauge transducers shall be equipped with resistance shunt calibration resistors or equivalent that can be connected before or after test sequences. The calibration signal shall be at least 50 percent of the normal vertical load and shall be recorded.