



Designation: E2340/E2340M – 11 (Reapproved 2021)

Standard Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces Using a Continuous Reading, Fixed-Slip Technique¹

This standard is issued under the fixed designation E2340/E2340M; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the measurement of the skid resistance of a pavement or other trafficked surface using the continuous reading, fixed-slip technique.

1.2 This test method covers braked wheel measurements obtained with less than 100 % slip. It does not cover side force measurements.

1.3 This test method provides a record of the skid resistance along the whole length of one track of the test surface and enables averages to be obtained for specified test segments.

1.4 This test method is used to measure skid resistance on a wide variety of surfaces in a wide variety of circumstances. Consequently, there are many different designs of continuous reading, fixed-slip measuring equipment (CFME) and as many different test procedures governing their use.

1.5 This test method does not attempt to detail these different equipment and procedures but does set out the essential common principles.

1.6 CFMEs function by creating and measuring a frictional force between a test tire operating at a selected slip and the test surface. Different types of CFME do not necessarily create the same frictional force between their particular test tire and a common test surface and do not necessarily use the same method to measure this frictional force.

1.7 CFME measurements are obtained at a selected steady test speed. This speed may vary according to the application.

1.8 The test surface may be contaminated or clean and dry. If it is clean and dry, a measured amount of water is normally deposited on the surface just in front of the test wheel.

1.9 The measuring apparatus may be built into a vehicle, built into a trailer that is towed by a vehicle, or built into a device that is manually pushed.

¹ This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.21 on Field Methods for Measuring Tire Pavement Friction.

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1.10 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

1.11 *This standard may involve hazardous materials, operations, and equipment. 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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* Safety precautionary information is contained in Section 7.

1.12 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- E178 Practice for Dealing With Outlying Observations
- E501 Specification for Standard Rib Tire for Pavement Skid-Resistance Tests
- E524 Specification for Standard Smooth Tire for Pavement Skid-Resistance Tests
- E867 Terminology Relating to Vehicle-Pavement Systems
- E1551 Specification for a Size 4.00-8 Smooth Tread Friction Test Tire
- E1844 Specification for a Size 10 × 4–5 Smooth-Tread Friction Test Tire
- F408 Test Method for Tires for Wet Traction in Straight-Ahead Braking, Using a Towed Trailer
- F457 Test Method for Speed and Distance Calibration of

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

Fifth Wheel Equipped With Either Analog or Digital Instrumentation

3. Terminology

3.1 For definitions of terms used in this test method, refer to Terminology [E867](#).

3.2 Definitions:

3.2.1 *braking force*, *n*—dynamic instantaneous frictional force acting on the test wheel.

3.2.2 *braking force coefficient (BFC)*, *n*—appropriately filtered mean of a number of instantaneous friction readings over a defined distance.

3.2.3 *braking slip friction*, *n*—tangential force generated between the test tire and the test surface.

3.2.4 *braking slip ratio*, *n*—ratio of relative braking slip circumferential speed to identical unbraked wheel circumferential speed, usually defined as a percent.

3.2.4.1 *Discussion*—An equivalent definition is the ratio of the relative braking slip velocity to the horizontal velocity of the wheel axle.

3.2.5 *continuous reading, fixed slip-measuring equipment (CFME)*, *n*—apparatus that can be moved over the test surface at the chosen test speed and includes a test wheel, a system for braking the test wheel, and instrumentation for measuring the resulting frictional force between the test tire and test surface.

3.2.6 *fixed slip*, *n*—braking system that forces the test wheel to roll at a constant slip or fixed reduction of its free-rolling speed.

3.2.7 *frictional force*, *n*—resistance generated when one surface moves relative to another with which it is in contact.

3.2.8 *instantaneous friction reading*, *n*—braking force divided by load or equivalently divided by torque on the test wheel (generated by braking force) divided by load times tire radius (moment arm).

3.2.9 *load force*, *n*—dynamic instantaneous vertical force acting on the test wheel.

3.2.10 *nominal water film thickness*, *n*—thickness of the film that the water application system is designed to create ahead of the test tire on an entirely smooth test surface.

3.2.11 *rate of water flow*, *n*—rate at which water is applied to the test surface in front of the test tire.

3.2.12 *reporting length*, *n*—defined length over which the BFC is calculated.

3.2.13 *standard nominal water film thickness*, *n*—nominal water film thickness associated with CFME measurements of a particular type of test application to facilitate comparisons between the results of different tests.

3.2.14 *standard test speed*, *n*—steady test speed associated with CFME measurements of a particular type of test application to facilitate comparisons between the results of different tests.

3.2.15 *test speed*, *n*—steady test speed associated with CFME measurements.

3.2.16 *water application system*, *n*—system for depositing a given amount of water in front of the test tire so that it passes between the tire contact area and the test surface.

3.3 Definitions of Terms Specific to This Standard:

3.3.1 *certifying calibration*, *n*—verification of test equipment, calibration equipment (separate or inbuilt), calibration procedures, and equipment operation recommended to be carried out once a year; the procedure records both as found values and adjusted values.

3.3.2 *field calibration*, *n*—primary force calibration or the equivalent carried out before each test or series of tests by a trained operator using calibration equipment supplied by the manufacturer; this equipment may be built into the CFME.

3.3.3 *friction map*, *n*—presentation of friction readings obtained down the length of a test surface (typically an airport runway) over a series of selected paths down the surface.

3.3.4 *operational friction testing*, *n*—measurement of the friction of a surface in response to an operational need and in whatever conditions exist at the time of the test, which may include contamination by ice, snow, slush, or water; these tests do not include the application of water.

3.3.5 *routine friction testing*, *n*—measurement of the friction of a surface under standardized test conditions that normally includes a standard test speed and a rate of water flow which gives a standard nominal water film thickness.

3.3.6 *test tire*, *n*—standard tire for pavement friction testing; test tires for routine friction testing shall have a smooth tread.

4. Summary of Test Method

4.1 The test system is moved over the test surface at the chosen test speed with the test wheel, fitted with a test tire, and forced to roll at a particular braking slip ratio.

4.2 If routine friction testing is taking place, the rate of water flow is adjusted to the test speed so that the chosen nominal water film is achieved.

4.3 The braking force or torque is measured (see Terminology [E867](#)) and the load is measured, calculated, or assumed to be the same as the dead weight load.

4.4 The instantaneous friction reading is calculated.

4.5 Either the instantaneous friction reading is recorded or the BFC for each friction length is calculated and recorded.

4.6 Test speed (see Test Method [F457](#)), rate of water flow, and other essential supporting data are recorded.

5. Significance and Use

5.1 CFMEs are used to measure skid resistance on runways, roads, and various other trafficked surfaces. These tests may comprise operational testing, performed to obtain an immediate assessment of skid resistance in current conditions or routine testing in standardized conditions which include the application of a precise amount of water in front of the test tire.

5.2 Standard test speeds and nominal water film thicknesses are according to national or international agency standards, the type of CFME, and the test application. Some examples of typical applications are given in [Appendix X1](#).