



Standard Guide for Standard Guide for the Evaluation, and Calibration, Continuous Friction Measurement Equipment (CFME)¹

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1. Scope

1.1 This guide describes the evaluation and calibration of friction measurement systems which are known as Continuous Friction Measuring Equipment (CFMEs). The evaluation, and calibration processes; using the specialized equipment, instruments, pavement surfaces, trained personnel, and approved facilities; are performed using the procedures described below.

1.2 This guide is offered as a process to identify and quantify the variables that affect system performance, to minimize the effect of these variables, and to provide a means to relate CFMEs to reference skid measurement systems.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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. Some specific hazards statements are given in Section 7 on Hazards.*

2. Referenced Documents

2.1 ASTM Standards:²

- [C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials](#)
- [E556 Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform \(User Level\)](#)
- [E670 Test Method for Testing Side Force Friction on Paved Surfaces Using the Mu-Meter](#)
- [E867 Terminology Relating to Vehicle-Pavement Systems](#)

¹ This guide 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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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.

[E1859 Test Method for Friction Coefficient Measurements Between Tire and Pavement Using a Variable Slip Technique](#)

[E1960 Practice for Calculating International Friction Index of a Pavement Surface](#)

[E2340 Test Method for Measuring the Skid Resistance of Pavements and Other Trafficked Surfaces Using a Continuous Reading, Fixed-Slip Technique](#)

[E2666 Practice for Correlations of Mu Values of Continuous Friction Measurement Equipment to Determine Maintenance Levels for Use at Airports](#)

[F377 Practice for Calibration of Braking/Tractive Measuring Devices for Testing Tires](#)

[F457 Test Method for Speed and Distance Calibration of Fifth Wheel Equipped With Either Analog or Digital Instrumentation](#)

2.2 Other Standards:

[BS 7941-1:2006 Method for measuring the skid resistance of pavement surfaces, Sideway-force Coefficient Routine Investigation Machine, SCRIM® \(British Standard\)](#)

3. Terminology

3.1 Definitions:

3.1.1 *Calibration Platform, n*—a frictionless moving platform for applying a tractive force in the contact plane of a tire and associated means for measuring the applied horizontal and vertical force, also referred to as a “force plate.” [E670](#)

3.1.2 *Field Test Center (FTC), n*—a facility with the needed test equipment, Reference Friction Measurement System (RFMS), test pavements and expertise to evaluate, calibrate and correlate CFME friction measurement systems. [E670](#)

3.1.3 *Horizontal Force, n*—a force in line with the direction of travel for fixed slip devices, perpendicular to direction of travel for side force devices. [E670](#)

3.2 Other terminology used in this guide conforms to the definitions in Terminology [E867](#)

4. Summary of Guide

4.1 There are three phases to this guide. Phase one records and reports the static and dynamic condition and accuracy of

the visiting system in an “As Arrived” condition with no changes being made. During phase two, each subsystem is evaluated and if necessary, adjusted to ensure compliance with tolerances outlined in Test Method [E670](#), [E1859](#), [E2340](#) or other appropriate standards. Phase three is the final dynamic correlation between the visiting system and the RFMS.

4.2 The FTC personnel will calibrate the calibration platform or force plate used by the visiting equipment owner if provided.

4.3 A detailed report may be generated and presented to the equipment owner describing all static and dynamic test results.

5. Significance and Use

5.1 Friction characteristics of pavement surfaces are monitored by friction measurement systems, and the operating procedure for the use of these systems is found in Test Method [E670](#), [E1859](#), [E2340](#) or other appropriate standards. However, mechanical or electronic system anomalies, over time, could result in measurement errors or inaccuracies. This requires that each of these systems be evaluated, calibrated and correlated on a regular basis.

5.2 This guide defines the process of ensuring that CFMEs produce consistent and accurate data and correlating the CFMEs to national benchmark RFMS.

6. Apparatus

6.1 *Reference Friction Measurement System (RFMS)*, a fixed slip type measurement system that meets the requirements of ASTM/FAA/FHWA, preferably the same type as the CFME(s) being calibrated: or a texture and low slip device.

6.2 *Five Test Pavements (pads)*, with an asphalt, concrete or seal coat surface having a uniform high, medium, and low friction that spans the typical operating range and used to correlate multiple CFME systems. Pads with similar macro texture should be avoided. A recommended range of μ for the low friction pad should be: one below 0.30, three medium friction pads between 0.30 and 0.50, and the high friction pad above 0.50. The length and width shall be suitable for the entire CFME system at the highest designated test speed. A suggested length and width is 300 ft (100 m) by 9 ft (3 m). The test surfaces shall be homogeneous, level, and free of contaminants and traffic. A nonpolishing surface is recommended. There shall be adequate space for the CFMEs to accelerate to the test speed and safely decelerate.

6.2.1 Facilities located with system manufacturers may not have test pads available, but should have identified pavements having μ values similar to that noted in [6.2](#).

6.3 *One or Two Load Cells as needed*, calibrated annually and National Institute of Science and Technology (NIST) traceable, 1000 lb (4448 N) and 2000 lb (8900 N). Accuracy is required in accordance with Practice [F377](#)

6.4 *One or two Calibration Platforms as needed*, with digital instrumentation as described in Test Method [E556](#) and calibrated in accordance with Practice [F377](#). The top surfaces of the platforms are to be installed at the same height as the

surrounding floor. Alternatively the unit may be raised above the floor to match the height of the platform with its associated equipment.

6.5 *One or two Calibration Platforms as needed*, lifting the test wheel. Alternatively the on board lifting devices may be used to lift the test wheel.

6.6 *Voltmeter, Oscilloscope, Strain Indicator*, and other test instruments capable of accurate measurement of voltages, and signals common in strain gauge instrumentation.

6.7 *Water Volume Measurement System*; to calibrate the water pumping ability of the water system, the following items are needed: a collector to capture all water pumped during a fixed time interval, a device to measure the volume of water pumped, and a stopwatch.

6.8 *Static Water Distribution Gauge (SDG)*, a collector, set at floor level, which is divided into ten sections, eight sections of the device are 1/8 the width of the test tire and two sections, one on each side, that are one inch.; so that each section catches water from the water nozzle and feeds it into a separate reservoir and viewing allows the water nozzle distribution to be evaluated and photographed. See Appendix A for specifications of a suggested unit.

6.9 *Speed Measurement System*, to measure vehicle speed, ± 0.1 mph (0.2 km/h). A fifth wheel calibrated to Test Method [F457](#), precision GPS or precision radar is recommended.

6.10 *Precision Pressure Gauge* and air system are required for the calibration of tire pressure gauges. Gauges should have an accuracy of ± 0.25 % full scale or better.

6.11 *Inclinometer*, with a measuring resolution of 1 minute.

6.12 *Force Plate Calibration Fixture*, a system, capable of developing a precise longitudinal and vertical force sufficient for the calibration of a calibration platform throughout its operating range as described in Practice [F377](#).

NOTE 1—The following procedures (Sections [7](#), [8](#), [9](#) and [14](#)) are for one test wheel, centered to vehicle/trailer width or on the driver’s side.

7. ‘As Arrived’ Data

7.1 Visiting systems, upon arrival, will be correlated³ with the RFMS on five surfaces at the systems normal test speed and optionally at one to two additional test speeds. Twelve repeats should be run at the normal test speed. The visiting system and the RFMS should attempt to measure in the same lateral and longitudinal location for each pair of tests. The twelve repeats will be averaged and the mean, standard deviation, and confidence level will be reported, for each system, for each of the five surfaces. Repeatability should be reported and reproducibility if more than three of the same devices are tested (see [C670](#)). These values will be referred to as the “As Arrived Data.”

³ The correlation will depend on the end use. Manufacturers would use their standard device to correlate their devices; for airport maintenance, E2666 would be followed; calibrated CFME can be used with similar CFME. If a standard CFME and the CFME being calibrated have vastly different slip ratios, no correlation may be possible. The method used should be reported as well as any deviations where 7.1 cannot be followed.