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Standard Guide for Evaluation, Calibration, and Correlation of E274 Friction Measurement Systems and Equipment¹

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1. Scope

1.1 This guide describes the evaluation, calibration, and correlation of Test Method **E274/E274M** friction measurement systems as conducted at an ISO 17025 accredited field test center (FTC).² The evaluation, calibration, and correlation process, using the specialized equipment, facilities, surfaces, trained personnel, and area reference friction measurement systems (ARFMS) available at each FTC, are conducted using the procedures described below.

1.2 The FTC complies with the requirements of Guide **E1890**. Guide **E1890** requires a more stringent calibration process and requires all ARFMS systems be correlated together once a year on three surfaces at three speeds with twelve repeats each for a total of 108 pairs.

1.3 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 Test Method **E274/E274M** friction measurement systems to reference friction measurement systems.

1.4 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.

1.5 *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.*

1.6 *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 Recom-*

mendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:³

- E274/E274M** Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire
- E501** Specification for Standard Rib Tire for Pavement Skid-Resistance Tests
- E524** Specification for Standard Smooth Tire for Pavement Skid-Resistance Tests
- E556/E556M** Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)
- E867** Terminology Relating to Vehicle-Pavement Systems
- E1890** Guide for Validating New Area Reference Skid Measurement Systems and Equipment
- 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

3. Terminology

3.1 Definitions:

3.1.1 *area reference friction measurement system (ARFMS), n*—a Test Method **E274/E274M** type measurement system that meets the requirements of Guide **E1890**.

3.1.2 *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 force (traction) and vertical force (load). More commonly referred to as a “force plate.”

3.1.3 *field test center (FTC), n*—a facility with the needed test equipment, area reference friction measurement system, test pavements, and expertise to evaluate, calibrate, and correlate Test Method **E274/E274M** friction measurement 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 Currently, two FTCs are available. One is located at Texas Transportation Institute (TTI) near College Station, Texas. The other FTC is located at the Transportation Research Center Inc. (TRC) near East Liberty, Ohio.

³ 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.

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:

4.1.1 Phase one (evaluation) documents the static and dynamic accuracy of the visiting system in an “as arrived” condition. This includes an arrival dynamic correlation (if requested by the visiting agency) and initial outputs from the subsystems (speed, water delivery, and force transducer) prior to each of the calibration steps.

4.1.2 Phase two (calibration) is the adjustment of each subsystem to ensure compliance with tolerances outlined in Test Method **E274/E274M**.

4.1.3 Phase three (correlation) is the final dynamic correlation between the visiting system and the ARFMS.

4.2 In addition, the FTC will calibrate the force plate used by the visiting agency.

4.3 A detailed report will be generated and presented to the visiting agency describing all static and dynamic test results.

5. Significance and Use

5.1 Friction characteristics of road surfaces are measured by friction measurement systems, and the operating procedure for the use of these systems is found in Test Method **E274/E274M**. However, over time, mechanical or electronic system anomalies may develop, resulting in measurement errors or inaccuracies. This requires that each of these systems be evaluated, calibrated, and correlated on a regular basis. The interval between calibrations depends on the frequency of use, maintenance, and other factors. If any repairs are made to the system that may affect the calibration, the system should be recalibrated before further use. Generally, calibrations and correlations are recommended to be performed on an annual basis by one of the FTCs.

5.2 This guide defines the process of ensuring that Test Method **E274/E274M** systems produce consistent and accurate data by correlating the Test Method **E274/E274M** systems to national standard Test Method **E274/E274M** systems.

6. Apparatus

6.1 *Area Reference Friction Measurement System (ARFMS)*, a Test Method **E274/E274M** type measurement system that meets the requirements of Guide **E1890**.

6.2 *Three Test Pavements (pads)*, with an asphalt, concrete, or seal coat surface having a uniform low, medium, and high friction that spans the typical operating range and used to correlate multiple **E274/E274M** friction measurement systems. Similar macrotexture of the pads should be avoided. A recommended range of SN40R for the low-friction pad to be below 30, the medium-friction pad between 30 and 50, and the high-friction pad above 50. The length and width shall be suitable for the entire water/lockup cycle of **E274/E274M** friction measurement systems at the highest designated test speed. The test surfaces shall be homogeneous, level, and free of contaminants and traffic. A nonpolishing surface is recommended.

6.3 *Three Load Cells (or equivalent Class F weights where appropriate)*, with National Institute of Science and Technology (NIST) traceability, to be used to calibrate force plates and friction measurement systems for traction force, load, and tongue weight. Accuracy is required in accordance with Practice **F377**.

6.4 *Two Force Plates*, with digital instrumentation as described in Test Method **E556/E556M** and having been calibrated in accordance with Practice **F377**. The top surfaces of the platforms are to be installed at the same height as the surrounding floor. Air or hydraulic cylinders are required for applying the horizontal test load.

6.5 *Two Jacks*, for lifting each test wheel.

6.6 *System Readouts*, for the test instruments, should be capable of accurate measurement of applied loads.

6.7 *Water Volume Measurement System*, to calibrate the water pumping ability of the water system. Consists of: 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 22 sections of equal width, $\frac{5}{8}$ in. (16 mm), so that each section catches water from the water nozzle and feeds it into a separate reservoir and viewing tubes, thus allowing the water nozzle distribution to be evaluated and photographed.

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 with accuracy at least equal to Test Method **F457** is recommended.

6.10 *Precision Pressure Gauge*, for the calibration of tire pressure gauges. Accuracy of ± 0.25 % full scale or better.

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

6.12 *Force Plate Calibration Fixture*, a system capable of developing a precision longitudinal and vertical force sufficient for the calibration of a force plate 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, usually the left. On systems using two test wheels, these procedures must be repeated for the opposite side.

7. “As Arrived” Correlation

7.1 Visiting friction measurement systems that have been in use in their current state, upon arrival, should be correlated with the FTC ARFMS on three surfaces at the system’s normal test speed and optionally at one to two additional test speeds (see Note 3), with twelve repeats each. This will be done with either an **E501** or **E524** test tire (or combination thereof) on each system as requested by the visiting personnel. The visiting system and the ARFMS should attempt to measure in the same lateral and longitudinal location for each pair of skids. The twelve repeats will be averaged and the mean and standard deviation will be reported, for each system, for each of the three surfaces. These values will be referred to as the “As Arrived Correlation Data.”



Documents

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