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Standard Guide for Validating New Area Reference Skid Measurement Systems and Equipment[1]

This standard is issued under the fixed designation E1890; 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 guide covers validating area reference skid measurement systems (ARSMS) and related equipment. These systems have been used since 1976 to evaluate and correlate Test Method E274 skid measurement systems used primarily as a pavement management tool by state Departments of Transportation. Also, this guide provides guidelines for the revalidation process following the replacement of components within an ARSMS.

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 method of validating a new ARSMS to replace an existing ARSMS that has provided quality correlation data for a very long time.

1.3 The values stated in inch-pound units are to be regarded as the standard since the ARSMS will be compared with state departments of transportation systems that all currently use inch-pound units. The SI values given in parentheses are provided for information only.

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.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E274 Test Method for Skid Resistance of Paved Surfaces Using a Full-Scale Tire

E501 Specification for Rib Tire for Pavement Skid-Resistance Tests

E556 Test Method for Calibrating a Wheel Force or Torque Transducer Using a Calibration Platform (User Level)

E867 Terminology Relating to Vehicle-Pavement Systems

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 Terminology used in this guide conforms to the definitions in Terminology E867.

4. Summary of Guide

4.1 There are three phases to the process of validating new ARSMS equipment. Phase One is the calibration of all the equipment and instrumentation to be used in this process. Phase Two addresses the variables associated with the determination of a skid number (SN) and attempts to quantify the impact that each variable may have upon the accurate determination of an SN. Phase Three is the dynamic validation process, based upon the variables confirmed in Phase Two.

4.2 The approach is based upon Test Method E274 but with much narrower tolerances and greater control of the many potential variables. The extra effort is required since the products are measurement tools which will be used to evaluate the variety of Test Method E274 systems.

4.3 It is anticipated that the SN data produced by the two existing ARSMS and the SN data produced by each of the new ARSMS will have no significant difference.

4.4 The following three-phase procedural guide identifies the individual components or pieces, the evaluation process for each item, and the expected results.

5. Significance and Use

5.1 Friction characteristics of traveled surfaces are monitored by skid measurement systems, and the operating procedure for the use of these systems is Test Method E274. However, dynamic measurement differences between these systems, that comply with the requirements of Test Method

[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.

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E274, require that each of these systems be correlated to each other system. The most effective approach to accomplish this correlation is to compare each system to a singular, highly accurate system, or to a very limited number (two or three) of systems, in a controlled environment. The ARSMS's were designed to be such systems. Fig. 1 depicts a skid measurement system and shows the general location of the major components.

5.2 This guide defines the process of ensuring that the ARSMS's continue to accomplish their intended purpose.

6. Apparatus

6.1 *Voltmeter(s)*, capable of accurate measurement of line voltage and dc voltages common in strain gage instrumentation.

6.2 *Thermometer*, to monitor temperature within the truck cab during static calibrations.

6.3 *Load Cell*, National Institute of Science and Technology traceable, 1000 lb (4448 N) and 2000 lb (8900 N) ranges are required in accordance with Practice F377.

6.4 *Distance/Velocity Measurement System*, required in accordance with Test Method F457.

6.5 *Tachometer*, to determine and monitor the speed of the water pump during calibration of the water system.

6.6 *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, a stopwatch, and a method to operate the water pump at various speeds.

6.7 *Static Water Distribution Gage, SDG*, a collector, set at the roadway level, that is divided into 22 sections of equal width, ⅝ in. (16 mm), so that each section catches water from the water nozzle and feeds it into a separate reservoir and viewing tube thus allowing the water nozzle distribution to be evaluated.

6.8 *Multiple-Event Timer*, to determine the cycle time of the water delivery, brake apply, wheel lock-up, data averaging, and brake release events. Timer must have an accuracy of ±0.001 s.

6.9 *Recorder*, to record vehicle speed, ±0.1 mph (0.2 km/h), versus time.

6.10 *Infrared Photo-Electric Trigger System*, capable of activating the brake apply circuitry in a repeatable manner.

7. Phase One

7.1 All ARSMS's shall meet all requirements of the current version of Test Method E274.

7.2 *Calibration of the Force Plate and Air Bearing Platform*:

7.2.1 Calibrate both axes of the calibration platform under simultaneous load conditions in accordance with Section 6 of Test Method F377, with the following modifications:

7.2.1.1 Calibrate traction through a range from 0 to 800 lb (3560 N). (See 6.3.4 of Test Method F377.)

7.2.1.2 Crosstalk shall be less than 0.5 % of the applied load. (See 6.3.4 of Test Method F377.)

7.2.1.3 Use the reference load cell to calibrate the vertical load axis of the platform with zero traction force. Repeat using an applied traction force of 500 lb (2225 N). (See 6.3.10 of Test Method F377.)

7.2.2 Adjust platform instrumentation zero and span to indicate correct values from National Institute of Science and Technology traceable load cells. Record calibration values.

7.2.3 Repeat the platform calibration two more times to verify repeatability, within tolerance specified in 7.2.1 or Test Method F377 whichever is less.

7.3 *Towing Vehicle*:

7.3.1 Perform maintenance, as required, to ensure the tow truck is dependable and capable of functioning to minimize any delays to the program. Determine the normal load distribution of the truck and maintain this distribution during this process, within the range of fuel and water load variation. Determine the hitch height, with the trailer connected and ¼ tank of water, and repeat this measurement with a full tank of water. The measured difference in hitch height with full water versus ¼ water should not exceed 2 in. (50 mm).

7.3.2 Determine the effect of engine speed on system electronics such as excitation voltage, amplifier outputs, and noise. The system electronics must not be affected by engine

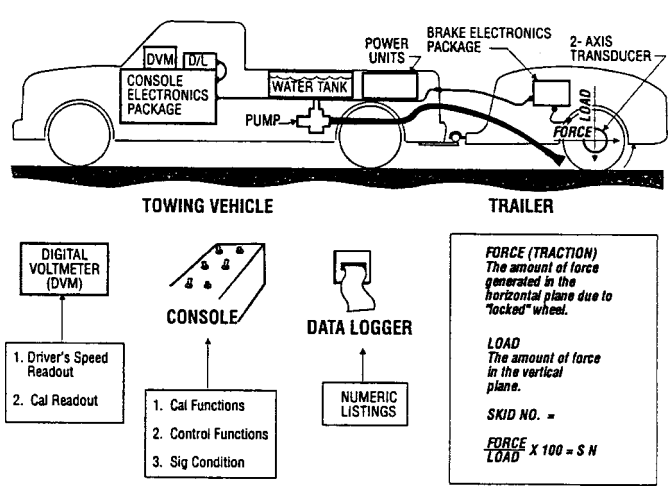

FIG. 1 Skid Measurement System

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