



Designation: E2157 – 15 (Reapproved 2024)

Standard Test Method for Measuring Pavement Macrotexture Properties Using the Circular Track Meter¹

This standard is issued under the fixed designation E2157; 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 procedure for obtaining and analyzing pavement macrotexture profiles using the Circular Track Meter (CT Meter).

1.2 The CT Meter consists of a charge coupled device (CCD) laser-displacement sensor that is mounted on an arm that rotates such that the displacement sensor follows a circular track having a diameter of 284 mm.

1.3 The CT Meter is designed to measure the same circular track that is measured by the Dynamic Friction Tester (DF Tester).

1.4 The CT Meter can be used both for laboratory investigations and in the field on actual paved surfaces.

1.5 The software developed for the CT Meter reports the mean profile depth (MPD) and the root mean square (RMS) values of the macrotexture profiles.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 *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.*

1.8 *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.*

¹ This test method is under the jurisdiction of ASTM Committee E17 on Vehicle - Pavement Systems and is the direct responsibility of Subcommittee E17.23 on Surface Characteristics Related to Tire Pavement Slip Resistance.

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2. Referenced Documents

2.1 *ASTM Standards*:²

E867 Terminology Relating to Vehicle-Pavement Systems

E1845 Practice for Calculating Pavement Macrotexture Mean Profile Depth

E1911 Test Method for Measuring Surface Frictional Properties Using the Dynamic Friction Tester

2.2 *Other Document*:

Manufacturer's "Operating Manual for the Circular Texture Meter"³

3. Terminology

3.1 See Terminology E867.

3.2 *Definitions*:

3.2.1 *negative texture, n*—macrotexture produced by depressions in the surface.

3.2.2 *positive texture, n*—macrotexture produced by asperities projecting above the surface.

4. Summary of Test Method

4.1 This test method uses a displacement sensor that is mounted on an arm that rotates clockwise at a fixed elevation from the surface being measured. The sensor is attached to the arm at a radius of 142 mm. The sensor measures vertical macrotexture depth and does not account for concave recesses in the pavement surface.

4.2 The device is controlled by a notebook computer that saves and processes the data. When the measurement is initiated by the computer, a DC motor drives the arm for a full 360° revolution.

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.

³ Available from Nippo Sangyo Co., Ltd., 12-26, Higashi Tokura 2-Chome, Kokubunji-shi, Tokyo 185-0002, Japan.

4.3 The profile is recorded in the computer memory and divided into eight segments for analysis (see Fig. 1). The computer software can process the data to report either the MPD in accordance with Practice E1845 or the RMS, or both, for each segment.

5. Significance and Use

5.1 In the PIARC International Experiment (1)⁴ it was found that the volumetric mean texture depth (MTD) was highly correlated to the speed constant of the International Friction Index. It has been found that the average of the MPD values for the eight segments using the CT Meter is extremely highly correlated with the MTD and can replace the volumetric measurement for determination of the MTD (2). The recommended relationship for the estimate of the MTD from the MPD by the CT Meter is:

$$\text{MTD} = 0.947 \text{ MPD} + 0.069 \quad (1)$$

Where MTD and MPD are expressed in millimetres.

NOTE 1—These equations differ from those given in Practice E1845, which are for the estimated texture depths from linear profiles.

5.2 Comparison of the MPD and the RMS for a surface provides information of the nature of the texture, that is, whether the texture is positive or negative (3).

5.3 Analysis of the individual segments can be performed to examine the profile parallel to the direction of travel (Segments A and E) and perpendicular to the direction of travel (Segments C and G). This information could be particularly useful in the study of surfaces that have texture with significant directional characteristics.

6. Apparatus

6.1 *CT Meter*—The measuring instrument consists of a CCD laser-displacement sensor mounted on an arm that rotates at 80 mm above the surface on a diameter of 284 mm. The arm is driven by a DC motor at a tangential velocity of 6 m/min in a counterclockwise direction.

6.2 *Data Collection*—The CCD is sampled 1024 times per revolution providing a sample spacing on 0.87 mm by an A/D converter.

⁴ The boldface numbers given in parentheses refer to a list of references at the end of the text.

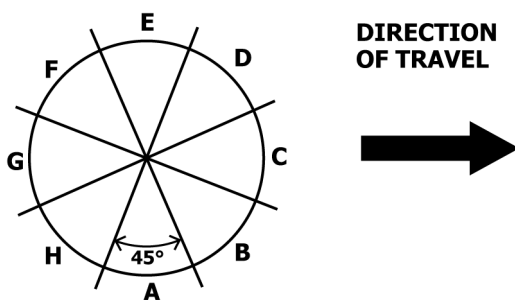


FIG. 1 Segments of the Circular Track Profile

6.3 *Data Recording*—The data are recorded in memory in a notebook computer. The data are segmented into eight 111.5 mm arcs of 128 samples each. The computer software computes the MPD or the RMS, or both, of each segment.

6.4 *Displacement Sensor*—The CCD laser-displacement sensor shall have a spot size of 70 μm over a range of 65 to 90 mm. The vertical resolution shall be 3 μm.

7. Test Samples

7.1 *Field*—Inspect the pavement surface to be measured and select a dry, homogeneous area that contains no unique, localized features such as cracks and joints. The test surface does not have to be horizontal provided the instrument can be leveled in working position. Field test surfaces shall be free of loose particles. Thoroughly clean the surface using the compressed air or soft-bristle brush, or both, in order to remove any visible residue, debris, or loose aggregate particles from the surface.

7.2 *Laboratory*—Laboratory test panels shall be clean and free of loose particles and shall be held firmly during measurement.

7.2.1 Flat laboratory test panels shall have a test surface of at least 600 by 600 mm with no disturbance from edge effects for a diameter of 500 mm.

8. Calibration

NOTE 2—*Manufacturer's Calibration*—The CT Meter shall be calibrated at the manufacturer's facility, using a precision-machined calibration surface having a sawtooth profile having an amplitude of 7 mm and a period of 28 mm, producing an MPD of 3.5 mm.

8.1 *Field Verification*—Before each measurement session, the CT Meter shall be checked using the verification panel provided by the manufacturer. The result shall be within ±0.05 mm of the value indicated on the panel. If the result is outside these limits, the CT Meter shall be returned to the manufacturer for calibration.

9. Procedure

9.1 Place the CT Meter on a dry, clean, and homogeneous area of the pavement surface to be measured. If the measurement is to be used in conjunction with a measurement by the Dynamic Friction Tester (DF Tester) specified in Test Method E1911, the location of the CT Meter should be marked such that the DF Tester can be placed in the same location.

NOTE 3—It is preferable to operate the CT Meter at a location where the surface is flat. However, it has been shown that the effect is negligible for a deviation from flatness of up to 6 mm over a 0.5 m specimen.

9.2 Orient the CT Meter with the Segments C and G perpendicular to the direction of travel as shown in Fig. 1.

NOTE 4—If there is no predominant travel direction, position the CT Meter in an identifiable orientation, such as a physical characteristic of the site or according to compass direction.

9.3 Select the option to compute the MPD or the RMS, or both, of the profiles and initiate the measurement from the notebook computer.

9.4 Record the test results or store the data for future analysis.