Designation: E1845 – 23

Standard Practice for Calculating Pavement Macrotexture Mean Profile Depth[1]

This standard is issued under the fixed designation E1845; 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 practice covers the calculation of mean profile depth from a profile of pavement macrotexture.

1.2 The mean profile depth has been shown to be useful in predicting the speed constant (gradient) of wet pavement friction.

1.3 A linear transformation of the mean profile depth can provide an estimate of the mean texture depth measured according to Test Method E965.

NOTE 1—A similar method for measurement and calculation of MPD is presented in ISO 13473-1. The only technical differences are the way spike removal and extreme MSD removal are calculated. Despite these differences, the ASTM and ISO methods will arrive at the same results, with only insignificant differences in normal cases. The ASTM method for spike removal applies calculations which are much more complicated but will result in less correct samples which are adjacent to spikes being removed. The extreme MSD removal in the ASTM method will also be more precise than the ISO method, but at the expense of more complicated calculations. Significant differences will potentially appear only on some uncommon or special textures, such as tined or grooved cement concrete pavements. In the next few years, attempts will be made to coordinate the calculations with a view to make them identical in both standards. The ISO standard includes eight annexes with additional information, for example about uncertainty calculations and how users can check their software against standard texture profiles. A note corresponding to this one will be included in the ISO 13473-1 standard.

1.4 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this 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 Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

E965 Test Method for Measuring Pavement Macrotexture Depth Using a Volumetric Technique

2.2 *ISO Standard:*[3]

ISO 13473-1 Acoustics—Characterization of Pavement Texture Using Surface Profiles—Part 1: Determination of Mean Profile Depth

3. Terminology

3.1 *Definitions:*

3.1.1 *base length, n*—length of a segment of a pavement macrotexture profile being analyzed, required to be 100 mm in this practice.

3.1.2 *estimated texture depth (ETD), n*—estimate of the mean texture depth (MTD), by means of a linear transformation of the mean profile depth (MPD).

3.1.3 *mean profile depth (MPD), n*—average of all the mean segment depths of all of the segments of the profile.

3.1.4 *mean segment depth, n*—average value of the profile depth of the two halves of a segment having a given base length.

3.1.5 *mean texture depth (MTD), n*—mean depth of the pavement surface macrotexture determined by the volumetric technique of Test Method E965.

3.1.6 *profile depth (PD), n*—difference between the amplitude measurements of pavement macrotexture and a horizontal line through the top of the highest peak within a given base length.

4. Summary of Practice

4.1 This practice uses a measured profile of the pavement macrotexture.

[1] This practice is under the jurisdiction of 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] 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 International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

4.2 *Measurement Conditions:*

4.2.1 *Surface Conditions:*

4.2.1.1 Measured surfaces should be dry and free of snow, ice, or other weather contaminants. The surface should also be clean and free of foreign objects and debris as much as practically feasible. Damp surfaces are acceptable as long as the measurement equipment had been proven to deliver valid texture profiles in damp conditions.

4.2.1.2 Measurements on newly laid asphalt surfaces or other surfaces that are glossy or hot should be handled with care, as reflections from glossy and dark surfaces or from high temperature differences between the surface and the air above could produce optical distortions.

4.3 The measured profile is processed according to Section 7 of this standard and results in an averaged texture depth referred to as "mean profile depth."

5. Significance and Use

5.1 This practice is suitable for the calculation of the average macrotexture depth from profile data. The results of this calculation (MPD) have proven to be useful in the prediction of the speed dependence of wet pavement friction.

5.2 The MPD can be used to estimate the result of a measurement of macrotexture depth using a volumetric technique according to Test Method E965. The values of MPD and MTD differ due to the finite size of the glass spheres used in the volumetric technique and because the MPD is derived from a two-dimensional profile rather than a three-dimensional surface. Therefore, a transformation equation must be used.

NOTE 2—The two concepts are closely related and have strong correlations; these correlations can differ depending on the pavement types used to establish the correlation. Although they are not the same physical characteristic, the MPD measurement technique is intended to replace the manual MTD measurements.

5.3 This practice may be used with pavement macrotexture profiles taken on actual road surfaces or from cores or laboratory-prepared samples.

5.4 Aggregate size, shape, and distribution are features which are not addressed in this practice. This practice is not meant to provide a complete assessment of texture characteristics. In particular, care should be used when interpreting the result for porous or grooved surfaces.

5.5 This practice does not address the problems associated with obtaining a measured profile. Laser or other optical noncontact methods of measuring profiles are usually preferred. However, contact methods using a stylus also can provide accurate profiles if properly performed.

6. Profile Requirements

6.1 *Amount of Data Required:*

6.1.1 A continuous profile should be collected along the entire length of the test section. The maximum allowed amount of interruptions (missing profile data) cannot exceed 15 % of the total length (see 7.2 and 7.3).

6.1.2 A minimum requirement shall be ten evenly spaced profiles of 100 mm in length for each 100 m of the test section. The minimum length of texture profile for the calculation of MPD cannot be less than 1.0 m after the exclusion of the interruptions in the measured segment. For surfaces having periodic texture (that is, grooved or tined surfaces), the total profile length shall include at least ten periods of the texture.

NOTE 3—Inspect the pavement surface to be measured and ensure that it is dry. When possible, thoroughly clean the surface using compressed air or a soft-bristle brush, or both, in order to remove any visible residue, debris, or loose aggregate particles from the surface. When characterizing a long test section with relatively short sample lengths, it is important to ensure that the texture is sufficiently homogeneous to provide a representative measure. It is necessary for the user to use sound judgment to determine the minimum number of samples to characterize a nonhomogeneous pavement.

NOTE 4—The texture of pavements that have been in service varies across the pavement. In this case, the transverse location of the measurements shall be determined by the intended use of the data.

6.1.3 *Spot Measurements:*

6.1.3.1 Spot measurement devices might not able to make the necessary minimum 1.0 m length requirement due to their design.

6.1.3.2 For spot measurement devices to provide a valid MPD for a test segment, at least eight measured individual and distinct 100 mm test segments are required in a longitudinal or circular pattern. For those spot measurement devices that measure in parallel lines, a minimum of eight 100 mm segments need to be measured. Each segment shall be measured continuously.

6.1.3.3 Spot measurement devices require multiple carefully selected locations to correctly characterize MPD values of longer test sections. Characterizing a long test section up to 1000 m with relatively short sample lengths requires a minimum of 18 different equally spaced measurement spots along the test section to provide a characteristic mean value of MPD where the ± 1 standard deviation will include the true mean value of MPD.

6.1.4 In the case of laboratory samples (either cores or rectangular slabs), the minimum requirement shall be at least eight profiles having a length of 100 mm evenly distributed over the surface of the sample. Care should be taken to avoid edge effects. For this reason, samples having a characteristic length of at least 150 mm are recommended.

6.1.5 On core samples or other laboratory samples that due to their dimensions restrict measurements to be circular, the length of the measured profile segment should be no less than 200 mm corresponding to a minimum of 64 mm measurement diameter.

NOTE 5—Measurements on laboratory samples have many different purposes. Therefore it is difficult to specify general minimum requirements. The specification here assumes that the purpose is to obtain values which are reasonably representative of pavements.

6.2 *Resolution:*

6.2.1 Vertical resolution shall be at least 0.05 mm. Vertical range shall be no less than 20 mm and vertical nonlinearity shall be no greater than 2 % of the range.

NOTE 6—For stationary devices on smooth pavements, a lesser range may be used. In this case, nonlinearity need not exceed the above requirement of 0.4 mm.

NOTE 7—For high-speed vehicle-mounted measurement equipment, the vertical measurement range should be 20 mm plus the expected maximum vertical vehicle motion.