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Standard Test Method for Measuring the Coefficient of Retroreflected Luminance of Pavement Markings in a Standard Condition of Continuous Wetting (R_{L-2})¹

This standard is issued under the fixed designation E2832; 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 a measurement of the wet retroreflective (R_{L-2}) properties of horizontal pavement marking materials, such as traffic stripes and road surface symbols. A standardized method utilizing a standardized continuous wetting device and a portable retroreflectometer is described to obtain measurements of the wet retroreflective properties of horizontal pavement markings.

1.2 Retroreflective performance obtained with this test in a standardized condition of continuous wetting does not necessarily relate to how markings perform in all conditions of natural rain.

NOTE 1—Test Method E2177 may be used to describe the retroreflective properties of pavement markings in conditions of wetness, such as after a period of rain.

1.3 This test method is suitable for measurements made in the laboratory and in the field when the necessary controls and precautions are followed.

1.4 This test method specifies the use of external beam retroreflectometers conforming to Test Method E1710.² The entrance and observation angles required of the retroreflectometer in this test method are commonly referred to as “30 meter geometry.”²

1.5 The test method excludes the effects of rain between the vehicle and the marking.

1.6 Results obtained using this test method should not be the sole basis for specifying and assessing the wet retroreflective effectiveness of pavement marking systems. Users should complement the results of this test method with other evaluation results, such as nighttime visual inspections.

¹ This test method is under the jurisdiction of ASTM Committee E12 on Color and Appearance and is the direct responsibility of Subcommittee E12.10 on Retroreflection.

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² Reference Test Method E1710. The standard measurement condition is intended to represent the angles corresponding to a distance of 30 m for the driver of a passenger car with an eye height of 1.2 m and a headlight height of 0.65 m above the road. See Annex A1.

1.7 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

1.8 *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.*

1.9 *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:*³

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

E965 Test Method for Measuring Pavement Macrot texture Depth Using a Volumetric Technique

E1710 Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer

E2177 Test Method for Measuring the Coefficient of Retroreflected Luminance (R_L) of Pavement Markings using the Bucket Method in a Condition of Wet Recovery

3. Terminology

3.1 *Definitions:*

3.1.1 *coefficient of retroreflected luminance, R_L , n* —the ratio of the luminance, L , of a projected surface to the normal illuminance, E , at the surface on a plane normal to the incident light, expressed in millicandelas per square metre per lux ($\text{mcd}/\text{m}^2/\text{lx}$).

³ For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at www.astm.org/contact. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.1.2 *conditions of continuous wetting, n* —the test condition where the pavement marking specimen is subjected to continuously uninterrupted water spray applied uniformly over a pavement marking at a defined and controlled rate during measurement.

3.1.3 *external beam R_L retroreflectometers, n* —a pavement marking retroreflector that measures the coefficient of retroreflected luminance, R_L , in a measurement area that falls entirely outside the retroreflector.

3.1.4 *R_{L-2} , n* —the steady state coefficient of retroreflected luminance, R_L , determined under defined conditions of continuous wetting at a rate of 2 inches per hour.

3.1.4.1 *Discussion*—The results from this test method shall be reported as $R_{(L-2)}$ where “2” designates the wetting rate used in inches per hour (in./h).

3.1.5 *steady state conditions, n* —the measurements have reached steady state when six consecutive retroreflector instrument readings made at approximately 10 s intervals show no consistent tending of the coefficient of retroreflected luminance value up or down.

4. Summary of Test Method

4.1 This test method describes a standard procedure for measuring the retroreflective properties of horizontally applied pavement marking systems under conditions of continuous wetting.

4.2 The pavement marking system under test is subjected to continuous wetting delivered by a wetting device of a specified design calibrated to provide a controlled wetting rate.

4.3 A protocol and instrument requirements are described for measuring R_{L-2} under a defined condition of continuous wetting.

5. Significance and Use

5.1 This test method produces a measure of retroreflective efficiency (coefficient of retroreflected luminance, R_{L-2}) for a pavement marking system under conditions of continuous wetting. The test result depends on factors such as the pavement marking binder and optic materials, their application, wear from traffic and plowing, wetting rate, and road grade and cross slope.

5.2 The measured retroreflective efficiency under conditions of continuous wetting may be used to characterize the properties of a pavement marking on the road as water is continuously falling on it. The retroreflective efficiency of the marking under conditions of continuous wetting is almost always different than under dry conditions.

5.3 The wetting rate of 2 in./h represents the upper limit of what is meteorologically classified as heavy rainfall. Rainfall rates above 2 in./h are classified as extreme or violent, and are sometimes associated with weather such as tropical storms.

5.4 The retroreflectivity of pavement markings degrades with traffic wear and requires periodic measurement to ensure that the coefficient of retroreflected luminance under continuous wetting meets requirements and provides adequate visibility for nighttime drivers.

5.5 The continuous wetting rate as well as the roadway grade and cross slope impact the results of this test method. The user shall measure and report the rate used for testing.

5.6 The roadway grade and cross slope adjacent to the measurement area impact the results of this test method. A digital level (inclinometer) can be used to quickly measure grade and cross slope.

5.7 Results obtained using this test method should not be the sole basis for specifying and assessing the wet retroreflective effectiveness of pavement marking systems. Users should complement the results of this test method with other evaluation results, such as nighttime visual inspections.

6. Interferences

6.1 Newly installed pavement markings may have surface properties that prevent uniform wetting. This hydrophobic condition can produce inconsistent and highly variable results when measuring the coefficient of retroreflected luminance under continuous wetting conditions.

6.1.1 It is recommended that measurements be made at least 14 days after markings are applied. Hydrophobic conditions are generally eliminated by exposure to the environment and wear of traffic.

6.1.2 For laboratory measurements of pavement marking systems installed on panels, particular care must be taken to avoid hydrophobic conditions, since the panels are typically not exposed to traffic. The use of a surfactant in the water reservoir has created problems of microscopic foaming and bubbles, resulting in unacceptable variability in readings. More testing is needed before a specific surfactant can be recommended.

7. Apparatus

7.1 Retroreflector:

7.1.1 The retroreflector shall be an external beam R_L retroreflector (see 3.1.3).

7.1.2 The retroreflector shall have such dimensions and location of the measurement area such that the retroreflector can be placed relative to the wetting device so that the measurement area falls entirely within the wetted area inside the wetting device.

7.1.3 The retroreflector shall meet the requirements of Test Method E1710.

7.2 Wetting Device:

7.2.1 The wetting device shall conform to the design and operating parameters in Annex A1.

NOTE 2—Water drop size and velocity at impact will impact retroreflected luminance measurements of markings. The wetting apparatus described in Annex A1 has particular water impact characteristics that have not been quantified. In order to measure the retroreflected luminance measurements of markings under conditions of continuous wetting in a standard way, the design and construction of the wetting device described in Annex A1 must be followed.

8. Reagents and Materials

8.1 Clean water free of particulate and dissolved solids shall be used to prevent clogging of the nozzles. Commercial distilled drinking water is recommended.