INTERNATIONAL

Designation: D8225 – 19

Standard Test Method for Determination of Cracking Tolerance Index of Asphalt Mixture Using the Indirect Tensile Cracking Test at Intermediate Temperature[1]

This standard is issued under the fixed designation D8225; 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 procedures for preparing, testing, and measuring asphalt mixture cracking resistance using cylindrical laboratory-prepared asphalt mix samples or pavement cores. Testing temperatures are selected from the long-term pavement performance (LTPP) database intermediate temperatures. The test method describes the determination of the cracking tolerance index, CT_{Index}, and other parameters determined from the load-displacement curve. These parameters can be used to evaluate the resistance of asphalt mixtures to cracking.

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

1.3 The text of this standard references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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]

D8 Terminology Relating to Materials for Roads and Pavements

D3203/D3203M Test Method for Percent Air Voids in Compacted Asphalt Mixtures

D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials

D6373 Specification for Performance Graded Asphalt Binder

D6925 Test Method for Preparation and Determination of the Relative Density of Asphalt Mix Specimens by Means of the Superpave Gyratory Compactor

2.2 *AASHTO Standards:*[3]

R 30 Practice for Mixture Conditioning of Hot Mix Asphalt (HMA)

M 320 Specification for Performance-Graded Asphalt Binder

M 332 Specification for Performance-Graded Asphalt Binder Using Multiple Stress Creep Recovery (MSCR) Test

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this standard, refer to Terminology D8.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 CT_{Index}, *n*—cracking tolerance index, value used to evaluate mixture resistance to cracking.

3.2.2 G_f, *n*—failure energy (Joules/m^2) required to induce a unit surface area of a crack and calculated as the work of

[1] This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.26 on Fundamental/Mechanistic Tests.

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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 American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, http://www.transportation.org.

failure divided by specimen diameter (150 ± 2 mm) and normalized thickness of 62 mm.

3.2.3 l_{65}, *n*—displacement (mm) corresponding to 65 % of the peak load at the post-peak stage. See Fig. 1.

3.2.4 l_{75}, *n*—displacement (mm) corresponding to 75 % of the peak load at the post-peak stage. See Fig. 1.

3.2.5 l_{85}, *n*—displacement (mm) corresponding to 85 % of the peak load at the post-peak stage. See Fig. 1.

3.2.6 $|m_{75}|$, *n*—slope (N/m) calculated as $\left|\frac{P_{85}-P_{65}}{l_{85}-l_{65}}\right|$ using a linear regression with all data points between P_{85} (l_{85}) and P_{65} (l_{65}). See Fig. 1.

3.2.7 P_{65}, *n*—65 % of the peak load (kN) at the post-peak stage. See Fig. 1.

3.2.8 P_{75}, *n*—75 % of the peak load (kN) at the post-peak stage. See Fig. 1.

3.2.9 P_{85}, *n*—85 % of the peak load (kN) at the post-peak stage. See Fig. 1.

3.2.10 W_f, *n*—work of failure (Joules) calculated as the area under the load-displacement curve.

4. Summary of Test Method

4.1 A cylindrical specimen is centered in the fixture. The load is applied such that a constant load-line displacement (LLD) rate of 50.0 ± 2.0 mm/min is obtained and maintained for the duration of the test. Both the load and LLD are measured during the entire duration of the test and are used to calculate the CT_{Index}.

4.2 This test procedure considers both crack initiation and propagation in asphalt mixtures, and is developed based on fracture mechanics.[4]

5. Significance and Use

5.1 The indirect tensile cracking test is used to determine asphalt mixture cracking resistance at an intermediate temperature which could range from 5 °C to 35 °C, depending on local climate. The specimens are readily obtained from Superpave gyratory compactor compacted cylinders with a diameter of 150 ± 2 mm, with no cutting, gluing, notching, drilling, or instrumentation required. Similarly, field cores can be tested to measure remaining cracking resistance of in-place asphalt mixtures.

5.2 The CT_{Index} of an asphalt mixture is calculated from the failure energy, the post-peak slope of the load-displacement curve, and deformation tolerance at 75 % of the peak load. The CT_{Index} is a performance indicator of the cracking resistance of asphalt mixtures containing various asphalt binders, asphalt binder modifiers, aggregate blends, fibers, and recycled materials. Generally, the higher the CT_{Index} value, the better the cracking resistance and, consequently, the less the cracking amount in the field. The range for an acceptable CT_{Index} will vary with mix types and associated specific applications.[4] Users can employ the CT_{Index} and associated criteria to identify crack-prone mixtures during mix design and production quality control/assurance.

[4] Zhou, F., Im, S., Sun, L., and Scullion, T., "Development of an IDEAL Cracking Test for Asphalt Mix Design and QC/QA," *Road Materials and Pavement Design*, Vol 18, Supplement 4, 2017, pp. 405–427.

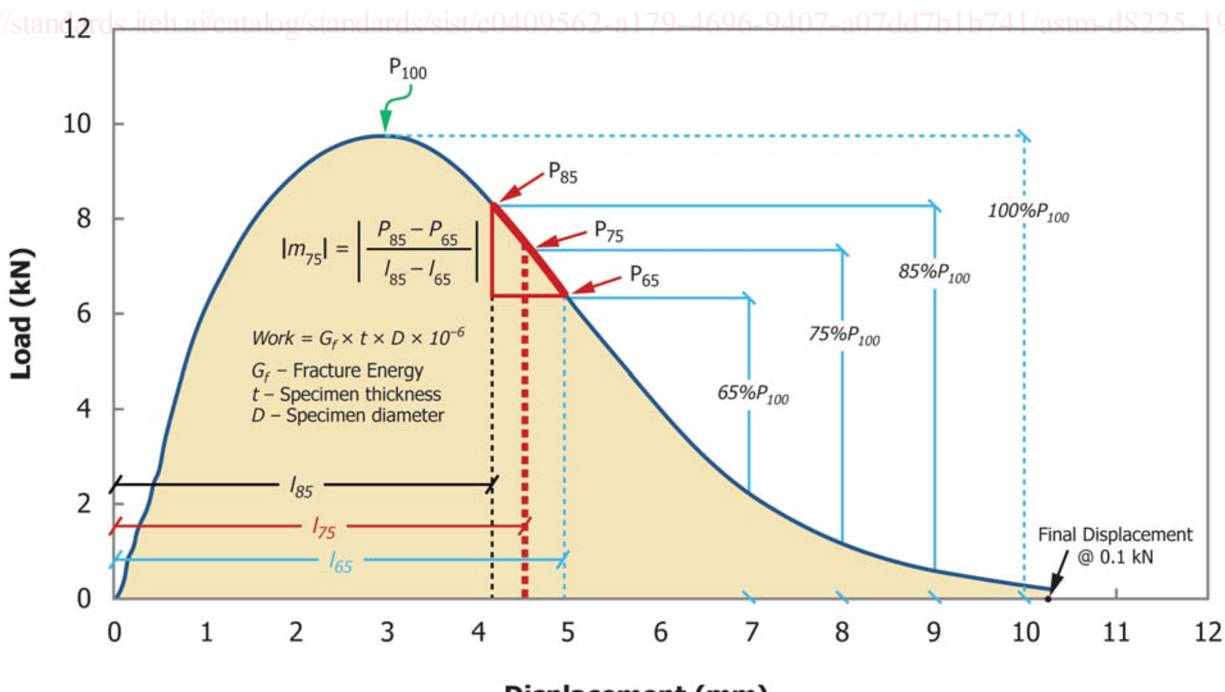

FIG. 1 Recorded Load (*P*) versus Load-Line Displacement (*l*) Curve

NOTE 1—The quality of the results produced by this standard are dependent on the competence of the personnel performing the procedure and the capability, calibration, and maintenance of the equipment used. Agencies that meet the criteria of Specification D3666 are generally considered capable of competent and objective testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification D3666 alone does not completely ensure reliable results. Reliable results depend on many factors; following the suggestions of Specification D3666 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.

6. Apparatus

6.1 *Test Apparatus*—An indirect tensile cracking test apparatus consists of an axial loading device, a load cell, loading strips, specimen deformation measurement devices, and a data acquisition system. Alternatively, the load cell, loading strips, specimen deformation measurement devices, data acquisition system, or combinations thereof can be integrated into a test fixture.

6.1.1 *Axial Loading Device*—The loading apparatus shall be capable of delivering loading in compression with a capacity of at least 25 kN. It shall be capable of maintaining a constant deformation rate of 50 ± 2.0 mm/min, which may require a closed-loop, feedback-controlled servo-hydraulic load frame. An electromechanical, screw-driven frame may be used if it can maintain the constant deformation rate.

6.1.2 *Load Cell*—The load cell shall have a resolution of 10 N and a capacity of at least 25 kN.

6.1.3 *Loading Strips*—Steel loading strips with a concave surface having a radius of curvature equal to the nominal radius of the test specimen. For specimens with a nominal diameter of 150 ± 2 mm, the loading strips shall be 19.05 ± 0.3 mm wide. The length of the loading strips shall exceed the thickness of the specimen as in Fig. 2. The outer edges of the loading strips shall be beveled slightly to remove sharp edges.

6.1.3.1 *Option A*—The loading strips can be part of a test fixture similar to that shown in Fig. 2, in which the lower loading strip is mounted on a base having two perpendicular guide rods or posts extending upward. The upper loading strip shall be clean and freely sliding on the posts. Guide sleeves in the upper segment of the test fixture shall direct the two loading strips together without appreciable binding or loose motion in the guide rods.

6.1.3.2 *Option B*—The upper and lower loading strips, as shown in Fig. 3, are parts of an axial loading device. They are permanently attached to the top loading actuator and the base plate, respectively.

6.1.3.3 *Option C*—The upper and lower loading strips, as shown in Fig. 4, are part of a test fixture integrated with a load cell, loading strips, specimen deformation measurement devices, and a data acquisition system.

6.1.4 *Internal Displacement Measuring Device*—The displacement shall be measured to a resolution of ±0.01 mm. The machine stroke linear variable differential transformer (LVDT) or other type of displacement transducer can be used if its resolution is sufficient to meet the requirement. The displacement data measured during the test may need to be corrected for system compliance through standardizing the test system.

6.1.5 *External Displacement Measuring Device*—If an internal displacement measuring device does not exist or has insufficient precision, one or more external displacement measuring devices such as LVDTs can be used (Fig. 3).

6.1.6 *Data Acquisition System*—Time, load, and LLD (using either internal or external displacement measuring devices)

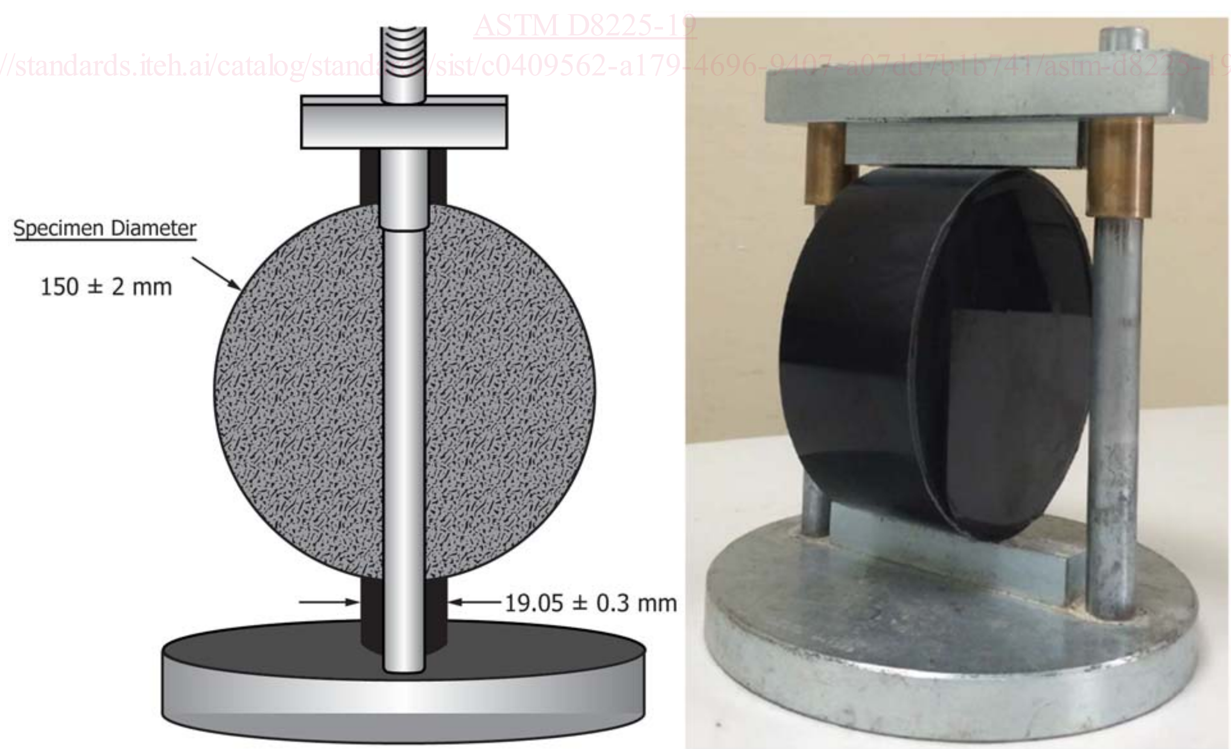

FIG. 2 Traditional Indirect Tension Test Fixture