



Designation: D8292 – 20

Standard Test Method for Permanent Deformation Behavior and Rutting Resistance of Compacted Asphalt Mix in the Modified Loaded Wheel Tracker Test Utilizing Controlled Confining Pressure¹

This standard is issued under the fixed designation D8292; 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 describes a procedure for testing permanent deformation behavior and rutting resistance of compacted asphalt mixtures using a modified version of a loaded wheel tracker device² utilizing controlled confining pressure. The test specimen is tested either dry or moisture conditioned. A laboratory roller compactor or its equivalent is used to prepare test slabs of 305 mm by 305 mm [12 in. by 12 in.] and thickness 50 mm, 75 mm, or 100 mm [2 in., 3 in., or 4 in.] depending on the nominal maximum aggregate size. The thickness of the specimen must be at least two and half times the nominal maximum aggregate size. Alternatively, saw-cut slab specimens with dimensions 305 mm by 305 mm [12 in. by 12 in.] and thickness 50 mm to 100 mm [2 in. to 4 in.] may be secured from the field.

1.2 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the 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 Since a precision estimate for this standard has not been fully developed, the test method is to be used for research and informational purposes only. Therefore, this standard should not be used for acceptance or rejection of a material for purchasing purposes.

¹ This test method is under the jurisdiction of ASTM Committee D04 on Road and Paving Materials and is the direct responsibility of Subcommittee D04.20 on Mechanical Tests of Asphalt Mixtures.

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² The modified wheel tracker is covered by a patent. Interested parties are invited to submit information regarding the identification of an alternative(s) to this patented item to the ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

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:³

- D8 Terminology Relating to Materials for Roads and Pavements
- D2041/D2041M Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
- D2493/D2493M Practice for Viscosity-Temperature Chart for Asphalt Binders
- D2726/D2726M Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
- 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
- D5361/D5361M Practice for Sampling Compacted Asphalt Mixtures for Laboratory Testing
- D6027/D6027M Practice for Calibrating Linear Displacement Transducers for Geotechnical Purposes
- D6857/D6857M Test Method for Maximum Specific Gravity and Density of Asphalt Mixtures Using Automatic Vacuum Sealing Method
- D8079 Practice for Preparation of Compacted Slab Asphalt Mix Samples Using a Segmented Rolling Compactor
- E1 Specification for ASTM Liquid-in-Glass Thermometers

³ 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.

E2877 Guide for Digital Contact Thermometers

2.2 AASHTO Standard:⁴

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

3. Terminology

3.1 *Definitions*—Refer to Terminology D8.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inflection point, n*—the point at which the second derivative of the permanent deformation relative to the number of passes will change from positive to negative, or vice versa. The number of passes at this point is denoted as the flow number.

3.2.2 *permanent deformation (δ), n*—the cumulative irrecoverable deformation after each loading pass.

3.2.3 *primary deformation phase or post-compaction phase, n*—the initial densification of the compacted specimen which occurs at a decelerated rate until it becomes constant at the start of secondary phase.

3.2.4 *secondary deformation phase, n*—the permanent deformations occurring after the end of the post-compaction phase and before the inflection point. The slope of the secondary phase is termed as the creep slope.

3.2.5 *tertiary deformation phase, n*—the permanent deformations accumulating after the inflection point. The slope of the permanent deformation curve for the tertiary phase is termed as the stripping slope.

4. Summary of Test Method

4.1 The compacted asphalt specimen is placed in a mold under controlled confining pressures during the test. The confining pressures must remain constant during the test. The test specimen must be tested in an air-temperature-controlled cabinet that maintains constant temperature during the test within ± 1 °C [± 1.8 °F]. The test specimen is repeatedly loaded by loaded wheel and the vertical and horizontal permanent deformations are recorded against the number of wheel passes. If the moisture susceptibility is required, the asphalt specimen must be conditioned in a separate thermostatically controlled water bath at the required temperature and for the duration specified by the agency.

5. Significance and Use

5.1 This test method measures the permanent deformation behavior and rutting resistance of an asphalt mixture specimen.

5.2 This method can also measure moisture susceptibility of an asphalt mixture specimen if required by the agency.

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 The device must be capable of moving 203 ± 2.0 mm [7.99 ± 0.08 in.] diameter, 50 ± 2 mm [1.97 ± 0.08 in.] wide pneumatic non-treaded rubber tire with tire pressure of 700 ± 50 kPa [101.5 ± 7.25 psi] or solid rubber tire of 20 ± 2 mm [0.79 ± 0.08 in.] thickness wheel over the center of the test specimen. The tire shall have a hardness number of 80 ± 10 IRHD units. The load on the wheel is 700 ± 4.5 N [157.37 ± 1.01 lb]. The wheel reciprocates over the specimen with the position varying sinusoidally over time with travel distance of 230 ± 5 mm [9.06 ± 0.20 in.]. The frequency of the wheel ranges from 53 ± 3 passes per minute across the specimen. The average speed of the wheel is 0.203 ± 0.012 m/s [0.67 ± 0.04 ft/s].

6.2 *Specimen Mounting System*—The test specimen must be tested under controlled confining pressures during the test. The confining pressure must remain constant during the entire duration of the test. The confining pressures are controlled either by pneumatic, hydraulic system or other means as shown in Fig. 1. Fig. 1 shows an example of a mold system that controls confining pressures on two opposite sides of the slab specimen while the other two sides remain fixed. The confining pressure system must be capable of applying a wide range of confining pressures over a range from zero for unconfined condition and up to 50 ± 1 kPa [7.25 ± 0.15 psi]. The mold holding the asphalt mix specimen shall have internal dimensions of 305 mm by 305 mm [12 by 12 in.].

6.3 *Temperature Control*—The device must be provided with a temperature control system to maintain the specimen temperature constant during the test within ± 1 °C [± 1.8 °F]. The system must be able to apply a range of test temperatures from 30 to 70 °C [86 to 158 °F].

6.4 *Deformation Measuring Devices*—The system must be provided with displacement transducer devices calibrated according to Practice D6027/D6027M and capable of measuring the depth of the vertical permanent deformation and the lateral flow of the specimen along the length of the wheel's path, to within ± 0.15 mm [± 0.006 in.], over a minimum range of 0 to 20 mm [0 to 0.79 in.] or when 50 000 passes are achieved, whichever occurs first. The system must continuously measure the vertical and lateral permanent deformations at least every 100 passes.

6.5 *Number of Passes Counter*—The system must be capable of recording the number of passes of the loaded wheel.

6.6 *Ovens*, for drying and heating aggregates and asphalt binder to the mixing and compaction temperatures.

6.7 *Balances*, for weighing and batching asphalt mixes with capacity of at least 15 000 g [33.07 lb] and accuracy of at least ± 0.1 g [± 0.0002 lb].

6.8 *Compactors*—Roller compactor for slab specimens in accordance with Practice D8079; see Note 2.

⁴ 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>.



FIG. 1 Mold System That Can Control Lateral Pressure on Two Opposite Sides of Slab Specimen

NOTE 2—Different compactors can cause some differences in aggregate orientation and, therefore, different behavior in permanent deformation.

6.9 Mixers—Mechanical mixers.

6.10 Mixing bowls, metal trays, spatula, slab molds, vernier caliper, thermometer.

7. Specimen Preparation

7.1 *Number of Specimens*—At least two slabs must be prepared for each test.

7.2 *Laboratory-Prepared Mix:*

7.2.1 For hot mix asphalts, determine mixing temperature range at which the binder viscosity is 170 ± 20 mPa·s [170 ± 20 cSt] in accordance with Practice D2493/D2493M or as recommended by the manufacturer. For warm mix asphalts, follow the recommended ranges by the additive manufacturer.

7.2.2 For hot mix asphalt, determine compaction temperature range at which binder viscosity is 280 ± 30 mPa·s [280 ± 30 cSt] in accordance with Practice D2493/D2493M or as recommended by the manufacturer. For warm mix asphalts, follow the recommended ranges by the additive manufacturer.

7.2.3 Dry out aggregates at 110°C [230°F] until constant mass. Allow aggregates to cool down before blending.

7.2.4 Blend dry aggregates and mineral fillers to the design job mix formula.

7.2.5 Heat blended aggregates for 2 h at a temperature 28°C [50.4°F] higher than the mixing temperature for hot mix asphalts, or at the recommended temperature for the warm mix asphalts.

7.2.6 Heat the asphalt binder to the mixing temperature for no more than 2 h.

7.2.7 Add asphalt binder to the heated aggregates and thoroughly mix using a mechanical mixer until aggregate particles are fully coated.

7.2.8 Prepare enough quantity of the asphalt mix to produce two slab specimens in addition to a sufficient amount of mix to conduct the maximum specific gravity test in accordance with Test Method D2041/D2041M.

7.3 Preheat the plant-prepared mix to the mixing temperature and stir the mix, in case the mix is left to cool.

8. Conditioning

8.1 Short-term age (condition) the laboratory-prepared asphalt mixture for 2 h at the compaction temperature in accordance with AASHTO R 30 or other asphalt mix conditioning practice. Stir the mix every 60 min to maintain uniform conditioning.

8.2 Plant-prepared asphalt mixture does not need any short-term aging and can be compacted directly at the compaction temperature.

9. Compaction and Curing

9.1 *Compacting Asphalt Slab Specimens*—Heat molds and tools to compaction temperature. Compact slab specimens 305 mm by 305 mm [12 in. by 12 in.] using a roller compactor or its equivalent. Specimen thickness must be at least two and half times the nominal maximum aggregate size, generally yielding a specimen 50 mm to 100 mm [2 in. to 4 in.] thick. Allow compacted slab specimens to cool down at normal room temperature. The mold holding the asphalt mix specimen shall have internal dimension of 305 mm by 305 mm.