Designation: ~~D7981 – 15~~ D7981 – 20

Standard Practice for Compaction of Prismatic Asphalt Specimens by Means of the Shear Box Compactor[1]

This standard is issued under the fixed designation D7981; 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 fabrication of prismatic specimens of asphalt mixture using the ~~Shear Box Compactor~~shear box compactor (SBC). Compacted specimens are suitable for volumetric and physical property testing. This standard practice should not be used for acceptance or rejection of a material or for purchasing purposes.

1.2 *Units*—The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard with exception of degrees (°) where angle is specified.

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

~~1.4 *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.*~~

1.5 *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]

~~D1188 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Coated Samples~~
~~D2041~~D2041/D2041M Test Method for Theoretical Maximum Specific Gravity and Density of Asphalt Mixtures
~~D2726~~D2726/D2726M Test Method for Bulk Specific Gravity and Density of Non-Absorptive Compacted Asphalt Mixtures
D3666 Specification for Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
~~D6752~~D6752/D6752M Test Method for Bulk Specific Gravity and Density of Compacted Asphalt Mixtures Using Automatic Vacuum Sealing Method
~~D6857~~D6857/D6857M Test Method for Maximum Specific Gravity and Density of Asphalt Mixtures Using Automatic Vacuum Sealing Method
~~D6925 Test Method for Preparation and Determination of the Relative Density of Asphalt Mix Specimens by Means of the Superpave Gyratory Compactor~~
E644 Test Methods for Testing Industrial Resistance Thermometers

2.2 *AASHTO Standards:*[3]

AASHTO ~~TP79~~T 378 Standard Method of Test for Determining the Dynamic Modulus and Flow Number for ~~Hot Mix~~ Asphalt ~~(HMA)~~Mixtures Using the Asphalt Mixture Performance Tester (AMPT)

[1] This practice 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] 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.

AASHTO ~~T321~~T 321 Standard Method of Test for Determining the Fatigue Life of Compacted ~~Hot Mix~~ Asphalt ~~(HMA)~~Mixtures Subjected to Repeated Flexural Bending
AASHTO ~~T342~~T 342 Standard Method of Test for Determining Dynamic Modulus of ~~Hot Mix~~ Hot-Mix Asphalt Concrete Mixtures

3. Terminology

3.1 *Definitions:*

3.1.1 *load cycle*—the angular movement of the shearing platens in the compactor going from the vertical position to the position of maximum shear angle at one side, then going to the maximum shear angle at the other side and back to the vertical position (90 ± 0.25° with reference to the horizontal plane).

3.1.2 *shear angle*—the external angle measured between a vertical plane (angle of 90° with respect to a horizontal plane) and the plane formed by a shearing plate in the compactor when it has reached its maximum travel. Set at 4°.

4. Summary of Practice

4.1 A sample of loose asphalt mixture is compacted in a fully automatic apparatus by the combination of a static vertical force and a horizontal cyclic shear force applied to twin vertical parallel platens up to a fixed maximum shear angle, to produce a prismatic specimen of compacted asphalt to a target uncorrected density (that is, based on the geometric volume of the specimen).

5. Significance and Use

5.1 Asphalt prisms compacted with the ~~Shear Box Compactor~~shear box compactor can be used to obtain specimens for further testing, including bulk specific gravity following Test Methods ~~D6752~~D6752/D6752M and ~~D2726~~D2726/D2726M~~, Dynamic~~; dynamic modulus following AASHTO ~~T342,~~ T 342; dynamic modulus, flow number, and flow time following AASHTO ~~TP79,~~ T 378; and fatigue performance characteristics following AASHTO ~~T321.~~T 321.

5.2 Specimens to perform other standard tests could also be obtained, as long as their volume is contained within the volume of a prism having maximum width, length, and height ~~(W×L×H)~~ (W × L × H) of 150 mm, 450 mm, and 185 mm, respectively. The maximum prism height depends on the mix type, the target air voids, and the equipment limitations.

NOTE 1—The aggregate orientation in the samples produced by this method ~~maybe~~ may be different from samples produced by other laboratory compaction methods. This should be considered when comparing mechanical test results from different compaction methods.

NOTE 2—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.~~ testing, sampling, inspection, etc. Users of this standard are cautioned that compliance with Specification D3666 alone does not completely ~~assure~~ensure reliable results. Reliable results depend on many ~~factors chr(59).~~ 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 *Shear Box Compactor*—A compactor capable of fabricating asphalt prisms comprised of the following system components: *(1)* reaction ~~frame,~~frame; *(2)* fully integrated loading system, including loading rams, controller, and data acquisition to record vertical force applied, height measurements, and number of ~~cycles,~~cycles; and *(3)* top and bottom compaction platens and wearing plates. The compactor ~~must comply with the following specifications:~~shall have an integrated heating system capable of preheating the SBC mold to the designated compaction temperature; if it does not, an alternate means of heating the mold is required.

NOTE 3—Consider pouring and compacting a hot sample into the mold to allow all machine components to heat up, prior to fabricating samples for actual testing.

NOTE 4—Porous asphalt mixtures have significantly higher air voids compared to dense-graded mixtures, so the cooling rate of the porous asphalt mixture will be faster than standard asphalt mixture. It is not good practice to overheat porous asphalt mixtures, as it can result in binder drain-down issues in the mix. The use of the SBC heater is recommended to preheat the mold to the required compaction temperature prior to mix loading.

The compactor must comply with the following specifications:

6.1.1 Vertical ~~Stress~~stress adjustable by the user up to 1.0 MPa.

NOTE 5—The maximum vertical force required considering the specimen dimensions should be 67.5 kN (measured and controlled to an accuracy of ~~± 5%~~ ±5 % of applied ~~load),~~load). The loading system used to achieve the required load can be electro-pneumatic, electro-mechanic, or hydraulic.

6.1.2 Shear ~~Force~~force of at least 50 kN, with the capability to perform horizontal cyclic loading at a rate of ~~3~~three to ~~4~~four cycles every minute.

6.1.3 Shear ~~Angle~~angle fixed at 4° ~~(± 0.25°).~~(±0.25°).

6.1.4 The compactor must be capable of producing compacted prismatic specimens 450 mm ~~(± 1.0~~ (±1.0 mm) long, 150 mm ~~(± 1.0~~ (±1.0 mm) wide, and with a height ranging from 120 mm to ~~185~~200 mm ~~(± 1.0~~ (±1.0 mm).

6.1.5 The controller must be ~~capable~~able to automatically terminate a compaction run after meeting one of two termination criteria: sample height ~~or,~~or number of loading cycles. The sample height and vertical load shall be recorded.

6.1.6 The reaction frame shall be rigid and capable of sustaining the maximum forces generated during the compaction process with system compliance of less than 0.1 mm per ~~1 kN.~~ 1 kN. It shall also be able to sustain shear reaction forces being applied to the mold side plates and pivots.

6.1.7 The loading system (Fig. 1) shall consist of a controlled ~~dual axis~~ dual-axis loading system (vertical and horizontal). A constant vertical force shall be applied to achieve a vertical stress as per specified ~~above .~~ above. The horizontal force shall be perpendicular to the vertical load axis, and applied through a system that ensures the rotational parallel movement of the walls of the mold during the compaction process. The pivot points shall be concentrically located at both ~~end~~ends of the mold walls such that ±2 mm of parallelism can be ~~achieved~~achieved; see Fig. 1.

6.1.8 The horizontal loading system shall be capable of inducing a preset constant maximum degree of rotation (maximum shear angle) during a compaction of 4° ~~(± 0.25°).~~ (±0.25°).

6.1.9 The vertical actuator or the reaction element shall slide freely and parallel to the horizontal loading axis (Fig. 2~~.~~). The vertical force applied shall be measured during the compaction process with suitable transducers.

6.1.10 The shear box compactor system shall also include a specimen extraction unit.

6.2 *Mold Plates, Wear Plates ~~used~~Used on ~~top~~Top and ~~bottom~~Bottom of the ~~specimen~~Specimen, and Ram Heads*—All mold plates and ram heads shall be fabricated from steel with a minimum Rockwell hardness of C48. The mold plates and vertical ram heads shall be flat ~~(< 0.1~~ (<0.1 mm over 500 mm).

6.3 *Loading Chute*—A ~~purpose built heat resistant~~ purpose-built, heat-resistant chute approximately 445 mm long, 140 mm wide, and 295 mm high, with horizontal slots near the bottom of the chute approximately 75 mm apart and 75 mm tall, and with quick-release holding gates at the base to ensure the mix is transferred uniformly from the heating trays to the compaction mold assembled within the shear box compactor.

6.4 *Thermometers*—A platinum resistance thermometer (PRT), thermocouple, or dial-type thermometer with a range of at least 10 to ~~232°C.~~232 °C. Calibrate the thermometer system (probe and readout) in accordance with Test Methods E644.

6.5 *Balance*—At least one balance with a minimum capacity of 30 000 g, with a sensitivity of 0.1 g.

6.6 *Ovens*—At least one oven, capable of achieving up to ~~204°C,~~204 °C, and thermostatically controlled to ~~±3°C~~±3 °C must be available for heating aggregates, ~~bitumen~~asphalt binders, and equipment. If ~~short term~~ short-term oven aging is going to be conducted on the mixture, an additional ~~forced draft~~ forced-draft oven capable of maintaining the requested temperature must be available.

6.7 *Tamping Rod or ~~similar tool~~—Similar Tool*—Diameter 10.0 mm, ~~Length ~ 450 mm, Shape Round, Material Mild~~length ~450 mm, shape round, material mild steel.

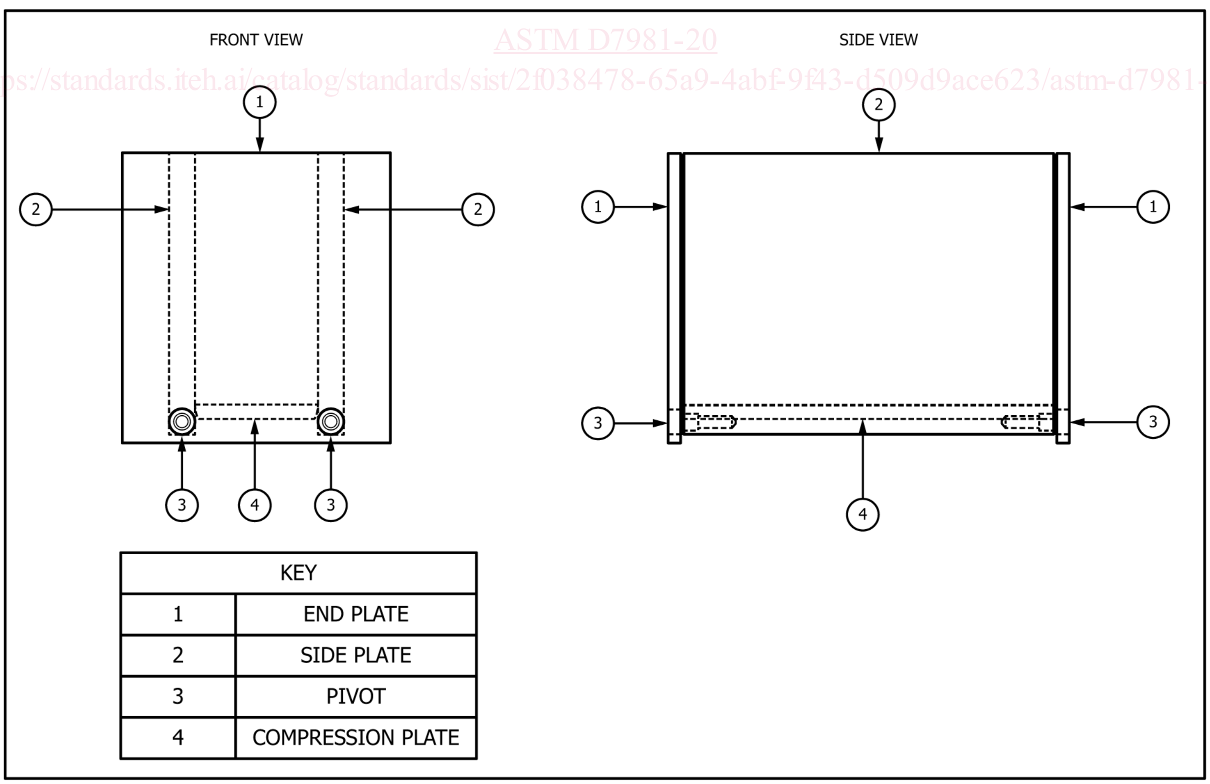

FIG. 1 Example Schematics of Shear Box Pivot Points