Designation: D 1561 – 92 (Reapproved 2000)

Standard Practice for Preparation of Bituminous Mixture Test Specimens by Means of California Kneading Compactor[1]

This standard is issued under the fixed designation D 1561; 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 The practice covers the preparation of test specimens of bituminous paving mixtures by means of a mechanical compactor that imparts a kneading action to the test specimens by a series of individual impressions made with a ram.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

1.3 The values stated in acceptable metric units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 1560 Test Methods for Resistance to Deformation and Cohesion of Bituminous Mixtures by Means of Hveem Apparatus[2]

D 4753 Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Soil, Rock and Construction Materials Testing[3]

3. Significance and Use

3.1 This practice can be used to prepare cylindrical specimens of bituminous mix for subsequent testing. The procedure incorporates the use of the California Kneading Compactor in an attempt to duplicate the kneading action that is provided by the equipment now being used for the compaction of asphalt concrete pavement.

4. Apparatus

4.1 *California Kneading Compactor*—Mechanical kneading compactor, as shown in Fig. 1,[4] for consolidating test specimens.

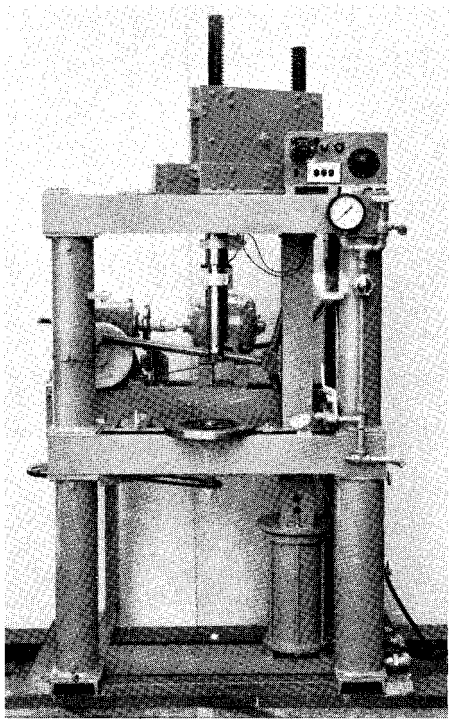

FIG. 1 California Kneading Compactor

NOTE 1—Kneading compactors, which on calibration develop a trace curve similar to that of the California kneading compactor, shall be considered acceptable under this test method. Alternatively, any kneading compactor capable of fabricating specimens that will show stabilometer values equivalent to those obtained from the California kneading compactor shall be acceptable for use under this test method. The supplier has the responsibility of furnishing those substantiating data for his device.

NOTE 2—Curves are considered within calibration when they show the same peak pressure and dwell time in load time tract obtained in the calibration procedure.

NOTE 3—This compactor shall be considered in calibration when the peak momentary load applied to a test specimen is held within ±5 % of the intended foot pressure (within the range from 2.4 to 3.4 MPa) (350 to 500 psi).

NOTE 4—The stabilometer values from replicate specimens fabricated by this Practice D 1561 and tested in accordance with Test Methods D 1560, shall fall within a range of 3 units for all dense-graded bituminous mixtures containing aggregates not larger than 12.7 mm (½ in.) and within a range of 4 units for coarser graded bituminous mixtures containing up to 25.4-mm (1-in.) maximum size aggregates.

4.2 *Compactor Foot*—A ram having a face shaped as shown

[1] This 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 Bituminous Mixes.

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[2] *Annual Book of ASTM Standards*, Vol 04.03.

[3] *Annual Book of ASTM Standards*, Vol 04.08.

[4] Blueprints of detailed drawings of the apparatus illustrated in Fig. 1 are available at a nominal cost from the American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103. Request Adjunct No. ADJD1561.

in Fig. 2, and having an area of approximately 20.059 cm^2 (3.1 $in.^2$).

4.3 *Mold Holder, Funnel, and Feeder Trough*, as shown in Fig. 3.

4.4 *Molds*—Molding cylinders, 101.6 ± 0.13 mm (4 ± 0.005 in.) in inside diameter by 127 mm (5 in.) in height. A minimum of three such compaction molds is recommended.

4.5 *Rod*—Round-nose steel rod, 9.5 mm (⅜ in.) in diameter by 406.4 mm (16 in.) long.

4.6 *Paper Disks*—Heavy paper disks, 101.6 mm (4 in.) in diameter.

4.7 *Shim*—Steel shim, 6.4 mm (¼ in.) thick, 19.1 mm (¾ in.) wide, and 63.5 mm (2½ in.) long.

4.8 *Metal Followers*—Two metal followers, 101.2 mm (3.985 in.) in diameter; one 139.7 mm (5.5 in.) high, the other 38.1 mm (1.5 in.) high.

4.9 *Testing Machine*—A compression testing machine having a minimum capacity of 22 kN (50 000 lbf).

4.10 *Ovens*—Electric ovens capable of maintaining temperatures of up to 163°C (325°F).

4.11 *Balance*—A balance having a minimum capacity of 5 kg and meeting the requirements of Specification D 4753 for a balance with 0.01-g readability.

4.12 *Sample Splitter*, riffle-type, or equivalent.

4.13 *Sample Mixing Apparatus*—Use suitable equipment. Hand mixing is permissible, but mechanical mixing is recommended.

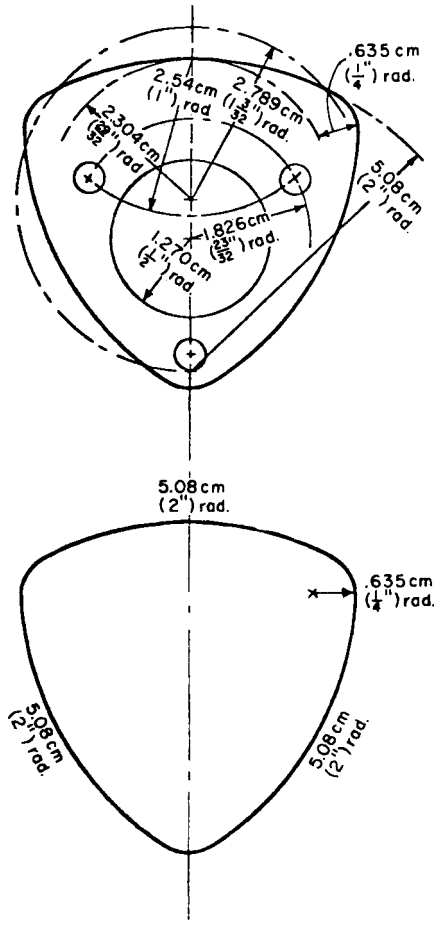

FIG. 2 Face of Compactor Ram

4.14 *Miscellaneous Apparatus*—Thermometers, trowels, pans, spatulas, scoops, gloves, and metal pans.

5. Test Specimens

5.1 *Selection of Bitumen Content for Specimens*—The optimum amount of bitumen for the aggregate may be determined by the method commonly employed by the laboratory.

5.2 *Preparation of Mixtures*:

5.2.1 Obtain a sieve analysis on the fine and coarse aggregate (aggregate shall be separated by means of a 4.75-mm (No. 4) sieve). Separate the aggregate into the various size fractions necessary for accurately recombining into test mixtures conforming to specified grading requirements.

5.2.2 Combine the moisture-free aggregates into batches weighing 1200 g. (Every effort should be made to fabricate test specimens 64 ± 3 mm (2.5 ± 0.1 in.) in height. Heat the aggregate to the proper mixing temperature; then weigh the required amount of bitumen at the proper temperature into the aggregate mixture. For mixes employing asphalt cement, the temperature of the aggregate and asphalt at the time mixing begins shall be in accordance with the following:

	Temperature Range, °C (°F)	
Grade	min	max
AC-2.5, AR1000, or 200–300 Pen	99(210)	121(250)
AC-5, AR2000, or 120–150 Pen	110(230)	135(275)
AC-10, AR4000, or 85–100 Pen	121(250)	149(300)
AC-20, AR8000, or 60–70 Pen	132(270)	163(325)
AC-40, AR16000, or 40–50 Pen	132(270)	163(325)

Mixtures containing liquid asphalts do not require heat for mixing. For tar mixtures, heat the aggregates and tar to the desired temperatures, not to exceed 107°C (225°F). Mixing of the aggregate and bitumen shall be as thorough and rapid as possible; mechanical mixing is recommended.

5.2.3 When mixing is completed, transfer the mix to a suitable flat pan approximately 279 by 178 by 25 mm (11 by 7 by 1 in.) and cure this mixture for 2 to 3 h at a temperature of 146 ± 3°C (295± 5°F).

NOTE 5—Another procedure that has been used is to cure this mixture for 15 to 18 h at a temperature of 60 ± 3°C (140 ± 5°F) in an oven equipped with air circulation.

NOTE 6—Bituminous mixtures may also be prepared in accordance with requirements of other test methods for which it is desired to use the California kneading compactor.

5.3 *Compaction of Specimens*:

5.3.1 *Temperatures*—Use one of the three following specified temperatures when compacting the bituminous mixture. The mixtures and molds shall be brought to temperature prior to molding operations.

5.3.1.1 60°C (140°F) for mixtures containing liquid-grade asphalts.

5.3.1.2 110°C (230°F) for mixtures containing paving grade asphalts.

5.3.1.3 Room temperature for mixtures containing liquid grade asphalts when it is desired to test with whatever moisture may be present in the mixture.

5.3.2 *Molding Specimens*—Place the compaction mold in position in the mold holder and insert a paper disk, 101.6 mm (4 in.) in diameter, to cover the base plate of the mold holder. Place a steel shim under the edge of the mold temporarily in order to have the base plate of the mold holder act as a

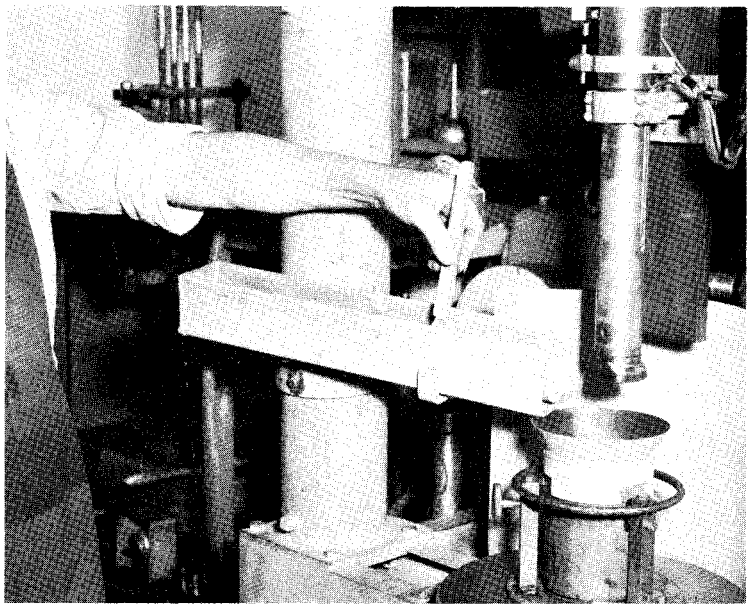

FIG. 3 Funnel, Feeder Trough, and Mold Assembly of the California Kneading Compactor

free-fitting plunger during the compaction operation. Preheat the round-nose rod. Weigh out the required amount of bituminous mixture for one specimen at the specified temperature and place in the insulated feeder trough, which shall have been preheated approximately to the compaction temperature for mixture. Spread the mixture uniformly on the feeder trough to ensure uniformity when transferring to the mold. By means of a paddle of suitable dimensions to fit the cross section of the trough, push one-half of the mixture into the mold. Rod the one-half portion of the mixture 20 times in the center of the mass and 20 times around the edge by means of the round-nose rod. Transfer the remainder of the sample to the mold and repeat the rodding procedure. Place the mold and assembly into position on the California kneading compactor. By means of the variable transformer controlling the heater, maintain the compactor foot sufficiently hot to prevent the mixture from adhering to it. Apply approximately 20 tamping blows at a pressure of 1.7 MPa (250 psi). The number of tamping blows will vary, depending upon the type of the mixture, the purpose being to form the mixture into a semi-compacted condition so that it will not be unduly disturbed by the full pressure of 3.4 MPa (500 psi). After semi-compaction has been accomplished, remove the shim and release the mold-tightening screw sufficiently to allow approximately 3 mm (⅛in.) side movement of the mold. Increase the compactor foot pressure to 3.4 MPa and apply 150 tamping blows to complete compaction in the California kneading compactor.

NOTE 7—When testing referee samples for the purpose of qualifying a compactor, use only material for the test specimens which will compact under the maximum foot pressure prescribed in 5.3.2 without visible movement, distortion, or penetration of the compactor foot.

NOTE 8—In some instances where sandy or unstable material is involved, it may not be possible to accomplish the compaction in the kneading compactor because of undue movement of the mixture under the compactor foot. In these instances use a 178-kN (40 000-lbf) static load (for a 101.6-mm (4-in.) diameter specimen) applied by the double plunger method in which a free-fitting plunger is placed on both the bottom and top of the test specimen. Apply the load at the rate of 1.3 mm (0.05 in.)/min and hold for 30 ± 5 s.

5.3.3 *Application of Static Load*—After compaction in the California kneading compactor, place the mold and the specimen in an oven at 60°C (140°F) for the following periods of time prior to applying the static leveling off load:

If compacted at 60°C (140°F)	1 h
If compacted at 110°C (230°F)	1.5 h

5.3.4 The "leveling off" load shall consist of the application of a static load of 56 kN (12 600 lbf) in a compression testing machine. Use a testing machine head or platen speed of 6 mm (0.25 in.)/min. Apply the load by the double plunger method in which metal followers are employed as free-fitting plungers on the top and bottom of the specimen. After releasing the "leveling off" load, measure the height of the specimen to the nearest 0.25 mm (0.01 in.), record the measurement, and place the specimen, in the mold, in an oven in order to obtain the desired temperature for testing.

NOTE 9—A push-out device for removing the specimen is described in Test Methods D 1560. The temperature of the specimen and the method of transfer from the mold to the stabilometer are given in the procedure of Test Methods D 1560.

6. Report

6.1 Report the following information:

6.1.1 Specimen curing procedure,

6.1.2 Height of the specimen, and

6.1.3 Temperature of compaction in the California kneading compactor.

7. Precision and Bias

7.1 Since the procedure is used only for the preparation of test specimens, no precision statement can be developed.