Designation: D 5581 – 96 (Reapproved 2001)

Standard Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus (6 inch-Diameter Specimen)[1]

This standard is issued under the fixed designation D 5581; 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 measurement of the resistance to plastic flow of cylindrical specimens of bituminous paving mixture loaded on the lateral surface by means of the Marshall apparatus. This test method is for use with mixtures containing asphalt cement and aggregate up to 1½ in. (37.5 mm) nominal maximum size.

1.2 The values stated in inch-pound units are to be regarded as standard except for reference to sieve sizes and size of aggregate as measured by testing sieves in which SI units are standard according to Specification E 11. The SI equivalent shown in parentheses may be approximate.

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

2. Referenced Documents

2.1 *ASTM Standards:*

C 670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials[2]

D 1559 Test Method for Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus[3]

E 11 Specification for Wire Cloth and Sieves for Testing Purposes[4]

3. Significance and Use

3.1 This test method is used in the laboratory mix design of bituminous mixtures. Specimens are prepared in accordance with the method and tested for maximum load and flow. Density and voids properties may also be determined on specimens prepared in accordance with the method. The testing section of this method can also be used to obtain maximum load and flow for bituminous paving specimens cored from pavements or prepared by other methods. These results may differ from values obtained on specimens prepared by this test method.

3.2 It has been determined that 75 and 112 compaction blows applied to a 6-in. (152.4 mm) diameter specimen using the apparatus and procedure in this standard give densities equivalent to 50 and 75 compaction blows, respectively, applied to a 4-in. (101.6 mm) diameter specimen using Test Method D 1559.

4. Apparatus

4.1 *Specimen Mold Assembly*—Mold cylinders nominal 6.5 in. (165.1 mm) outside diameter steel tubing with 6.000 ± 0.008 in. (152.4 ± 0.2 mm) inside diameter by 4.5 in. (114.3 mm) in height, base plates, and extension collars shall conform to the details shown in Fig. 1. Nine mold cylinders are recommended.

4.2 *Specimen Extractor*—steel, in the form of a disk with a diameter from 5.950 to 5.990 in. (151.1 to 152.1 mm) and 0.5 in. (13 mm) thick for extracting the compacted specimen from the specimen mold with the use of the mold collar. A suitable bar is required to transfer the load from the ring dynamometer adapter to the extension collar while extracting the specimen.

4.3 *Mechanical Compactor and Compaction Hammer*—Compactor with ⅓ hp (250W) minimum motor, chain lift, frame, and automatic sliding weight release. The compaction hammer (Fig. 2) shall have a flat, circular tamping face 5.88 in. (149.4 mm) in diameter and a 22.50 ± 0.02 lb (10.21 ± 0.01 kg) sliding weight with a free fall of 18.0 ± 0.1 in. (457.2 ± 2.5 mm). Two compaction hammers are recommended.

4.4 *Compaction Pedestal*—The compaction pedestal shall consist of an 8 by 8 by 18-in. (203.2 by 203.2 by 457.2-mm) wooden post capped with a 12 by 12 by 1-in. (304.8 by 304.8 by 25.4-mm) steel plate. The wooden post shall be oak, pine, or other wood having an average dry weight of 42 to 48 lb/ft^3(0.67 to 0.77 g/cm^3). The wooden post shall be secured by four angle brackets to a solid concrete slab. The steel cap shall be firmly fastened to the post. The pedestal assembly shall be installed so that the post is plumb and the cap is level.

[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 Bituminous Mixes.

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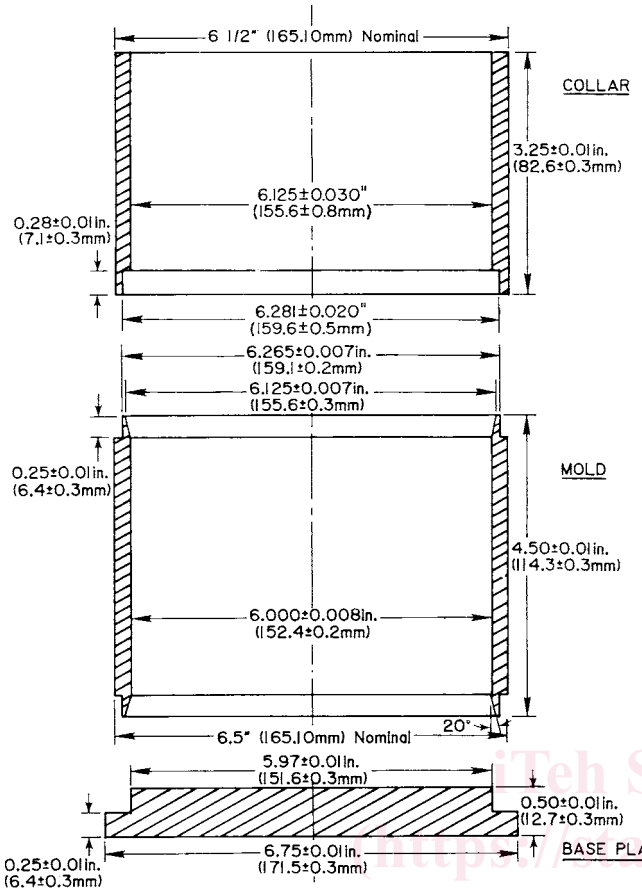
[2] *Annual Book of ASTM Standards*, Vol 04.02.

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

[4] *Annual Book of ASTM Standards*, Vol 14.02.



Note: collar should fit the mold.

FIG. 1 Compaction Mold

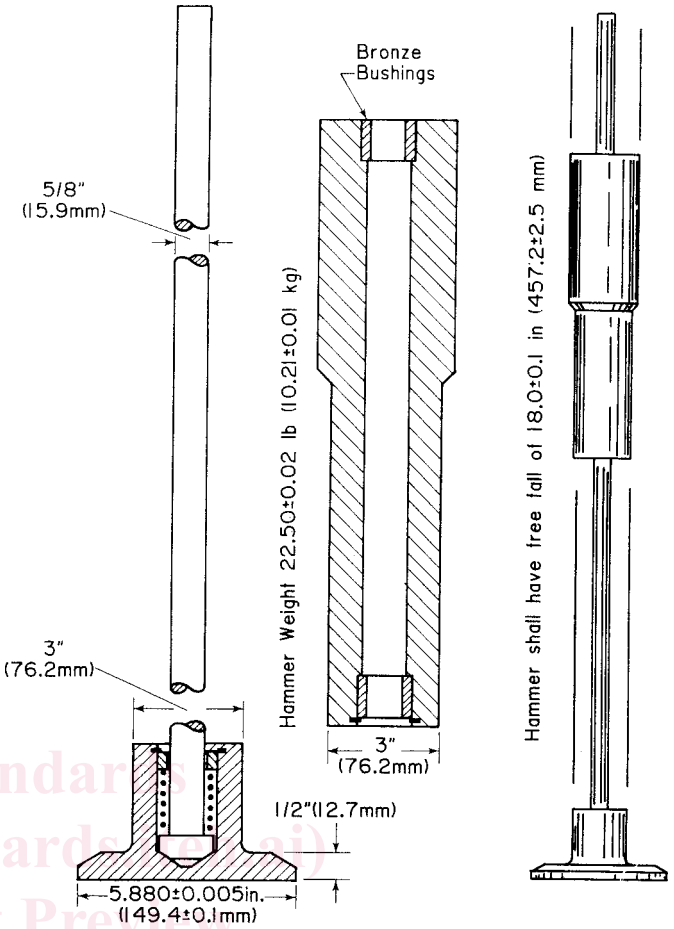


FIG. 2 Compaction Hammer (Generic)

4.5 *Specimen Mold Holder*—mounted on the compaction pedestal so as to center the compaction mold over the center of the post as shown in Fig. 3 or equivalent arrangement. It shall hold the compaction mold, collar, and base plate securely in position during compaction of the specimen.

4.6 *Breaking Head*— The breaking head (Fig. 4) shall consist of upper and lower cylindrical segments or test heads having an inside radius of curvature of 3 in. (76.2 mm) accurately machined. The lower segment shall be mounted on a base having two perpendicular guide rods or posts extending upward. Guide sleeves in the upper segments shall be in such a position as to direct the two segments together without appreciable binding or loose motion on the guide rods. When a 6.000 in. (152.4 mm) diameter by 4 in. (100 mm) thick metal block is placed between the two segments, the inside diameters and the gaps between the segments shall conform to Fig. 4. All steel components shall be plated.

4.7 *Loading Jack*— The loading jack (Fig. 5) shall consist of a screw jack mounted in a test frame and shall produce a uniform vertical movement of 2 in. (50.8 mm)/min. An electric motor may be attached to the jacking mechanism.

NOTE 1—Instead of the loading jack, a mechanical or hydraulic testing machine may be used provided the rate of movement can be maintained at 2 in. (50.8 mm)/min while the load is applied.

4.8 *Ring Dynamometer Assembly*—One ring dynamometer (Fig. 5) of 10 000-lb. (4536-kg) capacity and sensitivity of 10 lb (4.536 kg) up to 1000 lb (453.6 kg) and 25 lb (11.340 kg) between 1000 and 10 000 lb (453.6 and 4536 kg) shall be equipped with a micrometer dial. The micrometer dial shall be graduated on 0.0001 in. (0.0025 mm). Upper and lower ring dynamometer attachments are required for fastening the ring dynamometer to the testing frame and transmitting the load to the breaking head.

NOTE 2—Instead of the ring dynamometer assembly, any suitable load-measuring device may be used provided the capacity and sensitivity meet the above requirements.

4.9 *Flowmeter*—The flowmeter shall consist of a guide sleeve and a gage. The activating pin of the gage shall slide inside the guide sleeve with a slight amount of frictional resistance. The guide sleeve shall slide freely over the guide rod of the breaking head. The flowmeter gage shall be adjusted to zero when placed in position on the breaking head when each individual test specimen is inserted between the breaking head segments. Graduations of the flowmeter gage shall be in 0.01-in. (0.25-mm) divisions.

NOTE 3—Instead of the flowmeter, a micrometer dial or stress-strain recorder graduated in 0.001 in. (0.025-mm) may be used to measure flow.

4.10 *Ovens or Hot Plates*—Ovens or hot plates shall be provided for heating aggregates, bituminous material, specimen molds, compaction hammers, and other equipment to the