Standard Method of Test for

Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop

AASHTO Designation: T 99-19

Technical Subcommittee: 1b, Geotechnical Exploration, Instrumentation, Stabilization, and Field Testing

Release: Group 3 (July)

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1. SCOPE

1.1. These methods of test are intended for determining the relation between the moisture content and density of soils compacted in a mold of a given size with a 2.5-kg (5.5-lb) rammer dropped from a height of 305 mm (12 in.). Four alternate procedures are provided as follows:

- *Method A* —A 101.60-mm (4-in.) mold: Soil material passing a 4.75-mm (No. 4) sieve (see Sections 4 and 5);
- *Method B* —A 152.40-mm (6-in.) mold: Soil material passing a 4.75-mm (No. 4) sieve (see Sections 6 and 7);
- *Method C* —A 101.60-mm (4-in.) mold: Soil material passing a 19.0-mm ($^3/_4$-in.) sieve (see Sections 8 and 9); or
- *Method D* —A 152.40-mm (6-in.) mold: Soil material passing a 19.0-mm ($^3/_4$-in.) sieve (see Sections 10 and 11).

1.2. The method to be used should be indicated in the specifications for the material being tested. If no method is specified, the provisions of Method A shall govern.

1.3. This test method applies to soil mixtures that have 40 percent or less retained on the 4.75 mm-(No. 4) sieve, when Method A or B is used and 30 percent or less retained on the 19.0-mm ($^3/_4$-in.) sieve, when Method C or D is used. Material retained on these sieves shall be defined as oversized particles (coarse particles).

1.4. If the test specimen contains oversized particles, dry density and moisture corrections must be made in accordance with Annex A1. The person or agency specifying this method may specify a minimum percentage of oversized particles above which a correction must be applied. If no minimum percentage is specified, correction for the oversized particles shall be applied to material containing more than 5 percent by weight of oversized particles.

1.5. If the specified oversized particle maximum percentage is exceeded, other methods of compaction control must be used.

Note 1—One method for the design and control of the compaction of such soils is to use a test fill to determine the required degree of compaction and a method to obtain that compaction. Then use a method specification to control the compaction by specifying the type and size of compaction equipment, the lift thickness, and the number of passes.

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1.6. The following applies to all specified limits in this standard: For the purposes of determining conformance with these specifications, an observed value or a calculated value shall be rounded off “to the nearest unit” in the last right-hand place of figures used in expressing the limiting value, in accordance with ASTM E29.

1.7. The values stated in SI units are to be regarded as the standard.

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards* :

- M 231, Weighing Devices Used in the Testing of Materials
- R 76, Reducing Samples of Aggregate to Testing Size
- T 19M/T 19, Bulk Density (“Unit Weight”) and Voids in Aggregate
- T 85, Specific Gravity and Absorption of Coarse Aggregate
- T 217, Determination of Moisture in Soils by Means of Calcium Carbide Gas Pressure Moisture Tester
- T 255, Total Evaporable Moisture Content of Aggregate by Drying
- T 265, Laboratory Determination of Moisture Content of Soils
- T 310, In-Place Density and Moisture Content of Soil and Soil–Aggregate by Nuclear Methods (Shallow Depth)

2.2. *ASTM Standards* :

- D2168, Standard Practices for Calibration of Laboratory Mechanical-Rammer Soil Compactors
- E11, Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- E29, Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. APPARATUS

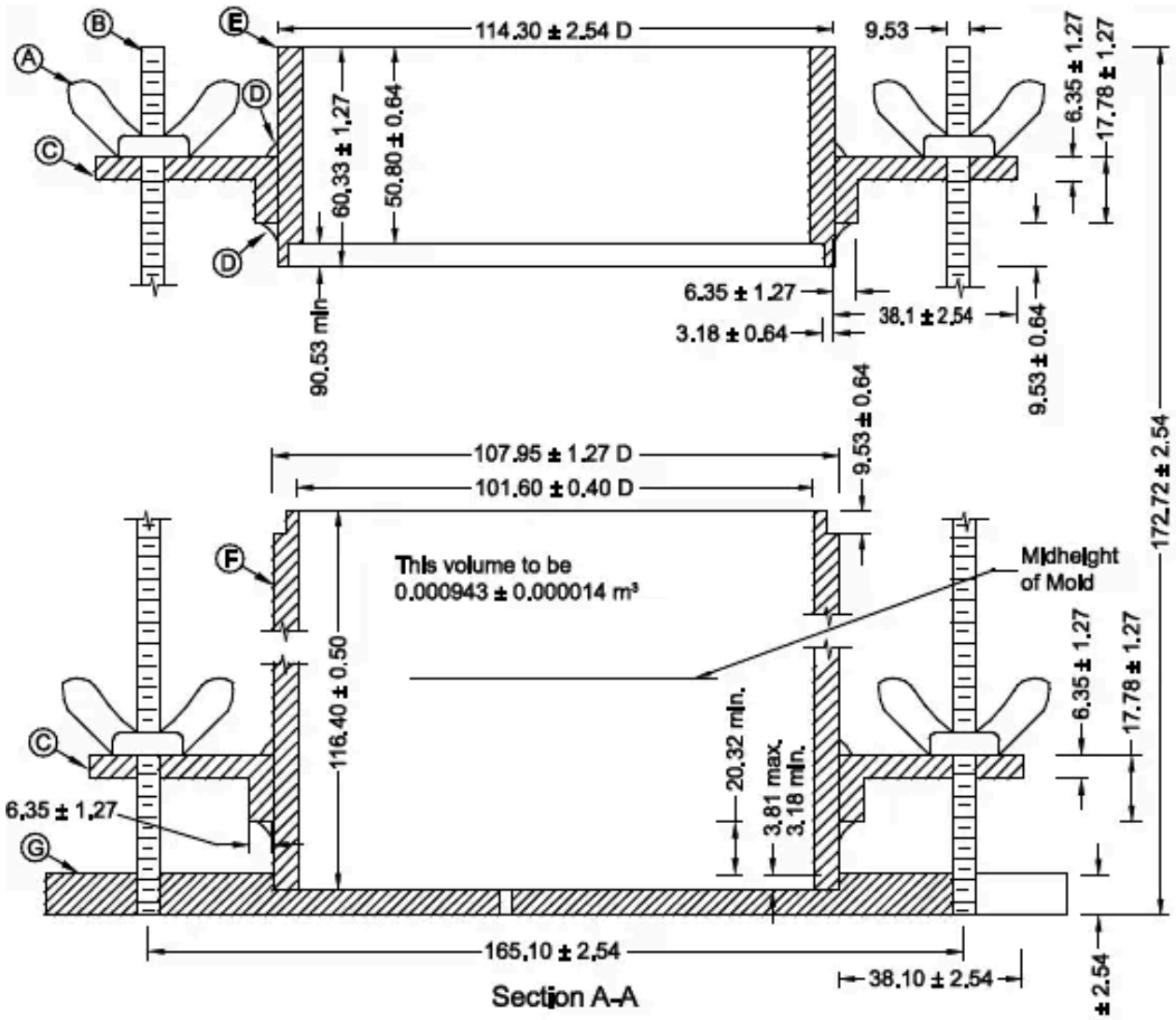
3.1. *Mold Assembly (Mold, Collar, and Base Plate)* —Molds shall be solid-wall, metal cylinders manufactured with dimensions and capacities shown in Sections 3.1.1, 3.1.2, and Figures 1 and 2. They shall have a detachable collar approximately 60 mm (2.375 in.) in height, to permit preparation of compacted specimens of soil-water mixtures of the desired height and volume. The mold and collar shall be so constructed that it can be fastened firmly to a detachable base plate made of the same material (Note 2). The base plate shall be plane to 0.005 in. as shown in Figures 1 and 2.

Note 2—Alternate types of mold assemblies with capacities as stipulated herein may be used, provided the test results are correlated with those of the solid-wall mold on several soil types and the same moisture–density results are obtained. Records of such correlation shall be maintained and readily available for inspection, when alternate types of molds are used.

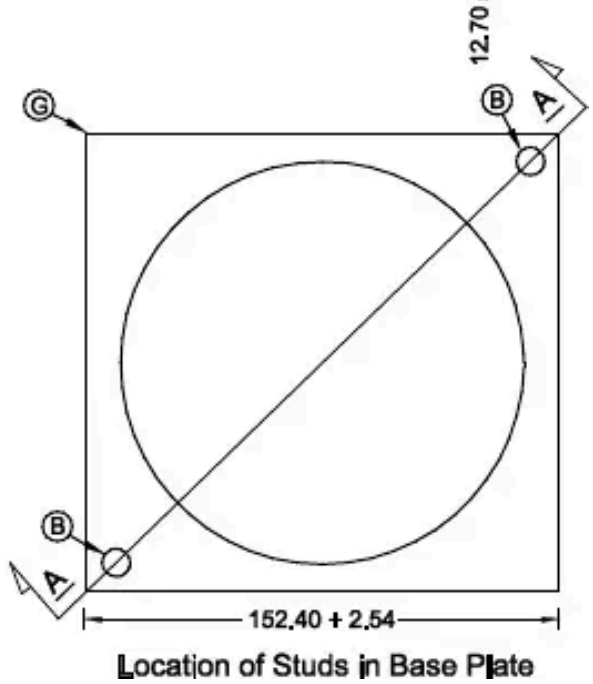
3.1.1. Molds having a volume of 0.000943 ± 0.000014 m^3 (0.0333 ± 0.0005 ft^3) shall have an inside diameter of 101.60 ± 0.40 mm (4.000 ± 0.016 in.) and a height of 116.40 ± 0.50 mm (4.584 ± 0.018 in.) (Figure 1). Determine the mold volume in accordance with the “Calibration of Measure” section of T 19M/T 19 for Unit Mass of Aggregate.

3.1.2. Molds having a volume of 0.002124 ± 0.000025 m^3 (0.07500 ± 0. 0009 ft^3) shall have an inside diameter of 152.40 ± 0.70 mm (6.000 ± 0.026 in.) and a height of 116.40 ± 0.50 mm (4.584 ± 0.018 in.) (Figure 2). Determine mold volume in accordance with the “Calibration of Measure” section of T 19M/T 19 for Unit Mass of Aggregate.

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A Wing Nut (4)
B Stud (2)
C Hanger (4)
D Weld (Top and Bottom of Each Hanger)
E Collar (1)
F Mold (1)
G Base Plate (1)



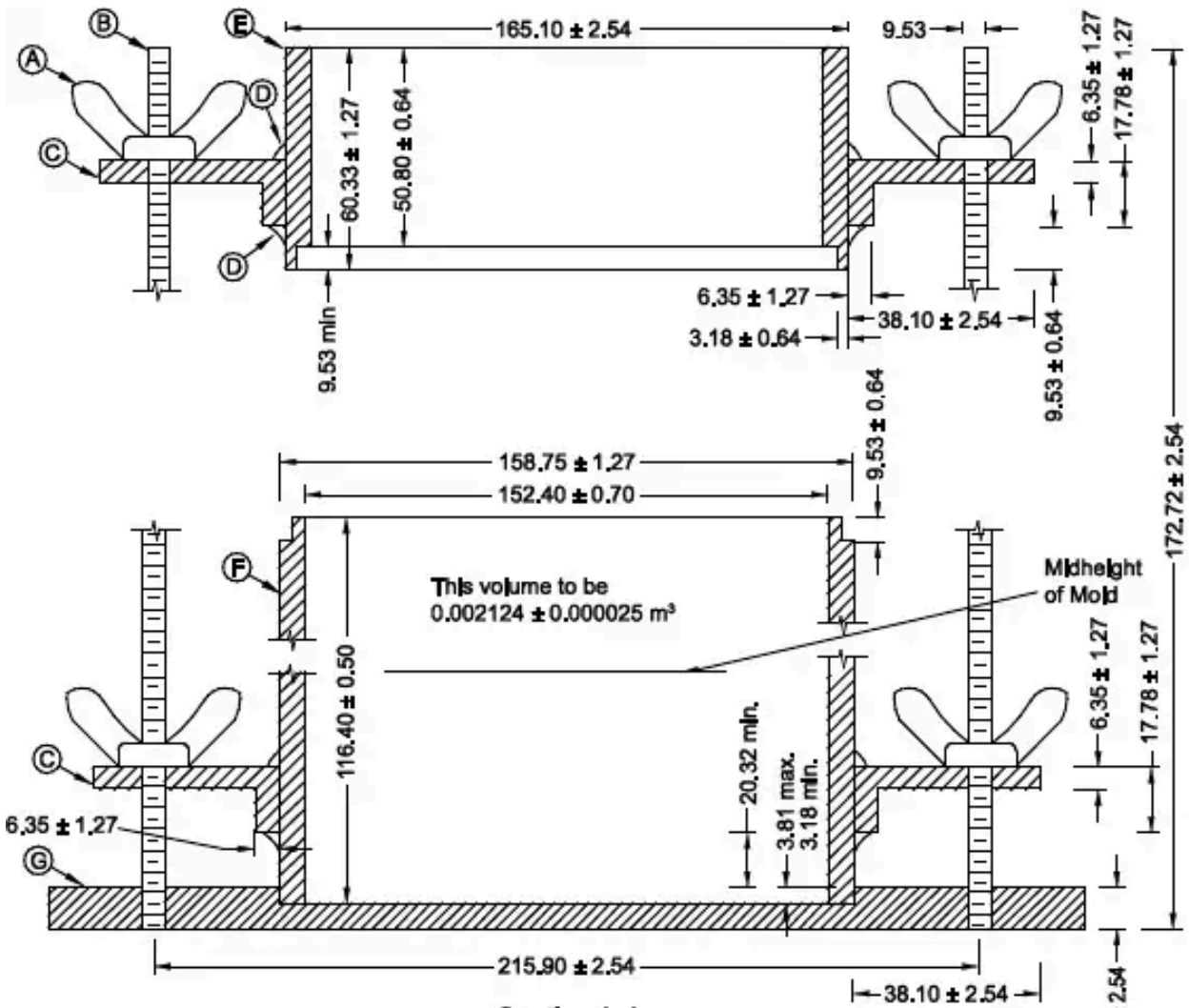
Notes: 1. All dimensions shown in millimeters unless otherwise noted.

2. Hanger on the mold portion only cannot extend above the midheight line.

3. Figure 1 is to be used for all compaction molds purchased after the publication of the 21st edition (HM-21).

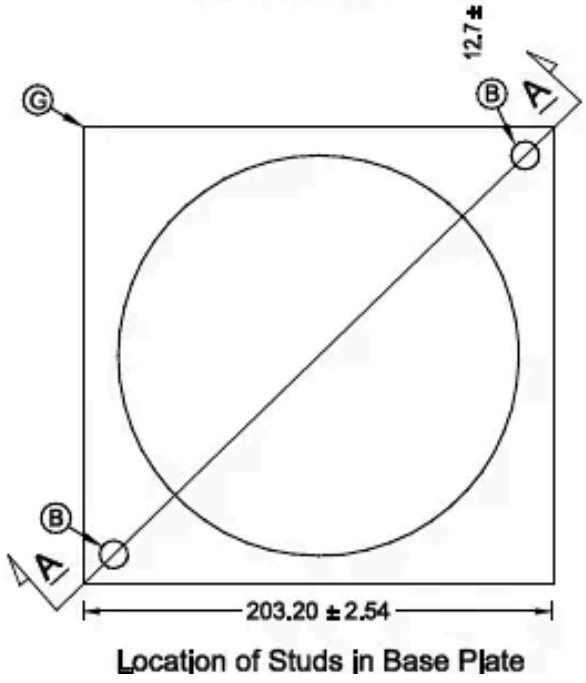
Figure 1 —Cylindrical Mold and Base Plate (101.6-mm Mold)

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Section A-A

A Wing Nut (4)
B Stud (2)
C Hanger (4)
D Weld (Top and Bottom of Each Hanger)
E Collar (1)
F Mold (1)
G Base Plate (1)



Location of Studs in Base Plate

Notes: 1. All dimensions shown in millimeters unless otherwise noted.

2. Hanger on the mold portion only cannot extend above the midheight line.

3. Figure 2 is to be used for all compaction molds purchased after the publication of the 21st edition (HM-21).

Figure 2 —Cylindrical Mold and Base Plate (152.4-mm Mold)

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