
Standard Method of Test for Moisture–Density Relations of Soil–Cement Mixtures

AASHTO Designation: T 134-22

Technically Revised: 2022

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



**American Association of State Highway and Transportation Officials
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1. SCOPE

- 1.1. These methods of test are intended for determining the relation between moisture content and density of soil–cement mixtures when compacted before cement hydration. Appendix X1 provides commentary and protocols to characterize soil–cement mixtures that are susceptible to the effects of time delay between cement addition and compaction. Appendix X1 protocols are primarily intended for soil–cement mixtures having a maximum dry density, as determined in Section 9.3, lower than the maximum dry density of the same soil evaluated under the compaction prescribed in these methods without cement addition (i.e., soil and water only).
- 1.2. A 944-cm³ (1/30-ft³) mold and a 2.5-kg (5.5-lb) rammer dropped from a height of 305 mm (12 in.) are used and two methods, depending on soil gradation, are covered, as follows:
 - 1.2.1. *Method A*—Soil material passing a 4.75-mm (No. 4) sieve. This method shall be used when 100 percent of the soil sample passes the 4.75-mm (No. 4) sieve; or
 - 1.2.2. *Method B*—Soil material passing a 19.0-mm (³/₄-in.) sieve. This method shall be used when part of the soil sample is retained on the 4.75-mm (No. 4) sieve.
- 1.3. This test method applies to soil–cement mixtures that have 30 percent or less retained on the 19.0-mm (³/₄-in.) sieve, when Method B is used. The material retained on the 19.0 mm (³/₄-in.) sieve shall be defined as oversized particles (coarse particles).
- 1.4. 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.
- 1.5. *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 R 18 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with R 18 alone does not completely assure reliable results. Reliable results depend on many factors; following the suggestions of R 18 or some similar acceptable guideline provides a means of evaluating and controlling some of those factors.*

2. REFERENCED DOCUMENTS

2.1. *AASHTO Standards:*

- M 85, Portland Cement
- M 145, Classification of Soils and Soil-Aggregate Mixture for Highway Construction Purposes
- M 231, Weighing Devices Used in the Testing of Materials
- M 240M/M 240, Blended Hydraulic Cement
- R 18, Establishing and Implementing a Quality Management System for Construction Materials Testing Laboratories
- T 19M/T 19, Bulk Density (“Unit Weight”) and Voids in Aggregate
- T 99, Moisture–Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and 305-mm (12-inch) Drop
- T 134, Moisture Density Relations of Soil–Cement Mixtures
- T 265, Laboratory Determination of Moisture Content of Soils

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

2.3. *Other Document:*

- Sullivan, W. G., Howard, I. L. Time Delay Effects on Compactability of Soil-Cement Materials during Proctor Testing. In *Transportation Research Record 2675*. Available from doi.org/10.1177/0361198121998700.

3. APPARATUS

3.1. *Molds*—Molds shall conform to T 99, Sections 3.1 and 3.1.1.

3.2. *Rammer and Rammer Face*—Rammers and rammer faces shall conform to T 99, Section 3.2.1 or 3.2.2, and 3.2.3. Note 1 below applies to Section 3.2.2.

Note 1—The rammer apparatus shall be calibrated with several soil–cement mixtures and the mass of the rammer adjusted, if necessary, to give the same moisture–density results as with the manually operated rammer. It may be impractical to adjust the mechanical apparatus so the free fall is 305 mm (12 in.) each time the rammer is dropped, as with the manually operated rammer. To make the adjustment of free fall, the portion of loose soil to receive the initial blow should be slightly compressed with the rammer to establish the point of impact from which the 305-mm (12-in.) drop is determined. Subsequent blows on the layer of soil–cement may all be applied by dropping the rammer from a height of 305 mm (12 in.) above the initial-setting elevation, or when the mechanical apparatus is designed with a height adjustment for each blow, all subsequent blows should have rammer free fall of 305 mm (12 in.) measured from the elevation of the soil–cement as compacted by the previous blow.

3.3. *Sample Extruder*—A jack, lever, frame, or other device adopted for the purpose of extruding compacted specimens from the mold. Not required when a split-type mold is used.

3.4. *Balances and Scales*—A balance or scale conforming to the requirements of M 231, Class G 20. Also, a balance conforming to the requirements of M 231, Class G 2.