



Designation: D1634 – 17

Standard Test Method for Compressive Strength of Soil-Cement Using Portions of Beams Broken in Flexure (Modified Cube Method)¹

This standard is issued under the fixed designation D1634; 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 determination of the compressive strength of soil-cement, using portions of beams broken in flexure in accordance with Test Method D1635, as test specimens.

1.2 *Units*—The values stated in inch-pound units are to be regarded as standard, except as noted below. The values given in parentheses are mathematical conversions to SI units, which are provided for information only and are not considered standard.

1.2.1 The gravitational system of inch-pound units is used when dealing with inch-pound units. In this system, the pound (lbf) represents a unit of force (weight) while the unit for mass is slugs.

1.2.2 The slug unit of mass is almost never used in commercial practice; that is, density, balances, etc. Therefore, the standard unit for mass in this standard is either kilogram (kg) or gram (g), or both. Also, the equivalent inch-pound unit (slug) is not given/presented in parentheses.

1.2.3 It is common practice in the engineering/construction profession to concurrently use pounds to represent both a unit of mass (lbm) and of force (lbf). This implicitly combines two separate systems of units; that is, the absolute system and the gravitational system. It is scientifically undesirable to combine the use of two separate sets of inch-pound units within a single standard. As stated, this standard includes the gravitational system of inch-pound units and does not use/present the slug unit for mass. However the use of balances or scales, recording pounds of mass (lbm) or recording density in lbm/ft³ shall not be regarded as nonconformance with this standard.

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026 unless superseded by this test method.

1.3.1 The procedures used to specify how data are collected/recorded and calculated in the standard are regarded as the

industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user's objectives; and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of these test methods to consider significant digits used in analysis methods for engineering data.

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

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

- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D1632 Practice for Making and Curing Soil-Cement Compression and Flexure Test Specimens in the Laboratory
- D1633 Test Methods for Compressive Strength of Molded Soil-Cement Cylinders
- D1635 Test Method for Flexural Strength of Soil-Cement Using Simple Beam with Third-Point Loading
- D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D6026 Practice for Using Significant Digits in Geotechnical Data

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.15 on Stabilization With Admixtures.

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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.

*A Summary of Changes section appears at the end of this standard

E4 Practices for Force Verification of Testing Machines

3. Terminology

3.1 Definitions:

3.1.1 For definitions of common technical terms in this standard, refer to Terminology **D653**.

4. Significance and Use

4.1 This test method is intended for use in the laboratory and as a research tool for determining relative compressive strength values for various soil-cement mixtures. It is not intended as an alternative for Test Method **D1633** and the test values obtained by these two test methods are not interchangeable and not necessarily comparable. A comparison of strengths obtained by Test Methods **D1633** and **D1634** is given by Feld and Abrams.³

NOTE 1—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this standard are cautioned that compliance with Practice **D3740** does not in itself assure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

5. Apparatus

5.1 *Compression Testing Machine*—The testing machine may be of any type having sufficient capacity and control to provide the rate of loading prescribed in **7.2**. The testing machine shall be equipped with a spherically seated head block having a bearing surface of at least 75 % of the width of the specimen but not greatly in excess of the width of the specimen. The movable portion of this block shall be held closely in the spherical seat, but the design shall be such that the bearing face can be rotated freely and tilted through small angles in any direction. The compression machine shall be verified in accordance with Practice **E4** at least annually to determine if indicated loads are accurate to ± 1.0 % in the applicable range of loading.

5.2 *Bearing Plates*—Square, hardened steel bearing plates 0.75 ± 0.05 in. (19 ± 0.13 mm) thick with side dimensions of 3 ± 0.005 in. (75 ± 0.13 mm) (for standard beams as described in **D1632**). The bearing faces when new shall not depart from a plane by more than 0.0005 in. (0.013 mm) at any point, and they shall be maintained within a permissible variation of 0.001 in. (0.025 mm). The bearing plate surfaces intended for contact with the specimen shall have a Rockwell hardness of not less than HRC 60.

6. Test Specimens

6.1 The standard size beams from which broken portions are selected for the compression test shall conform to the requirements of **D1632**. However, a similar test method may be used for testing specimens from other beam sizes. The beam-end specimens shall have a length at least 1 in. (25 mm) greater than their depth and shall be free from cracks, chipped

surfaces, or other obvious defects. Test the specimens on their sides with respect to their molded position.

6.2 During the interval between testing of specimens as beams and testing the broken portions as cubes, maintain the specimens at a constant water content by suitable protection.

6.3 Determine the width (original height) of the standard specimen at the point where the test will be made to the nearest 0.01 in. (0.25 mm) if it is less than 3 in. (76.2 mm); otherwise take it equal to 3 in. (76.2 mm). Take the length equal to 3 in. (76.2 mm). Calculate the cross-sectional area.

6.4 Check the smoothness of the faces with a straightedge. If necessary, cap the faces to meet the requirements of the section on Capping Specimens of Practice **D1632**. The caps shall cover the full width of the specimen and shall be of such length as to permit adjustment of the bearing plates for the test so that the upper bearing plate may be placed directly over the lower bearing plate.

7. Procedure

7.1 Place the specimen on its side between the hardened steel bearing plates directly under the spherically seated head of the testing machine, making certain that the vertical axis of the specimen is aligned with the center of thrust of the head. Use a device such as a guide template to ensure that the upper bearing plate is directly over the lower bearing plate. As the spherically seated head is brought to bear on the top bearing plate, rotate its movable portion gently by hand so that uniform seating is obtained.

7.2 Apply a constant rate of deformation without shock to produce an approximate rate of strain of 0.05 in./min (0.02 mm/s). Alternatively, the load may be applied at a constant rate resulting in a rate of stress of 10 to 30 psi/s (70 to 210 kPa/s). Apply the load until it decreases steadily, indicating failure. Record the maximum load carried by the specimen during the test to the nearest 10 lbf (45 N).

7.3 Determine the water content of the test specimen in accordance with Test Method **D2216** using the entire specimen, unless capped. If the specimen is capped, break away as much material as practical from the capping, for the water content specimen.

8. Calculation

8.1 Calculate the unit compressive strength of the specimen by dividing the recorded maximum load by the cross-sectional area determined as described in **6.3**.

9. Report: Test Data Sheet(s)/Form(s)

9.1 The methodology used to specify how data are recorded on the test data sheet(s)/form(s) is covered in **1.3**.

9.2 Record as a minimum the following general information (data):

9.2.1 Testing date, operator name, location, and unique conditions.

9.2.2 Information on the sample from which the test specimen was obtained.

9.3 Record as a minimum the following test specimen data:

³ Felt, E. J., Abrams, M. S., *Strength and Elastic Properties of Compacted Soil-Cement Mixtures*, ASTM STP 206, ASTM, 1957.