



Designation: D2850 – 23

Standard Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils¹

This standard is issued under the fixed designation D2850; 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 determination of the strength and stress-strain relationships of a cylindrical specimen of either intact, compacted, or remolded cohesive soil. Specimens are subjected to a confining fluid pressure in a triaxial chamber. No drainage of the specimen is permitted during the application of the confining fluid pressure or during the compression phase of the test. The specimen is axially loaded at a constant rate of axial deformation (strain controlled).

1.2 This test method provides data for determining undrained strength properties and stress-strain relations for soils. This test method provides for the measurement of the total stresses applied to the specimen, that is, the stresses are not corrected for pore-water pressure.

NOTE 1—The determination of the unconfined compressive strength of cohesive soils is covered by Test Method [D2166/D2166M](#).

NOTE 2—The determination of the consolidated, undrained strength of cohesive soils with pore pressure measurement is covered by Test Method [D4767](#).

1.3 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice [D6026](#).

1.3.1 The procedures used to specify how data are collected/recorded or calculated in this 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 this standard to consider significant digits used in analysis methods for engineering design.

1.4 *Units*—The values stated in SI units are to be regarded as the standard. The values given in parentheses are mathemati-

cal conversions to inch-pound units, which are provided for information only and are not considered standard. Reporting of test results in units other than SI shall not be regarded as nonconformance with this test method.

1.4.1 The converted inch-pound units use the gravitational system of units. In this system, the pound (lbf) represents a unit of force (weight), while the unit for mass is slugs. The slug unit is not given, unless dynamic ($F = ma$) calculations are involved.

1.5 *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.*

1.6 *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

[D422 Test Method for Particle-Size Analysis of Soils](#) (Withdrawn 2016)³

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer](#)

[D1587/D1587M Practice for Thin-Walled Tube Sampling of Fine-Grained Soils for Geotechnical Purposes](#)

[D2166/D2166M Test Method for Unconfined Compressive Strength of Cohesive Soil](#)

[D2216 Test Methods for Laboratory Determination of Water \(Moisture\) Content of Soil and Rock by Mass](#)

¹ This test method is under the jurisdiction of ASTM Committee [D18](#) on Soil and Rock and is the direct responsibility of Subcommittee [D18.05](#) on Strength and Compressibility of Soils.

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² For referenced ASTM Standards, visit the ASTM website, www.astm.org, or contact 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.

³ The last approved version of this historical standard is referenced on www.astm.org.

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

- D2487** Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- D2488** Practice for Description and Identification of Soils (Visual-Manual Procedures)
- D3740** Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D4220/D4220M** Practices for Preserving and Transporting Soil Samples (Withdrawn 2023)³
- D4318** Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- D4753** Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing
- D4767** Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
- D6026** Practice for Using Significant Digits and Data Records in Geotechnical Data
- D6913/D6913M** Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *failure*—a stress condition selected to represent the maximum stress supported by a test specimen.

3.2.1.1 *Discussion*—Failure is often taken to correspond to the maximum principal stress difference (deviator stress) attained or the principal stress difference (deviator stress) at 15 % axial strain, whichever is obtained first during the performance of a test.

3.2.2 *unconsolidated-undrained compressive strength*—the value of the principal stress difference (deviator stress) at failure.

3.2.3 *unconsolidated-undrained shear strength*—the value of the principal stress difference (deviator stress) at failure divided by two.

4. Summary of Test Method

4.1 A cylindrical soil specimen with known dimensions and mass is sealed between loading platens inside the chamber using a flexible membrane. A confining pressure is applied to the specimen in the chamber and the specimen is given time to equalize without consolidation, as drainage of the specimen pore water is not allowed at any time during the test. The specimen is then loaded axially using a strain rate between 0.3 and 1 %/min such that the time to failure does not exceed approximately 15 min. During the shearing phase of the test, measurements of elapsed time, axial deformation, axial load, and chamber pressure are taken. Based on these data, the soil specimen unconsolidated-undrained compressive strength and unconsolidated-undrained shear strength are determined.

5. Significance and Use

5.1 In this test method, the compressive strength of a soil is determined in terms of the total stress, therefore, the resulting

strength depends on the pressure developed in the pore fluid during loading. In this test method, fluid flow is not permitted from or into the soil specimen as the load is applied, therefore the resulting pore pressure, and hence strength, differs from that developed in the case where drainage can occur.

5.2 If the test specimens is 100 % saturated, consolidation cannot occur when the confining pressure is applied nor during the shear portion of the test since drainage is not permitted. Therefore, if several specimens of the same material are tested, and if they are all at approximately the same water content and void ratio when they are tested, they will have approximately the same unconsolidated-undrained shear strength.

5.3 If the test specimens are partially saturated, or compacted/reconstituted specimens, where the degree of saturation is less than 100 %, consolidation may occur when the confining pressure is applied and during application of axial load, even though drainage is not permitted. Therefore, if several partially saturated specimens of the same material are tested at different confining stresses, they will not have the same unconsolidated-undrained shear strength.

5.4 Mohr failure envelopes may be plotted from a series of unconsolidated undrained triaxial tests. The Mohr's circles at failure based on total stresses are constructed by plotting a half circle with a radius of half the principal stress difference (deviator stress) beginning at the axial stress (major principal stress) and ending at the confining stress (minor principal stress) on a graph with principal stresses as the abscissa and shear stress as the ordinate and equal scale in both directions. The failure envelopes will usually be a horizontal line for saturated specimens and a curved line for partially saturated specimens.

5.5 The unconsolidated-undrained shear strength is applicable to situations where the loads are assumed to take place so rapidly that there is insufficient time for the induced pore-water pressure to dissipate and for consolidation to occur during the loading period (that is, drainage does not occur).

5.6 Compressive strengths determined using this procedure may not apply in cases where the loading conditions in the field differ significantly from those used in this test method.

NOTE 3—The quality of the results 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 testing. Users of this test method are cautioned that compliance with Practice **D3740** does not ensure reliable results. Reliable results depend on several factors; Practice **D3740** provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Axial Loading Device*—The axial loading device shall be screw jack driven by an electric motor through a geared transmission, a hydraulic loading device, or any other compression device with sufficient capacity and control to provide the rate of loading prescribed in **8.5**. The rate of advance of the loading device shall not deviate by more than ± 5 % from the selected value. Vibrations due to the operation of the loading device shall be sufficiently small to not cause dimensional changes in the specimen.