



Designation: D5202 – 08

Standard Test Method for Determining Triaxial Compression Creep Strength of Chemical Grouted Soils¹

This standard is issued under the fixed designation D5202; 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 long-term strength and deformation of a cylindrical specimen of either a (undisturbed) field sample or laboratory-fabricated chemical grouted soil when it is sheared undrained in compression under a constant sustained load.

NOTE 1—The voids of chemical grouted soils are most often substantially filled with grout. Thus, pore pressures are unlikely to develop. This test method is not applicable to partially grouted soils in which substantial pore pressures may develop. If pore pressures must be measured, reference is made to Test Method D4767 for equipment and procedures.

1.2 This test method provides data useful in determining strength and deformation properties of chemical grouted soils subjected to sustained loads. Mohr strength envelopes may also be determined.

1.3 The determination of strength envelopes and the development of relationships to aid in interpreting and evaluating test results are left to the engineer or office requesting the test.

1.4 The values stated in either SI or inch-pound units shall be regarded separately as standard. The values in each system may not be exact equivalents, therefore, each system must be used independently of the other, without combining values in any way.

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

1.6 *This test method offers a set of instructions for performing one or more specific operations. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this practice may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service*

must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word "Standard" in the title of this document means only that the document has been approved through the ASTM consensus process.

2. Referenced Documents

2.1 ASTM Standards:²

- D422 Test Method for Particle-Size Analysis of Soils
- D653 Terminology Relating to Soil, Rock, and Contained Fluids
- D854 Test Methods for Specific Gravity of Soil Solids by Water Pycnometer
- D2850 Test Method for Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils
- D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
- D4219 Test Method for Unconfined Compressive Strength Index of Chemical-Grouted Soils
- D4320 Practice for Laboratory Preparation of Chemically Grouted Soil Specimens for Obtaining Design Strength Parameters
- D4767 Test Method for Consolidated Undrained Triaxial Compression Test for Cohesive Soils
- D6026 Practice for Using Significant Digits in Geotechnical Data

3. Terminology

3.1 For common definitions of terms used in this test method, refer to Terminology D653.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *failure*—in creep studies, the stress condition at excessive (15 to 20 %) strain, or at continuing strain leading to fracture.

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.

Current edition approved Jan. 1, 2008. Published February 2008. Originally approved in 1991. Last previous edition approved in 2002 as D5202 – 02. DOI: 10.1520/D5202-08.

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

4. Significance and Use

4.1 Data from these tests may be used for structural design purposes. Adequate safety factors, based on engineering judgment must be determined by the user.

NOTE 2—Sampling procedures for in-situ specimens have a major influence on test results. Specimens carefully trimmed in the laboratory from large block samples taken in the field have the least chance of fracturing prior to testing. Sample preparation methods of laboratory-fabricated specimens also have a major influence on test results. Specimens should be fabricated in accordance with Test Method D4320.

NOTE 3—The quality of the result produced by this test method 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 test method 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 The requirements for equipment needed to perform satisfactory tests are given in the following sections:

5.2 *Axial Loading Device*—The axial compression device may be a dead weight system, a pneumatic or hydraulic load cell, or any other device capable of applying and maintaining desired constant loads to the accuracy prescribed for the load-measuring device.

5.3 *Axial Load-Measuring Device*—The axial load-measuring device may be a load ring, electronic load cell, hydraulic load cell, or any other load-measuring device capable of the accuracy prescribed in this subsection and may be part of the axial loading device. The axial load-measuring device shall be capable of measuring the axial load to an accuracy of within $\pm 1\%$ of the axial load at failure. If the load-measuring device is located inside the triaxial chamber it shall be insensitive to horizontal forces and to the magnitude of the chamber pressure.

5.4 *Triaxial Compression Chamber*—The triaxial chamber shall consist of a headplate and a baseplate separated by a cylinder. The size of the cylinder should be enough to yield a minimum annular clearance of $\frac{1}{2}$ in. (12 mm) with the untested specimen. The cylinder may be constructed of any material capable of withstanding the applied pressures. It is desirable to use a transparent material or have a cylinder provided with viewing ports so the behavior of the specimen may be observed. The headplate shall have a vent valve such that air can be forced out of the chamber as it is filled. The baseplate shall have an inlet through which the pressure liquid is supplied to the chamber, and appropriate connections for the specimen base.

5.5 *Axial Load Piston*—The piston passing through the top of the chamber and its seal must be designed so the variation in the axial load due to friction does not exceed 0.1 % of the axial load at failure and so there is negligible lateral bending of the piston during loading. Alternatively, the apparatus may be calibrated, and a correction for friction may be made.

NOTE 4—The use of two linear ball bushings to guide the piston is recommended to minimize friction and maintain alignment.

NOTE 5—A minimum piston diameter of $\frac{1}{8}$ the specimen diameter has been used successfully in many laboratories to minimize lateral bending.

5.6 *Pressure Control Devices*—The chamber pressure control devices shall be capable of applying and controlling pressures to within ± 0.25 psi (2 kPa) for pressures less than 28 psi (200 kPa) and to within $\pm 1\%$ for pressures greater than 28 psi (200 kPa). The device may consist of self-compensating mercury pots, pneumatic pressure regulators, or any other device capable of applying and controlling pressures to the required tolerances.

5.7 *Pressure-Measurement Devices*—The chamber pressure measuring devices shall be capable of measuring pressures to the tolerances given in 5.6. They may consist of Bourdon gages, pressures manometers, electronic pressure transducers, or any other device capable of measuring to the stated tolerances.

5.8 *Deformation Indicator*—The vertical deformation of the specimen is usually determined from the travel of the piston acting on top of the specimen. The piston travel shall be measured with an accuracy of at least $\pm 0.2\%$ of the initial specimen height. The deformation indicator shall have a travel range of at least 20 % of the initial height of the specimen and may be a dial indicator, linear variable differential transformer (LVDT), extensometer, or other measuring device meeting the requirements for accuracy and range.

5.9 *Specimen Cap and Base*—The specimen cap and base shall be constructed of a rigid, noncorrosive, impermeable material, and shall have a circular plane surface of contact with the specimen and a circular cross section. The weight of the specimen cap shall be less than 0.5 % of the applied axial load at failure or less than 0.1 lb (50 g). The diameter of the cap and base shall be equal to the initial diameter of the specimen. The specimen base shall be connected to the triaxial compression chamber to prevent lateral motion or tilting, and the specimen cap shall be designed to receive the piston such that eccentricity of the piston-to-cap contact relative to the vertical axis of the specimen does not exceed 0.05 in. (0.13 cm). The end of the piston and specimen cap contact area shall be designed so that tilting of the specimen cap during the test is minimal. The cylindrical surface of the specimen base and cap that contacts the membrane to form a seal shall be smooth and free of scratches.

5.10 *Rubber Membrane*—The rubber membrane used to encase the specimen shall provide reliable protection against leakage. To check a membrane for leakage, the membrane shall be placed around a cylindrical form, sealed at both ends with rubber O-rings, subjected to a small air pressure on the inside, and immersed in water. If air bubbles appear from any point on the membrane, it shall be rejected. To offer minimum restraint to the specimen, the unstretched membranes diameter shall be between 90 and 95 % of that specimen. The membrane thickness shall not exceed 1 % of the diameter of the specimen. The membrane shall be sealed to the specimen cap and base with rubber O-rings with an unstressed inside diameter between 75 and 85 % of the diameter of the cap and base, or by other means that will provide a positive seal. An equation for