



Standard Test Methods for One-Dimensional Swell or Collapse of Soils¹

This standard is issued under the fixed designation D4546; 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 standard covers two laboratory test methods for measuring the magnitude of one-dimensional wetting-induced swell or collapse of unsaturated soils and one method for measuring load-induced compression subsequent to wetting-induced deformation.

1.1.1 Test Method A is a procedure for measuring one-dimensional wetting-induced swell or hydrocompression (collapse) of reconstituted specimens simulating field condition of compacted fills. The magnitude of swell pressure (the minimum vertical stress required to prevent swelling), and free swell (percent swell under a pressure of 1 kPa or 20 lbf/ft²) can also be determined from the results of Test Method A.

1.1.2 Test Method B is a procedure for measuring one-dimensional wetting-induced swell or collapse deformation of intact specimens obtained from a natural deposit or from an existing compacted fill. The magnitude of swell pressure and free swell can also be determined from the results of Test Method B.

1.1.3 Test Method C is a procedure for measuring load-induced strains on a reconstituted or intact specimen after the specimen has undergone wetting-induced swell or collapse deformation.

1.2 In Test Method A, a series of reconstituted specimens duplicating compaction condition of the fine fraction of the soil in the field (excluding the oversize particles) are assembled in consolidometer units. Different loads corresponding to different fill depths are applied to different specimens and each specimen is given access to free water until the process of primary swell or collapse is completed (Fig. 1) under a constant vertical total stress (Fig. 2). The resulting swell or collapse deformations are measured. This test method can be referred to as *wetting-after-loading tests* on multiple reconstituted specimens. The data from these tests can be used to estimate one-dimensional ground surface heave or settlement that can occur due to full wetting after fill construction. In

addition, the magnitude of swell pressure and the magnitude of free swell can be interpreted from the test results.

1.3 Test Method B is commonly used for measuring one-dimensional wetting-induced swell or hydrocompression of individual intact samples. This method can be referred to as *single-point wetting-after-loading test*. The vertical pressure at wetting for the specimen is chosen equal to the vertical in-situ stress (overburden stress plus structural stress, if any) corresponding to the sampling depth. The test result indicates the amount of heave or hydrocompression that can result when the soil at a given fill depth is wetted from the current moisture condition to full inundation condition. If intact specimens from various depths are tested, the swell or collapse strain data can be used to estimate heave or settlement of the ground surface. If the objective of the test is to measure swell pressure for an expansive soil, a series of intact specimens from a given depth zone can be wetted under a range of pressures (similar to Test Method A) and the results interpreted to determine the magnitude of the swell pressure.

1.4 Test Method C is for measuring load-induced strains after wetting-induced swell or collapse deformation has occurred. This method can be referred to as *loading-after-wetting test*. The test can be performed on either intact or reconstituted specimens, and can be on one specimen or a series of specimens. The results would apply to situations where new fill, additional structural loads, or both, are applied to the ground that has previously gone through wetting-induced heave or settlement. The first part of the test is the same as in Test Method A or B. After completion of the swell or collapse under a given vertical load, additional vertical load increments are applied to the specimen in the same manner as in a consolidation test (Test Methods D2435) and the load-induced strains are measured.

1.5 It shall be the responsibility of the agency requesting this test to specify the magnitude of each load for Test Method A and Test Method B. For Test Method C, the agency requesting the test should specify the magnitude of the stress under which the specimen is wetted, and the magnitudes of the additional stress increments subsequent to wetting.

1.6 These test methods do not address the measurement of soil suction and suction-controlled swell-collapse tests. The addition of suction-controlled wetting does not constitute nonconformance to these test methods.

¹ These test methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.05 on Strength and Compressibility of Soils.

Current edition approved March 1, 2014. Published April 2014. Originally approved in 1985. Last previous edition approved in 2008 as D4546 – 08. DOI: 10.1520/D4546-14.