~~Designation:D4829–95~~ Designation: D 4829 – 08

Standard Test Method for Expansion Index of Soils[1]

This standard is issued under the fixed designation D 4829; 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.

Note—Table 1 was editorially updated and the year date was changed on April 18, 2008.

1. Scope*

1.1 This test method ~~provides an index to the~~allows for determination of expansion potential of compacted soils when inundated with distilled water.[2]

~~1.2This test method controls variables that influence the expansive characteristics of soils and still retains a relatively simple test for practical engineering applications.~~

1.2 This test method provides a simple yet sensitive method for determination of expansion potential of compacted soils for practical engineering applications using an index parameter.

1.3 The values stated in SI units are to be regarded as the standard. The values stated in inch-pound units are approximate.

~~1.4~~

1.4 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D 6026.

1.4.1 The method used to specify how data are collected, calculated, or recorded in this standard is not directly related to the accuracy to which the data can be applied in design or other uses, or both. How one applies the results obtained using this standard is beyond its scope.

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.*

2. Referenced Documents

2.1 *ASTM Standards:* [3]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids

D 698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12~~,~~ 400 ft-lbf/ft^3(600 kN-m/m^3))

D 854~~Test Method for Specific Gravity of Soils~~[3] Test Methods for Specific Gravity of Soil Solids by Water Pycnometer

D 2216 Test Method~~s~~ for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass

D 2435~~Test Method for One-Dimensional Consolidation Properties of Soils~~[3] Test Methods for One-Dimensional Consolidation Properties of Soils Using Incremental Loading

D 3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D 3877~~Test Methods for One-Dimensional Expansion, Shrinkage, and Uplift Pressure of Soil-Lime Mixtures~~[3]

~~D4318Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils~~[3] Test Methods for One-Dimensional Expansion, Shrinkage, and Uplift Pressure of Soil-Lime Mixtures

D 4753~~Specification for Evaluating, Selecting, and Specifying Balances and Scales for Use in Testing Soil, Rock and Related Construction Materials Testing~~[3] Guide for Evaluating, Selecting, and Specifying Balances and Standard Masses for Use in Soil, Rock, and Construction Materials Testing

D 6026 Practice for Using Significant Digits in Geotechnical Data

E 11~~Specification for Wire-Cloth Sieves for Testing Purposes~~ Specification for Wire Cloth and Sieves for Testing Purposes

~~[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.05 on Structural Properties of Soils.~~

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[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] Refer to Anderson, J. N., and Lade, P. V., "The Expansion Index Test," *Geotechnical Testing Journal*, Vol 4, No. 2, ASTM, 1981, pp. 58–67.

[3] 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* ~~, Vol 04.08:~~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.**

E 145 Specification for Gravity-Convection and Forced-Ventilation Ovens

3. Terminology

~~3.1Refer to Terminology D653 for standard definitions of terms. Additional terms are as follows:~~

~~3.2*expansion index, EI*~~

3.1 For common definitions of other terms used in this Test Method, refer to Terminology D 653.

3.2 *Definitions:*

3.2.1 *scarification*—scratching the surface of a compacted layer to facilitate bonding with the next layer to avoid potential separation between compacted layers.

3.3 *Definitions of Terms Specific to This Standard:*

3.3.1 *expansion index (EI), n*—1000 times the difference between final and initial height of the specimen divided by the initial height.

4. Summary of Test Method

~~4.1The specimen is compacted into a metal ring so that the degree of saturation is between 40 and 60% and the specimen and the ring are placed in a consolidometer. A vertical confining pressure of 6.9 kPa (1 lbf/in.~~

4.1 A specimen is prepared by compacting a test soil into a metal ring at a degree of saturation of 50 ± 2 %. The specimen and the ring are then placed in a consolidometer. A vertical confining pressure of 6.9 kPa (1 lbf/in.^{2}) is applied to the specimen and ~~then~~ the specimen is then inundated with distilled water. The deformation of the specimen is recorded for 24 h or until the rate of deformation becomes less than ~~0.0005~~0.005 mm/h (0.0002 in./h), whichever occurs first. A minimum recording time of 3 h is required.

5. Significance and Use

~~5.1The expansion index, *EI*, is used to measure a basic index property of soil and therefore, the *EI* is comparable to other indices such as the liquid limit, plastic limit, and plasticity index of soils, as in Test Method D4318~~

5.1 The expansion index, *EI*, provides an indication of swelling potential of a compacted soil.

5.2 The *EI* test is not used to duplicate any particular field conditions such as soil density, water content, loading, in-place soil structure, or soil water chemistry. However, consistent test conditions are used in preparation of compacted specimens such that direct correlation of data can be made between organizations.

NOTE 1—Qualitative classification of potential expansion in a soil based on *EI* is provided in Table 1.

~~5.2The *EI* is not used to duplicate any particular field conditions such as soil density, water content, loading, in-place soil structure or soil water chemistry. However, the test procedure keeps all conditions constant allowing direct correlation of data between organizations. All organizations can benefit from these collective experiences.~~

~~5.3The classification of a potentially expansive soil is based on the following table:~~

~~Expansion Index, EI~~	~~Potential Expansion~~
~~0–20~~	~~Very Low~~
~~21–50~~	~~Low~~
~~51–90~~	~~Medium~~
~~91–130~~	~~High~~
~~>130~~	~~Very High~~

NOTE 2—Notwithstanding the statements on precision and bias contained in this test method: The precision of this test method is dependent on the competence of the personnel performing it and the suitability of the equipment and facilities used. Agencies which meet the criteria of Practice D 3740 are generally considered capable of competent testing. Users of this test method are cautioned that compliance with Practice D 3740 does not ensure reliable testing. Reliable testing depends on several factors; Practice D 3740 provides a means of evaluating some of those factors.

TABLE 1 *EI*

~~AverageExpansion Index~~	~~Standard Deviation (1s limit)~~	~~Difference Two-St~~andard-Deviation Limit (d2s limit)
Expansion Index, *EI*	Potential ~~(1s limit)~~	~~Difference Two-St~~Expansion
~~56~~	~~11~~	~~30~~
0–20	~~11~~	~~30~~Very Low
~~76~~	~~14~~	~~39~~
21–50	~~14~~	~~39~~Low
~~77~~	~~Medium~~	
51–90	Medium	
~~918~~	~~5High~~	
91–130	High	
~~>130~~		
>130	Very High	

6. Apparatus

6.1 *Mold*—The mold shall be cylindrical in shape, made of metal, and shall have the capacity and dimensions indicated in Fig. 1. ~~It~~ The mold shall have a detachable collar inscribed with a mark ~~5.08~~50.8 mm (2.00 in.) above the base. The lower section of the mold is designed to retain a removable stainless steel ring ~~2.54~~25.4 mm (1 in.) in height, ~~10.19~~101.9 mm (4.01 in.) in internal diameter, and not less than ~~0.31~~3.10 mm (0.120 in.) in wall thickness.

6.2 *Rammer*~~—A metal rammer having a 5.08 mm (2.00 in.) diameter circular face and weighing 2.5 kg (5.5 lbf) shall be equipped with a suitable arrangement to control height of drop to a free fall of 30.5 mm (12 in.) above the top of the soil. See Test Methods D698 for specification of a suitable rammer.~~ —A metal rammer with a circular face with a diameter of 50.8 mm (2.00 in.) and a mass of 2.5 kg (5.5 lbm) shall be used. The rammer shall be equipped with a suitable arrangement to control height of drop to a free fall of 304.8 mm ± 1.3mm (12 in. ± 0.05 in.) over the top of the soil to be compacted. See Test Methods D 698 for further specification of a suitable rammer.

6.3 *Balance*—A balance of at least 1000 g capacity meeting the requirements of ~~Specification~~Guide D 4753, Class GP2. ~~Note1—For further information refer to Specification D4753.~~

6.4 *Drying Oven*~~—A thermostatically controlled drying oven capable of maintaining a temperature of 110 ± 5°C (230± 9°F) for drying moisture samples.~~ —A thermostatically controlled drying oven (specified in Specification E 145) capable of maintaining a temperature of 110 ± 5°C (230 ± 9°F) for drying water content samples.

6.5 *Straight Edge*~~—Steel straight edge 30.5 mm (12 in.) in length and having one bevelled edge.~~ —Steel straight edge at least 150 mm (6 in.) in length with one beveled edge.

6.6 *Sieves*—A 4.75-mm (No. 4) sieve conforming to the requirements of Specification E 11.

6.7 *Mixing Tools*—Miscellaneous tools such as mixing pans, spoons, trowels, spatula, ~~and so forth, or~~ a suitable mechanical device, and so forth for thoroughly mixing the sample of soil with ~~increments of~~ water.

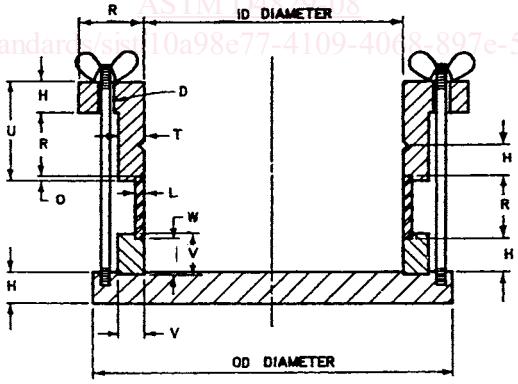
6.8 *Loading Device*—A consolidometer or equivalent loading device as described in Test Methods D 2435 for supporting and submerging the specimen, for applying a vertical load, and for measuring the change in height of the specimen. The consolidometer ring must be as specified in 6.1.

6.9 *Porous Disks*—The disks shall be smooth ground and fine enough (Note 3) to minimize intrusion of soil into the ~~disks and~~ disks. The disk shall reduce false displacements caused by seating of the specimen against the surface of ~~porous disks (Note 2).~~ the disk. Such displacements ~~may be~~are significant, especially if displacements and applied vertical pressures are small.

NOTE ~~2—A~~ 3—A suitable pore size is 10 µm.

6.9.1 Porous disks shall be air dry.

~~6.9.2Porous disks shall fit close to the consolidometer ring to avoid extrusion or punching. Suitable disk tolerances are described in 6.3 of Test Method D2435~~



Letter	in.	Tolerances (in.)	mm	Tolerances (mm)
ID	4.010	± 0.005	101.9	± 0.1
OD	6.00	± 1.01	152.4	± 0.2
H	0.50	± 0.01	12.7	± 0.2
D (Hole)	7/32	+ 1/64	5.5	+ 0.2
U	1.625	± 0.01	41.3	±0.2
T	0.325	± 0.01	9.5	± 0.2
O	0.125	± 0.004	3.2	± 0.1
R	1.00	± 0.01	25.4	± 0.2
W	0.563	± 0.004	14.3	± 0.1
V	0.688	± 0.01	17.5	± 0.2
L	0.120	± 0.000	3.05	± 0.0

FIG. 1 Mold with Ring for Compaction of Specimen for Expansion Index Test