



Designation: D1883 – 21

Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils¹

This standard is issued under the fixed designation D1883; 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.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers the determination of the California Bearing Ratio (CBR) of laboratory compacted specimens. The test method is primarily intended for, but not limited to, evaluating the strength of materials having maximum particle size less than $\frac{3}{4}$ in. (19 mm).

1.2 When materials having a maximum particle size greater than $\frac{3}{4}$ in. (19 mm) are to be tested, this test method provides for modifying the gradation of the material so that the material used for testing all passes the $\frac{3}{4}$ -in. (19-mm) sieve while the total gravel fraction (material passing the 3-in. (75-mm) sieve and retained on the No. 4 (4.75-mm) sieve) remains the same. While traditionally this method of specimen preparation has been used to avoid the error inherent in testing materials containing large particles in the CBR test apparatus, the modified material may have significantly different strength properties than the original material. However, a large experience database has been developed using this test method for materials for which the gradation has been modified, and satisfactory design methods are in use based on the results of tests using this procedure.

1.3 Past practice has shown that CBR results for those materials having substantial percentages of particles retained on the No. 4 (4.75 mm) sieve are more variable than for finer materials. Consequently, more trials may be required for these materials to establish a reliable CBR.

1.4 This test method provides for the determination of the CBR of a material at optimum water content or a range of water contents from a specified compaction test and a specified dry unit weight. The dry unit weight is usually given as a percentage of maximum dry unit weight determined by Test Methods D698 or D1557.

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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1.4.1 The client requesting the CBR test may specify the water content or range of water contents and/or the dry unit weight for which the CBR is desired.

1.5 Unless specified otherwise by the requesting client, or unless it has been shown to have no effect on test results for the material being tested, all specimens shall be soaked prior to penetration.

1.6 *Units*—The values stated in inch-pound units are to be regarded as standard. The SI units given in parentheses are mathematical conversions, which are provided for information purposes only and are not considered standard. Reporting of test results in units other than inch-pound units shall not be regarded as nonconformance with this test method.

1.6.1 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. The slug unit is not given, unless dynamic ($F = ma$) calculations are involved.

1.6.2 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.

1.6.3 It is common practice in the engineering/construction profession, in the United States, 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.

1.6.4 The terms density and unit weight are often used interchangeably. Density is mass per unit volume whereas unit weight is force per unit volume. In this standard, density is given only in SI units. After the density has been determined, the unit weight is calculated in SI or inch-pound units, or both.

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

1.7 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice **D6026**.

1.7.1 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 analytical methods for engineering design.

1.8 *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.*

1.9 *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

- C670** Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
- D653** Terminology Relating to Soil, Rock, and Contained Fluids
- D698** Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³))
- D1557** Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³))
- D2168** Practices for Calibration of Laboratory Mechanical-Rammer Soil Compactors
- D2216** Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- 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
- 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

- 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
- E11** Specification for Woven Wire Test Sieve Cloth and Test Sieves

3. Terminology

3.1 Definitions:

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

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *water content of the compaction specimen, w_p* , n —water content in percent of material used to compact the test specimen.

3.2.2 *water content top 1 in. (25-mm) after soaking, w_{sp}* , n —water content in percent of upper 1 in. (25 mm) of material removed from the compacted specimen after soaking and penetration.

3.2.3 *water content after testing, w_p* , n —water content in percent of the compacted specimen after soaking and final penetration; does not include material described in **3.2.2**.

3.2.4 *dry density as compacted and before soaking, ρ_{dr}* , n —dry density of the as compacted test specimen using the measured wet mass and calculating the dry mass using the water content defined in **3.2.1**.

4. Summary of Test Method

4.1 The California Bearing Ratio (CBR) is an index of the bearing resistance of a compacted soil by forcing a circular piston at a constant rate of penetration into the soil and measuring the force during penetration. The CBR is expressed as the ratio of the unit force on the piston required to penetrate 0.1 in. (3 mm) and 0.2 in. (5 mm) of the test material to the unit force required to penetrate a standard material of well-graded crushed stone.

4.2 This test method is used to determine the CBR of a material compacted in a specified mold. It is incumbent on the requesting client to specify the scope of testing to satisfy the client's protocol or specific design requirements. Possible scope of testing includes:

4.2.1 CBR penetration tests can be performed on each point of a compaction test specimen prepared in accordance with either Method C of Test Methods **D698** or **D1557**. The CBR mold with the spacer disk specified in this standard has the same internal dimensions as a 6.000-in. (152.4-mm) diameter compaction mold.

4.2.2 Another alternative is for the CBR test to be performed on material compacted to a specific water content and density so as to bracket those anticipated in the field. A water content range may be stated for one or more density values and will often require a series of specimens prepared using two or three compactive efforts for the specified water contents or over the range of water contents requested. The compactive efforts are achieved by following procedures of Test Methods

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.