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## Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>))<sup>1</sup>

This standard is issued under the fixed designation D698; 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 ( $\epsilon$ ) 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 These test methods cover laboratory compaction methods used to determine the relationship between molding water content and dry unit weight of soils (compaction curve) compacted in a 4 or 6-in. (101.6 or 152.4-mm) diameter mold with a 5.50-lbf (24.5-N) rammer dropped from a height of 12.0 in. (305 mm) producing a compactive effort of 12 400 ft-lbf/ft<sup>3</sup> (600 kN-m/m<sup>3</sup>).

**Note 1**—The equipment and procedures are similar as those proposed by R. R. Proctor (*Engineering News-Record*—September 7, 1933) with this one major exception: his rammer blows were applied as “12 inch firm strokes” instead of free fall, producing variable compactive effort depending on the operator, but probably in the range 15 000 to 25 000 ft-lbf/ft<sup>3</sup> (700 to 1200 kN-m/m<sup>3</sup>). The standard effort test (see 3.1.4) is sometimes referred to as the Proctor Test.

1.1.1 Soils and soil-aggregate mixtures are to be regarded as natural occurring fine- or coarse-grained soils, or composites or mixtures of natural soils, or mixtures of natural and processed soils or aggregates such as gravel or crushed rock. Hereafter referred to as either soil or material.

1.2 These test methods apply only to soils (materials) that have 30 % or less by mass of particles retained on the 3/4-in. (19.0-mm) sieve and have not been previously compacted in the laboratory; that is, do not reuse compacted soil.

1.2.1 For relationships between unit weights and molding water contents of soils with 30 % or less by mass of material retained on the 3/4-in. (19.0-mm) sieve to unit weights and molding water contents of the fraction passing 3/4-in. (19.0-mm) sieve, see Practice [D4718/D4718M](#).

1.3 Three alternative methods are provided. The method used shall be as indicated in the specification for the material being tested. If no method is specified, the choice should be based on the material gradation.

#### 1.3.1 Method A:

1.3.1.1 *Mold*—4-in. (101.6-mm) diameter.

1.3.1.2 *Material*—Passing No. 4 (4.75-mm) sieve.

1.3.1.3 *Layers*—Three.

1.3.1.4 *Blows per Layer*—25.

1.3.1.5 *Usage*—May be used if 25 % or less (see 1.4) by mass of the material is retained on the No. 4 (4.75-mm) sieve.

1.3.1.6 *Other Usage*—If this gradation requirement cannot be met, then Method C may be used.

#### 1.3.2 Method B:

1.3.2.1 *Mold*—4-in. (101.6-mm) diameter.

1.3.2.2 *Material*—Passing 3/4-in. (9.5-mm) sieve.

1.3.2.3 *Layers*—Three.

1.3.2.4 *Blows per Layer*—25.

1.3.2.5 *Usage*—May be used if 25 % or less (see 1.4) by mass of the material is retained on the 3/4-in. (9.5-mm) sieve.

1.3.2.6 *Other Usage*—If this gradation requirement cannot be met, then Method C may be used.

#### 1.3.3 Method C:

1.3.3.1 *Mold*—6-in. (152.4-mm) diameter.

1.3.3.2 *Material*—Passing 3/4-in. (19.0-mm) sieve.

1.3.3.3 *Layers*—Three.

1.3.3.4 *Blows per Layer*—56.

1.3.3.5 *Usage*—May be used if 30 % or less (see 1.4) by mass of the material is retained on the 3/4-in. (19.0-mm) sieve.

1.3.4 The 6-in. (152.4-mm) diameter mold shall not be used with Method A or B.

**Note 2**—Results have been found to vary slightly when a material is tested at the same compactive effort in different size molds, with the smaller mold size typically yielding larger values of density/unit weight (1, pp. 21+).

1.4 If the test specimen contains more than 5 % by mass of oversize fraction (coarse fraction) and the material will not be included in the test, corrections must be made to the unit mass and molding water content of the specimen or to the appropriate field-in-place density test specimen using Practice [D4718/D4718M](#).

1.5 This test method will generally produce a well-defined maximum dry unit weight for non-free draining soils. If this

<sup>1</sup> These Test Methods are under the jurisdiction of ASTM Committee D18 on Soil and Rock and are the direct responsibility of Subcommittee D18.03 on Texture, Plasticity and Density Characteristics of Soils.

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<sup>ε</sup> The boldface numbers in parentheses refer to the list of referencers at the end of this standard.

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

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**United States. Federal Aviation  
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## **Astm D 698:**

Geotechnical Properties of Oil Shale Retorted by the PARAHO and TOSCO Processes Frank C. Townsend, Richard W. Peterson, 1979 *National Handbook of Conservation Practices* United States. Soil Conservation Service, 1978

**Standards for Specifying Construction of Airports** United States. Federal Aviation Administration, 1989 *A Review of the Physical and Engineering Properties of Raw and Retorted Oil Shales from the Green River Formation* Donald Snethen, Warren J. Farrell, Frank C. Townsend, 1977

**Hazardous Waste Site Soil Remediation** David J. Wilson, 1993-10-28 Introduces the most up to date techniques for soil remediation including chemical fixation stabilization soil vapor extraction thermally enhanced vapor stripping biodegradation and air sparging written in a style accessible to nonspecialists Describes the existing technique of thermal desorption of soil contaminants a low cost alternative to incineration for the removal of organics

**Recent Advancements on Expansive Soils** John S. McCartney, Laureano R. Hoyos, 2018-10-29 This volume includes a collection of technical papers on an important topic in geotechnical engineering the behavior and treatment of expansive soils The research studies include investigations into novel stabilization techniques for expansive soils using different admixtures or mechanical consolidation techniques as well as new experimental approaches to evaluate the behavior of expansive soils They also include an evaluation of wetting boundary conditions on the volume change of expansive soils as well as the role of hydrologic boundary conditions in arid climates The volume is based on the best contributions to the 2nd GeoMEast International Congress and Exhibition on Sustainable Civil Infrastructures Egypt 2018 The official international congress of the Soil Structure Interaction Group in Egypt SSIGE

*Getty and Cities Service Shale Oil Projects, Garfield County*, 1984

**Forensic Geotechnical and Foundation Engineering, Second Edition** Robert W. Day, 2011-06-08 A complete up to date guide for forensic engineers Fully revised and packed with current case studies Forensic Geotechnical and Foundation Engineering Second Edition provides a step by step approach to conducting a professional forensic geotechnical and foundation investigation This authoritative resource explains how to Investigate damage deterioration and collapse in a structure Determine what caused the damage Develop repair recommendations Diagnose cracks Prepare files and reports Avoid civil liability Helpful charts and photographs aid in your understanding of the material covered With expert advice on all aspects of the process from accepting the assignment to delivering compelling testimony this is a practical all in one guide to geotechnical and foundation investigations in forensic engineering Explains how to investigate damage due to Settlement of structures Expansive soil Lateral Movement Earthquakes Erosion Deterioration Bearing Capacity Failures Shrinkage Cracking of Concrete Foundations Timber Decay Soluble Soil Groundwater and Moisture Problems And Other Causes

**Santa Ana River Main Stem and Santiago Creek**, 1978

**Earth Manual** United States. Bureau of Reclamation, 1990 *Illinois Standard Specifications for Construction of Airports*, 1985

**Geotechnical Engineer's Portable Handbook** Robert Day, 1999-12-02 One volume library of instant

geotechnical and foundation data Now for the first time ever geotechnical foundation and civil engineers geologists architects planners and construction managers can quickly find information they must refer to every working day in one compact source Edited by Robert W Day the time and effort saving Geotechnical Engineer s Portable Handbook gives you field exploration guidelines and lab procedures You ll find soil and rock classification basic phase relationships and all the tables and charts you need for stress distribution pavement and pipeline design You also get abundant information on all types of geotechnical analyses including settlement bearing capacity expansive soil slope stability plus coverage of retaining walls and building foundations Other construction related topics covered include grading instrumentation excavation underpinning groundwater control and more

**Manual of Soil Laboratory Testing** K. H. Head,R. Epps,2006 This working manual covers the basic tests for the classification and compaction characteristics of engineering soils The book includes the use of flow diagrams and sets out test data and calculations It is useful to those engaged in the testing of soils in a laboratory for building and civil engineering purposes

**Aerodrome Design Manual** International Civil Aviation Organization,1980

**Aerodrome Design Manual: Pavements** International Civil Aviation Organization,1983

Proceedings ,2001 *Pavement Base and Foundation Materials, Deformation Characteristics of Subgrade, and Properties of Unconventional Aggregates* ,1997

**Geotechnical and Foundation Engineering** Robert W. Day,1999 This study presents practical aspects of geotechnical and foundtion engineering with the emphasis on visual aspects It develops a project and uses it as an example for the way to conduct design and construction methods and procedures

Florida Administrative Weekly ,1992 **Journal of Geotechnical Engineering** ,1996

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