



Designation: D4542 – 15

## Standard Test Methods for Pore Water Extraction and Determination of the Soluble Salt Content of Soils by Refractometer<sup>1</sup>

This standard is issued under the fixed designation D4542; 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.

### 1. Scope\*

1.1 These test methods cover a rapid procedure for squeezing pore water from finegrained soils for the purpose of determining the amount of soluble salts present in the extracted pore water.

1.2 These test methods were developed for soils having a water content equal to or greater than approximately 14 %, for example, marine soils. An extensive summary of procedures for extracting pore water from soils has been presented by Kriukov and Manheim (1).<sup>2</sup>

1.3 These test methods are not generally applicable for determining the soluble salt content of the pore water extracted from coarse-grained soils, such as clean sands and gravels.

1.4 Test Method A provides a procedure using a refractometer with a refraction index scale; Test Method B provides a procedure using a refractometer with a parts per thousand (ppt) scale.

1.5 *Units*—The values stated in SI units are to be regarded as the standard.

1.6 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026 unless superseded by these test methods.

1.6.1 The procedures used to specify how data are collected/recorded and calculated in the 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 these test methods to consider significant digits used in analysis methods for engineering data.

1.7 *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.*

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

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction

D6026 Practice for Using Significant Digits in Geotechnical Data

E832 Specification for Laboratory Filter Papers

2.2 *Federal Document*:

GG-S-945a Specification for Syringe and Needle, Disposable, Hypodermic, Sterile, Single Injection<sup>4</sup>

### 3. Terminology

3.1 *Definitions*:

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

### 4. Significance and Use

4.1 The soluble salt content may be used to correct the index properties of soils such as water content, void ratio, specific gravity, degree of saturation, and dry density).

4.2 Minimize the time period between sampling and testing to reduce chemical changes, which may occur within the soil sample.

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.06 on Physical-Chemical Interactions of Soil and Rock.

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<sup>2</sup> The boldface numbers in parentheses refer to the list of references appended to this standard.

<sup>3</sup> 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.

<sup>4</sup> Available from Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, PA, 19120.

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

NOTE 1—The quality of the result produced by this standard 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 standard are cautioned that compliance with Practice D3740 does not in itself ensure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

NOTE 2—Hulbert and Brindle (2) and Torrance (3) have shown that prolonged storage should be avoided as unpredictable and non-reproducible chemical changes may occur.

## 5. Apparatus

5.1 *Refractometer*—A temperature compensated refractometer scaled to either index of refraction or ppt (parts per thousand). A typical hand held refractometer is shown in Fig. 1.

5.2 *Soil Press*—The apparatus shall conform to the example shown in Fig. 2. It should be constructed from material appropriate for the application and chemically compatible with the material being tested.

5.3 *Syringe*—A 25-cm<sup>3</sup> syringe without needle, in accordance with Fed. Std. GG-S-945a.

5.4 *Balance*—A balance capable of determining mass with a readability of  $\pm 0.01$  g.

### 5.5 Filter Paper:

5.5.1 A general purpose quantitative filter paper in accordance with Specification E832, Type II, Class F, for medium crystalline precipitates in the size range from 5 to 10  $\mu\text{m}$ , with an ash content of 0.13 mg/12.5-cm circle. Cut filter paper to a diameter of 55 mm.

5.5.2 A general purpose quantitative filter paper in accordance with Specification E832, Type II, Class G, for fine crystalline precipitates in the size range from 0.45  $\mu\text{m}$ , with an ash content of 0.13 mg/12.5-cm circle. Cut filter paper to a diameter of 25 mm.

5.6 *Refrigerator*—Cooling unit capable of maintaining a uniform temperature between 1 and 5°C.



FIG. 1 Typical Hand-Held Refractometer

5.7 *Micro-Syringe Filter Holder*—A device to filter a liquid directly from a syringe.<sup>5</sup>

5.8 *100-mL Polyethylene or Glass Bottle and Cap*.

5.9 *Miscellaneous Supplies*—Distilled water, alcohol, diluted HCl (1:10), detergent, and optional sterile bags for sample storage (see 8.6).

## 6. Reagents

6.1 *Purity of Reagents*—Reagent grade chemicals shall be used in all tests. Unless otherwise indicated, it is intended that all reagents shall conform to the specifications of the Committee on Analytic Reagents of the American Chemical Society, where such specifications are available.<sup>6</sup>

6.1.1 Hydrochloric Acid diluted 1:10

6.1.2 Alcohol

6.1.3 Chromic acid

6.1.4 Acetone

## 7. Preparation of Apparatus

7.1 Wash the parts of the press thoroughly. Rinse twice with distilled water and dry. Rust should not be present, especially inside or around the top of the cylinder. If rust is present, scrub gently with steel wool and soap or chromic acid. Rinse well with tap water and then twice with distilled water and dry.

7.2 If the press parts have been coated with rust preventer, wash them with alcohol and rinse once with tap water and twice with distilled water.

7.3 Dry by a method that will not contaminate the press. Clean compressed air, oven or air drying, or rinsing with acetone followed by air drying are acceptable.

7.4 Assemble the press.

NOTE 3—To prevent mud from circumventing the stainless steel wire screen, use flexible TFE-fluorocarbon gaskets on each side.

## 8. Sampling and Test Specimen Squeezing

8.1 Select a representative soil sample of approximately 50 g and place into the cylinder on top of a single sheet of 5 to 10- $\mu\text{m}$  (55-mm) filter paper.

8.2 Apply pressure slowly until the first drops of water are expelled, then insert a clean, disposable, syringe (25 mL) in the effluent passage shown in Fig. 2. This process reduces the amount of air in the syringe and therefore, the amount of evaporation.

8.3 Apply pressure gradually to a maximum of 80 MPa, and hold until no more water is expelled or until the syringe is full (see Note 4 and Note 5).

8.4 Withdraw the syringe when the pressure is at a maximum and immediately expel the fluid from the syringe through

<sup>5</sup> An apparatus such as the stainless steel Millipore Micro-Syringe Filter Holder XX30-025-00 is satisfactory for this purpose.

<sup>6</sup> Reagent Chemicals, American Chemical Society Specifications," American Chemical Society, Washington, DC. For suggestions on the testing of reagents lot listed by the American Chemical Society, see "Reagent Chemicals and Standards," by Joseph Rosin, D. Van Nostrand Co., Inc., New York, NY, and the "United States Pharmacopeia."