Designation: ~~D4972 – 01 (Reapproved 2007)~~ D4972 – 13

Standard Test Method for pH of Soils[1]

This standard is issued under the fixed designation D4972; 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~~ Scope*

1.1 This test method covers the measurement of the pH of soils for uses other than for corrosion testing. Such measurements are used in the agricultural, environmental, and natural resources fields. This measurement determines the degree of acidity or alkalinity in soil materials suspended in water and a 0.01 *M* calcium chloride solution. Measurements in both liquids are necessary to fully define the soil's pH. This variable is useful in determining the solubility of soil minerals and the mobility of ions in the soil and assessing the viability of the soil-plant environment. A more detailed discussion of the usefulness of this parameter is not warranted here; however, it can be found in many discussions of the subject. A few such discussions are given as Refs **(1-6)**[2] at the end of the text.

1.2 The values ~~given~~stated in SI units are to be regarded as ~~the~~ standard. No other units of measurement are included in this standard.

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

1.4 *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]

C670 Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials
D653 Terminology Relating to Soil, Rock, and Contained Fluids
D1193 Specification for Reagent Water
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
G51 Test Method for Measuring pH of Soil for Use in Corrosion Testing

3. Terminology

3.1 *Definitions:*

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

4. Summary of Test Method

4.1 Measurement of the pH of soils in both suspensions of water and a calcium chloride solution are made with either a potentiometer using a pH sensitive electrode system (Method A), or pH sensitive paper (Method B). The potentiometer is calibrated with buffer solutions of known pH. The pH sensitive paper is a less accurate measurement and should only be used for a rough estimate of the soil pH. The electrode must be used for this measurement unless the pH sensitive paper is specified.

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

[1] This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.22 on Soil as a Medium for Plant Growth.

Current edition approved ~~Sept. 1, 2007~~Nov. 1, 2013. Published ~~October 2007~~November 2013. Originally approved in 1989. Last previous edition approved in ~~2001~~2007 as ~~D4972 – 01.~~D4972 – 01 (2007). DOI: ~~10.1520/D4972-01R07.~~10.1520/D4972-13.

[2] The boldface numbers in parentheses refer to a list of references at the end of ~~the test method.~~this standard.

[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* 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**

equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection and the like. Users of this standard are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

5. Significance and Use

5.1 The pH of the soil is a useful variable in determining the solubility of soil minerals and the mobility of ions in the soil and assessing the viability of the soil-plant environment.

5.2 pH measurements are made in both water and a calcium chloride solution because the calcium displaces some of the exchangeable aluminum. The low ionic strength counters the dilution effect on the exchange equilibrium by setting the salt concentration of the solution closer to that expected in the soil solution. The pH values obtained in the solution of calcium chloride are slightly lower than those measured in water due to the release of more aluminum ions which then hydrolyses. Therefore, both measurements are required to fully define the character of the soil's pH.

5.3 For the purpose of this test method the test soil must be sieved through a ~~No. 10 sieve (2 mm sieve mesh openings).~~ 2-mm (No. 10) sieve. Measurements on soils or soil fractions having particle sizes larger than 2 mm by this test method may be invalid. If soil or soil fractions with particles larger than 2 mm are used, it must be stated in the report since the results may be significantly different.

5.4 All water used for this test method must be ASTM Type III or better. Type III water is defined by Specification D1193. It is prepared by distillation, ion exchange, reverse osmosis, or a combination thereof.

6. Interferences

6.1 This test method as measured by a pH probe has possible interferences due to a suspension effect or sedimentation potential. Users interested in a detailed discussion of the mechanism of this effect can find it in Refs **(5)** and **(6)**.

6.2 This effect is the main reason Test Method G51 can not be used for general measurement of pH outside of that for corrosion analysis. Test Method G51 measures pH (an aqueous parameter) without adding any aqueous phase to the soil. This results in excessive soil particle-pH probe contact that overestimates the activity of the hydrogen ions in solution and is therefore unacceptable for general soil analysis.

6.3 The suspension effect can be mitigated by careful attention to 10.1.

7. Apparatus

7.1 *Method A, pH Meter*—Potentiometer equipped with ~~glass-calomel~~an electrode system. Follow the manufacturer's instructions for the pH meter used. A silver/silver chloride electrode system or similar is also acceptable.

7.2 *Method B, pH Paper*—pH paper sensitive to a pH range from 1 to 12, with resolution to the nearest 0.2 pH unit.

8. Reagents

8.1 *Purity of Reagents*—Reagent grade chemicals should be used in all tests. Unless otherwise indicated, it is intended that all reagents should conform to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.[4] Other grades may be used, provided it is first ascertained that the reagent is of sufficient purity to permit its use without lessening the accuracy of the determination.

8.2 *Purity of Water*—All water used for this test method must be ASTM Type III or better. Type III water is defined by Specification D1193. It is prepared by distillation, ion exchange, reverse osmosis, or a combination thereof.

8.3 *Acid Potassium Phthalate Buffer Solution* (0.05 *M*)—Dissolve 10.21 g (dried 1 ~~h at 105°C)~~ hour at 105 ± 5°C) of potassium phthalate in water and dilute to 1 L. The pH of this solution should be 4.0 at 20°C. Protect the solution against evaporation and against contamination with molds. Replace the solution when mold is noticed. The effect of temperature is as follows:

°C	pH
5 to 37	4.0

This illustrates that the pH of the solution does not change over the range in temperature from 5 to 37°C.

8.4 *Calcium Chloride Stock Solution* (1.0 *M*)—Dissolve 147 g of $CaCl_2 * 2H_2O$ in water in a 1-L volumetric flask, cool, dilute to volume with water, and mix.

8.5 *Calcium Chloride Solution* (0.01 *M*)—Dilute 20.0 mL of stock 1.0 *M* $CaCl_2$ solution to 2 L with water. The pH of this solution should be between 5 and 7.

[4] *Reagent Chemicals, American Chemical Society Specifications* , American Chemical Society, Washington, DC. For suggestions on the testing of reagents not listed by the American Chemical Society, see *Analar Standards for Laboratory Chemicals*, BDH Ltd., Poole, Dorset, U.K., and the *United States Pharmacopeia and National Formulary*, U.S. Pharmaceutical Convention, Inc. (USPC), Rockville, MD.