



Standard Test Methods for pH of Water¹

This standard is issued under the fixed designation D 1293; 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 Department of Defense.

1. Scope

1.1 These test methods cover the determination of pH by electrometric measurement using the glass electrode as the sensor. Two test methods are given as follows:

	Sections
Test Method A—Precise Laboratory Measurement	8 to 15
Test Method B—Routine or Continuous Measurement	16 to 24

1.2 Test Method A covers the precise measurement of pH in water utilizing at least two of seven standard reference buffer solutions for instrument standardization.

1.3 Test Method B covers the routine measurement of pH in water and is especially useful for continuous monitoring. Two buffers are used to standardize the instrument under controlled parameters, but the conditions are somewhat less restrictive than those in Test Method A.

1.4 Both test methods are based on the pH scale established by NIST (formerly NBS) Standard Reference Materials.²

1.5 Neither test method is considered to be adequate for measurement of pH in water whose conductivity is less than about 5 μS/cm. Refer to Test Methods D 5128 and D 5464.

1.6 Precision and bias data were obtained using buffer solutions only. It is the user's responsibility to assure the validity of these test methods for untested types of water.

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.*

2. Referenced Documents

2.1 ASTM Standards:

D 1066 Practice for Sampling Steam³

D 1067 Test Methods for Acidity or Alkalinity of Water³

D 1129 Terminology Relating to Water³

¹ These test methods are under the jurisdiction of ASTM Committee D19 on Water and are the direct responsibility of Subcommittee D19.03 on Sampling of Water and Water-Formed Deposits, Surveillance of Water, and Flow Measurement of Water.

Current edition approved Dec. 10, 1999. Published March 2000. Originally published as D 1293 – 53 T. Last previous edition D 1293 – 95.

² "Standard Reference Materials: Standardization of pH Measurements" Wu and Koch, NBS Special Publications No. 260-53, 1988.

³ *Annual Book of ASTM Standards*, Vol 11.01.

D 1192 Specification for Equipment for Sampling Water and Steam in Closed Conduits³

D 1193 Specification for Reagent Water³

D 2777 Practice for Determination of Precision and Bias of Applicable Methods of Committee D-19 on Water³

D 3370 Practices for Sampling Water from Closed Conduits³

D 5128 Test Method for On-Line pH Measurement of Water of Low Conductivity³

D 5464 Test Methods for pH Measurement of Water of Low Conductivity³

E 70 Test Method for pH of Aqueous Solutions with the Glass Electrode⁴

3. Terminology

3.1 *Definitions*—For definitions of terms used in these test methods, refer to Terminology D 1129.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *pH, n*—the pH of an aqueous solution is derived from E , the electromotive force (emf) of the cell

glass electrode | solution || reference electrode

(where the double vertical line represents a liquid junction) when the electrodes are immersed in the solution in the diagrammed position, and E_s is the electromotive force obtained when the electrodes are immersed in a reference buffer solution.

With the assigned pH of the reference buffer designated as pH_s , and E and E_s expressed in volts is the following:⁵

$$pH = pH_s + \frac{(E - E_s)F}{2.3026 RT}$$

where:

F = Faraday,

R = gas constant, and

T = absolute temperature, t (°C) + 273.15.

The reciprocal of $F/2.3026 RT$ is known as the slope of the electrode, and is the expected difference in observed voltage for two measurements one pH unit apart. Values of the slope at various temperatures are given in Table 1.

⁴ *Annual Book of ASTM Standards*, Vol 15.05.

⁵ Bates, R. G., *Determination of pH: Theory and Practice*, 2nd Ed., J. Wiley and Sons, New York, 1973, p. 29.