National Institute of Standards & Technology

Certificate

Standard Reference Materials®

191b - Sodium Bicarbonate
192b - Sodium Carbonate

pH(S) Primary Standard

These Standard Reference Materials (SRMs) are intended for use in preparing an admixture in solution for calibrating pH measuring systems. SRM 191b Sodium Bicarbonate ($NaHCO_3$) and SRM 192b Sodium Carbonate (Na_2CO_3) were selected to meet high purity and uniformity requirements; however, these SRMs are certified with respect to pH(S) values only. SRMs 191b and 192b are supplied as crystalline materials in units of 25 g and 30 g, respectively.

Certified Values and Uncertainties: The certified pH(S) values listed in Table 1 were derived from electromotive force (emf) measurements of cells without liquid junction using Pt|H_2 (corrected to 101.325 kPa) electrodes and Ag|AgCl electrodes by the method of calculation described in references [1,2]. The pH(S) values correspond to -log (a_H), where a_H is the activity of the hydrogen ion referred to the standard state on the molality scale. **Note:** The values for pH(S) apply only to solutions prepared from the current lot (b) of these SRMs. Small differences in pH(S) values, typically less than 0.01, can occur between SRM lots.

A solution with a molality of 0.0250 mol/kg with respect to both $NaHCO_3$ and Na_2CO_3 is recommended for the calibration of pH measuring systems (See Preparation of the 0.0250 mol/kg Solution). The pH(S) of this solution as a function of temperature is given in Table 1.

The uncertainty in the certified value is expressed as an expanded uncertainty, U, and is calculated according to the method described in the ISO Guide [3]. The expanded uncertainty is calculated as $U = ku_c$, where k is the coverage factor and u_c is the combined standard uncertainty; k = 2.06, 1.99, and 2.01 for the pH(S) at temperatures 15.0 °C, 25.0 °C, and 35.0 °C, respectively. The value of u_c represents, at the level of one standard deviation, uncertainty components due to: the calculation of the activity coefficient of the chloride ion (Bates-Guggenheim convention); the extrapolation of the acidity function to zero added molality of chloride ion; stability of the reference electrodes; concentration of the HCl; the measurements of potential, temperature, and pressure; and the values of the fundamental constants. The value of U represents an approximate 95 % level of confidence.

Table 1. Certified pH(S) Values and Uncertainties

t/°C	0.0250 mol/kg Solution pH(S)
15.0	10.117 ± 0.008
25.0	10.015 ± 0.006
35.0	9.926 ± 0.006

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.C. Colbert.

Gaithersburg, MD 20899
Certificate Issue Date: 5 May 1998

Thomas E. Gills, Chief
Standard Reference Materials Program

The certification measurements were performed by K.W. Pratt and P.A. Berezansky of the NIST Analytical Chemistry Division and M. Torres-de Silva, Guest Scientist from Centro Nacional de Metrología (CENAM), Querétaro, Mexico.

Statistical consultation was provided by K.R. Eberhardt of the NIST Statistical Engineering Division.

Expiration of Certification: This certification is valid until **15 April 2003**, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification is invalid if the SRM is contaminated or modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Return of the attached registration card will facilitate notification.

Source of Material: The sodium bicarbonate and sodium carbonate were obtained from Mallinckrodt, Inc., St. Louis, MO. They meet the specifications of the American Chemical Society for reagent-grade materials, but should not be considered entirely free from impurities such as traces of water, free alkali, silica, chlorides, sulfur compounds, and heavy metals.

NOTICE AND WARNINGS TO USER

Storage of Crystalline Material: SRMs 191b and 192b must be stored in their original bottles at room temperature. They must be tightly re-capped after use and protected from moisture and light.

Drying Instructions: It is recommended that SRM 191b sodium bicarbonate be dried at room temperature for 24 h over anhydrous magnesium perchlorate before use. SRM 192b sodium carbonate **must** be dried for 2 h at 275 °C before use and stored over anhydrous magnesium perchlorate.

Preparation of the 0.0250 mol/kg Solution: Measure 2.1 g of SRM 191b (sodium bicarbonate) to an accuracy of 1 mg into a clean, dry, 1 L polyethylene bottle. Add a mass of carbon dioxide-free water equal to 475.8449 multiplied by m_{191b}, where m_{191b} is the mass of SRM 191b added. Shake until the solid has totally dissolved. Into a separate clean, dry, 1 L polyethylene bottle, measure 2.5 g - 2.6 g of SRM 192b (sodium carbonate) to an accuracy of 1 mg. Add to the second bottle containing the SRM 192b a mass of the SRM 191b solution equal to 377.9171 multiplied by m_{192b}, where m_{192b} is the mass of SRM 192b added into the second bottle. Preparation in this manner reduces the possibility of CO_2 adsorption by the buffer and also eliminates the need for exact measurement of masses of solid samples.

Carbon dioxide-free water can be prepared by boiling distilled water for 10 min and guarding it with a soda lime tube while cooling. The distilled water must have a conductivity no greater than 2 µS/cm. Although elaborate precautions to prevent contamination of the buffer solution with atmospheric carbon dioxide are usually unnecessary, it is recommended to keep the container tightly stoppered at all times when a sample is not actually being removed.

Stability of Prepared Solution: The prepared 0.0250 mol/kg solution should be discarded after two weeks or sooner if sediment appears or if it has been exposed repeatedly to air containing carbon dioxide.

REFERENCES

[1] Bates, R.G., Determination of pH: Theory and Practice, 2nd Ed., John Wiley & Sons, New York, pp. 72-75, (1973).

[2] Wu, Y.C., Koch, W.F., and Durst, R.A., Standard Reference Materials: Standardization of pH Measurements, NBS Spec. Publ. 260-53 (February 1988).

[3] *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993); see also Taylor, B.N. and Kuyatt, C.E., "Guidelines for Evaluation and Expressing the Uncertainty of NIST Measurement Results," NIST Technical Note 1297, U.S. Government Printing Office, Washington, DC (1994).

It is the responsibility of users of this SRM to assure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: Phone (301) 975-6776 (select "Certificates"), Fax (301) 926-4751, e-mail srminfo@nist.gov, or via the Internet http://ts.nist.gov/srm.