National Institute of Standards & Technology

Certificate

Standard Reference Materials

Potassium Dihydrogen Phosphate (186-I-e)

Disodium Hydrogen Phosphate (186-II-e)

pH Standards

These Standard Reference Materials (SRMs) are intended for use in preparing solutions for calibrating pH measuring systems. SRMs 186-I-e, potassium dihydrogen phosphate (KH_2PO_4), and 186-II-e, disodium hydrogen phosphate (Na_2HPO_4), were prepared to ensure high purity and uniformity. However, these SRMs are certified only with respect to pH(S) values, not as pure substances.

The certified pH(S) values listed below were derived from emf measurements of cells without liquid junction using hydrogen gas and AgCl/Ag electrodes (where the hydrogen gas was at 1 atmosphere) by the method of calculation described in reference [1]. The pH(S) values correspond to $\log(1/a_H)$, where a_H is the conventional activity of the hydrogen ion referred to the standard state on the molal scale.

The uncertainty of the certified values of pH(S) is estimated not to exceed ± 0.005 unit for the temperature range 0 to 50 °C. *The listed values apply only to the lots issued on this certificate. Minor variations of pH(S) values (of the order of a* few thousandths of a unit) may be expected to occur between SRM lots.

A solution 0.025 molal with respect to both KH_2PO_4 and Na_2HPO_4 is recommended for the calibration of pH measuring systems. The pH(S) of this solution as a function of temperature is given below. [2]

°C	pH(S)	°C	pH(S)	°C	pH(S)
0	6.984	20	6.879	37	6.842
5	6.950	25	6.863	40	6.840
10	6.924	30	6.852	45	6.837
15	6.899	35	6.844	50	6.836

For pH measurements in the physiologically important range pH 7 to 8, a solution 0.008695 molal in KH_2PO_4 and 0.03043 molal in Na_2HPO_4 is also useful. The pH(S) of this solution as a function of temperature is given below.

°C	pH(S)	°C	pH(S)	°C	pH(S)
0	7.534	20	7.431	37	7.395
5	7.504	25	7.416	40	7.392
10	7.477	30	7.404	45	7.390
15	7.452	35	7.397	50	7.389

Gaithersburg, MD 20899
February 12, 1991

William P. Reed, Acting Chief
Standard Reference Materials Program

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The potassium dihydrogen phosphate and the disodium hydrogen phosphate were obtained from Sigma Chemical Co., St. Louis, Missouri. These lots of potassium dihydrogen phosphate (KH_2PO_4) and disodium hydrogen phosphate (Na_2HPO_4) meet the specifications of the American Chemical Society for reagent-grade materials, but should not be considered as entirely free from impurities such as traces of water, free acid or alkali, carbon dioxide, chlorides, sulfur compounds and heavy metals.

Stability

SRMs 186-I-e and 186-II-e are stable when stored in their original container, with the caps tightly closed, in a dry environment, and under normal laboratory temperatures.

The certification measurements were performed by Yung-Chi Wu and Daming Feng of the Inorganic Analytical Research Division. Corroborating measurements were made by Hans Bjarne Kristensen at Radiometer A/S, Copenhagen, Denmark. Statistical consultation was provided by K. Eberhardt of the Statistical Engineering Division.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of W.F. Koch, Deputy Chief, Inorganic Analytical Research Division.

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

Directions for Use

Drying:

The two salts should be dried for two hours at 110 °C before use.

Preparation of the 0.025-molal solution:

Add 3.404 g of the potassium dihydrogen phosphate (186-I-e) and 3.551 g disodium hydrogen phosphate (186-II-e) to 1000.0 g of distilled water and mix thoroughly. The distilled water should not contain dissolved carbon dioxide and should have an electrolytic conductivity no greater than 2 microsiemens/cm. Carbon dioxide-free water can be prepared by boiling a good grade of distilled water for 10 minutes and guarding it with a soda-lime tube while cooling. (The values given are weights in air).

If volumetric apparatus is to be used, transfer 3.387 g of the potassium dihydrogen phosphate (186-I-e) and 3.533 g of the disodium hydrogen phsophate (186-II-e) to a 1-liter volumetric flask. Dissolve and fill to the mark with distilled water at 25 °C and mix thoroughly. (The values given are weights in air).

Although elaborate precautions to prevent contamination of the buffer solution with atmospheric carbon dioxide are usually unnecessary, the container should be kept tightly stoppered at all times when a sample is not actually being removed.

The solution should be replaced after two weeks or sooner if molds or sediment appear, or if it has been exposed repeatedly to air containing carbon dioxide.

Preparation of the physiological buffer solution:

Add 1.184 g of potassium dihydrogen phosphate (186-I-e) and 4.322 g of disodium hydrogen phosphate (186-II-e) to 1000.0 g of distilled water as described above. If volumetric apparatus is to be used, transfer 1.179 g of potassium dihydrogen phosphate (186-I-e) and 4.303 g of disodium hydrogen phosphate (186-II-e) to a 1-liter volumetric flask, dissolving, and filling to the mark with water of the quality described above. (The values given are weights in air).

This buffer solution is more sensitive to contamination with carbon dioxide than is the 0.025-molal solution. If the solution is to maintain the assigned pH(S) for two weeks, exclusion of carbon dioxide is essential.

References

[1] Wu, Y.C., Koch, W.F. and Marinenko, G.J. Res. Nat'l Bur. Stand. 89 395 (1984).

[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).