

# Certificate of Analysis

## Standard Reference Materials

### Sodium Bicarbonate (2191)

### Sodium Carbonate (2192)

Purity

These lots of sodium bicarbonate ( $\text{NaHCO}_3$ ) and sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) were prepared to ensure high purity and uniformity. They 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 alkali, silica, chlorides, sulfur compounds and heavy metals.

#### $pD(S)$ Values

The  $pD(S)$  values listed below correspond to  $\log(1/a_D)$ , where  $a_D$  is the *conventional* activity of the deuterium ion referred to the standard state on the scale of molality. The values were derived from the emf of cells without liquid junction by a method of calculation analogous to that described for the assignment of  $pH(S)$  values [Journal of Research of the National Bureau of Standards, 66A, 179 (1962)]. The uncertainty of the assigned values for  $pD(S)$  is estimated not to exceed 0.01 unit. The values listed below apply only to the lots here certified. Minor variations of  $pD(S)$  (of the order of a few thousandths of a unit) may be expected to occur between different lots.

This solution, 0.025 molal with respect to both  $\text{NaDCO}_3$  and  $\text{Na}_2\text{CO}_3$ , is recommended for the calibration of  $pH$  meters to be used for the measurement of  $pD$  in deuterium oxide. The  $\text{NaDCO}_3$  is prepared *in situ* by the hydrogen-deuterium exchange between the protium salt and the deuterium oxide solvent. The  $pD(S)$  of these solutions as a function of temperature is given below:

$t, ^\circ\text{C}$	$pD(S)$	$t, ^\circ\text{C}$	$pD(S)$	$t, ^\circ\text{C}$	$pD(S)$
5	10.998	25	10.736	40	10.597
10	10.923	30	10.685	45	10.559
15	10.855	35	10.638	50	10.527
20	10.793				

#### DIRECTIONS FOR USE

The preparation of the 0.025 molal solution should be carried out by the addition of weighed quantities of the salts to weighed quantities of deuterium oxide in the following proportions (weights in vacuo): 0.002100g  $\text{NaHCO}_3$  and 0.002650g  $\text{Na}_2\text{CO}_3$  per g of deuterium oxide. The deuterium oxide should have an isotopic composition of at least 99.5 mole percent  $\text{D}_2\text{O}$ . It should not contain dissolved carbon dioxide or other gases and should have a conductivity no greater than  $2 \times 10^{-6} \Omega^{-1} \text{cm}^{-1}$ . The sodium bicarbonate should not be dried by heating; the sodium carbonate should be dried for two hrs at  $275^\circ\text{C}$  before use. 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 development of the  $pD$  scale and the experimental work leading to the certification of these materials were performed by Maya Paabo and Roger G. Bates.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of Roger G. Bates.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by T. W. Mears.