Broadley-James Corporation

pH Electrode Calibration Procedure

All pH electrodes require calibration from time to time. A two point calibration characterizes an electrode with a specific pH meter. Once an electrode is characterized, the electrode/meter pair can be used to determine the pH of a solution. Please follow the step-by-step procedure outlined below to perform a two point calibration. A 7.00 pH buffer solution and a 4.01 pH buffer solution are required.

1) Rinse the electrode thoroughly with D.I. water to remove all traces of storage solution, process medium, or previous test solution. Thoroughly rinse the electrode after each buffer test to prevent carry over contamination of the pH buffer solutions. Gently blot the electrode on a soft tissue to remove the excess rinse water. Do not rub the bulb since it can cause a static charge build-up.

2) Insert the electrode and the A.T.C. (automatic temperature compensator) in 7.00 pH buffer solution. Allow 30 seconds for the electrode/A.T.C. to reach thermal equilibrium with the buffer solution. Adjust the pH meter with the standardize/zero control for a pH indication equal to 7.00. **Note:** If the meter does not have an A.T.C., place a thermometer along with the electrode in the 7.00 pH buffer solution. Allow 30 seconds for the pair to reach thermal equilibrium with the buffer. Adjust the temperature dial on the meter to correspond with the thermometer reading. Then adjust the pH meter with the standardize/zero control for a pH indication equal to 7.00.

3) Repeat Step 1, and insert the electrode and the A.T.C. in a 4.01 buffer solution. Allow 30 seconds before adjusting the pH meter with the slope/span control for a pH indication equal to 4.01.

4) Repeat Steps 2 and 3 to maximize the precision of the calibration.

   Notes:

   a) Always use fresh pH buffer solutions for the most accurate results.

   b) A 10.00 pH buffer solution may be substituted for the 4.01 pH buffer solution in Step 3. All pH buffer solutions above 7.00 pH are less stable and have a limited life. These high pH buffers will more readily absorb CO_2 from the atmosphere and will typically change to a lower pH value when left open. For this reason, a 4.01 buffer solution is recommended to perform a reliable two point calibration. Also, the buffers should bracket the desired pH range.

   c) When a pH electrode is calibrated with an autocalibration meter, consult the meter's operation manual for the required calibration procedure.

pH Electrode Storage Procedure

When a pH electrode is not in use, the bulb should be kept in a wetted environment. Dehydration of the bulb will temporarily impair the electrode's performance. The following storage procedure is recommended when the electrode is not in use.

1) Short-Term: Immerse the electrode in 3.8M KCl solution (Broadley-James Part Number: AS-3120-C20-0500). Do not store electrode in D.I. water.

2) Long-Term: Fill soaker bottle (Broadley-James Part Number: AM-1050-12) with fresh 3.8M KCl solution and insert electrode. The soaker bottle O-ring should be securely in place, and the cap should be hand tightened. Do not store electrode in D.I. water.

BROADLEY JAMES CORPORATION

Manufacturers of pH & D.O. Sensors
for Science and Industry

19 Thomas, Irvine, California 92618 USA **Phone:** 949.829.5555 **Toll-Free:** 800.288.2833 **Fax:** 949.829.5560 **E-Mail:** sales@broadleyjames.com

pH Electrode Test Procedure

The purpose of this test is to determine if a pH electrode is functioning within acceptable limits. The **A. P. (asymmetry potential)** and **slope (efficiency)** can be used as guidelines to judge an electrode's performance. Typically an electrode is replaced when the **A. P.** is greater than ±20 mV and/or the **slope** drops below 91%. Consideration should also be given to the electrode's speed of response. Please follow this step-by-step procedure to determine the performance of an electrode. Required test equipment includes 7.00 and 4.01 pH buffer solutions with a pH meter that has an mV readout.

1) Set the pH/mV switch on the pH meter to the mV position.

2) Connect a shorting plug to the input on the pH meter, or connect a precision mV generator with a 0 mV input. Adjust the standardize/zero control on the pH meter for a reading equal to 0.0 mV.

3) Disconnect the shorting plug/precision mV generator, and connect the electrode that will be tested.

4) Rinse the electrode thoroughly with D.I. water to remove all traces of storage solution, process medium, or previous test solution. Thoroughly rinse the electrode after each buffer test to prevent carry over contamination of the pH buffer solutions. Gently blot the electrode on a soft tissue to remove the excess rinse water. Do not rub the bulb since it can cause a static charge build-up.

5) Insert the electrode and the A.T.C. (automatic temperature compensator) in 7.00 pH buffer solution. Allow 30 seconds for the electrode/A.TC. to reach thermal equilibrium with the buffer solution. Record the polarity and the mV reading. This is the **asymmetry potential** of the electrode. Ideally the electrode should have an **A. P.** equal to 0 mV.
Note: If the meter does not have an A.T.C., place a thermometer along with the electrode in the 7.00 pH buffer solution. Allow 30 seconds for the pair to reach thermal equilibrium with the buffer. Adust the temperature dial on the meter to correspond with the thermometer reading. Record the polarity and the mV reading to determine the **A. P.**

6) Repeat Step 4, and insert the electrode and the A.T.C. in a 4.01 buffer solution. Allow 30 seconds before recording the mV reading.

7) Determine the mathematical difference between the two mV readings. This is the electrode's **span**.

8) Divide the electrode's span by the theoretical span of 176.9 mV (at 25°C) and multiply by 100. This determines the **slope** of the electrode.
Note: For best results, the pH buffer solutions should be used at 25°C. Otherwise, record the temperature of the buffer and determine the temperature adjusted pH with the temperature coefficient charts printed on the buffer container.

Example:

Reading in a 7.00 pH buffer solution: -7.4 mV

Reading in a 4.01 pH buffer solution: +164.6 mV

Asymmetry Potential = -7.4 mV

Span = +164.6 - (-7.4) = 172.0 mV

$$\text{Slope} = \frac{\text{Span}}{\text{Theoretical Span}} = \frac{172.0 \text{ mV}}{176.9 \text{ mV}} \times 100 = 97\%$$

Electrode Test Results:

Reading in a 7.00 pH buffer solution: ________________ mV (max/min range ±20 mV)
(Asymmetry Potential)

Span = ________________mV - ________________mV = ________________mV (min 161.5 mV)
(Reading in 4.01 pH) (Asymmetry Potential)

$$\text{Slope} = \frac{\text{Span}}{\text{Theoretical Span}} = \frac{\rule{3cm}{0.4pt}}{176.9 \text{ mV}} \times 100 = \rule{3cm}{0.4pt}\ \% \text{ (min 91\%)}$$

Date Tested:________________ Initial:________ Identification:________________________________
(Electrode P/N, Vessel Location/No.)

All electrodes have a finite life, and should be tested from time to time to determine acceptable performance.