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pH Electrode

Titra-Gel:	PCE-80-PH1012
Titra-Fill:	PCE-80-PH1013
Titra-Flo:	PCE-86-PH1105
TitraSleeve:	PCE-80-PH1108
TitraPRO4:	PCE-80-PH1200D

pH

pH ELECTRODE
INSTRUCTION MANUAL

Introduction

The pH electrode you have purchased is a hand crafted, precision analytical device. This electrode was fully tested prior to shipment.

The directions contained herein should be followed carefully to ensure optimum performance and maximum life.

Preparation

PLEASE FOLLOW THESE STEPS PRIOR TO USING ELECTRODE

Note: For refillable electrodes, the level of the fill solution must always be kept above the internal element. The fill hole should be open whenever the electrode is in solution.

For PCE-86-PH1105 (Titra-Flo), PCE-80-PH1012 (Titra-Gel), PCE-80-PH1013 (Titra-Fill), and PCE-80-PH1200D (TitraPRO4):

1. Remove the bulb protector boot or soaker bottle and reserve for future storage. Immerse the lower end of the electrode into pH 4 buffer for at least 30 minutes. This operation hydrates the pH bulb and reference junction for optimum performance.
2. Fill refillable electrodes with the appropriate fill solution (see spec chart below) to a level just below the filling hole. Gently shake the electrode downward like a thermometer to remove trapped air bubbles.
3. MANTECH specifications, including slope and offset, are guaranteed on a two- or three-point calibration using pH 4, 7, and 10 buffer solutions*.

   *PCE-80-PH1012 electrode specifications are guaranteed on a two-point calibration using pH 4 and 7 buffer solutions.

   Using pH buffers outside of this range may affect the achievable slope. For example, if using a pH 13 buffer, the expected slope is expanded to -50 at the higher end. A description for this is found at the end of this document and on the FAQ page of our website www.mantech-inc.com.

For PCE-80-PH1108 (Titra-Sleeve):

1. With gloved hands, remove the rubber cap covering the bulb of the electrode.
2. Peel off all the parafilm covering the junction hole, and allow the fill solution to drain out.
3. Squirt deionized water into the electrode fill hole, cover with your finger, and gently shake to loosen any crystals built up inside the electrode. Remove your finger from the hole, invert the electrode, and allow it to drain. You may need to do this multiple times to rid the electrode of salt crystals.
4. Rinse DI water through the electrode in order to rinse out any excess crystals.
5. Lift the sleeve in order to reveal the junction hole and rinse the ground glass both under the sleeve and on the electrode.
6. Allow the water in the electrode to flow out the hole in the body of the electrode, normally covered by the sleeve. If it does not flow freely repeat steps 4 and 5. If it does flows freely through the hole, proceed to the next step. Gently wipe the electrode clean with a lab tissue.
7. Tighten the sleeve by turning it to the right. Getting the right tightness may take some practice. The tightness of this sleeve is what dictates the flow rate of the electrode. If the sleeve is too tight or too loose, poor results will be obtained due to inadequate fill solution flow.

8. Fill the electrode with the fill solution that is in the box to a level just below the fill hole. NOTE: When the electrode is in use the fill hole must be open.
9. Ensure that there are no air bubbles in the electrode liquid. If air bubbles are observed, hold the electrode vertically and gently tap to release the bubbles.
10. Soak the electrode in pH 4 buffer for 2 hours.
11. The electrode is now ready to be used on your system.

Electrode Cleaning

Electrodes are susceptible to coating by many substances and the response time can deteriorate dramatically. Do not use strong solvents to clean electrodes. If they are mechanically intact, they can often be restored to normal performance using one of the following procedures:

For PCE-86-PH1105 (Titra-Flo), PCE-80-PH1012 (Titra-Gel), and PCE-80-PH1013 (Titra-Fill):

1. If coated with salt deposits, rinse with water. If crystal deposits remain, soak in 0.1M KCl for 5 minutes followed by 0.1M NaOH for 5 minutes.
2. If coated with oil or grease, wash the electrode in warm tap water with a mild detergent. Rinse the electrode in tap water and then with distilled water. Soak the electrode in pH 4 buffer for at least 30 minutes after this procedure.
3. If the reference junction has become clogged, soak the electrode in 0.1M KCl for 10 minutes.

For PCE-80-PH1200D (TitraPRO4):

1. If coated with salt deposits, rinse with water. If the crystals remain or if the electrode is coated with oil or grease, rinse electrode with methyl alcohol and then with distilled water.
2. If deposits remain, soak in 1% HCl for 5 minutes followed by 1% NaOH for 5 minutes.
3. If the reference junction has become clogged, soak the electrode in 0.1M KCl for 10 minutes.

Electrode Storage

Do not allow the junction of the electrode to dry out between measurements. For best results, always keep the pH bulb wet, preferably in pH 4 buffer with 1/100 part of saturated KCl added. Other pH buffers or tap water are acceptable storage media but avoid storage in distilled water.
When taking the electrode out of service for an extended period, rinse the electrode thoroughly, and refit the soaker bottle or storage boot filled with buffer. Ensure there is enough storage solution in the bottle or boot to keep the junction wet.

Troubleshooting

Should a refillable electrode repeatedly fail calibration, try the following to remedy the calibration:

1. Ensure the stopper at the top of the electrode is removed from the fill hole during readings.
2. Ensure standards are poured fresh for each use, and they are not expired.
3. Replace the fill solution: remove the fill solution, refill with deionized water, invert the probe several times to ensure any salt crystals that may be present are fully dissolved, remove the deionized water

from the probe, and add electrode fill solution to the probe. Ensure the fill solution comes to a level just below the fill hole.

4. Shake the electrode like a thermometer to remove any trapped air bubbles.
5. Wipe the bulb clean with a soft cloth dampened with denatured alcohol followed by a soaking in pH 4 buffer for at least 30 minutes.

Order a new probe if repeated cleaning and troubleshooting does not remedy calibration failures.

Specifications

Electrode P/N	**pH Range**	**Fill Solution**	**Slope**	**Zero Point**	**Accuracy**	**Size** (length w/out cap)	**Storage**
PCE-86-PH1105 Titra-Flo	0-12	4M KCl	-55 to -62	pH 7	+/- 0.05	110 mm +/- 2mm length; 12 mm diameter	pH 4 buffer
PCE-80-PH1108 Titra Sleeve	0-12	LiCl	-55 to -62	pH 7	+/- 0.1	110 mm +/- 2mm length; 12 mm diameter	pH 4 buffer
PCE-80-PH1012 Titra-Gel	0-12	N/A	-55 to -62	pH 7	+/- 0.1	110 mm +/- 2mm length; 12 mm diameter	pH 4 buffer
PCE-80-PH1200D TitraPRO4	0-14	4M KCl	-55 to -62	pH 7	+/- 0.05	120 mm +/- 2mm length; 12 mm diameter	pH 4 buffer
PCE-80-PH1013 Titra-Fill	0-12	4M KCl	-55 to -62	pH 7	+/- 0.1	110 mm +/- 2mm length; 12 mm diameter	pH 4 buffer

Ordering Information

P/N	Description
PCE-R001013	4M KCl electrolyte fill solution
PCE-R001015	10% KNO electrolyte fill solution
PCE-R001009	Lithium Chloride Electrode Fill Solution
PCE-86-PH1105	Titra-Flo pH Electrode (electrode cable attached)
PCE-80-PH1108	TitraSleeve pH Electrode*
PCE-80-PH1012	Titra-Gel pH Electrode*
PCE-80-PH1200D	TitraPRO4*
PCE-80-PH1013	Titra-Fill pH Electrode*
PCE-86-EX1001	*Detachable electrode cable *(for Titra-Pro, Titra-Gel, TitraPro3, and Titra-Fill electrodes)*

Document Change Log

Version	Date	Author	Changes
1	31-Oct-2019	Heather Jasumani	• Document created
2	20-Dec-2019	Heather Jasumani	• PCE-80-PH1200C (TitraPRO3) removed (discontinued) and PCE-80-PH1200D (TitraPRO4) added
3	11-Mar-2020	Maggie Grierson	• Updated accuracy

Changes to slope at higher pHs

Alkaline Error or Sodium Error occurs when pH is very high (e.g. pH 12) because Na^+ concentration is high (from NaOH used to raise pH) and H^+ is very low.

Electrodes respond slightly to Na^+ and give a false low reading. This is related to the concept of selectivity coefficients where the electrode responds to many ions but is most selective for H^+. This problem occurs because Na^+ is 10 orders of magnitude higher than H^+ in the solution.

High pH electrodes use a 0-14 pH glass. This electrode will read pH 14 (1 M NaOH) to be around pH 13.7 with a 0.3 pH sodium error.

A standard pH electrode uses a 0-12 pH glass. The electrode will read pH 14 (1 M NaOH) to be around pH 12.4 with a 1.6 pH sodium error.

Alkaline error

The alkaline effect is the phenomenon where H^+ ions in the gel layer of the pH-sensitive membrane are partly or completely replaced by alkali ions. This leads to a pH measurement which is too low in comparison with the number of H^+ ions in the sample. Under extreme conditions where the H^+ ion activity can be neglected the glass membrane only responds to sodium ions. Even though the effect is called the alkaline error, it is only sodium or lithium ions which cause considerable disturbances. The effect increases with increasing temperature and pH value (pH > 9), and can be minimized by using a special pH membrane glass.

Sodium Ion Error

Although the pH glass measuring electrode responds very selectively to H^+ ions, there is a small interference caused by similar ions such as lithium, sodium, and potassium. The amount of this interference decreases with increasing ion size. Since lithium ions are normally not in solutions, and potassium ions cause very little interference, Na^+ ions present the most significant interference.

Sodium ion error, also referred to as alkaline error, is the result of alkali ions, particularly Na^+ ions, penetrating the glass electrode silicon-oxygen molecular structure and creating a potential difference between the outer and inner surfaces of the electrode. H^+ ions are replaced with Na^+ ions, decreasing the H^+ ion activity, thereby artificially suppressing the true pH value. This is the reason pH is sometimes referred to as a measure of the H^+ ion activity and not H^+ ion concentration.

Na^+ ion interference occurs when the H^+ ion concentration is very low and the Na^+ ion concentration is very high. Temperature also directly affects this error. As the temperature of the process increases, so does the Na^+ ion error.

Depending on the exact glass formulation, Na^+ ion interference may take effect at a higher or lower pH. There is no glass formulation currently available that has zero Na^+ ion error. Since some error will always exist, it is important that the error be consistent and repeatable. With many glass formulations, this is not possible since the electrode becomes sensitized to the environment it was exposed to prior to experiencing high pH levels. For example, the exact point at which the Na^+ ion error of an electrode occurs may be 11.50 pH, after immersion in tap water, but 12.50 pH after immersion in an alkaline solution.

Controlled molecular etching of special glass formulations can keep Na^+ error consistent and repeatable. This is accomplished by stripping away one molecular layer at a time. This special characteristic provides a consistent amount of lithium ions available for exchange with the hydrogen ions to produce a similar millivolt potential for a similar condition.

www.mantech-inc.com

MANTECH
5473 Highway 6 North
Guelph, Ontario N1H 6J2
Canada
519-763-4245