GRAB SAMPLE CALIBRATION:

1. Grab sample calibration of a pH electrode is more valid when the electrode has been previously "characterized" to its pH meter via the two point pH buffer calibration procedure. The grab sample technique will evaluate the pH electrode's performance under actual operating conditions which differ from the pH buffer calibration conditions previously seen by the electrode.

2. For a proper grab sample technique, a known good laboratory pH electrode and pH meter that are in calibration with each other are required equipment. The laboratory pH electrode should be exposed to the grab sample at the identical temperature that the on-stream pH electrode sees in service to prevent the introduction of an "error" introduced by the solution-temperature-effects on accurate pH measurements.

3. No two pH electrodes are identical, therefore, exact pH readings are rarely achievable. The on-stream pH electrode has been conditioned to the process environment and may be more correctly reporting the process pH than a laboratory pH electrode which has not yet totally acclimated to the process conditions.

4. The grab sample should be taken as physically close to the on-stream pH electrode as possible to ensure that a "representative" sample is being taken. The pH readings should be compared immediately. If required, adjust the on-stream pH meter to match the reading of the grab sample pH meter. Avoid any time lag between the grab sample pH reading and the calibration adjustment of the on-stream pH meter.

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Broadley-James®
FermProbe®
pH Electrodes

Designed with a
Sealed Ag/AgCl and Dual Salt Bridge

REFERENCE HALF-CELL

For use in all steam sterilizable and autoclavable pH measurement applications. T-Pull handle and/or integral cable styles are not autoclavable.

ELECTRODE SPECIFICATIONS

pH Range:	0 - 14 pH
with least Na^+ Error:	0 - 13 pH
Bulb Glass:	HT-3 (steam sterilizable)
Temperature Range:	-5 - 135°C
Pressure:	150 psig max.
Cable:	Low Noise Coax, Dual Shielded

Broadley-James ®

PREPARATION FOR USE:

1. Remove electrode from the "soaker bottle" containing the storage solution (3.8 Molar KCl) by unscrewing the bottle from the lid/electrode. Carefully slip the lid and sealing o-ring off the electrode body.

NOTE:
DO NOT remove the teflon spacer and o-ring which are fitted to the electrode body just beneath the electrode's cap.

2. Save the electrode's "soaker bottle", cap, and sealing o-ring for future use as a storage container for the FermProbe when it is not in service. Be certain to use 3.8M KCl (BJC P/N: AS-3120-C20-0500) as the storage solution.

3. For first-time use after removing the FermProbe from its storage solution: Inspect the electrode for any signs of breakage or shipping damage and commence with its use in your application.

4. For reuse of the FermProbe, or after long term storage in a solution other than the recommended 3.8M KCl solution: Immerse the lower 30 mm of the FermProbe in a 3.8M KCl solution for 10 to 30 minutes. This treatment conditions the pH sensitive bulb and prepares the ceramic liquid junction for contact with solutions to be tested.

CALIBRATION PROCEDURE:

1. Rinse the FermProbe thoroughly with DI water to remove all traces of storage solution, process medium, or previous test solution and to prevent "carry over" contamination of the pH buffer test solutions. Thoroughly rinse the FermProbe with DI water after each buffer test.

2. Insert the FermProbe in 7.0 pH buffer solution and momentarily stir with electrode to ensure proper contact. Allow a minimum of 30 seconds for electrode to thermally equilibrate with the buffer solution before taking a pH reading. The pH reading should be 7.0 pH ± 0.33 pH (±20 mV) @ 25°C. Make necessary adjustment to the pH meter with the "standardize" or "zero" control for a pH indication = 7.0 pH.

3. Rinse the FermProbe with DI water and insert in a 4.01 pH buffer solution. Stir with electrode to ensure proper contact. Allow a minimum of 30 seconds for proper electrode/solution equilibration before taking a pH reading. Make any necessary adjustments to the pH meter with the "slope" or "span" control for a reading = 4.01 pH units.

NOTES:

- Always use "fresh" pH buffer solutions for best results.
- pH buffer solutions above 7.0 pH are less stable and have a very 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.
- Keep in mind the "older" an electrode becomes, it will exhibit slower response times and will become less efficient in terms of its ability to span several pH units with the same repeatability.
- pH electrodes are imperfect devices and require "calibration" from time to time in order to be properly characterized to its host pH meter.

CLEANING A FERMPROBE WITH IMPAIRED RESPONSE:

Used pH electrodes which are physically intact can sometimes be restored to an improved level of performance. All pH electrodes have a given useful life span depending upon the conditions of use. One of the following cleaning procedures may prove helpful in restoring a used pH electrode.

1. **Initial Cleaning:** Wash with a solution of liquid detergent or enzyme detergent and warm water by gently scrubbing with a soft toothbrush or soft tissue. Follow with thorough rinse in DI or clean tap water.

2. **Inorganic Scale Deposits:** Dissolve the deposit by immersion of the electrode's measurement tip in *dilute* hydrochloric acid for a few minutes. Repeat step #1 above.

3. **Organic Oil or Grease Films:** Perform initial cleaning procedure . If film is known to be soluble in a particular organic solvent which is not harmful to glass, wash with this solvent. Repeat step #1 above. Depending on the extent of the oil or grease contamination, it's possible that the ceramic liquid junction may be damaged beyond recovery. Soak in 3.8M KCl solution for a minimum of 30 minutes before recalibration and returning electrode to service.

4. **Plugged or Dry Ceramic Liquid Junction:** Remove any observed contaminant with one of the above procedures, then soak in 3.8M KCl solution for a minimum of 30 minutes.

NOTES:

- Never permit the pH electrode to dehydrate or dry-out. Always keep it in a wetted environment especially when not in service.
- Cracked or broken electrodes are not repairable.
- Inspect cable and connector to ensure that the insulation integrity is intact and that there are no signs of corrosion or contaminants on the metal components.
- T-Pull handle and/or integral cable styles are not autoclavable.

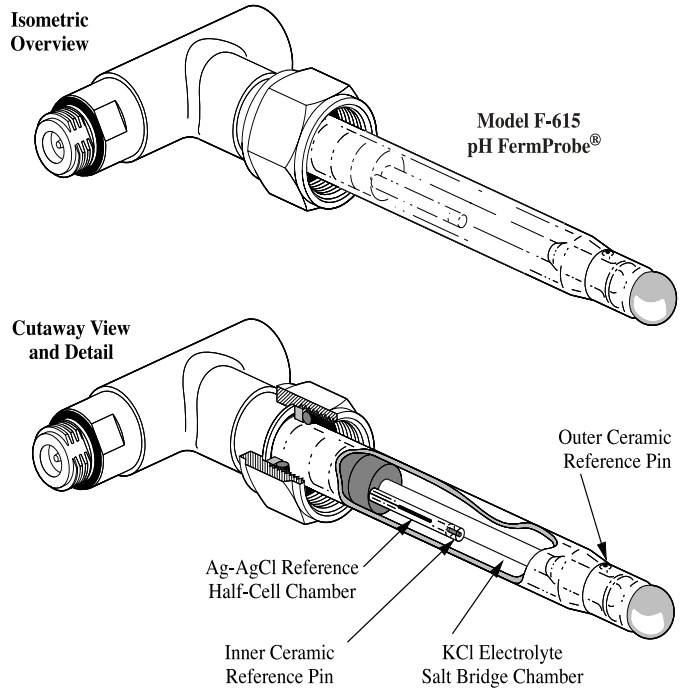
STORAGE:

1. **Short Term:** Immerse electrode measurement tip and liquid junction surface areas in 3.8M KCl. If this solution is not available, use 4.01 pH buffer, clean tap water, or lastly, a sample of the process being measured to keep the electrode hydrated.

2. **Long Term:** Fill soaker bottle that the electrode was originally shipped in with a freshly prepared 3.8M KCl solution and insert electrode. Be certain that the soaker bottle's sealing O-ring and cap are securely in place. Tighten cap hand tight only. The electrode should be stored in an upright (vertical) position.

Cutaway Views of the pH FermProbe® Double Junction Reference System

FERMPROBE



The FermProbe® Double Junction Reference System

All FermProbes have two built-in electrolyte chambers that act to protect and isolate the sensitive inner AgCl reference half-cell. This "double junction", dual chamber design effectively prevents two very common failure modes of pH electrodes in biopharmaceutical applications:

1. Only the inner, smaller chamber has Ag ions in the electrolyte. The larger chamber is free of Ag ions. This design prevents Ag ions from coming into contact with proteins in the sample media. Reactions between these proteins and the Ag ions will cause the formation of substances that will clog the outer ceramic reference pin junction.

2. Sulfide ions are frequently found in sample medias. These ions have a reputation for rapidly diffusing into both sealed electrodes and pressurized refillable electrodes. If the sulfide ions should come into contact with the inner AgCl half-cell, the electrode will fail. Again, the FermProbe's dual chamber design effectively blocks the inward migration of sulfide ions and protects the inner AgCl half-cell.

• • •

All pH and Redox FermProbes have this double junction reference system as a standard feature to ensure maximum service life over the widest range of operating conditions.