pH and ORP Electrode Manual

Contents

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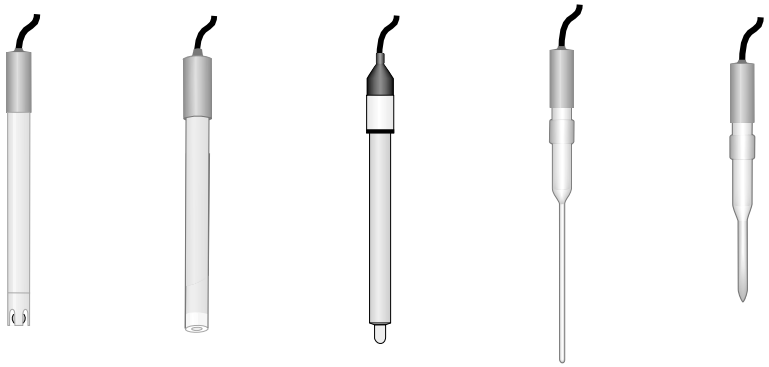
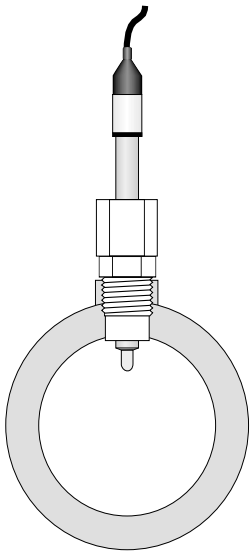
Electrode Applications

pH and ORP (Redox) electrodes are sensitive measuring sensors and should be treated with care. The electrodes are replaceable items and the life span is dependent on the chemical and temperature conditions. A typical life span for an electrode is 2 to 3 years but this may be much less if the electrode is subjected to harsh conditions. The following manual is intended as a guide for maintaining common electrodes for laboratory, in-line and submersible applications.

1/ Laboratory Electrodes

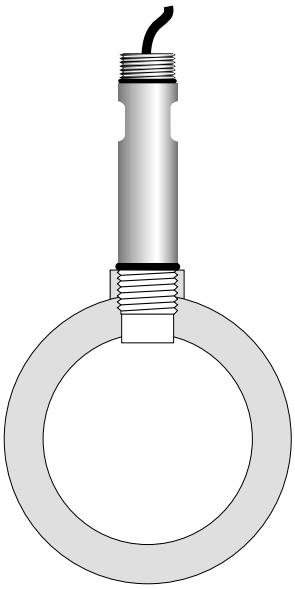
Laboratory electrodes usually have a body diameter of 12mm. The body material may be typically glass, epoxy or polymer. For specialised applications such as, measuring in a test tube or penetrating food products, the probe profile is specially designed. Laboratory probes are often adapted for in-line measurements, using a threaded adapter.





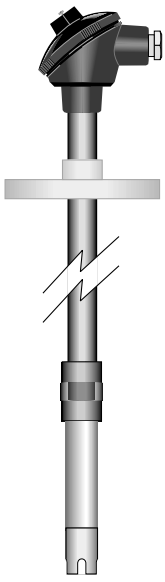
2/ In-line Electrodes

For measuring pH or ORP in a pipe, a threaded in-line electrode is used. It is important to install the electrode so that an air cavity does not form around the sensing area of the electrode. Ideally install from the top of the pipe to maintain the fluid within the glass bulb. When installed the electrode should be at an angle of between 30º and 90º to the horizontal.



3/ Submersible Electrodes

For pH and ORP measurements in an open tank or viaduct, a submersion electrode coupled with an immersion assembly is used. In this application it is important NOT to immerse the electrode cable. By using a submersion assembly, the electrode is supported and the cable contained within the immersion assembly.



Electrode Cable

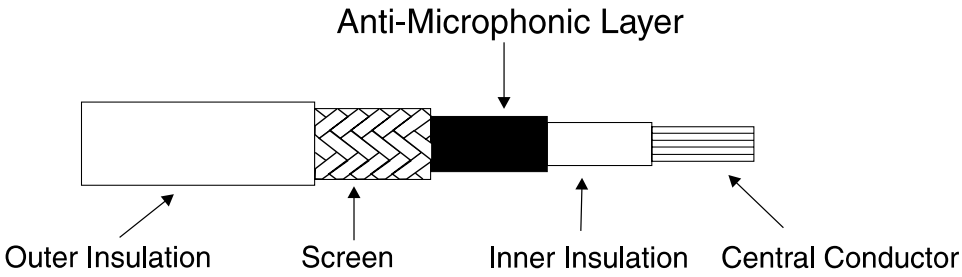
The cable used for pH and ORP electrodes is a special screened low noise cable. The electrode is a high impedance device and is coupled to a high impedance measuring instrument.

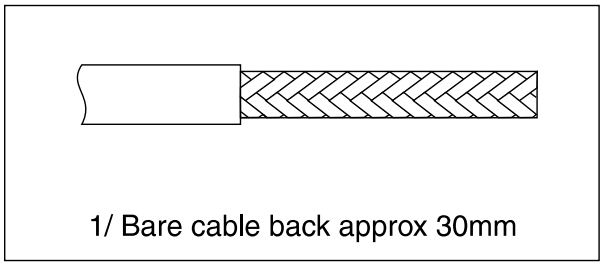
The cable incorporates a special conductive rubber material known as an anti-microphonic layer. This prevents voltages being generated when the cable is moved or vibrated.

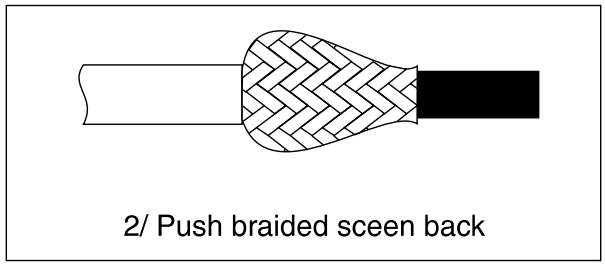
Special Note:

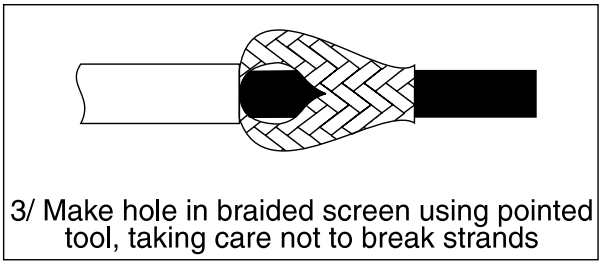
Most electrodes are supplied with a BNC connector fitted. It is often necessary to remove the BNC connector or shorten the cable to make the cable suitable for connecting to screw terminals. IMPORTANT When re-terminating the cable, the anti-microphonic layer must be stripped back from the centre conductor to prevent a short circuit in the cable.

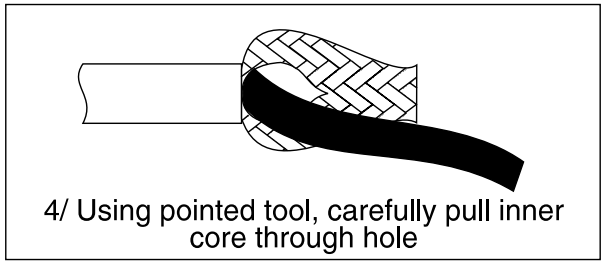
Techniques for re-terminating the cable

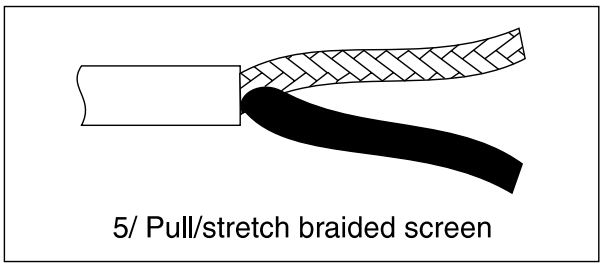


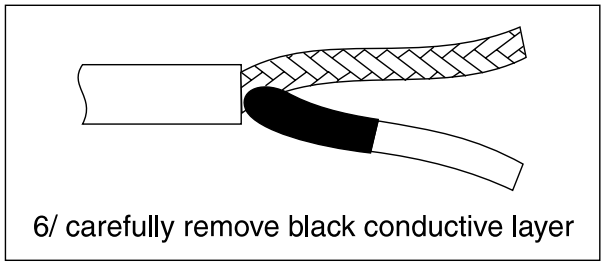

1/ Bare cable back approx 30mm

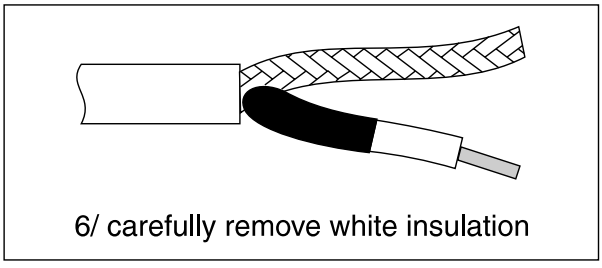

2/ Push braided sceen back

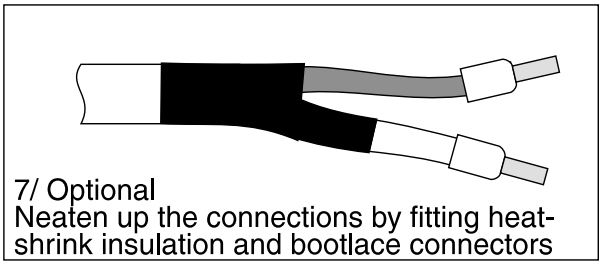

3/ Make hole in braided screen using pointed tool, taking care not to break strands


4/ Using pointed tool, carefully pull inner core through hole


5/ Pull/stretch braided screen


6/ carefully remove black conductive layer

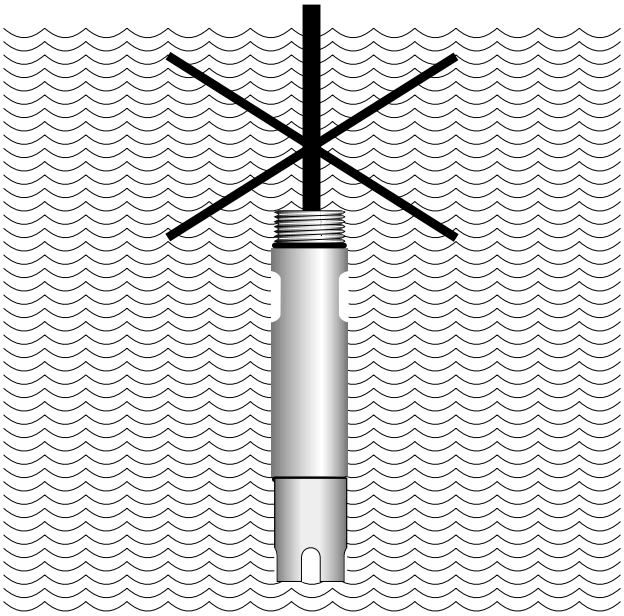

6/ carefully remove white insulation

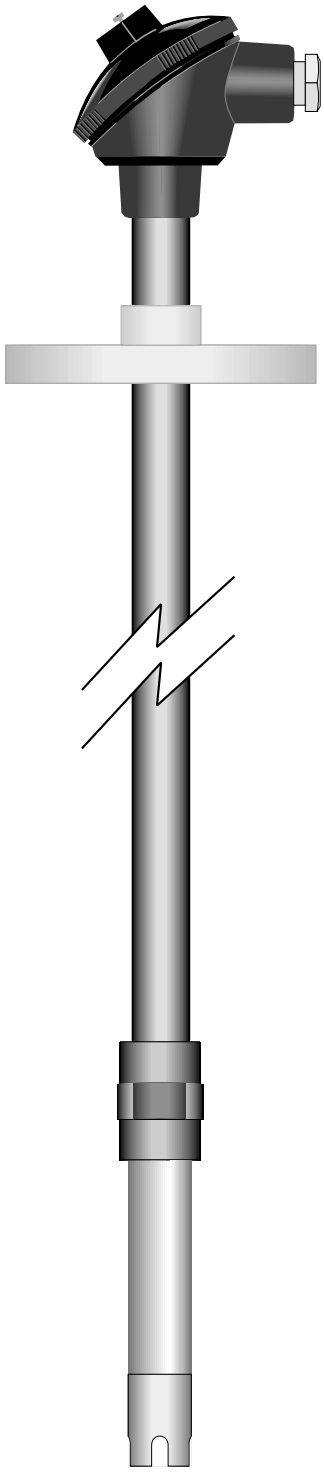

7/ Optional
Neaten up the connections by fitting heat-shrink insulation and bootlace connectors

Installing Submersible Electrodes

Electrodes may be submersed by using an immersion assembly. The electrode is fitted and thread sealed to the end of a pipe section. This provides a rigid assembly and protects and seals the cable. The assembly may be built from standard plumbing fittings, or purchased as a complete assembly.

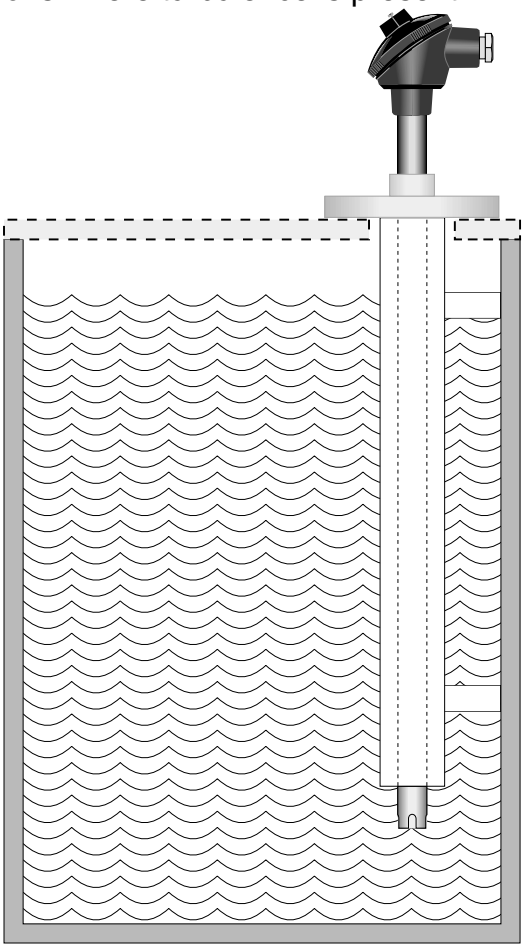
IMPORTANT - DO NOT IMMERSE THE CABLE





Application Example

In the example below additional protection is provided by the fixed open ended pipe. This is ideal for applications where turbulence is present.



Example of immersion assembly

The immersion assembly should be built to suit the application. In the example above a flange is incorporated to stabilise and support the assembly. The junction head makes electrode replacement easier, by allowing the cable to be accessed without undue twisting.

In models with an inbuilt 4-20mA amplifier, the junction head contains the electronic circuit board, calibration adjustments and the 4-20mA terminals.

Electrode Care and Maintenance

New Electrodes

When you receive your electrode the sensor zone is protected by a cover which contains a soaker solution. Before you use the electrode, rinse off the soaker solution and leave in clean tap water or a weak acid for 15 minutes. This will re-activate the reference junction.

Occasionally during shipment air bubbles may form in the glass bulb of pH electrodes. Before use, visually check the electrode for trapped air bubbles. Should bubbles be present, then they can be removed by shaking the electrode in a downward motion.

Important

The electrode membranes must be kept wet at all times. For short term storage the electrode may be stored in a tap water solution. When the electrode is not in use for long periods, it should be stored in a 3M KCl soaker solution adjusted to 4 pH.
Note: When storing double junction electrodes, use a solution saturated with the same salt type as the reference junction.

Cleaning the electrode

If the electrode becomes sluggish in response it may be necessary to clean the electrode. Usually cleaning with a mild detergent will remove the deposit and restore the electrode performance. Take care not to touch the glass at any time. Clean the electrode by washing in the mild detergent and then rinsing with clean tap water.

More difficult deposits may be removed by rinsing with methyl alcohol, followed by a rinse in clean tap water.

If the methyl alcohol rinse does not restore the response, carry out the following procedure:
1/ Soak the electrode in 0.1M HCl for 1 hour and then rinse the electrode with tap water.
2/ Soak the electrode in 0.1M NaOH for 1 hour and then rinse with tap water.

If the electrode performance is not restored repeat the steps 1 and 2, but increase the soaking times to 24 hours. If this does not restore the electrode performance, replace the electrode.

Re-fillable Electrodes

Most combination electrodes contain a gelled electrolyte which is never replaced. In some specialised applications the electrode may have a flowing electrolyte. The electrolyte is contained in a chamber which must be constantly replenished. A variety of refillable solutions are available and should be selected to suit the application.
Note: single junction AgCl lab electrodes should be topped up with 3 molar KCl/sat with AgCl, as “KCl” only can shorten the electrode life and cause an offset in pH 7 buffer.

Points to Remember

By following these points, it is possible to significantly increase the expected life of an electrode, and also greatly improve the quality of measurement results.

- pH and ORP electrodes must always be stored wet.
- For short term storage soak the electrode in KCl.
- For long term storage fill a container with the soaker solution immerse the electrode sensor zone and seal to prevent evaporation.
- Never store the electrode in: de-ionised water, solvents, hydrofluoric acid, pH buffers containing mercury based preservatives.
- Sensing tips should always be rinsed after use (laboratory electrodes).
- Reference cells should be kept regularly topped up with electrolyte (refillable laboratory electrodes).
- Connectors should be kept clean and dry.
- If the electrode needs to be cleaned physically, always use a soft tissue soaked in a mild detergent or methyl alcohol. Important: do not wipe the glass - use a dabbing technique.
- Never touch the electrode glass bulb with your fingers or other oily or abrasive objects.

Calibration

pH Calibration

You will need:

The equipment to be calibrated: comprising, pH electrode coupled to the pH meter.
Buffer solutions: typically 1 x pH 7.00 and 1 x pH 4.00.
DI rinsing water: de-ionised or distilled water (ideally in a fast flow wash bottle).
Tissue to dab electrode dry - do not wipe electrode - this can damage the glass surface.
Thermometer to measure temperature of buffer solutions.

Before you start:

Make sure the pH meter is powered up and stabilised.
Check the temperature of the buffer solutions (they should both be at ambient temperature).
If the meter does not have automatic temperature compensation, set manually to the solution temperature.
Allow the pH electrode to stabilise to the same ambient temperature as the buffer solutions.

Calibration procedure:

Rinse the electrode in de-ionised or distilled water - shake off excess water - dab dry with tissue.
Immerse the electrode in a buffer of 7.00 pH - allow to stabilise for 1 to 2 minutes.
Adjust the calibration of pH meter to read 7.00.
Remove electrode and rinse in DI water - shake off excess - dab dry with tissue.
Immerse electrode in buffer of 4.00 pH - allow to stabilise for 1 to 2 minutes.
Adjust pH meter to read 4.00.

Repeat procedure to confirm calibration - if necessary repeat until calibration is acceptable.
(note: this should not be necessary on microprocessor based instruments).

ORP (Redox) Calibration

You will need:

The equipment to be calibrated: comprising, ORP electrode coupled to the ORP meter.
Buffer solutions: typically 1 x pH 7.00 and 1 x pH 4.00, a small quantity of quinhydrone.
DI rinsing water: de-ionised or distilled water (ideally in a fast flow wash bottle).
Tissue to dab electrode dry - do not wipe electrode - this can damage the glass surface.
Thermometer to measure temperature of buffer solutions.

Before you start:

Make sure the ORP meter is powered up and stabilised.
Check the temperature of the buffer solutions (they should both be at ambient temperature).
Allow the ORP electrode to stabilise to the same ambient temperature as the buffer solutions.
Add a pinch of quinhydrone to each buffer, mix well, add more quinhydrone until the solutions are saturated and will not absorb more quinhydrone.

Calibration procedure:

Rinse the electrode in de-ionised or distilled water - shake off excess water - dab dry with tissue.
Immerse the electrode in the ORP 7.00 pH buffer - allow to stabilise for 1 to 2 minutes.
Adjust the calibration of ORP meter to read 86mV.
Remove electrode and rinse in DI water - shake off excess - dab dry with tissue.
Immerse electrode in the ORP 4.00 pH buffer - allow to stabilise for 1 to 2 minutes.
Adjust ORP meter to read 263mV.

Repeat procedure to confirm calibration - if necessary repeat until calibration is acceptable.
(note: this should not be necessary on microprocessor based instruments).

Note: the mV values quoted are for electrodes with a silver-silver chloride reference. For electrodes with a calomel reference subtract 42mV from the above values.

Electrode Problems

pH and ORP electrodes continually age and will not last indefinitely. The life span cannot be accurately predicted and is dependent on the chemical and temperature conditions experienced by the electrode. As the electrode ages the slope (output) decreases. The electrode should be replaced when the electrode slope reduces below 90% of an ideal electrode. However it is often possible to rejuvenate a pH electrode by:

1/ Soak the electrode in 0.1M HCl for 5 minutes and then rinse the electrode with tap water.
Soak the electrode in 0.1M NaOH for 5 minutes and then rinse with tap water.

2/ the process is detailed on the bottom of this page.
Caution: this process uses hazardous chemicals and should only be carried out by a qualified chemist.

See chapters "Care and maintaining of your electrode" for information on cleaning the electrodes and "Electrode Cable" for anti-microphonic layer.

Slow Response

Possible cause: Electrode glass surface contaminated.
Remedy: Clean electrode.

Possible cause: Reference junction or reference electrolyte contaminated.
Remedy: Clean electrode.

Unstable Reading

Possible cause: Reference junction blocked or contaminated.
Remedy: Clean electrode.

Low Slope (less than 90%)

Possible cause: Electrode glass surface not clean.
Remedy: Clean electrode.

Possible cause: Glass membrane aged.
Remedy: Try rejuvenating the electrode or replace electrode.

Possible cause: Dampness or contamination around cable connections.
Remedy: Clean with methyl alcohol and allow to dry in a warm place.

Displays approximately 7 pH (or 0mV for ORP) for all buffers

Possible cause: Electrical short circuit.
Remedy: Check connector for short circuit.
Check cable anti-microphonic layer.

Displays 4 to 5 pH for all buffers

Possible cause: Breakdown within electrode body.
Remedy: Replace electrode.

Advanced information - Rejuvenating the glass electrode

When the electrode is used at elevated temperatures the pH glass loses it's sensitivity. The following procedure may rejuvenate the glass surface and provide an extended electrode life.

1. Prepare a 20% solution of ammonium bifluoride.
2. Immerse the electrode in the solution for 15 to 20 seconds.
3. Rinse the electrode with tap water.
4. Immerse the electrode in 5-6M HCl for 5 minutes to remove the bifluoride.
5. Rinse electrode with tap water.
6. Immerse the electrode in pH buffer 4.00 for 1 to 2 hours.

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