PH/ORP ELECTRODE MEASUREMENT HANDBOOK

BY BURT PROCESS EQUIPMENT

BURT | PROCESS EQUIPMENT

Partners In Global Water Quality

TABLE OF CONTENTS

BURT | PROCESS EQUIPMENT

Dave Carson | Executive VP

Burt Process Equipment

Founded in 1970, Burt Process Equipment is a leader in the worldwide community of people, businesses, and organizations striving to create a better environment through the innovative and responsible use of water and natural resources. Our mission at Burt Process is to be a value-added supplier to our customers.

Many engineers, technicians, water treatment operators, and consultants have requested technical pH/ORP measurement information. Throughout the years, Burt Process Equipment has provided a variety of books, publications, charts, tables, and other reference materials. Our pH/ORP measurement handbook is intended to bring this information together in a convenient and easy-to-use format. We hope this handbook's collective information provides value in gaining wisdom when using, maintaining, cleaning, and selecting a pH/ORP probe.

We want to thank Georg Fischer for their wealth of information and willingness to support us in creating this reference handbook.

Respectively,

Dave Carson

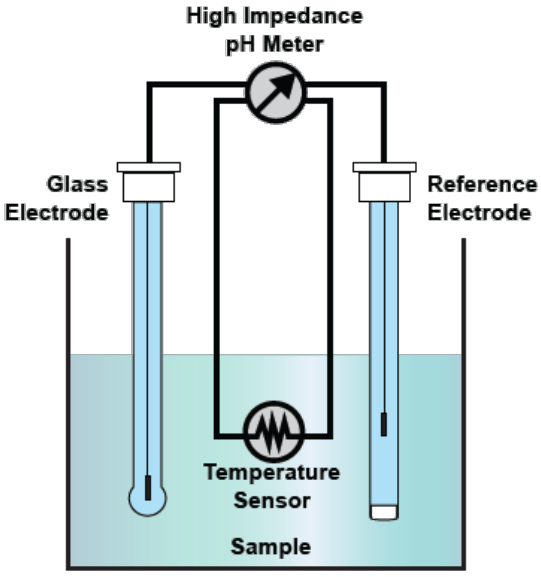
pH/ORP Introduction/Theory

pH and Oxidation-Reduction Potential (ORP) are two of the most fundamental parameters that often must be controlled to maintain good water quality. Controlling pH helps ensure product quality, reduces corrosion and scaling in power plant equipment, and protects the environment by helping wastewater generators meet regulatory limits. In water treatment, ORP measurement helps monitor and control oxidation-reduction reactions and maintain proper levels of disinfection.

pH is a quantitative measurement of the acidity or basicity of a substance. Acidic solutions have excess hydrogen ions (H+), can be corrosive, have a sour taste, and react with bases to form water and salt. Basic solutions are characterized by excess hydroxide ions (OH-), are slippery, are bitter-tasting, and react with acids to form water and salt. Common acids include hydrochloric acid, sulfuric acid, nitric acid, and hydrofluoric acid. Common bases include sodium hydroxide, potassium hydroxide, and ammonium hydroxide.

ORP is the measurement of a solution's ability to oxidize or reduce another chemical species. The presence of oxidizers in a water system will cause the organics to be oxidized or destroyed. Applications where ORP is used to determine the efficacy of chemical disinfectants and control of biological growths include swimming pools, aquatic life support systems, and cooling towers. Applications that use ORP for monitoring and controlling oxidation-reduction reactions include cyanide destruction, chromate reduction, and chlorine scrubber monitoring using bisulfate. Common oxidizers are hypochlorous acid, sodium hypochlorite, ozone, peracetic acid, and hypobromous acid. Common reducers include sulfur dioxide, sodium sulfite, ferrous sulfate, and ammonia.pH/ORP Measurement

pH is a potentiometric measurement where an electrical signal (in mV) is converted to a pH reading. The signal produced is the difference between the electrical potential of the reference electrode in contact with a highly concentrated salt solution and the electrical potential of the measuring electrode in contact with the solution being measured, which is the pH value of the solution.



The measuring electrode is a special formulation glass membrane sensitive to the hydrogen ions' activity in the solution. The pH glass will generate a potential, which depends on the pH of the solution. Temperature affects the hydrogen ion's activity in solution. To ensure accurate measurement pH sensors are equipped with a temperature sensor. The pH is automatically corrected for temperature using the Nernst equation.

BURT
PROCESS
EQUIPMENT

These pH sensors are known as combination electrodes. This means the reference, measuring electrodes, and temperature sensor are enclosed in the same body.

Similarly to the pH measurement, the ORP sensor consists of a measuring electrode in contact with the solution being measured and a reference electrode in contact with a highly concentrated salt solution. The measuring electrode is an inert noble metal (platinum, sometimes gold), which will form a thin oxide layer on the surface when exposed to dissolved oxygen. This oxide layer facilitates the ORP measurement by attracting hydrolyzed oxidant or reductant molecules to the surface of the electrode. The number of electrons exchanged per unit area (loss of electrons to an oxidant or accepting electrons from a reductant) will build up a surface charge that is equal to the ORP of the solution in mV.

ORP measurement is not specific. It cannot be used to determine the activity of a particular chemical or chemical species in a solution. For this reason, it is not possible to correct ORP measurements for temperature changes. Temperature affects each individual chemical species differently. Therefore, ORP measurements are never temperature compensated. A positive reading indicates an oxidizing solution and a negative reading indicates a reducing solution.

Defining pH/ORP

pH is defined as the negative logarithm of the Hydrogen ion concentration in aqueous solutions. The common pH scale ranges from 0 to 14, with 7 being neutral water (H2O). At pH 7, Hydrogen ions (H+) exist in equal concentration to Hydroxyl ions (OH-). A solution is acidic if the concentration of H+ exceeds that of OH- and is indicated by pH values below 7. Conversely, a solution is basic if the concentration of H+ is less than that of OH- and is indicated by pH values above 7.

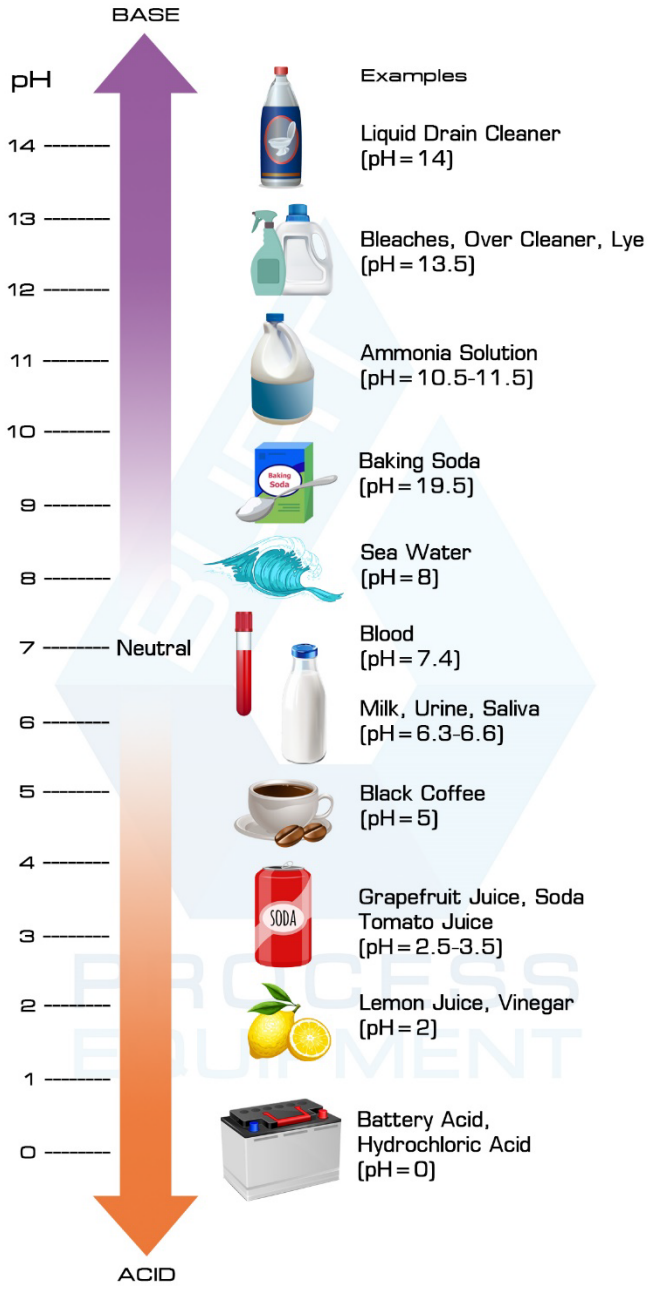
pH Examples

ORP is an abbreviation for Oxidation-Reduction Potential. Oxidation is a term used to denote the occurrence of a molecule losing an electron. Reduction occurs as a molecule gains an electron. The "potential" is simply an indication of a solution's propensity to contribute or accept electrons. ORP reactions (sometimes referred to as REDOX) always take place simultaneously. There is never oxidation without reduction, and ORP electrodes are used to detect electrons exchanged by molecules as these reactions occur.

Both pH and ORP electrodes produce voltages that depend on the solutions in contact with their sensing ends. Most pH electrodes are designed to produce 0 mV at pH 7, positive mV below pH 7 (associated with the charge of the Hydrogen ion, H+), and negative mV above pH 7 (associated with the charge of the Hydroxyl ion, OH-). According to the Nernst Equation, the interval between each pH unit is approximately 59.16 mV at 25 °C. This "raw" output is converted to a pH value by the display instrument.

The ORP scale is typically -1000 mV to +1000 mV, and the electrodes produce these values directly.

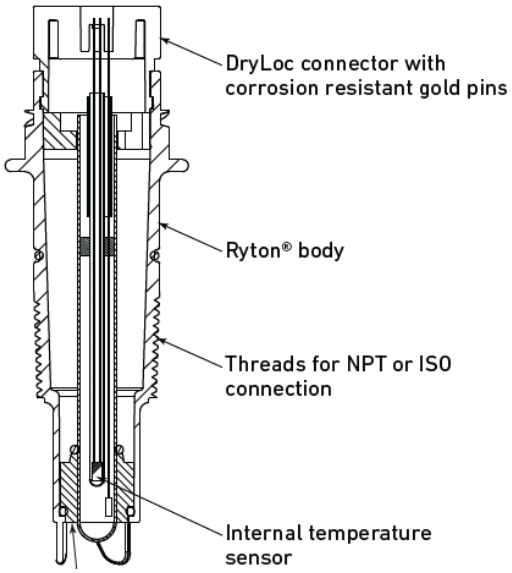
Whereas pH is a specific measure of the Hydrogen ion concentration in solution, ORP only provides relative measures of chemicals and cannot discriminate one from another. Although non-specific, it is a very useful and inexpensive method of monitoring and controlling the activity of such compounds as chlorine, ozone, bromine, cyanide, chromate, and many other chemical reactions.



It is worth noting that Temperature Compensation, which is very important for accurate pH measurement, is NOT used in ORP measurements. Temperature affects the reactionary potential of all chemicals, some to a greater extent than others. But even if the effects of temperature could be precisely known in all the many different REDOX reactions, removing them from the measurement would not be desirable. True ORP is the direct measurement of electrons in transit during Oxidation-Reduction reactions, regardless of temperature.

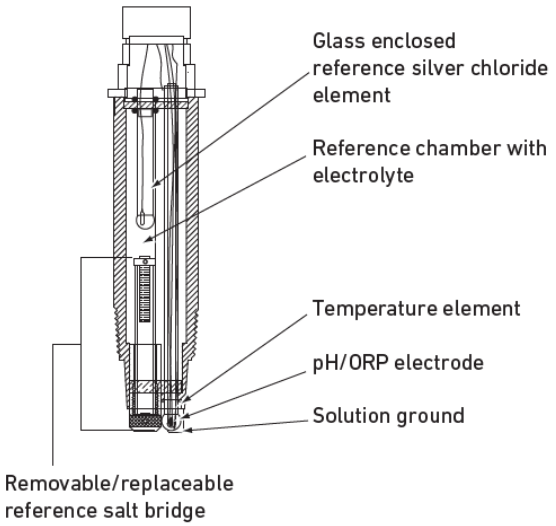
Standard pH/ORP electrodes are also commonly called combination electrodes; a pH/ORP measuring electrode and a reference measuring electrode are combined in a single body. The pH/ORP sensor measures the amount of hydrogen ions in the liquid. The pH signal is measured against the steady reference signal. Various chemical elements leaching through the porous reference junction can react with the reference electrolyte, dilute the electrolyte solution, or attack the silver chloride element; in either case, it will disturb the steady reference signal. Stray electrical currents will also affect the steady reference signal. A temperature element is also built into the pH combination electrode. Instruments interpret the temperature-compensated pH signal into a pH reading at 25 °C (77 °F). ORP values are not temperature dependent.

Cutaway of 2724 pH electrode



Differential pH/ORP electrodes function like the standard (combination) electrodes, but the reference design is modified, and there is a third electrode, the solution ground. The pH and reference electrodes are measured against the solution ground. The solution ground drains stray currents away from the reference element, hence always maintaining a steady signal. The reference salt bridge slows or stops various chemical elements from leaching into the reference chamber. Chemicals that leach in may dilute the electrolyte but will not react with the glass-encased reference silver chloride element. The reference electrolyte can be refreshed if it is diluted or depleted. The temperature element is embedded in the pH/ORP electrode for an extremely quick response.

Cutaway of 2766 pH electrode



Combination pH/ORP electrodes combine three or four electrodes built into one common body that measures the pH or ORP of the solutions. These electrodes are the pH/ORP sensing element, temperature

sensing element (pH only), the reference, and sometimes a solution ground. An electrical path between the process solution, reference electrode, and the pH/ORP sensing electrode must always be present to complete the measuring circuit. When the circuit is broken or interrupted, a faulty reading results. Only a few things in a chemical process would affect the glass-sensing element. These include concentrations of HF, constant high temperatures, and particles that can break the glass.

On the other hand, many problems can occur with the reference electrode. The reference silver chloride sensing element (wire) is exposed to the process liquid via the primary porous reference junction, which is in constant contact with the process and allows liquid to pass through to the reference electrolyte. Because of the direct contact with the process liquid, the reference electrolyte and reference silver chloride sensing element can react with chemicals in the process. Many application liquids do not chemically react with the reference; therefore, a standard electrode will perform well in this scenario. However, other process chemicals will easily attack the reference, and consequently, a differential-style electrode should be used. There are three advantages of the differential electrode:

1. If the process chemicals attack the KCl electrolyte, the reference electrolyte chamber is refillable.

2. If the reference junction becomes clogged by chemical reactions between the KCl and the process chemicals, the reference salt bridge is replaceable.

3. If there are stray currents or if there are process chemicals that attack the silver chloride wire in the standard electrodes, they will not attack it in the differential electrode because the wire is encased in a glass electrode.

A general rule of thumb is to use a differential electrode if you have mercury, copper, lead, chlorate, bromine, iodine, cyanide, or sulfide compounds in the process liquid. Differential electrodes may also be useful in processes where oil, grease, and dirt build up on the reference junction because it is easily replaced.

Application Tips

- It is important that the sensing end of pH and ORP electrodes remain wet, for it may be permanently damaged if allowed to dehydrate. This is true for both inline and submersible installation configurations. However, be careful to always keep the electrical interconnection between the electrode and preamplifier dry and clean. Moisture in this area can also cause permanent damage.

- pH control is best when performed in a tank. This is especially true in neutralization applications since it is very important for reagents to mix thoroughly with waste fluids and to be allowed adequate time for the reactions to occur. Limiting adjustments to fewer than 3 pH units per stage and sizing tanks to provide at least 10 minutes of retention time will increase the probability of producing safe effluents.

- For bulb-style pH and ORP electrodes, significant natural self-cleaning by turbulent eddies is achieved at velocities of 1.5 m/s or more (5 ft/s). Flat surface electrodes get adequate self-cleaning at velocities of 0.3 to 0.6 m/s (1 to 2 ft/s). In all cases, exposure to velocities greater than 3 m/s (10 ft/s) can cause excessive measurement noise and electrode wear and should be avoided.

- The aging of pH and ORP electrodes (i.e., reference depletion and decreased glass sensitivity) results from a series of chemical reactions. And as a rule, the rates of chemical reactions double with every increase of 10 °C or 18 °F. This means shorter life expectancy for all pH and ORP electrodes as application temperatures increase.

- HF acid and strong caustics etch pH glass. High concentrations, especially at high temperatures, destroy electrodes quickly. For applications containing trace quantities of HF (< 2%), use an electrode specifically designed for HF. This electrode has a polymeric constituent in the pH glass that resists attack by HF and extends the service life considerably over "normal" electrodes.

- In applications where process temperatures will drop below 10 °C (50 °F), use the bulb-style electrodes in place of the flat-style electrode. This is a function of the electrical impedance of the glass that increases dramatically as temperature decreases.

- Proper electrode placement within a tank is also very important. Electrodes should be mounted in well-mixed areas, away from reagents and waste introduction. It is usually advisable to position the electrode near the discharge outlet of the tank.

- Inline pH control is not recommended because it is very difficult to determine the amounts of reagent necessary to achieve a desired reaction if both pH and fl ow are variables. However, inline pH monitoring is very common and useful.

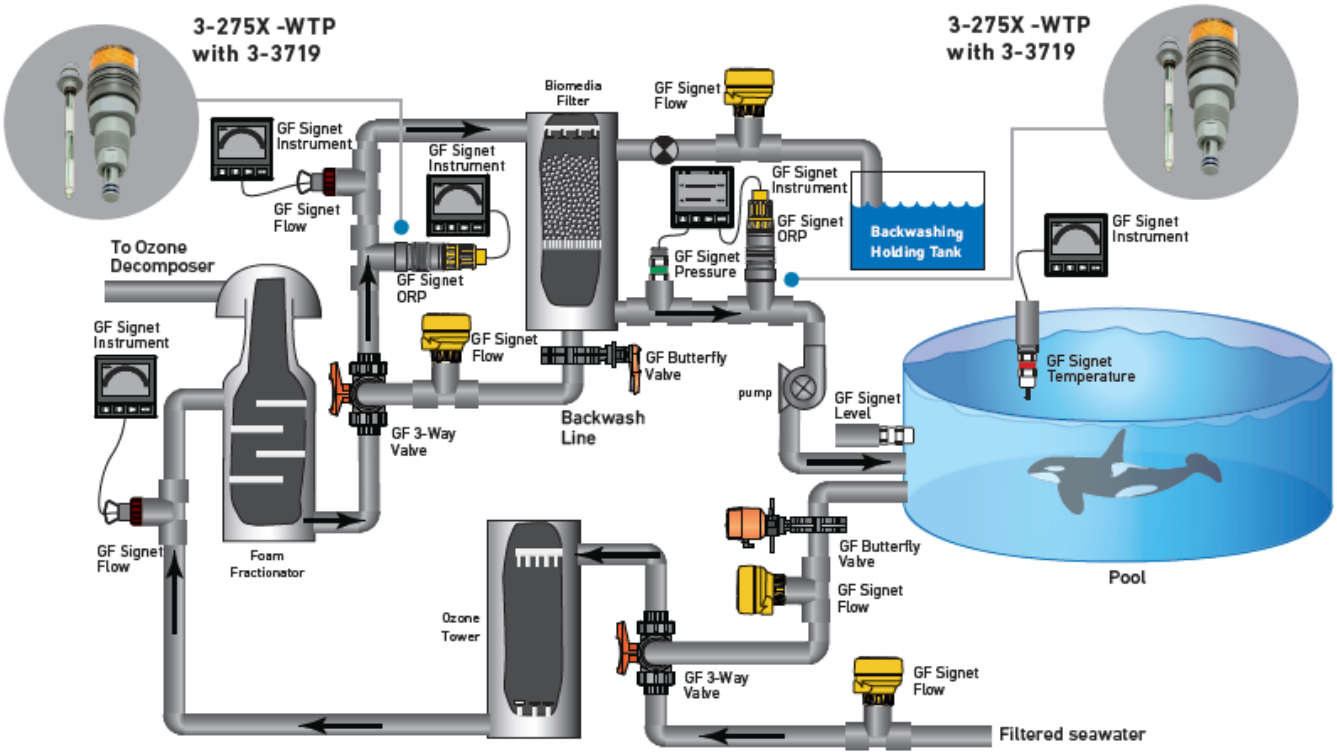
Example Application

Aquariums

In aquariums or applications where system shutdown is not an option, inline Wet-Tap probes and assemblies provide a solution.

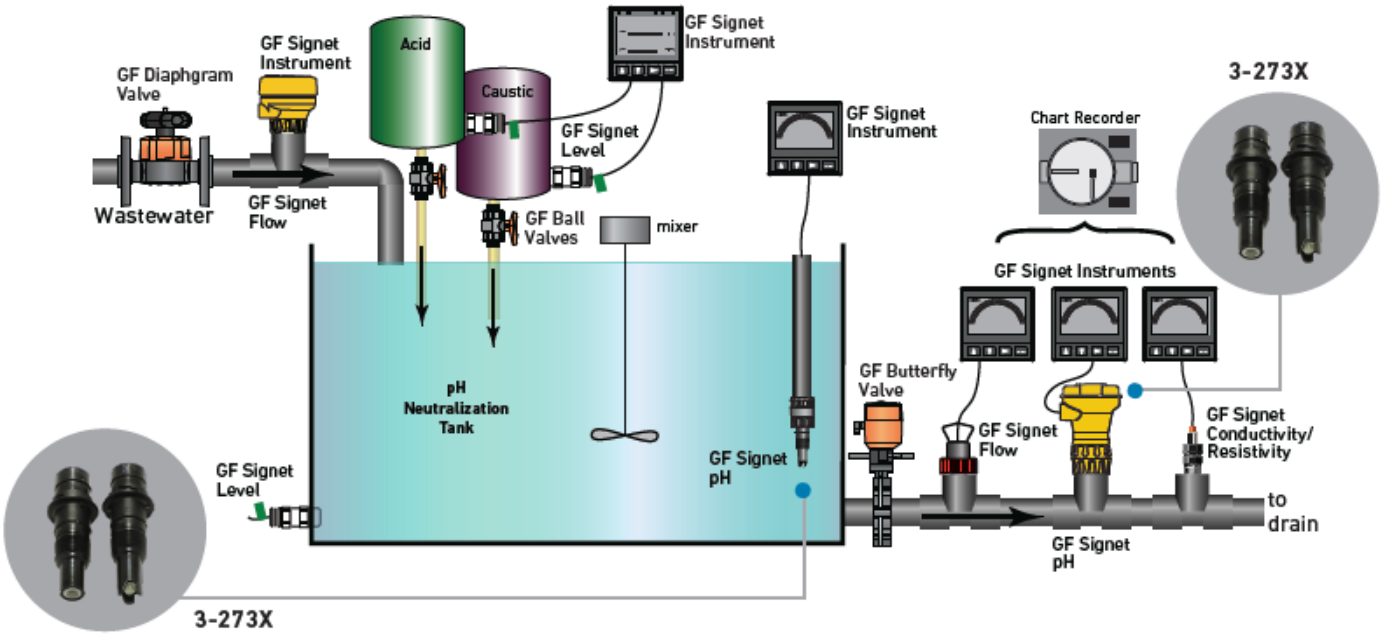
Selection Advantage:

- No system downtime: The 3719 Wet-Tap Assembly allows pH or ORP electrode installation and removal for maintenance even under process pressure without the need for system shutdown.
- Space saving: 45 mm (1.75 in) short-stroke design
- Low maintenance and easy to use: PTFE junction resists coating and biological fouling.



- CPVC durable, robust assembly: Protects against mechanical damage and ensures excellent compatibility with aquarium media.
- Memory chip-enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety.

Example Application: Neutralization

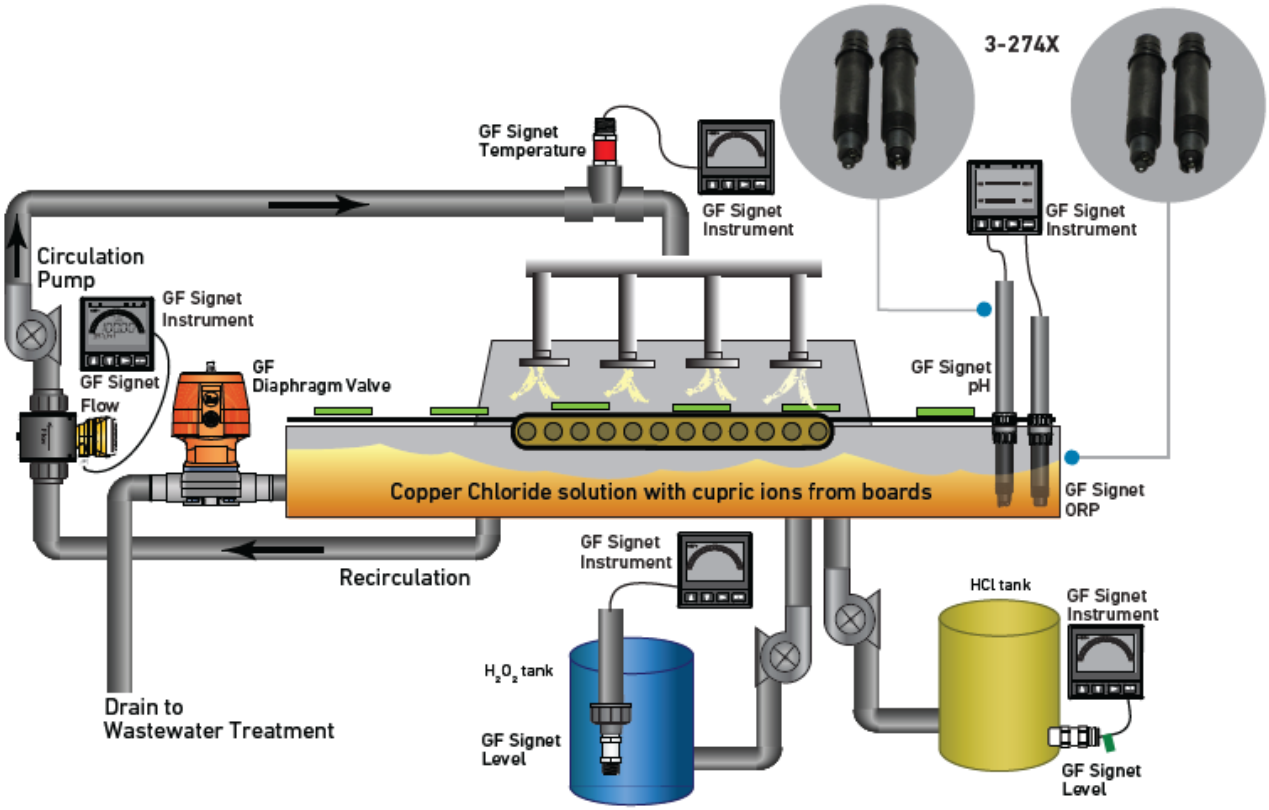


In a neutralization application, submerging the sensor in an optimal location within the neutralization tank is necessary.

Selection Advantage:

- Long lasting: In neutralization applications containing heavy metals, sulfides, organics, or any other biological media due to the patented Interdigitated Axial Ion Path and enhanced reference chemistry.
- Stable and reliable measurement: Enhanced reference chemistry protects against poisoning ions such as cyanide (CN-) or sulfide (S2-).
- Low maintenance: Self-cleaning flat-style electrodes suitable for dirty applications and media with suspended solids
- Memory chip-enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety.

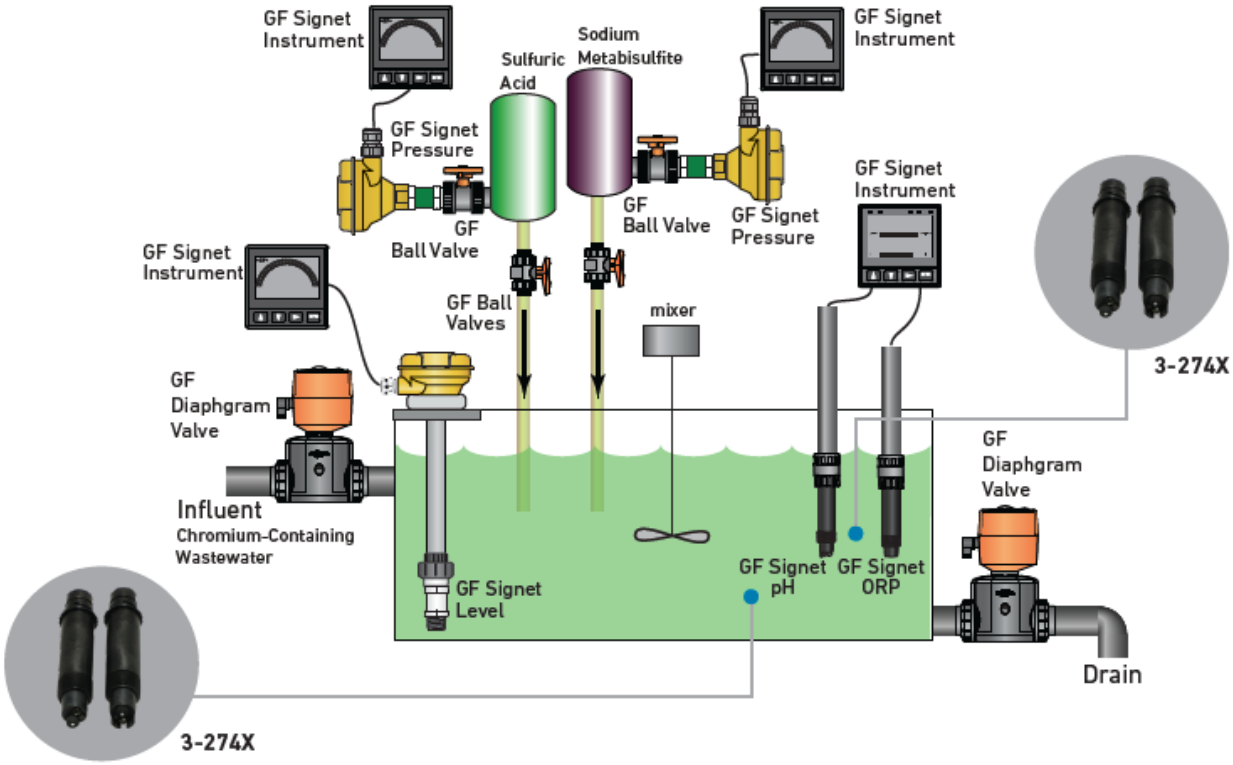
Example Application: Plating



Selection Advantage:

- Long lasting: In the harshest plating conditions due to ruggedized process glass, protected reference electrode, and re-buildable design.
- Highly accurate and reliable measurement: Due to built-in solution ground, which eliminates ground loop measurement errors.
- Great stability and less downtime due to the differential design.
- Low maintenance: Due to internal buffered electrolyte solution.
- Cost-effective: The electrode can be reconditioned in the field by refilling the reference electrolyte and replacing the double junction salt bridge.
- Memory chip-enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety.

Example Application: Chromium Reduction



Selection Advantage:

- Long lasting: Due to ruggedized process glass, protected reference electrode, and re-buildable design.
- Highly accurate and reliable measurement: Due to built-in solution ground, which eliminates ground loop measurement errors.
- Great stability and less downtime: Due to the differential design.
- Low maintenance: Due to internal buffered electrolyte solution
- Cost-effective: The electrode can be reconditioned in the field by refilling the reference electrolyte and replacing the double junction salt bridge.
- Memory chip-enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety.

pH/ORP Electrode Selection Guide

pH/ORP Electrode Specification	 General Purpose	 General Purpose	 General Purpose/ Industrial	 General Purpose/ Industrial	 High Performance
Model	**272X**	**275X-WTP**	**277X**	**273X**	**274X**
Body Material	Ryton®(PPS)	PAS (Polyarylsulphone)	Ryton® (PPS)	Ryton® (PPS)	Ryton® (PPS)
Junction Material	UHMH Polyethylene	PTFE	PTFE	PTFE	PTFE
O-rings	FKM	FKM	FKM	FKM	EPR (EPDM)
Sensing Element	Glass (Protected Bulb or Flat)	Glass (Protected Bulb)	Glass (Protected Bulb or Flat)	Glass (Protected Bulb or Flat)	Glass (Protected Bulb or Flat)
Reference Junction	Single	Double	Double	Single	Double
Reference Electrolyte	KCl and AgCl gel	KCl and AgCl gel	KNO_3 and KCl/AgCl gel	KCl and AgCl gel	Buffered KNO_3 liquid
Temperature Element	Pt1000 or 3KΩ Balco	Pt1000 or 3KΩ Balco	Pt1000 or 3KΩ Balco	Pt1000	Pt1000 or 3KΩ Balco
Process Connection/ Thread	3/4" MNPT or ISO 7/1-R3/4	N/A	3/4" MNPT	3/4" MNPT or ISO 7/1-R3/4	1" MNPT
Insertion Length	1 - 1.4 in (25.4 - 35.5 mm)	2.75 - 3.4 in (70 - 86 mm)	1.3 - 1.7 in (32 - 43 mm)	1 - 1.4 in (25.4 - 35.5 mm)	1.13 in (28.7 mm)
ORP Version	2725	2757-WTP	2775 and 2777	2735	2745 and 2747
ORP Element	Platinum	Platinum	Platinum or Gold	Platinum	Platinum
Special Feature	Patented Interdigitated Axial Ion Path	Wet-Tap electrode	Large junction surface area	Patented Interdigitated Axial Ion Path and enhanced reference chemistry	Differential design
Compatible Signet Instruments	8900/9900/9950 0486 Profibus Concentrator	8900/9900/9950 0486 Profibus Concentrator	8900/9900/9950 0486 Profibus Concentrator	8900/9900/9950 0486 Profibus Concentrator	8900/9900/9950 0486 Profibus Concentrator
Standards and Approvals	Manufactured under: ISO 9001 and ISO 45001	Manufactured under: ISO 9001 and ISO 45001	Manufactured under: ISO 9001 and ISO 45001	Manufactured under: ISO 9001 and ISO 45001	Manufactured under: ISO 9001 and ISO 45001

BURT PROCESS EQUIPMENT

Applications	General Purpose 272X	General Purpose 275X-WTP	General Purpose/ Industrial 277X	General Purpose/ Industrial 273X	High Performance 274X
Clear Water Treatment					
Drinking Water	●	●			
Raw Water Feed	●	●			
Pool and Spa Control	●	●			
Boiler Feed Water	●	●			
Cooling Towers	●	●			
Reverse Osmosis	●	●			
Wastewater Treatment					
Neutralization	○		●	●	
Heavy Metal Removal / Recovery			○	○	●
Cyanide Destruction			○	○	●
Chromium Reduction			○	○	●
Aquatic Life Support Systems	●	●			
Aquaculture/Fish/Shrimp Farming	●	●	●		
Landfield Leachate	○		○	○	●
Food Industry	○		●	●	
Ground Water Remediation			○	○	●
Municipal Wastewater/ Sewage			●	○	
Industrial Processes					
Plating Baths			○	○	●
Metal and Surface Finishing			○	○	●
Fume Scrubbing			○	○	●
Leather/Dyeing			○	○	●
Pulp and Paper			○	○	●
Chemical Injection			○	○	●
Chemical Refineries			○	○	●
Pesticide Manufacturing			○	○	●
Fertilizer Manufacturing			○	○	●
Agriculture Nutrient Dosing	○		●	●	○
Hydrofluoric Acid (< 2%)	●			●	
Low Conductivity (20 to 100 µS/cm)	●				
Low Temperature (0 °C to 15 °C)	●	●			
High Temperature (60 °C to 110 °C)			●		●

Key:

● Best Performance, Longevity and Economical Value

○ Performance and longevity may depend on process conditions: metals present, overall concentration of chemicals, temperature and pH range

BURT PROCESS EQUIPMENT

General Purpose pH/ORP Electrodes

Process electrodes designed for general use are built with durable, robust bodies with built-in process connections (NPT threads or ISO threads). These sensors are suited for continuous monitoring and controlling of pH or ORP in a wide range of light/moderate-duty applications. Process sensors designed for general use provide a long-lasting, affordable solution in most industries, especially Drinking Water, Wastewater Treatment, Neutralization, Process Control, Surface Water, Aquatic, Animal Life Support Systems, Pools, Spa Control, Theme Park Water Rides, Cooling Tower, and Aquaculture.

Specifications

Operating Range	pH 0 to 14 pH (for long term monitoring recommended pH range: 0 to 11.0 pH) ORP ± 2000 mV
Operating Temperature	0 °C to 85 °C (32 °F to 150 °F)
Operating Pressure	6.8 bar @ 0 to 65 °C (100 psi @ 32 to 150 °F) 4 bar @ 65 to 85 °C (58 psi 150 to 185 °F)
Wetted Materials	Ryton® (PPS), UHMWPE, FKM, glass membrane/Pt disk
Reference Junction	Single, UHMWPE

Features

- Patented reference design for prolonged life in media containing moderate contamination
- Bulb and flat style HF resistant glass available
- Low conductivity media sensor available for liquids down to 20 µS/cm
- Hemispherical and flat styles with either Pt1000 or 3 kΩ Balco RTD temperature sensor
- Quick temperature response
- Process connection NPT ¾" suitable for in-line and immersion installation as well as Insertion design for use with any Signet ½" - 4" installation fitting, or threaded adapter
- Patented DryLoc® connector with corrosion resistant gold plated contacts ensures a robust connection to the sensor electronics
- Memory chip enabled for access to a wide range of unique features when connected to GF Signet 2751 Smart Sensor Electronics

Benefits

- Low cost pH solution for general purpose/ light duty applications
- Accurate and reliable measurement even in installations with high flow rates
- Small assembly, the electrode saves space in submersible or inline installations
- Low maintenance and easy to use
- Durable robust housing protects against mechanical damage and ensures excellent compatibility with a wide range of chemicals
- Memory chip enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety and performance

BURT PROCESS EQUIPMENT

General Purpose Wet-Tap pH/ORP Electrodes

General-purpose electrodes are ideal for a wide range of applications where the removal and reinstallation of the electrode can be performed without the need for system shutdown. Process sensors designed for general use provide a long-lasting, affordable solution in most industries, especially Aquatic, Animal Life Support Systems, Recreational Water Monitoring, Water & Wastewater Monitoring, Neutralization Systems, Sanitization Systems, Pool, Spa Control, and Effluent Monitoring.

Specifications

Operating Range	pH 0 to 14 pH (for long term monitoring recommended pH range: 0 to 11.0 pH) ORP ± 2000 mV
Operating Temperature	0 °C to 85 °C (32 °F to 185 °F)
Operating Pressure	6.9 bar @ 25 °C (100 psi and 77 °F)
Wetted Materials	PAS (polyarylsulphone), PTFE, FKM, glass membrane/Pt disk
Reference Junction	Double, PTFE

General-Purpose, Industrial pH/ORP Electrodes

Features

- Electrode removal without process shutdown when installed in the GF Signet 3719 pH/ORP Wet-Tap Assembly
- PTFE reference junction resists fouling and chemical attack
- General purpose bulb pH glass suitable in a wide range of applications
- Pt1000 or 3kΩ Balco RTD temperature element for quick temperature response
- Special design allows for installation at any angle, even inverted or horizontal
- Patented DryLoc® connector with corrosion resistant gold plated contacts ensures a robust connection to the sensor electronics
- Memory chip enabled for access to a wide range of unique features when connected to GF Signet 2751 Smart Sensor Electronics

Benefits

- No system downtime: The wet-tap assembly allows pH or ORP electrode removal and re-installation for maintenance even under process pressure without the need for system shutdown
- Space saving: 45 mm (1.75 in) short-stroke design
- Low maintenance and easy to use
- CPVC/PVC-C durable robust assembly protects against mechanical damage and ensures excellent compatibility with a wide range of chemicals
- Memory chip enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety and performance

BURT PROCESS EQUIPMENT

The 273X series of electrodes are cost-effective pH and ORP electrodes for industrial applications. These sensors are suitable for continuous monitoring of pH and ORP in a wide range of harsh process liquids. Signet 2734-2736 are the robust pH and ORP electrodes for industrial water treatment, wastewater, and metal. It monitors Neutralization, Influent & Effluent Monitoring, Wastewater Treatment, Groundwater Remediation, Process Control, Cooling Towers & Boiler Protection, Leaching, Metal Plating, Surface Finishing, Mining, Agriculture Nutrient Dosing, and Textile Industries.

Specifications

Operating Range	pH 0 to 14 pH (for long term monitoring recommended pH range 0 to 11.0 pH) ORP ± 2000 mV
Operating Temperature	10 °C to 100 °C (50 °F to 212 °F)
Operating Pressure	0 to 6.9 bar @ 10 °C to 65 °C (0 to 100 psi @ 50 °F to 100 °F) Linearity Derated 6.9 to 4.0 bar @ 65 °C to 100 °C (100 to 58 psi @ 149 °F to212 °F)
Wetted Materials	Ryton® (PPS), PTFE, FKM, glass membrane/Pt disk
Reference Junction	Single, PTFE

Features

- Patented reference design for prolonged life in media containing moderate contamination
- Enhanced reference chemistry to block various poisoning ions
- Porous PTFE reference diaphragm resists fouling, clogging and chemical attack
- Hemispherical and flat styles with Pt1000 RTD temperature sensor
- HF resistant glass available in hemispherical and flat style
- Gel-compact electrolyte
- Ryton® (PPS) housing and FKM O-rings for superior chemical resistance in a wide range of chemicals
- Process connection NPT ¾“ suitable for in-line and submersible installation as well as insertion design for use with any Signet ½” -4” installation fitting, or threaded adapter
- Patented DryLoc® connector with corrosion resistant gold plated contacts ensures a robust connection to the sensor electronics
- Memory chip enabled for access to a wide range of unique features when connected to GF Signet 2751 Smart Sensor Electronics

Benefits

- Long lasting solution in applications containing heavy metals, sulfides, organics or any other biological media due to the patented reference design and enhanced reference chemistry
- Stable and reliable measurement: Enhanced reference chemistry protects against poisoning ions such as CN^- or S^{2-}
- Self-cleaning flat style electrodes suitable for applications with suspended solids and high flow rates
- Durable robust housing protects against mechanical damage and ensures excellent compatibility with a wide range of chemicals
- Memory chip enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety and performance

BURT PROCESS EQUIPMENT

High-Performance pH/ORP Electrodes

Process electrodes are built with superior glass formulation, a 3-electrode differential design, and a protected reference electrode housed in a glass half-cell to withstand extreme pH conditions, elevated temperatures, and poisoning ions. These sensors are suitable for continuous monitoring of pH and ORP in a wide range of heavy-duty applications. Suitable applications are media with high concentrations of poisoning ions, high pH, elevated temperatures, and high concentrations of suspended solids. It supports, Metal Plating Industries, Surface Finishing, Wastewater Treatment, Ground Water Remediation, Process Control, Neutralization, Pulp & Paper, Textile Industries, Chemical Refineries, Heavy Metal Removal & Recovery, Pesticide Manufacturing, and Fertilizer Manufacturing.

Specifications

Operating Range	pH 0 to 14 pH (for long term monitoring recommended pH range 0 to 11.0 pH) ORP ± 2000 mV
Operating Temperature	10 °C to 100 °C (50 °F to 212 °F)
Operating Pressure	0 to 6.9 bar @ 10 °C to 65 °C (0 to 100 psi @ 50 °F to 100 °F) Linearity Derated 6.9 to 4.0 bar @ 65 °C to 100 °C (100 to 58 psi @ 149 °F to212 °F)
Wetted Materials	Ryton® (PPS), PTFE, FKM, glass membrane/Pt disk
Reference Junction	Single, PTFE

Features

- Patented reference design for prolonged life in media containing moderate contamination
- Enhanced reference chemistry to block various poisoning ions
- Porous PTFE reference diaphragm resists fouling, clogging and chemical attack
- Hemispherical and flat styles with Pt1000 RTD temperature sensor
- HF resistant glass available in hemispherical and flat style
- Gel-compact electrolyte
- Ryton® (PPS) housing and FKM O-rings for superior chemical resistance in a wide range of chemicals
- Process connection NPT ¾" suitable for in-line and submersible installation as well as insertion design for use with any Signet ½" -4" installation fitting, or threaded adapter
- Patented DryLoc® connector with corrosion resistant gold plated contacts ensures a robust connection to the sensor electronics
- Memory chip enabled for access to a wide range of unique features when connected to GF Signet 2751 Smart Sensor Electronics

Benefits

- Long lasting solution in applications containing heavy metals, sulfides, organics or any other biological media due to the patented reference design and enhanced reference chemistry
- Stable and reliable measurement: Enhanced reference chemistry protects against poisoning ions such as CN^- or S^{2-}
- Self-cleaning flat style electrodes suitable for applications with suspended solids and high flow rates
- Durable robust housing protects against mechanical damage and ensures excellent compatibility with a wide range of chemicals
- Memory chip enabled for convenient data storage allows operators easy troubleshooting and convenient remote calibration to minimize system downtime and increase safety and performance

BURT PROCESS EQUIPMENT

pH/ORP Smart Sensor Electronics

The Signet 2751 pH/ORP Smart Sensor Electronics, featuring the DryLoc connector, is the solution for field-free calibration, out-of-range glass impedance, and broken glass detection, alerting the operator to probe failure or maintenance needs. Robust design for use in a submersible or inline configuration in general purpose and harsh media conditions in all industries, especially Water & Wastewater Treatment, Neutralization Systems, Scrubber Control, Effluent Monitoring, Surface Finishing, Flocculent Coagulation, Heavy Metal Removal & Recovery, Toxics Destruction, Sanitization Systems, Pool & Spa Control, Aquatic & Animal Life Support Systems.

Specifications

Operating Range	pH -1 to 15 pH ORP ± 2000 mV	
Operating Temperature	0 °C to 85 °C (32 °F to 185 °F)	
Response Time	pH	< 6 sec. for 95% of change
	ORP	Application dependent
Materials	In-line	PBT and polypropylene (retaining nut)
	Submersible	CPVC/PVC-C

Features

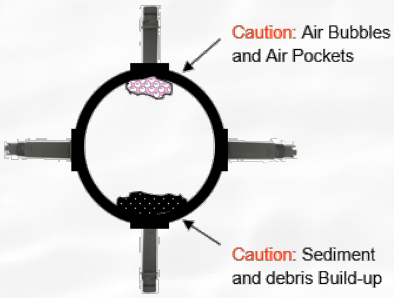
- Probe health monitoring, glass impedance and broken glass detection
- Memory chip interface that allows for transferable calibration, runtime data, and manufacturing information
- In-line integral mount and submersible installation versions
- Automatic temperature compensation
- Auto configuration for pH or ORP operation
- Optional EasyCal calibration aid with automatic pH buffer recognition for 4, 7 and 10 pH and ORP solutions: quinhydrone saturated pH 4.01 or 7.00 buffers and Light's Solution
- Junction boxes for convenient wiring
- Patented DryLoc® connector provides a quick and secure connection to the sensor

Benefits

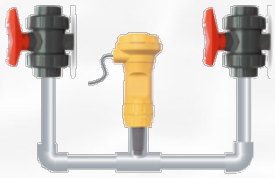
- Two different outputs: 4 to 20 mA loop output enables a low cost pH/ORP system solution while the digital (S³L) output allows for longer cable length and connection to the Signet SmartPro instruments
- Reduced operating costs: Remote to the sensor does not get thrown away when the electrode is due for replacement
- User-friendly connection: Easy DryLoc connect/disconnect
- Reduced system downtime, calibration time and calibration costs: Remote, transferable calibration eliminates the hassle of filed calibration by allowing calibration under lab conditions for increased sensor longevity and measurement accuracy
- Improved measurement performance: Probe health monitoring through automatic or manual glass impedance measurement, alerts user on broken glass or when set glass impedance is exceeded.
- Data management: Read and write capabilities for convenient historical data storage in the sensor's memory chip can be used for troubleshooting or predictive maintenance and process optimization

BURT PROCESS EQUIPMENT

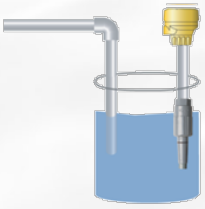
pH/ORP Installation



Sensors are designed for both inline mounting or submersible installation. It's important to mount electrodes in a location with ample clearance for removal for periodic cleaning and recalibration. Choose a location that keeps the electrode glass completely submerged and ensures that the electrode can be isolated for removal. Place the electrode tip in pH 4 buffer during system maintenance or storage to avoid dehydration and reduce chemical activity.



Be aware of mounting positions. Some sensors must be mounted +/- 45 degrees of the vertical. When mounting inline, use caution, as air bubbles and air pockets can form at the top of a horizontal pipe. In addition, sediment and debris build-up can form on the bottom. It's crucial to avoid locations that could negatively impact probe performance.



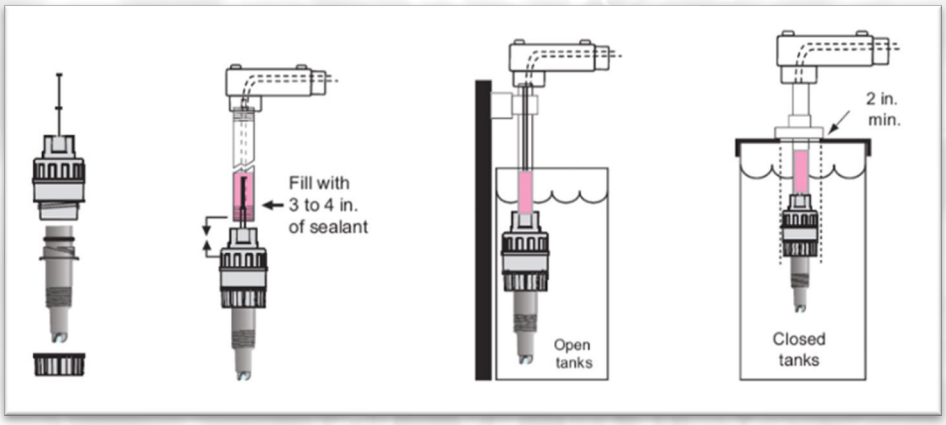
When installing a submersible installation, first and foremost, make certain the electrode and preamp are compatible for submersion. Always ensure the DryLoc O-ring is lubricated before assembly. The wire entryway must be sealed with RTV or other flexible sealant to prevent damage to the preamp. Use a flat-style electrode and, if possible, protect the tip from contacting the bottom of the tank by using a flange with a short pipe or other protection. Sensors are designed to be installed in tanks by attaching a conduit to the ¾" threads at the top of the accompanying preamplifier or sensor electrodes. Installing a sensor can simply be done by following these steps:

1. The O-ring at the top of the electrode fits very tightly into the preamplifier. Use a small amount of lubricant (non-petroleum-based) to assist the assembly.

2. To prevent moisture from migrating into the preamplifier, backfill the conduit with 3 to 4 inches of sealant.

3. Mount electrodes in a location with ample clearance to remove them for periodic cleaning and recalibration.

4. Choose a location that keeps the electrode glass completely, and always submerged.



BURT
PROCESS
EQUIPMENT

Why do electrodes need to be calibrated?

Calibration ensures the pH or ORP electrode continues to function properly and accurately. pH and ORP electrode readings vary over time due to changes in reference voltage or aging of the pH glass. pH electrode output decreases with age, coating, elevated temperatures, and pH glass erosion (by abrasion and strong sodium hydroxide (NaOH), potassium hydroxide (KOH), or hydrofluoric acid (HF) solutions).

Sensors are good when a new electrode reads very close to the theoretical value (±0.25 pH). A used pH electrode may read as far off as ±0.84 pH before it needs to be replaced. If the pH readings in all buffers have shifted greater than 0.84 pH units (for example, the electrode is reading 4.85 in a 4 buffer and 7.85 in a 7 buffer) or if the millivolt offset for pH/ORP sensors is extreme (outside of ±50 mV) in both pH/ORP solutions), a problem with the reference electrode is indicated, and the electrode should be replaced.

Calibration helps to identify when the electrode is worn out and needs to be replaced.

How often should an electrode be calibrated?

- New applications Weekly calibration is recommended for a new process where a pH or ORP electrode has never been installed. If the electrode calibrates within acceptable limits over the next few weeks, change the calibration schedule to once every two weeks and continue to extend the schedule to meet your needs.
- Existing applications It is recommended the electrode be calibrated at least every month to ensure proper function of the electrode.
- For applications in locations where measurement accuracy is extremely critical, the electrode should be calibrated as frequently as required for proper Performance.
- In dirty applications where the electrode needs frequent cleaning, the electrode should be calibrated after each cleaning to ensure proper functionality.

Why do some electrodes need frequent calibration while others need calibration every month?

If a process plant has a variety of processes within the facility, a calibration schedule needs to be determined for sensors placed in each type of process liquid.

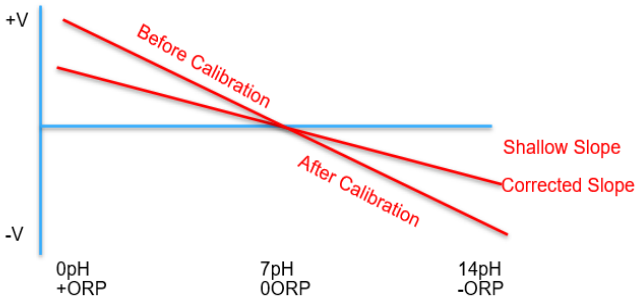
- Clean applications, like drinking water, are rarely a problem for pH or ORP measurements, and calibration is typically required every month.
- If the process solution contains high concentrations of chemicals, elevated temperature and/or pressure, or has many suspended solids, it is common to calibrate once every one or two weeks.
- For dirty process liquid applications, an electrode should be cleaned before calibrating.

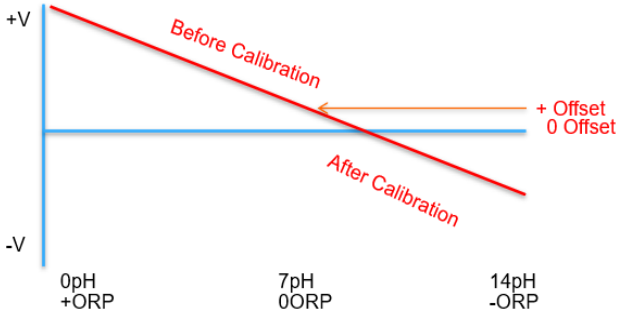
pH/ORP Single & Two-Point Calibration

Calibration can occur either in the system, using a secondary measurement device known as a pH/ORP system tester, or external to the system using buffers. Calibration is required for both ORP and pH electrodes. There are two types of calibration: single point and two points.

Single-point calibration can be performed in the system using standard buffers. GF does have testers that can be used for verification and troubleshooting. These testers are not a direct substitute for calibration with the use of buffers. A single-point calibration will adjust the offset of the probe. As the reference electrode in the probe ages, the voltage generated in the reference cell will drift, which will cause an offset in the measurement. Single-point calibrations allow the measurement device to compensate for voltage offset. Offset should never exceed +/- 30 mV. Single-point calibrations are good when you only have one measurement point, for example, in a system where you need to maintain a specific pH. You can also perform a two-point calibration.

Most manufacturers of pH and ORP instrumentation include single and two-point calibration. These may be indicated under different names, such as Standardize or Slope calibrations, but they perform the same effect as a single (Standardize) or two (Slope) point calibration.





Some manufacturers include multi-point calibrations as an option. Multiple point calibrations allow for a more accurate characterization of the electrode. However, in most applications, the additional complexity and work involved are not justified. Single and Two-point calibration will allow readings within ±0.03 pH.

Calibration and maintenance schedules are dependent on each application and the desired accuracy. In critical applications, cleaning and calibration may be performed multiple times per day, while in other applications, a monthly calibration is all that is required. Due to the nature of pH and ORP electrodes, the increased frequency of calibration allows for a more accurate measurement. pH and ORP electrodes should be maintained and calibrated at least monthly. This will ensure proper operation of the system and allow for the replacement of the electrodes before complete failure.

pH/ORP Buffers

Buffers and Standards are premade solutions or mixes with a specific pH value. Common pH buffers are 4, 7, and 10 pH. Many other values of pH buffers are produced in response to various demands from specific application areas. Manufacturers can color code the pH buffers to allow the operator to distinguish from the various values. There is no standard for the colors; the manufacturer determines the colors.

pH buffers will drift with temperature. Producers of the buffers will normally include a chart showing the expected value of the buffer at different temperatures. The buffer will automatically compensate if the instrument includes temperature compensation for pH measurements. If the instrument does not offer temperature compensation, then the value associated with the temperature of the buffer solution will need to be used during calibration. If there is a difference in temperature between the buffer solutions and the system, allow the probe to soak in the buffer until the temperature of the probe and solution equalize before performing the calibration.

ORP buffers are available in a number-standard millivolt value. Two standard ORP buffers are ZoBell's Solution (238mV @ 25 °C) and Light's Solution (486mV @ 25 °C). Additionally, 4 pH (255 mV) and 7 pH (86 mV) buffers, when saturated with Quinhydrone, 125 mg per 50 mL of buffer, will generate known ORP mV values.
When using commercial ORP buffers, it is important to read the calibration data associated with the buffers. Many commercial buffers will vary from lot to lot, the actual mV value of the buffer should be included with the shipment and used for the calibration value. If there is a difference in temperature between the buffer solutions and the system, allow the probe to soak in the buffer until the temperature of the probe and solution equalize before performing the calibration.

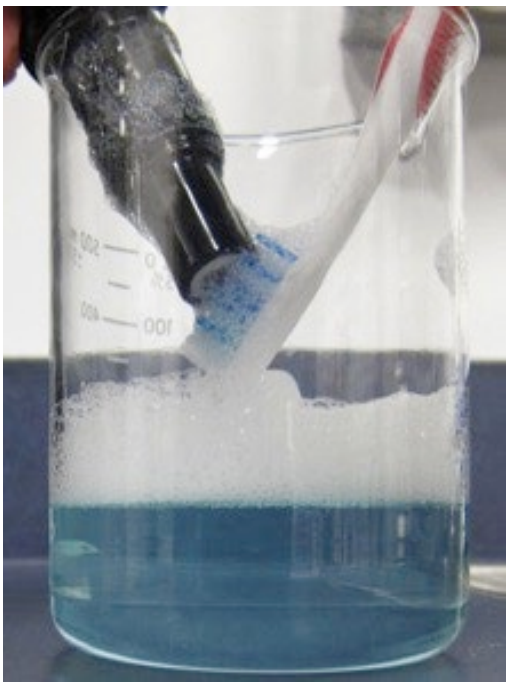
pH and ORP buffers and standards have limited shelf life and include a use-by or expiration date. Buffers past the expiration date should not be used. Buffers should be stored in a cool, dark environment to prolong their life. Buffers should never be allowed to freeze. If a buffer has frozen, it should be discarded. Once the seal on a buffer or standard is broken, the buffer should be used as soon as possible. 4 pH and 7 pH buffers will last approximately 6 months after being opened. 10 pH buffers will only last 3 to 4 months after opening. Follow the manufacturer's recommendations for the life of the buffer. If there is growth in the buffers, they should be discarded.

The electrode should never be inserted into the buffer container. Place an amount of buffer in a clean container sufficient to cover the tip of the electrode, ensuring the pH glass or metal tip for ORP probes and the reference junction are completely covered. Never pour the used buffer back into the container. Always dispose of used buffers after calibrations are complete. Multiple probes can be calibrated using the same buffer. However, ensure the probe is cleaned and rinsed before placing it in the buffer to prevent contamination.

If the calibration involved both pH and ORP electrodes and ORP is calibrated using Quinhydrone, calibrate the pH electrodes first and then reuse the 4 and 7 pH buffers for the ORP calibration. The Quinhydrone solution has a limited stable life. Once mixed, it should be used within 60 to 120 minutes. Please follow all manufacturer's safety instructions for the proper handling of the buffers. Some ORP buffers contain strong acids. Follow manufacturers and government regulations when disposing of the used or expired buffers.

Cleaning pH/ORP Electrodes

Always clean pH/ORP electrodes prior to calibration. The sensor must be cleaned and inspected. Regular cleaning is effective for most applications, including biological fouling chemicals, fats, greases, and oils. Soak the probe in dish detergent for 5 to 10 minutes. You can use a soft toothbrush to scrub the electrode gently. If the sensor has a significant amount of scale or build up, soak it in a mild acid 0.1 molar HCI or vinegar. Do not exceed 5 to 10 minutes. Rinse and then soak in a 4 buffer for double the soak time in 10 to 20 minutes of mild acid. Make sure to rinse the probe with DI or tap water.



During the cleaning process, inspect the probe and examine the glass, looking for nicks, breaks, cracks, chemical attacks, or missing glass. For ORP electrodes, examine the metal tip and look for films, corroded metal, or missing sense tip. The reference junctions for both pH and ORP can have some decoloring, which is normal, but look for damage, coatings, or being out from the sensor body,

pH/ORP Calibration Check Log

A calibration check is a simple test to ensure the pH meter is working and reading pH correctly. You will need to do this regularly. Application conditions will ultimately dictate frequency. To check the calibration of the pH electrode, you will use two buffer solutions with a known pH (one with a pH of 7.0, and another with a pH of 4.0).

To check the calibration, remove your pH probe, rinse the probe with distilled water, and dip the probe into a small container of fresh 7.0 buffer solution. Record the pH reading on this form. Rinse the probe again with distilled water and dip the probe into a small container of fresh 4.0 buffer solution. Record the pH reading on this form.

The pH reading from the meter should be within 6.9-7.1 for the 7.0 buffer solution and 3.9-4.1 for the 4.0 buffer solution. If the pH meter reads outside this range, you will need to follow the manufacturer's instructions to calibrate the pH meter and redo the calibration check afterward. If the pH meter is still not reading correctly, you must replace the pH probe.

Date	Time	pH Reading 7.0 Buffer	pH Reading 4.0 Buffer	MV Reading	Initials of Employee	Meter Recalibrated

100 Overlook Drive, Hamden, CT 06514 | 877-742-2878 | burtprocess.com