

# Model Q22RX14

## 2-Wire ORP Sensor

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## PRODUCT WARRANTY

Analytical Technology, Inc. (Manufacturer) warrants to the Customer that if any part(s) of the Manufacturer's equipment proves to be defective in materials or workmanship within the earlier of 18 months of the date of shipment or 12 months of the date of start-up, such defective parts will be repaired or replaced free of charge. Inspection and repairs to products thought to be defective within the warranty period will be completed at the Manufacturer's facilities in Collegeville, PA. Products on which warranty repairs are required shall be shipped freight prepaid to the Manufacturer. The product(s) will be returned freight prepaid and allowed if it is determined by the manufacturer that the part(s) failed due to defective materials or workmanship.

This warranty does not cover consumable items, batteries, or wear items subject to periodic replacement including lamps and fuses.

Gas sensors carry a 12 months from date of shipment warranty and are subject to inspection for evidence of misuse, abuse, alteration, improper storage, or extended exposure to excessive gas concentrations. Should inspection indicate that sensors have failed due to any of the above, the warranty shall not apply.

The Manufacturer assumes no liability for consequential damages of any kind, and the buyer by acceptance of this equipment will assume all liability for the consequences of its use or misuse by the Customer, his employees, or others. A defect within the meaning of this warranty is any part of any piece of a Manufacturer's product which shall, when such part is capable of being renewed, repaired, or replaced, operate to condemn such piece of equipment.

This warranty is in lieu of all other warranties (including without limiting the generality of the foregoing warranties of merchantability and fitness for a particular purpose), guarantees, obligations or liabilities expressed or implied by the Manufacturer or its representatives and by statute or rule of law.

This warranty is void if the Manufacturer's product(s) has been subject to misuse or abuse, or has not been operated or stored in accordance with instructions, or if the serial number has been removed.

Analytical Technology, Inc. makes no other warranty expressed or implied except as stated above.

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# Part 1 - Introduction

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## 1.1 General

The Q22RX14 Two-Wire ORP (also known as “REDOX”) Sensor is designed to allow non-Quantum analyzer systems and generic panel meters to utilize the same robust features of the standard Quantum Q25R sensor. The Q22RX14 sensor may be used as a replacement sensor in non-Quantum analyzers or as a building-block component in user-designed custom measuring systems.

The Q22RX14 is a 2-wire, or “loop-powered” sensor. This sensor requires an external 7-30V DC power supply and provides a 4-20 mA output signal for direct connection to generic panel meters, DAS systems, etc., to convert them into high-quality ORP measurement systems. The sensor includes integral temperature compensation of the ORP signal, so no temperature output is provided. The sensor output is uncalibrated; therefore, the receiving instrument must be capable of providing user calibration of the ORP signal on a periodic basis. A connection example is shown in Figure 2-3 of this manual.

## 1.2 Sensor Features

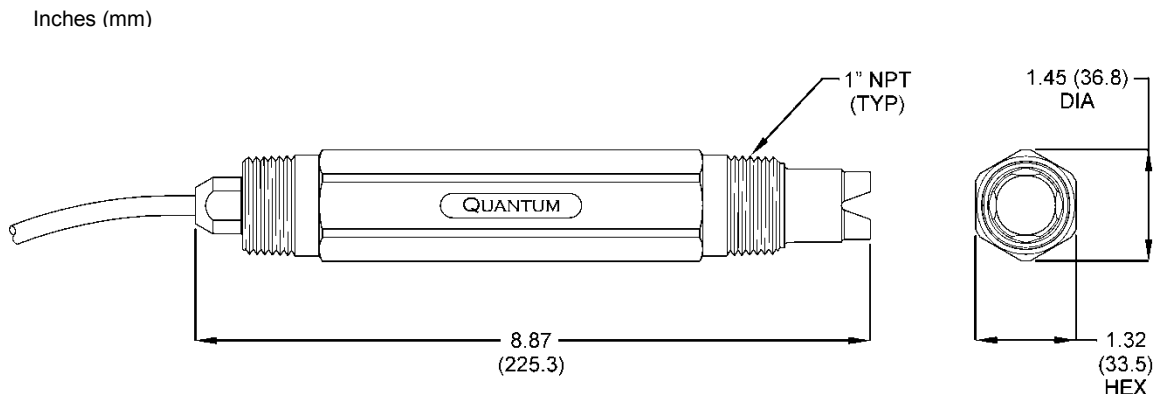
- A high volume, dual junction saltbridge is utilized to maximize the in-service lifetime of the sensor. The annular junction provides a large surface area to minimize the chance of fouling. Large electrolyte volume and dual reference junctions minimize contamination of the reference solution. The saltbridge is replaceable.
- The reference element of the sensor is a second glass pH electrode immersed in a reference buffer solution. This glass reference system greatly increases the range of sensor applications.
- An integral preamplifier is encapsulated in the body of the sensor. The 4-20 mA DC current output ensures a clean signal output with stable readings in electrically noisy environments. The maximum possible distance between sensor and transmitter is 3,000 feet (914 meters)
- The sensor is supplied with an integral 15 foot cable leader as standard. This cable is a proprietary, high performance, cross-linked PE jacket that offers high chemical resistance in all applications. This cable may be user-specified with additional length, or the user may add other more generic 2-wire shielded cable to the end of the existing leader using a junction box
- The Q22RX14 is fully submersible.

### 1.3 Sensor Specifications

<b>Measuring Range</b>	-1000 to +1000 mV
<b>Sensitivity</b>	0.2 mV
<b>Stability</b>	2 mV per 24 hours, non-cumulative
<b>Wetted Materials</b>	PEEK, ceramic, titanium, glass, Viton, EDPM, Platinum (optional: gold, 316SS body)
<b>Sensor Cable</b>	6 Conductor (2 are used) plus 2 shields, 15 feet (4.6 meters) standard length
<b>Temperature Range</b>	-5 to +95 °C (23 to 203 °F)
<b>Pressure Range</b>	0 to 100 psig
<b>Maximum Flow Rate</b>	10 feet (3 meters) per second
<b>Max. Sensor-Analyzer Distance</b>	3,000 feet (914 meters)
<b>Sensor Body Options</b>	1" NPT convertible, 1¼" insertion, 1½" or 2" sanitary-style
<b>Weight</b>	1 lb. (0.45 kg)

*Notes:* 1. The type of hardware used to mount the sensor may limit the maximum temperature and pressure ratings. Please consult the hardware manufacturer's specifications to obtain the relevant temperature and pressure rating information.

2. The maximum flow rate specification is lower for process solutions with low ionic conductivity or high suspended solids concentration. High flow rates in low ionic conductivity processes may cause a measurement error due to static electrical discharge. High flow rates in processes with high suspended solids concentration may decrease the functional life of the sensor by eroding the active electrode



**Figure 1-1 Q22RX14 Sensor Dimensions (Standard, Convertible-style)**

#### 1.4 Important Notes

- The measuring electrode must be wetted at all times to ensure proper functionality. Q22RX14 sensors are shipped with a fluid-filled cap over the electrode to enable immediate use (remove cap before installing, save for storage and shipping purposes). Electrodes that have dried out for any reason should be hydrated for 24 hours to restore full functionality.
- Hydrofluoric acid (HF) will dissolve conventional glass electrodes. Please contact the factory when the process application involves this or any other questionable substance.
- A platinum measuring electrode is standard. However, DO NOT use platinum electrode in process applications containing cadmium (Cd), nickel (Ni), tin (Sn), or zinc (Zn). A gold electrode is available for these applications; see Page 16 for ordering information.
- Likewise, DO NOT use a gold electrode in process applications containing Cyanide (CN<sup>-</sup>).



**NOTE:** The standard Q22RX14 process electrode is made of glass and can break if not handled properly. Should the electrode ever break, USE CAUTION when handling the sensor to avoid serious cuts.

## Part 2 – Installation

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### 2.1 General

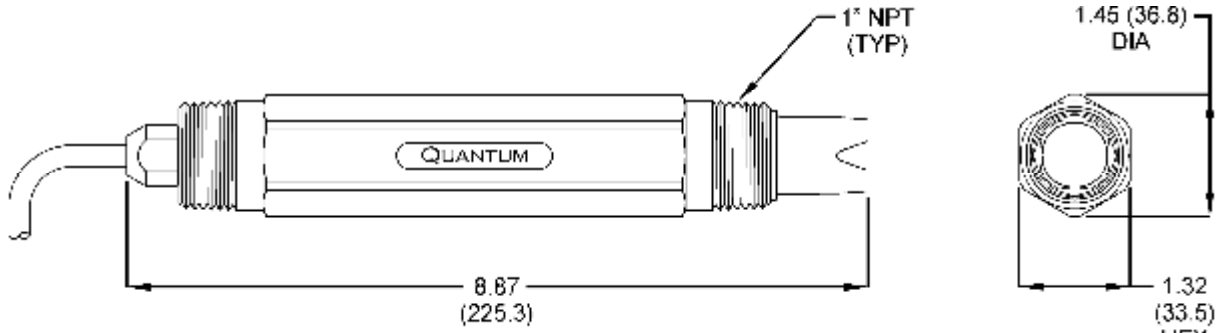
The Q22RX14 ORP Sensor is designed for industrial and municipal process applications. Mounting options include flow-through, submersion, or insertion (special hardware required). The sensor's built-in preamp allows sensor-to-instrument distances of up to 3,000 feet (914 meters). However, to ensure ease of calibration, install the transmitter as close to the sensor as possible.

The sensor should be mounted vertically (electrode face down) whenever possible. When mounting on an angle, make sure sensor is at least 10° above horizontal. Do not mount sensor completely on its side or upside down.

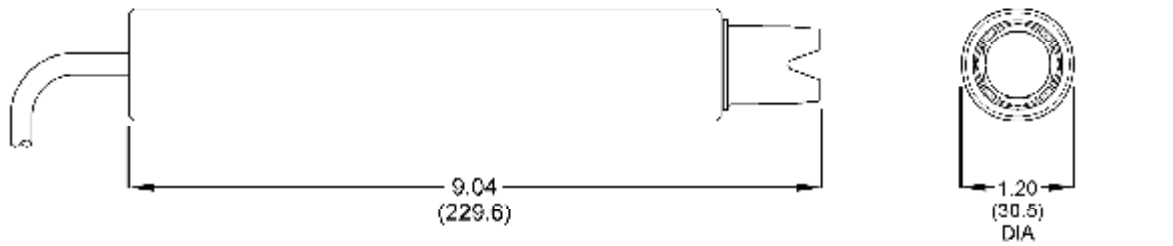
Do NOT use a sealant (e.g., pipe dope) when mounting the insertion or convertible style sensor. Use industrial/plumber pipe tape when needed.

Calibrate the sensor before placing it into the process. See Model Q45P Monitor/Analyzer Instruction Manual for detailed calibration instructions.

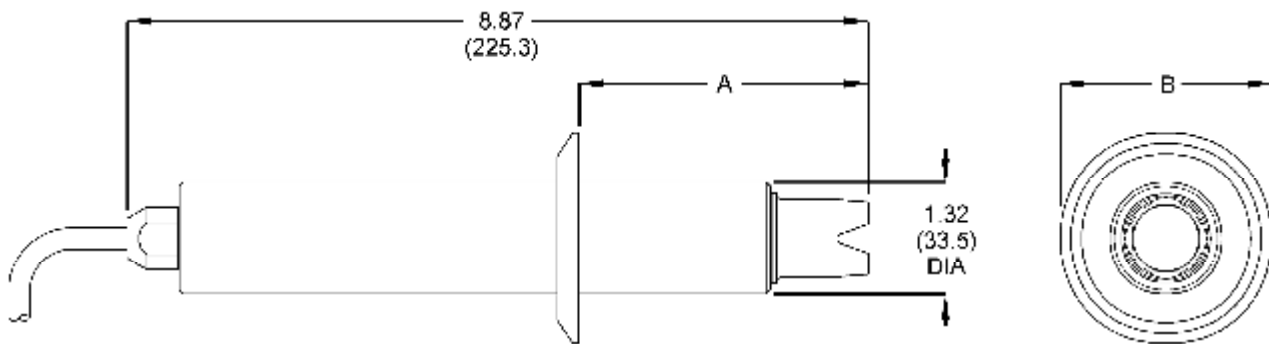
Inches (mm)



**CONVERTIBLE SENSOR**



**INSERTION SENSOR**



**SANITARY SENSOR**

SENSOR SIZE	A	B
1-1/2"	2.75 (70.0)	1.88 (50.4)
2"	3.50 (88.9)	2.50 (63.5)

**Figure 2-1 Q22RX14 Sensor Types**



## 2.2 Electrical

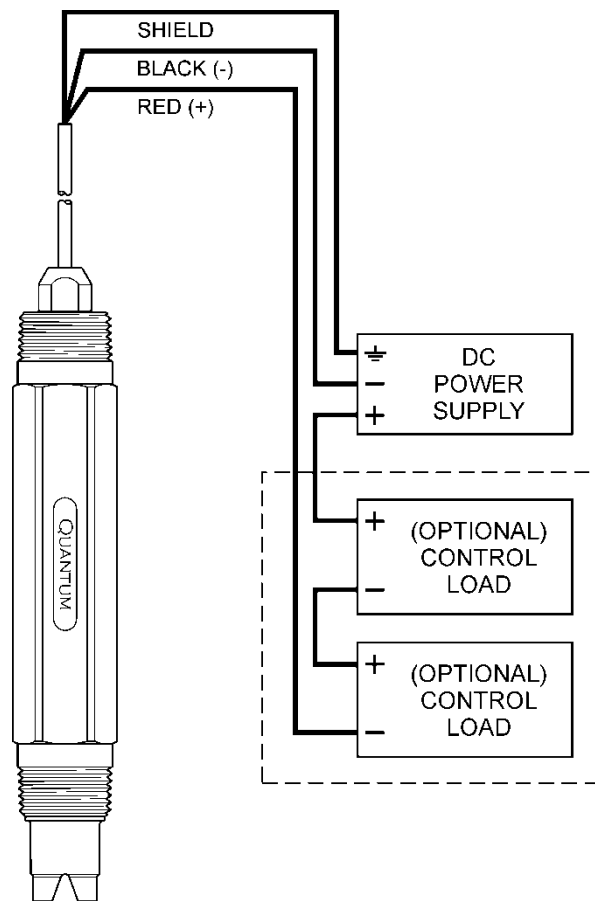
The Model Q22RX14 Sensor has a built-in preamplifier and comes standard with 15 feet of double shielded cable. Only two wires are used in the cable to connect the sensor: RED (+) and BLACK (-). The cable is permanently attached to the sensor, and a PEEK cordgrip is used to seal around the cable. Nevertheless, the cable should always be kept as clean and dry as possible. For optimum electrical noise protection, run the sensor shield wire to an earth ground terminal.



**WARNING: DO NOT connect sensor cable to power lines. Serious injury result!**

Take care to route sensor cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run signal lines in the same conduit as AC power lines. Run signal cable in dedicated metal conduit if possible. For optimum electrical noise protection, run an earth ground wire to the ground terminal in the transmitter

Refer to Figure 2-2 Wiring Diagram for illustrative details on electrical installation.



**Figure 2-2 Wiring Diagram, Q22RX14 Sensor**

Notes: 1. Voltage across the sensor MUST be between 7 and 30 VDC.

2. Earth grounding is STRONGLY recommended. This connection can greatly improve stability in electrically noisy environments.

A separate DC power supply must be used to power the sensor. The exact connection of this power supply is dependent on the control system into which the sensor will connect. Any general twisted pair shielded cable can be used to extend the sensor cable to the power supply. Route signal cable away from AC power lines, adjustable frequency drives, motors, or other noisy electrical signal lines. Do not run sensor or signal cables in conduit that contains AC power lines or motor leads.

**2.3 Loop Load Drive Capability**

The resistive load-drive level possible in the 4-20 mA loop is dependent on the DC supply voltage providing power to the sensor.

The two-wire sensor can operate on a power supply voltage of between 7 and 30 VDC. The available load drive capability can be calculated by applying the formula  $V/I=R$ , where V=load drive voltage, I=maximum loop current (in Amperes), and R=maximum resistance load (in Ohms).

To find the load drive voltage required, subtract 7 VDC from the actual power supply voltage being used (the 5 VDC represents insertion loss). For example, if a 24 VDC power supply is being used, the load drive voltage is 19 VDC.

The maximum measuring loop current of the two-wire sensor is always 20.00 mA, or .02 A. Therefore,

$$\frac{(\text{Power Supply Voltage} - 7)}{.02} = R_{MAX}$$

For example, if the power supply voltage is 24 VDC, first subtract 7 VDC, then divide the remainder by .02.  $17/.02 = 850$ ; therefore, a 850 Ohm maximum load can be inserted into the loop with a 24 VDC power supply.

Similarly, the following values can be calculated:

Power Supply Voltage (VDC)	Total Load (Ohms)
7.0	0
10.0	150
12.0	250
24.0	850
30.0	1150

## Part 3 – Calibration and Operation

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### 3.1 General

The Q22RX14 sensor is designed to allow operation with very simple panel meters. The sensor allows users to create very low-cost measurement systems that include state-of-the-art sensor performance.

The sensor produces a linear 4-20 mA output signal over the input range of –1000 mV to +1000 mV. The center point of the output span, 12 mA, is positioned at 0 mV. The 4 mA point occurs at approximately -1000 mV, and the 20 mA point occurs at approximately +1000 mV.

### 3.2 Basic Calibration and Operation

In its basic form, the sensor is simply a two-wire device that produces a linear 4-20 mA output in response to changing ORP input. If the sensor is being used as a competitive replacement sensor, consult the specific analyzer operation and installation manual for information on calibration. If the sensor is being used to simply connect to a generic panel meter, an example of how the sensor can be wired is shown in Figure 2-3. The basic system can be calibrated using the following procedure:

1. Place the sensor into a beaker of **fresh** +86 mV solution (a mixture of quinhydrone powder and pH 7 buffer is recommended to produce this mV level). Agitate the sensor in the buffer slightly, then allow the sensor to temperature stabilize (this may take several minutes).
2. Measure the current output of the sensor. The output should read between 12 mA and 14 mA in the +86 mV solution.
3. Remove the sensor and rinse thoroughly with de-ionized water to avoid transferring any buffer. Place the sensor into a second beaker containing **fresh** +263 mV solution (a mixture of quinhydrone powder and pH 4 buffer is recommended to produce this mV level). Agitate the sensor slightly, then allow the sensor to temperature stabilize (may take several minutes).
4. Measure the current output of the sensor. The output of the sensor will be dependent on the buffer chosen and the reading in the prior test. Ideally, the sensor produces approximately 1.4 mA higher than in the first buffer solution. The output of the sensor will be linear through these two recorded calibration points. It is recommended that two buffers always be used to establish the calibration line for the sensor.

### 3.3 Calibration and Operation with Panel Meters

Since the sensor provides an un-calibrated current signal output, for ease of use the User should select receiving instrumentation or panel meters that allow for storage of sensor calibration values. In addition, since ORP systems require fairly frequent calibration checks, it is helpful to utilize the sensor with panel meters that allow the User to store measured calibration values directly from the 2-wire current output of the sensor, rather than to measure the current output with a separate meter and then enter data values. When using the sensor with panel meters, consult the meter operating instructions for connection of a two-wire sensor. Follow the calibration sequence in Section 3.2 after connecting to the meter.

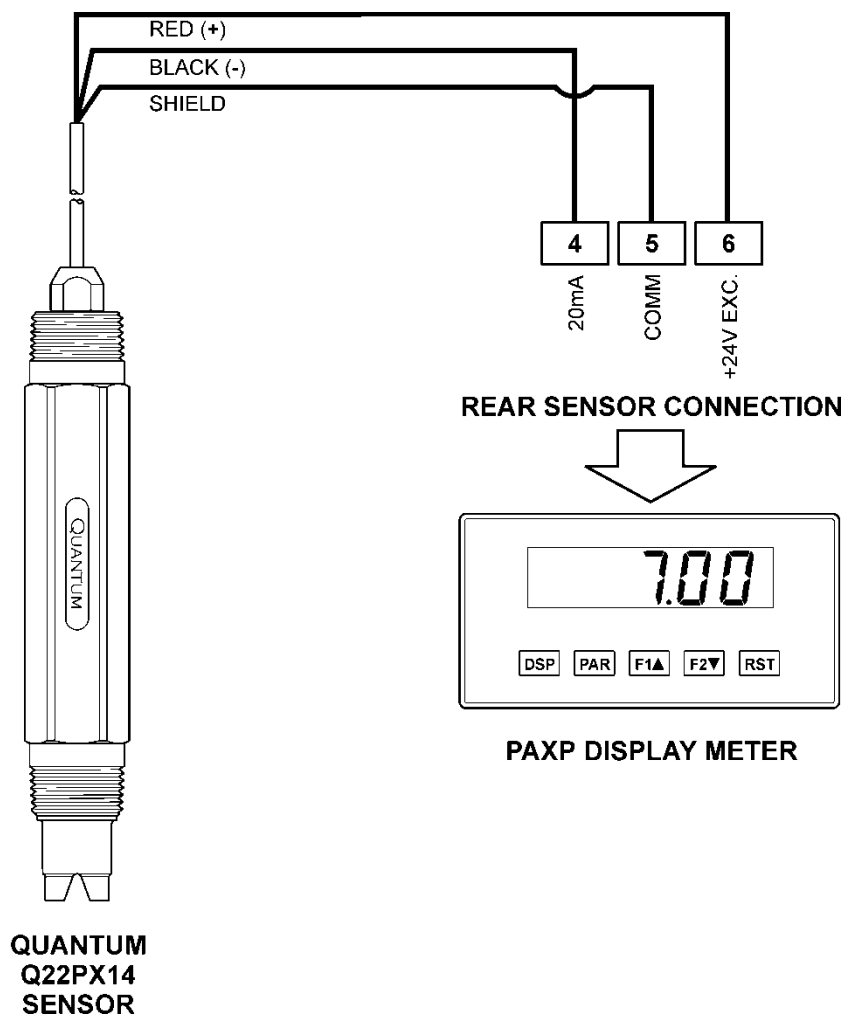
Some panel meters that provide no earth ground connection for power, especially those with switching power supplies, may produce varying degrees of electrical noise that travel down input sensor leads to the measured solution. This electrical noise can then affect the stability of other sensors in the same solution. This situation is more likely to develop when measuring in a plastic container or in plastic plumbing, where inherent earth-grounding may not be present. To correct this situation once it has developed, either isolate the sensor through the use of a simple isolation module, or earth ground the solution by placing an earth-ground wire or rod into the solution.

#### Red Lion PAXP

The Red Lion Model PAXP0000 is a good choice of panel meter for use with the Q22RX214 sensor. For this meter in particular, the sensor is connected as shown in Figure 3-1. The PAXP Meter allows quick and easy 2-point calibration of the Q22RX14 sensor. Once the sensor has been connected and the system is under power, perform the following sequence to calibrate the system:

1. Using the keys labeled PAR and F1, scroll to the Scaling Set-up section of Module 1 ("INP 1"). See Red Lion PAXP Manual for further details. The following sequence is used to get to this menu item:  
PAR-F1-PAR-PAR-PAR-PAR-PAR-PAR-PAR  
At the end of this sequence of key presses, the display will read "STYLE".
2. Change the default input method from "KEY" to "APLY" by pressing the F1 key once.
3. Press the PAR key. The display will now read "INP 1". Place the sensor into a beaker of **fresh** +200 mV solution. Agitate the sensor in the solution slightly. The display will show the current output of the sensor while the signal stabilizes. When the current output has stabilized, press the PAR key again.

4. The display will now show an ORP reading. Using the F1 and F2 keys, adjust the displayed value until it matches the value of the solution. Once the value has been set, press the PAR key once.
5. The display will now read "INP 2". Remove the sensor from the first buffer and rinse thoroughly with de-ionized water to avoid transferring any solution. Place the sensor into a beaker of **fresh** +600 mV solution. Agitate the sensor in the solution slightly. The display will show the current output of the sensor while the signal stabilizes. When the current output has stabilized, press the PAR key.
6. The display will now show an ORP reading. Using the F1 and F2 keys, adjust the displayed value until it matches the value of the second ORP solution. Once the value has been set, press the PAR key twice to end the calibration sequence. The system is now calibrated.



**Figure 3-1 Sensor Connection, Q22RX14 to Red Lion Model PAXP0000**

## Part 4 – Maintenance and Troubleshooting

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**WARNING: EXPLOSION HAZARD - SUBSTITUTION OF COMPONENTS MAY IMPAIR SUITABILITY FOR CLASS I, DIVISION 2.**

### 4.1 Cleaning the Sensor

Keep the sensor as clean as possible for optimum measurement accuracy - this includes both the saltbridge and the measuring electrode. Frequency of cleaning depends upon the process solution.

Carefully wipe the measuring end of the sensor with a clean soft cloth. Then rinse with clean, warm water - use distilled or de-ionized water if possible. This should remove most contaminate buildup.

Prepare a mild solution of soap and warm water. Use a non-abrasive detergent (such as dishwashing liquid).



**NOTE: DO NOT use a soap containing any oils (such as lanolin). Oils can coat the electrode and harm sensor performance.**

Soak the sensor for several minutes in the soap solution.

Use a small, extra-soft bristle brush (such as a mushroom brush) to thoroughly clean the electrode and saltbridge surfaces. If surface deposits are not completely removed after performing this step, use a dilute acid to dissolve the deposits. After soaking, rinse the sensor thoroughly with clean, warm water. Placing the sensor in pH 7 buffer for about 10 minutes will help to neutralize any remaining acid.



**NOTE: DO NOT soak the sensor in dilute acid solution for more than 5 minutes. This will help to prevent the acid from being absorbed into the saltbridge.**



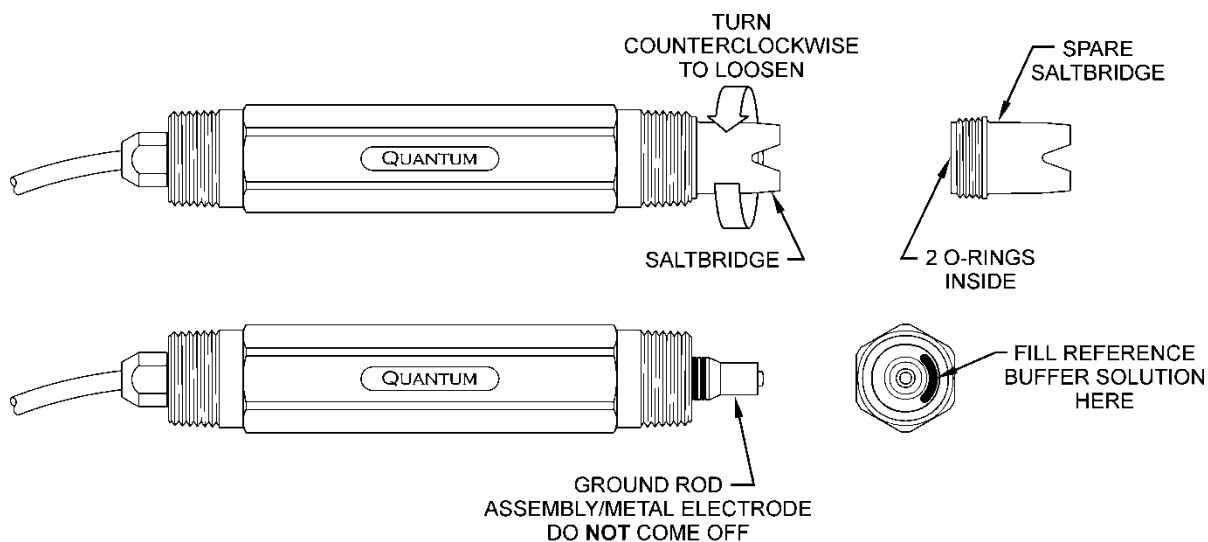
**WARNING: ACIDS ARE HAZARDOUS. Always wear eye and skin protection when handling. Follow all Material Safety Data Sheet recommendations. A hazardous chemical reaction can be created when certain acids come in contact with process chemicals. Make this determination before cleaning with any acid, regardless of concentration.**

#### 4.2 Replacing the Saltbridge and Reference Buffer Solution

1. Hold the sensor with the process electrode pointing up. Place a cloth or towel around the saltbridge. Turn the saltbridge counterclockwise (by hand) to loosen and remove the saltbridge. Do NOT use pliers.
2. Pour out the old reference buffer by inverting the sensor (process electrode pointing down). If the reference buffer does not run out, gently shake or tap the sensor.
3. Rinse the reference chamber of the sensor with de-ionized water. Fill the reference chamber of the sensor with fresh Reference Cell Buffer. The chamber holds 6 to 7 mL of solution. MAKE SURE that 6 to 7 mL is used when refilling. The chamber should be FULL.
4. Inspect the new saltbridge to verify that there are 2 o-rings inside the threaded section of the saltbridge
5. Place the new saltbridge over the ground assembly of the sensor. Place a cloth or towel around the saltbridge and hand-tighten the saltbridge by turning it clockwise.



**NOTE:** Every ATI Q22RX14 Sensor includes a spare bottle of Reference Buffer Solution, 7.0 pH. This is NOT typical pH 7 buffer, it is a special “high-capacity” buffer developed to ensure the highest possible stability of the reference portion of the pH measurement. No substitutions should be made.



**Figure 4-1 Replacing the Saltbridge and Reference Buffer**



### 4.3 Troubleshooting

The first step in resolving any measurement problem is to determine whether the trouble lies in the sensor or the transmitter. Since measurement problems can often be traced to dirty sensor electrode glass and/or saltbridge, cleaning the sensor using the method outlined in Section 4.1 should always be the first step in any troubleshooting.

In addition, check the wiring thoroughly and refer back to the illustrations in this manual, as well as the operating manual for the instrument to which the sensor is connected. With longer sensor cables, carefully review the wiring path, any junction boxes, and the shield connections (for this sensor, twist the shield wires together). In many cases, it will shorten troubleshooting time if all connecting cable is bypassed and the Q22RX14 sensor cable is connected directly to the power system during test.

Check the load size in the loop against the load calculations in Section 2.3. Too large a load, or too small a power supply, can result in abnormally low readings when close to 20 mA.

The sensor must be thoroughly hydrated before proceeding with any tests. If the sensor has been left out and has dried, it must soak in tap water for at least 2-3 hours before these tests are attempted. This is necessary in order to re-hydrate the reference electrode. If the sensor has been left out of solution for too long, the saltbridge may be too dried out to be recoverable. In this case, it may be necessary to replace the saltbridge and the internal fill solution.

## Part 4 – Parts and Ordering Information

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### **MODEL Q22R - A - 14 - B - C - D - E ORP SENSOR**

Suffix A - Electrode Type  
1 - Platinum (Standard)  
2 - Gold

Suffix B - Body Material  
1 - PEEK  
2 - 316SS

Suffix C - Mounting Style  
1 - Convertible  
2 - Insertion  
3 - Sanitary-Style, 1½"  
4 - Sanitary-Style, 2"

Suffix D - Cable Leads  
1 - Stripped

Suffix E - Cable Length  
1 - 15'  
2 - 30'  
3 - Special (See Note A)

**Note A:** All cable lengths greater than 30 feet will be charged a \$25 fee plus \$1 per foot of cable greater than 30 feet.

**Note B:** Insertion and Sanitary Mounting Styles must use 316SS Body Material. The 316SS material is ONLY available with the Insertion or Sanitary Mounting Styles.

### **OPTIONS**

09-0034 pH 4 Buffer, 1000 mL  
09-0035 pH 7 Buffer, 1000 mL  
05-0056 Quinhydrone Powder, 5 grams  
09-0042 200 mV ORP Solution, 500 mL  
09-0043 600 mV ORP Solution, 500 mL  
05-0057 pH/ORP Sensor Regeneration Kit