

# Signet 275X Series Wet-Tap DryLoc® pH and ORP Electrodes

## Signet 276X Series Differential DryLoc® pH and ORP Electrodes

## Signet 277X Series Threaded DryLoc® pH and ORP Electrodes

English



3-2764.090

Rev C 04/11

English



### SAFETY INSTRUCTIONS

- Do not alter product construction.
- Depressurize and vent system prior to installation or removal.
- Confirm chemical compatibility before use.
- Do not exceed maximum temperature/pressure specifications.
- Wear safety goggles or faceshield during installation/service.
- When using chemicals or solvents use appropriate body and respiratory protection.

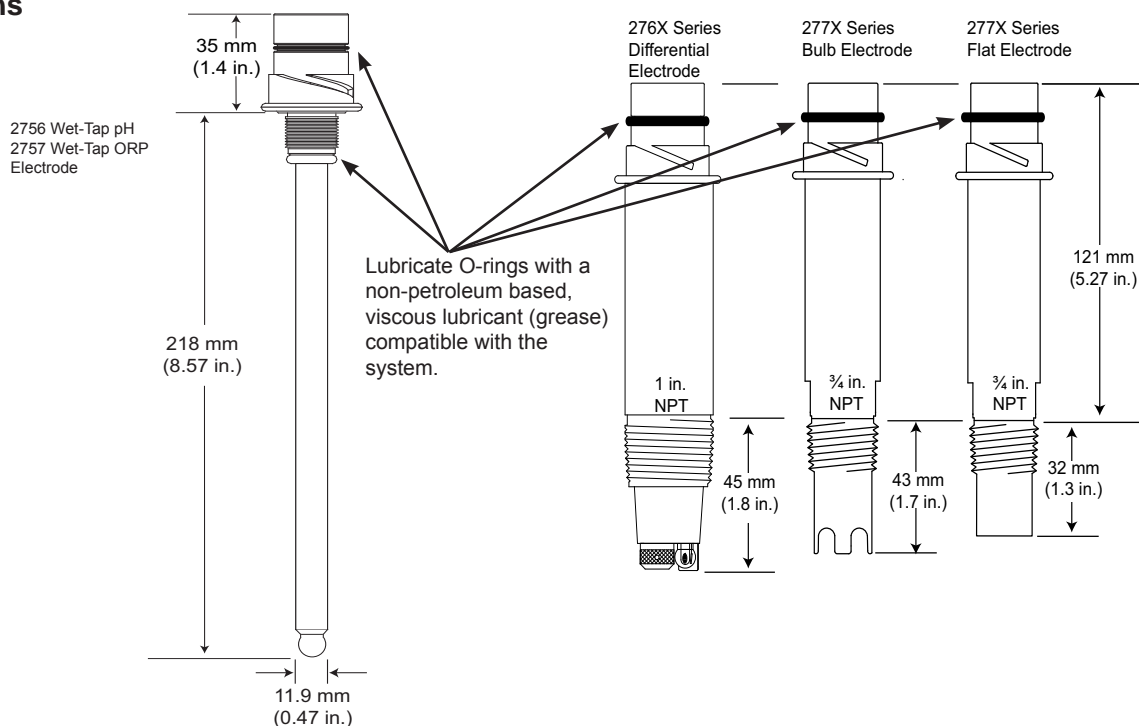



### Description

The 275X Wet-Tap, 276X and 277X electrodes are all-purpose sensors ideal for a wide range of universal applications. They feature a unique foul-proof DryLoc® connector with gold-plated contacts, designed specifically for use with the Signet 2750 and 2760 Sensor Electronics and Preamplifiers. These dependable and highly responsive electrodes feature a large reference chamber volume and intelligent positioning of internal elements that combine to extend the service life. The electrodes are offered with either flat or bulb sensing elements. The flat versions allow sediment and particles to sweep past the measurement surface, minimizing the risks of abrasion, breakage and coating. The bulb versions can be used for general purpose applications and are also offered with a glass or plastic body for use with the 3719 Wet-Tap assembly. The choice of a PT1000 or 3 KΩ temperature sensor allows compatibility into all Signet pH/ORP instruments.


- Signet 276X Series Differential pH and ORP electrodes feature a Ryton® body and PTFE reference junction to resist fouling, clogging and chemical attack under harsh chemical applications.
- Differential electrodes use a 3-electrode technique, measuring the pH and reference electrodes against a ground electrode for a more stable output signal. The solution ground eliminates noisy measurements by draining electrical current away from the reference electrode. The reference electrode is housed in a glass half-cell embedded in the reference chamber to protect it from poisoning or contamination. The electrolyte chamber is refillable and the salt bridge is field replaceable.
- Signet 277X Series pH and ORP electrodes are dependable and highly responsive electrodes featuring a PTFE double reference junction, a KNO<sub>3</sub> salt bridge and a large reference chamber that combine to extend service life.
- Both the 276X Series and the 277X Series feature a unique foul-proof DryLoc® connector with gold-plated contacts designed specifically for use with the Signet 2750 and 2760 preamplifiers, sensor electronics, and connectors. They are available with either flat or bulb style sensing elements. The bulb versions can be used for general-purpose applications. The flat versions allow sediment and particles to sweep past the measurement surface, minimizing risks of abrasion, breakage and coating. All versions can be installed at any angle.
- The temperature device is positioned at the tip of the measurement surface, resulting in a temperature response of less than 1 minute. Temperature devices available include 3 KΩ, 300 Ω, or PT1000 RTD.

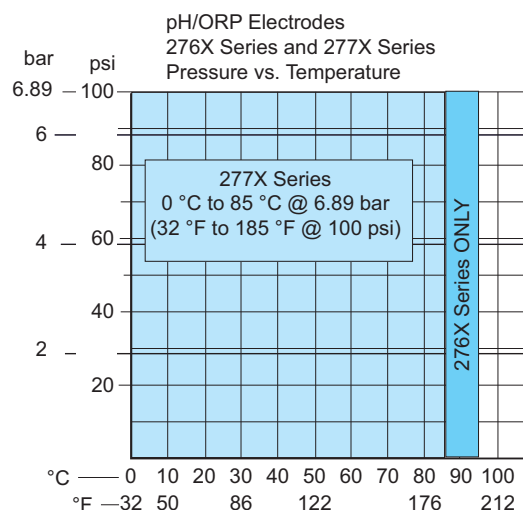
### Dimensions



<b>Specifications:</b> <b>276X Series Differential Electrodes</b> <b>277X Series Threaded Electrodes</b>	
<b>General</b>	
Compatibility	Signet 2750 and 2760
Shipping Weight	0.25 kg (0.55 lbs.)
Operating Range	
276X Series	0 to 14 pH, $\pm$ 1500 mV ORP
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Reference Electrolyte	
276X Series	Buffered KNO <sub>3</sub> solution
277X Series	KCl/AgCl gel with KNO <sub>3</sub> salt bridge
Reference Element	
276X Series	pH glass electrode
277X Series	Ag/AgCl
Temperature Sensor	
276X Series pH	3 K $\Omega$ , PT1000 RTD, or 300 $\Omega$
277X Series pH	3 K $\Omega$ or PT1000 RTD
276X Series ORP	10 K $\Omega$ ID for Signet instruments;
	PT1000 RTD or 300 $\Omega$ options for use with other instruments
277X Series ORP	10 K $\Omega$ ID for Signet instruments
Temp response time	$\tau_{95\%}$ < 1 min.
<b>Wetted Materials</b>	
Body	Ryton®
Reference junctions	PTFE
Sensing surface	Glass (pH), Platinum (ORP)
O-rings	FPM
Solution ground	Carbon graphite (276X series only)
<b>Standards &amp; Approvals</b>	
CE Manufactured under ISO 9001 and ISO 14001  China RoHS (Go to <a href="http://www.gfsignet.com">www.gfsignet.com</a> for details)	
Operating Temperature	
276X Series	0 °C to 95 °C (32 °F to 203 °F)
277X Series	0 °C to 85 °C (32 °F to 185 °F)
Storage Temperature	> 0 °C (32 °F)
Max Operating Pressure	6.89 bar (100 psi)

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<b>Specifications:</b> <b>275X Series Wet-Tap Electrodes</b>	
<b>General</b>	
Compatibility	Signet 2750 and 2760
Shipping Weight	0.25 kg (0.55 lbs.)
Operating Range	0 to 14 pH, $\pm$ 2000 mV ORP
Reference Electrolyte	Solidified Acrylamide Gel
Wet-Tap electrolyte	3.5 M KCl
Reference Element	Ag/AgCl
pH Temp Sensor	PT-1000 or 3K Balco
ORP Identification	10 K $\Omega$ ID for Signet instruments
<b>Temp response time, <math>\tau</math></b>	
Wet-Tap	438 s
ORP response time	Application dependent
Efficiency	> 97% @ 25 °C (77 °F)
Impedance (pH)	< 150 M $\Omega$ @ 25 °C
Sodium Ion Error	< 0.05 pH in 0.1 M Na <sup>+</sup> ion at 12.8 pH
<b>Wetted Materials</b>	
Wet-Tap body	Glass or PAS (Poly Aryl Sulphone)
Wet-Tap Junctions	Porous PTFE
Sensing surface	Glass (pH), Platinum (ORP)
O-rings	FPM
Solution ground	Carbon graphite (276X series only)
<b>Standards &amp; Approvals</b>	
CE Manufactured under ISO 9001 and ISO 14001  China RoHS (Go to <a href="http://www.gfsignet.com">www.gfsignet.com</a> for details)	
Operating Temperature	
	0 °C to 85 °C (32 °F to 185 °F)
Storage Temperature	
	0 °C to 85 °C (32 °F to 185 °F)
Maximum Temperature and Pressure rating	
6.89 bar @ 0 °C to 65 °C (100 psi @ 32 °F to 149 °F)	
4.00 bar @ 65 °C to 85 °C (58 psi @ 150 °F to 185 °F)	



2. Electrode Care and Application

Lubricate O-rings with a non-petroleum based, viscous, lubricant (grease) compatible with the system.

pH/ORP electrodes are similar to batteries; they age with time and usage. The following information will help maximize electrode life.

2.1 Conditions to Avoid:

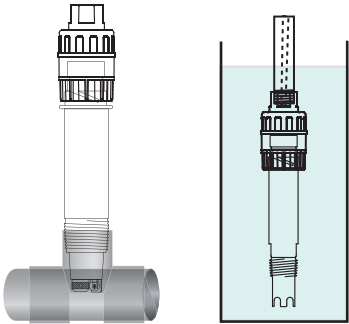
- High temperatures, strong acids or caustics will accelerate electrochemical reactions and speed electrode aging.
- Coatings on the glass or junction surfaces (e.g., proteins) cause extended response time and inaccurate measurement.
- Never store the electrode tip in deionized (DI) water. Use pH 4 buffer solution to keep the glass wet when out of the process.
- Never expose electrode to temperatures below 0 °C (32 °F) or allow it to dehydrate. These conditions may damage the electrode.
- Never scrape or sand the glass electrode surface.
- Treat glass electrode surfaces with care to prevent accidental breakage.

2.2 Submersible Installation Tips:

- Choose a location that keeps the electrode glass completely submerged at all times.
- Mount electrodes in a location with ample clearance for removal.
- Place the electrode tip in pH 4 buffer during system maintenance or storage to avoid dehydration.
- Mount the electrode near tank outlets, away from reagent addition areas.

2.3 In-Line Installation Tips:

- pH and ORP electrodes respond best in moving fluids.
- Differential (2764 series) electrodes must be mounted at a downward angle (> 15° from horizontal).
- 2774 and 2775 electrodes can be mounted at any angle.



3. pH Electrode Calibration

All pH electrodes are designed to provide linear output during their lifespan. The following sections define proper electrode operation.

3.1 Offset (STD)

Electrode offsets occur due to:

- Clogged reference junction
- Aged or contaminated reference electrochemical cell.

Check offsets in a pH 7 buffer @ 25 °C. The theoretical output is 0 mV. Any deviation from 0 mV is the pH electrode offset.

pH electrode offset pH 7 buffer @ 25 °C.	Theoretical:	7.0 pH (0.0 mV)
	New electrode:	pH 7 ± 0.25 pH (±15 mV)
	Reliable:	pH 7 ± 0.85 pH (± 50 mV)

Electrode offsets greater than 0.85 pH (50 mV) indicate the electrode requires cleaning or replacement. See section 5: Maintenance and Cleaning.

Theoretical mV Values @ 25 °C	
pH	mV
2	+296 mV
3	+237 mV
4	+177 mV
5	+118 mV
6	+59 mV
7	0 mV
8	-59 mV
9	-118 mV
10	-177 mV
11	-237 mV
12	-296 mV

### 3.2 Slope (SLP)

Electrode slope is the ratio of mV per pH unit. At 25 °C the theoretical slope is 59.16 mV per pH. Temperature has an appreciable effect on electrode slope. Reliable instrumentation includes temperature compensation. The graph below illustrates potential pH error when a temperature compensated instrument is not used.

°C	pH Error										
	2	3	4	5	6	7	8	9	10	11	12
15	0.15	0.12	0.09	0.06	0.03	0	0.03	0.06	0.09	0.12	0.15
25	0	0	0	0	0	0	0	0	0	0	0
35	0.15	0.12	0.09	0.06	0.03	0	0.03	0.06	0.09	0.12	0.15
45	0.3	0.24	0.18	0.12	0.06	0	0.06	0.12	0.18	0.24	0.3
55	0.45	0.36	0.27	0.18	0.09	0	0.09	0.18	0.27	0.36	0.45

#### Recommendations:

- Calibrate temperature before calibrating the standard and slope.
- The mV offset will track across the entire pH range.  
The slope is usually not affected by offset changes.

(e.g., pH 7 = +10 mV, pH 4 = +187 mV); slope = 59 mV

Slope = (pH 4 mV value - pH 7 mV value) ÷ Span between pH 7 and pH 4

Slope = (187 - 10) ÷ 3 = 59 mV

- Coatings on the glass may affect sensor slopes. See section 5: Maintenance and Cleaning.
- A constant output near 0 mV in all buffer solutions indicates a shorted electrode that must be replaced.

### 3.3 Response Time/Stability

Response time and stability are affected by the condition of the pH glass measuring surface (for an ORP electrode, the platinum surface), the reference junction and the reference solution. Electrodes may sometimes be restored to acceptable levels by cleaning the measuring surface and reference junction.

Electrode mV values should remain stable  $\pm 3$  mV. Conditions that may cause fluctuations are:

- Electrode coating
- Clogged reference junction
- Ground fault: If proper operation is observed in the beaker, but readings are unstable in the application, a ground fault may exist.
  - Using instrumentation with isolated inputs and outputs may restore stable operation.
  - Solution grounding may also restore stable operation.

## 4. ORP Electrode Calibration

ORP electrodes are designed to ensure linearity during their lifespan. The following sections define proper electrode operation.

### 4.1 Offset (STD)

- Electrode offsets are usually caused by clogged reference junctions or by an aged or contaminated reference solution/wire.
- Offsets should be checked in pH 7 buffer saturated with quinhydrone @ 25 °C. The theoretical output is +86 mV. Any deviation from +86 mV is the ORP electrode offset (e.g., +90 mV).
- Quinhydrone is the oxidizer measured by the ORP electrode and is required for calibration. To measure ORP electrode offset, saturate 50 mL of pH 4 and pH 7 buffers with 1/8 grams of quinhydrone:

	4 pH w/Quinhydrone			7 pH w/Quinhydrone		
Temp:	20 °C	25 °C	30 °C	20 °C	25 °C	30 °C
ORP:	268 mV	263 mV	258 mV	92 mV	86 mV	79 mV

A new ORP electrode measures these values  $\pm 15$  mV. The electrode continues to be functional until the offset from these values exceeds 50 mV. Electrodes with offset greater than 50 mV should be cleaned and replaced if necessary.

### 4.2 Slope (SLP)

ORP slope errors are generally caused by contamination of the platinum electrode surface. Cleaning the electrode surface will usually restore proper values, response time, and stability. See section 5: Maintenance and Cleaning.

Many systems require both pH and ORP calibration. To conserve calibration reference solutions, use pH 7 and 4 buffers for pH calibration first. ORP calibration can be performed with the same buffers by adding quinhydrone.

## 5. Maintenance and Cleaning

### 5.1 Maintenance

Variables can affect long-term pH or ORP electrode life. For this reason, a maintenance log is recommended for trend analysis. When storing boxed sensors, lay the sensor flat to maximize hydration of the glass surface. Keep the glass surface wet at all times. Soak the sensor tip in pH 4.0 buffer during system maintenance intervals. In-line applications should be plumbed with a depression (trap) so liquid is maintained around the sensor tip. If the sensor dehydrates, soak the sensor tip in pH 4 buffer for 24 to 48 hours, then visually inspect the electrode for surface cracks, swelling, or discoloration. Severely dehydrated electrodes cannot be restored to normal operation.

### 5.2 Cleaning

Cleaning techniques vary depending on the type of coating present on the glass electrode surface or reference junction.

- Soak electrodes in pH 4 buffer or KCl solution after cleaning.
- Soft coatings can be removed by vigorous stirring, or with directed spray of an applicable detergent or solvent onto the glass surface. Chlorine bleach or mild detergent can be used to remove soft coatings. Always rinse electrode tip in clean water after cleaning.
- Hard coatings can be chemically removed. Use the least harsh chemical which will remove the contaminant within two (2) minutes without attacking the materials of construction. e.g. calcium carbonate may be removed with a 5% HCl (muriatic acid) solution.
- Oily or organic coatings can be removed with detergents or an appropriate solvent that does not attack the materials of construction; e.g. isopropyl alcohol may be used but acetone must be avoided to prevent damage to the CPVC sensor body.
- ORP platinum electrode surfaces can be gently wiped with a wet paper towel. More stubborn coatings can be removed by gently sanding with 600 grit wet and dry silicone or carbide sandpaper, jewelers rouge, crocus cloth, or very fine steel wool.

### 5.3 276X Series Differential Electrodes

Differential electrodes have a replaceable salt bridge and the electrolyte chamber can be refilled. The electrolyte chamber should be full. If any fluid is audible when shaken, the chamber should be refilled. Refill the electrolyte chamber when the electrode offset exceeds 50 mV. Replace the salt bridge when performance becomes sluggish or if the output is erratic or inaccurate.

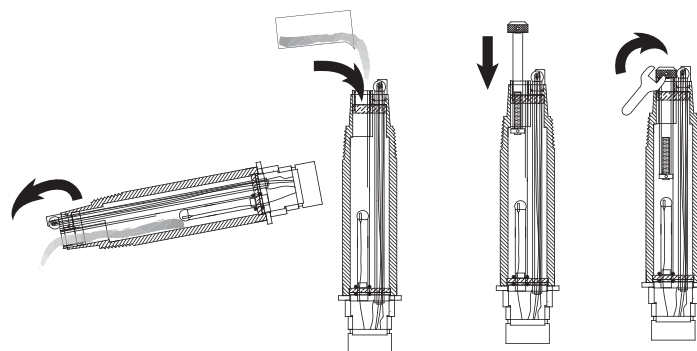
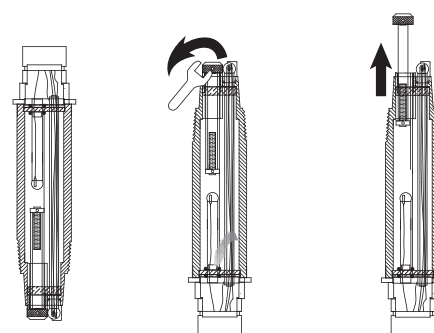
#### Replacing the Salt Bridge

Parts Required: Salt Bridge (order number 3864-0001) and  
Differential Reference Solution  
(order number 3864-0002)

Tools Required: Small pliers

Procedure:

1. Remove sensor from mounting.
2. Hold upside down and unscrew salt bridge using a pair of small pliers. Be careful not to damage the glass bulb!
3. Drain the depleted reference solution and dispose of properly.
4. Fill reference chamber with fresh reference solution (approx. 30 ml).
5. Replace salt bridge and screw finger tight. Solution will drip out while screwing in salt bridge. Use pliers to turn approximately  $\frac{1}{4}$  turn past finger-tight.
6. Perform calibration (standard and slope) before returning the system to service.



#### NOTE:

The refillable electrolyte chamber in 276X series differential electrodes may leak during storage and shipping. Check the fluid and refill before installation if necessary.



#### WARNING!

Wear appropriate eye, face, hand, body, and respiratory protection when using chemicals or solvents.

## Ordering Information

Electrode Part Number- Choose either a pH or ORP Electrode		
pH Electrode		
3-2756-WT	Glass electrode with DryLoc® connector; for use with the 3719 Wet-Tap Assembly only	
3-2756-WTP	Plastic electrode with DryLoc® connector; for use with the 3719 Wet-Tap Assembly only	
	Temperature Element - Choose one	
	-	PT1000 RTD for pH, for use with the 8900 instrument when used with the 2750 sensor
	-1	3 KΩ for pH, for connection to 8750 or 5700 instruments when used with the 2760 preamplifier
ORP Electrode		
3-2757-WT	Glass electrode; for use with the 3719 Wet-Tap Assembly only	
3-2757-WTP	Plastic electrode; for use with the 3719 Wet-Tap Assembly only	
3-2757-WT	Example Part Number	

pH Electrode		
3-2764	Flat pH surface differential electrode	
3-2766	Bulb pH differential electrode with bulb protection	
	Temperature Element - Choose one	
	-1	3 KΩ for pH for connection to 8750 or 5700 instruments when used with the 2760 preamplifier
	-2	PT1000 RTD for pH for use with the 8900 instrument when used with the 2750 sensor electronics
	-3	300 Ω for connection to other instruments when used with the 2760 preamplifier or connector
ORP Electrode		
3-2765	Flat ORP surface differential electrode	
3-2767	Bulb ORP differential electrode with bulb protection	
	Temperature Element - Choose one	
	-1	10 KΩ ID resistor for connection to 8750 or 5700 when used with the 2760 preamplifier or connection to the 8900 with used with the 2750 sensor electronics
	-2	PT1000 RTD for connection to other instruments using the 2760 preamplifier or connector
	-3	300 Ω for connection to other instruments using the 2760 preamplifier or connector
3-2765	-1	Example Part Number

pH Electrodes		
3-2774	Flat pH surface electrode	
3-2776	Bulb pH electrode with bulb protection	
	Temperature Element - Choose one	
	-	3 KΩ RTD for pH for connection to 8750 or 5700 instruments when used with the 2760 preamplifier.
	-1	PT1000 RTD for pH for connection to the 8900 when used with the 2750 sensor electronics
	Special Order Options for pH - OPTIONS -HT AND -C CAN ONLY BE USED WITH THE 3-2721 PREAMPLIFIER.	
	-HT	For high temperature and high pressure applications, up to 110 °C (230 °F) @ 150 psig; DryLoc® connector is removed and replaced with a 4.6m (15 ft) cable.
	-C	Remove DryLoc® connector and add 4.6m (15 ft) cable. Other cable lengths are available
	-ISO	ISO 7/1-R¾ Threaded electrodes are available.
ORP Electrodes		
3-2775	Flat ORP surface electrode	
3-2777	Bulb ORP electrode with bulb protection	
	Temperature Element - Choose one	
	-	10 K ID resistor for ORP electrodes for connection to the 8750 and 5700 when used with the 2760 preamplifier or the 8900 when used with the 2750 sensor electronics
	-1	No T.C. for ORP electrodes for use with other suppliers instruments when used with the 2760 connector
	Special Order Options for ORP - OPTIONS -HT AND -C CAN ONLY BE USED WITH THE 3-2721 PREAMPLIFIER.	
	-HT	For high temperature and high pressure applications, up to 110 °C (230 °F) @ 150 psig; DryLoc® connector is removed and replaced with a 4.6m (15 ft) cable.
	-C	Remove DryLoc® connector and add 4.6m (15 ft) cable. Other cable lengths are available
	-ISO	ISO 7/1-R¾ Threaded electrodes are available.
3-2775	Example Part Number	



## Ordering Information

Mfr. Part No.	Code	Description
3-2756-WT	159 000 834	See Page 6
3-2756-WT-1	159 001 383	
3-2756-WTP	159 001 390	
3-2756-WTP-1	159 001 384	
3-2757-WT	159 000 835	
3-2757-WTP	159 001 391	
3-2764-1	159 000 943	
3-2764-2	159 000 944	
3-2764-3	159 000 945	
3-2765-1	159 000 946	
3-2765-2	159 000 947	
3-2765-3	159 000 948	
3-2766-1	159 000 949	
3-2766-2	159 000 950	
3-2766-3	159 000 951	
3-2767-1	159 000 952	
3-2767-2	159 000 953	
3-2767-3	159 000 954	
3-2774	159 000 955	
3-2774-1	159 000 956	
3-2775	159 000 957	
3-2775-1	159 000 958	
3-2776	159 000 959	
3-2776-1	159 000 960	
3-2777	159 000 961	
3-2777-1	159 000 962	

### Accessories and Replacement Parts for all pH

Mfr. Part No.	Code	Description
<b>Calibration</b>		
3-2759	159 000 762	pH/ORP System Tester
3-2759.391	159 000 764	Adapter Cable for use w/2750, 2760
3-0700.390	198 864 403	pH Buffer Kit (includes 4.0, 7.0, and 10.0 buffer powder)
3-2700.395	159 001 605	Calibration Kit: includes 3 PP cups, cups stand, 1 pint pH 4.01, 1 pint pH 7.00
3822-7115	157 001 606	20 gm bottle Quinhydrone for ORP calibration (must use pH 4.01 and/or pH 7.00 buffer solutions)
3822-7004	159 001 581	pH 4 buffer solution, 1 pint (473 ml) bottle
3822-7007	159 001 582	pH 7 buffer solution, 1 pint (473 ml) bottle
3822-7010	159 001 583	pH 10 buffer solution, 1 pint (473 ml) bottle

### Accessories and Replacement Parts for 275X

1224-0205	159 000 836	O-ring, EPR (EPDM)
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### Accessories and Replacement Parts for 276X

3864-0001	159 001 007	Repl. Salt Bridge (2764)
3864-0002	159 001 008	Electrolyte solution, 500 mls
2120-0015	159 001 009	CPVC adapter: 1½ in. to 1 in.
2122-0015	159 001 010	PVDF adapter: 1½ in. to 1 in.

### Accessories and Replacement Parts for 277X

3-2721	198 864 610	Remote mount, 8750-X or 5700, pH/ORP preamplifier, for 2775-HT, 2777-HT
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