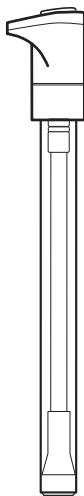


# User Guide

Redox/ORP  
Electrodes



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# Introduction

This user guide contains information on the preparation, operation and maintenance of the Thermo Scientific Orion ORP electrodes. These ORP electrodes combine a platinum redox sensing electrode and a silver/silver chloride reference electrode in one body.

The redox/ORP electrodes can be used to make direct measurements of redox potentials or perform potentiometric titrations. The ORP Triode electrodes have a built-in thermistor for measuring temperature.

## **Epoxy Sure-Flow Combination Redox/ORP Electrodes, Cat. No. 9678BNWP and 967800**

The Sure-Flow junction prevents the electrode from clogging in dirty, viscous or wastewater samples. The epoxy body is break-resistant for rugged environments.

## **Glass Combination Redox/ORP Electrodes, Cat. No. 9778BNWP and 9778SC**

The glass body enables the electrode to be used in solutions that contain organic solvents. Use the electrode in water, wastewater, metal plating and organic solvent samples.

## **Epoxy Refillable ORP/ATC Triode, Cat. No. 9180BNMD and 9180BN**

The electrode includes a built-in temperature probe for measuring ORP and temperature with one electrode. The refillable design allows the electrode filling solution to be changed in case of contamination or clogging.

## **Epoxy Low Maintenance ORP/ATC Triode, Cat. No. 9179BNMD and 9179BN**

The electrodes include a built-in temperature probe for measuring ORP and temperature with one electrode. The electrodes contain a gel reference solution, so no filling solution is required.

**Note:** *Redox/ORP electrodes are not designed for constant current or amperometric titrations, such as Karl Fischer moisture analysis.*

## Required Equipment

1. Thermo Scientific Orion pH/mV meter, such as the 3-Star pH meter, 4-Star pH/ISE meter, 4-Star pH/DO meter, 4-Star pH/conductivity meter or 5-Star pH/ISE/DO/conductivity meter.

ORP electrodes can be used on any pH/mV meter with a BNC or U.S. standard connection. The electrodes can also be used on meters with a variety of inputs when an adapter cable is used. Visit [www.thermo.com/water](http://www.thermo.com/water) for details.

Refillable ORP Triodes have temperature connectors that are compatible with specific meters, refer to the list below.

2. Thermo Scientific Orion ORP electrode.
  - The 9180BNMD and 9179BNMD ORP/ATC Triode electrodes have a temperature connector that is compatible with the Star Series meters.
  - The 9180BN and 9179BN ORP/ATC Triode electrode have a temperature connector that is compatible with the A+ Series meters.
3. ORP electrode filling solution. Use Cat. No. 900011 filling solution for samples that have a total ionic strength greater than 0.2 M. Use Cat. No. 900001 filling solution for samples that have a total ionic strength less than 0.2 M.

ORP electrode filling solution is not required if using a 9179BNMD or 9179BN low maintenance ORP/ATC Triode

4. ORP standard, Cat. No. 967901 or 967961.

ORP standard is highly recommended to ensure accurate ORP measurements.

5. Beakers, plastic or glass.
6. Magnetic stirrer or Orion stirrer probe, Cat. No. 096019. The stirrer probe can be used with 3-Star, 4-Star and 5-Star benchtop meters.
7. Distilled or deionized water.

## Sample Requirements

Electrodes with an epoxy body should only be used in aqueous solutions.

Electrodes with a glass body may be used in non-aqueous solutions and solutions that contain organic solvents.

The ORP electrodes contain a silver/silver chloride (Ag/AgCl) reference that may become clogged in solutions that contain silver complexing or binding agents such as TRIS, proteins and sulfides. Frequent cleaning may be required when measuring solutions that contain these agents. Proteins cause the additional problem of coating the electrode, so extra care should be taken to keep the electrode clean while measuring samples that contain proteins.

# Electrode Preparation

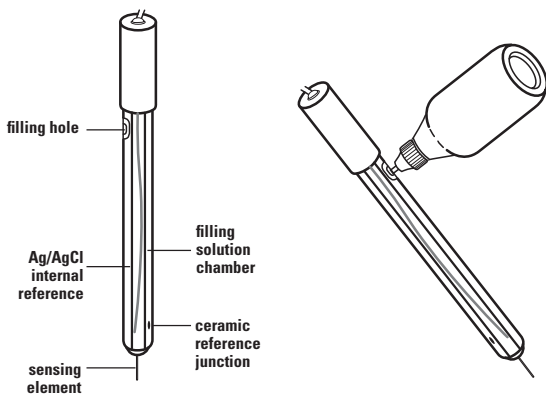
## Electrode Preparation for Refillable Electrodes

1. Remove the protective shipping cap from the sensing element and save the cap for storage.
2. Clean any salt deposits from the exterior of the electrode by rinsing with distilled water.
3. Uncover the filling hole by removing the tape and then add electrode filling solution, Cat. No. 900011, to the electrode. To maintain an adequate flow rate, the level of filling solution must always be above the reference junction and at least one inch above the sample level. The filling hole should be open whenever the electrode is in use.
4. For Sure-Flow electrode only, wet the junction by pressing down on the electrode cap to let a few drops of the filling solution flow out of the electrode and then replenish any lost solution.
5. Shake the electrode downward (similar to a clinical thermometer) to remove air bubbles.
6. Connect the electrode to the meter.

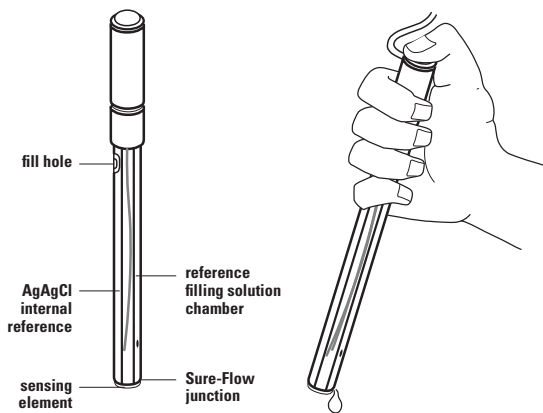
**Note:** *The fill hole must be open when the electrode is in use.*

## Electrode Preparation for Gel-Filled Electrodes

1. Remove the protective shipping cap from the sensing element and save the cap for storage.
2. Clean any salt deposits from the exterior of the electrode by rinsing with distilled water.
3. Shake the electrode downward (similar to a clinical thermometer) to remove air bubbles.
4. Connect the electrode to the meter.



**Figure 1– Refillable ORP Electrode**



**Figure 2– Sure-Flow Refillable ORP Electrode**

# Electrode Calibration

ORP readings can be reported using the absolute mV values or the  $E_H$  mV values.  $E_H$  mV values give the corresponding mV values that would be obtained using a Standard Hydrogen Electrode (SHE), also known as the Normal Hydrogen Electrode (NHE). Orion ORP standard, Cat. No. 967901 or 967961, allows operators to correlate measurements to the  $E_H$  mV value with an Orion ORP electrode.

The relative mV mode can be used to calibrate the ORP electrode so the electrode reads the  $E_H$  mV values in samples. When an ORP electrode is calibrated to read  $E_H$  mV values, the resulting sample readings can be compared among multiple meter and electrode systems.

**Note:** If the meter can perform an automatic ORP calibration using an  $E_H$  mode, refer to the meter user guide for detailed instructions on the meter calibration procedure.

1. Set the meter to the relative millivolt mode. Refer to the meter user guide for detailed instructions.
2. Place the ORP electrode in ORP standard, Cat. No. 967901 or 967961.
3. Set the meter to the  $E_H$  mV value of the ORP standard at the measured temperature using the information in **Table 1**.

**Table 1– ORP Standard Values**

Absolute mV values may vary by  $\pm 60$  mV

Temperature (°C)	$E_H$ Value (mV)	Absolute Value with Cat. No. 900011 Filling Solution (mV)	Absolute Value with Cat. No. 900001 Filling Solution (mV)
0	438	218	176
1	437	218	176
2	437	218	176
3	436	218	176
4	435	218	176
5	435	218	176
6	434	218	176
7	433	218	176
8	433	218	175
9	432	219	175



<b>Temperature (°C)</b>	<b>E<sub>H</sub> Value (mV)</b>	<b>Absolute Value with Cat. No. 900011 Filling Solution (mV)</b>	<b>Absolute Value with Cat. No. 900001 Filling Solution (mV)</b>
10	431	219	175
11	430	219	175
12	430	219	175
13	429	219	175
14	428	219	175
15	428	219	175
16	427	219	174
17	426	219	174
18	425	219	174
19	424	219	174
20	424	219	174
21	423	219	174
22	422	219	174
23	421	219	173
24	420	220	173
25	420	220	173
26	419	220	173
27	418	220	173
28	417	220	172
29	416	220	172
30	415	220	172
31	414	220	172
32	413	220	172
33	412	220	171
34	412	220	171
35	411	220	171
36	410	220	171
37	409	220	171
38	408	220	170
39	407	220	170
40	406	220	170
41	405	220	170
42	404	220	169
43	403	220	169
44	402	220	169
45	401	220	169
46	400	220	168
47	399	220	168
48	398	220	168
49	397	220	168
50	396	220	167

# Measurement Techniques

- Always use fresh ORP standard for calibration.
- If the electrode is refillable, remove the filling hole cover during measurements to ensure a uniform flow of filling solution.
- Between measurements, thoroughly rinse the electrode with distilled water. Gently shake the electrode after rinsing to prevent solution carryover and then blot the electrode dry with a lint-free tissue.
- Stir all standards and samples at a uniform rate.
- Place a piece of insulating material, such as Styrofoam or cardboard, between the magnetic stirrer and beaker to prevent measurement errors from the transfer of heat to the sample.
- Allow all standards and samples to come to room temperature for precise measurements.
- If the electrode is used in dirty or viscous samples or the electrode response becomes sluggish, empty the electrode completely and hold the junction under running water. Empty any water from the electrode and refill it with fresh electrode filling solution.
- If a Sure-Flow electrode is used in dirty or viscous samples or the electrode response becomes sluggish, empty the electrode completely and hold the junction open under running water. Empty any water from the electrode and refill it with fresh electrode filling solution. Press down on the electrode cap to let a few drops of the filling solution flow out of the electrode and then replenish any lost solution.
- Make sure the electrode filling solution is appropriate for the sample. Use Cat. No. 900011 filling solution for samples that have a total ionic strength greater than 0.2 M. Use Cat. No. 900001 filling solution for samples that have a total ionic strength less than 0.2 M.

# Electrode Measurements

## Direct Measurements

Direct oxidation-reduction potential (ORP) measurements can be used to determine the oxidizing or reducing capability of a solution and are commonly made in polluted streams, chlorinated waters, industrial wastewaters and other water samples.

1. Prepare the electrode according to the **Electrode Preparation** section.
2. Set the meter to the millivolt, relative millivolt or  $E_H$  measurement mode.
3. Place the electrode into the sample solution.
4. When the reading stabilizes, record the displayed mV potential and temperature.

**Note:** *Platinum redox electrodes may give unstable readings in solutions that contain chromous, vanadous and titanous ions or other ions that are stronger reducing agents than hydrogen or platinum.*

## Oxidation-Reduction Titrations

Oxidation-reduction or redox titrations provide a simple, reliable method for determining many substances in solution. A redox titration consists of adding to an unknown sample small increments of a titrant that converts the unknown to a different oxidation state. After each addition of titrant, the platinum redox electrode develops a potential proportional to the logarithm of the ratio of the activities of the two oxidation states. At the inflection point, or endpoint, the titrant has completely oxidized or reduced the unknown, causing a sharp change in the logarithm of the ratio of the activities of the two oxidation states. A corresponding sharp change in the potential is developed by the platinum electrode. Often several oxidizing or reducing species can be precisely determined in the same solution by a single titration with several inflection points.

**Table 2** lists suitable titrants for different unknowns, the equation for the titration reaction, interferences, and a reference where information about preparing the sample and running the titration can be found. For similar information about unknowns not listed in the table, consult the standard texts listed as references.

The following is a general procedure for performing a redox titration once the sample is prepared.

1. Fill a 10 mL buret with a standard titrant solution whose normality is 5-10 times that of the sample.
2. Connect the electrode to the meter and set the meter to the mV mode.
3. Pipet 50 mL of sample into a 150 mL beaker. Stir the solution thoroughly throughout the titration.
4. At first, add titrant in 0.5 to 1 mL increments, recording the potential after each addition. Near the endpoint, when large potential changes appear, add increments of 0.1 to 0.2 mL. Continue the titration 3 to 4 mL past the endpoint.
5. Plot the electrode potential versus volume of added titrant on linear graph paper and draw a smooth curve through the points. The endpoint is the point of inflection (the point of greatest slope).

6. Calculate the normality of the sample,  $N_x$ , in equivalents per liter.

$$N_x = (V_t * N_t) / V_x$$

where:

$N_t$  = normality of titrant (Eq/1)

$V_t$  = volume of titrant at end point (mL)

$V_x$  = volume of sample (mL)

**Table 2 References:**

1. Furman (ed.), Scott's Standard Methods of Chemical Analysis, 5th Ed., Van Nostrand, Princeton, N.J. 1938.
2. Hillebrand, Lundell, Bright, and Hoffman, Applied Inorganic Analysis, 2nd Ed., Wiley, New York, 1953.
3. Kolthoff and Sandell, Testbook of Quantitative Inorganic Analysis, 3rd. Ed., MacMillan, New York, 1952.
4. Oesper, Newer Methods of Volumetric Chemical Analysis, Van Nostrand, Princeton, N.J., 1938.
5. Treadwell and Hall, "Analytical Chemistry," vol. 2, Quantitative Analysis, 8th Ed., Wiley, New York, 1935.

**Table 2– Typical Redox Titration Methods**

<b>Unknown</b>	<b>Interferences</b>
antimony ( $\text{Sb}^{+3}$ )	As, Fe, $\text{SO}_2$ , V, and organic substances
arsenic ( $\text{As}^{+3}$ )	other reducing agents
hydrogen peroxide ( $\text{H}_2\text{O}_2$ )	preservatives present in commercial $\text{H}_2\text{O}_2$ may interfere
hypochlorite ion ( $\text{ClO}^-$ ) or chlorine ( $\text{Cl}_2$ )	$\text{Br}_2$ and other oxidizing agents interfere by liberating $\text{I}_2$
iodine ( $\text{I}_2$ )	other reducing agents
iodine ( $\text{I}_2$ )	direct sunlight, high acidity, copper salts and other catalysts promote air oxidation and cause false high results
iron (as $\text{Fe}^{+2}$ , $\text{Fe}^{+3}$ or in steel)	high levels of organic acids, such as acetic, oxalic, tartaric, and alcohols; $\text{F}^-$ if present in more than trace amounts; $\text{Cl}^-$ , $\text{PO}_4^{-3}$ (remove by adding acid)
iron (as $\text{Fe}^{+2}$ , $\text{Fe}^{+3}$ or in steel)	other reducing agents
manganese (as permanganate $\text{MnO}_4^-$ )	other oxidizing agents
manganese (as $\text{Mn}^{+2}$ )	other reducing agents
stannous tin ( $\text{Sn}^{+2}$ )	other reducing agents
sulfur (as sulfur dioxide $\text{SO}_2$ )	$\text{S}^{-2}$ and $\text{SO}_2^{-2}$ , remove by shaking with $\text{CdCO}_3$ and filtering
thallium ( $\text{Ti}^+$ )	other reducing agents
thiosulfate ion ( $\text{S}_2\text{O}_3^{-2}$ )	$\text{S}^{-2}$ and $\text{SO}_2^{-2}$ , remove by shaking with $\text{CdCO}_3$ and filtering
uranium (as uranyl ion $\text{UO}^{+2}$ )	other reducing agents
Zinc ( $\text{Zn}^{+2}$ )	other reducing agents

Suitable Titrants	Titration Reaction	Ref
potassium permanganate (KMnO <sub>4</sub> )	$5\text{Sb}^{+3} + 2\text{MnO}_4^- + 16\text{H}^+ \rightarrow 5\text{Sb}^{+3} + 2\text{Mn}^{+2} + 8\text{H}_2\text{O}$	2
sodium bromate (NaBrO <sub>3</sub> )	$\text{BrO}_3^- + 3\text{As}^{+3} + 6\text{H}^+ \rightarrow \text{Br}^- + 3\text{As}^{+5} + 3\text{H}_2\text{O}$	3
potassium permanganate (KMnO <sub>4</sub> )	$5\text{H}_2\text{O}_2 + 2\text{MnO}_4^- + 6\text{H}^+ \rightarrow 5\text{O}_2 + 2\text{Mn}^{+2} + 8\text{H}_2\text{O}$	5
sodium iodide (NaI)	in acid solution $\text{Cl}_2 + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^-$ , In basic solution $2\text{ClO}^- + 2\text{I}^- \rightarrow \text{I}_2 + 2\text{Cl}^- + 2\text{OH}^-$	1
sodium iodate (NaIO <sub>3</sub> )	$2\text{I}_2 + \text{IO}_3^- + 5\text{HCN} + \text{H}^+ \rightarrow 5\text{ICN} + 3\text{H}_2\text{O}$	4
sodium thiosulfate (Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> )	$\text{I}_2 + 2\text{S}_2\text{O}_3^{-2} \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6^{-2}$	3
ceric sulfate [Ce(SO <sub>4</sub> ) <sub>2</sub> ] (not recommended for samples containing Cl <sup>-</sup> )	$\text{Fe}^{+2} + \text{Ce}^{+4} \rightarrow \text{Ce}^{+3} + \text{Fe}^{+3}$	2
potassium dichromate (K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> ), recommended for samples containing Cl <sup>-</sup>	$\text{Cr}_2\text{O}_7^{-2} + 6\text{Fe}^{+2} + 14\text{H}^+ \rightarrow 2\text{Cr}^{+3} + 6\text{Fe}^{+3} + 7\text{H}_2\text{O}$	3
ferrous sulfate (FeSO <sub>4</sub> )	$\text{MnO}_4^- + 5\text{Fe}^{+2} + 8\text{H}^+ \rightarrow \text{Mn}^{+2} + 5\text{Fe}^{+3} + 4\text{H}_2\text{O}$	2
potassium permanganate (KMnO <sub>4</sub> )	$3\text{Mn}^{+2} + 2\text{MnO}_4^- + 7\text{H}_2\text{O} \rightarrow 5\text{MnO}_3 + \text{H}_2\text{O} + 4\text{H}^+$	1
ceric sulfate [Ce(SO <sub>4</sub> ) <sub>2</sub> ]	$\text{Sn}^{+2} + 2\text{Ce}^{+4} \rightarrow \text{Sn}^{+4} + 2\text{Ce}^{+3}$	4
iodine (I <sub>2</sub> )	$\text{SO}_2 + \text{I}_2 + 2\text{H}_2\text{O} \rightarrow \text{SO}_4^{-2} + 2\text{I}^- + 4\text{H}^+$	1
sodium bromate (NaBrO <sub>3</sub> )	$\text{BrO}_3^- + 3\text{Ti}^{+3} + 6\text{H}^+ \rightarrow \text{Br}^- + \text{Ti}^{+3} + 3\text{H}_2\text{O}$	3
Iodine (I <sub>2</sub> )	$\text{I}_2 + 2\text{S}_2\text{O}_3^{-2} \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6$	3
potassium dichromate (K <sub>2</sub> Cr <sub>2</sub> O <sub>7</sub> )	$3\text{UO}^{+2} + \text{Cr}_2\text{O}_7^{-2} + 8\text{H}^+ \rightarrow 3\text{UO}_2^{+2} + 2\text{Cr}^{+3} + 4\text{H}_2\text{O}$	3
sodium iodate (NaIO <sub>3</sub> )	$\text{ZnHg}(\text{SCN})_4 + 6\text{IO}_3^- + 6\text{Cl}^- + 8\text{H}^+ \rightarrow \text{Zn}^{+2} + \text{Hg}^{+2} + 6\text{ICl} + 4\text{HCN} + 4\text{SO}_4^{-2}$	2

## Electrode Maintenance

1. Inspect the electrode for scratches, cracks, salt crystal buildup, or membrane/junction deposits.
2. Rinse off any salt buildup with distilled water. Remove any membrane/junction deposits as directed in the **General Cleaning** section.
3. If the electrode is refillable, drain the reference chamber, flush it with fresh filling solution and refill the chamber with fresh filling solution.
4. If the electrode is refillable, make sure that the filling solution does not crystallize or dry out. Remove any crystals by rinsing the electrode with distilled water or wiping with a damp, lint-free tissue. To prevent crystallization of the filling solution, cover the fill hole whenever the electrode is being stored and open the fill hole when calibrating and measuring.



# Electrode Cleaning Procedures

## General Cleaning

1. Soak the electrode in 0.1 M HCl or HNO<sub>3</sub> for half an hour.

The electrode can also be soaked for 15 minutes in a 1:10 dilution of household laundry bleach or a 0.1 to 0.5% liquid detergent solution mixed with hot water. The solution should be stirred at a moderate to fast rate.

2. If the electrode is refillable, drain the reference chamber and refill it with fresh filling solution.
3. Thoroughly rinse the electrode with distilled water.

## Cleaning Solutions

**Cat. No. 900021**– pH cleaning solution A for removing protein contaminants.

**Cat. No. 900022**– pH cleaning solution B for removing bacterial contaminants.

**Cat. No. 900023**– pH cleaning solution C for general cleaning.

**Cat. No. 900024**– pH cleaning solution D for removing oil and grease contaminants.

**Cat. No. 900020**– pH cleaning solution kit, includes cleaning solutions A, B, C and D.

## **Sure-Flow Electrode Cleaning**

### **Cat. No. 9678BNWP and 967800**

If the area between the electrode sleeve and inner cone becomes clogged with sample or precipitate, flush the area with filling solution or distilled water.

1. Hold the electrode body with one hand and use your thumb to push down on the electrode cap to drain the chamber. Push down on the cap until all the filling solution is drained from the chamber.
2. Fill the electrode with distilled water and then push down on the cap until all the water is drained from the chamber.
3. Fill the electrode with fresh filling solution up to the fill hole. Push down on the cap to allow a few drops of filling solution to drain out of the electrode and then refill any lost filling solution.

### **Disassembling the Sure-Flow Electrode**

**Note:** *Disassembly is usually not required and should not be done unless a thorough cleaning is required.*

1. Tip the electrode so the filling solution moistens the O-ring on the electrode body. Hold the electrode body with one hand and use your thumb to push down on the electrode cap to drain the chamber.
2. Unscrew the cap counter clock-wise and then slide the cap and the spring up the cable.
3. Hold the outer sleeve with one hand and firmly push down on the threaded portion with the thumb and forefinger to separate the inner body from the sleeve.
4. Grasp the cone with a clean, lint-free tissue and withdraw the body from the sleeve using a gentle twisting motion. Do not touch the pellet above the cone, it will damage to the pellet. Rinse the outside of the electrode body and the entire sleeve with distilled water. Allow it to air dry.

## Reassembling the Sure-Flow Electrode

1. Moisten the O-ring on the electrode body with a drop of filling solution. Insert the screw-thread end of the electrode body into the tapered, ground end of the sleeve.
2. Push the body into the sleeve using a gentle twisting motion until the bottom surface of the inner cone is flush with the tapered end of the sleeve.
3. Place the spring onto the electrode body and screw on the cap. Refill the electrode with filling solution.

## Electrode Storage

### Short-term Storage (up to one day)

To ensure a quick response and free-flowing junction, the reference junction must not dry out. It is recommended that the electrode be soaked in a 4 M potassium chloride (KCl) solution. Electrodes may also be stored in water.

### Long-term Storage (over one day)

**For gel-filled electrodes**— rinse the electrode with distilled water, dry the electrode with a lint-free tissue and cover the measuring surface with the protective cap.

**For refillable electrodes**— rinse the electrode with distilled water, drain all of the filling solution from the electrode, flush out the electrode with distilled water, cover the measuring surface with the protective cap and store the electrode dry.

# Troubleshooting

Follow a systematic procedure to isolate the problem. The measuring system can be divided into four components for ease in troubleshooting: meter, electrode, sample/application and technique.

## Meter

The meter is the easiest component to eliminate as a possible cause of error. Thermo Scientific Orion meters include an instrument checkout procedure and shorting cap for convenience in troubleshooting. Consult the pH meter user guide for directions.

## Electrode

1. Thoroughly rinse the electrode with distilled water.
2. Place electrode in the Orion ORP standard and wait until the reading stabilizes.
3. The mV potential should be  $220 \text{ mV} \pm 60 \text{ mV}$ . If the mV reading is out of range, repeat the measurement with fresh ORP standard. If the electrode fails this procedure, clean the electrode thoroughly as directed in the **Electrode Maintenance** section. If the electrode response is slow or drifting and the electrode is refillable, drain and refill the electrode with fresh filling solution. Replace the electrode if cleaning and maintenance fail to rejuvenate it.

## Sample/Application

The electrode and meter may operate with standards, but not with the sample. In this case, check the sample composition for interferences, incompatibilities or temperature effects.

## Technique

If trouble persists, review operating procedures. Review calibration and measurement sections to be sure proper technique has been followed.

## Checking Electrode Operation

Checking the electrode is necessary only when there is evidence of malfunction that cannot be traced to other causes. Fill the electrode with Cat. No. 900011 filling solution for this testing procedure.

1. Prepare solution A (0.1 M potassium ferrocyanide and 0.05 M potassium ferricyanide): weigh out 4.22 g reagent-grade  $K_4Fe(CN)_6 \cdot 3H_2O$  and 1.65 g reagent-grade  $K_3Fe(CN)_6$ . Place in a 100 mL volumetric flask. Add about 50 mL distilled water and swirl to dissolve solids. Dilute to volume with distilled water.
2. Prepare solution B (0.01 M potassium ferrocyanide, 0.05 M potassium ferricyanide and 0.36 M potassium fluoride): weigh out 0.42 g reagent-grade  $K_4Fe(CN)_6 \cdot 3H_2O$ , 1.65 g reagent-grade  $K_3Fe(CN)_6$  and 3.39 g reagent-grade  $KF \cdot 2H_2O$ . Place in a 100 mL volumetric flask. Add 50 mL distilled water and swirl to dissolve solids. Dilute to volume with distilled water.
3. Transfer solution A to a 150 mL beaker. Place the electrode in the solution and wait until the reading stabilizes. The potential should be about 234 mV.
4. Transfer solution B to a 150 mL beaker. Rinse the electrode and then place it in the solution and wait until the reading stabilizes. The potential should be about 66 mV greater in solution B than in solution A.

## Assistance

After troubleshooting all components of your measurement system, contact Technical Support. Within the United States call 1.800.225.1480 and outside the United States call 978.232.6000 or fax 978.232.6031. In Europe, the Middle East and Africa, contact your local authorized dealer. For the most current contact information, visit [www.thermo.com/water](http://www.thermo.com/water).

## Warranty

For the most current warranty information, visit [www.thermo.com/water](http://www.thermo.com/water).

## Ordering Information

Cat. No.	Description
<b>9179BNMD</b>	Low maintenance gel ORP/ATC Triode with epoxy body and waterproof BNC and 8 pin MiniDIN connectors
<b>9179BN</b>	Low maintenance gel ORP/ATC Triode with epoxy body and BNC and 8 pin DIN connectors
<b>9180BNMD</b>	Refillable ORP/ATC Triode with epoxy body and waterproof BNC and 8 pin MiniDIN connectors
<b>9180BN</b>	Refillable ORP/ATC Triode with epoxy body and BNC and 8 pin DIN connectors
<b>9678BNWP</b>	Sure-Flow refillable ORP/redox electrode with epoxy body and waterproof BNC connector
<b>967800</b>	Sure-Flow refillable ORP/redox electrode with epoxy body and U.S. standard connector
<b>9778BNWP</b>	Refillable ORP/redox electrode with glass body and waterproof BNC connector
<b>9778SC</b>	Refillable ORP/redox electrode with glass body and screw cap connector
<b>900011</b>	ORP electrode filling solution, for samples that have a total ionic strength greater than 0.2 M, 5 x 60 mL bottles
<b>900001</b>	ORP electrode filling solution, for samples that have a total ionic strength less than 0.2 M, 5 x 60 mL bottles
<b>967901</b>	ORP standard, 475 mL bottle
<b>967961</b>	ORP standard, 5 x 60 mL bottles
<b>910001</b>	4 M KCl storage solution, 475 mL bottle

**Thermo Fisher Scientific**

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