User Manual

Refillable ORP/Redox Probe: Model MTC30101 or MTC30103

Safety information

Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

Specifications

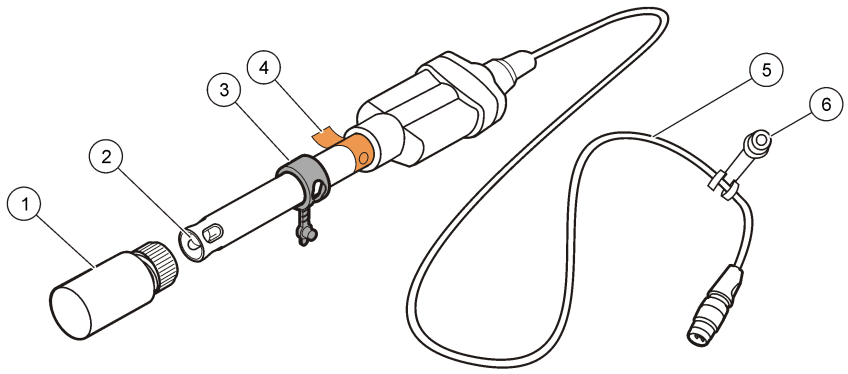
Note: *Specifications are subject to change without notice.*

Specifications	Details
Probe type	Digital combination electrode with a refillable Ag/AgCl reference and a built-in temperature sensor
Range	±1200 mV
Resolution	0.1 mV
Temperature accuracy	±0.3 °C (±0.54 °F)
Operating temperature range	0 to 80 °C (32 to 176 °F)
Storage temperature range	5 to 40 °C (41 to 104 °F)
Junction	Ceramic
Reference potential versus Standard Hydrogen Electrode	207 mV at 25 °C
Fill solution	3M KCl with saturated AgCl
Reference type	Ag/AgCl (3 M KCl)
Minimum sample depth	20 mm
Dimensions	Diameter: 12 mm (0.47 in.) Length: 175 mm (6.89 in.) Cable length: 1 or 3 m (3.28 or 9.84 ft)
Cable connection	M12 digital output and connector compatible with HQd meters

Product overview

The MTC301 series probe is a refillable, combination oxidation reduction potential (ORP/Redox) probe with a built-in temperature sensor (Figure 1). The MTC30101 or MTC30103 probe is available with a 1 or 3 m (3.28 or 9.84 ft) cable and is intended for laboratory use. The probe measures absolute mV values in wastewater, drinking water and general applications. The probe measures ORP/Redox in wastewater, drinking water and general applications. A 59 mL bottle of reference electrolyte filling solution (3M KCl solution saturated with AgCl) is included with the probe.

Figure 1 Probe overview



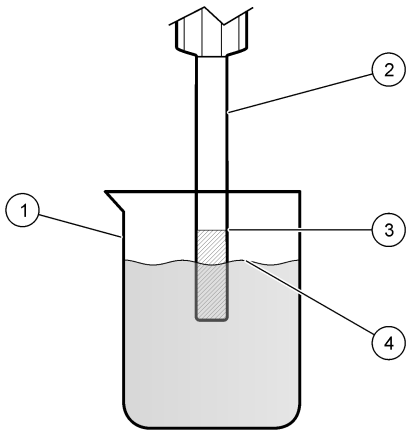
1 Probe soaker bottle	**4** Protective tape and filing-hole
2 Reference junction, platinum and temperature sensor	**5** 1 or 3 meter (3.28 or 9.84 ft) cable
3 Filling-hole cap	**6** Probe soaker bottle holder

Preparation for use

Prepare the probe for use before calibration or sample measurement.

1. Turn the probe soaker bottle cap counter-clockwise to loosen the cap.
2. Remove the soaker bottle from the probe.
3. Rinse the reference junctions and electrode with deionized water thoroughly to remove the viscous storage/filling solution completely. Blot dry with a lint-free cloth.
4. Remove the protective tape from the filling hole before initial use (refer to Figure 1 on page 2). Dispose of the protective tape.
5. Add filling solution to the probe as necessary (refer to Fill the probe on page 11). The filling solution must be above the standard solution or sample level during measurement (Figure 2).
6. Make sure that the filling hole is open during measurement for the proper flow of the filling solution.

Figure 2 Measurement method



1 Container	**3** Filling solution level
2 Probe body	**4** Standard solution or sample level

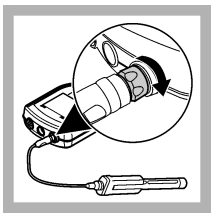
Calibration

Before calibration:
The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.
It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options.
To view the current calibration, push , select View Probe Data, then select View Current Calibration.
If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.
Prepare the probe for use (refer to Preparation for use on page 2).

Calibration notes:

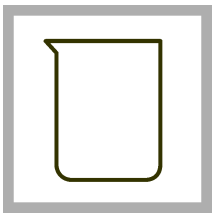
- Additional standards can be selected in the Calibration Options.
- Do not dilute ORP/Redox standards. Use fresh ORP/Redox standard for calibration.
- ZoBell's redox potential is temperature dependent. The HQd calibration routine factors in this temperature dependency allowing accurate calibrations within the temperature range of 0 to 30 °C (32 to 86 °F). Light's solution should be read at 25 °C (77 °F). Custom ORP/Redox calibration solution values and temperature are user-defined.
- The calibration is recorded in the probe and the data log. The calibration is also sent to a PC, printer or flash memory stick if connected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a calibration error occurs, refer to Troubleshooting on page 12.

Calibration procedure:



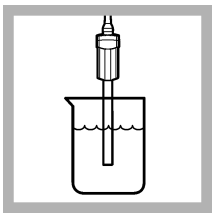
1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.

2. Push **Calibrate**. The display shows the ORP/Redox standard solution that is necessary for calibration.



3. Add the fresh ORP/Redox standard solution to a beaker or an appropriate container.

4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



5. Put the probe in the standard solution so that the temperature sensor is completely submerged. Stir gently. Shake the probe from side to side in the sample to refresh the reference junction.

6. Push **Read**. Stir gently. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display shows the standard solution value and the mV offset when the reading is stable.

7. Push **Done** to view the calibration summary.

8. Push **Store** to accept the calibration and go back to the measurement mode.

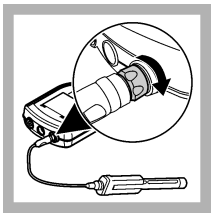
Sample measurement

Before measurement:
The probe must have the correct service-life time stamp. Set the date and time in the meter before the probe is attached.
If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the HQd meter manual for more information.
Regular calibration is required for the best measurement accuracy (refer to Calibration on page 3).
Prepare the probe for use (refer to Preparation for use on page 2).
Make sure that the platinum disc is clean and smooth (refer to Clean the probe on page 10).

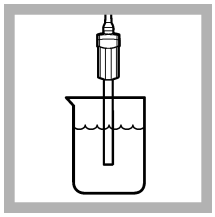
Measurement notes:

- Data is automatically stored in the data log when **Press to Read** or **Interval** is selected in the Measurement Mode. When **Continuous** is selected, data will only be stored when **Store** is selected.
- Air bubbles under the sensor tip when submerged can cause slow response or error in measurement. If bubbles are present, gently shake the probe until bubbles are removed.
- If a measurement error occurs, refer to Troubleshooting on page 12.

Measurement—direct method procedure:

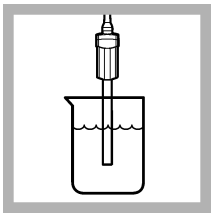


1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn the meter on.



2. To significantly reduce the stabilization time for reducing-type samples, put the platinum disc in Reducing Solution for ORP Electrodes for 3-10 minutes before the initial sample measurement.

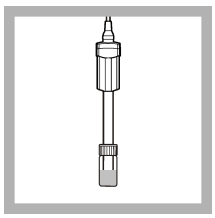
3. Rinse the probe with the sample.



4. Put the probe in the sample and stir gently. Make sure that the reference junctions are completely submerged. Do not put the probe on the bottom or sides of the container. Shake the probe from side to side in the sample to refresh the reference junction.

5. Push **Read**. The display will show "Stabilizing" and a progress bar as the probe stabilizes in the sample. The display will show the lock icon when the reading stabilizes. If necessary for the application, record the sample pH and temperature.

6. Repeat steps 3-6 for additional measurements.



7. When measurements are done, store the probe (refer to Storage on page 11).

Measurement—conversion to SHE reference procedure:

For some applications, it is customary to report redox potential readings relative to the standard hydrogen electrode (SHE), also called normal hydrogen electrode (NHE). To do this, select the value in Table 1 that corresponds to the temperature of the solution measured. Substitute that value Eref into the equation and solve for E_h:

$E_h = E + E_{ref}$

where:

E_h = oxidation reduction potential of the sample relative to the SHE

E = potential developed by the ORP/Redox electrode

E_{ref} = potential developed by the reference electrode portion relative to the SHE (Table 1).

Table 1 shows the potentials, E_{ref}, developed by the reference electrode portion relative to the SHE at various temperatures.

Table 1 Standard potential of reference electrode

Temperature (°C)	Electrode potential in mV (E_{ref})
80	163.1
75	167.7

Table 1 Standard potential of reference electrode (continued)

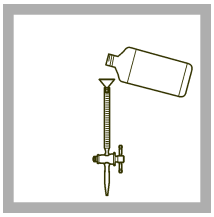
Temperature (°C)	Electrode potential in mV (E_{ref})
70	172.1
65	176.4
60	180.3
55	184.4
50	188.4
45	192.3
40	196.1
35	199.8
30	203.4
25	207.0
20	210.5
15	214.0
10	217.4
5	220.9
0	224.2

Measurement—oxidation titrations procedure:

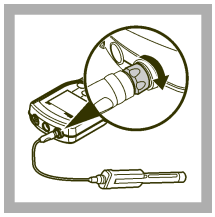
Oxidation-reduction, or redox titrations, give a simple, reliable method to identify many substances in a solution. A redox titration consists of adding to an unknown sample, small increment of a titrant that converts the unknown to a different oxidation state. After each addition of titrant, the ORP/Redox electrode develops a potential proportional to the logarithm of the ratio of the activities of the two oxidation states.

At the inflection, or end point, 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 identified in the same solution by a single titration with several inflection points.

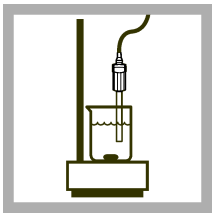
The following directions represent a general procedure for doing a redox titration once the sample is prepared for measurement.



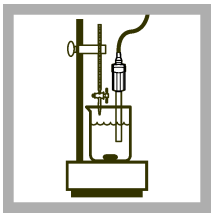
1. Fill a 10 mL burette with a standard titrant solution with a normality that is 5-10 times that of the sample.



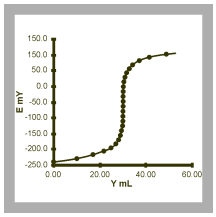
2. Connect the probe to the meter.



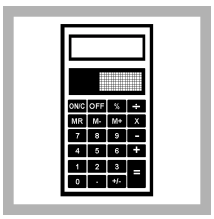
3. Pipet a 50 mL sample into a 150-mL beaker. Stir with a magnetic stirrer throughout the titration.



4. Add titrant in 0.5 to 1 mL increments. Record the potential after each addition. Near the end point, when large potential changes are seen, add increments of 0.1 to 0.2 mL. Continue the titration 3 to 4 mL past the end point.



5. Plot the electrode potential versus volume of added titrant and fit a smooth curve through the points. The end point is the point of inflection (the point of greatest slope).



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

$N_x = (V_t \times N_t) / V_x$

where:

N_t = normality of titrant (Eq/L)

V_t = volume of titrant at end point (mL)

V_x = Volume of sample (mL)

Run Check Standard

The Run Check Standard feature validates the instrument performance between sample measurements. Use the Run Check Standard feature for a periodic or a user-defined interval measurements of a traceable standard solution. Set the criteria for check standards from the MTC301 probe Settings menu.

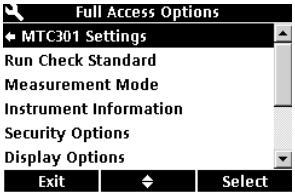
Note: *Access control must be set to off or a valid password must be used to change the Run Check Standard options.*

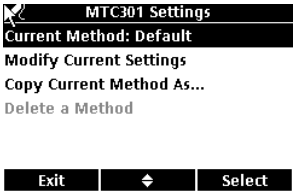
1. Push . The Full Access Options menu shows.
2. Select Run Check Standard.
   Note: *Select the correct probe if two probes are connected to the meter.*
3. Use the standard solution shown on the display.
4. Rinse the probe with deionized water. Dry the probe with a no-lint cloth.

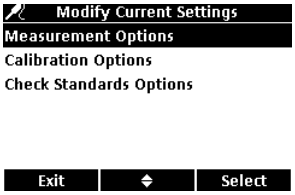
5. Put the probe in the standard solution. Make sure that the reference junction is fully in the standard. Move the probe up or down or lightly shake the probe to remove air bubbles.
6. Push **Read**. The display shows "Stabilizing" and a progress bar as the reading stabilizes. The display shows the value of the check standard and Check Standard Passed or Check Standard Failed.
7. If the display shows **Check Standard Passed**, the check standard measurement is in the accepted limits. Select **Done** to continue the sample measurement.
8. If the display shows **Check Standard Failed**, the measurement is out of the accepted limits. A calibration is recommended. Make sure that the limits are set correctly at the MTC301 probe Settings menu. If the acceptance criteria is set to "Cal Expires on Failure: Yes", the display shows the calibration icon and a question mark until the probe is calibrated again. To correct the probe calibration and status indicator, calibrate the probe (refer to Calibration on page 3).

Advanced operation

Parameter-specific settings can be changed through the Full Access Options menu. Details about menu navigation, available options and how to change them are given in the screens, tables and procedures throughout this section.







The settings that can be changed are shown in Table 2.

Table 2 Parameter-specific settings

Setting	Options
Measurement Options	• Response time • Upper and lower range limits (defines mV limits per method)
Calibration Options	• Standard • Calibration reminder • Offset limit • Standard value (if Custom option is selected)
Check Standards Options	• Standard (temperature compensated for ZoBell's and Light's solutions) • Check standard reminder • Acceptance criteria • Standard value (at 25 °C if Custom option is selected)

Change measurement options

Methods are groups of default or user-defined settings relevant to specific applications. If the meter is set to the default method and the Modify Current Settings option is chosen, a prompt for a new name is shown after the changes are entered. The settings are saved with this name to distinguish them from the default method settings, which cannot be changed. A saved method can be used instead of multiple adjustments to the individual settings. Changes made to a user defined method are automatically saved with the existing name. Multiple methods can be saved for the same probe on each meter.

1. Make sure a probe is connected to the meter.
2. Push and select MTC301 Settings.

3. Select Modify Current Settings.
4. Select Measurement Options and update the settings:

Option	Description
Response Time	Sets the response time— • Fast (2 mV/minute) • Medium (1 mV/minute) (default) • Slow (0.5 mV/minute) The response time affects the speed of the measurement by adjusting the stabilization criteria.
Measurement Limits	Sets the measurement limits—Lower limit (default: -1200.0 mV) or Upper limit (default: 1200.0 mV). The measurement limits can be set to match the acceptable values for the sample. When the measurement is above the upper limit setting or below the lower limit setting, the meter shows an "Out of limits" message. This message is an alert to a potential problem with the process conditions.

5. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
6. Push **EXIT** until the meter returns to the measurement mode.

Change calibration options

1. Make sure a probe is connected to the meter.
2. Push and select MTC301 Settings.
3. Select Modify Current Settings.
4. Select Calibration Options and update the settings:

Option	Description
Standard	Sets the calibration standard— • ZoBell's (221mV – 25 °C) • Light's (468mV – 25 °C) • Custom Temperature compensated for ZoBell's solution. Standard values are shown on the Calibration Options screen. Light's solution is characterized at 25 °C. Custom standard values and temperature are user-defined.
Offset Limits	Sets the offset limits—±1 mV to 250 mV (default: ±25 mV). The offset must fall within set limits for successful calibration.
Standard Value	When Standard is set to Custom, sets the values for the custom calibration standard— -1200.00 to 1200.0 mV (default: +221.0 mV). Custom standards are characterized at 25 °C.

5. Select Calibration Reminder and update the settings:

Option	Description
Reminder Repeat	Meter will make an audible sound when a calibration is due and repeat the sound at the selected interval—Off (default), 1 d, 7 d or 30 d.
Expires	Calibration expires after the selected time—Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h or Continue Reading. ***Note:*** *The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.*

6. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
7. Push **EXIT** until the meter returns to the measurement mode.

Change check standard options

1. Make sure a probe is connected to the meter.
2. Push and select MTC301 Settings.
3. Select Modify Current Settings.
4. Select Check Standards Options and update the settings:

Option	Description
Standard	Sets the check standard— • ZoBell's (221 mV – 25 °C) (default) • Light's (135 mV – 25 °C) • Custom Temperature compensated for ZoBell's solution. Standard value for check standard. Standard value is shown on Check Standard Options screen. Lights solution is characterized at 25 °C. Custom standard values and temperature are user-defined.
Standard Value	When Standard is set to Custom, enter the standard value using the up/down arrow keys— -1200.0 to 1200.0 mV (default: 221.0 mV). The value and temperature for custom check standard are user-defined.

5. Select Check Standard Reminder and update the settings:

Option	Description
Reminder Repeat	Sets the time interval for the check standard reminder—Off (default), 1 d, 7 d or 30 d.
Allow Defer	Allows the postponement of check standard reminders—Yes (default) or No.

6. Select Acceptance Criteria and update the settings:

Option	Description
Acceptance Limits	Sets the tolerance limits for check standard—-±1 mV to 25 mV (default: ±10 mV).
Cal Expires on Failure	Recalibration required if check standard fails—Yes or No (default).

7. If prompted, enter a name for the new method settings. Additional changes made to the settings of an existing method are automatically saved with the same method name.
8. Push **EXIT** until the meter returns to the measurement mode.

Maintenance

Clean the probe

Clean the probe when:

- Drifting/inaccurate readings or slow stabilization time occurs as a result of contamination on the platinum disc or the probe being left dry for extended periods of time.
- Measurement values are outside the calibration/measurement range of the probe even after a calibration is done using freshly prepared standards.

Note: *After cleaning is done, condition the platinum electrode in representative sample before use.*

For general cleaning (including oils, greases and organics):

1. Rinse the probe with deionized water and blot dry with a lint-free cloth.
2. Put the probe sensor and platinum disc in Electrode Cleaning Solution or warm detergent solution for up to 15 minutes.
   Note: *The platinum disc can be polished using a soft cloth or cotton swab with detergent solution.*
3. Rinse the probe sensor and platinum disc with deionized water. Blot dry with a lint-free cloth.

For inorganic deposits:

1. Put the platinum disc in a solution of 0.1 M hydrochloric or nitric acid solution for up to 15 minutes.
2. Rinse the probe sensor and platinum disc with deionized water. Blot dry with a lint-free cloth.

Fill the probe

Add filling solution to the probe when the filling solution level is low (refer to Preparation for use on page 2). Refer to Specifications on page 1 for the applicable filling solution.

1. If the filling hole is closed, remove the filling-hole cap from the filling hole (refer to Product overview on page 1).
2. Remove the cap from the tip of the filling solution bottle.
3. Hold the bottle so that the tip is down. Put the tip of the bottle in the filling hole.
4. Slowly squeeze the bottle and fully fill the probe.
   Note: *Fully fill the probe for the best performance.*
5. Put the probe into storage if not used immediately (refer to Storage on page 11).
6. Keep the filling solution bottle and cap for later use.
   Note: *If the dispensing tip becomes clogged, remove the dispensing tip and soak the tip in warm water. Fully dry and assemble the tip.*

Storage

For the best probe performance, do not let the reference junction dry out.

Short-term and long-term storage

Note: *The probe can be stored in a sample for up to 2 hours if the sample pH is not high.*

1. Put the filling-hole cap in the filling hole (refer to Figure 1 on page 2).
2. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.
3. Fill the probe soaker bottle half full with Hach Electrode Storage Solution or 3 M potassium chloride (KCl) solution.
4. Loosen the soaker bottle cap and put the soaker bottle on the probe.
5. Turn the soaker bottle cap clockwise to tighten the soaker bottle cap.
6. Make sure that the solution in the soaker bottle completely covers the reference junction holes.

Troubleshooting

Message or symptom	Possible cause	Action
Probe not supported	Software not updated	To download the most current version of the software, refer to the applicable product page on the manufacturer's website. Refer to the HQd Series meter manual for specific instructions for the meter model.
	HQd meter does not support IntelliCAL® probe	Contact a Technical Support Representative.
Connect a probe or probe requires service	Probe not connected correctly	Disconnect, then connect the probe. Tighten the locking nut.
	Software not updated	To download the most current version of the software, refer to the applicable product page on the manufacturer's website. Refer to the HQd Series meter manual.
	Large number of methods stored on the probe	Continue to let the probe connect. Do not disconnect the probe.
	Damaged probe	Make sure there is connectivity with another probe or meter to confirm isolated issue with probe. Contact a Technical Support Representative.
Standard not recognized error	Storage cap not removed	Remove the storage cap from the probe.
	Incorrect or contaminated standard solution	Use fresh standard solution as specified in the method.
mV reading is same for all solutions	Storage cap not removed	Remove the storage cap from the probe.
	Electrical issue	Contact a Technical Support Representative.
Slow stabilization time	Tape not removed from the filling hole	Remove the tape from the filling hole.
	Contaminated filling solution	Drain and replace the filling solution in the probe with fresh solution.
	Filling hole is closed	Open the filling hole cap while in use.

Message or symptom	Possible cause	Action
Slow stabilization time	Contaminated platinum sensor	Clean the probe (refer to Clean the probe on page 10).
	Probe not conditioned/pre-treated for reducing type samples	To significantly reduce the response time for reducing type samples the platinum disc must undergo the following: **1.** Make sure that the platinum disc is clean and smooth. **2.** Put the platinum disc in Reducing Solution for ORP Electrodes for 3-10 minutes before sample analysis. **3.** Rinse the probe with sample, then measure.
	Low sample temperature or temperature difference between samples	Check the sample temperature. The lower the temperature or the greater the difference of temperatures between samples, the longer the response time.
	Platinum electrode not conditioned for reducing-type samples	**1.** Make sure that the platinum disc is clean and smooth. **2.** Put the platinum disc in Reducing Solution for ORP Electrodes for 3-10 minutes before sample analysis. **3.** Rinse the probe with sample, then measure.
	Air bubbles around inner reference electrode	Gently tap the probe with hand or shake the probe while holding the probe downward in the solution/sample to remove any air bubbles in the reference junction holes.
Out of range	Measure value is outside the calibration/measurement range of the probe	Calibrate again using freshly prepared standards.
		Clean the probe and calibrate again.
		Make sure that the sample is within the range of the probe.
	Air bubbles around inner reference electrode	Gently tap the probe with hand or shake the probe while holding the probe downward in the solution/sample to remove any air bubbles in the reference junction holes.

Message or symptom	Possible cause	Action
Drifting/Inaccurate readings	Contaminated platinum disc	Clean the probe (refer to Clean the probe on page 10).
	Clogged reference	Thoroughly rinse the reference junction holes with deionized water. Gently tap the probe with hand while holding the probe downward to remove any air bubbles.
	Improper storage conditions	The probe may not function correctly if the probe has been left dry for extended periods of time. **1.** Clean or condition the probe and attempt to recalibrate the probe. **2.** If recalibration fails, attempt to recondition the reference junctions by putting the probe tip in a 3.0 M KCl storage solution for 1-2 hours. **3.** Rinse the probe with deionized water before use.
	Electromagnetic Forces (EMF) such as voltaic cells, thermoelectric devices, electrical generators, resistors and transformers.	Do not test in areas where EMF is present. For testing in process units (i.e. spot checking), make sure that the equipment is grounded.
	Air bubbles around inner reference electrode	Gently tap the probe with hand or shake the probe while holding the probe downward in the solution/sample to remove any air bubbles in the reference junction holes.
Out of limits	Check standard value is outside of limits set in the current method	Make sure that the standard is within the limits of the current method.
		Create a new method that expands the acceptable limits.
	Measurement value is outside of measurement limits set in the current method.	Make sure that the sample is within the limits of the current method.
		Create a new method with an expanded range.
	Calibration adjustment offset value outside the limits set in the current method	Make sure that the standard is within the limits of the current method.
		Create a new method that expands the acceptable limits.
	Storage cap not removed	Remove the storage cap.
Temperature out of range	Calibration temperature value is outside of range	Make sure that the sample temperature is within the range of the probe.
		Make sure that the temperature sensor is working correctly.
	Measured temperature is outside range of the probe	Make sure that the standard temperature is within the range of the probe.
		Make sure that the temperature sensor is working correctly.
	Check standard temperature value is outside of range	Make sure that the Check Standard temperature is within the range of the probe.

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07/2014, Edition 3