

Refillable ORP/Redox electrode: 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, if noted on the instrument, will be included with a danger or caution statement in the manual.

	Electrical equipment marked with this symbol may not be disposed of in European public disposal systems after 12 August of 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the Producer for disposal at no charge to the user. Note: For return for recycling, please contact the equipment producer or supplier for instructions on how to return end-of-life equipment, producer-supplied electrical accessories, and all auxiliary items for proper disposal.
	This is the safety alert symbol. Obey all safety messages that follow this symbol to avoid potential injury. If on the instrument, refer to the instruction manual for operation or safety information.

Overview

The MTC30101 or MTC30103 is a refillable, combination oxidation reduction potential (ORP/Redox) electrode with a built-in temperature sensor. The MTC30101 or MTC30103 is available with a 1 or 3 meter cable and is intended for laboratory use. The electrode provides ORP/Redox measurements 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 electrode.

Specifications

Specifications are subject to change without notice.

Specification	Details
Electrode 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
Storage temperature range	5 to 40 °C
Junction	Porous pin
Reference potential versus Standard Hydrogen Electrode	207 mV at 25 °C
Reference electrolyte	Electrode filling solution, 3M KCl
Fill solution	3M KCl with saturated AgCl
Reference type	Ag/AgCl (3M KCl)
Minimum sample depth	20 mm
Dimensions	Diameter: 12 mm, Length: 103 mm, Total length: 200 mm, Cable length: 1 or 3 meter
Cable connection	Digital output and connector compatible with HQd meters
Warranty	Sensor is covered by a 1 year warranty.

Preparation for use

- 1. Remove the electrode storage cap.
- 2. Before first use, remove the tape from the filling-hole and the label from the electrode body. Refer to [Figure 1](#).
- 3. Install the filling-hole cap by sliding the cap over the filling hole. Close the cap when not in use, and open when filling and during measurements.
- 4. Rinse the reference junction and platinum electrode with deionized water and blot dry with a lint-free cloth.
- 5. For temporary storage, fill the soaker bottle halfway with **Hach Electrode Storage Solution** or **3M KCl Filling Solution**. Loosen the soaker bottle cap and push to install the soaker bottle on the electrode. Tighten the soaker bottle cap to secure.

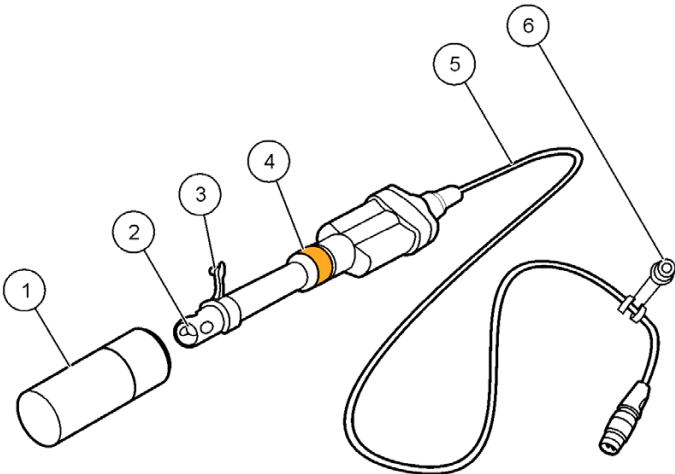


Figure 1Electrode overview

1	Electrode soaker bottle	4	Filling-hole and tape
2	Reference junction, platinum and temperature sensor	5	1 or 3 meter cable
3	Filling-hole cap	6	Electrode storage cap lid

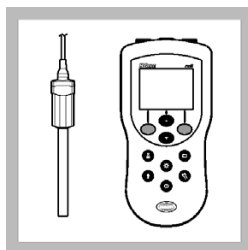
Calibration

Before calibration:

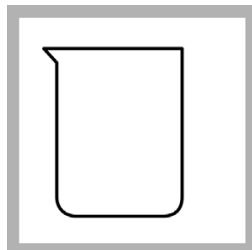
The electrode must have the correct service-life time stamp. Set the date and time in the meter before attaching the electrode.
It is not necessary to recalibrate when moving a calibrated probe from one HQd meter to another if the additional meter is configured to use the same calibration options. If the additional HQd meter uses different calibration options (e.g. standard calibration routine), calibrate the probe or change the method settings/select a different method.
To view the current calibration, select the DATA LOG key, View Probe Data , then View Current Calibration .
If two probes are connected the meter, push the UP or DOWN arrow to change to the single display mode to show the Calibrate option.
ORP/Redox standards should not be diluted. Always use fresh ORP/Redox standard for calibration.
Stir gently. Avoid resting the electrode on the bottom or sides of the container.
Refer to the troubleshooting section for calibration errors (Troubleshooting on page 12).
The filling-hole must be open during calibration for the proper flow of the filling solution. Close the cap when not in use.

Calibration notes

- Probes are initially calibrated at the factory. However, regular calibration by the user is recommended for best measurement accuracy.
- Additional standards can be selected in the MTC101 Calibration Options.
- 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 - 30 °C. Light's solution should be read at 25 °C. Custom ORP/Redox calibration solution values and temperature are user defined.
- The calibration is recorded in the electrode and the data log. The calibration is also sent to a PC, printer, or flash memory stick if connected.



1. Connect the electrode to the meter.



2. Add fresh ORP/Redox standard to a beaker or appropriate container.



3. Select **Calibrate**. The display will show the required ORP/Redox standard solution.



4. Rinse the electrode with deionized water, blot dry, and place it in the standard solution.



5. Push **Read**. Stir gently. The display will show **Stabilizing...** and a progress bar as the electrode stabilizes in the standard.



6. The display will show the standard solution value and the mV offset when the reading is stable. Select **Done** to view the calibration summary.



7. The display will show the calibration summary. Select **Store** to accept the calibration and return to the measurement mode.

Run check standard

The run check standard feature validates instrument performance between sample measurements. Use the run check standard feature for periodic or user-defined interval measurement of a traceable standard solution. Set the criteria for check standards from the MTC301 settings menu.

Note: Access control must be off or a valid password entered before any of the check standard method options can be changed.

- 1. Select **Run Check Standard** from the Meter Options menu.

Note: Select the appropriate probe if two probes are connected to the meter.

- 2. Obtain the standard solution specified in the display.
- 3. Place the electrode in the standard solution and select **READ**. The display will show **Stabilizing...** and a progress bar as the electrode stabilizes in the standard. The display shows the value of the check standard and either **Check Standard Passed** or probe **Check Standard Failed**.

If the display reads **Check Standard Passed**, the check standard measurement is within the accepted limits defined by the administrative user. Select **DONE** to proceed with sample measurement.

If the display reads **Check Standard Failed**, the measurement is outside of accepted limits defined by the administrative user and a recalibration is suggested. If the acceptance criteria is set to **Cal Expires on Failure: Yes**, the display will show the calibrate icon with a question mark until the electrode is recalibrated. Recalibrate the electrode to correct the status indicator ([Calibration on page 2](#)).

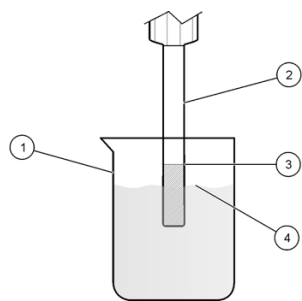


Figure 2: Measurement method

1	Sample container	3	Filling solution level
2	electrode body	4	Sample level

Measurement–Direct Method

Before measurement:

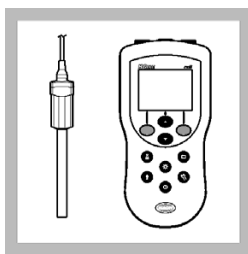
The electrode must have the correct service-life time stamp. Set the date and time in the meter before attaching the electrode.
The electrode is factory calibrated and ready for use. For applications that require greater accuracy and precision, verify the calibration with check standards or perform a user calibration. Routine calibrations are required (Calibration on page 2).
Make sure that the platinum electrode is clean before sample measurement (Clean the probe on page 8).
If complete traceability is required, enter a sample ID and operator ID before measurement.
For measurement errors refer to Troubleshooting on page 12 .
Stir samples gently during measurement.
The filling-hole must be open during measurement for optimal response time. Close when not in use.

Measurement notes

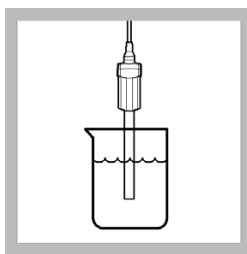
- Data is stored automatically in the data log when **Press to Read** or **Interval** is selected in the **Setup Measurement Mode**. If **Continuous** is selected, data will be stored only when the STORE key is pushed.
- The filling-hole must be open during measurement for the proper flow of the filling solution.
- The filling solution must be above the sample level during measurement. Refer to [Figure 2](#).
- To significantly reduce the response time for reducing-type samples:
 - The platinum disc must be clean and smooth.
 - Immerse the platinum disc for 3-10 minutes in **Reducing Solution for ORP Electrodes** prior to sample analysis.
 - Rinse the electrode with sample, then measure.



1. Prepare the electrode for use. Refer to [Preparation for use on page 2](#).



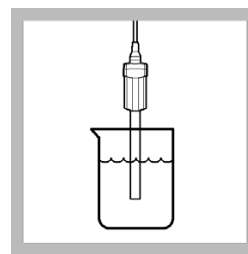
2. Connect the electrode to the meter.



3. Rinse the electrode with sample and place the electrode in fresh sample.



4. Push **Read**. The display will show **Stabilizing...** and a progress bar as the electrode stabilizes in the sample. If required by the application, also record the sample pH and temperature.



5. Repeat steps 3 and 4 for additional measurements.

Measurement - conversion to SHE reference

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 Standard potential of reference electrode](#) that corresponds to the temperature of the solution measured. Substitute that value E_{ref} 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 (refer to [Table 1 Standard potential of reference electrode](#)).

[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

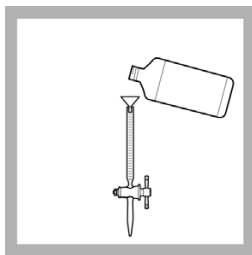
Temperature (°C)	Electrode Potential in mV (E_{ref})
80	163.1
75	167.7
70	172.1
65	176.4
60	180.3
55	184.4
50	188.4
45	192.3
40	196.1
35	199.8
30	203.4
25	207.0
20	210.5
15	214.0
10	217.4
5	220.9
0	224.2

Measurement - Oxidation Titrations

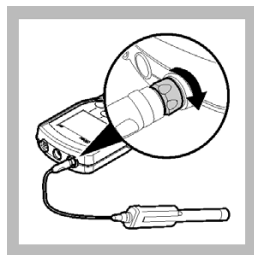
Oxidation-reduction, or redox titrations, provide a simple, reliable method for determining many substances in solution. A redox titration consists of adding to an unknown sample small increments of a titrant that converts the unknown to a different oxidation state. After each addition of titrant, the 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 determined in the same solution by a single titration with several inflection points.

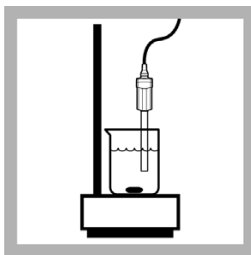
The following directions represent a general procedure for performing a redox titration once the sample is prepared for measurement.



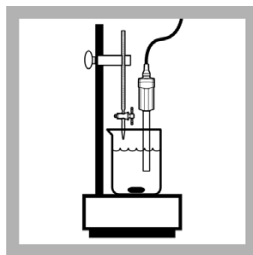
1. Fill a 10 mL burette with a standard titrant solution with a normality that is 5-10 times that of the sample.



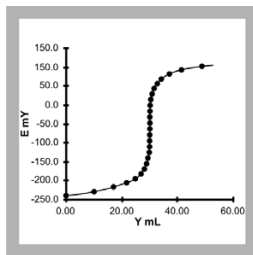
2. Connect the electrode to the meter.



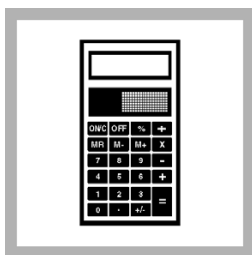
3. Pipet a 50 mL sample into a 150-mL beaker. Stir with a magnetic stirrer throughout the titration.



4. Begin by adding titrant in 0.5 - 1 mL increments, recording the potential after each addition. Near the end point, when large potential changes appear, add increments of 0.1 - 0.2 mL. Continue the titration 3-4 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)

Maintenance

Clean the probe if the response time becomes slow ([Clean the probe on page 8](#)).

Storage

Note: For optimal performance the reference junction must not dry out.

Short term storage

Store the electrode in **Hach Electrode Storage Solution** or **3M potassium chloride (KCl)** solution. The electrode can also be stored for up to 2 hours in a sample (if the sample pH is not extreme).

Long-term storage

1. Rinse the electrode with deionized water. Dry the electrode with a lint-free cloth.
2. Fill the electrode storage cap halfway with **Hach Electrode Storage Solution** or **3M potassium chloride (KCl)** solution.
3. Install the electrode storage cap. Make sure that the storage cap covers the reference junction completely.

Fill the probe

1. Open the filling-hole cap.
2. Remove the cap from the tip of the filling solution bottle.
3. Insert the dispensing tip into the filling hole and position downward.
4. Slowly squeeze the filling solution container and fill the electrode.

Note: Fill the electrode completely for optimum performance.

5. Close the filling-hole cap until use and save the filling solution container and cap for later use.

Note: If the dispensing tip becomes clogged, remove luer lock dispensing tip and soak in warm water. Dry thoroughly and reassemble.

6. Install the filling-hole cap.

Clean the probe

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

- Rinse the electrode with deionized water and blot dry with a lint-free cloth.
- Immerse the sensor array 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.

- Rinse the electrode sensor array and platinum disc with deionized water. Blot dry with a lint-free cloth.

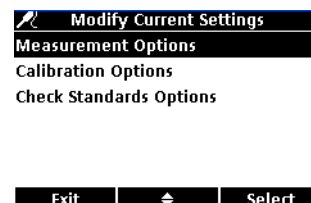
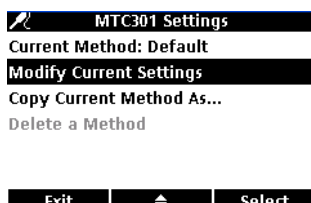
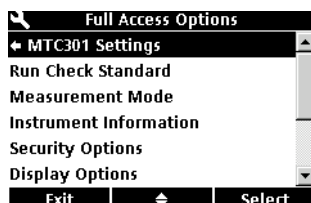
For inorganic deposits:

- Immerse the platinum disc in a solution of 0.1M hydrochloric or nitric acid solution and soak for up to 15 minutes.
- Rinse the electrode sensor array and platinum disc with deionized water. Blot dry with a lint-free cloth.

After cleaning is performed, condition the platinum electrode in representative sample prior to use.

Advanced operations

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.



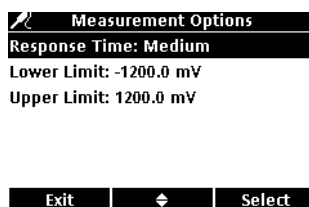
The settings that can be changed are shown in [Table 2](#).

Table 2 Parameter-specific settings

Setting	Options
Measurement options	• Response time • Upper and lower range limits (defines pH limits per method)
Calibration options	• Standard • Offset limits
Check standard options	• Standard (temperature compensated for ZoBell's and Light's solutions) • Check standard reminder • Acceptance criteria • Standard value (at 25 °C if custom standard 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 will display to name the method after 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 repeatedly adjusting 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.



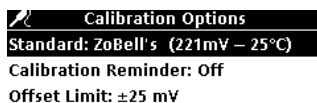
1. Make sure an electrode is connected to the meter.
2. Push the **METER OPTIONS** key and select (MTC301) Settings.
3. Select Modify Current Settings.
4. Select Measurement Options.
5. Update the settings. Refer to [Table 3](#).

Table 3 Measurement options settings

Setting	Options	Description
Response time	Fast Medium (default) Slow	The response time affects the speed of the measurement by adjusting the stabilization criteria. Fast: 2 mV/min Medium: 1 mV/min Slow: 0.5 mV/min
Measurement limits	Lower limit (default: -1200.0 mV) Upper limit (default: 1200.00 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 will show an "Out of limits" message. This message is an alert to a potential problem with process conditions.

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 calibration options





1. Make sure an electrode is connected to the meter.
2. Push the **METER OPTIONS** key and select (MTC301) Settings.
3. Select Modify Current Settings.
4. Select Calibration Options.
5. Update the settings. Refer to [Table 4](#).

Table 4 Calibration options settings

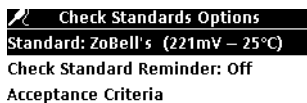
Settings	Option	Description
Standard	ZoBell's (221mV -- 25°C) Light's (468mV -- 25 °C) Custom	Temperature compensated for ZoBell's solution. Standard values will appear on Calibration Options screen. Light's solution is characterized at 25 °C. Custom standard values and temperature are user defined.
Calibration reminder	Reminder repeat: Off (default), 1 d, 7 d, 30 d	Meter will make an audible sound when calibration is due. and repeat the sound at selected interval.
	Expires: Immediately, Reminder + 30 min, Reminder + 1 hr, Reminder + 2 hr, Continue Reading	Calibration expires after a specified time. Note: The meter cannot be used to read samples after calibration has expired unless Continue Reading is selected.

Table 4 Calibration options settings

Settings	Option	Description
Offset limits	$\pm 1 \text{ mV} - 250 \text{ mV}$ ($\pm 25 \text{ mV}$ default)	Offset must fall within set limits for successful calibration.
Standard value (for custom standard option)	Enter standard value using up/down arrow keys. Range -1200.0 mV to 1200.0 mV	Custom standard value. Custom standards are characterized at 25°C .

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

 Check Standards Options
Standard: ZoBell's ($221 \text{ mV} - 25^\circ\text{C}$)
Check Standard Reminder: Off
Acceptance Criteria

 Exit  Select

1. Make sure an electrode is connected to the meter.
2. Push the **METER OPTIONS** key and select (MTC301) Settings.
3. Select Modify Current Settings.
4. Select Calibration Options.
5. Update the settings. Refer to [Table 5](#).

Table 5 Check standard options settings

Settings	Options	Description
Standard	ZoBell's ($221 \text{ mV} - 25^\circ\text{C}$) (default) Light's ($135 \text{ mV} - 25^\circ\text{C}$) Custom	Temperature compensated for ZoBell's solution. Standard value for check standard. Standard value will appear on Check Standard Options screen. Light's solution is characterized at 25°C . Custom standard values and temperature are user defined.
Check standard reminder	Reminder: On or Off (default) Allow Defer: Yes	Meter automatically displays check standard screen if reminder is on. Measurement of check standard can be delayed if Allow defer : is set to Yes.
Acceptance Criteria	Acceptance Limits: $\pm 1 \text{ mV}$ to 25 mV (default: $\pm 10 \text{ mV}$) Cal Expires on Failure: Yes or No (default)	Values (as mV) that check standard must fall within in order to pass. Calibration expires if check standard fails.
Standard value (for Custom Standard option)	Enter standard value using up/down arrow keys. Range -1200.0 mV to 1200.0 mV	Value and temperature for custom check standard are user defined.

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.

Troubleshooting

Message or symptom	Possible cause	Action
Probe not supported	Software not updated	Update the HQd software to the newest revision at www.hach.com/SoftwareDownloads . Refer to the HQd Series Meter Manual.
	HQd meter does not support IntelliCAL probe.	Contact a Hach Technical Support Representative.
Connect a probe or Probe requires service	Electrode not connected properly	Disconnect, then connect the electrode. Tighten the locking nut.
	Software not updated	Update the HQd software to the newest revision at www.hach.com/download-resources .
	Damaged electrode	Verify connectivity with another electrode or meter to confirm isolated issue with the electrode. Contact a Hach Technical Representative.
	Large number of methods stored on probe.	Continue to let probe connect. Do not disconnect probe.
Standard not recognized error	Storage cap not removed.	Remove storage cap.
	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.
	Electrical issue	Contact a Hach Technical Support Representative.
Slow response time	Tape not removed from the filling-hole	Remove the tape.
	Contaminated platinum sensor	Clean the electrode.
	Contaminated filling solution	Drain and replace the filling solution with fresh solution.
	Filling hole closed	Open filling hole cap while in use.
	Electrode 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: --The platinum disc must be clean and smooth. --Immerse the platinum disc for 3-10 minutes in Reducing Solution for ORP Electrodes prior to sample analysis. --Rinse the electrode 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, traditionally the longer the response time.
	Platinum electrode not conditioned for reducing-type samples	The platinum disc must be clean and smooth. Immerse the platinum disc for 3-10 minutes in Reducing Solution for ORP Electrodes prior to sample analysis. Rinse the electrode with sample, then measure.
Out of range	Measure value is outside the calibration/measurement range of the electrode.	Recalibrate using freshly prepared standards
		Clean the electrode and recalibrate
		Verify that the sample is within the range of the electrode

Troubleshooting (continued)

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

Parts

Description	Quantity	Catalog Number
IntelliCAL ORP/Redox refillable electrode, standard, with 1 m cable	1	MTC30101
IntelliCAL ORP/Redox refillable electrode, standard, with 3 m cable	1	MTC30103

Accessories

Description	Quantity	Catalog Number
Citizen PD-24 USB handy printer, 120-220 VAC	1	2960100
Color coded electrode clips (5 color coded sets)	10/pkg	5818400
Electrode storage cap	5/pkg	5857305
Electrode storage cap lid	1	5829800
Field kit (Includes glove kit, and 5 120 mL sample cups)	1	5825800
Glove kit only for HQd meters	1	5828700
IntelliCAL probe stand (for standard probes)	1	8506600
Meter stand	1	4754900
Printer paper for PD-24, thermal	5/pk	5836000
Standard probe holder (use with protective glove)	1	5829400
USB and AC power adapter for HQd meters (included w/HQ40d)	1	5826300
USB keyboard for HQd meters (must have and 5826300)	1	LZV582

Consumables

Electrode cleaning solution	500 mL	2965249
Electrode storage solution (3M KCl)	500 mL	2756549
Light's solution (10 mL ampules)	20/pkg	2612520
Reducing solution for ORP electrodes	500 mL	2965349
ZoBell's ORP standard solution	1	2316949

HACH Company World Headquarters

P.O. Box 389
Loveland, Colorado 80539-0389 U.S.A.
Tel (800) -227-4224 (U.S.A. only)
Fax (970) 669-2932
orders@hach.com • www.hach.com

International customers:
Tel +001 (970) 669-3050
Fax +001 (970) 669-2932
intl@hach.com

