User Manual

Luminescent Dissolved Oxygen Probe: Model LDO10101, LDO10103, LDO10105, LDO10110, LDO10115 or LDO10130

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 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.*

Specifications

Note: Specifications are subject to change without notice.

| Specifications	Details
Probe type	Luminescent dissolved oxygen (LDO) probe
Dissolved oxygen range	0.1 to 20.0 mg/L (ppm) 1 to 200% saturation
Dissolved oxygen accuracy	±0.1 mg/L for 0 to 8 mg/L ±0.2 mg/L for greater than 8 mg/L
% saturation resolution	0.1%
Stabilization time	T90% at 10 seconds (when stirred)
Temperature resolution	0.1 °C (0.18 °F)
Temperature accuracy	±0.3 °C (±0.54 °F)
Pressure resolution	1 hPa
Pressure accuracy	±0.8%
Operating temperature range	0 to 50 °C (32 to 122 °F)
Storage temperature range	0 to 40 °C (32 to 104 °F)
Minimum sample depth	25 mm (0.984 in.)
Dimensions (standard)	Diameter: 29 mm (1.14 in.) Length: 191 mm (7.52 in.) Cable length: 1 or 3 m (3.28 or 9.84 ft)
Dimensions (rugged)	Diameter: 46 mm (1.81 in.) Length: 223 mm (8.73 in.) Cable length: 5, 10, 15 or 30 meter (16.40, 32.81, 49.21 or 98.42 ft)
Cable connection	M12 digital output and connector compatible with HQd meters

Product overview

The LDO101 series probe is a luminescent dissolved oxygen probe (Figure 1). The LDO10105, LDO10110, LDO10115 or LDO10130 rugged probe is available with a 5, 10, 15 or 30 m (16.40, 32.81, 49.21 or 98.42 ft) cable. The LDO10101 or LDO10103 standard

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 the dissolved oxygen concentration in wastewater, drinking water and general applications.

Note: For BOD applications, use the LBOD10101 probe which has LDO technology and a stirrer.

Figure 1 Probe overview
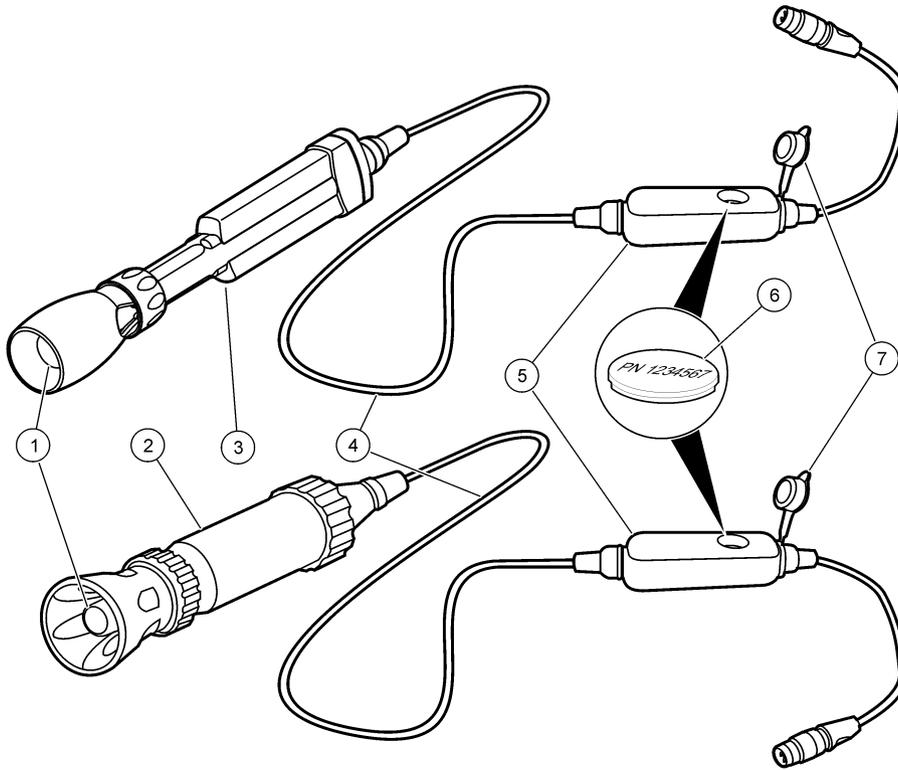
1	LDO probe cap	5	Pressure sensor module
2	Rugged probe (5, 10, 15 or 30 meter cable)	6	iButton® compartment[1]
3	Standard probe (1 or 3 meter cable)	7	Pressure sensor module cap
4	Probe cable		

[1] iButton is a registered trademark of Maxim Integrated Products, Inc.

Preparation for use

Note: Do not touch the probe cap with a hand, fingers or any surface that can scratch the cap.

Prepare the probe for use before calibration or sample measurement.

1. Make sure that the probe cap and iButton are installed correctly. The iButton label should be up.
2. Make sure that the probe cap and iButton have the same lot code.
3. If a rugged probe, make sure that the shroud is installed before field use (refer to Install the shroud on page 9).

   Note: Damage to the sensing elements can occur if the shroud is not installed during field use. Damage under these conditions is not covered by the product warranty.
4. Rinse the probe cap with deionized water. Blot dry with a lint-free cloth.
5. If dissolved oxygen monitoring periods are longer than 6 hours, condition the probe cap for 72 hours. Calibrate the probe once every 8 hours.

   Note: After 72 hours, the probe cap will reach a fully hydrated state.

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. |
| If a rugged probe, remove the shroud from the probe (refer to Remove the shroud on page 9). |

Calibration notes:

- % saturation or mg/L calibration methods are available in the Modify Current Settings menu.
- The slope value is the comparison between the latest calibration and the factory calibration shown as a percentage.
- An additional zero point calibration can be added to the calibration routine. Refer to Change calibration options on page 8.
- 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.
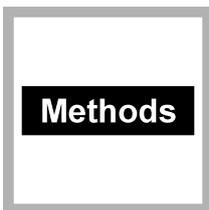- If a calibration error occurs, refer to Troubleshooting on page 10.

Water-saturated air (100%) calibration procedure:
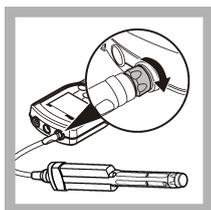
1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.
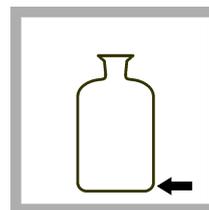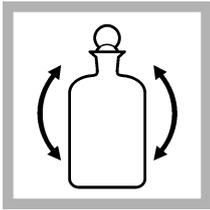
2. Push **Calibrate**.

3. Push **Methods**. Select User Cal - 100%. Push **OK**.

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

5. Add approximately ¼ inch (6.4 mm) of reagent water to a narrow-neck bottle, such as a BOD bottle.

		Read	**Done**	**Store**
6. Put a stopper in the bottle and shake the bottle vigorously for approximately 30 seconds to saturate the entrapped air with water. Allow up to 30 minutes for contents to equilibrate to room temperature.	**7.** Remove the stopper. Carefully dry the probe cap with a non-abrasive cloth. Put the probe in the bottle.	**8.** Push **Read**. The display shows "Stabilizing" and a progress bar as the probe stabilizes. The display shows the standard value when the reading is stable.	**9.** Push **Done** to view the calibration summary.	**10.** Push **Store** to accept the calibration and return to the measurement mode. If a rugged probe, install the shroud on the probe (refer to Install the shroud on page 9).

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). Calibrate the probe if accuracy better than ±0.50 mg/L is necessary for the application. |
| Prepare the probe for use (refer to Preparation for use on page 2). |
| To deploy a rugged probe at a distance, toss the probe body with a gentle underhand throw. Do not swing the probe by the cable as this may cause injury to the user, will cause severe strain on the cable and will shorten the service life of the cell. Damage under these conditions is not covered by the product warranty. |

	Do not submerge the pressure sensor module.

Measurement notes:

- Stabilization times with smaller concentration changes generally will be longer and can be minimized by correct stirring and conditioning. Experiment to determine the correct stir rate if necessary.
- Salinity affects the concentration of dissolved oxygen in the sample. To correct for salinity effects, refer to Advanced operation on page 6 or do the Auto salinity correction on page 5.
- 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 10.
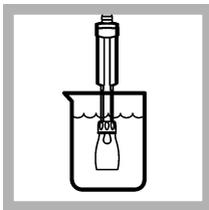
Measurement procedure:

Note: Procedures also apply for rugged model probes.
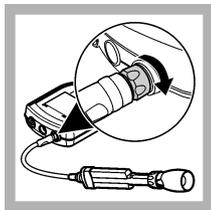
1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn on the meter.

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

3. Put the probe in the sample and stir gently or add a stir bar. Do not put the probe on the bottom or sides of the container. Stir the sample at a moderate rate or put the probe in flowing conditions.

4. Put the probe in the sample at least 25 mm (0.984 in.) deep. 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.
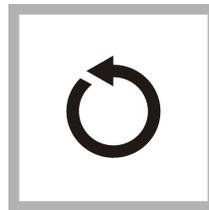
5. Repeat steps 2-4 for additional measurements. When measurements are done, store the probe Storage on page 10.

Auto salinity correction

Dissolved substances affect the amount of oxygen water can hold. Manually enter salinity settings for the most accurate dissolved oxygen measurements or use the optional Auto Salinity Correction feature.

The manufacturer recommends using the Auto Salinity Correction feature when measuring dissolved oxygen in samples where salinity varies. Auto salinity correction measures dissolved oxygen through the connection of one LDO101 probe and one CDC401 conductivity cell (set to Salinity parameter). The value obtained by the CDC401 conductivity cell automatically adjusts the salinity value for the LDO101 series probe. Salinity units are represented as parts per thousand (ppt) or (º/ºº).

1. Connect the LDO101 probe and CDC401 conductivity cell to the HQd meter. Turn the meter on.
Note: Security options must be turned off to use auto salinity correction.

2. Push ⚲ and select the CDC401 Settings.

3. Select Current Method, Hach Salinity. Push **OK**.
Note: To change more measurement options, choose Modify Current Settings, change the parameter to Salinity and any other desired settings.

4. Push **EXIT** until the Full Access Options menu is shown.

5. Select LDO101 Settings, Modify Current Settings, Measurement Options, Salinity Correction: Off. Then select Sal Correction Mode: Off. Push the **DOWN** arrow to select Auto (*) - Use CDC401. Push **OK**.

6. Push **EXIT** until the meter returns to the measurement mode. The HQ40d meter is now set up to automatically use the salinity values obtained by the CDC401 with the LDO101 probe. If the salinity value is out of range, the display will show ***S= ----** above the dissolved oxygen reading as shown in Figure 2.
Note: The asterisk (*) indicates that salinity is automatically correcting the dissolved oxygen value. No asterisk indicates that salinity is being manually corrected. Warning messages will override the asterisk (*) priority.

Figure 2 Salinity value out of range
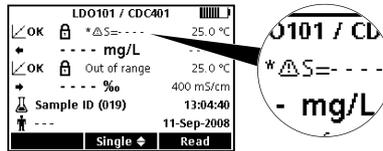
Advanced operation

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.
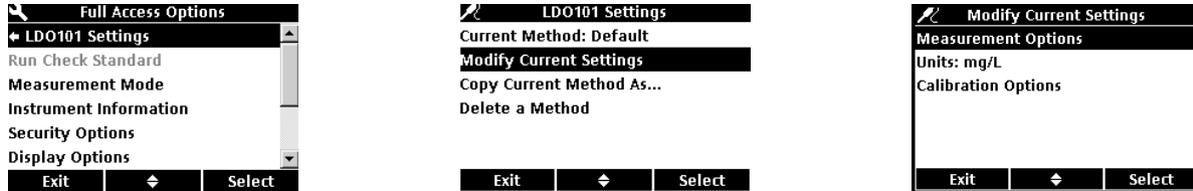
The settings that can be changed are shown in Table 1.

Table 1 Parameter-specific settings

Setting	Options	Description
Measurement Options	Resolution	Defines measurement resolution
	Measurement Limits	Upper and lower measurement limits
	Salinity Correction	Value for salinity correction
	Pressure Units	Atmospheric pressure units
	Averaging Interval	How often the meter calculates an average readings
Units	mg/L %	Primary unit of measurement
Calibration Options	Calibration	• User 100% • User 100% with 0 • User mg/L • User mg/L with 0 • Factory
	Calibration Reminder	Reminder Repeat—Off, 8 h, 12 h, 1 d, 2 d, 5 d or 7 d
		Expires—Immediately, Reminder + 30 m, Reminder + 1 h, Reminder + 2 h or Continue Reading

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.

There are three default methods available for the LDO101 probe:

• Factory Cal (Calibration with default LDO calibration)
• User Calibration—100% (allows user calibration)

- Default

1. Make sure a probe is connected to the meter.
2. Push ⚒ and select LDO101 Settings.
3. Select Modify Current Settings.
4. Select Units. Select mg/L (default) or %.
5. Select Measurement Options and update the settings:

Option	Description
Resolution	Sets the resolution: • 0.1—Fast (0.35 mg/L)/min • 0.01—Fast (0.35 mg/L)/min • 0.01—Medium (0.15 mg/L)/min (default), or • 0.01—Slow (0.05 mg/L)/min The resolution affects the number of decimal places and the stabilization time. Higher resolution measurements take more time to stabilize.
Measurement Limits	Set the measurement limits—Lower limit (default: 0.0 mg/L; 0%) or Upper limit (default: 20.0 mg/L; 200%). 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.
Salinity Correction	Sets the salinity correction—Off (default), Manual or Auto (connect conductivity probe). Salinity lowers the solubility of dissolved oxygen in water. To correct for salinity in the sample, set salinity correction to manual and then enter the salinity value. *Note: When the HQ40d meter is used, a conductivity probe can also be connected for automatic salinity measurement and correction. The parameter setting for the conductivity probe must show salinity.*
Salinity Value	Sets the salinity value—‰ (default: 35.0 ‰). When salinity correction is set to manual, sets the salinity value of the sample. Salinity can be measured with a conductivity probe.
Pressure Units	Sets the pressure units—hPa, mBar, inHg or mmHg. The meter shows the atmospheric pressure at the current elevation, which is necessary for accurate measurements. *Note: This pressure reading will not agree with readings from sources such as weather stations, which report atmospheric pressure at sea level.*
Averaging Interval	Sets the averaging interval—Off, 30, 60, 90 seconds, 3, 5 minutes. The averaging interval is useful for samples that contain a lot of air bubbles, for example in an aeration basin. The air bubbles cause the dissolved oxygen readings to vary greatly from one reading to the next. To make the readings more consistent, increase the averaging interval. The meter will take measurements at the same frequency but show only the average over a longer interval. *Note: Labels and options may vary depending on the units 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 calibration options

1. Make sure that a probe is connected to the meter.
2. Push 🔧 and select LDO101 Settings.
3. Select Modify Current Settings.
4. Select Calibration Options and update the settings:

Option	Description
Calibration	• User—100% (water-saturated air (100%) calibration) • User—100% with 0 (water-saturated air (100%) calibration with 0 point) • User—mg/L (calibration with a specified dissolved oxygen concentration (mg/L) solution) • User—mg/L with 0 (calibration with a specified dissolved oxygen concentration (mg/L) solution with 0 point) • Factory (calibration with the default LDO calibration)
Standard Value	When Calibration is set to mg/L or mg/L with 0, sets the concentration of the solution that will be used for calibration—2.00 to 20.00 mg/L (default=7.00 mg/L)

5. Select Calibration Reminder and update the settings:

Option	Description
Reminder Repeat	Meter will make an audible sound when calibration is due and repeat the sound at selected interval—Off, 8 h, 12 h, 1 d, 2 d, 5 d or 7 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 goes back to the measurement mode.

Maintenance

Clean the probe

Keep the probe cap free of deposits for the best measurements.

Note: Do not touch the black colored substrate of the probe cap. Do not use alcohol or other organic solvents to clean the black colored substrate of the probe cap. These solvents cause damage to the probe cap.

1. Remove the shroud (refer to Remove the shroud on page 9).
2. Gently clean the probe cap with a mild detergent, water and a soft cloth or cotton swab. Do not remove the black colored substrate from the probe cap. Do not scrub the probe cap or lens.
3. If water is present between the probe cap and lens:

   a. Remove the probe cap.
   b. Blot dry the probe cap and lens with a soft dry cloth.
   c. Install the probe cap.
4. Install the shroud (refer to Install the shroud on page 9).

Replace probe cap

The probe cap must be replaced every 365 days or more often if the cap becomes damaged or fouled. The meter will show a reminder message when 30 days of probe service life remains on the probe cap.

For LDO probe cap replacement instructions, refer to the instructions provided with the LDO probe cap replacement kit.

Remove the shroud

1. Loosen and remove the locking ring (Figure 3).
2. Slide the shroud and locking ring off the probe.

Figure 3 Probe exploded view
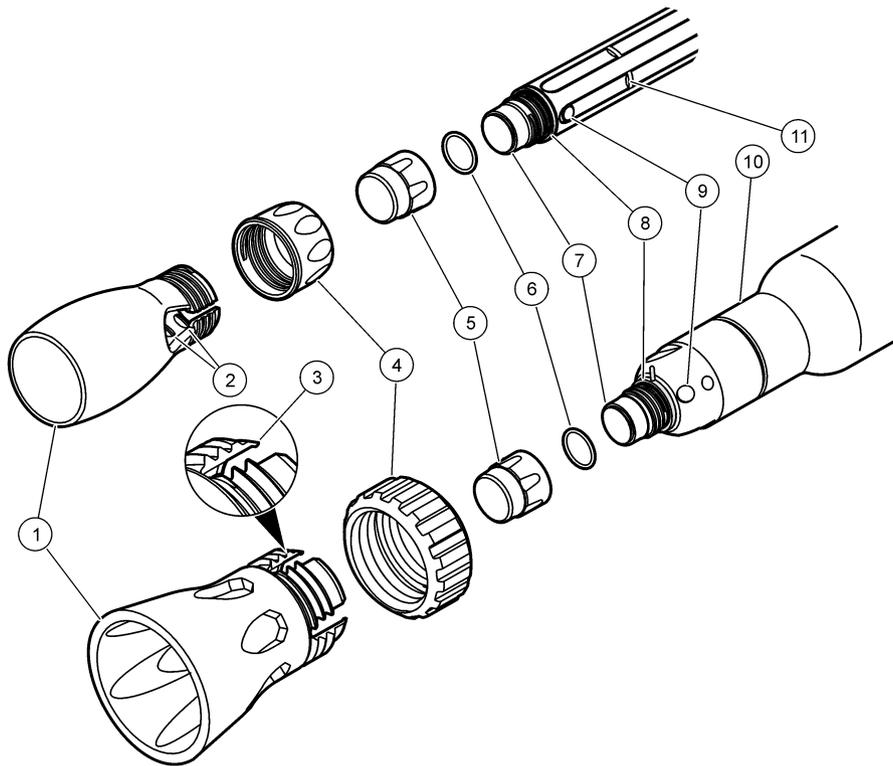
1	Shroud	7	Probe lens
2	Locking ridges (8x)	8	Cap seal
3	Locking rib	9	Temperature sensor
4	Locking ring	10	Locking groove
5	Probe cap	11	Locking ribs (4x)
6	O-ring		

Install the shroud

1. Put the locking ring on the probe with the threads toward the probe cap (Figure 3 on page 9).
2. Slide the shroud on the probe until it is against the locking groove (rugged) or ribs (standard). Slide the standard probe shroud on the standard probe until the inside locking ridges align halfway between the ribs on the probe. Turn the shroud slightly until it is seated.
3. Hand-tighten the locking ring on the shroud.

Storage

- Dry storage—the manufacturer recommends that the probe is stored dry when the probe is used for measurements of short duration (less than 6 hours).
- Wet storage—the probe must be stored wet when the probe is used for monitoring periods longer than 6 hours.

Dry storage

Note: Rugged probes may be stored dry with the shroud installed if the storage container is sufficiently large.

1. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
   Note: The probe must be conditioned again in tap water for at least 30 minutes prior to use.
2. If a rugged probe, remove the shroud (optional). Refer to Remove the shroud on page 9.

Wet storage

Note: The need for recalibration is minimized if the probe cap is kept wet.

1. Put the probe in tap water.
2. During the initial 72 hours in tap water, calibrate the probe once every 8 hours.
   Note: After 72 hours of storage in tap water, the probe cap will reach a fully hydrated state.

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.

Message or symptom	Possible cause	Action
Out of range	Probe cap loose, scratched or damaged	Reposition or replace the probe cap.
	Temperature and/or pressure sensor error	Make sure that the temperature and pressure sensors are both reading correctly.[1]
	Damaged probe	Make sure that the blue and red LEDs are both illuminated on the probe. If not, replace the probe or contact a Technical Support Representative.
	Sample outside of specifications	Make sure that the sample concentration, temperature and pressure are within the range of the probe.
	iButton number does not match probe cap lot number	Replace the iButton or probe cap or do a user calibration.
	Bubbles trapped under probe tip	Gently shake the probe until bubbles are removed.
Out of range	Probe cap exposed to direct sunlight	Install the protective shroud.
Slope out of range	Probe not prepared for sample	Let the probe reach equilibrium in a water-saturated air environment and do the calibration again.
	Calibration method settings	Make sure that the calibration standards in the method are correct.
	Probe cap loose, scratched or damaged	Locate and install the iButton that matches the probe cap and replace the probe cap.
	Temperature and pressure errors	Make sure that the temperature and pressure sensors are both reading accurately. Contact a Technical Support Representative.[1]
	LED lights do not function	Contact a Technical Support Representative.
	Bubbles trapped under probe tip	Gently shake the probe until bubbles are removed.
LDO–calibration not supported (factory calibration)	LDO method calibration option is set to Factory.	If user calibration is necessary, change the settings in Calibration Options. Refer to Change calibration options on page 8.
O2 Sensor 0 days remaining	There are 0 days remaining in the life of the probe cap	Replace the probe cap. Calibration will be allowed, however the calibration icon and question mark will be shown on the measurement screen even if the calibration has passed.
	Meter set to incorrect date and time	Disconnect the probe from the meter. Set the correct date and time in the Meter Options menu. Connect the probe and make sure that the message has been removed.
	Software not updated	Update the HQd software to the latest version and test again.
O2 Sensor ## of days remaining	There are 30 days or fewer remaining in the life of the probe cap.	Replace the probe cap soon.

Message or symptom	Possible cause	Action
Calibration failed: outside of acceptance criteria/Temperature out of range/Offset out of limits	Water Saturated air equilibration not reached	Allow longer equilibration time.
	Probe cap loose, scratched, or damaged	Change the location of the probe cap or replace the probe cap.
	Temperature and/or pressure sensor error	Make sure that the temperature and pressure sensors are both reading correctly and within range.[1]
	Damaged probe	Make sure that the blue and red LEDs are both illuminated on the probe. If not, replace the probe or contact a Technical Support Representative.

[1] The pressure as measured by the probe is what is referred to as atmospheric pressure and is not corrected to sea level. Weather station pressures are reported at sea level and commonly referred to as mean sea level pressure. As a result the probe will not read the same as most household or professional barometers or weather station reports (which are compensated) unless reported at sea level. In order to compare the pressure results obtained from the probe barometer and these compensated barometers, it is necessary to first compensate the pressure reported by the probes mathematically.

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