

## pH Refillable Probe for Low Ionic Strength Samples: Model PHC28101 or PHC28103

### 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

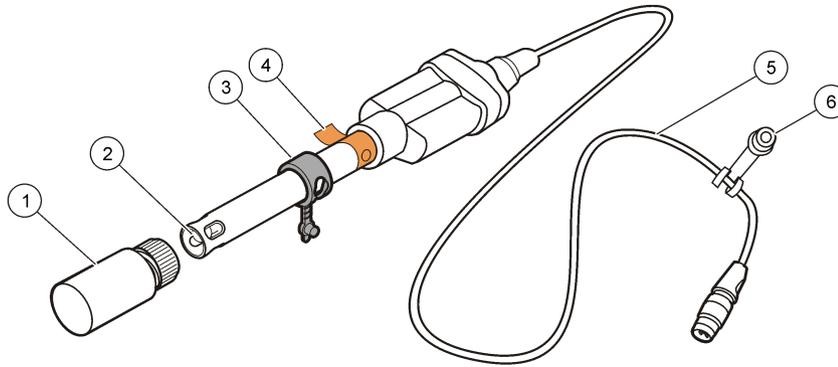
**Note:** Specifications are subject to change without notice.

Specifications	Details
Probe type	Digital combination probe with refillable double junction reference and built-in temperature sensor
pH range	pH 0 to 14
pH resolution	User-selectable stabilization time and resolution—Fast: 0.1, Fast: 0.01, Medium: 0.01, Slow: 0.01 or Slow: 0.001
Slope	-59 mV/pH (90 to 110% at 25 °C per Nernstian theoretical value)
Operating temperature range	0 to 50 °C (32 to 122 °F)
Storage temperature range	5 to 40 °C (41 to 104 °F)
Junction	Open
Reference type	Ag/AgCl
Minimum sample depth	15 mm (0.59 in.)
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 PHC281 series probe is a pH refillable probe made for difficult samples with a built-in temperature sensor (Figure 1). The PHC28101 or PHC28103 probe is available with a 1 or 3 m (3.28 or 9.84 ft) cable and is intended for laboratory use. The pH refillable probe has a high electrolyte flow rate and a large open junction ideal for difficult samples, such as Low Ionic Strength (LIS), Ultrapure, dirty samples and samples with high solids content. The probe is not suitable for use with organic solvents. A 59-mL bottle of 2.44 M KCl Electrode Filling Solution is included with the probe.

**Figure 1 Probe overview**



1 Probe soaker bottle	4 Protective tape and filling-hole
2 Glass bulb, reference junction and temperature sensor	5 1 or 3 meter (3.28 or 9.84 ft) cable
3 Filling-hole cap	6 Probe soaker bottle holder

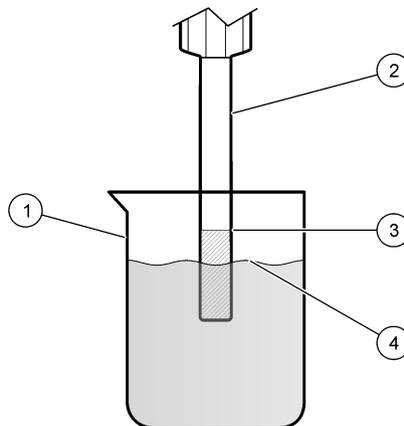
## Preparation for use

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 glass bulb 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 10). 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.

**Note:** For the best stabilization time, condition the probe for several minutes in the sample before use.

**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.

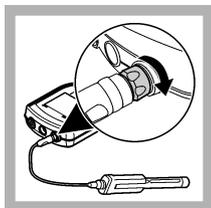
If any two probes are connected, push the **UP** or **DOWN** arrow to change to the single display mode in order to show the Calibrate option.

Prepare the probe for use (refer to [Preparation for use](#) on page 2).

## Calibration notes:

- pH buffers can be used in any order. Use buffers that are two pH units apart.
- Additional standard sets along with the minimum number of calibration points can be selected in the Calibration Options. For a two point calibration, it is recommended that two buffers be selected: one with a pH above and one with a pH below the expected sample pH. For a one point calibration, select the buffer nearest to the expected sample pH.
- 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 11.

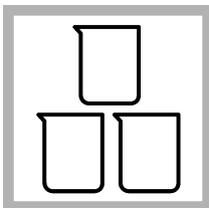
## Calibration procedure:



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



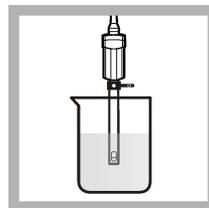
**2.** Push **Calibrate**. The display shows the buffers that are necessary for calibration.



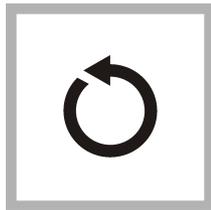
**3.** Prepare the fresh buffers in separate beakers or appropriate containers.



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



**5.** Put the probe in the pH buffer solution and stir gently. Make sure that the reference junctions are completely submerged. Shake the probe from side to side in the standard solution 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 standard. The display shows the buffer that has just been read and shows the temperature corrected pH value when the reading is stable.

**7. Repeat steps 4 - 6** until the minimum number of calibration points specified in the current method have been collected.

**8. Push **Done**** to view the calibration summary. The display will not show Done until the minimum number of calibration points have been collected.

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

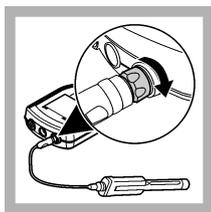
## Sample measurement

<b>Before measurement:</b>
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 <a href="#">Calibration</a> on page 3).
Prepare the probe for use (refer to <a href="#">Preparation for use</a> on page 2).

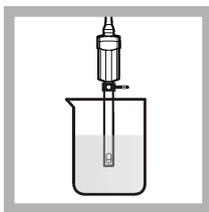
### Measurement notes:

- 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 11.

## Measurement procedure:



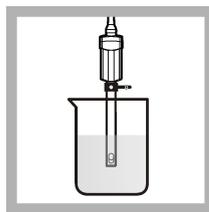
1. Connect the probe to the meter. Make sure that the cable locking nut is securely connected to the meter. Turn the meter on.



2. For the best stabilization time, condition the probe in the sample for at least 10 minutes before the initial sample measurement.



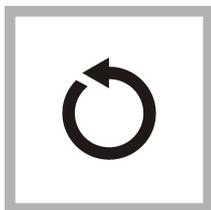
3. Rinse the probe with deionized water and then with the sample. Blot dry with a lint-free cloth.



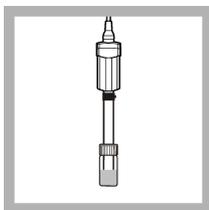
4. Put the probe in the sample and stir gently. Make sure that the reference junctions are completely submerged. Do not put the probe on the bottom or sides of the container. Shake the probe from side to side in the sample to refresh the reference junction.



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.



6. Repeat steps 2-4 for additional measurements.



7. When measurements are done, store the probe (refer to [Storage](#) on page 10).

## Run a 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 measurements of a traceable standard solution. Set the criteria for check standards from the PHC281 Settings menu.

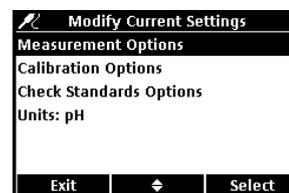
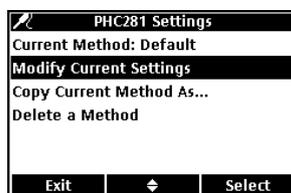
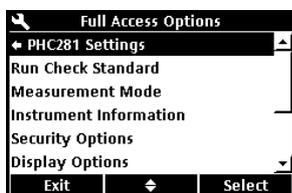
**Note:** Access control must be off or a valid password must be entered before any of the check standard method options can be changed.

1. Push . The Full Access Options menu is shown.
2. Select Run Check Standard.  
**Note:** Select the correct probe if two probes are connected to the meter.
3. Get the standard solution shown on the display.
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
5. Put the probe in the standard solution until the temperature sensor is completely submerged. Move the probe up or down or gently tap on the beaker to remove air bubbles from the probe.

6. Push **Read**. The display will show "Stabilizing" and a progress bar as the reading stabilizes. The display shows the value of the check standard and either Check Standard Passed or Check Standard Failed.
7. If the display shows **Check Standard Passed**, the check standard measurement is within the accepted limits set by the administrative user. Select **Done** to continue with the sample measurement.
8. If the display shows **Check Standard Failed**, the measurement is outside of accepted limits set by the administrative user and a recalibration is recommended. 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 recalibrated. 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 1](#).

**Table 1 Parameter-specific settings**

Setting	Options
Measurement Options	<ul style="list-style-type: none"> <li>• Resolution</li> <li>• Upper and lower range limits</li> </ul>
Calibration Options	<ul style="list-style-type: none"> <li>• Buffer set</li> <li>• Buffer set values (if Custom Buffer Set selected)</li> <li>• Reminder</li> <li>• Minimum Cal points</li> <li>• Slope limit</li> </ul>
Check Standard Options	<ul style="list-style-type: none"> <li>• Standard (temperature compensated buffer or custom at 25 °C)</li> <li>• Reminder</li> <li>• Acceptance criteria</li> <li>• Standard value at 25 °C (if custom standard selected)</li> </ul>
Units	<ul style="list-style-type: none"> <li>• pH</li> <li>• mV</li> </ul>

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## 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 PHC281 Settings.
3. Select Modify Current Settings.
4. Select Units. Select pH (default) or mV.  
**Note:** The mV option can be used to find the probe offset in a pH 7 buffer or to measure the slope. Both units are shown when the detail display mode is selected.
5. Select Measurement Options and update the settings:

Option	Description
<b>Resolution</b>	Sets the resolution: <ul style="list-style-type: none"><li>• 0.1pH—Fast</li><li>• 0.01pH—Fast (default)</li><li>• 0.01pH—Medium</li><li>• 0.01pH—Slow, or</li><li>• 0.001pH—Slow</li></ul> <p>The resolution affects the number of decimal places and the stabilization time. Higher resolution measurements take more time to stabilize. Slower stabilization times provide higher accuracy measurements.</p>
<b>Measurement Limits</b>	Set the measurement limits—Lower limit (default: 0.00 pH) or Upper limit (default: 14.00 pH). <p>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.</p>

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 a probe is connected to the meter.
2. Push  and select PHC281 Settings.
3. Select Modify Current Settings.

4. Select Calibration Options and update the settings:

Option	Description
<b>Buffer Set</b>	Sets the temperature compensated buffer set used for calibration— <ul style="list-style-type: none"><li>• Color Coded—4.01, 7.00, 10.01 (default)</li><li>• IUPAC—4.01, 7.00, 10.01, 12.45</li><li>• DIN—4.65, 9.23</li><li>• IUPAC—4.01, 6.86, 10.01, 12.45</li><li>• IUPAC—4.01, 6.86, 9.18, 12.45</li><li>• IUPAC—4.01, 7.00, 9.18, 12.45</li><li>• Custom Buffer Set (refer to <a href="#">Table 2</a>)</li></ul> Custom buffer sets are characterized at 25 °C (77 °F). Buffer set values are shown on the Calibration Options screen. <b>Note:</b> Only the minimum calibration points must be measured for <b>DONE</b> to be shown on the calibration screen.
<b>Buffer Set Values</b>	If the Buffer Set is set to Customer Buffer Set, sets the custom buffer set (refer to <a href="#">Table 2</a> ).
<b>Minimum Cal Points</b>	Sets the minimum number of calibration points necessary before a calibration can be completed—1 (default), 2 or 3.
<b>Slope Limit</b>	Sets the slope limit—1% to 10% (acceptable slope criteria, default = 5%). The slope must fall within set limits for successful calibration.

5. Select Calibration Reminder and update the settings:

Option	Description
<b>Reminder Repeat</b>	Meter will make an audible sound when a calibration is due and repeat the sound at the selected interval—Off (default), 2 h, 4 h, 8 h, 2 d, 5 d or 7 d.
<b>Expires</b>	Calibration expires after the selected time—Immediately, Reminder + 30 min, Reminder + 1 h, Reminder + 2 h or Continue Reading. <b>Note:</b> 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.

**Table 2 Custom buffer set**

Buffer set values	Option	Description
Std1	1.09pH—25 °C	Pre-set temperature compensated buffer values. <i>Note: Selected standards must differ by a minimum of 2 pH units. For example, if 1.09 pH is chosen for the first standard, the second standard must differ by at least 2 pH. Standards that do not meet this minimum will appear gray on the screen and will not be selectable.</i>
Std2	1.68pH—25 °C	
Std3	4.01pH—25 °C	
Std4	4.65pH—25 °C	
Std5	6.86pH—25 °C	
	7.00pH—25 °C	
	9.18pH—25 °C	
	9.23pH—25 °C	
	10.01pH—25 °C	
	12.45pH—25 °C	
	Custom Buffer	
	No Buffer	Standard is undefined when this option is selected.

### Change check standard options

1. Make sure a probe is connected to the meter.
2. Push  and select PHC281 Settings.
3. Select Modify Current Settings.
4. Select Check Standards Options and update the settings:

Option	Description
<b>Standard</b>	Sets the temperature compensated buffer value for check standard— <ul style="list-style-type: none"> <li>• 4.01pH—25 °C</li> <li>• 4.65pH—25 °C</li> <li>• 6.86pH—25 °C</li> <li>• 7.00pH—25 °C</li> <li>• 9.18pH—25 °C</li> <li>• 9.23pH—25 °C</li> <li>• 10.01pH—25 °C</li> <li>• 12.45pH—25 °C</li> <li>• Custom</li> </ul> <p>The standard value is shown on the Check Standard Options screen. No temperature compensation for custom buffers.</p>
<b>Standard Value</b>	When Standard is set to Custom, enter the standard value using the up/down arrow keys.

5. Select Check Standard Reminder and update the settings:

Option	Description
<b>Reminder Repeat</b>	Sets the time interval for the check standard reminder—Off, 30 minutes, 2 h, 4 h, 8 h, 12 h or 24 h.
<b>Allow Defer</b>	Allows the postponement of check standard reminders—Yes or No.

6. Select Acceptance Criteria and update the settings:

Option	Description
<b>Acceptance Limits</b>	Sets the tolerance limits for check standard—0.005pH (default) to 1.000pH.
<b>Cal Expires on Failure</b>	Recalibration required if check standard fails—Yes or No.

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 occur as a result of contamination on the glass sensor or the probe being left dry for extended periods of time.
- Slow stabilization time occurs as a result of contamination on the glass sensor.
- A calibration error occurs as a result of contamination on the glass sensor.

#### For general contaminants:

1. Rinse the probe with deionized water and blot dry with a lint-free cloth.
2. Soak the glass bulb for 12 to 16 hours in Hach Electrode Cleaning Solution.
3. Rinse or soak the probe for 1 minute in deionized water.
4. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with deionized water.
5. Blot dry with a lint-free cloth.

#### For fats, grease and oils:

1. Soak the glass bulb in a warm detergent solution for up to 2 hours.
2. Rinse or soak the probe for 1 minute in deionized water.
3. Soak the probe in pH 4 buffer for up to 20 minutes, then rinse with deionized water.
4. Blot dry with a lint-free cloth.

### Fill the probe

To add filling solution to the probe:

1. If the filling hole is closed, remove the filling-hole cap from the filling hole (refer to [Figure 1](#) on page 2).
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 fill the probe completely.  
*Note: Fill the probe completely for the best performance.*
5. If the probe will not be used immediately, store the probe (refer to [Storage](#) on page 10).
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. Dry thoroughly and assemble.*

### 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 2.44 M KCl Electrode Filling 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 glass bulb and reference junction holes.

If the glass bulb becomes dry:

1. Soak the probe tip in the 4.01, 7.00 and 10.01 buffers each for 5 minutes.
2. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
3. Calibrate the probe.

## 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 <sup>®</sup> probe	Contact a Technical Support Representative.
Connect a probe or probe requires service	Probe not connected properly	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 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.
pH reading and/or mV reading is same for all solutions	Soaker bottle not removed	Remove the soaker bottle.
	Electrical issue	Contact a Technical Support Representative.
Standard not recognized error	Soaker bottle not removed	Remove the soaker bottle.
	Incorrect or contaminated buffer solution	Use fresh buffer solution as specified in the method.
	Contaminated filling solution	Drain and replace the filling solution with fresh solution.

Message or symptom	Possible cause	Action
Slow stabilization time	Tape not removed from the filling-hole	Remove the tape that is over the filling hole.
	Contaminated glass sensor	Clean the probe (refer to <a href="#">Clean the probe</a> on page 10).
	Contaminated filling solution	Drain and replace the filling solution with fresh solution.
	Filling hole closed	Open the filling hole while in use by removing the filling-hole cap from the filling hole.
	Poor contact between reference junction and solution	Shake the probe in the solution from side to side to refresh the reference junction.
	Probe not prepared for LIS sample	For the best stabilization time, soak the probe in the sample for 1 to 3 minutes before the initial measurement.
	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 stabilization time will be.
	Air bubbles around inner reference electrode	Gently tap the probe with hand or shake the probe downward to remove any air bubbles.
Calibration errors	Calibration not done correctly	Recalibrate using freshly prepared pH buffers.
	Contaminated glass sensor	Clean the probe (refer to <a href="#">Clean the probe</a> on page 10).
	Slope exceeds the criteria for % of theoretical (as defined in the method slope limit)	<ol style="list-style-type: none"> <li>1. Widen the slope limits by changing the PHC281 calibration settings and method.</li> <li>2. Recalibrate the probe.</li> <li>3. Run a check standard to check the performance of the probe.</li> </ol>
Drifting/Inaccurate readings	Contaminated glass bulb	Clean the probe (refer to <a href="#">Clean the probe</a> on page 10).
	CO <sub>2</sub> absorption (for low ionic strength or high purity sample)	Use the LIS chamber for LIS/high purity samples to prevent sample contamination.
	Clogged reference	Rinse the reference junction holes with deionized water and then gently tap the probe with hand or shake the probe to remove any air bubbles.
	Improper storage conditions/ Dehydrated glass bulb	<p>Clean or condition the probe and do recalibration. The probe may not operate correctly if the probe has been left dry for a long time. Condition the glass sensor and reference junctions again:</p> <ol style="list-style-type: none"> <li>1. Soak the probe tip in the 4.01, 7.00 and 10.01 buffers each for 5 minutes.</li> <li>2. Rinse with deionized water. Blot dry with a lint-free cloth.</li> <li>3. Calibrate the probe.</li> </ol>
	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 (spot checking), make sure that the equipment is grounded.
	Colloidal and/or particulates in the filling solution.	Replace the filling solution, calibrate and test again.
	Air bubbles around inner reference electrode	Gently tap the probe with hand or shake the probe downward to remove any air bubbles.
Out of range	Measurement value is outside of range	Make sure that the sample is within the range of the probe.

Message or symptom	Possible cause	Action
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 another 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.
Temperature out of range	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 the 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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