



DOC022.53.80316

sympHony™ pH Probes

07/2012, Edition 1

User Manual

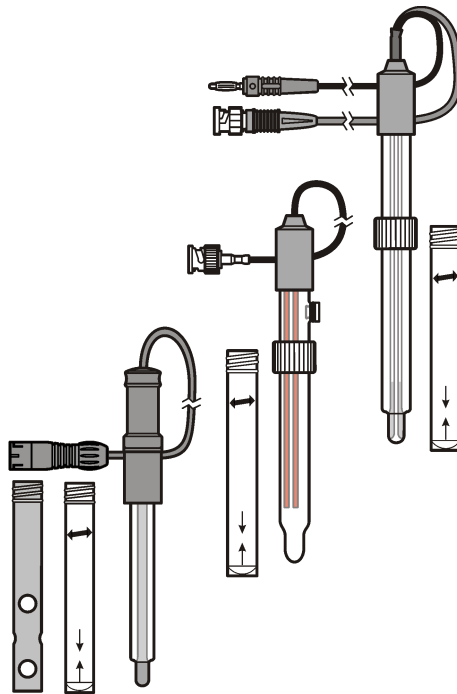


Table of contents

[Safety information](#) on page 3

[Specifications](#) on page 3

[Product overview](#) on page 5

[Meter compatibility](#) on page 6

[Preparation for use](#) on page 6

[Calibration](#) on page 8

[Sample requirements](#) on page 10

[Sample measurement](#) on page 10


[Maintenance](#) on page 11

[Troubleshooting](#) on page 14

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.

	<p>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.</p> <p>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.</p>
--	---

Specifications

Specifications are subject to change without notice.

Table 1 Combination pH probes

Specification	89231-572	89231-574	89231-576	89231-578	89231-584
pH range	0 to 14 pH	0 to 14 pH	0 to 14 pH	0 to 14 pH	0 to 14 pH
Temperature range	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)
Temperature sensor	No	No	No	No	No
Reference type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Junction type	Porous pin	Porous pin	Porous pin	Porous pin	Wick
Electrolyte	Refillable	Refillable	Non-refillable gel	Non-refillable gel	Non-refillable gel
Filling solution	3M KCl with saturated AgCl	3M KCl with saturated AgCl	—	—	—
Sensor	Standard	Semi-micro diameter	Semi-micro diameter	Semi-micro diameter	Flat surface
Body material	Epoxy	Glass	Epoxy	Epoxy	Epoxy
Length	103 mm	150 mm	150 mm	305 mm	120 mm
Diameter	12 mm	6.5 mm	6.5 mm	8 mm	12 mm
Cable	1 m	1 m	1 m	1 m	1 m
Connector	BNC	BNC	BNC	BNC	BNC

Specification	89231-588	89231-590	89231-592	89231-604	89231-606
pH range	0 to 14 pH	0 to 14 pH	0 to 14 pH	0 to 14 pH	0 to 14 pH
Temperature range	0 to 100 °C (32 to 212 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)
Temperature sensor	No	No	No	No	No
Reference type	Ag/AgCl	Double-junction Ag/AgCl	Double-junction Ag/AgCl	Ag/AgCl	Double-junction Ag/AgCl
Junction type	High-flow	Porous pin	Porous pin	Porous pin	Porous pin
Electrolyte	Refillable	Refillable	Refillable	Non-refillable gel	Non-refillable gel
Filling solution	3M KCl	3M KCl	3M KCl	—	—
Sensor	Standard	Micro diameter	Semi-micro diameter	Standard	Standard
Body material	Epoxy	Epoxy	Glass	Epoxy	Epoxy
Length	120 mm	155 mm	155 mm	103 mm	103 mm
Diameter	12 mm	4.75 mm	6.5 mm	12 mm	12 mm
Cable	1 m	1 m	1 m	1 m	1 m
Connector	BNC	BNC	BNC	BNC	BNC

Table 2 Combination pH probes with temperature sensor

Specification	89231-594	89231-596	89231-598	89231-600
pH range	2 to 14 pH	0 to 14 pH	0 to 14 pH	0 to 14 pH
Temperature range	0 to 80 °C (32 to 176 °F)	−10 to 100 °C (14 to 212 °F)	0 to 60 °C (32 to 140 °F)	0 to 80 °C (32 to 176 °F)
Temperature sensor	Yes	Yes	Yes	Yes
Reference type	Ag/AgCl (with sleeve)	Ag/AgCl (cartridge with Ag+ barrier)	Ag/AgCl (cartridge with Ag+ barrier)	Ag/AgCl
Junction type	Open	Porous pin (2x)	Sleeve	Porous pin
Electrolyte	Non-refillable gel	Refillable	Refillable	Non-refillable gel
Filling solution	—	3M KCl	3M KCl	—
Sensor	Standard	Standard	Standard	Standard
Body material	Glass	Glass	Glass	Epoxy
Length	120 mm	120 mm	120 mm	103 mm
Diameter	12 mm	12 mm	12 mm	12 mm
Cable	1 m	1 m	1 m	1 m
Connector	BNC and banana	BNC and banana	BNC and banana	BNC and telephonic

Specification	89231-602	89231-608	89231-610	89231-612
pH range	0 to 14 pH	0 to 14 pH	2 to 14 pH	0 to 14 pH
Temperature range	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 80 °C (32 to 176 °F)	0 to 100 °C (32 to 212 °F)
Temperature sensor	Yes	Yes	Yes	Yes
Reference type	Double-junction Ag/AgCl	Ag/AgCl	Ag/AgCl (with sleeve)	Ag/AgCl (with sleeve)
Junction type	Porous pin	Porous pin	Open	Annular porous ring
Electrolyte	Non-refillable gel	Non-refillable gel	Non-refillable solid polymer	Non-refillable gel
Sensor	Standard	Standard	Standard	Standard
Body material	Epoxy	PC	Glass (with protective shroud)	Glass (with protective shroud)
Length	103 mm	170 mm	170 mm	170 mm
Diameter	12 mm	12 mm	12 mm	12 mm
Cable	1 m	1 m	1 m	1 m
Connector	BNC and telephonic	MP5 ¹	MP5 ¹	MP5 ¹

¹ For use with sympHony handheld meters only

Table 3 Red Rod combination pH probes

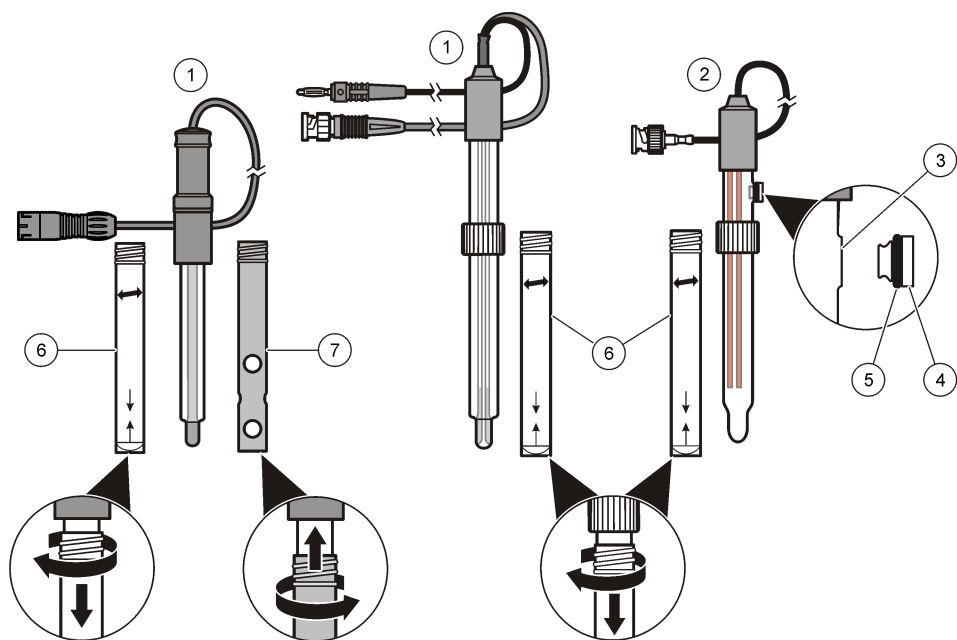
Specification	89231-580	89231-582	89231-586
pH range	0 to 14 pH	0 to 14 pH	0 to 14 pH
Temperature range	–10 to 100 °C (14 to 212 °F)	–10 to 100 °C (14 to 212 °F)	–10 to 100 °C (14 to 212 °F)
Temperature sensor	No	No	No
Reference type	Red Rod	Red Rod	Red Rod
Junction type	Porous pin	Porous pin	Sleeve
Electrolyte	Refillable	Refillable	Refillable
Filling solution	Saturated KCl	Saturated KCl	Saturated KCl
Sensor	Standard	Thicker (rugged) bulb	Standard
Body material	Glass	Glass	Glass
Length	103 mm	103 mm	103 mm
Diameter	12 mm	12 mm	12 mm
Cable	1 m	1 m	1 m
Connector	BNC	BNC	BNC

Product overview

The pH probes measure pH in general aqueous samples. Refer to [Figure 1](#). Refer to [Sample requirements](#) on page 10. A bottle of filling solution is supplied with refillable pH probes.

These pH probes are used with sympHony meters. Refer to [Meter compatibility](#) on page 6.

Figure 1 Probe overview



1 Non-refillable probe	5 O-ring
2 Refillable probe	6 Probe storage tube
3 Filling hole	7 Protective shroud ¹
4 Filling hole plug	

¹ 89231-610 and 89231-612 only

Meter compatibility

The pH probes with BNC or BNC and banana/telephonic connectors are compatible with the symphony benchtop meter model(s): B10P, B20PI, B30PCI and B40PCID.

The pH probes with MP5 connectors are compatible with the symphony handheld meter model(s): H10P, H30PCO and H30PCD.

Preparation for use

CAUTION

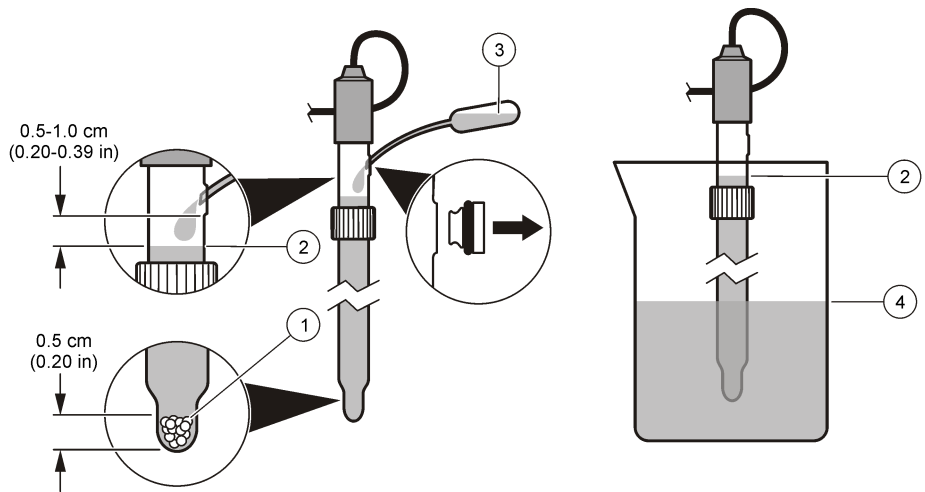
Personal injury hazard. Broken glass can cause cuts. Use tools and personal protective equipment to remove broken glass.

To prepare the probe for sample measurement:

1. Turn the probe storage tube and remove it from the probe. Keep the probe storage tube.
2. Rinse the reference junction(s) and glass bulb thoroughly with deionized water to fully remove the storage solution or any KCl salt buildup. Blot dry with a lint-free cloth.
3. For refillable probes, remove the filling hole plug (or sleeve cover from the filling hole on the 89231-588) and keep it for storage. The filling hole must be open when the probe is in use.

4. For refillable probes, add the applicable filling solution to the probe until the filling solution is above the standard solution or sample level when in use (approximately 0.5–1.0 cm below the filling hole). Refer to [Figure 2](#). Refer to [Fill the probe](#) on page 13.
5. For Red Rod probes, make sure that there is approximately 0.5 cm (0.2 in.) of KCl crystals in the filling solution in the probe. Refer to [Figure 2](#). For measurements at temperatures higher than 60 °C (140 °F), add KCl crystals through the filling hole. Refer to [Table 4](#) to calculate the amount of KCl crystals to add. The amount of KCl crystal necessary increases linearly from 60 to 100 °C.
6. For Red Rod probes, make sure that the KCl crystals move freely through the liquid when the probe is inverted. If necessary, shake the probe to loosen the crystals.
7. For the 89231-588 probe, before initial use, remove the paper strip from the outer reference junction. Push down on the cap to open the junction, then remove the paper strip and discard. Release the cap to close the junction.
8. For probes supplied with a protective shroud, put the probe in the protective shroud and turn to tighten.
9. Shake the probe downwards (like a thermometer) to remove any air bubbles in the bulb or between the KCl crystals. Air bubbles can cause slow responses or errors in measurement.
10. For the 89231-588 probe, rinse the reference junction with filling solution. To rinse the junction, push and release the cap multiple times until filling solution visibly flows from the junction. If necessary, add more filling solution so that it is at the recommended level. Refer to [step 4](#).
11. Before initial use, soak the probe bulb in pH 4.01 or pH 7.00 buffer for several minutes.
12. For a faster response, condition the probe for several minutes in the sample or in a solution comparable to the sample in terms of pH and ionic strength.

Figure 2 Filling solution level for refillable probes



1 KCl crystals ¹	3 Filling solution
2 Filling solution level	4 Standard solution or sample level

¹ Red Rod probes only

Table 4 KCl crystal level for Red Rod pH probes

Temperature	Amount of KCl crystals	Add	Temperature	Amount of KCl crystals	Add
60 °C (158 °F)	0.5 g (0.5 cm)	0 g	90 °C (194 °F)	0.875 g	0.375 g
70 °C (158 °F)	0.625 g	0.125 g	100 °C (212 °F)	1.0 g (1.0 cm)	0.5 g
80 °C (176 °F)	0.750 g	0.25 g			

Calibration

Before calibration:

Prepare the probe for use. Refer to [Preparation for use](#) on page 6.

Prepare the meter. Refer to the meter manual.

Calibration notes

- Prepare fresh buffers for the calibration.
- The calibration and sample measurement conditions must be as similar as possible (e.g., the temperature of the solution, stir procedure, stir rate and position of the probe).
- When the probe is submerged, make sure that there are no air bubbles under the probe tip. Gently shake the probe from side to side to remove any air bubbles.
- Make sure that the reference junction is fully in the solution.
- Do not put the probe on the bottom or sides of the container.
- If stabilization is slow, shake the probe from side to side in the solution to refresh the reference junction.
- If a calibration error occurs, refer to [Troubleshooting](#) on page 14.

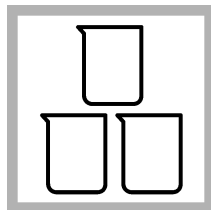
Calibration procedure



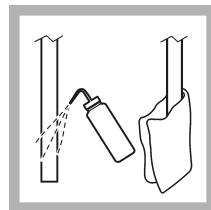
1. Connect the probe to the meter. Turn the meter on.



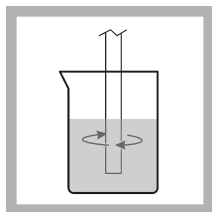
2. Push **Calibrate** and select the probe if applicable.



3. Prepare the buffers in separate beakers or applicable containers.



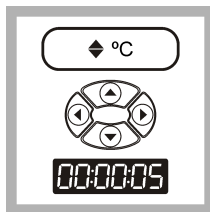
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



5. Put the probe in the buffer. Stir the buffer gently at a constant rate to prevent the formation of a vortex.



6. Push **Read**. Stir gently. The display shows "Stable" when the reading is stable.



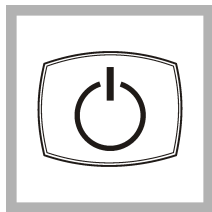
7. If the probe does not have a temperature sensor and a temperature probe is not used, push **°C** during the measurement. Use the arrow keys to enter the buffer temperature. The new value is set in 5 seconds.



8. When the reading is stable, the meter prompts for the next calibration point. Do steps 4–6 again for additional buffers. The calibration is complete when the last buffer is read.

Calibration to a specific value

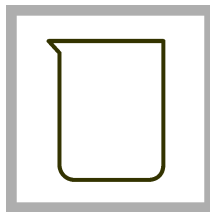
When TO A SPECIFIC VALUE is selected as the type of calibration, the probe is calibrated with a single buffer. Select the buffer nearest to the expected sample value.



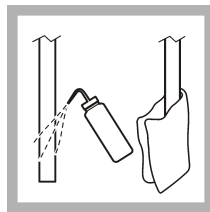
1. Connect the probe to the meter. Turn the meter on.



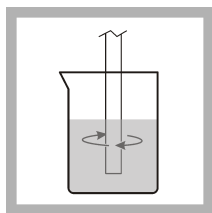
2. Push **Calibrate** and select the probe if applicable.



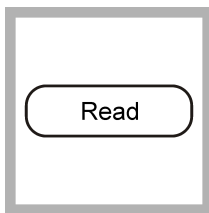
3. Prepare the buffer in a beaker or an applicable container.



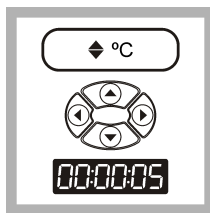
4. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



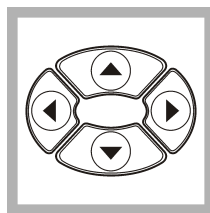
5. Put the probe in the buffer. Stir the buffer gently at a constant rate to prevent the formation of a vortex.



6. Push **Read**. Stir gently. The display shows "Stable" when the reading is stable.



7. If the probe does not have a temperature sensor and a temperature probe is not used, push **°C** during the measurement. Use the arrow keys to enter the buffer temperature. The new value is set in 5 seconds.




8. When the reading is stable, use the arrow keys to enter the buffer value, then push **OK**.

Sample requirements

Some probes are not compatible with specific sample types. Probe damage can occur.

- Do not use epoxy body probes in samples that contain non-aqueous solutions or organic solvents.
- Samples should be aqueous. Measurements may be made in partially aqueous or some water-miscible solvents. The results must be interpreted with caution as the full pH scale is shifted when the solvent system changes.
- Probes with an Ag/AgCl reference system and a single junction are not compatible with solutions that contain silver complexing or binding agents such as TRIS, proteins and sulfides. To measure in these solutions, use a double junction probe, probe with an Ag⁺ (silver ion) barrier or a Red Rod probe. Red Rod probes are compatible with these types of samples as they have an encapsulated reference system.
- Proteins can collect on the sensing bulb. Make sure the probe stays clean when these types of samples are measured.
- Do not use probes in solutions that are outside the temperature range of the probe.

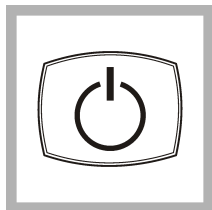
Sample measurement

⚠ WARNING	
	Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current material safety data sheets (MSDS) for safety protocols.
Before measurement:	
Prepare the probe for use. Refer to Preparation for use on page 6.	
Calibrate the probe. Refer to Calibration on page 8. The manufacturer recommends that the probe is calibrated at least once a day for the best measurement accuracy.	

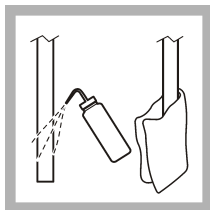
Measurement notes

- When the probe is submerged, make sure that there are no air bubbles under the probe tip. Gently shake the probe from side to side to remove any air bubbles.
- Make sure that the reference junction is fully in the solution.
- Do not put the probe on the bottom or sides of the container.
- If stabilization is slow, shake the probe from side to side in the solution to refresh the reference junction.
- Flat surface probes (e.g., 89231-584) can be used on any moist surface or in liquids.
- For the 89231-588 probe, rinse the reference junction with filling solution between measurements. To rinse the junction, push and release the cap multiple times until filling solution visibly flows from the junction. If necessary, add more filling solution so that it is at the recommended level. Refer to step 4 of [Preparation for use](#) on page 6.
- Do not use probes in areas where EMF is present (i.e., voltaic cells, thermoelectric devices, electrical generators, resistors and transformers). For use in process units (i.e., spot checking), make sure that the meter is grounded.
- For low ionic strength (LIS) or high purity samples, use an LIS chamber or flow cell to prevent sample contamination.
- If a measurement error occurs, refer to [Troubleshooting](#) on page 14.

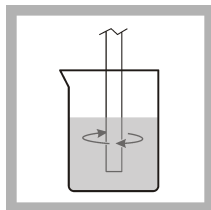
Measurement procedure



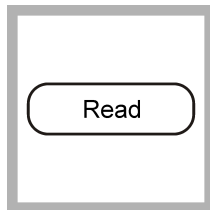
1. Connect the probe to the meter. Turn the meter on.



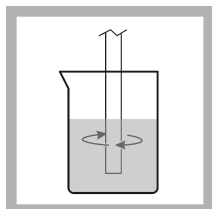
2. Rinse the probe with deionized water. Blot dry with a lint-free cloth.



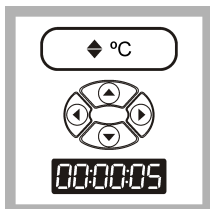
3. Put the probe in the sample and stir gently at a constant rate to prevent the formation of a vortex.



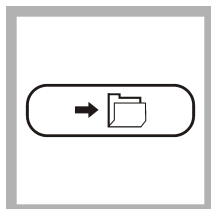
4. Push **Read**. Select the channel for the parameter to be measured if applicable.



5. Stir gently. The display shows "Stable" when the reading is stable.

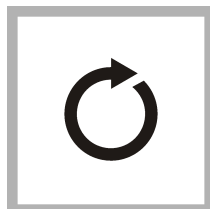


6. If the probe does not have a temperature sensor and a temperature probe is not used, push **°C** during the measurement. Use the arrow keys to enter the buffer temperature. The new value is set in 5 seconds.

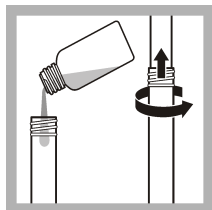


7. If the folder icon is shown, push the folder icon to save the data.

Note: Data is automatically saved if the folder icon is not shown.



8. Do steps 2–7 again for additional measurements.



9. When measurements are done, prepare the probe for storage. Refer to [Storage](#) on page 13.

Maintenance

Clean the probe

Clean the probe when there is contamination on the sensor. Symptoms of contamination are:

- Readings are not accurate or consistent.

- The stabilization time is slow.
 - A calibration error occurs.
 - Contamination is visible on the probe (i.e., dirt).
1. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
 2. Soak the glass bulb of the probe in the appropriate cleaning agent. Refer to [Table 5](#).
Note: Remove KCl salt buildup from the probe with warm deionized water.
 3. Rinse or soak the probe for 1 minute in deionized water.
 4. Soak the probe in pH 4 buffer for 20 minutes.
 5. Rinse the probe with deionized water.
 6. Blot dry with a lint-free cloth.

Table 5 Cleaning agent

Contaminant	Cleaning agent	Soak time
General contaminants	Electrode cleaning solution	12–16 hours
Mineral deposits	0.1 N HCl solution	10–15 minutes
Fats, grease and oils	Warm, mild detergent solution	2 hours (maximum)
Protein deposits	Pepsin cleaning solution	3 hours (maximum)
Inorganic buildup	EDTA solution	3 hours (maximum)

Clean the interior of the probe

For the 89231-588 probe only, if the reference junction becomes clogged, fully clean and rinse the interior of the probe.

1. Disassemble the probe:
 - a. Turn the black plastic cap and remove it from the top of the probe.
 - b. Remove and keep the black retaining ring.
 - c. Turn the cap body and slide the spring and cap body backward from the main body assembly.
2. Gently push the internal element out of the probe body and 2.5 cm (1 in.) to expose the annular reference junction. The internal element is made of glass and is fragile.
3. Fully rinse the open reference junction with deionized water. If a more vigorous rinse is necessary, hold the probe under warm tap water.
4. To remove fats, grease, oils or other organic contaminants from the tapered junction, use a mild detergent solution. Do not use solvents to clean the probe. Rinse with deionized water or distilled water.
5. Hold the probe and gently pull on the cable to move the internal element back in the probe.
6. Assemble the probe:
 - a. Slide the spring and cap body back on the main body assembly.
Turn the cap body to tighten.
 - b. Install the black retaining ring. Make sure that the cable is in the groove.
 - c. Install the black plastic cap on top of the probe, then turn to tighten.

Replace the filling solution

Replace the filling solution and KCl crystals (if applicable) when either occurs:

- The filling solution becomes contaminated.

- The KCl crystals in a Red Rod probe no longer move freely through the liquid when the probe is inverted.
1. Use a syringe or small pipette to remove as much filling solution from the probe as possible.
 2. For Red Rod probes, if KCl crystals are still in the probe:
 - a. Fill the probe half full with the filling solution.
 - b. With a finger over the filling hole, shake the probe until the crystals become loose.
 - c. If the crystals will not loosen, fill the probe with filling solution. Put the probe into a warm water bath for approximately 10 minutes (up to 60 °C (140 °F)).
 - d. Do step 1 again.
 3. For Red Rod probes, add approximately 0.5 cm (0.2 in.) of KCl crystals to the probe through the filling hole. For measurements at temperatures more than 60 °C (140 °F), more crystals are necessary. Refer to [Preparation for use](#) on page 6.
 4. Fill the probe. Refer to [Fill the probe](#) on page 13.

Fill the probe

Add filling solution to the refillable probe when the filling solution level is low or is replaced. Refer to [Specifications](#) on page 3 for the applicable filling solution.

1. Remove the filling hole plug from the filling hole.
2. Remove the cap from the tip of the filling solution bottle.

***Note:** If the tip of the filling solution bottle becomes clogged, remove the tip and soak it in warm water. Dry the tip fully.*
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 until the filling solution level is approximately 0.5–1.0 cm below the filling hole.
5. If the probe will not be used immediately, put the probe in storage. Refer to [Storage](#) on page 13.
6. Install the cap on the filling solution bottle.

Storage

For the best performance, do not let the reference junction become dry. The probe can be kept in a sample for a maximum of 2 hours if the sample pH is not too high.

1. For refillable probes, put the filling hole plug in the filling hole.
2. For probes with a protective shroud, turn the protective shroud to remove it from the probe. Save the protective shroud.
3. Rinse the probe with deionized water. Blot dry with a lint-free cloth.
4. For refillable probes, put filling solution in the probe storage tube. Refer to [Specifications](#) on page 3 for the applicable filling solution.
5. For non-refillable probes, put storage solution in the probe storage tube.
6. Put the probe in the storage tube and turn to tighten.
7. Make sure that the glass bulb and reference junction(s) of the probe is fully in the solution in the storage tube.

Rehydrate the probe

If the glass bulb becomes dry, rehydrate the probe. A dry bulb will not operate correctly.

1. Soak the probe bulb in 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. Refer to [Calibration](#) on page 8.

Troubleshooting

For the best performance, make sure to:

- Prepare the probe for use before calibration or measurement.
- Obey the calibration and measurement notes.
- Obey the calibration and measurement procedures.

Troubleshooting notes:

- Magnetic stirrers may supply sufficient heat to change solution temperature. Put a piece of insulating material between the stirrer and beaker.
- Protect the sensing element from direct light during measurement.

Refer to [Table 6](#) for calibration warnings and errors. Refer to [Table 7](#) for measurement warnings and errors.

Table 6 Calibration warnings and errors

Error/Warning	Solution
Calibration out of range	The slope is out of range. Calibrate the probe. Refer to Calibration on page 8. Connect a new probe.
Standard or electrode in poor condition	Calibrate the probe. Refer to Calibration on page 8. Examine the probe. Refer to Examine the probe on page 15.
Outside slope limits	Examine the buffer solution. Make sure that the buffer used is the buffer selected in the calibration setup. Identify the temperature specification in the calibration setup. Use a new buffer.
Standard not recognized	
Unstable reading Time $t > 120$ s	Calibrate the probe. Refer to Calibration on page 8. Examine the probe. Refer to Examine the probe on page 15. Make sure that the probe is correctly immersed in the sample.
Electrode in poor condition	Examine the probe. Refer to Examine the probe on page 15.
Check the electrode	
SAME BUFFERS	Calibrate the probe. Refer to Calibration on page 8. Examine the probe. Refer to Examine the probe on page 15. Examine the buffer. Use a new buffer.

Table 7 Measurement warnings and errors

Error/Warning	Solution
pH 12.78 19°C	Calibrate the probe. Refer to Calibration on page 8.
Measurement out of range ("_____")	Examine the probe. Refer to Examine the probe on page 15.
Unstable reading	Examine the probe. Refer to Examine the probe on page 15. Make sure that the probe is correctly immersed in the sample.
The temperature is out of °C range.	Examine the temperature sensor. Connect a different probe to identify if the problem is with the probe or the meter.
Time > 120 s	Make sure that the probe is correctly immersed in the sample. Measure the sample temperature. Examine the probe. Refer to Examine the probe on page 15.
Time > 240 s	
Time > 300 s	

Examine the probe

Note: *The lower the sample temperature or the larger the temperature difference between the samples, the longer the stabilization time will be.*

1. Clean the probe.
2. For refillable probes, if the filling solution is contaminated, drain and replace the filling solution with fresh filling solution.
3. Rinse the reference junction diaphragm with deionized water. Then, shake the probe downwards (like a thermometer) to remove any air bubbles in the bulb or between the KCl crystals (Red Rod probes).
4. Turn off the meter. Disconnect and then connect the probe again.
5. Connect a different probe to identify if the problem is with the probe or the meter.



vwr.com 1.800.932.5000

Prices, product appearance and specifications are current at the time of printing, subject to change without notice. Availability for certain products may be limited by federal, state, provincial or local licensing requirements. All prices are in U.S. dollars unless otherwise noted. Offers valid in USA, void where prohibited by law or company policy, while supplies last. Visit vwr.com to view our policy and additional disclaimers.

VWR, forms of VWR and the VWR logo and/or design are either registered trademarks, trademarks, or service marks of VWR International, Inc. in the United States and/or other countries. All other marks referenced herein are registered marks of their respective owner(s). For a complete list of trademarks owners, please visit vwr.com.

© VWR, 2012.

All rights reserved. Printed in U.S.A.