



# Platinum Series Flat pH Electrode

Model 51915-00

## TRADEMARKS OF HACH COMPANY

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AccuVac®	H <sub>2</sub> OU™	PourRite®
AccuVer™	Hach Logo®	PrepTab™
AccuVial™	Hach One®	ProNetic™
Add-A-Test™	Hach Oval®	Pump Colorimeter™
AgriTrak™	Hach.com™	QuanTab®
AluVer®	HachLink™	Rapid Liquid™
AmVer™	Hawkeye The Hach Guy™	RapidSilver™
APA 6000™	HexaVer®	Ratio™
AquaChek™	HgEx™	RoVer®
AquaTrend®	HydraVer®	<i>sensio</i> ™
BariVer®	ICE-PIC™	Simply Accurate <sup>SM</sup>
BODTrak™	IncuTrol®	SINGLET™
BoroTrace™	Just Add Water™	SofChek™
BoroVer®	LeadTrak®	SoilSYS™
C. Moore Green™	M-ColiBlue24®	SP 510™
CA 610™	ManVer®	SpecV™
CalVer®	MolyVer®	StabiCal®
ChromaVer®	Mug-O-Meter®	StannaVer®
ColorQuik®	NetSketcher™	SteriChek™
CoolTrak®	NitraVer®	StillVer®
CuVer®	NitriVer®	SulfaVer®
CyaniVer®	NTrak®	Surface Scatter®
Digesdah®	OASIS™	TanniVer®
DithiVer®	On Site Analysis. Results You Can Trust <sup>SM</sup>	TenSette®
Dr. F. Fluent™	OptiQuant™	Test 'N Tube™
Dr. H. Tueau™	OriFlow™	TestYES! <sup>SM</sup>
DR/Check™	OxyVer™	TitraStir®
EC 310™	PathoScreen™	TitraVer®
FerroMo®	PbEx®	ToxTrak™
FerroVer®	PermaChem®	UniVer®
FerroZine®	PhosVer®	VIScreen™
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Formula 2533™	Pocket Pal™	WasteAway™
Formula 2589™	Pocket Turbidimeter™	ZincoVer®
Gelex®		

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## SPECIFICATIONS

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**pH Range:**  
0–13 pH units

**Isopotential Point:**  
7.0  $\pm$ 0.5 pH (0  $\pm$ 29 mV)

**Electrode Resistance:**  
450 Mohms at 25 °C (new)

**Slope:**  
-58  $\pm$ 3 mV @ 25 °C

**Temperature Range:**

**Routine Use:**  
0° to 45 °C (32 to 113 °F)

**Occasional Use:**  
45° to 80 °C (113 to 176 °F)

**Storage:**  
-40° to 50 °C (-40 to 122 °F)

**Reference Element:**  
Silver/Silver Chloride Double Junction

**Electrode Dimensions:**  
Tip diameter: 12.7 mm (0.50 inches)  
Tip length: 104 mm (4.10 inches)  
Total length: 229 mm (9.0 inches)

**Cable Length:**  
91.5 cm (36 inches)

**Connector Type:**  
BNC Connector

**Reference Gel Solutions:**  
KCl Cartridges (Cat. No. 25469-02)  
Ammonium Sulfate (Cat. No. 25971-02) (does not contain silver)  
Ammonium Chloride (Cat. No. 25958-02)



## SAFETY PRECAUTIONS

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Please read this entire manual before unpacking, setting up, or operating this instrument. Pay particular attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that which is specified in this manual.

### Use of Hazard Information

If multiple hazards exist, this manual will use the signal word (Danger, Caution, Note) corresponding to the greatest hazard.

#### **DANGER**

*Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.*

#### **CAUTION**

*Indicates a potentially hazardous situation that may result in minor or moderate injury.*

#### **NOTE**

*Information that requires special emphasis.*

### Precautionary Labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed.



This symbol, if noted on the instrument, references the instruction manual for operational and/or safety information.





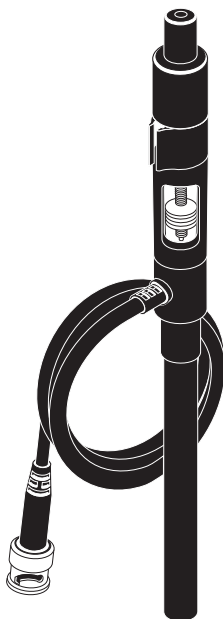
## SECTION 1 INTRODUCTION

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### 1.1 Electrode Description

Platinum Series pH electrodes, featuring improved reference junction designs, provide fast, stable response and accurate measurements. Conventional combination electrodes use porous frits as the junction between the reference half-cell and the sample. The porous material rapidly clogs with precipitated silver chloride, causing unstable junction potentials. The Flat-End pH Electrode uses a double junction reference half-cell with a free-flowing outer reference junction. The free-flowing junction provides nearly constant junction potential, greater accuracy and reliability than conventional porous junction electrodes, and is ideal for both routine and demanding applications. *See Figure 1.*

Figure 1 Platinum Series pH Flat End Electrode



## SECTION 1, continued

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The Flat-End pH Electrode contains a silver/silver chloride element in an inner chamber that contacts the electrolyte solution at an inner junction. Electrolyte flows from the free-flowing outer junction at the electrode tip. This design makes it ideal for use with samples containing sulfide or other substances.

The Hach electrode uses a flat glass membrane that can be used at temperatures of 0 to 45 °C, hydrates easily, and has durability at high temperatures. A moderate sodium error occurs at pH levels greater than 12. See *Section 3.2 Sodium Error Interferences*.

### 1.2 Electrolyte Description

In a conventional electrode, a frit restricts the release of electrolyte into the sample. In the Platinum Series electrodes, medium viscosity electrolyte gel acts as a restriction device. Fresh reference electrolyte is supplied from a replaceable cartridge inside the electrode body by depressing the dispenser button. By refreshing the electrolyte at the reference junction, the Hach's free-flowing reference system eliminates junction potential errors caused by clogged frits. The gelling agent is non-ionic and does not interfere with the free flow of ions across the reference junction. Proper use and care of the reference half cell extends its life.

### 1.3 Preparing the Electrode for Use

#### 1.3.1 Assembling the Electrode

New electrodes are shipped with a protective vinyl cap containing cotton saturated with pH 4.00 buffer/KCl solution to keep the glass bulb hydrated. Prepare the electrode as follows:

1. Remove the cap from the electrolyte cartridge. Align the fins on the cartridge with the grooves on the electrode body. Press the cartridge firmly into the inlet tube of the electrode body and rotate the cartridge clockwise until it is seated (*Figure 2*).
2. Place the dispenser unit over the electrolyte cartridge. Screw the dispenser unit onto the electrode body until it stops turning. **Do not over tighten.**

## SECTION 1, continued

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Figure 2 Assembling the Flat Electrode



**Note:** The electrode will be automatically primed by screwing the dispenser unit onto the electrode body.

3. If electrolyte gel is not visible at the reference outlet, depress the pump button until it clicks; release the button. Repeat this procedure until gel is visible at the reference outlet. Alternatively, fully depress the button and rotate it clockwise until gel is visible at the reference outlet (1 to 3 rotations).
4. Rinse the electrode with deionized water and blot dry with a paper towel. **Do not scrub the bulb.**
5. To remove an empty cartridge, unscrew the dispenser unit and rotate the cartridge counterclockwise while gently pulling it out of the electrode.
6. Condition the electrode by soaking in a pH standard buffer until the reading drifts less than 0.05 pH units/minute. Remove from the buffer and wipe dry.

## SECTION 1, continued

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7. Press the dispenser button until a “click” is heard, then release. Repeat until electrolyte gel emerges at the electrode tip.
8. Rinse with deionized water and blot dry. The electrode is ready for calibration.

### 1.3.2 Conditioning the Electrode

When a pH bulb is immersed in an aqueous solution, a hydrated layer slowly forms at the glass/liquid interface. The formation characteristics of this layer depend upon the type of glass, the age of the glass, the previous usage history of the glass, the temperature, the ionic strength of the aqueous solution, etc. This hydrated layer affects the sensing properties of the bulb (charge transfer, and ion transport). A dry bulb will simply not function.

To ensure the full development of the hydrated layer, condition electrodes for several minutes in a solution comparable to the sample in terms of pH and ionic strength. Some samples may require special conditioning. See specific applications for details.

#### 1.3.2.1 Normal Conditioning

**(For routine measurements in samples of moderate to high conductivity, approximately 150  $\mu$ S and greater):**

**Initial use:** During shipping, the electrode is kept hydrated by a cotton/wool ball saturated in a pH 4.00 buffer/KCl solution. The electrode and saturated ball are encased in a protective vinyl cap. Before using the electrode, remove the cap and soak the electrode in a pH 4.0 or pH 7.0 buffer. If the cotton ball is saturated, the electrode will be hydrated after several minutes in the NIST standard. If the cotton ball and electrode are dry, the bulb typically requires soaking in the standard for 30 minutes before becoming hydrated.

**Between uses:** Between sample measurements of medium to high conductivity, store the electrode in Hach electrode storage solution, a pH 6.35/1.7M KCl buffer solution. The solution keeps the bulb hydrated and prevents the reference gel from solidifying in the reference junction. Hach electrode storage solution is available in powder pillow form for dilution with deionized water or as a prepared solution.

## SECTION 1, continued

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### 1.3.2.2 Low Ionic Strength (LIS) Conditioning

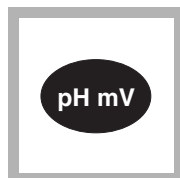
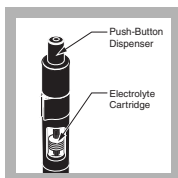
(For measurements in samples of low ionic strength, approximately 150  $\mu\text{S}/\text{cm}$  or less):

**Initial use:** Before measuring a LIS sample, pre-soak the electrode for 10 to 15 minutes in a solution similar to the sample in ionic strength and pH. Remove the electrode from this solution and click the reference electrolyte dispenser until gel emerges from the tip. Rinse the electrode with a small stream of sample delivered through a disposable plastic Pasteur pipette, or with deionized water from a wash bottle. Blot excess liquid with a soft paper towel. Place the electrode in the sample.

**Between uses:** Between uses, in intervals of up to a few hours, the electrode can be stored in the sample (if not an extreme pH), or in a neutral LIS solution such as tap water. Before measuring a new sample, refresh the reference electrolyte gel by clicking the dispenser until fresh gel emerges. Carefully rinse the electrode to prevent sample contamination.

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### 1.3.3 Calibrating the pH Electrode and Meter



**1.** Install the electrolyte gel cartridge in the pH electrode. (See Section 1.3.1 Assembling the Electrode.)

**Note:** Hach sensION 1-4 meters may be used for this analysis.

**2.** Prime the electrode by pushing the dispenser button until gel comes out of the reference junction. Rinse excess gel from the tip and the outlet.

**3.** Connect the electrode to the sensION pH meter.

**Note:** Ensure that the electrode has been conditioned according to Section 1.3.2 Conditioning the Electrode.

**Note:** Be sure that the BNC connector is selected in the meter setup.

**4.** Turn on the meter by pressing I/O. Press pH mV until the display shows pH.

## SECTION 1, continued

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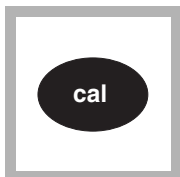
**5.** Press **SETUP**. Press the **UP ARROW** three times. Press **ENTER** to toggle to the number of desired decimal places, then **EXIT** to leave setup.



**6.** In two 50-mL beakers or cups, prepare buffers of 4.0 and 7.0 pH or 7.0 and 10.0 pH.

**Note:** *The sample pH should fall within the range of the calibration buffers.*

**Note:** *pH 6.86 buffer may be used instead of pH 7.0. Autobuffer recognition for either pH 6.86 or 7.0 is user selectable in the **sensION** meter setup function.*



**7.** Press **CAL**. The display will show: **Standard 1?**



**8.** Rinse electrode in deionized water and blot dry.

## SECTION 1, continued

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**9.** Place the electrode in pH 7.0 buffer. Press **ENTER**. The display shows:

### Stabilizing...

**Note:** Temperature variation causes changes in buffer pH. Hach **sensION** meters correct for these changes during calibration when using buffers of pH 4, 6.86, 7, and 10.



**10.** When a stable pH is determined, the display will show **Standard 2?**.

Remove the electrode from the cup, rinse, and blot dry.

**Note:** The meter will select a stable reading using default meter parameters and the specified resolution. To override the default meter parameters, see the meter manual.

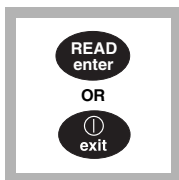


**11.** Place the electrode in 4.0 (or 10.0) pH buffer. Press **ENTER**.



**12.** After the last calibration point has stabilized and the display reads **Standard 3?**, press **EXIT**.

**Note:** For a three-point calibration, repeat steps 11–13 with an additional buffer.



**13.** The display will show **Store?**. Press **ENTER** to store the calibration or **EXIT** to leave the calibration mode without storing the values.

## SECTION 1, continued

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### 1.4 Measuring Samples

1. Immerse or press the electrode end onto the sample to be measured. Press the dispenser button once if the reading is unstable.
2. Record the pH value when the reading is steady.
3. Rinse the electrode end with deionized water or a portion of the next sample (if a solution), and blot dry with a paper towel.

### 1.5 Measuring Hints

- To obtain stable readings, press the dispenser button. One click of the dispenser ejects 6  $\mu$ l of electrolyte to form a fresh reference junction. If the solution is not agitated solution, the junction may be stable for several measurements. With experience, the analyst can determine when electrolyte should be dispensed. If the measurement becomes erratic or drifts, press the dispenser button.
- If the potential becomes erratic, visually check the reference junction tubing for air bubbles. Place the electrode in a clear solution. Dispense electrolyte while observing the electrode tip. Either dense electrolyte will sink from the electrode tip or air bubbles will be ejected.

*Note: Often air bubbles are introduced into the tubing when an electrolyte cartridge is removed and then re-connected to the electrode. These air bubbles interfere only when they reach the tubing between the inner junction and the sample.*

- When transferring electrodes between samples, rinse the electrode with deionized water or a portion of the next sample; blot dry with a paper towel.

#### 1.5.0.1 Stirring During Measurement

Stirring during measurement may cause problems in conventional electrodes with frit-type reference junctions. Stirring can cause reference-junction potential shifts in this type of electrode.

Hach's Platinum Series pH electrodes, with their patented reference junction technology, have eliminated reference-junction



## SECTION 1, continued

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potential shift errors. Initial stirring can speed response times, and is essential during titration when using a pH electrode to measure an end point.

However, in low ionic strength, basic solutions with limited buffer-capacity, stirring can cause more rapid absorption of atmospheric CO<sub>2</sub>. This absorption lowers the pH of the solution. If stirring is necessary in these situations, the Hach Platinum Series pH electrodes are recommended due to their extremely low reference junction potential shift during stirring.

### 1.6 Applications

The Flat-End pH electrode is ideal for surfaces or small sample volumes. The Flat pH electrode is also ideal for use with strong chemical solutions containing sulfide. The double-junction design protects the reference element. Single junction pH electrodes are not recommended for strong sulfide solutions.

The double-junction design makes the Flat pH electrode an excellent choice when silver, chloride, or potassium contamination of the sample must be avoided. In this case, use ammonium sulfate electrolyte gel. See *REQUIRED REAGENTS AND APPARATUS* on page 35.



## 2.1 Storing the Electrode

Proper electrode storage requires different approaches based on how long the electrode will be stored, how quickly the electrode needs to be used, and the type of sample being measured. Storage affects the reference electrolyte gel, the Ag/AgCl reference element, and the pH sensing glass bulb.

**Intermittent storage:** Between uses, store the electrode in solutions of similar ionic strength and pH to the samples of interest. Before measuring a new sample, refresh the reference electrolyte gel by clicking the dispenser until fresh gel emerges. Carefully rinse the electrode to prevent sample contamination.

**Overnight storage:** Store the electrode in Hach electrode storage solution to keep the electrode hydrated. The KCl will not leach excessively from the electrolyte gel overnight. Prior to use, click the electrolyte gel dispenser. A dilute gel/storage solution will initially be ejected from the reference junction tube. The reference gel of thicker viscosity will follow. Eliminating the dilute gel/storage solution will guarantee continuity of the reference junction with the sample. Blot the reference junction with a tissue to clearly see that the electrolyte gel, not gel diluted with storage solution, is emerging.

**Longer-term storage:** To store electrodes for longer periods, soak the electrode in storage solution (*Overnight storage*, above) and re-establish gel at the reference junction on a daily basis to keep the electrode ready for use. If the electrode soaks for longer periods without purging the diluted electrolyte, the entire reference electrolyte gel cartridge can become diluted through diffusion. Typically this will not harm the Ag/AgCl reference element, but the electrolyte cartridge itself will be ruined. This storage method keeps the electrode ready to use, but requires purging the gel every day.

**Shelf storage:** For very long-term storage, store the electrode dry. To empty the reference half-cell of electrolyte gel, remove and discard the electrolyte cartridge. Use a syringe with a male Luer fitting and no needle to inject deionized water through the reference cell to flush out the reference electrolyte gel. Expel the water injected into the reference cell with an air-filled syringe. Wet the cotton/wool ball located in the vinyl storage cap with

## SECTION 2, continued

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storage solution. Place the cap over the electrode. This will help keep the pH glass membrane hydrated. This procedure allows for the longest term storage, but takes more time to store and set up.

### 2.2 Cleaning the Electrode

A contaminated glass bulb or fouled electrode may cause slow response times. Clean the electrode only after conducting the steps described in *SECTION 5 TROUBLESHOOTING* or when the electrode is known to be dirty. Don't clean the bulb more frequently than necessary, or bulb life may shorten. According to the instructions below, clean the electrode according to the type of contaminant present:

**General contamination**—Immerse the electrode tip in 0.1 N hydrochloric acid followed by immersion in 0.1 N sodium hydroxide and again in 0.1 N hydrochloric acid, each for a 2-minute period. Rinse with deionized water and soak in deionized water for at least 15 minutes.

**Oils and fats**—Immerse the electrode tip in a detergent solution such as Alconox™. Use a soft brush or ultrasonic bath if necessary. **Avoid scratching the glass bulb.**

**Organic films**—Use an appropriate solvent, such as methanol or acetone.

**Note:** *Keep the cable and connector away from dirt, abrasives, and harsh solvents.*

After cleaning, refresh reference half cells by pumping fresh electrolyte through them. If the electrode has been sitting in a sample for several weeks, the reference gel will become diluted. In this case, discard the cartridge and replace it with a fresh one.

If these steps fail to improve electrode response, complete the *ELECTRODE SERVICE REQUEST QUESTIONNAIRE* and contact Technical Support.

### 3.1 Theory of Operation

pH is a measure of the hydrogen ion activity in a solution and is defined as:  $-\log_{10} a_{\text{H}^+}$  where  $a_{\text{H}^+}$  is the activity of the hydrogen ion. The 0–14 range of pH measurement is the measurement of a difference in hydrogen ion concentration of 100,000,000,000,000 ( $1 \times 10^{14}$ ). This means that at pH 0, the hydrogen ion concentration is  $1 \times 10^{14}$  times greater than at pH 14. This also means that the hydroxyl ion concentration at pH 14 is  $1 \times 10^{14}$  times greater than at pH 0.

When the hydrogen and hydroxyl ions are present in equal numbers (the neutral point), the pH is 7. pH values from 0 to 7 are termed acidic and those from 7 to 14 are termed basic. It is important to note that a pH change of one unit (for instance from pH 6 to pH 7) is a factor-of-10 change in hydrogen ion concentration.

The glass membrane of a pH electrode responds to the hydrogen ion activity by developing an electrical potential at the glass/liquid interface. At a constant temperature, this potential varies linearly with the pH of the solution being measured. The change in potential per pH unit is termed the slope of the electrode. The slope of the electrode increases linearly with temperature.

The potential inside the pH glass bulb is fixed by the filling solution, and the reference electrode potential is constant. For these reasons, any change in the potential of the electrode system at a given temperature will be due to any change in the pH of the solution being measured.

Effects of temperature on pH measurements depend on the reference electrode used, pH of the solution within the pH electrode, and pH of the test solution. At a certain pH, temperature will have no effect on the potential of the electrode system. This is known as the isopotential point. Also, at some pH level, the system will exhibit no potential. This is known as the zero potential point. Both the isopotential point and the zero potential point are features designed into electrodes. Each electrode is designed so the isopotential and zero potential points are at pH 7 to minimize temperature effects at this

## SECTION 3, continued

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calibration point. At 25 °C, an electrode performing at 100% efficiency will decrease by 59.2 mV for every unit increase in pH.

### 3.2 Sodium Error Interferences

Sodium error occurs at elevated pH values when sodium ions in the sample solution are incorrectly sensed as hydrogen ions by the glass pH bulb. Below pH 12, sodium error is negligible.

The pH sensing bulbs can be optimized for different applications by altering glass composition. This electrode has been designed to balance quick response in low ionic strength (LIS) samples with a fairly wide working range (pH 0–13) while maintaining a flat profile. Additionally, it has low sodium ion susceptibility.

In a single lab, using a sample group of three pH sensing half-cells, in a controlled test versus a Standard Hydrogen Electrode, the following results were obtained:

**Table 1 Sodium Ion Error**

pH	[Na <sup>+</sup> ]	Error
12.1	0.00 M	0.00
12.1	0.01 M	0.01
12.1	0.05 M	0.03
12.1	0.10	0.06
12.5	0.00 M	0.01
12.5	0.01 M	0.05
12.5	0.05 M	0.08
12.5	0.10	0.1
13.7	0.00 M	0.1
13.7	0.01 M	0.15
13.7	0.05 M	0.20

To correct for sodium error in samples of similar composition, this error must be added to the pH reading observed (the indicated pH will always be more acidic than the actual pH value).

## SECTION 4 TROUBLESHOOTING

Symptom	Cause	Remedy
No response	Electrode is improperly connected to meter.	Check connection.
	If a two-channel meter, is the electrode connected to the displayed channel? (A shorting cap on a channel input will show <b>ZERO</b> on the display.)	Reconnect the electrode to the desired channel or change the displayed channel on the meter.
	Connector is dirty or wet.	<ol style="list-style-type: none"> <li>1. Inspect both male and female connectors.</li> <li>2. Clean with mild solvents such as alcohol or acetone.</li> <li>3. Clean and dry with a lint-free cloth or compressed air.</li> </ol>
	Reference junction is blocked.	Press the electrolyte dispenser and see if gel is expelled from the reference junction tube. If the junction is blocked, see <i>Section 1.3.1</i> on page 10.
	pH sensing bulb and reference junction are not in contact with the sample.	Submerge the probe deeper into the sample.
	Cable contains kinks, breaks, loose connectors, etc.	Replace or repair cable.
	The meter is broken.	<ol style="list-style-type: none"> <li>1. Try another electrode.</li> <li>2. Try the other channel.</li> <li>3. Check and replace batteries, if necessary.</li> <li>4. Put shorting caps on and see if meter 'zeros'.</li> </ol>
	BNC connector is not selected.	Select BNC connector in meter setup.
Out-of-range response	See "No response", above.	The pH glass membrane may be broken.

## SECTION 4, continued

Symptom	Cause	Remedy
Erratic response	Reference junction contains bubbles.	Push dispenser button and turn clockwise two turns.
	Electrode is not plugged in to selected meter channel.	Plug electrode into meter channel.
	Reference junction has not been properly primed with gel.	Follow instructions in <i>Section 1.3.1</i> on page 10.
	Extreme external electrical fields are present. (The pH cable, though shielded, can act as an antenna.)	Install a shorting cap on the unused meter terminal. Do not use stirrers. Avoid static electricity, nearby pumps, power supplies, etc.
	pH sensing bulb and reference junction are not in contact with the sample.	Submerge the probe deeper into the sample.
	The sample chemistry is changing.	None.
	The pH of a LIS solution is changing due to CO <sub>2</sub> uptake.	Use LIS Chamber Accessory.
	The bulb is cracked, discolored, or contaminated.	If dirty, clean according to <i>Section 3.2</i> on page 36. If cracked, discard.
	The sample container is contaminated.	Use a clean sample container.
Low slope	Bulb is old.	Replace electrode.
	Bulb is dirty.	Clean according to <i>Section 3.2</i> on page 36.
	Standards are inaccurate.	Make sure standards were entered into meter correctly. Use only NIST traceable buffers. Use fresh buffers. Change buffers frequently.
	History of harsh usage.	Replace electrode.
	Cracked pH membrane.	Replace electrode.



## SECTION 4, continued

Symptom	Cause	Remedy
High slope	Buffers are incorrect.	Use appropriate buffers.
	Incorrect measurement or calibration technique.	Follow procedures described in <i>SECTION 2</i> on page 17.
	Temperature variations in standards.	Keep sample and standards at same temperature.
	Standards contaminated.	Prepare fresh standards.
High offset	Leakage pathway results in stray voltage via internal electrical short.	Return electrode under warranty.
	Reference gel has become diluted or junction is plugged by solidified gel or an air bubble.	Replace cartridge and reprime.
	Cracked bulb.	Replace electrode.
	A 5-pin electrode that is not in use is connected to the 5-pin connector.	Disconnect the 5-pin electrode.
Sluggish response	Sample is cold and of low ionic strength.	Wait patiently. Samples may respond slowly.
	Improper conditioning.	Condition according to <i>Section 1.3.2</i> on page 11.
	Bulb, guard, and electrode stem are dirty.	Clean according to <i>Section 3.2</i> on page 36.



## **ELECTRODE SERVICE REQUEST QUESTIONNAIRE**

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1. What model of meter is the electrode being used with?
2. What is the complete lot code of the electrode (located on the electrode cable)?
3. What is the date the electrode was purchased?
4. How long has the electrode been in use?
5. What types of samples are being tested?
6. What is the temperature of the samples being tested?
7. How often is the electrode being used?
8. How is the electrode being stored between uses?
9. What is the electrode slope during a typical calibration?
10. If a new electrode, has it been conditioned according to instructions?
11. If the electrode has been in use for a while, what maintenance has been performed?
12. Describe the suspected problem or failure of the electrode.
13. When calling for telephone support, have your meter, electrode, and buffers/standards, along with this completed questionnaire, near the phone before calling.
14. Did you use ISA in samples or standards?
15. Did you use the low range method for LIS and high purity drinking water samples with conductivity below 150  $\mu\text{S}/\text{cm}$ ?
16. Is the sample above pH 12 with a high  $\text{Na}^+$  concentration (the linear range of the electrode)?



## GLOSSARY

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**Acid**—A chemical compound that contributes hydrogen ions ( $H^+$ ) to an aqueous solution or causes the pH to be less than 7.0.

**Acidic**—A solution or system with a pH less than 7.0.

**Activity**—The measure of work performed by an ion as it moves through a system. The activity is dependent upon the concentration of all ions in the system and the charge associated with the ion.

**Alkali**—A solution or system with a pH greater than 7.0.

**Alkalinity**—Capacity of water to accept hydrogen ions ( $H^+$ ). Indicates presence of carbonate ( $CO_3^{2-}$ ), bicarbonate ( $HCO_3^-$ ), and hydroxyl ( $OH^-$ ) ions.

**Anion**—A negatively charged ion (i.e.,  $NO_3^-$ ,  $Cl^-$ ).

**Base**—A chemical compound that contributes hydroxide ions ( $OH^-$ ) to an aqueous solution or causes the pH to be greater than 7.0.

**Buffer**—

1) A compound, mixture of compounds, or solution which, when added to a system, changes pH to a specified, known value.

2) The ability a solution or system to resist change in pH if either an acid or a base is added.

**Buffering capacity**—A measurement of the amount of acid or base which can be added to a solution before the pH changes.

**Cation**—A positively charged ion (i.e.,  $NH_4^+$ ,  $Ca^{2+}$ ).

**Combination electrode**—An electrode composed of a reference half-cell and a sensing half-cell. The reference half-cell is the half of the electrode pair that maintains a constant potential regardless of solution composition. The sensing half-cell develops a potential proportional to solution composition.

**Conditioning**—The process of preparing an electrode for use by soaking the electrode in a solution with a pH and ionic strength similar to the sample. Conditioning allows the formation of the hydrated layer, necessary for accurate measurements.

## GLOSSARY, continued

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**Decade**—Any two standards with a concentration ratio of 10.  
For example:

$$\frac{\text{Concentration of the higher standard}}{\text{Concentration of the lower standard}} = 10$$

**Dilution factor**—A numerical value by which results must be multiplied in order to obtain the actual value of the sample. For example, if 1 mL of sample is diluted to 10 mL, then the result obtained must be multiplied by 10 to obtain the value for the sample before dilution.

**Electrolyte**—A solution made of dissolved ions that is used to facilitate electrical conductance and ionic transport. The composition is usually potassium chloride (KCl), sodium chloride (NaCl), ammonium chloride (NH<sub>4</sub>Cl), or ammonium sulfate ((NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>).

**Free-flowing reference junction**—The point on the electrode where reference gel is freely dispensed without obstruction by frits or other materials.

**Hydrated layer**—A layer that forms at the glass/liquid interface. Chemically similar to the sample being measured (especially in samples of low ionic strength), the formation characteristics of this layer depend upon the type of glass, the age of the glass, the previous usage history of the glass, the temperature and ionic strength of the aqueous solution, etc.

**Inert**—Does not react with other substances.

**Ion**—An atom, group of atoms or molecule that is electrically charged as the result of gaining or losing electrons. An ion resulting from the gain of electrons becomes negative (anion), while an ion resulting from the loss of electrons becomes positive (cation).

**Ionic strength**—A measure of the concentration of any ion in solution, usually expressed in moles per liter.

**Occasional use**—Infrequent use where the probe is subjected to test conditions just long enough to obtain a proper reading.

## GLOSSARY, continued

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**pH**—A relative numerical measurement of the acidic, neutral, or alkali nature of a solution or system. Mathematically defined as the negative log of the hydrogen ion concentration.

**Potential**—The capacity of a system to perform work. When two ions of opposite charge are separated by a distance, there is a potential developed from the tendency of the ions to come back together. Each ion exerts work to come back together. The amount of work needed by each ion to come back together is the potential.

**Reference element**—A silver wire coated with silver chloride, this element develops a constant potential when immersed in an electrolyte such as potassium chloride.

**Reference half-cell**—Provides a constant voltage against which the pH dependent voltage from the sensing half-cell is compared.

**Reference junction**—The point on the electrode where reference gel is dispensed.

**Routine use**—Typical use following regular, frequent routines, but not continuous as with an in-line monitoring process.

**Sensing half-cell**—Provides a voltage proportional to the concentration of a specific ion in solution.

**Salt**—An ionic compound.

**Siemen**—The unit of conductivity equivalent to mho ( $\text{ohm}^{-1}$ ). Conductivity is often expressed as microSiemens per centimeter ( $\mu\text{S}/\text{cm}$ ) and milliSiemens per centimeter ( $\text{mS}/\text{cm}$ ) and it is a measure of how readily a sample conducts electricity. More concentrated solutions conduct more electricity and have higher conductivity.

**Sodium error (alkaline error)**—Occurs in strongly alkaline solutions, generally greater than 13 pH, when concentrations of  $\text{H}^+$  are low, and small, positively charged ions such as  $\text{Na}^+$  generate potential differences across the pH glass membrane. These differences can result in measurement errors between -0.5 and -1.0 pH.







## GENERAL INFORMATION

**At Hach Company, customer service is an important part of every product we make.**

**With that in mind, we have compiled the following information for your convenience.**



## REPLACEMENT PARTS

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### REQUIRED REAGENTS AND APPARATUS

Description	Unit	Cat. No.
Ammonium Sulfate Reference Electrolyte Gel Cartridge.....	2/pkg .....	25971-02
Ammonium Chloride Reference Electrolyte Gel Cartridge.....	2/pkg .....	25958-02
Buffer Solution, pH 4 (red) .....	500 mL.....	22834-49
Buffer Solution, pH 7 (yellow).....	500 mL .....	22835-49
Buffer Solution, pH 10 (blue) .....	500 mL .....	22836-49
Platinum Series Flat-End Combination pH Electrode, without temperature sensor, BNC Connector .....		51915-00
Potassium Chloride Reference Electrolyte Gel Cartridge.....	2/pkg .....	25469-02
pH 4.01 Buffer Powder Pillows, red .....	50/pkg .....	22269-66
pH 6.86 Buffer Powder Pillows.....	15/pkg .....	14098-95
pH 7.00 Buffer Powder Pillows, yellow .....	50/pkg .....	22270-66
pH 10.00 Buffer Powder Pillows, blue.....	50/pkg .....	22271-66
Water, deionized .....	4 L.....	272-56

### OPTIONAL APPARATUS

Adapter, BNC-to-U.S. Standard (meter) .....		43867-00
Clipper (for opening powder pillows) .....		968-00
Electrode Stand w/Electromagnetic Stirrer, 115 V .....		45300-01
Electrode Stand w/Electromagnetic Stirrer, 230 V .....		45300-02
Stir Bars, magnetic .....	each .....	45315-00
<i>sensation1</i> <sup>TM</sup> Portable pH Meter .....	each .....	51700-10
<i>sensation2</i> <sup>TM</sup> Portable pH/ISE Meter .....	each .....	51725-10
<i>sensation3</i> <sup>TM</sup> Laboratory pH Meter .....	each .....	51750-10
<i>sensation4</i> <sup>TM</sup> Laboratory pH/ISE Meter.....	each .....	51775-10



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### Information Required

- Hach account number (if available)
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- Brief description or model number
- Quantity

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Telephone: (204) 632-5598; FAX: (204) 694-5134

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Authorization must be obtained from Hach Company before sending any items for repair. Please contact the Hach Service Center serving your location.

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**HACH COMPANY**  
WORLD HEADQUARTERS  
P.O. Box 389  
Loveland, Colorado 80539-0389  
Telephone: (970) 669-3050  
FAX: (970) 669-2932

**HACH EUROPE**  
Chaussée de Namur, 1  
B-5150 Floriffoux (Namur), Belgium  
Telephone: (32)(81) 44.71.71  
FAX: (32)(81) 44.13.00

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**FOR TECHNICAL ASSISTANCE, PRICE INFORMATION AND ORDERING:**

In the U.S.A. - **Call toll-free 800-227-4224**

Outside the U.S.A. - **Contact the HACH office or distributor serving you.**

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