



Parameter

Troubleshooting a pH electrode with the Orion VERSA STAR Meter and pH with LogR Temperature Technology Module system

Introduction

Many factors affect performance of a pH electrode. When performance degrades, it is always a challenge for the analyst to identify the cause(s). Common troubleshooting procedures (1), which include evaluation of slope, electrode drift, time response, and accuracy, take considerable time. The Thermo Scientific Orion VERSA STAR Meter and pH with LogR Temperature Technology Module system provides a new, quick and easy tool for electrode diagnostics based on the measuring the sensing bulb resistance.

Reference

(1) Thermo Scientific pH Electrode Handbook, www.thermoscientific.com/water

Recommended Equipment

Orion VERSA STAR Meter and pH with LogR Temperature Technology Module system (Orion cat. no. VSTAR80 or VSTAR82 for kit with solutions); Stirrer (Orion 096019); Orion ROSS or PerpHecT ROSS pH electrode (for example, 8172BNWP or 8220BNWP); digital or glass thermometer.

Required Solutions

pH 7.00 Buffer (Orion 910107 for a pint bottle, 910760 for five 60mL bottles or 910710 for a pack of 10 pouches); pH 4.01 Buffer (Orion 910104 for a pint bottle, 910460 for five 60mL bottles or 910410 for a pack of 10 pouches); pH Electrode Filling Solution (see pH Electrode User Guide); deionized water.

Meter Setup

Connect the pH electrode to the module, and connect the module and a stirrer to the meter. Turn on the meter, press *channel* key to display the pH with LogR channel. In the setup mode, select the pH/LogR channel. Set for continuous read type in *Mode* and for LogR temperature compensation in *Temperature*. For more details refer to the reference guide.

Electrode Setup

Refer to the electrode's user guide for proper electrode preparation.

Measuring Resistance Data for Electrode Troubleshooting

To get the most out of this diagnostic procedure, when the electrode is new, perform an initial check of resistance (R) and record the R and temperature (from a separate glass or digital thermometer) readings for future reference. (Appendix C in reference guide of the Orion VERSA STAR Meter pH with LogR Temperature Technology Module includes an electrode diagnostics log that can be used.)

To determine the electrode bulb resistance, proceed as follows:

1. Prepare meter and electrode as described in the sections above.
2. Rinse the electrode with deionized water and then with pH 7 buffer.
3. Place the electrode in fresh pH 7 buffer at room temperature (20 - 25°C). It is important to maintain the same temperature (+/- 1°C) of the pH 7 buffer for each resistance test.
4. The resistance value will be displayed as the Bulb Resistance value on the upper right of the primary measurement.
5. Wait for stable reading and record the resistance and temperature. Ensure that prior R readings were taken at a similar temperature.

Troubleshooting the Faulty Electrode

When electrode performance degrades, measure the electrode bulb resistance of the faulty electrode as described above. Consult the Flowchart (on page 2) and Table 1 (on pages 3 & 4) to find the matching electrode symptom, the corresponding change from the initial resistance value, the possible causes, and suggested corrective actions. For details of the recommended corrective action procedures (as referenced in Table 1 and the **Flowchart**) see below:

Procedure # 1 - Replacing the Electrode

If electrode is within warranty, contact technical service for replacement. If outside of warranty, place an order for a replacement electrode.

Procedure # 2 - Cleaning the Electrode

Clean the electrode with appropriate Orion cleaning solution (Orion kit 900020 or individual Orion solutions 900021, 900022, 900023, 900024). Soak overnight in pH 4 buffer, rinse with DI water and recalibrate in fresh buffers. If all these steps failed, replace the electrode (see procedure # 1).

Procedure # 3 - Checking Electrode Performance

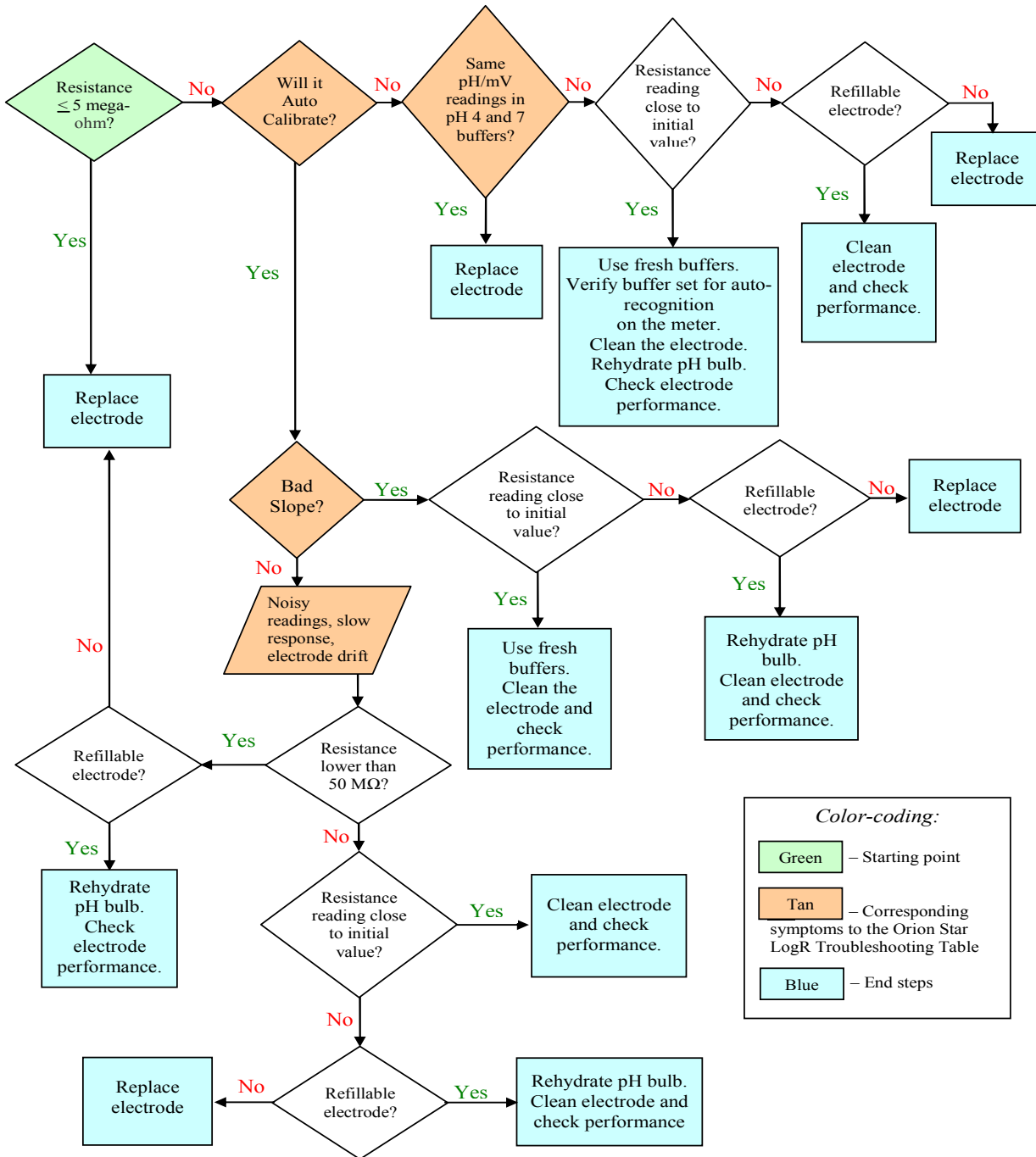
Change the measurement mode to read mV. Rinse the pH electrode with DI water and then with pH 4.01 buffer solution; place the electrode into pH 4.01 buffer at room temperature (20 - 25°C). Wait for the reading to stabilize and record the mV value. Rinse electrode with DI water. Repeat the same steps to record mV reading in the pH 7 buffer. Refer to Table 2 or 3 to verify that mV reading is ± 30 mV from the theoretical mV reading of the buffer. If mV readings are out of range, replace the electrode (as highlighted in procedure # 1). If mV readings are correct, perform the corrective action described in procedure # 2.

Procedure #4 - Rehydrating the pH Bulb

Rehydrate the sensing bulb in pH 4 buffer. (Overnight soak is recommended.) Store the electrode in appropriate pH storage solution.

Orion Star LogR Troubleshooting Flow Chart

Note: Need to have initial resistance readings.



Color-coding:

- Green – Starting point
- Tan – Corresponding symptoms to the Orion Star LogR Troubleshooting Table
- Blue – End steps

Table 1. Troubleshooting a pH Electrode on the Orion Star LogR Meter

Symptom	Resistance (R) reading at room temperature, megohm	Possible Causes	Next step (Corrective action)
Won't auto cal (cannot run auto calibration with pH 4.01, 7.00, and 10.01 buffers)	R is very low (less than or equal to 5 megohm)	Short circuit (glass bulb cracked/or stem/or outer body; damaged cable or BNC connector, moisture intrusion)	Replace the electrode. (See procedure # 1.)
	R is close to the initial reading (between 1/2 of initial resistance value to less than 2 times initial resistance value)	Bad buffers	Use fresh, not expired buffers
		Wrong buffer set in setup	Choose the correct buffer set. Meter is auto recognizing USA or EURO pH buffers (see Tables 2 or 3), depending on the selected set in setup.
		Damaged (scratched) glass bulb by soil or sand samples; aged glass bulb	Check electrode performance. (See procedure # 3.)
		Chemically damaged bulb, e.g., due to exposure of the electrode to ammonium bifluoride or hydrofluoric acid for long period of time (hours)	Check electrode performance. (See procedure # 3.)
		Dehydrated/dried glass bulb (after ethanol samples, organic solvents, etc. or dry storage)	Rehydrate pH bulb. (See procedure # 4.)
		Dirty bulb, clogged junction	Clean the electrode. (See procedure # 2.)
	R is high (greater than or equal to two times the initial reading)	Dried gel (only non-refillable gel electrodes)	Replace the electrode. (See procedure # 1.)
		Dirty or contaminated glass bulb	Clean electrode and check performance. (See procedure # 2 followed by procedure # 3.)
		Severely clogged or sealed junction	Clean electrode and check performance. (See procedure # 2 followed by procedure # 3.)
pH and mV readings in pH 4.01 and pH 7.00 buffers are the same	R is very low (less than or equal to 5 megohm)	Short circuit (glass bulb cracked/or stem/or outer body; possible electrical damage)	Replace the electrode. (See procedure # 1.)
Slope is bad (out of 92 -102% range or mV difference between readings in pH 4 and pH 7 is not within 160-180 mV)	R is very low (less than or equal to 5 megohm)	Short circuit (glass bulb cracked/or stem/or outer body; possible electrical damage)	Replace the electrode. (See procedure # 1.)
	R is close to the initial reading (between 1/2 of initial resistance value to less than 2 times initial resistance value)	Damaged or aged bulb	Check electrode performance. (See procedure # 3.)
		Dirty bulb	Clean the electrode. (See procedure # 2.)
		Clogged junction	Clean the electrode. (See procedure # 2.)
		Buffers are bad	Use fresh, not expired buffers.
	R is high (greater than or equal to two times the initial reading)	Severely clogged or sealed junction	Clean electrode and check performance. (See procedure # 2 followed by procedure # 3.)
		Dried gel (only non-refillable gel electrodes)	Replace the electrode. (See procedure # 1.)
		Dehydrated/dried glass bulb (after ethanol samples, organic solvents, etc. or dry storage)	Rehydrate pH bulb. (See procedure # 4.)

Noisy readings (for example, won't lock onto pH value during calibration), slow response, drift (for example, reading changes with time, cal check is not within criteria)	R is lower than 50 megohm	Aged electrode	Check electrode performance. (See procedure # 3.)
		Dry bulb	Rehydrate pH bulb. (See procedure # 4.)
		Dried gel (only non-refillable gel electrodes)	Replace the electrode. (See procedure # 1.)
	R is close to the initial reading (between 1/2 of initial resistance value to less than 2 times initial resistance value)	Dirty bulb	Clean the electrode. (See procedure # 2.)
		Damaged or aged glass bulb	Check electrode performance. (See procedure # 3.)
		Clogged junction	Clean the electrode. (See procedure # 2.)
	R is high (greater than or equal to two times the initial reading)	Dry bulb	Rehydrate pH bulb. (See procedure # 4.)
		Severely clogged junction	Clean electrode and check performance. (See procedure # 2 followed by procedure # 3.)
		Aged electrode	Clean electrode and check performance. (See procedure # 2 followed by procedure # 3.)
		Dried gel (only non-refillable gel electrodes)	Replace the electrode. (See procedure # 1.)

Table 2. Expected mV reading of the pH electrode in USA pH Buffer Set

Buffer	mV Range
1.68	+285 to +345 mV
4.01	+207 to +147 mV
7.00	- 30 to + 30 mV
10.01	-207 to -147 mV
12.46	-293 to -353 mV

Table 3. Expected mV reading of the pH electrode in EURO pH Buffer Set

Buffer	mV Range
1.68	+285 to +345 mV
4.01	+207 to +147 mV
6.86	+38 to -22 mV
9.18	-99 to -159 mV