



## Parameter

pH of Lake Water (ROSS Ultra Triode™ Gel-filled)

## Introduction

For surface water, in-situ pH measurement is recommended (see reference). This measurement can be made using a gel-filled Orion ROSS Ultra Triode™ which allows simultaneous measurements of pH and temperature and automatic temperature compensation. This probe guarantees precise measurements in samples with low ionic strength and over a large temperature range.

## Reference

USGS National Field Manual: pH Method, Chapter 6.4; Version 2.0, 10-2008. <http://water.usgs.gov/>.

## Recommended Equipment

Orion 3-Star Plus Portable pH Meter (Orion 1212000); Orion ROSS Ultra Triode™ gel-filled (Orion 8107BNUMD); sample bucket.

## Required Solutions

pH 4.01, 7.00, and 10.01 NIST-traceable Buffer Pouches (Orion 910425, 910725 and 911025); deionized water (DI); ROSS storage solution (810001) or pH electrode storage solution (Orion 910001).

## Solutions Preparation

Per USGS, buffers used for field calibration should be equilibrated to the temperature of the sample. This can be done by placing two pouches for each buffer directly in lake water or in a bucket of sample for about 10 minutes prior to calibration. Alternately, calibrate the Ross at room temperature prior to field work. See Electrode Log # 66 for comparison of field vs. laboratory calibration results.

## Meter Setup

Connect both plugs of the triode to the Star Plus meter. Turn the meter on and set measurement mode to pH. In Setup mode, set read type to auto, log delete to no (to allow overwrite of the oldest data points), turn data log on. Set the following pH settings: resolution to 0.01 and buffer set to USA. If all steps were followed correctly the meter display will show a number with two decimal places in the top line and "pH" to the right of the top line. The temperature will also be displayed in the top left of the screen.

## Electrode Setup

See the electrode manual for preparation of the electrode.

## Electrode Performance Check

Be sure electrode is working properly before going out to the

field to make measurements - check slope and drift. Drift may be checked by comparing a 1-minute to 2-minute reading of pH 7 buffer. Results should agree with desired criteria. See troubleshooting section of manual if slope and/or drift are not acceptable.

## Electrode Storage, Soaking, and Rinsing

Store electrode in pH 4.01 or 7.00 buffer pouch at sample temperature in between measurements. Rinse the electrode with DI water and blot dry with lint-free tissue before measuring the next sample. Store electrode in small bottle with electrode storage solution when transporting probe and for long term storage.

## Sample Preservation

Samples cannot be preserved; measure in-situ for best results or immediately following collection.

## Sample Preparation

Sample is measured in the field; no preparation required.

## Calibration

Calibrate the triode temperature against a NIST calibrated thermometer annually. Per USGS, calibrate pH sensor in the field. Buffers must equilibrate to sample temperature before calibration (See Solution Preparation). Rinse electrode in one buffer pouch and calibrate in the second pouch. Perform a three point calibration using pH 4.01, 7.00 and 10.01 buffers. The meter automatically recognizes the buffers and displays the temperature-corrected pH value for each calibration point. The electrode slope should be between 92 and 102%. Read a fresh portion of pH 7.00 buffer in the field (equilibrated to sample temperature) to verify calibration before proceeding to sample testing. Reading will be temperature-adjusted - see table on page 2 for expected values. If readings are not acceptable and/or slope is not within range, see troubleshooting section of manual.

## Analysis

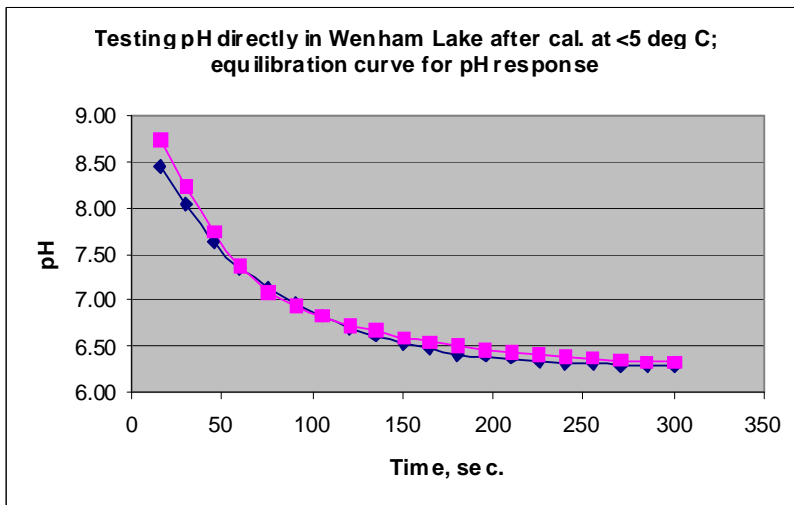
Rinse electrode with DI water and blot with a lint-free wipe. Immerse the pH triode in the water to the correct depth and allow 1 to 5 minutes for probe to equilibrate to water temperature. Press the MEASURE key on the meter. The "pH" icon will flash until the reading is stable. When a stable reading is achieved, the pH result and temperature will be displayed and saved in the data log. Repeat pH measurement at several points of the lake, as desired.

## Quality Control (QC)

Recommended QC procedures include: calibration and calibration verification, sample replicates, slope, and drift.



**Electrodes were pre-equilibrated in lake water for 5 minutes prior to pH AUTO read.**



**pH of Lake Water (measured in-situ at low temperature)**  
Conductivity of lake water measured in the range of 100 – 225 uS/cm

	Gel Ross Triode #1		Gel Ross Triode #2	
<b>Slope</b>	<b>98.8%</b>		<b>99.0%</b>	
<b>Lake Water (public water supply)</b>	<b>pH</b>	<b>T°C</b>	<b>pH</b>	<b>T°C</b>
Sample 1	6.20	0.4	6.21	0.3
Sample 2	6.20	0.4	6.22	0.3
Sample 3	6.19	0.3	6.20	0.3
<b>Median</b>	<b>6.20</b>		<b>6.21</b>	
Standard Deviation	0.007		0.009	
Time per sample	72 sec.		70 sec.	

**Calibration Verification: read pH 7.00 (AUTO read) in field after sample measurement**

Gel Ross Triode #1		Gel Ross Triode #2		Expected pH	Difference from expected pH	
pH	T°C	pH	T°C		Triode #1	Triode #2
7.09	4.6	7.08	4.7	7.08	0.01	0.00

**Discussion of Results:**

- After allowing time (5 minutes) for the electrodes to equilibrate to about 0.4 deg C, pH response was quick just over 1 minute for Auto read value to display and log.
- pH results in samples 1-3 were very reproducible and the two Ross Gel Triode results agreed very well.
- After testing, and even at very cold temperatures ( $\leq 5$  deg C), the Ross Gel Triodes read pH 7 buffer within +/- 0.01 pH of expected buffer pH at that temperature.

**Temperature Corrected Values for pH 7.00 buffer**

°C	0	10	20	30	40	50	60	70	80	90
<b>pH</b>	7.11	7.06	7.01	6.98	6.97	6.97	6.97	6.99	7.03	7.08