

Standard Operating Procedures for Measuring pH, Conductivity, and Temperature

A Guide to pH, Conductivity, and Temperature Field Measurements Using a Handheld Multiparameter Meter and other Handheld Meters



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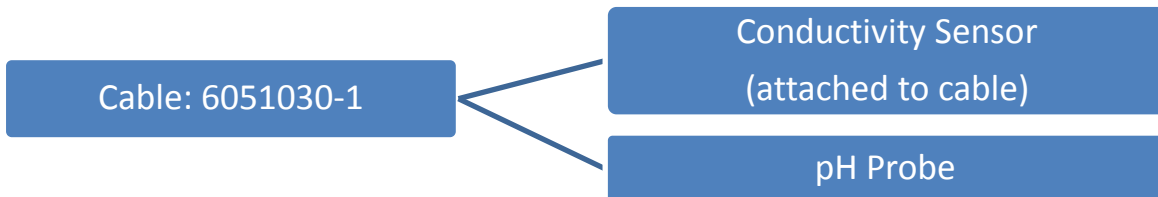
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1. Purpose and Scope

- 1.1. This document is the Standard Operating Procedure (SOP) for conducting field measurements of pH, conductivity, and temperature using a handheld multiparameter meter and sensor. Additionally, SOPs for other meters that measure these parameters are included.
- 1.2. This document is a guide for measuring water quality characteristics of onsite septic system effluent. The YSI Professional Plus and Electrode Sensors are able to measure pH, conductivity, and temperature. These parameters are useful indicators of wastewater treatment efficiency. The procedures performed are in accordance with the following Standard Methods:
 - pH, Standard Methods 4500HB
 - Conductivity, Standard Methods 2510B
 - Temperature, Standard Methods 2550

2. Applicability

- 2.1. This procedure is to be followed when performing field measurements of pH and conductivity using the handheld YSI Professional Plus Multiparameter Meter combined with the ISE/conductivity/temp cable and YSI pH (ISE) sensor. This document is intended for measuring parameters within the following ranges:
 - pH, 0-14 units
 - Conductivity, 0-200 mS/cm
 - Temperature, -5-70° C.
- 2.2. This procedure utilizes the ISE/Cond/Temp cable connected to the YSI Professional Plus Meter. A visual of the cable setup is shown below. After initial assembly, the only connections/ disconnections needed are between the cable and the YSI Professional Plus Meter.



3. Definitions

- 3.1. Calibration- To standardize or correct sensor after determining, by measurement or comparison with a standard, the correct value.
- 3.2. Conductivity- A measure of the ability of an aqueous solution to carry an electrical current. Specific conductance is the conductivity value corrected to 25° C.
- 3.3. DOH- Washington State Department of Health.
- 3.4. Field Log- A standard document for recording field measurements, located in the Guidance Manual binder.
- 3.5. $\mu\text{S}/\text{cm}$ - ‘microsiemens per centimeter’ is a unit for measuring the conductivity of a solution. $1000 \mu\text{S}/\text{cm} = 1 \text{ mS}/\text{cm}$.
- 3.6. MSDS- Material Safety Data Sheets located in the Guidance Manual binder.
- 3.7. pH- A measure of the acidity of a solution. Pure water is nearly neutral with a pH of 7.0. For our study, we expect pH values within the 6.5 to 7.8 range.

4. Personnel Qualifications/Responsibilities

- 4.1. All field measurements will be performed by DOH personnel with lab experience and a professional background in wastewater treatment.
- 4.2. Review appropriate Material Safety Data Sheets before calibration.

5. Equipment, Reagents, and Supplies

5.1. Equipment, Reagents and Supplies Need for All Procedures:

- 5.1.1. YSI Professional Plus Multiparameter Meter, Model # 6050000

5.2. Equipment, Reagents and Supplies For pH Procedures:

- 5.2.1. YSI pH (ISE) Probe, Model # 605101
- 5.2.2. pH Buffer 4 (2 pints)
- 5.2.3. pH Buffer 7 (2 pints)

5.3. Equipment, Reagents and Supplies For Conductivity Procedures:

- 5.3.1. YSI ISE/conductivity Cable, Model # 6051030-1
- 5.3.2. 3167 Conductivity Standard 1: 1,000 $\mu\text{S}/\text{cm}$ (8 pints)

- 5.4. Cotton Swabs
- 5.5. Probe storage cap
- 5.6. Probe protective cap
- 5.7. Rubbing Alcohol
- 5.8. Deionized water
- 5.9. Minimum 2 Alkaline C-cell Batteries
- 5.10. Disposable Rubber Gloves
- 5.11. YSI Meter, Cables, and Probes Manuals
- 5.12. YSI Professional Plus Calibration Tips
- 5.13. Field Data Logs
- 5.14. NIST traceable thermometer (Control company brand model 4038)
- 5.15. YSI pH100 (Back-up) Meter and Supplies: Spare 9V Batteries, Instruction Manual and Carrying Case

1. Summary of Procedures


1.1. YSI ProPlus Meter and Temperature Cable Calibration

Calibration Frequency: Prior to calibration, verify the temperature reading is similar to the temperature in the laboratory. During the first sample event of the month, verify that the temperature sensor is reading properly by comparing it with the NIST traceable thermometer. *The Pro Plus temperature sensor cannot be calibrated nor should calibration be required.* If the temperature sensor is not reading accurately refer to the Professional Plus Calibration Tips for guidance.

1.2. YSI ProPlus Meter and Conductivity Cable Calibration


Calibration Frequency: Prior to each day of usage.

Calibrate the specific conductance.

1. Install the pH and conductivity cable. Push together firmly and then twist the outer ring until it locks into place. It is important that the entire sensor connector and cable connector ends be dry when installing, removing or replacing. This will prevent water from entering the port
2. Ensure that the conductivity sensor is clean and dry before performing calibration.
3. Press Sensor, highlight setup, and press enter. Highlight Conductivity, press enter.
4. Press Cal , select Conductivity press enter, highlight Sp Conductance and press enter.
5. Always use fresh conductivity standard when calibrating the conductivity sensor. The shelf life of conductivity is *one month* after being opened.
6. Remove the safety cover and be very careful not to damage the probes.
7. Pre-rinse the calibration tube and sensors three times with calibration standard.
8. Submerge the Conductivity sensor into the calibration 1,000 $\mu\text{S}/\text{cm}$ calibration standard. Ensure that the entire conductivity sensor is submerged, this should include the two vent holes located close to the cable. Note: The pH sensor will be submerged as well.
9. Move the sensor up and down in solution to remove any air bubbles that may be trapped in the conductivity sensor. Air bubbles will result in erroneously low readings.
10. Write the conductivity value reading on the Calibration Log in the PRE METER READING column.
11. Highlight the Calibration value and enter 1000 μS . Make sure that you are entering the correct units. (1 mS = 1,000 μS)
12. Wait for the temperature and conductivity readings to stabilize. Write the conductivity reading in the PRE METER READING Column.
13. Highlight Accept Calibration and press enter.
14. If the meter shows a warning message indicating a questionable calibration, repeat the above steps or refer to the troubleshooting section of the Calibration Tips document.
15. Once a good calibration has been accepted, navigate to the GLP file and confirm that the conductivity cell constant is 5.0 +/-0.5. If constant is outside of this range, recalibrate. A conductivity cell constant less than 4.0 or greater than 6.0 is unacceptable.
16. Return the probe to the 1,000 μS standard, record meter reading in the POST CAL CHECK column.
17. Put the safety cover back on.
18. Rinse the probes three times with deionized (DI) water.

6.3. YSI ProPlus Meter and pH Probe Calibration

Calibration Frequency: Prior to each day of usage. Two-point pH calibration required.

1. Rinse the sensors and calibration cup three times with pH 7 buffer. Fill the calibration cup so that the pH sensor tip and the temperature sensor are submerged in the buffer solution. Keep the top of the Rubber Boot from going into the solution.
2. Press Cal , select highlight ISE (pH) and press enter.
3. Highlight the Calibration Value and enter the pH value of the specific buffer solution.
4. Record the pH reading and millivolts for the pH 7 calibration point in the PRE METER READING column.
5. Wait for the pH to stabilize in the buffer and press enter to accept the pH 7 calibration point.
6. Rinse the sensor and calibration cup with a small amount of pH 4 buffer solution. Fill the calibration cup so that the pH sensor tip and the temperature sensor are submerged in the buffer solution. Keep the top of the Rubber Boot from going into the solution.
7. Highlight the Calibration Value and enter the pH value of the specific buffer solution.
8. Record the pH reading and millivolts for the pH 4 calibration point in the PRE METER READING column.
9. After pressing enter to accept your last calibration point, press CAL to complete the calibration. Otherwise you will continue calibrating up to 6 calibration points.
10. Place the probe into pH 7 buffer. Record meter reading in POST CAL CHECK column.
11. After accepting a good calibration, navigate to the GLP file and check the pH Slope and Slope %. A good slope should be between 55 and 60 mVs while the ideal is 59 mV. If the slope drops below 53, the sensor should be reconditioned and recalibrated. Perform the pH check at the bottom of the Calibration Log.

NOTE: If you receive a warning message stating that the calibration is questionable, do not continue with the calibration. Instead, select 'No' and investigate what is causing the questionable results. If you accept a questionable calibration, your pH readings will be erroneous. Typical causes for this error message include: incorrect Sensor/Port setup in the instrument, a dirty sensor or bad buffer solution.

6.4. YSI ProPlus Grab Sample Measurement Procedure: pH and Conductivity

1. Install the pH and conductivity cable if the cable is not already connected to the meter. Push together firmly and then twist the outer ring until it locks into place. It is important that the entire sensor connector and cable connector ends be dry when installing, removing or replacing. This will prevent water from entering the port.
2. Turn the meter ON.
3. Remove the storage cover.
4. Rinse the probe three times with DI water.

5. Immerse the probe into the sample bottle so the sensors are completely submerged and then gently move the probe to release any air bubbles. Allow both the pH, conductivity, and temperature to stabilize.
6. Record the readings into the field data log. Confirm that the correct units are used (pH, $\mu\text{S}/\text{cm}$, and $^{\circ}\text{C}$).
7. Rinse the sensors with DI water three times and dab dry with kimwipes. Cover with storage container; keep a small amount of tap water in the pH sensor container during storage. Be sure the water volume is small enough to not cover the pH sensor, as this may damage the glass sensor. This maintains a 100% saturated air environment which is ideal for short-term sensor storage. Confirm that the storage vessel is properly sealed
8. Turn meter OFF.
9. At the end of the day, clean the conductivity electrodes using a small brush and clean water. Insert the brush into each hole 10 to 12 times. If deposits have formed on the electrodes, use a Dow Bathroom Cleaner with the brush.
10. Rinse thoroughly with clean water.
11. Rinse the pH sensor with DI water three times and dab dry with kimwipes.
12. Install the storage sleeves and store probe in calibration/storage cup filled with 1/8" of tap water (**never use distilled or deionized water to store probe**). Confirm that the storage vessels are properly sealed.

Note: The key to storing the pH sensor is to make certain that the sensor does NOT dry out. Sensors which have dried out may be irreparably damaged by dehydration. Always maintain a *small* amount of tap water in the storage vessel. The sensor needs to be kept in a moist (*not submerged*), sealed environment.

7. Records Management

- 7.1. All hardcopy documentation of the data, such as the completed Field Log will be reviewed, verified, and entered into a database after being approved by WSDOH's project manager.
- 7.2. All calibration and field records should include: the instrument manufacturer, model number, the standards used to calibrate the instruments (including source), the calibration date and time, instrument readings, the post-calibration check and the name of the person(s) who performed the calibration. An example of the Field Log and calibration record is shown in the Appendix.

8. Quality Control and Quality Assurance Section

- 8.1. The Sensor and Meter should be calibrated before each use and checked again for accuracy using standards following calibration measurements.
- 8.2. Although field instruments are robust, they should still be handled carefully.
- 8.3. All procedures should be completed in accordance with the project Quality Assurance Project Plan.

9. Safety

- 9.1. Review all attached MSDS before handling standards.
- 9.2. Wear gloves when handling wastewater and Standards.
- 9.3. Wear goggles when testing wastewater and handling standards.
- 9.4. Wash hands after calibration and exposure to wastewater.

9.5. When using equipment in the field, be aware of your surroundings. Select an area in which you are safe and secure from hazards.

10. References

American Public Health Association (APHA) (2005). *Standard Methods for the Examination of Water and Wastewater*. 21st ed. A.D. Eaton, L.S. Clesceri, E.W. Rice, and A. E. Greenberg, eds. APAH-AWWA-WEF, Washington D.C.

YSI Incorporated (2009) *Professional Plus User Manual*

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YSI Incorporated (2009) *Professional Plus Calibration Tips*

<http://www.yisi.com/media/pdfs/YSI-Professional-Plus-Calibration-Tips.pdf>

YSI Incorporated (2009) *YSI Model 30 and YSI Model 30M Operations Manual*

<http://www.yisi.com/media/pdfs/030136-YSI-Model-30-Operations-Manual-RevE.pdf>

YSI Incorporated (2008) *YSI EcoSense pH100 Operations Manual*

<http://www.yisi.com/media/pdfs/605367-YSI-pH100-Operations-Manual-English-Deutsch-Espanol-Francais-Italiano-RevE.pdf>

Appendix A: Back-up Meter Standards of Procedure

YSI pH100 (Back-up) pH Meter and Probe Calibration

Calibration Frequency: Prior to each day of usage.

The pH100 uses a 2-point calibration. The first point must be a 7.00 standard, and the second either a 4.00 or 10.00.

1. Turn the unit on. Connect the pH electrode to the BNC connector and the ATC/Temp probe to the ATC/Temp connector of the unit; The display should read“ATC,,” Press MODE until “pH” displays. Autolock should be ‘off’.
2. Place the pH and ATC/temp probes into the first, 7.00 standard solution. Allow temperature readings to stabilize, then press and hold “STAND” for 3 seconds to calibrate. Once the unit calibrates the first point, “SLOPE” flashes. Record the reading in the calibration data log.

NOTE: If no temperature probe is connected, adjust the temperature reading to that of the first standard using the Δ or ∇ keys (0.0 to 60°C) BEFORE pressing “STAND”.

3. Rinse the pH and ATC/temp probes in distilled water three times, then place into the second, 4.00 standard solution. Allow temperature readings to stabilize, then press “SLOPE” to calibrate. The second point has been calibrated. Record the reading in the calibration data log.
4. .NOTE: If no temperature probe is connected, adjust the temperature reading to that of the first standard using the Δ or ∇ keys (0.0 to 60°C) before pressing “SLOPE”.
5. The unit calculates and compensates for the pH electrode slope deviation corresponding to the values of the two calibration standards. The unit is now dual-point calibrated and ready for measurements. After calibration, press and hold MEA. /EFF. for about 5 seconds to display the new electrode efficiency.

YSI pH100 (Back-up) Direct In-Situ Sampling Procedure

1. Turn meter on.
2. “STAND” and “SLOPE” must display steadily, indicating the unit is dual-point calibrated and ready for measurements. If either is blinking, recalibrate the meter.
3. Rinse the pH electrode with distilled water three times then immerse in the sample. Remove any air bubbles trapped around the probe by shaking or stirring the probe. Allow pH to stabilize.
4. Record the readings in the field data log.
5. Clean the sensor using distilled water.
6. At the end of data collection, verify the instrument’s calibration, place the sensor in its calibration environment and check to see that the pH reading is correct.
7. Rinse with DI water three times.

YSI Model 30 (Back-up) Conductivity and Temperature Meter and Probe Calibration

Calibration Frequency: Prior to each day of usage.

1. Turn the instrument on and allow it to complete its self test procedure.
2. Select a calibration solution which is most similar to the sample you will be measuring (1 mS/cm conductivity standard).
3. Place at least 3 inches of solution in a clean glass beaker.
4. Insert the probe into the beaker deep enough to completely cover the oval shaped hole on the side of the probe. Do not rest the probe on the bottom of the container -- suspend it above the bottom at least 1/4 inch.
5. Press the **MODE** key until the instrument is reading conductivity or specific conductance.
6. Allow at least 60 seconds for the temperature reading to become stable.
7. Move the probe vigorously from side to side to dislodge any air bubbles from the electrodes.
8. Press and release both the **UP ARROW** and **DOWN ARROW** keys at the same time. The **CAL** symbol will appear at the bottom left of the display to indicate that the instrument is now in Calibration mode.
9. Use the **UP ARROW** or **DOWN ARROW** key to adjust the reading on the display until it matches the value of the calibration solution you are using.
10. Once the display reads the exact value of the calibration solution being used (the instrument will make the appropriate compensation for temperature variation from 25°C), press the **ENTER** key. The word “**SAVE**” will flash across the display for a second indicating that the calibration has been accepted. Record the calibration reading in the calibration data log.

NOTE: If the up or down arrow keys are not pressed during the calibration process, the “SAVE” message will not be displayed since the calibration value has not changed. If an error occurs during calibration, see Section 9 in the Operations Manual, *Troubleshooting*.

YSI Model 30 Conductivity and Temperature (Back-up) Direct In-Situ Sampling Procedure

1. Once the batteries are installed correctly, press the **ON/OFF** key. The instrument will activate all segments of the display for a few seconds, which will be followed by a self test procedure which will last for several more seconds. If the instrument were to detect a problem, a **continuous** error message would be displayed. See Section 9 of the Operations Manual, *Troubleshooting* for a list of error messages.
2. After the self test procedure is complete, the temperature will be displayed in the lower right of the display and the instrument is ready to make a measurement. Simply insert the probe into the liquid sample. It is important that the probe be inserted into the liquid deep enough so that the hole on the side of the probe is completely covered by the liquid. If possible, do not allow the probe to touch any solid object while you are taking readings; this may affect the reading slightly. Additionally, it is important that there not be any air bubbles around the probe

electrodes. To dislodge any bubbles which might have formed, move or shake the probe vigorously several times before recording the measurement.

3. Make sure that you are recording the correct reading- Conductivity. To confirm that you are in the Conductivity mode the large numbers will be followed by a μS or mS *AND* the $^{\circ}\text{C}$ display will *NOT* be flashing.
4. Wait for the reading to stabilize and record the value in the field data log.
5. Rinse the conductivity cell with clean water after each use.
6. At the end of data collection, verify the instrument's calibration, place the sensor in its calibration environment and check to see that the conductivity reading is correct.
7. Before storing, clean the conductivity cell. Dip the cell in a cleaning solution and agitate for two to three minutes. Use Dow Chemical Bathroom Cleaner. Remove the cell from the cleaning solution.
8. Use the nylon brush (supplied) to dislodge any contamination formed inside the electrode chamber.
9. Rinse the cell thoroughly in DI water and store the conductivity cell in the meter storage chamber with the moist sponge to maintain a 100% humid environment.
10. For storage >30 days, remove the batteries form the instrument. Moisten the sponge in the chamber and inspect the sponge every 30 days to make sure it is still moist.