

**Colorado Department of Agriculture
Groundwater Protection Program**

Calibration Procedure & Log

Instrument Relevancy: YSI 556-MPS & YSI ProODO
Most Recent Version Date: March 2013

Calibration Procedure/Information For YSI 556 MPS Probe

Keys

- It is important to calibrate instrument in a constant temperature environment as many of the variables being determined are temperature dependent
 - If calibrating in the field, it may benefit to place the Cal Cup assembly inside a cooler in order to minimize temperature drift especially when ambient air temperatures are greater than calibrant solution temperature
- If any of the following variables come back with an error of “Out of Range” during the calibration attempt because of having to use a temperature adjusted calibrant value, then you may need to ‘Uncalibrate’ the sensor being calibrated and try again
 - Uncal is accomplished by pressing Enter + Escape at the same time when you are at the screen asking for the calibrant value for the probe being calibrated
 - It is not good to uncalibrate the probes frequently

Procedure

- 1) Ensure thermistor is calibrated and reading correctly
 - This needs to be done at the beginning of the season by a certified service technician
 - It is important to occasionally check the temperature accuracy throughout the field season since all other calibration/measurements depend on the accuracy of the temperature sensor.
- 2) Calibrate EC
 - Fill Cal Cup $\frac{3}{4}$ full with EC Solution and screw onto sonde
 - Thoroughly agitate solution so it fully rinses probes; empty solution
 - Re-fill Cal Cup $\frac{3}{4}$ full with EC solution and calibrate
 - On Controller navigate to Calibration Menu → Conductivity → Specific Conductance
 - Enter **appropriate** calibrant value to stabilize on
 - **Wait** for reading to stabilize, **record** reading, **then** press Enter
 - If confronted with error of “Out of Range”, then it will be necessary to ‘uncalibrate’ the probe and retry calibration
 - Upon successful calibration, remove Cal Cup, empty calibrant solution and thoroughly rinse cup and probes with D.I. H₂O
- 3) Calibrate pH
 - On Controller, navigate to Calibration Menu → pH → 2 point (3 point optional)
 - Follow instructions on controller: Measure Neutral pH FIRST, then measure other value(s)
 - Thoroughly agitate and rinse cal cup and probes once with calibrant solution
 - Refill cal cup with pH calibrant solution and calibrate
 - When prompted, enter **appropriate**, temperature-dependent value for calibrant
 - **Wait** for pH reading to stabilize, **record** pH reading, temperature, and millivolt reading, **THEN** press Enter
 - If confronted with error of “Out of Range”, it may be necessary to ‘uncalibrate’ the probe and retry calibration
 - Repeat above for other pH points making sure to thoroughly rinse the Cal Cup and probe with D.I. H₂O **and** new calibrant solution between calibrant solutions

- Thorough rinse the Cal Cup with D.I. H₂O
- 4) Calibrate ORP
- Fill the Cal Cup ¼ full with ORP Calibrating Solution and thoroughly rinse pH/ORP sensors, empty solution
 - This solution gets easily contaminated, keep lid on bottle when not in use
 - Refill Cal Cup with ORP calibrant
 - On Controller, navigate to Calibration→ORP
 - Enter the **appropriate**, temperature-dependent value for the calibrant
 - **Wait** for reading to stabilize, **record** measurements, **then** press Enter
 - Thoroughly rinse the probe and Cal Cup with D.I. H₂O as the ORP Calibration Solution can leave a hefty residue which may foul some sensors
- 5) Calibrate D.O.
- It takes the D.O. sensor 15 minutes to activate after the controller is turned on, so calibrating D.O. prior to activation will result in an inaccurate calibration
 - Place about 1/8" of tap water in Cal Cup
 - Place sonde in Cal Cup and screw cup onto just one thread, so atmosphere can interact
 - **Wait** for reading to stabilize, **record** reading, **then** press Enter
 - It is common for the D.O. value to drop down and then rise back up before coming to a stable state.
 - Calibration Key:
 - About 82.1 % is ideal at an altitude around 5300 ft
 - The Controller has an on-board barometer that will adjust the D.O. readings for altitude
 - The procedure should not take more than 15 minutes
- 6) After calibrating the necessary parameters check the Calibration File
- From Main Menu→File→View File
 - Select File and navigate to bottom right corner of file with the arrow keys
 - Calibration Keys:
 - pH Calibration
 - The first gain reading is from when the instrument was turned on and the second gain reading is from after the calibration
 - The **perfect** pH Gain is -5.05 mV
 - When this value is near or less than -6.0 mV there is something wrong with the pH probe
 - When calibrating 2 points (7 & 10) the mV readings help tell the story
 - If the difference between the two values is around 175 mV then the probe is functioning efficiently
 - The farther from 175 mV the difference gets then the more likely the probe needs replacing
 - Low confidence ORP values may also point to a problem with the probe
 - D.O. Calibration
 - The first gain reading is from when the instrument was turned on and the second gain reading is from after the calibration
 - The ideal D.O. Gain is between 0.90 and 1.0
 - When the value drops below 0.90 two things should be checked:

- First, check the membrane to ensure that it is not broken
 - Second, it may be necessary to clean the gold & silver portions of the sensor as they may have become oxidated
 - When cleaning, BE SURE to use a different piece of sand paper (always wetted) for the different metal types
- 7) When finished calibrating, place about 1/8" of **tap-water** in the Cal Cup and secure it to the sonde for storage
- The unit can be stored this way for up to 2 weeks
 - If storage over 2 weeks:
 - Remove the pH probe and store it in pH 4.0 Buffer Solution
 - Remove blue D.O. lens cap and replace with black storage lens cap (dry)
 - After removing probes, place plugs in ports, replace dry cal cup, be sure to keep track of which probe goes in which port (they are numbered on the sonde)

Calibration Procedure/Information For YSI Pro-ODO Probe

Keys

- The calibration of optical based dissolved oxygen meters is very stable but YSI still recommends that it be verified on a regular basis to ensure accurate data
- Ensure that no water droplets are on the membrane of the sensor during calibration in order to ensure accurate readings
- For the best calibration results, it is very important to have the DO system in an environment where the temperature is stable and does not change prior to, or during the calibration procedure
- For electrochemical sensors in spot sampling applications, it is required to calibrate daily, but not between samples

How to verify my calibration?

- Place the sensor in its calibration environment and check to see that the instrument is reading the calibration value for the **current** barometric pressure
 - The YSI Pro-ODO has an on-board barometer (so does the YSI-556MPS)
- Take the barometric reading and divide it by 760 (maximum possible mmHg) and then multiply by 100 to get what the “TRUE” water-saturated air or air-saturated water reading should be
- A post-check can also be performed with this value in mind. If, for example, you calibrate your instrument to 98% and then conduct your D.O. testing, you can place the sensor back into the same calibration environment and it should read +/- 2% for polarographic sensor and +/- 1% for optical sensor, of 98% once stable

How often should the membrane of an electrochemical sensor be replaced?

- As a general rule, YSI recommends that the membrane be changed every 2-8 weeks. This is dependent on the sampling application.
 - Keeping the membrane clean and in a moist environment between used will lengthen the membrane life
 - When measuring in clean water, membrane changes can easily go beyond 4 weeks without negative effects

How often do electrochemical sensor electrodes need to be cleaned/serviced?

- Maintaining electrochemical sensors is relatively easy but is only necessary when the sensor no longer performs to factory established specifications.
- When calibrating, YSI instruments perform a sensor performance check. If the sensor is outside of its normal working parameters, the instrument will give an out of range indication.
- **Before** cleaning electrodes, **always** try fresh probe electrolyte solution and a new membrane.
- It is normal for a polarographic sensor’s silver (Ag) anode to darken over time due to the build-up of silver chloride. This typical darkening will not affect the sensors performance so do not clean the electrodes just because they ‘look dirty’

- Long-term exposure to hydrogen sulfide can cause darkening of the anode that will influence a sensors performance
- Typical symptoms will be jumpy readings, inability to calibrate and/or low probe current, both of which may respond well to cleaning. Typically, the electrodes will require cleaning/servicing about once per year

How often should I replace an Optical sensing element?

- The optical sensing element is warranted for 1 year but may last longer. Be sure to keep the sensing element clean and stored in a moist environment between uses to obtain the longest usable life possible.

Procedure to calibrate D.O. sensor in water-saturated air environment

1. In the calibration cup or sensor sleeve place a small amount of D.I. H₂O.
2. Loosely screw on the calibration cup, or place the sleeve around, the sensor ensuring the following:
 - a. That there is venting to allow for atmospheric interaction
 - b. That **NO** water droplets are on the surface of the membrane
 - c. That the calibration environment is kept in a near static temperature
 - i. Definitely do not conduct calibration in direct sunlight
 - ii. If conducting calibration when ambient temperatures are greater than the initial temperature of the water being used in the calibration cup or sensor sleeve, place the setup into either a cooler with liquid ice or the electric cooler to obtain a static temperature
3. From the barometer measurement on the instrument (both the YSI-556MPS and the YSI Pro-ODO have an onboard barometer), calculate the % DO Saturation that the sensor would read if it was 100% accurate.
 - a. $\text{Barometer Reading in mmHg} / 760 \text{ mmHg} * 100 = \text{Maximum \% Saturated DO possible at local elevation}$
4. If the unit is within +/- 2% for a electrochemical sensor or +/- 1% for an optical sensor, then no calibration is needed. If the unit is outside of this limit then calibration is required
5. To start calibration, enter the DO calibration mode:
 - a. On the YSI Pro-ODO press the **Cal** button, then select DO, then select DO %
 - b. On the YSI 556-MPS navigate to Calibration → DO and select % DO
6. Then be sure confirm or accept the local barometric reading from the instrument's onboard barometer
7. After the temperature and DO readings have stabilized within a water-saturated air calibration environment, then press enter to accept the calibrated reading
8. Be sure to log the stabilized calibrated value in the calibration environment just prior to accepting; and also, log the instruments % saturation DO reading after accepting the calibration

**Colorado Department of Agriculture
Groundwater Protection Program Monitoring
Record of Calibration - YSI 556 MPS/YSI Pro-ODO**

Date of Calibration				
Time of Calibration				
Current Network Being Sampled				
Personnel doing Calibration				
YSI-556 MPS Battery Check (%)		YSI Pro-ODO Battery Check (%)		
Specific Conductance Lot #		Exp Date		Date Opened
Temperature	Calibrant Value ($\mu\text{S cm}^{-1}$)	Stabilized Value	Accepted?	
pH 2 Point 3 Point				
Parameter	Lot # / Exp Date / Date Opened	Stabilized Value @ T ($^{\circ}\text{C}$)	mV Reading	Accepted?
pH 7.0 Buffer (0 ± 50 mV)				
pH 10.0 Buffer (-165 to -180 mV)				
pH 4.0 Buffer (+165 to +180 mV)				
Span between pH4 and 7 and 10 should be 165-180 mV			Total mV	
			pH Gain	
ORP - Calibration Solution Lot #				
Exp Date		Date Opened		
Calibrant Value @ T ($^{\circ}\text{C}$)	Stabilized Value	Temperature ($^{\circ}\text{C}$)	Accepted?	
Dissolved Oxygen:				
			0.7 - 1.4	
Stabilized Reading (%Sat/mg L⁻¹)	Temperature (oC)	Barometer (mmHg)	D.O. Gain	Accepted?
Calibration Successful?				
Calibration Notes:				
PRO-ODO Calibration [True % Sat D.O. = (Baro Reading / 760) * 100 = Reading should be +/- 1% of this]				
Barometer Reading (mmHg)				
% Saturation in Calibration Environment (Hydrated Probe Cup & Stable Temp)				
TRUE % Saturated D.O.				
% Saturation / Temperature ($^{\circ}\text{C}$) after ACCEPTING Calibration				
YSI Calibration Confidence Solution - Calibration Check				
Date/Time Measured	Lot #	Exp Date	Date Opened	
	Temperature ($^{\circ}\text{C}$)	SEC ($\mu\text{S cm}^{-1}$)	ORP (mV)	pH
YSI Confidence Solution				
YSI-556 Post-Cal Readings				
Variability (over/under)				