Multiparameter Instrument Calibration and Maintenance

Since most of the SWAMP entities conducting field data measurements utilize Hydrolab and YSI products, this section was included to address Hydrolab and YSI equipment calibration and maintenance. If another multiprobe instrument (Solomat or Horiba, etc.) is being used, refer to the manufacturers' instruction manual, and if possible, provide such information to the SWAMP QA program, so it can be included in future QAMP revisions. Manufacturers' maintenance and calibration instructions for all instruments are to be kept for reference. All calibration and maintenance activities must be recorded in a SWAMP Multiprobe Calibration Logbook.

Dissolved Oxygen Sensor

Oxygen meters use a polarographic electrode to measure the dissolved oxygen concentration in water. The instrument senses the partial pressure of oxygen at the surface of the membrane, rather than the actual concentration of oxygen (weight/volume). The relationship between partial pressure and concentration is dependent upon atmospheric pressure and temperature when a reading is made in the air (i.e., during the air calibration procedure), whereas, the equilibrium solubility of oxygen in water is influenced by temperature, salinity, and pressure (of the gaseous phase).

Corrections for these factors must be made either by the instrument, by the user during calibration or after readings are taken. The Winkler titration directly measures oxygen equivalents and reports dissolved oxygen concentration (weight/volume) in a form that requires no corrections.

Dissolved Oxygen Sensor Calibration

Hydrolab Instruments

Precalibration

Clean the Sonde and stirrer under running tap water to remove debris. Swab the D.O. membrane and pH probe with a cotton ball, soaked in Alconox or methanol. This will remove surface films that may cause the calibration to drift. Check the condition of the membrane. The membrane must be intact and free of wrinkles, bubbles, and surface films and not discolored below the membrane.

Calibration

Remove the D.O. sensor guard and invert the multiprobe with the calibration cup attached.

Fill the calibration cup with water to just below the O-ring securing the D.O. membrane. Carefully remove any water droplets from the membrane (kimwipe or soft towel).

Cover the calibration cup with the inverted plastic storage cup lid and allow to stabilize for about five (5) minutes.

Select Calibrate, (%) Saturation and then enter the correct barometric pressure (mm-Hg) and hit enter.

Barometric Pressure

Obtaining the correct barometric pressure is essential in calibrating the DO sensor. A detailed discussion on obtaining the uncorrected absolute barometric pressure follows.

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Absolute Barometric Pressure

Where to Get Barometric Pressure

Barometer: Absolute barometric pressure is defined as what a mercury barometer would read in the room where the calibration is taking place. There are several options for determining barometric pressure. The most direct method is to read a hand-held or fixed mounted barometer. The barometer displays the absolute barometric pressure, so corrections are not required.

Weather Reports: The second option is to obtain a barometric pressure reading from a local weather office, radio/television station, weather radio, or other source. Many local television stations have web sites or links to web sites where local weather information, including barometric pressure, is continuously updated.

Uncorrecting Barometric Readings Corrected to Sea Level

Most barometric readings obtained from local and Internet sources are corrected to sea level (the effect of altitude is removed) and reported in inches of mercury. Sometimes they are reported as altimeter readings in inches of mercury. Convert the barometric reading reported in inches to millimeters (mm) by multiplying inches by 25.4. The Acorrected≅ barometric pressure value will always be available; however, you may ask for the Auncorrected≅ barometric pressure. Many stations can provide this absolute reading. The Auncorrected≅ barometric pressure reading (after conversion to mm) can be directly entered, provided the weather station is located nearby and at the same general elevation.

If the barometric pressure reading supplied is corrected to sea level, obtain the local altitude where the instrument is being calibrated in feet above sea level (from a USGS topographic map or other source) and use the following equation (the equation is also located on each calibration log sheet) to account for altitude.

To decorrect the barometric pressure that was set to sea level:

Barometric Pressure (BP) = Corrected Barometric Pressure (CBP) -2.5 (A/100)

Where: BP = estimated absolute barometric pressure

CBP = local barometric pressure corrected to sea level (from weather bureau other source; convert reading supplied in inches to mm; inches x 25.4 = mm

2.5 = a constant, atmospheric pressure decreases 2.5 mm Hg for each increase in altitude of 30.5 meters (100 feet)

A = local altitude in feet above mean sea level

Example: A barometric pressure reading of 29.50 inches Hg, corrected to sea level and an altitude of 650 feet above sea level is uncorrected by:

29.5 inches x 25.4 = 749 mm Hg

BP = 749 mm - 2.5 (650/100)

BP = 732.8 mm Hg

The above equation should be posted in the laboratory or site where the instruments are routinely calibrated. Once an initial calculation is made, the back half of the equation, i.e., 2.5 (A/100), will then be constant and can be subtracted from the corrected barometric pressure.

If an instrument needs to be calibrated at a remote location where the barometric pressure is not available from the usual sources, the barometric pressure can be estimated from the following equation:

Barometric Pressure (BP) = 760 - 2.5 (A/100)

Example: If the altitude at the site of calibration is 1,200 feet above sea level, the estimated barometric pressure is:

BP = 760 - 2.5 (1200/100)
BP = 730 mm Hg

YSI Instruments

DO Calibration Procedure for Instantaneous Sampling

- When using the Model 600xlm or Model 6920 for instantaneous sampling the auto sleep must be disabled. From the Main Menu, select Advanced and then Setup. If the Auto Sleep functions are enabled, select Auto Sleep RS232 and Auto Sleep SDI12 and press Enter to disable.
- Place approximately 1/8 inch of water in the bottom of the calibration (transport) cup. Dry the probe. Place the probe in the cup. Make certain that the DO and temperature probes are not immersed in the water. Engage only one thread of the calibration cup to insure the DO probe is vented to the atmosphere. Wait at least 10 minutes for the air in the calibration cup to become water saturated and for the temperature to equilibrate.
- From the Calibrate Menu, select "Dissolved Oxygen", then DO% to access the DO% calibration procedure.
- Enter the current barometric pressure in mm of Hg (inches of Hg x 25.4 = mmHg).
- Observe the temperature and DO readings and when there is no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration had been accepted and to press Enter again to return to the Calibrate Menu.
- Record calibration information (see AYSI Calibration Record Form≅ in Appendix E).

DO Calibration Procedure for Unattended Sampling (Logging)

- When using the Model 600xlm or Model 6920 in the unattended mode the auto sleep must be enabled. From the Main Menu, select 8-Advanced and then 2-Setup. Ensure that 5-Auto Sleep RS232 and 6-Auto Sleep SDI12 are enabled. If the Auto Sleep functions are not enabled, select 5-Auto Sleep RS232 and 6-Auto Sleep SDI12 and press Enter to enable.

Follow the calibration procedure described above.

- A countdown timer for the DO warm-up time is activated. After DO warm-up is complete, the readings just before and after calibration are displayed. A message

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saying press Enter to continue will appear. When Enter is pressed, the screen will return to the DO calibration menu.

DO warm-up time should not be decreased; it may be increased to yield better results. Contact YSI before adjusting the DO warm-up time.

pH Sensor

When single function pH meters are used, pH is calibrated for each day of use, and as necessary and appropriate, at each sampling site, or whenever necessary during the sampling event (changing matrices, questionable results, etc.). The pH system is calibrated with a buffer of pH 7.0 and either 4.0 for naturally acidic waters or pH 10.0 for alkaline waters.

The pH buffers contain high concentrations of phosphate. Care must be taken during calibration to avoid leaving traces of buffer on equipment or at the work place that could contaminate water samples. Buffer solutions prepared in the field offices from reagent powder or concentrate are labeled with date of preparation and replaced after one month.

Multiprobe pH Sensor Calibration

Hydrolab Instruments

- Before calibration, check the condition of the probes. The probes must be intact and free of surface films. The probes can be wiped with cotton soaked in mild detergent or methanol.
- Remove the storage cup from the Sonde and replace with the calibration cup. Before calibration, rinse the sensors twice with deionized water. Use the rubber cap to cover the calibration cup and shake. Rinse a minimum of two more times with pH 7 buffer.
- Completely fill the calibration cup with pH 7 buffer. After allowing the pH to stabilize for two (2) minutes use the temperature reading to determine the pH 7 calibration value (or standard).
- Refer to the SWAMP *Multiprobe Calibration Logbook* for a table of pH calibration values adjusted for temperature. Correct the initial pH value to match the calibration value and save calibration.
- Record the initial value, value of standard, calibrated to value and temperature in the *SWAMP Multiprobe Calibration Logbook*.
- Repeat this procedure with either pH 4 or 10. Choose a pH buffer which best represents the pH of the area to be monitored.

YSI Instruments

Two-Point Calibration

pH 7

Place enough pH 7 buffer into a clean, dry or pre-rinsed calibration cup to immerse the pH probe, reference junction, and thermistor. Allow at least one minute for the temperature to equilibrate before reading.

From the Calibrate Menu, select ISE 1 pH to access the pH calibration choices; then press 2 Point (or 3 Point). Press Enter and input the value of the buffer at the prompt. Press Enter and the

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current values of all enabled sensors will appear on the screen. Observe the pH mV reading. This value should range from -40 to +40.

Observe the pH reading and when it shows no significant change for approximately 30 seconds, press Enter. The display will indicate that the calibration is accepted.

After the pH 7 calibration is complete, press Enter again to continue. Rinse the Sonde in water and dry the Sonde before proceeding.

pH 4 or 10

Next, place enough pH 4 (or 10) buffer into a clean, dry or pre-rinsed calibration cup to immerse the pH probe, reference junction, and thermistor. Allow at least one minute for the temperature to equilibrate before reading. Observe the pH mV reading. This value should range from 140 to 220 in pH 4 buffer and -140 to -220 in pH 10 buffer.

Press Enter and input the value of the second buffer at the prompt. Press Enter and the current values of all enabled sensors will appear on the screen.

Observe the pH reading and when it shows no significant change for approximately 30 seconds, press Enter. After the second calibration is completed, press Enter again. If performing a 2-Point Calibration the screen will return to the Calibrate Menu.

Record calibration information (see AYSI Calibration Record Form≅ in Appendix E). Rinse the Sonde with water and dry. Rinse and dry the calibration cup for future use.

Three-Point Calibration

pH 4 and 10 (continued)

If a 3-Point Calibration is being performed, the prompt will request the value of a third buffer. Follow that same calibration procedures described above.

Conductivity Sensor

The conductivity system is calibrated with a solution of known specific conductance. Choose a standard solution with about the same conductance as the water to be sampled and calibrate with this solution. Conductivity standards are “one-shot” solutions – do not reuse the standard. The performance of the instrument can be determined by following with a lower standard but this step is not required.

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Conductivity Sensor Calibration

Hydrolab Instruments

Remove the storage cup from the Sonde and replace with the calibration cup. Before calibration, rinse the sensors twice with deionized water. Use the rubber cap to cover the calibration cup and shake. Rinse a minimum of two more times with the chosen standard solution. Fill the calibration cup with the standard and allow to stabilize. Correct the initial specific conductance value to match the standard value and save calibration. Record the initial value, value of standard, calibrated to value and temperature in the SWAMP Multiprobe Calibration Logbook.

YSI Instruments

< Pour enough standard into the calibration cup to fully immerse the cell and thermistor (Make sure the hollow indentation on the sonde is fully covered without any air bubbles trapped – see below.). The standard chosen should be within the same conductivity range as the ambient water to be measured.

NOTE: standards with conductivities less than 1 ms/cm (100 Φs/cm) are not recommended.

< Rinse the sensor twice with the conductivity standard. Place the probe into the standard solution and make sure that the probe is completely immersed, past the vent hole. Gently tap the side of the calibration cup to dislodge any air bubbles from the cell.
< Allow at least one minute for temperature equilibration to occur before processing.
< From the Calibrate Menu, select 1-Conductivity to access the calibration procedure or 1-SpCond to access the specific conductance calibration procedure. Enter the calibration value of the standard (Φs/cm or ms/cm at 25E C) and press Enter. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
< Observe readings under Specific Conductance or Conductivity and when they show no significant change for approximately 30 seconds, press Enter. The screen will indicate that the calibration has been accepted. Press Enter again and return to the Calibrate menu.
< Record calibration information (see AYSI Calibration Record Form≅). Rinse Sonde in tap or purified water and dry Sonde.

NOTE: This procedure calibrates conductivity, specific conductance, salinity and total dissolved solids.

Depth and Temperature Sensor

< Zero the depth sensor immediately prior to making the initial measurement with the instrument at the first station of the day.
< Several times a year or when a malfunction is suspected, check the temperature reading against an NBS thermometer to ensure suitable instrument performance.

Post-Calibration

Post-calibration must be performed after each day of use of the instrument and before any instrument maintenance is performed. The sooner this procedure is performed, the more representative the results will be for assessing performance during the preceding field

measurements. Calibration and post-calibration are no more than 24-hours apart. When the instrument is used several days in a row, the adjustments made during calibration on the following day can be recorded as post-calibration. The same care used in the initial calibration for rinsing the sensors and waiting for functions to stabilize is required when performing the post-calibration checks.

After making measurements at the last station of the day, fill the sampling cup with tap water (bring with you on field trip; not deionized water). Repeat the initial calibration procedures performed before the sampling trip. Record post-calibration values in the SWAMP Multiprobe Calibration Logbook (generally on the same page with the initial calibration for that sampling trip).

The purpose of the post-calibration is to determine if the instrument has held calibration during the period of sampling. The post-calibration values are compared to the expected values for the standards, so the field measurements for the day can be reported with confidence. The difference between the post-calibration value and expected standard value can be used to indicate both calibration precision and instrument performance.

Note: During the post-calibration make sure that the pH sonde is removed from the probe and stored in pH storage solution. Use the supplied plug to cover the pH connector on the probe.

General Maintenance

The following information applies to Hydrolab instruments. Please refer to the instrument manual or manufacturer for maintenance requirements specific to the YSI.

Storage Between Sampling Runs

The sensors must be kept moist. Thoroughly rinse the sensors with tap water upon return from the field. Put some tap water in the storage cup and screw onto the Sonde. The sensors do not have to be kept covered with the water, just moist.

Avoid extremes of temperature, especially high temperatures which exact a toll on the plastic and electronic components of the instrument. If the Sondes are to be stored where temperatures may fall below freezing, use a solution of 2 tap water and 2 methanol. When the battery pack is connected, the liquid crystal display is protected from freezing by an internal heating element.

Scheduled Maintenance

Hydrolab Multiprobes

The following is a schedule for minimum maintenance that must be followed, regardless of the use that the instruments get. This schedule has been developed from the record of instrument performance and consultation with the manufacturer.

After each sampling trip

Post-calibrate the instrument prior to general cleaning and maintenance. Following post-calibration, rinse off the sensors and store them in tap water. Do not use distilled or deionized water for storage. These are important steps in preventive maintenance that are done each day the instrument is used.

Multiparameter Instrument Calibration and Maintenance

The watertight rubber cable connectors must stay well lubricated and dry on the inside. The best procedure is to store the instrument with all connectors separated and open to the air. Check them regularly to ensure that the mated surfaces are covered with a thin film of white silicone. As necessary, use some tissue paper to remove old traces of silicone and dirt and then reapply the silicone.

Before calibrating

Clean off the sensors. Use a cotton pad and methanol or a mild solution of Alconox to clean the D.O. and pH probes. Cotton swabs or gauze pads are the only materials that will not scratch the soft glass of the pH probes. Paper, including lens paper, is not suitable.

Conductivity

Every two months or **once every 15 field trips**	Polish the conductivity electrode shaft and tips with emery paper. The O-rings on the electrodes are removed during the polishing process. Take care not to scratch the glass pH probe. Swab the conductivity cell block with a Q-tip soaked in methanol to remove dirt, grease and other substances. Rinse twice with deionized water. Inspect the small O-rings and replace if stiff, cut or flattened. Reassemble the components ensuring that the O-rings are wet. This will provide a proper seal. Rinse well with deionized water. If possible, let the conductivity electrodes stand in tap water overnight before calibrating again.

pH

***Every two months* or once every 15 field trips**	Wipe the pH probe with a Q-tip soaked in methanol. Replace the solution in the pH reference sleeve with 3M KCl (potassium chloride) solution in pH 7 buffer (225g KCl in 1 liter of pH 7 buffer) for 4000 series, Surveyor 2's, and DataSonde I's. Use a standard electrolyte (3.5 molar KCl saturated with silver chloride) for H20's, DataSonde 3's and 4's. Reporters, Recorders, and MiniSondes. Clean the plastic reference probe sleeve and fritted end piece inside and out with a Q-tip soaked in methanol. Wipe the internal glass reference bulb with a Q-tip soaked in methanol on 4000's series, Surveyor 2's, and DataSonde I's. Newer generation products (H20's, DataSonde 3's and 4's, Reporter, Recorder and MiniSondes) have a silver metallic post instead of glass. This post requires no cleaning or general maintenance. Rinse everything with deionized water before filling and reassembling. Always apply a thin layer of silicone to the O-rings. When replacing the sleeve, point the sensor down and push the sleeve up until it just covers the O-ring, then point the sensor up and continue to push the sleeve all the way to the base of the probe. This will purge air out of the sleeve and force electrolyte through the Teflon junction. Inspect the reference sleeve for air bubbles by observing the sensor while

Multiparameter Instrument Calibration and Maintenance

inverting the Sonde. If bubbles are present, repeat the filling procedure.

Multiparameter Instrument Calibration and Maintenance

pH Trouble Shooting

If pH still doesn't calibrate correctly, evaluate the condition of the Teflon junction on the terminal end of the pH reference sleeve. The sleeve should slide on easily with some force applied. If the sleeve is difficult to apply then the junction may have become clogged. In contrast, if the sleeve slides on too easily with little resistance the junction is too porous. In both instances the junction must be replaced.

If this does not solve pH problems then clean the probe by alternately soaking in 0.1 N HCl (hydrochloric acid) and 0.1 N NaOH (sodium hydroxide) for five minutes in each solution.

The small black caps that protect display unit terminals may be used to isolate the probes for soaking with these solutions. The glass pH and reference probes in 4000 series, Surveyor 2's, and DataSonde I's should also be cleaned at the same time. DO NOT use these solutions on the metallic posts of newer generation products (H20's, Reporters, Recorders, DataSondes 3 or 4 and MiniSondes). Reattach the calibration cup and fill with pH 4.0 buffer and allow the probe(s) to soak an additional 10 minutes. Thoroughly rinse with deionized water and refill the pH reference sleeve.

If these two procedures do not correct pH problems then a new probe may be required.

Batteries

Every two months or once every 15 field trips

Review the calibration and replacement schedule for batteries. Recharge the six-volt NiCad Gelcell batteries (nickel-cadmium or nickel-metal hydride) for 12 to 24 hours, regardless of the voltage displayed by the instrument.

Stirrer

Every two months or once every 15 field trips

Remove the magnetic metal wheel from the stirrer post. Thoroughly clean all lubricant, dirt and debris from the inside of the wheel and stirrer post with a paper towel and Q-tip. Reapply a very small amount of white silicone lubricant to the tip of the stirrer post.

Multiparameter Instrument Calibration and Maintenance

Dissolved Oxygen

Every six months or once every 15 field trips	

pH

Every 12 months	Replace Teflon junctions on pH reference sleeve. Spare junctions must be stored in a 2-5 molar (> 50,000 Φmhos/cm) KCl solution. Inspect the O-ring at the bottom of the Teflon junction and at the base of the reference sleeve. Replace if appear flattened or have small nicks/cuts.

Sonde

Every 12 months	Replace desiccant inside the display and Sonde units.

Multiparameter Instrument Calibration and Maintenance

YSI Multiprobes Minimum Maintenance Schedule

The following is a schedule for minimum maintenance that must be followed, regardless of the use that the instruments get. This schedule has been developed from the record of instrument performance and consultation with the manufacturer.

DO Probe (C.C. Lynch & Associates, Inc., 2001)

The KCl solution and membrane should be changed prior to each week of field work and at least once every 30 days. In addition, the KCl and membrane should be replaced if (a) air bubbles are visible under the membrane; (b) deposits of dried KCl appear on the membrane or o-ring; (c) the readings are unstable; (d) the DO charge reading is outside of the 50+/-25 range.

If the DO charge is higher than 75, DO probe maintenance should be performed. Remove the membrane and dry the probe completely with lens cleaning tissue. Next, hold the probe in a vertical position, place one of the fine sanding disks (in the 6035 DO Probe Reconditioning Kit) under your thumb, and stroke the probe face in a direction parallel to the gold electrode. The motion should be similar to that used in striking a match. Stroke the electrodes 10 times in each direction.

After completing the sanding procedure, rinse the probe face with water and wipe with lens cleaning tissue to remove any grit left by the sanding disk. After cleaning, thoroughly rinse the entire tip of the probe with water. Replace the KCl solution and install a new membrane

Important Notes: (1) Use *only* the fine sanding disks provided in the 6035 maintenance kits; (2) Sand parallel to the gold electrode.

Conductivity/Temperature Probe

The conductivity cell must be cleaned regularly to remove deposits formed on the electrode. The conductivity cell constant should be in the range of 4.5 to 5.5. Dip the cleaning brush into water and insert into each hole 15-20 times. A mild detergent may also be used to remove deposits from the electrodes. Rinse the cell with tap water followed by several rinses with deionized water.

After cleaning, check the response and accuracy of the conductivity cell with fresh standard. Check the cell constant to ensure the cell constant is in the specified range. Dry the sonde port and probe connector. Clean probe o-rings and apply a very thin coat of lubricant before installation.

The thermistor should be clean and free of debris. Clean with water and cotton swab. Use mild detergent and a cloth if necessary.

Note: To access the conductivity cell constant using the 610-D Display: From the main menu, select Smart Terminal, then choose Advanced, and choose Cal constants. To access the cell constant using the 610-DM Display/Logger: From the Main Menu, select Communications and then Smart Terminal. Select Advanced and then choose Cal constants. To access the conductivity cell constant using PC 6000 and 650 MDS or Ecowatch software, select 8-Advanced, press Enter, and then choose 1-Cal constants.

Multiparameter Instrument Calibration and Maintenance

pH Probe

Cleaning is required whenever deposits or contaminants appear on the glass surface of the probe. Use clean water and a cotton swab to remove all foreign material from the glass bulb. Then use a moistened cotton swab to carefully remove any material, which may be blocking the reference electrode junction of the sensor.

If good pH is not restored, perform the following procedure:

1. Soak the probe for 10-15 minutes in clean water containing a few drops of dishwashing liquid.

2. GENTLY clean the glass bulb with a cotton swab soaked in the acid.

3. Rinse the probe with clean water, wipe with a cotton swab saturated with clean water, and the rinse with water.

If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following cleaning steps:
1. Soak the probe for approximately 1 hour in a 1:1 dilution of commercially available chlorine bleach and water.

2. Rinse the probe with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the probe for a period of time longer than 1 hour in order to remove all traces of chlorine bleach). Then re-rinse the probe with clean water and re-test.

CAUTION: Dry the sonde port and probe connector and apply a very thin coat of O-ring lubricant to all O-rings before re-installation.

Note: The pH sonde has to be removed from the probe and placed into pH storage solution after every field event for storage! Use the supplied plug to cover the pH connector on the probe.

Depth Sensor

The depth sensor should be cleaned (after each deployment) or when readings become unstable. The depth module is located between the bulkhead and the sonde tube. One the side of the sonde, there is a circular cap with 2 or 4 small holes that protect the depth sensor. The cap cannot be removed, but a syringe is supplied in the maintenance kit to clean the pressure port. Fill, the syringe with clean water, place the tip of the syringe into one of the holes and gently force water through the pressure port. Ensure that the water comes out of the other hole. Continue flushing the pressure port until the water comes out clean.

CAUTION: Never try to remove the circular pressure port cap.

Multiparameter Instrument Calibration and Maintenance

Shelf Life of Reagents and Standards

The following is a guide for maintaining perishable supplies. Although some samples have an extended shelf life, they should be replaced when they exceed the manufacturers expiration date.

Specific Conductance Standards

Shelf life 1.5 years; same if stored in a vehicle.

pH Buffers

pH buffer solution	One month in a small container on the shelf; one month in a vehicle. Prepared solution that remains in the manufacturer's cubitainer can be used until the stamped expiration date.
pH buffer powder	Indefinite shelf life.
pH reference sleeve solution	(KCl) for multiprobe instrument; indefinite shelf life.

Dissolved Oxygen Reagents

Powder pillows	Shelf life eight years; same in a vehicle.
Starch solution	Unopened bottles have a shelf life of five years when protected from high temperatures; keep opened bottles stored in the refrigerator for up to one year; renew field kit monthly. The solution should be discarded immediately if signs of mold or other growth appear. The starch solution degrades rapidly at high temperatures.
Dissolved Oxygen (electrolyte)	Probe filling solution (electrolyte) for multiprobe instrument; indefinite shelf life as crystals or solution.

Storage of Multiparameter Field Instruments

The following information applies to Hydrolab instruments. Please refer to the instrument manual or manufacturer for long-term storage requirements specific to the YSI. **(Note: Is applicable for YSI as well).**

Long Term Storage

Field instruments are often stored for indefinite periods. For example, back-up instruments are used during repair of the primary instrument. The instrument cannot be kept in a perpetual state of readiness without regular maintenance.

Whenever multiprobes are to be stored for extended periods of time:

- < Thoroughly clean the sensors.
- < Remove installed batteries (AA batteries, C batteries, polarizing batteries).
- < Fill the storage cap about 3 full of tap water (if the multiprobe may be exposed to freezing temperatures a solution of 2 tap water and 2 methanol should be used).
- < Store away from direct sunlight. The instrument can be reliably reactivated for field use with minimum of effort the day before field use.

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Surface Water Quality Monitoring Multiprobe Calibration Logbook

SWAMP Multiprobe Calibration Logbooks should include the following information written in pencil or waterproof ink, and dark enough to permit photocopying. Each instrument should have its own logbook to facilitate efficient review of calibration and maintenance procedures. Hydrolab and YSI calibration log sheets are located in Appendix E.

- Date and time of calibration; initials of person conducting the calibration for each calibration of any instrument used to collect SWAMP data.
- Name and model number or other descriptor specific to the instrument being calibrated.
- Record of battery voltage if available.
- Record of instrument reading while immersed in the calibration standard before calibration.
- Record instrument reading while immersed in the calibration standard after calibration, i.e., the calibration value.
- Record out-of-region instrument maintenance including: date shipped for repair; date returned from repair; and description of repair/work.
- Record in-region instrument maintenance including: date of maintenance; description of maintenance activity, i.e., battery replacement, probe cleaning, membrane replacement, stirrer cleaning and reference solution replacement. Include periodic observations made on the condition of the D.O. membrane and notes on any sensor cleaning.
- Record any problems occurring during use in the comments section.
- SWAMP Multiprobe Calibration Logbooks are kept on file at each organization conducting field data measurements for SWAMP. They must not be discarded.

Post-Calibration Error Limits for Multiprobe Instruments

Parameter	Value
Dissolved Oxygen	∀0.5 mg/L
pH	∀0.5 standard units
Specific Conductance	∀5%
Temperature	∀1 EC, annual calibration check
Depth	∀0.2 at 1 m, annual calibration check

If post calibration values fall outside the error limits for D.O., pH, and specific conductance, data collected does not meet SWAMP Program QA. This data should not be reported. If post calibration measurements do not consistently fall within the error limits (and after in-house trouble shooting), the instrument should be returned to the manufacturer for maintenance. For depth and temperature, errors found during the annual check need to be corrected by the manufacturer.