Washington State Department of Ecology

Environmental Assessment Program

Standard Operating Procedures for Hydrolab DataSonde® and MiniSonde® Multiprobes.

Version 1.0

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Please note that the Washington State Department of Ecology's Standard Operating Procedures (SOPs) are adapted from published methods, or developed by in-house technical and administrative experts. Their primary purpose is for internal Ecology use, although sampling and administrative SOPs may have a wider utility. Our SOPs do not supplant official published methods. Distribution of these SOPs does not constitute an endorsement of a particular procedure or method.

Any reference to specific equipment, manufacturer, or supplies is for descriptive purposes only and does not constitute an endorsement of a particular product or service by the author or by the Department of Ecology.

Although Ecology follows the SOP in most instances, there may be instances in which Ecology uses an alternative methodology, procedure, or process.

SOP Revision History

Revision Date	Rev number	Summary of changes	Sections	Reviser(s)
June 2, 2010	1	Minor changes and updates	All except 2 and 8	Trevor Swanson
July 1, 2010		Recertified	All	Kammin

Environmental Assessment Program

Standard Operating Procedures for Hydrolab DataSonde® and MiniSonde® Multiprobes.

Introduction

DataSondes® and MiniSondes® are water quality multiprobes used by the Environmental Assessment Program (EAP) to measure pH, dissolved oxygen (D.O.), D.O. percent saturation, conductivity, temperature, depth, rhodamine dye concentration, Oxidation-Reduction Potential (ORP), and total dissolved gas (TDG) data. They can be used for short-term spot-sampling as the user moves from site to site throughout the course of a day, depth profiling, or long-term unattended monitoring at specified time intervals. Currently, EAP does not use Hydrolab sondes to gather chlorophyll *a*, blue-green algae, ambient light and photosynthetically active radiation (PAR), turbidity, ammonium, chloride, or nitrite data, but these nonstandard sensors are available through Hach/Hydrolab if needed.

Reservations for all Hydrolab equipment must be made on EAP's SharePoint site (http://teams/sites/EAP/Pages/Default.aspx). Click on "Hydrolab Reservations" and then "Hydrolab Reservations" to reserve Hydrolabs and related equipment. Equipment information and specifications are also on SharePoint. Go to. http://teams/sites/EAP/Pages/Default.aspx and click on "Hydrolab Reservations" to see all folders associated with Hydrolabs and their use.

1.0 Purpose and Scope

1.1 This document is the Environmental Assessment Program (EAP) Standard Operating Procedure (SOP) for using Hydrolab DataSondes® and MiniSondes®.

1.2 The information hereafter should be used for quick reference and additional information and is not a substitute for the Hydrolab user's manuals or mandatory training. Consult the appropriate manual for a complete guide of the proper use, calibration, maintenance, storage, deployment, and troubleshooting of Hydrolab sondes. For information on using rhodamine, TDG, ORP, and other nonstandard sensors, please consult the appropriate Hydrolab manual or Hach's website at http://www.hydrolab.com/ or contact a Hydrolab custodian.

2.0 Applicability

2.1 This SOP must be followed when using Hydrolab sondes. Hydrolab equipment is expensive and must be treated and maintained carefully. Anyone not following proper procedures is subject to losing rights to future use.

3.0 Definitions

3.1 Calibration: To standardize or correct sensors after determining, by measurement or comparison with a standard, the correct value.

3.2 Clark Cell: The Clark Cell dissolved oxygen sensor consists of two electrodes surrounded by an electrolyte solution and covered with an oxygen permeable membrane. As oxygen crosses the membrane, it is consumed in a chemical reaction which generates a small electrical current between the electrodes. The current measured is directly proportional to the amount of oxygen in the water sample. Since the oxygen is consumed from the water surrounding the sensor, the water must be replaced either by natural flow or the use of a circulator to prevent the readings from drifting downwards.

3.3 Conductivity: A measure of the ability of water to pass an electrical current. This parameter indicates the amount of dissolved substances (salts) present in the water.

3.4 D.O.: Dissolved oxygen in water, measured in mg per liter.

3.5 D.O.%: The percent saturation of dissolved oxygen in water.

3.6 LDO: Luminescent dissolved oxygen. The Hach LDO sensor cap is coated with a luminescent material. Blue Light from an LED strikes the luminescent chemical on the sensor. The luminescent chemical instantly becomes excited. As the excited chemical relaxes, it releases red light. The higher the oxygen concentration, the less red light given off by the sensor cap. The red light is detected by a photo diode. The time it takes for the chemical to return to a relaxed state is measured. The oxygen concentration is inversely proportional to the time it takes for the luminescent material on the sensor cap to return to a relaxed state. Between flashes from the blue LED, a red LED of known intensity is flashed. The red LED acts as an internal standard for reference comparison to the red light given off by the luminescent sensor cap. This comparison allows the sensor readings to remain stable for long periods of time.

3.7 Multiprobe: The combination of several sensors, probes, or probe assemblies into a complete, stand-alone piece of equipment, which simultaneously measures several parameters for profiling, spot-checking, or logging readings and data. A multiprobe is a multiparameter instrument.

3.8 NIST: National Institute of Standards and Technology.

3.9 ORP: Oxidation-reduction potential, (also known as Redox) is a measurement of the voltage at an inert electrode, reflecting the extent of oxidation of the water sample. The more positive the ORP of a solution, the more oxidized are the chemical components of the water (less positive indicates less oxidized, or more reduced).

3.10 PAR: A specific type of ambient light known as photosynthetically active radiation.

3.11 pH: A measure of the hydronium ion concentration of a solution. Solutions with a pH less than 7 are considered acidic, while those with a pH greater than 7 are considered basic. The pH is the negative logarithm of the hydronium ion concentration in solution. For example, if the hydronium ion concentration is 10^{-7}, the pH is 7.

3.12 Post-calibration (a.k.a. post-checking): Assessing the performance of a sensor - after use - by noting the variation from a standard, to ascertain necessary correction factors.

3.13 Profiling: Lowering a multiprobe through a water column to measure changes in parameter values with depth.

3.14 Rhodamine: Rhodamine is a synthetic red to pink dye having brilliant fluorescent qualities. It is often used as a tracer in water to determine the rate and direction of flow and transport. Rhodamine dyes fluoresce and can thus be measured easily and inexpensively with fluorometers or with a Hydrolab rhodamine sensor.

3.15 Sonde: Generic term for a water quality multiprobe.

3.16 TDG: Total dissolved gas is the total pressure of gaseous compounds dissolved in water, measured directly in units of mmHg, and also expressed as percent of saturation (ratio of dissolved gas pressure to ambient barometric pressure).

4.0 Personnel Qualifications/Responsibilities

4.1 You must be properly trained to use any Hydrolab equipment. A Hydrolab custodian or company representative can help fulfill the training requirement. See your supervisor for further details.

5.0 Equipment, Reagents, and Supplies

5.1 pH standard (a.k.a. buffer) solution (low or normal ionic strength)

5.2 Conductivity standard solution

5.3 Tap and deionized water

5.4 DataSonde® or MiniSonde® multiprobe

5.5 Surveyor (deck unit) and 5 meter cable

5.6 Profiling communication cable (longer than 5 meters)

5.7 Sonde calibration cup, other communication cables, charger, probe/sensor protection cage

5.8 Toolbox containing: extra parts (o-rings, screws, calibration cups, etc.), soft wipes, cotton swabs, silicone grease, pH reference solution, ethyl alcohol, D.O. sensor electrolyte and membranes, small scissors, Phillips and flathead screwdrivers, toothbrush, pliers, crescent wrench, tweezers, electrical tape, "AA" and "C" batteries, Allen wrenches for outer case and battery compartment, and other miscellaneous supplies.

5.9 Laptop and HyperTerminal or Hydras 3LT if applicable

5.10 Hydrolab manuals

6.0 Summary of Procedure

6.1 Calibration

6.1.1 Note: ORP, TDG, and rhodamine sensors are nonstandard and not covered in this SOP. To learn more about calibrating these and all other sensors, please see http://www.hydrolab.com/resources/VideoIndex.asp. TDG calibration procedures are also discussed in detail in a separate SOP (Pickett, 2006).

6.1.2 Make sure the sonde stirrer is turned off and the calibration cup is attached. Rinse the sensors three times with copious amounts of deionized or tap water, then one to three times with a small amount of the standard you are using. Discard and shake out. Clamp the sonde to a support stand and slowly pour the calibration standard over the sensors. Make sure the standard covers every sensor on the sonde because they make references to each other.

6.1.3 Always discard used conductivity standard after each use. It goes bad very quickly, especially the 100 µS standard. Opened conductivity standard bottles should not be kept longer than two weeks. pH 9.15 low ionic strength buffer solution fouls quickly as well, so check it against a new bottle if you've used it several times, or if it's been opened and stored longer than one month. Other standards should be carefully checked for expiration dates and possible fouling before each use.

6.1.4 Recommended Calibration Order

6.1.4.1 Conductivity (0, then your standard; bracket expected field readings if possible)

6.1.4.2 pH (7, then 10 or 4; bracket expected field readings if possible)

6.1.4.3 D.O. (LDO or Clark Cell)

6.1.4.4 Depth (if necessary)

6.1.4.5 Temperature is factory-calibrated.

6.1.4.6 TDG, ORP , and rhodamine (if needed)

6.1.5 Calibration Procedures

6.1.5.1 Start by cleaning the sonde (see section 6.3).

6.1.5.1.1 Conductivity: Dry off and buff the conductivity sensor with a cotton swab or paper towel to remove any oil or dirt. If you're calibrating a DataSonde 4a® or higher, first calibrate the dry sensor to 0.0 µS. Then cover all sensors with conductivity standard and calibrate using your standard (100, 1000, 10,000 µS or other; bracket expected field readings). If you're using a DataSonde 3®, skip the dry calibration and calibrate only once, using a standard in the range of your expected field readings.

6.1.5.1.2 pH: A two point calibration is most common. Cover all sensors with the pH standard. Always start with pH 7 standard, then 4 or 10; bracket expected field readings. If you're doing a three point calibration, start with pH 7 standard, then 10, then 4.

6.1.5.1.3 D.O. (Clark Cell): D.O. can be calibrated using air or a saturated water bath.

6.1.5.1.3.1 *Air Calibration:* Fill the sonde cup with tap water to just under the D.O. sensor o-ring, gently dry off the D.O. membrane with a cotton swab or soft cloth if necessary, and set the cap on top upside down. Wait about five minutes for equilibration, then calibrate the D.O.% saturation to 100.0 by entering the current barometric pressure. If you are calibrating in a location more that several hundred feet above sea level, make sure you are using the true local barometric pressure and not barometric pressure at sea level.

6.1.5.1.3.2 *Water bath calibration:* Place the sonde in a water bath which has had a bubbler running for at least 24 hours. Turn on the sonde and allow the D.O. sensor to equilibrate. Take two water samples from the bath and run Winkler titrations. Calibrate the sonde to the average of the two Winkler values.

6.1.5.1.3.3 D.O. (LDO): The LDO sensor can be calibrated using an air saturated water bath. Use tap water and make sure the temperature of the water you're using has stabilized and will not change more than 0.5 degrees C during calibration. Setting some tap water out overnight so the temperature stabilizes with the room temperature works well. Shake the water for 40 seconds. Fill the sonde cup with this water so the LDO sensor is covered and the water is just under the threads on the calibration cup. Set the cap on top upside down. Wait for equilibration, which may take a few minutes. Calibrate the D.O.% saturation to 100.0 by entering the current barometric pressure. If you are calibrating in a location more that several hundred feet above sea level, make sure you are using the true local barometric pressure and not barometric pressure at sea level.

6.1.5.1.4 Depth: Make sure nothing is blocking the depth port. Rinse out if necessary. Do not put anything down the port, the membrane damages easily. Put on the weighted sensor guard and turn the sonde upside down. Calibrate to zero. For more accurate results, calibrate in the field just prior to use.

6.1.5.1.5 Temperature is already factory-calibrated and cannot be recalibrated, but can be checked for accuracy using an NIST thermometer.

6.2 Field Use

6.2.1 Methods for profiling, spot-sampling, or long-term deployment vary and will be discussed during training. Basic methods are described in the Hydrolab user's manual. Tips for collecting more precise and accurate data while in the field are located at http://teams/sites/EAP/Hydrolab%20Reservations/Forms/AllItems.aspx. Remember, for the Clark Cell sensors to accurately measure D.O., it's best to deploy sondes in around 1 cubic foot per second of water flow.

6.3 Cleaning, disinfecting, and preparing sondes for the next user.

6.3.1 Clean all sensors before and after each use. Mild detergent and a soft toothbrush work well for general clean-up on most sensors. If extra attention is needed on specific sensors, follow the steps below.

6.3.1.1 Gently wipe the D.O. membrane with a cotton swab or soft wipe to remove any residue or oily build-up. If the membrane is torn, wrinkled, or otherwise compromised, replace it and the D.O. electrolyte solution and soak the sensor in water for at least 4 hours.

6.3.1.2 Gently wipe the glass pH sensor. If it's really dirty, a soft toothbrush may be used. Do not use alcohol. Replace the pH reference electrolyte solution and add two salt pellets after long-term storage or if pH takes a long time to equilibrate.

6.3.1.3 There is no need to clean the white pH reference sensor unless it's visibly dirty. Do not use alcohol. If the reference junction (on regular ionic strength sensors) is visibly fouled or electrolyte doesn't seep out when the junction is screwed back on, replace it with a new one.

6.3.1.4 Firmly wipe the conductivity electrodes with a cotton swab. Alcohol may be used if necessary.

6.3.1.5 Remove all iron shavings from in and around the stirrer.

6.3.1.6 Wipe down and rinse everything else and make sure there are no problems for the next user.

6.3.1.7 If you run into problems or something doesn't work properly, consult the troubleshooting section of a Hydrolab manual, call a Hydrolab technician directly (1-800-949-3766), or consult an experienced Hydrolab user. If a solution cannot be found, you must fill out the appropriate section(s) of the "Hydrolab problem-repair tracker" located at http://teams/sites/EAP/Hydrolab%20Reservations/Forms/AllItems.aspx.

6.3.1.8 If you're concerned about controlling invasive species, please see Jenifer Parsons or an experienced Hydrolab user. In most cases, washing with mild detergent or Simple Green®, while paying close attention to parts of the sonde that are hard to reach, should suffice. Other methods for decontamination are currently under review.

6.4 Short-term Storage (one day to three months)

6.4.1 Clean the sonde. Keep a minimal amount of tap water or pH 4 buffer (about ½ inch) in the plastic sonde cap when not in use. A clear pH 4 buffer without red dye is recommended for sondes equipped with a rhodamine sensor. Do not use any other type of water unless it's the only water available. If the sonde is equipped with a low ionic strength pH reference sensor, fill the rubber cap with pH reference solution and place it securely over the sensor.

6.5 Long-term Storage (over three months)

6.5.1 Follow the short-term instructions. In addition, remove external batteries, but do not remove the lithium battery which powers the sonde's internal time clock.

6.6 Troubleshooting

6.6.1 Visit http://www.hydrolab.com/ or consult the appropriate manual. The Hydrolab website and manuals have a lot of useful information not covered in this SOP and are easy to use. Manuals can be downloaded from the Hydrolab website and can also be found on the Hydrolab equipment shelves in the electronic storage room at the Operations Center (OC), in the drawers in the wet lab at the OC, or at the desks of field leads who frequently use Hydrolab equipment.

6.6.2 Call a Hydrolab custodian or a Hydrolab technician if problems arise that the manuals can't help you with. Hach's technical support line for Hydrolabs: 1-800-949-3766.

6.7 Equipment Repair

6.7.1 Every sonde will need sensor replacement or repair at some time. Follow these instructions for sending sondes to Hach/Hydrolab for repairs, performance tests and evaluations (PT and E), sensor replacements, or any other problems you or an OC technician cannot solve. DataSonde 3s can only be sent to Hydrotech for repair since Hach/Hydrolab does not support these sondes anymore. Go to http://www.hydrotechzs.com/repair.html for more specific information and follow the below instructions for shipping (6.7.1.3). *Note: The following process may change without notice. If you are unfamiliar with repairing and shipping Hydrolabs, see a Hydrolab custodian or OC technician.*

6.7.1.1 Go to Hach's Hydrolab website for instrument repair at http://www.hydrolab.com/resources/InstrumentRepair.asp and fill out the "Support Form." Or call Hydrolab (1-800-949-3766) and ask what the current repair/PT and E procedures are.

6.7.1.2 You will receive an email from the Hach/Hydromet tech department instructing you on your next steps. Please follow them, then pack the Hydrolab equipment carefully and bring your box(es) to Ecology's shipping department located in the basement (if at Headquarters).

6.7.1.3 When you get an estimate from Hydrolab (should take around two weeks) submit a Preliminary Purchase Request (PPR) to Ecology for that amount.

6.7.1.4 When you get the Purchase Order (PO) number from Ecology (this is the part that takes the most time), send it to Hydrolab and they will then return the equipment with a summary of what was done.

6.7.1.5 Make sure to read the summary of work done in case the manufacturer forgot to do any of the repairs.

6.7.1.6 Note that your shipping address and billing address may be different. At Headquarters the address is:

Shipping:

WA State Dept. of Ecology
300 Desmond Drive
Olympia, WA 98504

Billing (P.O. box):

WA State Dept. of Ecology
300 Desmond Drive
P.O. Box 47612
Olympia, WA 98504

6.8 Communicating with the Sonde.

6.8.1 Using a Computer

6.8.1.2 Make sure batteries are in the sonde. Attach the communication cable from the sonde to the computer.

6.8.1.3 Open HyperTerminal: (Start/Program/Accessories/Communications/HyperTerminal)

6.8.1.4 Box Opens: "Connection Description." Type in a name (your choice) and pick an icon.

6.8.1.5 Box opens: "Connect To." Under "Connect using" pull down menu and pick "COM1." Click OK. (This should be the serial port you connect the Hydrolab cable to. If you do everything that follows and this doesn't seem to work, try a different COM).

6.8.1.6 Box Opens: "COM1 Properties." "Bits per second" = 19200 for series 4 and 5 sondes; 1200 for series 3 sondes. "Data bits" = 8. "Parity" = NONE. "Stop bits" = 1. "Flow Control" = Xon/Xoff.

6.8.1.7 You will now be connected. At the bottom of the window it might say "Connected 0:00:xx" with a clock counting. Disconnect (click the "phone off the hook" button or menu "Call/Disconnect").

6.8.1.8 Click menu "File/Properties." In the Properties box click the "Settings" tab. Under "Emulation" select "ANSI." You should now be able to connect and communicate with the sonde.

6.8.1.9 You can also communicate via Hach's Hydras 3LT software provided in CD format with new Hydrolab equipment. CDs are located in the electronics room near the Hydrolab equipment and the wet lab drawer designated for Hydrolab use. For more information on Hydras 3LT, visit http://www.hydrolab.com/products/hydras3lt.asp.

6.8.2 Using the handheld Surveyor ®

6.8.2.1 Make sure batteries are in the sonde. Connect the Surveyor® to the sonde with the appropriate cable and turn the Surveyor® on. Numeric values should appear after the parameter names on the screen within one minute. If the sonde and the Surveyor® do not communicate within one minute, check that the Surveyor's® I/F mode is set properly. To do this no cables should be connected to the Surveyor®. Select "setup/cal" then select "setup." Highlight sonde "I/F:mode" and press "select." Now select the appropriate number that matches the sonde series you're using. You should now be able to communicate with the sonde.

6.9 File Handling

6.9.1 Please see a Hydrolab manual for detailed instructions on how to create, transfer, download, and delete data files.

7.0 Records Management

7.1 To make a reservation or report a problem with Hydrolab equipment, go to http://teams/sites/EAP/Hydrolab%20Reservations/Forms/AllItems.aspx.

8.0 Quality Control and Quality Assurance Section

8.1 Sondes should be calibrated before each use and post-calibrated using standards afterward. A post-calibration is really a "post-check" since it is not necessary to recalibrate the sonde unless you're using it afterward.

8.2 When traveling from site to site, make sure the sonde's sensors are kept moist so they don't dry out and become inaccurate.

8.3 Although Hydrolab equipment is robust and made for heavy field use, it should be handled carefully at all times.

8.4 Further quality control and quality assurance procedures will be addressed thoroughly on a project-by-project basis in the Quality Assurance Project Plan for the project.

9.0 Safety

9.1 Conductivity and pH standards and D.O. and pH reference solutions are nontoxic, but can irritate eyes and other sensitive areas because of their high salt content. Rhodamine dye is also relatively nontoxic, but stains everything it contacts.

9.2 Wash hands thoroughly after calibration or after use in contaminated waters.

9.3 When using a sonde in the field, be aware of your surroundings. Select an area in which you feel safe and secure from hazards.

9.4 For further field health and safety measures, please refer to the EAP safety manual (EAP, 2006).

10.0 Theft

10.1 Sondes deployed in small creeks and clear rivers are easily seen. To avoid problems with theft and vandalism, hide them carefully. Deploy sondes upstream or downstream of public access areas, private property, or places where boaters and swimmers can see them. Under overhanging vegetation or behind instream rocks and fallen tress are often good places to hide them, as long as water circulation is not limited.

10.2 Do not use large floats or anchors in smaller streams; they attract attention. Instead, note where the sonde is and cover it as much as possible while maintaining good water flow past the sensors. Small cement blocks work well as anchors. If the sonde is deployed in a large river, floats, line, and larger anchors may be necessary. See an experienced Hydrolab user for further details.

10.3 If you cannot find a sonde and suspect theft is the cause, visit the local police station and fill out a report. Ecology has also located lost equipment by running ads in local papers.

11.0 References

11.1 Environmental Assessment Program, 2006. Environmental Assessment Program Safety Manual. July 2009, with updates in 2010. Washington State Department of Ecology. Olympia, WA.

11.2 Pickett, Paul. 2006. Standard Operating Procedures for Monitoring Total Dissolved Gas in Freshwater. Environmental Assessment Program, Washington Department of Ecology. Olympia, WA.