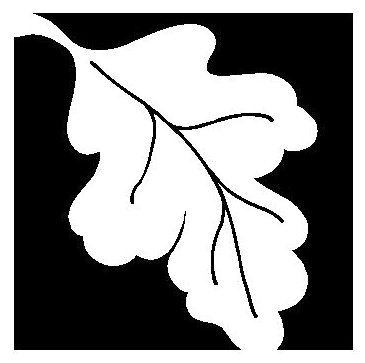
**Department of Environmental Protection**

**Division of Watershed Management**

627 Main Street, Second Floor

Worcester, MA



# Standard Operating Procedure

**Title: *Water Quality Multi-probes \****

**CN**: 004.25

**Date: \_\_\_\_\_\_\_\_\_\_\_\_**, 2020

**Prepared By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(Richard Chase,Jeff Smith, Laura Chan and Bob Haynes,

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(Suzanne Flint )

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(Arthur Johnson)

***\* This SOP also contains information pertaining to single-probe instruments used by DWM.***

## SCOPE and Application

Use of water quality probes is an integral component of the MADEP-Division of Watershed Management’s ambient monitoring program. Use of probes is primarily designated for short term, hands-on monitoring and spot-checking of streams, rivers, ponds and lakes. Typically, setup consists of a display logger cabled to a submersible transmitter (multiple probe sonde or single probe). Single probe units are used “hands-on” in the field, while stand-alone multi-probe loggers can be used using either attended or unattended (see also CN 4.4) methods.

DWM’s multiprobe workgroup responsible for purchases, setup, calibrations, maintenance, lab management, data retrievals, data validation and data management are as follows:

|  |  |  |
| --- | --- | --- |
| **Staff** | Primary Responsibilities | Secondary Roles |
|  | Overall management of calibration lab, calibrations and maintenance, preparation of standards, data validation and training, product testing and purchasing | Data retrieval (backup), |
| Suzanne Flint | Quality assurance for all activities involving probes (including field/lab safety, data accuracy and validation, SOP revisions, training), instrument calibrations/checks | Data retrieval (backup), product testing and purchasing |
|  | Instrument calibrations and checks | Data retrieval (backup) |
| Kari Winfield | Data retrieval and management, database applications | ---) |
| Misc. staff | Data retrieval, processing; cleaning deployed sondes after use… | --- |

## COMPONENTS

As of 9/2005, DWM’s fleet of single probes, multi-probe sonde transmitters (no internal data storage capability), display data loggers and multi-probe sonde loggers (with internal data storage capability) includes the following:

| **Make** | Model | Serial # | Alpha Code | Software Version | Variables Measured |
| --- | --- | --- | --- | --- | --- |
| Hydrolab | SRV3 | 24571 | A | 2.02 | NA (7070 scans) |
| Hydrolab | SRV3 | 24572 | B | 2.02 | NA (7070 scans) |
| Hydrolab | SRV3 | 24573 | C | 2.02 | NA (7070 scans) |
| Hydrolab | SRV3 | 31160 | D | 2.02 | NA (3559 scans) |
| Hydrolab | Series 3 sonde logger | 24569 | E | 1.35 | Standard Sensors1 |
| Hydrolab | SRV4 | S1454 | F | 2.00 | NA (1572864 MB memory) |
| Hydrolab | SRV4 | S1455 | G | 2.00 | NA (1572864 MB memory) |
| Hydrolab | MS4a-SE sonde logger | 41215 | H | 3.31 | Standard Sensors1 |
| Hydrolab | MS4a-SE sonde logger | 41217 | I | 3.31 | Standard Sensors1 |
| Hydrolab | MS4a | 41705 | J | 3.31 | DO & Temp |
| Hydrolab | MS4a | 41706 | K | 3.31 | DO & Temp |
| Hydrolab | MS4a | 41707 | L | 3.31 | DO & Temp |
| Hydrolab | DS4 sonde transmitter | 36275 | M | 2.01 | Standard Sensors + Turbidity |
| Hydrolab | DS4 sonde transmitter | 36276 | N | 2.01 | Standard Sensors  (+ PAR3 & Chl a 4: removed) |
| Hydrolab | Series 3 sonde transmitter | 15559 | --- | 1.03 | Standard Sensors1 |
| Hydrolab | Series 3 sonde transmitter | 15486 | --- | 1.03 | Standard Sensors + ORP2 |
| Hydrolab | Series 3 sonde transmitter | 24570 | --- | 2.20 | Standard Sensors + Turbidity |
| YSI | 6920 sonde |  |  |  | Standard Sensors1 and BGA, Chl a |
| YSI | 6920 sonde |  |  |  | Standard Sensors1 and BGA, Chl a |
| YSI | 650 MDS |  |  |  | NA |
| YSI | 650 MDS |  |  |  | NA |
| YSI | 600XLM sonde logger | 767AA | P | 2.20 | Standard Sensors1 |
| YSI | 600XLM sonde logger | 767AB | Q | 2.20 | Standard Sensors1 |
| YSI | 650 MDS | 1139 AI | R | 1.09 | NA |
| YSI | 650 MDS | 1139AJ | S | 1.09 | NA |
| Hydrolab | MS4a | 42235 | T |  | DO & Temp |
| Hydrolab | MS4a | 42236 | U |  | DO & Temp |
| Hydrolab | MS4a | 42237 | V |  | DO & Temp |
| Hydrolab | MS4a | 42238 | W |  | DO & Temp |
| Hydrolab | MS4a | 42239 | X |  | DO & Temp |
| Hydrolab | MS4a | 42240 | Y |  | DO & Temp |
| Hydrolab | MS5 | 42967 | ZA |  | DO & Temp |
| Hydrolab | MS5 | 42968 | ZB |  | DO & Temp |
| Hydrolab | MS5 | 42969 | ZC |  | DO & Temp |
| ***Other probes*** |  |  |  |  |  |
| YSI | 33 S-C-T |  | --- | --- | Conductivity, salinity and temp. |
| YSI | 57 |  | --- | --- | D.O. |
| YSI | 54 |  |  |  | D.O. |
| Orion |  |  |  |  | pH |
| Markson |  |  |  |  | pH |
| Eutechnics |  |  | --- | --- | Temperature |
| Digi-Sense | Thermologger RTD |  | --- | --- | Temperature |
| Onset | Stowaway® | 515486 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 552434 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 515472 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 706751 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 735455 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 730537 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 9140 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 729121 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 515474 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 738001 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 552435 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 552426 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 552431 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 515471 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 729118 | --- | --- | Continuous temperature |
| Onset | Stowaway® | 737992 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134422 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134432 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134433 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134434 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134435 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134436 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134437 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134438 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134439 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134440 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134441 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134442 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134443 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134444 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134445 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134446 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134447 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134448 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134449 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134450 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134451 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134452 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134453 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134454 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134455 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134456 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134457 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134458 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134459 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1134460 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292378 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292379 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292380 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292381 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292382 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292383 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292384 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292385 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292386 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 1292387 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381495 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381496 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381497 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381498 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381499 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381500 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381501 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381502 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381503 | --- | --- | Continuous temperature |
| Onset | Pro v2 | 2381504 | --- | --- | Continuous temperature |
| Onset | Pro v2 |  | --- | --- | Continuous temperature |
|  |  |  |  |  |  |
| ESD |  |  |  |  | Turbidity |
| Oakton |  |  |  |  | pH, temperature, conductivity |
|  |  |  |  |  |  |

1 Standard Sensors include water depth, temperature, dissolved oxygen, conductivity (or total dissolved solids; or salinity), TDS and pH.

2 Oxidation-reduction potential.

3 Photosynthetically-active radiation (ambient light)

4 Via in-situ fluorometry

In addition, DWM owns accessory equipment to operate and maintain these units, such as auxiliary batteries, cables, solutions, misc. spare parts and hardware, etc. Series 3 and 4 Hydrolab system components include three 12-volt rechargeable battery packs and cables of various lengths. The battery packs are used during pre- and post-calibration as well as back-up voltage should one of the Surveyor 3 and 4 display logger internal batteries discharge completely during *in situ* monitoring. All of DWM’s Hydrolab cables are enclosed in urethane jackets and equipped with high pressure marine connectors. Available cable lengths include 15 meters (4 each), 25 meters (1 each), and 50 meters (1 each). YSI units take either a rechargeable battery pack or 8 “C” cell batteries.

# SPECIFICATIONS

Sensor resolution, accuracy and precision, as provided by the manufacturers, are provided below for each water quality parameter measured. These specifications represent a baseline of expected performance and for comparison to results. DWM’s well-maintained, accurately-calibrated units typically display results well within these specifications.

|  |  |  |  |
| --- | --- | --- | --- |
| **Hydrolab Series 3** | **Resolution** | **Range** | **Accuracy (+/-)** |
| Temperature (deg. C) | 0.01 | -5 to 50 | 0.15 |
| Depth (m) | 0.1 | 0-100 | 0.45 |
| pH | 0.01 | 0-14 | 0.2 |
| Dissolved Oxygen (mg/l) | 0.01 | 0-20 | 0.2 |
| Specific Conductance (uS/cm) | 4 digits | 0-100000 | 1% of range |
| % Oxygen Saturation | NA | 0-100 | NA |
| Turbidity (NTU) | 0.1,1 (100, 1000 ranges) | 0-100 | 5% of range |
| **Hydrolab Series 4/5** |  |  |  |
| Temperature | 0.01 | -5 to 50 | 0.1 |
| Depth | 0.1 | 0-100 | 0.3 |
| pH | 0.01 | 0-14 | 0.2 |
| Dissolved Oxygen | 0.01 | 0-50 | 0.2 |
| Specific Conductance | 4 digits | 0-100000 | 1% of range |
| % Oxygen Saturation | NA | 0-100 | NA |
| Barometer, internal (mm Hg) | 0.1 | 500-850 | 1-2 (at 25C) |
| Turbidity | 0.1, 1 | 0-1000 | 5% of range |
| Chlorophyll a (in-situ) (ug/l) | 0.01 | 0.03-75 | 3.5 |
| **YSI 600XLM** |  |  |  |
| Temperature (deg. C) | 0.01 | -5 to 45 | 0.15 |
| Depth (m) | 0.001 | 0-61 | 0.4 |
| pH | 0.01 | 0-14 | 0.2 |
| Dissolved Oxygen (mg/l) | 0.01 | 0-50 | 0.2 |
| Specific Conductance (uS/cm) | 0.1 | 0-100000 | 0.05% of reading |
| % Oxygen Saturation | NA | 0-100 | NA |
|  |  |  |  |
|  |  |  |  |

#### Storage and Transport of probes

When not in use, all probes are stored per manufacturer recommendations or as otherwise specified herein, in order to maximize probe life and maintain probe accuracy. When not in use, the cased instruments shall be stored on separate shelves of locked metal cabinets in the calibration laboratory.

When used, each probe unit must be transported in a dedicated carrying case along with various accessories. Standard accessories can include a weighted stirrer, sonde weight, back-pack and over-the-shoulder straps for the carrying case, low-ionic standard check solution, temporary storage bottle for sonde tip, temporary storage cup for sonde tip (Series 3), clamps, extra field data sheets and COC forms, laminated field quickguides, and cleaning towels. When packed, the instruments and accessories shall be positioned properly in the cushioned sections of the carrying case. In particular, all transmitters and the Recorder shall be positioned so that the pH reference probe is in the 2:00 o’clock position when viewed from above. Carrying cases shall be zipped/closed to the closed position at all times during transport.

Transporting encased units in the beds of pickup trucks or in boats under tow is not allowed. Suitable locations for transport include the trunk or rear seat area of small sedans, the rear seat of pickup trucks, or the floor of a van.

Each unit is calibrated and provided to the survey coordinator with all cables attached. Cables should remain attached for the duration of the survey. This saves time and minimizes wear of the cable connections.

For the Hydrolab Series 3 (only), a threaded storage cup must be threaded securely into each Series 3 Hydrolab transmitter bulkhead to protect the multiprobe sensors at all times, except during *in situ* monitoring and calibration. Each storage cup shall be filled to approximately two-thirds of its volume with 1º (primary) Nanopure water to bathe the sensors, especially after each use in the “field.” A cap for the storage cup is provided in the carrying case to prevent spillage when the instrument is being used. If spillage does occur, the Hydrolab operator shall replace the lost volume with low-ionic standard check solution that is stored in each carrying case. For all other units (Series 4 and YSI), a temporary storage bottle containing a moist sponge is used to cover the end of the sonde.

All cables shall be protected from abrasion, unnecessary tension, bending over sharp radii such as boat gunnels or bridges, repetitive twisting, and excessive weight. Cable connectors shall be kept clean and free of dust, sand, grit, and water. Protective “dummy” plugs shall be installed at the ends of each cable except when the cable is being used. And, when in use, opposing cable plugs shall be coupled and stored in the carrying case. Cables shall be coiled neatly after each use and stored within the carrying case. Upon return to the calibration laboratory, all cables shall be inspected by the calibrator or laboratory supervisor and then stored on shelves beneath the bench top.

**Pre-survey Calibration & post-SURVEY checks**

Accurate and reliable calibration of probes in both concentrated and dilute standards is essential for recording valid *in* *situ* water quality data. These activities shall be performed by competent DWM staff trained and supervised by the calibration laboratory supervisor or, if necessary, by the supervisor. Pre-survey calibration and post-survey checks shall be performed on all probes used for routine monitoring as well as special projects. All calibration and QC check data shall be stored in lab notebooks and electronically in calibration files.

**NOTE:** In the rare instance of an emergency fish kill, the specific conductance and dissolved oxygen sensors shall be pre-calibrated at a minimum prior to releasing the unit for immediate field use. However, data recorded simultaneously for all non-calibrated variables (excluding depth and temperature) shall be censored.

#### Equipment and Supplies

The equipment and supplies listed below are essential for routine calibration of DWM’s multiprobes.

* Nanopure® water deionization system with 0.2µm porosity final filters. Use pretreated feed cartridge kit (Catalog No. D5026). Note: the Barnstead/Thermolyne Corporations’s “Nanopure® Analytical Deionization System Operation Manual and Parts List,” Series 851, is thorough and descriptive in all aspects of operation, maintenance, and diagnoses of problems. This Manual shall serve as the Standard Operating Procedure for the Nanopure Deionization system.
* 2000 ml ± 0.5 ml volumetric flask with plastic cap.
* Volumetric TD (“to deliver”) pipets: 10 ml ± 0.04 ml @ 20ºC; 2ml ± 0.012 ml @ 20ºC.
* Advanced Polymer Systems, Inc., primary calibration standards for turbidity: Item nos. CRS-40 (40 NTUs); CRS-20(20 NTUs); CRS-10 (10 NTUs). *NOTE: use of this solution has been discontinued (from 2002 on)*
* 1.0 M KCl stock solution prepared by the Laboratory Manager for Inorganic Chemistry, Wall Experiment Station. Store in an amber-colored, 1 liter bottle and seal tightened cap with Parafilm®.
* Low-ionic phosphate standard stock solution developed by Metcalf and Peck (1993) as a quality control standard for pH, conductivity and acid-neutralizing capacity of dilute surface waters, such as those typical of central and southeastern Massachusetts. This standard has a theoretical pH of 6.98, a calculated conductivity of 75.3 µS/cm, and an acid neutralizing capacity of 12.5 mg/L (Metcalf and Peck 1993). A copy of the recipe for this standard is included as Attachment B. The stock solution is prepared by the Laboratory Manager for Inorganic Chemistry, Wall Experiment Station. It is stored in an amber-colored, 1 liter bottle and its tightened cap is sealed with Parafilm®.
* Fisher Scientific Gram-Pacs® of certified buffer salts (dry): Catalog Nos. B77 (10.4 ± 0.1 @ 25ºC); B78 (6.86 ± 0.02 @ 25ºC); and, B79 (4.01 ± 0.02 @ 25ºC).
* Nalgene® 250 ml LDPE dispensing bottle (Fisher 98/99 catalog no. 03-409-13B) with molded-in side arm spigot.
* Fisher brand silicone bulb-type safety pipet filler (Fisher 98/99 catalog no. 13-681-102B).
* PC Duster®2 (or comparable product); a non-flammable, ozone-safe, compressed gas canister with reusable nozzle.
* Misc. lab supplies, such as clean single-edge razor blades, Kim-Wipes, pH and DO probe electrolyte solutions, etc.

#### Material Safety and Waste Management

Stock and primary calibration standards (liquid) listed above are non-toxic, stable and safe to dispose of down the drain. The zero D.O. check solution should be refreshed as needed to maintain <0.5 mg/l D.O. If/when disposal is needed, dilute sodium-sulfite-only solution 50-100 times (e.g., for 100 mls., fill 1 gallon bucket to overflow) and drain to sanitary sewer.

The Fisher Scientific dry buffer salts may cause irritation of the eyes, skin, respiratory tract, and digestive tract if handled improperly or in the case of an accident. Each box of 12 Gram-Pacs® includes a warning about the aforementioned irritations as well as precautions and first aid measures. A primary first aid measure is to “flush eyes with plenty of water for at least 15 minutes…,” and there is an emergency shower and eyewash directly forward of the door to the calibration laboratory (Room 226). Material Safety Data Sheets (MSDS) for Fisher Scientific dry buffer salts are kept in Room 226 and 228.

There are no medical conditions generally aggravated by exposure to these solutions of 1% copolymer beads. MSDS sheets for Advanced Polymer Systems, Inc. primary turbidity standards are also kept in Room 226 and 228. *NOTE: use of this solution has been discontinued (from 2002 on)*

#### Preparation of Calibration Standards

Accurate, quantitative preparation of calibration standards is accomplished with skill, patience, and clean bench-top chemistry. Completion of this task on a routine basis shall be the responsibility of the calibration laboratory supervisor or by a skilled assistant trained by that supervisor.

Reagent bottle cleanliness

Bottles for stock solutions should be clean and free of contamination. Check condition of the calibration standards and bottles periodically and when making fresh standards. If necessary, clean and decontaminate bottles:

* Don safety glasses, plastic apron, and gloves
* Shake the solution remaining in the bottle vigorously to help dislodge at least some of the material that may be adhering to the walls of the bottle
* Add 20 ml of Clorox to a 500 ml bottle (Note: The dose for disinfection, as recommended on the Clorox label, is 1:32, or 15.625 ml per 500 ml; I rounded up to 20 ml per 500)
* Fill bottle with DI water
* Invert bottle to make sure bleach solution makes contact with all inner surfaces
* Place lab tape marked “Clorox” or “Bleach” across the cap and neck of the bottle
* Allow solution to sit in capped bottle for one hour to assure adequate contact time for disinfection
* Remove tape from cap/neck of bottle and empty solution into sink
* Fill bottle about half full with DI water, shake vigorously, empty, and repeat 4 more times
* Rinse bottle 2 times with small aliquots of fresh reagent
* Refill bottle with the appropriate solution

This procedure also works well for the plastic rinse bottles.

### Specific conductance standards

Quantitative preparations from a 1.0 M KCl stock solution to yield 2 liter or 1 liter volumes of the standards typically used to calibrate the conductivity sensor are presented in the tabulation below. Note that the milliliters of KCl stock are based on a 1 liter standard volume, whereas 2 liter volumes are typically prepared.

|  |  |  |
| --- | --- | --- |
| Specific Conductance **@ 25ºC (µS/cm)** | KCl Molar Concentration | Milliliters KCl Stock/L |
| 1413 | 0.01 | 10.0 |
| 718 | 0.005 | 5.0 |
| 147 | 0.001 | 1.0 |
|  |  |  |

Consistency is achieved by adhering to the steps that follow for the preparation of **2 liter** volumes of specific conductance calibration standards.

* Prepare specific conductance standards from the most dilute to the most concentrated; for example, 147µS/cm, 718µS/cm, and 1413µS/cm.
* Add 1º Nanopure water to a clean 2 liter volumetric flask. Fill to approximately volume of flask. **Note**: 1º Nanopure water is contained in a separate carboy that is filled directly from the Nanopure® deionization and filtration system remote dispenser. It is used only for the preparation of calibration standards, calibration of Hydrolab sensors, and for final rinses of volumetric flasks, pipets, and multiprobe sensors. A second carboy of “flushing” Nanopure water is used to flush volumetric flasks and flush Hydrolab multiprobe sensors during calibration. The “flushing” carboy is partially filled directly from the Nanopure® system remote dispenser, but Nanopure “flush” water is added as well. The so-called “flush” water is the volume (typically 500 ml) withdrawn from either the remote dispenser or the auxiliary valve prior to filling the primary carboy or field blanks.
* Carefully add required dose of stock solution to the 2 liter volumetric flask with appropriate volumetric pipet (refer to tabulation above) and swirl to mix. **Note: the dose of stock solution needs to be doubled for preparation of 2 liter volumes.**
* Add another volume of 1º Nanopure water to the volumetric flask with periodic interruptions to swirl its contents.
* Fill with 1º Nanopure water to a point just below etched line on neck of flask.
* Carefully add 1º Nanopure water, drop-by-drop, from the side arm spigot of a 250 ml dispensing bottle (or “squeeze” bottle) until the bottom of the liquid meniscus is at the same plane as the etched line.
* Snap plastic cap securely to top of volumetric flask and invert ten (10) times slowly. Be sure to shake contents of flask when it is in the inverted position.
* Let flask stand at least 0.5 minutes to allow all of its fluid content to drain down its neck.
* Dispense contents of volumetric flask into the **appropriate** calibration standard carboy. **Double-check this step carefully**, else the consequences will be problematical. Update information on the manila tag attached to the carboy handle.
* Rinse volumetric flask five (5) times with flushing Nanopure water followed by one (1) rinse with 1º Nanopure water. Invert flask to drain and place on calibration rack. Collect drain water in glass or plastic vessel and discard in sink. Air dry flask in storage cabinet.

### Low-ionic calibration check standard

The procedures described below are followed for preparation of the low-ionic standard. “Shelf life” or batch preparation cycle for the low-ionic standard is two weeks. See also Attachment B for preparation of stock solution.

* Add 1º Nanopure water to a clean 2 liter volumetric flask. Fill to approximately of its volume.
* Carefully add 20.0 ml of freshly-prepared 6.86 pH buffer to the 2 liter volumetric flask with a volumetric pipet and swirl to mix. Alternatively, use 20.0 mls. of the low-ionic phosphate stock solution (available from WES; the two recipes compare very well and essentially give the same readings for pH, SC, TDS, etc..
* Add another volume of 1º Nanopure water to the volumetric flask with periodic interruptions to swirl its contents.
* Fill with 1º Nanopure water to a point just below etched line on neck of flask.
* Carefully add 1º Nanopure water, drop-by-drop, from the side arm spigot of a 250 ml dispensing bottle (or “squeeze” bottle) until the bottom of the liquid meniscus is at the same plane as the etched line.
* Snap plastic cap securely to top of volumetric flask and invert ten (10) times slowly. Be sure to shake contents of flask when it is in the inverted position.
* Let flask stand at least 0.5 minutes to allow all of its fluid content to drain down its neck.
* Dispense contents of volumetric flask into the **appropriate** calibration standard carboy. **Double-check this step carefully**, else the consequences will be problematical. Update information on the manila tag attached to the carboy handle. Prepare new batch every two weeks.
* Rinse volumetric flask five (5) times with flushing Nanopure water followed by one (1) rinse with 1º Nanopure water. Invert flask to drain and place on calibration rack. Collect drain water in glass or plastic vessel and discard in sink. Air dry flask in storage cabinet.

### pH standards

Buffer salt pH standards are prepared similar to that described for specific conductance and low-ionic standards, except that there is **no stock solution**. Instead, pre-weighed dry buffer salts are sealed in Fisher Gram-Pac® packets. Empty the contents of two (2) packets of the same pH standard into the 2 liter volumetric flask following the basic steps listed below.

* Add volume 1º Nanopure water to the 2 liter volumetric flask as described previously for specific conductance and low-ionic calibration standards.
* Tap pH buffer packet on laboratory bench top to concentrate dry salt at bottom. Place packet horizontally on a cardboard backing and slice off top just below seal with a single-edge razor blade. Squeeze sides of packet (avoid touching top) to create a puckered, mouth-like opening.
* Carefully place lower part of packet opening into neck opening of 2 liter volumetric flask, and tap packet gently with index finger to **slowly** dislodge buffer salt, which should slide into flask without any spillage. **Note**: if spillage does occur, the preparer must begin anew by disposing of the remaining buffer salt, emptying the contents of the volumetric flask, rinsing the flask as described previously, *et cetera.*
* Rinse remaining buffer salt and fines from Gram-Pac® with a 250 ml dispensing (squeeze) bottle containing 1º Nanopure water, and pour the contents into the volumetric flask. Repeat several times to assure that no buffer salt remains within the Gram-Pac®. Open Gram-Pac® carefully to verify that all buffer salt has been dissolved and rinsed into the volumetric flask. Do not dispose of rinsed Gram-Pac® at this time.
* Repeat the aforementioned procedure for the second of two (2) Gram-Pac® packets that must be added to prepare 2 liters of pH standard (either 10.4, 6.86, or 4.01). Verify that both Gram-Pac® buffers are the same pH standard, then dispose of the empty packets.
* Rinse neck of volumetric flask with 250 ml dispensing bottle containing 1º Nanopure water, then fill and swirl the contents of the volumetric flask as described previously for specific conductance and low-ionic standards.
* Dispense the contents of the volumetric flask into the **appropriate** pH standard carboy (either 10.4, 6.86, or 4.01) as described previously. **Note: double check this step before proceeding**. Update information on the manila tag attached to the pH standard carboy handle.

##### Turbidity standards

Primary standards for calibrating the turbidity sensor are purchased directly from Advanced Polymer Systems, Inc., of Redwood City, California, or equivalent provider. Typically, 40, 20, and 10 NTU polymer standards are stocked in the calibration lab, and the one-year expiration date on each 1 liter bottle shall be highlighted.

0 mg/l D.O. Standard

For use in pre- and post-survey checks on dissolved oxygen for surveys in which low D.O.s are critical (e.g., lake hypolimnions, highly polluted/enriched waterbodies), a “zero” (0.0 mg/l) D.O. standard is used (starting in 2006).

Following Standard Methods and USGS TWRI Book 9, the zero standard is prepared daily as follows:

* Add sodium sulfite to excess in a 500-1000 ml container. This is achieved by dissolving approx. > 1 gram sodium sulfite per liter DIW.
* Add a trace (a few crystals) of cobalt chloride and mix (optional catalyst; (GENERALLY NOT NEEDED---DO NOT USE).
* Prepare weekly prior to use and/or as needed.

Following calibrations, perform final check using the zero DO standard by immersing DO probe into solution to confirm <0.5 mg/l result. If test fails, perform maintenance or use another probe. When done, rinse probe and store in storage cup. See “waste management” section for disposal considerations for this solution.

#### Procedures for Calibration and Checks for Multiprobe Sensors

Laboratory calibration of sensors includes the following provisions:

* Detailed record keeping
* Annotation of text into logger memory (Hydrolab only)
* Instrument setup and configuration (including editing of Site List for YSI units)
* Sequential calibration of multiprobe sensors immediately preceding the survey
* QC checks within 24 hours following survey.

With a partial exception for turbidity (described below), calibration of multiprobe sensors is an intense and tedious process in which the same steps are performed for each standard. And, with the exception of multiple flushings of the multiprobe sensors, these steps are clearly and systematically presented on the two-page, back-to-back, “Hydrolab Multiprobe Calibration Record.” A sample copy of the Calibration Record is included (Attachment A). For YSI calibration procedures, see Attachment G.

In general, calibrations of pH, sp. Conductance and D.O. follow the instrument manual directions, with slight modifications (e.g., more washes, post-cal checks using zero DO and low ionic solutions). Not evident on the Calibration Record is the fact that DWM’s standard operating procedures include at least two (2) pre-survey calibration rinses with previously-used standard, one (1) rinse with the primary standard, and three (3) or more post-survey calibration rinses, as needed, with flushing and then 1º Nanopure water until specific conductance is reduced to the instrument’s minimum recorded (“normal”) value (typically within the range of 1.0 ±0.3 µS/cm). The “**thorough rinse protocol**” is a key element to the consistent and reliable sensor calibration that is routinely performed at DWM, primarily because it assures that every calibration begins with essentially residue-free sensors. Also, the “thorough rinse protocol” often reveals the first indication of change to a particular sensor’s normal response pattern, which may signal that additional maintenance is necessary or that it may be a prelude to eventual replacement of that sensor.

The front page of the Calibration Record includes initial record-keeping steps, checks on instrument configuration, annotations, and systematic calibration of the multiprobe sensors. Post-survey quality control (QC) checks of the multiprobe sensors in the zero DO standard (starting in 2006), low-ionic standard and in 1º Nanopure deionized, filtered (0.2µm porosity) water are on the backside of the one-page Calibration Record. Since the zero DO and low-ionic standards “decay” over time, fresh “batches” of these solutions are prepared daily and every two weeks, respectively. The date of preparation is recorded manually and annotated electronically prior to each pre- and post-survey quality control check of the sensors in this standard. Specific conductance, pH and percent saturation of dissolved oxygen are the key variables that are monitored when the multiprobe sensors are checked in the low-ionic standard. The key variable in the second of two quality control checks is specific conductance (~1.0 ±0.3 µS/cm) of the deionized, filtered water. This is a measure of the lowest possible recording of that sensor when it has been thoroughly flushed and tested in this medium. If it is not within the range of 1.0 ± 0.3µS/cm, it will have affected adversely linearity checks of specific conductance performed previously in the 147µS/cm check standard and the low-ionic QC standard. This is an unlikely outcome, however, since the multiprobe sensors are checked in the same deionized, filtered water prior to the onset of the calibration process. Otherwise, it is an indication that the conductivity sensor needs to be cleaned and that its pins need to be polished.

Calibration of the turbidity sensor entails the “thorough rinse protocol” as well. But, a further requirement is that all multiprobe sensors be “blown dry” with compressed gas prior to each calibration or check on linearity with NTU (Nephelometric Turbidity) standards. The purpose of this step is to eliminate excess water and, therefore, excess use of NTU standard solutions, which are comparatively expensive. Based on DWM lab experience, calibration of the turbidity sensor is not done during every pre-survey calibration, but must be performed at least once for every 5 field trips***.*** *Note: Hydrolab turbidity probes are currently (as of 3/2003) not being used due to as-yet unresolved QC problems, and replacement by lab turbidity measurement.*

TDS Calculation

Internal calculation of Total Dissolved Solids (TDS) by the Hydrolab is as follows: TDS (mg/l) = measured conductivity (uS/cm) x C, where C=0.6. (For YSI, the multiplication factor is 0.65)

Temperature Calibration

See Appendix K for an example of multi-probe thermistor calibration and check.

#### Depth Calibration in the field (at each site):

#### Set all multi-probes to 0.0 in air at each site, prior to deployment.

#### use of probes in the field

The specific procedures for scheduling, using and returning multiprobe units back to the DWM lab are as follows:

##### Requests for Calibrated Probes

A seasonal river basin sampling schedule shall be issued each spring by DWM’s Monitoring Coordinator. Subsequently, the survey coordinator or lead person for surveys in each basin shall complete a MultiprobeRequest Form (Attachment C). The completed forms (electronic copy at a minimum) shall be sent to the calibration laboratory supervisor and QA Analyst at least one (1) week prior to each scheduled survey. A one-time seasonal form may be submitted for repetitious monitoring. In this instance, the number of multiprobes, pick-up times, dates of monitoring, etc., are more-or-less set for the sampling “season.” Coordinators for special purpose monitoring surveys shall follow these same procedures.

##### Multiprobe Use “Rules”

Use of multiprobes shall be restricted to DEP employees (primarily DWM staff) that have been trained by the calibration laboratory supervisor/QA Analyst and who are sufficiently experienced to set up these instruments properly so that valid *in situ* data are generated consistently. These individuals shall be designated as “primary users.” Other trained DEP employees may assist in the monitoring effort, but the primary users shall assume complete responsibility for multiprobes assigned to them and for adhering to the standard operating procedures stated herein. The prohibitions listed below shall apply to all users of DWM multiprobe instruments.

* Use of multiprobes in canoes or other small, unstable boats is prohibited.
* Use of multiprobes from dangerous or precarious locations (cliffs, steep embankments, waterfalls, *et cetera*) is prohibited.
* Use of multiprobes at municipal or other waste treatment plants, or discharges therefrom, or any other discharge site or outfall other than stormwater, shall be prohibited. Such discharges, including chlorinated effluents, may “foul” and/or interfere with multiprobe sensors. Immediate and subsequent survey data would likely be invalid, as revealed in the post-calibration process and/or data quality control checks.
* Use of multiprobes from bridges or other such overpasses is allowed provided that it is safe to do so and provided that it is not otherwise prohibited or restricted in these standard operating procedures.
* Use of multiprobes in turbulent conditions or in areas containing sub-surface eddies is prohibited.
* Use of multiprobes in buckets containing waters of interest is not preferred and introduces a likely, unacceptable amount of measurement error.
* Use of multiprobes shall be performed such that the unit is rotated to a position where the “turbidity sensor well” is facing downward.

###### In situ Measurements of Multiprobe Parameters

The way multiprobes are used in the field will depend, in part, on project-specific objectives, as may be found in the monitoring QAPP. A detailed QAPP, coupled with proper training and adherence to this guidance, should produce quality multiprobe data.

The guidance contained in the laminated “QuickGuides” located in the inside zipper pocket of each carrying case should be followed. The most recent version for the Hydrolab units is included as Attachment D. The QuickGuides include instructions for assembling multiprobe components, deploying the multiprobe in surface waters, annotating essential information, and recording measured variables. Therefore, the most recently issued Guide is an integral component of these standard operating procedures. (Out-of-date Guides are kept on file in the calibration laboratory).

In general, readings are recorded every 30 seconds for five (5) minutes, and only after all enabled variables are stable. Recordings during colder months may require additional recording time, since certain multiprobe variables are slower to reach equilibrium at cooler water temperatures (~ 5-10°C). When any surface water is less than 5°C, readings should be recorded for at least seven (7) minutes at 30 second intervals. There are no standard operating procedures for monitoring water quality variables under ice cover since DWM generally does not engage in surveys under these conditions.

A duplicate set of multiprobe readings can be taken at a rate of once per trip by removing the multiprobe from the water (after all readings have been taken and the last recorded), immediately redeploying in the same location and storing an additional reading. The duplicate readings can provide information on overall precision or repeatability of the in-situ measurements. (Most of any variation observed will be assumed to typically be due to natural variation, but this assumption may not hold in all cases, which may lead to inferences regarding quality control).

For Hydrolab data, users shall ONLY annotate (enter) a single OWMID prior to recording (storing) data, consistent with the Guide.

Additional standard operating procedures not included in the Guides shall be required for different surface water sampling sites, as described below.

#### Depth Calibration in the field (at each site):

#### Due to elevation differences between sampling locations, it is necessary to calibrate the “depth” readings when using Hydrolab (and other) multi-probes. This is performed by the user at each station by entering a “0.00” meter offset in the depth calibration mode, with the sonde IN AIR.

#### Specifically for the DS3, “calibrate-depth” and enter “0.00”.

#### For the DS4, go to “Set Up”, “Cal”, “Calibrate”, “Sonde”, “Depth”, “0.00”, “Select”, and “Done”.

For depth calibration of YSI multi-probes, see CN 4.31.

Rivers and stream monitoring from bridges and/or other suspended platforms

The following example procedures (using a Hydrolab unit) are relevant for any *in* *situ* monitoring from bridges and/or other suspended platforms, where it has been determined by the primary user that velocity and flow conditions are sufficient enough to necessitate the use of a multiprobe anchoring setup. In general, if the unit cannot be placed on the river/stream bed (ie.must be held in the water column), or if the unit does not stay sitting where placed (due to movement or potential for movement by high flow/velocity), then the anchoring setup as described below must be employed.

* Suspend an anchor over the bridge wall or railing, above a non-turbulent location, and release the line slowly until the anchor is at the surface of the river or stream*.* Mark the anchor line; then, lower it slowly to the riverbed. Estimate the depth of this sampling site from the distance “traveled” by the “mark.” Secure the anchor line to the bridge railing.
* Wait several minutes to assure that the position of the anchor remains unchanged and that any plume of resuspended sediments has been carried downstream. If it is moved by water currents, use a heavier anchor or move it laterally to a more quiescent location. Monitoring Hydrolab variables shall be postponed unless a secure and suitable anchoring site can be located. See note below and proceed to the next step.

Note: Measuring Hydrolab variables from a bucket of water drawn from the river or stream below a bridge is a less desirable alternative, it does not constitute *in* *situ* monitoring, and is generally not allowed. (The exchange rates of atmospheric and water soluble gases such as carbon dioxide and oxygen will likely be enhanced in such a large, open, sample container. Displayed values for dissolved oxygen and pH may differ from *in* *situ* values, which is especially likely in the low-ionic, poorly buffered waters of central and eastern Massachusetts). As a last resort to Hydrolab use in ambient water, the primary user of the Hydrolab multiprobe shall clearly note on the field data sheet that Hydrolab variables were measured and recorded from a bucket of river water. A brief annotation preceded by the OWMID number shall be entered into the Surveyor 3 or 4 manual file (5) as well.

* Assemble the Hydrolab stirrer to the transmitter, connect all cables, and secure the main cable eyebolt to the transmitter bail with one of the small clamps fastened to the carrying case zippers.
* Retrieve caribiner clamp from carrying case and press to the open position. Pass open end through one of the stainless steel eyebolts that secures the triangular bail to the transmitter bulkhead.
* Rotate caribiner so that its narrow end wraps around the eyebolt.
* Next, clamp broad end of caribiner around anchor line and release to lock.
* Check that all cable and clamp connections are secure and free of entanglements. Also, assure that there are no right-angle or other sharp bends in Hydrolab cables and that there will be no abrasion on coarse surfaces of the bridge.
* Press Surveyor 3 or 4 display logger “On/Off” keypad and assure that the stirrer is rotating.
* Slowly lower Hydrolab multiprobe transmitter to the desired water depth.
* Follow the standard operating procedures stated in the Guide for annotating information and recording equilibrated variables. Note: prior to storing lines of data at one-minute intervals, annotate the OWMID number for the particular sampling site and press the “Enter” keypad (Series 3) or “Done” keypad (Series 4a).

Press “On/Off” keypad of Surveyor 3 or 4 Display Logger when *in situ* monitoring is completed.

Carefully retrieve the Hydrolab and its component parts. Wipe off excess water with clean cloth stored in zipped pocket, and disassemble for storage in the carrying case. Retrieve anchor.

Multiprobe use in shallow water

At times, very shallow water may pose a problem for *in situ* monitoring of rivers and streams. The options may be few in such instances. If an alternative sampling location is not practicable, then the primary user shall attempt to excavate a depression that is longer, wider, and deeper than the transmitter and stirrer. The user must wait until resuspended sediments, etc., are flushed downstream before placing the transmitter in the excavated depression. Also, make sure that the probes are submerged, not floating or above the water line.

Unattended Multi-probe Deployments for Interval Data Collection

Standard operating procedures for deployment of multiprobe sondes to log continuous data at set recording intervals are contained in CN 4.4.

Water column profiles of lakes and ponds (general)

The same standard operating procedures described heretofore shall apply to *in situ* monitoring of ponds and lakes (referred to subsequently as “lakes”). However, additional procedures are necessary for developing water column profiles of lakes from measured multiprobe variables. It is acknowledged that these procedures may not be applicable at all times and to every single lake in Massachusetts since there is considerable variability in type (i.e., kettlehole, natural drainage, reservoir, and run-of-the-river), flushing rate, mean depth, surface area, morphometry, orientation of basin to prevailing winds, altitude, micro-climate, concentration of dissolved organic compounds, *et cetera*. Among these, depth is the primary criterion for developing vertical profiles of multiprobe variables. Se also Attachment E.

In Massachusetts, maximum depths of lakes range from about one meter (~3 feet) to thirty-five meters (~115 feet). Given this disparity, the protocols that follow have been established to set standard operating procedures for lakes that typically exhibit distinct stratification into epilimnia, metalimnia, and hypolimnia from those lakes with less distinct or ephemeral stratification patterns, or that are more-or-less isothermal during the interval from mid-May to mid-September. Since mean depth is unknown for the vast majority of Massachusetts’ nearly 3,000 lakes, the distinction between the two sets of procedures shall be set at a maximum depth of eight meters (26 feet).

#### NOTE: an “Abbreviated Standard Operating Procedures for Vertical Profiles of Lakes and Ponds” is located within the inside zipper pocket of each carrying case, and is included as Attachment E to these SOPs.

Sonar devices shall be used to locate the site of maximum depth for each lake. If inoperative, a graduated depth line shall be substituted. However, if the weighted depth line is used, the site of the water column profile shall be offset horizontally by a minimum distance of five (5) meters to avoid monitoring multiprobe variables within a possible plume of resuspended sediments.

Two Anchor Method: Anchors shall not be lowered to the lake bottom at or near the location where water column profiling will be done. Instead, a bow anchor shall be lowered upwind (if applicable) of the maximum depth site, and the anchor line shall be payed out until the boat is positioned downwind of this site. Then, a stern anchor shall be lowered. The lengths of each anchor line are adjusted and secured to position the boat in a fixed location above the lake’s maximum depth. This procedure shall be followed even under no wind conditions. Further, any attempt to profile multiprobe variables through the water column shall be aborted if the suspended transmitter-stirrer assembly cannot be maintained in a vertical position that is perpendicular to the lake’s surface.

While readings may fluctuate at any given depth more than for river surveys, it is paramount that readings be as stable as possible prior to storing data.

Water column profiles of lakes and ponds (Lakes with maximum **depths ≤ 8 meters**)

multiprobe measurements shall be recorded at 0.5 meters and at each subsequent one (1) meter interval (e.g., 1.5m, 2.5m) until the multiprobe transmitter and its attached stirrer are positioned 0.5 meters above the sediment - water interface. The last set of measurements shall be recorded at this depth, but only if the primary user is certain that the transmitter-stirrer assembly has not made contact with lake sediments.

Three (3) recordings at one-minute intervals shall be stored at each depth during the months of June, July, and August, but only after all enabled variables are at equilibrium values. Recordings at the fourth (4th) minute interval shall be added during the months of May and September since certain variables are slower to reach equilibrium at cooler water temperatures. At other ice-free times of the year when water temperature is greater than 5°C, five (5) recordings at one minute intervals shall be made at 0.5 meters below the lake’s surface, at mid-depth, and at 0.5 meters above the sediment-water interface. Seven (7) or more recordings at one minute intervals shall be required when any surface water is less than 5°C.

Water column profiles of lakes and ponds (Lakes with maximum **depths > 8 meters**)

Perform a preliminary scan of most of the water column by slowly lowering the transmitter-stirrer and observing the displayed variation in temperature and dissolved oxygen. The lowermost depths of the hypolimnion need not be scanned; in fact, the primary user shall assure that the transmitter-stirrer does not contact lake sediments. Approximate boundaries of the three lake strata (epi-, meta-, and hypolimnia) shall be recorded on a DWM field data sheet. Next, the primary user shall document the water column profile by following the procedures stated below.

* Data recordings shall be completed at the 0.5 meter depth, mid-epilimnion, and lower depth of this stratum. It is preferable that whole-meter or half-meter increments be used to monitor this stratum (e.g., 0.5m, 2.5m, 4.5m).
* Similarly, data recordings shall be completed at the upper, mid-, and lower depths of the metalimnetic and hypolimnetic strata. If practicable, record variables at half-meter or whole meter increments (e.g., 6.5m, 9.0m, 11.5m; and 14.5m, 18.0m, and 21.5m, respectively).
* Any subsurface peak(s) in dissolved oxygen shall be recorded (along with other enabled variables) even if additional depths need to be added to the water column profile to document this phenomenon.
* The minimum number of one-minute interval recordings shall be three (3) for both the epilimnion and hypolimnion, and four (4) for the metalimnion during the interval mid-May through mid-September.

In summary, a minimum of thirty (30) recordings shall be stored at nine (9) discrete depths in stratified lakes with maximum depths exceeding eight (8) meters. Additional recordings shall be required to profile subsurface peaks in dissolved oxygen, if any. These procedures shall apply during the interval from mid-May to mid-September, or unless the preliminary water profile scan of temperature reveals that the lake is not in a state of thermal stratification. In that instance, the procedures described in the following paragraph shall apply.

When *in situ* monitoring of “deep” lakes coincides with a transition state or probable holomixis (so-called lake “turnover”), then data shall be recorded at four (4) depths as follows: 0.5 meters; at depths representing one-third and two-thirds of the maximum depth (e.g., 7.5m and 14.5m); and at 0.5m above the sediment-water interface. At a minimum, five (5) recordings at one-minute intervals shall be stored at all four depths. Again, no data shall be stored until all enabled variables are at equilibrium values.

#### QUALITY ASSURANCE, QUALITY CONTROL, AND TRAINING

Quality assurance operating principles and quality control measures to produce credible multiprobe data are integral components of these standard operating procedures. DWM’s multiprobes have consistently been proven to be accurate and reliable instruments for measuring basic physico-chemical water quality variables because they are maintained, stored, calibrated and used properly by trained and experienced personnel (DWM’s “primary users”). However, some primary users occasionally generate data for one or more variables that are subsequently censored or qualified by DWM’s data quality control group. Common problems resulting in censored or qualified multiprobe data are:

* Variables in question had not come to equilibrium prior to initiating the standard logging procedure
* Improper placement of the multiprobe transmitter
* Inattention of the primary user to on-screen fluctuations of variables

A duplicate set of readings can be taken at a rate of once per trip by removing the multiprobe from the water (after all readings have been taken and the last recorded), immediately redeploying in the same location and storing an additional reading. The duplicate readings can provide information on overall precision or repeatability of the in-situ measurements. (Most of any variation observed will be assumed to typically be due to natural variation, but this assumption may not hold in all cases, which may lead to inferences regarding quality control).

Other points to consider are as follows:

1) The conductivity and turbidity sensors will not display equilibrium values when the multiprobe is placed in turbulent water, or even in a location of more subtle, subsurface eddies.

**NOTE**: Placement at stream locations exhibiting laminar-type flows should lead to equilibrium values.

2) Another recurrent problem is also traceable to *in situ* placement of a multiprobe. In this instance, some experienced users are inattentive to the appearance of a question mark immediately to the right of the turbidity data display. This symbol signifies that ambient radiation is interfering with the turbidity photodiode sensors. All logged data displaying the question mark shall be censored.

**NOTE**: Primary users shall adopt one or more of the following options to resolve this problem: a) rotate the transmitter to position the “turbidity sensor well” in a downward “facing” position; b) cast a body shadow over the multiprobe sensor; and/or c), move the transmitter to a shaded, non-turbulent location.

3) A third monitoring problem occurs infrequently when primary users fail to recognize that some of the multiprobe sensors take longer to reach equilibrium in the cold waters of late fall through spring. For this reason the number of required one-minute recordings increases to five (5) during ice-free months when water temperatures are greater than 5°C. Seven or more recordings at one minute intervals shall be required when any surface water temperature is less than 5ºC, and primary users shall not commence logging of data until all variables appear to be at equilibrium values.

**NOTE**: The number of required readings at one minute intervals is temperature-dependent,as follows

|  |  |
| --- | --- |
| **WATER TEMPERATURE** | **# of REQUIRED ONE-MINUTE INTERVAL READINGS** |
| >10 deg. C | 3 |
| Between 5 and 10 deg. C | 5 |
| <5 deg. C | 7 |

The aforementioned “problems” are neither pervasive nor complex, but measures to ameliorate them and other similar issues shall be an ongoing component of these standard operating procedures. This shall include *in situ* training. In-lab training and field guides have proven to be successful for the vast majority of primary users of multiprobes, and that practice shall be continued.

# DATA RETRIEVAL (DOWNLOADS)

DWM’s database manager shall be responsible for periodic downloading and archiving of all logged data and relevant information stored in sonde and logger files. The following procedures shall be performed by members of the multiprobe group only. When it has been established that all logged data have been downloaded and archived successfully, then all logged data shall be erased from memory. Standard operating procedures for these tasks are described in detail in Attachment F.

NOTE: Any disconnect of a lithium battery will erase all stored data. If a lithium battery needs to be disconnected or replaced, then the database manager shall download, archive, and erase all stored data before the display logger case is opened.

# DATA VALIDATION and MANAGEMENT

Multiprobe data will be reviewed, validated and assessed for usability by the multiprobe coordinator, QA analyst and Database Manager, consistent with this SOP and DWM’s SOP for data validation, CN 056.2. Once downloaded and archived, multiprobe data will be managed by DWM’s Database Manager, who will be responsible to ensure that the long-term integrity of data is maintained.

### Maintenance and Repair

Frequent inspection and regular maintenance of DWM’s multiprobe instruments and accessories shall be performed by the calibration laboratory supervisor (or his agents) to assure continuous and reliable operation. Maintenance activities shall be based on training, knowledge of instruments, experience, and reference to technical manuals. Consultation with technical personnel at Hach/Hydrolab and YSI may be required when there is uncertainty about a particular maintenance or repair problem. Otherwise, instruments and/or their component parts shall be shipped to the company for special maintenance problems or for repairs that cannot be performed in DWM’s calibration laboratory.

The key to continuous and reliable performance of multiprobes, display loggers, and accessories is adherence to the principle of responsible care, frequent inspection and proper use by all users.

The following standard operating procedures shall be followed to prevent and/or resolve the more common maintenance problems.

* Multiprobe sensors shall be protected with a calibration cup or storage cup except during *in situ* monitoring or maintenance and repair. Storage cups shall be filled to about two-thirds of their volume (Hydrolab Series 3 and 4 large cups) or about ¾” (Series 4 mini-sonde and YSI) with 1º Nanopure water or low-ionic standard solution to protect the sensors from drying out and/or damage.
* The calibration laboratory supervisor shall inspect each multiprobe sensor prior to its pre-calibration, and routinely during storage. Calibrators shall inspect the sensors prior to post-calibration. A multiprobe shall not be pre-calibrated and used for *in situ* monitoring if the dissolved oxygen membrane is damaged or wrinkled, or if air bubbles are detected beneath the membrane. And, if a dissolved oxygen membrane is replaced by the laboratory supervisor, the multiprobe must be stored overnight (12-24 hours) prior to its calibration and use.
* Post-survey checks shall include inspection of the dissolved oxygen sensors. When membranes are abraded, torn, or wrinkled, or if air bubbles are detected, calibrators shall record their observations on the Calibration Record, prior to initiating post-calibration procedures.
* The pH reference probe shall be inspected prior to pre-calibration and routinely during storage. A multiprobe shall not be calibrated or used for *in situ* monitoring if a sizeable (>2mm) air bubble is detected at the base of the reference probe when the transmitter is inverted. However, this problem can be resolved quickly by the laboratory supervisor, and the multiprobe can be calibrated immediately thereafter.
* Post-calibrators shall inspect the pH reference probe. They shall record the observation of an air bubble as described previously for the dissolved oxygen sensor.
* If pH begins to “drift” from its normal response to calibration standards, the calibration laboratory supervisor shall “rebuild” the reference probe, including replacement of the Teflon® cap and both O-rings (for “rebuildable pH probes).
* Occasionally a slight “drift” in the normal display of specific conductance (e.g., 1.0µS/cm to 1.3µS/cm) is observed when that sensor is tested in 1º Nanopure water. Most often this occurs following calibration of pH at 4.01 units. When this happens, the calibrator shall flush the sensors in pH 10.4 buffer followed by several flushes with Nanopure water. If the normal value displayed for specific conductance is not restored in 1º Nanopure water, the cell block for that sensor shall be loosened to expose the bases of the six pin-shaped nickel electrodes and their O-rings. Flush the electrodes and O-rings with 1º Nanopure water, tighten the cell block, and retest the sensor in 1º Nanopure water. These simple procedures are usually sufficient. If not, the process of calibration shall be continued to its conclusion. For Hydrolab units, the calibration laboratory supervisor can “polish” the six nickel electrodes per Part 3.4 of Hydrolab Corporation’s H20® Multiprobe Operating Manual or Section 10.2 of the Customer Service Technical Manual (refer to “References” on page 13).
* The calibration laboratory supervisor shall inspect cables and dummy plugs following their use. The supervisor shall clean dummy plug inserts and reapply silicone grease as needed. The rubber post and electrode pins on the bulkheads of multiprobe transmitters and the Recorder shall be inspected periodically as well.

For Hydrolab stirrers, calibrators shall remove the magnetic impeller from the stirrer post after each use, and then dislodge water droplets from the post and impeller with short blasts directed from a PC Duster® 2 nozzle. The calibration laboratory supervisor shall apply a thin coating of silicone grease to the post, but only periodically or as needed. And, immediately thereafter, the supervisor shall test that the impeller spins freely when cabled to a Surveyor 3 display-logger.

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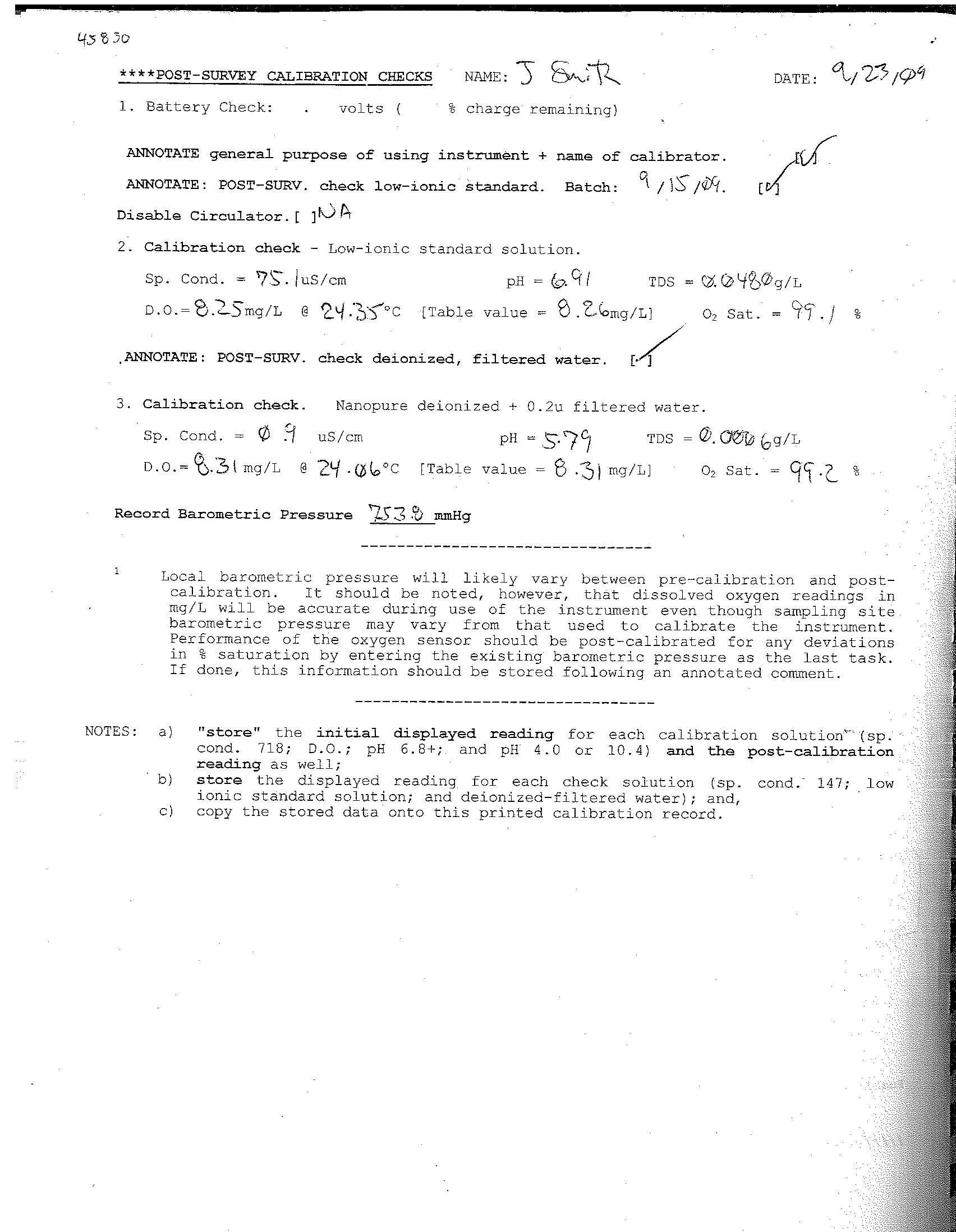
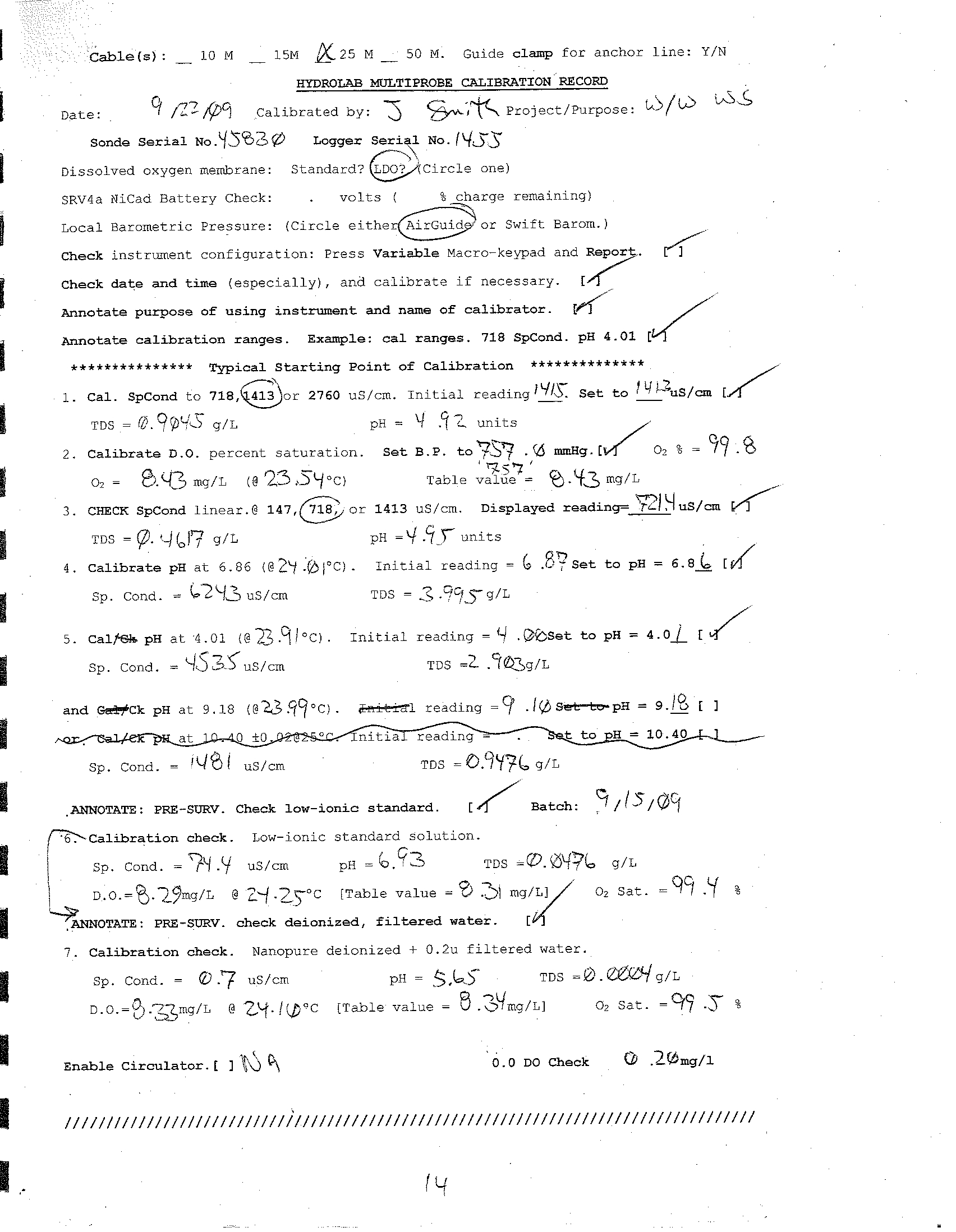
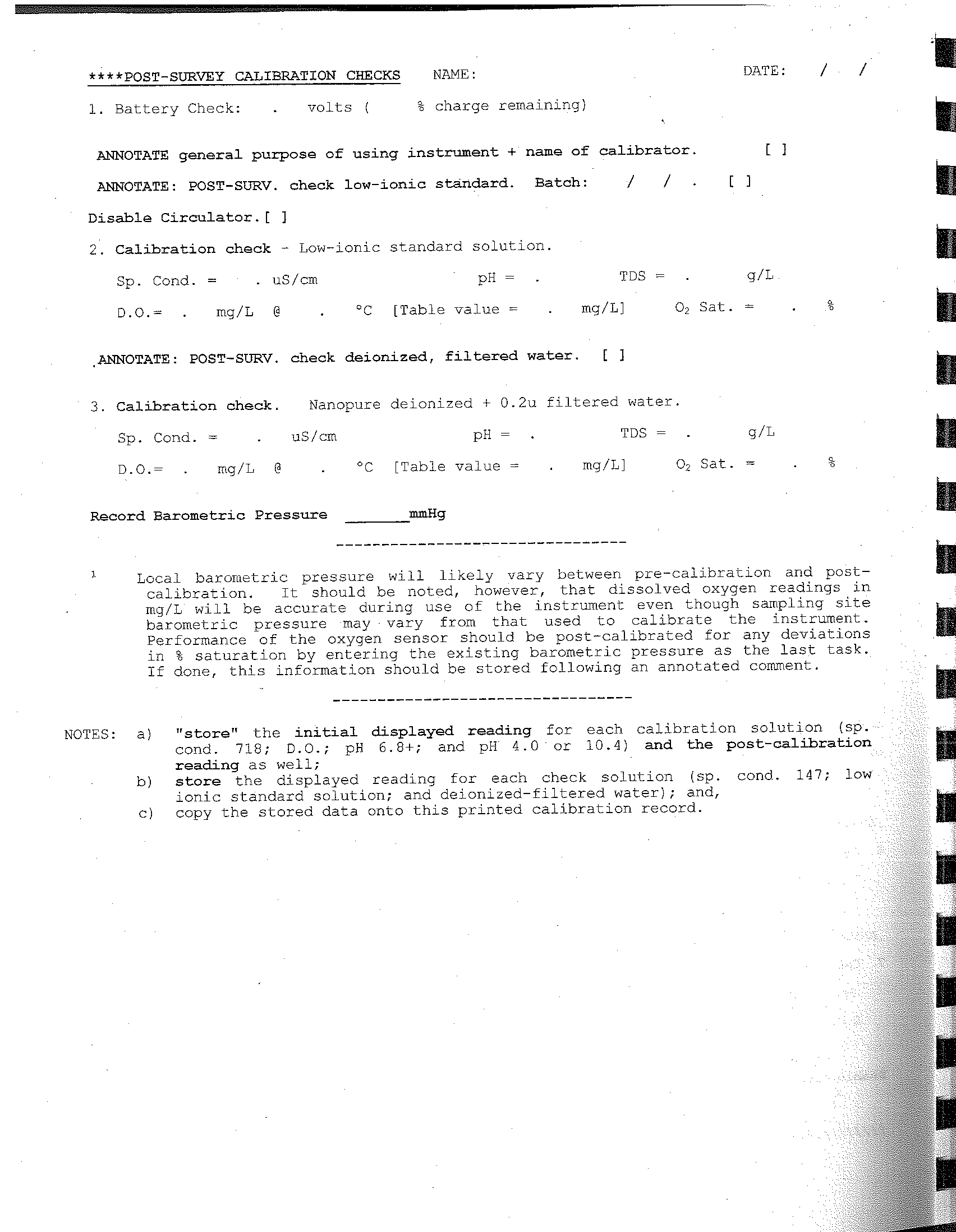
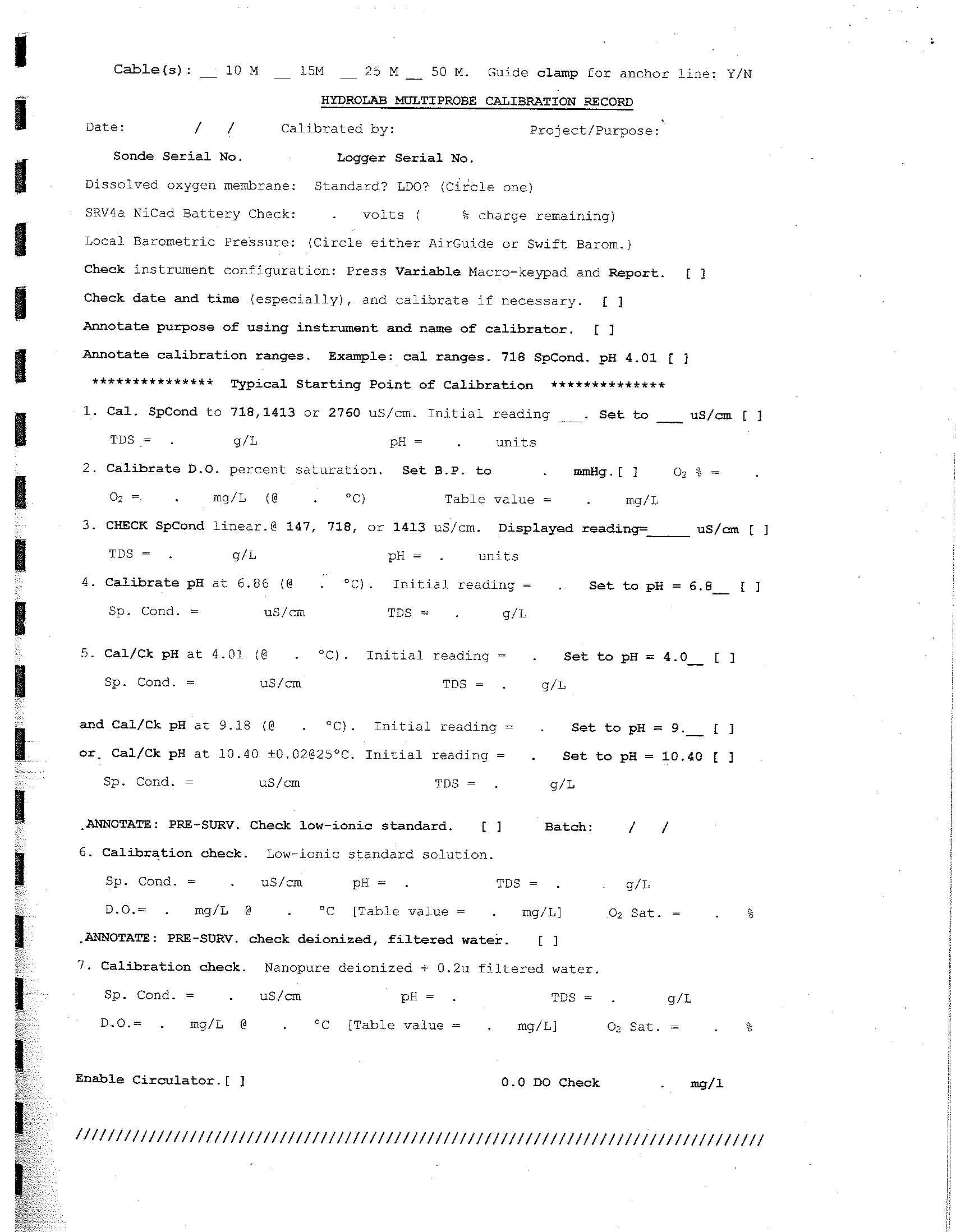
YSI Environmental Operation Manual. 2003. 6-Series (600XLM Sonde), Yellow Springs Inc.

**Attachments**

1. **Pre-Survey Calibration and Post-Survey Check Record**
2. **Low Ionic Stock Solution**
3. **Multi-probe Request Forms**
4. **Hydrolab Series 3 Use Quick Guide**
5. **Guide for Vertical Profiles in Lakes**
6. **Guide for Downloading and Storing Probe Data**
7. **YSI 600XLM Quick Guide for Setup and Use**
8. **Hydrolab DS4/4a Use QuickGuide**
9. **YSI Model 33 S-C-T Meter QuickGuide**
10. **Single pH probe meter QuickGuide**
11. **Thermistor Check (example)**
12. **Eureka QuickGuide**

**ATTACHMENT A:**

**MULTIPROBE CALIBRATION RECORD (example: Hydrolab)**



ATTACHMENT B

**Low-Ionic Phosphate Standard Stock Solution (Metcalf and Peck, 1993)**

The stock concentrate solution is the U.S. National Institute of Standards and Technology 0.025 mol kg-1 (of solvent) KH2PO4 and Na2HPO4 primary pH standard solution having a pH of 6.865 at 25ºC (Bates and Acree 1945; Bates 1973). The essential reason for this stock composition is that we felt that if our inferences about unpredictable pH changes (caused by varying CO2 gas concentrations) in previous dilute, neutral pH standards were correct, that a successful new standard would have more H+ complexed by non-carbonate species than the previous carbonate-based standards (Peck and Metcalf 1991). Even when diluted 200 times, the stock solution’s chemical characteristics are controlled by phosphate equilibria, rather than carbonate equilibria (Peck and Metcalf 1991). Additionally, the necessary high purity reagents are readily available and inexpensive. The equilibrium constants for the controlling equilibria have been measured very accurately (Bates and Acree 1945), which allows accurate computer modeling of the pH of diluted stock solution (Peck and Metcalf 1991). In undiluted form, the stock concentrate solution has been found to change less than 0.007 pH units during 28 months of storage (Bates 1973).

A “Small Stock” concentrate solution is prepared to yield about 1 L of solution. The following analytical reagent grade chemicals, dried at 120ºC for three hours and stored desiccated, are dissolved in 1000.0 g (1.0018 L at 20C; 1.0029 L at 25ºC) of deionized, or distilled water (with a conductivity less than 2.0 μS CM-1 at 25ºC): 3.4022 g of KH2PO4 and 3.5490 g of Na2HPO4. Alternately, a “Large Stock” concentrate solution is prepared by dissolving 68.0447 g of dry KH2PO4 and 70.9795 g of dry Na2HPO4 in 20,000.0 g (20.0355 L at 20ºC; 20.0588 L at 25ºC) of deionized, or distilled water (with a conductivity less than 2.0 μS cm-1 at 25ºC). This is readily done in a large polyethylene carbuoy container, which can be rotated around its vertical axis on the floor to ensure mixing. The 100:1 dilute phosphate standard is prepared by adding 200.0 grams of stock concentrate solution (either Small Stock or Large Stock) to 20000.0 g of deionized water. Rotating the carbuoy on its edge for one minute is sufficient to adequately mix the solution. (If a balance weighing to within 0.1 mg is not available, the Large Stock can still be accurately made by weighing to the nearest 0.01 g).

**ATTACHMENT C**

**Multiprobe Request Form (examples)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Attended Survey Probe Request** | | | | | |  |  |
| **Request Date:** | | 07/16/09 |  |  | | **Crew** | **Lead** |
| **Date Needed:** | | **07/22/09** |  | **1** | Meek |
| **Time Needed:** | | 9:00 AM |  | **2** |  |
| **Requestor:** | | J.Meek |  |  |  | **3** |  |
| **Project Name:** | | Boston Harbor-Neponset (2009) | | | | **4** |  |
| **Survey Type:** | | Attended |  |  |  | **5** |  |
| **Fresh/Salt:** | | Fresh |  |  |  | **6** |  |
| **Comments:** | | Lake Survey - A typical 15m cable will be fine | | |  | **7** |  |
|  |  |  |  | **8** |  |
|  |  |  |  | **Attended Details** | | | |
| **Crew** | **Order** | **Sonde ID** | **LoggerID** | **Site** | **OWMID** | **Crew Lead** | **Date** |
| **1** | 1 |  |  | PONK | **73-0415** | Meek | 07/22/09 |
| **1** | 2 |  |  | RESP | **73-0416** | Meek | 07/22/09 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Deploy Survey Probe Request** | | | | |  |  | **Attended QC Probes** | |  |  |  |  |
| **Request Date:** | | 07/31/09 |  | | **Crew** | **Lead** | **Date** | **Activity** | **SondeID** | **LoggerID** |  |  |
| **Date Needed:** | | **08/07/09** | **1** | M. Reardon | 08/07/09 | Deploy |  |  |  |  |
| **Time Needed:** | | 8:00 AM | **2** | D. Davis | 08/10/09 | Redeploy |  |  |  |  |
| **Requestor:** | | James Meek |  |  | **3** | J. Carr | 08/10/09 | Redeploy |  |  |  |  |
| **Project Name:** | | Boston Harbor-Neponset (2009) | | | **4** | P. Mitchell | 08/12/09 | Pickup |  |  |  |  |
| **Survey Type:** | | Deploy |  |  | **5** |  |  |  |  |  |  |  |
| **Fresh/Salt:** | | Fresh |  |  | **6** |  |  |  |  |  |  |  |
| **Comments:** | |  |  |  | **7** |  |  |  |  |  |  |  |
|  |  |  | **8** |  |  |  |  |  |  |  |
|  |  |  | **Deployment (Fri to Mon OR Wed)** | | | | **Redeploy Crew** | **Redeployment (Mon to Wed)** | | | | |
| **Crew** | **Tube** | **Sonde ID** | **Site** | **Deploy OWMID** | **Deploy QC OWMID** | **Pickup QC OWMID** | **Site** | **OWMID** | **Deploy QC OWMID** | **Pickup QC OWMID** | **Pickup Crew** |
| **1** | 1 |  | TH02 | **73-0427** | 73-0447 | 73-0467 | 2 | MOB032 | **73-0437** | 73-0457 | 73-0477 | 4 |
| **1** | 2 |  | HAB010 | **73-0428** | 73-0448 | 73-0468 | 2 | NR03 | **73-0438** | 73-0458 | 73-0478 | 4 |
| **1** | 3 |  | NR01 | **73-0429** | 73-0449 | 73-0469 | 2 | NER185 | **73-0439** | 73-0459 | 73-0479 | 4 |
| **1** | 4 |  | PC01 | **73-0430** | 73-0450 | 73-0470 | 2 | PTB047 | **73-0440** | 73-0460 | 73-0480 | 4 |
| **1** | 5 |  | NE12B | **73-0431** | 73-0451 | 73-0471 | 2 | UQ01 | **73-0441** | 73-0461 | 73-0481 | 4 |
| **1** | 6 |  | POB040 | **73-0432** | 73-0452 | 73-0472 | 3 | NE11 | **73-0442** | 73-0462 | 73-0482 | 4 |
| **1** | 7 |  | BM02 | **73-0433** | 73-0453 | 73-0473 | 3 | UT01 | **73-0443** | 73-0463 | 73-0483 | 4 |
| **1** | 8 |  | PQ01 | **73-0434** | 73-0454 | 73-0474 | 3 | MB01 | **73-0444** | 73-0464 | 73-0484 | 4 |
| **1** | 9 |  | NE12C | **73-0435** | 73-0455 | 73-0475 | 3 | TK01 | **73-0445** | 73-0465 | 73-0485 | 4 |
| **1** | 10 |  | BB01 | **73-0436** | 73-0456 | 73-0476 | 3 | GB02 | **73-0446** | 73-0466 | 73-0486 | 4 |
|  |  |  |  |  |  |  |  |  |  |  |  |  |

ATTACHMENT D

**FIELD USE of HYDROLAB MULTIPROBE INSTRUMENTS (Series 3, 4 and 5)**

*NOTES: 1) AS OF APRIL 2008, THIS QUICKGUIDE AND THE SERIES 3 HYDROLABS ARE NO LONGER IN USE*

*2) See also Attachment H*

1. IF NOT ALREADY ATTACHED, lay out cable, with eyebolt and transmitter connectors on top.

2. IF NOT ALREADY ATTACHED, attach "bottom" end of cable to "Multiprobe/Charger" connector on display/logger (blue box). Match grooves and ridges, insert, and twist knurled knob clockwise to lock in place.

3. IF NOT ALREADY ATTACHED, carefully attach 6 pin cable connector at "top" of cable to H20 transmitter. Align raised rubber knob (above large pinhole) with large pin, and carefully force the two together. If you do not hear a popping sound, squeeze rubber end of connector to expel trapped air. It may be necessary to bend the connector slightly to the left and right during the "squeeze." Refer to no. 10, Note #1 below re “Error” message.

4. AS NEEDED, place all protective rubber "boots" and cable dummy plugs in carrying case, and join matching dummy plugs to prevent dust and dirt from clinging to silicone lubricant.

5. Grasp H20 transmitter firmly and unscrew storage cup that protects the probes. Cap storage cup to prevent spillage.

7. Carefully insert multiprobes into the stirrer housing/probe guard, then thread stirrer into H20 bulkhead.

8. For Series 3, carefully plug the 2 pin cable connector to the stirrer cable by aligning raised rubber knobs. Connection is complete when expelled air "pops."

9. Press Surveyor "**ON**" and confirm stirrer is rotating. Immerse H20 transmitter in stream, etc., soon after connecting the stirrer. Immerse probe-end first, at a 450 angle, with the white conductivity block facing upwards. Note: for Series 3, the stirrer weight keeps the multiprobe sensors submerged and, when used in streams and wadable rivers, the opposite end of the transmitter will tend to rise above the streambed.

1. Scan variables on both screens (Screen 1 = core variables; Screen 2 = auxiliary variables, digital clock, and battery voltage). Note #1: an "ERROR" message indicates that one or both of the cable connections performed in nos. 2 and 3 above is/are not secure. Note #2: if the specific conductance reading is fluctuating up and down, there is too much turbulence within the white conductivity block. The same is true for the turbidity sensor. Reposition the H20 transmitter to a deeper and/or a less turbulent stream location. If monitoring from a bridge or on a lake, simply jerk the cable quickly to release trapped bubbles. Otherwise, proceed to No. 11 while the variables stabilize at equilibrium values.
2. Follow the standard operating procedures stated in the Guide for annotating information and recording equilibrated variables. **Note: prior to storing lines of data at 30 second intervals for five (5) minutes, annotate the OWMID number for the particular sampling site and press the “Enter” keypad (Series 3) or “Done” keypad (Series 4a).** Also, note that a single OWMID number is all that is needed to perform vertical profiles of lakes and ponds. Refer to no. 15 below regarding the assignment of OWMID numbers.

12. Check data screens 1 and 2 again. If data are stable, press the "Store" keypad (note: the hundredth digit of certain variables may fluctuate slightly).  **Record at 30 second intervals for five (5) minutes (use clock on screen 2).**  Review the file when finished to record the last line of data stored on field data sheets (see no.13 below). WARNING: multiprobe sensors require more time to stabilize when placed in cold water; record at least seven (7) minute-interval lines of data when water temperature is ≤ 50C.

13. To review the data and text that you have just logged, press the gray-colored "Logging" macro-keypad and then "Review." The cursor should be on "**5**" (Manual File); if not, scroll to "**5**" with right arrow. Press "Enter." Scroll right one space on the next screen from (**B**)eginning of file to (**E**)nd, and press "Enter" to review the last line of information logged. Press **Screen** to view screen 2, and vice versa. Use “up” arrow to scroll from the 5th line of data (5th minute) to the 4th, 3rd, 2nd, 1st, and Annotation, respectively. Press **Escape** to return to real time data (Screen 1 or 2).

14. Press "On/**Off**" keypad to turn the Surveyor off. **Do not disassemble instrument and cable until the last site is done.**  Wipe off excess moisture (except near multiprobes) with cloth provided in inside zipper pocket. Repackage instrument and cable in carrying case. Note: do not transport a Hydrolab instrument unless it is properly packaged in a fully zipped carrying case.

15. Each river basin has been assigned a unique set of numbers that identify sampling events for database management. Use one string of numbers (e.g., 84-0001) to "tag" the Hydrolab measurements and samples of water, but only if both tasks were completed more-or-less simultaneously at each station. Otherwise, use a separate, sequential string of numbers (e.g., 84-0002) to "tag" the second of these two tasks. Note: QC samples must be tagged with separate OWMID numbers, even if collected or filled at the same time as other samples. Confer with Tom Dallaire for specifics and for the next available OWMID number in each basin. The full range of DWM database numbers for river basins that may be sampled during 1999, and decades thereafter, are listed below.

**?Boston Harbor:**

Mystic River 71-0000 through **71**-9999

**Neponset River 73**-0000 through **73**-9999

**Weymouth & Weir Rivers 74**-0000 through **74**-9999

**?Cape Cod 96**-0000 through **96**-9999

**?French River 42**-0000 through **42**-9999

**?Merrimack River 84**-0000 through **84**-9999

**?Mount Hope Bay 61**-0000 through **61**-9999

**?Narragansett Bay 53**-0000 through **53**-9999

**?Parker River 91**-0000 through **91**-9999

**?Quinebaug River**  **41**-0000 through **41**-9999

**ATTACHMENT E**

**ABBREVIATED STANDARD OPERATING PROCEDURES**

**FOR VERTICAL PROFILES OF**

**LAKES & PONDS**

MAXIMUM DEPTHS GREATER THAN 8 METERS (26 FEET)

|  |  |  |
| --- | --- | --- |
| # | **Time of Year** | **Data Logging Procedure** |
|  |  |  |
| **1** | 5/15-9/15 | Perform preliminary scan of water column to see if stratified and to what extent; Record approx. depths to metalimnion and hypolimnion. **If stratified, go to # 2. If not stratified, proceed to #3 or #4** |
| **2** |  | In epilimnion, record 3 readings at 1 minute intervals at 3 depths---0.5 meter, mid-epilimnion and lower-epilimnion, for a minimum of 9 readings. |
|  |  | In metalimnion,, record 3 readings at 1 minute intervals at 4 depths (equally spaced depths), for a minimum of 12 readings. Note any points of metalimnetic D.O. maxima. |
|  |  | In hypolimnion, record 3 readings at 1 minute intervals at 3 depths (equally spaced depths), staying at least 0.5 meters off the bottom, for a minimum of 9 readings. |
| **3** | At temps>5 deg. C, and lake is not stratified | Record 5 readings at 1 minute intervals at each of 4 depths---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom (total of 20 readings). |
| **4** | At temps<5 deg. C, | Record 7 readings at 1 minute intervals at each of 4 depths---0.5 meter, 1/3 max. depth, 2/3 max. depth and 0.5 meters off bottom (total of 28 readings). |
|  |  |  |

MAXIMUM DEPTHS LESS THAN 8 METERS (26 FEET)

|  |  |  |
| --- | --- | --- |
| # | **Time of Year** | **Data Logging Procedure** |
|  |  |  |
| **1** | 6/1-9/1 | Record 3 readings at 1 minute intervals at 0.5 meters and then every meter down until 0.5 meters from the bottom. |
| **2** | May, September | Record 4 readings at 1 minute intervals at 0.5 meters and then every meter down until 0.5 meters from the bottom. |
| **3** | At temps>5 deg. C. | Record 5 readings at 1 minute intervals at 0.5 meters, mid-depth and 0.5 meters from the bottom. |
| **4** | At temps<5 deg. C. | Record 7 readings at 1 minute intervals at 0.5 meters, mid-depth and 0.5 meters from the bottom. |
|  |  |  |

**ATTACHMENT F**

Multiprobe Setup, Download, Archive and Erase Procedures

**OBJECTIVES:**

* Download logged data from the sonde loggers and display units on a periodic basis and as needed.
* Archive downloaded data files
* Erase memory from all units after confirming proper download.

**MATERIALS LIST:**

* Hydrolab® or YSI sonde loggers and display loggers containing files to be downloaded.
* Cables
* Network PC or Grid 1680 Laptop (486, DOS, 4 MB ram) or Equivalent
* Qmodem 4.52 terminal emulation software or Equivalent
* Calibration and Testing, Inspection and Maintenance Logbook

**REQUIRED STAFF:**

* One member of the multiprobe workgroup (for downloading and archiving). First in line to perform downloads/archiving are Jeff Smith and a selected assistant from among the group. See Table below for multiprobe work group staff and responsibilities.
* Two members of the multiprobe work group (for erasing).

Multiprobe Work Group:

|  |  |  |
| --- | --- | --- |
| **Staff** | Primary Responsibilities | Secondary Roles |
| Tom Dallaire (and Kari Winfield) | Data retrieval and management, database applications | Product testing, calibrations and checks (backup), |
| Jeff Smith | Overall management of calibration lab, calibrations and maintenance, preparation of standards, data validation and training, product testing and purchasing | Data retrieval (backup), |
| Richard Chase | Quality assurance for activities involving probes (including field/lab safety, data accuracy and validation, SOP revisions, training), instrument calibrations/checks | Data retrieval (backup), product testing and purchasing |
| Bob Nuzzo, Matt Reardon | Instrument calibrations and checks | Data retrieval (backup) |

**LOGGING SETUP PROCEDURES**:

1. **Hydrolab 4/5-Series**:
   1. Open Hyperterminal session (COM 1; 19200 bits/sec; data bits 8; parity none; stop bits 1; Xon X off). If no shortcut available, go to C:\...all programs/accessories/communications; OR go C:\program files\windowsNT\hyperterm.exe.
   2. Connect each pre-calibrated sonde to PC and go to FILE, CREATE
   3. Enter deploy OWMID#, start date, start time, stop date, stop time, logging interval (30 min.), sensor warmup time (30 sec. optic DO; 2 min. Clark cell DO), circulator warmup time (2 min.), enable audio. Verify file created.
   4. If Hyperterminal not cooperating, unplug and reconnect sonde cable connection and try again. Repeat as necessary until HT responds. If still no response, close the HT session and reopen to begin again.
   5. If Clark cell DO, enable circulator using SETUP.
   6. If sonde battery voltage <10.3, replace all batteries with new ones. Make sure to install each battery in correct direction. New batteries will bring sonde power to >12. Following battery change, verify correct sonde date and time.
   7. When setup complete, go to FILE, STATUS and “print screen” for a deploy-setup paper record for each sonde.
   8. If logging is set to start in the lab (e.g., 6am), logging (and circulator function) can be verified using the audio beeps and visually by watching for circulator function.
   9. Place sondes in deploy tubes with pipe insulation cushions. Provide sonde guards to field crew.
   10. Make copy of deploy request form listing the tube-OWMID#-sondeID combinations. Keep one copy in the lab and provide one to field crew.

**DOWNLOAD PROCEDURES:**

1. Document download activity in the appropriate Testing, Inspection and Maintenance Logbook. At a minimum, provide the name(s) of staff conducting download, the date and time of download, and the serial number(s) of the unit(s) to be downloaded.
2. Download all of the raw data files on the unit(s) according to the specific instructions provided for the unit to be downloaded.

***Surveyor 3 (SRV3)***

1. Connect SRV3 to computer using SRV3-IC Cable
2. Run communications software in terminal mode
3. Press the space bar to get the Hydrolab® SRV3 menu
4. For each file to be downloaded, repeat Steps (e) through (dd)
5. Select “L” from the menu (Logging)
6. Select “D” from the menu (Dump)
7. Select “N” in response to “Power down probes during dump?” prompt
8. Select log file to be downloaded (i.e. “5”)
9. Select “P” for “Printer ready”
10. Select “F” for “Follow variable and calibration changes”
11. Select “N” for “No Statistics”
12. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
13. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
14. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
15. Press any key – Data should scroll down the screen
16. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
17. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
18. Press any key to continue
19. Select “L” from the menu (Logging)
20. Select “D” from the menu (Dump)
21. Select “N” in response to “Power down probes during dump?” prompt
22. Select log file to be downloaded (i.e. “5”)
23. Select “S” for “Spreadsheet importable”
24. Select “F” for “Follow variable and calibration changes”
25. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
26. Select XMODEM as Download Protocol
27. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
28. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
29. Start file download and wait for completion of download
30. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
31. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from SRV3 unit being handled
32. Repeat the above steps for each individual SRV3 unit, then proceed below to “Archive Data Steps”

***Surveyor 4a (SRV4a)***

1. Connect SRV4a to computer using SRV4a-IC Cable
2. Run communications software in terminal mode
3. On the SRV4a, select “Files” from the menu, and then select “Review” to determine how many files are on the unit.
4. Select files one at a time and repeat Steps (e) through (x) for each file.
5. Select “Files” from the menu
6. Select “Transmit” from the menu
7. Select Printer-Ready
8. Select “N” for No Statistics
9. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
10. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
11. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
12. Press any key on SRV4a – Data should scroll down the screen
13. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
14. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
15. Select “Files” from the menu
16. Select “Transmit” from the menu
17. Select upload Spreadsheet (SS) Importable
18. Select “N” for No Statistics
19. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
20. Select XMODEM as Download Protocol
21. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
22. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
23. Start file download and wait for completion of download
24. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded
25. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from SRV4a unit being handled
26. Repeat the above steps for each individual SRV4a unit, then proceed below to “Archive Data Steps”

***MiniSonde (MS4a or MS4a-SE) and 5-series?***

1. Connect the MiniSonde to the computer
2. Run communications software in terminal mode. Use the following settings in HyperTerminal:

Bits per second: 19200

Data bits: 8

Parity: None

Stop bits: 1

Flow Control: X on/X off

1. Press the space bar to get the MS4a menu
2. Select “Files” from the menu, and then “Status” to check number of files
3. For each file, repeat Steps (f) through (dd)
4. Select “File” from the menu
5. Select “Transfer” from the menu
6. Select Sensors – Off
7. Select Printer-Ready
8. Select Statistics – None
9. Select log file to be downloaded (i.e. “5”)
10. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
11. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
12. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
13. Press any key – Data should scroll down the screen
14. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
15. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
16. Press any key to continue
17. Select “File” from the menu
18. Select “Transfer” from the menu
19. Select Sensors – Off
20. Select Spreadsheet Importable (XMODEM)
21. Select Statistics – None
22. Select log file to be downloaded (i.e. “5”)
23. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
24. Select XMODEM as Download Protocol
25. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
26. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
27. Start file download and wait for completion of download
28. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
29. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from MS4a unit being handled
30. Repeat the above steps for each individual MS4a unit, then proceed below to “Archive Procedure”

***Series 3 Sonde (“Big Bertha”)***

a. Connect the Sonde to the computer

1. Run communications software in terminal mode. Use the following settings in HyperTerminal:

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow Control: X on/X off

1. Press the space bar to get the Series 3 Sonde menu
2. For each file to be downloaded, repeat Steps (e) through (ee)
3. Select “L” from the menu (Logging)
4. Select “D” from the menu (Dump)
5. Select “N” in response to “Power down probes during dump?” prompt
6. Select log file to be downloaded (i.e. “5”)
7. Select “P” for “Printer ready”
8. Select “F” for “Follow variable and calibration changes”
9. Select “N” for “No Statistics”
10. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
11. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
12. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
13. Press any key – Data should scroll down the screen
14. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
15. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
16. Press any key to continue
17. Select “L” from the menu (Logging)
18. Select “D” from the menu (Dump)
19. Select “N” in response to “Power down probes during dump?” prompt
20. Select log file to be downloaded (i.e. “5”)
21. Select “S” for “Spreadsheet importable”
22. Select “F” for “Follow variable and calibration changes”
23. Select “N” for “No Statistics”
24. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
25. Select XMODEM as Download Protocol
26. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
27. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
28. Start file download and wait for completion of download
29. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
30. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from Series 3 unit being handled
31. Proceed below to “Archive Procedure”

***DS4***

a. Connect the DS4 to the computer

1. Run communications software in terminal mode. Use the following settings in HyperTerminal:

Bits per second: 19200

Data bits: 8

Parity: None

Stop bits: 1

Flow Control: X on/X off

c. Press the space bar to get the DS4 menu

d. Select “Files” from the menu, and then “Status” to check number of files

1. For each file, repeat Steps (f) through (dd)
2. Select “File” from the menu
3. Select “Transfer” from the menu
4. Select Sensors – Off
5. Select Printer-Ready
6. Select Statistics – None
7. Select log file to be downloaded (i.e. “5”)
8. At the “Activate Printer and/or open capture file, then press any key to continue…” prompt, activate terminal emulation screen capture file feature
9. Type a unique file name as per naming convention (i.e. yymmddun.txt, where u is the letter corresponding to the Hydrolab unit, and n is the file number) and save the file into a designated directory on the computer’s local hard drive
10. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
11. Press any key – Data should scroll down the screen
12. At the “Deactivate printer and/or close capture file…” prompt, close the screen capture file
13. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .txt file has been downloaded
14. Press any key to continue
15. Select “File” from the menu
16. Select “Transfer” from the menu
17. Select Sensors – Off
18. Select Spreadsheet Importable (XMODEM)
19. Select Statistics – None
20. Select log file to be downloaded (i.e. “5”)
21. At the “Starting XMODEM Transfer” prompt, activate terminal emulation software file download protocol (“Receive File”)
22. Select XMODEM as Download Protocol
23. Type a unique name as per naming convention (i.e. yymmddun.xmd) and save the file into a designated directory on the computer’s local hard drive
24. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Enter filename into logbook
25. Start file download and wait for completion of download
26. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook: Indicate that the .xmd file has been downloaded.
27. At completion of download, exit terminal emulation software and confirm that: a) the appropriate number of files were downloaded and, b) downloaded files contain data from DS4 unit being handled
28. Repeat the above steps for each individual MS4a unit, then proceed below to “Archive Procedure”

***YSI 650***

1. **SETUP**: Take out all 650 units and set up next to Room 226 computer. Connect 650 to PC via dedicated 9-prong cable (COMM2).
2. **SONDE FILES**: (OPTIONAL) Upload all sonde files to the 650 logger by connecting to sonde via 650 and selecting “File” then “Upload”. [Now all files of potential interest, including internal calibration .glp file(s) are on the logger. Upload the .glp file as a .glp (binary) file as well as a .txt (comma-delimited) file. Upload .dat files as file type “PC6000.”]
3. **UPLOAD**: Login to PC and launch “**EcoWatch**” software. Go to *COMM* menu and set COMM2 (or other) under ***Settings, Sonde* and *Terminal.*** *(x-modem or kermit; 8 bits, parity none and 9600 BAUD).* Hit “Enter” to get # prompt on the PC.
4. On 650 logger, select ***File/Upload* to PC** to upload all 650 .DAT files to PC. Individually select all files and upload from the 650 to PC memory, including CAL, GLP, TXT files. The files will automatically be saved in c:\winnt\ecowin\data folder. **[**If EcoWatch does not ask you to overwrite an existing file, click Esc on the 650 logger and cancel the upload. Then try to upload the file again. When prompted to overwrite, click “No” and type in a filename based on this naming convention: yymmddun.dat, where u is the letter corresponding to the YSI unit, and n is the file number (1-9). The .dat extension is important. ]
5. After uploading all files off the 650 logger, **open each .dat file in Ecowatch, and “export” as comma-delimited file (.cdf)** by selecting “export” and keeping the same filename based on the naming convention: yymmddun.dat, where u is the letter corresponding to the YSI unit, and n is the file number (1-9), but with .cdf extension. EXAMPLE: 040815j1.cdf for data downloaded from the “J” logger on August 15, 2004.
6. **SPREADSHHEET OPTION**: Open .cdf file using EXCEL. Convert “text to columns” (move units row to be the top row, then select column 1 (all) and convert as comma, delimited). Save columner spreadsheet as .xls file.
7. **Data Management**: Copy all .dat, .cdf and .xls files from c:\winnt\ecowin\data to protected W/dwm folder (*W:\dwm\SOP\DatLog\YSI-Raw and/ or other)*.
8. **PRINT OPTION** (on screen QC checks are preferred over printing): In Word, open each .cdf file (delimited/ comma/ general) for printing. *Print* out columnar data for each file using the following tools: *Select all/convert to table/autofit to contents/ 8 font/page setup/0.5 margins/print layout/repeat column headings for first two rows/insert header&footer text (filename\path\page x of y\date\time).* Save Word .doc files to *W:\dwm\SOP\DatLog\YSI-Raw\.*
9. **SECURITY**: Copy the files from *W:\dwm\SOP\DatLog\YSI-Raw\* *to W:\dwm\owmdata\DatLog\2004\YSI\* for more secure, permanent storage. (Database Manager) In WinExplorer, change the properties of all *W:\dwm\owmdata\DatLog\2004\YSI\* files to READ-ONLY.
10. Proceed to archive and erase procedures (below).

***YSI 600XLM***

a. See above (i.e., transfer all files to 650, then download 650 files).

**ARCHIVE PROCEDURES:**

Files downloaded in the previous step will be archived in 5 locations:

* On the hard disk of the computer assigned to downloading files (e.g., Grid 1680)
* On a network drive (in directory **N:\temp\DataLoggerDownloads**
* On a floppy disk for transport off-site (to be kept at the home of the Database Manager)
* 1 Hard copy submitted to the Hydrolab® Coordinator
* 1 Hard copy maintained in Hydrolab® Data Management paper file

Confirm that “All” SRV3 units have had data downloaded for each log file before proceeding to the steps listed below:

1. ~~Copy downloaded files to a 1.44 mb floppy disk~~
2. ~~Label floppy disk with date and file names~~
3. Copy downloaded files on floppy disk to the following network drive - w:\dwm\owmdata\hyd-raw
4. Import individual \*.hlp files into MSWord (DO NOT OVERWRITE FILE WITH SAME FILENAME!)
5. Change properties to “Read Only”
6. Add the download filename, date and time to an inserted header (as variables), select “Line printer” or other appropriate font and print hard copy of each file
7. Repeat steps 4 and 5 until all \*.hlp files have been printed
8. Make 1 copy of each print out and submit to Hydrolab® Coordinator

**ERASE MEMORY PROCEDURE:**

First, compare each downloaded and archived hardcopy file to unit’s files to ensure that all data has been downloaded completely and accurately. When it has been established independently by 2 members of the multiprobe group that all data has been successfully downloaded and archived, each unit’s memory will be erased using the following procedures.

**Hydrolab Units:**

1. Make entry into the Hydrolab®Testing, Inspection and Maintenance Logbook. At a minimum, the Name(s) of staff erasing the unit, the date and time of the erasure of memory, and the serial number(s) of the unit(s) to be erased
2. Connect Hydrolab® unit to computer
3. Run communications software in terminal mode
4. Press the space bar to get Hydrolab® menu
5. For Series 3 units, follow steps a-d below.
6. Select “L” from the menu (Logging) or go to “Files”
7. Select “R” from the menu (Review)
8. Select log file to be reviewed (i.e. “5”)
9. Select “B” (Beginning of file) at the “Starting location for review ?” prompt
10. For Series 4 units, there is no menu available to view beginning and end of file; therefore, you should execute the steps to transfer the data as Printer-Ready in HyperTerminal (allow text to scroll on-screen, but do not capture text). Scroll up to view the beginning of the file.
11. Compare the first several lines of data on-screen to the hard copy print out, confirm that these lines are the same if not identical (Navigation instructions are on-screen)
12. If both the Hydrolab® Coordinator and the Database Manager agree that the beginning of the file is the same, proceed to the next step
13. For Series 3 units, press Ctrl-H to reselect location and then select “E” (End of file)
14. For Series 4 units, scroll down in the HyperTerminal window to view the end of the file.
15. Compare the last couple of lines of data on-screen to the hard copy print out, confirm that these lines are the same
16. If both the Hydrolab® Coordinator and the Database Manager agree that the end of the file is the same, proceed to the next step. If there is any doubt about the sameness of data expressed by either the Hydrolab® Coordinator or the Database Manager, the Erase Procedure is aborted and steps taken to identify the source of difference
17. Press the “Esc” key (Escape)
18. Press the space bar to get Hydrolab® menu
19. For Series 3 units, select “L” from the menu (Logging), then select “E” from the menu (Erase)
20. For Series 4 units, go to “File”, then “Delete”
21. Select log file that is to be erased
22. At the “Are you sure you want to erase?” prompt, both the Hydrolab® Coordinator and the Database Manager must confer and agree or disagree. If both agree enter “Yes”, if not enter “No”

**YSI Units:**

After all data files have been uploaded to PC and archived, go to 650 Main Menu and select ***File***, and then enter ***Delete All Files,*** then ***Delete***.

**NOTE: All data stored in 650 memory will be irretrievably lost!!!** This will not, however, affect the site designations in the Site List.

ATTACHMENT G

**QuickGuide for Calibration and Use of YSI 600XLM and 6920V2 Multi-Probes**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Application*:** The YSI 600XLM and 6920V2 multi-probe sonde units are used with the YSI 650 MDS data logger to measure and store temperature, pH, dissolved oxygen and specific conductance (and other parameters for the 6920) data collected in the field at rivers, lakes, estuaries, etc.. This QuickGuide covers pre-survey calibration, field use and post-survey QC checks. These QuickGuide steps are consistent with the MADEP-DWM SOP for Multi-probe use (CN 4.21), and should be followed for all field surveys. For info on data retrieval, see CN 4.21.

***Field Use (station to station)***:

1. Schedule to pick up a pre-calibrated YSI kit(s) VIA E-MAIL to Jeff Smith, Richard Chase and Art Johnson ONE WEEK PRIOR to the survey date(s) by filling out a Multi-probe Request Form, providing the following information (see example below):
   1. Project Name, # of crews and survey lead names, dates/times needed
   2. pH ranges expected for each crew (e.g. 5-7, 6-8, etc)
   3. fresh and/or salt water use for each crew
   4. List of ***MULTI-PROBE OWMIDs*** to be used by each crew, sequentially from first to last station visited .

2. Upon receipt of the YSI Kit, inspect contents and review Multi-probe User Report form accompanying the kit. The top part of this form has been filled out by the Multi-probe calibrator and lists kit contents. The bottom part of the Multi-probe User Report needs to be filled out by the survey crew leader upon completion of the survey and return of the unit back to DWM-Worcester.

3. IMPORTANT: Do not remove the attached YSI field cable from the sonde. Keeping the cable connected for the duration of the survey will prevent potential contamination of the o-ring inside the sonde connector plug.

1. At first station, unscrew the storage cup surrounding the probe assembly and install the probe guard. Discard the water in the storage cup and store the cup in the case. REMEMBER: Use the field storage cup (containing wet sponge) after each use and during transport.
2. Connect the 650 to the open end of the sonde cable. Also, connect the strain relief connector to the bail. (if these are not already connected).

**650 Keypad**:

* 1. ***ESC*** key= back to previous screen (REMEMBER: use ***ESC*** to backout of toggle options and ***Enter*** to change)
  2. Arrow key= “***ENTER***” ; Right/Left/Up/Down arrow keys (4)= scroll menus and rows of data

c. Number and Letters are input by successive key presses as follows: (1=1); 2 = ABC2abc2; 3 = DEF3def3...; (0=0)

1. Turn ON the YSI 650 recorder (if the unit does not respond, try battery removal and re-insertion/replacement) and go to Sonde Menu/Calibrate/Pressure. With the sonde in air, enter 0.00 meter to calibrate the unit for water depth. Then Press “enter” again.  **PERFORM DEPTH CALIBRATION AT EACH STATION IMMEDIATELY PRIOR TO USE.**  Press ESC 3 times to return to menu.
2. **Multi-Site List Method**: (PREFERRED METHOD; for typical “wade-in” station where sonde and logger are held while standing in the water).
   1. Select a suitable location and wade into the stream (with the YSI 650 in one hand secured by the hand-strap and with thumb-keyboard control; and the wound cable and sonde in the other hand) for the taking of a representative sample (e.g. center stream, completely-mixed, flowing, non-turbulent, etc.).
   2. NOTE: The multi-probe calibration staff person has already created a project-specific multi-site list in coordination with the project coordinator PRIOR TO THE SURVEY (using the OWMID list provided per #1 above). The operator will use this list in the field to record data to the correct file and site #. **DO NOT EDIT PRE-SET SITE LIST ENTRIES**. Additional Site Names and Site #s, however, can be added in the field, if needed, using the “Edit Site List” menu.
   3. At each station, go to ***Logging Setup*** to make sure “Use Site List” mode is ON. If not, scroll down and toggle to check “Use Site List” box.
   4. Facing upstream, hold the sonde in the water in front and away from your body with the probes approx. 6-12 inches (typical) below the surface. If the sonde is placed on the stream bottom for shallow sites, make sure there are no undesirable effects due to sediment disturbance or sonde movement. DO NOT ***Start Logging*** UNTIL PROBES ARE IN THE WATER AND READINGS ARE STABLE.
   5. Go to and select ***Sonde Run*** (Main Menu)
   6. Scroll to and select (Enter) ***Start Logging*** (to 650, not sonde!), after verifying stability of readings. The automatic logging interval has been pre-set to take readings every 30 seconds.
   7. The multi-site list will appear. Scroll to select the correct ***FileName***, then scroll to and select the pre-assigned ***Site Num*** (the multi-probe OWMID# for the station). This is the same File Name and Site Number that are on the pre-loaded Fieldsheet for the station.
   8. The unit is now recording data at the pre-set interval (30 seconds). Record the time logging was initiated (in order to stop logging at the approp. time). Note the stability of real-time readings throughout the logging period. Examples of “unstable” readings include unidirectional pH changes every few seconds, moderately fluctuating DO, and large jumps in conductivity. The 650 display is ordered as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| **650** | | **Sonde** | |
| Log One Sample | | Log One Sample | |
| Start Logging | | Start Logging | |
| Date | D.O. |
| Time | D.O. Charge |
| Temp | pH |
| Sp. Cond. | pH (mV) |
| D.O. %SAT | Battery (V) |

* 1. **AFTER 5 MINUTES** of stable recorded readings (10 rows of data), select ***Stop Logging***, and then ***ESC.*** NOTE: Do not “stop logging” until 3 minutes of stable readings have been taken. Note: The unit shuts off automatically after 15 minutes of no keypad use. Turn unit back ON and continue where you left off (e.g. review file to see if you logged 4-5 minutes of good quality data).
  2. On the Main Menu, select ***File***, and then ***View File***. Scroll to select the correct ***File Name*** and ***Site Num*** (e.g., “810105”. Note: no dash in OWMID) for that station.
  3. Scroll down using the down arrow key to view the last row of data and record this data on the fieldsheet manually (scroll sideways to view all data), including the site #.
  4. IMPORTANT: ***ESC*** to Main Menu and turn 650 OFF prior to proceeding to the next site.

1. Use the extra ID (-0000) provided in the Site List (e.g. 810000 for Nashua) for any unplanned station visits or in situations where the correct ID #s are not in the site list (due to miscommunication). Upon return to DWM, coordinate with the QC Analyst and Database Manager to ensure that new, proper multi-probe ID#s are provided to replace the –0000(s).
2. After data collection at each station, replace the field storage cup containing wet sponge, and clean the sonde, cable and 650 with the clean rags in the case. Pack securely in case using rags for extra cushion and placing end of sonde in bubble wrap sleeve. Zip up case. After the last station, securely pack the cleaned kit as above for transport back to DWM, leaving the cable connected as always and with the storage cup back on.

10. Complete the Multi-Probe User Report, noting any problems encountered during field use of the YSI 600XLM. Deliver this report and the YSI 600XLM kit to the DWM water lab.

***Field Use (@ bridge drop locations):*** Same as above, except for the following:

1. Due to the very light weight of the YSI 600XLM sonde and the potential for the sonde to drift into non-vertical position, attach screw-in anchor weights to bottom of sonde prior to deployment. If weights (one each per kit) are not available for some reason, attach the carbiner on the cable to an anchor rope (to stabilize the sonde in a vertical position and not drifting downstream with the current and/or bobbing on the surface). If this method is used, the preferred option (as with the Hydrolab units) is to deploy and tie off the anchor rope, attached the YSI sonde carbiner to the anchor rope and lower the YSI into position. Alternatively (if the preferred method is not possible) tie a loop in the anchor rope at the desired depth for sonde deployment, making sure that the sonde will not bang into the metal anchor when deployed. Then, attach the sonde carbiner to the loop and slowly lower the anchor/sonde assembly down into the water. When the anchor is stable and the sonde is at the desired depth, tie the anchor rope to the bridge.

***Additional Considerations for Use of the YSI 6920:***

**Clean optics:**  The 6920V2 has an additional option to clean the optic sensor(s). Using this feature cleans optics on one or both optic probes (e.g., ODO, Chlorophyll, phycocyanin).

***Field Use (fixed deployment):***  See CN 4.41

***Field Use (Lake-specific procedures):*** See CN 4.21

**Project Key for YSI 650 File & Site # List:** Actual OWMIDs must be supplied by survey coordinators prior to survey.

| **Project** | **2-Number Prefix** |
| --- | --- |
| Probabilistic | 10 |
| Targeted (misc) | 14 |
| Reference Site Network | 15 |
|  |  |
| Lakes Baseline (LB) | 24 |
| Lakes Nutrient Criteria (LC) | 25 |
| CERO/SMART (SM) | 26 |
| TBD | 27 |
| TBD | 28 |
| Training | 29 |
|  |  |
| Hoosic | 11 |
| Kinderhook | 12 |
| Bash Bish | 13 |
| Housatonic | 21 |
| Farmington | 31 |
| Westfield | 32 |
| Deerfield | 33 |
| Connecticut | 34 |
| Millers | 35 |
| Chicopee | 36 |
| Quinebaug | 41 |
| French | 42 |
| Blackstone | 51 |
| Ten Mile | 52 |
| Narragansett Bay | 53 |
| Mt. Hope Bay | 61 |
| Taunton | 62 |
| Boston Harbor | 70 |
| Mystic | 71 |
| Charles | 72 |
| Neponset | 73 |
| Weymouth & Weir | 74 |
| Nashua | 81 |
| Concord | 82 |
| Shawsheen | 83 |
| Merrimack | 84 |
| Parker | 91 |
| Ipswich | 92 |
| No. Coastal | 93 |
| S. Coastal | 94 |
| Buzzards Bay | 95 |
| Cape Cod | 96 |
| Islands | 97 |

**\* REMEMBER**: Provide the approp. extra ID# in the Site List during calibration using the “0000” format (e.g. 810000)

***Pre-Survey Calibration and Post-Survey Checks of the YSI 600XLM and 6920****: (for station-to-station use)*

Pre-Survey Calibration:

Use Multi-probe Calibration Record form for pre-calibration and post-check data. IMPORTANT: Use pre-set 650 “CALcircuitboardserial#” File (e.g., “CAL7A7B”) for logging and storage of ALL calibration and check data to the 650 memory, using the ***Site #*** 999999.

1. Power supply for pre-calibrations and post-checks is C cell alkaline or Ni-Cd rechargeable.
2. Connect sonde to 650 logger using 25’/50’field cable. OPTION: If two units needed, consider pre-/post- calibrating two at the same time.
3. Fill out individual calibration sheet with preliminary information for pre- and post-calibration of each sonde, recording the final readings for each calibration to the calibration sheets. Use DWM standard rinse procedures: 2 pre-rinses and 2 rinses prior to standard. Fill cal cup each time 2/3rd full and shake. Be careful removing cup each time.
4. Remove storage/calibration cup from sonde and inspect DO membrane and other sensors for any potential problems. DO membrane should be changed as needed and once a month during heavy use.
5. Install probe guard to verify secure fit and to perform depth calibration.
6. Turn ON 650 logger, go to *Sonde Menu* to *Calibrate* *“Pressure” (depth).* To approximate the depth from the water surface to the probe array, enter 0.15 meter (not 0.0) with the sonde in air. Press enter again to calibrate. LOG 1 sample to the 650 “CAL” file by *ESC*ing to the 650 Main Menu (“disconnecting” from sonde) and selecting *Sonde Run/* log one sample and selecting the “CAL” file from the Site List.
7. Add 718 uS/cm conductivity std. to just below the DO membrane and just above the temp sensor for an inverted sonde (using DWM rinse protocols).
8. Remove probe guard, screw cal cup (containing 718 cond. solution) onto sonde, hand-tighten, invert and place securely in bench-top double-clamp ringstand. Loosen the bottom part of the cal cup to vent (only 1-2 threads). Ensure that sonde unit is securely situated in ringstand clamps at all times (and not over the edge of the counter---just in case…).
9. Examine liquid level in cal cup of inverted sonde to ensure that the level is just below the DO probe o-ring with temp sensor and pH probe completely submerged. Make sure that DO membrane is free of droplets. Wait 15 minutes before calibrating conductivity and D.O.
10. While waiting, review Multi-Probe Request Form from monitoring coordinator and perform #11-19.
11. Check and record the following parameters on the 650 Main Menu (for a specific survey):

□ 650 Battery status □ Barometer & units □ Date & Time □ Lat/Long (if GPS)

12. Scroll to *650 System Setup* to verify/edit proper system parameters (for a specific survey):

□ Deactivated ‘Power Sonde’ □ Baud rate 9600 □ Shut off time 15 minutes □ Date/Time □ Deactivated ‘Comma radix’ □ Barometer calibration (if necessary; use calibrated Swift barometer)

13. *Esc* to *650 Logging Setup* to check/edit proper logging parameters (for a specific survey):

□ Logging interval 15 seconds □ Use of Multiple Site List ON (unless single site method to be used)

□ Store Barometer readings ON □ Store Site # ON □ Store Lat/Long (if GPS)

□ Select *Edit Site List* to create the appropriate survey *File Name* and *Site #s* (Site Names are optional) by annotation for a specific crew’s survey, based on information provided on the Multi-Probe Request Form. Provide one extra *Site Num* for every survey using the standard format for extra IDs as follows: e.g., 810000 (for Nashua), in case one or more unplanned stations are visited. Also, DELETE ALL PREVIOUSLY-USED SITE #S FROM THE SITE LIST.

Examples*: File Names* (up to 8 char.): use sonde unit ID

*Site Names*: leave blank (or station-specific unique ID or station locator)

*Site #s* (sequential in order of use for each file): 810105, 810108, 810113, etc. (Nashua file);

250001, 250002, etc. (Lakes LC file); 260001, 260002, etc. (SMART file), 999999 for CAL file.

1. Select *Sonde Menu* to connect to the Sonde Main Menu and scroll to *Advanced/Sensor* to verify setup parameters:

□ Moving probe ON □ Altitude 0 feet

15. *Esc* to *Advanced/Setup* and *Filter* to verify setup parameters:

□ VT100 emulation ON □ All other parameters OFF □ Data Filter enabled

16. *Esc* to Sonde Main Menu to check *Sensor(*s) enabled:

□ Time □ Temperature □ Cond. □ D.O. □ Pressure □ ISE pH □ Battery

17. *Esc* to Sonde Main Menu to check *Report* parameters enabled:

□ Date □ Time □ Temperature □ Spec. Cond. (uS/cm) □ TDS □ Salinity (ppt, if SW) □ DO (%sat) □ DO (mg/l) □ DO charge □ Depth (feet) □ pH □ Battery volts

1. *Esc* to Sonde Main Menu and edit *System* as needed:

□ Sonde date/time □ Sonde ID □ Comm (Auto ON; 9600 ON)

1. *Esc* to Sonde Main Menu and verify *Status*:

□ Battery volts (max = 6) □ Logging “inactive”

1. Now, go to *Sonde Run* and log one 718 COND sample (before calibration COND value). Then, *ESC* to Sonde Main Menu to *Calibrate* sensors, and select “*Conductivity” and “SpCond”.* Enter concentration in mS/cm (0.718). When readings are stable, press enter again to calibrate (inverted sonde). LOG 3 after-calibration samples to 650 “CAL” file by *ESC*ing to the 650 Main Menu (“disconnecting” from sonde) and selecting *Sonde Run/* log one sample and selecting the “CAL” file from the Site List (at 30 second intervals). *ESC/disconnect* to view file and record readings on lab data sheet.
2. *Esc* to Sonde Main Menu to *Calibrate* *“Dissolved Oxygen”* to 100% saturated air using 718 Cond solution (with “AutoSleep OFF!). Enter barometric pressure. When readings are stable, press enter again to calibrate. LOG 3 after-calibration samples to 650 “CAL” file by *ESC*ing to the 650 Main Menu (“disconnecting” from sonde) and selecting *Sonde Run/* log one sample and selecting the “CAL” file from the Site List (again, at 30 second intervals). NOTE: the calibrated %sat value will usually not be exactly 100% (unlike for the Hydrolab) due to correction for the barometric pressure entered (e.g. 94.7% sat value for 720BP; (720/760)\*100). Compare table values for saturated DO to 650 readings to confirm calibration.
3. Screw cal cup cap back on tight before removing sonde from ringstand holder. Perform linearity check using the 147 uS/cm conductivity std. by discarding the 718 std and replacing with 147. Record readings. NOTE: Do not calibrate to 147, just take the reading. (inverted sonde). LOG 3 check samples to 650 “CAL” file
4. Screw cal cup cap back on fully and remove sonde from ringstand, discard conductivity solution in the cup, perform rinses, and add pH 6.86 standard to the cup to the black fill line and replace in clamp holder in a straight-up position. LOG one before-calibration pH sample to “CAL” file before entering the “calibrate” mode.
5. *Esc* to Sonde Main Menu to *Calibrate* *“pH”* using the 2-point method.Enter 6.86 for standard #1. When readings are stable, press enter again to calibrate. Manually record 3 pH readings. (Alternatively, LOG 3 after-calibration pH 6.86 samples to 650 “CAL” file by backing out and logging to “CAL” file. Then, re-do 2-point pH calibration starting with 6.86, followed by 4.01 (or 10.04, 9.18)). Put 2nd pH solution into cup before pressing *Enter* to calibrate.
6. Discard, rinse and add 4.01 (pH 9.18 or 10 as appropriate) to the cal cup and replace in clamp holder. Enter standard pH value #2 (4.01). When readings are stable, press enter again to calibrate. (straight-up position) LOG 3 samples to the 650 “CAL” file as previously described.
7. Discard pH solution, rinse and perform Low Ionic Std. check (LI solution up to black fill line). LOG 3 samples to 650 “CAL” file at approx. 30 sec. intervals . (inverted sonde)
8. Perform DI water check (DIW up to black fill line). LOG 3 samples to 650 “CAL” file at approx 1 minute intervals. (inverted sonde)
9. Complete Multi-Probe User Report checklist for calibrated sonde unit, including multiple site list information (created Files and Site #s) NOTE: the data output file will contain the date, time and Site # only (not File or Site Name).
10. Pack YSI kit for field use, placing ½ inch DI water in the cal cup.

***Additional Considerations for Calibration of the YSI 6920:***

*pending*

**Post-Survey Checks:**

1. Review Multi-probe User Report, and use it to make additional notes as necessary in addition to the Calibration Sheet.
2. Inspect YSI 600XLM kit for cleanliness, function and quality, including each probe. Clean and maintain as necessary.
3. Turn 650 logger ON and review file/directory to verify field data has been logged to 650 as required (and not to sonde), and general setup parameters to verify that nothing was inadvertently/intentionally changed in the field that should’nt have been.
4. Perform Low Ionic Std. check (see #26 above). LOG 3 samples to 650 “CAL” file. (inverted sonde). Record data.
5. Perform DI water check. (see #27 above) LOG 3 samples to 650 “CAL” file. (inverted sonde). Record data.
6. Replace storage cup onto sonde with 1/8 inch DI water.
7. Go to ***Sonde Menu*** and transfer any files resident on the sonde memory to the 650 memory as ASCII files (e.g. .glp file).
8. Disconnect sonde, add ½ inch DI water to the cal cup and pack entire kit for short-term storage (until the next survey), and file completed Multi-probe User Report.
9. Dry out sponges in sonde storage bottles.

ATTACHMENT H

QuickGuide for Field Use of HYDROLAB MS4/5 and SVR4a/5

* Take cup off sonde unit and put on weighted strainer. Connect Cable to sonde.
* Push On/Off key and check to see if the stirrer is on. (If for some reason the stirrer isn’t on push the Setup/Cal key then the setup key then the sonde key. After a short wait you’ll get a screen with options. Scroll down 1 to ‘Circulator’ with arrow keys then press ‘Select’. You’ll get another screen with “Circltr: off on”. 0: off 1: on Old: ? New: ? 0123456789. Using the arrow keys move cursor to 1 then press select. Press done to enter your selection. Press ‘Go Back’ until you reach the main menu.

# TO CALIBRATE DEPTH

- Make sure the sonde is in air near the surface of the water. Press Setup/cal. then press calibrate then sonde. After a short wait you’ll get a screen with options, scroll to Dep 100: Meters using arrow keys. Press select you’ll get another screen: Dep 100: meters. Old: ? New: ? -0123456789. Use arrow keys and select for each character. **Enter 0.00.** Press ‘done’. Go back to the main menu using ‘Go Back’.

# TO ANNOTATE

* **Annotate OWMID# ONLY** for the station (e.g., SM-0389).
* To annotate press ’Files’, then ‘Svr4a’, then choose file (usually 2: Surveyor 4a) and press ‘Select’.
* The cursor should now be on Annotate, if not, move it there with arrow key’s, press select.
* Using the arrow keys and ‘Select’ for each character, type the OWM-ID (remember 2 characters a dash and 4 numbers).

Use the ‘Backspace Key’ to correct errors.

* When typed correctly press ‘Done’ to store the annotation to the file. Go back to the main menu using the ‘Go Back’ key.

# TO SAMPLE

* Place sonde in the water.
* Wait for probes to equilibrate and stabilize. When readings are stable press ‘Store’. Select again to use the “manual” file. It will store one set of readings automatically to the logger.
* **Continue to store readings manually @ 30 second intervals for a minimum of 5 minutes.**

**TO REVIEW DATA**

* To review files, press ‘Files’, then ‘Svr4a’ next screen arrow down to review, press ‘Select’. Arrow to correct file if necessary. Press ‘Select’. It will ask Beginning or Date/ Time. Move to ‘Beginning’ press ‘Select’. Press the up arrow from the next screen to get the last readings. Record on fieldsheet.
* Go back to the main menu using ‘Go Back’.
* Press on/off key.

ATTACHMENT I

YSI S-C-T METER (MODEL 33) QUICK GUIDE

# Operation

1. Adjust meter to zero (if necessary) by turning the Bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale. When reading the meter make sure the needle and the reflection in the mirror on the scale line up. This will give you an accurate reading.
2. Calibrate the meter by turning the **MODE** control to **REDLINE** and adjusting the **REDLINE** control so the meter needle lines up with the red line on the meter face. If this cannot be accomplished, replace the batteries.
3. Plug the probe into the probe jack on the side of the instrument.
4. Put the probe in the solution to be measured (see back).\*

# Temperature

Set the **MODE** control to **TEMPERATURE**. Allow time for the probe temperature to come to equilibrium with that of the water before reading. Read the temperature on the bottom scale of the meter in degrees Celsius. Record to nearest 1/10 degree.

# Conductivity

1. Switch to X100. If the reading is below 50 on the 0-500 range (5.5 on the 0-50 mS/m range), switch to X10. If the reading is still below 50 (5.0 mS/m), switch to the X1 scale. Read the meter scale and multiply the reading appropriately (x1, x10, x100). The answer is expressed in micromhos/cm (mS/m) (e.g. if the **meter reading**=247 and **the scale**= X10, then **conductivity**= 2470umhos/cm (247.0 mS/m)). Record data and scale used. **Measurements are not temperature compensated**.
2. When measuring on the X100 and X10 scales (does not function on the X1 scale), depress the **CELL TEST** button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. The probe needs to be cleaned (This should only be done in the lab).

# Salinity

1. Determine the sample temperature and adjust the temperature dial to that value.
2. Switch to X100. If the reading is above 500 umho/cm (50 ms/m), the salinity value is beyond the measurement range.
3. If the reading is in range, switch to **SALINITY** and read salinity on the red 0-40 ppt meter scale. Record the data (it is temperature compensated).
4. Depress the **CELL TEST** button. The fall in meter reading should be less than 2%; if it is greater, the probe is fouled and the measurement is in error. The probe needs to be cleaned (This should only be done in the lab).

# Pack-up

* Put unit back in storage case.
* Keep probe moist/wet in DI solution.

ATTACHMENT J

pH METER QUICK GUIDE

# Calibration and Set-Up

* Use 2-point calibration in the lab (pH 7 and 4). Use CAL dial to adjust to pH 7. Mark CAL dial pointer with pencil mark on unit face. Use inset screw to adjust to pH 4.
* Ensure battery condition

# Operation

* Make sure CAL knob is set at pencil mark.
* Take ambient temperature and set TEMP knob.
* Plug the probe into the unit.
* Put the probe in the solution to be measured. Only immerse probe ½ way in to solution to avoid the potential for contaminating the electrolyte solution.
* Press ON and hold until stable readings (to .05). Record.

# Pack-up

* Put probe back in case with end of probe facing down when the closed case is held by the handle.
* Disconnect probe and turn off unit.

**Appendix K**

**HYDROLAB THERMISTOR CHECK (example)**

A check of the thermistors on the Hydrolab DS3 units was performed on July 2, 2001. A cooler chest was filled with water was set up in the Instrumentation Lab a circulation pump was used to make sure the water was well mixed assuring consistent temperatures throughout the cooler. The Hydrolab sonde units were the placed in the cooler and a certified thermometer was placed on a rack under water toward the front of the cooler where it would be easy to read. The thermometer used is an ERTCO NIST Model 1003-FC Certified Thermometer Ser# 1537 (Total Immersion). The range is –1 to 51° C with scale divisions of 0.1°C and a resolution under magnification of 0.01. The last date of certification was 12-13-01. The Hydrolab thermistors have a range of –5 to 50°C and an accuracy of 0.15°C (The standard thermistor provides +/- 0.20°C accuracy worst case and 0.13°C using the 95% Certainty method for calculating accuracies). As the test chamber we used wasn’t capable of fine temperature control or of working to the ends of the thermometer range we attempted to test at the lower end of our observed sample temperatures, at the high end, and two points in between. Again these numbers aren’t at specific temperatures but we used the Certified Thermometer to compare the Hydrolab readings. The following is a table of the readings obtained by both the Certified Thermometer and each Hydrolab unit.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Certified Thermometer@ | Sonde\* 15486 | Sonde\* 15559 | Sonde\*  24569 | Sonde\*  24570 |
| 6.71°C | 6.74°C | 6.72°C | 6.54°C | 6.56°C |
| 10.18°C | 10.09°C | 10.19°C | 10.08°C | 10.08°C |
| 15.17°C | 15.08°C | 15.18°C | 15.08°C | 15.08°C |
| 23.40°C | 23.36°C | 23.40°C | 23.31°C | 23.31°C |

\*All Sonde units are +/- 0.15C.

@”Uncertainty” for the Certified Thermometer is as follows:

|  |  |
| --- | --- |
| Test Temperature C° | Standard Uncertainty |
| 0.00 | 0.01 |
| 10.00 | 0.04 |
| 20.00 | 0.04 |
| 30.00 | 0.04 |
| 37.00 | 0.04 |
| 40.00 | 0.04 |
| 50.00 | 0.04 |

Appendix L

QuickGuide for EUREKA MANTA AND AMPHIBIAN

SETUP

* Take cup off sonde unit and put on weighted strainer.
* Press **Bottom Right key** on ipaq (Eureka program should come up. If not go to **START** and click on the **Eureka icon**).
* Check to see if the stirrer is on. If for some reason the stirrer isn’t on, tap on the **Circulator Icon** on the bottom right of the screen to start it.

# TO CALIBRATE DEPTH

- Make sure the sonde is in air near the surface of the water. Tap on ‘**Probe’** (bottom middle of screen) then tap **Calibration** then under Probe Info (top of screen) tap **down arrow** then ‘**Depth’** (it should be set for 0.0 m. if not **highlight present setting** bring up the keyboard at the bottom of the screen and **type 0.00**, then tap ‘**Calibrate’** and then ‘**Okay’**. Go back to the main screen using ‘**OK**’ in the top right part of the screen and tapping **Yes** to save the calibration..

# TO ANNOTATE and SAMPLE

* Place sonde in the water.
* When readings are stable tap **green ‘LOG’ icon** then ‘**Append’**, Program will ask for new annotation. Type it in. The unit will automatically start logging. When finished logging tap the **Red ‘Stop’ Icon** on the bottom of the screen.

**TO REVIEW DATA**

* To review files, tap ‘**File’**, then **Highlight file used** (there should only be one) tap ‘**Select’** and scroll to the bottom of the data to get the last reading. Record on fieldsheet.
* Go back to the main screen by tapping **ok** in the upper right corner of the screen.
* Press **power key** on the upper right corner of the ipaq

**AT THE FINAL STATION**

**To Shut Off Tap ‘File’, Then** ‘**Exit’, Then Press power key on the upper right corner of the ipaq**