STANDARD OPERATING PROCEDURE

Calibration, Field Measurement, Cleaning, and Storage of the YSI EXO1 Multiparameter Sonde

KEY WORDS

Sonde, pH sensor, dissolved oxygen sensor, conductivity sensor, temperature sensor, water quality

APPROVALS

APPROVED BY: *Original signed by* DATE: xx/xx/2020
Jenifer Teerlink, Ph.D.
Environmental Monitoring Branch Manager I

APPROVED BY: *Original signed by* DATE: xx/xx/2020
Christopher Collins
Environmental Monitoring Branch Quality Assurance Officer

APPROVED BY: *Original signed by* DATE: xx/xx/2020
Michael P. Ensminger, Ph.D.
Senior Environmental Scientist (Specialist)

PREPARED BY: *Original signed by* DATE: xx/xx/2020
Emily Edgerton
Scientific Aid

Environmental Monitoring Branch organization and personnel, such as management, senior scientist, quality assurance officer, project leader, etc., are defined and discussed in SOP ADMN002.

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1.0 INTRODUCTION

1.1 Purpose

The YSI EXO1 sonde is a handheld water quality monitoring instrument that collects water quality data such as temperature, conductivity, total dissolved solids, salinity, dissolved oxygen, and pH (1, 2). This document provides standard operating procedures (SOPs) for calibration, quality control, field use, cleaning and maintenance, and storage procedures for the EXO1 sonde.

1.2 Definitions

1.2.1 Calibration solutions - standard solutions used to calibrate sensors.

1.2.2 Confidence solution - solution used to ensure sensors are within control limits.

2.0 MATERIALS

2.1 EXO1 sonde (Figures 1 and 2)

2.2 Classic handheld (HH) (YSI 599150) (Figure 1C)

2.3 Field cable (Figure 1D)

2.4 Conductivity/temperature sensor (YSI 599870)

2.5 pH sensor, guarded (YSI 577601; replacement module, YSI 577603-01)

2.6 Dissolved oxygen (DO) sensor (YSI 599100-01; cap YSI 599110-01)

2.7 EXO 4-pin bulkhead connector port plugs (YSI 599475) (Figure 1C)

2.8 EXO 6-pin dummy plug (YSI 599665) (Figure 1D)

2.9 Rechargeable Li-Ion battery pack for the EXO1 Classic HH

2.10 Battery compartment (cover) tool

2.11 Magnetic sensor removal tool (YSI 599469) (Figure 3)

2.12 Silicone Krytox GPL 205 lubricant (YSI 599352)

2.13 YSI soft-sided carrying case (YSI 6655)

2.14 Conductivity/temperature brush (YSI 599470)

2.15 Conductivity calibration solution (1000 µS m^{-1}, YSI 3167)

2.16 pH buffer calibration solutions (pH 4.0, 7.0, or 10.0)

2.17 Confidence solution (YSI 5580)

2.18 NIST-certified thermometer

2.19 Calibration and Confidence Solution Check (CCSC) Logbook (Appendix 2)

2.20 Lint-free tissue (e.g., Kimwipes®)

2.21 Deionized (DI) or distilled water

2.22 Hydrochloric acid (HCl)

2.23 Bleach

2.24 Screw drivers (Phillips and slotted)

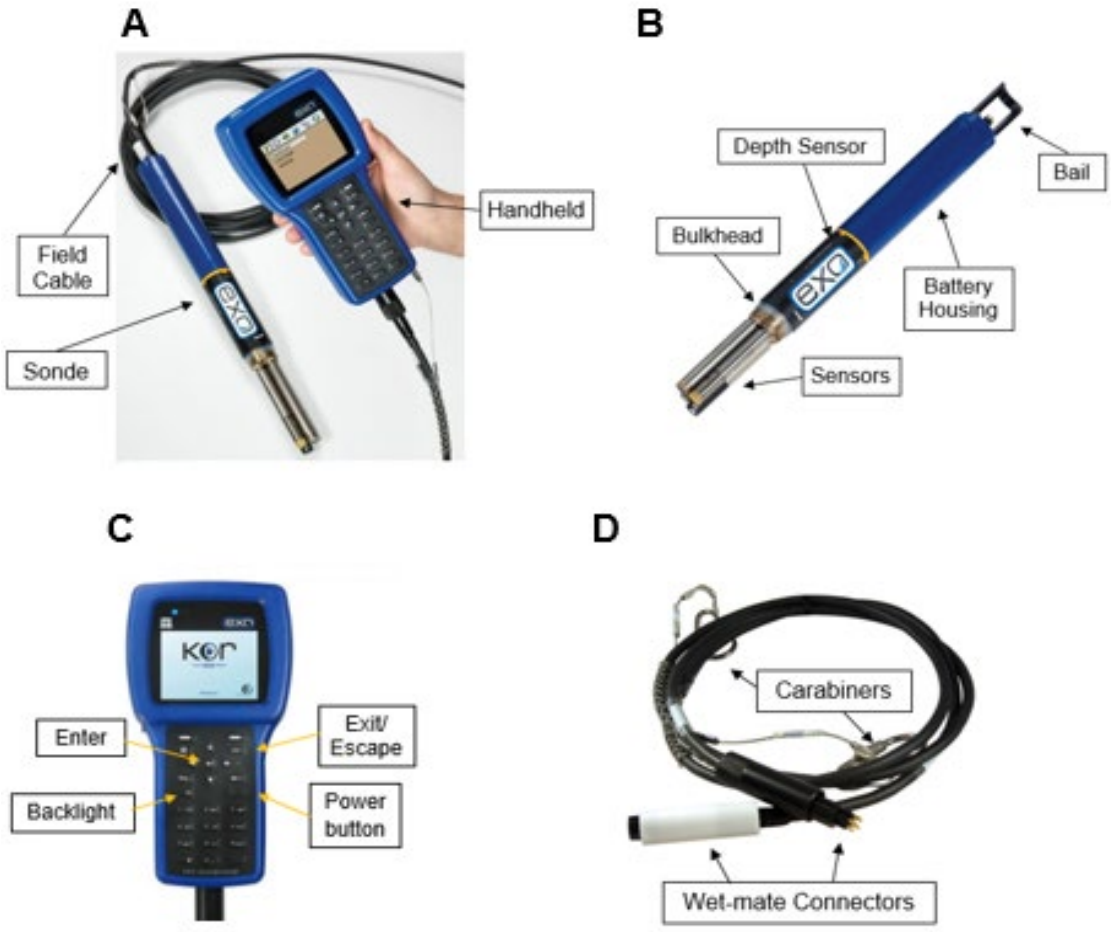

Figure 1. EXO1 sonde system. A, classic handheld, sonde, and field cable connected; B, EXO1 sonde; C, classic handheld; D, field cable

Figure 2. EXO1 sonde components. A, calibration cup for holding solutions; B, sonde guard to protect sensors; C, bulkhead connector port plug; D, 6-pin dummy plug

Figure 3. Magnetic sensor tool to turn on sonde bluetooth for connectivity to hand held (HH), showing blue light connectivity to HH

3.0 EXO1 Sonde Operation

3.1 Connect Sonde to HH

3.1.1 Powering on HH and sonde

The EXO1 has ports for four sensors. Prior to use, plug unused ports with port plugs (Figure 2C). Connect the sonde and HH via cable or bluetooth. Bluetooth connection allows for working with the sonde without field cable connection, but will not function when the sonde is submerged.

Power on the HH with the power button, then power sonde on via field cable connection or wirelessly. For wireless operation, press the magnetic tool (or magnet in the top left of the HH) against the magnetic symbol on the sonde (circled in red in Figure 3). For field cable connection, ensure wet-mate connections are aligned and lock in place. The sonde will automatically power on with field cable

connection.

Blue and red led lights indicate sonde status. When powered on (awake), the blue led light will be solid and the red led light will blink at 1 sec intervals; solid red indicates the sonde is awake but with faults (problems that will need fixing prior to use).

3.1.2 Connect the HH to sonde

When powered on, the default screen appears on the HH (Figure 4). Arrow to the **Connections** icon and select **Rescan** (Figure 5). When the corresponding sonde's serial number appears, select **Connect**. The sonde and HH are now paired. Note that wireless connection may take multiple attempts and longer to connect.

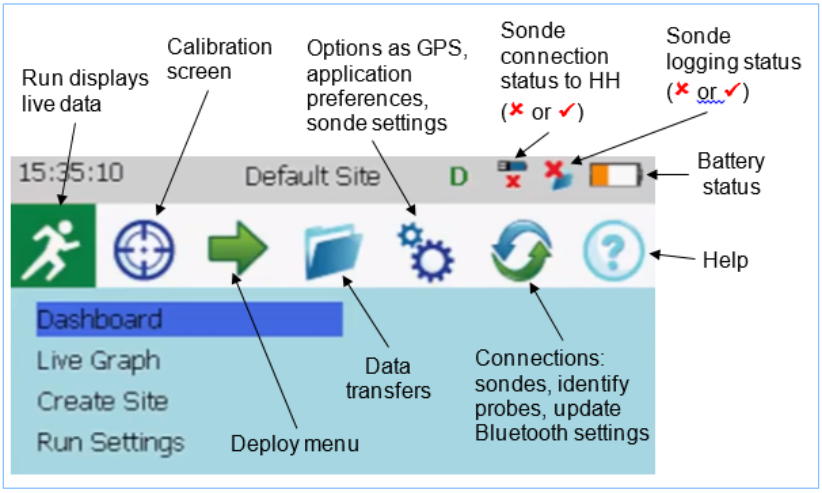

Figure 4. HH screen symbols (YSI, 2014; Appendix 1)

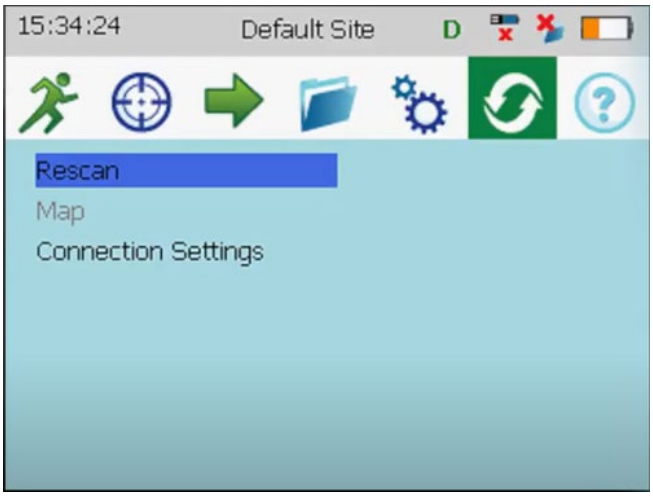

Figure 5. HH Rescan Screen

3.1.3 Operation

When the sonde and HH are paired, the Dashboard screen will appear on the HH and record live readings from the sonde (Figure 6).

To change units/readings on the Dashboard, go to the default screen and select the **Options** icon, then select **Units** and arrow over to enable or disable the unit of choice. The enabled units appear in the dashboard view on the HH, but the sonde is still collecting other data of other parameters not enabled.

For spot readings, set the averaging mode to accelerated averaging mode. With the sonde connected to the HH, set in **Options**, **Sonde**, **Averaging Modes**; arrow over to **Accelerated**. Select **Apply**, then **OK**. This will speed up the sonde's response time over the **Default** setting. When in accelerated mode, the letter "**A**" will appear in the title bar in the Dashboard view. For spot sampling, record sampling data on a field datasheet after the sonde stabilizes (~5 min).

For data profiling or logging data, set the averaging mode to **Rapid** or **Default**, respectively. Use **Capture Data** on the HH Dashboard for profiling or logging data (not covered in this SOP, refer to YSI (1-3).

After use, turn off sonde by disconnecting the field cable or with the magnetic sensor tool if connected wirelessly. If the field cable was removed, place connector plug on sonde connectors. Put the HH to sleep or off, dependent on need. Rinse sensors with DI water, then fill a clean calibration cup with ~40 ml of water and place on the sonde. Tap water is preferred to DI water, as DI water will shorten the lifespan of the pH sensor. Ensure sensors are **not** submerged in water.

3.1.4 KOR Software

Staff with laptop computers can utilize the YSI proprietary software KOR to use with the sonde in the laboratory. KOR software assists with QC, calibration, and storage of calibration records of the sensors. KOR software also allows for setting up sites for data logging, initiates data logging, and downloading of logged data (4, 5).

Figure 6. Dashboard screen on the classic handheld

3.2 Calibration

Check the sensors prior to use, as they require calibration about once per month. Calibrate any new sensors after installing and before use. Current Surface Water Program guidelines recommend recording conductivity, DO, pH, and temperature in field monitoring (6). For all calibrations, record pre- and post-readings, appropriate QC information (see Section 3.3, QC),

and date and time in individual logsheets in the CCSC logbook (Appendix 2). For additional information, see YSI (1, 2).

Prior to calibrating a specific sensor, rinse the sonde 3x with the appropriate calibration solution. To do this, remove the calibration cup from the sonde, keeping the sensor guard in place. Select a clean, dry calibration cup and pour ~40 ml of the appropriate solution into the cup (rinse solutions can be from a previous opened or used calibration solution bottle). Fasten the cup to the sonde and shake to wet the sensors. Remove the cup and dispose the solution in the sink with copious amounts of water.

After calibrating the conductivity and pH sensors, newly opened or previously used conductivity and pH solution can be saved to rinse sensors in subsequent calibrations. Pour the calibration solution into their respective “Rinse” bottles for future use.

3.2.1 Calibrating the sensors

3.2.1.1 Conductivity sensor

Calibrate conductivity using specific conductivity (SPC). Use manufacturer recommended concentration dependent on monitoring situation (1000, 10000, and 50000 µS cm^{-1} for surface, brackish, and seawater, respectively).

Using the calibration cup used to rinse the conductivity sensor, fill the cup with conductivity solution from a new, unexpired, unopened bottle to the 2nd line of the cup (counting from the bottom to top, ~250 mL). Gently submerge the sonde sensors into the solution-filled cup and secure. Lightly tap the cup to dislodge any trapped air bubbles in the sensors. Ensure the solution is above the conductivity cell of the conductivity sensor (Figure 8).

Under the **Calibrate** icon (Figure 4), select **CT - SPC**. Select **Start Cal** to initiate calibration. When **Stable** appears on the screen, select **Apply** then select **Complete** to exit the calibration. Record pre- and post-readings, cell constant, appropriate QC information (see Section 3.3, QC), and date and time in individual logsheet in the CCSC logbook (Appendix 2). After recording values, select **OK**.

Remove calibration cup and dispose of calibration solution in the sink with copious amounts of water or save solution in a “Rinse” bottle. Rinse sonde and cup 3x with DI water. Continue to next calibration; if all calibrations are completed, add a small amount of tap water (~40 ml) to a clean calibration cup and replace cup on sonde. Ensure sensors are **not** submerged in water and replace sonde.

3.2.1.2 pH sensor

For pH, conduct a 2- or 3-point calibration dependent on expected pH of monitored streams. A 2-point calibration (pH 7 and pH 10) will suffice for most California surface waters. Initiate the pH calibration with pH 7.

Using the calibration cup used to rinse the pH 7 sensor, fill the cup with unused, unexpired pH 7 solution to the 2nd line of the cup (counting from the bottom to top, ~250 mL). Gently submerge the sonde sensors into the solution-filled cup and secure. Lightly tap the cup to dislodge any trapped air bubbles in the sensors.

Then, under the **Calibrate** icon (Figure 4), select **pH**; then **pH** again. Select **Start Cal**. When readings stabilize, select **Apply**, then **Next**. A prompt will pop up saying **Proceeding to Standard (4** or **10)**. Select **OK,** or wait ~30 seconds for the prompt to disappear. Rinse the sonde with DI water, then rinse 3x with the appropriate pH buffer solution. After rinsing, attach calibration cup with the appropriate pH buffer (pH 4 or 10). When readings stabilize, select **Apply**, then **Complete** (or **NEXT** if conducting a 3-point calibration, following the same steps for the 2nd pH). Record the data, including the voltage readings (mV) for the calibrated pH buffers, in the logsheet. After recording values, select **OK**.

Remove calibration cup and dispose of calibration solution in the sink with copious amounts of water or save solution in a “Rinse” bottle. Rinse sonde and cup 3x with DI water. Continue to next calibration; if all calibrations are completed, add a small amount of tap water (~40 ml) to a clean calibration cup and replace cup on sonde. Ensure sensors are **not** submerged in water and replace sonde.

3.2.1.3 DO sensor

Calibrate DO with a 1-point water-saturated air calibration. Remove sensor guard and inspect DO sensor to ensure there are no water droplets on the DO membrane or titanium thermistor tip. If so, dry with a lint-free tissue as a Kimwipe® or with compressed air. Re-install guard.

Fill the bottom of cup with ~40 ml of water and loosely screw (1 turn) onto sonde so that the cup is not sealed and air can flow into the cup (prevents pressure buildup inside the cup resulting in a false DO reading). Let DO sensor equilibrate for 15 to 30 minutes, then select the **Optical DO** - **ODO sat** in the **Calibrate** screen (calibrates both %sat and mg/L DO). When **Stable** appears on the screen, select **Apply** and then **Complete**. After recording values in logsheet, select **OK**.

If all calibrations are completed, add a small amount of tap water (~40 ml) to a clean calibration cup and replace cup on sonde. Ensure sensors are **not** submerged in water and replace sonde.

3.2.1.4 Temperature sensor

There is no calibration for temperature, but check reported temperature with a NIST certified thermometer. If out of control, the sonde needs to be sent back to the manufacturer for recalibration.

3.3 QC

3.3.1 Expiration dates

Mind expiration dates of calibration solutions and advise project lead when volumes are low. Write the date opened on the bottle. Dispose of opened confidence solution after three months of use.

3.3.2 Conductivity QC

Record the cell constant in a logsheet in the CCSC logbook with each calibration and compare to previous calibrations. An ideal cell constant is 5.1 cm^{-1} +/- 10%. If the cell constant changes dramatically between calibrations, there is a problem with the

calibration, standard, or sensor. The biggest cause of drift in the conductivity cell is fouling or accumulation inside the sensor's flow path. Cleaning a cell (Section 5) can bring a sensor back into specification.

3.3.3 pH QC

When calibrating, record mV in the CCSC logbook with each buffer calibrated. Subtract the two mV readings (e.g., pH 7 mV – pH 10 mV). The value should be greater than 160 mV. If this value is below 160mV, the sensor must be reconditioned or replaced (Sections 5.3 and 5.4). Generally, as mV differences approach 160mv, the pH sensor responds slower during calibration (> 60 sec), which is an indicator that the sensor is reaching the end of its lifespan.

3.3.4 Confidence solution

Confidence solution checks for drift in the pH and conductivity sensors to ensure accuracy of these sensors. Apply this check before monitoring and at the end of multi-day trips. Compare the recorded values with their respective recommended values based on the temperature. If these values are within specs, the pH and conductivity field measurements are valid. If these values are out of control, recalibrate the sonde. Record all confidence solution checks in the CCSC logbook.

For conducting a confidence solution check, follow rinse and fill guidelines found in Section 3.2 Calibration. For readings, see Section 3.1, Connect Sonde to HH and sonde. Use spent confidence solution for rinsing (if available), but for readings use fresh confidence solution.

4.0 FIELD USE: SPOT SAMPLING

This section details procedures for operation of the EXO1 sonde for spot sampling in the field. The HH uses a Li-ion battery pack; charge the pack prior to field monitoring (rechargeable in about two hours). Bring backup batteries (4 C cell), battery cover, and a Phillips screwdriver in case the Li-ion battery pack fails in the field. Also bring backup batteries (2 D cell) and the battery compartment tool for the sonde (alternatively, the sonde

batteries can be checked with a volt meter prior to sampling). For overnight trips, bring a charger to recharge the Li-ion battery pack. Always use the provided sonde storage case during transportation. Walk carefully when carrying the monitoring system in the field.

During field sampling, always attach the strain relief carabiners to sonde and HH to relieve stress on the field cable. With the sonde, connect the carabiner to the sonde bail prior to attaching the carabineer as once the field cable is attached, the carabiner will not fit on the bail.

At the monitoring site, if the sonde was placed in a carrying case, leave the case in the vehicle to keep it clean. Remove the sonde from the case, then remove the calibration cup, ensuring that the sonde sensor guard is securely attached. Carry the sonde to the water and slowly lower it into the water to avoid disturbing bottom sediments. Ensure all sensors are fully submerged. Leave the sonde in the water undisturbed for up to five minutes to allow readings to stabilize. When stable, record the water quality measurements required for the study. If using KOR software, data can be logged and downloaded after sampling.

If water levels are too shallow to submerge the sonde, collect surface water into a large container (such as a stainless steel bucket) and submerge the sonde. When equilibrium is reached, record water quality parameters and collection method. Extremely shallow water conditions may not allow for sonde measurements.

After measurements are recorded, remove the sonde from the water and rinse the sensors and guard with DI water. Screw on calibration cup containing ~40 ml water. Conversely, if sampling additional nearby sites, a damp paper towel wrapped around the sensor guard will keep sensors in a humid environment for short-term use.

When traveling between sites, the HH can be put to sleep (depress the power button once) or turned off. When sampling is completed, turn off the HH and disconnect the field cable. Place the 6-pin dummy plug on the sonde and replace the calibration cup filled with a small volume of water. Wipe the dirt off the sonde and HH with a damp cloth, then dry and place in the carrying case. When back at the lab, re-inspect HH, sonde, sensors, and carrying case to ensure they are clean and dry. Clean and remove any solids, oil layers, or debris from the sonde or sensors with DI or a damp cloth. Dry sensors and sonde with a lab tissue (such as Kimwipes®)

or compressed air and store appropriately.

Additional features of the EXO 1 multiparamter sonde not discussed in this SOP, such as creating sites, depth profiling, data capture, and data logging, can be found in information provided by YSI (1-3, 7).

5.0 MAINTENANCE AND STORAGE

Periodically clean the sonde to ensure quality data. Dirty and fouled sensors can lead to bad calibrations, poor data quality, and damage to the sonde. Biofouling inside the conductivity sensor, and sediment in the sensors, connectors and O-rings are of most concern. When not in frequent use, store the sonde appropriately to protect the sonde and preserve sensors.

5.1 General Cleaning

5.1.1 Sonde

Periodically, inspect sonde for biofouling or dirty conditions and clean as necessary. Clean the sonde by rinsing with water. If oily contamination cannot be removed with a water rinse, wash with cleaning detergents as Liquinox® or Simple Green®. Clean the guard by removing it from the sonde and spraying the inside with cleaning detergents and lightly brush, then rinse. Or soak the guard in a calibration cup with soapy water, lightly brush, and rinse with water. With severe fouling, soak the guard in the calibration cup with white vinegar for 5 - 10 minutes, then clean with soapy water.

5.1.2 Sensors

5.1.2.1 General cleaning of sensors

Spray sensors with soapy water or a with a cleaner such as Simple Green® and lightly brush. A toothbrush can also be a useful tool to get into the small crevices. Do **not** use a brush on the DO sensor cap (Figure 7). Prior to cleaning DO sensor, check that the black paint on the cap end is intact (not scratched or black paint missing; if so, the cap needs to be replaced [see Section 5.5, Sensor replacement]). Clean the cap with DI water-moistened lens-cleaning paper (e.g., Kimwipes®), then dry with Kimwipes® or

compressed air.

When the sonde is used to log data over a period of time, severe fouling can occur. With severe fouling, scrape debris from sensors, taking care not to shatter the glass of the pH sensor or scratch the face of the sensors. Sensors can also be soaked for 5 - 10 minutes in white vinegar to remove dirt and biofouling. Afterwards, clean with soapy water, rinse, and dry sensors with a lab tissue like Kimwipes® or with compressed air.

Figure 7. DO sensor cap

5.1.2.2 Conductivity Sensor

If there is hard growth or dirt inside the sensor, remove it and soak in white vinegar for 5 - 10 minutes. Rinse with DI. With a wetted conductivity brush, clean out the side holes and the inside of the cells at the tip of the conductivity sensor (Figure 8). Rinse with DI and dry with compressed air.

5.1.3 Connectors

Periodically lubricate connectors with a thin coating of Krytox lubricant, especially if they are difficult to attach/detach.

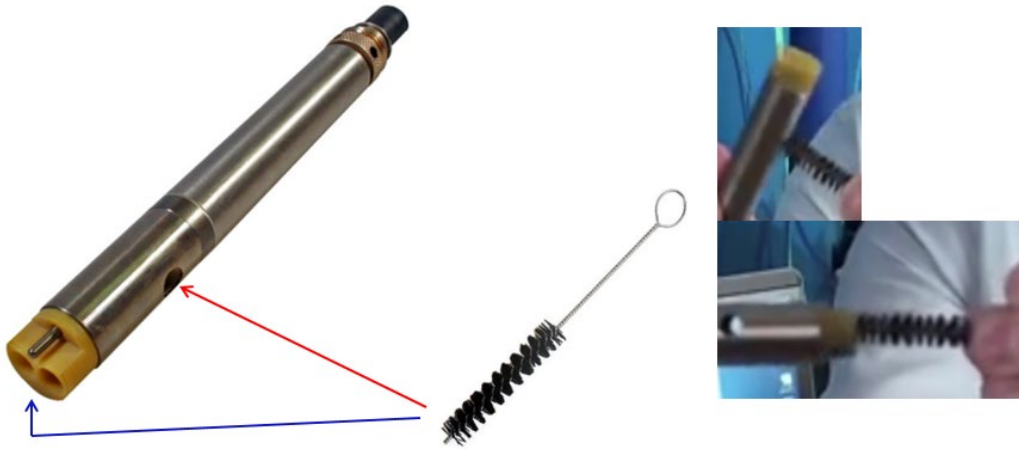

Figure 8. Cleaning the conductivity sensor; red arrow points to the conductivity cell that needs to be submerged when calibrating or taking water quality readings

5.2 Short-term Storage

Prepare the sonde for short-term storage when not expected to be used for > 30 days.

5.2.1 Ensure the HH is powered down and not in sleep mode.

5.2.2 Ensure the field cable is not coiled tighter than an 8-inch radius.

5.2.3 To avoid acid damage and corrosion, remove alkaline batteries from sonde and HH. The Li-ion battery pack does not need to be removed. When removing the battery cover, clean the sealing surface of the mating battery cover with a lint-free cloth (e.g., Kimwipe®) to remove grime or grit.

5.2.4 Remove any dirt, oil layers, or debris from the sonde and HH with a damp cloth and dry. See Section 5.1.1 for more detail.

5.2.5 Inspect the conductivity, pH and DO sensors for fouling. Clean as necessary following steps in Section 5.1.2.

5.2.6 Fill the bottom of a calibration cup with a small amount (~40 ml, or 1 cm deep) of tap water and tightly screw on. Tap water is preferred to DI water; DI water will accelerate internal electrolyte leaching

from the pH sensor (i.e., the pH sensor will wear out more quickly). **DO NOT** immerse the sensors in water but **DO** store in a humid environment. For short-term storage, do not store the pH sensor any solution.

5.2.7 Dry the outside of the sonde housing with a soft cloth or paper towel. Charge HH if it is not fully charged. Place the field cable and the carrying case in their proper storage areas.

5.3 Semi-annual Cleaning or Long-term Storage

For periods longer than 6 months of inactivity, store sonde for long-term storage. For programs that continue year-round, conduct maintenance and semi-annual cleaning every six months (recommended: September prior to storm monitoring; February/March after storm sampling). Manufacturer videos ("EXO Storage;" "EXO Getting Started") also provide demonstration and instruction these topics (2).

5.3.1 Follow steps outlined in Sections 5.2.1 – 5.2.5 of short-term storage.

5.3.2 Inspect all O-rings (battery compartment and installed sensors) and remove any dirt, hair, or other debris with a lint-free cloth such as a Kimwipe®. Replace any damaged O-rings by rolling lightly lubricated rings into place. Never use a sharp tool or stretch to remove/replace O-rings. Lightly lubricate all existing O-rings with Krytox lubricant. Note that excessive lubricant can cause contamination and seal failure.

5.3.3 Remove all sensors and visually inspect each port for dirt and contamination; clean with compressed air. When dry, lightly lubricate port with Krytox lubricant.

5.3.4 pH sensor

5.3.4.1 Remove sensor and recondition as described in Section 5.4.

5.3.4.2 For long-term storage, return the pH sensor to its storage bottle with 1M KCl solution or store in pH 4 buffer solution. Cover unused port with a dummy plug (lubricate O-ring with Krytox lubricant). For returning sonde to field use, replace

pH sensor on sonde after lightly lubricating O-ring.

5.3.5 For either long-term storage or field use, replace the conductivity/temperature sensor on the sonde after lightly lubricating the O-ring.

5.3.6 For either long-term storage or field use, replace the DO sensor after lightly lubricating the O-ring. For long-term storage, the DO sensor can be stored “wet” (in humidified air) or dry. For returning the sensor to field use, always keep the sensor in a humidified environment (“wet method”).

5.3.6.1 Wet storage method: Fill a clean calibration cup with a small volume of water (~ 40 ml; ensure the sensor is not submerged in water) and fasten onto the sonde. Mold, mildew, or bacterial growth during long-term wet storage can produce off-odors in the calibration cup.

5.3.6.2 Dry storage method – *only for long-term storage*: dump water out of the calibration cup, dry thoroughly, then reassemble the cup. With this method, the sensor will need to be rehydrated upon use (re-assembly, see below).

5.3.7 Re-assembly after long-term storage

5.3.7.1 If the DO sensor was stored dry, remove from sonde and soak in a beaker filled with tap water for at least 12 hours.

5.3.7.2 Remove pH sensor from its storage bottle and, if the dry method was used for DO storage, remove the DO sensor from the beaker. Lightly lubricate the O-rings on the sensors and connections to the sonde with Krytox lubricant. Plug in sensors to sonde and lightly tighten with sensor installation/removal tool.

5.3.7.3 After reassembly, calibrate all sensors as described in Section 3.2.

5.4 Reconditioning the pH Sensor

With regular use (i.e., frequent data logging), recondition the pH sensor quarterly. If not logging data, recondition the sonde during the semi-annual

cleaning. The reference (sensor tip) can become dirty, increasing the response time and can give the illusion that the pH will not stabilize.

The procedure for reconditioning the pH sensor is listed below. In Environmental Monitoring's Chemical Hygiene plan, HCl is listed as a hazardous chemical. Follow the safety procedures defined in the Chemical Hygiene Plan and dispose HCl as hazardous waste.

5.4.1 Remove the sensor from sonde and rinse in tap water.

5.4.2 Soak sensor in 1M HCl for 5 minutes.

5.4.3 Remove sensor and thoroughly rinse with tap water.

5.4.4 Soak sensor in a 1:1 solution of bleach and tap water (do not use DI water) for 30 minutes.

5.4.5 Rinse thoroughly in tap water.

5.4.6 Soak in tap water for 60 minutes to leach out any remaining bleach.

5.4.7 Remove sensor, rinse and dry. Replace sensor on sonde or place in long-term storage.

5.5 Sensor Replacement

5.5.1 General guideline for replacing sensors

When replacing all sensors, be consistent with the port placement of the sensors in all sondes. For example, place the conductivity/temperature probe in port 1, DO sensor in port 2, and pH sensor in port 3. This is most important when using KOR software on a laptop.

When inserting a sensor into its port, hand tighten. Do not tighten the locking nut excessively, as the seal is watertight with hand tightening.

After replacing a sensor, enter the date it was installed into the logbook.

5.5.2 Replacing the ODO sensor cap

Over time, the DO sensor becomes less responsive and accurate. This occurs after 12–24 months, depending on the frequency and duration of applications. Replace the DO sensor cap as described below (1, 8).

5.5.2.1 Remove the DO cap by grabbing the textured end and twisting CCW. Do not use tools unless excessively fouled through long-term data logging (see Figure 7).

5.5.2.2 With your fingers, remove/discard old O-ring. Inspect new O-ring for nicks, cracks, and dust to ensure it is of good quality. Slide the new O-ring into place. Apply a thin layer of Krytox lubricant to the O-ring.

5.5.2.3 Clean the glass surface of the probe with a lint free cloth as a Kimwipe®. Remove new cap from wet storage. Inspect the replacement cap for dust; clean with a lint-free cloth. Screw on cap and finger tighten. Do not overtighten or use tools to tighten.

5.5.2.4 Enter the eight DO coefficients (K1-K7 and KC) in the KOR software, either using a laptop computer (recommended as this is easier) or in the HH. In the Calibration screen, select **ODO**/**ODO % sat**/**Advanced**/**Edit** to enter the coefficients found in the instruction sheet provided with the DO replacement cap. **Apply**/**OK**/**Exit** to complete the entry.

5.5.2.5 Calibrate the DO sensor as described in Section 3.2.

5.5.3 pH sensor module

The pH sensor module begins to wear out as chemicals in the module get used. Replace the module every 12-24 months while retaining its smart base (Figure 9). Replace the module as described in the below listed steps (1, 9).

5.5.3.1 Peel off the existing sticker covering the module. With a slotted screwdriver, remove the small rubber plug from the gap in the plastic ring.

5.5.3.2 Squeeze the hard plastic ring while steadily pulling the sensor module straight out from the body of the sensor.

5.5.3.3 Inspect the inside of the cavity of the sensor. Remove any

debris or moisture with a lint-free cloth or compressed air.

5.5.3.4 Remove new module from its storage cup. Remove the plastic cap and storage O-ring. Inspect O-rings on module to ensure there are no nicks, tears, or dust on O-rings. Lightly lubricate with Krytox lubricant.

5.5.3.5 Install new module into sensor base. Align pins in module with pins in sensor base. Slowly plug in module. Apply sticker with date of installation around the sensor-module interface.

5.5.3.6 Calibrate as described in Section 3.2.

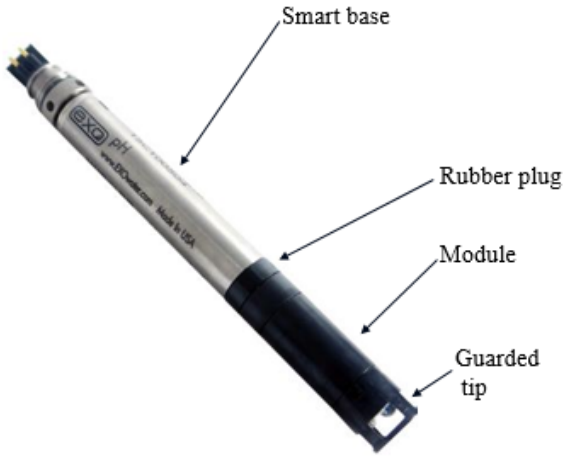

Figure 9. pH sensor

6.0 SAFETY

Follow Environmental Monitoring's Chemical Hygiene Plan when working in the laboratory. General safety includes wearing gloves, safety glasses, and closed-toed shoes. When using bleach and HCl, other protection (as lab coat or rubber apron) may be required. Dispose of any solutions according to the Chemical Hygiene Plan.

7.0 REFERENCES

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8.0 APPENDIXES

Appendix 1. Classic HH information

Appendix 2. Calibration and Confidence Solution Check logsheet