NEON PREVENTIVE MAINTENANCE PROCEDURE:

AIS SURFACE WATER QUALITY MULTISONDE

(HB07530000, HB07530010, HB07530100)

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Change Record

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A	07/20/2017	ECO-04064	Initial release AIS Sensor Maintenance Procedure

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1 DESCRIPTION

1.1 Purpose

NEON sites host sensors that take measurements from air, wind, soil, and sun. Regular maintenance of sensors and infrastructure is necessary for the continued operation of the observatory, and to identify small problems before they escalate.

This document details procedures necessary for preventive maintenance of the **Aquatic Instrumentation System (AIS) Surface Water Quality Multisonde (HB07530000, HB07530010, HB07530100)**. This assembly consists of the EXO2 Multiparameter sonde, manufactured by Yellow Springs Instrument (YSI), Inc., a Xylem Brand. This sonde is connected with probes to measure temperature and conductance, dissolved oxygen (DO), turbidity, total algae (chlorophyll *a* and blue-green algae), pH and fluorescent dissolved organic matter (fDOM). The sonde assembly is deployed as three versions: HB07530000 is deployed in wadeable streams and includes fDOM; HB07530010 is deployed in wadeable streams but omits fDOM; and HB07530100 is deployed in non-wadeable systems and includes fDOM. This document includes a brief overview of the instrument and operation, instrument-specific safety and handling precautions, and maintenance schedule and procedures.

1.2 Scope

The procedures detailed in this document are strictly preventive. Any corrective maintenance issues uncovered while performing preventive maintenance should be addressed using the corrective maintenance procedure associated with this subsystem.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

AD [01]	NEON.DOC.004300	Environmental, Health, Safety and Security (EHSS) Policy, Program and Management Plan
AD [02]	NEON.DOC.004316	Operations Field Safety and Security Plan
AD [03]	NEON.DOC.050005	Field Operations Job Instruction Training Plan
AD [04]	NEON.DOC.000727	NEON Chemical Hygiene Plan
AD [05]	NEON.DOC.004257	All Systems Standard Operating Procedure: Decontamination of Sensors, Field Equipment, and Field Vehicles

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms
RD [03]	NEON.DOC.001166	NEON Sensor Command, Control and Configuration: Multisonde, Wadeable Streams
RD [04]	NEON.DOC.001477	NEON Algorithm Theoretical Basis Document: AIS Surface Water Quality Multisonde
RD [05]	NEON.DOC.001154	AOS Protocol and Procedure: Aquatic Decontamination
RD [06]	NEON.DOC.003880	NEON Preventative Maintenance Procedure: AIS In-stream Infrastructure for Wadeable Streams
RD [07]	NEON.DOC.003162	AOS Protocol and Procedure: Wadeable Stream Morphology
RD [08]	NEON.DOC.002767	AIS Subsystem Architecture, Site Configuration and Subsystem Demand by Site - SCMB Baseline

2.3 External References

External references contain information pertinent to this document, but are not NEON configuration-controlled. Examples include manuals, brochures, technical notes, and external websites.

ER [01]	USGS TM 1-D3	Guidelines and SOP for Continuous Water-Quality Monitors
ER [02]	EXO user manual	YSI Incorporated, www.EXOwater.com, accessed December 2013
ER [03]	Xylem, YSI Incorporated-Integrated Systems and Services. Vertical Profile System (CR1000) Manual Version 3, St. Petersburg, FL. 19 December 2011: www.ysisystems.com	

2.4 Acronyms

AIS	Aquatic Instrumentation System

CVAL	Calibration Validation Laboratory
DAS	Data Acquisition System
DI	Deionized
DO	Dissolved Oxygen
DOM	Dissolved Organic Matter
EHSS	Environmental, Health, Safety and Security
ESD	Electrostatic Discharge
fDOM	Fluorescent Dissolved Organic Matter
FNU	Formazin Nephelometric Units
IR	Infrared
LOTO	Lock-out/Tag-out
NTU	Nephelometric Turbidity Units
PVC	Polyvinyl Chloride
PRT	Platinum Resistance Thermometer
QSU	Quinine Sulfate Units
RAW	Raw Sensor Signal
SOA	Signal Output Adapter
SOP	Standard Operating Protocol
TSS	Total Suspended Solids
UV	Ultraviolet
YSI	Yellow Springs Instrument Company

3 SAFETY AND TRAINING

This document identifies procedure-specific safety hazards and associated safety requirements. It does not describe general safety practices or site-specific safety practices.

Personnel working at a NEON site must be compliant with safe field work practices as outlined in AD [01] and AD [02]. Additional safety issues associated with this field procedure are below. The Field Operations (FOPS) Manager and the Lead Field Technician have primary authority to stop work activities based on unsafe field conditions; however, all employees have the responsibility and right to stop their work in unsafe conditions.

All technicians must complete required safety training and protocol-specific training for safety and implementation of this protocol per AD [03]. Employ Lock-out/Tag-out (LOTO) procedures when handling electrical equipment.

3.1 Handling Precautions

3.1.1 Multisonde Sensors

While the Multisonde body should perform well with normal use, the individual sensors may be damaged if the sensor is dropped or mishandled during deployment or maintenance. The connection between the sensor and the Multisonde bulkhead may be another source of lost data if damaged by force or if a sensor is unsecured.

3.1.2 Grapes

Grapes contain ESD sensitive parts; therefore, all Grapes require ESD (antistatic) packaging and handling during inter- and intra-site transport, reception, and storage. As a rule, when handling (installing, removing, and servicing) these electrical components, all Technicians must ground themselves. Wear an anti-static wristband and frequently touch grounded metal objects (such as unpainted metal with clear ground path) to redirect electrostatic discharge away from sensitive devices.

3.1.3 Reagents

A variety of liquid chemical reagents are used in conjunction with the protocols in this document. As a rule, the appropriate personal protection should be worn when handling any potentially harmful chemical. All chemicals should be properly stored and handled according to the NEON Chemical Hygiene Plan (AD [04]). Special care should be taken to contain all chemical reagents, particularly when implemented in terrestrial and aquatic environments to prevent contamination and damage to ecosystems.

4 SENSOR OVERVIEW (SENSORS ONLY)—AIS SURFACE WATER QUALITY MULTISONDE (YSI EXO2)

4.1 Associated Equipment

- YSI Incorporated EXO2 Surface Water Quality Multisonde
- EXO conductivity/temperature combination sensor
- EXO optical dissolved oxygen (DO) sensor
- EXO optical turbidity sensor
- EXO optical total algae sensor
- EXO pH (acidity or alkalinity) sensor
- EXO optical fluorescent dissolved organic matter (fDOM) sensor
- EXO central wiper
- Merlot Grape (12V)
- Signal Output Adapter (which resides in the Converter/Splitter box next to the Merlot Grape)

4.2 Description

4.2.1 Overview

The YSI, Inc. EXO2 Water Quality Multisonde (referred to as a Multisonde or sonde) is a multiparameter instrument that collects data using up to six replaceable sensors (also called probes) and an integrated pressure transducer.

This model contains seven ports available for sensors and an antifouling[1] wiper. The EXO2s deployed across NEON aquatic sites are configured with the sensors in the corresponding port numbers shown in **Error! Reference source not found.**

Table 1. Sensor configuration for EXO2

Port No.	Sensor Type
1	Conductivity/Temperature
2	Optical Dissolved Oxygen
3	pH
4	Total Algae
5	Turbidity
6	fDOM
7	No Sensor (optical wiper)

[1] The process to prevent the buildup of algae and other biological matter on underwater surfaces. *Source: http://www.dictionary.com/browse/antifouling*

Each sensor measures a parameter in a variety of methods. Each port in the EXO2 automatically recognizes the type of sensor. For the NEON network, the EXO2 will transfer the data to the NEON Data Acquisition System (DAS) via cable. The temperature probe and integrated pressure transducer are secondary measurements in the NEON network and do not have corresponding data products.

In addition to the six standard ports, the EXO2 has a central port for an antifouling wiper to maintain the function of each sensor by preventing the buildup of algae and other matter underwater.

NEON calibrates the Multisonde's pressure transducers for depth measurements. NEON employs these pressure transducers at non-wadeable sites, such as lakes, where the Multisonde resides on a buoy infrastructure. On a buoy, the Multisonde intermittently measures along the vertical profile of a water column. This is a simple definition of the YSI Profiler, Vertical Profile System via ER [03]. At present, NEON does not require additional calibration and validation of the pressure transducers in wadeable stream sites. This is due to the area where the pressure transducer resides, which may not always be under water.

A protective copper guard attaches to the end of the Multisonde body to enclose the probes and minimize biofouling.

4.2.2 Multisonde Body

The Multisonde body is the large primary part of the Multisonde to which the probes are attached. It contains the ports for sensor cables at the top, the battery compartment with a pressure relief valve in the middle, and the pressure transducer in the bulkhead at the base of the body. See Figure 1**Error! Reference source not found.** and Figure 2 for details.

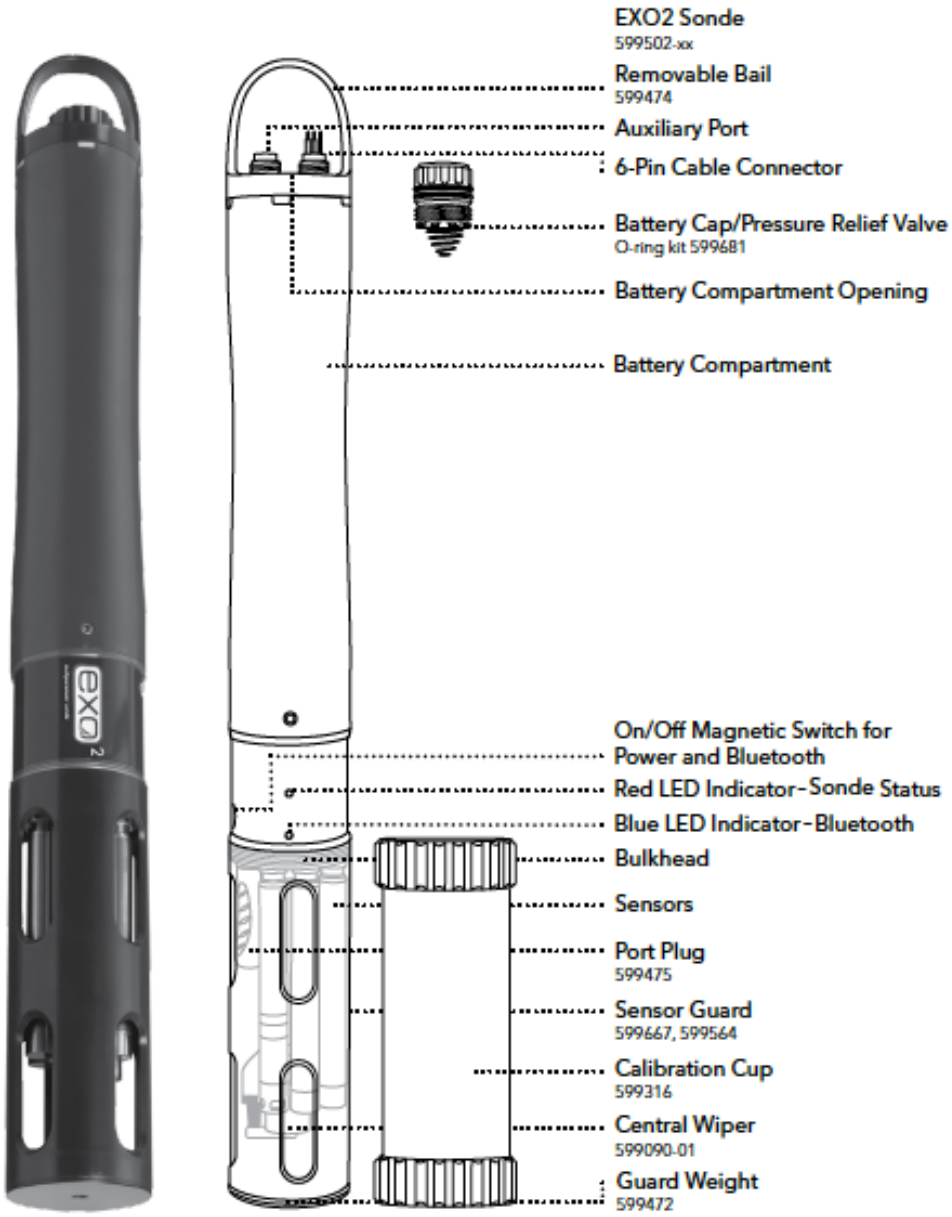


Figure 1. Schematic of Multisonde and Key Components

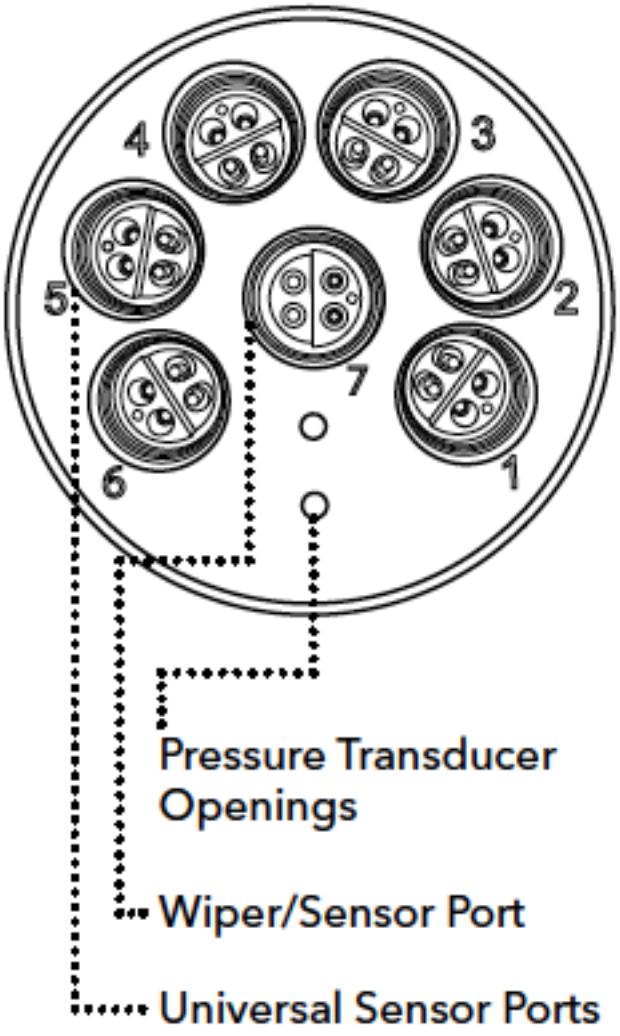


Figure 2. Schematic of EXO2 Bulkhead with Probe Sensor Ports 1-6 and Wiper Port 7

4.2.3 Individual Sensors/Probes

The probes developed for the EXO2 use smart technology that allows the Multisonde to recognize what type of sensor is plugged into a given port. NEON has developed a consistent configuration schema for aquatic sites which must be followed. Individual probes store their associated calibration coefficients and identification information on board. Individual probes may be removed and replaced as needed. No port should be left open and plugs shall be utilized to fill any port that a sensor is not plugged into (see Figure 3).

Figure 3. Copper antifouling guard (left) and sensors plugged into the Multisonde body (right).

NOTE: This example shows a plug in port 6 when using HB07530010 where fDOM is omitted at S1.

4.2.4 Infrastructure

4.2.4.1 Wadeable Stream Sites

At wadeable stream sites the Multisonde is housed in a polyvinyl chloride (PVC) enclosure mounted onto a stainless steel anchor (see Figure 4). The enclosure has slots to provide adequate flushing of stream water while securing the Multisonde at the appropriate orientation in the stream, providing protection from impact from debris, and shielding the Platinum Resistance Thermometer (PRT) from direct solar insolation. A PVC slip cap covers the top of the enclosure. A retaining bolt and mounting discs secure the Multisonde in the enclosure. The mounting discs, which are also referred to as the Delrin sensor-mounting discs, secures the PRT and acts as a spacer between the Multisonde and the PVC enclosure. See Figure 5 and Figure 6 below for reference of the location of these supporting infrastructure components.

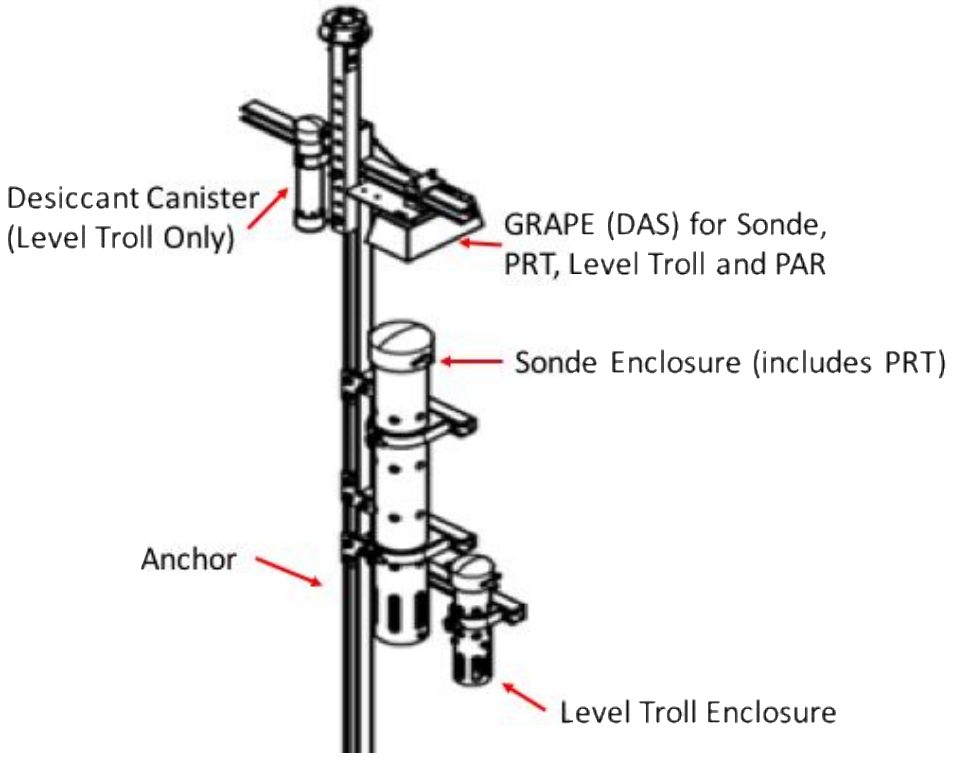


Figure 4. Schematic of infrastructure showing the location of the Multisonde enclosure and Grape relative to the anchor.

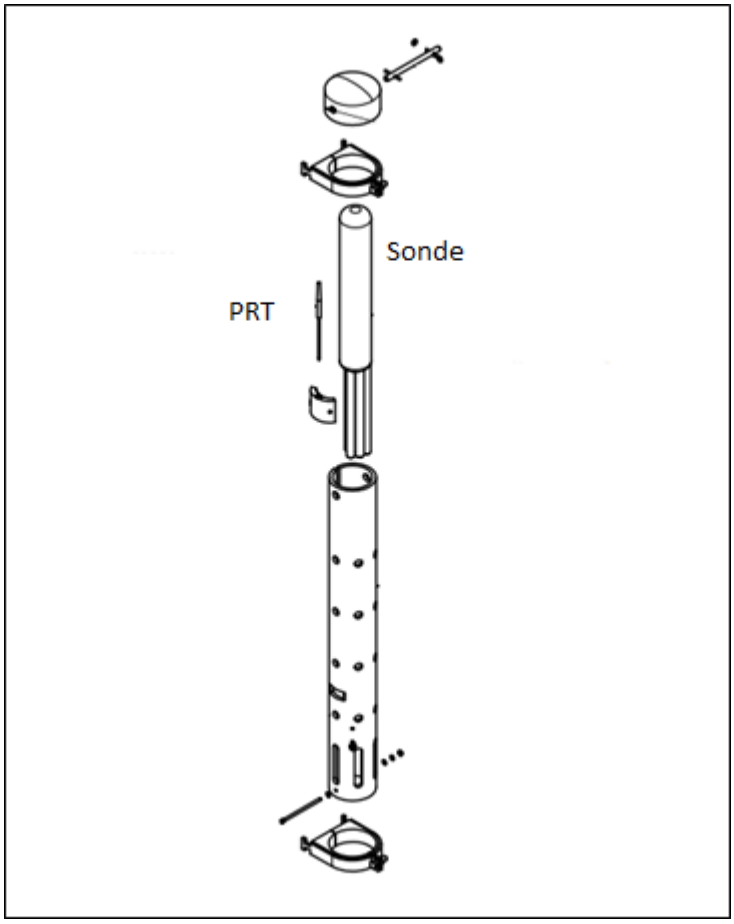


Figure 5. Exploded view of Multisonde enclosure assembly.

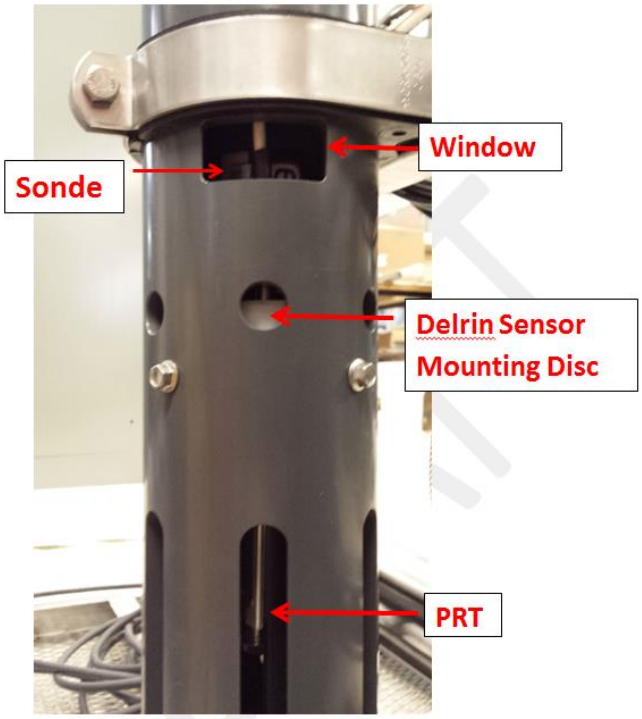


Figure 6. Base of the enclosure showing the Multisonde, PRT and mounting disc through the holes for flow and access.

4.2.4.2 River and Lake Sites

At non-wadeable river and lake sites, the Multisonde suspends from a buoy platform via YSI's Vertical Profile System. At lakes and lower energy river sites, the Multisonde links to a cable assembly that wraps around a winch controller. The winch assembly lowers the sensor to profile dynamic depth measurements in intervals. At high-energy river sites, the Multisonde is in a PVC standpipe beneath the buoy platform at a static depth. See Figure 7 for schematics of these deployment configurations.

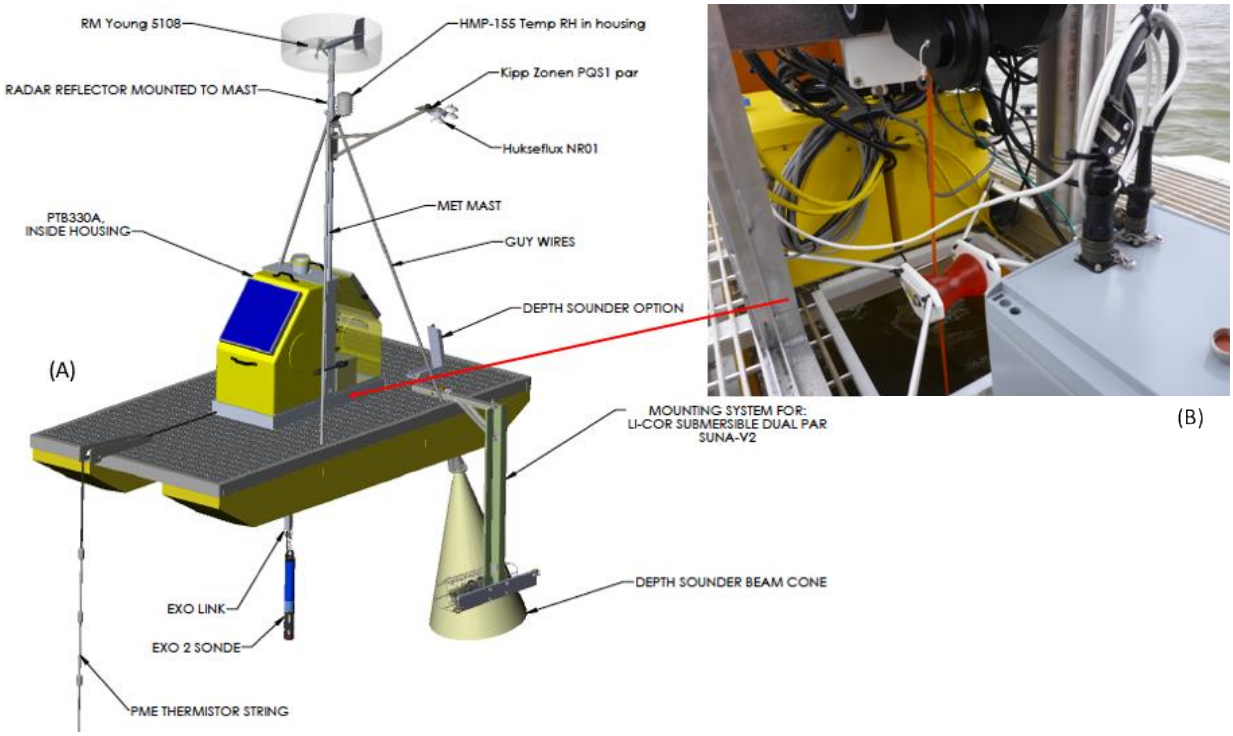


Figure 7. Schematic of buoy assembly (A) and picture of pass-through (B) where the Multisonde suspends from a winch assembly under the T-frame, inside the buoy housing.

4.2.5 Data Acquisition System (DAS)

The DAS requires a signal output adapter, which connects the sensor and a 12V Merlot Grape (custom NEON data-logger) along the communication signal path (Figure 8). Integrity of the cables, connectors and electronic housing is critical to power distribution and signal transmission.

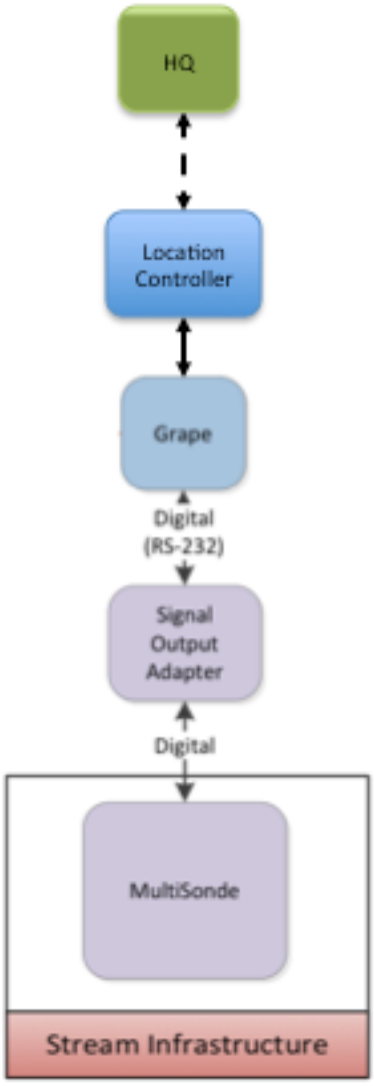


Figure 8. Schematic of transmission of data generated by the Multisonde

4.3 Sensor Specific Handling Precautions

The tip of each sensor should be protected with care, as the data collected may be biased by damage to the sensor tip. In general, most of the sensors mounted to the Multisonde have a measurement surface or port that will require maintenance.

Each probe attached to the bulkhead of the Multisonde has a specific NEON tracking number. These numbers are also listed on the plastic tag attached to the Multisonde bail. If a probe needs to be detached and shipped for any reason, the identity tag should remain with the probe. Likewise, if a new

probe is attached to the Multisonde, the identity tag associated with the new probe should be added to the collection attached to the Multisonde bail.

Many components on the EXO2 Multisonde are made of antifouling copper-alloy material that discourages the growth of aquatic organisms. However, NEON will be deploying Multisondes for longer deployment intervals in highly productive waters which could result in biofouling. Thus, equipment should be cleaned of biofouling periodically. Cleaning procedures for specific probes will be detailed later in this document.

During calibration checks, calibration reagents may require specific safety precautions, specifically the fDOM sensor calibration solution is quinine sulfate in dilute sulfuric acid. Wear nitrile gloves and eye protection when dispensing acid. The material safety data sheets (MSDS) for the calibration solutions can be found in Appendix A3. These precautions are detailed in the NEON Chemical Hygiene Plan (AD [04]). Only trained personnel should handle chemicals. Dispose of all liquid reagents after each use. No solutions may be reused for calibration or checks.

NOTE: In addition to the safety protocol AD [02], calibration personnel should note that exposure of the dilute quinine sulfate solution to any copper-based component of the EXO2 Multisonde and EXO sensors (including the wiper assembly) will begin to degrade the solution significantly within minutes. Remove the copper guard on the probe for all calibration activities.

4.3.1 Overview

This section briefly defines the operation and method of each sensor utilized by the sonde.

4.3.1.1 pH

The EXO pH sensor measures pH with two electrodes combined in the same probe: one for hydrogen ions and one as a reference. The sensor is a glass bulb filled with a solution of stable pH and the inside of the glass surface experiences constant binding of H^+ ions. The outside of the bulb is exposed to the sample, where the concentration of hydrogen ions varies. The resulting differential creates a potential read by the meter versus the stable potential of the reference.

Signal conditioning electronics within the pH sensor improve response and increase stability. Amplification (buffering) in the sensor head is used to eliminate any issue of humidity in the front-end circuitry and reduce noise. Finally, the EXO pH sensor is insensitive to proximal interference during calibration due to having the circuit next to the sensor and having a well-shielded pH signal.

4.3.1.2 Dissolved Oxygen (DO)

The EXO DO sensor is based on the concept that dissolved oxygen quenches both the intensity and the lifetime of the luminescence associated with a chemical dye. This sensor operates by shining a blue light

of the proper wavelength on this luminescent dye to luminesce and the lifetime of the dye luminescence is measured via a photodiode in the probe. A red light is also used to irradiate the dye during part of the measurement cycle to act as a reference in the determination of the luminescence lifetime.

When there is no oxygen present, the lifetime of the signal is maximal; as oxygen is introduced to the membrane surface of the sensor, the lifetime becomes shorter. Thus, the lifetime of the luminescence is inversely proportional to the amount of oxygen. For most lifetime-based DO sensors, this relationship is not strictly linear (particularly at higher oxygen pressures) and the data must be processed using analysis by polynomial non-linear regression. Fortunately, the non-linearity does not change significantly with time so that, as long as each sensor is characterized with regard to its response to changing oxygen pressure, the curvature in the relationship does not affect the ability of the sensor to accurately measure oxygen for an extended period of time.

4.3.1.3 **Fluorescent Dissolved Organic Matter (fDOM)**

The EXO fDOM sensor is a fluorescence sensor that detects the fluorescent component of dissolved organic matter (DOM) when exposed to near-ultraviolet (UV) light. In acid solution, quinine sulfate fluoresces similarly to DOM. The units of fDOM are given as quinine sulfate units (QSUs) where 1 QSU = 1 ppb quinine sulfate. The EXO fDOM sensor shows virtually perfect linearity (R^2=1.0000) on serial dilution of a colorless solution of quinine sulfate. However, on serial dilution of stained water field samples, the sensor shows some under linearity. The point of under linearity in field samples varies and is affected by the UV absorbance of the DOM in the water.

4.3.1.4 **Turbidity**

Turbidity is the indirect measurement of the suspended solid concentration in water and is typically determined by shining a light beam into the sample solution and then measuring the light that is scattered off the particles which are present. The EXO turbidity sensor employs a near-infrared (IR) light source and detects scattering at 90 degrees of the incident light beam. According to ASTM D7315 method, this type of turbidity sensor has been characterized as a nephelometric near-IR turbidimeter, non-ratiometric. This method calls for this sensor type to report values in Formazin nephelometric units (FNU). FNU is the default calibration unit for the EXO sensor but the EXO2 Multisonde allows for a change of calibration units to nephelometric turbidity units (NTU), raw sensor signal (RAW), or total suspended solids (TSS) assuming the appropriate correlation data are also used.

4.3.1.5 **Chlorophyll *a***

While only chlorophyll *a* is a NEON data product, the EXO total algae sensor is a dual-channel fluorescence sensor that generates two independent data sets: one resulting from a blue excitation beam that directly excites the chlorophyll *a* molecule, present in all photosynthetic cells, and a second from an orange excitation beam that excites the phycocyanin accessory pigment found in blue-green

algae (cyanobacteria). The orange excitation channel is included here for reference and not used by NEON as a data product.

Although blue-green algae contain chlorophyll *a*, the chlorophyll fluorescence signal detected by *in-situ* fluorimeters is weaker than in eukaryotic phytoplankton. This results in an underestimate of algae biomass when using a single-channel chlorophyll sensor when blue-green algae are present. The EXO total algae sensor generates a more accurate total biomass estimate of the planktonic autotrophic community by exciting chlorophyll *a* and phycocyanin.

The sensor generates data in three formats: RAW, RFU, and an estimate of the pigment concentration in µg/L.

4.3.1.6 **Conductance**

The EXO conductivity probe uses four internal, pure-nickel electrodes to measure solution conductance. Two of the electrodes are current driven, and two are used to measure the voltage drop. The measured voltage drop is then converted into a conductance value in milliSiemens (millimhos). To convert this value to a conductivity value in milliSiemens per cm (mS/cm), the conductance is multiplied by the cell constant that has units of reciprocal cm (cm-1). The cell constant for the conductivity cell is approximately 5.5/cm±10%. The cell constant is automatically determined (or confirmed) with each deployment of the system when the calibration procedure is followed.

4.3.1.7 **Temperature**

The EXO temperature probe data are produced by using a stable and aged thermistor. The thermistor's resistance changes with temperature. The measured resistance is then converted to temperature within the Multisonde's programming using an algorithm. No calibration is required, but accuracy checks will be conducted.

4.3.1.8 **Pressure**

The Multisonde body contains a non-vented differential strain gauge transducer which measures pressure on one side of the transducer exposed to the water and the other side exposed to a vacuum. For accurate readings, the pressure transducer must be calibrated by "zeroing" it in the atmosphere at a known barometric pressure. Because it is not vented, changes in barometric pressure affect the "zero" reading, resulting in a shift of the measurement value unless recalibrated.

4.3.1.9 **Wiper**

The EXO2 Multisonde is configured with a central anti-fouling wiper that is configured to rotate and wipe the ends of each of the probes every 5 minutes to minimize biological growth.

4.3.2 Sensor Placement

The operational goal for monitoring water quality at NEON aquatic sites is to obtain the most accurate and complete record possible. The general operational categories include maintenance of the sensor set equipment and infrastructure, periodic verification of sensor calibration, troubleshooting of the Multisonde and probes, recording equipment, and thorough record keeping.

The Multisonde is deployed at both aquatic sensor set 1 (S1) and sensor set 2 (S2) for wadeable streams and at the lake buoy. Non-wadeable streams will have one or two Multisondes deployed, depending on the site. Placement of water-quality monitoring sensors is determined by the Science team and dependent on the purpose of monitoring and the data quality objectives.

5 INSPECTION AND PREVENTIVE MAINTENANCE

5.1 Equipment

Table 2. Multisonde Maintenance Equipment

Item No.	Description	Quantity
Tools		
0337790000	EXO Signal Output Adapter – USB (YSI 599810), with mini-USB cable	1
0337870000	EXO C/T Sensor Cleaning Brush (YSI 599470)	1
	Wash Bottle, 1 for deionized (DI) water, 1 for mild P-free Detergent	2
0337890000	EXO2 Calibration Cup (YSI 599316)	1
0337930000	EXO Tool Kit (YSI 599594)	1
	EXO Sensor Port Plug (YSI 599475)	1-2, as needed
	5 gallon bucket	1
	5 gallon bucket with lid for rinsate waste	1
Consumable items		
	Clean tap water	1 gallon
	DI water	1 gallon
	Cotton Swab	1 package
	Mild detergent (biodegradable)	1
	Krytox grease (YSI 599352)	1
0337940000	EXO2 replacement o-ring kit (YSI 599680)	1
	Conductivity standard solution, 1000 uS/cm	1 Liter

Item No.	Description	Quantity
	Turbidity Solutions, 124 FNU, 1010 FNU standard solutions	1 Liter each
	Rhodamine WT, 625 µg/L and 25 µg/L dye solutions	1 Liter each
	pH buffer solutions, pH-4, pH-7, pH-10	1 Liter each
	Quinine sulfate solution, 300 µg/L	1 Liter
Resources		
	YSI, ink EXO2 User Manual	1
	YSI KOR software	1
	Clean tap water	1 gallon
	DI water	1 gallon
	Cotton Swab	1 package
	Mild detergent (biodegradable)	1
	Krytox grease (YSI 599352)	1
0337940000	EXO2 replacement o-ring kit (YSI 599680)	1
	Conductivity standard solution, 1000 uS/cm	1 Liter
	Turbidity Solutions, 124 FNU, 1010 FNU standard solutions	1 Liter each
	Rhodamine WT, 625 µg/L and 25 µg/L dye solutions	1 Liter each
	pH buffer solutions, pH-4, pH-7, pH-10	1 Liter each
	Quinine sulfate solution, 300 µg/L	1 Liter
Resources		
	YSI, ink EXO2 User Manual	1
	YSI KOR software	1

5.2 Subsystem Location and Access

5.2.1 Wadeable Stream Sites

At wadeable stream, sites a Multisonde is located at both the upstream and downstream sensor stations (two total). Multisondes are ideally placed at 60% depth of the water in either the thalweg[2] or in a well-mixed location. In practice, multisonde locations chosen by Science have been in pools with minimal eddy effects and a maximal chance of continuous data throughout the year.

5.2.2 AIS Lake and River Sites

At river and lake sites, buoy infrastructure enables the Multisonde to sample along the vertical profile of a water column in intervals. The Multisonde suspends from a winch assembly under the T-frame of the buoy housing (one total). At AIS non-wadeable lake sites, this is typically at the deepest location of the lake. At AIS non-wadeable river sites, this is typically as close to the thalweg as possible, with limitations due to either navigation pathways or the level of energy at mean to high flows.

5.3 Maintenance Procedures

Table 3 is an interval schedule of each infrastructure component requiring preventive maintenance.

Table 3. Multisonde Preventive Maintenance Tasks Interval Schedule

Maintenance	Bi-Weekly	Monthly	Quarterly	Bi-Annual	Annual	As Needed	Maintenance Type
Multisonde							
Visual Inspection	X						P
Remove Debris from/Clean Multisonde PVC Enclosure	X					X	P
Conduct Field Validation (Second Reference CVAL Sensor)			X				P
Clean Multisonde Probes	X						P
Calibration Check Multisonde Probes	X						P

[2] A line following the lowest part of a stream or river. *Source: https://www.merriam-webster.com/dictionary/thalweg*

Maintenance		Bi-Weekly	Monthly	Quarterly	Bi-Annual	Annual	As Needed	Maintenance Type
	Battery Check			X				P
	Replace Batteries						X	P/R
	Wiper Brush Check	X						P
	Replace Wiper Brush						X	P/R
Electrical & Communication Infrastructure (DAS and PDS)								
	Visual Inspection	X						P
	Remote and Onsite Condition and /or Diagnostic Monitoring	X					X	P
	Replace Cable Ties						X	R
	Clean Biofouling from Cables/Wires	X					X	P/R
MISCELLANEOUS EQUIPMENT								
Subsystem Support Structure								
	Visual Inspection	X						P
	Verify Structural Integrity Bolt Connections and Unistrut			X			X	P

NOTE: The biweekly and annual inspections should be carried out regardless of whether they coincide or not. P = Preventive, R = Repair, X = Indicates preventive maintenance task time interval may increase due to environmental (seasonal/weather) or unforeseen/unanticipated site factors.

NOTE: If the wiper is active, wait until it completes its rotation and returns to the parked position. This should take less than a minute to complete. If the wiper is already in the parked position, proceed with preventative maintenance.

Prior to conducting maintenance, technicians should review Section 5.3.1, Preventative Maintenance Procedure Sequence, to understand the order of the full maintenance procedure.

5.3.1 Preventative Maintenance Procedure Sequence

Preventive maintenance will occur at AIS sites ***once every two weeks***. For each Multisonde on site the following procedures detailed below will be implemented. For wadable stream sites, the preventive maintenance should start at the downstream Multisonde (S2). Multisonde preventive maintenance trips must include the following steps:

1. Verify system integrity (Section 5.3.2).
    a. Remove debris from the unistrut and Multisonde enclosure.
    b. Check cables and connectors.

2. Remove the Multisonde from enclosure, inspect probes and proceed with the quality assurance and maintenance procedures outlined in Section 5.3.5.
3. Inspect the wiper brush and replace as necessary (Section 5.3.4)
4. Disconnect the Grape. Connect the Multisonde to YSI KOR software on your laptop (Section 5.3.6).
5. Partially fill a 5 gallon bucket with site water.
6. Remove Multisonde from infrastructure and place in bucket. Record pre-cleaned data for DO, Temperature, Specific Conductivity, fDOM, Turbidity, Chlorophyll, pH and depth (Section 5.3.7).
7. Rinse and clean Multisonde and guard (Section 5.3.8).
8. Remove and replace probes as needed for cleaning according to Section 5.3.8.
9. Place the Multisonde in the bucket of ambient site water and record post-cleaning data for DO, Temperature, Specific Conductivity, fDOM, Turbidity, Chl. *a* and pH (Section 5.3.9).
10. Record pre-calibrated Multisonde data for DO, Temperature, Specific Conductivity, fDOM, Turbidity, Chlorophyll, pH and depth (Section 5.3.10).
11. Remove Multisonde from the bucket.
12. Check the calibration the DO probe and recalibration as necessary using Section 5.3.11.
13. Check the calibration the Conductivity probe and recalibration as necessary using Section 5.3.12.
14. Check the calibration the pH probe and recalibration as necessary using Section 5.3.13.
15. Check the calibration the fDOM probe and recalibration as necessary using Section 5.3.14.
16. Check the calibration the Total Algae probe and recalibration as necessary using Section 5.3.15.
17. Check the calibration the Turbidity probe and recalibration as necessary using Section 5.3.16.
18. Check the calibration the Pressure Transducer and recalibration as necessary using Section 5.3.17 (only for buoy systems).
19. Place the Multisonde into the bucket of ambient site water and record post-calibration data for DO, Temperature, Specific Conductivity, fDOM, Turbidity, Chlorophyll, pH and depth (Section 5.3.19).
20. *Check the validation of Temperature Sensor using Section 5.3.18
21. Reconnect Multisonde to Grape and replace Multisonde into the enclosure.
22. *Compare the post-cleaning, post-calibrated field data to the CVAL provided reference sensor in the field every 3 months (Section 5.3.20)
23. *Check Multisonde batteries once every 3 months or after a power outage; replace batteries as needed (Section 5.3.3).
24. *Check the Multisonde O-rings each time one is exposed during routine activities
25. *Remove and replace sensors as necessary (Section 6).

** Indicates not part of biweekly maintenance activities.*

5.3.2 Verify System Integrity

Visually inspect the sensor station for damage.

1. Check for debris collection on infrastructure (see Figure 9).

a. Remove debris as necessary.
    i. Allow snags to continue downstream, if the debris is not affecting the infrastructure.
    ii. Tumbleweeds or other vegetation or items that are not naturally part of the aquatic ecosystem may be remove from the stream and place on the bank.

NOTE: AIS approves the removal of debris that snags/catches on the supporting infrastructure on S1 and S2, as appropriate. DO NOT remove or manipulate natural vegetation, unless it directly affects the system. If in doubt, take a picture of the vegetation and provide it to NEON HQ via the Issue Management/Reporting System for AIS personnel to review and determine a course of action.

Figure 9. Pictures of debris accumulating on sensor station after a high flow event.

2. Check cable assemblies (see Figure 10). Cables may act as a net for debris to accumulate underwater.
    a. Visually inspect cable housings and report any damage by generating a trouble ticket.
    b. Visually inspect cable dressing. Ensure the sensor cable has the appropriate relief and secure any slack.
        i. Redress cables, as appropriate.

ii. Remove any debris that may pull on the cables underwater. Watch for wildlife and wear waders!

Figure 10. Picture of damaged cable.

3. Check connections.
    c. Visually inspect connections.
        i. Clean any corrosion.
            1. Remove corroded items to the bank
            2. Remove deposits with a wire brush, taking care not to damage silicon or plastic surfaces
            3. Replace connectors
    d. Gently feel that connections are secure.
        i. Secure any above water loose connections.
        ii. Report loose connections found underwater.
    e. Report any excessive corrosion, deterioration or signs of overheating by generating a trouble ticket.

5.3.3 Battery Check

The Multisonde cable is wired to the NEON DAS, which provides external power to the Multisonde. The Multisonde can be powered either internally, using batteries, or externally with the DAS. When powered externally, the Multisonde will not drain the internal batteries. However, if external power is lost, the four D-cell internal batteries will be used. To ensure that the batteries are fully charged in the

event of a power outage, technicians should check Multisonde batteries once every three months or if there has been a significant power outage at the site, and replace with new fully charged batteries as needed.

Check the battery voltage:

1. Disconnect the Grape. Connect the Multisonde to YSI KOR software on your laptop (Section 5.3.6).
2. Read the battery voltage on the Dashboard (see Figure 11)

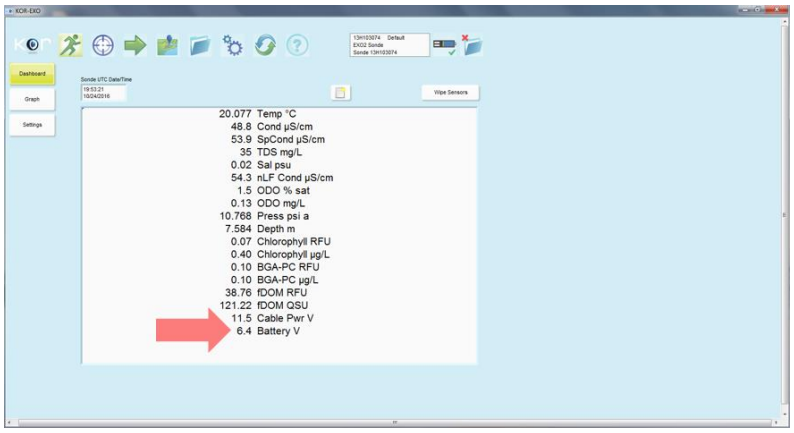


Figure 11. Screenshot of Dashboard on KOR software showing battery voltage reading (red arrow).

3. If battery voltage is less than 5.5V, replace the batteries

Replace batteries (Figure 12):

1. Use the yellow manufacturer-provided wrench to loosen the cap.
2. Remove the battery cap.
3. Remove the batteries.
4. Replace the four D-cell batteries with the positive (+) terminal facing up.

NOTE: Check the O-rings and replace and/or add a coat of Krytox lubricant to each O-ring as needed.

5. Replace battery cap.

NOTE: DO NOT overtighten the cap.

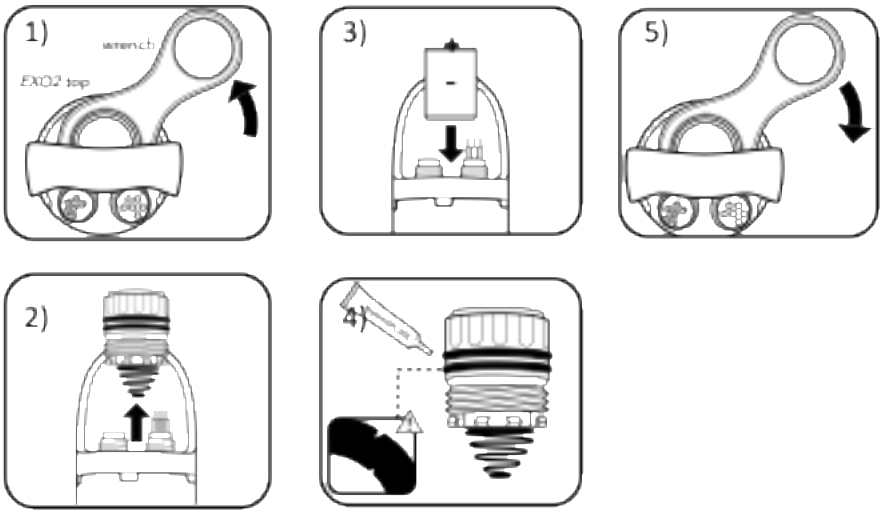


Figure 12. Illustrations showing the steps involved with replacing batteries.

5.3.4 Wiper Check

The antifouling wiper is configured to sweep the sensors every 5-minutes. At this configuration the wiper brush will wear quickly and need to be replaced every 2-6 months. The brush should be replaced before it is excessively worn (Level 3 in Figure 13) to ensure proper function.

Figure 13. Examples of antifouling wiper wear

NOTE: Inspection of the brush should take place after cleaning of the sonde.

1. Visually inspect the brush of the wiper (post-cleaning).
2. Assess the splay of the bristles and determine if it needs replacement.
3. Replace the wiper brush as necessary.
4. Loosen the set screw with a 0.05 inch Allen wrench and remove brush assembly.

5. Clean any residue from wiper shaft and end cap.
6. Install new brush assembly by gently pressing it down and then tightening the screw while slowly rocking the brush to ensure tight fit on the shaft (Figure 14).

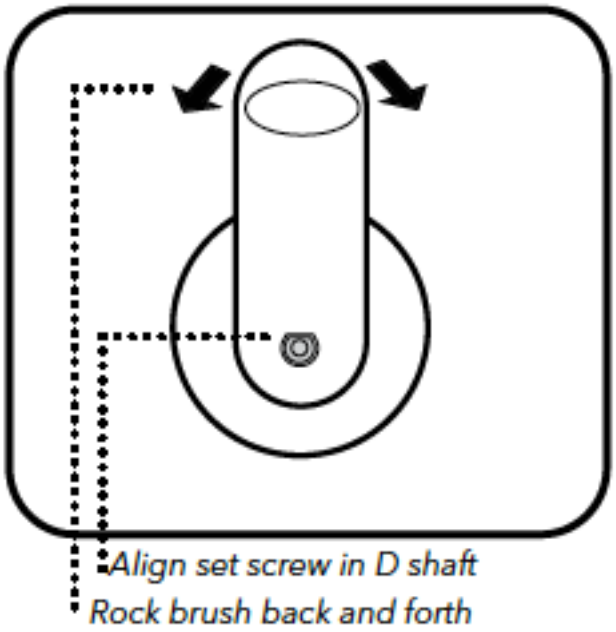


Figure 14. Illustration of tightening set screw while rocking brush on shaft to install new brush assembly on the central wiper.

5.3.5 Multisonde Calibration and Validation Procedures

The following sections provide the procedures to conduct field validation checks, sensor calibrations, sensor cleaning and sensor refresh for the Multisonde if/when the NEON CVAL requires it.

Sensor calibration checks are conducted biweekly in the field for all Multisonde sensors. If calibration drift has occurred, field calibration is required for that sensor at that time. If the calibration software's quality metrics do not allow the user to proceed with the calibration, then the individual probe should be detached and sent to CVAL for servicing. Table 4 contains calibration requirements for the Multisonde.

In short, the standard protocol for general operation, maintenance and quality assurance of data is as follows:

1. Conduct site and sensor inspection
2. Remove sonde from monitoring location
3. Place sonde in a steady, controlled environment (bucket of ambient water)
   a. Record "dirty" sensor readings
4. Clean sensors

5. Return sonde to steady, controlled environment (bucket of same ambient water)
   a. Record "clean" sensor readings
6. Check calibration
   a. Record calibration-check values
   b. Recalibrate sensor as necessary
7. Return sonde to monitoring location

Table 4. Calibration check criteria for surface water quality Multisonde ER [01]

Measurement	**Calibration Check Criteria** Variation outside the value shown results in a failed calibration check. Proceed with field calibration.
pH	± 0.2 pH unit
Dissolved Oxygen	± 0.3 mg/L
fDOM	± 4% of the measured value[1]
Turbidity	± 0.5 turbidity unit or ±5% of the measured value, whichever is greater
Chlorophyll *a*	± 1% of the measured value[1]
Conductivity	± 5 µS/cm or ±3% of the measured value, whichever is greater
Temperature	± 0.2 °C
Depth	± 0.04 m

[1]Earp, et. al, 2011; Leeuw, et. al, 2013.

5.3.6 Connecting to YSI KOR Software

To calculate calibration drift and provide CVAL with necessary data, technicians must record all measurement readings from Table 4 prior to cleaning, after cleaning, during calibration and after calibration. For pre-cleaning, post-cleaning, and post-calibration readings, the Multisonde must be in the housing. Use the worksheet in Appendix A2 to collect additional data needed for CVAL, connect a laptop equipped with the YSI KOR software to the Multisonde as shown in Figure 15.

Figure 15. Schematic for connecting directly Multisonde to a laptop via a USB signal output adaptor (SOA).

1. Disconnect the Grape Ethernet cable.
2. Remove the Multisonde from its enclosure (Section 6.2)
3. Loosen and remove the sensor cable assembly from the Multisonde.

NOTE: The Multisonde cable may be looped and suspended on the infrastructure above water. The Multisonde sensor cable is wet-mateable. If it is dropped in the water, simply shake off excess water before reconnecting.

4. Press the female end of the signal output adaptor (SOA) onto the pins of the open connector.
5. Connect the small end of a high speed mini USB cable to the SOA.
6. Connect the standard USB end of the cable to the port on the laptop.
7. Launch the KOR software.
8. Connect to the sensor by pressing the scan button (green arrow) at the top of the home screen and selecting the appropriate communication channel that shows the EXO USB SOA attached and press the “connect” button as shown in Figure 16.
9. Verify the Multisonde is now connected checking that all data fields are active in the dashboard (see Figure 17).

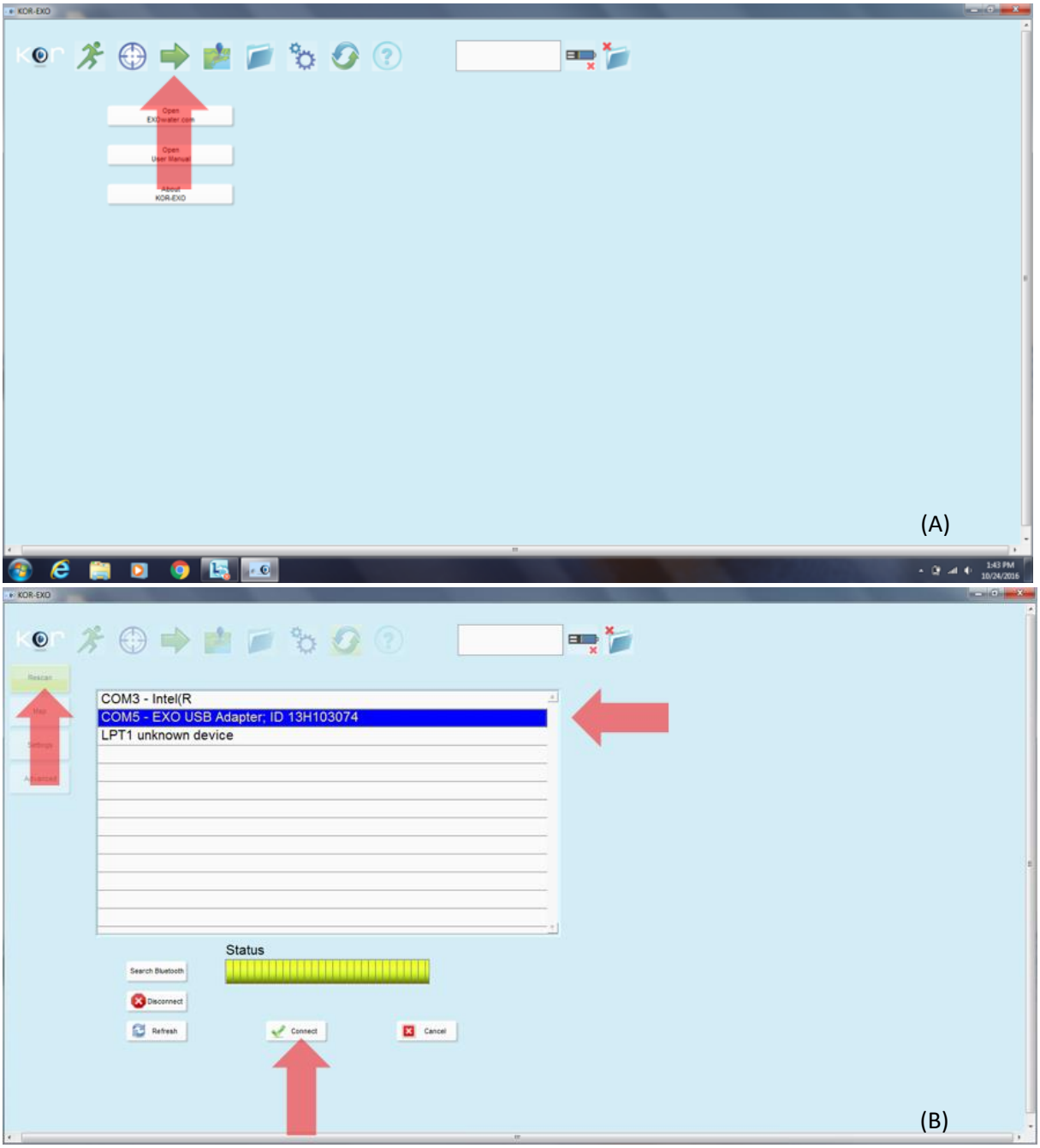


Figure 16. Screenshot showing (A) the scan button on the home screen of the KOR software and (B) the rescan button, found devices/channels list, and the connect button on the scan screen.

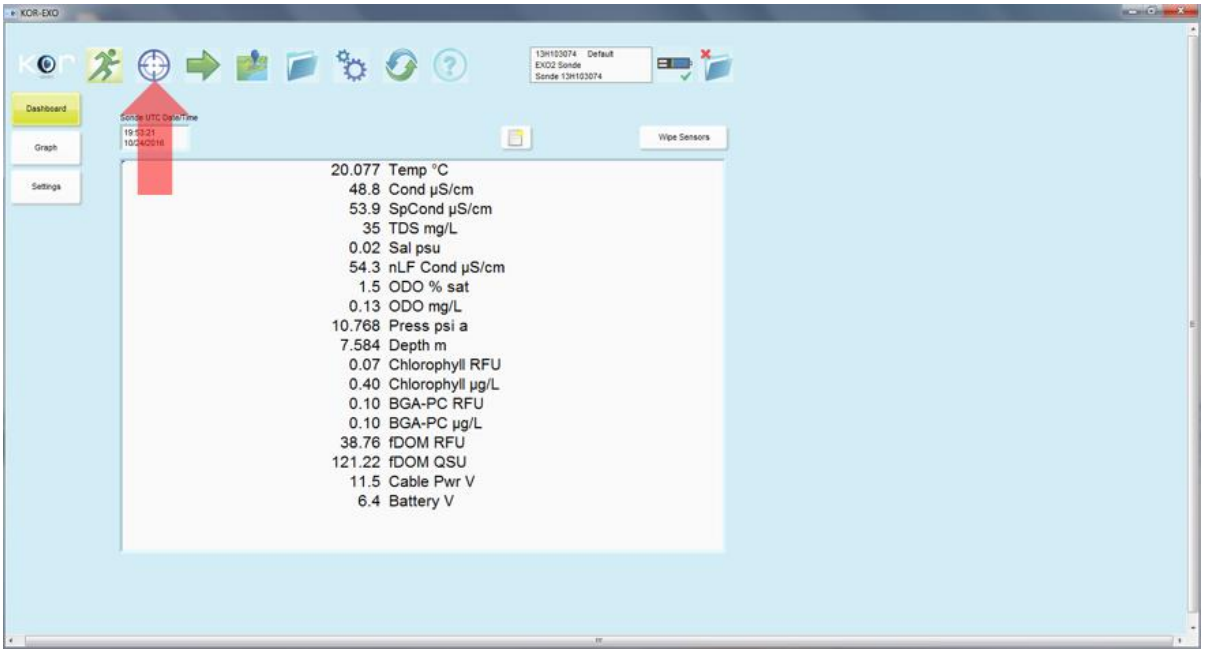


Figure 17. Screenshot of dashboard showing the active data streams transmitted from the Multisonde.

5.3.7 Pre-Cleaning Sensor Readings

To assess any drift due to biofouling, pre- and post-cleaning measurements must be captured. Use the KOR software to capture DO, Temperature, Specific Conductivity, fDOM, Turbidity, Chlorophyll *a* and pH measurements prior to performing sensor cleaning.

With the sensor placed in a bucket of ambient site water and connected to the laptop and KOR software (Section 5.3.6), record the following values in the Quality Assurance Datasheet in Appendix A2:

1. DO
2. pH
3. fDOM
4. Temperature
5. Turbidity
6. Chlorophyll
7. Specific Conductance

5.3.8 Clean the Multisonde and Probes

5.3.8.1 Multisonde Body and Guard

This section describes how to remove minimal and heavy biofouling from the Multisonde and copper guard and the probes.

1. Wear gloves to protect probes during handling.
2. Remove the protective copper guard from the Multisonde.
3. If the guard is covered in a thin layer of slime or filaments, wipe away any film with a cloth soaked in clean water and a few drops of a dishwashing liquid that contains a degreaser.
4. Rinse the guard with clean water and inspect.
5. For heavy biofouling, remove the antifouling Multisonde guard from the Multisonde.
    a. If the guard is covered in a thick layer of filaments or invertebrates, soak the guard for 10 to 15 minutes in a solution of clean water and a few drops of a dishwashing liquid that contains a degreaser.
        a. Following the soak, rinse the guard with clean water and inspect.
        b. If biofouling remains, use a small plastic scrub brush or plastic scraper to gently scrub the biofouling off the guard.
        c. Wipe the guard with a wet, soapy cloth and rinse.
6. Use a squirt bottle or syringe to rinse and remove dirt from probes.
7. Use a clean cotton cloth to further remove any remaining dirt.
        d. If the probes are still dirty, they must be removed to clean further (Section 5.3.8.2 and Section 6.2 below)
8. Use the syringe from the EXO Tool Kit to gently flow clean water through the pressure transducer ports as shown in Figure 18.
        e. If the inside is clean, water should flow between the holes.
        f. Continue flushing the port until the water comes out clean.

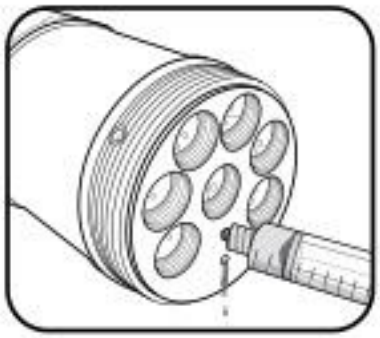


Figure 18. Illustration of injecting water into the pressure transducer ports.

9. Reassemble all probes as needed, if removed during cleaning.
10. Visually inspect all probes for damage.
        a. Record issues using the metadata sheet in Appendix A1 as necessary and report by generating a trouble ticket.
11. Reassemble the sensor guard.

5.3.8.2 Probe Removal and Cleaning

5.3.8.2.1 Probe Removal

Conduct probe removal as outlined in Section 6.2 with the sensor removal tool, as indicated in Figure 19.

Figure 19. The sensor removal tool is inserted into the probe lock ring to unscrew it counter clockwise to free the probe from the Multisonde body.

5.3.8.3 Sensor Cleaning

5.3.8.3.1 Optical Sensors (DO, Turbidity, Total Algae and fDOM)

1. Visually inspect the optical window at the base of the probe.

NOTE: Use only Kimwipes or other non-abrasive, lint-free cloth to clean the sensor window.

2. Wipe the sensor window.
    a. Use DI water to wet the wipe if needed (Figure 20).

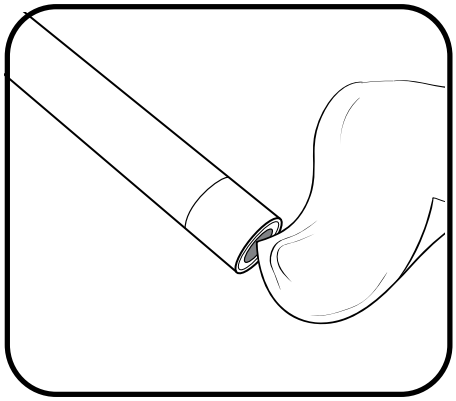


Figure 20. Illustration of cleaning the optical sensor window.

5.3.8.3.2 pH Sensor

NOTE: Never scrub or swab the glass bulb on the pH sensor.

1. *For general cleaning, soak the sensor in a mild dish soap solution for 10 to 15 minutes (Figure 21).
2. *For heavy contamination (may be indicated by poor response time), soak the sensor in 1M hydrochloric acid (HCl) for 30 to 60 minutes (Figure 21).
    a. If HCl is not available, white vinegar can be used instead.
3. Rinse the sensor in tap water.
4. Repeat as necessary.
5. Soak the sensor in a 1:1 dilution of chlorine bleach and tap water (Figure 21).
6. Rinse the sensor in tap water.
7. Soak the sensor in tap water for at least 60 minutes.

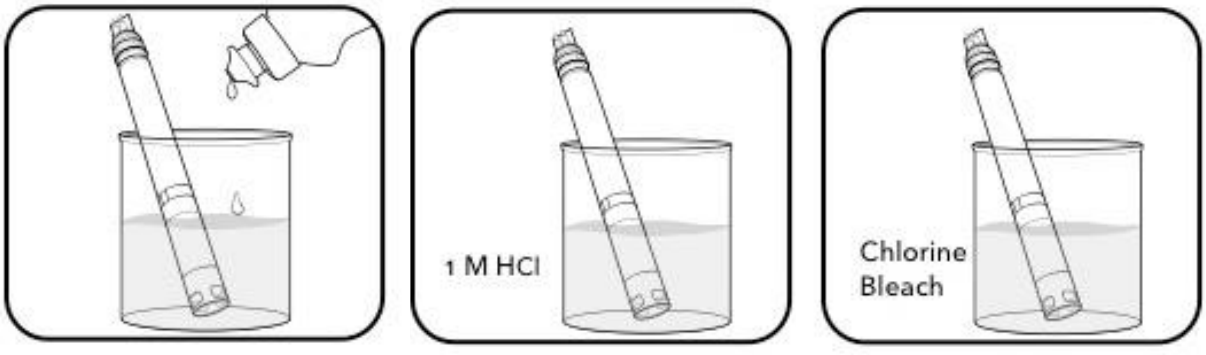


Figure 21. Illustration showing the soaking of pH sensor in solutions.

NOTE: pH probes should never be left dry or stored in DI water (saturated air is acceptable for short-term). pH probes should be stored in either a buffer solution or tap water.

5.3.8.3.3 Temperature and Conductivity Sensor

NOTE: Use only the cleaning brush included with the EXO conductivity probe to clean the sensor.

1. Dip the cleaning brush in clean water.
2. Insert the clean brush into the channels in the base of the conductivity sensor (Figure 22).
3. Sweep the channels 15 to 20 times.
4. *If deposits are present on the electrodes, use mild dish soap solution.
5. *If heavy deposits are present, soak the sensor in white vinegar and repeat steps 1 through 3.

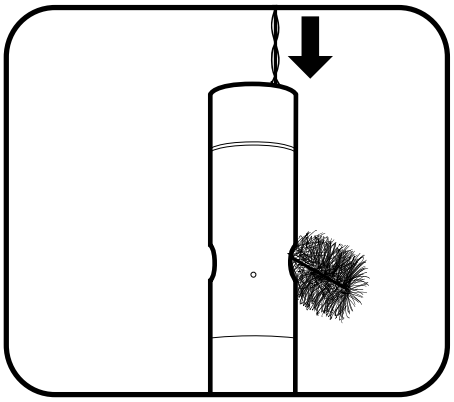


Figure 22. Illustration of cleaning the conductivity cell.

5.3.9 Post-Cleaning Sensor Readings

1. Replace the Multisonde in the same bucket of ambient site water used for Pre-cleaning Sensor Readings above.
2. Connect the Multisonde to the laptop using the KOR software according to Section 5.3.6.
3. Record the following values in the Quality Assurance Datasheet in Appendix A2.
    a. DO
    b. pH
    c. fDOM
    d. Temperature
    e. Turbidity
    f. Chlorophyll
    g. Specific Conductance

5.3.10 Pre-Calibration Sensor Readings

To assess any drift due to the sensor, pre- and post-calibration measurements must be captured. Use the KOR software to capture sensor measurements prior to performing sensor calibrations.

1. Replace the Multisonde in the same bucket of ambient site water used for Pre-cleaning Sensor Readings above.
2. Connect the Multisonde to the laptop using the KOR software according to Section 5.3.6.
3. Record the following values in the Quality Assurance Datasheet in Appendix A2.
   a) DO
   b) pH
   c) fDOM
   d) Temperature
   e) Turbidity
   f) Chlorophyll
   g) Specific Conductance

5.3.11 DO Sensor Calibration

The DO calibration must be performed at the ambient temperature and barometric pressure for accurate measurements.

5.3.11.1 **Apparatus Setup**

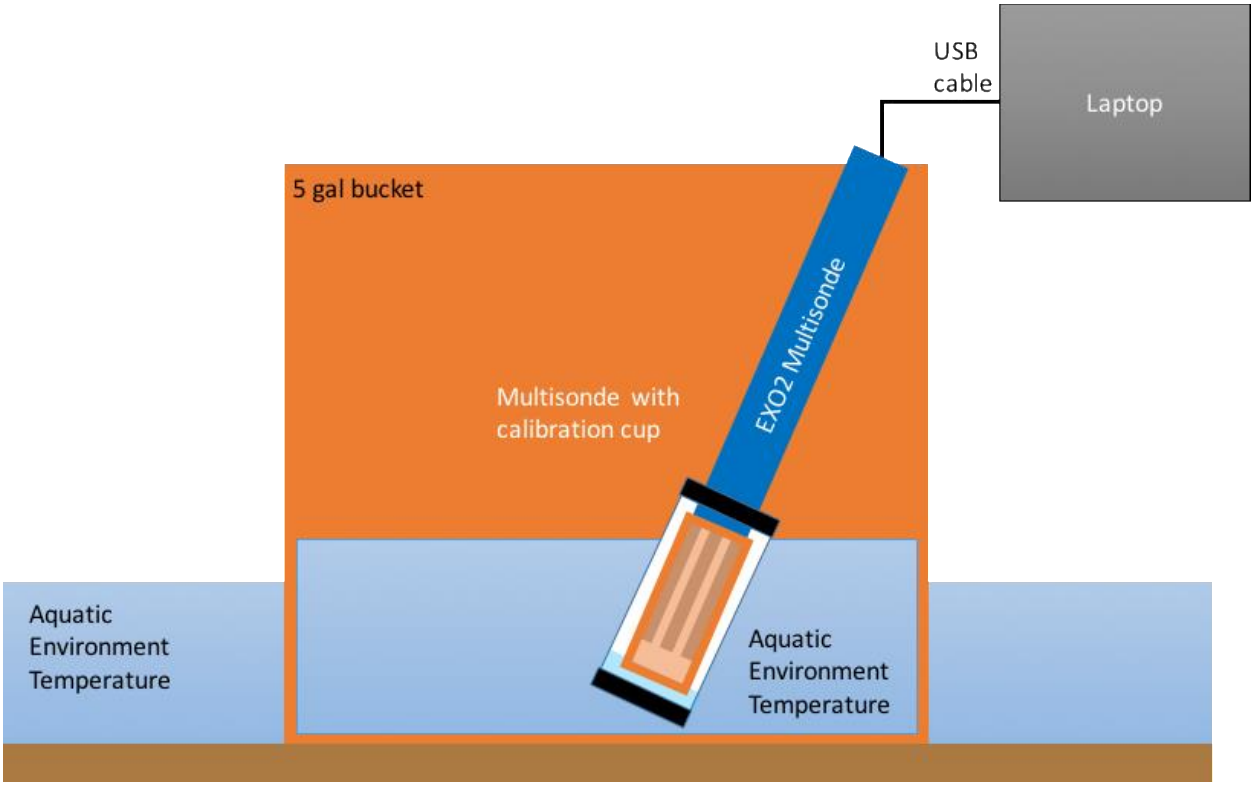


Figure 23. Schematic illustrating the apparatus setup for calibration of the dissolved oxygen sensor.

1. Set up water bath to equilibrate calibration cup with environment (Figure 23).
    a. Place approximately 6 inches of water into a 5-gallon bucket using water from the site (e.g., stream, river or lake).
    b. Place the bucket securely in the water at the site.
        i. Set the bucket near the water's edge.
        ii. Make sure the bucket is in 4 to 6 inches, but not more than 6 inches, of water so that it does not float.
2. Add 1 cm of DI water to the calibration cup (Figure 24).
    a. Loosely set the Multisonde into the calibration cup with the guard attached.
    b. Ensure the sensor is not submerged and no droplets are on sensor.
    c. Place the calibration cup and Multisonde into the water bath.
    d. Let stand at least 15 minutes for head space in the calibration cup to come into equilibrium and become completely saturated at the same temperature as the environment.

Figure 24. Calibration cup with arrow pointing to 1 cm.

5.3.11.2 Sensor Field Calibration

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the Multisonde to the laptop using the KOR software according to Section 5.3.6.

NOTE: The dashboard should open, showing the current (live) readings from the Multisonde. In some cases, the readings will not show up if the Multisonde is on battery power. In this case, plug the Multisonde into a power cable.

2. Press the calibration button to enter the calibration menu (Figure 25).
3. Select “ODO” from the calibration menu.
4. Select “ODO % sat” from the submenu.

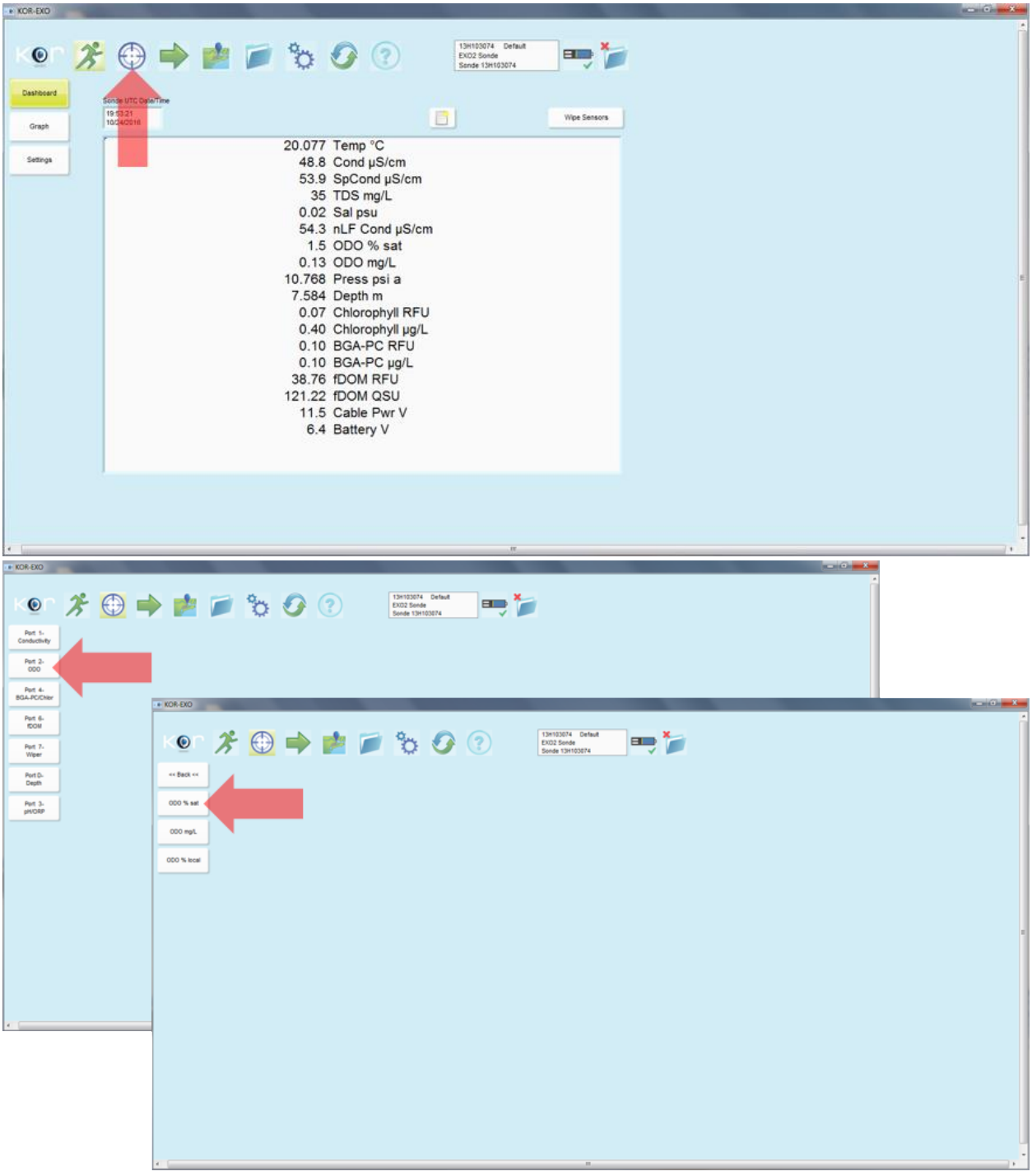


Figure 25. Screenshots showing (A) the calibration menu button, (B) the ODO button on the calibration menu, and (C) the ODO % sat button on the submenu.

5. Look up the local barometric pressure.
    a. If possible, access the barometer on the AIS met station at the site.

b. If the AIS met station barometer data are not accessible, pull from the closest meteorological station.

c. Ensure the barometric pressure is for the location station pressure and NOT sea level.

NOTE: Most reported pressures are adjusted to mean sea level. The station pressure can be back-calculated using Equations 4 through 12 in RD [08].

d. Convert pressure to mmHg if necessary (e.g. unitconversion.org).

6. Input the barometric pressure (Figure 26).
7. Press the "Start Cal" button.

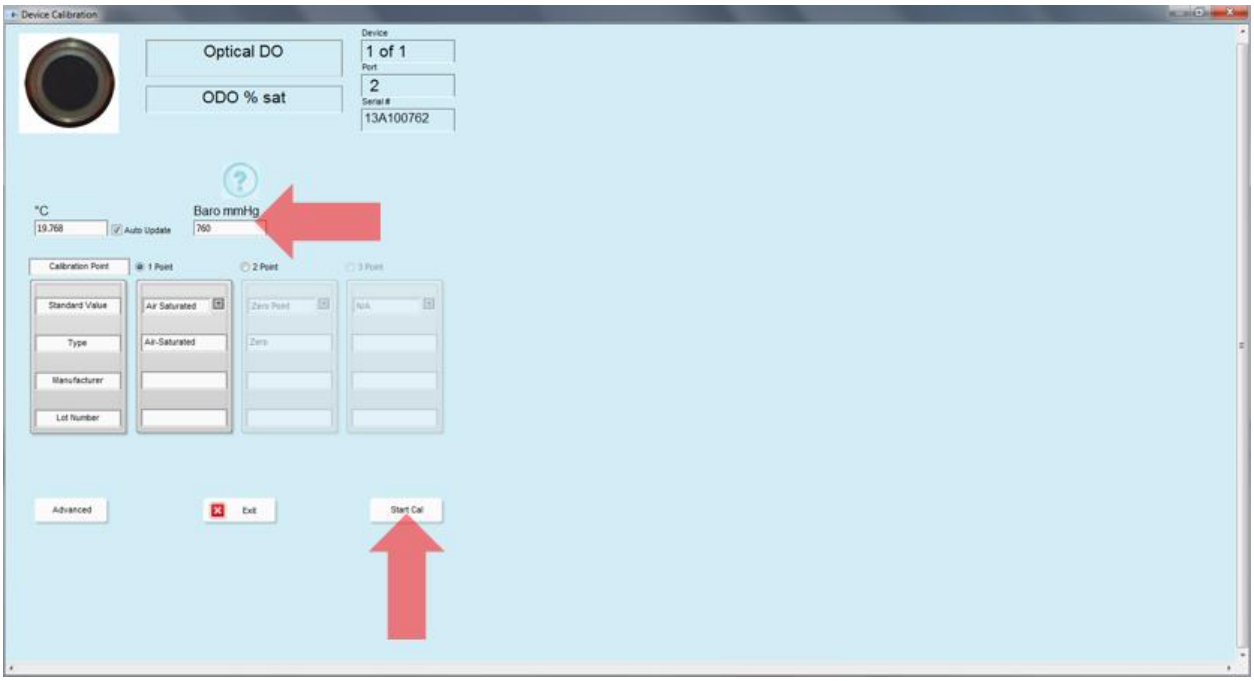


Figure 26. Screenshot of the Device Calibration window.

8. Wait for the signal to stabilize and press "Apply" (Figure 27).
9. Accept or Reject and re-perform the calibration as necessary.
10. Provide calibration information to CVAL following the Field Calibration Data Transmission Instruction in Appendix A4.

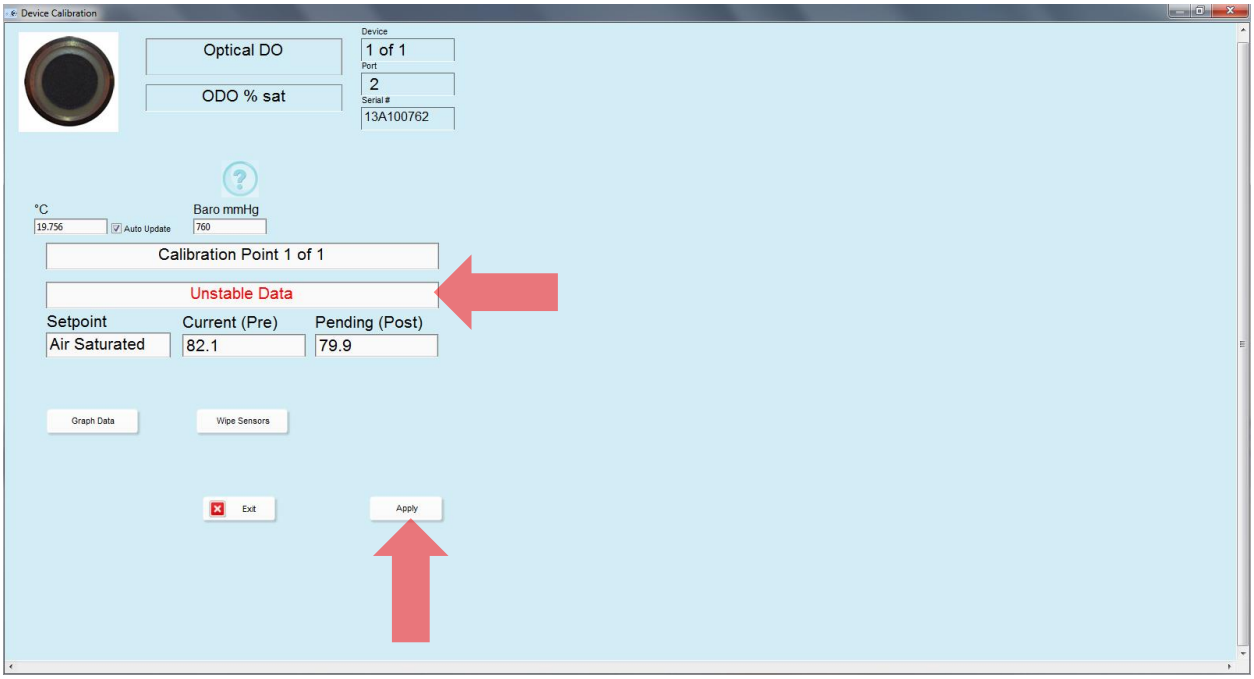


Figure 27. Screenshot of device calibration window showing unstable data and the Apply button.

5.3.12 Conductivity Sensor Calibration

It is recommended to perform a single point calibration for the conductivity probe similar to the conditions of deployment. For freshwater applications, it is recommend to not use less than 1000 µS/cm to mitigate against contamination. Therefore the only standard solution used must be 1000 µS/cm. The accuracy of the probe should be within 5% for conductance values less than or equal to 100 µS/cm. Conductance standard solutions must be discarded safely after use as described by NEON Chemical Hygiene Plan AD [04].

5.3.12.1 Sensor Calibration

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Enter the Calibration Menu and select Specific Conductivity (Figure 28).

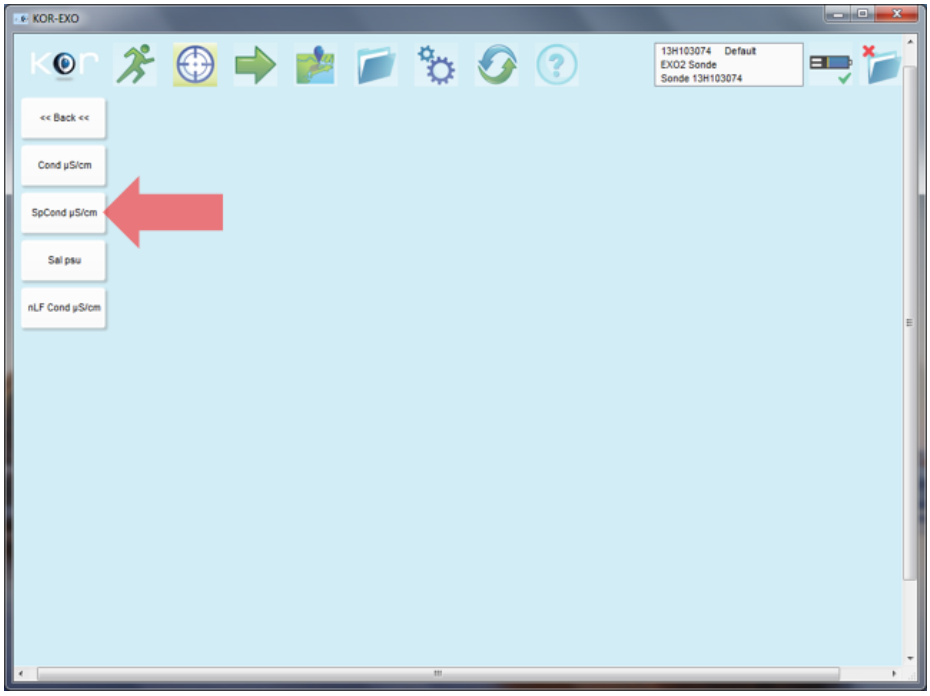


Figure 28. Screenshot of the Conductivity calibration submenu.

3. Select the 1-point calibration option (Figure 29).

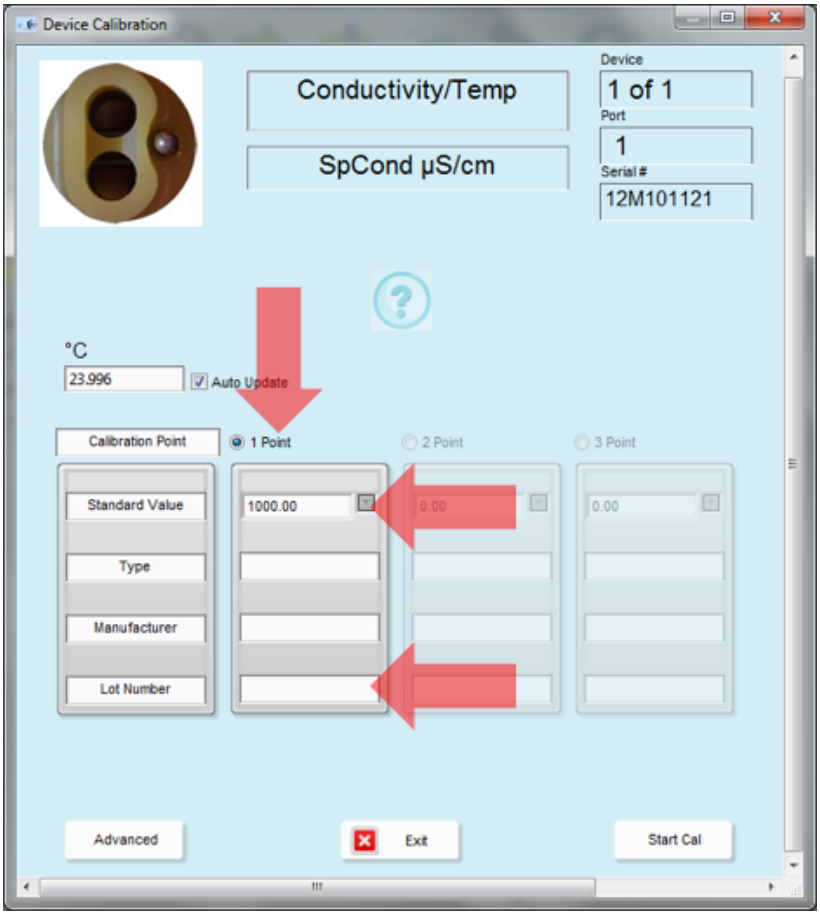


Figure 29. Screenshot of the Specific Conductance calibration window.

4. Input 1000 µS/cm for the value.
5. Input the lot numbers for the calibration standard solution.
6. Remove the copper guard from the sonde.
7. Hold the Multisonde over the calibration cup and rinse the probes with the 1000 µS/cm specific conductivity standard solution, catching the solution in the cup.
8. Swirl the solution to rinse the cup and empty.
9. Repeat steps 7 and 8 twice, for a total of three rinses, according to steps (a) through (e).
   a) Three opened bottles, marked 1st, 2nd, and 3rd, will be used for rinsing only. An unopened, non-expired bottle must be used for the calibration solution.
   b) Rinse bottle, labeled 1st, should be poured into the calibration cup first. Swirl solution around the sensors and discard the waste.
   c) Follow the same steps for rinse bottle 2, except the rinsate is poured into the bottle marked "1st".
   d) Similarly, after rinsing with rinse bottle 3, it is poured into bottle marked "2nd"

e) The calibration solution is then poured into the cup. Once calibration is completed, pour the remainder of the calibration solution into rinse bottle 3.

10. Add 2-5 cm of 1000 µS/cm specific conductivity standard solution in the calibration cup and immerse the sensor in the solution.
11. Click "Start Calibration."
12. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.
    a) If the pre-calibration value is within the threshold identified in Table 4, the previous calibration is still valid. DO NOT click "Accept" and Exit the calibration menu.
    b) If the pre-calibration value fails the criteria in Table 4, record the new calibration by clicking the "Accept."

NOTE: Make sure to conduct the conductivity readings before the pH readings in Section 5.3.13. ***pH calibration solutions are extremely conductive and can throw off the conductivity probe readings if the conductivity probe is not calibrated before the pH probe.***

5.3.13 pH Sensor Calibration

The pH calibration must be performed at ambient temperature for accurate measurements. pH sensors deployed continuously in aquatic environments must be regularly calibrated to mitigate drift.

5.3.13.1 **Apparatus Setup**

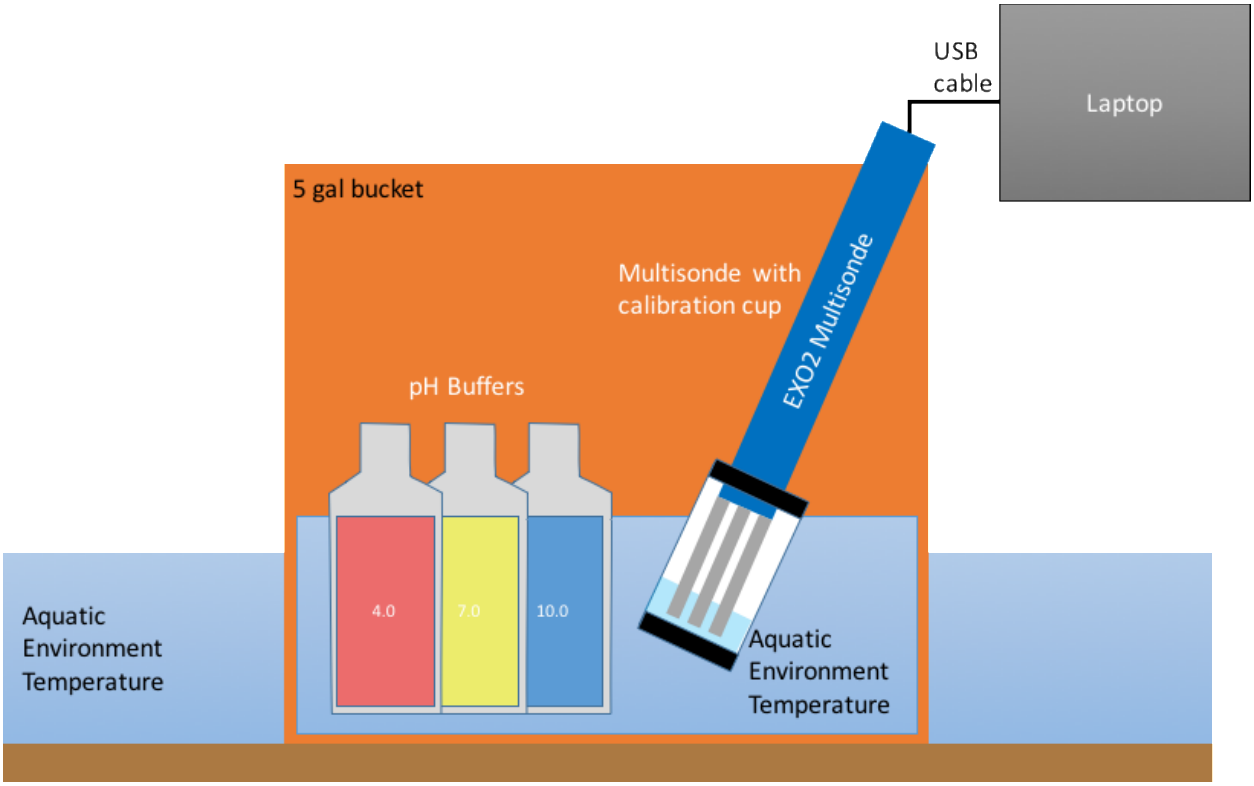


Figure 30. Schematic illustrating the apparatus setup for calibration of the pH sensor.

1. Set up water bath to equilibrate pH buffers with environment (Figure 30).
    a. Place approximately 6 inches of water into a 5-gallon bucket using water from the site (e.g., stream, river or lake).
    b. Place the bucket securely in the water in the site.
        i. Set the bucket near the water's edge.
        ii. Make sure the bucket is in 4 to 6 inches, but not more than 6 inches, of water so that it does not float.
2. Place the pH buffers into the water in the bucket.
    a. Let stand at least 30 minutes for the temperature of the buffers to reach the same temperature as the environment.

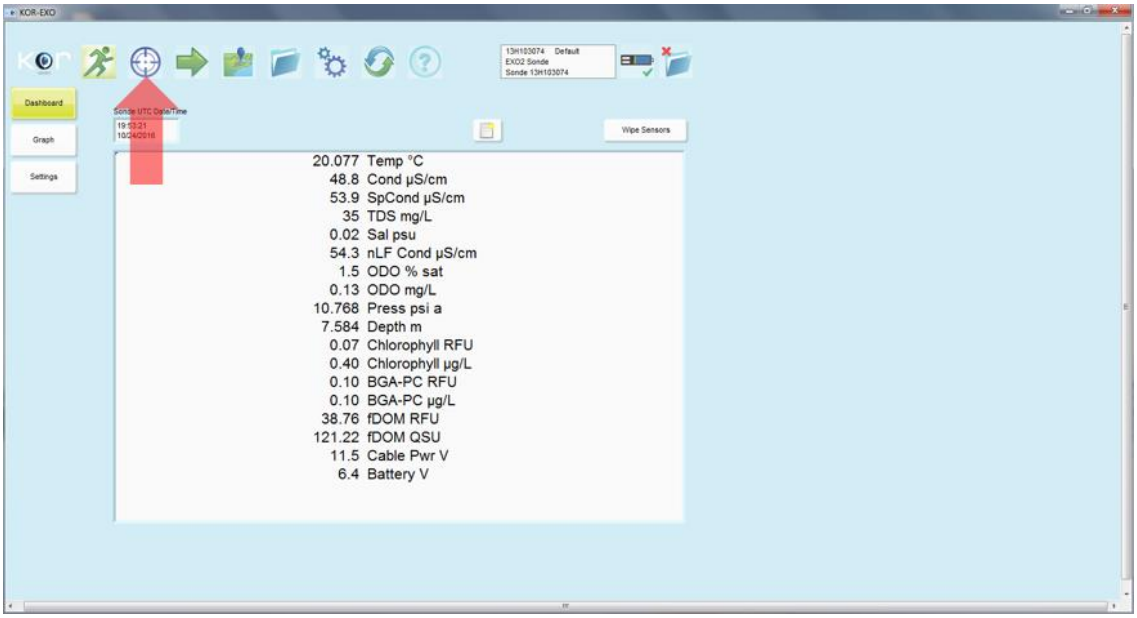
5.3.13.2 **Sensor Calibration**

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the Multisonde to the laptop using the KOR software according to Section 5.3.6.

NOTE: The dashboard should open, showing the current (live) readings from the Multisonde. In some cases, the readings will not show up if the Multisonde is on battery power. In this case, plug the Multisonde into a power cable.

2. Press the Calibration button to enter the calibration menu (Figure 31).
3. Select “pH/ORP” from the calibration menu.
4. Select “pH” from the submenu.



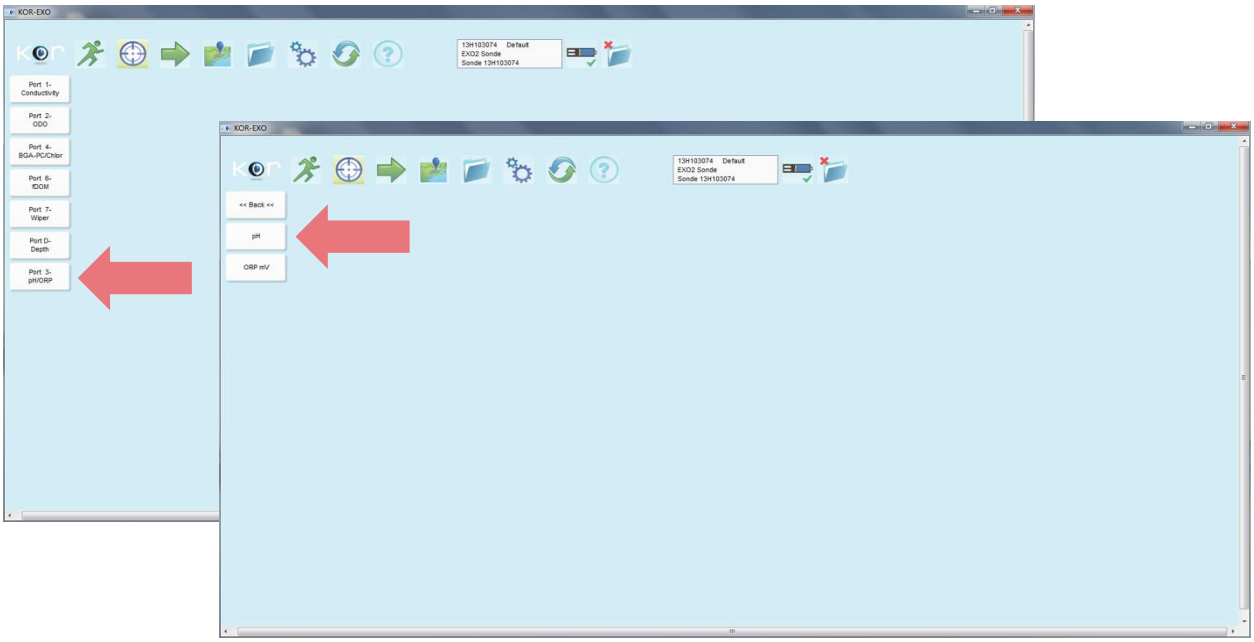


Figure 31. Screenshots showing (A) the calibration menu button, (B) the pH/ORP button on the calibration menu, and (C) the pH button on the submenu.

5. Select "3 Point Calibration" (Figure 32).
6. Input the calibration buffer values for each point at the appropriate temperature according to Table 5.

Table 5. Table of Temperature effects on pH Buffer Solutions

Temperature (°C)	pH Buffer Solution Nominal Value		
	4.01	**7**	**10**
0	4.00	7.14	10.30
5	4.00	7.10	10.23
10	4.00	7.07	10.17
15	4.00	7.04	10.11
20	4.00	7.02	10.05
25	4.01	7.00	10.00
30	4.01	6.99	9.96
35	4.02	6.98	9.92
40	4.03	6.98	9.88

7. Input the Lot Number for each buffer used (see Figure 32).

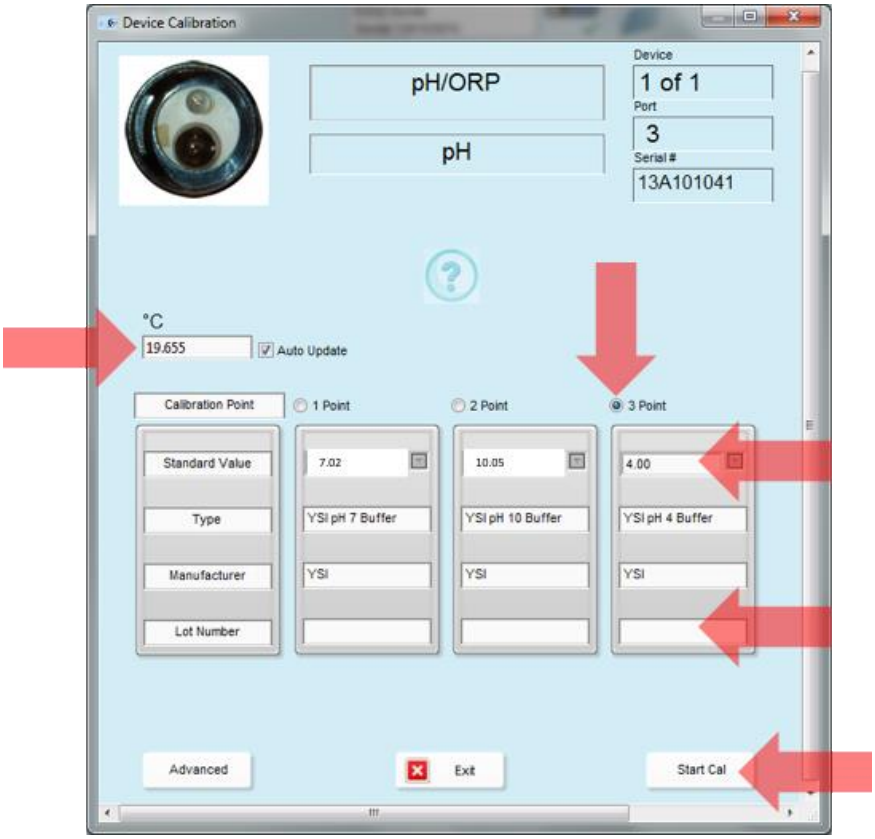


Figure 32. Screenshot of the Device Calibration window.

8. Rinse the pH probe and all other EXO probes with DI water.
9. Rinse the calibration cup three times with DI water, swirling after pours.
10. Hold the Multisonde over the calibration cup and rinse the probes with pH buffer 7, catching the buffer in the cup.
11. Swirl the buffer to rinse the cup and empty.
12. Repeat steps 10 and 11 twice, for a total of three rinses, according to steps (a) and (e).
    a. Three opened bottles, marked 1st, 2nd, and 3rd, will be used for rinsing only. An unopened, non-expired bottle must be used for the calibration solution.
    b. Rinse bottle, labeled 1st, should be poured into the calibration cup first. Swirl solution around the sensors and discard the waste.
    c. Follow the same steps for rinse bottle 2, except the rinsate is poured into the bottle marked "1st".
    d. Similarly, after rinsing with rinse bottle 3, it is poured into bottle marked "2nd"
    e. The calibration solution is then poured into the cup. Once calibration is completed, pour the remainder of the calibration solution into rinse bottle 3.
13. Add about 2 cm of pH buffer 7 to Fill Line 1 of the calibration cup.

14. With the guard off (this requires less volume of the buffer), place the probe in the buffer.
15. Place the cup in the water bath.
16. Press “Start Cal”.
17. Wait for the signal to stabilize and press “Apply” (Figure 33).
18. Accept or Reject and re-perform the calibration as appropriate.
19. Repeat steps 8 through 18 for pH buffers 10 and 4.
20. Provide calibration information to CVAL following the Field Calibration Data Transmission Instruction in Appendix A4.

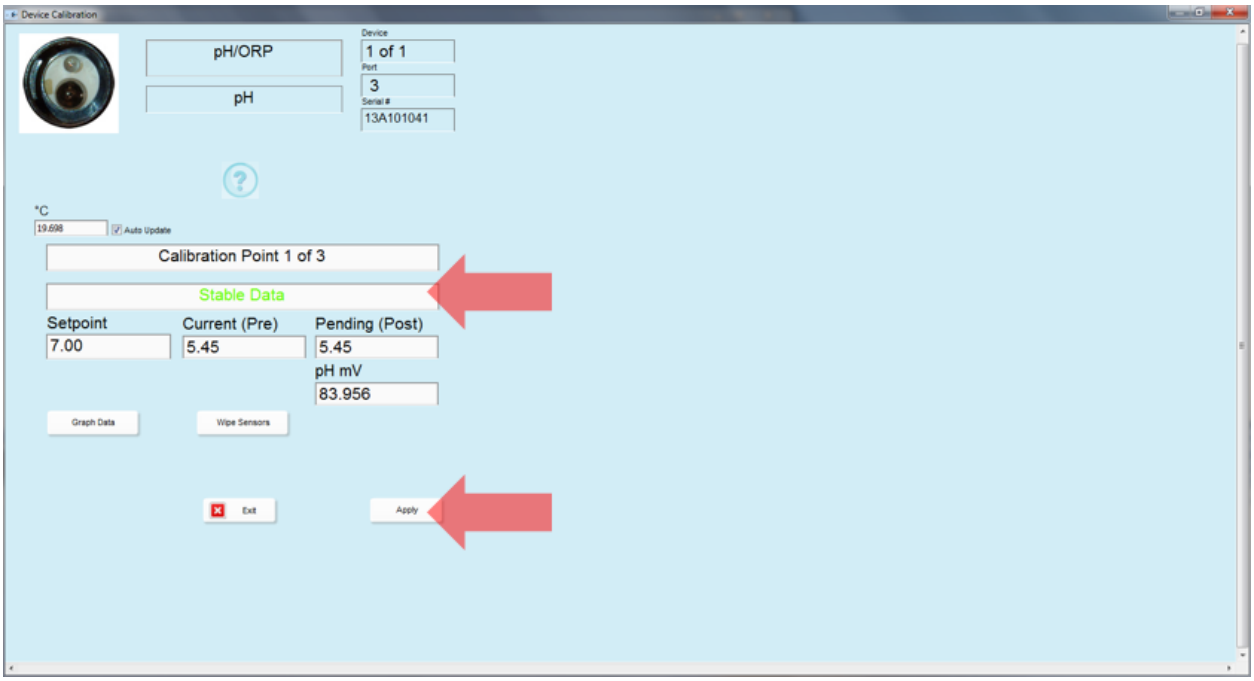


Figure 33. Screenshot of device calibration window showing stable data and the apply button.

5.3.14 Fluorscent Dissolved Organic Matter (fDOM) Sensor Calibration

The fDOM calibration is a 2-point calibration; one standard must be clear de-ionized water (0 µg fDOM/L) and the other standard should be a 300 µg/L quinine sulfate solution. The EXO User Manual section 5.10 includes detailed instructions (ER [02]).

NOTE: Do not leave the probe in quinine sulfate solution for a long time. A chemical reaction occurs with the copper (sonde bulkhead) that degrades the solution and causes it to drift.

Quinine sulfate is prepared in dilute sulfuric acid. Acid must be stored in acid-safe containment cabinet in compliance with the NEON Chemical Hygiene Plan (AD [04]).

5.3.14.1 Calibration Solution Preparation

1. Wear nitrile gloves and eye protection.
2. Handle acid under a fume hood.
3. Weigh 0.100g of solid quinine sulfate dehydrate and quantitatively transfer the solid to a 100 mL volumetric flask.
4. Dissolve the solid in 0.1N (0.05 M) sulfuric acid (H_2SO_4) to make a 1000 ppm quinine sulfate solution (0.1%)

NOTE: Store the concentrated standard solution in an amber glass bottle in a refrigerator.

5. Transfer 0.6 mL of the 1000 ppm solution to a 2000 mL volumetric flask.
6. Fill the volumetric flask to the top of the graduation with 0.1N sulfuric acid to make a 300 μg/L (300 QSU/QSE) solution.
7. Cap the volumetric flask and invert 5 times to mix.

NOTE: Dilute standard must be used within 5 days and not reused.

5.3.14.2 Sensor Calibration

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Enter the Calibration Menu and select fDOM.
3. Select QSU (see Figure 34).

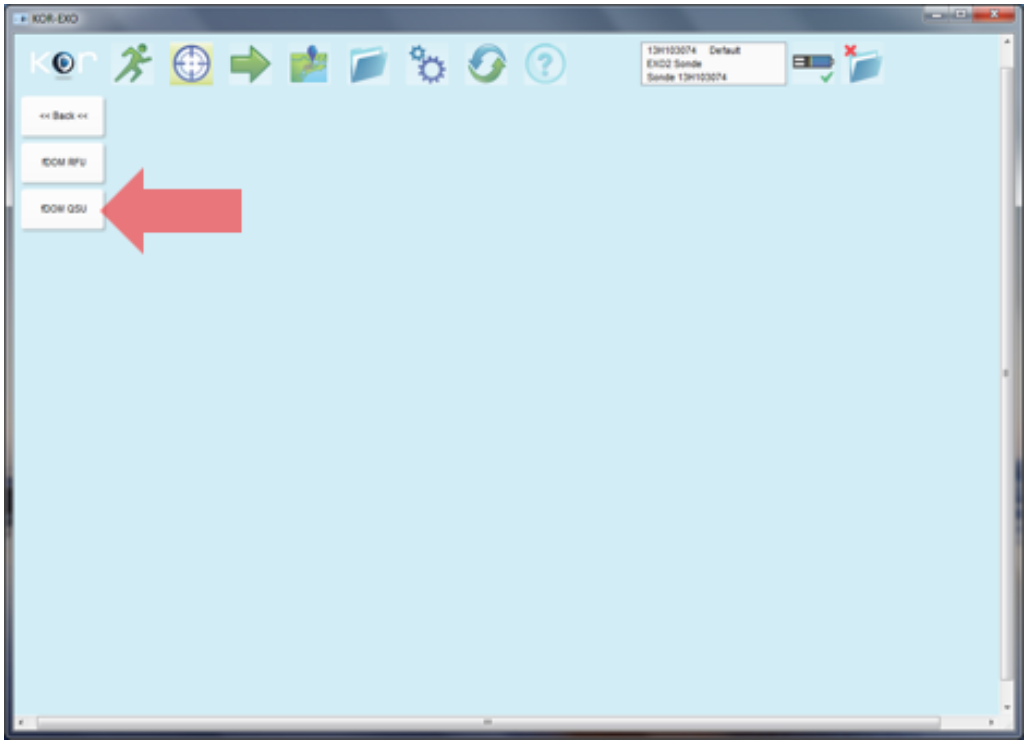


Figure 34. Screenshot of fDOM Calibration submenu.

4. Select the 2-point calibration option (Figure 35).

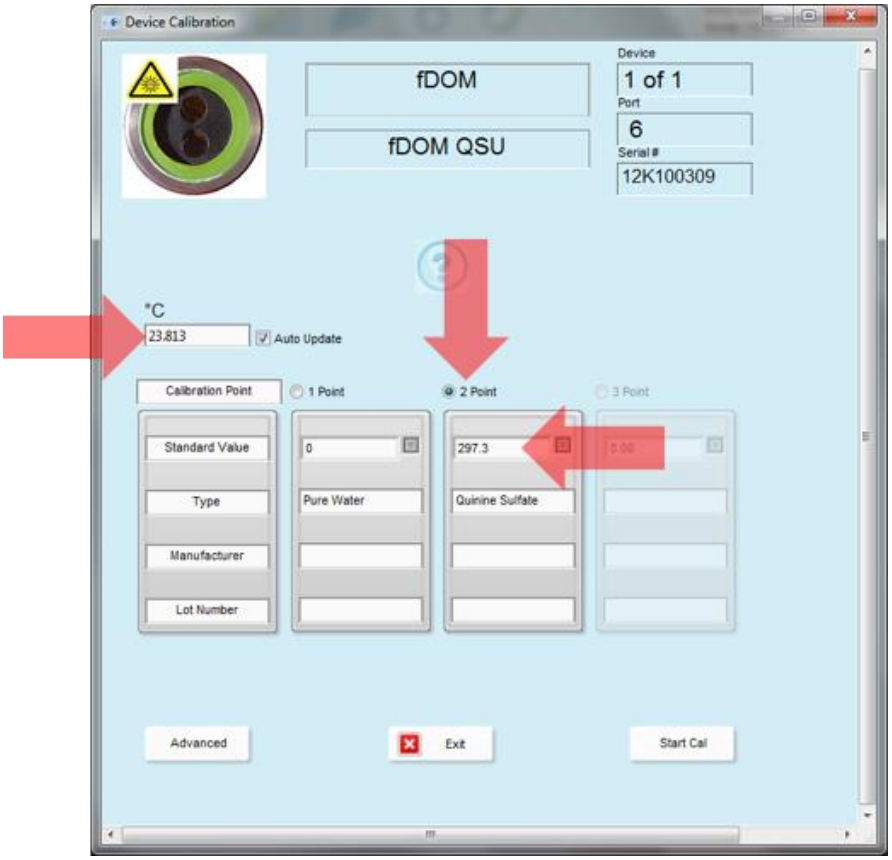


Figure 35. Screenshot of fDOM Calibration window.

5. Input zero for the first value.
6. Input the temperature corrected value for the 300 ug/L quinine sulfate solution according to Table 6 for the second standard value.

Table 6. Temperature effect on fDOM calibration solution.

Temperature (°C)	fDOM Calbiration Solution Nominal Value
	300 ug/L Qunine Sulfate (300 QSU)
8	319.2
10	316.5
12	313.8
14	310.8
16	308.1
18	305.4
20	302.7
22	300.0
24	297.3

26	294.6
28	291.9
30	289.2

7. Rinse calibration cup with deionized water.
8. Pour deionized water to Fill Line 1 of the clean calibration cup.
9. Remove the copper guard from around the probe.
10. Remove the central wiper from the sonde.
11. Immerse the probe end of the sonde in the deionized water
12. Click “Start Calibration”.
13. Observe the readings under Current and Pending data points, and when they are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the “Apply” button.
14. Hold the Multisonde over the calibration cup and rinse the probes with the 300 ug/L quinine sulfate standard, catching the solution in the cup.
15. Swirl the buffer to rinse the cup and empty.
16. Repeat steps 13 and 14 twice, for a total of three solution rinses. You will need to make 2000 mL additional solution for this rinse.
17. Add 2-5 cm of 300 ug/L quinine sulfate standard in the calibration cup and immerse the sensor in the solution.
18. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the “Apply” button.
    a) If the pre-calibration value is within the threshold identified in Table 4, the previous calibration is still valid. DO NOT click “Accept” and Exit the calibration menu.
    b) If the pre-calibration value fails the criteria in Table 4, record the new calibration by clicking the “Accept.”

5.3.15 Total Algae Sensor Calibration

For the 2-point calibration, one standard must be clear de-ionized water (0 µg chlorophyll/L), and this standard must be checked first. A dye solution whose fluorescence can be correlated to that of chlorophyll will be used. Rhodamine WT dye solution with a concentration of 625 µg/L is preferred. The EXO User Manual section 5.10 includes detailed instructions (ER [02]).

5.3.15.1 Solution preparation

1. Wear nitrile gloves and eye protection.

Stock Solution:

2. Accurately transfer 5.0 mL of the 2.5% Rhodamine WT dye (Fluorescent FWT Red Dye) to a 1000 mL volumetric flask.
3. Fill the volumetric flask to the top of graduation with deionized water.
4. Cap the volumetric flask and invert 5 times and swirl to mix well. This obtains a solution that is 125 mg/L

NOTE: Store the concentrated (125 mg/L) standard solution in an amber glass bottle in a refrigerator.

Chlorophyll Calibration Solution:

5. Accurately transfer 10.0 mL of the 125 mg/L Rhodamine WT solution to a 2000 mL volumetric flask.
6. Fill the volumetric flask to the top of graduation with deionized water.
7. Cap the volumetric flask and invert 5 times and swirl to mix well. This obtains a solution that is 0.625 mg/L to be used for calibrating the sensor for chlorophyll.

Blue-Green Algae Calibration Solution:

8. Accurately transfer 0.2 mL of the 125 mg/L Rhodamine WT solution to a 1000 mL volumetric flask.
9. Fill the volumetric flask to the top of graduation with deionized water.
10. Cap the volumetric flask and invert 5 times and swirl to mix well. This obtains a solution that is 0.025 mg/L to be used for calibrating the sensor for BGA.

NOTE: Dilute standard solutions must be used within 24 hours and not reused.

5.3.15.2 Sensor Calibration

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Enter the Calibration Menu and select Total Algae.
3. Select Chlorophyll ug/L (see Figure 36).

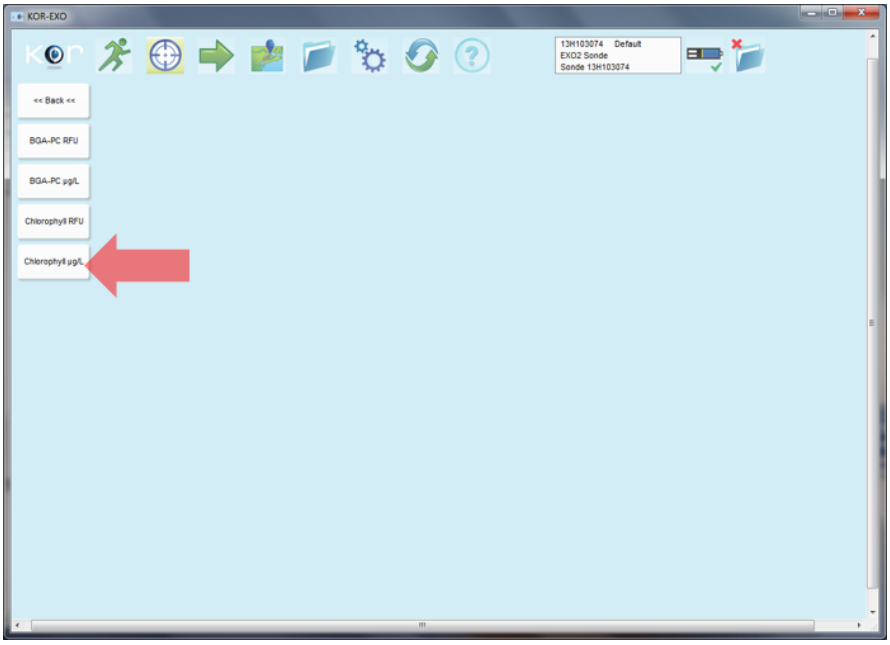


Figure 36. Screenshot of Total Algae Calibration submenu.

4. Select the 2-point calibration option (Figure 37).

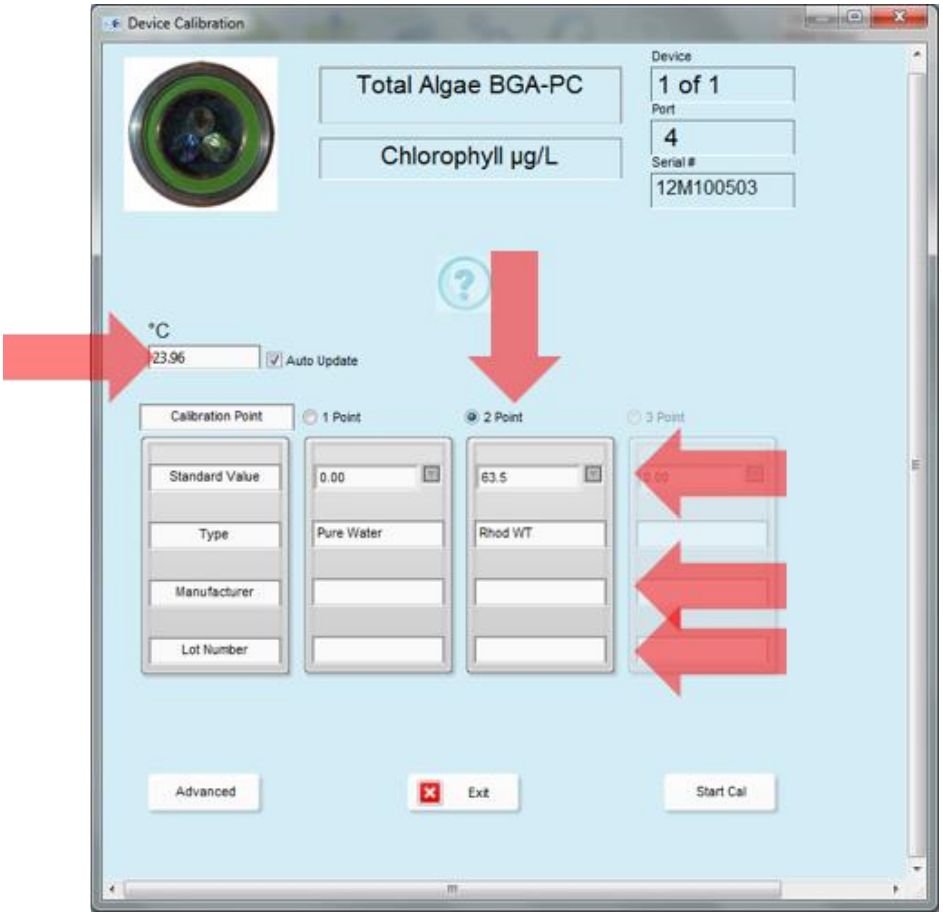


Figure 37. Screenshot of the Chlorophyll calibration menu.

5. Input zero for the first value.
6. Input the temperature corrected value for the 0.625 mg/L Rhodamine WT solution according to Table 7 for the second standard value.
7. Input the lot number for the concentrated dye used.

Table 7. Temperature effects on fluorescence of Rhodamine WT solution.

Temperature (ºC)	Total Algae Fluorescence Calbiration Solution Nominal Value, 625 ug/L Rhodamine WT	
	Chlorophyll, ug/L	Blue-Green Algae-PC, ug/L
8	83.8	22.6
10	81.2	22.2
12	78.6	21.2
14	76.0	20.1
16	73.5	19.1
18	70.8	17.5
20	68.4	17.1

22	66.0	16.0
24	63.5	15.0
26	61.3	14.1
28	58.7	13.1
30	56.5	11.4

8. Pour at least 2 cm of deionized water to Fill Line 1 of the calibration cup.
9. Immerse the probe end of the sonde in the deionized water
10. Click “Start Calibration”.
11. Observe the readings under Current and Pending data points, and when they are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the “Apply” button.
12. Hold the Multisonde over the calibration cup and rinse the probes with the 0.625 mg/L Rhodamine WT standard, catching the solution in the cup.
13. Swirl the solution to rinse the cup and empty.
14. Repeat steps 12 and 13 for a total of three rinses, as described in steps (a) through (e).

    a) Three opened bottles, marked 1st, 2nd, and 3rd, will be used for rinsing only. An unopened, non-expired bottle must be used for the calibration solution.
    b) Rinse bottle, labeled 1st, should be poured into the calibration cup first. Swirl solution around the sensors and discard the waste.
    c) Follow the same steps for rinse bottle 2, except the rinsate is poured into the bottle marked “1st”.
    d) Similarly, after rinsing with rinse bottle 3, it is poured into bottle marked “2nd”
    e) The calibration solution is then poured into the cup. Once calibration is completed, pour the remainder of the calibration solution into rinse bottle 3.

15. Add 2-5 cm of 0.625 mg/L Rhodamine WT standard in the calibration cup and immerse the sensor in the solution.
16. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the “Apply” button.
    a) If the pre-calibration value is within the threshold identified in Table 4, the previous calibration is still valid. DO NOT click “Accept” and Exit the calibration menu.
    b) If the pre-calibration value fails the criteria in Table 4, record the new calibration by clicking the “Accept.”
17. Enter the Calibration Menu and select Total Algae once more.
18. Select BGA-PC ug/L (see Figure 38).

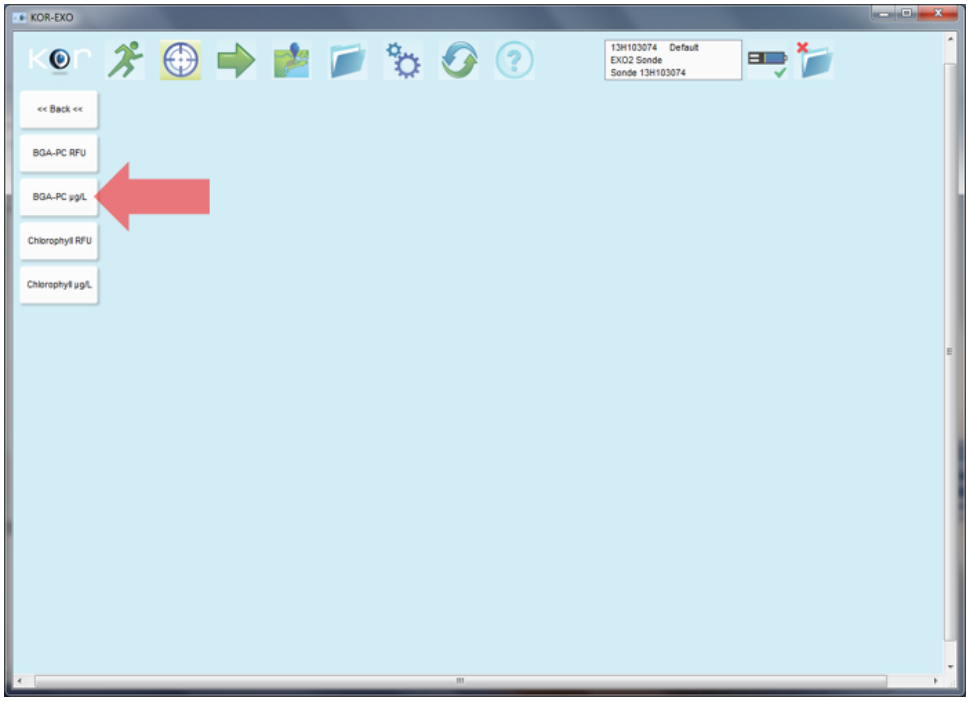


Figure 38. Screenshot of Total Algae Calibration submenu.

19. Select the 2-point calibration option (Figure 39).

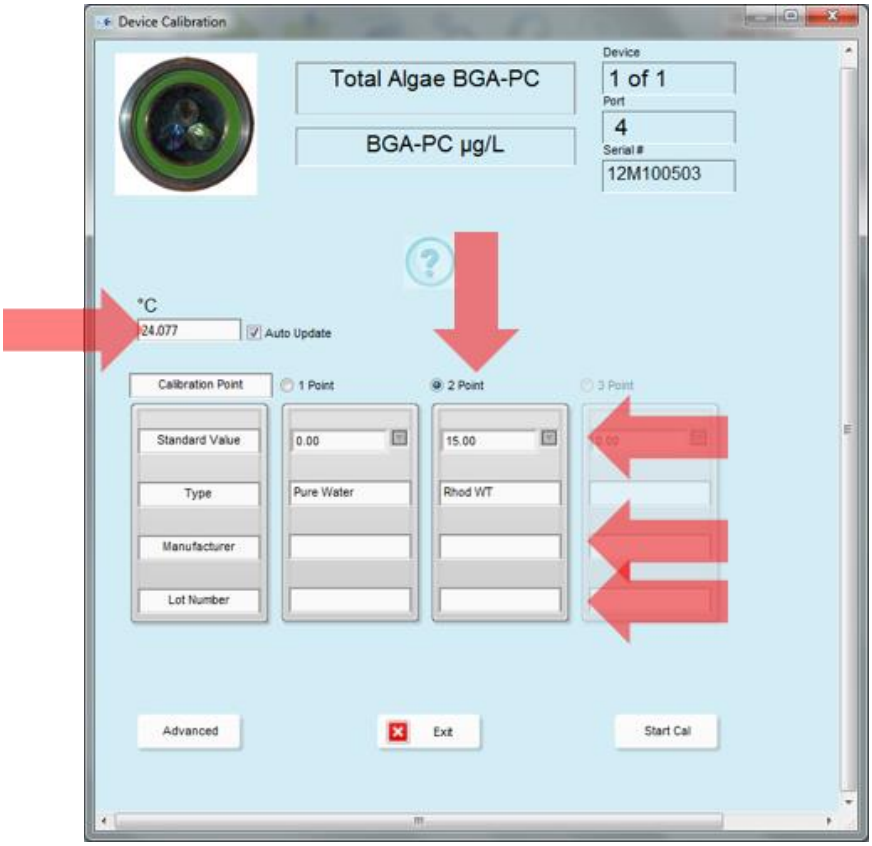


Figure 39. Screenshot of the BGA-PC Calibration window.

20. Input zero for the first value.
21. Input the temperature corrected value for the 0.025 mg/L Rhodamine WT solution according to Table 6 above for the second standard value.
22. Input the lot number for the concentrated dye used.
23. Rinse the calibration cup 3 times with deionized water, swirling around the sides.
24. Pour at least 2 cm of deionized water to Fill Line 1 of the the calibration cup.
25. Immerse the probe end of the sonde in the deionized water.
26. Click “Start Calibration”.
27. Observe the readings under Current and Pending data points, and when they are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the “Apply” button.
28. Hold the Multisonde over the calibration cup and rinse the probes with the 0.025 mg/L Rhodamine WT standard, catching the solution in the cup.
29. Swirl the solution to rinse the cup and empty.
30. Repeat steps 28 and 29 twice, for a total of three rinses. You will need to make 2000 mL additional solution for this rinse.

31. Add 2-5 cm of 0.025 mg/L Rhodamine WT standard in the calibration cup and immerse the sensor in the solution.
32. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.
    a) If the pre-calibration value is within the threshold identified in Table 4, the previous calibration is still valid. DO NOT click "Accept" and Exit the calibration menu.
    b) If the pre-calibration value fails the criteria in Table 4, record the new calibration by clicking the "Accept."

5.3.16 Turbidity Sensor Calibration

A 3-point calibration is required for maximum accuracy over a wider range. This allows the same calibration procedure to be used for sensors deployed at both pristine streams and highly turbid river and lake sites. The first standard must be 0 FNU (deionized water); the other two standard turbidity values shall be 124 and 1010 FNU. The EXO User Manual section 5.10 includes detailed instructions (ER [02]).

5.3.16.1 Sensor Calibration

NOTE: Wear nitrile gloves when performing calibrations and ensure the sensor surface is clean to minimize any contamination or artifacts during calibration.

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Enter the Calibration Menu and select Turbidity.
3. Select the 3-point calibration option.
4. Input zero for the first value, 124 FNU for the second value and 1010 FNU for the third value.
5. Input the lot numbers for the calibration standard solutions.
6. Remove the copper guard from the sonde.
7. Rinse calibration cup with clear de-ionized water.
8. Pour 0 FNU standard (clear de-ionized water) to Fill Line 1 of the clean calibration cup.
9. Immerse the probe end of the sonde into the water.
10. Click "Start Calibration".
11. Observe the readings under Current and Pending data points, and when they are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.
12. Hold the Multisonde over the calibration cup and rinse the probes with the 124 FNU turbidity standard solution, catching the solution in the cup.
13. Swirl the solution to rinse the cup and empty.
14. Repeat steps 11 and 12 twice, for a total of three rinses, following steps (a) through (e).

a) Three opened bottles, marked 1st, 2nd, and 3rd, will be used for rinsing only. An unopened, non-expired bottle must be used for the calibration solution.
b) Rinse bottle, labeled 1st, should be poured into the calibration cup first. Swirl solution around the sensors and discard the waste.
c) Follow the same steps for rinse bottle 2, except the rinsate is poured into the bottle marked "1st".
d) Similarly, after rinsing with rinse bottle 3, it is poured into bottle marked "2nd"
e) The calibration solution is then poured into the cup. Once calibration is completed, pour the remainder of the calibration solution into rinse bottle 3.

15. Add 2-5 cm of 124 FNU turbidity standard solution in the calibration cup and immerse the sensor in the solution.

NOTE: The turbidity solution has a soap-like consistency and should not be swished around as this may affect the calibration.

16. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.
17. Rinse the calibration cup 3 times with a small deionized water, swirling around the sides.
18. Hold the Multisonde over the calibration cup and rinse the probes with the 1010 FNU turbidity standard solution, catching the solution in the cup.
19. Swirl the solution to rinse the cup and empty.
20. Repeat steps 17 and 18 twice, for a total of three rinses, according to steps (a) through (e).
    a) Three opened bottles, marked 1st, 2nd, and 3rd, will be used for rinsing only. An unopened, non-expired bottle must be used for the calibration solution.
    b) Rinse bottle, labeled 1st, should be poured into the calibration cup first. Swirl solution around the sensors and discard the waste.
    c) Follow the same steps for rinse bottle 2, except the rinsate is poured into the bottle marked "1st".
    d) Similarly, after rinsing with rinse bottle 3, it is poured into bottle marked "2nd"
    e) The calibration solution is then poured into the cup. Once calibration is completed, pour the remainder of the calibration solution into rinse bottle 3.
21. Add 2-5 cm of 1010 FNU turbidity standard solution in the calibration cup and immerse the sensor in the solution.
22. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.
    a) If the pre-calibration value is within the threshold identified in Table 4, the previous calibration is still valid. DO NOT click "Accept" and Exit the calibration menu.

b) If the pre-calibration value fails the criteria in Table 4, record the new calibration by clicking the "Accept."

5.3.17 Depth Sensor Calibration (River and Lake Buoys Only)

The depth sensor is comprised of an internal pressure transducer housed inside sonde body. This sensor provide the depth at which measurements are taken at non-wadeable river and lake sites. Both pressure of the non-vented sensor and the converted depth are reported by the Multisonde. The accuracy of the depth sensor should be +/- 0.04m. A single point calibration in dry air is used to zero the depth sensor.

5.3.17.1 Apparatus Setup

1. Remove the sensor from the enclosure.
2. Secure the sensor in the air and ensure it is not immersed in any solution.

5.3.17.2 Sensor Calibration

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Enter the Calibration Menu and select Depth.
3. Select the 1-point calibration option (Figure 40).
4. Input zero for the value.
5. Click "Start Calibration."
6. Observe the readings under Current and Pending data points, and when data are Stable (or data shows no significant change for approximately 40 seconds), record the calibration point by clicking the "Apply" button.

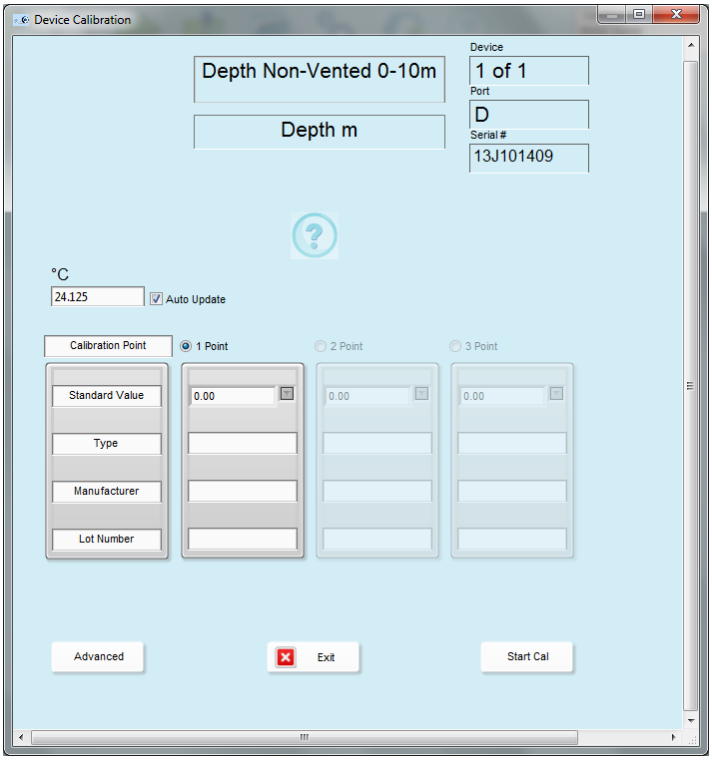


Figure 40. Screenshot of the depth sensor calibration window.

5.3.18 Temperature Sensor Validation

The temperature sensor does not require calibration, but accuracy checks must be conducted. Details are in YSI, Inc. EXO owners' manual, ER [02]. The thermometer must be checked against a calibration thermometer, which is either certified by the National Institute of Standards and Technology (NIST) or certified by the manufacturer as NIST traceable. Thermistors must be accurate within ± 0.2 °C. Two-point calibration checks over the maximum and minimum expected annual temperature range must be made three or more times per year.

Temperature probe calibration checks are expected to be more accurate than other probes. Temperature readings are compared between the probe and thermometers that are NIST-traceable. The two temperature readings should be recorded simultaneously. If the readings are off by ±0.2 °C, troubleshooting steps must be taken. If troubleshooting fails, the probe must be replaced.

5.3.18.1 **Apparatus Setup**

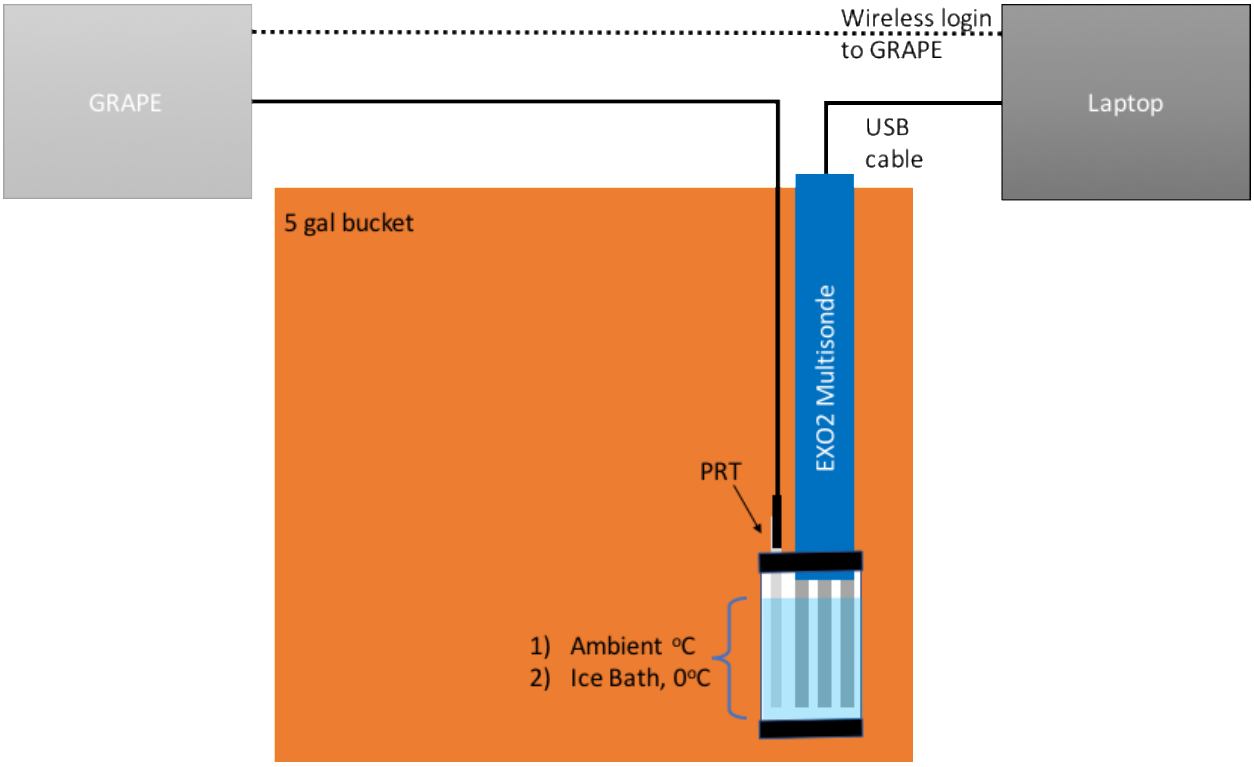


Figure 41. Schematic of apparatus setup for temperature validation.

5.3.18.2 **Sensor Validation**

1. Connect the sonde to the laptop using the KOR software according to Section 5.3.6.
2. Select the Dashboard to view the current temperature sensor reading on the Multisonde (Figure 42).
3. Fill the calibration cup with distilled or tap water

NOTE: the bucket may be used for securing the calibration cup and Multisonde.

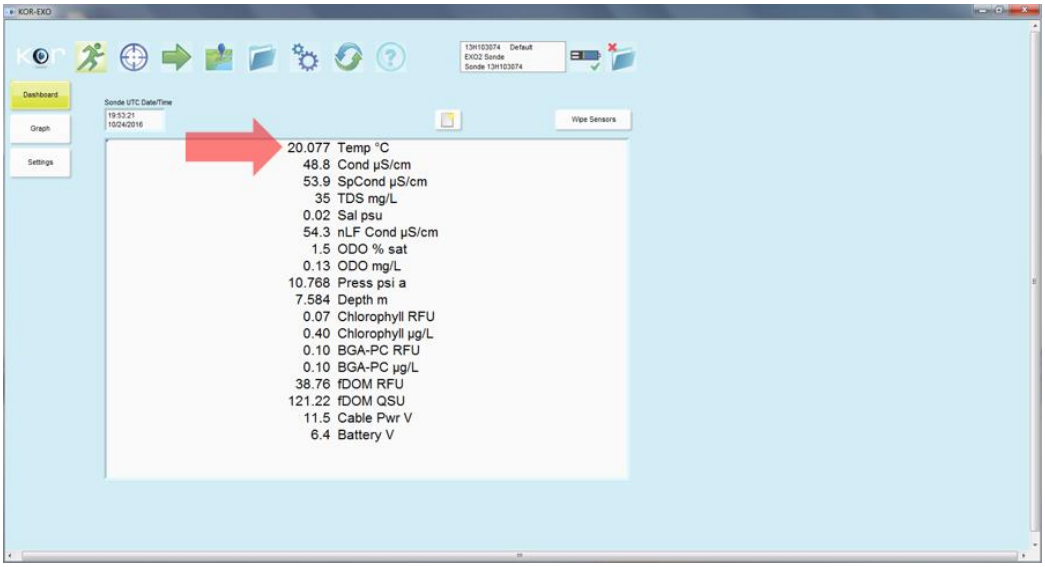


Figure 42. Screenshot of Dashboard showing the current temperature measurement.

4. Remove the guard from the sonde to create room for the sonde and the reference temperature sensor to fit in the calibration cup together.
5. Remove the PRT from the Multisonde enclosure and place it in the calibration cup with the sonde, leaving the PRT plugged into the Grape.
6. Using the NEON site wireless network, log into the LC
7. Find the current temperature readings from PRT
   a) If a Labview program is not available to convert the resistance, the calibration coefficients for the specific PRT will be needed.
   b) Use the View Data program to log at least 30 resistance reading within a 60 second window.
   c) Use Equation 1 to find the mean resistance over the interval

$$\overline{\Omega} = \frac{1}{30}\sum_{i=x}^{30}\Omega_i. \quad (1)$$

   d) Use Equation 2 to convert the mean resistance to temperature

$$T = C_2{R_T}^2 + C_1R_T + C_0 \quad (2)$$

Where:

T = Temperature (°C)
C_0 = Calibration coefficients provided by CVAL (°C)
C_1 = Calibration coefficients provided by CVAL (°C/Ω)
C_2 = Calibration coefficients provided by CVAL (°C/Ω^2)
R_T = Resistance at temperature T (Ω)

8. Compare the mean temperature from step 7 to the sonde temperature sensor reading on the dashboard.
9. Record the temperature measurements for both sensors in the Quality Assurance Datasheet in Appendix A2.
10. Add ice to the water in the calibration cup and stir occasionally for 5 minutes to bring the water to 0 ^{o}C.
11. Compare the mean temperature from step 7 to the sonde temperature sensor reading on the dashboard.
12. Record the temperature measurements for both sensors in the Quality Assurance Datasheet in Appendix A2.
13. If the PRT does not read 0 after equilibration in the ice bath, it should be considered out of calibration and should be sent back for servicing
    a) Generate a trouble ticket
    b) Stop Temperature Validation
14. If the PRT and Multisonde temperature measurements differ by greater than 0.2^{o}C, the Multisonde should be considered out of calibration and should be sent back for servicing
    a) Generate a trouble ticket

5.3.19 Post-Calibration Sensor Readings

1. Replace the Multisonde into the enclosure or buoy.
2. Connect the Multisonde to the laptop using the KOR software according to Section 5.3.6.
3. Record the following values in the Quality Assurance Datasheet in Appendix A2.
    a) DO
    b) pH
    c) Temperature
    d) Turbidity
    e) Chlorophyll
    f) Specific Conductance
4. Reconnect sensor to Grape. Reconnect Grape Ethernet cable. Check that data are arriving at Location Controller using Data Monitor or other DAS tool.

5.3.20 Field Validation Procedure

Periodically (currently every 3 months) the field calibration procedure will be validated using a freshly calibrated secondary reference sensor provided by CVAL. The DFS manager will coordinate the scheduling of this activity with CVAL

management.

During the calibration of each sensor in Sections 5.3.11 – 5.3.16 above the reference unit will be used in parallel with the same calibration solutions to validate their standardization. To perform the field validation procedure repeat the calibration section above for each sensor on the reference unit immediately preceding the calibration of the field unit. If the difference in post-calibration value of the field unit and pre-calibration unit is greater than the calibration criteria identified in Table 4**Error! Reference source not found.**, then the calibration standards should be checked for expiration and/or contamination and replaced; after which the validation procedure may be repeated. If the field validation fails a second time, generate a trouble ticket according to Section 7.

6 REMOVAL AND REPLACEMENT (SUBSYSTEM ONLY)

6.1 Equipment

Table 8. Equipment for Sensor Removal and Replacement.

Item No.	Description	Quantity
Tools		
	Snips – for cutting zip ties	1
Consumable items		
	Zip ties	10
YSI sku# 599475	Plugs	Up to 6
Resources		
	Decontamination Protocol	1
	EXO User Manual	1

6.2 Removal and Replacement Procedure

Always disconnect the power prior to removing or replacing any components. Power down the Merlot Grape connecting to the Multisonde by removing the Ethernet Cable via the RJF connection port. NEVER remove a sensor connection from a Grape without removing the Ethernet Cable. (The Multisonde connects to the splitter box and has more connections than the SUNA Merlot Grape.) Figure 43 provides an example of disconnecting the RJF connection port from an AIS Merlot Grape.

Figure 43. Disconnecting the Ethernet Cable from an AIS Merlot Grape (Faustine Bernadac removing the Ethernet Cable to the SUNA Merlot Grape during AIS Training at D06, Kings Creek).

When the cable is disconnected from the Grape, the cable, asset tags, and locking carabineer should continue to connect the cable to the EXO2 bail (Figure 44).

NOTE: When a probe is removed for shipment, the asset tags must be removed from the carabineer and sent with the probe. Likewise, when a new probe is installed, the asset tag should be added to the carabineer. In order to preserve the asset tags themselves, NEON recommends storing the tags in a Comm box on the device post as a standard practice. NEVER SHIP A PROBE WITHOUT ITS ASSET TAG! In addition, the asset tag is important for the MAXIMO record and Command and Control (CNC) programing of AIS instrumentation. Ensure the asset tag aligns with the CFG location in the MAXIMO record, and if a Multisonde asset tag changes or sensor is swapped from HQ, update the MAXIMO record accordingly and provide NEON ENG with the new asset tag and EPROM ID.

Figure 44. Asset tags attached to Multisonde cable carabineer.

6.2.1 Wadeable Stream Sites

Figure 45. Photo of Multisonde enclosure.

1. Remove zip ties retaining the sensors cables on the infrastructure as necessary.
2. Unlock the enclosure by pulling the lock pin.
3. Remove the cap from the enclosure (Figure 45).
4. Use the Multisonde sensor cable (black) to gently lift the Multisonde from the enclosure (Figure 46).
5. Disconnect the Ethernet Cable from the Multisonde Grape (contains more connections than the SUNA, includes the PRT and connects to the converter/splitter box).
6. Disconnect the sensor cable from the Grape. NEVER disconnect a sensor connection from a Grape without powering down the Grape by removing its Ethernet Cable. Always connect the Ethernet cable last.

NOTE: Keep the Grape termination of the senor cable dry and clean.

7. The Multisonde is now free for removal from the site.

Figure 46. Photo of inside of Multisonde enclosure showing the cable relief system.

6.2.2 Non-wadeable River and Lake Sites

1. Log into the Winch Controller.
2. Ensure the Multisonde is high enough that the linkage is safe to access.
3. Remove the sensor cable from the Multisonde.
4. Remove the Multisonde from the cable linkage (Figure 47 and Figure 48).
5. The Multisonde is now free.

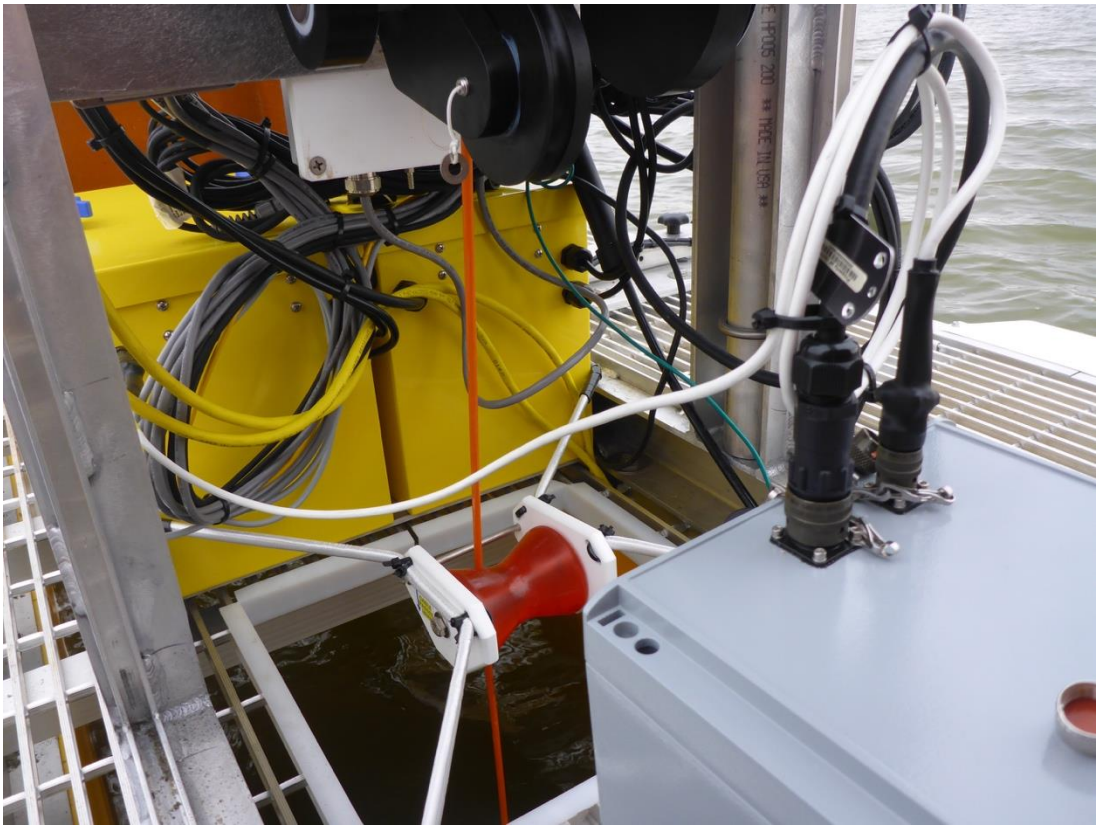


Figure 47. Photo of cable assembly suspending the Multisonde from the winch through passage in the buoy platform.

Figure 48. Photo showing the link between the Multisonde and cable assembly attaching the Multisonde to the winch on the buoy platform.

6.3 Cleaning and Packaging of Returned Sensor

6.3.1 Decontamination

If the Multisonde is to be removed from the site for repair, replacement or laboratory calibrations, it must be thoroughly cleaned following the decontamination protocol (AD [05] and RD [05]).

6.3.2 Short-term Storage

For interim storage, users should keep sensors moist, but not submerged; submersion during storage may produce sensor drift. Users should aim for a storage environment of water-saturated air (100% humidity) for the sensors.

1. Place approximately 0.5 in (1 cm) of water (DI, distilled, or tap) in the bottom of the calibration cup (Figure 49).

2. Place the Multisonde with its sensors into the cup and close it tightly to prevent evaporation.
3. To protect the cable connector, either leave the cable installed on the connector or install the connector guard.

NOTE: Users can also use a moist sponge to create a humid environment.

NOTE: Ensure that unused sensor ports are properly protected with port plugs.

NOTE: The Multisonde itself should be stored in dry air.

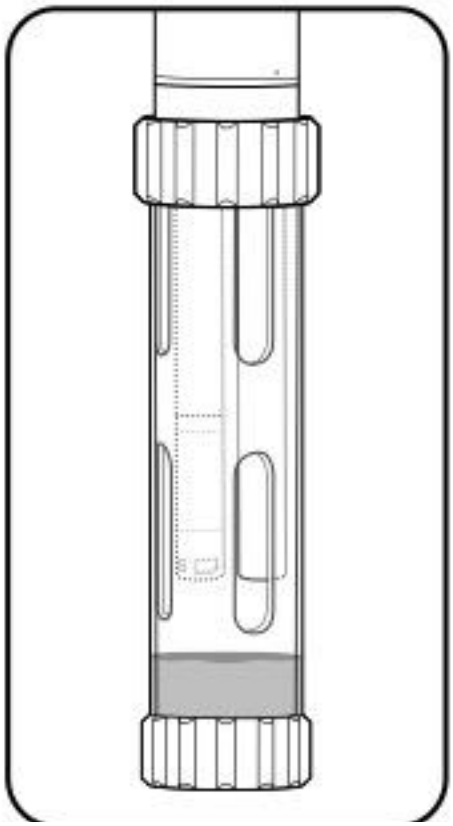


Figure 49. Illustration of Multisonde placed in calibration cup with approximately 1cm of water such that the probes are not submerged.

6.3.3 Long-term Storage

Store all removed sensors according to the specific instructions in their sensor storage section (ER[02]).

1. Plug all open ports.
2. Remove batteries.
3. Store in a dry environment that is kept between -20 and +80°C.

6.3.4 Packaging and Shipping

Repackage the Multisonde and probe in the original packing and boxes used for delivery during deployment.

If the original packaging from NEON HQ is not available, then use the following procedure:

1. Keep the sensors installed into the Multisonde body.
2. Place the Multisonde into the calibration cup with a moist sponge (no standing water).

NOTE: If a sponge is not available, wet paper towels can be used.

3. Place the Multisonde into the YSI, EXO-fitted Pelican case (with form fitted foam).
4. Label as FRAGILE and ship to the appropriate address.

For Grapes, conduct the following steps:

1. Remove Ethernet cable to power down the Merlot Grape.
2. Remove Sensor connections.
3. Remove biologics and clean caps and connectors.

4. Cap all connectors.
5. Conduct decontamination.
6. Cap connections and place the device in an ESD bag and shipping container.
7. Update asset records via the NEON's project Asset Management and Logistic Tracking System (e.g., MAXIMO). NEON HQ, Logistics Warehouse (LOGWAR) receives the Grapes for refresh and distributes to CVAL.
8. Provide an electronic packing list to CVAL with the Box number and Asset Tag number (14-digit Property Tag ID ("Property of") number) of each item. CVAL uses this information to verify items via LOGWAR/general HQ distribution of shipments.
9. Prepare a Bill of Lading.

NOTE: For any Non-CVAL initiated sensor returns, please notify CVAL of the return.

Package sensor items via packaging from CVAL HQ or per guidance via the Issue Management System and return to the NEON project HQ using the following address:

BATTELLE ECOLOGY, **ATTN: CVAL**
1685 38TH STREET, SUITE 100
BOULDER, CO 80301

Only include sensors/subsystems for refresh. Additional equipment must ship separately as they may require attention from other NEON HQ departments. Sensor refresh shipments go direct to CVAL. If sensors are shipping to HQ to address a trouble ticket, per guidance via the Issue Management System, return to the NEON project HQ using the following address:

BATTELLE ECOLOGY, **ATTN: REPAIR LAB**
1685 38TH STREET, SUITE 100
BOULDER, CO 80301

6.4 Sensor Refresh Record Management of Assets

In addition to the physical movement of devices, the sensor refresh process requires dedicated and accurate record management of asset movement and location.

6.4.1 NEON Asset Management and Logistic Tracking System Requirements

Technicians must update the instrumentation records via the NEON's project Asset Management and Logistic Tracking System (MAXIMO). NEON HQ must maintain accurate record keeping on the location, date, and time offline of an instrument to ensure NEON HQ, Computer Infrastructure, Data Products, and CVAL are aware to apply the correct algorithms, calibrations, and processing factors. Ensure the CFG location reflects the current site of the sensor.

6.4.2 Command and Control Program Information Requirements

Provide notification of the new sensor/subsystem NEON Asset Tag Number via the Asset Management and Logistic Tracking System (MAXIMO), which is the 14-digit Property Tag ID ("Property of") number on

the sensor/subsystem and EPROM ID[i] via the NEON project issue management and reporting system (JIRA). This ensures integration of the new sensors/subsystems into the NEON Command and Control program. Route and/or add NEON Engineering to the ticket to notify the appropriate points of contact.

7 ISSUE REPORTING OUTPUTS

If any issues arise that may affect the integrity of the AIS or data quality, complete the metadata sheet in Appendix A1 and submit it with a trouble ticket.

For Multisonde corrective actions, ensure proper tracking of the asset via the NEON issue management and tracking system (e.g., JIRA) to establish a chain of custody of the asset between Engineering Repair Laboratory and CVAL.

Conduct the following tasks to ensure the proper management of the asset between sites:

1. For each issue where NEON, HQ is replacing a defective instrument/subsystem at an AIS site, please create a sub-task in the NEON Issue Management and Reporting System for the defective asset from the reported issue. Resolution of an issue does not occur with the installation of a replacement, but with the root cause analysis of the issue deriving from the defective asset. FOPS may resolve the ticket upon installation of the replacement if a sub-task exists for the defective asset for NEON HQ to conduct root cause analysis.[ii] Figure 50 displays where to create a sub-task from an issue involving a defective asset returning to NEON HQ.

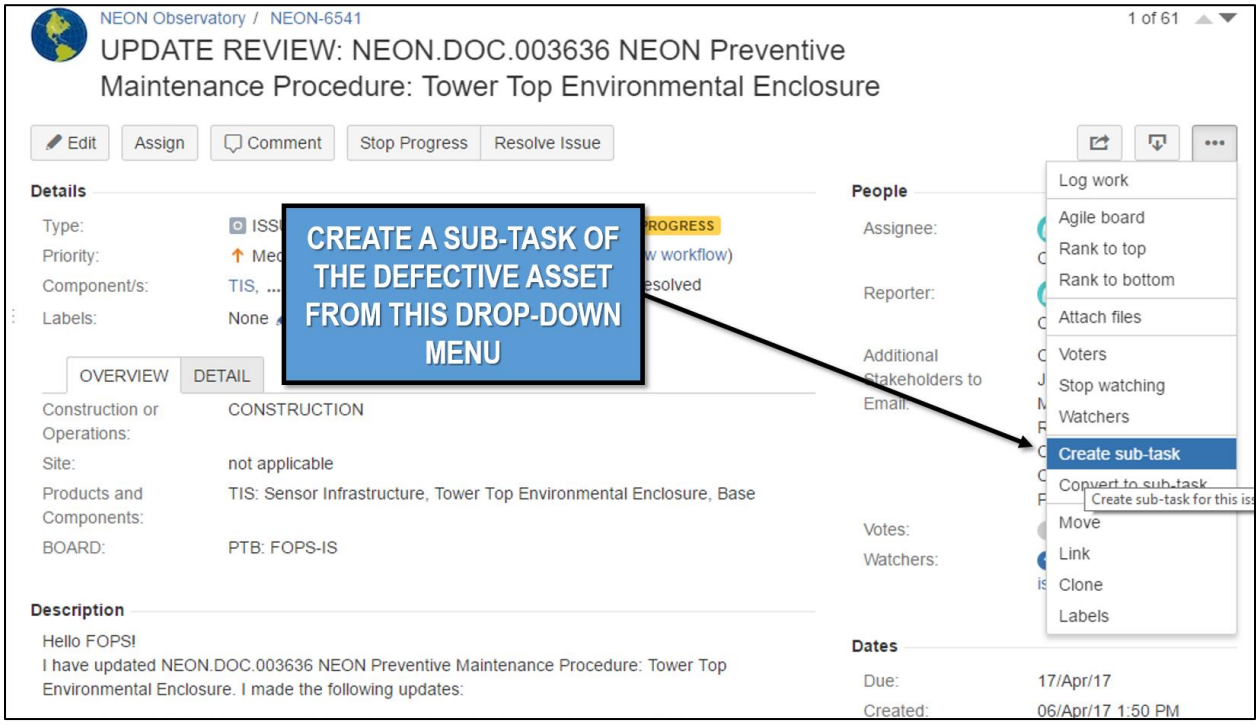


Figure 50. Create a Sub-Task for Chain of Custody of the Defective Asset for Root Cause Analysis via ENG Repair Lab and/or CVAL.

2. Ship all defective equipment/assets with a red “Rejected” tag. Figure 51 displays the minimum information requirements for each tag.

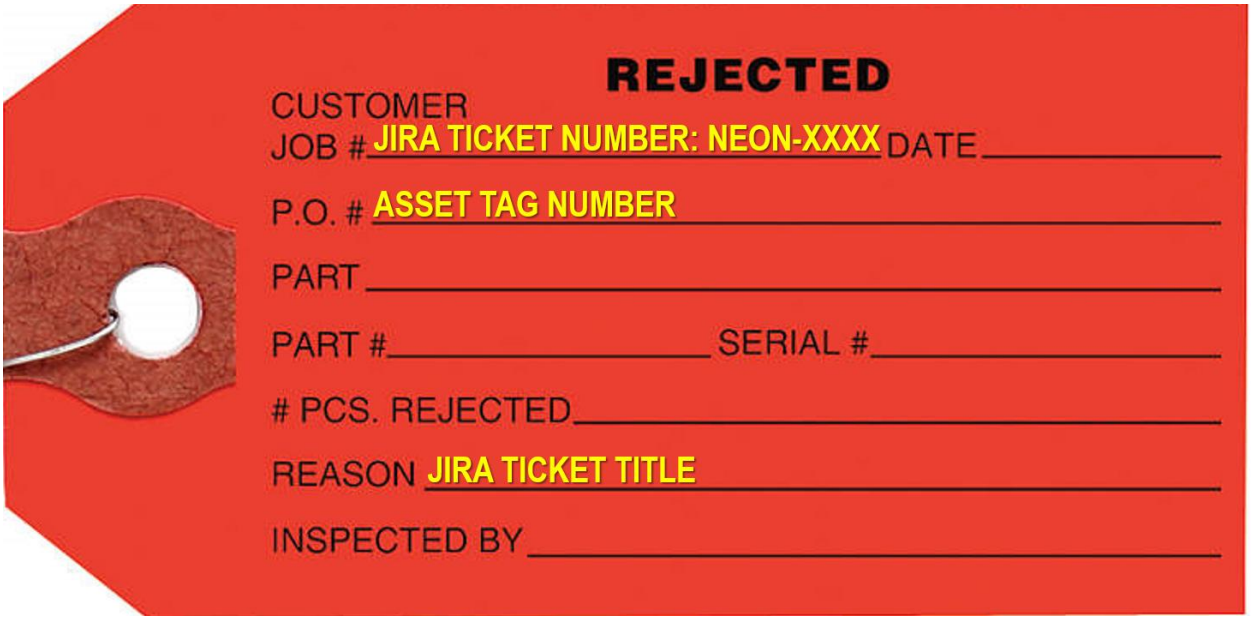


Figure 51. Red Rejected Tag for Defensive Assets (MX104219)

8 REFERENCES

ASTM International, (2003). Standard test method for turbidity of water: ASTM International, Annual Book of Standards, Water and Environmental Technology, v. 11.01, 6 p.

Earp, A., Hanson, C. E., Ralph, P. J., Brando, V. E., Allen, S., Baird, M., & Doblin, M. A. (2011). Review of fluorescent standards for calibration of in situ fluorometers: Recommendations applied in coastal and ocean observing programs. *Optics express*, *19*(27), 26768-26782.

EXO User Manual ,YSI incorporated, www.EXOwater.com, accessed December 2013

Leeuw, T., Boss, E. S., & Wright, D. L. (2013). In situ Measurements of Phytoplankton Fluorescence Using Low Cost Electronics. *Sensors*, *13*(6), 7872-7883.

Wagner, R.J., Boulger, R.W., Jr., Oblinger, C.J., and Smith, B.A., 2006, Guidelines and standard procedures for continuous water-quality monitors—Station operation, record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3, 51 p. + 8 attachments; accessed April 10, 2006, at http://pubs.water.usgs.gov/tm1d3

9 APPENDIX

9.1 A1—Issue Reporting Datasheet

Issue Reporting Datasheet		
Datasheet field	**Entry**	
NEON Site Code		
Maintenance Date		
Maintenance Technician		
Preventive Maintenance	**Issue Noted**	**Issue Summary**
Cables & Connectors - Condition Check	☐	
Sensor - Condition Check	☐	
Sensor - Configuration Check	☐	
Sensor – Clean	☐	
Sensor - Other Specific Checks	☐	
Environmental Information	☐	
Notes		

9.2 A2—Preventative Maintenance Quality Assurance Datasheet

Preventative Maintenance Quality Assurance Datasheet				
Datasheet field	**Entry**			
NEON Site Code				
Maintenance Date				
Maintenance Technician				
Quality Assurance Data	**Pre-Cleaning Value**	**Post-Cleaning Value**	**Pre-Calibration Value**	**Post-Calibration Value**
S1 - Turbidity				

S1 - Chlorophyll				
S1 - BGA-PC				
S1 - Specific Conductivity				
S1 - Dissolved Oxygen				
S1 – pH				
S1 – Temperature (Multisonde)				
S1 – Temperature (PRT)				
S1 - Depth				
S2 - Turbidity				
S2 - Chlorophyll				
S2 - BGA-PC				
S2 - Specific Conductivity				
S2 - Dissolved Oxygen				
S2 – pH				
S2 – fDOM				
S2 – Temperature (Multisonde)				
S2 – Temperature (PRT)				

Notes

9.3 A3—Materials Safety Data Sheets

9.3.1 Rhodamine WT

BRIGHT DYES™ MATERIAL SAFETY DATA SHEET
FWT RED™ 25 LIQUID
PAGE 1 OF 3

MSDS PREPARATION INFORMATION

PREPARED BY:	T. P. MULDOON (937) 886-9100
DATE PREPARED:	1/1/08

PRODUCT INFORMATION

MAUNFACTURED BY:	KINGSCOTE CHEMICALS 3334 S. TECH BLVD. MIAMISBURG, OHIO 45342
CHEMICAL NAME	NOT APPLICABLE
CHEMICAL FORMULA	NOT APPLICABLE
CHEMICAL FAMILY	XANTHENE DYE FORM

HAZARDOUS INGREDIENTS

DESCRIPTION	%	T.L.V.	C.A.S. #
TRIMELLITIC ACID	.375	NONE	528-44-9
	LD/50, SPECIES		LC/50, SPECIES
ORAL (MOUSE)	2500 MG/KG		NONE AVAILABLE
DERMAL (RABBIT)	NOT AVAILABLE		NOT AVAILABLE

PHYSICAL DATA

PHYSICAL STATE	LIQUID
ODOR AND APPEARANCE	DARK RED LIQUID WITH MILD ODOR
SPECIFIC GRAVITY	~1.03
VAPOR DENSITY (mm Hg @ 25 ° C)	NOT APPLICABLE
VAPOR DENSITY (AIR =1)	NOT APPLICABLE
EVAPORATION RATE (Butyl Acetate = 1)	NOT APPLICABLE
BOILING POINT	~ 100 degrees. C (212 degrees. F)
FREEZING POINT	~ 0 degrees C (32 degrees F)
pH	8.6 TO 8.8
SOLUBILITY IN WATER	VERY SOLUBLE

FIRE HAZARD

CONDITION OF FLAMMABILITY	NON-FLAMABLE
MEANS OF EXTINCTION	WATER FOG, CARBON DIOXIDE, DRY CHEMICAL, WEAR SCBA
FLASH POINT AND METHOD	NOT APPLICABLE
UPPER FLAMABLE LIMIT	NOT APPLICABLE
LOWER FLAMABLE LIMIT	NOT APPLICABLE
AUTO-IGNITION TEMPERATURE	NOT APPLICABLE
HAZARDOUS COMBUSTION PRODUCTS	BURNING MAY PRODUCE OXIDES OF CARBON & NITROGEN
UNUSUAL FIRE HAZARD	NOT APPLICABLE

9.3.2 Turbidity Standards, 100 NTU

www.ysi.com
Revision Date: 12/17/2014

Safety Data Sheet
According to the (US) Hazard Communication Standard (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name	AMCO Clear® Turbidity Standard, 100 NTU	
Catalog Number	**YSI 607300 (6073G)**	
Product Description	Reagent for determination of turbidity of liquids	
Supplier	YSI, a Xylem brand Telephone: 937-767-7241 Emergency: CHEMTREC US/Can: 800-424-9300 International: 001 703-572-3997	1725 Brannum Lane Yellow Springs, OH 45387 MSDSinfo@ysi.com YSI.com Collect calls accepted
Manufacturer	GFS Chemicals, Inc. Telephone: 740-881-5501 Email: service@gfschemicals.com	PO Box 245, Powell, OH 43065 Fax: 740-881-5989 Emergency Contact: 1-800-424-9300 (Chemtrec)

SECTION 2: HAZARDS IDENTIFICATION

Physical Hazards	Not classified
Health Hazards	Not classified
Environmental Hazards	Not classified
OSHA Defined Hazards	Not classified (no hazards resulting from the material as supplied)
Label Elements	
Hazard symbol	None
Signal word	None
Hazard statement	Not available
Precautionary statement	
Prevention	Not available
Response	Not available
Storage	Not available
Disposal	Not available
Hazard(s) not otherwise classified (HNOC)	None known
Supplemental Information	None

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Name	CAS #	Approximate %
Water	7732-18-5	90-100
Styrene Divinylbenzene Copolymer Beads	9003-70-7	<0.1
Other components below reportable levels	Not found	<0.1

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General First Aid Measures	Never give anything by mouth to an unconscious person. Seek medical advice if you feel unwell.
If Inhaled	Remove person to fresh air and keep comfortable for breathing. Allow victim to rest. Call a physician if symptoms develop or persist.
In Case of Skin Contact	Dry skin with paper towel or similar. Remove contaminated clothing and wash exposed skin with mild soap and water. Rinse with warm water.

9.3.3 Turbidity Standard, 800 NTU

www.ysi.com
Revision Date: 12/17/2014

Safety Data Sheet
According to the (US) Hazard Communication Standard (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name	AMCO Clear® Turbidity Standard, 800 NTU	
Catalog Number	**YSI 607400 (6074)**	
Product Description	Reagent for determination of turbidity of liquids	
Supplier	YSI, a Xylem brand Telephone: 937-767-7241 Emergency: CHEMTREC US/Can: 800-424-9300 International: 001 703-572-3997	1725 Brannum Lane Yellow Springs, OH 45387 MSDSinfo@ysi.com YSI.com Collect calls accepted
Manufacturer	GFS Chemicals, Inc. Telephone: 740-881-5501 Email: service@gfschemicals.com	PO Box 245, Powell, OH 43065 Fax: 740-881-5989 Emergency Contact: 1-800-424-9300 (Chemtrec)

SECTION 2: HAZARDS IDENTIFICATION

Physical Hazards	Not classified
Health Hazards	Not classified
Environmental Hazards	Not classified
OSHA Defined Hazards	Not classified (no hazards resulting from the material as supplied)
Label Elements	
Hazard symbol	None
Signal word	None
Hazard statement	Not available
Precautionary statement	
Prevention	Not available
Response	Not available
Storage	Not available
Disposal	Not available
Hazard(s) not otherwise classified (HNOC)	None known
Supplemental Information	None

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Mixture

Name	CAS #	Approximate %
Water	7732-18-5	90-100
Styrene Divinylbenzene Copolymer Beads	9003-70-7	<0.1
Other components below reportable levels	Not found	<0.1

*Designates that a specific chemical identity and/or percentage of composition has been withheld as a trade secret

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General First Aid Measures	Never give anything by mouth to an unconscious person. Seek medical advice if you feel unwell.
If Inhaled	Remove person to fresh air and keep comfortable for breathing. Allow victim to rest. Call a physician if symptoms develop or persist.
In Case of Skin Contact	Dry skin with paper towel or similar. Remove contaminated clothing and wash exposed skin with mild soap and water. Rinse with warm water.

9.3.4 Ph Buffer, 4.0

www.ysi.com
Revision Date: 12/10/2014

Safety Data Sheet
According to the (US) Hazard Communication Standard (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name	Buffer Solution pH 4.00	
Catalog Number	**YSI 3821**	
Product Description	Laboratory chemical, for use in calibrating pH probes.	
Supplier	YSI, a Xylem brand Telephone: 937-767-7241 Emergency: CHEMTREC US/Can: 800-424-9300 International: 001 703-572-3997	1725 Brannum Lane Yellow Springs, OH 45387 MSDSinfo@ysi.com YSI.com Collect calls accepted
Manufacturer	NCL of Wisconsin, Inc. Telephone: 1-800-648-7836 Email: nclabs@nclabs.com	PO Box 8, Birnamwood, WI 54414 Fax: 715-449-2454 Emergency Contact: 1-800-424-9300 (Chemtrec)

SECTION 2: HAZARDS IDENTIFICATION

GHS Classification	Not classified
Signal Word	Not applicable
Pictograms	None
Hazard Statements	Not applicable
Precautionary Statements	Not applicable
Other Hazards Not Contributing to the Classification	None under normal conditions.

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Identity	Not applicable
Common Name	Not applicable

Mixture

Name	CAS #	Approximate %
Water	7732-18-5	>98.8
Potassium Hydrogen Phthalate	877-24-7	1.1
Red Food Coloring	Not found	<0.001

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General First Aid Measures	Never give anything by mouth to an unconscious person. Seek medical advice if you feel unwell.
If Inhaled	Remove person to fresh air and keep comfortable for breathing. Allow victim to rest.
In Case of Skin Contact	Remove contaminated clothing and wash exposed skin with mild soap and water. Rinse with warm water.
In Case of Eye Contact	Immediately flush eyes with plenty of water. Remove contact lenses, if present and easy to do. Get medical attention if irritation develops.
If Swallowed	Rinse mouth. Do NOT induce vomiting. Get medical attention if you feel unwell.

Most Important Symptoms/Effects Acute and Delayed

Not expected to present a significant hazard under normal use.

Indication of Immediate Medical Attention and Special Treatment Needed

No additional information available.

9.3.5 Ph Buffer, 7.0

www.ysi.com
Revision Date: 12/10/2014

Safety Data Sheet
According to the (US) Hazard Communication Standard (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name	Buffer Solution pH 7.00	
Catalog Number	**YSI 3822**	
Product Description	Laboratory chemical, for use in calibrating pH probes	
Supplier	YSI, a Xylem brand Telephone: 937-767-7241 Emergency: CHEMTREC US/Can: 800-424-9300 International: 001 703-572-3997	1725 Brannum Lane Yellow Springs, OH 45387 MSDSinfo@ysi.com YSI.com Collect calls accepted
Manufacturer	NCL of Wisconsin, Inc. Telephone: 1-800-648-7836 Email: nclabs@nclabs.com	PO Box 8, Birnamwood, WI 54414 Fax: 715-449-2454 Emergency Contact: 1-800-424-9300 (Chemtrec)

SECTION 2: HAZARDS IDENTIFICATION

GHS Classification	Not classified
Signal Word	Not applicable
Pictograms	None
Hazard Statements	Not applicable
Precautionary Statements	Not applicable
Other Hazards Not Contributing to the Classification	None under normal conditions

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Identity	Not applicable
Common Name	Not applicable

Mixture

Name	CAS #	Approximate %
Water	7732-18-5	>98
Potassium Phosphate Monobasic	7778-77-0	<1
Yellow Food Coloring	Not found	<0.001

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General First Aid Measures	Never give anything by mouth to an unconscious person. Seek medical advice if you feel unwell.
If Inhaled	Remove person to fresh air and keep comfortable for breathing. Allow victim to rest.
In Case of Skin Contact	Remove contaminated clothing and wash exposed skin with mild soap and water. Rinse with warm water.
In Case of Eye Contact	Immediately flush eyes with plenty of water. Remove contact lenses, if present and easy to do. Get medical attention if irritation develops.
If Swallowed	Rinse mouth. Do NOT induce vomiting. Get medical attention if you feel unwell.

Most Important Symptoms/Effects Acute and Delayed

Not expected to present a significant hazard under normal use.

Indication of Immediate Medical Attention and Special Treatment Needed

No additional information available.

9.3.6 Ph Buffer, 10.0

www.ysi.com
Revision Date: 12/10/2014

Safety Data Sheet
According to the (US) Hazard Communication Standard (29 CFR 1910.1200)

SECTION 1: PRODUCT AND COMPANY IDENTIFICATION

Product Name Buffer Solution pH 10.00

Catalog Number **YSI 3823**

Product Description Laboratory chemical, for use in calibrating pH probes

Supplier
YSI, a Xylem brand
Telephone: 937-767-7241
Emergency: CHEMTREC
US/Can: 800-424-9300
International: 001 703-572-3997

1725 Brannum Lane
Yellow Springs, OH 45387
MSDSinfo@ysi.com
YSI.com
Collect calls accepted

Manufacturer
NCL of Wisconsin, Inc.
Telephone: 1-800-648-7836
Email: nclabs@nclabs.com

PO Box 8, Birnamwood, WI 54414
Fax: 715-449-2454
Emergency Contact: 1-800-424-9300 (Chemtrec)

SECTION 2: HAZARDS IDENTIFICATION

GHS Classification
Reproductive Toxicity — Category 1B

Signal Word Danger

Hazard Statements
H360 — May damage fertility or the unborn child

Precautionary Statements
P201 — Obtain special instructions before use
P202 — Do not handle until all safety precautions have been read and understood
P280 — Wear protective gloves and eye protection
P308+P313 — IF exposed or concerned: Get medical advice/attention
P405 — Store locked up
P501 — Dispose of contents/container to comply with local, state, and federal regulations

Other Hazards Not Contributing to the Classification None under normal conditions

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Identity Not applicable

Common Name Not applicable

Mixture

Name	CAS #	Approximate %
Water	7732-18-5	>96
Potassium Hydroxide	1310-58-3	<1
Disodium EDTA dihydrate	6381-92-6	<1
Potassium Carbonate	584-08-7	<1
Potassium Borate	1332-77-0	<1
Bromphenol Blue, Sodium Salt	62625-28-9	<0.01
Bromcresol Green, Sodium Salt	62625-32-5	<0.01

SECTION 4: FIRST AID MEASURES

Description of First Aid Measures

General First Aid Measures Never give anything by mouth to an unconscious person. Seek medical advice if you feel unwell.

If Inhaled Remove person to fresh air and keep comfortable for breathing. Allow victim to rest.

In Case of Skin Contact Remove contaminated clothing and wash exposed skin with mild soap and water. Rinse with warm water.

In Case of Eye Contact Immediately flush eyes with plenty of water. Remove contact lenses, if present and easy to do. Get medical attention if irritation develops.

9.3.7 Conductivity Standard, 1000 µS/cm

Conductivity Calibrator 1,000-100,000 micromho/cm

Safety Data Sheet

according to Federal Register / Vol. 77, No. 58 / Monday, March 26, 2012 / Rules and Regulations

Revision date: 09/11/2013 Supersedes: 04/04/2011 Version: 2.0

SECTION 1: IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY

Product Identifier

Product name: Conductivity Calibrator 1,000-100,000 micromho/cm

Product code: 3160, 3161, 3163, 3165, 3167, 3168, 3169

Intended Use Of The Product

Use of the substance/preparation: Calibration of YSI Analytical equipment

Name, Address, And Telephone Of The Responsible Party

YSI
1700/1725 Brannum Lane
Yellow Springs, OH 45387

T 937-767-7241

www.ysi.com
MSDSinfo@ysi.com

Emergency Telephone Number

Emergency number : Within USA and Canada: 1-800-424-9300 - Outside USA and Canada: +1 703-527-3887 (collect calls accepted) CHEMTREC

SECTION 2: HAZARDS IDENTIFICATION

Classification Of The Substance Or Mixture

Classification (GHS-US)

Not classified

Label Elements

GHS-US labeling No labeling applicable

Other Hazards Not available

Unknown acute toxicity (GHS US) Not available

SECTION 3: COMPOSITION/INFORMATION ON INGREDIENTS

Substances

Mixture

Name	Product identifier	% (w/w)	Classification (GHS-US)
Water	(CAS No.) 7732-18-5	93 - 100	Not classified
Potassium chloride	(CAS No.) 7447-40-7	0.1 - 7	Eye Irrit. 2B, H320

Full text of H-phrases: see section 16

SECTION 4: FIRST AID MEASURES

Description Of First Aid Measures

General: Never give anything by mouth to an unconscious person. If you feel unwell, seek medical advice (show the label where possible).

Inhalation: When symptoms occur: go into open air and ventilate suspected area.

Skin Contact: Remove contaminated clothing. Drench affected area with water for at least 15 minutes.

Eye Contact: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

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9.3.8 Quinine Sulfate Dihydrate

ThermoFisher SCIENTIFIC

SAFETY DATA SHEET

Creation Date 26-Sep-2009 **Revision Date** 25-May-2017 **Revision Number** 2

1. Identification

Product Name **Quinine sulfate dihydrate**

Cat No. : **AC163710000; AC163710100; AC163710500**

Synonyms Quinine bisulfate; Quinine hydrogen sulfate.; Quinine sulfate

Recommended Use Laboratory chemicals.
Uses advised against Not for food, drug, pesticide or biocidal product use

Details of the supplier of the safety data sheet

Company
Fisher Scientific
One Reagent Lane
Fair Lawn, NJ 07410
Tel: (201) 796-7100

Acros Organics
One Reagent Lane
Fair Lawn, NJ 07410

Emergency Telephone Number
For information **US** call: 001-800-ACROS-01 / **Europe** call: +32 14 57 52 11
Emergency Number **US:**001-201-796-7100 / **Europe:** +32 14 57 52 99
CHEMTREC Tel. No.**US:**001-800-424-9300 / **Europe:**001-703-527-3887

2. Hazard(s) identification

Classification
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200)

Acute oral toxicity	Category 4
Acute dermal toxicity	Category 4
Acute Inhalation Toxicity - Dusts and Mists	Category 4
Skin Corrosion/irritation	Category 2
Serious Eye Damage/Eye Irritation	Category 2
Respiratory Sensitization	Category 1
Skin Sensitization	Category 1
Specific target organ toxicity (single exposure)	Category 3
Target Organs - Respiratory system.	

Label Elements

Signal Word
Danger

Hazard Statements
Harmful if swallowed
Harmful in contact with skin
Harmful if inhaled
Causes skin irritation
Causes serious eye irritation
May cause allergy or asthma symptoms or breathing difficulties if inhaled
May cause an allergic skin reaction

9.3.9 Sulfuric Acid

Safety Data Sheet
per OSHA HazCom 2012

Page 1/4
Printing date 11/24/2015
Reviewed on 10/14/2011

1 Identification

Product identifier

Product name: Sulfuric acid, 0.1N Standardized Solution

Stock number: 35651
Relevant identified uses of the substance or mixture and uses advised against.
Identified use: SU24 Scientific research and development

Details of the supplier of the safety data sheet
Manufacturer/Supplier:
Alfa Aesar
Thermo Fisher Scientific Chemicals, Inc.
30 Bond Street
Ward Hill, MA 01835-8099
Tel: 800-343-0660
Fax: 800-322-4757
Email: tech@alfa.com
www.alfa.com
Information Department: Health, Safety and Environmental Department
Emergency telephone number:
During normal business hours (Monday-Friday, 8am-7pm EST), call (800) 343-0660. After normal business hours, call Carechem 24 at (866) 928-0789.

2 Hazard(s) identification

Classification of the substance or mixture in accordance with 29 CFR 1910 (OSHA HCS)
The product is not classified according to the Globally Harmonized System (GHS).
Hazards not otherwise classified No information known.

Label elements
GHS label elements Not applicable
Hazard pictograms Not applicable
Signal word Not applicable
Hazard statements Not applicable
WHMIS classification Not controlled
Classification system
HMIS ratings (scale 0-4)
(Hazardous Materials Identification System)

HEALTH 1
FIRE 0
REACTIVITY 0
Health (acute effects) = 1
Flammability = 0
Physical Hazard = 0

Other hazards
Results of PBT and vPvB assessment
PBT: Not applicable.
vPvB: Not applicable.

3 Composition/information on ingredients

Chemical characterization: Mixtures
Dangerous components: Not applicable
Additional information None known.

Non-Hazardous Ingredients

7664-93-9	Sulfuric acid	Skin Corr. 1A, H314	0.05%
7732-18-5	Water		99.95%

4 First-aid measures

Description of first aid measures
After inhalation
Supply fresh air. If required, provide artificial respiration. Keep patient warm.
Seek immediate medical advice.
After skin contact
Immediately wash with water and soap and rinse thoroughly.
Seek immediate medical advice.
After eye contact Rinse opened eye for several minutes under running water. Then consult a doctor.
After swallowing Seek medical treatment.
Information for doctor
Most important symptoms and effects, both acute and delayed No further relevant information available.
Indication of any immediate medical attention and special treatment needed No further relevant information available.

5 Fire-fighting measures

Extinguishing media
Suitable extinguishing agents Product is not flammable. Use fire-fighting measures that suit the surrounding fire.
Special hazards arising from the substance or mixture
If this product is involved in a fire, the following can be released:
Sulfur oxides (SOx)
Advice for firefighters
Protective equipment:
Wear self-contained respirator.
Wear fully protective impervious suit.

6 Accidental release measures

Personal precautions, protective equipment and emergency procedures
Wear protective equipment. Keep unprotected persons away.
Ensure adequate ventilation
Environmental precautions: Do not allow material to be released to the environment without proper governmental permits.
Methods and material for containment and cleaning up: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust).
Prevention of secondary hazards: No special measures required.
Reference to other sections
See Section 7 for information on safe handling

(Contd. on page 2)

9.4 A4—Field Calibration Data Transmission Instructions

When aquatic sensors are calibrated in the field, NEON is limited to using the manufacturers' programs (versions controlled by CVAL in the directory shown in Figure 52), and thus reliant on manual transmission of data via the files created by these programs.

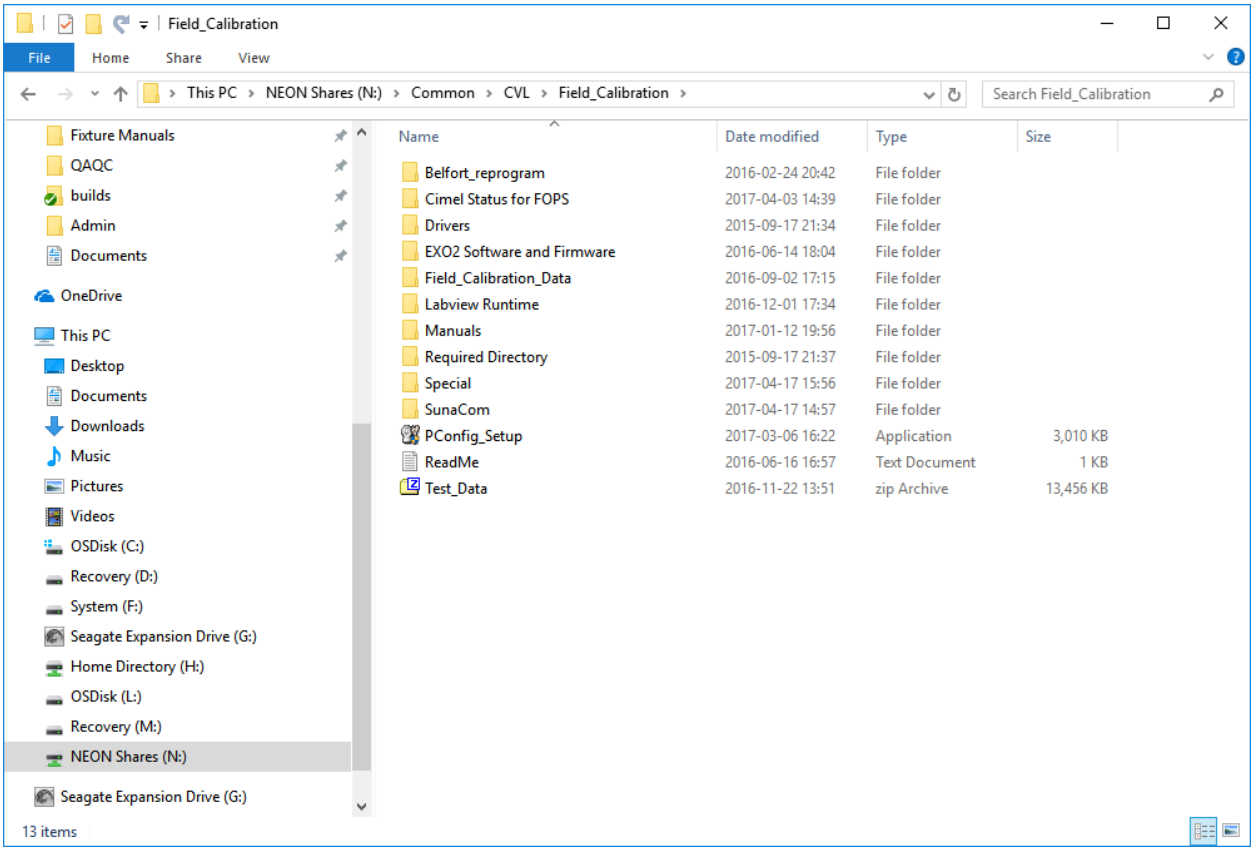

Figure 52. Location of version controlled calibration software for SunaCom (Suna Sensor) and EXO2 Software and Firmware (Multisonde Sensors) at \\eco.neoninternal.org\neon\Common\CVL\Field_Calibration or N:\Common\CVL\Field_Calibration.

The transfer of the files needs to happen on the device used for the calibrations and when network connectivity is available. It is prudent that these be transferred as soon as possible from the date of the maintenance for prompt transmission to the data portal. Sensors that fall under this protocol include the SUNA and Multisonde sensors (pressure, pH, fDOM, turbidity, BGA, conductivity, and DO). Note that not all Multisondes will have an fDOM sensor. Further, the depth (or pressure) sensor is associated with the body of the Multisonde and thus the asset tag for that sensor is the same as for the body. The other sensors have individual asset tags, which are included in the file structures described below.

For file transfers, use the common drive with the following directory (if N-drive is mapped properly, the lower directory is sufficient):

\\eco.neoninternal.org\neon\Common\CVL\Field_Calibration\Field_Calibration_Data\AIS

or

N:\Common\CVL\Field_Calibration\Field_Calibration_Data\AIS

Here you will see an example folder created after all sensors captured with this protocol are calibrated (Figure 53). However, not all sensors necessarily will proceed to the calibration portion.

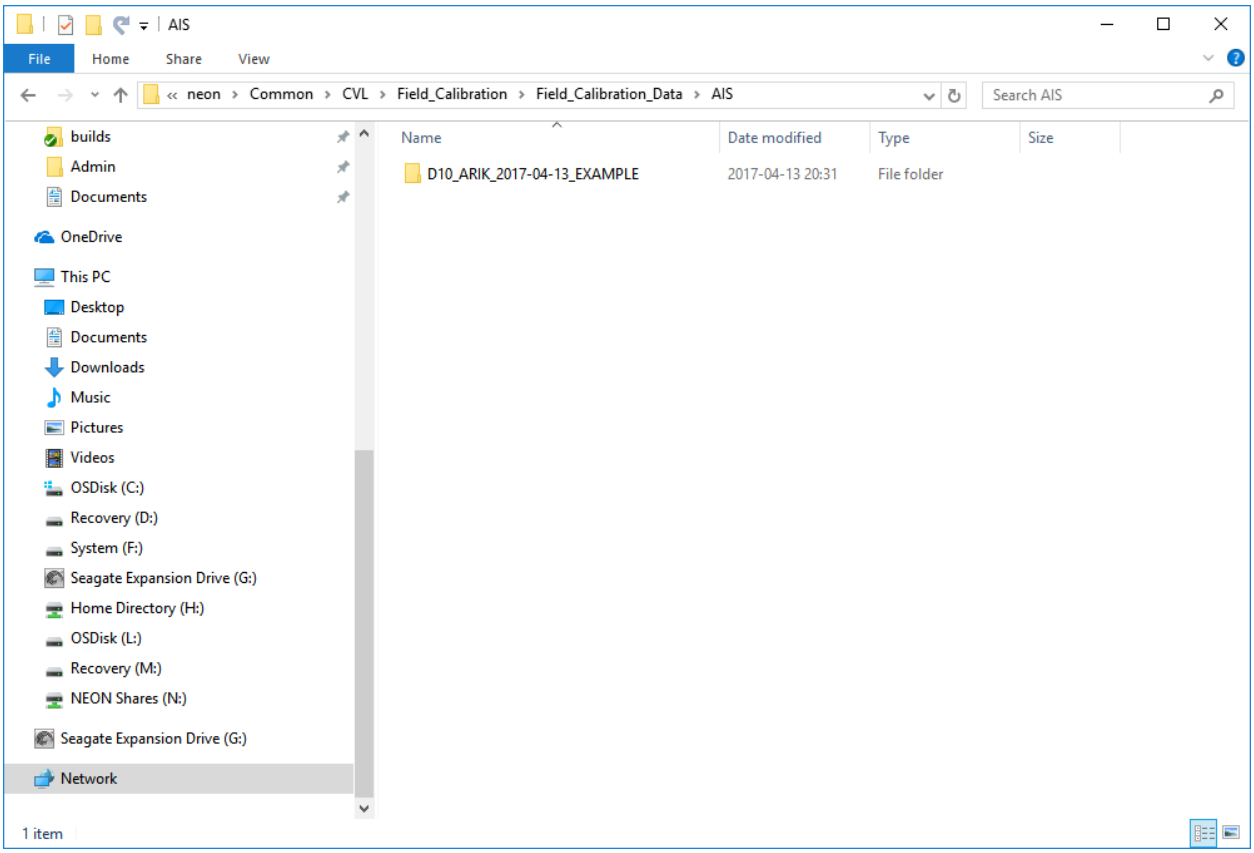

Figure 53. Example folder structure in data transmission directory.

As shown in the example, folders should be named as: Domain#_Site_Date, e.g., D10_ARIK_2017-04-13. Use the date format YYYY-MM-DD for consistency; the date should correspond to the date of the file transfer. Calibration dates will be taken from the file contents. Figure 54 provides an example of the folder structure for each sensor: Asset#_SensorID operator.

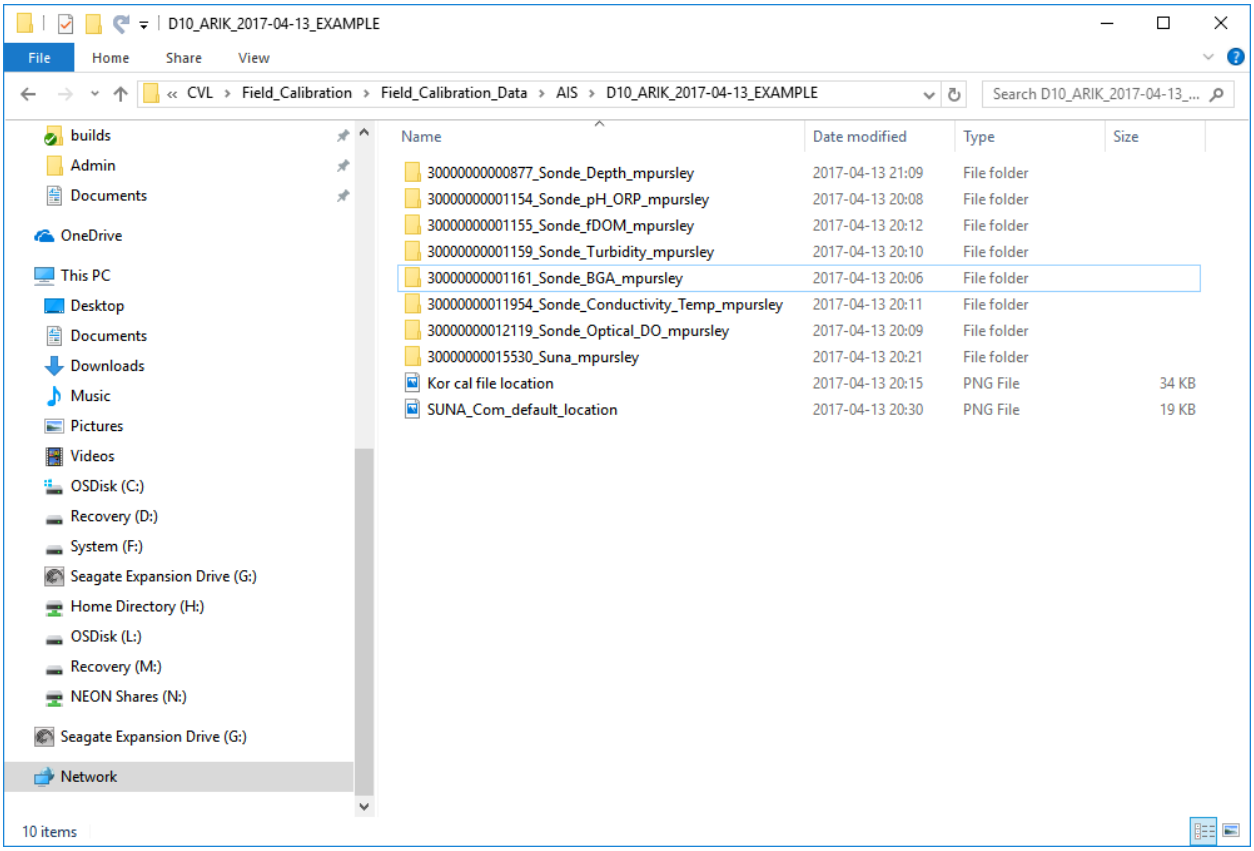

Figure 54. Sensor calibration folder structure with asset tag, sensor description, and operator provided.

The Asset # must be the 14 digit identification (ID) on the asset scan-able tag and operator should be first initial last name. It is recommended that this folder structure be created annually upon sensor receipt, updated when sensors are changed out, and saved to a domain specific directory, as these will need to be copied here whenever a calibration occurs. Entire folders will be transferred and deleted out of this directory once the automated program scans them for calibration transmission.

This example folder has two images to provide information to where the files from the calibrations are typically stored. The KOR-EXO software for the Multisonde is generally consistent with Figure 55.

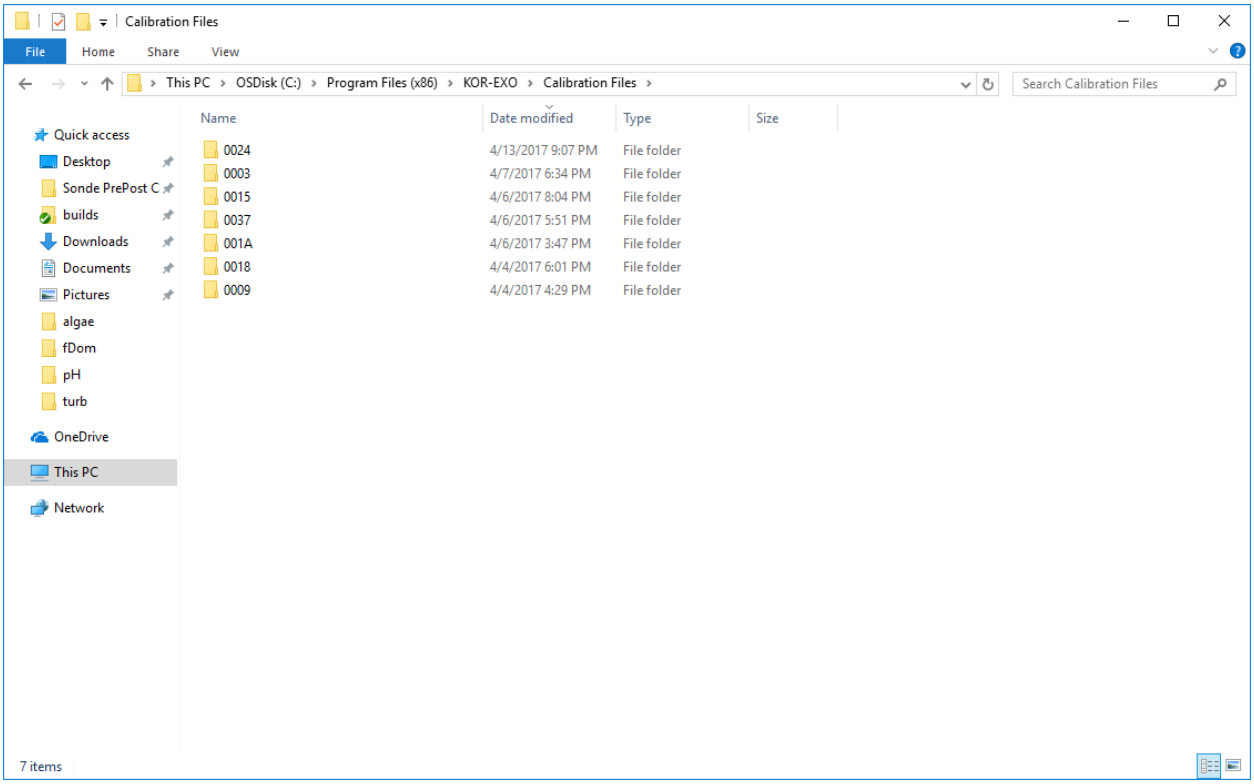

Figure 55. KOR-EXO program calibration file directory for the Multisonde sensors.

The folder names relate to the sensors as follows:

001A: BGA

0018: Conductivity

0015: Turbidity

0009: DO

0003: pH

0037: fDOM

0024: Depth

The files in the local directory should have all historic calibrations for the sensors. Initially, copy all files over to the transmission folder. Files or the file most recently created can continue to be copied. However, it is important to capture all calibrations that have occurred in the field, so if you are unsure if

a file has been transferred, copy it to the directory and the automated program will determine if a new calibration event occurred.

Figure 56 provides an example for the depth calibration file.

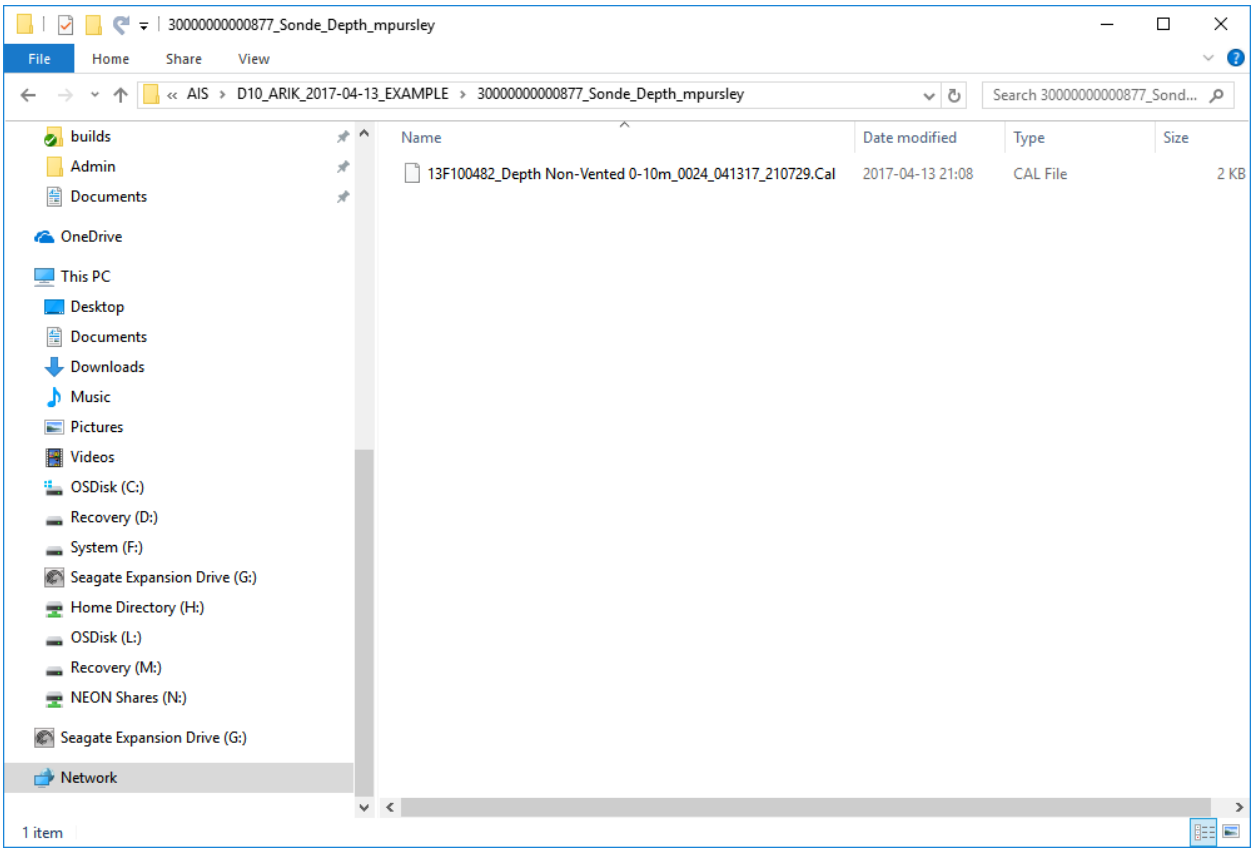

Figure 56. Example depth calibration file from the Multisonde program with the .cal extension.

Make sure all files copied over have the .cal extension as the PDF files cannot be used to transmit data from the calibration. Please contact Mike Pursley mpursley@battelleecology.org with questions.

[i] An EPROM ID or erasable programmable read-only memory is a type of memory chip that retains its data when its power supply is switched off. Source: https://en.wikipedia.org/wiki/EPROM

[ii] JIRA-5848 is a good example for reference.