

SOP 1: CTD Maintenance, Storage, and Calibration version 2

1 CTD Maintenance, Supplies, and General Handling Procedures

Two CTDs are used in this program. One is referred to as “primary” and is intended to be used for an entire season. The second is called “backup” and is kept in reserve for use only in the case that the primary device suffers failure and must be sent out for repair. Typically, two devices are rotated through these positions, each operating as primary every other year.

1.1 General CTD Handling, Care, and Use Instructions

The Sea-Bird SBE-19 and SBE-19plus V2 operators’ manuals (available on the SEAN and Sea-Bird websites) document all recommended practices for cleaning the CTD, accessing the battery compartment, care and installation of O-rings, instrument operation, instrument setup, and CTD-computer communications. The Project Leader will read and become comfortable with all aspects of the manual.

Based on SBE Application Notes 34, 2D, and 64

(http://www.seabird.com/application_notes/ANindex.htm) and further consultation with SBE technicians, the following within-a-single-cruise-day procedure has been adopted. After each cast (within a single day), the plumbed line connecting the pump and sensors should be flushed with ambient-temperature 0.1% Triton X-100 solution (note: Triton X-100 is a nonionic biogenic detergent; be careful not to get the solution in eyes or on skin) followed by distilled water, using the syringe/tubing assembly and leaving the assembly attached to the open end (nylon hose barb fitting) of the conductivity cell until the next cast (*remember to remove prior to cast!*). This leaves the sensors bathed in distilled water between casts to dissolve any residual salts. During very cold weather (e.g., during the midwinter survey when ambient air temperatures fall below freezing [0 °C]), the syringe/tubing assembly should be removed after the distilled-water flush, allowing the entire plumbed line to drain and reducing the risk of freeze damage to the conductivity cell. Additionally, after each cast the faces of the upward-looking PAR sensor and the downward-facing fluorometer should be rinsed with distilled water from a wash bottle in order to prevent the formation of salt crystals.

Between consecutive days of a multiday cruise (overnight storage), the above procedure is followed except when ambient temperatures are expected to fall below freezing overnight, in which case the syringe/tubing assembly should be removed to allow the plumbed line to drain; in addition, efforts should be made to store the instrument overnight in a heated space to protect the sensors from freeze damage.

For longer-term storage (i.e., between cruises), see Section 2 below.

The above procedure departs from a strict following of the SBE Application Notes based on our local marine and shipboard environments, taking into consideration that the ambient seawater and air temperatures are relatively cool, the seawater salinities are relatively low, the vessel lacks a source of warm and/or deionized water, the time between casts within a day is relatively short (<1 hour), and each cast is preceded by a two-minute surface soak with the pump running. These conditions

combine to allow for a practical protocol that adequately reduces risks of sensor fouling, salt build-up, or other contamination while minimizing sensor drift over time.

1.2 Supplies

On an ongoing basis, all field gear should be assessed and repaired or replaced as needed. Necessary equipment and supplies include but are not limited to the CTD lowering line, spare CTD and GPS batteries, the computer-to-CTD interface cable, spare O-rings, cable ties, electrical silicone grease, distilled water, and Triton X-100 solution. A supply of KimWipes or other similar nonabrasive lint-free wiping towel is necessary for proper O-ring handling. The 450 m+ lowering line (3/8" nylon) is marked with blue tapes at 10-m increments except at every 50 m (red tapes) and every 100 m (green tapes). The line should be inspected annually, and missing or damaged tapes should be replaced. Because the first half of the line receives more wear than the second half, the line should be “reversed” end-to-end every two years; note that, minimally, the number of green tapes at the 100-m increments will also need to be reversed. The line should be replaced with new line at least every six years, or more frequently if wear is observed.

2 Long-term Storage

“Long-term storage” means between cruises, and during the one-year “shelf rest” as the back-up unit to the primary instrument in active service. However, if the back-up instrument is not pressed into service during its “shelf rest” then no cleaning is required and it remains in the condition it arrived in when received from calibration service.

2.1 Instrument Cleaning

Thoroughly cleaning the CTD after each cruise is important to maintain sensor viability and reduce the potential for the negative effects of biofouling, contamination by oil, and buildup of salt crystals on the sensors, especially the relatively sensitive and delicate conductivity cell and oxygen sensor. Again, refer to SBE Application Notes 34, 2D, and 64 for detailed long-term cleaning and storage instructions.

First, rinse the entire instrument thoroughly with fresh water. Then, disconnect the tubing connecting the dissolved oxygen sensor to the conductivity cell so that it is not exposed to the following conductivity cell cleaning procedure. Flush the conductivity cell with a 0.1% solution of Triton X-100. Wash the solution back and forth with the syringe. Allow the cell to soak in the solution for one hour. Drain the cell and tubing, and use the syringe to thoroughly rinse with fresh water for five minutes. Soak the cell for one minute with a 500–1,000 ppm solution of bleach (dilute concentrated household bleach at 50 parts fresh water to one part bleach). After the soak, drain and flush with warm (not hot) fresh water for five minutes, finishing with a final rinse with distilled water. Sea-Bird cautions not to use a brush or Q-tip to clean the flow tube on the conductivity cell, as this can alter the calibration or damage the sensor.

After treating the conductivity cell as above, implement the following procedure to prepare the (now disconnected) DO sensor for long-term storage between cruises. Using the syringe, flush the sensor for one minute with a 1% (vs. 0.1%) Triton X-100 solution, preferably warmed to 30 °C (86 °F). Drain and flush with warm (not hot) fresh water for five minutes. Soak the sensor for one minute

with a 500–1,000 ppm solution of bleach (dilute concentrated household bleach at 50 parts fresh water to one part bleach). After the soak, drain and flush with warm (not hot) fresh water for five minutes, finishing with a final rinse with distilled water. Assuming there is no danger of freezing, connect the sensor inlet and outlet with a short loop of Tygon tubing. Place a small piece of clean sponge, slightly moistened with fresh, clean water, in the center of the tubing (not near the sensor membrane).

2.2 Storage

After the conductivity cell is thoroughly dry from its last cleaning, store by reattaching the syringe/tubing assembly to seal the dry cell. For long-term storage, keep the DO sensor isolated with its closed tubing loop. *Remember, however, to remove the loop and reconnect the DO sensor to the in-line tubing train on the CTD just before redeploying the instrument on the first cast of the next cruise!*

3 Factory Calibrations

Immediately after each October cruise, ship the entire primary CTD instrument to Sea-Bird Electronics (SBE) for calibration of all sensors. SBE can arrange for any third-party ancillary sensors to be calibrated at the originator's factory and generally be returned in timely fashion. Be sure to get a returned materials authorization (RMA) number from SBE before shipping the CTD to them (<http://www.seabird.com/service/rma/rma.aspx>). Include a printed SBE Service Request Form in the shipping crate. Ship the CTD via FedEx, and make sure the RMA number is written on the address label. Email the serial number of the instrument to SBE in advance. The serial number may be found by looking inside a unit's CON file. SBE shipping information is as follows:

SEA-BIRD ELECTRONICS, INC.

1808 136th Place NE

Bellevue, WA 98005

Phone: (425) 643-9866

Fax: (425) 643-9554

Email: seabird@seabird.com

Contacts: Mike Handewith, Dave Armstrong, Andy Heard

SBE's website (http://seabird.com/customer_support/retgoods.htm) also has return information.

When the instrument is returned to GLBA by SBE, it will serve as the backup unit for the upcoming cruise year. The previous backup unit should be promoted to primary unit at that time. All sensors in the backup unit (except the dissolved oxygen sensor) will perform adequately with environmentally stable storage in “off-years” and factory calibration once every two years. In this way, rotating two CTD instruments annually will provide both adequate redundancy and accurate readings.

Each DO sensor, however, requires calibration annually. Therefore, after each October cruise, the DO sensor should be removed from the then-backup unit and also be shipped to SBE for service. When it is returned after calibration, it must be reinstalled on its original unit (which is being promoted to primary). Individual sensors should never be interchanged between CTD units. While it

may be physically possible to swap sensors, doing so will likely result in incorrect calibration factors being applied when calculating the parameters, resulting in invalid readings. In order to avoid accidentally interchanging DO sensors, it is recommended the detached DO sensor be separately shipped to SBE under a different RMA; having two DO sensors on the same RMA could lead to confusion regarding calibration data when the CON files get updated.

In the event the backup CTD had to be deployed during the just-ended cruise year, then that entire CTD unit should be sent in for calibration instead of just its DO sensor. The results of the calibration for every machine that collected data during a cruise year are required in order to complete the year's data quality assessment as detailed in SOP 9. Typically, when the full CTD is returned it is accompanied by a computer CON file and certification PDF documents to be processed as described in SOP 3 and SOP 2, respectively. When an individual DO sensor (or PAR sensor, as below) is received, it will usually have calibration factors and certifications on paper. Note there are special sections in SOP 3 and SOP 2 for handling this situation.

As alluded to above, some sensors are manufactured and calibrated by a company other than SBE. SBE thus has no direct control over the timeliness of calibration and return of such third-party sensors, and in some cases they have been unable to return the complete fully calibrated instrument in time for the midwinter (December through early February) cruise window. Consequently, in order to ensure that a complete instrument is always available as a backup, it is recommended that immediately following the October cruise the PAR sensor be shipped directly to Biospherical Instruments, Inc., for calibration instead of to SBE. This saves time by obviating shipping, tracking, and communicating calibration details between SBE and Biospherical, Inc.

Biospherical shipping information is:

BIOSPHERICAL INSTRUMENTS, INC.

5340 Riley Street

San Diego, CA 92110

Phone: (619) 686-1888

Fax: (619) 686-1887

Email: biospherical.com

As with SBE, the company website (<http://www.biospherical.com>) has detailed return information, and an RM.