



This application note presents recommendations for best practices when preparing profiling floats for deployment and shipping. The application note is divided into three sections:

- General guidelines
- Instructions for Care and Cleaning of Conductivity Cells
- Installing or Replacing of Anti-Foulant Device in SBE 41/41CP

General Guidelines

In order to prevent drift of temperature and conductivity sensor from the calibration, it is important to follow these general guidelines when preparing floats for deployment or shipping.

- Avoid exposure of the float or SBE 41/41CP to high temperatures during shipping and handling. Temperatures over 45 °C can cause drift of the thermistor from the calibration. In addition, the installed anti-foulant device is less viscous at higher temperatures and can leak into the conductivity cell. If this happens, the resulting salinity data will read fresher during the first few profiles. Since the anti-foulant device in the SBE 41/41CP is of high purity, it will eventually wash out completely and, in the absence of fouling, return the conductivity cell to its calibrated state.
- Prevent contamination of the conductivity cell by surface oil slicks present in tanks during ballasting of the float. This can be easily achieved by filling the entire volume of the conductivity cell with de-ionized water and sealing the intake and outflows with the plugs provided, before performing ballasting of the float.
- Always pack the SBE 41/41CP or float carefully to protect the instrument from impact during shipping. The conductivity cell is made of glass, which is breakable.

If a conductivity cell is cracked or fouled, it typically causes a salinity shift or erratic data. The following sections describe procedures to identify damaged cells and provide cleaning instructions for fouled cells. The last section contains directions for installing or replacing anti-foulant in the T-C duct of the SBE 41/41CP.

Instructions for Care and Cleaning of Conductivity Cells

Since any conductivity sensor's output reading is proportional to its cell dimensions, it is important to keep the cell clean of internal coatings. Cell electrodes contaminated with oil, biological growths, or other foreign material will eventually cause low conductivity readings. To control growth of bio-organisms in the conductivity cell, follow these rinsing and cleaning recommendations.

- Bleach is extremely effective in controlling growth of bio-organisms in the conductivity cell. Sea-Bird recommends cleaning the conductivity sensor in a dilute bleach solution.
- Triton X-100 is a mild, non-ionic surfactant (detergent), valuable for removal of surface and airborne oil ingested into the CTD plumbing as the CTD is removed from the water and brought on deck. Sea-Bird recommends rinsing and cleaning the conductivity sensor in a Triton solution.
- White vinegar, which is 5 – 8% acetic acid, **may** be used to remove minor mineral deposits on the inside of the cell.

No adverse effects have been observed as a result of dry storage, if the cell is rinsed or soaked with fresh, clean water before storage to remove any salt crystals. This leads to the following conductivity cell storage recommendations:

- Short-term storage (< 1 day, typically between casts): If there is no danger of freezing, store the cell with a dilute bleach solution and plugs installed at the intake and outflows. If there is danger of freezing, store the cell dry, with plugs installed at the intake and outflows.
- Long-term storage (> 1 day): Since conditions of transport and long-term storage are not always under the user's control, store the conductivity cell dry, with plugs installed at the intake and outflows. Dry storage eliminates the possibility of damage due to unforeseen freezing, as well as the possibility of bio-organism growth in water in the cell. Filling the cell with a Triton X-100 solution for 1 hour before deployment will *rewet* the cell adequately.

Identifying Damaged or Severely Fouled Cells

Every conductivity calibration certificate has a frequency output for *zero* conductivity, obtained from a cell thoroughly rinsed in distilled or de-ionized water, with all the water shaken out (**dry cell**). A *zero conductivity frequency* that has changed by more than a few 10ths of a Hertz may indicate a cell that is damaged or considerably out of calibration. Noisy readings (\pm a few 10ths of a Hertz) indicate a dirty cell; follow the procedure for *Cleaning Severely Fouled Sensors* to clean a dirty cell.

Example Calibration Sheet

BATH TEMP (ITS-90)	BATH SAL (PSU)	BATH COND (Siemens/m)	INST FREQ (Hz)	INST COND (Siemens/m)	RESIDUAL (Siemens/m)
22.0000	0.0000	0.00000	2448.38	0.0000	0.00000
1.0000	34.6962	2.96668	4921.91	2.9667	0.00000
4.5000	34.6766	3.27284	5108.92	3.2728	-0.00000
15.0000	34.6339	4.25160	5664.72	4.2516	-0.00000
18.5000	34.6244	4.59565	5847.26	4.5957	0.00000
24.0000	34.6134	5.15177	6130.50	5.1518	0.00000
29.0000	34.6065	5.67181	6383.64	5.6718	0.00000
32.5000	34.6019	6.04282	6558.06	6.0428	-0.00000

Frequency associated with *zero conductivity* (dry conductivity cell). Variation of \pm few 10ths of a Hz indicates a dirty cell.

Rinsing, Cleaning, and Storage Procedures

Note: See *Cleaning Materials* below for discussion of appropriate sources / concentrations of water, Triton X-100, bleach, white vinegar, and tubing. Always remove the anti-foulant device (see *Installing and Replacing Anti-Foulant Devices in SBE 41/41CP*) before rinsing or cleaning the conductivity cell.

CAUTIONS:

- The conductivity cell is primarily glass, and can break if mishandled. Use the correct size Tygon tubing; using tubing with a smaller ID will make it difficult to remove the tubing, and the cell may break if excessive force is used. **The correct size tubing for cleaning / storing all SBE 41/41CP cells is 7/16" ID, 9/16" OD.**
- **Do not put a brush or object (e.g., Q-Tip) inside the conductivity cell to clean it or dry it.** Touching and bending the electrodes can change the calibration; large bends and movement of the electrodes can damage the cell.
- **If a dissolved oxygen (DO) sensor is plumbed to the CTD** - Before soaking the conductivity cell for more than 1 minute in Triton X-100 solution, **disconnect the tubing between the conductivity cell and DO sensor** to prevent extended Triton contact with the optical window (SBE 63). Extended Triton contact can cause sensitivity [slope] changes, usually temporary, to the sensors. For rinsing, cleaning, and storage, see the SBE 63 manual.

Routine Cleaning (no visible deposits or marine growths on sensor)

1. **Agitate** a **500 – 1000 ppm Bleach** solution warmed to 40 °C (wrist warm) through the cell in a washing action (this can be accomplished with Tygon tubing and a syringe kit – see *Application Note 34*) for **2 minutes**. **Drain and flush** with warm (not hot) fresh, clean water for **5 minutes*** or **until rinsed thoroughly**.
2. **Agitate** a **1%-2% Triton X-100** solution warmed to 40 °C (wrist warm) through the cell many times in a washing action (this can be accomplished with Tygon tubing and a syringe kit). Fill the cell with the solution and let it **soak for 1 hour**. **Drain and flush** with warm (not hot) fresh, clean water for **5 minutes*** or **until rinsed thoroughly**.

* If you do not have a large supply of fresh water: As a minimum, flush the cell with enough warm, fresh, clean water to fill the cell five times, or until rinsed thoroughly.

Cleaning Severely Fouled Sensors (visible deposits or marine growths on sensor, and/or shift in zero conductivity frequency)

1. Repeat the *Routine Cleaning* procedure up to 5 times.
 - A. Thoroughly rinse in distilled or de-ionized water, and shake out all the water. With the conductivity cell dry, take and record a raw conductivity reading (in Hz). Compare to the *zero conductivity frequency* on the calibration sheet. The output should be within a few tenths of a Hz of the *zero conductivity frequency*. If not, proceed to Step 2.
2. Clean with a white vinegar solution or diluted HCl solution; see the *Cleaning Materials* section of this application note for details.

If the zero conductivity is still outside the expected range, the conductivity cell may require factory cleaning.

Cleaning Materials

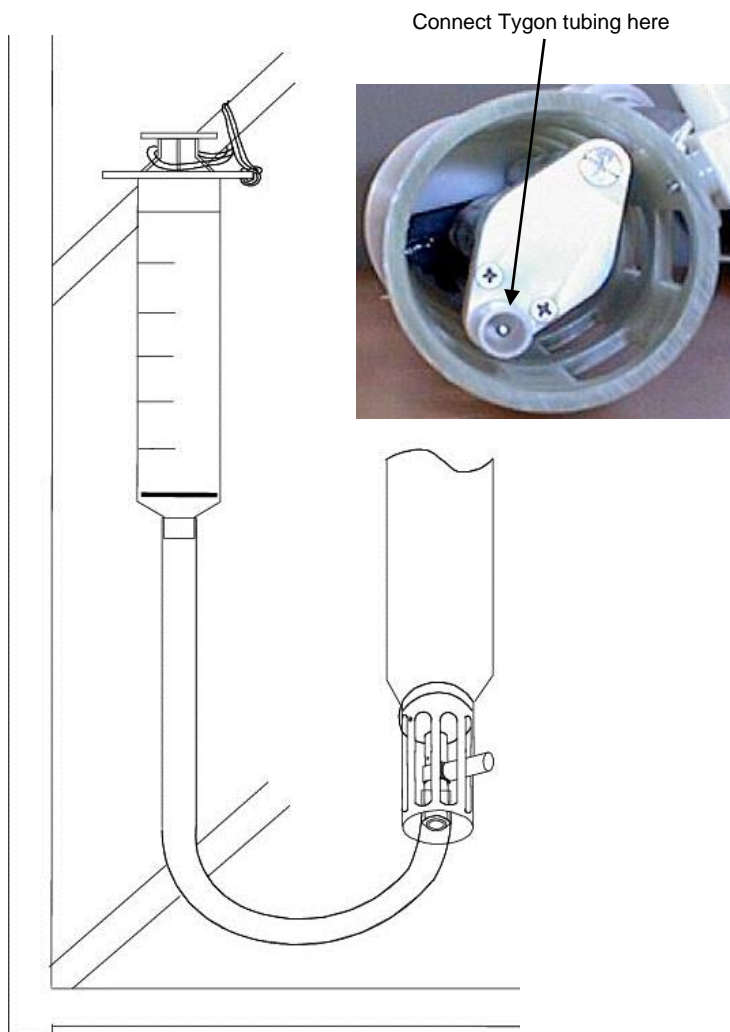
Water

De-ionized (DI) water, commercially distilled water, or fresh, clean, tap water is recommended for rinsing, cleaning, and storing sensors.

- On ships, **fresh water is typically made in large quantities by a distillation process, and stored in large tanks. This water may be contaminated with small amounts of oil, and should not be used for rinsing, cleaning, or storing sensors.**

Where fresh water is extremely limited (for example, a remote location in the Arctic), you can substitute **clean seawater** for rinsing and cleaning sensors. If not immediately redeploying the instrument, follow up with a **brief fresh water rinse** to eliminate the possibility of salt crystal formation (which could cause small shifts in calibration).

- **The seawater must be extremely clean, free of oils that can coat the conductivity cell. To eliminate bio-organisms in the water, boil the water or filter it with a 0.5 micron filter.**



Triton X-100

Triton X-100 is Octyl Phenol Ethoxylate, a mild, non-ionic surfactant (detergent). Triton X-100 is included with every CTD shipment and can be ordered from Sea-Bird, but may be available locally from a chemical supply or lab products company. It is manufactured by Avantor Performance Materials (<http://avantormaterials.com/commerce/product.aspx?id=2147509608>). Other liquid detergents can probably be used, but scientific grades (with no colors, perfumes, glycerins, lotions, etc.) are required because of their known composition. It is better to use a non-ionic detergent, since conductivity readings taken immediately after use are less likely to be affected by any residual detergent left in the cell.

100% Triton X-100 is supplied by Sea-Bird; dilute the Triton as directed in *Rinsing, Cleaning, and Storage Procedures*.

Bleach

Bleach is a common household product used to whiten and disinfect laundry. Commercially available bleach is typically 4% - 7% (40,000 – 70,000 ppm) sodium hypochlorite (Na-O-Cl) solution that includes stabilizers. Some common commercial product names are Clorox (U.S.) and eau de Javel (French).

Dilute to 500 – 1000 ppm. For example, if starting with 5% (50,000 ppm) sodium hypochlorite, diluting 50 to 1 (50 parts water to 1 part bleach) yields a 1000 ppm (50,000 ppm / 50 = 1000 ppm) solution.

Tygon Tubing

Sea-Bird recommends use of Tygon tubing, because it remains flexible over a wide temperature range and with age. Tygon is manufactured by Saint-Gobain (www.tygon.com). It is supplied by Sea-Bird, but may be available locally from a chemical supply or lab products company.

Keep the Tygon in a clean place (so that it does not pick up contaminants) while the instrument is in use.

White Vinegar

White vinegar is a common household product used to dissolve mineral deposits, and may be used to remove minor mineral contamination of the conductivity cell. Commercially available white vinegar is typically 5 – 8% acetic acid (CH₃COOH) in aqueous solution; verify that there are no oils or other ingredients.

1. Prepare for cleaning:
 - A. Place a 0.6 m (2 ft) length of Tygon tubing over the end of the conductivity cell.
 - B. Clamp the instrument so that the cell is vertical, with the Tygon tubing at the bottom end.
 - C. Loop the Tygon tubing into a U shape, and tape the open end of the tubing in place at the same height as the top of the glass cell.
2. Clean the cell:
 - A. Pour **weak white vinegar** solution (1 part white vinegar, 2 parts water) into the open end of the tubing until the cell is nearly filled. **Let it soak for 2-3 minutes only.**
 - B. Drain the solution from the cell and flush for 5 minutes with warm (not hot), clean, de-ionized water.
 - C. Rinse the exterior of the instrument to remove any spilled solution from the surface.
 - D. Fill the cell with a **1% Triton X-100** solution and let it stand for 5 minutes.
 - E. Drain and flush with warm, clean, de-ionized water for 1 minute.
 - F. Carefully remove the 0.6 m (2 ft) length of Tygon tubing.
3. With the conductivity cell dry, take and record a raw conductivity reading (in Hz). Compare to the *zero conductivity frequency* on the calibration sheet. The output should be within a few tenths of a Hz of the *zero conductivity frequency*. If not, repeat Steps 1 and 2 with a moderate white vinegar solution (1 part white vinegar, 1 part water) and repeat the test. If still outside the expected range, repeat with a full strength white vinegar solution and repeat the test. If still outside the expected range, return to the factory.
4. Prepare for deployment, **or** follow recommendations above for storage.

Installing and Replacing Anti-Foulant Devices in SBE 41/41CP



AF24173
Anti-Foulant
Device

WARNING!

AF24173 Anti-Foulant Devices contain bis(tributyltin) oxide. Handle the devices only with rubber or latex gloves. Wear eye protection. Wash with soap and water after handling.

Read precautionary information on product label before proceeding.

It is a violation of US Federal Law to use this product in a manner inconsistent with its labeling.

The SBE41/41CP is supplied with anti-foulant device fittings and Anti-Foulant Devices.

The Anti-Foulant Devices are installed:

- in the T-C Duct assembly;
- in the anti-foulant device cup and cap (part of the external pump exhaust tubing).

Wearing rubber or latex gloves, follow this procedure to install each Anti-Foulant Device (two):

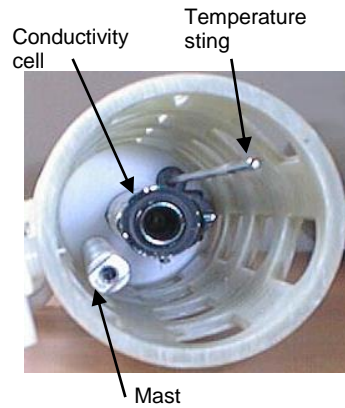
Anti-Foulant Device in T-C Duct Assembly

1. Remove the large screw securing the T-C Duct to the mast.
2. Gently pull the T-C Duct straight out - you will feel some resistance as the seals disengage. **Do not twist the T-C Duct or apply any sideways motion, or you may damage the conductivity cell.**
3. Remove the two small Phillips-head screws securing the T-C Duct top to the T-C Duct base.
4. Pull the T-C Duct top off of the base.
5. Place the Anti-Foulant Device in the T-C Duct base.
6. Replace the T-C Duct top on the base, reinstalling the two small Phillips-head screws.
7. **Carefully** slide the T-C Duct assembly over the temperature sting, aligning the large screw hole with the screw hole in the mast. Push the assembly onto the end of the conductivity cell - you will feel some resistance as the seals engage. **Do not twist the T-C Duct or apply any sideways motion, or you may damage the conductivity cell.**
8. Reinstall the large screw to secure the assembly to the mast.

Remove large screw securing T-C Duct to mast; then pull Duct straight out

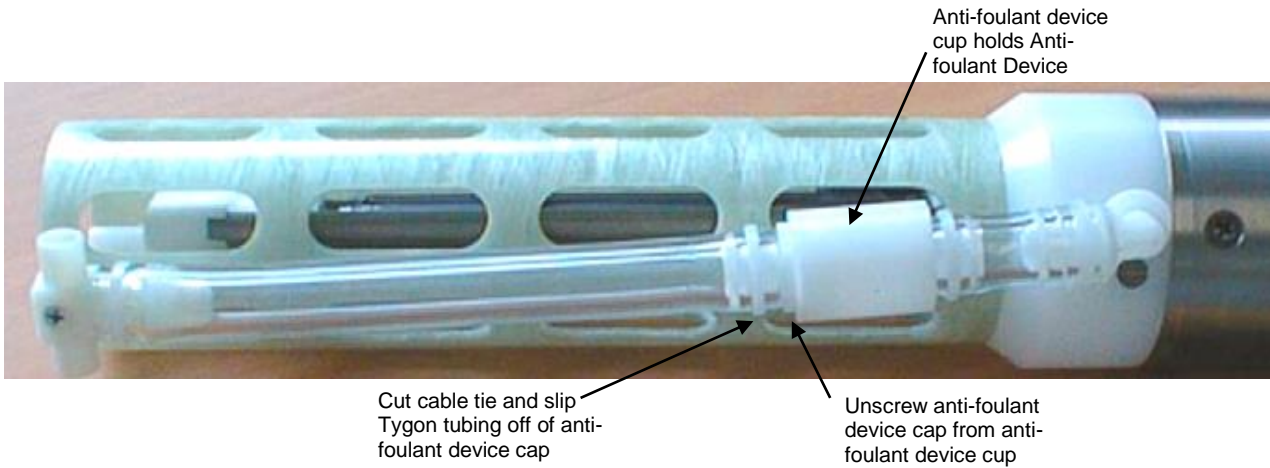


T-C Duct
Top Base



Installing Anti-Foulant Device in Pump Exhaust Tubing

1. Carefully cut the cable tie securing the Tygon tubing to the anti-foulant device cap. Slip the Tygon tubing off of the anti-foulant device cap.
2. Unscrew the cap with a socket wrench.
3. Place the Anti-Foulant Device in the cup.
4. Rethread the cap onto the cup. Do not over tighten.
5. Slip the Tygon tubing back onto the cap. Secure with a new cable tie.



Application Note Revision History

Date	Description
March 2017	<ul style="list-style-type: none"><li data-bbox="383 207 574 233">• Initial release