Application Note 2D

June 2025: Please refer to the sensor-specific user manual for conductivity cell care protocols

Care and Cleaning of Conductivity Cells

Does **not** apply to MicroCATs (SBE 37s) with DO sensors

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.
- Use a mild, non-ionic surfactant to remove 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 with a detergent 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. 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 in Tygon tubing looped around the cell. If there is danger of freezing, store the cell dry, with Tygon tubing looped around the cell.
- 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 Tygon tubing looped around the cell ends. 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 detergent solution for 1 hour before deployment will *rewet* the cell adequately.

The Tygon tubing looped around the ends of the conductivity cell, whether dry or filled with a bleach or detergent solution, has the added benefit of keeping air-borne contaminants (abundant on most ships) from entering the cell.

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 (± 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

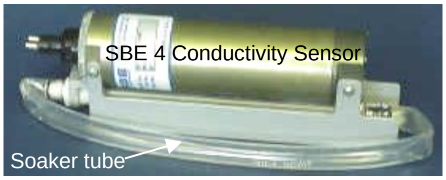
Frequency associated with *zero conductivity* (dry conductivity cell). Variation of ± few 10ths of a Hz indicates a dirty cell.

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

Rinsing, Cleaning, and Storage Procedures

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 cells produced since 1980 is 7/16" ID, 9/16" OD. Instruments shipped prior to 1980 require 3/8" ID tubing.



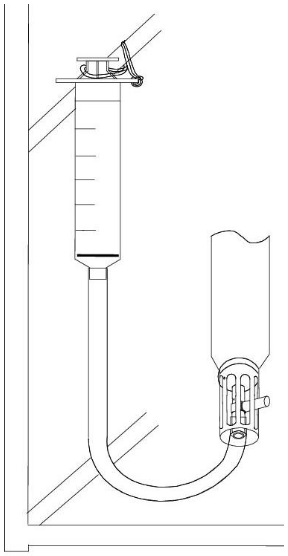
Do not put a brush or object (e.g., cotton swab) **inside the conductivity cell to clean it or dry it.** Touching and bending the electrodes can change the calibration; large bends and movement of the electrodes can damage the cell.

If a dissolved oxygen (DO) sensor is plumbed to the CTD, disconnect the tubing between the conductivity cell and DO sensor to prevent extended detergent contact with the DO sensor membrane (SBE 43) or optical window (SBE 63). Extended contact with detergent can cause temporary sensitivity (slope) changes to the sensors.

After each cast

1. Rinse: Remove the plumbing (Tygon tubing) from the exhaust end of the conductivity cell. Flush the cell with a 0.1% detergent solution. Rinse thoroughly with fresh, clean water and drain.
   - If not rinsed between uses, salt crystals may form on the conductivity cell platinized electrode surfaces. When the instrument is used next, sensor accuracy may be temporarily affected until these crystals dissolve.
2. Store: The intent of these storage recommendations is to keep contamination from aerosols and spray/wash on the ship deck from harming the sensor's calibration.
   - *No danger of freezing*: Fill the cell with a 500 – 1000 ppm bleach solution, using a loop of Tygon tubing attached to each end of the conductivity sensor to close the cell ends.
   - *Danger of freezing*: Remove larger droplets of water by blowing through the cell. **Do not use compressed air**, which typically contains oil vapor. Attach a loop of Tygon tubing to each end of the conductivity cell to close the cell ends.

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



Use the syringe kit and tubing supplied with the CTD, part number 50087, or 50087.1 for routine cleaning. If there is a limited supply of fresh, clean water available, flush the cell five times, or until it is thoroughly rinsed.

1. **Bleach**—Agitate a 500 – 1000 ppm solution warmed to 40 °C (wrist warm) through the cell in a washing action for 2 minutes. Drain and flush with warm (not hot) fresh, clean water for 5 minutes or until rinsed thoroughly.
2. **Detergent**—Agitate a 1-to-2% detergent solution warmed to 40 °C (wrist warm) through the cell many times in a washing action. 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.

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 five times. Thoroughly rinse in distilled or de-ionized water, then 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. If the zero conductivity is still outside the expected range, the conductivity cell may require factory cleaning.

Long-Term Storage

1. Remove the plumbing (Tygon tubing) from the exhaust end of the conductivity cell. Flush the cell with a 0.1% detergent solution. Rinse thoroughly with fresh, clean water and drain. Remove larger droplets of water by blowing through the cell. **Do not use compressed air**, which typically contains oil vapor.

2. Attach a loop of Tygon tubing to each end of the conductivity cell to close the cell ends and prevent contaminants from entering the cell. Storing the cell dry prevents the growth of any bio-organisms in water in the cell, thus preserving the calibration.

3. When ready to deploy again: Fill the cell with a detergent solution for 1 hour before deployment. Drain the detergent solution; there is no need to rinse the cell.

Cleaning Materials

Tygon® Tubing

Sea-Bird recommends use of Tygon tubing, because it remains flexible over a wide temperature range and with age. It is supplied by Sea-Bird, but is 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.

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. The seawater must be extremely clean, and 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.
- 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.

Detergent

A detergent with Octyl Phenol Ethoxylate, a mild, non-ionic surfactant, 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. 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.

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 pm/50 = 1000 ppm) solution.

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 (CH_3COOH) in aqueous solution; verify that there are no oils or other ingredients.

1. Place a 0.6 m (2 ft) length of Tygon tubing over the end of the conductivity cell.

2. Clamp the instrument so that the cell is vertical, with the Tygon tubing at the bottom end.

3. 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.

4. Pour a 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.**

5. Drain the solution from the cell and flush for 5 minutes with warm, clean, de-ionized water.

6. Rinse the exterior of the instrument to remove any spilled solution from the surface.

7. Fill the cell with a detergent solution and let it stand for 5 minutes.

8. Drain and flush with warm, clean, de-ionized water for 1 minute.

9. Carefully remove the 0.6 m (2 ft) length of Tygon tubing.

10. 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 Sea-Bird or see *Hydrochloric Acid (HCl)* below.

11. Prepare for deployment, or follow recommendations above for storage.

Hydrochloric Acid (HCl)

WARNINGS!

Observe all precautions for working with strong acid. • Avoid breathing acid fumes. • Work in a well-ventilated area.

Cautions

1. Sensors with integral, internal pumps: do not use HCl for cleaning because the pump may be damaged. Return the instrument to Sea-Bird.
   This includes:
   - SBE 37-IMP
   - SBE 37-IMP-ODO
   - SBE 37-SIP
   - SBE 37-SMP
   - SBE 49
   - SBE 52-MP
   - Any other instrument with an internal pump

2. Remove the SBE 4 conductivity cell and the TC Duct from the SBE 9plus, SBE 25, or SBE 25plus before performing acid cleaning.

3. Remove the AF24173 Anti-Foulant devices from all instruments before performing acid cleaning. Refer to the instrument's user manual for details and handling precautions.

Sea-Bird does not recommend this procedure, though in rare instances it may be needed to remove mineral contamination in the conductivity cell. Bleach has proven to be effective in eliminating growth of bio-organisms, and is much easier to use and dispose of than acid. Sea-Bird recommends that you return the equipment to the factory for this cleaning if it is necessary. The information below is provided in the even that it is not possible to return the equipment to Sea-Bird.

The acid cleaning procedure for the conductivity cell uses approximately 50–100 cc of acid. Sea-Bird recommends using a 20% concentration of HCl. However, acid in the range of 10% to full strength (38%) is acceptable.

If starting with a strong concentration of HCl that you want to dilute:
For each 100 cc of concentrated acid, to get a 20% solution, mix with this amount of water -

Water = [(conc% /20%) – 1] * [100 + 10 (conc% / 20%)] cc

Always add acid to water; never add water to acid.

Example -- concentrated solution 31.5% that you want to dilute to 20%:
[(31.5% / 20%) – 1] * [100 + 10 (31.5% / 20%)] = 66.6 cc of water.
So, adding 100 cc of 31.5% HCl to 66.6 cc of water provides 166.6 cc of the desired concentration.
For 100 cc of solution:
100 cc * (100 / 166.6) = 60 cc of 31.5% HCl   66.6 cc * (100 / 166.6) = 40 cc of water

To dispose of the acid, dilute the acid heavily or neutralize with bicarbonate of soda (baking soda).

1. Place a 0.6 m (2 ft) length of Tygon tubing over the end of the conductivity cell.
2. Clamp the instrument so that the cell is vertical, with the Tygon tubing at the bottom end.
3. 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.
4. Pour **10–38% HCl** solution into the open end of the tubing until the cell is nearly filled. **Soak for 1 minute only.**
5. Drain the acid from the cell and flush for 5 minutes with warm (not hot), clean, de-ionized water.
6. Rinse the exterior of the instrument to remove any spilled acid from the surface.
7. Fill the cell with a detergent solution and let it stand for 5 minutes.
8. Drain and flush with warm, clean, de-ionized water for 1 minute.
9. Carefully remove the 0.6 m (2 ft) length of Tygon tubing.
10. Prepare for deployment, or follow recommendations above for storage.