




## The Cruise: Before, During, and After

Sea-Bird Scientific University Module 22





## Overview



### The Cruise: Before, During, and After


This module covers the following:

- Pre-cruise inspections/checks of equipment
- Spare parts and tools you may want to have on hand when on a cruise
- Care and maintenance of equipment during cruise and between casts
- Post-cruise equipment maintenance



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## Pre-Cruise Equipment Checks



### Pre-Cruise Equipment Checks

- Helps to prevent *last minute* problems that can delay or impact a cruise
- Especially important if you are not *sole* user of equipment
- Should be done as soon before cruise as is reasonably possible

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## Pre-Cruise Equipment Checks

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### What should be checked? (Recommendations)

- All connectors and cabling
- All hardware/fasteners, mount clamps, and blocks
- Ferrites – Inductive Modem parts
- Instrument plumbing
- Pressure ports / plumbing
- Battery compartment(s) and batteries

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We'll discuss these in more detail in the next few slides.

These checks are directed mostly toward equipment that is typically only used a few times a year.

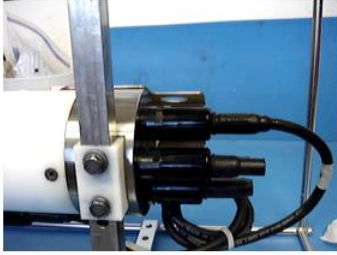
Equipment that is used in regular weekly/monthly sampling may not need to be checked as thoroughly before each use.

## Pre-Cruise Equipment Checks -- Connectors




### Check Connectors

- Disconnect each cable or dummy plug one at a time
  - Inspect each exposed connector for corroded or damaged pins
  - Make sure connector is not loose




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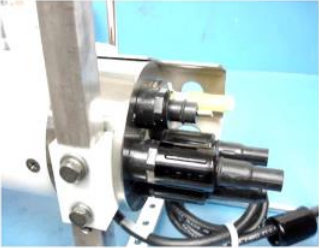
*Application Note 57: Connector Care and Cable Installation* on our website is a good resource for connector cleaning and installation, and also provides cold weather installation tips.

## Pre-Cruise Equipment Checks – Cables and Dummy Plugs



### Check Cabling


- Inspect each cable boot or dummy plug for corrosion
- Check cable for cracks and abrasions in its outer jacket



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Cables can be damaged by chaffing, extreme bends, or contact with the ship deck or hull (pinching).

## Pre-Cruise Equipment Checks – Cables and Dummy Plugs (*continued*)



### Re-Install Cables and Dummy Plugs

- Clean and re-lubricate connector boots, dummy plugs, and connectors
  - Clean with Kimwipes or other lint free cloth or wipe
  - SBE recommends Dow Corning® DC4 for lubrication
- Never use petroleum-based products




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**Do not use WD-40 or other petroleum-based lubricants;** petroleum-based lubricants will damage connectors.

Dow Corning® DC-4 is a silicone-based electrical insulating compound.


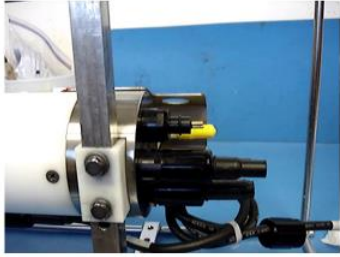
Other lubricants may have a tendency to *ball* when cold.

## Pre-Cruise Equipment Checks – Cables and Dummy Plugs (*continued*)



### Proper Installation Technique

- Clean and very lightly lubricate connector body and cable boot with DC4
- Align pins and press connector boot onto connector
- *Burp* connector to remove any trapped air



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Align the dimple on the connector boot with the large pin on the connector.  
Remember to *burp* the connector(s) after installation.

In cold weather, a connector may be hard to install and remove.

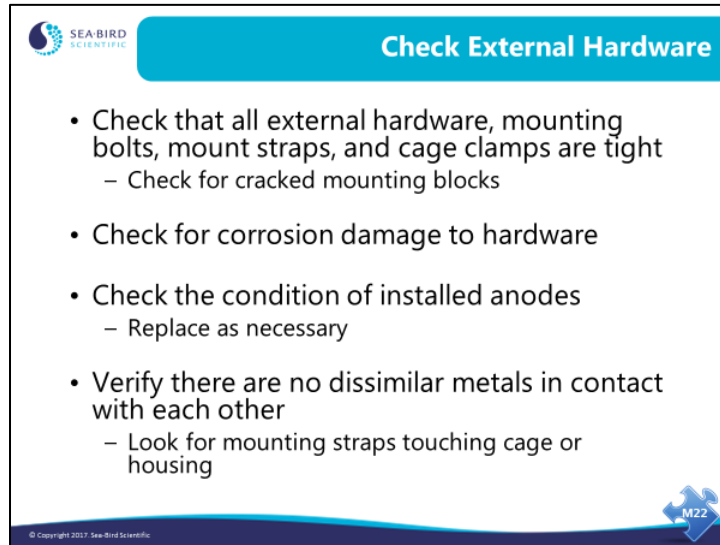
When possible, mate connectors in warm environments before the cruise and leave them connected. If not, warm the connector sufficiently so it is flexible.

To remove a frozen connector:

1. Wrap the connector with a washrag or other cloth.
2. Pour hot water on the cloth and let the connector sit for a minute or two. The connector should thaw and become flexible enough to be removed.



## Pre-Cruise Equipment Checks – External Hardware



The slide features the SEA-BIRD SCIENTIFIC logo in the top left corner. The title 'Check External Hardware' is centered at the top in a blue header bar. The main content is a bulleted list of four items, each with a sub-point. In the bottom right corner, there is a blue diamond icon with 'M22' inside. The bottom left corner contains the copyright text '© Copyright 2017, Sea-Bird Scientific'.


- Check that all external hardware, mounting bolts, mount straps, and cage clamps are tight
  - Check for cracked mounting blocks
- Check for corrosion damage to hardware
- Check the condition of installed anodes
  - Replace as necessary
- Verify there are no dissimilar metals in contact with each other
  - Look for mounting straps touching cage or housing

Excess corrosion on anodes can negate their effectiveness.

Rapid loss of anode material can be an indication of grounding problems.

Always install Teflon insulating tape on mounting straps. Pay particular attention to the buckle on the mounting strap.


## Pre-Cruise Equipment Checks – Plumbing



### Inspect Instrument's Plumbing

- Plumbing should be clean and free of salt and biological deposits
  - Clean/replace as necessary
- Ensure hole in air bleed valve is open
  - Use a piece of #26 AWG wire
- Make sure all plumbing connections are properly tie-wrapped
  - DO NOT tie-wrap to conductivity cell
- Examine conductivity cell for damage

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Contaminated plumbing may degrade the initial data.

New instruments include several pieces of wire for clearing the air bleed hole.

Conductivity cells are glass and can be damaged by impact or mishandling.

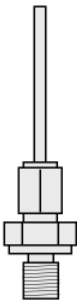
- Cells with chipped **ends** are usually OK to use.
- Larger cracks or breaks in the cell will cause bad data and may allow the instrument to flood.


## Pre-Cruise Equipment Checks – Pressure Capillary



Instruments with Pressure

- Instruments with pressure capillaries
  - SBE 9*plus*
  - SBE 16
  - SBE 16*plus* with Digiquartz pressure sensor
  - SBE 16*plus*-IM with Digiquartz pressure sensor
  - SBE 19
  - SBE 29 (used on SBE 25 CTD)
- Verify that pressure port is adequately filled with oil and that pressure port is not blocked by salt build-up
  - Re-fill as required





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Sea-Bird can provide a pressure sensor oil refill kit, PN 50025, for these instruments.

*Application Note 12-1: Pressure Port Oil Refill Procedure & Nylon Capillary Fitting Replacement* provides the details on use of the kit.

Note: Instruments with Druck strain gauge pressure use a pressure port plug instead of a pressure capillary; oil filling is not required. These instruments include: SBE 16*plus*, 16*plus*-IM, 16*plus* V2, 16*plus*-IM V2 with strain gauge pressure sensor; 19*plus* and 19*plus* V2, 25*plus*, 37, 39, 49, and 52-MP.

The SBE 26, 26*plus*, 53, and 54 have a pressure capillary connected to a bladder bag, which is filled with silicone oil at the factory. See the applicable user manual for details.

## Pre-Cruise Equipment Checks – Batteries



### Battery Compartment

- If history of installed batteries is unknown, Sea-Bird recommends that they be replaced
- Check battery pads and springs for corrosion damage
- If using NiMH or NiCad batteries, verify that they will take and hold a charge
- Clean and inspect battery end cap O-rings and sealing surfaces, and re-install end cap
  - Replace O-rings as required


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Batteries may have a *good* voltage reading when not under load.

**Always make sure that the battery end cap and the cage above the battery end cap are completely dry before opening the battery end cap.** This will prevent water from dripping into the battery compartment.


## Pre-Cruise Equipment Checks – Inductive Instruments



### Inductive Modem Instruments

- Inductive Modem instruments are equipped with an inductive coil, comprising two ferrite-core halves
- Check ferrites for cracks or chips; it is important that ferrite halves make good face-to-face contact when clamps are assembled
- Verify clamp inserts are correct size for your deployment cable


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Proper communications with an IM instrument requires that the ferrites are not damaged, and that the two modem halves mate closely ( $< 0.1$  mm gap). Note that if the clamp inserts are too small for the cable, there will be a gap between the modem halves. An attempt to reduce the gap may damage the cable or modem if the bolts are over-tightened.

*Application Note 85: Handling of Ferrite Core on Instruments with Inductive Modem Telemetry* provides details.

## Pre-Cruise Equipment Checks – Verify Functionality




### Verify Functionality



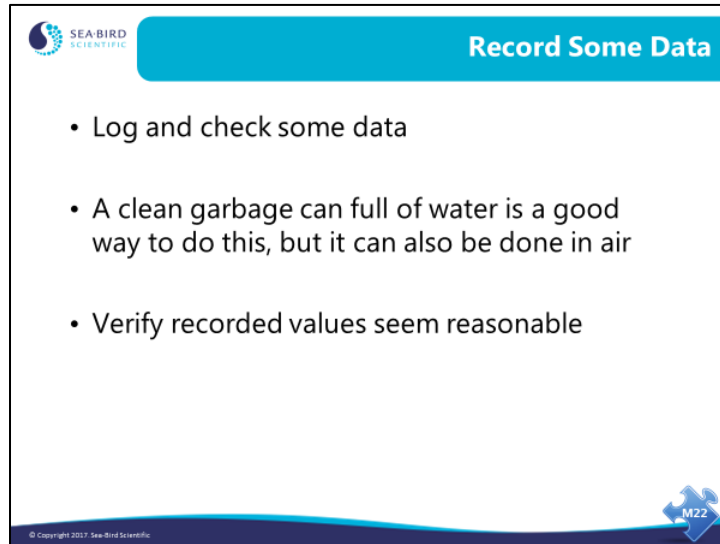
- Establish communications with instrument
- If possible, use same computer that will be used on cruise
- Verify you have most recent calibration coefficients
  - Check for both electronic and hard copies

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As applicable, capture and save responses to status commands (**DS** – display status, **DC** – display calibration coefficients, etc.). This will help to verify the instrument setup if troubleshooting is required later.

## Pre-Cruise Equipment Checks – Verify Functionality (continued)



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### Record Some Data

- Log and check some data
- A clean garbage can full of water is a good way to do this, but it can also be done in air
- Verify recorded values seem reasonable


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As mentioned on the last slide for the status commands, saving this data will help to verify the instrument was functioning properly before the deployment if troubleshooting is required later.

If the testing is performed in air, put a few drops of water in the pump head to lubricate the pump impeller.


## Shipping Precautions



### Prepare Instrument for Shipping

- Make sure instrument is dry
  - See App Note 2D for conductivity cell care
  - See App Note 64 for dissolved oxygen sensor care
- If instrument has a magnetic switch, place a piece of electrical tape across it in OFF position
- Verify all dummy plugs have been re-installed
- Package instrument for shipping

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If shipping by air:

- Lithium batteries cannot be shipped installed in MicroCATs or SBE 44s.
- D-cell lithium batteries cannot be shipped installed in the instrument.
- NiMH battery packs cannot be shipping installed in the instrument.

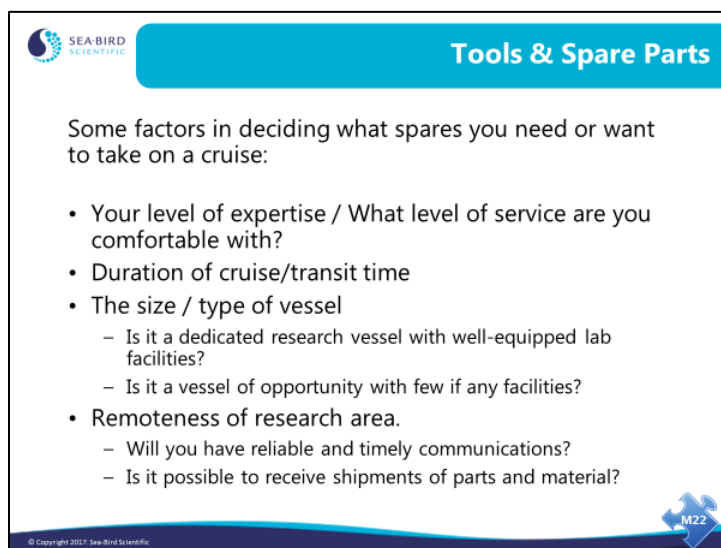
We'll cover this in more detail in Module 18.

Taping the magnetic switch will prevent the instrument from being turned on accidentally during transit.

If spare parts are being shipped in the crate, make sure they are adequately secured.



## Tools and Spare Parts



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### Tools & Spare Parts

Some factors in deciding what spares you need or want to take on a cruise:

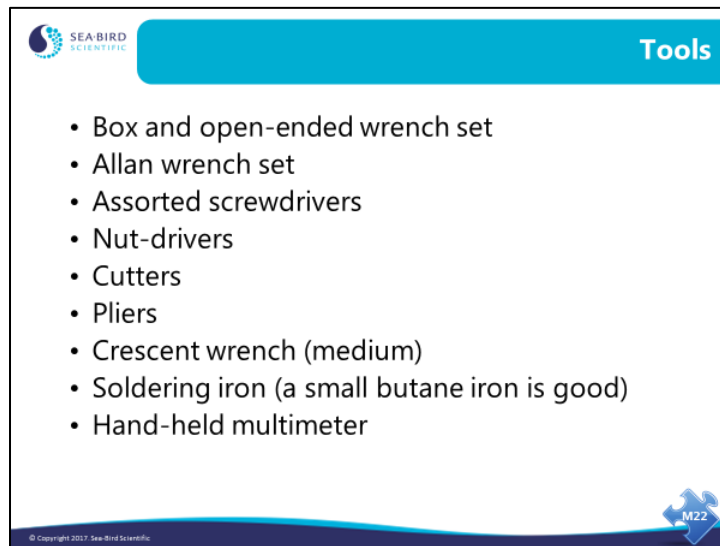
- Your level of expertise / What level of service are you comfortable with?
- Duration of cruise/transit time
- The size / type of vessel
  - Is it a dedicated research vessel with well-equipped lab facilities?
  - Is it a vessel of opportunity with few if any facilities?
- Remoteness of research area.
  - Will you have reliable and timely communications?
  - Is it possible to receive shipments of parts and material?

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Some spares are not practical as their use requires recalibration of the instrument (for example, spare conductivity cells and spare temperature probes).

## Tools and Spare Parts *(continued)*



The slide features a blue header with the 'SEA-BIRD SCIENTIFIC' logo on the left and the word 'Tools' on the right. A list of tools is centered on the slide. In the bottom right corner, there is a blue icon with the text 'M22' and a copyright notice '© Copyright 2017 Sea-Bird Scientific' in the bottom left corner.

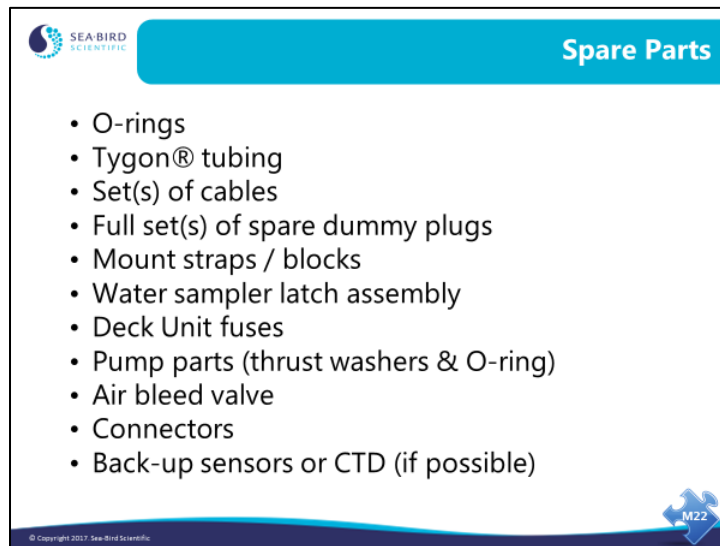
- Box and open-ended wrench set
- Allan wrench set
- Assorted screwdrivers
- Nut-drivers
- Cutters
- Pliers
- Crescent wrench (medium)
- Soldering iron (a small butane iron is good)
- Hand-held multimeter

If weight is a factor, create a custom tool box with only tools that fit the hardware installed on your instrument.

A crescent wrench is useful for opening the battery end cap.

The Multimeter can be a valuable diagnostic tool.

## Tools and Spare Parts (*continued*)



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- O-rings
- Tygon® tubing
- Set(s) of cables
- Full set(s) of spare dummy plugs
- Mount straps / blocks
- Water sampler latch assembly
- Deck Unit fuses
- Pump parts (thrust washers & O-ring)
- Air bleed valve
- Connectors
- Back-up sensors or CTD (if possible)


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When it comes to spares, having more is usually better!

Work within your comfort zone when deciding what you need as spares.

The best *Spare* is a backup system.

## Tools and Spare Parts (*continued*)




The slide is titled "Materials" and lists various supplies needed for a cruise. It features the SEA-BIRD SCIENTIFIC logo in the top left and a blue header bar. The list is organized into two columns. At the bottom right, there is a blue icon with the text "M22" and a copyright notice "© Copyright 2017, Sea-Bird Scientific" at the bottom left.

Materials	
<ul style="list-style-type: none"><li>• Spare batteries</li><li>• 1 L pre-mixed Triton X-100 solution, 0.1%</li><li>• 500 mL pre-mixed Triton X-100 solution, 1% - 2%</li><li>• 1 L pre-mixed Bleach solution, 500 – 1,000 ppm</li><li>• White vinegar</li><li>• Several liters of DI Water</li><li>• T/C backfilling syringe(s)</li><li>• Oil backfilling kit</li><li>• Kimwipes or other lint-free wipes</li><li>• Parker Super O Lube</li><li>• DC4</li></ul>	<ul style="list-style-type: none"><li>• Blue Moly</li><li>• Loctite® (or equivalent)</li><li>• Solder</li><li>• Electrical tape</li><li>• Air bleed valve cleaning wire</li><li>• Assorted tie-wraps</li><li>• Hard copies of Calibration Sheets</li><li>• Copy of the instrument's manual</li><li>• Short <i>test</i> cable (real-time instruments)</li><li>• Small plastic pail</li></ul>


Having pre-mixed solutions is a timesaver.

Use bottled DI water for flushing cells and sensors. The ship's fresh water supplies may contain trace contaminants.


## Activity: Troubleshooting

 **Activity: Troubleshooting**


- What is wrong with this instrument?



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## Deployment: Instrument Plumbing



### Plumbing for Success

- Sea-Bird conductivity cells and oxygen plenums rely on water passing through them, usually via a pump
- Pump is magnetically coupled impeller type, not self-priming
- Arrange tubing on instrument package to allow all air to escape from plumbing
- Periodically inspect impeller thrust washers and pump impeller housing

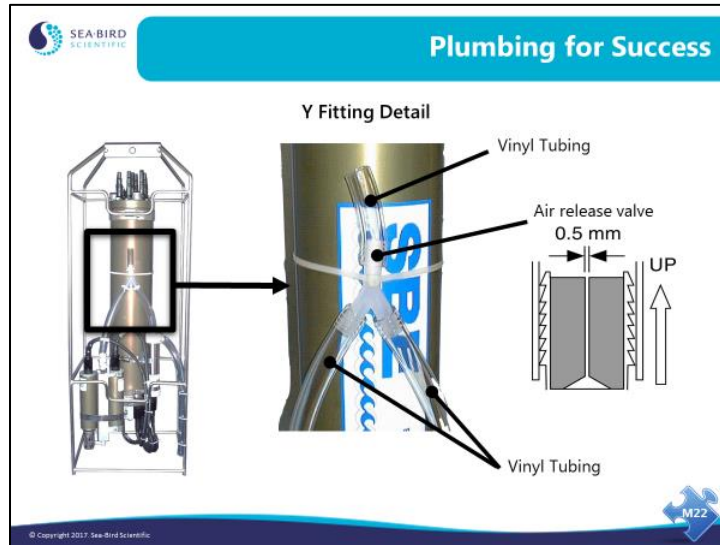


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Sea-Bird CTDs use a pump to maintain a constant flow of water through the conductivity cell and past the oxygen electrode. While this technique complicates the instrument package, it pays off in data quality. The tubing that connects the pump and the sensors must be arranged to allow all the air that is in the system while it is on deck to escape quickly when it is submerged. Failure to allow a path for the air to escape causes problems in the first 10 meters of data collection. Beyond 10 meters, the bubbles usually collapse sufficiently for the system to operate correctly. If bubbles collect in the pump, it will fail to prime. If bubbles are caught in the conductivity cell, the pump will fail to turn on. If bubbles are caught in the dissolved oxygen plenum, the dissolved oxygen signal will be in error.

Note: For additional information on self-priming vs non-self-priming pumps, see [www.pumpstoreusa.com/knowledgebase/selfpriming](http://www.pumpstoreusa.com/knowledgebase/selfpriming)

## Deployment: Instrument Plumbing (*continued*)

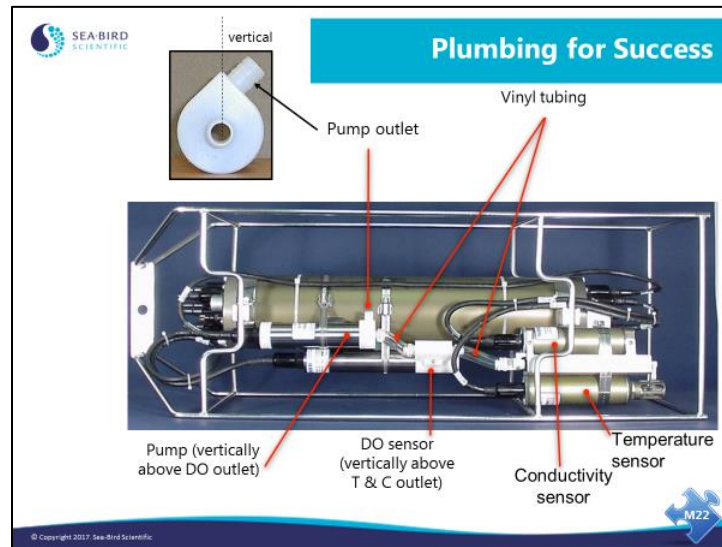


This slide shows the proper way to run the tubing for an instrument in a cage meant to be deployed vertically. Note the highest point in the plumbing is the top of the *Y*; there is a fitting with a small hole in the top of the *Y* that allows the air in the tubing to vent as the instrument goes into the water.

For the *SBE 9plus*, an exhaust tube runs from the pump outlet down the side of the cage, stopping at the same height as the T-C duct inlet. This equalizes pressure at the plumbing inlet and outlet, eliminating any acceleration / deceleration of water in the plumbing (which can cause small errors in the measurements). The exhaust tube is usually omitted for the *SBE 19* and *25* families of instruments, due to the lower accuracy of those systems.

Periodically clean the air release valve with a 0.4 mm diameter wire (you can use #26 AWG wire), and blow through it to ensure it is open. A clogged air release valve can trap air, preventing the pump from functioning properly; this will affect the data quality.

## Deployment: Instrument Plumbing (*continued*)





Instruments meant for horizontal deployment are easier to plumb. The pump is oriented so that the outlet is the highest point on the plumbing. Care must be taken to ensure there are no loops in the plumbing that would trap air. Because this system is meant to be deployed horizontally, there is no *sloshing* effect and no requirement for the SBE 9plus that the inlet and outlet be at the same height.

*Application Note 64-1: Plumbing Installation – SBE 43 DO Sensor and Pump on a CTD* on the website provides more details on both the vertical and horizontal plumbing schemes.




## Deployment: Pump Operation



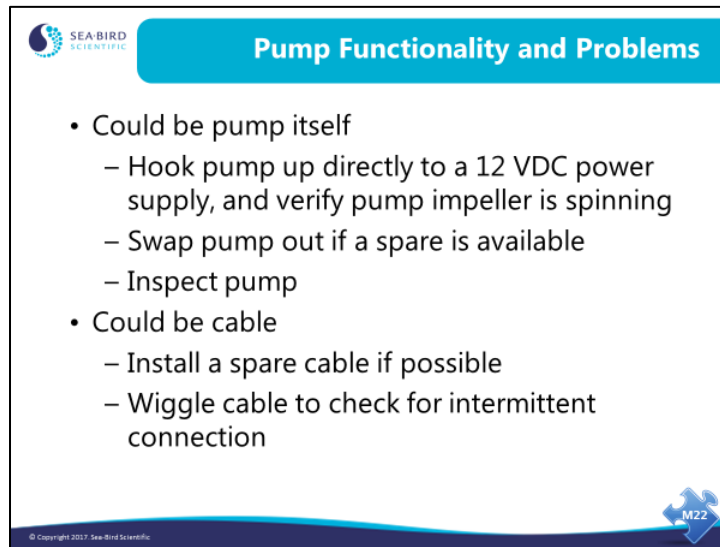
### Pump Testing

- Test pump (standard pump circuitry)
  - With instrument connect to your compute, run Seaterm V2, use PUMP ON command to see if pump turns on
  - Verify pump impeller is spinning
    - Listen for pump to turn on
    - Look for disturbance at exhaust of pump if in water
    - Put your finger at intake or exhaust to feel if there is water movement



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## Deployment: Pump Operation (*continued*)




The slide features the SEA-BIRD SCIENTIFIC logo in the top left corner. The title 'Pump Functionality and Problems' is centered in a blue header bar. The main content is a bulleted list of troubleshooting steps. In the bottom right corner, there is a blue puzzle piece icon with 'M22' written on it. The bottom left corner contains a small copyright notice: '© Copyright 2017 Sea-Bird Scientific'.

- Could be pump itself
  - Hook pump up directly to a 12 VDC power supply, and verify pump impeller is spinning
  - Swap pump out if a spare is available
  - Inspect pump
- Could be cable
  - Install a spare cable if possible
  - Wiggle cable to check for intermittent connection


Neatness counts! Secure all your loose cables. When you lower your instrument package at 1 meter per second, any loose cabling will flap. This sort of repetitive motion will fatigue the cables and shorten their working life.

## Deployment: Failed Underwater Connections...Be Neat!




### Make a Neat Underwater Package

- Cable tie or tape all loose cabling to frame of package
  - Loose cables flap as package rises or drops, resulting in fatigue
- Make sure no cables are in path of inlet to temperature sensors
- Instrument with aluminum housing: check zinc anodes occasionally; grounding problems can cause them to disappear




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Neatness counts! Secure all your loose cables. When you lower your instrument package at 1 meter per second, any loose cabling will flap. This sort of repetitive motion will fatigue the cables and shorten their working life.

## Deployment: Using your CTD in Very Cold Places



**Using Your CTD in Very Cold Places**

- Glass conductivity cell is subject to breakage due to water freezing in cell
- Remove all water from conductivity cell
  - Repeated ice formation (film or droplets) on electrodes will degrade calibration at 0.001 - 0.020 PSU level
- Make a solution of 1% triton in sterile seawater
  - Use 0.5 micron filtered seawater or boiled seawater
- **Never use anti-freezes like glycol or alcohol**
- SBE 43 Oxygen Sensor – prevent freezing



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**Never store water in the conductivity cells or plumbing if there is a risk of freezing.**

Another option in place of a Triton solution for the conductivity cell is the use of a brine solution (distilled seawater or homemade salt solution that is higher than 35 psu in salinity), as salty water depresses the freezing point. However, there is still a risk of forming ice inside the conductivity cell if deploying through frazil ice on the surface, if the freezing point of the salt water is the same as the water temperature.

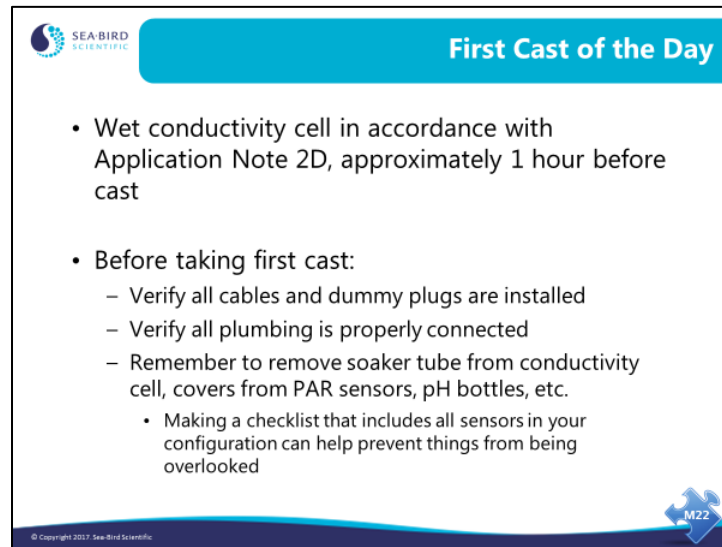
- If no surface frazil ice is present, rinse the conductivity cell in the 1% Triton solution or in a brine solution to prevent freezing during deployment. But this does not mean you can store the cell in this solution outside...it will freeze!
- If surface frazil ice is present, it is best to deploy the conductivity cell in a dry state.

Commercially available alcohol or glycol antifreezes contain trace amounts of oils that will coat the conductivity cell and the electrodes, causing a calibration shift, and consequently result in errors in the data. **Do not use alcohol or glycol in the conductivity cell!**

For the SBE 43 Dissolved Oxygen Sensor, avoid prolonged exposure to freezing temperatures, including during shipment. Do not store the SBE 43 with water, Triton

solution, alcohol, or glycol in the plenum. The best precaution is to keep the SBE 43 indoors or in some shelter out of the cold weather.

## Deployment: Final Preparation



**SEA-BIRD SCIENTIFIC** **First Cast of the Day**

- Wet conductivity cell in accordance with Application Note 2D, approximately 1 hour before cast
- Before taking first cast:
  - Verify all cables and dummy plugs are installed
  - Verify all plumbing is properly connected
  - Remember to remove soaker tube from conductivity cell, covers from PAR sensors, pH bottles, etc.
    - Making a checklist that includes all sensors in your configuration can help prevent things from being overlooked


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Use a 0.1% Triton X-100 solution to rewet the conductivity cell.

**Soaker tubes and par covers inadvertently left in place can cause severe damage.**



A check list is especially helpful if personnel unfamiliar with the system are assisting (Students, Grad Students, Ship's Tech, etc.).

## Deployment: Final Preparation (*continued*)



### What Do You Mean, Soak the Fish?

- This is not done in the galley!
- Soaking means putting the instrument package over the side and into water at a safe but shallow depth (like 10 meters)
- Soaking tip: use 2 display types
  - Fixed or scrolled text display to check all sensors and other parameters on deck and during soak
  - Multi-line plot for the cast




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As you prepare to take a cast, it is considered good practice to place the instrument package in the water and allow it to equilibrate. This allows several good things to happen. The whole package comes to the surface temperature rather than the air temperature on deck, the conductivity cell wets with seawater, and the oxygen sensor comes to surface temperature (and in the case of older sensors, the oxygen sensor polarizes). Further, if you are working in real-time, you can quickly confirm the operation of the instrument and all the sensors. This is a great idea because nothing irritates the deck crew more than starting the cast only to bring the instrument package back aboard a few minutes later.



If you are using a real-time system, use 2 different display types in Seasave: a text display (fixed and/or scrolled) for deck and surface soak checkout, and a plot for the cast. The text display will tell you that the sensors are working and when the pump comes on.

## Care and Maintenance during Cruise



### Between Casts

- Rinse equipment thoroughly with fresh water
  - On some vessels, amount of fresh water available for wash-down may be restricted; if so, use as much as Ship's Master will allow
  - Even a bucket full of fresh water is better than no wash-down at all
- Rinse and store conductivity cell in accordance with Application Note 2D
- Rinse and store dissolved oxygen sensor in accordance with Application Note 64

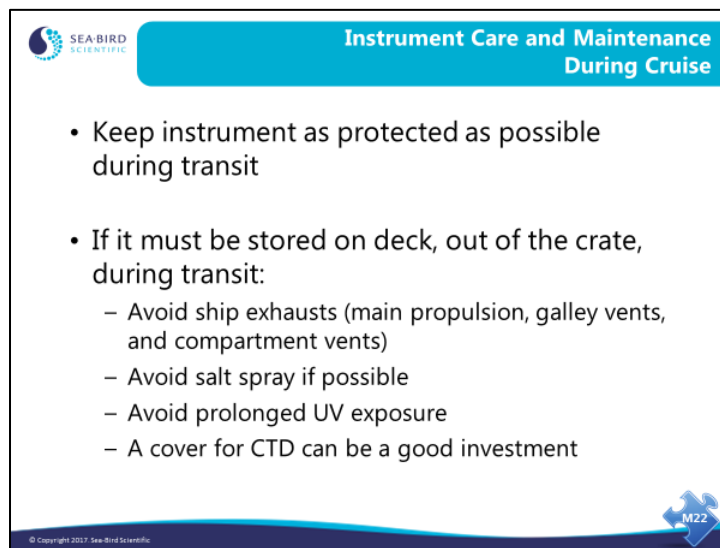


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Most ships have both freshwater and saltwater wash-down hose connections. Make sure you are using the freshwater.



## Care and Maintenance during Cruise (*continued*)



**SEA-BIRD SCIENTIFIC** Instrument Care and Maintenance During Cruise

- Keep instrument as protected as possible during transit
- If it must be stored on deck, out of the crate, during transit:
  - Avoid ship exhausts (main propulsion, galley vents, and compartment vents)
  - Avoid salt spray if possible
  - Avoid prolonged UV exposure
  - A cover for CTD can be a good investment

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Rough weather can create hazards.

Exhausts may contain traces of oils and other contaminants.

UV can shorten the life of plastics as well as promote growth of bio-fouling.


## Care of Conductivity Sensors in the Field



### Care of Conductivity Sensors in the Field


- How to tell when cell has sustained physical damage or is dirty
  - Rinse cell thoroughly with distilled or de-ionized water
  - Check sensor frequency (*zero frequency*) against calibration certificate
    - Numbers should agree to within a few tenths of a Hz
    - Noisy readings indicate a dirty cell
  - See Module 17 for more details on this check

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Every conductivity calibration certificate has a frequency output for zero conductivity. This is obtained from a cell thoroughly rinsed in distilled or de-ionized water, with all the water shaken out. This means there are no electrical paths within the cell. A zero 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; we suggest a good rinse with dilute bleach and Triton-X.

## Care of Conductivity Sensors in the Field (*continued*)



### Routine Cleaning of Conductivity Sensors

- Agitate 50:1 chlorine bleach solution through cell
- Follow with warm 1% - 2% Triton X solution
- Vinegar solution can be used to remove calcification
- Rinse well with distilled/deionized water



Never run a brush through a cell to clean it

Each platinum foil electrode has a coating of platinum black and is very delicate

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The cleaning with dilute bleach and Triton-X may be repeated several times for badly fouled sensors.

Sea lore has it that in some environments  $\text{CaCO}_3$  or other inorganic coatings may accrete on the inside of the cell. This is more likely in a moored instrument. An HCl solution will dissolve these. Rather than doing this aggressive cleaning yourself, Sea-Bird recommends that the sensor be returned to the factory for cleaning and inspection.

- For the SBE 37-IMP, 37-IMP-IDO, 37-SMP, 37-SMP-IDO, 37-SIP, and 37-SIP-IDO MicroCAT; SBE 49 FastCAT; and any other instruments with an integral internal pump: **Do not perform acid cleaning**; it must be performed at the factory to avoid damage to the pump.

See **Application Note 2D** on our website for complete details on cleaning conductivity cells.


## Care and Maintenance of Water Samplers



**SBE 32 Carousel and SBE 55 ECO  
Water Sampler Care**


- Proper care and maintenance of latch assemblies will help ensure reliable operation
  - Never use any lubricants on latches
  - Latches are water lubricated
  - Wash latches thoroughly between casts
  - (SBE 32 only) Depending on time between casts, store latches in a bucket of fresh water
  - Removing latches also permits proper washing of actuator magnets

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The titanium parts of the trigger are coated in Tiodizing (similar to anodizing aluminum).


## Flooded Instruments



Flooded Instruments

- While instrument flooding is rare, it does happen from time to time
- A flooded instrument can be under extreme pressure, particularly if flooded at deep depths
- If you suspect an instrument has flooded, use extreme caution
  - Point instrument's end cap(s) in a safe direction
  - **If applicable**, loosen end cap hardware (1/2 turn for each screw/bolt). If end cap *followed* hardware out, instrument may be under pressure






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Loosening the end cap hardware to test if the instrument is under pressure is only applicable to instruments that attach to the housing through the **top** of the end cap (for example, SBE *9plus*, *25*, *17plus*, *26*, *26plus*, *53*, *54*).


Loosening the end cap hardware to test if the instrument is under pressure is **not** applicable to instruments with end caps that attach to the housing through the **side** instead of the top of the end cap (for example, SBE *16plus* and *16plus V2*, *16plus-IM* and *16plus-IM V2*, *19plus* and *19plus V2*, *25plus*, *37*, *49*).

See your instrument manual for detailed instructions on handling flooded instruments.

## Flooded Instruments (*continued*)


 **Releasing Pressure**

- If instrument is pressurized, pressure can be released by **backing off** one of installed bulkhead connectors several turns
- This will break connector's O-ring seal and allow instrument to vent
  - Look for signs of internal pressure
    - *Hissing*
    - Leaking water



Pressure sensor port

Main Housing  
Bottom End Cap



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Some instruments do not have connectors Use extreme caution when handling these instruments.

## Flooded Instruments (*continued*)

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### What to Do with Instrument if Flooded


- Pour out any water inside housing
- Remove installed batteries
- Return instrument to Sea-Bird for evaluation

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Any details that you can provide to Sea-Bird regarding a flooded instrument are appreciated, especially deployment depth or the depth that good data was lost (modular or real time sensors).


## Care and Maintenance after Cruise



**Post-Cruise Maintenance  
for Profiling Instruments**

- Soak instruments in a clean garbage can full of fresh water, to help remove / dilute all salt water that may be trapped in gaps and crevices
  - Install loops of Tygon® tubing on conductivity cell and dissolved oxygen sensor to protect them
  - Remove locking sleeves from cables to allow flushing
- Soaking in fresh water especially applies to Carousel and ECO Water Samplers
  - Actuator magnets need thorough cleaning
  - Latches can be washed in a dishwasher

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Post-cruise maintenance is very important to the longevity of the instrument. Trapped salt water will form crystals as it dries; these crystals can eventually cause damage to both housings and O-rings.



## Care and Maintenance after Cruise (*continued*)

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### Post-Recovery Maintenance for Moored Instruments

- Manually remove as much bio-fouling as possible
  - Scotch-bright pads work well for this
  - A towel or rag soaked in white vinegar and wrapped around instrument helps to remove barnacle growth and other deposits
    - Plug cell ends or install a loop of Tygon®
  - Be careful not to damage conductivity cell if you remove cell guard
- Clean and inspect any installed cables
- Finally, soak these instruments in clean fresh water to remove / dilute any trapped saltwater and any remaining vinegar

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You need to remove as much biological material from the outside of the housing as possible. Sea-Bird cannot place an instrument with a large amount of biological material on the housing in our calibration bath. Plug the ends of the conductivity cell to prevent the cleaning solution from getting into the cell, and then soak the entire instrument in white vinegar for a few minutes. We recommend using a Heavy Duty Scotch-Brite pad ([http://www.3m.com/us/home\\_leisure/scotchbrite/products/scrubbing\\_scouring.html](http://www.3m.com/us/home_leisure/scotchbrite/products/scrubbing_scouring.html)) or similar scrubbing device.

When using vinegar on instruments with epoxy cast cells (SBE 4, 16, 19, and 21), avoid prolonged contact of the cell with the vinegar as it may damage the RTV on the cell.



If you painted the housing with anti-foul paint, you will need to remove this as well, using a Heavy Duty Scotch-Brite pad.

## Care and Maintenance after Cruise (*continued*)



### After Recovery

- Rinse equipment thoroughly with fresh water
- Rinse and store conductivity cell as described in Application Note 2D
- Rinse and store SBE 43 dissolved oxygen sensor as described in Application Note 64
  - SBE 63 follows similar protocol; see SBE 63 manual
- Remove fouling away from pressure sensor port
- If you want to post-calibrate sensors, **do not rinse** sensors prior to calibration or validation
  - Clean outside of instrument and loop Tygon to help protect sensors from getting rinsed



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Application note 2D:

<http://www.seabird.com/document/an02d-instructions-care-and-cleaning-conductivity-cells>

Application note 64:

<http://www.seabird.com/document/an64-sbe-43-dissolved-oxygen-sensor-background-information-deployment-recommendations>


## Care and Maintenance after Cruise (*continued*)



After Cleaning


- Allow instrument to dry
- Open battery compartment and remove any exhausted batteries
  - If instrument is going to be stored for an extended period, do not replace batteries
- Follow all storage guidelines for any installed sensors and for conductivity cell
- Store instrument in a clean, dry environment
- Place a loop of tubing between cell intake and pump exhaust to keep out dust/debris once dry

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If batteries leak in the battery compartment, battery bulkhead replacement needs to be performed at Sea-Bird.

## Sensor Storage

 **Storing Sensors**

- Conductivity cell storage between retrieval and calibration:
  - If stored in seawater, further bio-fouling may occur
  - Short-term (< 1 day): fill with distilled or DI water if no danger of freezing
  - Long-term (> 1 day): rinse with distilled or DI water, store dry, close ends
- If risk of freezing, always leave without water.



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Conductivity cell (See **Application Note 2D** for details.):

- Short-term storage: If there is no danger of freezing, store the conductivity cell with distilled or de-ionized water in Tygon tubing looped around the cell. If there is danger of freezing, store the conductivity cell dry, with Tygon tubing looped around the cell.
- Long-term storage: Since conditions of transport and long-term storage are not always under the control of the user, we recommend storing 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 inside the cell.

