

## **Module 16**


# **The Cruise – Before, During, and After**

## Overview

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*scuba*

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

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



## 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 the *sole* user of the equipment
- Should be done as soon before the cruise as is reasonably possible

## Pre-Cruise Equipment Checks



**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

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.

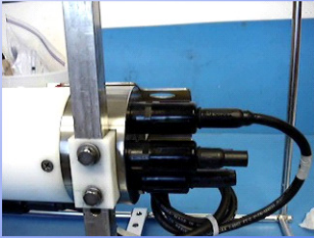
Equipment that is used in regular weekly/monthly sampling may not need to be checked as thoroughly before each use.

## Pre-Cruise Equipment Checks -- Connectors

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### Check Connectors

- Disconnect each cable or dummy plug one at a time.
  - Inspect each exposed connector for corroded or damaged pins.
  - Make sure the connector isn't loose.



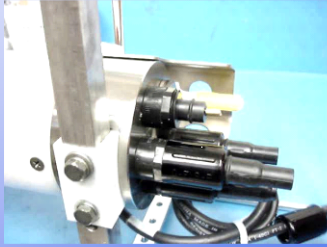
*Application Note 57: Connector Care and Cable Installation* on our website is a good resource for connector cleaning and installation, and also provides cold weather installation tips.

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

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### Check Cabling

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





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

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### 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.



**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.

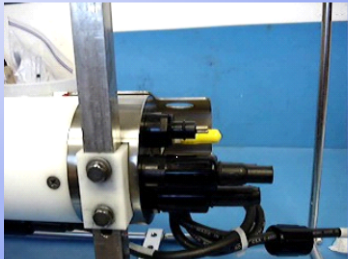
Other lubricants may have a tendency to *ball* when cold.

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

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CONCEPTS

### Proper Installation Technique

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



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



### Check the External Hardware


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




### Inductive Instruments

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

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 – Plumbing



### Inspect the Instrument's Plumbing

- Plumbing should be clean and free of salt and biological deposits.
  - Clean/replace as necessary.
- Ensure the hole in the 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 the conductivity cell.
- Examine the conductivity cell for damage.


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.

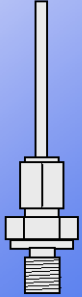
- Cells with chipped **ends** are usually OK to use.
- Larger cracks or breaks in the cell will cause bad data and may allow the instrument to flood.

## Pre-Cruise Equipment Checks – Pressure Capillary



### Instruments with Pressure

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




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 *16plus*, *16plus*-IM, *16plus* V2, *16plus*-IM V2 with strain gauge pressure sensor; *19plus* and *19plus* V2, *25plus*, 37, 39, 49, and 52-MP.

The SBE 26, *26plus*, 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 the history of the installed batteries is unknown, SBE recommends that they be replaced.
- Check the 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 the battery end cap O-rings and sealing surfaces, and re-install the end cap.
  - Replace O-rings as required.


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 – Verify Functionality

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### Verify the Functionality



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

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




**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 the recorded values seem reasonable.

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 the Instrument for Shipping**

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

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.



## Moored Instruments and Anti-Foul Paint




### Moored Instruments

- We request that moored instruments **NOT** be painted with marine anti-fouling bottom paint, as the paint will contaminate the calibration bath.
  - If the instrument is painted, all paint must be removed from the instrument prior to its return to SBE for re-calibration.



## Tools and Spare Parts



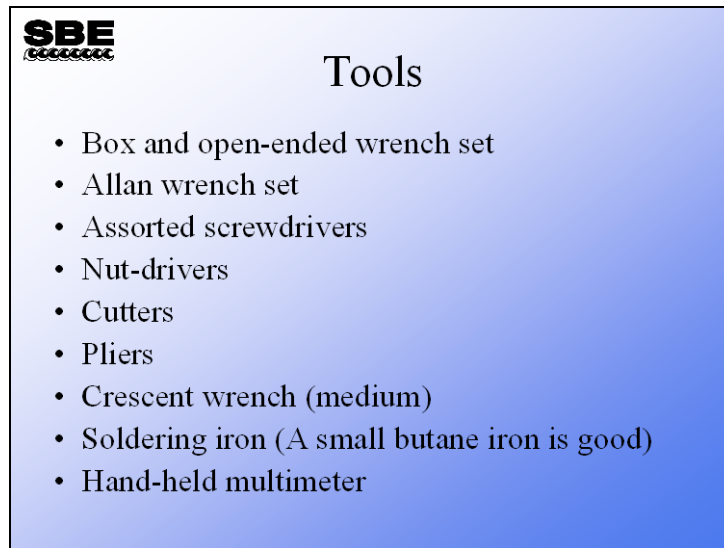
### Tools & Spare Parts

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?
- The duration of the cruise/transit time.
- The size / type of the 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 the research area.
  - Will you have reliable and timely communications?
  - Is it possible to receive shipments of parts and material?

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




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



### Spare Parts


- 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)

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




### Materials

- Spare batteries
- 1 L pre-mixed Triton X-100 solution, 0.1%
- 500 mL pre-mixed Triton X-100 solution, 1% - 2%
- 1 L pre-mixed Bleach solution, 500 – 1,000 ppm
- Several liters of DI Water
- T/C backfilling syringe(s)
- Oil backfilling kit
- Kimwipes or other lint-free wipes
- Parker Super O Lube
- DC4
- Blue Moly
- Loctite® (or equivalent)
- Solder
- Electrical tape
- Air bleed valve cleaning wire
- Assorted tie-wraps
- Hard copies of Calibration Sheets
- Copy of the instrument's manual
- Short *test* cable (real-time instruments)
- Small plastic pail

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.

## Care and Maintenance during Cruise



**Instrument Care and Maintenance  
During the Cruise**


- Keep the 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 the CTD can be a good investment.

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 and Maintenance during Cruise



### First Cast of the Day


- Wet the conductivity cell in accordance with Application Note 2D, approximately 1 hour before the cast.
- Before taking the first cast:
  - Verify all cables and dummy plugs are installed.
  - Verify all plumbing is properly connected.
  - Remember to remove the soaker tube from the 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.

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.).

## Care and Maintenance during Cruise



### After / Between Casts



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

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



## Care and Maintenance of Water Samplers




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

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

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.
- If you suspect an instrument has flooded, use extreme caution.
  - Point the instrument's end cap(s) in a safe direction.
  - **If applicable**, loosen the end cap hardware (1/2 turn for each screw/bolt). If the end cap *followed* the hardware out, the instrument may be under pressure.

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




### Releasing the Pressure

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

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

## Flooded Instruments




**What to Do with the Instrument  
if Flooded**

- Pour out any water inside the housing.
- Remove the installed batteries.
- Return the instrument to SBE for evaluation.

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

- Profiling instruments
  - Soak the instruments in a clean garbage can full of fresh water. This will help remove / dilute all salt water that may be trapped in gaps and crevices.
    - Install loops of Tygon® tubing on the conductivity cell and dissolved oxygen sensor to protect them.
    - Remove locking sleeves from the 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.

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 Moored Instrument Recovery



**Post-Recovery Maintenance  
for Moored Instruments**


- Manually remove as much bio-fouling as possible.
  - Scotch-bright pads work well for this.
  - A **short** soak in white vinegar will make this easier.
    - Plug the cell ends or install a loop of Tygon®.
  - Be careful not to damage the conductivity cell if you remove the cell guard.
- Clean and inspect any installed cables.
- Finally, soak these instruments in the same way as the profiling instruments to remove / dilute any trapped saltwater and any remaining vinegar.

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.

## Storing Instruments after Recovery



After Cleaning

- Allow the instrument to dry.
- Open the battery compartment and remove any exhausted batteries.
  - If the instrument is going to be stored for an extended period, do not replace the batteries.
- Follow all storage guidelines for any installed sensors and for the conductivity cell.
- Store the instrument in a clean, dry environment.

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

