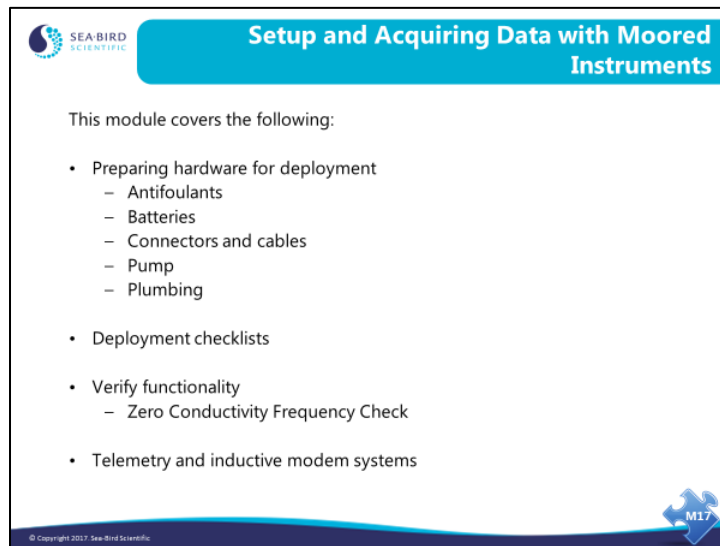




Setup and Acquiring Data with
Moored Instruments: Hardware
Sea-Bird Scientific University Module 17



Overview



SEA-BIRD SCIENTIFIC Setup and Acquiring Data with Moored Instruments

This module covers the following:

- Preparing hardware for deployment
 - Antifoulants
 - Batteries
 - Connectors and cables
 - Pump
 - Plumbing
- Deployment checklists
- Verify functionality
 - Zero Conductivity Frequency Check
- Telemetry and inductive modem systems


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In this module we will discuss setup of moored instruments for deployment, considering instrument status reports.

By the end of this module, you should be able to:



- Prepare your instrument for deployment

Anti-Foulant Paints




Anti-Foul Paint


- Do **NOT** paint instruments with marine anti-fouling bottom paint, as paint will contaminate calibration bath
 - If instrument is painted, all paint must be removed from instrument prior to its return to Sea-Bird for re-calibration
 - 3M Tape or the more expensive 3M-Copper tape is an effective anti-foulant that can be used and removed for easy cleaning




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Changing Batteries


 **Changing Batteries in SBE 16plus V2**


Unthread cap by rotating counter-clockwise

Remove Phillips-head screws and washers





Install new batteries, with + terminals against flat battery contacts and - terminals against spring contacts


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Changing Batteries (*continued*)


 **Changing Batteries in SBE 37**

 2 screws securing connector end cap (screws shown partially removed)
Cable mounting guide

 Handle
Loosen captured screw


 Twist end cap counter clockwise, twisting cap screw out of machined slot; end cap releases from housing

 Molex connector
O-rings



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Checking Cables and Connectors



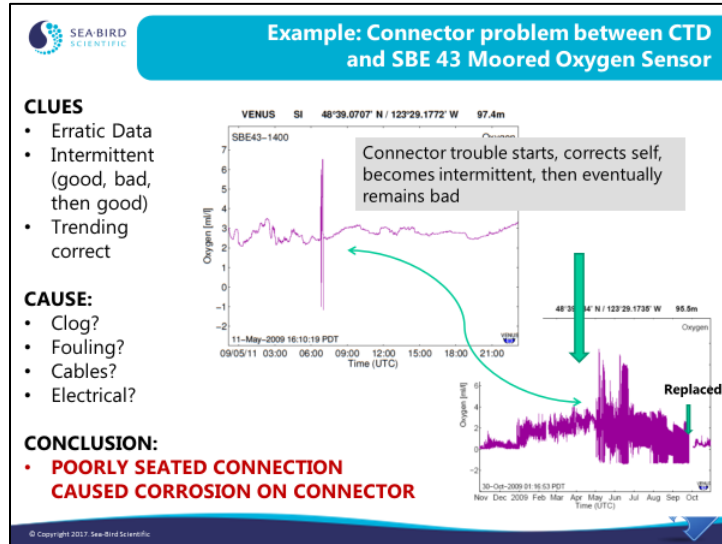
Check Connectors and Cables

- Check all the cabling
- Remove the cables from their bulkhead connectors
 - Inspect the bulkhead connectors and mating pieces
 - Clean and lubricate the bulkhead connectors
 - Burp all air out of the connectors when they are reseated


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Checking Cables and Connectors (*continued*)





Checking Cables and Connectors (*continued*)



When Underwater Connectors Go Bad




These were the connectors on recovery from the previous page DO plot showing intermittent data.




- **Look for signs of corrosion**
- **before plugging in in sensor.**
- **Be sure connectors are burped and seated.**
- **Align the pins and do not use too much lubricant.**

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Checking Cables and Connectors (*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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Clean Data Collection: Plumbing

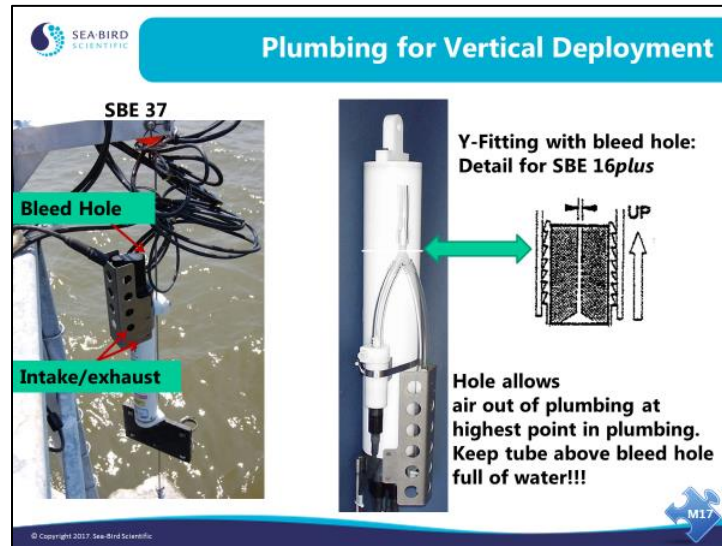


- Ensure that sensors sample same water
 - Plumbing
 - Place T, C sensors together and duct
- CTD deployment orientations
 - (vertical vs. horizontal)
- Ensure that sensors sample undisturbed water
 - No flow blockage/distortion on frame
 - No foreign thermal mass or wakes
- Periodically inspect impeller thrust washers and pump impeller housing



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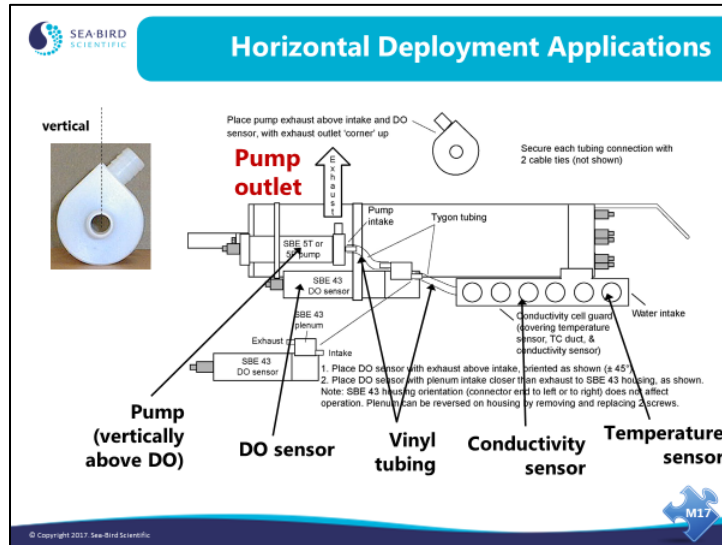
Clean Data Collection: Plumbing (*continued*)



On the right, SBE 16*plus* TC intake is lowest on package, so it is the first thing to see the water in the plumbing.


On the left, the SBE 37 MicroCAT can be deployed as shown or inverted. In the recommended orientation (shown), the air escapes through a bleed hole on the top. This orientation also helps prevent sedimentation in the plumbing. If deployed inverted, air escapes from the two openings at the intake and exhaust. But in this orientation, it is best to fill the plumbing with water before deployment, as there is no way for water to fill in fast enough through the bleed hole.

Clean Data Collection: Plumbing (continued)



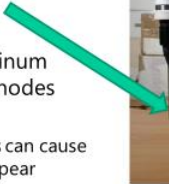

Notice here that the pump exhaust is now the highest point on the plumbing.

Clean Data Collection: Plumbing (*continued*)




Make a Neat Underwater Package



- Tie or tape all loose cabling to frame of package
 - Loose cables can move as package rises or drops
 - Results in wire 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 zinc anodes to disappear




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Preparing for Deployment




- Check memory, clear if necessary
 - (not all SBE 37s have internal memory)
 - Provides back up to real-time system
 - old data will NOT be overwritten
- Set Start Logging Date and Time
- Set sampling interval
 - be sure to check your battery endurance!



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Preparing for Deployment (*continued*)



**Sample Quickstart
Checklist for SBE 37**

SBE37 RS232 SN _____

Operator _____ Date _____ Checked by _____

Communications tab, Configure, Com Port _____, Baud 9600

DC (display coefficients) _____ *check to make sure they are in there and correct*

DS (display status) _____ *look at what you want to change*

Set Date/Time _____ (Local or UTC)

vMain _____


Sample Interval _____

Data format _____

Output Salinity (is it enabled?) _____ Mooring Depth Entered _____



Transmit real-time? _____

Minimum Conductivity Frequency _____




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Preparing for Deployment (*continued*)




- SBE 16*plus* series:
 - Check that you are getting outputs from all enabled sensors
- SBE 37 series:
 - Check that you are getting outputs from all sensors
- ALWAYS keep an archive copy of RAW, non-corrected data before initializing logging
 - This allows a return to original data for correction or reprocessing later on




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Preparing for Deployment: Sensor Check




Verify Functionality




- Log data on instrument, then upload and review
- or
- View data real-time using SeatermV2
 - Establish communications with instrument
- Verify you have most recent calibration coefficients
 - Check for both electronic and hard copies

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Preparing for Deployment: Sensor Check (*continued*)



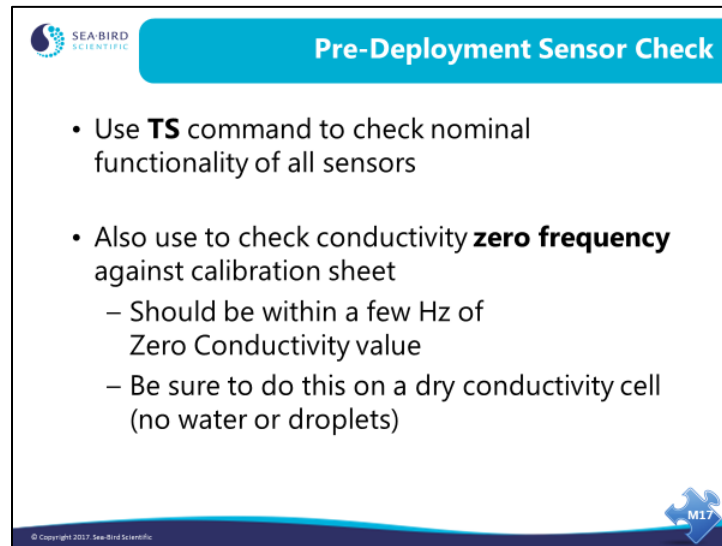
Record Some Data

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



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Preparing for Deployment: Sensor Check (*continued*)



The slide features the Sea-Bird Scientific logo in the top left corner. A blue header bar at the top right contains the title "Pre-Deployment Sensor Check". The main content area lists three bullet points. A small blue icon with "M17" is located in the bottom right corner of the slide frame. At the very bottom left, there is a small copyright notice: "© Copyright 2017 Sea-Bird Scientific".

- Use **TS** command to check nominal functionality of all sensors
- Also use to check conductivity **zero frequency** against calibration sheet
 - Should be within a few Hz of Zero Conductivity value
 - Be sure to do this on a dry conductivity cell (no water or droplets)

Before you invest a great deal of time and effort deploying a mooring, it is a great idea to send your instrument in for calibration. It is an excellent check on its functionality, not to mention its accuracy. If you are unable to do this, check to see that all the sensors are presenting nominally correct output. Sea-Bird moored instruments, with the exception of the SBE 16, have calibration coefficients stored internally and are able to output measurements in scientific units.

The best spot check for the conductivity cell is to observe its zero conductivity frequency. The zero conductivity frequency is the uncorrected (raw) frequency output at 0 conductivity. To do this, rinse the cell in distilled or de-ionized water and shake any remaining drops out. The sensor should read very close to the zero conductivity reading on the calibration sheet (within a few tenths of a Hz). If it does not, the cell may be dirty or damaged. Try cleaning it with a non-ionic detergent such as Triton X. If still bad, send for servicing.

Preparing for Deployment: Check Zero Conductivity Frequency

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Zero Conductivity Frequency

- Goal of test:** Check if conductivity cell is damaged or very dirty by comparing to in-air value from calibration sheet.

SENSOR SERIAL NUMBER: 4000
CALIBRATION DATE: 06-Aug-10

SBE19plus CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:

g = -9.750359e-001
h = 1.633805e-001
i = -4.569984e-004
j = 6.525413e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006

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	5109.92	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

f = INST FREQ / 1000.0
Conductivity = $(g + hf^2 + if^3 + jf^4) / (1 + \delta t + \epsilon p)$ Siemens/meter
t = temperature[°C]; p = pressure[decibars]; δ = CTcor; ϵ = CPcor;
Residual = instrument conductivity - bath conductivity

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The Zero Conductivity Frequency is provided on the conductivity calibration form we send you with your CTD.

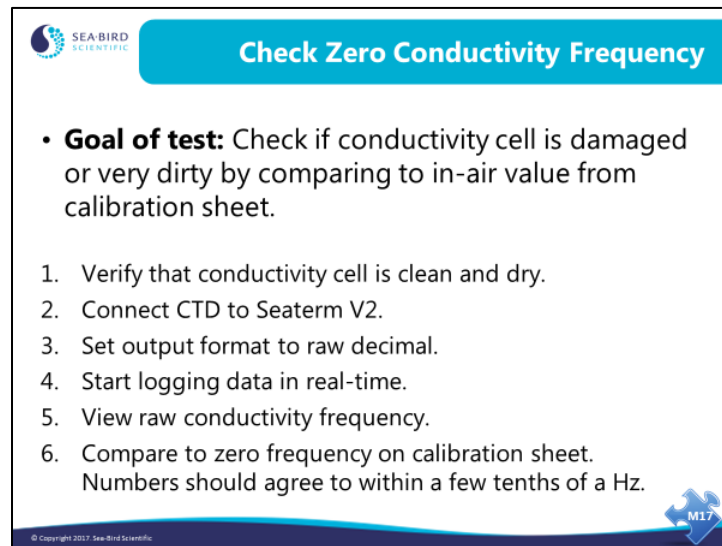
For salt water applications, the value for the *minimum conductivity frequency* is typically set at the factory to [*zero conductivity raw frequency* + 500 Hz]. A typical minimum conductivity frequency in salt water is $(2448 + 500) = 2948$ Hz.

For fresh water applications, the value for the *minimum conductivity frequency* is typically set at the factory to [*zero conductivity raw frequency* + 1- 5 Hz]. A typical minimum conductivity frequency in fresh water is $(2448 + 5) = 2453$ Hz

Reminder: The pump turns on when raw conductivity frequency exceeds the minimum conductivity frequency (MinCondFreq=). To prevent the pump from turning on when in air, set the minimum conductivity frequency for pump turn-on above the instrument's *zero conductivity raw frequency* shown in the configuration sheet. If the minimum conductivity frequency is too close to the *zero conductivity frequency*, the pump may turn on when the CTD is in air, as a result of small drifts in the electronics. Some experimentation may be required, and in some cases it may be necessary to rely

only on the pump turn-on delay time to control the pump. If so, set a minimum conductivity frequency lower than the *zero conductivity frequency*.

Preparing for Deployment: Check Zero Conductivity Frequency (*continued*)



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Check Zero Conductivity Frequency

- **Goal of test:** Check if conductivity cell is damaged or very dirty by comparing to in-air value from calibration sheet.

1. Verify that conductivity cell is clean and dry.
2. Connect CTD to Seaterm V2.
3. Set output format to raw decimal.
4. Start logging data in real-time.
5. View raw conductivity frequency.
6. Compare to zero frequency on calibration sheet. Numbers should agree to within a few tenths of a Hz.

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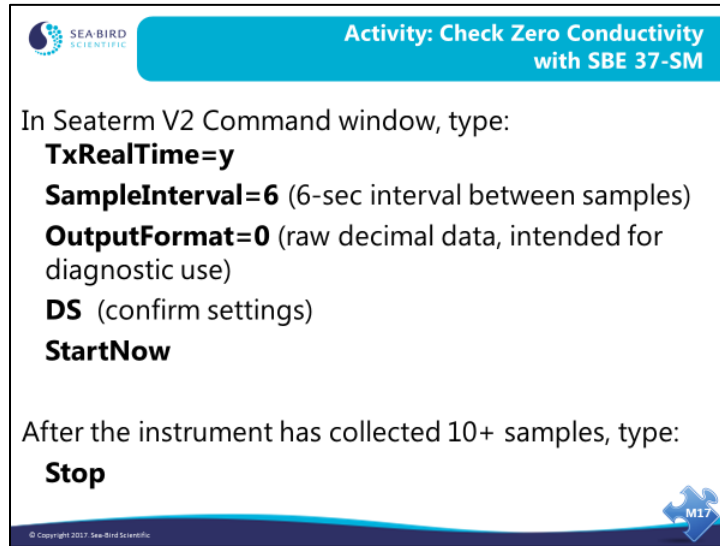
Click Capture button on menu bar in Seaterm V2 to create a file of your test data.

Clean and rinse cell thoroughly with distilled or de-ionized water and allow to dry completely prior to this test.

Note that each CTD has a unique zero frequency and calibration. Use the calibration sheet for each CTD to check the in-air zero conductivity frequency.

- If the conductivity frequency readings differ by more than 0.5 to 1 Hz different from the calibration sheet values, the conductivity cell is damaged or dirty. Try following the cleaning procedures again in Application Note 02D to see if the value improves. Make sure the cell has time to dry, and then repeat this procedure and check the raw frequency again.
- In addition, noisy readings can indicate a dirty cell.

Activity: Check Zero Conductivity for SBE 37-SM



Activity: Check Zero Conductivity with SBE 37-SM

In Seaterm V2 Command window, type:

TxRealTime=y

SampleInterval=6 (6-sec interval between samples)

OutputFormat=0 (raw decimal data, intended for diagnostic use)

DS (confirm settings)

StartNow

After the instrument has collected 10+ samples, type:

Stop

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Type **StartNow** to look at data in real-time.

Type **Stop** to stop logging.

Example:

Column Headings are as follows for **OutputFormat=0**:

Temperature Counts, **Conductivity Frequency**, Pressure Counts, Pressure sensor temperature counts, Date and Time

S>StartNow

<!--start logging at = 15 May 2012 17:10:03, sample interval = 15 seconds-->

S>

#224970, **2545.383**, 534298, 1557, 15 May 2012, 17:10:04

#224952, **2545.371**, 534298, 1556, 15 May 2012, 17:10:19

Activity: Check Zero Conductivity for SBE 37-SM (continued)

Activity: Check Zero Conductivity with SBE 37-SM

- Compare real-time zero conductivity output to calibration certificate

SENSOR SERIAL NUMBER: 9077
CALIBRATION DATE: 31-Mar-12

SBE 37 V2 CONDUCTIVITY CALIBRATION DATA
PSS 1978: C(35,15,0) = 4.2914 Siemens/meter

COEFFICIENTS:
g = -1.025598e+000
h = 1.589893e-001
i = -4.121291e-004
j = 5.494470e-005

CPcor = -9.5700e-008
CTcor = 3.2500e-006
WBOTC = 1.3095e-007

BATH TEMP (° C)	BATH SAL (PSU)	BATH COND (S/m)	INSTRUMENT OUTPUT (Hz)	INSTRUMENT COND (S/m)	RESIDUAL (S/m)
22.0000	0.0000	0.00000	2545.38	0.00000	0.00000
1.0000	35.0354	2.99290	5038.27	2.99289	-0.00001
4.4999	35.0131	3.30144	5227.67	3.30145	0.00000
15.0000	34.9639	4.28780	5791.02	4.28780	0.00000
18.5000	34.9509	4.63429	5976.07	4.63430	0.00001
24.0000	34.9372	5.19462	6263.46	5.19461	-0.00001
29.0000	34.9271	5.71842	6520.36	5.71840	-0.00002
32.5000	34.9183	6.09176	6697.28	6.09177	0.00001

f = Instrument Output(Hz) * sqrt(1.0 + WBOTC * t) / 1000.0
t = temperature (°C); p = pressure (decibars); δ = CTcor; ε = CPcor;
Conductivity (S/m) = (g + h * f + i * f² + j * f³) / 10 (1 + δ * t + ε * p)
Residual (Siemens/meter) = instrument conductivity - bath conductivity

Check against the calibration sheet that goes with your instrument.

In this example, for conductivity SN 9077, we find the zero conductivity values agree.

Real-time data from instrument:

<!--start logging at = 15 May 2012 17:10:03, sample interval = 15 seconds-->

S>

#224970, **2545.383**, 534298, 1557, 15 May 2012, 17:10:04


#224952, **2545.371**, 534298, 1556, 15 May 2012, 17:10:19

Calibration sheet value:

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	2545.38	0.00000	0.00000
1.0000	35.0354	2.99290	5038.27	2.99289	-0.00001
4.4999	35.0131	3.30144	5227.67	3.30145	0.00000
15.0000	34.9639	4.28780	5791.02	4.28780	0.00000
18.5000	34.9509	4.63429	5976.07	4.63430	0.00001
24.0000	34.9372	5.19462	6263.46	5.19461	-0.00001
29.0000	34.9271	5.71842	6520.36	5.71840	-0.00002
32.5000	34.9183	6.09176	6697.28	6.09177	0.00001

See how the zero air reading is within a few 10ths of a Hz of the zero conductivity value on the calibration sheet, indicating a clean, functional cell. The cell must be dry for this to work.

Removing Air from Plumbing



Removing Air from Plumbing

- On deployment or in test bath, try to expel air from plumbing
 - Moorings deeper than 10 m will expel air
 - For shallow moorings < 10 m, fill plumbing with DI water prior to deployment
- Observe bubbles coming out of bleed-hole or pump exhaust
 - Move instrument under water to “shake” air out
 - Pre-fill with water at deployment if no chance of freezing



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If you do not see air bubbles coming out of the bleed hole, the hole maybe clogged. Use a fine gauge wire to clear the bleed hole.

Another important note: Salt water can cause the bleed hole to clog with salt if not rinsed regularly. Sea-Bird recommends soaking instruments in freshwater after deployment to prevent this from happening.

Starting Logging



Log Data Now or Later?

- Use **StartNow** command to begin logging data immediately
- To begin logging later:
 1. Use **Startmddy=** command to enter a date to start logging, and then use **Starthhmmss=** command to enter a start time on that date
- Or -
Use **StartDateTime=** command to enter a date and time to start logging
 2. Use **StartLater** command to begin logging on date and time entered above

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You have the option of setting a logging start time and date, allowing you to begin data collection once the mooring is in place. The risk you run is that you might not place the mooring when you planned to. There are always some risks in life. The alternative is to trim off data that is meaningless at the beginning of the file.

Refer to the instrument manual for the exact commands for your instrument and your firmware version. For example, the *16plus V2* uses **StartDateTime=** to set the start date and time; the *16plus* uses **Startmddy=** and **Starthhmmss=** to set the start date and time.