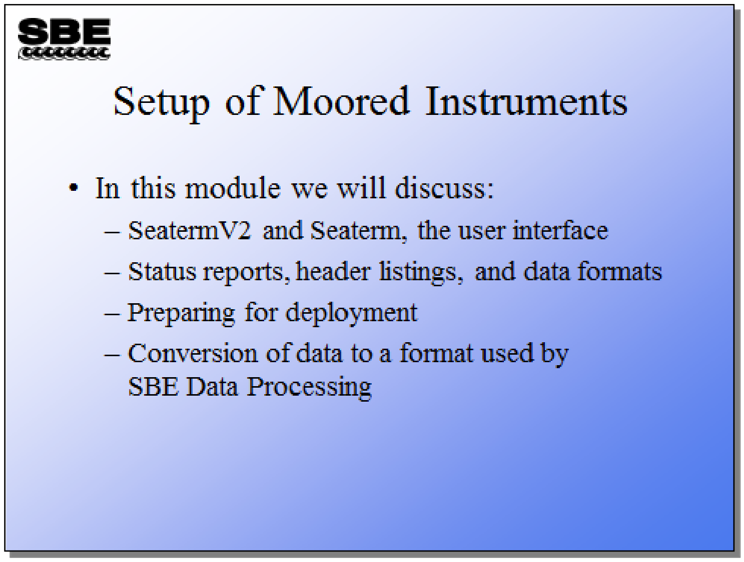
Module 11

Setup of Moored Instruments

Overview

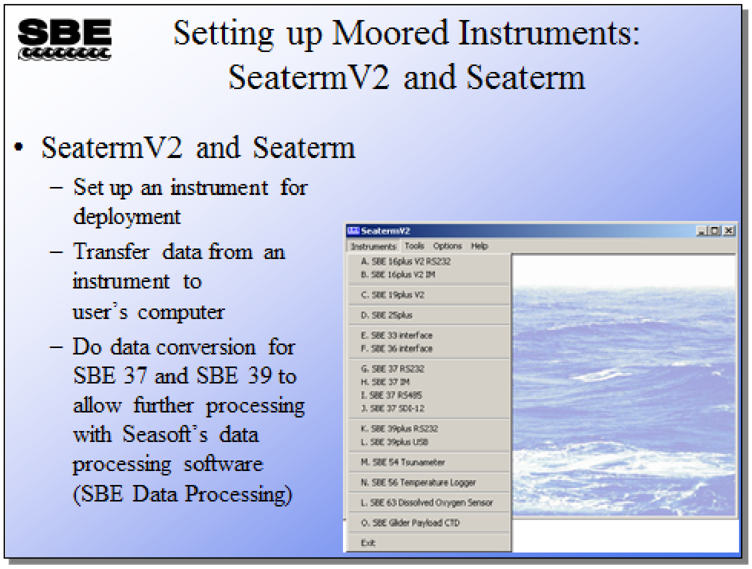


In this module we will discuss setup of moored instruments for deployment, considering sampling theory, the user interface, and instrument status reports.

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

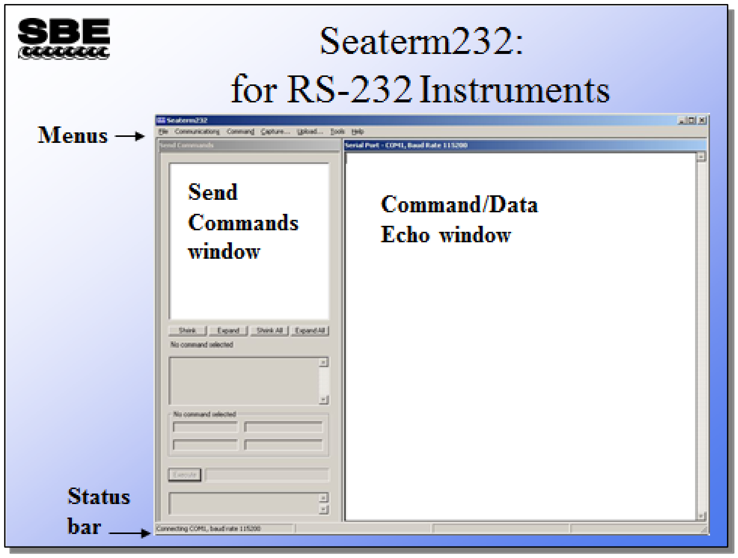
- Judge your instrument's readiness for deployment based on its status report
- Prepare your instrument for deployment
- Convert data from your instrument to a format that can be processed by SBE Data Processing

SeatermV2 and Seaterm: User Interface



Even in moorings that use inductive telemetry, the data that is stored in the instrument is of interest. There may be occasions where the link between the surface buoy and the ground station malfunctioned, or the telemetered data may be a subset of that collected by the remote instrument. SeatermV2 and Seaterm provide the facility for data transfer and for the conversion of SBE 37 and SBE 39/39*plus* data to a format that can be used by the processing programs in Seasoft.

Setting up SeatermV2 for Communications

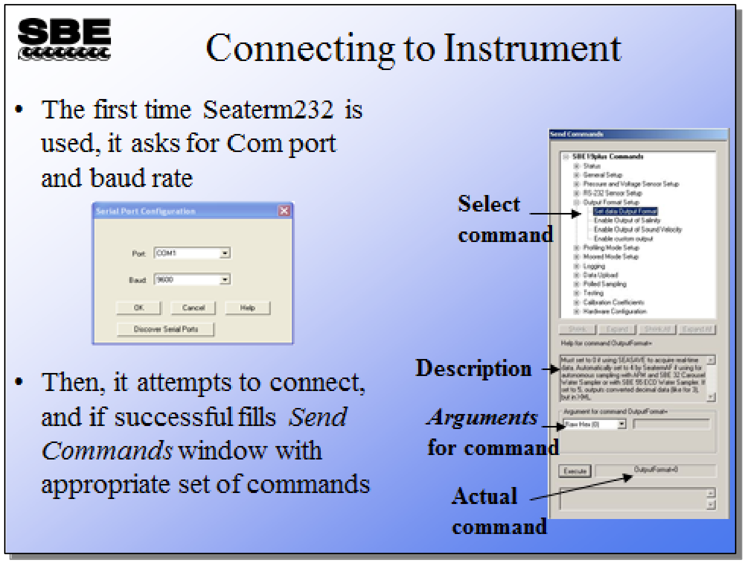


SeatermV2 launches one of the following programs:

- Seaterm**232** – for communication via RS-**232** (standard serial communications)
- Seaterm**IM** – for communication via **I**nductive **M**odem telemetry (instruments deployed in parallel, with each instrument assigned a unique ID)
- Seaterm**485** – for communication via RS-**485** (4-wire serial communications, instruments placed in parallel on the communications cable, with each instrument assigned a unique ID)
- Seaterm**USB** – for communication via **USB**

Seaterm232, SeatermIM, and Seaterm485 have similar interfaces, as shown on the slide for Seaterm232. SeatermUSB's interface varies, depending on the instrument you are connecting to.

Setting up SeatermV2 for Communications

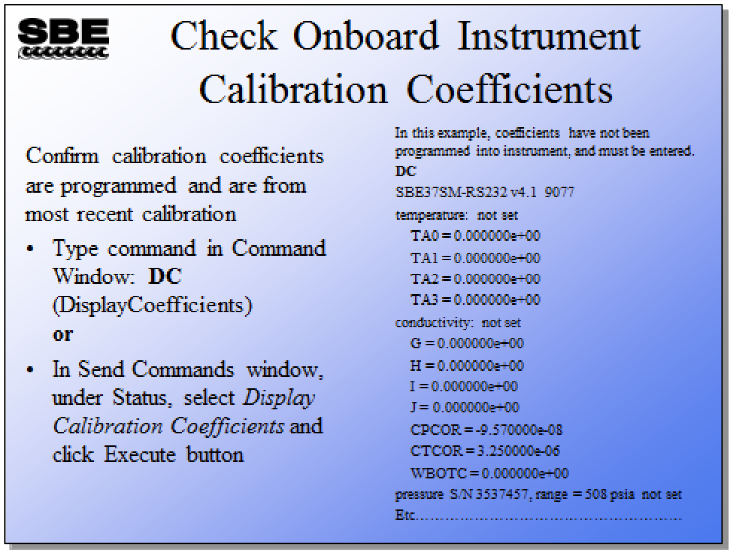


Seaterm232 will automatically try to set up communications with your instrument. Default speed is 9600 baud, but it cycles through all possible baud rates for the instrument.

Click Discover Serial Ports in the Serial Port Configuration dialog to 'discover' the list of possible serial ports, then select the appropriate port.

If Seaterm232 fails to connect (perhaps the COM port you selected was incorrect), click on the Command menu and select Abort. Then click on the Communications menu and select Configure to see the Serial Port Configuration dialog again. Select a different COM port and click OK. You may need to select Disconnect and Reconnect in the Communications menu to try to connect again.

Check Calibration Coefficients

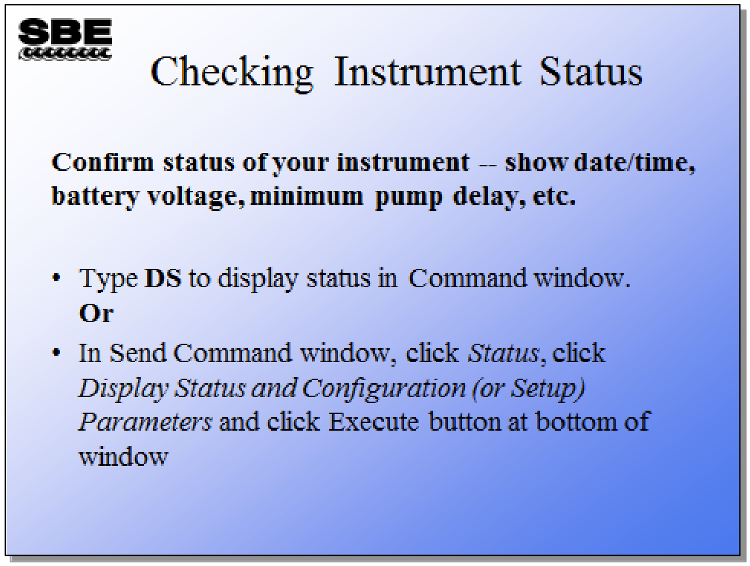


The calibration coefficients programmed into the instrument are used if outputting data in engineering units through a terminal program. Verify the coefficients are correct, and match the most recent calibration sheets that you received from Sea-Bird.

For instruments that do not have a configuration file (SBE 37 and 39 families), these coefficients are also used to convert uploaded data from memory to engineering units.

Note that measurement data is stored in the instrument's memory in raw format, so if you discover a mistake in the calibration coefficients before you erase the memory, you can re-enter the coefficients and re-upload the data.

Checking Status Report



The status report contains much valuable information that allows you to confirm the instrument setup before deployment.

Checking Status Report (*continued*)

SBE

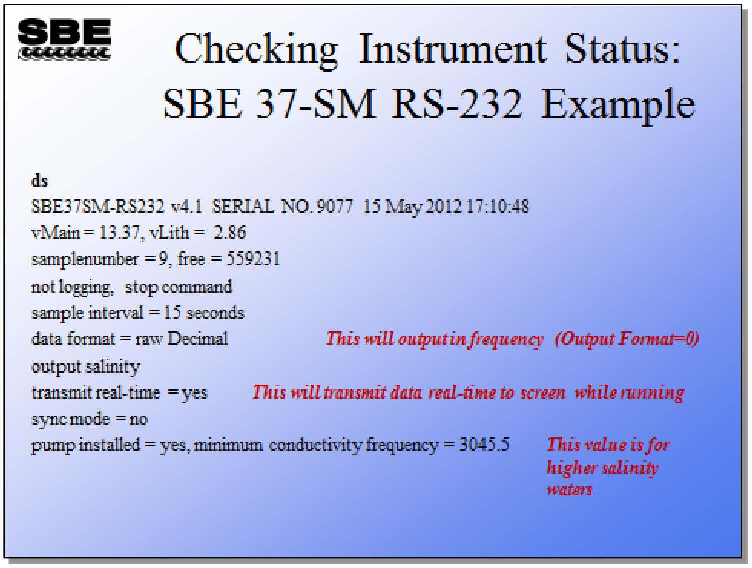
Checking Instrument Status
SBE 16*plus* V2 Example

```
DS
SBE 16plus V 2.5 SERIAL NO. 6001 24 Feb 2012 14:11:48                    [DateTime=]
vbatt = 10.3, vlith = 8.5, ioper = 62.5 ma, ipump = 21.6 ma, iext01 = 76.2 ma,
status = not logging
samples = 0, free = 3463060
sample interval=15 seconds, number of measurements per sample=1   [SampleInterval=,NCycles=]
pump=run pump during sample, delay before sampling=2.0 sec,
delay after sampling = 0.0 seconds        [PumpMode=,DelayBeforeSampling=,DelayAfterSampling=]
transmit real-time = yes                                                 [TxRealTime=]
battery cutoff = 7.5 volts
pressure sensor = strain gauge, range = 1000.0                           [PType=, PRange=]
SBE 38=no, SBE 50=yes, WETLABs = no, OPTODE = no, SBE63 = no,
Gas Tension Device=no     [SBE38=,SBE50=, WetLabs=,Optode=,SBE63=,GTD=,DualGTD=]
Ext Volt 0 = yes, Ext Volt 1 = no                                        [Volt0=,Volt1=]
Ext Volt 2 = no, Ext Volt 3 = no                                         [Volt2=,Volt3=]
Ext Volt 4 = no, Ext Volt 5 = no                                         [Volt4=,Volt5=]
echo characters = yes                                                    [Echo=]
output format = raw HEX                                                  [OutputFormat=]
serial sync mode disabled                                                [SyncMode=]
```

The 16*plus* V2 status report contains much valuable information:

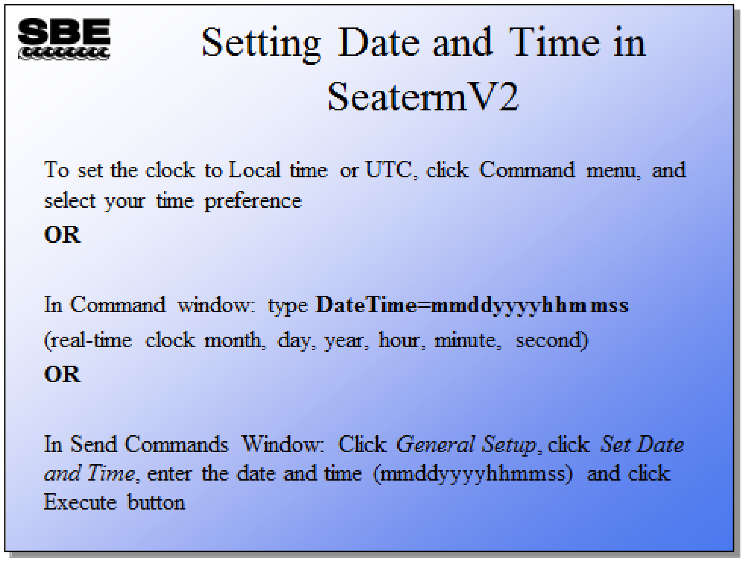
- Instrument type, firmware revision, serial number, date and time.
- Main battery voltage and back-up battery voltage. Operating current, pump current, and current to external voltage sensors provide an indication of the battery lifetime you can expect, as well as the health of the instrument in general.
- The status entry indicates whether the instrument is logging data or not.
- Number of samples stored and amount of space free.
- Sample interval and number of measurements that are averaged to make a sample.
- Parameters related to the pump and auxiliary sensors –
  - pump mode (no pump, run for 0.5 sec before each sample, or run during each sample)
  - delay before sampling (seconds after switching on power to auxiliary sensors before measurement is made) and delay after sampling (seconds after sampling is completed before turning off power to auxiliary sensors).
- Transmit real-time data or not.
- Battery cut-off voltage, which is the power level that causes the instrument to shut itself off because it does not have sufficient power to sample.
- Pressure sensor type and range are entered at the factory.
- Which auxiliary sensor channels are enabled and logged with the CTD data.
- Whether to show entered commands on screen as you type.
- Output data format
- Serial synchronization mode enabled or disabled.

Checking Status Report (*continued*)

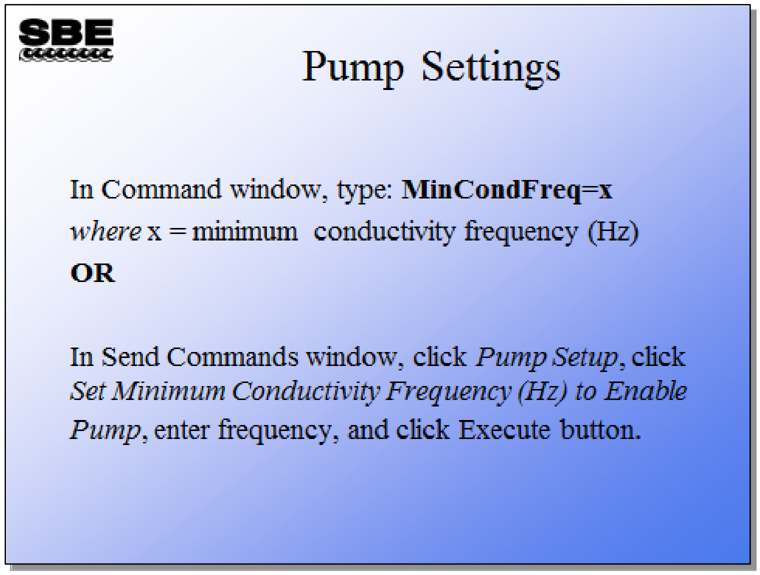


This is an example of a status report from an SBE 37-SMP MicroCAT.

Setting Date and Time



Pump Settings

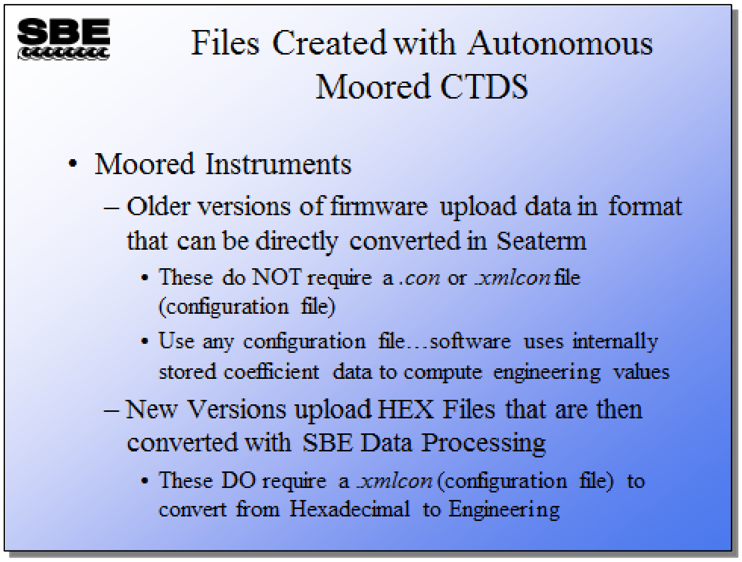


Set the Minimum Conductivity Frequency for the pump turn on signal. To prevent pumps from running dry, the pump will turn on only after a minimum conductivity value is measured by the conductivity sensor (an indication the instrument is in the water). You can control this by setting the frequency for the type of water you are working in.

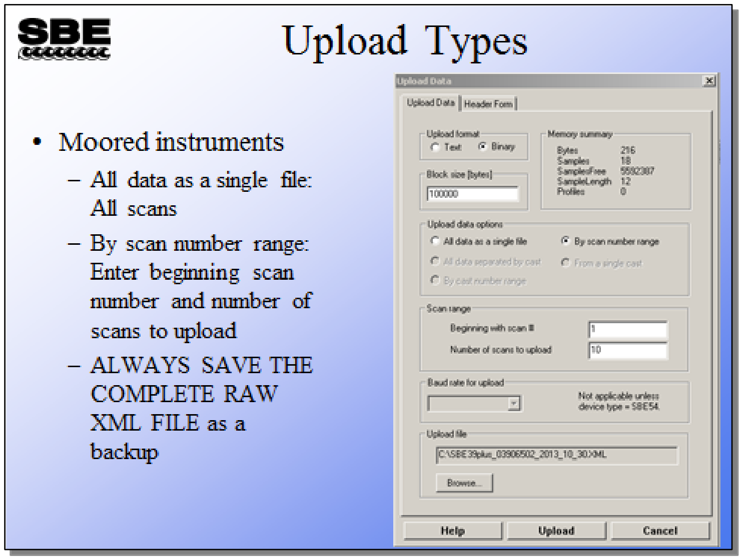
- For higher end salinity water, this is set for the Zero Conductivity Frequency (the sensor frequency output found on the Calibration sheet at the 0 S/m (0 salinity point) plus 500 Hz. This prevents the pump from turning on in air.
- For fresher water and brackish environments, it is best to lower this value to the Zero Conductivity Frequency + 5 Hz. This will also prevent the instrument from turning on in air, but it will turn on in lower salinity water.

If working in alpine lakes, which are very low in conductivity, you may need to set this to the Zero Conductivity Frequency value with no added Hz (or set to exactly the zero conductivity frequency), to ensure the pump turns on.

Upload Files



SeatermV2: Upload Types



Upload Format: Seaterm232, Seaterm485, and SeatermUSB can upload in text or binary. Binary is approximately twice as fast; the resulting output file is the same, regardless of which upload method you use.

Note: Binary upload is not available with SeatermIM.

Upload Data Options: Profiling instruments usually transfer data in casts. Moored instruments typically dump all their stored data at once. Data from an internally recording profiling instrument can be transferred to your computer in one of the following ways:

- **All scans:** All scans in the instrument are transferred into 1 file.
- **By scan range:** Enter the range in the dialog box. This is useful when only part of the data is desired.

Note for newer 37-IM/IMP (acquisition firmware ≥ 3.0) and all 37-IMP-IDO, 37-IMP-ODO, and 39-IM:

Data can be uploaded via RS-232 by connecting to an internal connector, providing much faster upload of large data sets. See the instrument manual for connection and upload details.

Activity: Setting Up, Logging, Uploading MicroCAT Data

1. Cable SBE 37-SM to computer.
2. Open SeatermV2. Select SBE 37 RS232; Seaterm232 opens.
3. Experiment with various ways to set date and time:
   A. In Command menu, select *Set Local Time*. Type **DS** to see that instrument time = computer time.
   B. In Command menu, select *Set UTC Time*. Type **DS** to see that instrument time = Greenwich Mean Time (from Seattle, +8 hours in summer, +9 hours in winter).
   C. In Command window, type: **datetime=mmddyyyyhhmmss** (where mmddyyyyhhmmss is the month day year hour minute second). To be as accurate as possible, wait for the second hand on your watch to land on known point in time before you hit Enter key.
   D. In Send Commands window, click *General Setup* and click *Set Date and Time.* Enter date and time (mmddyyyyhhmmss) in *Argument* box, and click Execute.
4. Type in commands below (upper case or lower case, it does not matter) or send these commands using Send Commands window.

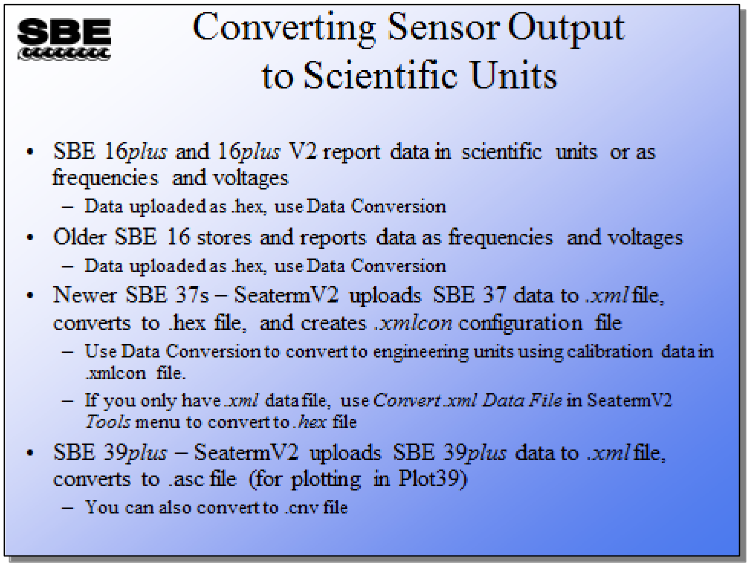
Send Commands **CATEGORY**	**COMMAND**	**DESCRIPTION**
General Setup	OutputExecutedTag=y	Enable output of executing and executed tags. This makes it easier to use the Send Commands window to transmit commands.
	TxRealTime=y	Transmit sample data as it is taken (in *real-time*).
Output Format Setup	OutputFormat=1	Output converted decimal data -- temperature, conductivity, pressure (if installed), s
	OutputSal=y	Calculate and output salinity.
	OutputSV=y	Calculate and output sound velocity.
Memory Setup	InitLogging	Reset memory (SBE 37 prompts you to send command twice).
Autonomous Sampling	SampleInterval=10	Set sampling interval to 10 seconds.
Serial Line Sync	SyncMode=n	Disable serial synchronization mode.
Status	DS	Verify setup with status command.

5. Start logging with **StartNow** command.
6. After a few minutes, stop logging with **Stop** command.
7. Check status with **DS** command to verify that logging has stopped.
8. Upload and review data in .xml data file.

Note about uploaded .xml file: When SeatermV2's Upload menu is used to upload MicroCAT data, SeatermV2 –

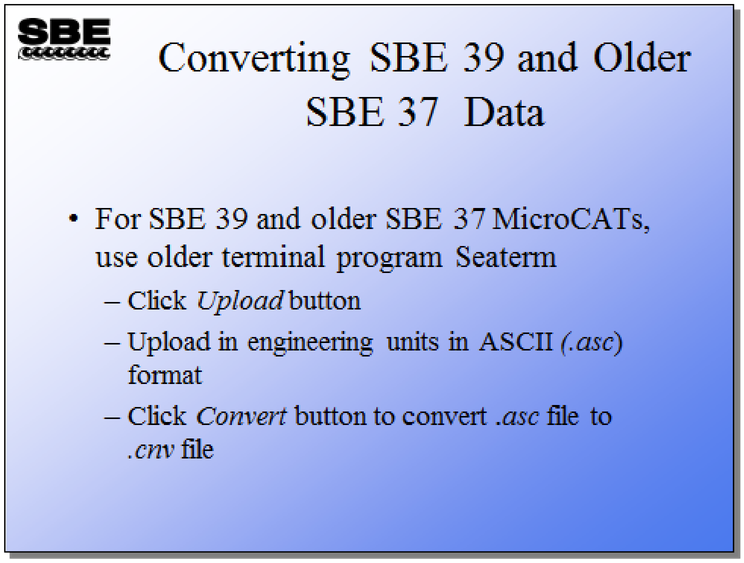
- Uploads the data to a .xml file,
- Converts the data to a .hex file and creates .xmlcon configuration file, to provide a data file and a configuration file that is compatible with SBE Data Processing, and
- Opens SBE Data Processing's Data Conversion module, with the appropriate .hex data file and .xmlcon file already selected for you. Running Data Conversion provides a .cnv file with columns of data in engineering units.
  Note: On the Data Setup tab in Data Conversion, select *Upcast and downcast* to convert all of the data.

Converting Sensor Output to Scientific Units



- The SBE 16*plus* and 16*plus* V2 can report data in scientific units. However, when the menu/toolbar is used to upload data, the terminal program sets the output format to raw hexadecimal, to provide a file that is compatible with SBE Data Processing. This data requires conversion with SBE Data Processing's Data Conversion module.
- The SBE 16 requires the same sort of data processing that was discussed earlier in the course, beginning with Data Conversion and ending with Bin Average.
- Newer SBE 37s (SM, SMP, IM, IMP, SI, SIP with firmware $\geq$ 3.0; all IDO and ODO versions) can report data in scientific units. However, when SeatermV2's Upload menu is used to retrieve SBE 37 data, SeatermV2 uploads the data to a .xml file, converts the data to a .hex file, and creates a .xmlcon configuration file, to provide a data file and a configuration file that is compatible with SBE Data Processing. This data requires conversion with SBE Data Processing's Data Conversion module.
- SBE 39*plus* can report data in scientific units. However, when SeatermV2's Upload menu is used to retrieve SBE 39*plus* data, SeatermV2 uploads the data to a .xml file, and converts the data to a .asc file, to provide a data file that is compatible with Plot39 plotting software. You can also convert the .xml file to a .cnv file that is compatible with SBE Data Processing, for use in ASCII Out and Sea Plot modules.

SBE 39 and older SBE 37 Data Conversion Utilities



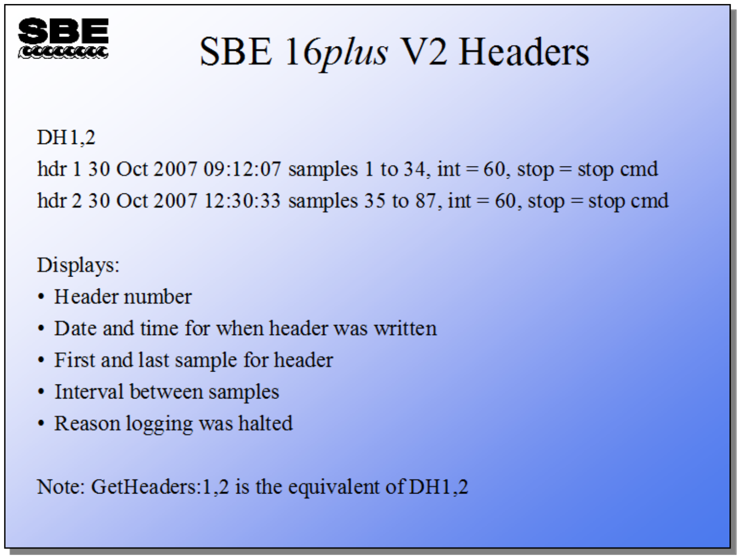
The SBE 37 and 39 can report data in scientific units.

Seaterm uploads data from SBE 39s and older SBE 37s in scientific units, to a .asc data file. This file format is not compatible with Seasoft's post-processing modules. If you wish to do any processing of this data with SBE Data Processing, you have to convert it to the *.cnv* file format. There is a utility in Seaterm to perform this conversion; click the Convert button on Seaterm's toolbar to create a .cnv file.

- To access the Convert button in Seaterm, you must first select the SBE 37 or SBE 39 in the Configure menu.

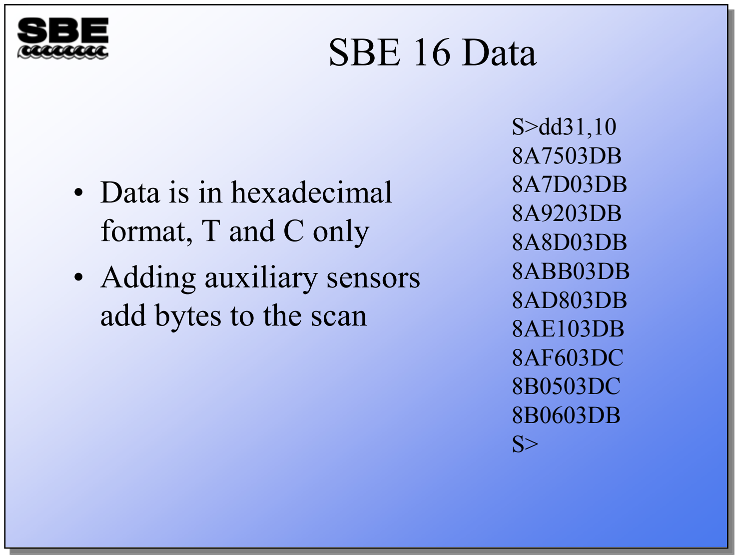
The .cnv file can then be processed and/or plotted using SBE Data Processing's modules.

SBE 16*plus* V2 Headers



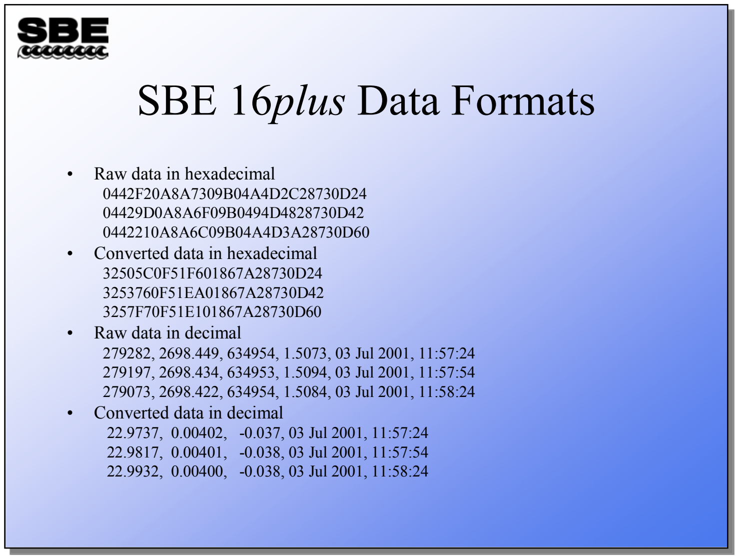
Header entries have start date and time, sample range, and sample interval as well as the reason for ending data collection.

Data Format: SBE 16



This data is an ASCII representation of hexadecimal numbers. This representation allows the data file to be readable with any text editor.

Data Format: SBE 16*plus*



A complete description of these formats is found in the manual.

- **Raw data in hexadecimal example:**

  SBE 16*plus* with strain gauge pressure sensor and two external voltages sampled,
  example scan = ttttttccccccppppppvvvvvvvvvvvvssssssss
  = 0A53711BC7220C14C17D820305059425980600

- **Converted data in hexadecimal example:**

  SBE 16*plus* with strain gauge pressure sensor and two external voltages sampled,
  example scan = ttttttccccccppppppvvvvvvvvssssssss
  = 3385C40F42FE0186DE0305059425980600

Note that some of the hexadecimal numbers are scaled. For example, in the raw hexadecimal data, the conductivity frequency is multiplied by 256. In the converted hexadecimal data, temperature is multiplied by 100,000 and conductivity by 1,000,000.

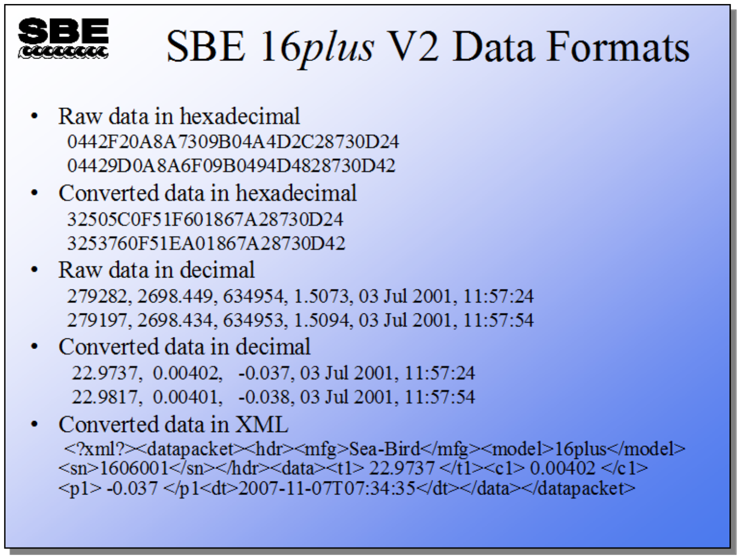
- **Raw data in decimal example:**

  SBE 16*plus* with strain gauge pressure sensor and two external voltages sampled,
  example scan =
  tttttt, cccc.ccc, pppppp, v.vvvv, v.vvvv, v.vvvv, dd mmm yyyy, hh:mm:ss
  = 676721, 7111.133, 791745, 2.4514, 0.0590, 0.1089, 12 nov 2000, 12:23:05

- **Converted data in decimal:**

  SBE 16*plus* with strain gauge pressure sensor and two external voltages sampled,
  example scan = ttt.tttt, cc.ccccc, pppp.ppp, v.vvvv, v.vvvv, dd mmm yyyy, hh:mm:ss
  = 23.7658, 0.00019, 0.062, 0.0590, 0.1089, 12 nov 2000, 12:23:05

Data Format: SBE 16*plus* V2



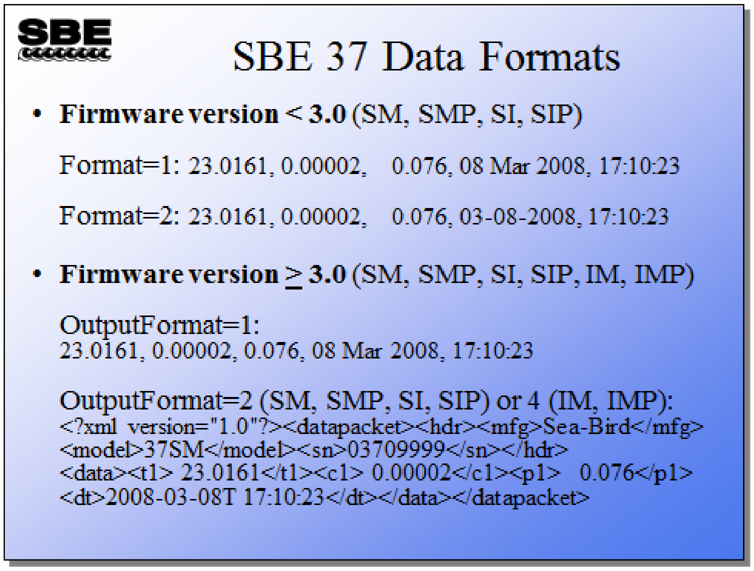
A complete description of these formats is found in the manual.

- **Raw data in hexadecimal example:**
  With strain gauge P and 2 external voltages sampled, example scan =
  ttttttccccccppppppvvvvvvvvvvvvvvssssssss = 0A53711BC7220C14C17D82030505940EC4270B
- **Converted data in hexadecimal example:**
  With strain gauge P and 2 external voltages sampled, example scan =
  ttttttccccccppppppvvvvvvvvvssssssss = 3385C40F42FE0186DE030505940EC4270B

Note: some of the hex numbers are scaled. For example, in the raw hex data, conductivity frequency is multiplied by 256. In the converted hex data, T is multiplied by 100,000 and C by 1,000,000.

- **Raw data in decimal example:**
  With strain gauge P and 2 external voltages sampled, example scan =
  tttttt, cccc.ccc, pppppp, v.vvvv, v.vvvv, v.vvvv, dd mmm yyyy, hh:mm:ss
  = 676721, 7111.133, 791745, 2.4514, 0.0590, 0.1089, 7 nov 2007, 07:34:35
- **Converted data in decimal:**
  With strain gauge P and 2 external voltages sampled, example scan =
  ttt.tttt, cc.ccccc, pppp.ppp, v.vvvv, v.vvvv, dd mmm yyyy, hh:mm:ss
  = 23.7658, 0.00019, 0.062, 0.0590, 0.1089, 7 nov 2007, 07:34:35
- **Converted data in XML:**
  With strain gauge P and 2 external voltages sampled, example scan =
  <?xml?><datapacket><hdr><mfg>Sea-Bird</mfg><model>16plus</model>
  <sn>nnnnnnnn</sn></hdr><data><t1> ttt.tttt </t1><c1> cc.ccccc </c1>
  <p1> pppp.ppp </p1><v0> v.vvvv </v0><v1> v.vvvv </v1>
  <dt>yyyy-mm-ddThh:mm:ss</dt></data></datapacket>
  =
  <?xml?><datapacket><hdr><mfg>Sea-Bird</mfg><model>16plus</model>
  <sn>1606001</sn></hdr><data><t1>23.7658</t1><c1>0.00019</c1>
  <p1>0.062</p1><v0>0.0590</v0><v1>0.1089</v1>
  <dt>2007-11-07T07:34:35</dt></data></datapacket>

Data Format: SBE 37



The basic data format is temperature, conductivity, pressure (if installed), date and time.

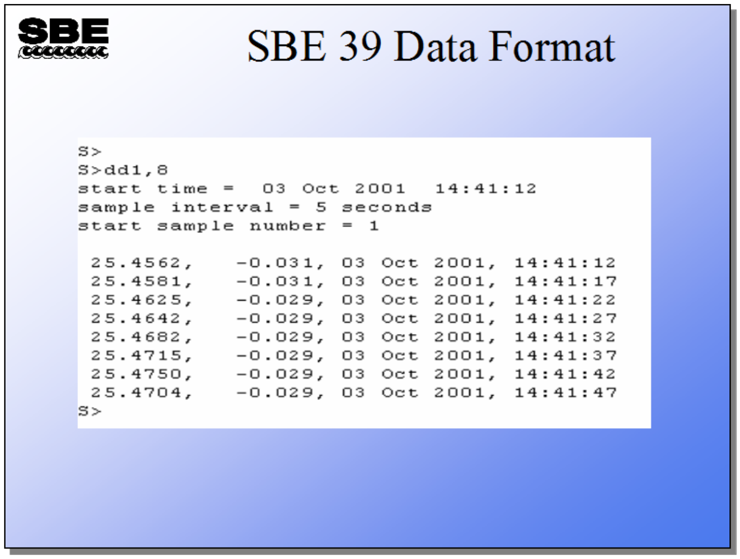
Note: IDO and ODO MicroCAT data format is not covered here.

Older MicroCATs (firmware version < 3.0) offer two date formats in the data output: dd mmm yyyy or mm-dd-yyyy. This is selected with the **Format=** command. There are some other differences in output format, depending on the specific MicroCAT model:

- 37-IM and 37-IMP: The **Format=** command also affects the output units for conductivity: S/m for **Format=1** and mS/cm for **Format=2**.
- 37-SM and 37-SMP: You can also output salinity and/or sound velocity if desired, with the use of the appropriate setup commands. You can suppress storage and output of date and time with the use of the appropriate setup command.
- 37-SI and 37-SIP: You can also output depth, salinity, sound velocity, and/or density sigma if desired, with the use of the appropriate setup commands. You can suppress output of date and time with the use of the appropriate setup command.

Newer MicroCATs (firmware version ≥ 3.0) eliminate one of the date format options, but add an XML output option. With the larger memory, date and time are always stored and output.

Data Format: SBE 39



- The SBE 39 data format is temperature, pressure (if installed), date and time.
- For the SBE 39-IM, there are options for the date format, similar to the older MicroCATs.
- For the SBE 39*plus*, there are options for output units (°C or °F; dbar or psi), and the ability to output sample number with each scan.

The instrument manuals provide complete details on all the data format options.

Activity: Converting and Plotting Time Series Data

Note: This exercise uses Seaterm, **not** SeatermV2, because it is based on data uploaded from an older SBE 37.

1. Open Seaterm.
   A. In Configure menu, select *SBE 37*. In Configuration Options dialog box, select *RS-232*, and click OK.
   B. Click Convert button.
      - In Convert dialog box, select C:\Data\Module11\Pacific.asc as the input file.
      - Click *Insert deployment pressure*, and enter 50 decibars as the pressure.
      - Click OK.

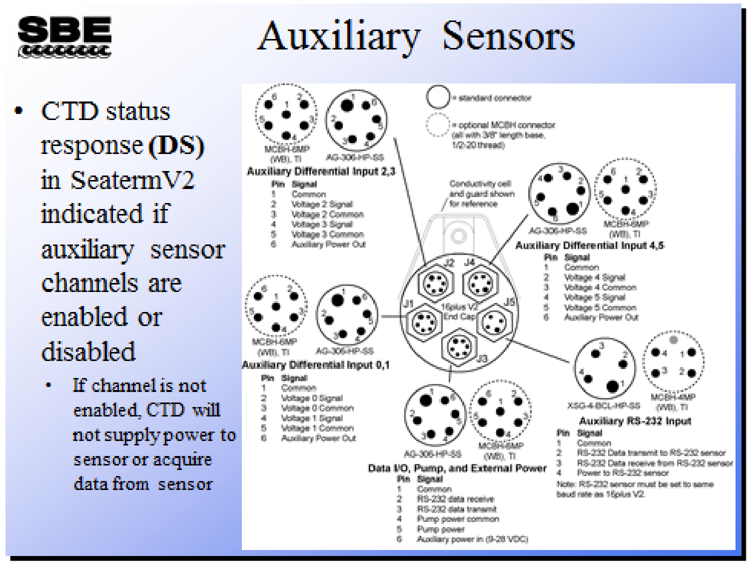
      Seaterm will create a .cnv file, which is compatible with SBE Data Processing.

2. In SBE Data Processing, run Derive and calculate Salinity and Density (Sigma-T).
   - Use name append *D*.
   - Use any .con or .xmlcon file! (see note below)

3. In SBE Data Processing, run Sea Plot.
   - Single X (Julian days), multiple Y (Salinity and Density, Sigma-T)
   - Uncheck reverse axis box on X axis
   - Start with auto range and re-plot as appropriate

Note about configuration (.con or .xmlcon) files and data from **older** MicroCATs:
The SBE 37 is not user-configurable (i.e., it cannot interface with auxiliary sensors), and it outputs converted data in engineering units (using calibration coefficients programmed into the instrument). Therefore, it does not have a configuration file (configuration file defines what sensor data is in the data stream and also defines the calibration coefficients). But, SBE Data Processing was originally written to process data from instruments that do have a configuration file, and the Derive module therefore requires the selection of a .con or .xmlcon file before it will allow you to select the variables to be derived. You can select any .con or .xmlcon file; the selection will have no impact on the results.

Auxiliary Sensors

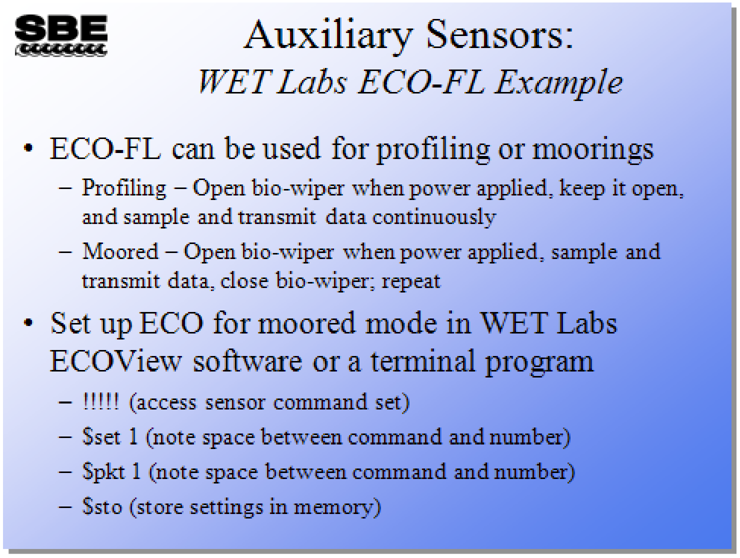


Sea-Bird CTDs can be configured with a wide range of auxiliary sensors. For example, the SBE 16*plus* V2 has three 6-pin bulkhead connectors for voltage output (0-5 volt) auxiliary sensors, each of which can accommodate two sensors (using a Y-cable). It also has one 4-pin bulkhead connector for an RS-232 output sensor. The connectors provide power to and acquire data from the auxiliary sensors.

Sea-Bird CTDs can accommodate almost any voltage output (0-5 volt) sensor whose response can be described with a polynomial equation. However, the 16*plus* V2 is currently limited to one of the following RS-232 sensors: SBE 63 optical DO sensor; SBE 38 secondary temperature sensor; SBE 50 secondary pressure sensor; WET Labs sensor (single, dual, or triple channel ECO sensor; WETStar; or C-Star); Pro-Oceanus Gas Tension Device; Aanderaa Oxygen Optode 4330 or 4835.
Note: Several WET Labs sensors are available as either voltage or RS-232 sensors.

As mentioned earlier, if you purchase auxiliary sensors from Sea-Bird along with the CTD, we handle the sensor integration – enabling the channel in the CTD, modifying the configuration file to describe where the data falls within the data stream and provide the calibration coefficients, and doing any required setup of the auxiliary sensor itself. If you add or remove a sensor in the field, you must do this work yourself.

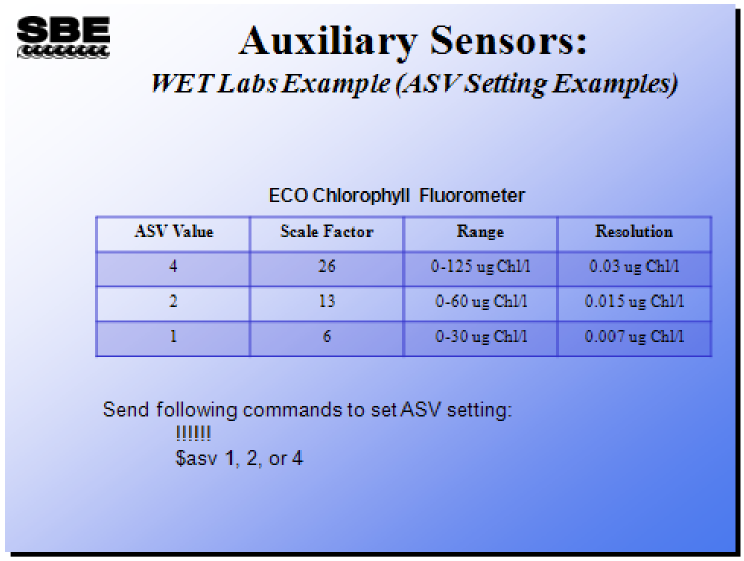
Auxiliary Sensors: WET Labs ECO Example



We will run through one example of setting up a CTD for use with an auxiliary sensor, using the WET Labs ECO-FL fluorometer. Application Note 72 provides details on the setup of this sensor.

The ECO can be used as a profiling sensor or a moored sensor. For this example, we are using a moored CTD, so we must first plug the ECO directly into the computer and set it up to work in moored mode. We did an example in Module 2 on setting up the system for operating in profiling mode.

Auxiliary Sensors: WET Labs ECO Example



ASV Value	Scale Factor	Range	Resolution
4	26	0-125 ug Chl/l	0.03 ug Chl/l
2	13	0-60 ug Chl/l	0.015 ug Chl/l
1	6	0-30 ug Chl/l	0.007 ug Chl/l

ASV is the Analog Scale Value. **Single channel ECOs** allow users to modify the range of the analog signal output to:

- Encompass the full range of the sensor.
- Decrease the range, increasing resolution, by a factor of 2 or 4.

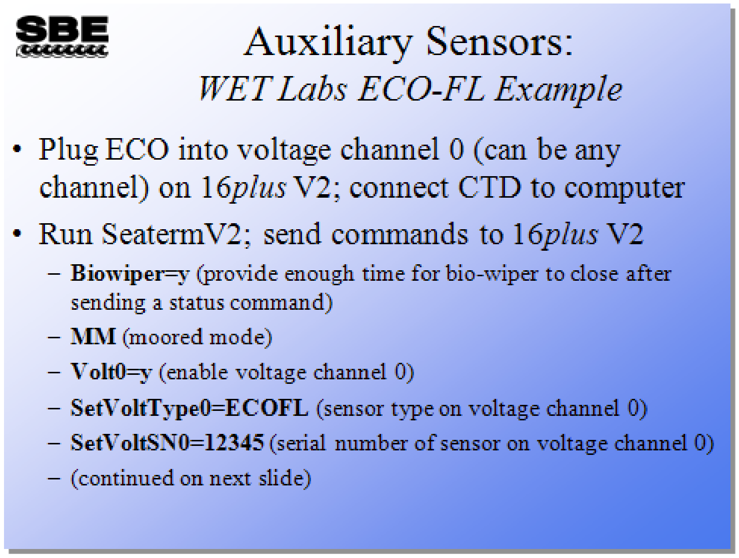
The factory default ASV is set to 4 (full scale).

The table above shows the ASVs and scale factors needed for your expected range of values for Chlorophyll a for the ECO-FLNTU.

While still connected directly to the ECO sensor, set the ASV.

Note: The ASV cannot be modified in dual-channel ECOs (such as ECO-FLNTU, which has both fluorometer and turbidity channels) or triple-channel ECOs (such as the ECO Triplet, which has a user-defined combination of fluorometer and scattering channels).

Auxiliary Sensors: WET Labs ECO Example *(continued)*

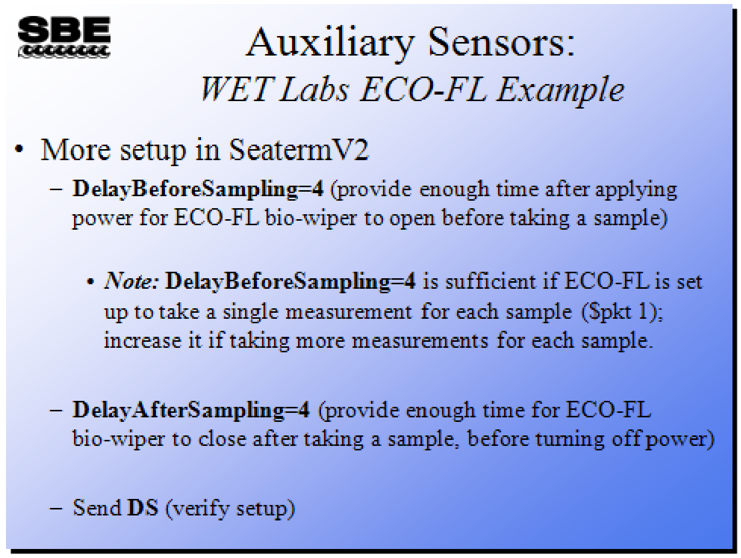


As mentioned earlier, when enabling/disabling a parameter, y and 1 are equivalent, and n and 0 are equivalent (i.e., **Volt0=y** and **Volt0=1** both enable voltage channel 0). The commands for enabling/disabling each voltage channel are **Volt0=** through **Volt5=**.

The **SetVoltType0=** and **SetVoltSN0=** commands record the user-input sensor types and serial numbers, and are informational only; the **GetHD** status response displays these, which may be useful for record keeping. The commands for each voltage channel are **SetVoltType0=** through **SetVoltType5=** and **SetVoltSN0=** through **SetVoltSN5=**.

For this example, we are using a voltage output version of the ECO-FL. It is also available as an RS-232 sensor. If using the RS-232 version, the command to enable the RS-232 channel in the 16*plus* V2 is **WetLabs=y**. And the informational commands to record the serial instrument type and serial number are **SetSerialType=** and **SetSerialSN=**.

Auxiliary Sensors: WET Labs ECO Example *(continued)*

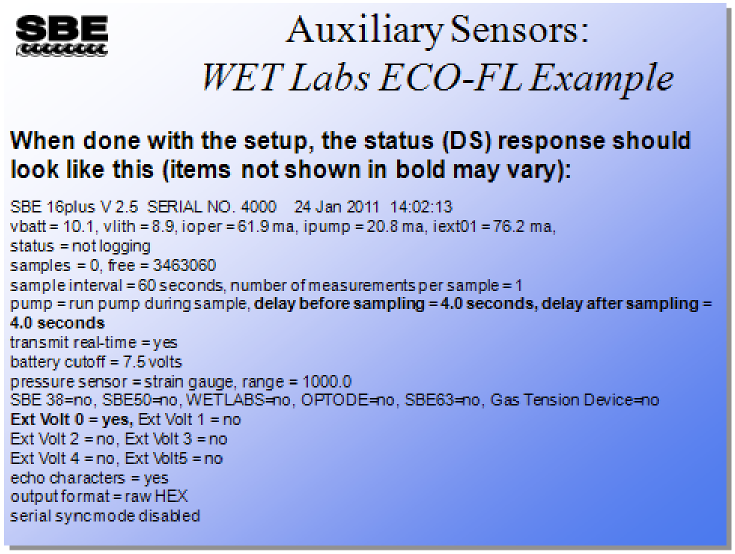


The CTD samples at user-programmable intervals for moored applications. It turns off power to the CTD and auxiliary sensors between measurements, conserving battery power. If integrating with a sensor with a bio-wiper, these settings are important:

- **DelayBeforeSampling=**
  Provide enough time for the bio-wiper to open after power is applied, before taking the measurement from the sensor. If you do not provide enough time, the measurement will be taken while the bio-wiper is still closed or only partially open, producing incorrect data.
- **DelayAfterSampling=**
  Similarly, provide enough time for the bio-wiper to close after taking the measurement from the sensor, before turning off the power to the sensor. If you do not provide enough time, the bio-wiper may remain open between measurements, leading to fouling of the sensor optical window and drifting data.

Note: The current version of 16*plus* V2 firmware (2.5) includes the **Biowiper=**, **DelayBeforeSampling=**, and **DelayAfterSampling=** commands. Older versions may not include any/all of the commands. If deploying an older 16*plus* V2 with an ECO-FL with bio-wiper, we recommend that you update your 16*plus* V2 firmware before deploying. This can easily be done in the field, via the data I/O connector; contact Sea-Bird for the firmware file, firmware loader software, and procedure.

Auxiliary Sensors: WET Labs ECO Example *(continued)*



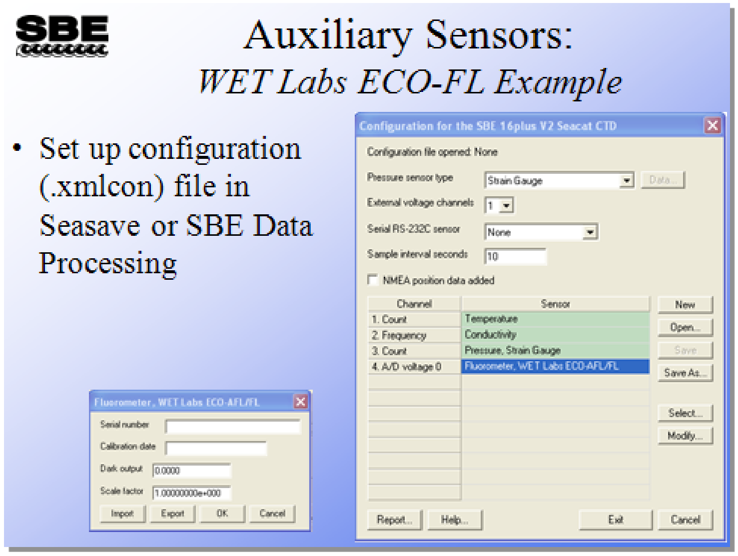
When the setup is complete, the **DS** response should show the values you entered for delay before sampling and delay after sampling, and **Ext Volt0 = yes** (you enabled voltage channel 0, so the CTD will supply power to that channel and incorporate data from that channel into the CTD data stream).

Additionally, because we set **Biowiper=y**, the response shows

`wait 4 seconds for biowiper to close`

before it measures the enabled external voltage currents.

Auxiliary Sensors: WET Labs ECO Example *(continued)*



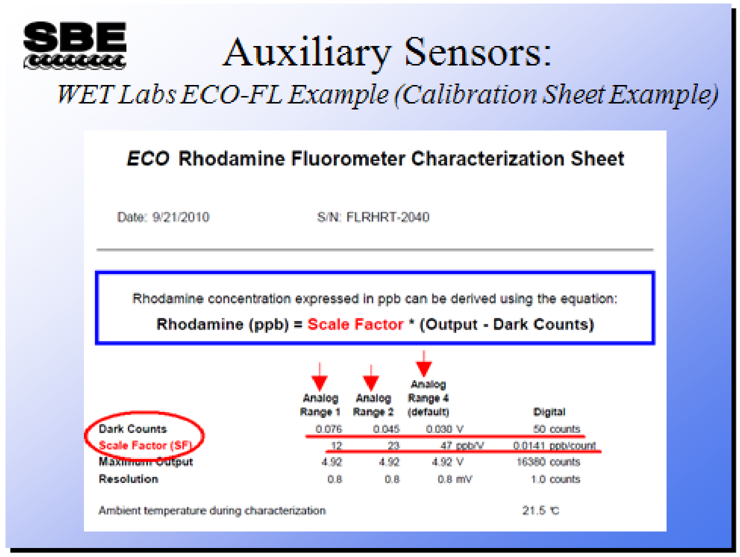
If using Seasave (real-time data acquisition; unusual for a mooring, but possible), you must modify/create the configuration file before deploying. Select *1* for *External voltage channels*. *A/D voltage 0* appears in the table, labeled *Free*. Double click to get a list of supported voltage sensors supported; click the + sign next to Fluorometers, and select WET Labs ECO-AFL/FL. A dialog box appears; enter calibration coefficients for the sensor.

What if you have multiple auxiliary sensors, and they are not using sequential channels (for example, sensors plugged into channels 0 and 4)? In SeatermV2, enable channels 0 and 4 in the CTD, so the CTD provides power to and receives data from those channels. In Seasave, select *2* for *External voltage channels*. *A/D voltage 0* and *A/D voltage 1* then appear in the table. In the configuration file, voltage 0 corresponds to the first auxiliary sensor voltage in the data stream, and voltage 1 corresponds to the second.

If you are not doing real-time data acquisition, create/modify the configuration file when you run SBE Data Processing (post-processing software). Seasave and SBE Data Processing use the same configuration file.

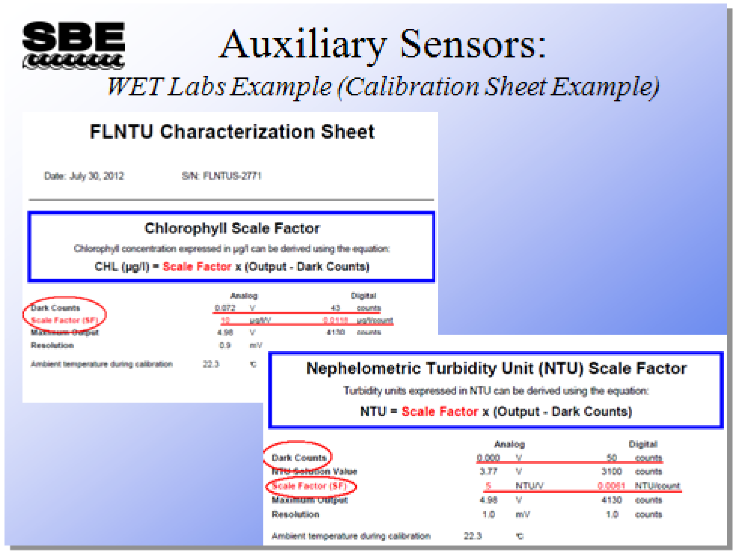
Note: For a dual-channel voltage-output ECO-FLNTU, you must enable two voltage channels in both CTD and configuration file. For a Triplet (available only as a RS-232 sensor), you must enable the RS-232 channel in the CTD (**WetLabs=y**) and select WET Labs as the RS-232 sensor in the configuration file; the software automatically creates 3 RS-232 channels in the configuration file.

Auxiliary Sensors: WET Labs ECO Example *(continued)*



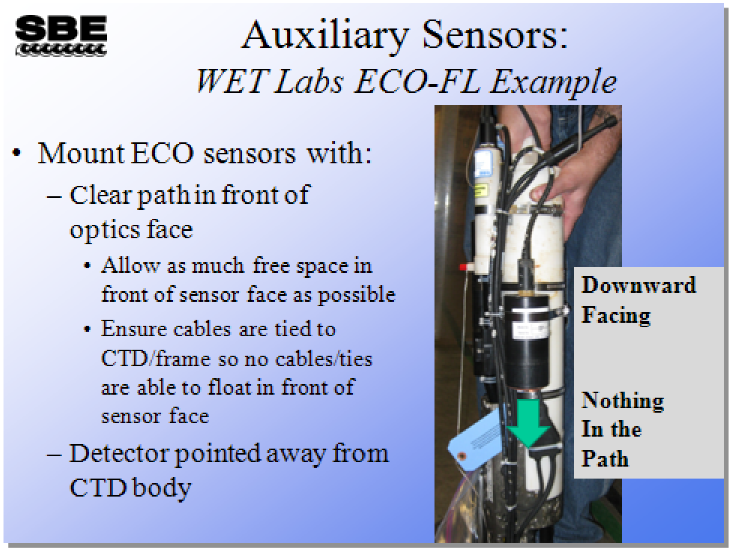
Here is an example calibration sheet from WET Labs. This calibration sheet is for an ECO-FL set that measures Rhodamine; it shows the Dark Counts and Scale Factor to input in the Sea-Bird configuration file.

Auxiliary Sensors: WET Labs ECO Example *(continued)*



These are calibration sheets for an ECO-FLNTU; one calibration sheet is for the FL (fluorometer) channel while the other is for the turbidity (NTU) channel. As mentioned earlier, the ECO-FLNTU is a dual-channel voltage-output instrument. You must enable two voltage channels in both the CTD and configuration file when using this sensor.

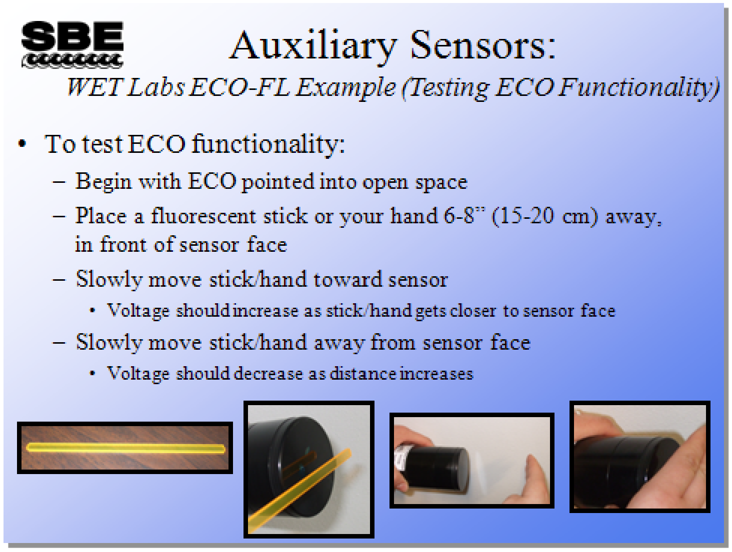
Auxiliary Sensors: WET Labs ECO Example *(continued)*



Attach the ECO on the CTD-cage or to the CTD. Preferred orientation is optical window facing down, to prevent sediment from settling on the window and to prevent sunlight from above from affecting the measurement. Be sure nothing is in the direct path of the optical window, and that nothing can reflect light back towards the sensor.

Remove the protective cap before deployment!

Auxiliary Sensors: WET Labs ECO Example *(continued)*

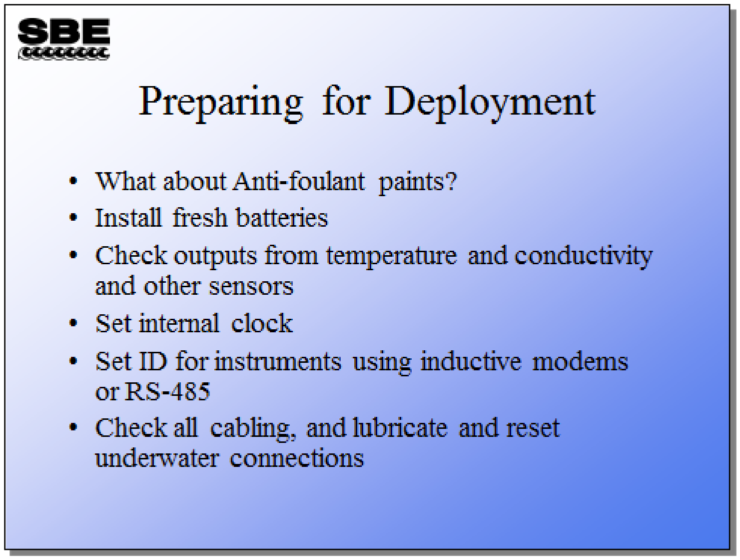


It is always good to be sure that all sensors are outputting data once they are installed. Sea-Bird does this by placing the assembled CTD with all auxiliary sensors into a test bath overnight and examining the recorded data the following day, prior to shipping to customers. If you install your own sensors, you may want to do something similar, or perform a bench test to ensure all sensor channels that are enabled are outputting data the way you think they should, and that you do not have something plugged into the wrong channel or enabled incorrectly in the CTD.

Easy checks for functionality include:

- The ECO-FL test described above. The fluorescent stick is shipped with the sensor.
- Conductivity check - Zero conductivity test with a dry conductivity cell and in air (should output a frequency very close to the zero conductivity calibration frequency on the conductivity sensor calibration sheet that came with your CTD).
- Temperature check.
- Pressure check - At known elevation (quick check) or against a barometer (more precise).
- Scan output rate check.

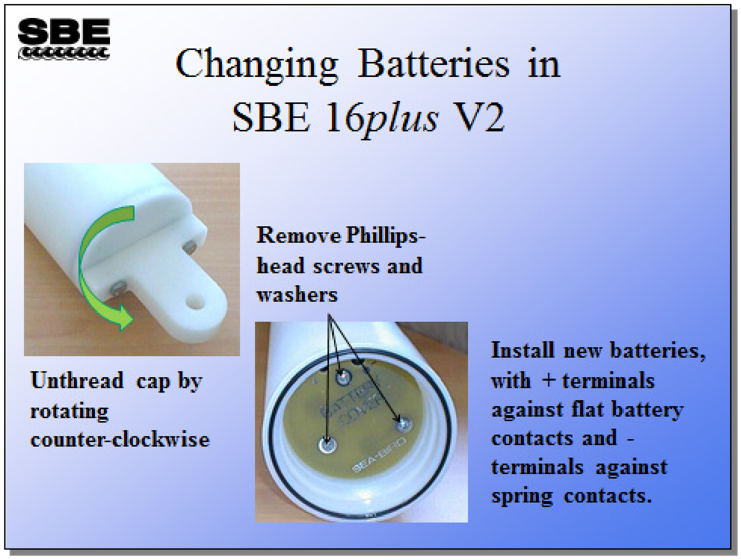
Anti-Foulant Paints



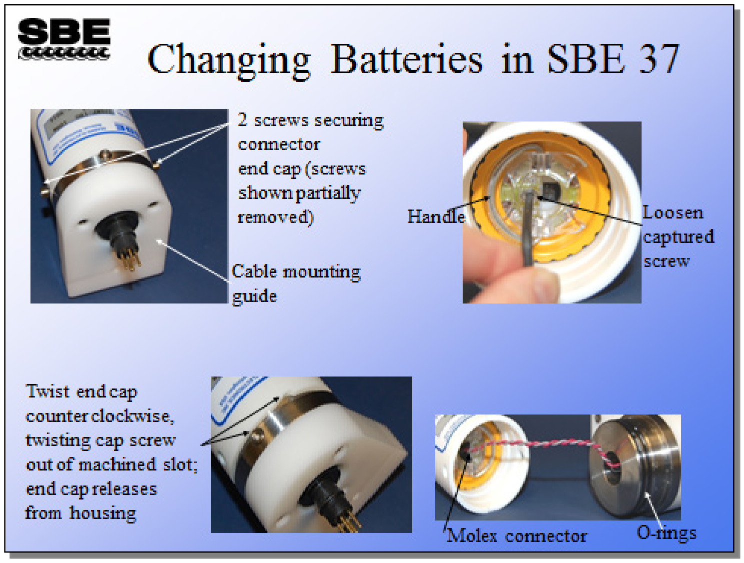
We are going to discuss preparation for deployment next. Some of these items need little explanation, while others require more consideration.

Anti-Foulant Paints (*continued*)

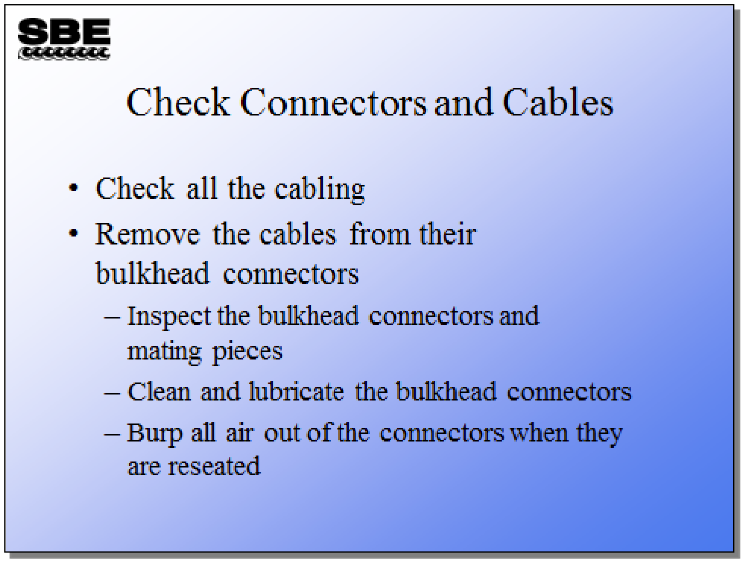
Changing Batteries



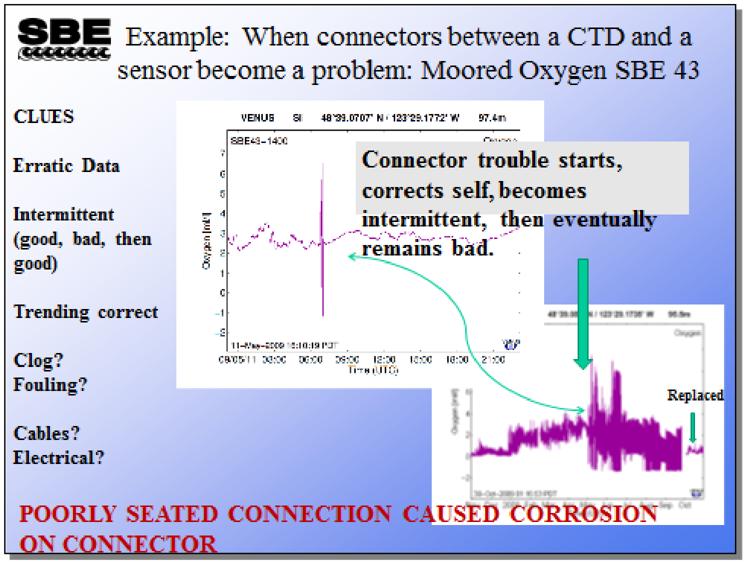
Changing Batteries (*continued*)



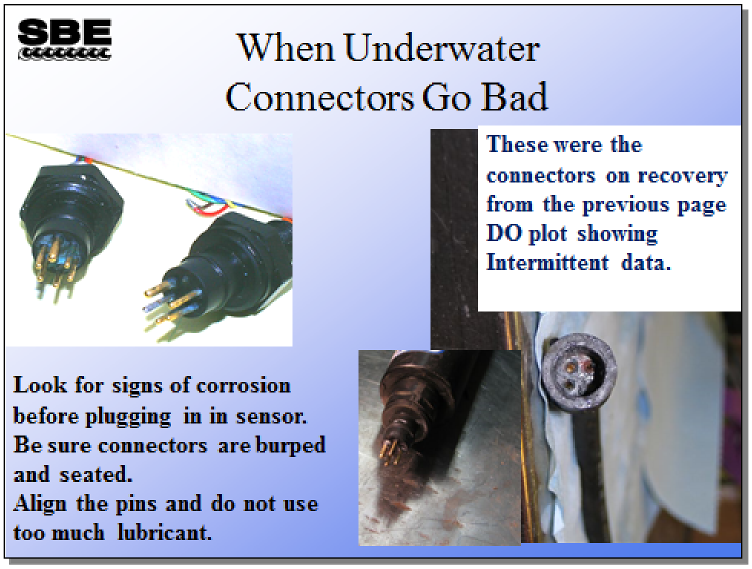
Checking Cables and Connectors



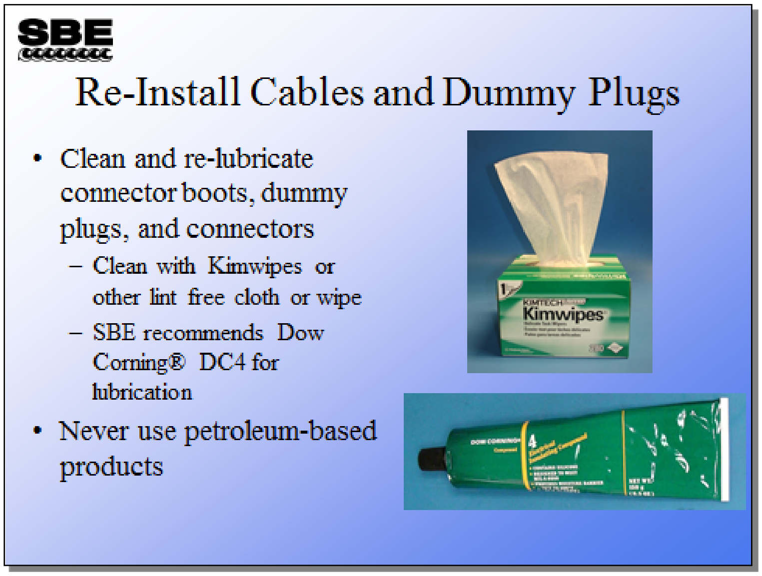
Checking Cables and Connectors (*continued*)



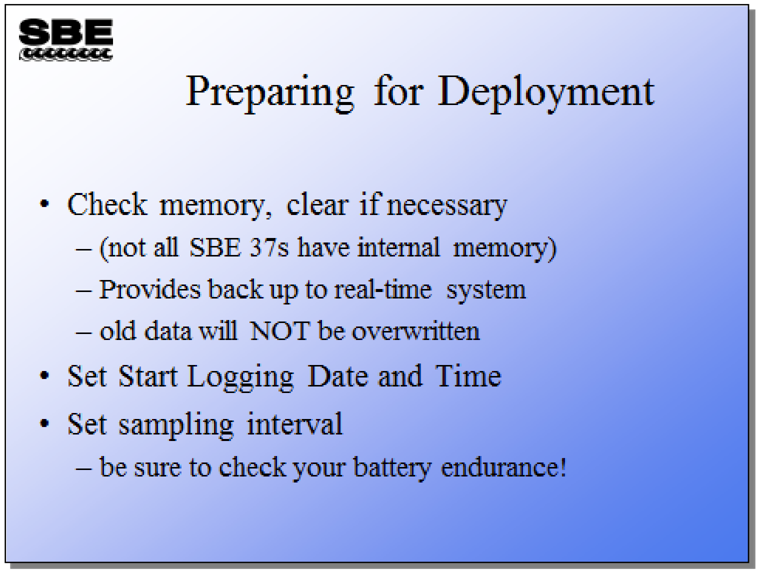
Checking Cables and Connectors (*continued*)



Checking Cables and Connectors (*continued*)



Preparing for Deployment



Preparing for Deployment (*continued*)

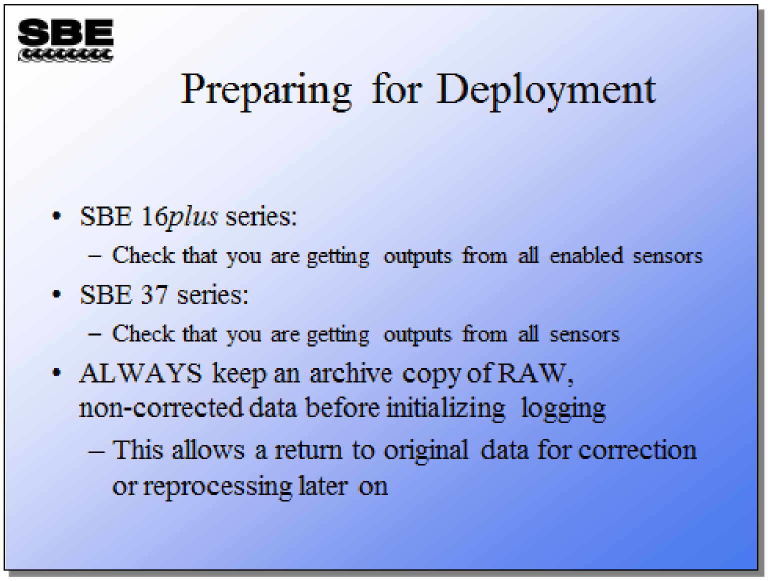
SBE

Sample QUICKSTART Checklist for SBE 37

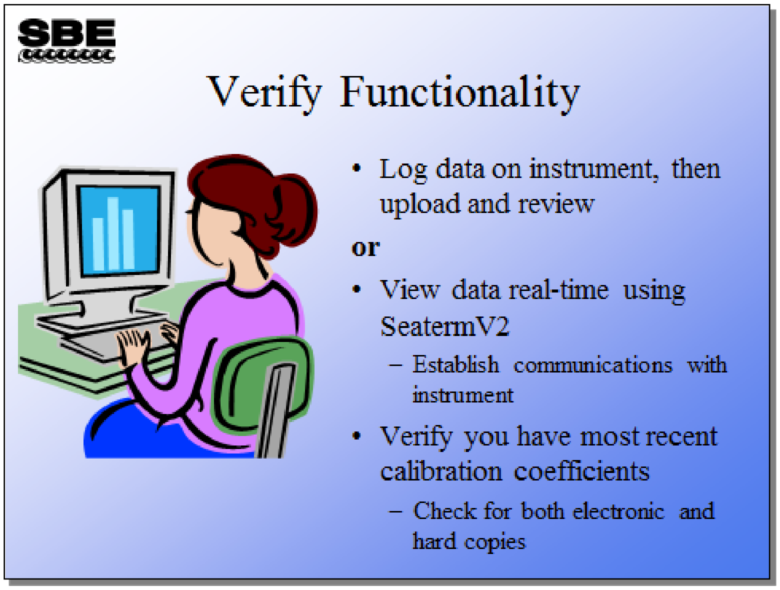
SBE37 RS232 SN ____________________
Operator _____________________ Date _____________ Checked by______

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 realtime ______________________________________
Minimum Conductivity Frequency __________________________

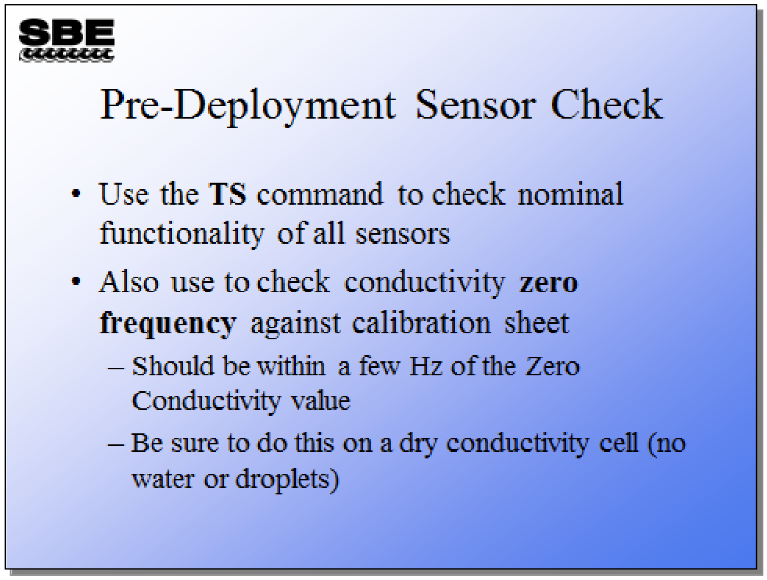
Preparing for Deployment (*continued*)



Preparing for Deployment: Sensor Check



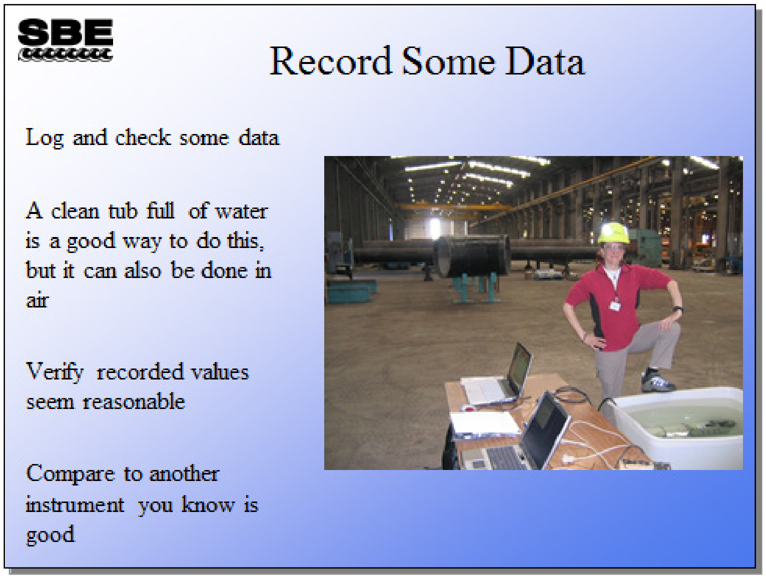
Preparing for Deployment: Sensor Check (*continued*)



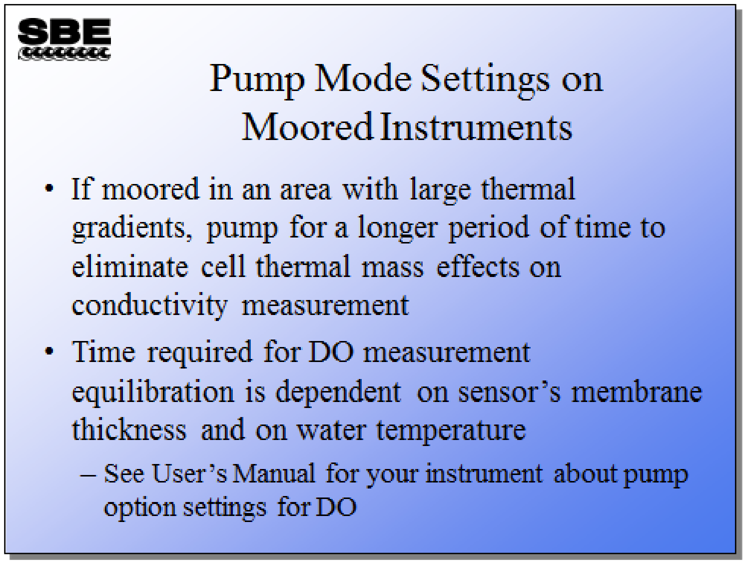
Before you invest a great deal of time and effort deploying a mooring, it is a great idea to send your instrument in for calibration. It is an excellent check on its functionality, not to mention its accuracy. If you are unable to do this, check to see that all the sensors are presenting nominally correct 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. 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.

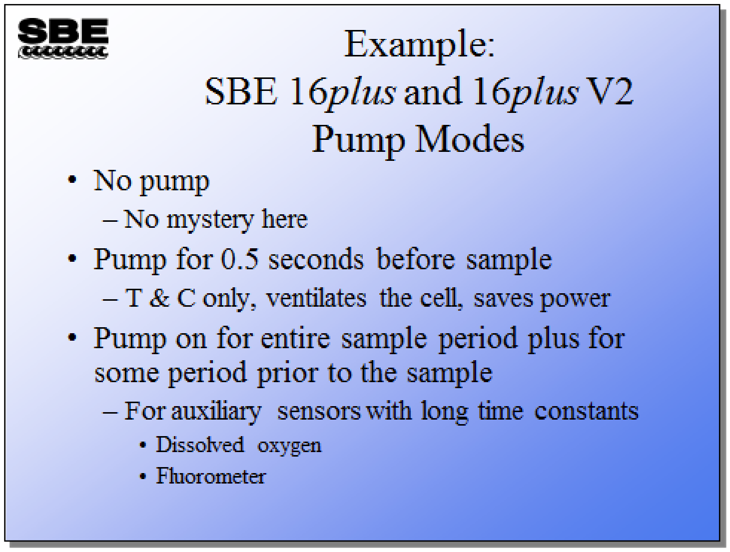
Preparing for Deployment: Sensor Check (*continued*)



Preparing for Deployment: Pump Operation



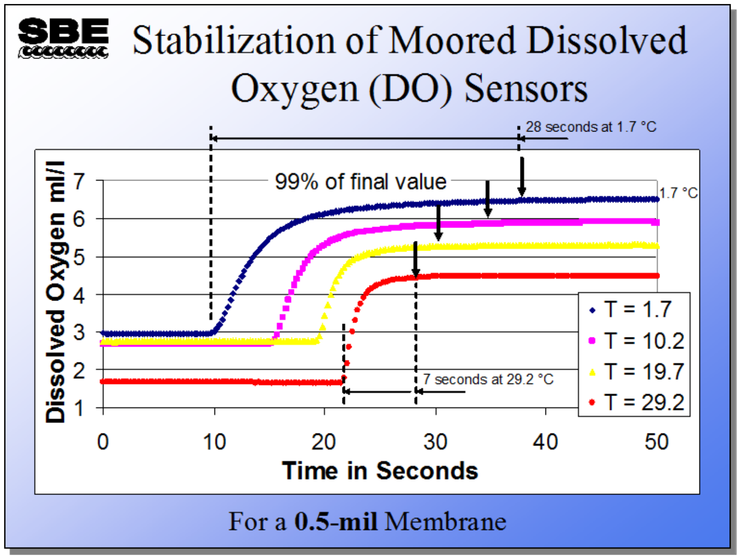
Preparing for Deployment: Pump Operation (*continued*)



Experience with the SBE 41 Argo CTD has led Sea-Bird to adopt the protocol of ventilating the conductivity cell for a short time before measuring the conductivity, and then turning the pump off. This saves power and has the additional benefit of reducing bio-fouling inside the cell while the pump is off and the instrument is waiting for the next sample. With this protocol the power requirement is small enough to allow long-term deployment at reasonably short sampling intervals (e.g., 15 minutes).

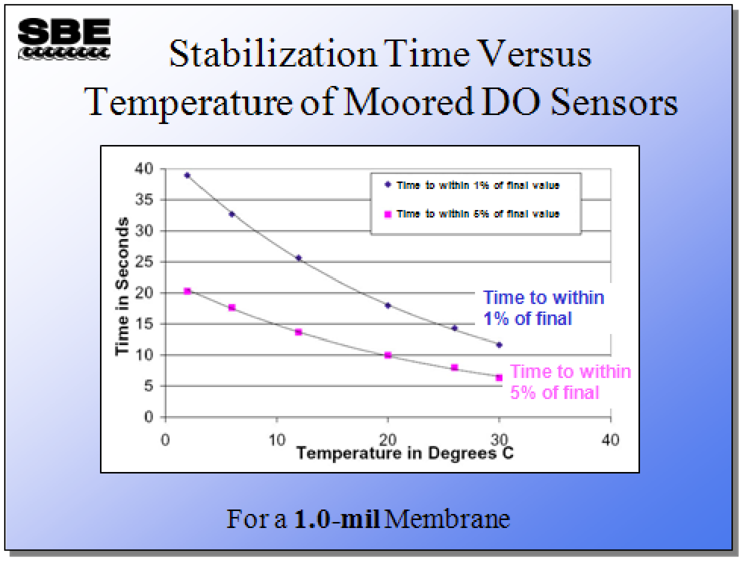
If you are using sensors with a comparatively long time constant, run the pump throughout the sample interval. Recall from the slide that showed the 16*plus* V2 status report, you can set the delay from the start of the sampling period to the moment when the auxiliary sensor is measured. This allows you to give a slow sensor 5 or 6 time constants to equilibrate.

Preparing for Deployment: Pump Operation (*continued*)



Oxygen sensors installed in moorings are always pumped and are typically plumbed between the pump and conductivity sensor of an SBE 16*plus* or 16*plus* V2. Between samples the pump does not run and water ceases to move past the oxygen electrode. As we have discussed, the electrode of the SBE 43 oxygen sensor is powered by an internal battery. When the water becomes still, the electrode depletes it of oxygen; if the CTD were to continue logging data you would observe oxygen concentration inside the sensor plenum approaching a steady state well below the ambient oxygen levels. When the CTD initiates a normal sampling interval by turning on the pump, you would observe a curve similar to the ones shown above. The water flow establishes a normal boundary layer above the oxygen electrode and the sensor equilibrates to the ambient oxygen level. The time required to reach 99% of the final equilibrium value depends on temperature, warmer water allowing faster equilibration. The arrows on the plot show the point at which the sensor has achieved 99% of the final value at each temperature.

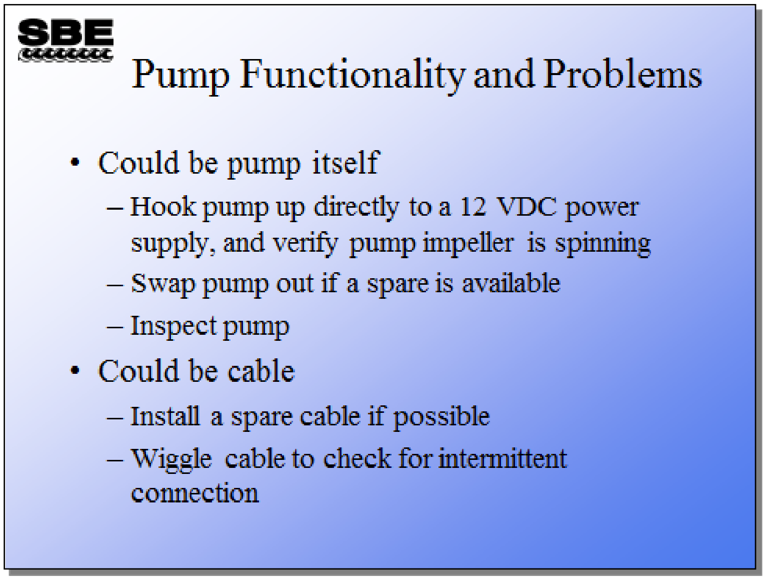
Preparing for Deployment: Pump Operation (*continued*)



Prior to 2007, all SBE 43s were sold with a 0.5-mil thick membrane. Beginning in 2007, Sea-Bird began offering two membrane thicknesses – 0.5 mil (faster response, typically for profiling applications and 1.0 mil (slower response but more durable, typically for moored applications). This plot is for a **1.0-mil membrane**.

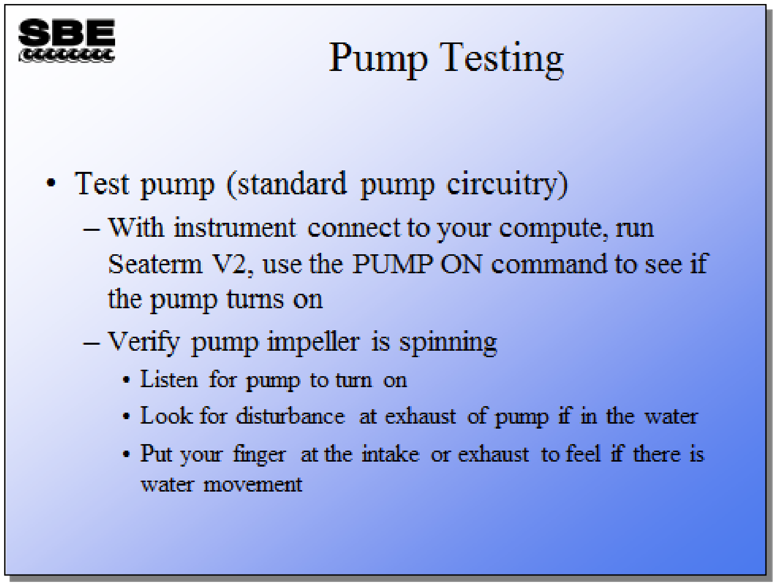
This plot may be used to determine the time required from power up and pump turn on to the availability of an acceptable dissolved oxygen sample. For example, if you were working in 20° C water and wanted your oxygen data to be better than 1% of actual ambient oxygen concentrations, you would want the sample interval to be longer than 18 seconds. Set the SBE 16*plus* or 16*plus* V2 pump mode to pump during the entire sample time (**MooredPumpMode=2** for 16*plus*; **PumpMode=2** for 16*plus* V2), and set the delay before sampling to 20 seconds (**DelayBeforeSampling=15**). We have allowed 2 extra seconds in our sampling time; this ensures that if the instrument finds itself in colder than expected water, that the sample will still be good. Note that longer pump times reduce battery endurance.

Preparing for Deployment: Pump Operation (*continued*)



For Maintenance of SBE 5T, 5P, and 5M Pumps, see **Application Note 75** (www.seabird.com/application_notes/AN75.htm) and a training video (www.seabird.com/training/Videos.htm).

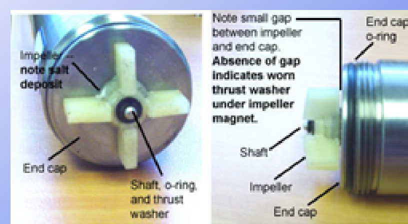
Preparing for Deployment: Pump Operation (*continued*)



Preparing for Deployment: Pump Operation (*continued*)

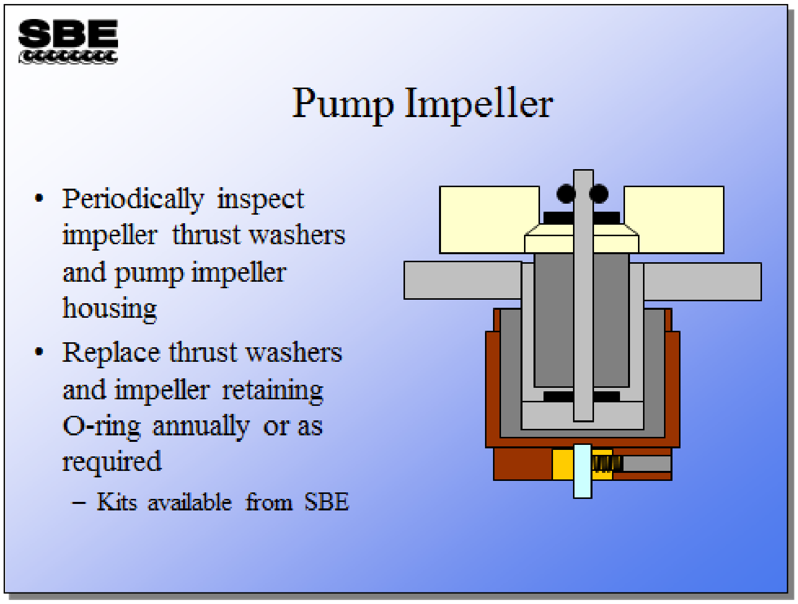
What if Pump Is Not Running?

- If pump is not running, remove pump head and inspect impeller and thrust washers to determine if a clogged impeller is problem
- Pump impeller can become stopped by sand, sediment, and salt crystals

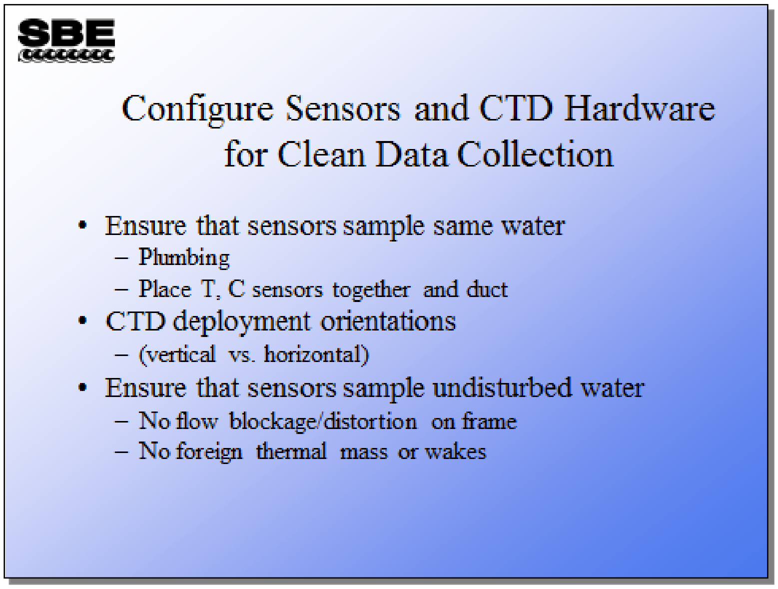


SBE 5T with Pump Head Removed

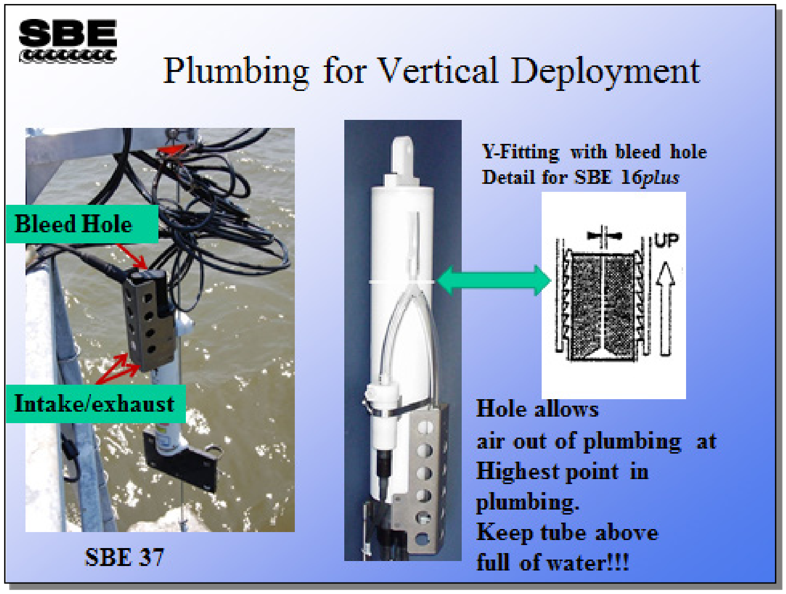
Preparing for Deployment: Pump Operation (*continued*)



Clean Data Collection



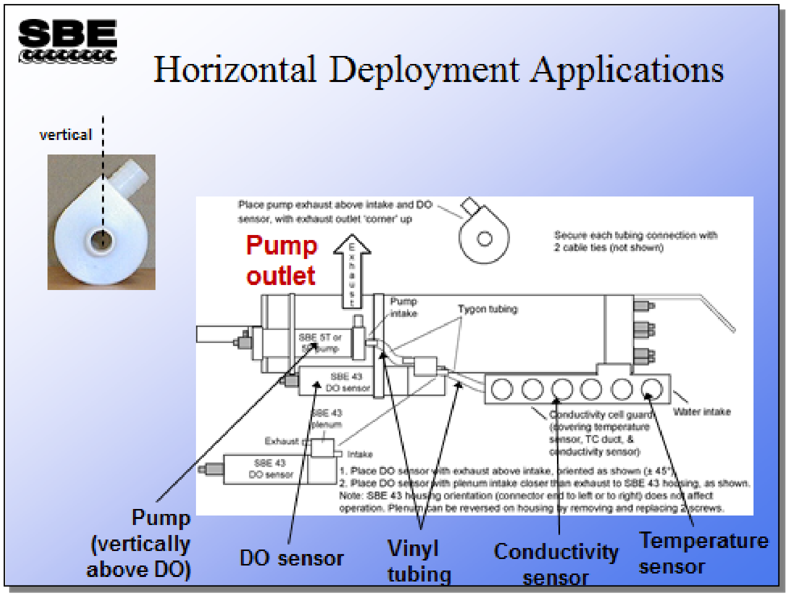
Plumbing



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.

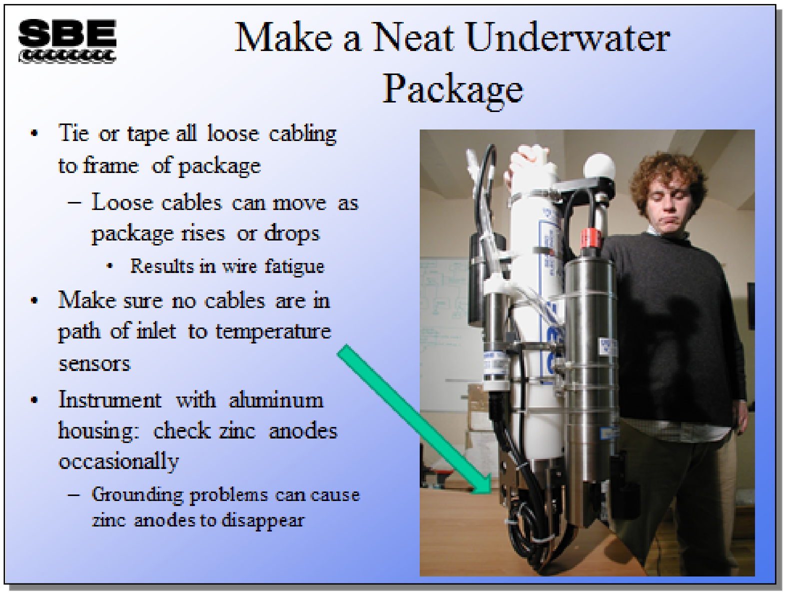
On the left, the SBE 37 MicroCAT can be deployed as shown or inverted. In the recommended orientation (shown), the air escapes through a bleed hole on the top. This orientation also helps prevent sedimentation in the plumbing. If deployed inverted, air escapes from the two openings at the intake and 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.

Plumbing (*continued*)

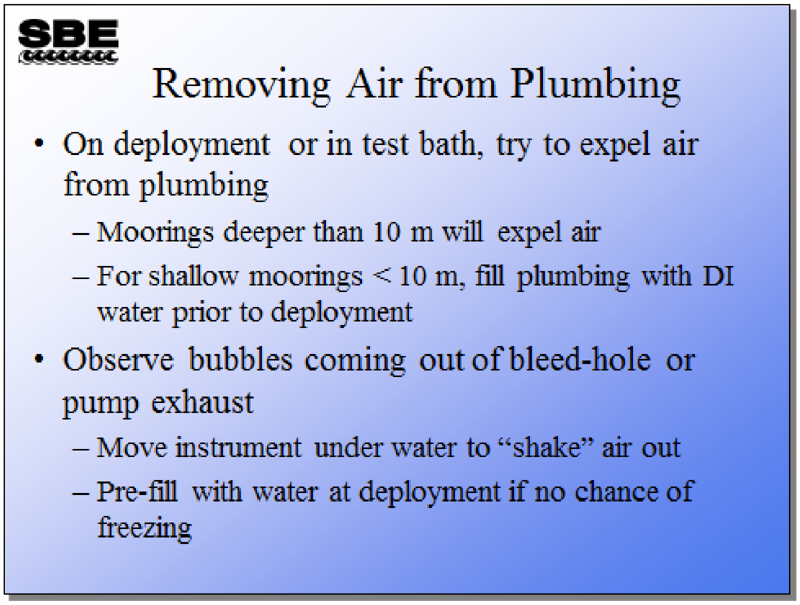


Notice here that the pump exhaust is now the highest point on the plumbing.

Clean Data Collection



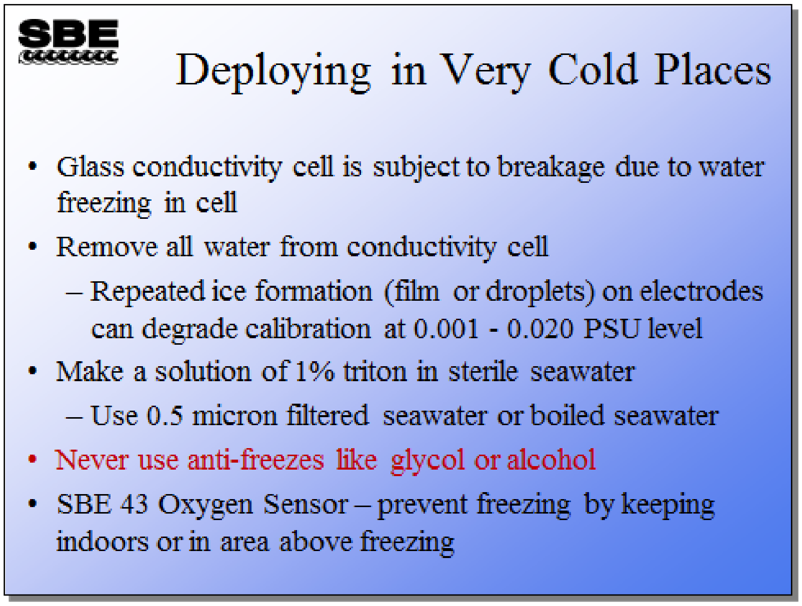
Removing Air from Plumbing



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.

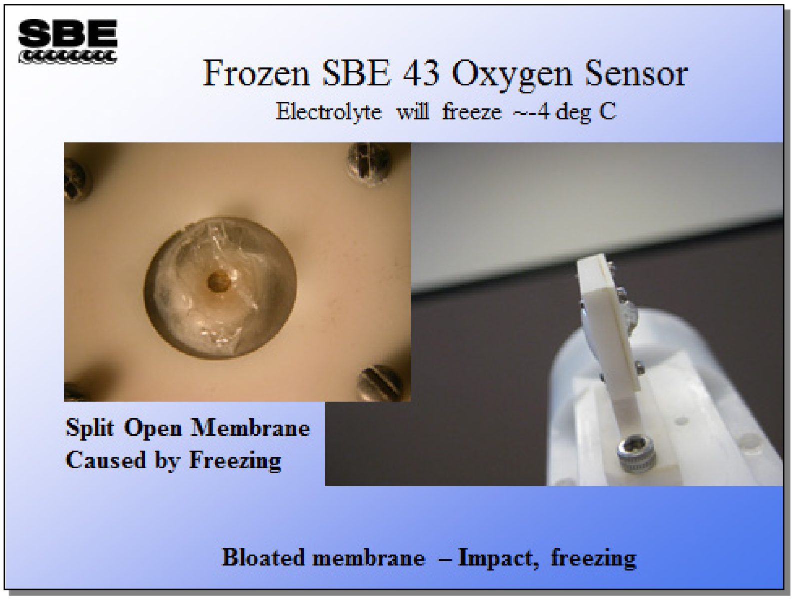
Another important note: Salt water can cause the bleed hole to clog with salt if not rinsed regularly. Sea-Bird recommends soaking instruments in freshwater after deployment to prevent this from happening.

Deploying in Cold Places



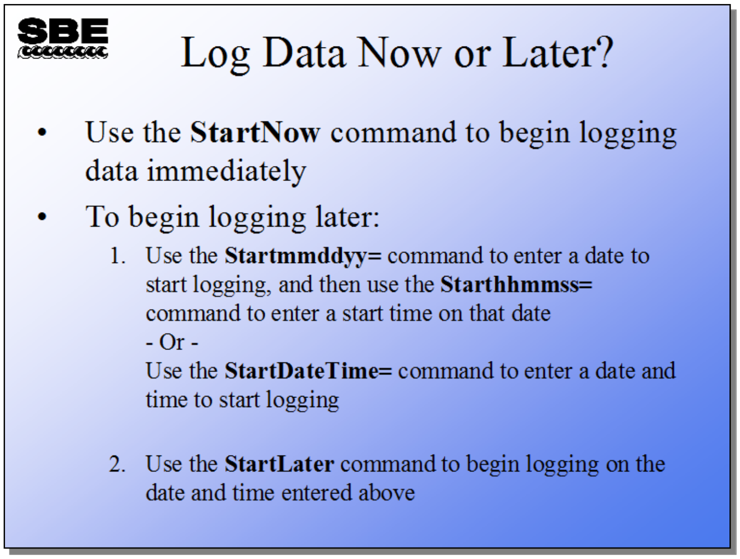
Never store water in the conductivity cells or plumbing if there is a risk of freezing.

Deploying in Cold Places (*continued*)



In both of these examples, the sensors were left on the deck of a boat when it froze outside overnight. The sensor on the left showed 0 volts output from the CTD data outputs. The sensor on the right showed some reasonable data near the surface, but the data became clearly unreasonable under pressure. The membranes and electrolyte solution had to be replaced on both sensors.

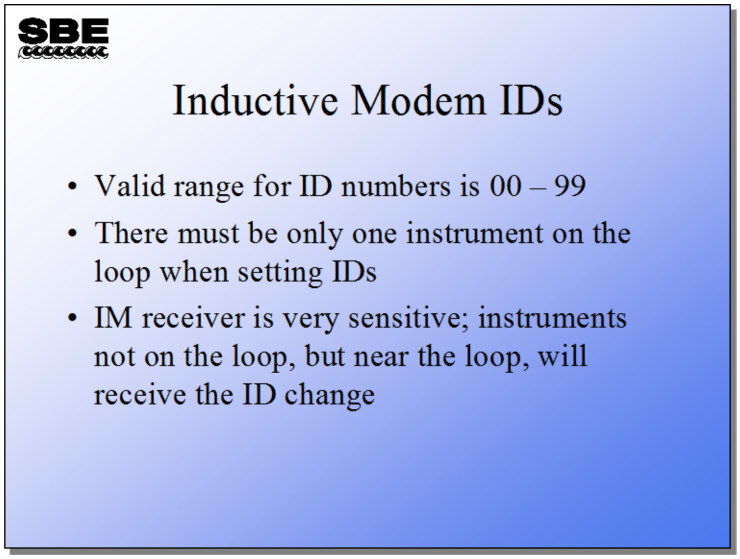
Preparing for Deployment: Starting Logging



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.

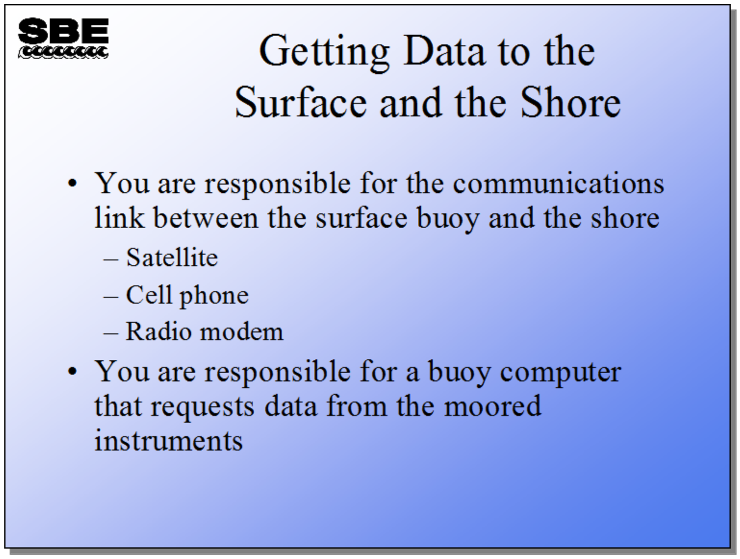
Refer to the instrument manual for the exact commands for your instrument and your firmware version. For example, the 16*plus* V2 uses **StartDateTime=** to set the start date and time; the 16*plus* uses **Startmmddyy=** and **Starthhmmss=** to set the start date and time.

Preparing for Deployment: Inductive Modem Systems



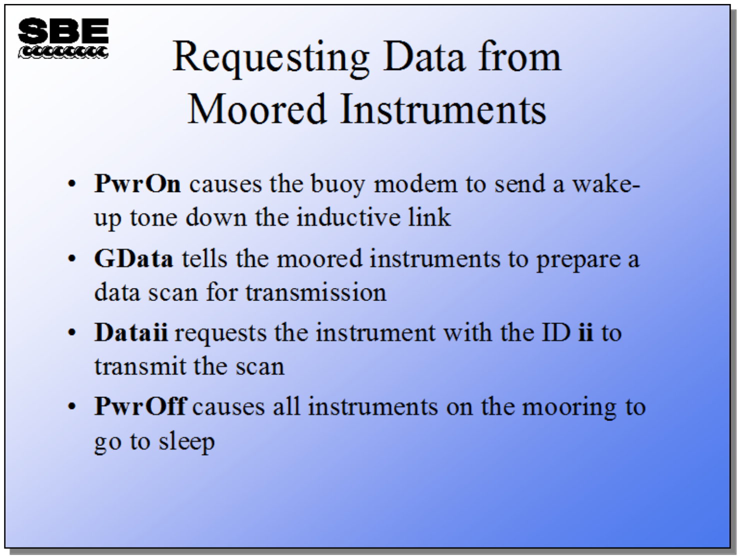
Do not change the ID of an inductive modem equipped instrument when another instrument is on the same loop; this will cause both instruments to take the same ID. The telemetry system will not work properly for those instruments, because they will try to use the link at the same time. The inductive modem receiver in the instruments is very sensitive. Two instruments that are side-by-side will take the same ID even if one of them is not connected to the loop. You must separate IM instruments by at least 1 meter when you change IDs.

Preparing for Deployment: Inductive Modem Systems (*continued*)



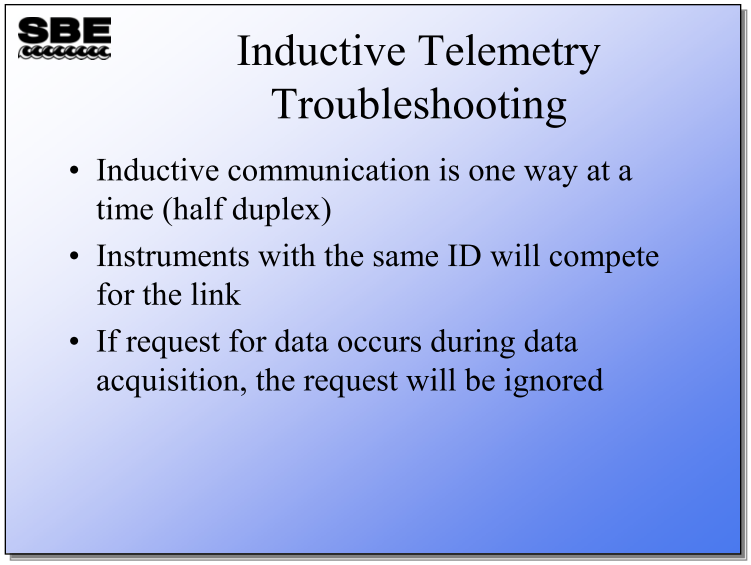
The complete inductive mooring system requires a computer at the surface, to send commands to the instruments via the surface inductive modem and to communicate with the shore. Sea-Bird has customers that use satellites, some that use cell phones, and some that use radio modems. It is your responsibility to develop the hardware and software to perform these duties.

Preparing for Deployment: Inductive Modem Systems (*continued*)



Communication with the moored instruments is simple. Sending **PwrOn** to the surface modem's serial port causes it to wake all the remote instruments with a 4800 Hz tone. Once awakened, the **GData** command causes the modems on the moored instruments to request the last sample or an average of the samples taken from their instruments (depending on the instrument and its setup). Then each instrument in turn is queried for a sample with the **Dataii** command, with **ii** being the instrument ID (for example, **data01** queries the instrument with ID=01). Finally, **PwrOff** puts all the instruments to sleep. If no **PwrOff** is issued, the instruments go to sleep after 2 minutes. Thus, if the sampling protocol requires more than 2 minutes, a **PwrOn** must be issued to make sure that none of the moored instruments has gone to sleep.

Preparing for Deployment: Inductive Modem Systems (*continued*)



The inductive link is half duplex. This means that only one device on the link may be actively transmitting data at a time. If the situation occurs where two devices are trying to transmit, the communication will be corrupt.

If two devices have the same ID, the above problem will occur whenever that ID is used.

Usually, moored instruments sample on schedule. If the inductive link becomes active while an instrument is sampling, a request for data may be ignored. This can occur because of clock drift in the buoy. If the buoy is equipped with a GPS, the GPS is a good source of time.

A final note on preparing moored instruments for deployment: **Application Note 83** provides a checklist for moored instruments, intended as a guideline to assist you in developing a checklist specific to your operation and instrument setup.