

V. Using the Autosalinometer to Check Data Accuracy

In order to cross-check the salinity data coming from the SEASOFT program, take samples from casts and find their salinity using the Guildline Autosalinometers located in the closet in the Bio Lab. This is often referred to as “running salts.” The salinometer is a very sensitive instrument, so it is imperative to follow the guidelines below. Also, the instruction book for the instrument is located in the salinometer room and provides some more information. Please see Appendix E for notes on sampling techniques.

Occasionally, it may be necessary to use the Portasal, a portable salinometer that is easier to operate than the Autosal, but provides lower accuracy. A complete procedure is located in Appendix F. Highlighted differences between the Autosal and the Portasal are located toward the end of this section.

About the Autosalinometer

- An image of the Autosal and Portasal can be found in Appendix I.
- The Guildline Autosalinometer (Autosal) is very temperature sensitive. The temperature reading on the machine must be within four degrees of the room temperature (on the warmer side—the best setting is typically 24° C). The samples should be at room temperature; put them in the closet at least 12 hours before running them. The unit has an easier time warming samples than it does cooling them. Keep the door to the salinometer room closed to keep the temperature stable. If there’s a problem keeping the temperature stable, close the door between the hall and the Bio Lab. **Temperature control is VERY important.**
- It is very easy to contaminate a sample. To prevent this, wear rubber or laytex gloves, and don’t touch anything that may go into the sample or the Autosal. Use a new kimwipe to wipe down the sample tube after each sample is run.
- Make sure there are no bubbles in the conductivity cell. This affects readings severely.
- Before running a sample, shake it very well to mix any stratified layers. Also, wipe off the mouth of the sample bottle very carefully, removing any salt crystals.
- Make sure that the sample bottle fits snugly over the rubber stopper; only an airtight seal will pump the sample water into the conductivity cell.
- When the Autosal is not in use, a sample bottle of distilled water should be attached and the conductivity cell filled with distilled water. See **Finishing a Run** for more information on this process.
- The function switch should be set at “Standby” when not in use.
- Once the pumps are turned on for a run, keep them on until the run is complete.
- For more detailed instructions for the instrument, please refer to the Guildline manuals located on the shelf just below and to the right of the Autosal instruments.

Starting the Autosol Process

Before running salts, make sure to have all the equipment you need:

- two seawater standard vials (at room temperature) from the same batch
- samples (at room temperature)
- an ample supply of kimwipes
- latex gloves
- file for removing glass tops of standardized seawater
- log sheets
- bucket to catch outflow
- supply of distilled water

Read the zero value of the instrument by turning the function switch to Zero. Ensure that the display reads between $0.0\ 0000$ and 0.0 ± 0005 . The closer the value is to zero, the better. If 0.0 ± 0005 can't be reached, contact the MST on board for assistance.

Standardizing the Autosol

Before and after a run of salts (usually 48 samples), the Autosol should be standardized in order to obtain accurate data. This is done by running a standardized seawater sample and standardizing the reading to twice the K_{15} value printed on the seawater sample.

When the instrument has been stored with distilled water in the cell, the cell should be flushed with some seawater (either an open standard or an old sample bottle) before standardizing in order to prime the cell. Flush the cell approximately 10 times before placing the standard on the instrument. See directions below for flushing the cell.

1. Turn the pump on.
2. Open the seawater standard by filing the neck to score the glass, then break off the glass tip by striking it with the file.
3. Cut a length of tubing to fit to the bottom of the seawater sample bottle and place on the metal tube fitting protruding from the rubber stopper. Use a rubber adapter to fit over the lip of the standard bottle and into the rubber stopper.
4. Place standard onto the adjustable sample table. Make a secure fit into the rubber stopper.
5. Be sure to set up a tube and bucket for the cell drain. Because of electrical conductivity, make sure the tube from the Autosol doesn't touch anything including the bucket and the waste in the bucket. Flush the Autosol by placing a finger over the Flush valve. Water will exit the conductivity cell and flow out the cell drain.
6. Flush the Autosol 3 times before taking a reading. This flush is for the standardization, and occurs between each reading. This shouldn't be confused with the original 10 flushes to remove distilled water.
7. Turn the function switch to Read, and adjust the reading to twice the value of K_{15} by
 - first turning the Suppression dial to stabilize the reading (make it stop blinking) and to set the first 4 numbers on the reading, and

- then turning the Standardize dial to set the last 2 digits.
8. When the reading is twice the value of K_{15} and steady, record the value and turn the function switch to Standby. Flush the cell and take another reading by turning the function switch to Read. Do this twice to ensure the reading of the standard is steady and not drifting. Move the black lever on the Standardize dial to lock, and turn the function switch to Standby. Make sure to record what values/readings were taken (see **Documentation** section below).
 9. The instrument is now standardized and ready to run samples. Do NOT change the Suppression or the Standardize knobs during a run.

NOTES

- If the volume in the sample or standard gets below 5 cm, don't use it. The data you may get can be faulty because of settling and/or evaporation of the sample.
- If the function switch is ever turned to Read before the cell has had a chance to refill (after flushing), the instrument will need 5 minutes to restabilize.

Analyzing Samples

1. Remove the standardized seawater bottle and the tubing. Place a shorter tubing (relative to the size of the sample bottle) onto the metal tube fitting.
2. Wipe the top of the sample bottle off, making sure not to let any salt crystals get into the sample bottle. Place the lip of the sample bottle over the rubber stopper, and adjust the sample table to ensure a snug fit.
3. Flush the conductivity cell three times. Make sure there are no bubbles in the cell. If there are any bubbles, flush again.
4. While flushing, gently shake the next sample bottle.
5. After the third flush, when the cell is filled, take a reading by turning the function switch to Read. Record the result on the log sheet and return the function switch to Standby.
6. Flush the cell again, and take another reading. Usually wait 5 seconds for the reading to stabilize before recording it. Do this for least 3 readings, or until the readings are accurate with each other. Under ideal conditions, the first three readings will agree to within a digit or two.
7. Remove the sample bottle, place an empty sample bottle on the rubber stopper in order to flush the tubing properly, and flush the cell to remove any of the sample from the tubing. This will ensure that the next sample isn't contaminated.
8. Wipe the tubing down with a kimwipe.
9. Replace the used sample bottle upside down in the case as a reminder that it's been run.
10. Repeat steps 2-9 for each sample.

Finishing a Run

When the run is finished, it is necessary to standardize the instrument again. Use a standard seawater sample from the same batch as the one you standardized with at the beginning of the run.

1. Remove the sample-sized tubing.

2. Replace the tubing with the longer standardizing-sized tubing, pushed in the black stopper.
3. Repeat the steps in **Standardizing the Autosol**. **It is MOST IMPORTANT to record what the reading is before you standardize to twice the value of K_{15} .**
4. Remove the standard bottle and the standardizing-sized tubing. Place the sample-sized tubing back on the metal fitting.
5. Place a sample bottle filled with distilled water (and clearly labeled) onto the instrument and flush. After the cell refills, shut off the pumps. This is the proper way to store the instrument when not in use.
6. Read the zero value again. The value should be the same as when you started the run. If it is different, it may indicate faulty readings within that run. Record the value.

Documentation

The log sheet (an example is shown on the following pages) offers a clear and accurate way to record data while running salts. It is imperative to complete the top section of this form for the computation of salinity.

The body of the log sheet has a number of columns for sample number, CTD cast number, and the number of the bottle on the rosette from which the sample came. There are 5 spaces for readings per sample. Each sample should have at least 3 readings.

When the log sheet is finished, place it in the CTD log book.

Converting Conductivity Ratios to Salinity

The Autosol gives readings for conductivity, while the Portasal computes salinity directly. The Guildline manual gives a formula to convert conductivity ratios to salinity measurements. There is a created MATLAB script (autosalinity.M) which will perform this computation located with the CTD files.

Compare the salinity figures obtained by the Autosol from a particular bottle with the corresponding value in the .ROS file for the same depth. A variation of ± 0.005 or larger in the salinity values warrants an investigation.

Running the Portasal

The Portasal can also be used to measure salts, although at a poorer precision and accuracy. It can be set up in the salinometer room in between the two Autosol instruments. Contact the MST to set up the Portasal. Always make sure it is secured.

The process for running the Portasal is similar to running the Autosol, with a few differences:

- The Portasal has a keypad for standardizing and running salts. It will output the salinity directly, as well as the conductivity ratio. Below is an explanation of the keys and their functions.
- The Portasal bath is smaller than the Autosol (approx. 10 liters). The error in salinity is ± 0.003 because of this, as opposed to the ± 0.001 for the Autosol.
- The Flow Rate switch controls the pumps. If the Flow Rate switch is turned to Off, then the pumps are off. The flow rate should be kept as fast as possible. However, if there is a great difference between the sample and bath temperatures (the lamp inside the bath will flash quickly and irregularly), the flow rate should be slowed to allow the sample and bath to equilibrate before taking a reading.
- Standardizing: Load the standard seawater and the samples the same way as with the Autosol. When the standard seawater sample has been flushed, turn the function switch to Read and press the STD button on the keypad. This will ask you to enter the K_{15} value (NOT twice the K_{15} value). Press **<Enter>**, and the Portasal will ask for the batch number. Key this in, and press **<Enter>** again. The Portasal will adjust itself to the K_{15} value you've entered. When the reading is steady, press **<Enter>** again. Record this number. This is the standard. To test this, flush the cell and run the standard as if it were a sample three times, filling the cell and reading to match the salinity listed on the standard. If the reading doesn't match the salinity, then standardize the instrument again.
- To read salinity instead of the conductivity ratio, turn the function switch to Read, then press the SAL button on the keypad.
- Because of the error, it is advised to take at least 5 readings per sample to ensure accuracy.
- It is imperative to have the Tank Overflow tubing attached in case of temperature flux which will necessitate evacuating the bath.

Detailed instructions for running the Portasal are found in Appendix D.

Key	Function
1/ T SET	Set the temperature
2/ HDR	Header function
3/ FLT	Filter function
4/ TEMP	Displays the temperature of the bath
5/ ZERO	Checks the zero
6/ REF	Provides a reference number for troubleshooting issues.

Key	Function
7/ SAL	Salinity. Press this after turning the function switch to Read in order to calculate salinity
8/ COND	Conductivity Ratio.
9/ STD	Standardize. Follow directions on display.
0/ I/O	
RESET	Resets the input that you've done on that function.
ARROW KEYS (↑←↓→)	Moves input within display.
ENTER	Inputs information.
SHIFT	Makes numerals available to enter.

Troubleshooting

Problem	Solution
Bubbles in the conductivity cell	Flush with distilled water. If the bubbles don't remove themselves, then mix a 1% solution of Triton-x [*] , flush that through the cell (at least 10 flushes) and flush a bottle of distilled water to rinse. The bubbles should be gone.
Drifting readings	<ol style="list-style-type: none"> 1. Check the temperature of the room, the samples, and the bath. They should be within one degree of each other. 2. Check the flow rate, and reduce it so that the heating lamp in the bath doesn't come on too often during the fill (which indicates the sample temperature is too cold relative to the bath). 3. Check that there aren't any bubbles in the conductivity cell. See above for removing bubbles.
Cell won't fill	<ol style="list-style-type: none"> 1. Check the seal of the bottle around the rubber stopper. Make sure it is snug. 2. Check the flow rate. Increase slightly until the cell starts filling.

* Make sure to keep this flow separate, as it is hazardous waste and needs to be documented and disposed of as such. Contact the MST on board for more information.

