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LOW COST DATA RECORDING SENSORS

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Odyssey Conductivity & Temperature Logger.

Contents.

Salinity Sensor & Software.

Multi-point polynomial calibration is recommended on all conductivity ranges. The use of multi-point calibrations using the polynomial program is necessary if the sensor is being used up to 30,000 or 80,000 micro Siemens per centimeter. If the range of salinity change at these high values is only 2,000 to 5,000 micro Siemens per centimeter then a two point linear calibration may be used. The two calibration solutions must be within the expected measurement range.

The conductivity of all solutions varies with temperature. This is due to increased mobility of the conducting ions in the solution being measured, as the temperature increases. This temperature coefficient is corrected in the Odyssey Salinity program. Most solutions have a temperature coefficient of approximately 1.8% to 2% per degree Celsius.

Note: *The Salinity and Temperature sensor calibration data is supplied on a CD accompanying the sensor.*

The temperature sensor should have the number of decimal places entered as 1, if micro Siemens is the unit of measurement; the salinity cell should have the number of decimal places entered as 0. If milli- Siemens is the unit of measurement, use 1 for the number of decimal places.

Conductivity Cell Calibration.

The calibration of the cell should be checked on a regular basis to ensure the validity of the data being recorded. The frequency of this calibration measurement is something that experience will indicate how often it is required. Even a single point calibration check can be used to verify that the calibration for the cell has not changed. Generally calibration shifts will be caused by a large amount of organic growth on the cell.

For small range measurements two standard solutions can be used. Concentrations should be such as to give readings that are approximately 20% and 80% of the range that is expected to be measured in the field. The temperature of the standard solutions should be maintained as near as possible to the reference temperature as is practical.

The cell should be first washed thoroughly in distilled water and after drying, placed in the low standard solution. The cell should be firmly supported in the centre of the container with the liquid sufficient to submerge the logger to within 40mm from its top. The liquid should be stirred to ensure that the conductivity is uniform over the entire volume.

Using the ‘Probe Trace Mode’ in the Odyssey software the temperature and un-calibrated salinity values must be recorded.

Repeat the above process using the high standard solution. Some drift in both temperature and salinity can be expected. It is best to take the average of the first five readings as your calibration value.

Care must be taken that the recorder cannot tip over and fill the recorder with water. If this does accidentally happen, the Odyssey recorder batteries MUST be removed immediately. If this is not done the recorder will be destroyed. The recorder should then be washed out with methylated spirits and then allowed to dry in a warm location for 24 hours. The methylated spirits will absorb any water that is still in the recorder housing.

Note: The electrical conductivity of electrolytes varies with temperature so the temperature of the standard must be measured. The actual value can then be read from the tables below. The cell has a large thermal mass and must be allowed to come to the same temperature as the standards before the calibration values are recorded. The cell takes between 20 and 30 minutes to reach temperature equilibrium.

If the cells and the calibration solution are allowed time to reach the same temperature the whole process of calibrating a cell can be completed in a couple of minutes with minimal errors due to temperature.

The above procedure has generated two calibration values. These two values can then be used to generate a two point linear calibration. If a very wide range of salinity is to be measured then 4 or 6 standards should be used. The standards must span the expected salinity range that is to be measured in the field. These values can then be entered in the polynomial calibration program.

The entry of this calibration data is covered in the Odyssey software handbook.
Because the cells are software-calibrated, the units of measurement are selectable by the end user by simply entering the calibration data in the units to be used when processing the data. The unit of measurement will govern the number of meaningful decimal places that can be displayed when the data is printed.

An approximate conversion to give milligrams per litre (ppm) is obtained by dividing the slope by 0.6, if micro Siemens per centimeter are used as the units of calibration.

Standard Solutions.

The two most common standardization solutions are potassium chloride and sodium chloride. A 1-molar solution of potassium chloride is made by dissolving 74.553 grams of KCl in distilled water and making up to one litre. A 0.1 and 0.01 standard is made by taking 100ml and 10 ml of the 1-molar standard and making up to one litre.
The conductivities of these standards at temperature from 18 - 30 ^{o}C are as follows.
Conductivity is in micro Siemens per centimeter.

Temperature	1M	0.1M	0.01M
18	98220	11190	1225
19	100140	11430	1251
20	102070	11670	1278
21	104000	11910	1305
22	105940	12150	1332
23	107840	12390	1359
24	109840	12640	1386
25	111800	12880	1413
26	113770	13130	1441
27	115740	13370	1468

A solution of sodium chloride can also be used as a calibration standard. The following tables for an electrolyte made with the weight of NaCl and made up to one litre is as follows. Conductivities are at 20^{o}C and are in micro Siemens per centimeter.

Weight gms	% By Weight	Conductivity uS
1	0.1	1700
2	0.2	3300
5	0.5	8200
10	1.0	16000
15	1.5	23200
20	2.0	30200
25	2.5	37100
30	3.0	44000
35	3.5	50700
40	4.0	57300
45	4.5	63800
50	5.0	70100
58	5.8	80000
60	6.0	82400

Temperature Coefficient

The temperature coefficient of conductance of the solution being measured will vary depending on the conducting ions that are in the solution being measured. Values are generally in the range of 1.8 to 3% per degree Celsius. It should not be assumed that a measured temperature coefficient will hold true for a wide range of temperatures or will hold true, as the chemical composition of the solution being measured varies. For example, as streams and catchments are flushed over a season, so the number and concentration of conducting ions in the water will vary. If information as to the exact temperature coefficient is not available then an approximation of 2% should be used.

To determine the actual temperature coefficient of the water that is being measured a sample of the water should be placed in a container and the cell placed in it. The sample volume should be sufficient to cover the cell up to within 40mm from the top of the Odyssey data recorder section. Once again great care should be taken to ensure that the recorder does not tip over and fill with water.

The liquid and cell temperature should be allowed to stabilize. To ensure that the sample and cell temperature are the same, the water sample in the container should be stirred frequently. Measure the temperature with an accurate thermometer; when the temperature has not changed over a 5-minute period it may be assumed to be stable.

Start the recorder in Trace Mode and note the temperature and salinity values. Also note the temperature reading from the thermometer.

Now cool the water sample by approximately 5 to 10 degrees. An easy way to do this is to use a FREEZER BRICK to reduce the temperature of the water sample. The water should be continually stirred until the temperature has decreased by approximately 5 to 10 degrees. Then remove the freezer brick and allow the temperature of the solution to stabilize.

These freezer bricks are readily available from supermarkets or camping stores. Allow the temperature to stabilize as described for the first point. When the temperature is stable enter the Trace Mode and record the temperature and conductivity reading. Also note the temperature reading from the thermometer.

The Odyssey software includes a Temperature Coefficient program. This enables you to calculate the Temperature Coefficient for the solution being measured from the data recorded in the above procedure.

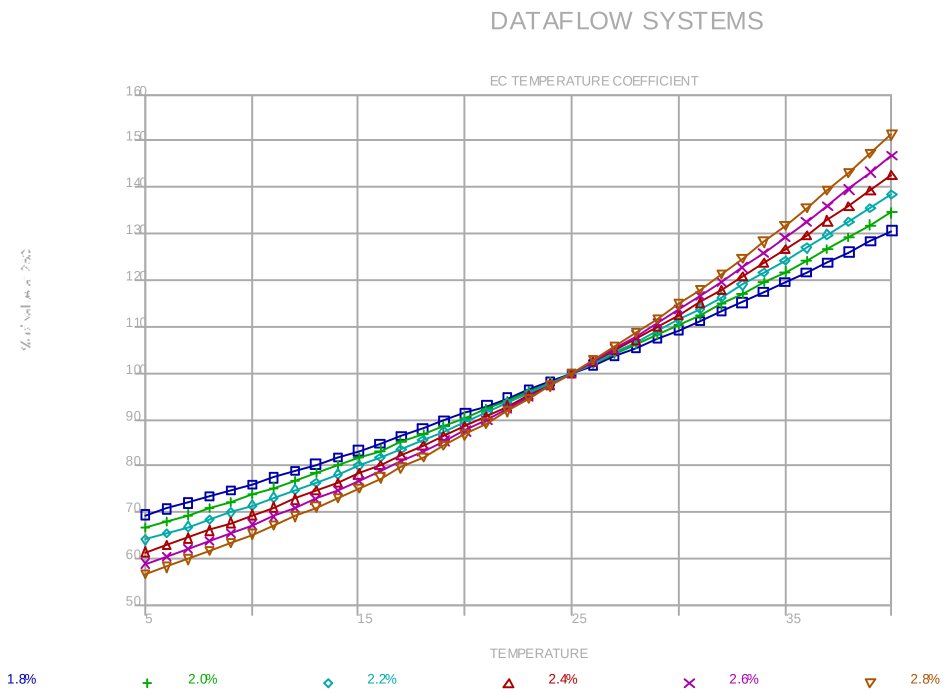
After entering the Calibration program and either selecting a previous Salinity sensor calibration or creating a new calibration file, click on the **Coeff: Calculator** button.

Then enter the Temperature Coefficient data as prompted by the program.

1. Enter the LOW temperature and then the LOW Salinity reading.
2. Enter the HIGH temperature and then the HIGH Salinity reading.

(**NOTE:** The temperature is the one you recorded with a thermometer during the calibration.) The program then calculates the temperature coefficient of the water sample. The result is in % per degree Celsius. This value is automatically entered into the calibration file.

<u>**NOTE**</u>**:** The temperature coefficient of most water catchments will vary slightly as the concentration of the conducting ions in the water changes. For most applications this is not a major problem. In most investigative studies a shift in EC and the time that it occurred is the most important feature of carrying out continuous on site EC recordings.



The temperature coefficient of some electrolytes also varies considerably as the concentration and type of conducting ions change in the solution being measured.

Positioning the Cell.

The cell should be mounted vertically, this helps to prevent silt deposits from streams building up in the sensor water way. The sensor should be a minimum of 100mm away from any object. If the cell is being lowered into a ground water bore, then it should have the suspension cable attached to the hole in the top cap of the recorder. If it is being mounted in open water then if a clamp is used it should only be placed on the top cap of the recorder. Any clamp placed on the body of the cell may cause damage to the cell.

Steel pipe bore linings will alter the conductivity readings if they are in close proximity to the cell.

Conductivity Cell Care & Cleaning

The Odyssey Salinity cell is fragile and should always be handled with care. The waterway through the centre of the Salinity cell should be checked on a regular basis to ensure that it is clean. Although the cell does not have any electrical contact with the solution being measured, any algae growth that may form in the water way will reduce the volume of water being measured in the cell and may cause slight errors in the measured conductance of the solution.

Cotton buds make suitable cleaning tools. Soak the cotton bud in some water and detergent then insert it into the cell water way. Move the cleaner up and down and rotate the cleaner as you move it up and down. Clean out the vertical tube and the two horizontal ones. Water must be able to move freely through all channels for the cell to operate properly.

The cell should be cleaned routinely to remove any growth or silt deposits. Household detergent will normally be sufficient to remove any biological slime or deposits. **Never use abrasive material** as this may permanently damage the cell. Dilute sulphuric acid may be used to remove any deposits that cannot be washed off with detergent. Rinse thoroughly with distilled water after cleaning.

If the cell is to be removed from service for any length of time, it should be cleaned and then stored dry with the battery removed.

Installation Notes.

Reference Calibration: If you have access to a conductivity calibration meter, it is a good idea to take a sample of the solution being measured just before the Odyssey recorder is deployed and again just after it has been retrieved. This will allow you to do comparative calibration checks on the recorder.

Memory Storage Capacity.

Salinity logger is a dual channel recorder and it stores 4 bytes per reading. The memory is capable of recording 16382 records. The time span in days can be calculated by dividing 16382 by the number of logs per day.

Example:

A scan time of 30 minutes has 48 recordings each day. The total number of days is 341days.

When the memory is full the recorder shuts down.

Note: *When using a long scan time it is possible for the battery to expire before the memory becomes full.*