221 East Lincoln Avenue • Fort Collins, CO 80524 USA
Tel: 970.498.1500 • 800.446.7488 • Fax: 970.498.1598
In-Situ Inc.
www.in-situ.com

Specific Conductance as an output unit for conductivity readings

Glenn Carlson, Technical Support, In-Situ Inc.

By default, Win-Situ is set to report readings from a conductivity sensor as Actual Conductivity (AC). Win-Situ offers the option to convert AC to Specific Conductance (SC), among other unit choices. Specific Conductance is a temperature corrected value, and approximates what the AC of a solution would be at 25 degrees C. There are problems with reporting SC, and that is why Win-Situ defaults to AC. However, SC has become a very widely used unit since it allows a standard of reporting across sampling sites and temperature ranges (varying environmental conditions). The conversion done by Win-Situ follows the formula specified by *Standard Methods for the Examination of Water and Wastewater*. That is:

$$SC = AC / (1 + r(T-25))$$

where:

SC = Specific Conductance in microSeimens / cm
AC = Actual Conductivity of the sample in microSeimens / cm
T = temperature of the sample in degrees C
r = temperature correction coefficient for the sample

The biggest problem with reporting SC is with the value used for r. *Standard Methods* suggests consistently using a value of 0.0191, which is the value for a pure potassium chloride solution. That is fine for calibrations where potassium chloride standards are used, but it is highly unlikely that a sample of natural water will have a solute composition that is pure potassium chloride. The r value for a given solution will be unique, dependent on the exact composition of solutes in that specific solution. If the r value for a sample is different from 0.0191 (which is almost guaranteed), then error proportional to that difference will be introduced into the reported SC value.

It is possible to calculate the value of r for a sample in the laboratory. The actual conductivity of the solution can be measured at exactly 25 degrees C. This value can be substituted for SC in the above equation since at 25 degrees C SC and AC are the same value (the term, "T-25" becomes zero at 25 degrees C). The actual conductivity of the same sample at a different temperature can then also be measured. This value can be substituted for AC in the equation, and the temperature at which the reading was taken can be substituted for T. By making these substitutions, one can solve the equation for r for the specific sample. This specific r value could then be used to convert AC readings from the sample site to SC values. For natural waters, however, the solute concentration is likely to change both spatially and temporally. This means that the r value will also not be constant.

Because *Standard Methods* recommends using a constant r value of 0.0191, Win-Situ also uses this constant value for SC calculations. The exception is during a Quick Calibration using In-Situ's Quick Cal solution. The r value for this solution is known to be 0.022, and that is what is used for temperature correction during the Quick Calibration routines. Once outside of that Quick Calibration software routine, Win-Situ has no way of knowing what solution is being used, so it goes back to using the generic r

value of 0.0191. For this reason, a user might see a slight difference in the SC value reported during a Quick Calibration and then during a read-back in the Quick Cal solution immediately after calibration is complete, particularly if the temperature of the solution is considerably different from 25 degrees C. This is merely a reflection of one of the pitfalls with using the derived SC unit for reporting. The "Traditional Calibration" in Win-Situ assumes that a potassium chloride standard is being used, and utilizes an r value of 0.0191. All conversions to SC reported in all other areas of software also assume an r value of 0.0191.

Be aware that calibrations always use SC conversions when reporting conductivity readings, but units of conductivity outside of calibration software routines depend on the user set preferences in Win-Situ. We often get calls from users who are concerned when they see different conductivity values reported during a calibration than what they get when doing a read-back on the calibration solution immediately after calibration. This results when the user has the output unit for conductivity set to AC in Win-Situ. The calibration is reporting SC for the solution, but the user then gets an AC value for the reading after the calibration is complete. This is easily reconciled by changing the Win-Situ output unit preference for conductivity to SC.

For more information contact In-Situ Inc.
221 East Lincoln Avenue
Fort Collins, CO 80524
Toll-Free 1-800-446-7488 (U.S. & Canada)
Internet: www.in-situ.com