

## Frequently Asked Questions on Conductivity

### What am I measuring when I measure the conductivity of my solution?

Conductivity is the measurement of the electrolytes in a solution. It is defined as the conductance in a given volume. Conductance is the ability of the solution to conduct electric current.

### How does temperature affect conductivity readings?

The effect of temperature on conductivity readings depends on the solution being measured. The effect is greatest in low ionic strength (low conductivity) solutions. A general rule to follow is there will be a 2% change (increase)/°C. This rule can be followed for most aqueous solutions, however if you require a high degree of accuracy, you should consult a chart for the particular solution you are measuring. Organics also have very different temperature curves.

### Can conductivity be measured in aqueous solutions only?

No, all substances possess some conductive properties. Generally organic compounds (such as benzene, alcohols, and petroleum products) have very low conductivities, while metals have very high conductivities. Measuring the conductivity of highly flammable liquids is very risky.

### How are conductivity and conductance related?

Conductance is the ability of a solution to conduct electric current, while conductivity is the conductance in a given volume (usually measured in  $\mu\Omega/\text{cm}$  or  $\mu\text{S}/\text{cm}$ ).

### What is a cell constant and why are there different ones?

The cell constant, K, is equal to the area normal to the current flow in centimeters squared divided by the length in centimeters between the electrodes. For solutions with low conductivities the electrodes can be placed closer together or made smaller so that the cell constant is less than one. This has the effect of raising the conductance so as to produce a value more easily interpreted by the meter. The converse also applies, in high conductivity solutions, the electrodes are placed farther apart or made larger. Different cell constants are used as range multipliers.

### How are conductivity and TDS related?

Salts, minerals, and even dissolved gases contribute uniformly to the conductivity of a solution. This means that the conductivity can be used as an indicator of the amount of dissolved materials in a solution. TDS can be used fairly accurately when comparing the status of a single source, such as NaCl, but error can arise when trying to compare two different types of solutions. It is necessary to calibrate the meter using the same dissolved materials that are in the test solution.

### How do I calibrate my meter for TDS if my dissolved solids are not the same as those in the calibration solutions sold?

Making your own standard will yield the most accurate results. This is done by formulating a mixture of salts in relative proportions that simulate the solution to be tested, then dissolving the mixture into distilled water. This should be done according to the following formula:

1 mg salt mixture/liter of distilled water = 1 ppm TDS, or in other words, X ppm TDS = X mg of salts + one liter of distilled water.

Remember that "X mg of salts" is the number of milligrams of a mixture of salt of which proportions

simulate your test solution, not X milligrams of each salt in the mixture. An appropriate value for "X" is determined by the following rule:

Choose a ppm value for a calibrated solution as close as possible to the expected ppm values of the test solutions. If the ppm content of the test solution is expected to vary a great deal, it is best to choose a ppm value for the calibrated solution in the upper 1/3 of the TDS indicator's measurement range.

**The standardization solution I purchased has three values listed on it. Which one should I use?**

This depends on what you are measuring. If it is conductivity, use the value with the units of micromhos ( $\mu\Omega/\text{cm}$ ) or microsiemens ( $\mu\text{S}/\text{cm}$ ). If it is TDS, use the one labeled ppm/NaCl if you are measuring the TDS of a sodium chloride solution. If you are measuring natural water, use the 442 formulation (442 is 40% sodium sulfate, 40% sodium bicarbonate, and 20% sodium chloride). Whichever you choose, you are referencing your solution to that standard.

**What is the difference between micromhos ( $\mu\Omega/\text{cm}$ ) and microsiemens ( $\mu\text{S}/\text{cm}$ )?**

There is no difference. Micromhos ( $\mu\Omega/\text{cm}$ ) is more common in the U.S., while microsiemens ( $\mu\text{S}/\text{cm}$ ) is more common in Europe.

**How do I clean my electrode?**

Clean cells with mild liquid detergent and/or dilute nitric acid (1% wt) by dipping or filling the cell with solution and agitating for 2 to 3 minutes. Dilute HCl (hydrochloric acid) or  $\text{H}_2\text{SO}_4$  (sulfuric acid) may also be used. When stronger cleaning is needed, try concentrated HCl mixed into 50% isopropanol (rubbing alcohol). Rinse the cell several times with distilled or deionized water and recalibrate before use.

**How often do platinum probes need to be replatinised?**

Some platinum electrodes are coated with platinum black before calibration. This coating is extremely important to cell operation, especially in solutions of high conductivity. Electrodes are platinised to avoid errors due to polarization.

Polarization is a condition in which conductivity plates are screened by ions in the solution, leading to inaccurate readings. Cells should be inspected periodically and after each cleaning. If the platinum black coating appears to be wearing or flaking off the electrode, the cell should be replatinised. It is recommended to replatinise the electrode approximately every six months.

**How should I store my conductivity electrode?**

Rinse it in tap water when you are finished using it. You can store your electrode either wet or dry. If it is stored dry you will need to recondition the electrode before use.

**How do I condition a probe?**

Place the probe in a standard solution or tap water and have power running to the probe. Let the probe soak for 30 minutes to 1 hour unless otherwise specified.

**What is the difference between conductivity and salinity?**

The probe is the same for conductivity and salinity, but in a salinity meter a correction factor is applied to the reading. The correction factor takes the conductivity reading and converts it to ppm of a specific salt. The salt varies from manufacturer to manufacturer. Some use NaCl while others use  $\text{CaCO}_3$ .

**How far can the probe be from the meter?**

Generally the probe can be about 200 feet from the meter. The meter sends a small AC voltage signal to the probe.

**Is there an expiration date on the standardizing solutions?**

Unopened with an unbroken seal, the solution will last one year. Opened, but placed in an airtight container, the solution will last six months. Opened and exposed to air, the solution will last one day.

**Note:** Standards below 100  $\mu\text{S}/\text{cm}$  will degrade at a faster rate than others due to air. The conductivity of air is approximately 120  $\mu\text{S}/\text{cm}$ ; any standard lower than 120  $\mu\text{S}/\text{cm}$  will slowly rise in conductivity until it reaches a state of equilibrium. Evaporation drastically increases conductivity values.

**Are conductivity probes interchangeable with meters?**

No, you cannot place one manufacturer's probe on another manufacturer's meter. The cell constant may be different and the pin configurations are usually different. The type of thermistor used for temperature compensation is usually different also. The cell constant is not a big problem, but not matching the pin configuration and temperature compensating element used would be a problem.

**How and when do I need to calibrate the probe?**

Calibrate using a standard solution in the range of the samples you are testing. Place the probe in standard solution, condition, rinse probe in second sample of standard solution, use a third sample of standard solution to calibrate, and then adjust the cell constant until the specified value is displayed. Recalibrate when you change ranges, or if readings seem to be incorrect.

**How do I find the correct temperature coefficient when not working with water?**

For water, the correction factor is 2% change per  $^{\circ}\text{C}$ . Check the conductivity of the sample at  $25^{\circ}\text{C}$ , then using the same sample, find the conductivity at another temperature to see what the percent change is. This will give you the temperature correction factor.