



CONDUCTIVITY MEASUREMENT TIPS

1. For greatest accuracy, ensure that no particulate matter is suspended in the test solution. If necessary, filter or allow particles to settle.
2. Ensure that no air bubbles are trapped in the cell when making measurements.
3. Ensure that the cell plates are completely immersed in the test solution.
4. Do not immerse the cell to the very bottom of the sample container if there is any possibility of a sedimentary layer existing there.
5. Ensure that the cell plates are thoroughly rinsed in deionized water when the cell is removed from solution. Leaving the cell immersed in deionized water is the preferred method for short-term storage.
6. Although it is not critical to store the conductivity cell with the plates in a wetted condition, if they are allowed to dry out completely, it may take some minutes for stability to be achieved upon usage as the plates become wetted.
7. Ensure that no deposits of dried salts or particulate matter are allowed to build up around the cell plates or on the body of the cell. This may produce a conductivity path lower than that through the solution.
8. Glass bodied cells must be used for solvents and strong acid or alkaline solutions.
9. Standard units and cells are calibrated to a reference temperature of 25 deg C.

What is Conductivity?

Conductivity (or specifically electrolytic conductivity) is defined as the ability of a substance to conduct electric current. It is the reciprocal of the more commonly encountered term, resistivity. All substances possess conductivity to some degree, the amount varies widely, ranging from extremely low (insulators such as benzene, glass) to very high (silver, copper, and metals in general). Most industrial interest is in the conductivity measurement of liquids, which generally consist of ionic compounds dissolved in water. These solutions have conductivities approximately midway between insulators and metallic conductors. This conductivity can be measured quite easily by electronic means, and this offers a simple test which can tell much about the quality of the water, or the makeup of the solution. A broad line of conductivity equipment is available to measure liquids ranging from ultrapure water (low conductivity) to concentrated chemical streams (high).

Units of Conductivity

The units of measurement used to describe conductivity and resistivity are quite fundamental and are frequently misused. Once the units are known, various waters can be quantitatively described.

The basic unit of resistance is the familiar ohm. Conductance is the reciprocal of resistance, and its basic unit is the siemens, formerly called mho. In discussions of bulk material, it is convenient to talk of its specific conductance, now commonly called its conductivity. This is the conductance as measured between the opposite faces of a 1-cm cube of the material. This measurement has units of siemens/cm. The units microsiemens/cm ($\mu\text{S}/\text{cm}$) and millisiemens/cm (mS/cm) are most commonly used to describe the conductivity of aqueous solutions. The corresponding terms for specific resistance (or resistivity) are ohm-cm ($\Omega\text{-cm}$), megaohm-cm ($\text{M}\Omega\text{-cm}$) and kilohm-cm ($\text{k}\Omega\text{-cm}$).

Users of ultrapure water prefer to use resistivity units of $\text{M}\Omega\text{-cm}$, because measurement in these units tends to spread the scale out in the range of interest. These same users frequently use $\text{k}\Omega\text{-cm}$ when dealing with less pure water such as tap water. Others, however, use the units of $[\text{S}/\text{cm}$ and mS/cm when dealing with any stream from quite pure to very concentrated chemical solutions. In these applications, the use of conductivity has the advantage of an almost direct relationship with impurities, especially at low concentration. Hence, a rising conductivity reading shows increasing impurities, or a generally increasing concentration in the case of a chemical stream (with some exceptions in concentrated solutions). See table 1 for a comparison of resistance and conductivity.



OSPREY SCIENTIFIC INC.

TECHNICAL SUPPORT AVAILABLE @ 1-800-560-4402

TABLE 1

SPECIFIC CONDUCTANCE MICROMHO/CM*	SPECIFIC RESISTANCE MEGOHM-CM*	PARTS PER MILLION			GR. / GAL. AS CaCO ₃
		AS ION	AS CaCO ₃	AS NaCl**	
.055	18.240	NONE	NONE	NONE	NONE
.056	18.000	.036	.028	.022	.002
.063	16.000	.041	.031	.025	.002
.071	14.000	.046	.036	.029	.002
.083	12.000	.054	.042	.033	.002
.100	10.000	.065	.050	.040	.003
.500	2.000	.325	.250	.200	.015
1.000	1.000	.650	.500	.400	.029
10.000	.100	6.500	5.000	4.000	.292
80.000	.0125	52.000	40.000	32.000	2.340
625.000	.0016	406.250	312.500	250.000	18.273
10,000.000	.0001	6,500.000	5,000.000	4,000.000	292.398

* At 25°C

** At 25°C given specific conductance values included in this table.

TABLE 2

CONDUCTIVITY (MICROMHOS-CM)	RESISTIVITY (OHMS-CM)	DISSOLVED SOLIDS (PPM)
.056	18,000,000	.0277
.084	12,000,000	.0417
.167	6,000,000	.0833
1.00	1,000,000	.500
2.50	400,000	1.25
20.0	50,000	10.0
200	5,000	100.
2000	500	1,000
20,000	50	10,000

Note: ppm x 2 = conductivity

The table below lists the increasing conductivity of different types of solutions.

CONDUCTIVITY OF VARIOUS AQUEOUS SOLUTIONS AT 25°C

SOLUTION	CONDUCTIVITY	RESISTIVITY
Pure water	0.05 uS/cm	18 MΩ-cm
Power plant boiler water	0.05-1 uS/cm	1-18 MΩ-cm
Distilled water	0.5 uS/cm	2 MΩ-cm
Deionized water	0.1-10 uS/cm	0.1-10 MΩ-cm
Demineralized water	1-80 uS/cm	0.01-1 MΩ-cm
Mountain water	10 uS/cm	0.1 MΩ-cm
Drinking water	0.5-1 mS/cm	1-2 kΩ-cm
Wastewater	0.9-9 mS/cm	0.1-1 kΩ-cm
KCl solution (0.01 M)	1.4 mS/cm	0.7 kΩ-cm
Potable water maximum	1.5 mS/cm	0.7 kΩ-cm
Brackish water	1-80 mS/cm	0.01-1 kΩ-cm
Industrial process water	7-140 mS/cm	rarely stated
Ocean water	53 mS/cm	rarely stated
10% NaOH	355 mS/cm	rarely stated
10% H ₂ SO ₄	432 MS/cm	rarely stated
31% HNO ₃	865 mS/cm	rarely stated