Conductivity

Conductivity is the ability of a material to conduct electric current. The principle by which instruments measure conductivity is simple—two plates are placed in the sample, a potential is applied across the plates (normally a sine wave voltage), and the current is measured. Conductivity (G), the opposite of resistivity (R), is determined from the voltage and current values according to Ohm's law.

$$G = 1/R = \text{amps/volts}$$

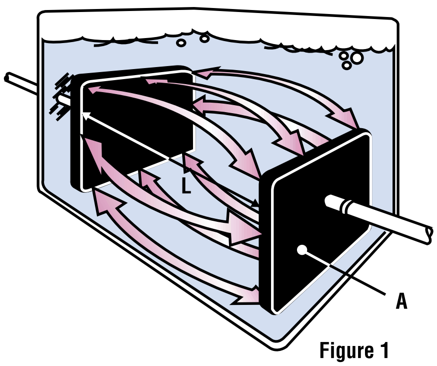

Figure 1

Units of Measurement

The basic unit of conductivity is the siemens (S), formerly called the mho. Since cell geometry affects conductivity values, standardized measurements are expressed in specific conductivity units (S/cm) to compensate for variations in electrode dimensions. Specific conductivity (C) is simply the product of measured conductivity (G) and the electrode cell constant (L/A), where L is the length of the column of liquid between the electrodes and A is the area of the electrodes (Figure 1).

$$C = G \times (L/A)$$

If the cell constant is 1 cm^{-1}, the specific conductivity is the same as the measured conductivity of the solution.

Although we specify conductivity ranges for our products in µS or mS due to space limitations, these ranges should be understood to reflect specific conductivity in µS/cm or mS/cm, respectively.

1 µS/cm = 0.001 mS/cm = 0.000001 S/cm = 1 µmho/cm

Conductivity Meter Calibration and Cell Maintenance

Conductivity meters and cells should be calibrated to a standard solution before using. Selecting a standard that is closest to the conductivity of the solution to be measured. A polarized or fouled electrode must be replatinized or cleaned to renew the active surface of the cell. In most situations, hot water with a mild liquid detergent is an effective cleanser. Acetone easily cleans most organic matter, and chlorous solutions will remove algae, bacteria, or molds. Do not use abrasives to clean an electrode.

Conductivity Temperature Compensation

Conductivity measurements are temperature dependent. The degree to which temperature affects conductivity varies from solution to solution and can be calculated using the following formula:

$$G_t = G_{tcal}\{1 + a(t-tcal)\}$$

where: G_t = conductivity at any temperature t in °C
G_{tcal} = conductivity at calibration temperature t_{cal} in °C
a = temperature coefficient of solution at t_{cal} in °C

Common alphas (α) are listed in the table at right. To determine the a of other solutions, simply measure conductivity at a range of temperatures and graph the conductivity values versus temperature. Then divide the slope of the graph by G_{tcal} to get α.

Substance at 25ºC	Concentration	Alpha (α)
HCl	10 wt%	1.56
KCl	10 wt%	1.88
H_2SO_4	50 wt%	1.93
NaCl	10 wt%	2.14
HF	1.5 wt%	7.20
HNO_3	31 wt%	31.0

All meters in our catalog have either fixed or adjustable automatic temperature compensation referenced to a standard temperature—usually 25ºC. Most meters with fixed temperature compensation use an a of 2% per °C (the approximate α of NaCl solutions at 25°C). Meters with adjustable temperature compensation let you adjust the a to more closely match the α of your solution.