Technical Reference Section: Conductivity/Resistivity

Information in this section addresses frequently asked questions regarding Conductivity (Resistivity) and is provided as REFERENCE ONLY to supplement procedures and recommendations specifically outlined in individual product instruction manuals. All manuals, data sheets, and additional helpful information are available at **www.gfsignet.com.**

Definition of Conductivity and Resistivity

Conductivity is a measure of the ability of a material to convey an electric current. The proper term for this ability of a *solution* is *electrolytic conductivity* since only *ions* conduct electric current in solution. When dissolved in solution, many substances such as salts, acids and bases dissociate into ions. Electrolytic conductivity (or simply *conductivity*) is therefore an indirect measure of the ionic concentration of a solution. Generally, conductivity increases and decreases with the concentration of ions.

Unlike pH, which is a specific measure of Hydrogen ion concentration, conductivity is a non-selective measurement of *all* the dissolved ionic species in a solution. As such, it is a highly utilized parameter in water, wastewater and industrial process analyses. For example, conductivity is used to monitor the salt load of waters entering treatment facilities, to monitor and control the quality of drinking water and ultra-pure water, and to otherwise detect contaminants in industrial processes.

According to the International Standards Organization (ISO) the unit of conductance is the Siemens (S), after Werner von *Siemens* (1816-1892). However, the following three separate units of measure are commonly used to express conductivity: Siemens/cm (S/cm), mhos/cm, and µS/cm. For any given measurement Siemens/cm and mhos/cm are exactly equal; they are merely different labels for the same value. The denominator in these units (cm) is sometimes truncated but is always assumed to be present.

Ohm·cm is a unit of resistivity (the inverse of conductivity) and is frequently replaced by "Ω" the symbol for electrical resistance. Units of resistivity are most commonly associated with ultra-pure water measurements in the millions of ohm·cm, or MΩ (megohms).

Some users will also find it desirable to express conductivity in terms of parts per million (PPM) or parts per billion (PPB) of total dissolved solids (TDS). +GF+ SIGNET instruments accommodate this by allowing the entry of a TDS factor to convert from standard units of conductivity. (See the instruction manual of any current +GF+ SIGNET conductivity instrument for details.)

Conductivity is a measurement parameter with a very wide range. For example, ultra-pure water has a theoretical maximum resistivity of approximately 18.3 MΩ, approximately 0.055 µS (microsiemens), whereas concentrated acids and bases can exceed 400,000 µS. Despite the wide-ranging possibilities most applications for conductivity measurement are much narrower. Tap water, for instance, typically measures between 50 and 1,000 µS.