Conductivity and TDS Meters

Table of Contents	Page
Comparison Charts	G2
Introduction	G3
Portable Meters	G6
Waterproof Meters	G11
Printing & Logging Portable Meters	G14
Bench Meters	G15
Combination EC/TDS/pH Meter	G16

Comparison Chart

Portable EC/TDS Meters

	HI 99300	HI 99301	HI 8033	HI 8734	HI 8633	HI 8733	HI 993310	HI 9033	HI 9034	HI 9835	HI 98360	HI 933300	HI 933301
EC Range	•	•	•		•	•	•	•		•	•	•	•
TDS Range	•	•	•	•					•	•	•		
Temperature Range	•	•								•	•	•	•
Waterproof	•	•		•	•	•		•	•	•	•		
Automatic Temperature Compensation	•	•				•	•	•	•	•	•	•	•
Adjustable Temperature Coefficient	•	•				•				•	•	•	•
Adjustable EC/TDS Conversion Factor	•	•								•	•		
Automatic Calibration	•	•								•	•	•	•
12 Vdc Power Supply										•	•	•	•
Built-in Printer												•	•
Data Logging											•	•	
4-ring Probe (included)			•	•	•	•	•	•	•	•	•	•	•
Salinity (NaCl) Range										•	•		
RS232 Serial Port for PC Connection											•	•	
Page	G6	G6	G7	G8	G9	G9	G10	G11	G11	G12	G13	G14	G14

Comparison Chart

Bench EC/TDS Meters

	EC 214	EC 215	EC 215R	HI 255	HI 2300
EC Range	•	•	•	•	•
TDS Range				•	•
Temperature Range				•	•
Salinity (NaCl) Range				•	•
Automatic Temperature Compensation		•	•	•	•
Adjustable Temperature Coefficient		•	•	•	•
Adjustable EC/TDS Conversion Factor				•	•
Automatic Calibration				•	•
RS232 Serial Port for PC Connection				•	•
Analog Output			•		
4-ring Probe (included)	•	•	•	•	•
Page	G15	G15	G15	G16	G18

Comparison Chart

Conductivity Probes

	HI 76300	HI 76301D	HI 76301W	HI 76302W	HI 76303	HI 76304	HI 76305	HI 76306	HI 76309	HI 76309/1.5	HI 76310	HI 7633W
EC/TDS Measurement	•	•	•									
EC/TDS/Temperature Measurement				•	•	•	•	•	•	•	•	•
7-pin DIN Connector	•	•			•	•	•					•
7-pin DIN Connector with Fixing Nut			•	•				•	•	•	•	
Cable Length (m)	1	1	1	1	1	1	1	1	1	1.5	1	1
4-ring Pt Sensor	•				•						•	
4-ring Steel Sensor		•	•	•					•	•		•
2-pin Steel Sensor						•						
2-electrode Sensor							•					
2-electrode Graphite Sensor								•				
Glass Body	•											
Glass / Ultem® Body					•						•	
PP Body		•	•	•					•	•		•
FG Reinforced PP Body						•		•				
Aluminum / Brass Body							•					
Operating Temperature (°C)				0-60	0-100	0-60	0-60	0-60	0-60	0-60	0-100	0-60

Conductivity Meters

Precision Instruments with Versatility and Portability for Lab or Field Applications.

Conductivity is a variable that is monitored in many fields ranging from the chemical industry to agriculture. This variable is basically a measurement of the amount of dissolved salts in a given liquid and is inversely proportional to resistance. With conventional meters, conductivity is obtained by applying a voltage across two probes and measuring the resistance of the solution. Solutions with a high conductivity, produce a higher current. In order to keep a low current in a highly conductive solution, you would have to reduce the surface area of the probe or increase the distance between the poles. The dual-sensor method is suitable for solutions with low-medium conductivity. For this reason, different probes must be used for higher ranges.

Only the four-ring method can measure multiple ranges with a single meter and a single probe. The advantages of four-ring over the two-probe (amperometric) method are numerous, including a linear reading over a wide range, no polarization, no need for thorough cleaning, etc. In 1980, HANNA instruments® was the world's first manufacturer to introduce the four-ring or potentiometric method of conductivity measurement with portable and bench meters.

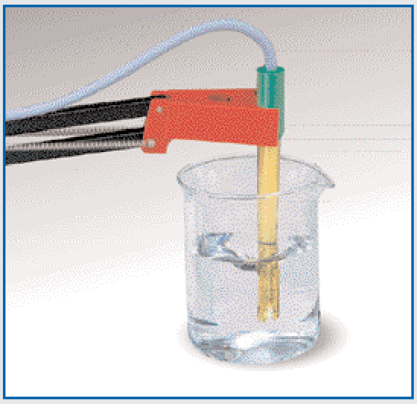
HANNA instruments® offers a wide range of Potentiometric (4-ring) and Amperometric (two-sensor) meters. In addition to the well-established models, you have a choice of multiple meters for TDS, conductivity and pH, as well as specific instruments made for boilers and agriculture.

Our portable instrument range has been substantially extended to include waterproof meters measuring TDS, as well as conductivity, for outdoor or industrial applications. For example, HI 98360 is a new water-resistant portable conductivity meter with a serial port for PC connection and a user-selectable "Auto Endpoint" feature, that freezes the reading on the LCD when it is stable.

Several new bench meters have been developed for lab applications. HI 2300 is a complete bench meter for lab analysis. It can measure EC, TDS, NaCl percentage and temperature. Moreover, the reference temperature for compensation can be set at 20 or 25°C, as required by European water analysis regulations.

HANNA instruments® also offers bench and portable meters with models featuring logging and printing capabilities, all with superior four-ring probe technology to provide a wide spectrum of conductivity and TDS meters for just about every application.

Conductivity (EC) and Total Dissolved Solids (TDS)



Definition

Electric conductivity is defined as the ability of a substance to conduct an electric current and it is the reciprocal of electrical resistivity. The unit of measurement commonly used is the Siemens/cm (S/cm), in millionths (10-6) of units, that is microSiemens/cm (µS/cm), or in thousandths (10-3), i.e. milli-Siemens (mS/cm).

Water Conductivity

Pure wter	0.055 µS/cm
Distilled water	0.5 µS/cm
Mountain water	1.0 µS/cm
Domestic water	500 a 800 µS/cm
Max. for potable water	10055 µS/cm
Sea water	52 mS/cm

In aqueous solutions, conductivity is directly proportional to the concentration of dissolved solids. Therefore the higher the concentrations of solids, the greater the conductivity. The relation between conductivity and dissolved solids is expressed, depending on the application, with a good approximation, by:

English Degrees — American Degrees

1.4 µS/cm = 1 ppm or 2 µS/cm = 1 ppm (parts per million of $CaCO_3$)

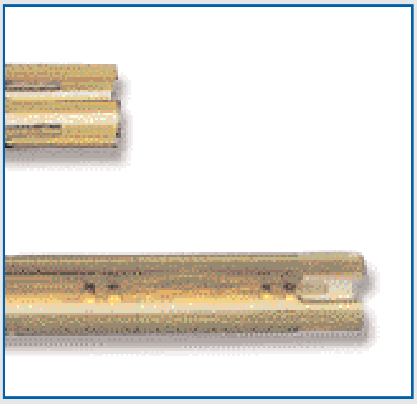
where 1 ppm = 1 mg/L is the measuring unit for dissolved solids.
In addition to conductivity meters, there are TDS instruments that automatically convert the conductivity value into ppm, thus providing a direct reading of the dissolved solids concentration.

The conductivity of a solution is determined by molecular motion. Temperature affects molecular motion and it is, therefore, important to compensate for temperature when accurate measurements are necessary. For comparative measurements, the standard temperature is normally 20°C or 25°C (68°F or 77°F). To correct for the effect of temperature, a compensation coefficient β is used. β is expressed in percentage per degrees Celsius or %/°C and it varies accordingly to the solution being measured. In most applications, 2% per degree Celsius is used as an approximate value for β.

Conductivity Measurement

It is possible to differentiate conductivity meters according to the measurement method they use, that is, amperometric or potentiometric. The amperometric system applies a known potential difference (V) to two electrodes and measures the current (I) that passes through them. According to Ohm's law:

$$I = V/R$$



where R is resistance, V is the known voltage and I is the current going from one electrode (probe) to the other.
It follows that the higher the current obtained, the greater the conductivity. The resistance, however, depends on the distance between the two electrodes and their surfaces, which can vary due to deposits of salts or other materials (electrolysis). For this reason amperometric system is recommended for solutions with low level of dissolved solids, i.e. up to 1 gram per liter (approx. 2000 µS/cm).

The 4-ring potentiometric method is based on the principle of induction and eliminates common problems associated with the amperometric system, such as the effects of polarization. The two outer rings apply an alternating voltage and induce a current loop in the solution. The two inner rings measure the voltage drop induced by the current loop, which is dependent on the conductivity of the solution. A PVC shield maintains the current field restrained and constant. Using the four-ring method, it is possible to measure conductivity with ranges up to 200000 µS/cm and 100 g/L.

It is possible to obtain the value of the hardness of water with good approximation even in French degrees, using conductivity or TDS meters. The main cause of hard water is the presence of dissolved calcium or magnesium ions. The most common measurement unit of hardness is the French degree (°f), defined as:

$$1°f = 10 \text{ ppm of } CaCO_3$$

Dividing the ppm measurement of the dissolved solids by 10 gives the hardness value of water with an error of 2-3°f. As noted earlier, 1 ppm = 2 µS/cm conductivity, thus:

$$1°f = 20\ \mu S/cm$$

Dividing the microSiemens conductivity measurement by 20 gives the French degree hardness of water (with a 2-3°f error).

IMPORTANT: Measurement of water hardness with either conductivity or dissolved solids meters must be performed before any softening treatments. During the water softening processes, carbonates are substituted by sodium, which does not alter the total concentration of dissolved solids, but diminishes the hardness of the water.

Table of Water Conductivity and Hardness

ppm	µS/cm	°f	hardness
0-70	0-140	0-7	very soft
70-150	140-300	7-15	soft
150-250	300-500	15-25	slightly hard
250-320	500-640	25-32	moderately hard
320-420	640-840	32-42	hard
above 420	above 840	above 42	very hard

Area of Application	Application
Graphic arts	Calibration baths, film processing
Breweries and yeast factories	Cleaning, filter monitoring, dispensing of common salt in yeast production
Water softening	Characterization of plants incoming water, control of the status of water softening resins, control of osmotic membranes
Fertilizer dosing	Hydroponics and fertigation systems
Chemical industry	Monitoring of heat exchangers for leak tightness, acid and alkaline solutions for concentration, alkalies, salts and acids for concentartion in manufacturing
Steam generation, power plants	Ion exchanger, boiler feed water for residual salt contents, evaporators and condensers for tightness
Electrolytic and electro-plating techniques	Forming baths in capacitor manufacturing, etching solutions, electrolytic dieforming, zinc electrolysis, plating baths, rinse water in semiconductor manufacturing
Metallurgical works	Ore preparation, bauxite processing
Food industry	Vegetables preservatives, potato peelings waste lyes, salt brines, dairies, etc.
Paper and textile industry, tanneries, etc.	Water treatment, bleaching, soap and washing baths, mordants
Soap and detergent industry	Removal of uncombined glycerine in soap manufacturing, residual lye, lye concentrations
Cooling towers	Testing of pipe scales and cooling water aggressivity