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CDB-210
and
CDB-215
M-3679

1.0 INTRODUCTION

Conductivity measurements are one of the simplest and most widely used applications. Applications range from ground water testing to bolier return condensate monitoring. Conductivity can be used to determine contaminant sources and to determine the quality of high purity water.

Some industries which use conductivity are chemical, power generation, semi-conductor, agriculture, hospitals, textile, electroplating, food processing, paper, iron, steel, brewing, petroleum, beverage, marine, and mining. Applications include chemical streams, cooling towers, bolier blowdown, condensate returns, steam boliers, waste stream, demineralizer outout, acid, salt or alkali concentrations, desalinization, and laboratories.

This meter measures the total ionized substances of an aqueous solution, in one convenient, economical package. The meter displays conductivity in five ranges from 0 to 20,000 micromhos/cm. It comes with a break-resistant probe which has an internal thermistor for automatic temperature compensation. Batteries allow versatility for use in the field or lab. Optional AC adaptors are available for lab models.

2.0 THEORY OF OPERATION

Conductivity measures the ability of a solution to conduct an electric current between two noble metal surfaces when a constant voltage is applied. Conductivity is a nonselective measurement with any charged ion contributing to the total conductivity. Solutions with higher number of ions present in the liquid will have a higher conductivity. Organic compounds such as phenols, alcohols, oils, etc., do not dissociate (ionize) in water and therefore have little or no effect on conductivity.

The actual measurement of conductivity is simple. The conductivity cell is placed in the sample. An AC voltage is applied to the cell. The signal passed to the detector is proportional to the resistance and capacitance of the cell and sample. The synchronous rectifer, which is controlled by the oscillator, corrects for the capacitive effect. A purely conductive reading is displayed.

Conductivity is normally expressed as micromhos per centimeter (µmho/cm). In the International Systems of Units (SI), conductivity is expressed as millisiemens per meter, where 1 mS/m is equal to 10 micromhos per centimeter.

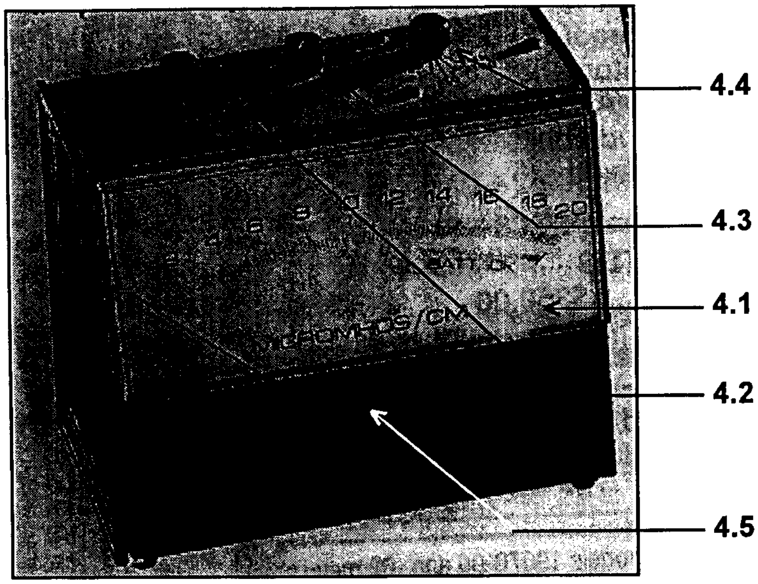
CONDUCTIVITES OF SOME COMMON LIQUIDS

Freshly distilled water	0.5 to 2.0 µS/cm
Power plant boiler water	1.0 µS/cm
Pure mountain stream	1.0 µS/cm
Good city water	50 µS/cm
Potable water	50 to 1500 µS/cm
Normal saline water	18,400 µS/cm
Seawater	53 mS/cm
10% NaOH (sodium hydroxide)	355 mS/cm
10% H_2SO_4 (sulfuric acid)	432 mS/cm

3.0 SPECIFICATIONS

Readout	6" Analog	$3\frac{1}{2}$ Digit LCD
Range	0.2 - 20,000 micromhos	
Steps	0 - 2, 0 - 20, 0 - 200, 0 - 2000, 0 - 20,000	
Accuracy	±2% of full scale	
Resolution	1% of full scale	0.1% of full scale
Temp. Compensation	Automatic, 0 - 50°C	
Probe	Dip style	
Size		
Bench	5"Hx8"Wx5"D	
Field	4"Hx12"Wx8"D	
Weight		
Bench	3 Lbs (1.4 Kg)	
Field	4 Lbs (1.8 Kg)	
Power		
Bench	8 AA Batteries or optional wall AC adaptor	
Field	8 AA Batteries	
Battery Life	170 hours	

4.0 INSTRUMENT FAMILIARITY



4.1 Readout

4.1.1 Analog Meter - displays conductivity in µmho/cm and battery OK results.

4.1.2 Digital LCD - displays conductivity in µmho/cm.

4.2 Function Selector

4.2.1 OFF - removes power from circuit.

4.2.2 ON - power is applied to circuit.

4.2.3 BATT+ - displays positive battery voltage.

4.2.4 'BATT-' - displays negative battery voltage.

4.3 CAL. - adjustment used to standardize meter to conductivity standards.

4.4 Range Selector - five position switch used to select proper conductivity range.

x .1	0 - 2 µmho/cm
x 1	0 - 20 µmho/cm
x 10	0 - 200 µmho/cm
x 100	0 - 2000 µmho/cm
x 1K (1000)	0 - 20,000µmho/cm

4.5 Zero Adjust Screw - used to adjust analog meters to zero.

4.6 Probe Input - 5 pin din connector for detachable conductivity probe.

4.7 Power Jack - input for optional wall adaptor. Located on back of bench models.

5.0 OPERATION

5.1 Power

5.1.1 Bench models are powered by internal batteries or by optional wall adaptor. The batteries do not have to be disconnected when using the wall adaptor.

5.1.2 Analog field model is powered by external disposable batteries.

5.1.3 Handheld model is powered by internal rechargeable batteries. Connecting the AC adaptor will re-charge the batteries as well as power the meter. Prior to field use, charge the batteries overnight.

5.2 Turn function switch to **Batt+**, then **Batt-**. Meter should read within Batt ok scale for proper operation.

5.3 Plug the conductivity probe into the DIN connector.

5.4 Set function switch to the **ON** position.

5.5 Turn the range switch to position **x1K**. Rinse the probe with distilled or deionized water.

5.6 Insert the probe into the unknown solution, at least one inch, without touching the sides or bottom of the container.

5.7 Decrease the range one step at a time, until the display reads between 2.00 and 19.99.

5.8 The probe will automatically compensate for sample temperatures between 5°C and 45°C.

Note: It may take several minutes for the reading to stabilize when the solution temperature differs from the test environment.

5.9 After determining the measurement range, chose a standard within that range and calibrate the meter at the selected range.

5.10 Re-measure the unknown solution. If the display reads over range after calibration, recalibrate on the next higher range and take the measurement.

6.0 CALIBRATION

6.1 Connect the conductivity probe.

6.2 Set function switch to the **ON** position.

6.3 Set the range switch to the **x10** position.

6.4 Select a conductivity standard in the range of 1000µS that will read in the **x10** range on the meter, 0 to 2000µS.

6.5 Insert the probe into the standard solution at least one inch without touching the sides or bottom of the container.

Note: It is best to calibrate with probe and standards at the same temperature as the sample environment.

6.6 Adjust the **CAL** knob so the meter displays the value of the standard solution.

6.7 The meter is now ready for use.

7.0 MEASUREMENT GUIDELINES

7.1 Avoid contaminating the standard and sample solutions. For best results, rinse in D.I. water after each measurement, then rinse with a small amount of the next standard or sample to be measured.

7.2 Choosing a calibration solution whose value lies as close as possible to the sample solution increases measurement accuracy.

7.3 If possible the calibration solution and sample solution should be at the same temperature.

7.4 The instrument functions by sensing very low signals at the electrode surfaces. Tests in solutions with stray AC voltages may cause spurious results. If in doubt, shield both the solution and cell.

7.5 After exposure to a sample, standard or rinse solution, shake the electrode with a snap motion to remove residual drops of solution. This will minimize contamination from carryover.

7.6 As a rinse solution, use a part of the next sample or buffer which is to be measured. This will minimize contamination from carryover.

7.7 When measuring low conductivity levels the sample should be protected from the atmosphere since dissolved gases will rapidly change the conductivity of a solution.

8.0 CONCENTRATION / TOTAL DISSOLVED SOLIDS (TDS)

Conductivity can be used to determine concentration. A nearly linear relationship exists between conductivity and ion concentration for most ionic compounds below 2000 micromhos/cm. As a result conductivity is often measured to determine total dissolved solids (TDS). It is important to note that this is only a valid methodology when the ionic solution is composed of a pure compound since the exact relationship between conductivity and concentration varies with each ionic compound.

Some examples of the relationship between concentration and conductivity are:

CONCENTRATION VS CONDUCTIVITY @ 25°C

SALT	CONCENTRATION*	CONDUCTIVITY
Calcium Carbonate (CaCo)	1000 ppm	2300 micromhos/cm
Sodium Chloride (NaCl)	1000 ppm	1990 micromhos/cm
Potassium Chloride (KCl)	1000 ppm	1880 micromhos/cm

*1000 ppm = 1 G/L

TOTAL DISSOLVED SOLIDS (TDS)

Conductivity in uS	Sodium Chloride ppm	Calcium Carbonate ppm
10	4.6	3.9
50	24	20
100	47	40
200	91	78
500	240	205
1000	495	424
2000	1020	873
5000	2560	2190
10000	5400	4620
20000	10800	9240

For "in between" measurements the following formula will give a good approximation:
ppm Sodium Chloride = uS x 0.5
ppm Calcium Carbonate = uS x 0.4

9.0 ELECTRODE CARE

The conductivity probe is a rugged, general purpose device which will be consistently accurate **if properly cared for**.

If the electrode surface area is scratched, or congested with impurities, probe linearity will suffer, especially above 1000 micromhos. Therefore, it is essential that the probe be kept clean. Rinsed in DI water after each measurement. Electrode can be stored dry or in DI water.

Coatings on the probe can lead to erroneous readings and shorten the probe life span. The type of coating will determine the cleaning technique. Soft coatings can be removed by vigorous stirring or by use of a squirt bottle. Salt deposits can be removed by scrubbing the electrode with a soft cloth. Organic chemicals or hard coatings should be removed using a mild soap detergent with some agitation. DO NOT scrub the electrode with a hard object. Use only a soft cloth.

10.0 STANDARDS

Conductivity standards can be purchased from your distributor/ dealer or prepared in your own lab. To prepare your own standards, dissolve research grade potassium chloride (KCL) in deionized water (DI) according to the following:

10,000 µS/cm - 5.8 grams KCL / 1 L (liter) of DI water

1000 µS/cm - 0.5232 grams KCL / 1 L of DI water or 5.2 grams KCL / 1 liter DI water, diluted 1/10 (100 mL/1 L DI water).

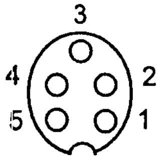
100 µS/cm - 5.1 grams KCL / 1 L DI water, diluted 1/100 (10 mL / 1 L DI water).

11.0 TROUBLESHOOTING

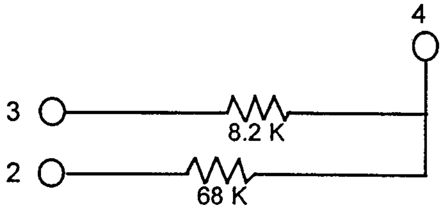
11.1 First isolate the problem to the meter or electrode.

11.1.1 If available, test meter with a spare electrode.

11.1.2 Simulate electrode with a resistor network as follows:



Meter Input

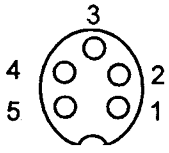


On Range...x1, meter will read 10 mS/cm with 68K resistor.

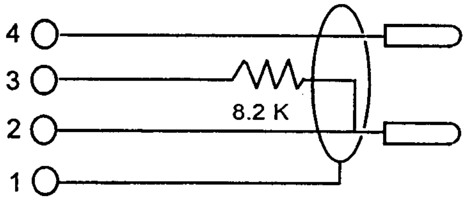
11.2 If electrode is faulty:

11.2.1 Check electrode for scratches or irregulatites in the cell surface.

11.2.2 A continuity check may be completed by following this sketch:



Probe Connector



11.3 No response or readings are inconsistent.

The batteries should provide about 180 hours of continuous operation. An analog meter will have no response when the batteries need to be replaced. A digital meter will display "BAT" when the batteries are low. Low batteries can also result in inconsistent readings. Inspect the meter and batteries for corrosion.

- **11.3.1** To replace batteries in bench models:
  - **11.3.1.1** Turn the meter off.
  - **11.3.1.2** Remove screws, one in each foot on bottom.
  - **11.3.1.3** Gently lift the shroud off.
  - **11.3.1.4** Remove battery holders and replace batteries, noting polarities.
  - **11.3.1.5** Reassemble meter.
- **11.3.2** To replace batteries in field unit:
  - **11.3.2.1** Turn the meter off.
  - **11.3.2.2** Remove batteries and replace, noting polarities.

If battery checks are okay and meter fails to respond, have instrument serviced.

11.4 Meter will not calibrate.

11.4.1 Check the electrode for large scratches or impurities in the cell surface. Replace electrode if scratches or impurities are found.

11.4.2 Check electrode for visible signs of contamination. If particles can be seen on the electrode, soak in warm water and mild soap. After soaking lightly rub electrode with a soft wet cloth to remove stubborn particles. Rinse well withdeionized water.

11.4.3 If no signs of contamination are visible, but contami nation is a possiblity (it is always a possiblity), clean the electrode with mild soap and a soft cloth. Rinse well with deionized water.

If problem continues, call your distributor/dealer.