

# ACL 800 MEGOHMMETER

## OPERATION MANUAL



Meter is warranted for one year from the date of purchase on parts and labor.  
Calibration is recommended every twelve months.

**NOTE: THIS MANUAL IS NOT TO BE SEPARATED FROM METER!**

# ACL 800 Megohmmeter

The ACL 800 Megohmmeter kit measures surface resistivity, resistance, temperature and humidity. It is designed to test conductive, dissipative, and insulative surfaces for electrical resistivity/resistance according to EOS/ESD, CECC, ANSI, ASTM and UL test procedures.

The internal parallel electrodes comply with DIN EN 100 015/1 and ASTM D257. The 5-lb electrodes can be externally connected for tests according to IEC 61340-4-1, ANSI/ESDA S4.1 & ANSI/ESDA S7.1. Optional concentric ring probe will allow compliance to ANSI/ESDA S11.11.

## **ACL 800 Megohmmeter Includes:**

- \* Tester
- \* Two 5-lb probes
- \* One ground cord
- \* Two accordion cables (monaural to banana)
- \* 110-volt power adapter (in the US only)
- \* 9-volt battery
- \* Foam-lined carrying case
- \* Certificate of calibration

## **Limits**

- \* Resistivity:  $10^3$  -  $10^{12}$  ohms/sq.
- \* Resistance:  $10^3$  -  $10^{12}$  ohms
- \* Relative Humidity: 10% - 90%
- \* Temperature: 32°F to 100°F or 0°C – 37.7°C if Celsius model was purchased
- \* Measuring voltage: 10v and 100v

## INTRODUCTION

The ACL 800 Megohmmeter is a dependable and easy-to-use audit kit for conductive and dissipative surfaces. This meter is designed to be used in all facets of material production including engineering, maintenance, quality control, incoming inspection, manufacturing, research, or sales departments for the testing of anti-static mats, floor finishes, paints, wrist straps, smocks, footwear, bags and containers.

When using the built-in electrodes, the meter’s test values for surface resistivity are in ohms per square. When using the external 5-lb electrodes, the meter’s test values for resistance are in ohms (although they are displayed in ohms/sq.).

### DECADE SCALE

10 <sup>3</sup>	=	1 kilohm
10 <sup>4</sup>	=	10 kilohms
10 <sup>5</sup>	=	100 kilohms
10 <sup>6</sup>	=	1 meg ohm
10 <sup>7</sup>	=	10 meg ohms
10 <sup>8</sup>	=	100 meg ohms
10 <sup>9</sup>	=	1000 meg ohms
10 <sup>10</sup>	=	10,000 meg ohms
10 <sup>11</sup>	=	100,000 meg ohms
10 <sup>12</sup>	=	1,000,000 meg ohms

The test value is indicated on the LCD display. Unlike meters with LEDS that indicate only the decade within which the measured value falls, the ACL 800 will show the actual value.

27 meg ohms (2.7 x 10<sup>7</sup>) is displayed as **2.7 e07 ohms/sq**

### TEST VOLTAGE

The applied test voltages are 10v and 100v. According to ESDA standards S4.1, S7.1, and S11.11 one should choose 10v for conductive surfaces less than 10<sup>6</sup> and 100v for materials 10<sup>6</sup> or greater. If the meter cannot apply the correct voltage automatically, it will advise you to change to the proper setting manually. Use the switch in front of the meter to change voltage setting.

As defined by the ESD Association, values indicate the following:

Voltage	Range	Definition
10 volt	< 10 <sup>6</sup> ohms per square	Conductive
100 volt	10 <sup>6</sup> – 10 <sup>11</sup> ohms per square	Dissipative
100 volt	> 10 <sup>11</sup> ohms per square	Insulative

## **A NOTE ABOUT VOLTAGE**

In previous years, those desiring to measure resistivity or resistance followed the ASTM D264, ASTM 991, NFPA 56A or NFPA 99 test standards. These procedures required one to test at either 500 or 1000 volts. This caused concern regarding safety to the person performing the tests. The ESDA standardized the test procedures so that lower voltages could be used within specific ranges.

The ACL 800 meter uses a 9-volt battery. Some meters with 9-volt batteries do not give the accuracy needed to perform the test, especially at values higher than  $10^7$ . The ACL 800 is built with a transformer that converts the 9-volt charge from the battery to 10 volts or 100 volts (whichever value is selected). The meter applies a constant charge over the complete voltage range. Accuracy depends on applied voltage, temperature, and humidity.

## **TEMPERATURE AND HUMIDITY**

Humidity and temperature affect the electrical properties of the material being tested. The combination of low humidity and low temperature will give the highest electrical resistance results and slowest dissipation times. At high humidity, a thin layer of water is condensed on or absorbed into the material being tested. This is true of hygroscopic additives that are incorporated into a material in order to increase the electrical conductivity. These additives will allow moisture to be absorbed into the materials to which they are added.

At elevated temperatures, the mobility of free electrons increases, thereby also increasing a material's conductivity. This is especially true for carbon black, metallic oxides, metals, and other substances. When the material is at a lower temperature, built-in stresses occur which may increase the resistance due to increased distance between the conductive additives. Thus, humidity and temperature must be known.

## **RECORDING DATA**

ANSI/ESD Association and European CECC recognize the effect environmental conditions have on test measurements and specify in their standards that they are measured and recorded. It is possible to test or manufacture a material at high humidity and pass all the test specifications, but when the customer receives the material and uses it at a lower humidity or temperature the material fails to pass the specifications. This can cause rejections and loss of product.

Both ESD S4.1 ESD Protective Worksurface sections 6.2.4 and ESD S7.1-1994 Resistive Characterization of Materials Floor Materials sections 5.2.4 and 5.3.3 require reporting of temperature and humidity at the time of testing. ANSI/EOS/ESD-S11.11-1993 Surface Resistance Measurement of Static Dissipative Planar Materials section 11.0 B states, "report the conditioning period, relative humidity, and temperature."

## CALIBRATION

Calibration is recommended annually. The ACL 800 meter comes with a NIST certificate when ordered. After one year the meters can be sent back to ACL Inc. for a new NIST certificate for a lab fee or it can be sent to a certified calibration lab (see page 11 for instructions). The meters also come with a CE mark approval.

## MEASURING WITH INTERNAL ELECTRODES

The parallel resistivity probe method complies with ASTM D257. It is used to give fast electrical resistivity measurements on flat homogeneous materials. It may be used on multilayered materials, but this should be noted along with the temperature and humidity values on the data report.

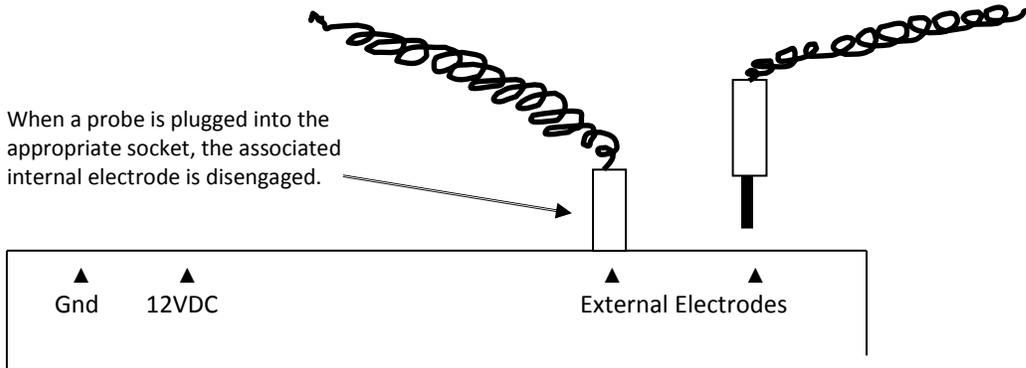
When the measurement is taken between the tester's two conductive rubber rails under the tester, the tester will indicate the surface resistivity of the material being tested.

- A. Prior to testing, make certain that surfaces to be tested are clean and free of contaminants.
- B. Allow the meter to acclimate to the atmosphere in which it will be used. Adjustment to new environmental conditions may take as long as a half hour.
- C. Place the meter on the desired surface to be tested.
- D. Move switch to desired test voltage position, either 10 or 100 volts, depending on the target range of the material.
- E. Press and hold the test button with approximately five pounds of applied force. The display will show the humidity and temperature. After approximately ten seconds, the meter will display the surface resistivity in ohms per square.

The meter will keep updating the display while the button is held down. The last reading will display for approximately twenty seconds after the button is released.

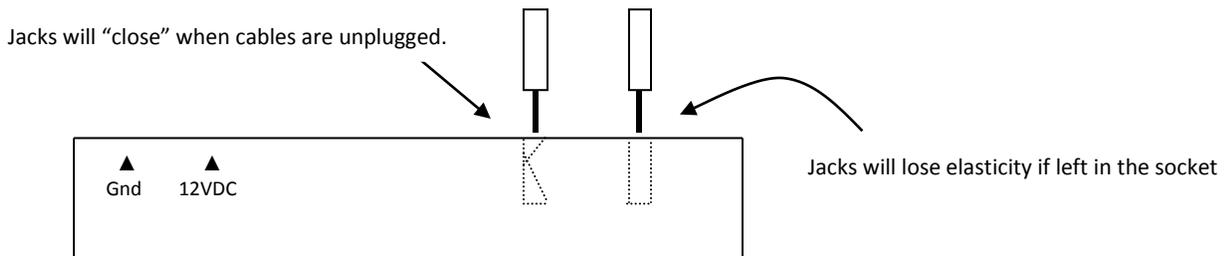
## MEASURING WITH EXTERNAL ELECTRODES

When the measurement is taken using the 5-lb external probes, the tester will indicate the resistance of the material being tested once the button is pressed (value is in ohms, though the display says ohms/sq).



By connecting these probes to the ACL 800's sockets it is possible to measure Point to Point (RTT) Resistance, Surface to Ground (RTG), and Volume Resistance. Using these probes will allow compliancy with various standards including ANSI/ESDA S4.1 for Worksurface – Resistance Measurements, ANSI/ESDA S7.1 Resistive Characterization of Materials – Floor Materials.

When auditing is finished, unplug the cables and store probes in the protective case. If cables are left in the tester, the jacks will lose their elasticity as shown below:



If jacks are damaged or left in the open position, the internal probes will not engage when testing for surface resistivity.

## Measuring Resistance Point to Point (RTT)

RTT measurements can be used for the evaluation of floors, chairs, carts, work surfaces and other ESD-controlled materials and products. Procedures vary regarding sample preparation, probe preparation and spacing of the 5-lb probes. Select and read the correct test procedure or standard for the desired measurement. Test procedures can be purchased from [www.esda.org](http://www.esda.org).

- A. Connect one end of each of the banana test leads into the sockets of the meter. Connect the other end of the test coil cords into the 5-lb probes.



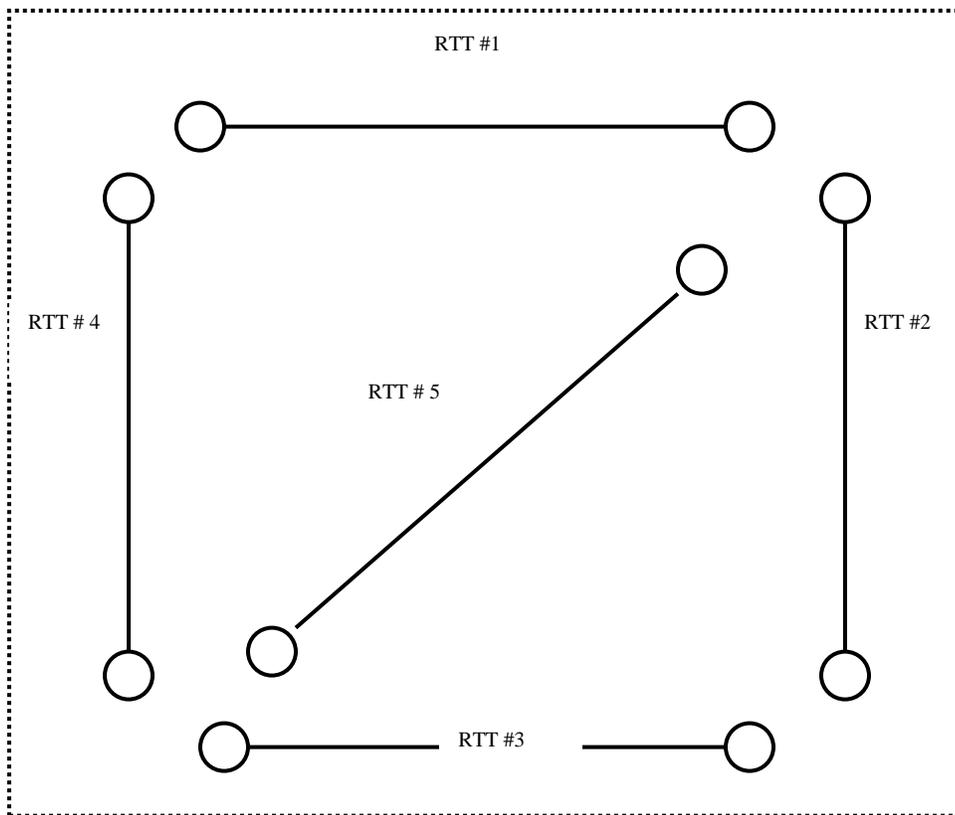
- A. Place both probes on the material according to test procedures or standard being used.
- B. Press the “TEST” button and the value will be displayed on the LCD. The meter will apply the correct voltage (10v or 100v) according to the value of what is measured.
- C. When performing test do not touch lead wires or probe. Avoid overlapping of lead wires. This will ensure accurate readings.

AN EXAMPLE OF MEASURING RTT ON DISSIPATIVE FLOORING:

Taking routine measurements of tiles coated with dissipative floor finish is a key component of proper floor maintenance. Any problems that arise with the floor will be easily detected. Keeping a record of test results for temperature, humidity and electrical properties will provide a reference and will point toward a blueprint of traffic patterns on the floor. Good record keeping will ensure success when developing and maintaining a maintenance program.

To get an average measurement of a floor, map out a 4' x 4' section and conduct five tests (one at a time) within the square. Conduct a test for each side of the square and a final test diagonally through the center as shown in the drawing below.

Each RTT test utilizes the 5-lb probes placed three feet apart (36 inches). Connect the test leads to the meter. Attach a 5-lb probe to the end of each lead and place three feet apart as indicated above. Press and hold the "TEST" button on the ACL 800 meter until a value is displayed.



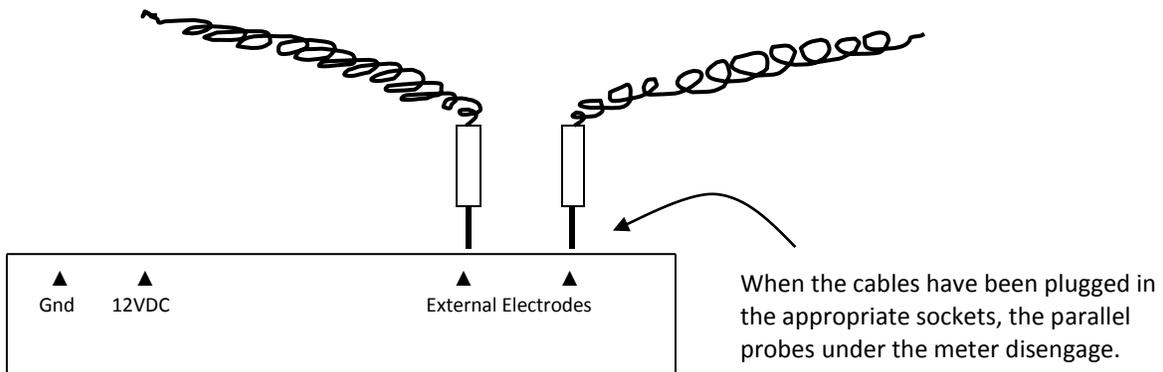
4' x 4' Section (not to scale)

### MEASURING RESISTANCE TO GROUND (RTG)

Resistance to ground measurements can be used for the evaluation of floors, chairs, carts, work surfaces and other ESD controlled materials and products. Keeping a record of test results for temperature, humidity and electrical properties will provide a reference.

AN EXAMPLE OF MEASURING RTG ON DISSIPATIVE FLOORING:

For Testing Resistance on Floors, S7.1 requires a minimum of five RTG tests per 5,000 sq. ft. Connect the leads for the external probes to the meter.



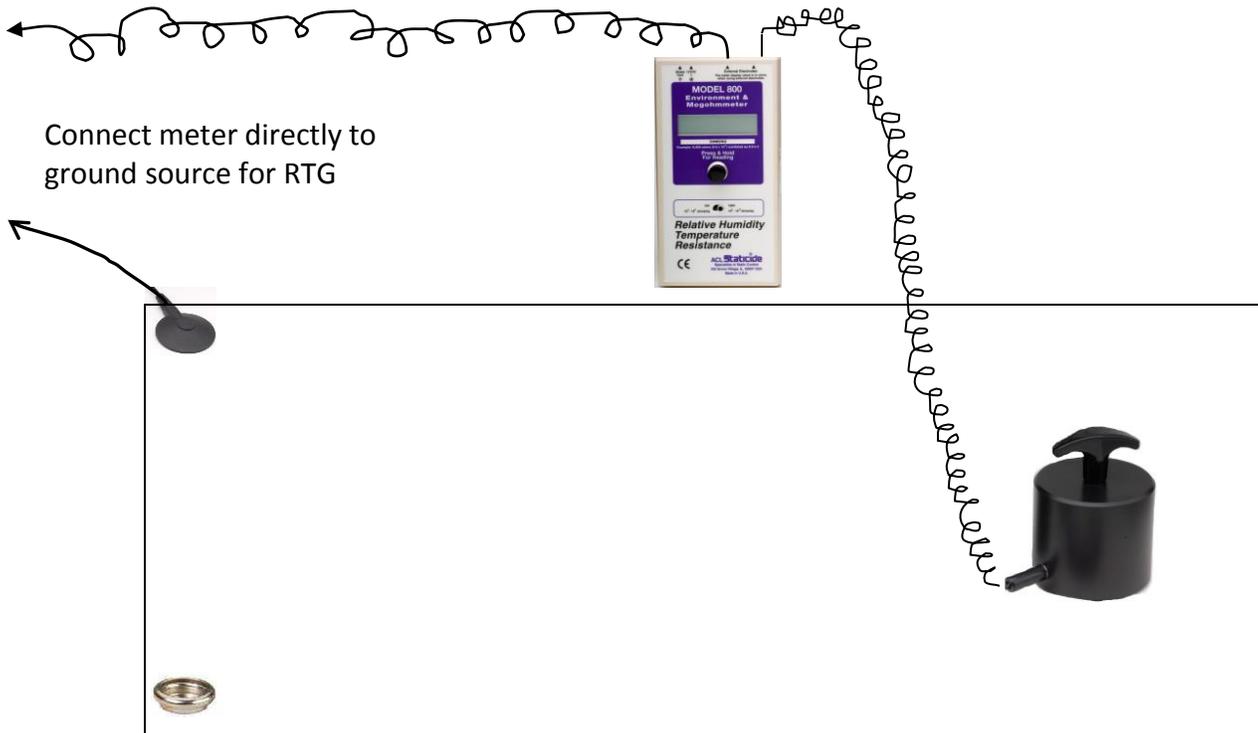
Attach one lead to a 5-lb probe and place probe on the floor that's being tested. Attach the other lead to an alligator clip and connect to ground or a groundable point (RTGP). If using a ground adapter plug, plug the banana lead into the adaptor after the adapter is plugged into the receptacle.

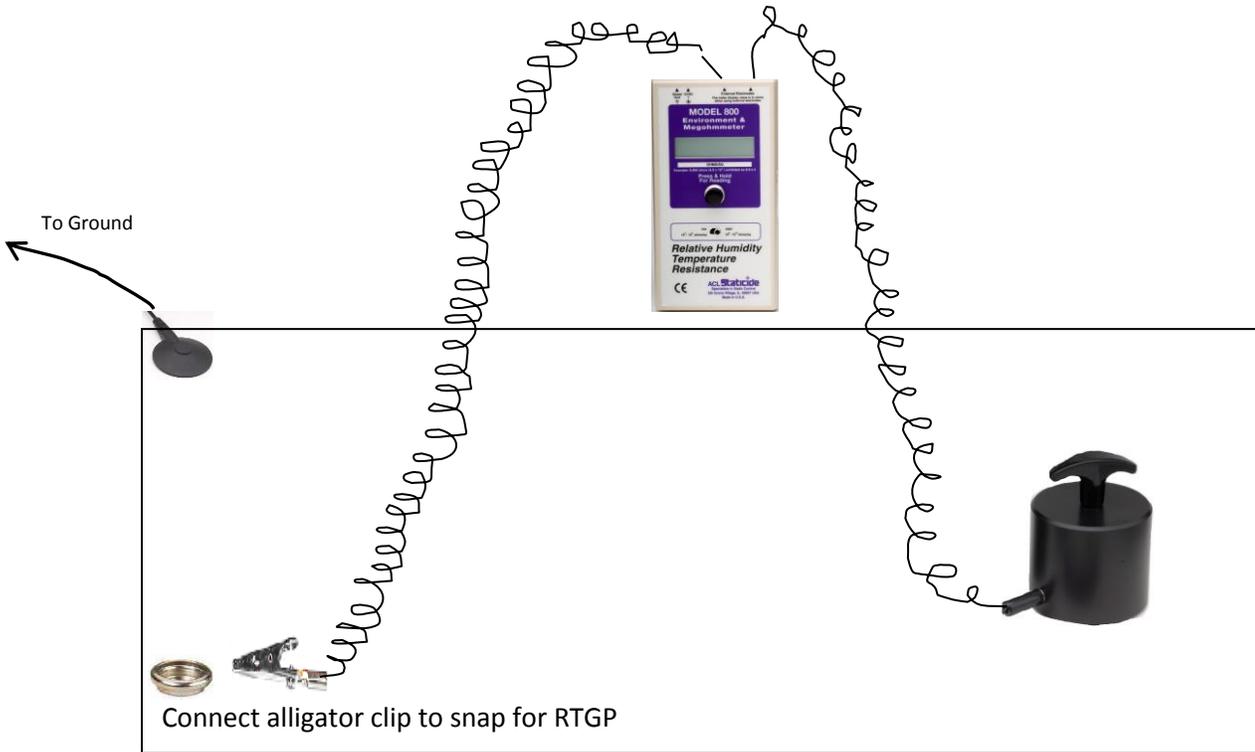


AN EXAMPLE OF MEASURING RTG ON DISSIPATIVE TABLE MATS:

- A. To test RTG for a workstation, connect the first lead to the meter and to a 5-lb probe. Place the probe on the work surface. Connect the second lead from the meter directly to a ground source. If connecting to a groundable point, the test is “resistance to groundable point” (RTGP) and not “resistance to ground” (RTG). Use the alligator clip if necessary.
- B. Press the “TEST” button and the value will be displayed on the LCD. When performing test do not touch lead wires or probe. Avoid overlapping of lead wires. This will ensure accurate readings.
- C. Resistance values are in ohms. Record temperature, humidity and resistance.

If the range of your work surface is  $10^6$  to  $10^9$ , measure at 100v. The EOS standard says the dissipative range is  $10^6 - 10^{11}$  but commonly  $10^6 - 10^9$  is considered a pass.

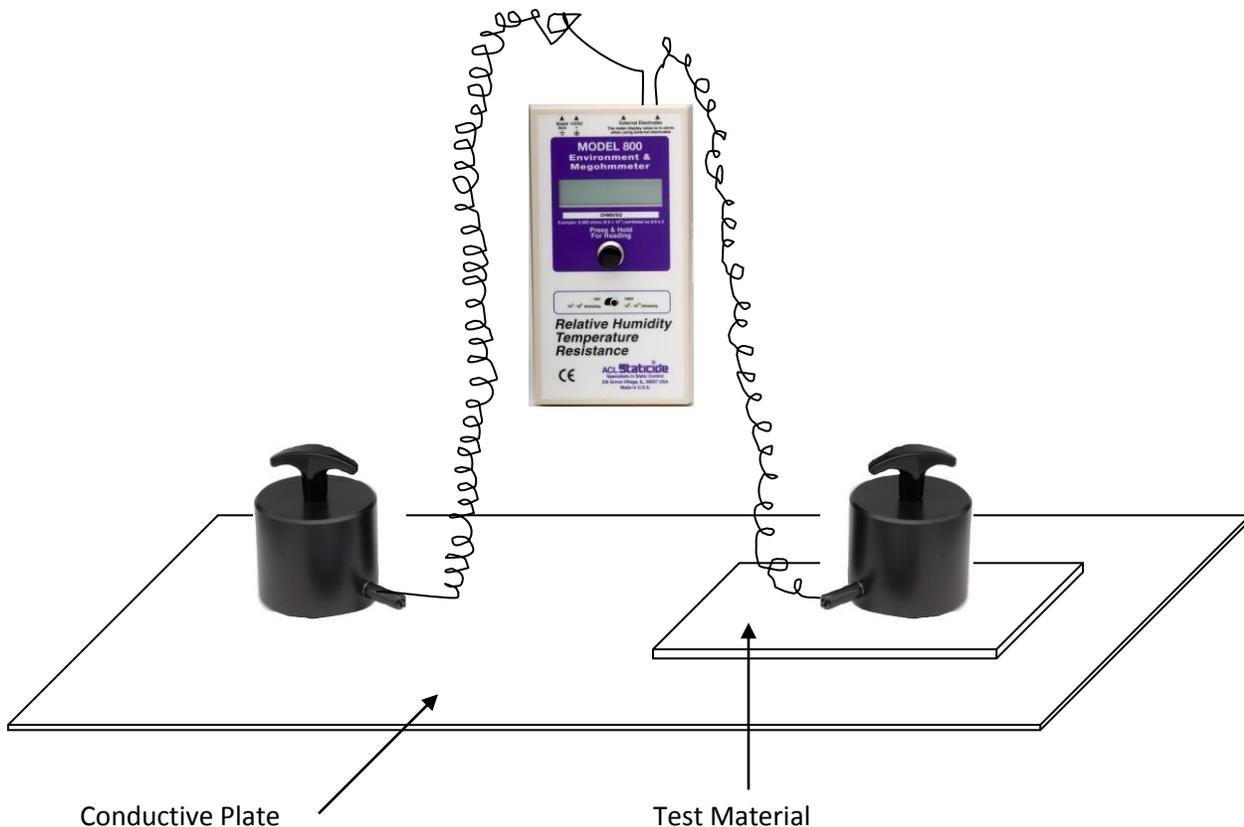




## MEASURING VOLUME RESISTANCE

Volume Resistance measures the electrical path through a material.

- A. Connect one end of each of the banana test leads into the sockets of the meter. Connect the other end of the test coil cords into the 5-lb probes.
- B. Place sample material on a conductive metal plate (such as stainless steel). Place one of the 5-lb probes on the material so that the material is sandwiched between the probe and metal plate. (See below)
- C. Place the second 5-lb probe on the conductive metal plate.
- D. Press the "TEST" button and the value will be displayed on the LCD. Volume Resistance is in ohms-cm.



## CALIBRATION INSTRUCTIONS

The ACL 800 meter is calibrated to be most accurate in the most widely-used range ( $10^6$  -  $10^8$ ). The lab calibrates meters between 30 - 40% RH at 65 - 73°F. If you are using the meter in atmospheres different than above, it is strongly advised to recalibrate the meter to your conditions.

1. Purchase 1%  $10^3$ - $10^{12}$  ohm resistors, high-accuracy relative humidity hygrometer, and high-accuracy thermometer.
2. Open meter, being careful not to disturb or break the two wires connecting the power button to the circuit board.
3. Observe on the right lower side of the meter printed circuit board four calibration pots.
4. **ALLOW THE METER TO EQUILIBRATE AND NORMALIZE IN THE ENVIRONMENT FOR 2 HOURS BEFORE TESTING.**
5. Using the supplied coil cords, attach alligator clips to the banana plug ends of the cords.
6. Insert the 3.5mm ends into the meter jacks.
7. Attach the ends of the resistors to the ends of the alligator clips.
8. The top pot is for humidity. The next pot under the top is for resistivity. The third pot is for temperature. The last pot on the bottom is to fine tune resistivity. Adjustment is done with a small screw driver. Clockwise is to increase the value, counter clockwise to decrease the value.
9. Press the power button and compare the resistor value, humidity, and temperature to the parameter to be calibrated.
10. Release the power button and slowly turn the correct adjustment pot.
11. Re-press the power button, and observe the LCD screen.
12. Re-press and adjust the pot if necessary.
13. Close case and tighten the four screws.
14. Press the power button to verify that the meter is working.
15. Test at **10** volts for values **under**  $1 \times 10^6$  ohms. Test at **100** volts for values **equal to or over**  $1 \times 10^6$  ohms.
16. Tolerance from  $10^3$  -  $10^8$  ohms is 10 %  
 $10^9$  -  $10^{10}$  ohms is 15 %  
 $10^{11}$  -  $10^{12}$  ohms is 25%
17. When testing at high resistance values, ground the meter with a ground cord in the "grounding" jack. Electrical interference and ESD can affect the tolerances and accuracy.
18. The tolerances for temperature and humidity are:  
 $\pm 3^\circ$  Fahrenheit up to  $70^\circ$ F  
 $\pm 5^\circ$  F over  $70^\circ$ F  
 $\pm 5\%$  10 to 70% RH

To increase the accuracy, adjust the calibration at the temperatures and humidities the meter will be used. For example, if you were using the meter at  $70^\circ$  F and 70 RH, you would calibrate the meter exactly at those conditions using a 1% accuracy standard thermometer and relative humidity meter.

**Should calibration traceable to the NIST be required, please call ACL, Inc. directly to arrange for calibration.**