ASTM D 991 TEST FIXTURE

Model 831

Operating Manual

10/12

electro-tech systems, inc.

www.electrotechsystems.com

3101 Mt. Carmel Avenue, Glenside, PA 19038 • Tel: (215) 887-2196 • Fax: (215) 887-0131

1.0 GENERAL DESCRIPTION

The Model 831 D 991 Test Fixture, shown in Figure 1.0-1 is designed specifically to test material in accordance with ASTM D 991 – RUBBER PROPERTY - VOLUME RESISTIVELY OF ELECTRICALLY CONDUCTIVE AND ANTISTATIC PRODUCTS.

Figure 1.0-1: Model 831 D 991 Test Fixture

This method is used to evaluate the electrical behavior of rubber products (also applicable to other types of rigid and sheet material) that are used in applications such as safety, static charge accumulation and dissipation, current transmission, etc. This test method is useful in predicting the behavior of such products having resistance up to approximately 100 megOhms.

D 991 utilizes the measurement of current (i) through a material and the voltage drop (V) across a section of the material to calculate the volume resistivity in Ohms-cm. It is designed for a standard 3"x5" (76x127mm) specimen, but can measure specimens from 0.4 - 4" (10 - 102mm) wide to 5-6" (127 -152mm) long.

The Fixture requires either a 4-pole resistance meter where the voltage source and Sense functions are contained within the same instrument or a separate adjustable voltage source and digital voltmeter. The voltage source is used to apply a potential across both sides of the test specimen (A-A' shown in Figure 1-2) causing current to flow through the specimen. The DPM is used to measure the voltage drop across a section of the specimen (B-B' shown in Figure 1-2). The milliammeter is used to measure the current from the voltage source.

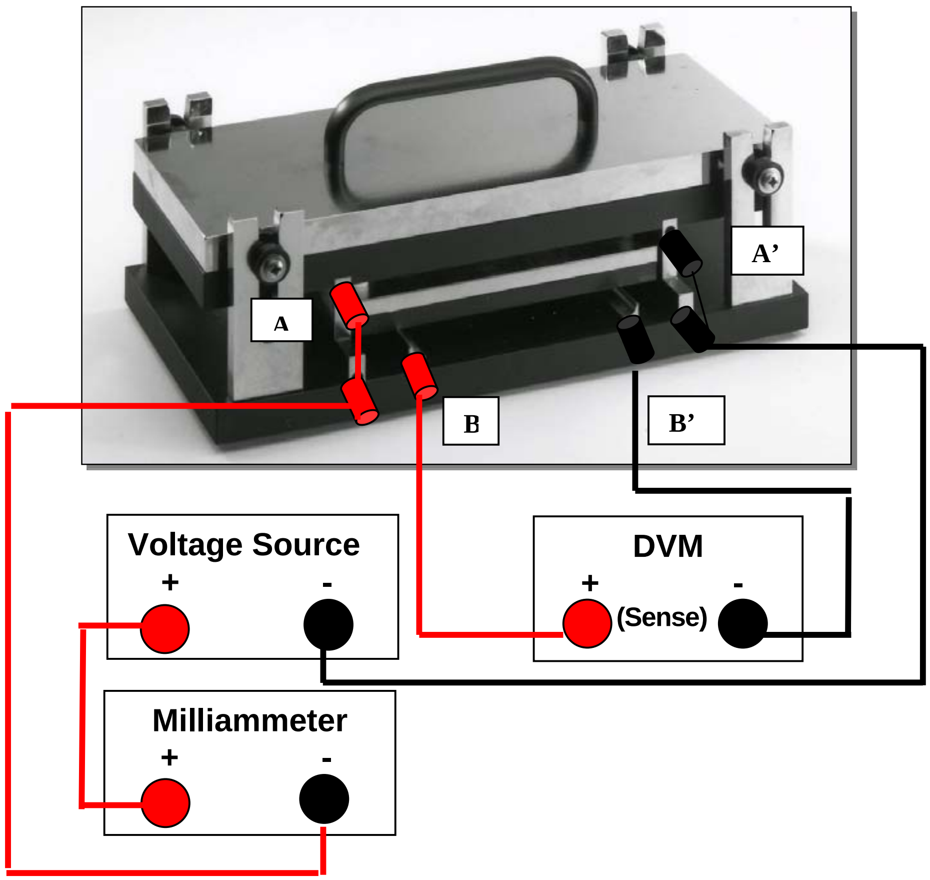

Figure 1.0-2: Model 831 meter connections

Using the following calculation from the D 991 test method, the volume resistivity of the material can be determined:

$$\rho_v = \frac{Vwd}{iL}$$

where

ρ_v = Volume resistively in Ohm-cm
V = Potential difference across potential electrodes (B-B')
i = Current through specimen (A-A')
w = width of specimen (7.62cm)
d = Thickness of specimen (cm)
L = distance between potential electrodes (6.35cm)

When using a standard size 3"x5" (7.62x12.7mm) sample the volume resistivity then becomes

$$\rho_v = \frac{7.62Vd}{6.35i} \ \Omega\text{-cm} = 1.2Vd$$

The Fixture has a fixed mass based on the maximum measurement width of 4.0” (10.2cm) specimen width.

Mass between current electrodes and specimen = 6.67 lb (3kg).

Mass between potential electrodes and specimen = 1.34 lb (0.6kg)

2.0 SET-UP

The Model 831 Test Fixture requires either a 4-pole resistance meter or individual instruments as shown in Figure 1.0-2. The red and black jumper cables connect the upper and lower electrodes together. All connections use standard 0.161 (4mm) banana plugs.

When possible sample size should be 3x5” (7.62x12.7cm)

3.0 TEST PROCEDURE

3.1 Characteristics of Static Dissipative and Conductive Material

Thermoformed plastics that are rendered static dissipative or conductive consist of a plastic resin filler with very high resistance properties loaded with a small percentage of a conductive material such as stainless steel fibers, or carbon powder or fibers. These materials have bulk resistance properties verses the surface only resistance properties found in other ESD materials. When a voltage is applied either across or through the material the dielectric of the filler breaks down and current flows from particle to particle. As the loading of the conductive medium decreases there is greater distance between particles that requires a higher voltage to break down the increased dielectric. At some point, once a higher voltage is applied to establish continuity the resistance of the path created may become altered permanently. Loaded thermoplastic materials are effective in reducing the upper resistance limit to approximately 10^8 Ohms.

Another characteristic associated with loaded thermoplastic materials that affects measuring resistance is the microscopic insulative layer that develops on the surface of the molded part. The dielectric of this layer must be broken down before a resistance measurement can be made. Once this occurs the actual resistance of the part may be lower than the measuring range of the instrumentation used.

In essence, these materials are non-linear and voltage dependent. Hence, different test voltages may give different results.

Loaded thermoelectric material is generally not adversely affected by humidity, as long as it is reasonable such as less than 75%.

At present, ESD materials are classified as follows:

	Conductive	Dissipative	Insulative
Surface	$<10^4$	10^4 to $<10^{11}$	$\geq 10^{11}$ Ohms
Volume		same	

Materials with bulk resistance characteristics can also be classified by specifying its volume resistivity. Increasing or decreasing the thickness of the material will change the measured resistance of the part with a specified volume resistivity. This is a common technique used in ESD products to achieve a particular resistance. It is the actual resistance of the part, not its resistivity that determines how a part dissipates a static charge.

3.2 Test Procedure

Measure the thickness and width of the test specimen in cm.

Place the test specimen in the Test Fixture. Verify that the electrodes are making good contact with the specimen surfaces.

NOTE:

Molded plaques may not be sufficiently flat to ensure good electrode contact. Application of additional pressure may alleviate this problem. The less electrode contact the higher the measured resistance.

If the samples have identification marks the sheets shall be normal to the calendar grain and shall not be in contact with, nor lie between the current electrodes.

Adjust the current through the specimen after connection of the voltage source so that the power dissipation in the specimen between the potential electrodes is approximately 0.1 Watt. The following voltages should not be exceeded for the maximum current specified.

Pontential-Volts	Current-ma
3	50
6	25
10	15
30	5
75	2
150	1
300	0.5

When the current has stabilized or after 5 seconds, measure the potential difference across the current electrodes to the nearest 1% of the respective values.

Calculate the volume resistivity using the formula listed in Section 1.0.

When performing measurements the following considerations should be taken into account:

1. Verify instrument operation by performing calibration and operation checks per manufacturer recommendations.
2. Verify test set-up by measuring a known sample with resistance in the1-10 MegOhm range.
3. Read and record the ambient temperature and relative humidity.
4. Verify that surfaces of the test specimen are clean and dry. Do not use a cleaner that could leave a non-conductive residue.
5. Place the specimen in the test fixture and make sure the electrodes are making good surface contact.
6. Select the appropriate voltage by starting with the lowest level and then increasing it until the correct current range is obtained.
7. Read and record the Test Voltage and Potential Difference.
8. Calculate and record the Volume Resistively.

4.0 CALIBRATION

The Model 831 D991 Test Fixture has fixed parameters and does not require periodic calibration. The only parameter that needs to be checked periodically is the electrodes. Place a flat 3x5” (7.62x12.7cm) plate in the fixture and observe that no gaps between the electrodes and plate are present. If gaps are observed then the unit should be returned to ETS for realignment.

10/12

5.0 WARRANTY

Electro-Tech Systems, Inc. warrants its equipment, accessories and parts of its manufacture to be and remain free from defects in material and workmanship for a period of one (1) year from date of invoice and will, at the discretion of Seller, either replace or repair without charge, F.O.B. Glenside, similar equipment or a similar part to replace any equipment or part of its manufacture which, within the above stated time, is proved to have been defective at the time it was sold. All equipment claimed defective must be returned properly identified to the Seller (or presented to one of its agents for inspection). This warranty only applies to equipment operated in accordance with Seller's operating instructions.

Seller's warranty with respect to those parts of the equipment that are purchased from other manufacturers shall be subject only to that manufacturer's warranty.

The Seller's liability hereunder is expressly limited to repairing or replacing any parts of the equipment manufactured by the manufacturer and found to have been defective. The Seller shall not be liable for damage resulting or claimed to result from any cause whatsoever.

This warranty becomes null and void should the equipment, or any part thereof, be abused or modified by the customer of if used in any application other than that for which it was intended. This warranty to replace or repair is the only warranty, either expressed or implied or provided by law, and is in lieu of all other warranties and the Seller denies any other promise, guarantee, or warranty with respect to the equipment or accessories and, in particular, as to its or their suitability for the purposes of the buyer or its or their performance, either quantitatively or qualitatively or as to the products which it may produce and the buyer is expected to expressly waive rights to any warranty other than that stated herein.

ETS must be notified before any equipment is returned for repair. ETS will issue an RMA (Return Material Authorization) number for return of equipment.

Equipment should be shipped prepaid and insured in the original packaging. If the original packaging is not available, the equipment must be packed in a sufficiently large box (or boxes if applicable) of double wall construction with substantial packing around all sides. The RMA number, description of the problem along with the contact name and telephone number must be included in formal paperwork and enclosed with the instrument. Round trip freight and related charges are the owner’s responsibility.