electro-tech systems

ETS Model 831 Test Fixture

ETS Model 831T Turnkey Test System

ASTM D 991

Operating Manual

Electro-Tech Systems, 700 West Park Avenue, Perkasie, PA 18944 – (215) 887-2196

D01296 Revision E

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Revision History:

Revision A: Released 2015 Initial release.

Revision B: 2020-04-29. Reformat.

Revision C: 2020-11-10. Add new address. Section number corrections.

Revision D: 2022-08-11. Update items included with Model 831T

Revision D: 2024-04-05. Upgrade to auto ranging precision meters, new power supply.

Products described in this manual are designed and assembled in the U.S.A. by

Electro-Tech Systems, Inc.

700 West Park Avenue

Perkasie, PA 18944

www.electrotechsystems.com

I. Important Safety Information

SAFETY INSTRUCTIONS

The equipment described in this Manual is designed and manufactured to operate within defined design limits. Any misuse may result in electric shock or damage to the equipment. To prevent the equipment from being damaged, the following rules should be observed for installation, use and maintenance. **Read the following safety instructions before operating the instrument.**

POWER

POWER CORD: No AC Power is used by the 831 fixture, however Meters and Power Supplies operate from 115VAC. Be sure to use a 3-prong connector to ensure proper grounding of these instruments. Ground your test setup to a verified earth ground.

OPERATION

CAUTION

DO NOT OPERATE WITH SUSPECTED EQUIPMENT FAILURES. If any odor or smoke becomes apparent turn off the equipment and unplug it immediately. Failure to do so may result in electrical shock, fire or permanent damage to the equipment. Contact the factory for further instructions.

DO NOT USE IN ANY MANNER NOT SPECIFIED OR APPROVED BY THE MANUFACTURER: Unapproved use may result in damage to the equipment or present an electrical

II. Description of Contents

Included with Model 831 Test Fixture:

Item	Qty.	Description
1	1	Volume Resistivity Test Fixture
2	1 pair	3” Jumper Cables, Red and Black, banana plugs each end
3	1	Verification Sheet, 3” x 5”

The Model 831 Test Fixture requires either a 4-pole resistance meter or individual Voltage and Current measurement instruments and a Power Supply.

Included with Model 831T Turnkey Test System:

Item	Qty.	Description
1	1	Volume Resistivity Test Fixture
2	1 pair	3” Jumper Cables, Red and Black, banana plugs each end
3	1	Cable #1 – 15” Black
4	1	Cable #2 – 18” Red
5	1	Cable #3 – 23” Black
6	1	Cable #4 – 18” Red
7	1	Cable #5 – 12” Red
8	2	Auto Ranging Precision Meter, Fluke-115
9	1	Power Supply, GW Instek Model GPS-3030DD
10	1	Verification Sheet, 3” x 5”

The Model 831T Turnkey Test System includes all necessary instruments and cabling:

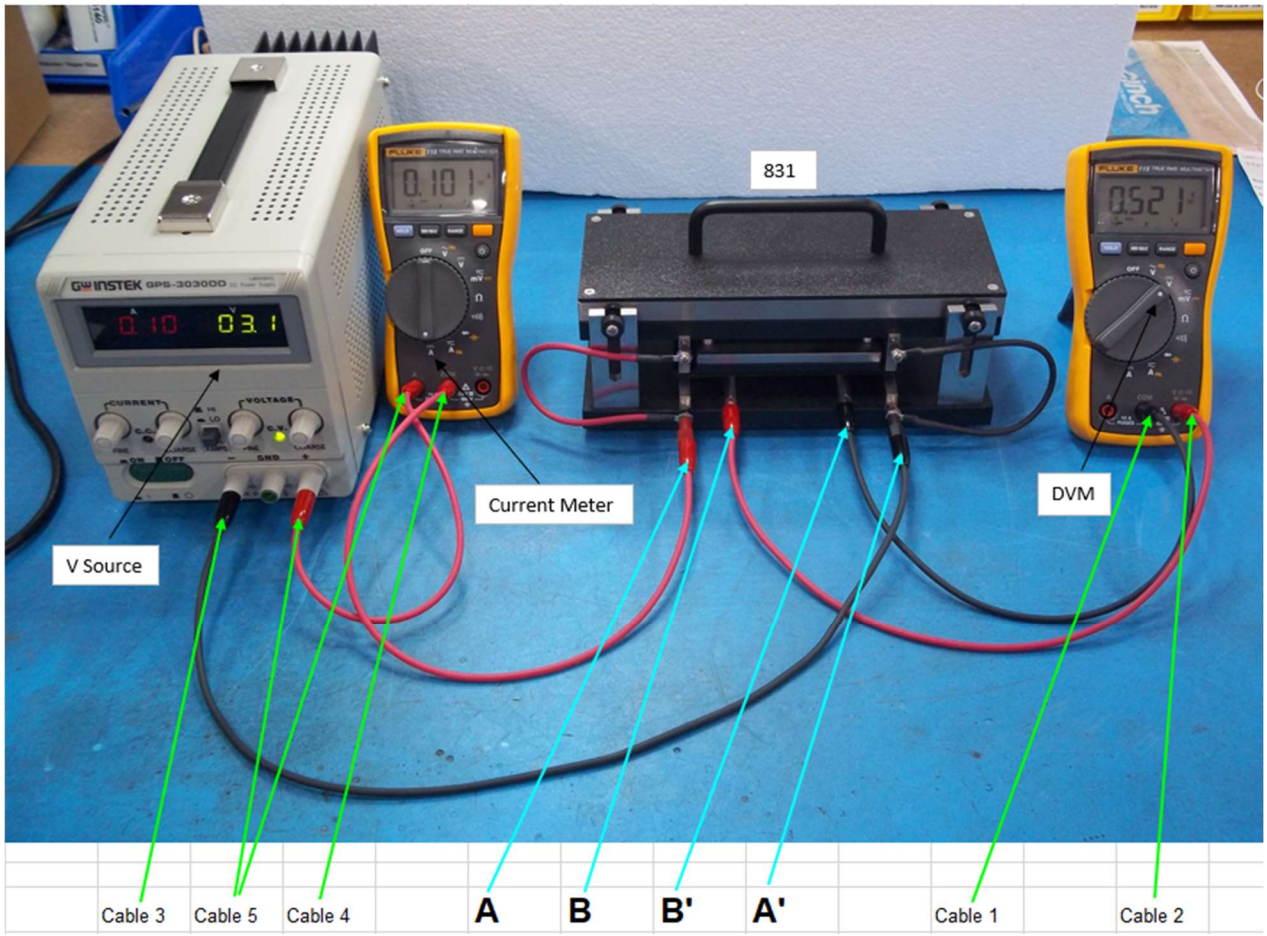
The short red and black jumper cables connect the upper and lower electrodes together. Cables #1 through #5 are provided to connect to the other instruments. All connections use standard 0.161 (4mm) banana plugs.

Illustrations in this manual reflect the ETS Model 831T system which includes cables, current meter, and power supply. To use the 831 with other equipment, connect in a similar fashion.

III. Set-Up Guide

Step 1 - Inspect:
Receive and inspect the unit for any damage, debris, or missing parts.

Step 2 - Arrange:
Arrange the Model 831 meters, and power supply on a stable level surface as shown.



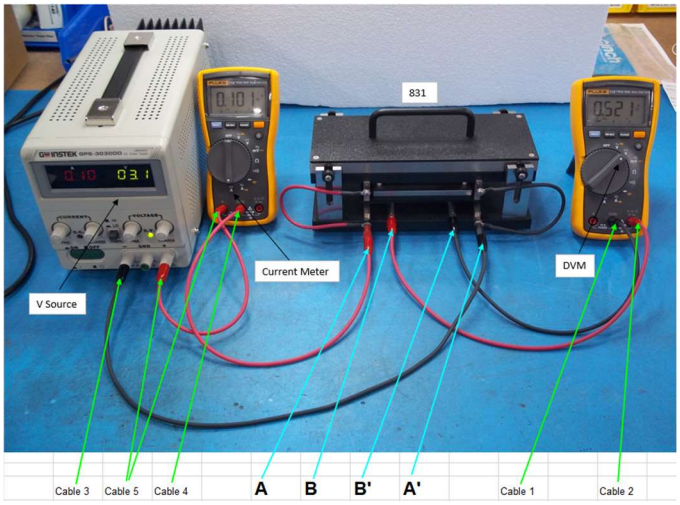
Step 3 - Calibration:
The M 831T has fixed parameters and does not require calibration.

Step 4 - Connect cables. See illustration above:

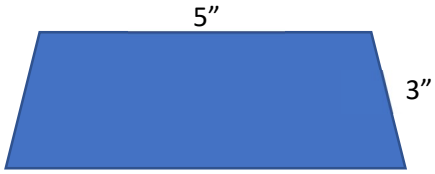
Cable 1 (15" - Black)	from B'	to "COM" of DVM
Cable 2 (18" - Red)	from B	to "V" of DVM
Cable 3 (23" - Black)	from A'	to (-)OUTPUT of Vsource
Cable 4 (18" - Red)	from A	to "COM" of Current Meter
Cable 5 (12" - Red)	from (+)OUTPUT of Vsource	to "A" of Current Meter

Step 4 - Perform Electrode Check:
Place the 3x5” (7.6x12.7cm) conductive Verification Sheet in the fixture and read the resistance. It should be between 1.0 and 10.0 megohms.

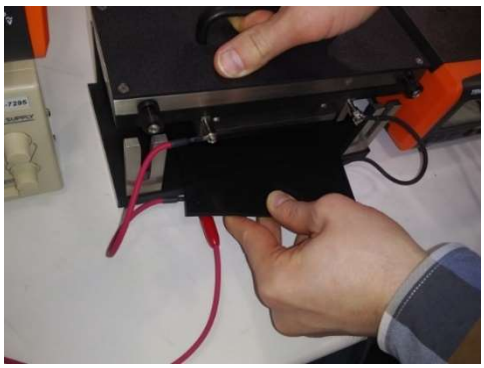
IV. Quick Start Guide



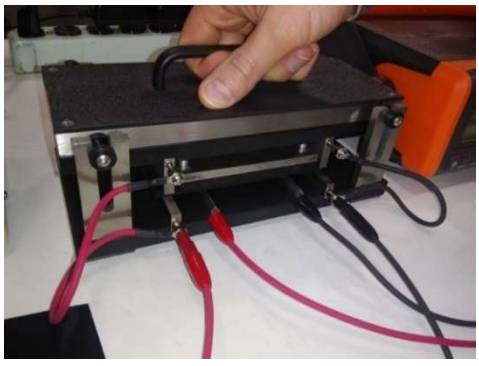
Step 1 - Verify that the 831 fixture is properly connected to the meters and power supply. Refer to the SETUP section of this manual for verification.



Step 2 – Prepare the sample. When possible, sample size should be 3x5” (7.62x12.7cm). If the sample is larger, the width (w) used in the calculation is limited to 3.0” (7.62cm). For narrower samples (w) should be the measured width.



Step 3 - Place the test specimen in the fixture…..



……and secure the top cover.

Basic Testing Sequence:	**Step 4 –** Switch Current Meter to “A” DC measurement.
	Step 5 - Switch Voltmeter (DVM) to “V” DC measurement.
	Step 6 - Adjustment. Not applicable since both DMMs are Auto Ranging Meters.
	Step 7 - Verification Sheet. Place the verification Sheet (M 844V) that was shipped with the system between the top and bottom electrodes.
	Step 8 - Remove Current Limit. With the two voltage knobs turned all the way down on the Power Supply, Turn the Current knobs all the way up to remove the current limiting resistance from the power supply.
	Step 9 - Gradually increase the voltage until the current reading on the Ammeter is 100 mA. If the voltage is less than 1.57 Volts, the sample is less than 12 ohms, and the system is operating properly

V. Functionality

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

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 to 4” (10 - 102mm) wide, and 5 to 6” (127 -152mm) long.

The Fixture requires a separate adjustable voltage source, digital voltmeter, and ammeter. The voltage source is used to apply a potential across both sides of the test specimen (A-A' as shown in the Setup section above) causing current to flow through the specimen. The DPM is used to measure the voltage drop across a section of the specimen (B-B' above). The milliammeter is used to measure the current from the voltage source.

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:

ρv = 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:

$$\rho v = \frac{7.62Vd}{6.35i} \quad \Omega\text{-cm} = \frac{1.2Vd}{i} \quad \text{or} \quad 1.2dRm$$

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)

VI. Test Procedures

A. Generic Specimen Test

1. 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.

2. 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.

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

3. 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.

4. Calculate the volume resistivity using the formula listed in the previous section.

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

- Verify instrument operation by performing operation checks per manufacturer recommendations.
- Verify test set-up by measuring the Verification Sheet, a known sample with resistance in the 1 to 10 megohm range.
- Read and record the ambient temperature and relative humidity.
- Verify that surfaces of the test specimen are clean and dry. Do not use a cleaner that could leave a residue which changes the conductivity of the surface.
- Place the specimen in the test fixture and make sure the electrodes are making good surface contact.
- Select the appropriate voltage by starting with the lowest level and then increasing it until the correct current range is obtained.
- Read and record the Test Voltage and Potential Difference.
- Calculate and record the Volume Resistively.

B. ASTM D 991 TEST - Basic Operating Instructions

ASTM D 991 test is used to evaluate electrical behavior of rubber products. It utilizes the measurement of current (**i**) through a material and the voltage drop (**V**) across a section of the material to calculate volume resistivity in Ohms-cm. Specimens over 4" (10cm) **w**ide but limited to 6" (15cm) **L**ong can be measured. Below is the test setup.

Current Reading

Voltage Reading

1. Set the meters to the following settings:

   1. **Voltage Source:** Start with low voltage (**V**) for example **0.30V**. (as seen above)
   2. **Current Meter:** Set the Ammeter (**i**) to "**A" DC.** (6:00 o'clock position)
   3. **Voltmeter:** Set the Voltmeter (**V**) to **"V" DC.** (2:00 o'clock position)

2. Using the ASTM D 991 calculation, volume resistivity (ρ_v) of the material is:

$$\rho_v = \frac{Vwd}{iL} \text{ Ohm-cm}$$

   width, **w=8.9cm;** length, **L=6.35cm** & sample thickness, **d=0.11cm** are fixed
   Therefore, volume resistivity, ρ_v becomes

$$\rho_v = \frac{10.16 \times 0.11\mathbf{V}}{6.35\mathbf{i}} = \frac{154\mathbf{V}}{\mathbf{i}} \text{ Ohm-cm}$$

3. From the above readings, the Power Dissipation is **V*i = (0.101A)*(0.521V) = 0.052621** Watt.

4. Increase **Voltage Source** until **V*i** calculation is falling between to **0.09 to 0.11** Watt.

5. Now these **V** and **i** values can be used to calculate the ρ_v.

VII. Maintenance and Calibration

Calibration

The Model 831 Test Fixture has fixed parameters and does not require periodic calibration.

Repair

To return equipment to ETS for repair it is first necessary to obtain a RMA number, please call 215-887-2196 or email service@ets2.com

VIII. Warranty

Limited Warranties. Seller warrants that all goods manufactured and delivered hereunder shall (a) conform to any samples, drawings, specifications, or other written documents provided to Seller by Buyer, or approved by Buyer to Seller and (b) be free from all defects in workmanship and material. Buyer's sole remedy against Seller for breach of either of the specifically mentioned warranty shall be the repair or replacement, at Seller's sole option, of the defective workmanship or material. Seller expressly disclaims all other warranties, express and/or implied, including but not limited to those of merchantability and fitness for a particular purpose. In no event shall Seller be liable, under either warranty or otherwise, to Buyer in excess of the purchase price of the products paid to Seller by Buyer. In no event shall Seller be liable for any loss or damage arising directly or indirectly from the use of the product or for consequential or incidental damages. Seller's specified warranties will expire and lapse (i) for renewable items (such as gloves, iris ports and desiccants), sixty (60) days from date of shipment and (ii) for all standard equipment and otherwise nonrenewable items, one year from date of shipment.