

Surface Resistance Test Kit Operation and Maintenance



Made in America



- Footwear - ESD S9.1 - Footwear - Resistive Characterization
- Garments - ESD STM2.1 Garments
- Seating - ESD STM12.1- Seating - Resistive Measurement
- Floor/Footwear - ESD STM97.1 - Floor Materials and Footwear-Resistance Measurement in Combination with a Person
- Workstations - ESD-ADV53.1 - ESD Protective Workstations

Versatility:

Measures RTT, RTG or Resistivity (requires optional Resistivity Attachment, item 50560)

- **Quick Checks** - Surface resistance exponent number illuminates immediately i.e. 8 = 10E8 ohms or 100,000,000 ohms
- **Periodic Checks of Installed Products** - Surface resistance exponent number illuminates immediately and displays Temperature and Relative Humidity during 15 second electrification period making numerous measurements and calculations to then display mantissa i.e. if LED displays 8 and LCD displaying 7.14 as mantissa = 7.14 x 10E8 ohms or 714,000,000 ohms
- **Test Lab Evaluation of Product** - Display same as Periodic Check above

Figure 1. Item 50557 Surface Resistance Test Kit

Description

The Surface Resistance Test Kit is a portable, accurate, and versatile instrument designed to measure resistance between two points (RTT), surface to ground (RTG), and surface resistivity in accordance with ESD Association Standard S4.1 including:

- Resistance measuring accuracy ± 10% (E11 & greater ±20%)
- Resistance range <1.0 x 10E3 ohms to >10E12 ohms
- Open circuit voltages of 10 and 100 volts ± 5%
- Electrification period of 15 seconds
- Electrodes (two) 5 pounds ± 2 oz with 50-70 durometer conductive pads

In addition, the Meter measures ambient temperature and relative humidity.

The Surface Resistance Test Kit (or its Meter) is referenced and designed to be used to make measurements in accordance with the test methods in:

- Worksurfaces - ESD S4.1 Worksurfaces - Resistance Measurements
- Floors - ANSI/ESD S7.1- Resistive Characterization of Materials Floor Materials

The Surface Resistance Test Kit is NIST calibrated and items available are:

Model	Description	Power
50557	Surface Resistance Test Kit	2 x AA Batteries
50560	Resistivity Attachment	N/A

Inspection

Remove the meter from the carton and inspect for damage. Each Surface Resistance Test Kit should include the following:

- 1 Protective carrying case
- 1 Meter
- 2 Test leads
- 2 5-pound electrodes
- 2 AA alkaline batteries

Properly store the Meter and component assemblies when not in use.

ESD protective products should be tested:

- A. Prior to installation to qualify for listing in user's ESD control plan approved ESD protective materials (see ANSI/ESD S20.20 paragraph 6.1.1.2)

- B. During initial installation
- C. For periodic checks of installed products as part of ESD control plan compliance verification plan

Per ANSI/ESD S20.20, test equipment is required to enact Compliance Verification Plan Requirement - "Test equipment shall be selected to make measurements of appropriate properties of the technical requirements that are incorporated into the ESD program plan."

Electrification Period

The Surface Resistance Test Kit provides the proper electrification period of 15 seconds per ESD S4.1, after numerous readings and calculations are executed, then displays surface resistance mantissa measurement (Note: most analog type meters display measurements instantaneously).

When the Test Button is depressed, the liquid crystal display (LCD) will indicate:

- Temperature in degrees Fahrenheit (tolerance $\pm 5^{\circ}\text{F}$, typical)
- Temperature in degrees Celsius (tolerance $\pm 3^{\circ}\text{C}$, typical)
- Humidity as percentage (from 5% - 95% tolerance, ± 10 typical)
- Surface resistance mantissa (with exponent displayed via LED, measurement in ohms)

Measurement being displayed is identified by the illuminated function LED. The surface resistance exponent (or power of number) is immediately illuminated and remains illuminated measuring the range the surface resistance in ohms.

Reference Literature

In addition to those noted above:
 ANSI/ESD S20.20 - Development of ESD Control Program
 ESD ADV1.0 - Glossary of Terms
 ANSI EOS/ESD S6.1- Grounding
 ANSI EOS/ESD S11.11 - Surface Resistivity

These documents can be obtained directly from the ESD Association, 7902 Turin Rd., Suite 4, Rome, NY 13440-2069, (315) 339-6937 or www.esda.org.

Other standards are available from the agencies who produce them. MIL-HDBK 263A, EIA-IS-5-A, ASTM-F-150, EN 100015, and EIA-625. If you need help in obtaining these documents, please contact our customer service department.

Features

A. LED Displays: Surface resistance exponent is displayed via light emitting diodes illuminating 1/8" high number. There are 12 LEDs displaying surface resistance exponent measurement. They are color coded for quick checks:

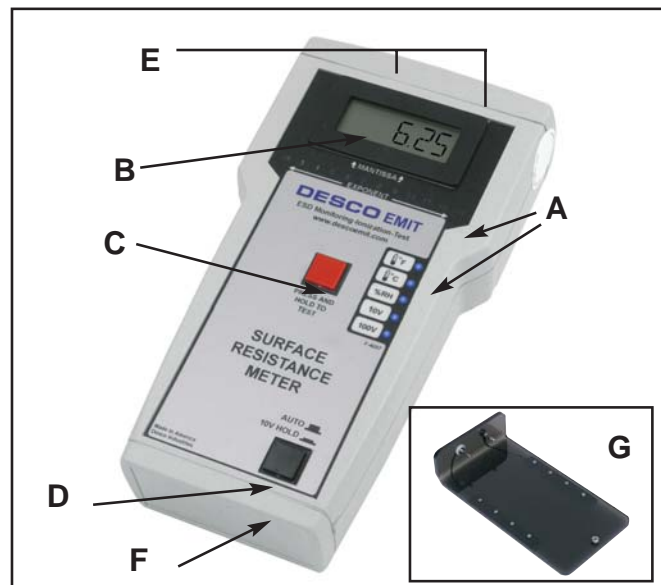


Figure 2. Features of the Surface Resistance Meter

Exponent	Color
<3, 3	Red
4, 5	Green
6, 7, 8	Blue
9, 10, 11	Green
12, >12	Yellow

Five Function LED's identify the measurement being displayed (see B below).

- When battery voltage drops to approximately 2 volts, one of the Function LED's to the right of the red pushbutton switch will begin to flash, indicating the need to replace batteries.

B. Liquid Crystal Display (LCD): Mantissa is displayed via 9/16" high liquid crystal display and provides easy to read resistance (or resistivity) measurements.

When the Test Button is depressed, the LCD will indicate:

- Temperature in degrees Fahrenheit
- Temperature in degrees Celsius
- Humidity as percentage
- Surface resistance mantissa (with exponent displayed via LED, measurement in ohms)

Surface resistance ohm values are expressed with a mantissa and exponent or power of the number. For example, if "8" is illuminated by its LED and the LCD displays a mantissa of "7.14", the measurement is 7.14 x 10E8 ohms or 714,000,000 ohms

If surface is over 10E12 ohms, the following will appear:

- "1 ____" on the LCD display indicate Overrange or that the reading exceeds the display capabilities

C. Test Button: This red button activates electrical power to the Meter. The exponent or power of the number is displayed immediately with LED illuminating number. If "8" is illuminated, the measurement is in the 10E8 ohm range. To make a measurement in accordance with ESD S4.1, the

button is to be depressed for 10-20 seconds for the unit to make numerous readings and calculations. (Testing in accordance with ESD S4.1-1997 requires 15 seconds of electrification; in contrast, most analog type meters display measurements instantaneously.) The LCD will display temperature (F), then temperature (C), then relative humidity, and then the surface resistance mantissa. For example, if the LCD displays a mantissa of "7.14", and "8" is illuminated by its LED, the measurement is 7.14×10^8 ohms or 714,000,000 ohms.

During the entire period, surface resistance exponent will be displayed by LED illuminating number.

D. Override Test Range Voltage Button: When in the "up" position, during resistance portion of test, Meter will automatically switch to the correct voltage for the resistance range. LED will illuminate noting selected voltage. Conductive material 10^5 ohms or less should be measured at 10 volts. Dissipative material 10^6 or greater ohms should be tested at 100 volts. The button is a switch, which if depressed will override automatic voltage selection and test will be performed at 10 volts regardless of resistance level.

E. Jacks: One end of Test Leads has 3.5mm plug (fits Meter left jack). The 3.5mm plug is shielded (identified by insulated tip and barrel black lead) - see RTG test procedure: Per ESD S4.1 "The sensing lead of the resistance meter shall be connected to groundable point." One end of Test Lead has standard banana plug (fits 5# Electrode jack).

F. AA Battery Compartment.

G. Resistivity Parallel Attachment with Electrodes.
(optional Item number 50560)

Cleaning

Per ESD S4.1 "Clean the electrodes with a minimum 70% isopropanol-water solution." Make sure conductive pads are dry prior to use.

See specific product test standard for test lab specimen cleaning instructions. Per ESD S4.1 Worksurfaces "The test specimens and electrodes shall be cleaned twice with a minimum 70% isopropanol-water solution using a clean, low-linting cloth each time." (Note: then conditioned for 72 hours, minimum.)

For installed product periodic testing, do not clean surfaces. However, if any measurements lie outside acceptable range, then clean the surface and re-test. (Note: for worksurfaces, use Desco Reztore™ Antistatic Surface and Mat Cleaner (item 10435) or other ESD cleaner not containing silicone. Be sure the surface is dry before testing.

Power Requirements

The Meter is powered by two replaceable alkaline AA batteries.

Battery Replacement

Depress buttons on both sides of bottom end cap of meter housing. Remove cap, press on right edge of protruding battery door, unlatching it, and swing door open. Carefully replace batteries with alkaline Type AA. Polarity must be correct or damage may occur. Close battery door and re-install bottom end cap on meter housing.

Test Procedure

General Guidelines:

- Use both 5# Electrodes for RTT
- Use one 5# Electrode and one lead to groundable point for RTG (note: groundable points are usually snaps installed on the material or workstation)
- Use optional Resistivity Attachment (removing leads & electrodes) for Resistivity measurements
- Ensure that item being measured is electrically isolated (i.e. placed on an insulative surface) as Meter will measure lowest resistance path
- Ensure that test leads are separated or Meter may measure lower resistance path
- When using 5# Electrodes:
 - Place no closer than 2" from edge of surface being measured
 - Place no closer than 3" to any groundable point
 - Place 5# Electrodes 10" apart for RTT
 - Preferred placements include: most commonly used surface portion, most worn, center, and furthest from groundable point.
 - For RTG, connect the sensing lead with shielded plug to groundable point
- If surface has sections (like floor tiles or garment panels), for RTT place a 5 pound electrodes on different sections
- Clean surface for Test Lab, but do not initially clean surface for installed products (if fails, clean and retest).

Test Lab Test Procedure Guideline

For test lab use of ESD Worksurfaces, Floor Materials, Footwear, Garments, or Seating, best advice is to follow procedures in applicable ESD Association standards (see above) which include details regarding:

- Cleaning (For example per S4.1 "The test specimens and electrodes shall be cleaned twice with a minimum 70% isopropanol-water solution using a clean, low-linting cloth each time). Allow to dry.
- Environmental chamber (For example per S4.1 control relative humidity to $12 \pm 3\%$ RH and $50 \pm 5\%$ RH and temperature to 23 ± 1 degrees C)
- Specimen support surface (For example per S4.1 greater than 1.0×10^{12} ohms such as PMMA, PTFE or polycarbonate)
- Specimen Pre-Conditioning (For example per S4.1 at 23 ± 1 degrees C; 3 specimens at $12 \pm 3\%$ relative humidity for up to 72 hours minimum, and 3 specimens at $50 \pm 5\%$ relative humidity for up to 72 hours minimum)

- Reporting Test Results, for example per S4.1 Reporting Test Results, Report:
 - Minimum, median and maximum readings for both resistance-to-groundable point and point-to-point resistance in ohms at low relative humidity
 - Minimum, median and maximum readings for both resistance-to-groundable point and point-to-point resistance in ohms at moderate relative humidity
 - Temperature
 - Relative humidity
 - Actual duration of conditioning
 - Test equipment used

Periodic Checks of Installed Product Test Procedure Guideline

Measure RTG Resistance to Ground

Test Procedure in accordance with ESD S4.1 paragraph 6.4 Periodic Worksurface Testing:

- Do not clean the surface
- Remove from the surface only those items that might interfere with the test.
- ESD sensitive devices shall also be removed
- Clip the sensing test lead with shielded plug to groundable point connected to ground
- Use one 5# Electrode on other test lead and place Electrode the farthest convenient point on the surface
- Press button and hold Test Button until measurement is displayed
- Perform additional measurements placing Electrode on the most commonly used or most worn area

If measurement is outside acceptable limits, clean surface and retest to determine if cause of failure is insulative dirt layer or the ESD protective product. Note: Use an ESD cleaner containing no insulative silicone (i.e. Reztore™ Antistatic Surface and Mat Cleaner).



Figure 3. Setting up for RTG testing.

Measure RTT Resistance Between Two Points on the Surface

- Do not clean the surface
- Remove from the surface only those items that might interfere with the test.
- ESD sensitive devices shall also be removed
- Use two 5# Electrodes, place in the most commonly used portion of the surface 10" apart (2" from any edge, 3"

from any groundable point)

- Press button and hold Test Button until measurement is displayed
- If the most used portion is not obvious, use two points near the center of the surface

If measurement is outside acceptable limits, clean surface & retest to determine if cause of failure is insulative dirt layer or the ESD protective product. Note: Use an ESD cleaner containing no insulative silicone (i.e. Reztore™ Antistatic Surface and Mat Cleaner)



Figure 4. Setting up for RTT testing.

Reporting and Using Test Results

Different standards have different requirements; use requirements as specified in user's ESD control plan. Examples are:

Per ESD 4.1 (worksurfaces), Report:

- RTG maximum and minimum values measured for resistance-to-ground
- RTT maximum and minimum values measured for point-to-point resistance in ohms

Per ESD 7.1 (floors) Report:

- RTG all values in ohms for resistance to ground
- RTT all values in ohms for point-to-point resistance
- Voltage level
- Test date
- Temperature
- Relative humidity
- Test equipment used

Summarize test data by reporting minimum, maximum, median, and mean values obtained. Include a diagram showing approximate electrode positions and ground connections used.

Recommended Frequency of Periodic Checks of Installed Products

Note: "The frequency of periodic testing is normally specified in corporate operating procedures. ...The frequency of testing is driven by the amount of risk exposure that can occur between tests. For, example, what is the quantity of product handled between test periods?" (See ESD Handbook TR 20.20) However, a common guide would be:

- Worksurface - at least quarterly (see TR 20.20 paragraph 5.3.1.13 Periodic Tests)

- **Footwear** - "Incoming inspection on a lot sampling basis should be performed for all static control footwear." (see TR 20.20 paragraph 5.3.3.4 Testing)
- **Floor** - "The types of monitoring and type of equipment are considerations. In some cases, a simple electrical resistance test with a megohmmeter may suffice. In others, a static charge generation test may be required." (see TR 20.20 paragraph 5.3.4.13 Performance Monitoring)
- **Seating** - "The recommended electrical resistance range for seating is less than 1×10^9 ohms as tested in accordance with ESD STM 12.1. This value should be during acceptance testing, installation and periodically thereafter." (see TR 20.20 paragraph 5.3.5.3 Testing)
- **Garments** - "To maintain process control, it is imperative that the garment be tested per ESD STM 2.1. The point to point and sleeve to sleeve resistance test should be made." (see TR 20.20 paragraph 5.3.13.3.1.8 Periodic Testing)

Surface Resistivity

Theoretically Resistivity is 10 times greater than Resistance, i.e. a material that measures 10^7 ohms RTT, Surface Resistivity should measure 10^8 ohms/square.*

Ref: ESD S11.11 paragraph 12.0 Conversion to Resistivity states, "When it is appropriate to convert a resistance obtained by this test method to an equivalent resistivity in ohms per square, multiply the resistance measurements obtained by this method by 10. The conversion factor of 10 is derived from the geometry of the electrode assembly."

No conversion is required with the Surface Resistance Test Kit. The Meter incorporates provision to install optional Resistivity Attachment which has parallel electrodes on bottom of the unit to make direct surface resistivity measurements. These parallel electrodes allow for measurement of resistivity or when quick testing without the use of 5 pound electrodes is desired.

*Note: Currently, there is discussion within the ESD Association if the proper unit of measurement of resistivity is ohms or ohms/square. S11.11-1993 uses ohms/square.

Battery Life: Approximately 1,500 measurements

Resistivity Electrodes: Two parallel conductive silicone rubber electrodes (optional item)

External Electrodes: Two 5-pound (± 2 oz) weighted electrodes, 2.5" in diameter, complies with ESD-S4.1

Display: One 3.5 digit .500" Liquid Crystal Display (LCD) Display and seventeen Light Emitting Diodes (LED's) illuminate exponent numbers and function being performed.

Accuracy: Resistance measurements within $\pm 10\%$ (E11 & greater $\pm 20\%$), complies with ESD-S4.1. Open circuit voltages of 10 volts $\pm 5\%$ and 100 volts $\pm 5\%$ exceeds requirements of ESD-S4.1

Meter Weight: 15.5 oz.

Dimensions: 8"L x 4.3"W x 1.6"H

Test Switch: Press the red test button for 15-20 second electrification period. Meter will immediately display surface

resistance exponent via LED. LCD will display temperature (both Fahrenheit & Celsius), then humidity, and after taking numerous readings and making numerous calculations display surface resistance mantissa.

Note: Reporting test results, you may want to record the resistance, humidity, temperature, and test voltage.

Maintenance

Your Surface Resistance Test Kit will require little maintenance, and there are no user serviceable parts. If your Meter requires service beyond cleaning the Electrodes or replacing the batteries, please contact the factory.

This product utilizes a high frequency switching circuit to step up the 3 volts from the batteries to the 100 volt test level. Some users are able to discern a slight hum or buzzing. This is perfectly normal and should not be considered a flaw or defect.

Calibration

The Surface Resistance Test Kit is calibrated to NIST traceable standards. Most users require calibration annually. Please call our Customer Service Department at 909-627-8178 (Chino, CA) or 781-821-8370 (Canton, MA) for details. In-house calibration can be performed by using 1% resistors in each of the meter ranges. Simply attach the resistors to the enclosed cords using grounding clips and recording the meter display. Keep the cords separated. Should adjustment be necessary, it is recommended that the unit be returned to the factory as access to internal adjustments requires special equipment and test cables.

Specifications

Ranges: 1×10^3 - 1×10^{12} ohms @ 10 Volts complies with ESD-S4.1
 1×10^6 - 1×10^{12} ohms @ 100 Volts complies with ESD-S4.1

Power Supply: Two AA alkaline batteries

Limited Warranty

Desco EMIT expressly warrants that for a period of five (5) years from the date of purchase, Desco EMIT Surface Resistance Test Kits will be free of defects in material (parts) and workmanship (labor). Within the warranty period, a credit for purchase of replacement Desco EMIT products, or, at Desco EMIT's option, the product will be repaired or replaced free of charge. If product credit is issued, the amount will be calculated by multiplying the unused portion of the expected five year life times the original unit purchase price. Call our Customer Service Department at 909-627-8178 (Chino, CA) or 781-821-8370 (Canton, MA) for a Return Material Authorization (RMA) and proper shipping instructions and address. Please include a copy of your original packing slip, invoice, or other proof of date of purchase. Any unit under warranty should be shipped prepaid to the Desco EMIT factory. Warranty replacements will take approximately two weeks.

If your unit is out of warranty, call our Customer Service Department at 909-627-8178 (Chino, CA) or 01892 665313 (Crowborough, U.K.) for a Return Material Authorization (RMA) and proper shipping instructions and address. Desco EMIT will quote repair charges necessary to bring your unit up to factory standards.

Warranty Exclusions

THE FOREGOING EXPRESS WARRANTY IS MADE IN LIEU OF ALL OTHER PRODUCT WARRANTIES, EXPRESSED AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE WHICH ARE SPECIFICALLY DISCLAIMED. The express warranty will not apply to defects or damage due to accidents, neglect, misuse, alterations, operator error, or failure to properly maintain, clean or repair products.

Limit of Liability

In no event will Desco EMIT or any seller be responsible or liable for any injury, loss or damage, direct or consequential, arising out of the use of or the inability to use the product. Before using, users shall determine the suitability of the product for their intended use, and users assume all risk and liability whatsoever in connection therewith.