

*ESD STM2.1-1997*

*ESD association standard test method*

*ESD STM2.1-1997*

*for the Protection of Electrostatic  
Discharge Susceptible Items*

*Garments*



*Electrostatic Discharge Association  
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ESD Association Standard Test Method for the  
Protection of Electrostatic Discharge  
Susceptible Items:

**Garments**

Approved September 20, 1997  
**ESD Association**



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## Foreword

This Standard Test Method provides test methods for evaluating the resistance of garments used in the electronics industry for the control of electrostatic discharge. This document is limited to defining procedures for measuring electrical resistance of garments. It does not address electrical resistance through a person or in combination with a person connected to ground. However, resistance may not fully characterize a garment's performance. Additional documents may cover procedures for evaluating these properties.

A common source of electrostatic charge is clothing made from synthetic fibers resulting in an accumulation of charge on a person's clothing. The effect of this charge can be minimized by evaluating and selecting an appropriate garment. To effectively control electrostatic charges, the garment should be grounded.

This document may be used in part to cover specific applications. To fully characterize a garment, field attenuation and tribocharging may need to be considered, but these procedures are beyond the scope of this document.

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## ESD Association Standard Test Method for the Protection of Electrostatic Discharge Susceptible Items

### GARMENTS

#### 1. Purpose, Scope, and Application

##### 1.1 Purpose

This document provides specific test methods for evaluating electrical resistance of static control garments.

##### 1.2 Scope

This document defines the test methods for determining the electrical resistance from sleeve-to-sleeve and point-to-point of static control garments.

##### 1.3 Application

The test methods defined in this document utilize standard instruments to measure the resistance of static control garments. These methods are intended as qualification test procedures. They can also be used as periodic tests to ensure ongoing electrical integrity of the garment under ambient conditions.

1.3.1 The sleeve-to-sleeve method (Fig 1a & 1b) is intended to test the integrity of the electrical resistance across the seams of the garment.

1.3.2 The point-to-point test method (Fig 1c) is intended to test the electrical resistance between any two points on the garment, which may include the electrical resistance across the seams of the garment.

#### 2. Reference Documents

EOS/ESD ADV1.0, EOS/ESD Glossary of Terms<sup>1</sup>

<sup>1</sup> ESD Association, 7900 Turin Rd, Bldg 3, Ste 2, Rome, NY 13440, 315-339-6937

ANSI/EOS/ESD S4.1, EOS/ESD Standard for Protection of Electrostatic Discharge Susceptible Items – ESD Protective Worksurfaces

ANSI/EOS/ESD S6.1, EOS/ESD Standard for Protection of Electrostatic Discharge Susceptible Items - Grounding -Recommended Practice

EOS/ESD S11.11, Surface Resistance Measurement of Static Dissipative Planar Materials

#### 3. Definition of Terms

The following definitions shall apply for the purpose of this draft standard in addition to those specified in the EOS/ESD Glossary of Terms.

##### **Garment System:**

Any electrically interconnected components of static control apparel.

##### **Point-to-Point Resistance:**

The resistance in ohms measured from one point to another on the surface of the same panel or two different panels of a garment.

##### **Sleeve-to-Sleeve Resistance:**

The resistance in ohms measured from the sleeve opening of the garment to the other sleeve opening of the same garment.

##### **Static Control Garments:**

Personnel garments that are designed for electrostatic charge control.

#### 4. Personnel Safety

4.1 The procedures and equipment described in this document may expose personnel to hazardous electrical conditions. Users of this document are responsible for selecting equipment that complies with applicable laws, regulatory codes and external and internal policy. Users are cautioned that this document cannot replace or supercede any requirements for personnel safety. The ultimate responsibility for personnel safety resides with the end user of this document.

4.2 Ground Fault Circuit Interrupters (GFCI) and other safety protection should be considered wherever personnel might come into contact with electrical sources.

4.3 Electrical hazard reduction practices should be exercised and proper grounding instructions for the equipment must be followed when performing these tests.

## 5. Test Methods

This section defines the test methods for measuring the sleeve-to-sleeve and point-to-point electrical resistance of a static control garment or garment system.

### 5.1 Test Equipment Requirements

#### 5.1.1 Resistance Measuring Equipment

Self-contained resistance meters (i.e. megohmmeter) or power supplies and current meters in the appropriate configuration for resistance measurement within a  $\pm 10\%$  accuracy shall be utilized. The equipment shall be capable of open circuit voltage of  $100\pm 10$  volts D.C. Both test leads must be isolated from ground.

#### 5.1.2 Clamps/Electrodes (Sleeve to Sleeve)

The electrodes shall consist of two flat electrically conductive plates (e.g. stainless steel) with a dimension of 50.8 mm X 25.4 mm (2 inches X 1 inch) each as shown in figure 1a. The clamps shall be electrically conductive with sufficient pressure to suspend the garment, see figure 1b.

#### 5.1.3 Electrodes (Point to Point)

Use electrodes in accordance with ANSI/EOS/ESD S4.1. (Two cylindrical 2.27 kg (5 pound) electrodes with a diameter of 63.5 mm (2.5 inches) each having contacts of electrically conductive material with a Shore-A (IRHD) durometer hardness of 50-70. The resistance between the two electrodes should be less than

100 kilohms when measured at 10 volts on a metallic surface. Electrodes that meet ASTM F-150 and NFPA 99 also meet these characteristics.)<sup>2</sup>

#### 5.1.4 Environmental Test Chamber

A closed chamber capable of controlling relative humidity (RH) at  $12 \pm 3\%$  RH and  $50 \pm 5\%$  RH and temperature at  $23 \pm 3$  degrees C. The humidity indicating instrumentation shall be accurate to  $\pm 3\%$  RH in the operation range and traceable to national standards, such as National Institute of Standards and Technology (NIST) in the United States or international standards.<sup>3</sup>

#### 5.1.5 Support Surface

The support surface shall be a smooth flat insulative surface. Surface resistance of the support surface shall be greater than  $1.0 \times 10^{13}$  ohms when tested in accordance with EOS/ESD S11.11.

### 5.2 Test Parameters

#### 5.2.1 Sample Preparation

The test sample shall be processed through 3 cycles of the garment material manufacturer's prescribed cleaning process prior to performing the test.

##### 5.2.1.1 Sample Sketch

Tester should examine the garment's construction and make a general sketch showing separate FRONT and BACK panels used to fabricate the garment. Number the panels for measurement identification purposes from #1 through #n. Identify the sleeves as LEFT and RIGHT.

#### 5.2.2 Humidity

The test samples shall be tested at two humidity conditions.

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<sup>2</sup> American Society for Testing and Materials (ASTM) 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, 610-832-9500

<sup>3</sup> National Institute of Standards and Technology, Bldg 820, NIST North, Gaithersburg, MD 20899, 301-948-1784

#### 5.2.2.1 Low Humidity

The test sample shall be preconditioned at  $12 \pm 3\%$  RH and  $23 \pm 3$  degrees C for a minimum of 48 hours prior to performing the test at these environmental conditions.

#### 5.2.2.2 Moderate Humidity

The test sample shall be preconditioned at  $50 \pm 5\%$  RH and  $23 \pm 3$  degrees C for a minimum of 48 hours prior to performing the test at these environmental conditions.

#### 5.2.3 Test Sample Quantity

Test all samples for each style and manufacturer when using this test procedure as a qualification test.

#### 5.3 Sleeve to Sleeve Test Procedure

- a) Precondition the test samples per 5.2.2.1
- b) Hang garment from each sleeve with electrically isolated clamps. Clamps shall be placed over the sleeves as shown in Figure 1b.
- c) The resistance measurement shall be made by applying the voltage lead (positive) to one clamp and attaching the sensor lead (negative) to the other clamp.
- d) Apply the test voltage of 100V for a maximum of 15 seconds (or until reading stabilizes) and record the results.
- e) Repeat this Sleeve to Sleeve Resistance Measurement procedure (5.3b through 5.3d) with the remaining two (minimum) garment samples.
- f) Precondition the test samples per 5.2.2.2.
- g) Repeat this Sleeve to Sleeve Resistance Measurement procedure (5.3b through 5.3e) with the remaining two (minimum) garment samples at moderate humidity.

#### 5.4 Point to Point Test Procedure

- a) Precondition the test samples per 5.2.2.1.
- b) Place the garment on an insulative surface per 5.1.5.
- c) Place one electrode on a panel of the sample.
- d) Place the second electrode on another panel of the same sample. (Figure 1c)
- e) Apply the test voltage of 100V for a maximum of 15 seconds or until reading stabilizes and record results.
- f) Repeat 5.4d through 5.4e for all panels.
- g) Repeat 5.4b through 5.4f for all test samples.
- h) Precondition samples per 5.2.2.2.
- i) Repeat 5.4b through 5.4g for all samples.

#### 6. Test Data Reporting

Record all resistance values in ohms. Record the voltage levels, humidity, and temperature for each test sample. Record type of test equipment used. Record test date.

#### 7. Recommended Electrical Resistance Range

The recommended electrical resistance range is  $1 \times 10^5$  ohms to  $1 \times 10^{11}$  ohms. Values less than  $1 \times 10^5$  ohms may constitute an electrical hazard.

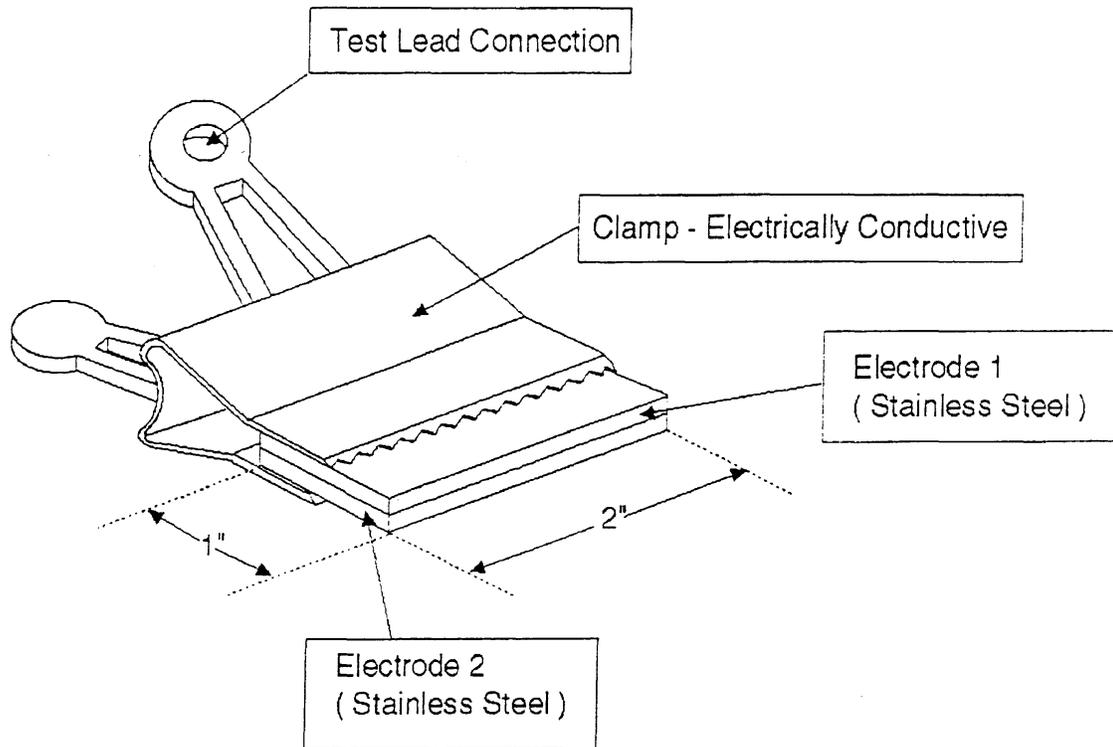
**8. NOTES:**

**8.1 Garments with Groundable Points**

If the garment has an identified groundable point, the electrical integrity of the groundable point to the garment material shall be measured. This can be accomplished using the point-to-point method described herein. Place one electrode on the groundable point and the second electrode on the panel attached to the groundable point. Complete the test as described herein.

( Figure 1a )

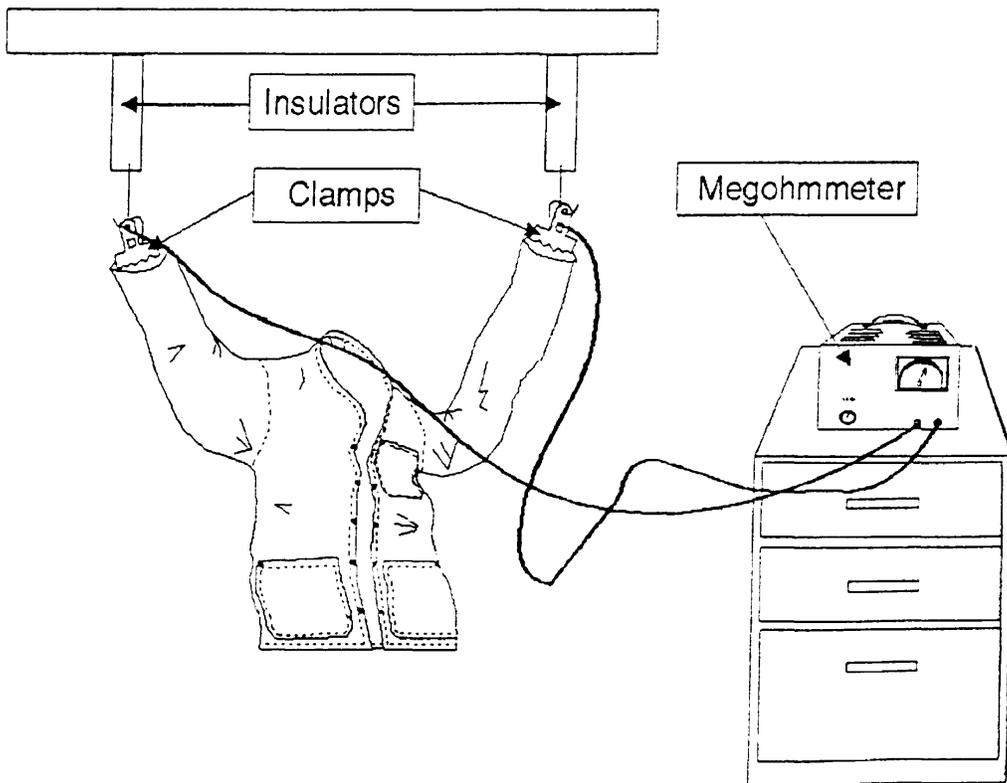
### CLAMPS / ELECTRODES



**NOTE:** Electrode 1 & Electrode 2 shall be stainless steel and each have a minimum area of two square inches on the same contacting surfaces.

( Figure 1b )

# TEST SET - UP SLEEVE TO SLEEVE



( Figure 1c )

TEST SET - UP  
POINT TO POINT

