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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrostatics –
Part 4-9: Standard test methods for specific applications – Garments

Électrostatique –
Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques – Vêtements

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61340-4-9 has been prepared by IEC technical committee 101: Electrostatics.

The text of this standard is based on ANSI/ESD STM2.1-1997. It was submitted to the National Committees for voting under the Fast Track Procedure.

This bilingual version (2011-04) replaces the English version.

The text of this standard is based on the following documents:

FDIS	Report on voting
101/294/FDIS	101/298/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

The French version of this standard has not been voted upon.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61340 series, under the general title *Electrostatics*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 61340 provides test methods for evaluating the resistance of garments used in the electronics industry for the control of electrostatic discharge. This part 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 parts may cover procedures for evaluating these properties.

A common source of electrostatic charge is clothing made from synthetic fibres 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 standard 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 standard.

ELECTROSTATICS –

Part 4-9: Standard test methods for specific applications – Garments

1 Scope

This part of IEC 61340 provides specific test methods for evaluating electrical resistance of static control garments.

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

The test methods defined in this standard 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.

The sleeve-to-sleeve method (Figures 1 and 2) is intended to test the integrity of the electrical resistance across the seams of the garment.

The point-to-point test method (Figure 3) 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 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ESD ADV1.0, *ESD Association glossary of terms*[1]

ANSI/ESD S4.1, *ESD standard for protection of electrostatic discharge susceptible items – ESD protective worksurfaces*

ANSI/ESD STM11.11, *Surface resistance measurement of static dissipative planar materials*

ASTM F-150, *Standard test method for electrical resistance of conductive and static dissipative resilient flooring*[2]

National Fire Protection Association (NFPA) 99:2005, *Standard for health care facilities*

[1] ESD Association, 7900 Turin Rd, Bldg 3, Ste 2, Rome, NY 13440, 315-339-6937

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions, in addition to those specified in the EOS/ESD glossary of terms, shall apply.

3.1
garment system
any electrically interconnected components of static control apparel

3.2
point-to-point resistance
resistance in ohms measured from one point to another on the surface of the same panel or two different panels of a garment

3.3
sleeve-to-sleeve resistance
resistance in ohms measured from the sleeve opening of the garment to the other sleeve opening of the same garment

3.4
static control garments
personnel garments that are designed for electrostatic charge control

4 Personnel safety

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

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 clause 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 ±10 % accuracy shall be utilized. The equipment shall be capable of open-circuit voltage of 100 V ±10 V 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 × 25,4 mm (2" × 1") each as shown in Figure 1. The clamps shall be electrically conductive with sufficient pressure to suspend the garment, see Figure 2.

5.1.3 Electrodes (point-to-point)

Use electrodes in accordance with ANSI/EOS/ESD S4.1 (ie. two cylindrical 2,27 kg (5 pound) electrodes with a diameter of 63,5 mm (2,5" 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 kΩ when measured at 10 V on a metallic surface. Electrodes that meet ASTM F-150 and NFPA 99 also meet these characteristics.)

5.1.4 Environmental test chamber

A closed chamber capable of controlling relative humidity (RH) at (12 ± 3) % RH and (50 ± 5) % RH and a temperature of (23 ± 3) °C. The humidity indicating instrumentation shall be accurate to within ± 3 % RH in the operation range and traceable to national standards, such as the National Institute of Standards and Technology (NIST) in the United States or international standards.[3]

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 $1{,}0\ \Omega \times 10^{13}\ \Omega$ 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 n° 1 through to n° *n*. Identify the sleeves as LEFT and RIGHT.

5.2.2 Humidity

The test samples shall be tested at two humidity conditions.

5.2.2.1 Low humidity

The test sample shall be preconditioned at (12 ± 3) % RH and (23 ± 3) °C for a minimum of 48 h prior to performing the test at these environmental conditions.

5.2.2.2 Moderate humidity

The test sample shall be preconditioned at (50 ± 5) % RH and (23 ± 3) °C for a minimum of 48 h prior to performing the test at these environmental conditions.

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[3] National Institute of Standards and Technology, Bldg 820, NIST North, Gaithersburg, MD 20899, 301-948-1784.

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

The following procedure shall be followed:

a) Precondition the test samples as shown in 5.2.2.1.

b) Hang the garment from each sleeve with electrically isolated clamps. Clamps shall be placed over the sleeves as shown in Figure 2.

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 100 V for a maximum of 15 s (or until reading stabilizes) and record the results.

e) Repeat this sleeve-to-sleeve resistance measurement procedure (5.3 point b) through 5.3 point d)) with the remaining two (minimum) garment samples.

f) Precondition the test samples as shown in 5.2.2.2.

g) Repeat this sleeve-to-sleeve resistance measurement procedure (5.3 point b) through 5.3 point e) with the remaining two (minimum) garment samples at moderate humidity.

5.4 Point-to-point test procedure

The following procedure shall be followed:

a) Precondition the test samples as shown in 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 3).

e) Apply the test voltage of 100 V for a maximum of 15 s or until reading stabilizes and record results.

f) Repeat 5.4, poind d) through 5.4 point e) for all panels.

g) Repeat 5.4 point b) through 5.4 point f) for all test samples.

h) Precondition samples as shown in 5.2.2.2.

i) Repeat 5.4 point b) through 5.4 point g) 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 $1\ \Omega \times 10^5\ \Omega$ to $1\ \Omega \times 10^{11}\ \Omega$. Values less than $1\ \Omega \times 10^5\ \Omega$ 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