

ANSI/ESD STM97.1-2006

ESD Association Standard Test Method

ANSI/ESD STM97.1-2006

Reaffirmation of ANSI/ESD STM97.1-1999

*For the Protection of Electrostatic
Discharge Susceptible Items*

*Floor Materials and Footwear –
Resistance Measurement in Combination
with a Person*

*Electrostatic Discharge Association
7900 Turin Road, Bldg. 3
Rome, NY 13440*

*An American National Standard
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***ESD Association Standard Test Method
for the Protection of Electrostatic Discharge Susceptible Items -
Floor Materials and Footwear –
Resistance Measurement in Combination with a Person***

Approved February 26, 2006
ESD Association



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Foreword

This standard test method is intended to provide test methods for measuring the resistance of floor materials, footwear and personnel, together as a system. This standard test method covers all floor materials used to control Electrostatic Discharge (ESD) including floor mats, floor coverings, coatings, paints and floor finishes, together with footwear.

This standard test method is limited to defining procedures for measuring electrical resistance through personnel in combination with floor materials and footwear. This standard test method provides data that is relevant during qualification testing or for testing on installed or applied material.

Electrical resistance is one property that can be used to evaluate the electrostatic characteristics of floor materials. However, resistance does not fully characterize these materials. An additional property to be considered in the selection and use of floor materials includes charge accumulation. Refer also to the ESD Association Standard ANSI/ESD STM97.2-2006, Floor Materials and Footwear - Voltage Measurement on a Person.

A common source of electrostatic charge in a work environment is the separation of foot or caster from the floor, resulting in the generation of electrostatic charge that can accumulate on personnel and equipment. The effect of this generation and accumulation of electrostatic charge can be minimized with appropriate selection or treatment of the floor material. To effectively control electrostatic discharge on personnel and equipment, floor materials shall be used in combination with ESD controlled footwear or other grounding devices.

A floor material which is conductive enough to discharge an object may also pose a safety hazard. The work performed on the floor material often entails the use of tools and test instruments which operate at voltages high enough to cause electrical shock. The presence of a floor material tested using the methods described in this document will not guarantee personnel safety.

This standard test method was originally designated ESD STM97.1-1999 and approved on February 7, 1999. This standard test method is a reaffirmation of ANSI/ESD STM97.1-1999 and was approved on February 26, 2006. This standard test method was prepared by the 97.1 Floor Materials Subcommittee. The 1999 version was prepared by the 97.1 Floor Materials Subcommittee. At that time the 97.1 Floor Materials Subcommittee had the following members:

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**ESD Association Standard Test Method for the Protection of Electrostatic Discharge
Susceptible Items –
Floor Materials and Footwear – Resistance Measurement in Combination with a Person**

1.0 PURPOSE, SCOPE AND APPLICATION

1.1 Purpose

This document provides test methods for measuring the electrical system resistance of floor materials in combination with persons wearing static control footwear.

1.2 Scope

This document establishes test methods for measuring the electrical system resistance of floor materials in combination with persons wearing static control footwear, shoes or other methods where protection of ESD susceptible items is required.

1.3 Application

This document provides test methods for resistance measurements of systems prior to installation or application, and test methods for evaluating and monitoring systems after installation or application.

Uses in connection with Electromagnetic Interference (EMI), ordnance, flammables or explosives are excluded along with protection from other sources of damage.

2.0 REFERENCED DOCUMENTS

ESD ADV1.0, Glossary of Terms¹

TR20.20, ESD Handbook¹

ANSI/ESD S6.1, Standard for Protection of Electrostatic Discharge Susceptible Items – Grounding – Recommended Practice¹

ANSI/ESD S7.1, Standard for Protection of Electrostatic Discharge Susceptible Items – Resistive Characterization of Materials – Floor Materials¹

AATCC-171, Carpets: Cleaning of; Hot Water Extraction Method, American Association of Textile Colorists and Chemists²

IICUC S001, Standard Reference Guide for Professional On-Location Cleaning of Installed Textile Floor Covering Materials³

3.0 DEFINITIONS OF TERMS

The following definitions shall apply for the purposes of this standard in addition to those specified in the ESD Association Glossary of Terms.

Groundable Point, Static Control Floor Material. A point on the floor material that accommodates an electrical connection from the floor material to an appropriate ground.

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² American Society of Textile Colorists and Chemists, P.O. Box 12215, Research Triangle Park, NC 27709-2215, 919-549-8141

³ The Institute of Inspection, Cleaning and Restoration Certification, 2715 E. Mill Plain Blvd, Vancouver, WA 98661, 360-693-5675

Hardboard (Standard or Tempered). Heavy sheet material of fibers matted and pressed or rolled to form a strong board. (*Masonite*, of the *Masonite Corp.*, or the equivalent, is one of several commonly available board products that will serve the purpose.⁴)

Static Control Floor. A permanently installed floor material such as tile, carpet, polymer, epoxy or sheet flooring that dissipates static charges by grounding personnel, equipment or other objects contacting the floor material or that controls the generation and accumulation of static charges associated with floor materials.

Static Control Floor Finish. A non-permanent coating periodically applied to existing floor surfaces that dissipates static charges by grounding personnel, equipment or other objects contacting the floor finish or that controls the generation and accumulation of static charges associated with floor materials.

Static Control Floor Mat. A movable island of material placed over existing flooring that dissipates static charges by grounding personnel, equipment or other objects contacting the mat or that controls the generation and accumulation of static charges associated with floor materials.

Static Control Footwear (Shoes). Coverings for the human foot that have properties to control the accumulation of static charge when used in conjunction with a static control floor, floor finish or mat.

Static Control Footwear (Other Devices). Coverings for the human foot such as foot straps, toe grounders, booties or other electro-mechanical connectors to control the accumulation of static charge when used in conjunction with a static control floor, floor finish or mat.

4.0 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 supersede 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 may come into contact with electrical sources.

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

5.0 TEST METHODS

This section describes the test methods for measuring the electrical resistance of floor materials, both prior to and after installation.

5.1 Apparatus Requirements

5.1.1 Resistance Measuring Apparatus (Meter)

Self-contained resistance meter (such as a megohmmeter) or power supplies and current meters in the appropriate configuration for resistance measurement with $\pm 10\%$ accuracy. This apparatus shall be capable of open circuit voltage of 10V and 100V.

⁴ Masonite Corp., 1 N. Dale Mabry Road, Suite 950, Tampa, FL 33609, 813-877-2726

5.1.2 Hand-Held Electrode

A stainless steel, brass or copper, round stock or tube approximately 2.5 cm (1 inch) in diameter x 7.5 cm (3 inches) in length with a banana plug receptacle or screw connector attached to one end of the cylinder.

5.1.3 Environmental Walk-In Test Chamber

An enclosed walk-in chamber with appropriate controls and meters capable of controlling relative humidity (RH) to 12% RH ($\pm 3\%$ RH) and temperature to 23 °C (± 1 °C). The humidity indicating instrumentation shall be accurate to $\pm 3\%$ RH in the operational range.

5.1.4 Specimen Support Material

5.1.4.1 For testing of floor finishes, use the floor surface to which the finish would be applied. Mount floor surface on 6.3 mm (0.25 inch) tempered hardboard.

5.1.4.2 For testing of floors and mats, mount sample on 6.3 mm (0.25 inch) hardboard.

5.1.4.3 Support material shall be clean, smooth and have a point-to-point resistance greater than 1.0×10^{11} when tested according to ANSI/ESD S7.1 under the previously defined humidity conditions.

5.2 Test Procedures – Qualification Testing

5.2.1 Specimen Preparation

5.2.1.1 Minimum size of specimen: 91 x 91 cm (36 x 36 inches) or larger.

5.2.1.2 Mounting of specimen: When mounting specimen on support material as per 5.1.4, use manufacturer's recommended procedures.

5.2.1.3 Each sample should have one or more ground connections that simulate end use grounding methods.

5.2.2 Pre-Conditioning

5.2.2.1 Cleaning of Specimens

5.2.2.1.1 Flooring, Mats or Other Hard Surface Materials and Footwear

Clean twice following manufacturer's recommendations or clean with a minimum 70% isopropanol-water solution using a clean, low-linting cloth.

5.2.2.1.2 Textile and Other Floor Coverings

For the purpose of removing residual, non-permanent substances, clean according to manufacturer's recommendations. In the absence of such recommendations, clean with standard hot water extraction procedures, such as IICUC S001 or AATCC-171.

5.2.2.1.3 Floor Finishes

Remove any surface contamination by wiping with a clean, dry, low-linting cloth.

5.2.2.2 Humidity Conditioning

Immediately after cleaning floor material specimens and footwear, place in an environmental chamber preset to the prescribed relative humidity and 23 °C (± 1 °C) for 72 hours minimum. If testing is to be performed at ambient conditions, condition specimens at these ambient conditions for 72 hours minimum.

5.2.3 Test Procedures – Resistance through a Person to a Test Surface's Groundable Point

Resistance through a person to a test surface's groundable point.

5.2.3.1 Condition specimens at 12% RH ($\pm 3\%$ RH) per 5.2.2.2.

5.2.3.2 Connect the negative lead of the meter to a groundable point of the specimen surface and the other lead to a hand-held electrode.

5.2.3.3 Wear the test footwear on both feet for at least 10 minutes. Set voltage to 10V or 100V direct current (DC). Stand on the test surface with both feet, grasp the hand-held electrode and apply the test voltage. Record the resistance after the measurement has stabilized or after 15 seconds has elapsed. Remove test voltage (see Figure 1).

5.2.3.4 Repeat 5.2.3.3 with only the left foot in contact with the surface and the other foot held in the air about 150 mm (6 inches) and record resistance. Repeat 5.2.3.3 with only the right foot in contact with the surface and the other foot held in the air and record resistance.

5.2.3.5 Repeat 5.2.3.2 through 5.2.3.4 with the test floor material specimen at three locations on the surface of the test specimen (see Figure 1).

5.2.4 Reporting of Test Results

Report all resistance measurements in ohms. Also report voltage level, temperature, relative humidity and date of testing, identity of footwear, composition of socks, identity of floor material, identity of person, test equipment used, and substrate to which the test specimen was applied. Summarize test data by reporting minimum, maximum, average and median values obtained.

5.3 Test Procedures – Installed or Applied Material

5.3.1 Test Procedures – Resistance through a Person to Ground

5.3.1.1 On new floor mats or newly installed floors, clean floors or mats per manufacturer's recommendations before testing for resistance. Some floor finishes may require 72 hours of drying before testing. Consult with manufacturer for details. (See Annex A for additional information.)

5.3.1.2 For testing of floor finishes or monitoring of existing floor materials, test in an "as-is" condition.

5.3.1.3 Perform tests at ambient temperature and humidity.

5.3.1.4 Wear the test footwear on both feet for at least 10 minutes. Connect the negative lead of the meter to ground (Ground is defined in ANSI/ESD S6.1), and the other lead to the hand-held electrode. Set voltage at 10V or 100V DC. Grasp the hand-held electrode. Stand on the test surface and apply the test voltage. Record the resistance after the measurement has stabilized or after 15 seconds has elapsed. Remove test voltage.

5.3.1.5 Repeat 5.3.1.4 with only the left foot in contact with the surface and the other foot held in the air and record resistance. Repeat 5.3.1.4 with only the right foot in contact with the surface and the other foot held in the air and record resistance.

5.3.1.6 Perform five tests per floor surface material or a minimum of five tests per 460 square meters (approximately 5,000 square feet) of floor material, whichever is greater. A minimum of three of the six tests should be conducted in those areas that are subject to wear or that have evidence of chemical or water spillage or that are visibly dirty.

5.3.2 Reporting of Test Results

Report all values in ohms for resistance measured. Also report voltage level, temperature, relative humidity and date of testing, identity of footwear, composition of socks, identity of floor material, identity of person, test equipment used, and substrate to which the test specimen was applied. Summarize test data by reporting minimum, maximum, average and median values obtained. Include a diagram showing approximate test locations and ground connections used. (Use Annex B to record results.)

6.0 OTHER CONSIDERATIONS

6.1 Resistance should be monitored on a regular schedule.

6.2 The data obtained under this standard should be analyzed by the end user in a manner consistent with their specifications for the materials being tested.

6.3 For further selection considerations, refer to TR20.20.

TEST SET-UP

Use a 91 x 91 cm (36 x 36 inch)
or Larger Flooring Sample

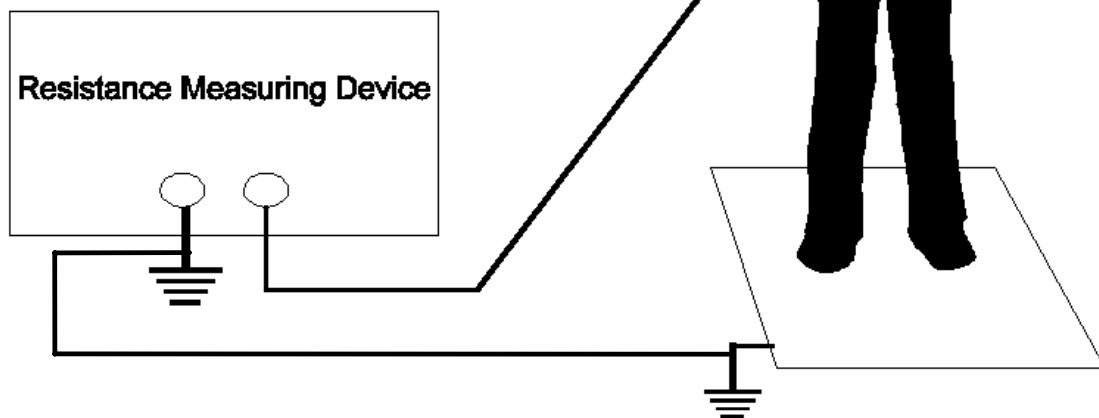


Figure 1: Test Set-Up

ANNEX A**Discussion on the Effects of Humidity**

The presence of moisture or water introduced from the environment or from the cleaning processes may lead to resistance values that are misleading if the testing is done immediately after the cleaning.

Some materials are hygroscopic by nature and may exhibit widely varying resistance results at different levels of RH or moisture introduced from cleaning. The time needed to allow the surface to equilibrate may be longer than 72 hours. Discuss the specifications of varying materials when exposed to different humidities and cleaning processes with the manufacturers.

ANNEX B**Sample Flooring and Footwear Systems Test Record**

Measurement	Feet on Floor	Resistance (Ohms) (Magnitude x Exponent)	Pass	Fail
1	Both Feet	XE		
2	Both Feet	XE		
3	Both Feet	XE		
4	Both Feet	XE		
5	Both Feet	XE		
6	Left Only	XE		
7	Left Only	XE		
8	Left Only	XE		
9	Left Only	XE		
10	Left Only	XE		
11	Right Only	XE		
12	Right Only	XE		
13	Right Only	XE		
14	Right Only	XE		
15	Right Only	XE		

BIBLIOGRAPHY

AATCC/ANSI 134, "Electrostatic Propensity of Carpets;" American Society of Textile Colorists and Chemists; American National Standards Institute.

AATCC-138, Carpets: Cleaning of: Washing of Textile Floor Coverings; American Society of Textile Colourists and Chemists; American National Standards Institute.

ANSI Z41, "Protective Footwear;" American National Standards Institute.

ANSI/ESD S9.1-1995, Footwear - Resistive Characterization.

The Institute of Inspection, Cleaning and Restoration Certification, www.iicrc.org.