



MICROSTAT LABORATORIES
RIVER'S EDGE TECHNICAL SERVICE

Specialists in Materials Testing and Technical Services

TEST REPORT

32North
STAT-A-REST ESD footwear

TESTED FOR

Electrical Properties Using
Point-to-Point Resistance
Point-to-Groundable-Point Resistance
Operator Resistance to Ground Using ANSI/ESD STM97.1
Voltage Generation of an Operator per ANSI/ESD STM97.2

Report #: 2012-033 (Final)
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SUMMARY

Four samples (two sizes) of STAT-A-REST ESD footwear were submitted for testing of their electrical properties using various industry standard test methods. Several point-to-point and point-to-ground measurements were made on each sample. In addition, operator resistance to ground measurements were made using the methods called out in ANSI/ESD STM97.1 - with the floor material being substituted with a stainless steel metal plate.

In addition to the "footwear only" tests, ANSI/ESD STM97.1 (Resistance in combination with an operator) and ANSI/ESD STM97.2 (voltage generation of an operator) tests were performed using DESCO epoxy floor coating applied over a 3 foot x 3 foot plywood substrate. One of the samples had a coating of a DESCO ESD floor finish over the conductive epoxy.

The electrical performance of the STAT-A-REST ESD footwear is excellent. The resistance of footwear is in the low to mid-static dissipative range, and voltage generation data is extremely low.

EXPERIMENTAL AND DISCUSSION

The samples were conditioned at 50% and 12% R.H. and 72°F for 48 hours prior to testing. Testing was performed in the conditioning environment.

Point-to-point resistance measurements were made on each sample by placing two 5-lb electrodes on the bottom surface of the footwear, one on the toe and one on the heel of each sample. The sample was placed on an insulative test bed for this test. Measurements were also made of the inside of the footwear (all readings were insulative for this test).

Point-to-groundable point measurements were made by placing the sample on the insulative test bed, then placing one 5-lb electrode on the toe and heel of each sample, and a second electrode on the grounding strap.

Operator resistance-to-ground measurements were made using the test methods described in ANSI/ESD STM97.1. This test is performed by having an operator don a footwear sample properly, then stand on a stainless steel metal plate. Resistance measurements from the operator's hand to the metal plate are then made using both feet, followed by individual foot measurements.

All resistance testing was carried out at 100 volts bias. Data from the footwear-only test is included below in Tables 1 and 2. Resistance data to a metal plate, using an operator wearing the footwear, is included in Tables 3 and 4. Resistance data to the flooring material, using an operator wearing the footwear is included in Tables 5 and 6.

The walking voltage test was conducted on the epoxy flooring samples while wearing the shoe grounding devices. Table 7 summarizes the data obtained from this testing, while Figures 1 through 4 show the walking voltage at each of the humidity conditions for the epoxy floor and the epoxy floor with coating respectively.



Table 1
STAT-A-REST ESD Footwear
Electrical Resistance Test Data @ 12% R.H. Conditions

| Sample # | Outside Heel to Outside Toe | Toe to Ground Strap | Heel to Ground Strap | Inside Heel to Inside Toe |
|------------|-----------------------------|---------------------------|---------------------------|-----------------------------|
| 1 (XL - R) | $2.55 \times 10^8 \Omega$ | $2.49 \times 10^8 \Omega$ | $2.04 \times 10^7 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 2 (XL - L) | $2.71 \times 10^8 \Omega$ | $2.33 \times 10^8 \Omega$ | $2.25 \times 10^7 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 3 (L - R) | $2.25 \times 10^8 \Omega$ | $2.04 \times 10^8 \Omega$ | $2.63 \times 10^7 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 4 (L - L) | $2.62 \times 10^8 \Omega$ | $2.28 \times 10^8 \Omega$ | $1.24 \times 10^7 \Omega$ | $> 1 \times 10^{12} \Omega$ |

Table 2
STAT-A-REST ESD Footwear
Electrical Resistance Test Data @ 50% R.H. Conditions

| Sample # | Outside Heel to Outside Toe | Toe to Ground Strap | Heel to Ground Strap | Inside Heel to Inside Toe |
|------------|-----------------------------|---------------------------|---------------------------|-----------------------------|
| 1 (XL - R) | $1.32 \times 10^8 \Omega$ | $1.29 \times 10^8 \Omega$ | $4.34 \times 10^6 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 2 (XL - L) | $1.30 \times 10^8 \Omega$ | $1.22 \times 10^8 \Omega$ | $7.25 \times 10^6 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 3 (L - R) | $9.58 \times 10^7 \Omega$ | $8.90 \times 10^7 \Omega$ | $4.65 \times 10^6 \Omega$ | $> 1 \times 10^{12} \Omega$ |
| 4 (L - L) | $1.11 \times 10^8 \Omega$ | $9.34 \times 10^7 \Omega$ | $2.94 \times 10^6 \Omega$ | $> 1 \times 10^{12} \Omega$ |



Table 3
STAT-A-REST ESD Footwear
In-Use Resistance Test Data @ 12% R.H. Conditions
Operator on a Metal Plate - ANSI/ESD STM97.1

| Sample ID | Both Feet | Left Foot Only | Right Foot Only |
|-----------|---------------------------|---------------------------|---------------------------|
| XL | $8.17 \times 10^6 \Omega$ | $9.25 \times 10^6 \Omega$ | $6.94 \times 10^6 \Omega$ |
| L | $7.35 \times 10^6 \Omega$ | $8.94 \times 10^6 \Omega$ | $7.29 \times 10^6 \Omega$ |

Table 4
STAT-A-REST ESD Footwear
In-Use Resistance Test Data @ 50% R.H. Conditions
Operator on a Metal Plate - ANSI/ESD STM97.1

| Sample ID | Both Feet | Left Foot Only | Right Foot Only |
|-----------|---------------------------|---------------------------|---------------------------|
| XL | $2.20 \times 10^6 \Omega$ | $6.03 \times 10^6 \Omega$ | $4.00 \times 10^6 \Omega$ |
| L | $2.52 \times 10^6 \Omega$ | $6.04 \times 10^6 \Omega$ | $5.79 \times 10^6 \Omega$ |

Table 5
STAT-A-REST ESD Footwear
In-Use Resistance Test Data @ 12% R.H. Conditions
Operator on ESD Floor - ANSI/ESD STM97.1

| | Both Feet | Left Foot Only | Right Foot Only |
|-------------|---------------------------|---------------------------|---------------------------|
| Floor Alone | $1.50 \times 10^7 \Omega$ | $5.53 \times 10^7 \Omega$ | $3.89 \times 10^7 \Omega$ |
| Floor Wax | $1.90 \times 10^7 \Omega$ | $5.45 \times 10^7 \Omega$ | $4.25 \times 10^7 \Omega$ |



Table 6
STAT-A-REST ESD Footwear
In-Use Resistance Test Data @ 50% R.H. Conditions
Operator on ESD Floor - ANSI/ESD STM97.1

| | Both Feet | Left Foot Only | Right Foot Only |
|-------------|--------------------------|--------------------------|--------------------------|
| Floor Alone | 2.10 x 10 ⁶ Ω | 4.80 x 10 ⁶ Ω | 4.50 x 10 ⁶ Ω |
| Floor Wax | 9.40 x 10 ⁵ Ω | 1.40 x 10 ⁶ Ω | 1.50 x 10 ⁶ Ω |

Table 7
STAT-A-REST ESD Footwear
In-Use Voltage Generation Test Data @ 12% & 50% R.H. Conditions
Operator on ESD Floor - ANSI/ESD STM97.2

| | 12% R.H. | 50% R.H. |
|-------------|-------------------------------|-------------------------------|
| | Mean + 3-sigma Voltage | Mean + 3-sigma Voltage |
| Floor Alone | -10 Volts | -7.13 Volts |
| Wax Floor | -24 Volts | -3.18 Volts |

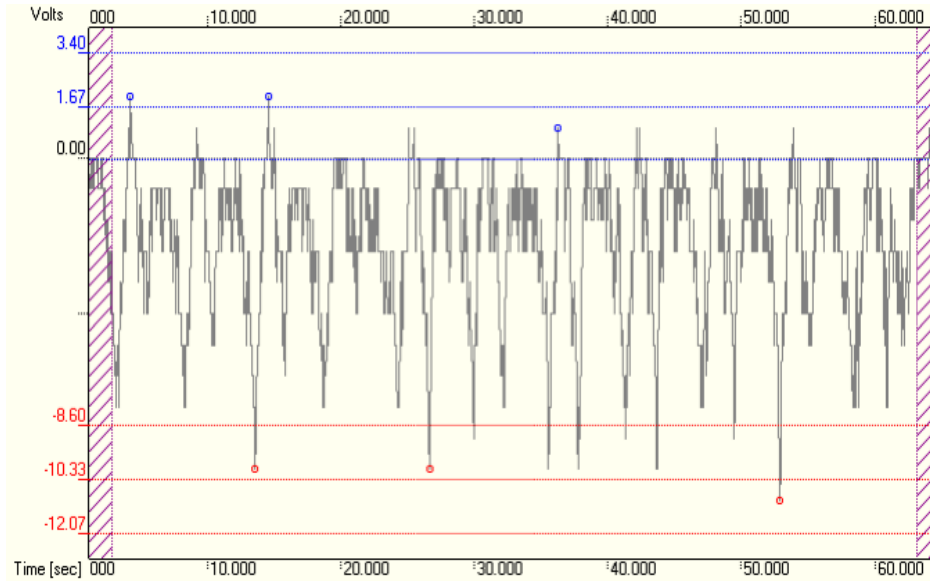


Figure 1 - Walking Voltage Generation Data from Epoxy Floor with No Wax - 12% R.H.

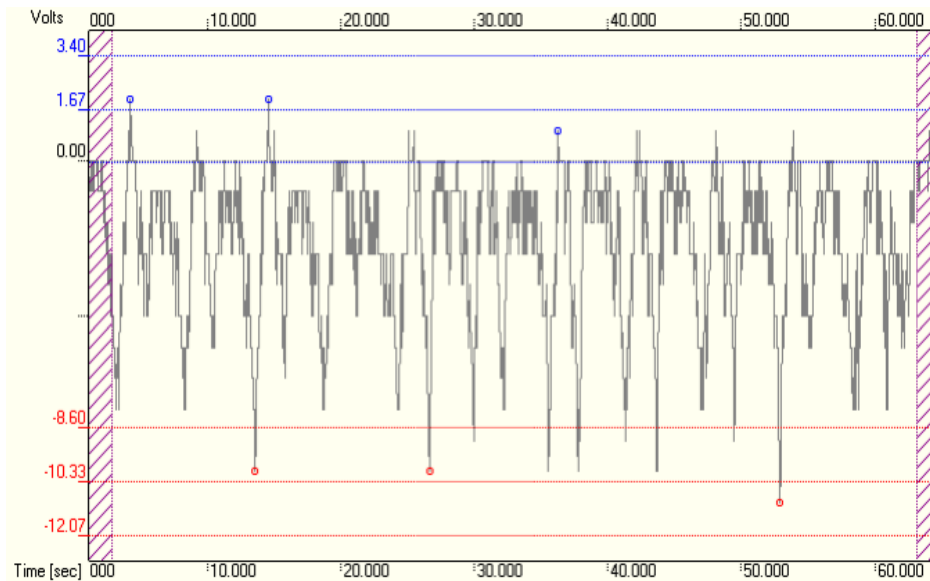


Figure 2 - Walking Voltage Generation Data from Epoxy Floor with No Wax - 50% R.H.

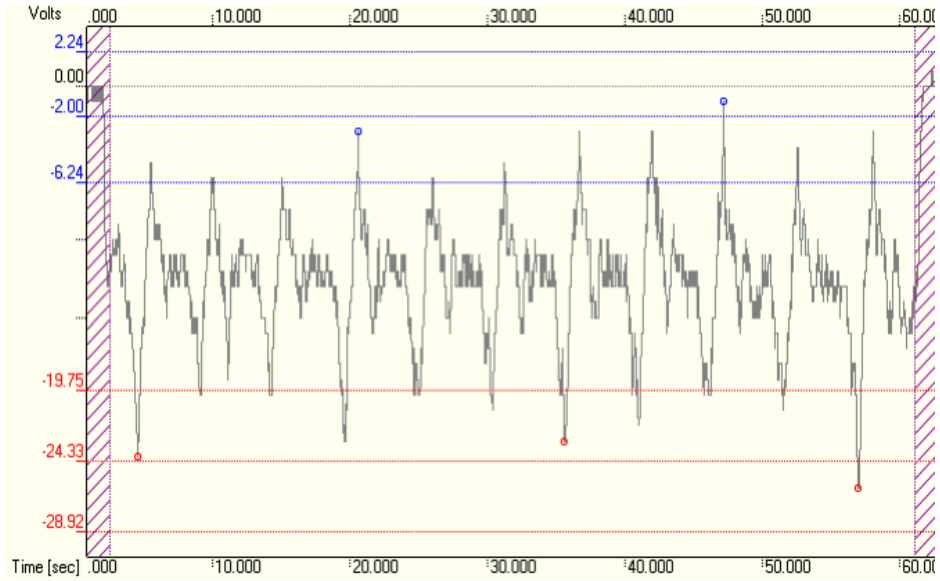


Figure 3 - Walking Voltage Generation Data from Epoxy Floor with Wax - 12% R.H.

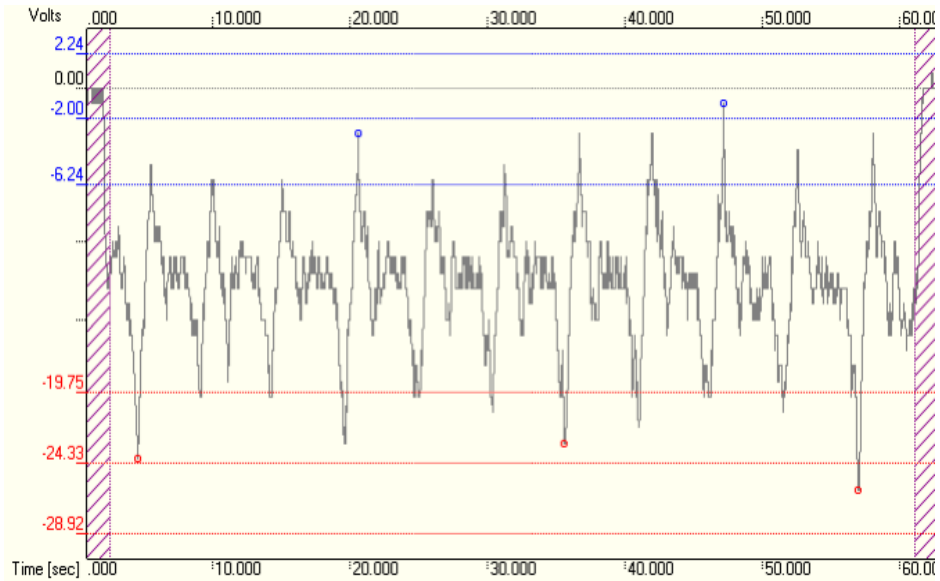


Figure 4 - Walking Voltage Generation Data from Epoxy Floor with Wax - 50% R.H.



EQUIPMENT USED FOR ELECTRICAL TESTING

Resistance Measurements:

- Keithley Model 6517a Electrometer/High Resistance Meter
- Prostat 801 Resistance Meter
- 5-lb Electrodes

Voltage Generation Measurements:

- Prostat PGA710 Data analysis system
- Prostat 711 Electrostatic Field meter

The results provided in this report are accurate within the limits appropriate to each test standard. The results of this report are statistically significant only to the samples submitted for testing. MicroStat Laboratories/River's Edge Technical Service, Inc. has no controls, and assumes no responsibility for the tested product's functionality or use. This report shall not be reproduced, except in full, without written permission from River's Edge Technical Service, Inc.

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Date