



## VPI Conductile<sup>®</sup> ESD Tile Testing to ANSI/ESD S7.1

### Executive Summary

VPI Conductive ESD tile, installed using both VPI 165 Acrylic Conductive Adhesive and VPI 150 Two-Part Epoxy Adhesive, was tested to the ANSI/ESD S7.1 – 2005 protocol. Conductile<sup>®</sup> was found to fully satisfy the test requirements for conductive ESD flooring measuring less than  $1.0 \times 10^6$  ohms. This report uses the 50% RH test condition; results a low humidity are pending.

### Sample Preparation

12" x 12" Conductile<sup>®</sup> tiles in colors White 02 and Glacier 09 were taken off the production line and conditioned at the laboratory condition, 72° F and 50% Relative Humidity (RH), for 72 hours.

Temperature and RH were monitored with a Honeywell Vision PRO TH8000 Series thermostat and a VWR Thermo-Hygro meter traceable to NIST calibration.

Two tiles were installed side by side on hard board sections measuring 13" X 25" to produce a sample specimen corresponding to S7.1 Figure 1. Groundable points in the form of copper strip were included as per Figure 1. Five tile/hardboard test specimens were prepared using VPI 165 Adhesive and five were prepared using VPI 150 Adhesive. Adhesive label instructions were followed. The samples were then allowed to set-up and cure in the laboratory for 48 hours, per adhesive requirements.

Figures I through IV show the sample preparation process. Figure V shows a finished test specimen.



Figure I. Adhesive Application



Figure II. Installation of Groundable Points



Figure III. Tile Installation

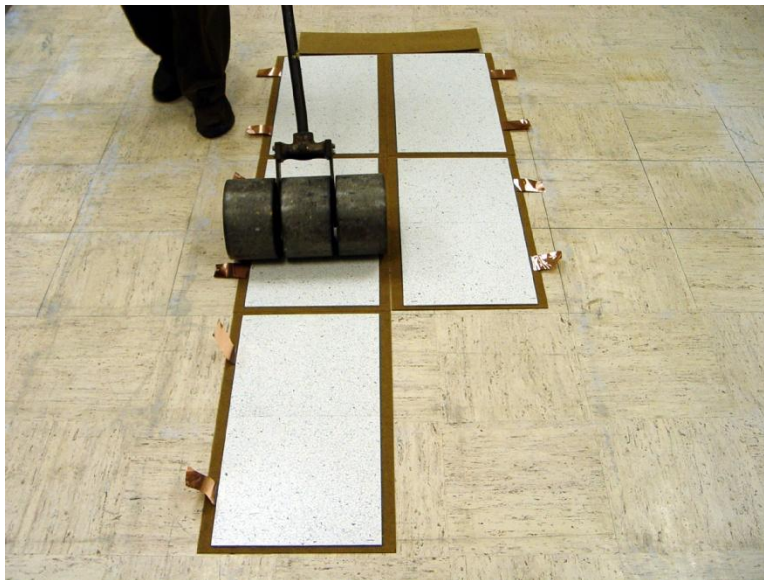


Figure IV. Adhesive Rolling



Figure V. Finished Test Specimen

### Testing

Testing was performed using a PROSTAT® PRS-801 Resistance System Set. The PRS-801 measures resistance from 0.1 ohms to  $2 \times 10^{14}$  ohms with a measurement accuracy of  $\pm 5\%$ . Voltage accuracy at 10 volts is  $\pm 0.2$  volts from  $1.0\text{E}+4$  to  $1.0\text{E}+6$  ohms. Electrodes were PROSTAT with a weight of 5 pounds, a diameter of 2.5 inches and contact surfaces with a Shore A Durometer hardness of  $60 \pm 10$ . Resistance between the electrodes on an aluminum plate was 28 ohms.

Testing followed the protocols specified in Section 6.1.6 (Resistance to Groundable Point) and Figure 1, and Section 6.1.7 (Resistance Point –to – Point) and Figure 2, of ANSI/ESD S7.1-2005. Figure VI shows the apparatus configuration for Groundable Point testing, Figure VII shows the configuration for Point to Point testing, and Figure VIII shows a close-up of the test equipment.

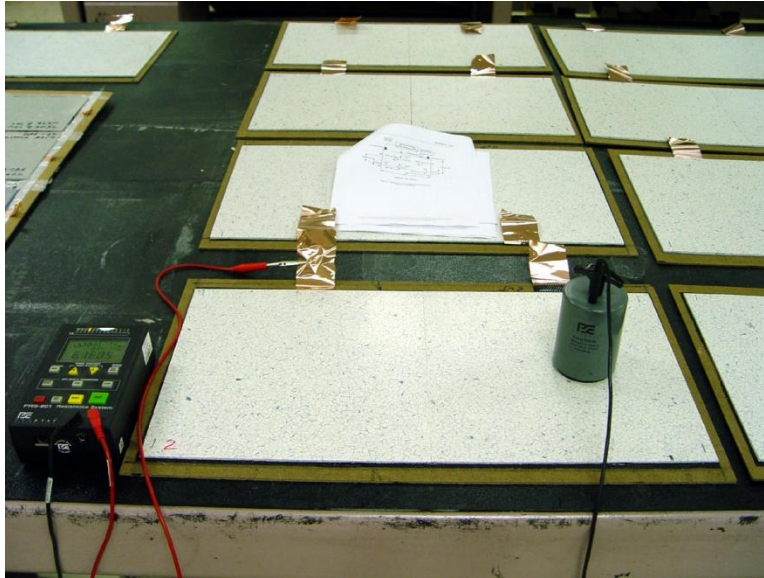


Figure VI. Groundable Point Testing

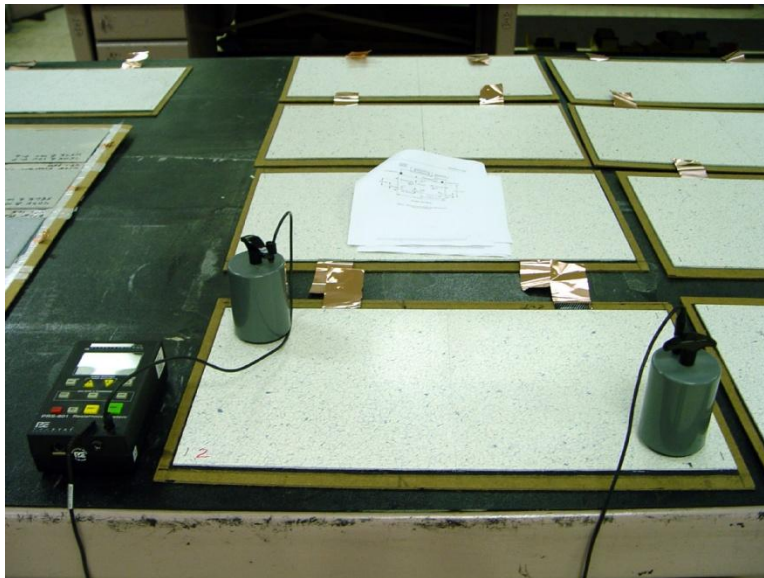


Figure VII. Point to Point Testing

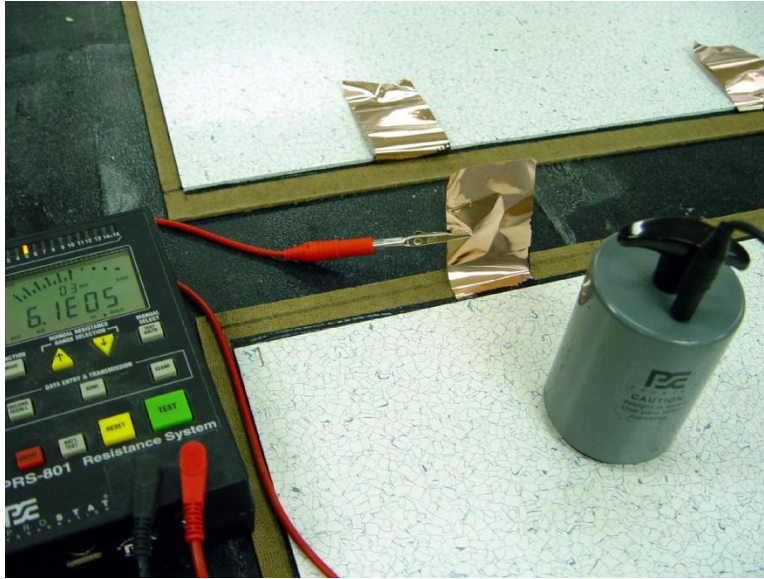


Figure VIII. Test Equipment

### Test Results

All the test data (240 data points) are presented in the following Tables. Result averages are summarized as follows:

	<u>Resistance (Ohms)</u>
Conductile <sup>®</sup> with VPI 165 Adhesive, to Ground	$2.1 \times 10^5$
Conductile <sup>®</sup> with VPI 165 Adhesive, Point to Point	$3.5 \times 10^5$
Conductile <sup>®</sup> with VPI 150 Adhesive, to Ground	$3.9 \times 10^5$
Conductile <sup>®</sup> with VPI 150 Adhesive, Point to Point	$5.8 \times 10^5$

The data clearly demonstrate that Conductile<sup>®</sup> used in conjunction with VPI adhesives very consistently meets S7.1 requirements for a conductive ESD flooring.

**VPI Conductile<sup>®</sup>/VPI 165 - Resistance to Ground - 50% RH - 10/2/2013**

<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>	<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>
<u>Specimen 1</u>			<u>Specimen 4</u>		
A to 1	10	7.1	A to 1	10	0.7
A to 2	10	0.5	A to 2	10	1.5
A to 3	10	2.7	A to 3	10	2.6
A to 4	10	1.1	A to 4	10	0.4
A to 5	10	1.1	A to 5	10	0.9
A to 6	10	0.3	A to 6	10	0.5
B to 1	10	1.2	B to 1	10	1.4
B to 2	10	2.3	B to 2	10	2.6
B to 3	10	0.8	B to 3	10	4.6
B to 4	10	2.1	B to 4	10	1.0
B to 5	10	5.7	B to 5	10	2.3
B to 6	10	5.4	B to 6	10	1.5
<u>Specimen 2</u>			<u>Specimen 5</u>		
A to 1	10	6.6	A to 1	10	5.7
A to 2	10	2.0	A to 2	10	1.1
A to 3	10	0.7	A to 3	10	0.9
A to 4	10	1.2	A to 4	10	1.8
A to 5	10	0.4	A to 5	10	0.7
A to 6	10	4.5	A to 6	10	1.8
B to 1	10	2.6	B to 1	10	2.6
B to 2	10	2.8	B to 2	10	0.3
B to 3	10	4.4	B to 3	10	3.9
B to 4	10	8.3	B to 4	10	0.3
B to 5	10	0.7	B to 5	10	1.0
B to 6	10	0.9	B to 6	10	2.8
<u>Specimen 3</u>			<b>Minimum</b>		<b>0.3 X 10<sup>5</sup></b>
A to 1	10	0.6	<b>Maximum</b>		<b>8.3 X 10<sup>5</sup></b>
A to 2	10	5.6	<b>Average</b>		<b>2.1 X 10<sup>5</sup></b>
A to 3	10	2.9	<b>Median</b>		<b>1.4 X 10<sup>5</sup></b>
A to 4	10	2.8	<b>No. Measurements</b>		<b>60</b>
A to 5	10	1.5	<b>Conductive Pass/Fail</b>		<b>Pass</b>
A to 6	10	4.4			
B to 1	10	1.1			
B to 2	10	2.4			
B to 3	10	1.5			
B to 4	10	1.4			
B to 5	10	4.6			
B to 6	10	0.6			

**VPI Conductile<sup>®</sup>/VPI 165 - Point to Point - 50% RH - 10/2/2013**

<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>	<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>
<u>Specimen 1</u>			<u>Specimen 4</u>		
A to 1	10	1.0	A to 1	10	2.4
A to 2	10	0.9	A to 2	10	2.0
A to 3	10	7.5	A to 3	10	1.3
A to 4	10	8.7	A to 4	10	1.0
A to 5	10	8.1	A to 5	10	2.5
A to 6	10	2.1	A to 6	10	1.7
B to 1	10	1.2	B to 1	10	1.0
B to 2	10	1.4	B to 2	10	7.7
B to 3	10	5.9	B to 3	10	1.0
B to 4	10	1.3	B to 4	10	0.8
B to 5	10	9.8	B to 5	10	3.5
B to 6	10	3.9	B to 6	10	1.1
<u>Specimen 2</u>			<u>Specimen 5</u>		
A to 1	10	8.1	A to 1	10	1.4
A to 2	10	7.1	A to 2	10	1.5
A to 3	10	1.5	A to 3	10	5.2
A to 4	10	6.9	A to 4	10	2.3
A to 5	10	3.9	A to 5	10	2.2
A to 6	10	1.5	A to 6	10	1.1
B to 1	10	2.3	B to 1	10	4.7
B to 2	10	2.4	B to 2	10	3.4
B to 3	10	3.0	B to 3	10	1.7
B to 4	10	5.5	B to 4	10	2.8
B to 5	10	2.6	B to 5	10	7.5
B to 6	10	2.2	B to 6	10	1.1
<u>Specimen 3</u>			<b>Minimum</b>		<b>0.8 X 10<sup>5</sup></b>
A to 1	10	6.3	<b>Maximum</b>		<b>9.8 X 10<sup>5</sup></b>
A to 2	10	3.4	<b>Average</b>		<b>3.5 X 10<sup>5</sup></b>
A to 3	10	1.3	<b>Median</b>		<b>2.4 X 10<sup>5</sup></b>
A to 4	10	5.1	<b>No. Measurements</b>		<b>60</b>
A to 5	10	1.6	<b>Conductive Pass/Fail</b>		<b>Pass</b>
A to 6	10	7.9			
B to 1	10	7.0			
B to 2	10	4.5			
B to 3	10	1.9			
B to 4	10	7.4			
B to 5	10	2.9			
B to 6	10	2.5			



**VPI Conductile<sup>®</sup>/VPI 150 - Resistance to Ground - 50% RH - 10/2/2013**

<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>	<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>
<u>Specimen 1</u>			<u>Specimen 4</u>		
A to 1	10	6.2	A to 1	10	3.1
A to 2	10	4.0	A to 2	10	5.9
A to 3	10	1.5	A to 3	10	1.1
A to 4	10	2.0	A to 4	10	2.5
A to 5	10	2.3	A to 5	10	2.9
A to 6	10	0.9	A to 6	10	2.0
B to 1	10	3.6	B to 1	10	4.8
B to 2	10	2.8	B to 2	10	2.6
B to 3	10	1.7	B to 3	10	2.5
B to 4	10	1.3	B to 4	10	6.0
B to 5	10	3.6	B to 5	10	2.5
B to 6	10	3.5	B to 6	10	3.3
<u>Specimen 2</u>			<u>Specimen 5</u>		
A to 1	10	6.3	A to 1	10	3.6
A to 2	10	6.1	A to 2	10	6.1
A to 3	10	7.9	A to 3	10	3.9
A to 4	10	8.7	A to 4	10	5.9
A to 5	10	4.0	A to 5	10	2.3
A to 6	10	2.4	A to 6	10	7.6
B to 1	10	1.7	B to 1	10	5.7
B to 2	10	3.0	B to 2	10	3.4
B to 3	10	2.4	B to 3	10	9.1
B to 4	10	4.6	B to 4	10	1.0
B to 5	10	4.2	B to 5	10	4.8
B to 6	10	7.8	B to 6	10	1.3
<u>Specimen 3</u>			<b>Minimum</b>		<b>0.8 X 10<sup>b</sup></b>
A to 1	10	1.3	<b>Maximum</b>		<b>9.6 X 10<sup>b</sup></b>
A to 2	10	3.6	<b>Average</b>		<b>3.9 X 10<sup>b</sup></b>
A to 3	10	8.5	<b>Median</b>		<b>3.3 X 10<sup>b</sup></b>
A to 4	10	4.5	<b>No. Measurements</b>		<b>60</b>
A to 5	10	4.3	<b>Conductive Pass/Fail</b>		<b>Pass</b>
A to 6	10	2.9			
B to 1	10	2.7			
B to 2	10	1.7			
B to 3	10	9.6			
B to 4	10	2.0			
B to 5	10	2.8			
B to 6	10	3.5			

**VPI Conductile<sup>®</sup>/VPI 150 - Point to Point - 50% RH - 10/2/2013**

<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>	<b>Measurement</b>	<b>Voltage</b>	<b>Resistance (Ohms) Magnitude X 10<sup>5</sup></b>
<u>Specimen 1</u>	10		<u>Specimen 4</u>	10	
A to 1	10	8.1	A to 1	10	2.2
A to 2	10	4.9	A to 2	10	4.8
A to 3	10	3.4	A to 3	10	7.7
A to 4	10	5.5	A to 4	10	6.8
A to 5	10	4.9	A to 5	10	5.1
A to 6	10	6.3	A to 6	10	6.8
B to 1	10	7.6	B to 1	10	8.4
B to 2	10	4.2	B to 2	10	7.2
B to 3	10	6.2	B to 3	10	3.5
B to 4	10	7.0	B to 4	10	6.4
B to 5	10	3.6	B to 5	10	8.5
B to 6	10	6.9	B to 6	10	9.4
<u>Specimen 2</u>			<u>Specimen 5</u>		
A to 1	10	8.2	A to 1	10	9.7
A to 2	10	4.1	A to 2	10	2.5
A to 3	10	6.9	A to 3	10	5.3
A to 4	10	5.2	A to 4	10	6.3
A to 5	10	2.6	A to 5	10	7.3
A to 6	10	5.8	A to 6	10	1.9
B to 1	10	9.3	B to 1	10	2.8
B to 2	10	5.4	B to 2	10	3.4
B to 3	10	9.5	B to 3	10	3.8
B to 4	10	5.5	B to 4	10	3.0
B to 5	10	5.5	B to 5	10	4.6
B to 6	10	5.9	B to 6	10	2.6
<u>Specimen 3</u>			<b>Minimum</b>		<b>1.9 X 10<sup>b</sup></b>
A to 1	10	4.0	<b>Maximum</b>		<b>9.7 X 10<sup>b</sup></b>
A to 2	10	7.8	<b>Average</b>		<b>5.8 X 10<sup>b</sup></b>
A to 3	10	8.1	<b>Median</b>		<b>5.8 X 10<sup>b</sup></b>
A to 4	10	3.0	<b>No. Measurements</b>		<b>60</b>
A to 5	10	6.5	<b>Conductive Pass/Fail</b>		<b>Pass</b>
A to 6	10	4.0			
B to 1	10	8.2			
B to 2	10	8.6			
B to 3	10	7.8			
B to 4	10	3.8			
B to 5	10	7.5			
B to 6	10	6.4			