Static-Control Flooring: Matching Products and Environments Through Evidence-Based Design
First and Foremost

Electrostatic discharge (ESD) is a well-documented, invisible threat to electronic parts, systems, and mission-critical operations. And the problem is intensifying as electronic devices are getting smaller, reducing the room for on-chip protection and increasing the vulnerability to ESD. Today, more environments are at risk if they don’t have anti-static, “fault-tolerant” flooring that performs regardless of variables such as footwear, maintenance, and humidity. While specifying any floor presents technical challenges and potential exposure to the specifier, this is especially true in environments where static control is necessary. But proper specification, product selection, and installation can be confusing without the necessary technical tools. Unfortunately, if flooring specs don’t address unique environmental conditions or meet the latest standards, you risk damage to equipment, product returns, facility downtime, communication errors, and liability. Fortunately, you can eliminate the usual guesswork and match the right product to the right environment by applying evidence-based design principles. It starts with assessing your specific conditions and understanding the impact of footwear on the performance of all static-control floors.

*It starts with determining how flooring and footwear must work together.*

*The following information can help you find tailor-made solutions that best meet your flooring needs.*

What’s Inside

The information in this guide is based on the review of hundreds of static-generation tests on all forms of ESD flooring using multiple test subjects wearing dozens of types of ordinary and ESD footwear. This provides a scientific framework for finding customized solutions.

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On cover (L to R: Electronics manufacturing facility with Ameriworx Vinyl Tile; 9-1-1 dispatch center with EclipseEC Rubber and ShadowFX Carpet Tile.)
Stay Grounded Checklist

It’s important to know the basics about static-control flooring. This checklist can help you stay grounded. For more information, see Figure 2.

✓ Check your environment.
Are you working in an ESD-protected area (EPA)—where special footwear and wrist straps are mandatory but difficult to enforce? Or in an end-user environment—where there are no static-control protocols? In either case, it is best to strive for fault-tolerant, maximum static protection.

✓ Check the footwear requirements.
Account for all types of footwear when evaluating the static-generation properties of the floor.

✓ Check on the most appropriate application.
Eclipse EC Rubber, ESD Vinyl, ESD Carpet, ESD Epoxy, Interlocking Tiles, and HPL are all appropriate for different environments. A combination of options may be appropriate.

✓ Check on your budget.
Factor in initial investment, maintenance and repair costs, lifetime value, and get the specs right the first time.

✓ Check on installation time.
Time is money, and products like carpet tile are the easiest to install.

✓ Check conductivity levels.
Find the “sweet spot” for conductivity (see Figure 3). Electrical resistance should be verified with an Ohm meter. If the material does not pass the Ohm meter test, it cannot be grounded. For example, use extreme caution when considering conductive carpet measuring less than 1.0 x 105 Ohms-to-ground in mission-critical operations.

✓ Check on durability.
If you require heavy loads, flooring like carpet tile may not be suitable. If you are concerned about scratch and gouge repair, solid vinyl tile will actually outperform epoxy coatings.

✓ Check terminology.
Check terminology. Pay special attention to terms like conductive, static dissipative, Ohms, and static generation (see Glossary, p. 10). Be aware of the common misuse of generic terms like ESD flooring.

✓ Check specification of upper limit and shoe type when evaluating body voltage generation (see Standards, p. 9).
- ANSI/ESD S97.2: ideal upper limit in EPA < 100 volts
- Mission-Critical: target < 400 volts with ordinary footwear
- Class-0 ESD: should not exceed 25 volts

✓ Check grounding standards and test methods (see Standards, p. 9).
Write your specification based on performance parameters.
- Reference ANSI/ESD S20.20 and IEC 61340-5-1 for electronics manufacturing.
- Reference Motorola R56 and ATIS-0600321.2010 for mission-critical environments like 911 dispatch areas, control rooms, and data centers.

✓ Check on sprays and waxes.
Some static-control floors actually derive their anti-static properties from special waxes.

✓ Check on environmental quality.
Try to avoid plasticizers and corrosive gases; look for “green” products. Avoid materials not tested for outgassing VOC content.

✓ Check on ergonomics.
Anti-fatigue, sound attenuation and slip resistance factors should be part of the equation.

✓ Check on aesthetics.
Will the floor maintain its appearance? Note that it’s impossible to remove scratches from Epoxy floors.

✓ Check on lifetime warranties.
Select a manufacturer that will offer lifetime ESD guarantees.

✓ Check where the product was manufactured.
Some flooring suppliers hide the country of origin. There are benefits to “Made in America,” including product quality. Many offshore floor tiles are die cut and have slight dimensional differences, causing unsightly gaps in the seams.

✓ Check on internet scans.
Are you buying a brand or are you just dealing with a website?

✓ Check the floor after it is installed.
Request a free flooring audit.
### Flooring Selector Guide

**Do you have sensitive electronics and/or mission-critical equipment that need to be protected from harmful static discharge? Are you concerned that static discharge might compromise the optimal, uninterrupted operation of your facility?**

**YES**
You need static-control flooring. Follow this chart to find flooring that is right for you.

**NO**
You do not need static-control flooring.

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**Is your facility an electronics manufacturing service (EMS) facility, cleanroom, or R&D environment that anticipates more sensitive devices than you presently handle?**

**YES**
The ESD footwear and wrist strap policy is strictly enforced.

**NO**
For this environment, you should comply with Class-0 ESD specifications (25 volt maximum)

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**Do you need flooring that will work with any type of footwear?**

**YES**
Our employees wear regular shoes and operate in an end-user/real-world environment.
(Examples: 9-1-1 dispatch area, data center, flight command center, networked office, hospital/imaging, control room, lab, government office, server room, etc.)

**NO**
We require our employees to wear ESD footwear and grounded wrist straps because we are a controlled/manufacturing ESD-protected (EPA) environment.
(Examples: microelectronics fabrication, circuit board assembly, manufacturing test and repair of electronics, clean rooms, etc.)

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**Are your employees compliant with the ESD footwear and wrist strap policy?**

**YES**
For this environment, you should use flooring that will inhibit static regardless of footwear or wrist straps.

Generates below 400 volts when test subject is wearing standard footwear. Complies with ANSI/ESD S20.20 100 volt static-charge maximum and Class-0 ESD 25 volt static-charge maximum when ESD footwear and wrist straps are enforced:

- **EC Rubber** (Ideal)
- **ESD Carpet** (Ideal)
- **Conductive Vinyl** (Recommended with caution)

---

**Are your employees compliant with the ESD footwear and wrist strap policy?**

**NO**
For this environment, you should use flooring that will inhibit static regardless of ESD footwear and wrist strap policy.

Generates below 400 volts when test subject is wearing standard footwear. Complies with ANSI/ESD S20.20 100 volt static-charge maximum when using ESD footwear and wrist straps:

- **EC Rubber** (Ideal)
- **Conductive Vinyl** (Ideal)
- **ESD Carpet** (Ideal)
- **Some Conductive Epoxy** (Recommended with caution)

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**For this environment, you should comply with Class-0 ESD specifications (25 volt maximum)**

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**For this environment, you should comply with ANSI/ESD S20.20 (100 volt maximum)**

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There are many variables to consider when selecting the best flooring solutions or combination of products. This includes understanding the relationship between footwear and flooring and recognizing that some types of ESD footwear actually create static. It is therefore recommended that you obtain an independent ESD flooring lab report that demonstrates the performance of flooring with multiple types of ESD footwear and standard footwear.
Voltage Limits by Environment Chart

3,500 volts is the amount of static charge it takes for a person to feel shock; however, that does not mean that any number fewer than 3,500 volts is safe for your sensitive electronics and/or mission-critical equipment. The maximum allowable voltage will depend on your environment and footwear. Use the chart below to find which specification you need to comply with and what flooring will keep you and your equipment safe.

<table>
<thead>
<tr>
<th>Maximum Allowable Voltage</th>
<th>Class-0</th>
<th>Controlled Environments (ANSI/ESD S20.20)</th>
<th>End-User/Real-World</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environment</td>
<td>Controlled/manufacturing ESD-protected areas (EPA) that anticipate handling more sensitive devices in the future</td>
<td>Controlled/manufacturing ESD-protected areas (EPA)</td>
<td>Mission-critical areas that require ESD protection regardless of footwear</td>
</tr>
<tr>
<td>E.g.: electronics manufacturing service (EMS) facilities, cleanrooms, R&amp;D environments</td>
<td>E.g.: microelectronics fabrication, circuit board assembly, manufacturing test and repair of electronics, etc.</td>
<td>E.g.: 9-1-1 dispatch areas, data centers, flight command centers, networked offices, hospital/imaging, control rooms, labs, government offices, server rooms, etc.</td>
<td></td>
</tr>
</tbody>
</table>

| Flooring Options with Regular Footwear | None | None | EC Rubber ESD Carpet |

| Flooring Options with ESD Footwear or Heel Straps | EC Rubber ESD Carpet Conductive Vinyl* | EC Rubber Conductive Vinyl* ESD Carpet Some Conductive Epoxy* | EC Rubber Conductive Vinyl* Static-Dissipative Vinyl Tile* Plastic Interlocking Conductive Flooring* Plastic Interlocking Dissipative Flooring* Conductive Epoxy Coatings* Static-Dissipative Epoxy Coatings* ESD Carpet Conductive High-Pressure Laminate* |

*Recommended with caution. Some types of ESD footwear actually create static. Therefore, it is recommended that all static-control flooring options should be tested and evaluated based on the type of footwear that will be used in the specific space. Epoxy and vinyl offer no static protection without the use of static-control footwear.
Shocking Information: Body Voltage Generated with Different Footwear

Figure 1
Click image to view full-size graph
**Flooring Comparison Chart**

<table>
<thead>
<tr>
<th>Category</th>
<th>ESD Carpet Tile</th>
<th>ESD Solid Vinyl Tile (Conductive)</th>
<th>ESD Multi-layer Poured Epoxy</th>
<th>Interlocking Plastic Flooring</th>
<th>ESD Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Low to Moderate</td>
<td>Lowest</td>
<td>Low to Moderate</td>
<td>Highest</td>
<td>Moderate to High</td>
</tr>
<tr>
<td>Total Cost of Ownership</td>
<td>Lowest</td>
<td>Low</td>
<td>Moderate</td>
<td>Highest</td>
<td>Moderate</td>
</tr>
<tr>
<td>Cost of Maintenance</td>
<td>Low to Moderate</td>
<td>Low to Moderate</td>
<td>Low</td>
<td>Moderate</td>
<td>Lowest</td>
</tr>
<tr>
<td>Maintenance</td>
<td>Vacuum and wet extraction</td>
<td>Sweep, damp mop, and buff</td>
<td>Sweep and damp mop</td>
<td>Sweep, damp mop, and buff</td>
<td>Sweep, damp mop, and buff</td>
</tr>
<tr>
<td>Durability</td>
<td>Good to Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good to Excellent</td>
</tr>
<tr>
<td>Ease of Repair</td>
<td>Easiest</td>
<td>Easy</td>
<td>Most Difficult</td>
<td>Easy</td>
<td>Moderate</td>
</tr>
<tr>
<td>Long-Term Appearance</td>
<td>Good to Excellent</td>
<td>Excellent</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Color throughout Thickness</td>
<td>N/A</td>
<td>Yes Ameriworx Precision-Milled Vinyl Tile</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Thickness (helps hide scratches)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Color Consistency for Projects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>of any Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handles/Withstands Rolling Loads</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
</tr>
<tr>
<td>Ease of Rolling</td>
<td>Fair</td>
<td>Excellent</td>
<td>Excellent</td>
<td>Good to Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Inhibits Static with Ordinary</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Footwear</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Figure 2*  
Continued on next page
<table>
<thead>
<tr>
<th>Category</th>
<th>ESD Carpet Tile</th>
<th>ESD Solid Vinyl Tile (Conductive)</th>
<th>ESD Multi-layer Poured Epoxy</th>
<th>Interlocking Plastic Flooring</th>
<th>ESD Rubber</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class-0 Qualified</td>
<td>Yes depending on type of ESD footwear.</td>
<td>Yes depending on type of ESD footwear.</td>
<td>No</td>
<td>No</td>
<td>Yes when using any ESD footwear.</td>
</tr>
<tr>
<td>Ease of Finding Small Parts</td>
<td>Fair</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
</tr>
<tr>
<td>Installation</td>
<td>Easiest and Fast</td>
<td>Easy and Fast</td>
<td>Difficult</td>
<td>Time consuming</td>
<td>Moderate and Fast</td>
</tr>
<tr>
<td>Slip Resistance</td>
<td>&gt; 0.6 meets or exceeds ADA guidelines.</td>
<td>0.5 - 0.6 meets or exceeds ADA guidelines.</td>
<td>0.4 – 0.6 depending on texture.</td>
<td>0.5 – 0.6</td>
<td>&gt; 0.6 meets or exceeds ADA guidelines.</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>Fair</td>
<td>Superior</td>
<td>Superior</td>
<td>Superior</td>
<td>Superior</td>
</tr>
<tr>
<td>Sound Absorption</td>
<td>Excellent</td>
<td>Poor to Fair 4 dB</td>
<td>Not sound resistant</td>
<td>Poor to fair</td>
<td>Excellent 5 – 19 dB</td>
</tr>
<tr>
<td>Anti-Fatiguing</td>
<td>Excellent</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Good</td>
</tr>
<tr>
<td>PSI</td>
<td>N/A</td>
<td>2500 - &lt; 3000</td>
<td>&gt; 3000</td>
<td>N/A</td>
<td>600 - 800</td>
</tr>
<tr>
<td>Wear Layer</td>
<td>N/A</td>
<td>Total thickness</td>
<td>Minimal</td>
<td>Total thickness</td>
<td>Total thickness</td>
</tr>
<tr>
<td>VOC Compliant</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes greenguard certified</td>
</tr>
<tr>
<td>Halogen Free – No Chlorine or Other Corrosive Gases in Fire</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Contributes toward LEED credits</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Caution: Static-control, interlocking flooring, vinyl, high pressure laminate, and some epoxy will not inhibit static charges without the use of ESD footwear. Persons wearing standard footwear can generate over 3.5 kV while walking on these four materials (see Figure 1).

For more comprehensive product information, please visit [www.staticworx.com/esd-flooring](http://www.staticworx.com/esd-flooring).
Industry Standards and Test Methods

The following are approved international standards for flooring applications. For personal and product protection—and to avoid exposure—don’t be complacent about compliance.

- National Fire Protection Agency (NFPA) 99, *Healthcare Facilities*
- ANSI/ESD STM97.1-2015, *Floor Materials and Footwear: Resistance Measurement in Combination with a Person*
- ANSI/ESD STM97.2-2006, *Floor Materials and Footwear: Voltage Measurement in Combination with a Person*
- AATCC (American Association of Textile Chemists and Colorist) 134, *Electrostatic Propensity of Carpets*
- Motorola R56, *Standards and Guidelines for Communication Sites*
- Alliance for Telecommunications Industry Solutions (ATIS) 0600321-2010, *Electrical Protection for Network Operator-Type Equipment Positions*

Safe at OHMs

Figure 3

Your “Sweet Spot” for Safe Conductivity

SAFETY ZONE

25,000
2.5 x 10^4
10,000
1 x 10^3
1,000
1 x 10^2
100
1 x 10^1
10
1 x 10^0
1
1 x 10^-1

CONDUCTIVE RANGE
DISSIPATIVE RANGE

All Staticworx flooring is within the safe range shown here.
**Glossary: A Dozen Key Terms**

- **Anti-Static Flooring:** This refers to a condition where static generation is inhibited during contact and separation with a different material. Anti-static or static-control flooring can either be static dissipative or static conductive (see below). Also known as ESD flooring.

- **Conductive:** The ability of a material to conduct a charge to ground and is usually indicated by an electrical resistance range measured in ohms (see below) with a minimum of $2.5 \times 10^4$ (25,000 ohms) to a maximum of $1.0 \times 10^6$ (1 million ohms).

- **Conductive Flooring:** This term is often misconstrued as too conductive. Unlike highly conductive materials like copper and steel, conductive flooring is actually relatively resistive. Conductive floors like static-dissipative floors are classified based on their electrical resistance to ground. Electrical resistance is measured in ohms of resistance. Conductive flooring always meets all three recommended electrical parameters of ANSI/ESD S20.20 (see below).

- **Dissipative Flooring:** Flooring used for the mitigation of ESD, usually composed of carpet, synthetic rubber, or vinyl composition. It is important to differentiate between the terms static-dissipative tile (SDT) and static dissipative. A static-dissipative floor inherently meets the electrical properties of “static-dissipative flooring” without the use of anti-static waxes, finishes, and glazes. A static-dissipative tile is not necessarily anti-static and should be carefully evaluated in applications where special controlled footwear will not be used.

- **Electrostatic Discharge (ESD):** The rapid, spontaneous transfer of electrostatic charge induced by a high electrostatic field. Usually, the charge flows through a spark between two bodies as they approach one another.

- **ESD-Grade Carpet Tile:** A generic descriptor for a type of carpet tile used to control the accumulation of electrostatic discharge on people, chairs, and tables. These modular floor tiles are comprised of conductive or dissipative tufted nylon and a carbon- loaded plastic backing, usually manufactured using conductive fibers. They are designed to provide an electrical path to ground for the dissipation of unwanted static electricity charges in applications where electronics are stored, manufactured, or handled. An ESD-grade flooring material will dissipate static electricity at any relative humidity level without the need for sprays or chemical treatment. Some ESD carpet tiles are too conductive. All ESD carpet should be tested for safe electrical continuity after they have been installed. Not to be confused with computer-grade or low Kv carpet materials.

- **Ground:** Ground is the safe point of discharge of unwanted static electricity. Ground represents “zero electrical potential.” When something is grounded, it is neutral; it has no charge. Attaching a conductive floor to ground ensures that the static charges will be diverted to the earth through the conductive floor system.

- **Mission Critical:** Any operation that cannot tolerate intervention, compromise, or shutdown during its. Mission-critical environments usually support health, safety, security, and human welfare.

- **Ohms:** Ohms are units of electrical resistance between two points. “One Meg” equals 1 million ohms or $1.0 \times 10^6$. The exponent 6 refers to the number of zeroes after the 1 and is generally considered the maximum electrical resistance level for a conductive flooring specification. The lowest end of the range is 25,000 ohms, represented as $2.5 \times 10^4$, or $2.5 \times 10,000$ ohms. Anything lower than this is considered an electrical shock hazard.

- **Resilient Flooring:** A type of flooring designed to be durable, resistant to stains and water, and comfortable to work on. Resilient flooring resists penetration by water, making it less likely than textile-based flooring to become a breeding ground for mold and mildew. It withstands heavy foot traffic and is slip resistant, making it an ideal solution for wet applications in manufacturing facilities.

- **Static-Dissipative Flooring:** These floors are defined by a property called electrical resistance, measured in ohms. The important parameter for describing a floor is the static-control flooring resistance to ground or path to ground. In order to meet the qualification of static dissipative, a floor must have an electrical resistance to ground of $\geq 1 \times 10^6$ (one million ohms) and $<1 \times 10^9$.

- **Static Electricity:** Literally “electricity at rest.” Static electricity is the stored energy that becomes dangerous when it becomes an ESD event.