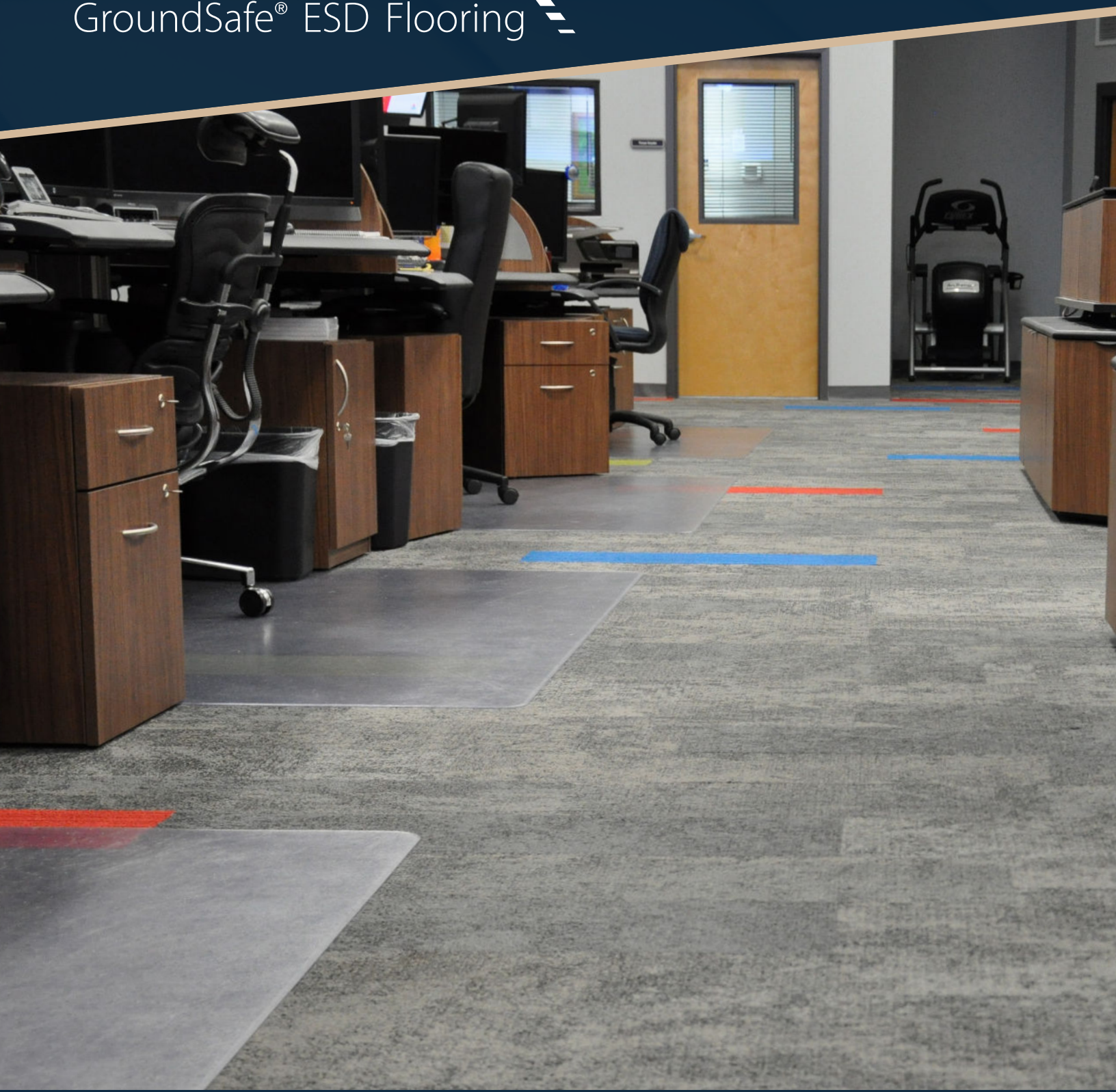
staticWorx®
GroundSafe® ESD Flooring



How to Specify an ESD Floor

Information for architects, designers, flooring specifiers

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As electronic components have become smaller and faster, they have become more vulnerable to electrostatic discharge. In any environment where electronic equipment is manufactured, handled or used—and where the core mission depends on electronic equipment—the likelihood of an ESD threat is high. In fact, static electricity affects almost every industry in one way or another.

In the workplace, static electricity affects almost every industry in one way or another.

Which Applications Use or Require ESD Flooring?

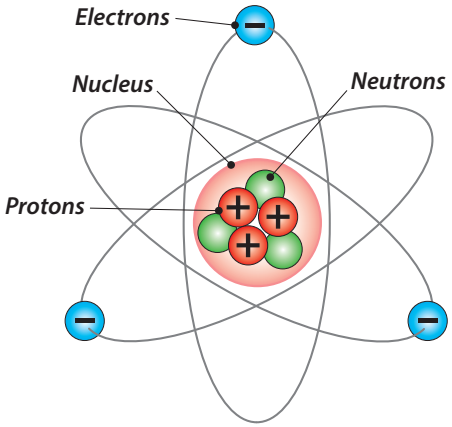
Any facility that manufactures, handles or uses electronic equipment should use special flooring to mitigate the threat of random electrostatic discharge (ESD) events. Here is a partial list of applications that require ESD flooring:

- Electronics manufacturing, storage and test spaces
- Contract manufacturing
- Software Development
- Research Labs
- Cleanrooms
- Computer Labs
- Computer Training Spaces
- Server Rooms
- University Labs
- Electronics R&D
- Repair Areas in Electronics Retail
- 9-1-1 Call Centers
- Police Forensics Labs
- Fire Emergency Locations
- PSAPs (Public Safety)
- Control Rooms
- Data Centers
- Call Centers/Help Lines
- Telecomm Equipment Closets
- Aerospace
- FAA Flight Towers
- Flight Training Simulation Rooms
- Casinos
- Banking and Financial Institutions
- Media (TV and Radio Stations)
- Nano Technology Research
- War Rooms
- Raised Access Flooring Installations
- Mobile Electronics Shelters

What is ESD and How is ESD Generated in The Workplace?

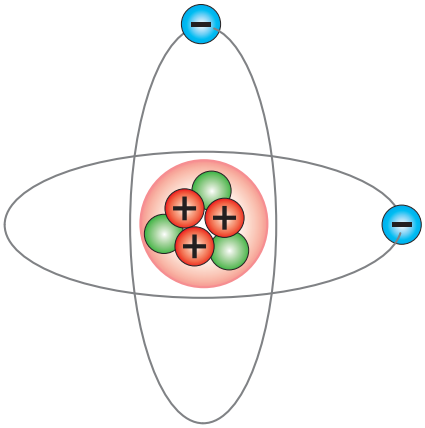
ESD is an acronym for electrostatic discharge. An electrostatic discharge occurs when two objects with different electrical potentials come into contact and then separate.

Electrical balance



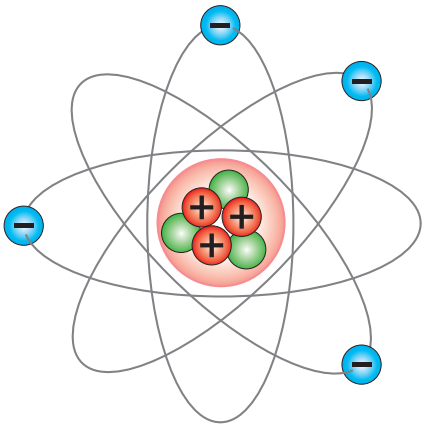
No electrical charge

Electron deficit



Positive charge

Electron surplus



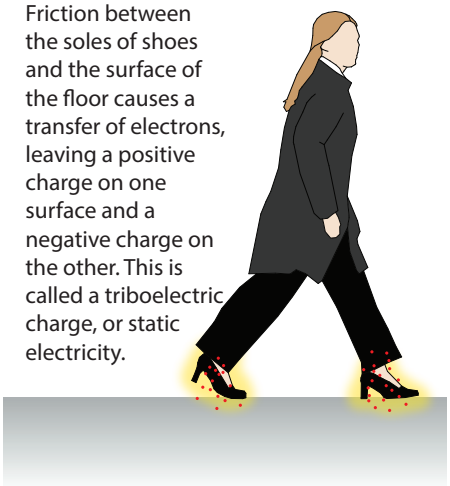
Negative charge

In the workplace, most ESD events occur when people walk across the floor. The contact and separation between their shoe soles and the surface of the floor generates a static charge. As people walk, static charges continue to build on their body, then discharge to the first person or object they touch. This transfer of electricity is called electrostatic discharge or ESD.

Walking Body Voltage

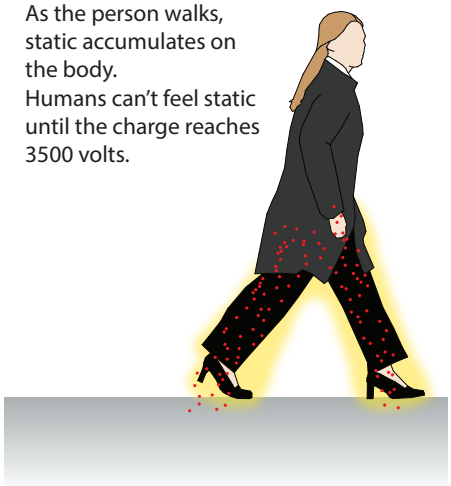
1

Friction between the soles of shoes and the surface of the floor causes a transfer of electrons, leaving a positive charge on one surface and a negative charge on the other. This is called a triboelectric charge, or static electricity.



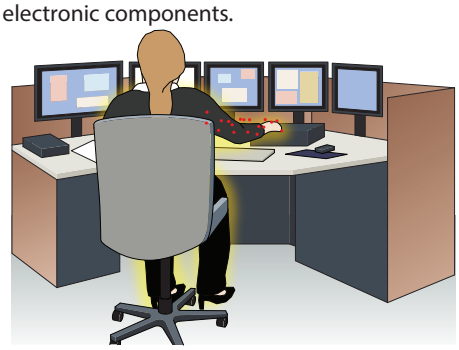
2

As the person walks, static accumulates on the body.
Humans can't feel static until the charge reaches 3500 volts.



3

Static stays in place until the person touches someone or something, then the charge transfers, or discharges, to the other person or object. A static charge as low as 20 volts can damage or destroy sensitive electronic components.



Why Do I—Or Why Does My Client—Need an ESD Floor?

An everyday static discharge, or static shock, can range from annoying to slightly painful. But it's not a big deal. In a facility that manufactures, repairs or handles electronic components, a random static discharge can destroy circuits (or circuit boards), causing electronic failures, in the manufacturing process or in the field.

In a critical call center, 9-1-1 dispatch operation, FAA flight tower, data storage facility, financial institution, government office, TV and radio studios—and any other end-user environment that relies on sophisticated electronics—static electricity can wreak havoc. ESD events scramble transmissions, cause lost calls, create noise interference, damage or destroy circuitry, and in some cases disrupt or even shut down network operations.

How Much Static is Necessary to Harm Electronics?

It requires approximately 3500 volts before a person can feel a static discharge. Microelectronic computer parts can be harmed by less than 20 volts of static and systems can be impacted by as little as 500 volts.

Since a human can't feel static discharges below 3500 volts, it is impractical to assume there is no static problem based on the fact that personnel are not getting zapped.

How Does ESD Flooring Solve Static Problems?

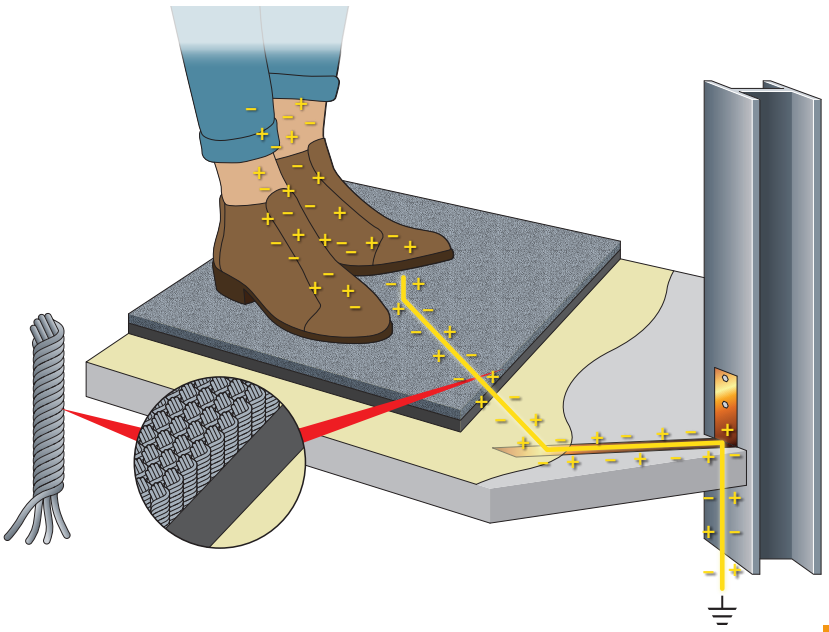
An ESD floor inhibits static generation when people walk and dissipates charges safely and effectively to ground. These two functions work together to prevent static from building on people, eliminating the threat of random ESD events.

A properly performing ESD floor performs two equally important functions:

1) draws static away from people and dissipates charges safely to ground;
2) inhibits static generation, preventing static from building as people walk.

As people walk across its surface, the ESD floor draws static away from the soles of their shoes. The conductive elements in the floor pull charges downward, through the thickness of the floor, across the underlying conductive ground plane—conductive adhesive or, with free-floating floors, the conductive underlayment—to copper strips placed at the perimeter of the room.

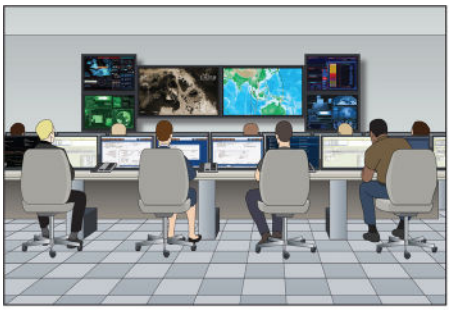
The copper strips are attached to an earth/ground connection. Charges flow through the copper strips to ground.



But dissipating static charges is only part of the story. An effective ESD floors inhibits static generation in the first place and prevents static charges from building on people as they walk.

In electronics manufacturing and handling facilities, with protocols mandating the use of special ESD footwear, ESD vinyl and epoxies made from static-generating base materials are perfectly acceptable—even preferable, for cost or other reasons – specifically in facilities that mandate the use of full-sole ESD shoes.

In non-manufacturing/end-user facilities, such as flight towers, communications centers, server rooms, etc., where ESD footwear is not required, it's crucial that the floor does NOT contribute to static generation. In these environments, ESD vinyl and epoxy should not be used. In these applications, always specify low static-generating materials, specifically ESD carpet or rubber.



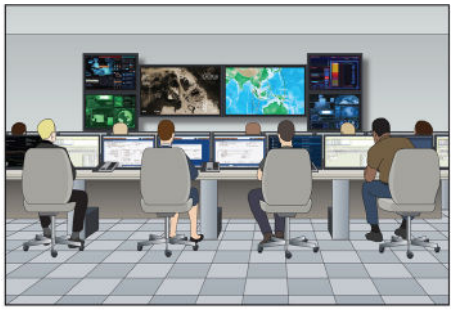
Functioning command center, with a new conductive floor that does not prevent static generation.

A person enters the room. Friction between the soles of her shoes and flooring material generates static. As she crosses the floor, a static charge builds on her body.

The static electricity on her body discharges to the first person or object she touches—in this case, the headset.

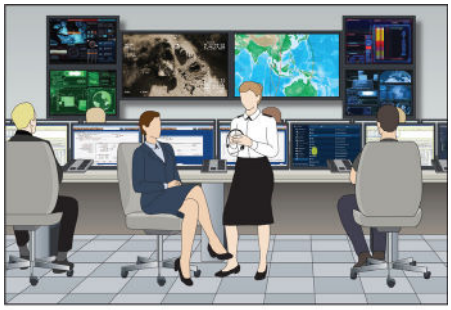
The sudden rush of electrical current through the headset damages the microcircuits inside the equipment, disrupting data and damaging or destroying components.

A low-charge-generating ESD floor is installed in the command center.

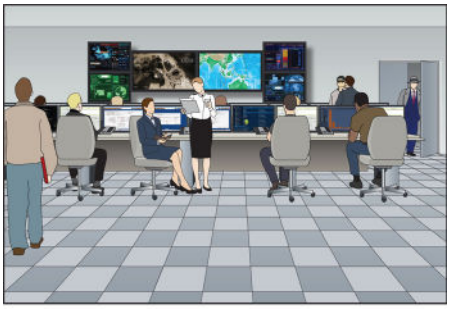


When personnel move in, the room is fully functional.

When a person walks across the floor, the friction generates minimal static, and the flooring material dissipates the charge safely to ground.



Because she has no static on her body, when she touches the headset—or a sensitive component—there is no damaging static event.



The command center remains fully functional, and people move and interact freely.

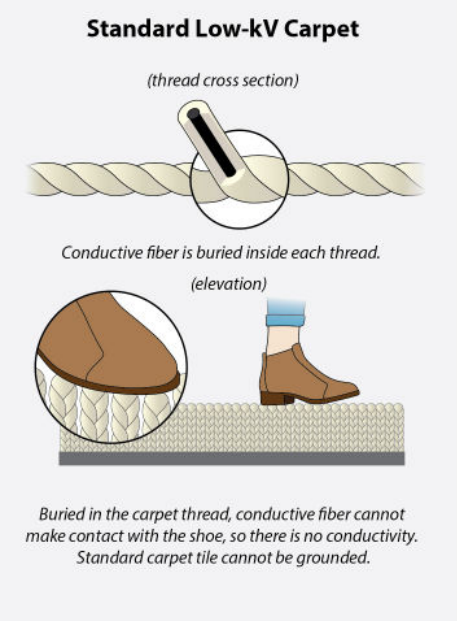
How is ESD Flooring Different from Regular Flooring?

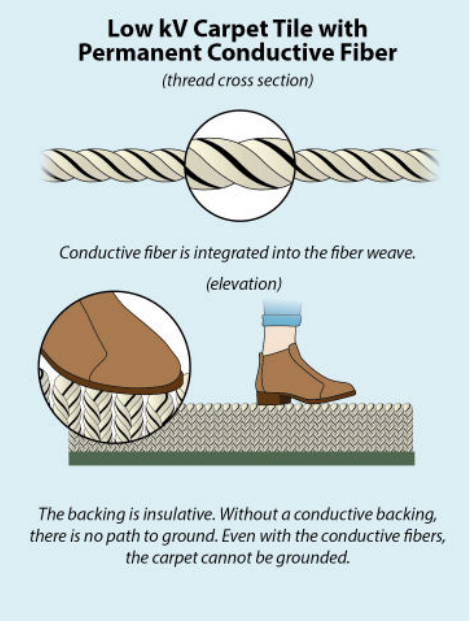
People often ask this question. It's confusing, because regular flooring materials are sometimes marketed as antistatic. Their antistatic properties are derived from topical wax, polish, or sprays that wear off over time.* Without repeated reapplication of the topical anti-stat—and regular testing—it's impossible to know if these floors have retained any of their antistatic properties. In other words, the floor could actually be generating static and no one would be the wiser.

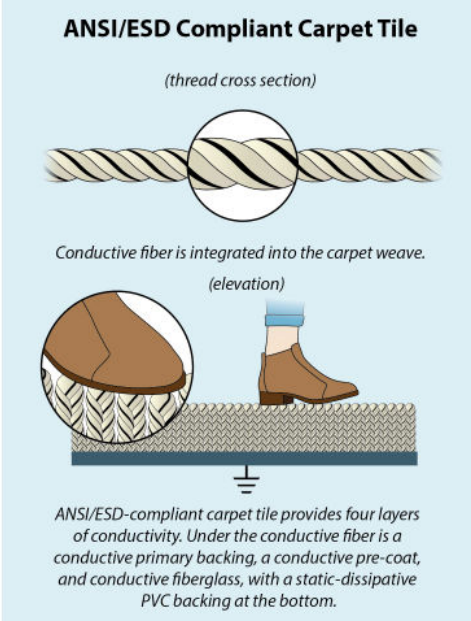
With ESD floors, conductive particles or additives are combined with the base flooring material during the manufacturing process. These conductive particles form an electrical connection with the conductive elements in ESD footwear, drawing charges away from the wearer, and dissipate static safely and effectively to ground. Because they're inherent, ESD properties do not wear off.

In ESD carpet, conductive fibers are wound into the yarn strands. These conductive fibers sweep static from shoe soles and dissipate charges through the thickness of the material to ground. Like other ESD floors, the static-control properties in ESD carpet are permanent and cannot wear off.

* This is true of carpet, as well as VCT (vinyl composition tile), some SDT (static-dissipative vinyl tile) other types of regular flooring marketed as antistatic.







Can I Use VCT for an ESD Application?

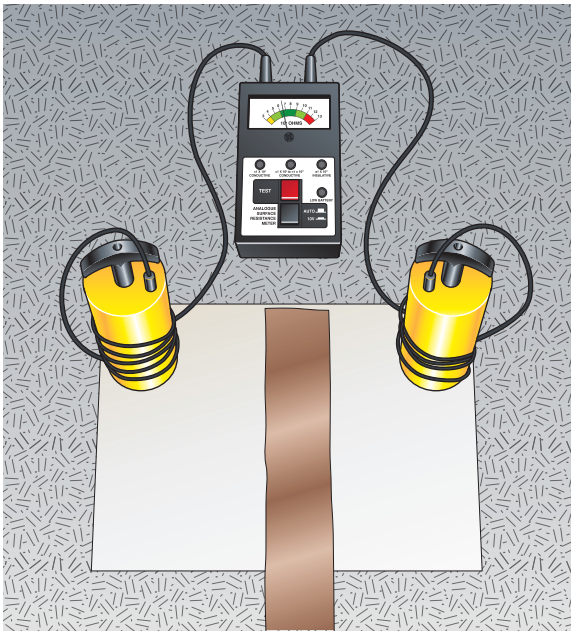
No, VCT (vinyl composition tile) is not inherently antistatic and cannot be grounded. To attain antistatic properties, VCT can be coated with special ESD polish or wax that wears off over time. Unless your client constantly measures the electrical resistance of the VCT, there is no way they'll know if the floor is effective or has lost its ability to control static electricity.

How Do I Know I'm Specifying the Right ESD Floor for the Application?

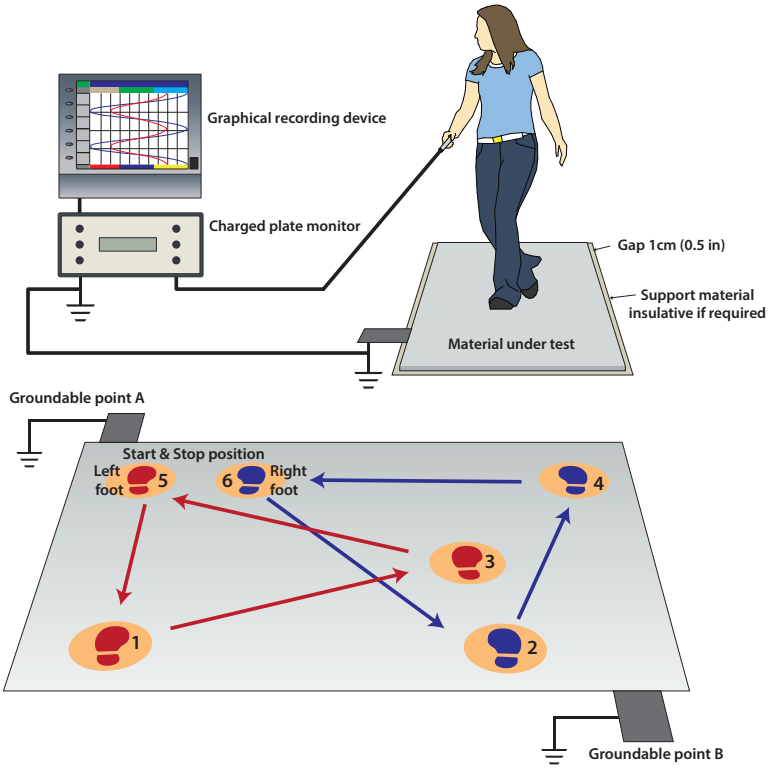
First, for all environments except electronics manufacturing and handling facilities, the right ESD flooring prevents static from generating in the first place.

To be sure you're specifying the right ESD floor for a particular space, it's crucial to familiarize yourself with specific industry standards. Standards are different across different industries—so a standard that's right for one space may be completely wrong or even detrimental for another. For instance, resistance standards for EPAs (ESD protected areas) in electronics manufacturing facilities require electrical resistance simply to measure below 10^9. Safe grounding standards for end-user spaces, on the other hand, require floors to measure 10^6 or above.

ANSI STM 7.1 Resistance Test



ANSI/ESD STM 97.2 Measurement of Voltage on a Person While Walking on a Floor



This is a critical distinction: Standards like Motorola R56 and ATIS 0600321-2015 for telecom, critical call and emergency dispatch spaces, and FAA 019f for flight towers, require higher resistance to protect people working around electrified equipment.

If you do your due diligence, reference the correct standard, then take other objectives into consideration—e.g. ergonomics, noise attenuation, durability, maintenance—you'll be on the right track.

What Happens If I Specify the Wrong ESD Floor?

An incorrect choice could yield a floor that will not work and may even generate static for a particular application. If you specify an ESD epoxy or vinyl flooring material for a space where people do not wear ESD-protective footwear, for example, not only will your floor not inhibit static—it will actually generate static. At least 70% of the specification errors we see in the field result from choosing floors that require ESD footwear for applications where ESD footwear is not used and/or the use of special ESD-protected footwear is an unrealistic expectation.

Is There One Specification That I Can Reference/Use for All Applications?

Unfortunately, no. Each industry has its own specifications designed to meet the needs of the specific application and environment. Electronics manufacturing and handling, for example, with mandates requiring everyone to wear ESD footwear with built-in electrical resistors (to protect the wearer from potential shocks) require resistance to measure below 10^9 and charge generation under 100 volts.

Most end-user environments, where people do not and will not wear ESD footwear, resistance must measure above 10^6 and below 10^9. In these environments, highly conductive flooring is considered a risk to personnel safety. For these environments the floor should be low static-generating. E.g. carpet or rubber.

SPECIFICATIONS INCLUDE:

ANSI/ESD S20.20-2014
Electronics manufacturing and handling

FAA 019f
Flight towers and spaces using FAA equipment

Motorola R56 and ATIS-0600321-2015
Telecommunications/call centers

IBM Data Center Recommendations
Data centers & Server rooms

DOD 4145.26-M
Department of Defense and U.S. Military

UFGS 09 62 38
Army Corps of Engineers, USACE, NAVFAC, AFCEC, NASA

What Is the Difference Between Conductive and Dissipative?

How quickly or slowly the floor dissipates charges to ground is a function of its electrical resistance. The lower the electrical resistance, the faster the floor will transport charges; the higher the resistance, the slower static charges will flow.

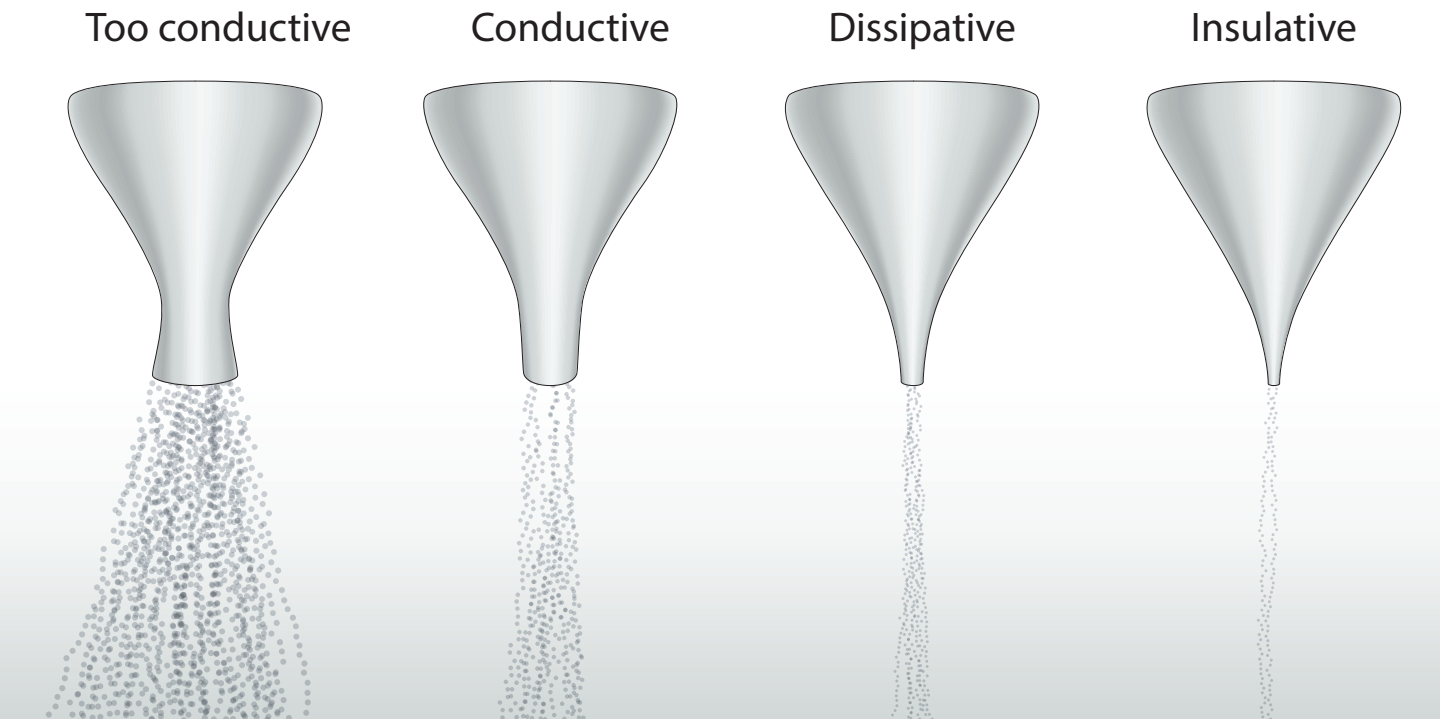
Floors with electrical resistance measuring $< 10^6$ are conductive.*

Floors with electrical resistance between 10^6 and $< 10^9$ are static dissipative.

* Floors measuring under 10^6 do not meet safety standards for end-user spaces. Conductive floors are considered unsafe in spaces where people work with electrified equipment.

Conductive floors versus static dissipative floors

Does it matter?



Which is Better: Conductive or Dissipative?

While arguments frequently arise over whether people "should" specify conductive or dissipative or whether a conductive or dissipative floor is preferable, such discussions are ill-founded.

ESD flooring should always be specified based on industry standards for the application. Never select any ESD floor in isolation. Always consider the ESD floor as part of a system that includes the environment in which it will be installed.

For manufacturing facilities, for example, specs for a conductive vinyl floor should be based on ANSI/ESD testing that includes evaluating the floor's ability to prevent charges on a person wearing ESD footwear. Floors will also perform differently with different

types of ESD footwear, so it's important to know which type(s) of footwear will be allowed in the space.*

For manufacturing facilities, footwear is as important as the properties of the floor.

Floors for end user spaces, such as 9-1-1 dispatch operations (PSAPs), critical call centers, data centers, and so on, should be specified based on having adequate electrical resistance (static-dissipative range) and on their ability to prevent static on people wearing ordinary footwear.

Never select a floor based on the descriptors "conductive" or "dissipative."

Always specify an ESD floor based on the standards for the industry and application.

Before specifying any ESD floor, is imperative to determine if there is a standard for choosing a floor for your or your client's particular industry.

ESD flooring should always be specified based on industry standards for the application.

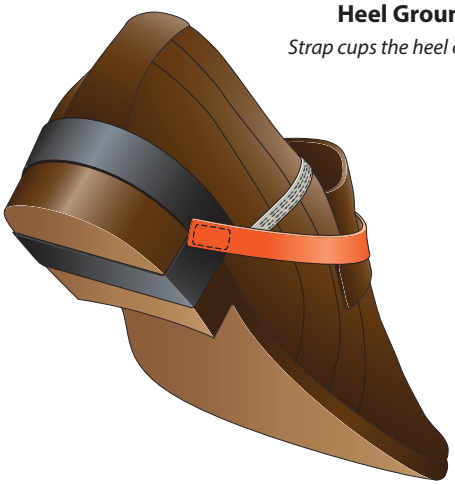
* For manufacturing facilities, footwear is as important as the properties of the floor.

Toe Grounder

Strap attaches to the toe, for use with high-heel shoes.

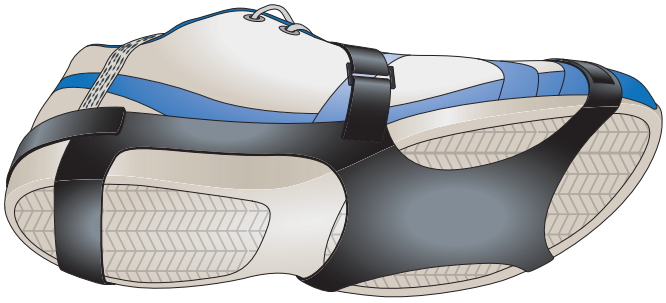
Heel Grounder

Strap cups the heel of the shoe.



Sole Grounder

Covers the sole, providing full contact with the floor.



Esd Shoes

Conductive outsole provides full contact with the floor.

Are Some Floors More Ergonomic Than Others?

Yes, carpet and rubber offer multiple ergonomic advantages over hard surfaces like vinyl or epoxy.

If an Application Requires ESD Flooring, Do I Need to Put It in Every Space?

Not necessarily. You need ESD flooring in any space where electronic equipment is manufactured, handled or used. Computers used in offices are not typically harmed by ESD events—because they are not usually disassembled and reassembled in an office. For this reason, special ESD flooring may be used but is not required for regular offices. Companies like WeWork put ESD flooring in their server rooms but not in their offices.

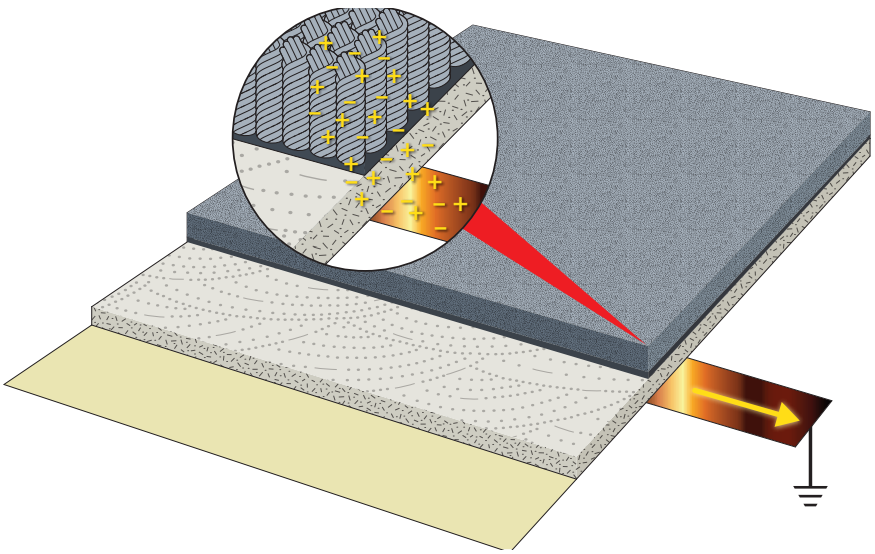
Networked offices—in critical call centers, for instance—might require ESD flooring if any disruption to the electronic system would present significant problems such impacting public safety; likewise, ESD floors should be used for operations that control power grids or those that involve banking and stock calculations. So the decision depends upon the sensitivity of the equipment and the stakes that a system failure might represent. If operations depend upon electronics to function, ESD flooring plays a necessary part in protecting the environment.

Can I Use Regular Flooring in a Room With ESD Mats Under Computers or Workspaces?

No, not in a space where operations rely on electronic equipment. Why? Because people will generate static when they walk across the floor and those charges will build on their body. A mat does not provide enough time, space—or conductivity—to safely and quickly discharge static on their body. So when they touch their equipment they would still risk an ESD event.

Do I Always Need to Ground an ESD Floor?

Yes, ESD floors must always be grounded. The purpose of an ESD floor is to discharge static electricity to ground. A properly performing floor draws static charges through the thickness of the floor to the conductive underlayment—conductive adhesive or GroundBridge conductive underlayment. Charges move across the underlayment to copper strips, placed at the perimeter of the room and connected to some form of earth ground, to ground.



ESD floors cannot perform unless they are grounded. Floors without inherent conductivity cannot be grounded; this is the reason they do not work and cannot be used to control ESD.

We Have Been Specifying Flooring for Mission Critical Operations for Years and We Have Never Required a Static Control Floor. Why Should We Change This Stance Now?

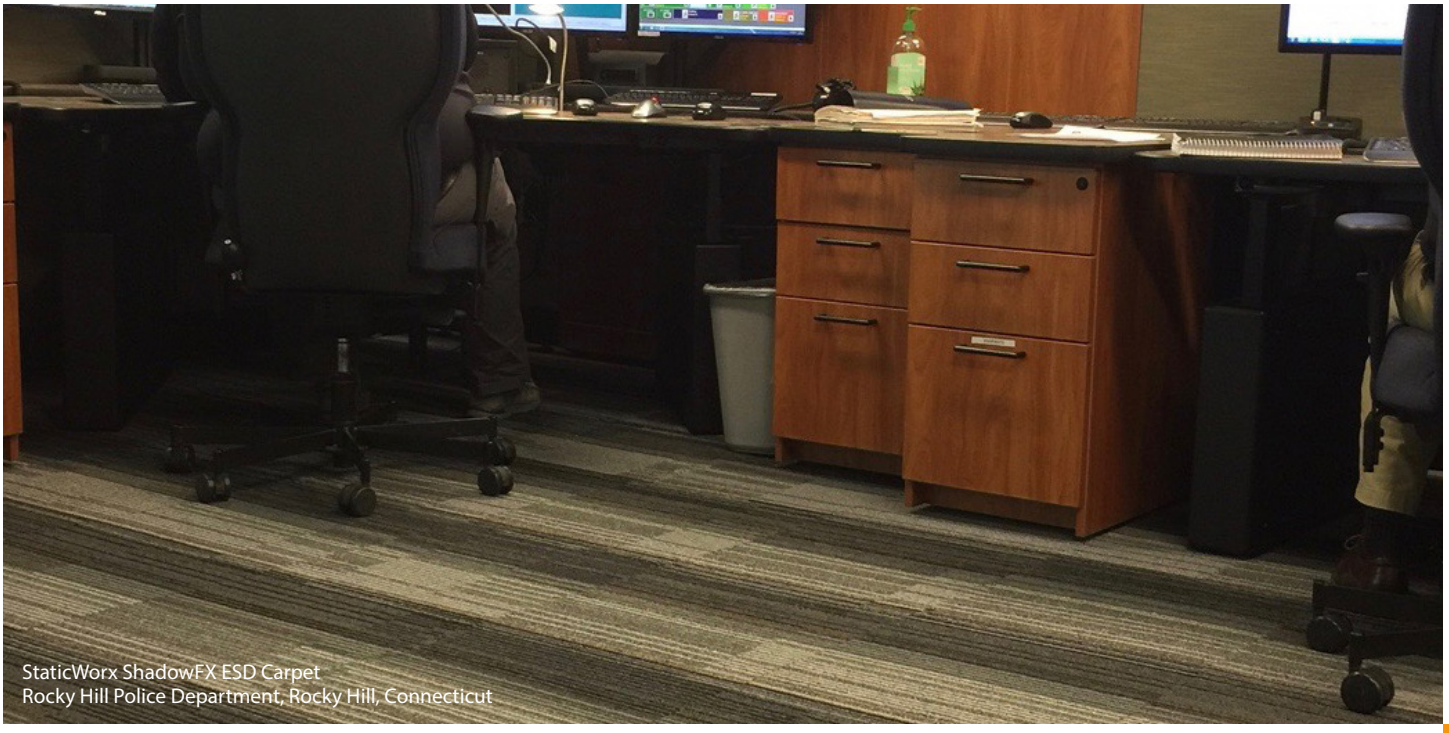
First of all, the flooring spec writer should never decide the stakes and what the impact would be if there were to be a ESD event in a client's mission-critical operation. Recognizing liability and possibly security threats is the responsibility of the client.

As components and systems have become more sophisticated, they have become more sensitive to ESD. Foregoing the use of an ESD floor may have been a cost savings decision yesterday. It isn't necessarily the right approach for tomorrow.

Operations like 9-1-1 call centers and FAA flight support and avionics operations have recognized the threat of static discharge for over 30 years. Many industries preemptively deal with static discharge due to the inherent liability in their everyday operations. Both the FAA and the largest manufacturer of radio backup communications systems, for instance, have both created 500-plus page documents dealing with grounding, lightening, surge suppression and ESD controls. For them, you might say, "failure is not an option."

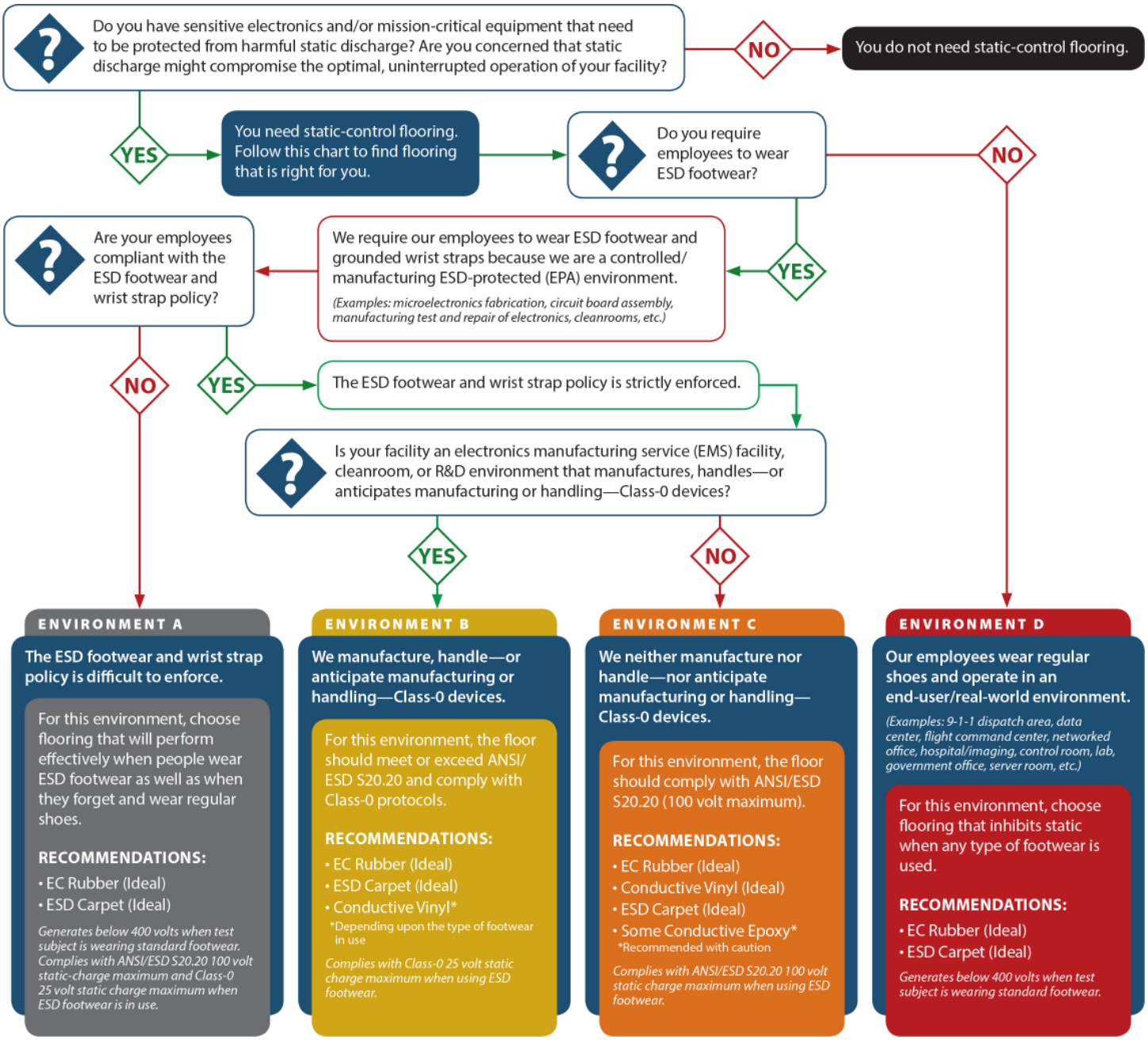
Although the equipment used in these operations is not much different than the equipment in call centers and server rooms, the fallout from a system failure would be a disaster. A flooring specifier may not be privy to this information. Thus, decisions about protecting their equipment should always be left to the client, not the outside specifier. The client should always weigh in on the impact and resulting liability of a breech in their electronic operations. The client should also decide whether they feel an investment of ESD flooring may be worthwhile.

This may seem like a simple calculus—namely, how much more does an ESD floor cost than a regular floor? But it's not that simple. A careful analysis often involves looking at other industries such as power plant control rooms, PSAPs, stock exchanges, gaming operations, flight towers and data centers and asking the critical question: "What is your liability if an ESD event were to shut down your operation?" Only the client can answer that question.



StaticWorx ShadowFX ESD Carpet
Rocky Hill Police Department, Rocky Hill, Connecticut

Selecting an ESD Floor



Specifications by Application

ANSI/ESD S20.20 – 2014

ESD Association Standard: Provides guidelines to protect electrical and electronic parts, assemblies and equipment from electrostatic discharge.

- **Handles Class-0**
  ANSI 20.20 (< 20 volts) — in addition to compliance with Class-0 protocols
- **Does Not Handle Class-0**
  ANSI 20.20 (100 volt maximum)

IEC 61340-5-1:2007 IECEE.ORG

The European equivalent to ANSI/ESD S20.20.

See ANSI 20.20 - 2014 (above)

Applications

- Electronics Manufacturing
- Microelectronics Fabrication
- Circuit Boards Assembly
- Electronics Test and Repair
- Cleanroom
- R& D
- Computer Manufacturing
- Military Base Electronics

FAA STD 019f

Standard for lightning protection, grounding, bonding and shielding requirements.

MOTOROLA R56

Public safety and telecommunications standards and guidelines for the installation of equipment, infrastructure, and facilities for communications centers.

ATIS-0600321

Telecommunications industry standard for applications where people access a computer keyboard while continually wearing a headset.

Applications

- All network-operator dispatch operations—e.g. 9-1-1 call centers
- Mission-critical Call Centers
- Communications Centers
- Networked Offices
- Government Mission-critical Areas
- Control Rooms
- Flight Towers
- All FAA/flight support areas (and 019e designation)

Mil STD 1686 (converted to ANSI/ESD S20.20)

The parent document for all ESD Association standards and is the main reference for Auditing an ESD Control Program.

Applications

Anyone auditing an ESD program

IBM Data Center Recommendations

IBM-recommended guidelines to minimize static-electricity buildup in a data centers. Safety recommendation: minimum floor resistance >150,000 ohms (1.5×10^5).

Applications

- Data Centers
- Server Rooms

NFPA 99 National Fire Protection Association– Defunct Standard for Conductive Flooring

Establishes criteria for health care services to minimize the hazards of fire, explosion, and electricity.

In 2015, all references to conductive flooring were removed from this standard.

Applications

No longer valid

DOD 4145.26-M

Safety standards for Department of Defense and private industry ammunition and explosives (AE) operations.

Applications

- Defense Contractors
- Facilities performing AE work
- AE Services
- Companies Covered Under DoD

ESD Test Methods

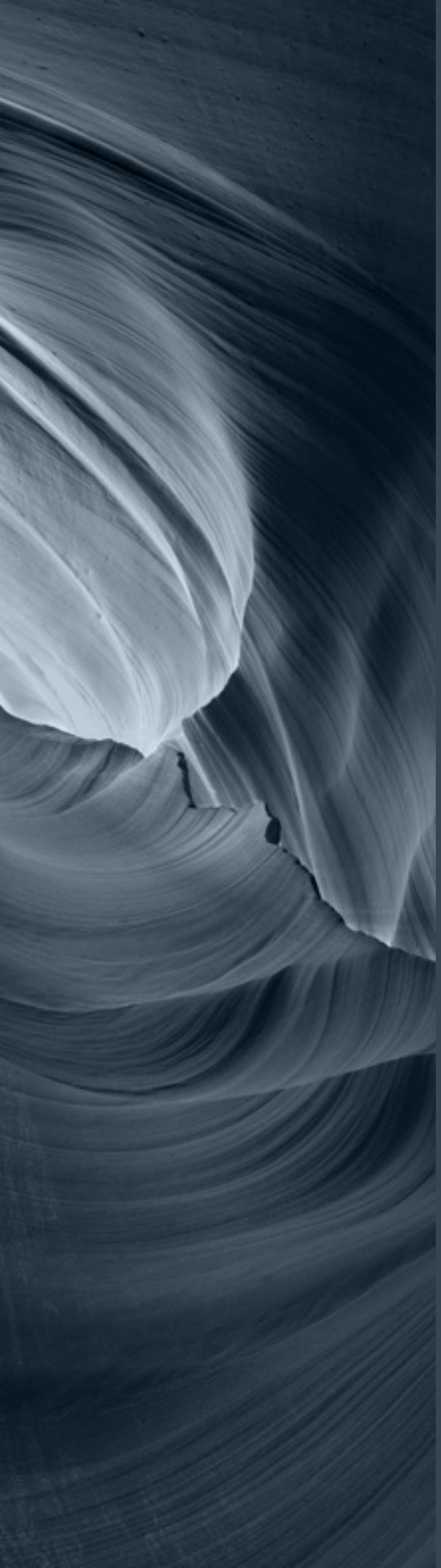
ANSI/ESD STM7.1-2013
Tests resistive properties of flooring materials.

ANSI/ESD STM97.1-2015
Measures the electrical system resistance of floor materials in combination with persons wearing static-control footwear.

ANSI/ESD STM97.2-2016
Measures the voltage on a person in combination with floor materials and static control footwear, shoes or other devices.

ASTM F150-06(2013)
Tests electrical resistance of resilient flooring.

AATCC 134
Electrostatic Propensity of Carpets. Standard carpet industry test, uses laboratory simulation to assess static generation when a person walks across the carpet.



About StaticWorx

StaticWorx manufactures the highest quality ESD flooring products available today. Our company has installed tens of millions of square feet of ESD flooring throughout the U.S., Canada, Mexico, Australia, Singapore, New Zealand and the U.K.

Some of our clients include EMC Corporation, BAE Systems, Benchmark, Flex, Lockheed Martin, Microsoft, Philips Healthcare, Amazon, Apple, Intel, Google, and Facebook.

All StaticWorx products are made in ISO-9000 certified factories and undergo rigorous testing by independent laboratories prior to shipment.

For clients who prefer a worry-free project, StaticWorx will help choose the best floor for the specific application, match your project with our best flooring installation team, oversee the installation, and test your new floor's electrical properties to be sure the floor meets your specifications.

> "The StaticWorx seminar may be the best AIA presentation I've sat through over the past 10 years. I recommend it to any architect or engineer that may have projects with static-control flooring."

To schedule a Zoom ESD training session or AIA (architects') CEU workshop, please contact us at info@staticworx.com
Or call: 617-923-2000

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