

Curing Static Electricity Damage In a Communications Center

A good-quality, high-performance conductive floor is the only fail-safe means of safely and effectively controlling static in a mission-critical environment or communications center.

**By David H. Long, President/Visionary, Staticworx, Inc.
Mission-Critical Flooring**

The LaVergne, TN Police Department handles all 9-1-1 calls for police, fire, and medical services for one of the fastest-growing municipalities in America. When their telephone consoles began crashing last year, the department was faced with a serious threat to their mission-critical operation. "At any given time, one of our consoles was down," says Lieutenant Freida Cameron, Communications Supervisor for the LaVergne County Police Department. A large-scale, multi-console crash — a remote, though viable possibility — could have left the municipality's 24,000 residents and 24,000-plus non-residents, working in the surrounding areas, with no access to emergency services. "Without the use of our phone system," Cameron says, "citizens have no way to reach us."

Assuming that the problem was in the telephone lines, Cameron contacted Bellsouth, the department's telecommunications provider. Bellsouth technicians replaced modules and grounded and re-grounded the telephone systems — to no avail. The consoles continued to crash. Finally, Bellsouth sent in a technical specialist. After retesting all of the equipment, the specialist determined that the problem was caused by static electricity.

Static Electricity Problems

The police department dispatchers had never considered the possibility that static might be causing their consoles to crash. When the center was renovated in 2001, the department had bought and installed chemically-treated antistatic mats to replace their old computer-grade carpet, which was no longer functional. "With the antistatic mats, we figured we'd solved any static problems," Cameron explains. However, Cameron learned from the Bellsouth technician that, "mats will prevent static in the place where they're located, but they do nothing to eliminate the static that builds up when people walk across the floor."

The problem LaVergne experienced is by no means unique. The electronics inside the current generation of computer hard drives are the single most sensitive components ever developed. In older model electronics, internal protective devices provided significant immunity to static events. The trade-off was that those devices slowed circuit speed, inhibiting production of faster, more advanced electronics. To produce today's higher performance electronic components, manufacturers were forced to eliminate the internal protective devices. Today, a static discharge of only 20 Volts — a discharge too small for a human to feel — can damage or destroy a sensitive electronic component.

Why Computer-Grade Antistatic Carpet and Mats Don't Work

Computer-grade low kV carpet, designed during the infancy of the computer age, contains a high density of bi-component yarns and generates less static than regular carpeting. The term bi-component refers to the co-extrusion of two materials within the same yarn strand. The internal cross-section of the yarn contains carbon; the surrounding fibers are composed of standard insulative (static generating) yarn. Bi-component yarn provides an overall reduction in static generation, but does not discharge or conduct static and does not provide a path to ground. Low kV carpet is usually specified to establish a space that is free of static charges, or zaps. When first installed, most low kV carpets will prevent shocks, as long as the relative humidity (RH) is above 50%. Low kV computer-grade carpet will not reduce static electricity when the humidity drops, as it does in the winter or when air conditioning is used.

Static shocks and zaps are Electrostatic Discharge (ESD) events, but the voltage in these charges is more than 1,000 times greater than the static discharge necessary to damage an electronic component. In fact, it takes 3500 volts of static electricity before a human feels or is in any way aware of the discharge. As already mentioned, today's lightning fast computers and telephony equipment can be damaged by a minute charge of just a few hundred volts.

Standard low kV carpets, designed to prevent people from getting shocked, are useless in areas where electronic components are used. The antistatic properties of low kV or computer-grade carpet are usually described by obsolete standards, such as the IBM/Burroughs standard that grades the carpet by its kV rating. A carpet specified for use in a mission-critical area or communications center should be rated by both triboelectric compatibility — antistatic properties — and resistance to ground, measured in ohms.

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LaVergne personnel had realized that computer-grade carpet would not protect their components, which was the reason they bought and installed the antistatic mats. The mats were treated with an antistatic chemical similar to the antistatic coating on a fabric softener sheet.

As with spraying a solution made with Downy fabric softener on the floor, antistatic carpets and mats do provide some initial benefit. As soon as the antistatic coating wears off — often within a few weeks — the carpet or mat loses its antistatic properties and can actually become a significant generator of static. The problem is, static is invisible: the only way to know that the antistat has worn off is when the console goes down for no explainable reason.

It is possible, of course, to periodically spray the floor with an antistatic chemical, like Downy, and people who know little about static sometimes recommend doing so. The trouble with periodic maintenance is twofold: 1) you don't always know when it's time to reapply the antistat; 2) more importantly, surface additives do not work in dry conditions, such as in winter or in air conditioned spaces. Unless the static problem is minor — involving nuisance shocks, in places where no sensitive computers, electronic components or telephone systems are in use—or the solution need not be long-term, these types of solutions are not recommended and should never be used.

Solving the Problem

As with any purchasing decision, finding the correct antistatic solution requires doing some homework. Before deciding on a solution, it's always best to understand the cause of a problem. That way, any problems will actually be fixed rather than applying a band-aid. Buyers should have at least a rudimentary understanding of three things:

- What is electricity discharge?
- What conditions cause or increased the generation of static charges?
- What can be done to prevent static in the first place?

Static electricity is electricity at rest; amperes of electrical current do not apply to static electricity as they do to the electricity flowing through plugs, switches, and electrical outlets. While at rest, electricity cannot harm anything. However, when it discharges, the electricity that was once static becomes

dynamic. That invisible, high-speed computers and telephony equipment. A seemingly insignificant signal from a static discharge can command a mainframe computer system to shut down or generate an unwarranted signal directing an unintended action.

Static generation, like any physical phenomena, requires certain conditions that will either promote or inhibit it. We know from birthday party experiences of rubbing balloons on our heads and watching hair stand on end that static is a good generator. We also know that static is more easily generated when the humidity is low. Since most communications centers are carpeted, which is essentially the same thing as coating a floor with plastic, the first condition for static generation has been satisfied. Until the advent of air conditioning, condition number two was only satisfied during the so-called heating months between November and April. However, today's 24/7 HVAC systems increase comfort by extracting humidity from the air whether they are heating or cooling, resulting in potential static problems on any given day regardless of the season or geographic location.

The most important thing to know about controlling static electricity in a 9-1-1 communications center is that it must be prevented. Because high humidity will reduce the possible generation of static, installing large humidification systems inside HVAC air ducts is an option to consider. Unfortunately, this solution usually backfires because most people become significantly less comfortable as relative humidity rises. Additionally, it is almost impossible to control static with humidity generators if the external humidity is already low as it is in the wintertime.

This forces us to attack condition number two, the plastic or static-generating floor. Since most carpets contain millions of static generating nylon fibers, many facilities have tried replacing carpet with conductive mats and or special conductive tiles. Unfortunately, mats are clumsy and they only prevent static that might

be generated after a person stands on them. They do nothing

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When evaluating a static control carpet, always keep the following points in mind:

- > Never rely on your sense of touch to tell you that you have a static problem. Static is invisible to the senses. It takes 3500 Volts of static before a human feels the discharge. A few hundred Volts will harm your electronic equipment or corrupt data.
- > An ounce of prevention is worth a pound of cure. It is better to prevent static than to ground static.
- > The floor should have both conductive and antistatic properties;
- > Grounded mats do not work in a call center. Static is accumulative, it builds as you walk. Mats cannot discharge static after it has accumulated on your body.
- > The static control floor must cover the entire call center. Otherwise, people can generate static and carry it over to the protected area.
- > The floor should never rely on special sprays or treatments. These are temporary and impossible to monitor.
- > Rolling casters destroy most conductive fibers and computer-grade floors.
- > Be sure your floor passes the "Roller Caster Electrical Test" or CET. The CET is the only predictor of what will happen to your floor's electrical properties after normal abuse in the most critical area — under your chair and next to your console.
- > Be wary of lifetime warranties from suppliers who do not provide test data after accelerated life testing.
- > Select the flooring before you call installers. Static is not their area of expertise. Beware of manufacturers that claim they will supply and install your floor. You need local support in case you have problems or need repairs.

to the static that a person brings with him or her when walking across the rest of the floor.

Covering the entire area with conductive vinyl tiles might seem like a good solution, but recent research has shown that vinyl tiles will not reduce static on people unless they wear special conductive footwear. Without special footwear, conductive vinyl tiles actually generate static electricity. Fortunately, the same research has proven that conductive — not low kV, not computer-grade, and not 2 or 3 kV — carpet tiles not only eliminate static, but also actually prevent charge generation or what we call walking body voltage, in the first place.

Understanding Charge Generation: Walking Body Voltage

The generation of static electricity from contact and separation is a well documented phenomenon: any time two materials interact and then separate, there is an exchange of electrons between the two materials. In the case of people and floors, shoe soles interact with the floor's surface, generating an electrical charge that accumulates on the person's body. This is called walking body voltage. The minute the person touches something — a door knob, for example — the voltage that has accumulated on his body immediately discharges from him to whatever he touched. If the object happens to be an electronic component — a telephone console, for instance — the electrical signal from the static discharge interferes with the component's internal circuitry, causing the sort of crash experienced by the LaVergne dispatchers and the military air traffic controllers.

Conductive Carpet Discharges Static to Ground

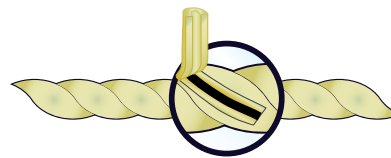
The floor is the central contact point in a dispatch center — everyone touches the floor. The floor is also the area where all static charges originate. The mats in the LaVergne PD didn't work because static is an accumulative problem. People walking around a busy call center generate and store static before they ever set foot on a mat. Since an antistatic mat provides no electrical path between the shoe soles and itself — to dissipate static, you need a conductive, not an antistatic material — it cannot discharge static electricity. With static electricity, the proper solution is always preemptive: static must be prevented before it becomes a problem. To solve the LaVergne Police Department static problem the old carpet and antistatic mats needed to be replaced with conductive carpeting, specially designed for use in mission-critical areas. To function properly, a conductive carpet must contain conductive fibers, have a conductive backing, be installed with conductive adhesive and be attached to a path to ground. The conductive floor must be installed throughout the center, not just in certain areas. When a person walks across a properly installed conductive carpet, the charge generated between his or her feet and the floor discharges to the carpet, then travels along the designated path to ground. A good-quality, high-performance conductive floor is the only fail-safe means of safely and effectively controlling static in a mission-critical environment or communications center.

Electrical Requirements of a Static Control Floor

When evaluating a floor for its ability to control static, the specifier should verify:

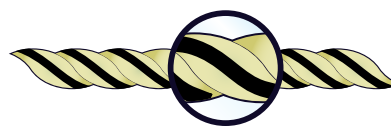
- That when a person walks across the floor, the floor itself will not generate more than 100 volts, regardless of the person's shoes

Standard Low-kv Carpet *(thread cross section)*



Conductive fiber is buried in the center of each thread of kv carpet

StaticWorx ESD Carpet *(thread cross section)*



Conductive fiber, integrated into the carpet weave, wraps around the outside of the thread, helix-style

A yarn strand comparison

- The electrical resistance of the floor should be below 100 meg-ohms or 1×10^8 ohms. Carpet with electrical resistance below 1×10^7 performs best.
- The electrical properties should be verified at low (less than 20 percent) relative humidity so you know what to expect during extremely dry months.
- Electrical properties should specify what happens when people walk on the floor with a variety of shoe soles and not just leather and neolite.
- Rubber shoes should always be included in any test since they are the most common footwear in use today.

These factors are particularly important in dispatch centers where people wear street shoes and are unlikely to use heel or wrist straps.

Roller Caster Electrical Test Assesses Long-Term Electrical Performance

When evaluating a static control carpet, always ask for test data. The Roller Caster Electrical Test (CET), an essential test for conductive carpet, will tell you whether or not the carpet will retain its electrical properties after it has been exposed to a year or two of chairs rolling over the floor. Rolling casters destroy or "mash" the carbon fibers in conductive carpeting and can turn a once conductive product into an insulator. In the LaVergne County Police Department,

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Walking Body Voltage

1

Walking across a floor, shoes contact and separate from the walking surface. This contact and separation (friction) generates a tribo-charge, or static electricity.



2

Electrons transfer between the surface of the floor and the person creating an electrical imbalance or charge. To restore balance, the charge must be dispersed.



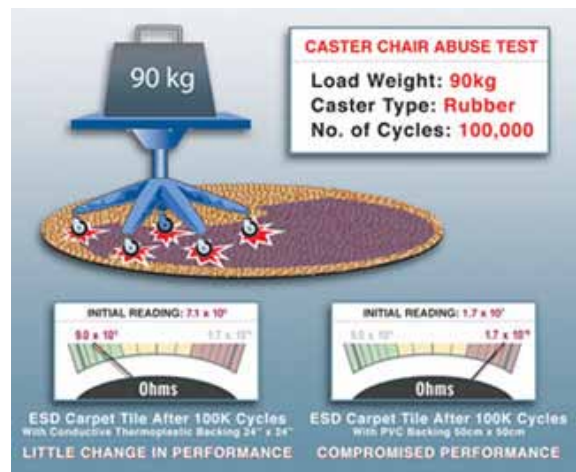
3

Most electrical charges are dispersed through the hands. If the charged person touches a computer or electronic component, the charge that's released can damage or destroy sensitive electronics. In most cases, the person never feels the discharge.



A walking body voltage drawing, showing the way static is generated and discharged.

the pre-renovation antistatic carpeting failed because the antistatic fibers, crushed by the chair casters, were no longer in contact with the dispatchers' shoe soles; as a result, the dispatchers were walking across a floor with less static protection than the living room carpet found in most people's homes. The static control properties of a conductive carpet should always be tested before and after the CET. The CET simulates the action of a person seated in a caster chair, rolling back and forth and moving around, and assesses delamination and edge-ravel performance. Areas where roller caster chairs are in use are the most demanding of any carpet. Again, because crushed fibers can render the static control properties useless, the CET is absolutely essential for evaluating the long-term performance of a conductive carpet. To make the test as rigorous as possible, an unsealed seam should be cut in each sample prior to testing. In addition, each sample must be installed over a defined cushion, which dramatically increases flexing at the seams, the most vulnerable point in any carpet. The flexing action, coupled with 198 pounds (90 kilograms) weighting and 25,000 cycles of the caster chair, imparts highly accelerated fatiguing of the carpet, seams and backing. With a regular carpet, no edge ravel or delamination should be evident after 100,000 cycles. Products that can successfully withstand this grueling test usually demonstrate outstanding field performance. Poor results help identify potential problems before the carpet is installed. Because the static control properties of a conductive carpet can be destroyed by repeated wear from rolling casters, floors with conductive yarn systems should be exposed to at least 100,000 cycles (less than two years of installed use in a 24/7 mission-critical space). The recommended requirements of ANSI/ESD S20.20. (ANSI/ESD S.20.20 is the electrical standard endorsed by the Electrostatic Discharge Association, the international organization that sets the standards for the proper control of static electricity. With this in mind, anyone in charge of selecting a static control floor should be aware that a lifetime-time electrical warranty cannot be interpreted as immunity to caster rolling damage; most suppliers of computer-grade or ESD carpet do not even test for caster damage because it is specifically excluded from any warranties they provide. The chair caster rolling test also revealed significant electrical performance weaknesses in certain types of static control carpet tiles. For example, tiles made with PVC



Chair caster graphics, showing how chair casters can damage a carpet.

backing fared very poorly in the test. There are several possible explanations for the inferior performance of tiles backed with PVC. First, PVC is a poor conductor. It is also possible that the tiles backed with PVC lacked other critical design features like insertion of conductive fiber in all the yarn ends of the carpet or that these PVC products were built with small denier (textile term for size) fragile conductive fibers. Whatever the explanation, 9-1-1 communications centers require extreme longevity from their static control floor — newer, faster, and more vulnerable electronics are constantly finding their way into the work place. Since installing conductive carpet, the LaVergne Police Department has suffered no more outages and the consoles are working perfectly. "Our problem," Cameron says, with a sigh of relief, "is finally solved."