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Does the flooring in your 9-1-1 center comply with grounding standards?

The expected standard of care in specifying static-control flooring

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Does the flooring in your 9-1-1 center comply with grounding standards?

The expected standard of care in specifying static-control flooring

The job of 9-1-1 dispatchers is to respond to calls from people who may be in danger. But what happens when electrostatic discharges (ESD) interfere with communications equipment and the call is lost?

Static-control flooring, particularly carpet tile, helps prevent ESD events from harming equipment in 9-1-1 dispatch centers and equipment rooms. Simply put, if this flooring doesn't meet international industry standards—as well as the **standard of care** established by the American Institute of Architects (AIA)—callers and dispatchers could be at risk.

Recent research reveals a rather shocking finding: Approximately 70% of anti-static floors installed in end-user environments such as emergency dispatch centers are improperly specified.

WHAT ACCOUNTS FOR SUCH A HIGH LEVEL OF FAULTY INSTALLATION?

- The main culprit is a general lack of awareness regarding communication industry standards. This unfamiliarity is commonplace among not only facility managers but also professionals such as architects, engineers, other specifiers, and the contractors who install flooring. In fact, even most flooring manufacturers often don't have the right technical information.

- Lack of information often leads to misinformation. Unfortunately, manufacturers and distributors sometimes confuse and mislead buyers by incorrectly recommending products that don't meet the latest standards. Unsuspecting specifiers read their marketing claims and assume the information is technically valid, even if that's not the case.

Approximately 70% of anti-static floors installed in end-user environments such as emergency dispatch centers are improperly specified.

- Compounding the problem is the fact that industry standards are subject to change. However, electrical engineers are usually the only people who are up to speed regarding important revisions that impact the selection of grounded flooring. So, if you don't conduct due diligence, you may be asking for trouble, especially if your carpet flooring is excessively conductive.

ShadowFX Carpet Tile complies with all standards, shown installed with Ground Grabbers® installation pads at the 9-1-1 call center for the City of Boston's Fire Department.

The upshot? Specialized flooring of this kind requires very specialized skills that facility managers and design professionals often don't have.

CARE, CAUTION, AND CORRECT CONDUCTIVITY

Facility managers and architects who write specifications for emergency call centers, radio dispatch sites, and PSAPs should exercise care and caution when specifying grounded flooring. Why? Because of the many implications related to performance, electrical safety, compliance, and liability.

- **Performance:** The floor needs to meet the needs of the application and prevent or ground static. In a call center,

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this requires choosing a floor that will prevent static on people wearing any kind of footwear. The challenge: many static-control floors like vinyl, epoxy, and interlocking plastic tare intended to be used with special static-control footwear. Independent studies have shown that static-dissipative carpet and rubber floors inhibit static regardless of footwear.

- **Safety:** A static-control floor isn't just a walking surface; it is a connection to ground, and it must not create a safety hazard while it eliminates ESD. If the grounded floor will be used around operational computer equipment, it can't be so conductive that it will act as a dangerous ground in the event of stray voltage or other electrical problems. An incorrectly specified static-control floor—particularly "low-resistance," conductive carpet—might eliminate static discharges, but it may also put workers at risk because it is too conductive to be installed around electrical equipment.

  The correct electrical resistance should be specified and verified after the floor is installed. **Note that 1 million ohms (1.0 X 10^6) is the standard minimum resistance value for equipment rooms and call centers.**

- **Compliance and Standard of Care:** Any static-control floor is also a grounded pathway for electricity. Based on a specifier's or architect's standard of care, it should meet or exceed industry grounding standards, comply with state and local codes, and meet the needs of the client. **Motorola R56 and ATIS 0600321.2010** are considered the definitive guides to site grounding and electrical protection for communication sites like 9-1-1 dispatcher operations (see below). These standards clearly define the best practice ohms resistance rating range for call centers, and both documents recommend at least 1 million ohms.

- **Liability:** At home, safeguards like ground fault interrupters and building code inspections protect against electrical shock and potentially harmful results. But what about safeguards in the workplace? The fact is that manufacturers, installers, and specifiers can be held liable for any damage or harm their products might cause.

  In an article published by IN Compliance Magazine in January 2012, nationally known liability attorney Kenneth Ross states, "Industry standards and even certifications like UL are considered minimum. As a result, compliance with standards and certifications is not an absolute defense, although it is pretty good evidence that the product was reasonably safe. Therefore, as with laws and regulations, the plaintiff can argue that you should have exceeded the standards. However, noncompliance is a problem if it caused or contributed to the injury. The reason is that the standard establishes a reasonable alternative design and the manufacturer has to justify why it didn't comply."

  In the case of static-control flooring, reasonable alternatives certainly exist. And in looking for the best solution, as noted above, it is prudent to exceed safety and electrical thresholds and never specify less electrical resistance than standards and compliance documents recommend. **This means the floor should measure in the static dissipative range: over 1,000,000 ohms and less than 1,000,000,000.**

In actual installations, environmental factors like moisture and wet shoes can and will reduce the resistance of any static-control floor. When resistance is reduced, electrical current will increase.

While most people ascribe to the adage, "You can't be too safe," some buyers or sellers prefer to downplay the risks that come with disregarding industry standards, asserting that electrical accidents from a highly conductive floor would be highly unlikely. Yet it is hard to ignore the documented cases of people receiving shocks while walking over steel manhole covers that become electrified due to stray voltage, corroded wire insulation, or inadequate grounding. Other cases involve persons standing on a wet and conductive surface while in the presence of an electrical short circuit.

ALL ABOUT OHMS

Rather than relying on anecdotal evidence, let's look at the scientific reasons electrical engineers don't recommend conductive floors in operational equipment environments:

Suppose a room is outfitted with a server or telecom switch operating at 220 volts. This voltage could cause a dangerous

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and even lethal shock if a person touches the electrical source while grounded to the conductive floor. **Ohm's Law** tells us that electrical current (I) can be calculated by dividing voltage (V) by resistance (R) (I = V/R). For example, the calculated current between a 220-volt source and a floor measuring 25,000 ohms would be 220 volts divided by 25000 ohms or 8.8 milliamps. According to OSHA, 8.8 milliamps will inflict a painful shock and cause a person to begin to lose muscular control. Electrical current between 6 and 16 milliamps is commonly referred to as the freezing current or "let-go" range.

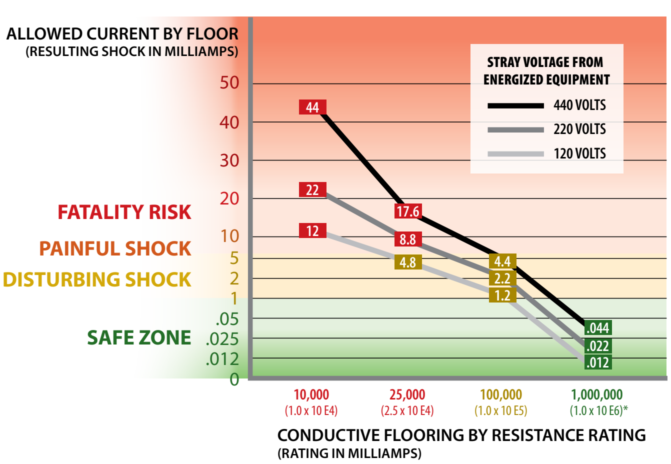
Floors should measure in the static dissipative range of over 1,000,000 ohms and less than 1,000,000,000.

After installation, factors like wet shoe soles and high moisture can cause a drop in resistance, which creates a lesser resistance path to ground than lab testing would have predicted. Conductive carpet tiles, for example, can measure 10,000 ohms or less even though they are typically specified as having an average resistance of no less than 25,000 ohms and no more than 1,000,000 ohms. At 10,000 ohms, the same 220-volt appliance could expose a person to an electrical current of 22 milliamps. According to OSHA (see chart below), extreme pain, respiratory arrest, or severe muscular contractions could occur from exposure to this amount of current. At this level, the individual may not be able to let go, and death may result.

To put these calculations into perspective, on a "static-dissipative" floor that meets Motorola R56, the same 220-volt appliance would only generate .22 milliamps of current—1/100th of the current allowed by the conductive floor. This explains why standards organizations recommend a 1 million ohm minimum resistance for static-control carpet installed in dispatcher areas.

This link to an Ohm's Law calculator (http://www.the12volt.com/ohm/ohmslawcalculators.asp) allows you to mathematically determine electrical current based on the resistance of floors that might be used around energized equipment and appliances. *Note: Keep in mind that Ohm's law likely presents a best-case scenario. In actual installations, environmental factors like moisture and wet shoes can and will reduce the resistance of any static control-floor. When resistance is reduced, electrical current will increase.*

Resulting electrical current allowed by conductive floors with different resistance ratings



Source: "How Electrical Current Affects the Human Body," OSHA (Occupational Safety and Health Administration) web site (http://www.osha.gov/SLTC/etools/construction/electrical_incidents/eleccurrent.html!)

*Conductive flooring with resistance ratings above 1.0 x 10 E6 and less than 1.0 x 10 E9 meet these industry safety standards: Motorola R56, ATIS 0600321, and FAA 019e.s

THE FACTS SPEAK FOR THEMSELVES

As noted earlier, risks are avoidable, and objective, third-party international standards are readily accessible. Look for standards that are specifically designed for communications and telecom environments, since ESD standards like ANSI/ESD S20.20 used in electronics manufacturing are not relevant to communications operations. For a specifier to satisfy the expected standard of care, it is important to know what the latest standards are—and to comply with them.

Motorola R56: The Motorola guidelines have become the recognized standard in the industry and serve as the most complete and rigorous specification for the protection of communication system equipment installed at public safety and commercial wireless communication sites.

[Link: Motorla R56 PDF file (http://www.radioandtrunking.com/downloads/motorola/

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R56_2005_manual.pdf). Refer to pages 468-470.]

Excerpt from Appendix C 3.3 - 68P81089E50-B: "Carpeting or floor tiles within an equipment room or dispatch center, including raised flooring, should have a resistance to ground measurement of between 1,000,000 and 1,000,000,000 ohms."

We mentioned before that standards are subject to change based on the latest research. To keep abreast of these developments, we recently contacted the standards committee at Motorola. As it turns out, Motorola will soon release a revision of R56 that will add a recommendation on the need to conduct flooring audits to ensure proper compliance.

ATIS 0600321-2010 (Alliance for Telecommunications Industry Solutions): ATIS publishes standards for the information, entertainment, and communications industries.

[Link: ATIS-0600321-2010—Electrical Protection for Network Operator-Type Equipment Positions (http://infostore.saiglobal.com/store/details.aspx?ProductID=1485999)]

Excerpt from Page, Section 4.2 Flooring: "Any carpeting or floor tiles should have a resistance to ground between 10^6 and 10^{10} ohms when measured using the method of ESD-S7.1."

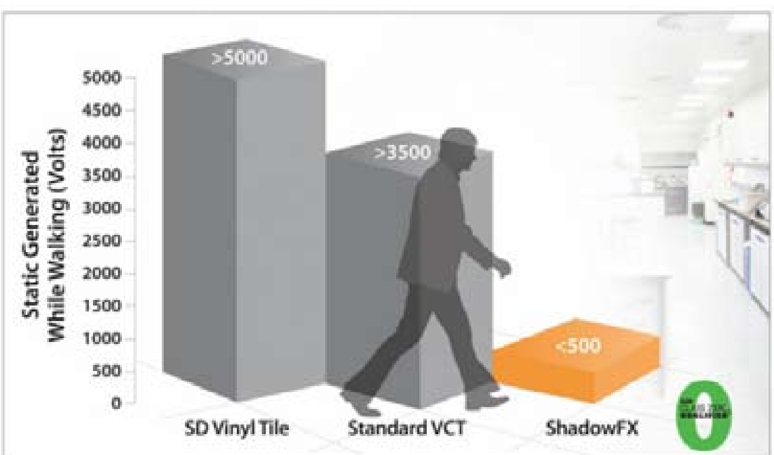
Look for standards that are specifically designed for communications and telecom environments, since ESD standards like ANSI/ESD S20.20 used in electronics manufacturing are not relevant to communications operations.

The above recommendations are not unique to the telecom industry. For example, FAA grounding standard STD 019e recommends the same ohms range for flooring in flight control equipment areas, and most computer manufacturers recommend static-control flooring measuring between 1 million ohms and less than one billion (1.0 X 10^9.) FAA's 019e document supersedes a previous document (019d) where conductive flooring was considered acceptable.

In addition to these accepted industry standards, it is useful to consult with other third-party sources such as ESD industry analyst Steve Fowler, president of Fowler Associates and publisher of ESD Journal (link). According to Fowler, electrical codes require Ground Fault Interrupter outlets when the floor's conductivity might allow over 5 milliamps. If the floor gains conductivity and is already border-line, there is a problem.

Static Charge Generation with Regular Footwear

STATIC DISSIPATIVE VINYL VERSUS SHADOWFX SD CARPET TILE



What if someone walks into the work area with wet shooes and the resistance between that person and ground is lower than intended? If the floor is compliant, it should be forgiving; if it is borderline, you may have a big problem.

DUE DILIGENCE

In the emergency response industry, with so much at stake, it is critical to communicate clearly and help people make the right decisions. The stakes are also high in the static-control industry, where the right information will lead to intelligent choices, including flooring that will not contribute an unnecessary risk to personnel and protect your organization from liability exposure.

To exercise due diligence, you will need to invest a little time—for example, you may need to compare the claims of product marketers with the recommendations of R56

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and ATIS. But without this investment, consider the costs of negligence, including replacing a non-complying floor or even a law suit.

A compliant floor should be forgiving; if it is border-line, you may have a big problem.

We also recommend that you review the AIA's latest document regarding Standard of Care. In short, the performance of design professionals such as architects and engineers is measured in two ways: the contract between the owner and the professional, and the over-riding professional Standard of Care. When that level of care is challenged, the burden of proof often falls more heavily on the professional (or the defendant).

In any event, it is sometimes tempting to take short cuts when websites and product brochures seem to be saying the right things. In our online world, we often do research and buy goods and services without ever meeting or talking to the supplier. But while the Internet may be a great resource, it also may lead to potholes and pratfalls. So before clicking on the "easy" button, consider well-grounded solutions…and avoid future shock.

David Long *is President and CEO of Staticworx, North America's largest manufacturer of electrostatic discharge (ESD) flooring products that protect work sites with customized, static-free solutions. Based in Newton, MA, Staticworx has warehouses on both coasts and is factory-direct. Comprehensive flooring options include rubber, carpet, vinyl tile, epoxy, and adhesives. All products meet international standards, are environmentally friendly, and come with lifetime warranties. Start-to-finish services include ongoing access to technical support. Contact Dave via e-mail at dave@staticworx.com or call 617-923-2000. For more information, visit www.staticworx.com.*

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- NIOSH [1998]. Worker Deaths by Electrocution; A Summary of NIOSH Surveillance and Investigative Findings. Ohio: US Heath and Human Services.
- Greenwald EK [1991]. Electrical Hazards and Accidents—Their Cause and Prevention. New York: Van Nostrand Reinhold.

Important Information from OSHA: **How Electrical Current Affects the Human Body**

Three primary factors affect the severity of the shock a person receives when he or she is a part of an electrical circuit:

- Amount of current flowing through the body (measured in amperes).
- Path of the current through the body.
- Length of time the body is in the circuit.

Other factors that may affect the severity of the shock are:

- The voltage of the current.
- The presence of moisture in the environment.
- The phase of the heart cycle when the shock occurs.
- The general health of the person prior to the shock.

Effects can range from a barely perceptible tingle to severe burns and immediate cardiac arrest. Although it is not known the exact injuries that result from any given amperage, the following table demonstrates this general relationship for a 60-cycle, hand-to-foot shock of one second's duration:

Electric Shock—Effects on the Body

Current level (Milliamperes)	Probable Effect on Human Body
1 mA	Perception level. Slight tingling sensation. Still dangerous under certain conditions.
5 mA	Slight shock felt; not painful but disturbing. Average individual can let go. However, strong involuntary reactions to shocks in this range may lead to injuries.
6 mA–16 mA	Painful shock, begin to lose muscular control. Commonly referred to as the freezing current or "let-go" range.
17 mA–99 mA	Extreme pain, respiratory arrest, severe muscular contractions. Individual cannot let go. Death is possible.
100 mA–2000 mA	Ventricular fibrillation (uneven, uncoordinated pumping of the heart.) Muscular contraction and nerve damage begins to occur. Death is likely.
> 2000 mA	Cardiac arrest, internal organ damage, and severe burns. Death is probable.

Original file: http://www.osha.gov/SLTC/etools/construction/electrical_incidents/eleccurrent.html