UNDERSTANDING ESD AND THE NEED FOR STATREZ™ STATIC CONTROL FLOORING

By Jim Essig

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What is ESD?

Electrostatic discharge (ESD) is the sudden spontaneous transfer of electric current. ESD events damage electronic parts during the manufacturing process and affect the performance of operational electronic systems such as communication equipment in 9-1-1 call centers, servers, data storage systems and even navigation systems in flight control operations. At the networked office level, ESD causes communication errors, equipment freeze-ups and system crashes.

Why has ESD Become so Critical?

The micro-miniaturization of electronics has intensified ESD sensitivity, as manufacturers can no longer design special circuit protectors into their devices. To give an interesting example, a microprocessor in 1970 typically consisted of around 2,300 transistors. Today, the number of transistors would be around 1.3 billion in the same amount of space. This correlates to doubling the number of transistors every two years for the last 40 years, which Intel has accomplished. That 1970 device could withstand a charge of 1,000 volts; today’s complex devices can be damaged by discharges as little as 15 volts.

Cost of ESD Damage to Industry

ESD can trigger two types of failures: catastrophic and latent. Catastrophic failures are the easiest to identify because the component will fail testing. Latent failures, however, are caused by a discharge not large enough to trigger a complete failure but can still weaken the component. This often allows the component to pass testing and then mysteriously fail during use. Ninety percent of all failures are latent failures, and the cost associated with ESD-damaged components can be staggering.

Cisco determined that a failure during assembly costs twice the cost of assembly and labor. If caught during testing, it’s 10 times the cost, and failure at the customer site costs 100 times the cost of assembly and labor. This doesn’t even take into account the cost of loss of reputation and business due to customer dissatisfaction. Industry experts estimate average product losses due to static range up to 33%. They also estimate the actual cost of ESD damage to the electronics industry at $5 billion annually.

An ESD Control Program Including Static Control Flooring

Some major companies report 25% of all identified electronic part failure is due to ESD. Implementing an ESD control program has greatly reduced latent field failures and allowed them to report return on investments of 10:1. Static control flooring is an integral part of all ESD control programs as the main source for static is from the interaction of personnel and the floor. Flooring is also the easiest place to mitigate the problem.

ESD Flooring Types

ESD Vinyl Tile

ESD tile is one of the oldest forms of ESD flooring. Early on it was determined that introducing conductive material into the tile would give it static control properties. Two drawbacks were that vinyl tile does not support heavy load traffic in manufacturing areas and that the tile, while un-waxed, had
static control properties but did not have the desired appearance of a traditional waxed floor. Waxing with traditional waxes insulated the tile, rendering them non-conductive. This led to the development of antistatic waxes, however, this introduced a very labor intensive maintenance schedule as the waxes’ properties were fugitive and also many relied on atmospheric moisture to function properly. There was no way to be sure the topical wax was performing properly without daily testing, so most maintenance schedules involved stripping and reapplying the wax over very short time intervals.

**ESD Carpet**

ESD Carpet was initially developed for residential and generic commercial applications to keep people from being shocked while walking across the carpet. This was accomplished, but it only limited charge generation to a certain degree, not to the level required for ESD applications. Further, ESD carpet could not stand the high traffic because the fibers would break down rendering the carpet non-conductive. Today’s carpet tiles have addressed most of the drawbacks to traditional ‘computer grade’ carpet, but they still aren’t practical for manufacturing environments and high-traffic areas.

**ESD Rubber**

For many years conductive rubber flooring was very popular as long as you liked the color black. The rubber flooring was better for anti-fatigue properties and some sound deadening properties. Today’s ESD rubber has addressed the issue of only being available in black by incorporating carbon contact points with decorative patterns. However the initial cost of rubber flooring is substantially higher than the other choices.

**ESD Epoxy**

In facilities where constant heavy loads and high traffic are the norm, epoxies are almost the only practical flooring material. Early versions of ESD epoxy were based on incorporating conductive carbon fibers within the non-conductive epoxy matrix and hoping that the application would allow the fibers to contact a conductive ground plane and stick out of the surface of the coating. Although the floors were very durable and easy to maintain, they were prone to dead spots where the fibers didn’t align properly and, more often than not, required much higher test voltages when testing surface resistance to burn through the insulating epoxy to get to the fibers.

Today’s next-generation ESD epoxies, such as Arizona Polymer Flooring’s StatRez™ 350 and StatRez™ 925, are particulate-based systems. The conductive particulates in the system make contact with each other, creating a continuous conductive network throughout the entire coating. They also allow for monolithic pastel color systems without black speckles or visible strands. The only drawbacks are that the floors are very hard and do not have anti-fatigue properties or sound deadening properties. Additionally, being an epoxy, they can yellow somewhat over time under UV light.

**ESD Polyurethane**

A recent development in the industry, ESD polyurethanes, including Arizona Polymer Flooring’s StatRez™ 225, address the issues of ESD epoxy’s UV stability. Using particulate technology incorporated into a UV-stable polyester urethane, all the benefits of ESD epoxy are retained with the addition of UV stability. Chemical and abrasion resistance are at least comparable and could be even be better than ESD epoxies depending on the type of epoxy. These systems are used often where
there are many windows or open doorways allowing for a great deal of UV exposure, such as aircraft hangars and car showrooms. As with all systems, there are limitations. StatRez™ 225 is a solvent-based material, and although VOC-compliant everywhere, it still generates odors during installation.

50-Year Lifecycle Costs

**ESD Vinyl Tile**

Lowest initial cost; typical 15-year service life requiring three replacement systems. ESD tile has very high maintenance costs, making this system the second most costly system over time.

**ESD Carpet**

Higher initial cost than epoxy and vinyl but lower than rubber; 10-year service life requiring four replacement systems. ESD carpet has medium maintenance costs, which make it more cost effective than vinyl or rubber.

**ESD Rubber**

Highest initial cost; typical 10-year service life requiring four replacement systems. Low maintenance costs, but the high initial and replacement cost of the rubber makes this the most expensive system overtime.

**ESD Epoxy and Polyurethane**

Slightly higher initial cost than vinyl, but not significantly so. ESD epoxy and urethane has a 15-year service life, so three replacement systems, although reapplication only involves sanding and recoating where all other systems require removal of old system before replacing. Along with very low maintenance costs, it is easy to see that these systems are by far the most cost effective over the lifecycle of the floor.

**Conclusion**

It’s clear that in this day and age almost every aspect of our lives is touched by sophisticated electronics. It’s also clear that controlling static events is critical in controlling both quality and costs in many diverse environments from semiconductor manufacturing to casino command centers. An ESD control program is the best way to address this, and some form of static control flooring is a necessary component of any ESD control program. The StatRez™ line of high performance static control flooring meet or exceed industry standards developed by ASTM, the National Fire Protection Agency, the ANSI/ESD Association, the Department of Defense, the International Electrotechnical Committee and JEDEC Solid State Technology Association, and they do so in an attractive, cost effective manner.