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The Facilities Manager's Guide To ESD Flooring Materials

Developments in flooring technology provide more options and offer flexible approaches

By Dave Long, President, Staticworx®

Many facilities managers agonize unnecessarily while attempting to choose the "right" ESD flooring for their corporate environments. Because most high tech businesses house multiple processes, each with its own individual flooring requirement, satisfying every department can be a daunting, thankless challenge. Further frustrated by conflicting ESD specifications as well as the plethora of propaganda from static control flooring manufacturers, facilities managers sometimes defer to the choice of a selection committee or else they invest countless hours of valuable time trying to find that perfect material. In either case, the result is too often the selection of a single type of surface for every area where ESD mitigation is required or anticipated as a future requirement.

Unfortunately, the "one-size-fits-all" philosophy for static control flooring typically yields compromised results. For example durability might be emphasized at the expense of ergonomics, or a decision might be based on the installed cost of the floor rather than on the total cost of ownership. Or maybe the committee, swayed by one influential person—from shipping and receiving, for instance—decides to install a tough, chemical resistant walking surface throughout the facility, even though 95 percent of the space resembles an office more than a factory.

To solve the problem, a growing number of high tech businesses are selecting different types of esd flooring for different parts of their businesses, often utilizing architects to help them create a functional, attractive and well-integrated environment.

A Bit Of History

In the 1970s and early 1980s, when ESD was slowly creeping into what has become our everyday world of PCs, PDAs and GPSs, flooring manufacturers were generally unaware of the need for ESD mitigation. In 1979, when military subcontractors adopted DOD- 1686, the Mil spec for ESD, flooring manufacturers raced to develop groundable materials for places where ESD sensitive equipment was handled, stored or used. Like any nascent industry, it took a while to perfect the various flooring materials, and some of the early suppliers got it right and some of them didn't, as the following paragraphs illustrate.

ESD Vinyl

Because static control properties were easy to incorporate into the regular compound, vinyl was initially the material of choice for ESD flooring. By introducing veins of conductive material into standard vinyl tile, suppliers could produce a static control floor that was reliable, while also easily and effectively manufactured.

Yet, while ESD vinyl was a start, and a good one, it wasn't the panacea people hoped it would be. Some vinyls were too soft while others were too brittle to handle the heavy loads in areas where large computer equipment is assembled and moved. In wave soldering areas, spills from the solder machines would melt the material. Some vinyls contained plasticizers that could not be used in certain clean-room applications.
Others utilized fire retardants like halogens which, in the event of a small fire, could create corrosive gases causing damage to unmanned spaces like the underground offices of a telephone company.

ESD Epoxy

Early versions of ESD epoxy, while durable and easy to maintain, often failed conductivity tests. During the mixing process, an incomplete dispersion of conductive fibers would produce an ESD floor that was not adequately conductive. To boost conductivity, it was common practice to "shock" epoxy floors with high-voltage power supplies, a process akin to medical defibrillation. Shocking helped bridge the insulative gaps between the suspended conductive fibers. Shocking, however, did not always work, particularly in cases where either an error in the mixing process or poor quality control by the chemical manufacturer produced a compound containing a deficient number of fibers or conductive particles.

ESD Carpet

Carpet had its own, albeit different, set of problems. The conductive fibers in the early carpets were not robust enough to withstand traffic and the fibers would break down, rendering the static control qualities of the floor ineffective. Also, conductive carpet produced in the 70s and early 80s was almost exclusively a broadloom product similar to the carpet installed in your house. Because repairs to broadloom carpet are both difficult and conspicuous, and because, at the time, electronic

manufacturing processes were much dirtier than they are today, facilities managers generally considered carpet unsuitable for manufacturing environments.

ESD Rubber
Though rubber has always been one of the most stable, durable and resilient flooring materials, early ESD rubber flooring was not attractive. The early rubbers were available only in the carbon-loaded black version of the material, which most people found either ugly or dirty-looking, so were considered unsuitable for large areas or for clean rooms.

Today, Excellent Choices Abound
By the late 1980s, however, several reliable options for ESD flooring had been introduced. Today, there are attractive static control versions of vinyl, epoxy, carpet and rubber, all of which provide effective, long-term ESD mitigation. Each product has its own positive attributes and each also has potential drawbacks that should be understood and possibly addressed.

ESD Vinyl
Vinyl is the oldest effective ESD flooring material. The best ESD vinyl floors are called solid vinyl tile or SVT. Properly maintained SVT vinyl is attractive and can give a facility that hospital look of cleanliness and shine. And because the material is relatively inexpensive, vinyl can be a cost-effective ESD flooring choice.

Facilities managers often favor vinyl floors because vinyl has a reputation for being inexpensive, simple to repair and easy to clean. The high quality vinyl manufacturers, aware of the need to contain cleaning costs, have developed true no-wax ESD vinyl floors. This doesn't mean they can't be waxed with static control floor finishes; but unlike cheaper SDT tiles, a good conductive SVT doesn't need waxes in order to eliminate static. They usually recommend cleaning methods that steer clear of finishes, polishes or waxes. High speed buffing, or what maintenance professionals call “burnishing,” is the method most often recommended for cleaning. Using heat from the buffing equipment, burnishing melts and then reseals the floor. A lower cost alternative to burnishing is low speed buffing using a static control spray buff formula. This maintenance method gives the facility manager the best of both worlds; a reflective high shine floor and an ESD walking surface that meets the most stringent ESD specs. Handled properly, the maintenance of a high quality SVT conductive tile should cost less than carpet and only marginally more than rubber.

A recent break-through in technology has made it possible to install conductive SVT over old floors like VCT and epoxy. The use of low VOC conductive pressure sensitive adhesives now allows some ESD tile to be installed on top of most types of old floors. Before moving forward it is important to make sure that the new floor will not shrink. Before buying any vinyl tile, ask the supplier where it was manufactured. Typically, any tile made in North America, will be free of heavy metals, will not shrink and will also meet all standards for squareness and electrical properties.

ESD Epoxy
Epoxy has matured to become a viable, high quality ESD flooring option. Today’s epoxies are easy to install and maintain, durable, and also attractive. Along with the solid-colored coatings typically used in parking garages and aircraft hangars, the new breeds of epoxies are available in patterns as well as in multiple colors and textures. The use of multiple layers of conductive materials as part of the overall thickness of a coating provides redundant paths to ground so that, installed properly, epoxies are highly effective in meeting all necessary ESD standards.

In facilities where constant heavy loads and high traffic are the norm, epoxies are almost the only practical flooring material. Take the case of EMC Corporation in Franklin, MA. In order to identify the best looking, most durable product for their facility, EMC performed a robotic durability test, called “Project Einstein,” on the various flooring materials and products. As part of the test, EMC rolled their 5000 pound computers throughout the manufacturing area, destroying then repairing the different vinyl and rubber materials. The only flooring material the computers didn’t destroy was a quartz loaded epoxy. However, the upside of epoxy is also its downside: the floor is ruggedly hard and allows sound to echo throughout the facility.

In addition to ergonomic considerations, facilities managers should understand that the color of an epoxy floor is not one hundred percent stable. Over time, exposed to ultraviolet rays, epoxy has been known to yellow or haze. Repairs are always conspicuous because the newly coated areas never match the adjacent aged surface. Also, because of the rigidity and shiny sleekness of its surface, epoxy can present noise and slipperiness issues. Another, perhaps larger problem with epoxy is that you don’t know for sure what you have or what it will look like until after the floor is installed and fully cured. To avoid field errors, some epoxy suppliers install several test patches at the factory immediately after blending the material.

ESD Carpet
At one time, carpet manufacturers believed that, to solve ESD problems, they had only to find a way to prevent people from getting shocks when they walked across the carpeted floor. They thought that, by preventing static buildup on the people who touched the components, the possibility of wiping out computer equipment would be reduced. To a certain extent, they succeeded in meeting their goal. By using antistatic additives or tufting the carpet with carbon bi-components, housed inside the core of the yarn fibers, they were able to prevent static shocks.

However, because the carbon bi-components were insulated from the exterior surface of the carpet and lacked contact points, the static dissipative properties of the carbon were rendered ineffective. The resulting products, while ideal for domestic use, did not meet the standards of the ESD industry for the manufacturing and handling of electronic components.

ESD carpet has come a long way since the days of the so-called “computer grade” carpet. Today, in the tufting process, heavier denier conductive fibers can be woven into the yarn bundle, creating an almost indefinite number of contact points, thus providing a fast and reliable path to ground. Because of the heavier denier fiber, the new generation of ESD carpet can also withstand the punishment of high traffic areas. Because they are easy to install and remove, carpet tiles are a popular choice among facilities managers, installers and maintenance people. Carpet tiles are installed with clean, fast-drying release adhesive. And the tiles can be installed directly over old vinyl tile or uneven concrete, which lowers the cost of installation. If the carpet is accidentally damaged, the damaged area is easily replaceable without the use of special tools or even the need to install new adhesive. Because carpet tile is durable and also easy to clean, repair and replace, ESD carpet usually offers a tremendous amount of flexibility.

Jim McIsaac, the facilities manager at Brooktrout Technologies, has been using carpet tiles for eight years and has found them to be the most effective solution for his assembly and test areas. Tired of waxing an SDT dissipative vinyl ESD floor, McIsaac switched to carpet tile, which he finds much easier to maintain. To handle motorized forklift traffic, he installed two aisles of heavy-duty EC rubber tiles in combination with the carpet. As with any of the options, carpet has its disadvantages. Carpet is not well suited to accommodate heavy loads, such as forklifts and pallet jacks. It is also difficult to roll Metro carts or systems on wheels over carpet. Carpet has a low resistance to chemicals and solvents. Possibly the biggest criticism against carpet; its tendency to "ugly out" after 3 to 5 years of use.

ESD Rubber

Rubber, the panacea of flooring materials, meets all of the recommended parameters of ANSI/ESD S.20-20-2007. The walking body voltage properties of ESD rubber are low. Conductive rubber used in conjunction with the right footwear is the best flooring solution for class zero ESD applications. Additionally, ESD rubber is viewed by many experts as a highly desirable walking surface because it not only performs with grounded footwear, but is highly effective at preventing static in areas where grounded footwear is not or cannot be used—places such as command centers, computer labs, 9-1-1 call centers and flight towers.

The old aesthetic issues have also been resolved. A new version of conductive rubber incorporates carbon contact points within the attractive patterns of a more decorative floor tile. Ergonomically, rubber is a better anti-fatigue floor than either epoxy or vinyl and, like carpet; rubber dampens noise from rolling carts and automatic equipment. Rubber, which is less porous than vinyl, is also easier to clean, wash and maintain. In fact, after a two-year study, AT&T found rubber to be the easiest ESD surface to care for. Rubber can be washed with neutral cleaners mixed with water; and finishes and buffing are unnecessary. Though its installed cost is the highest among the various options, the total cost of ownership for rubber is low because it is durable and inexpensive to maintain, making it a good choice for companies concerned about the long-term implications of their investment.
Nevertheless, despite its many advantages, the initial cost of rubber is substantially higher than some of the other choices. Also, it is important to be sure that the selected rubber is conductive and not static dissipative, as static dissipative rubber flooring resistive properties exceed the recommended system resistance (less than 35 megohms) parameters of ANSI/ESD S20.20-2007

High Tech Companies Turn To A Combination of Materials

To address the diverse needs of their various departments; managers of high tech facilities have begun to combine flooring solutions. For example, Acterna, a manufacturer of network solutions, located in Germantown, Maryland, installed vinyl tile over access floors and a quartz epoxy product in heavy traffic areas. Plexus Corporation, a contract manufacturer in Ayer, Massachusetts, installed conductive carpet tiles in their SMT assembly area then surrounded the carpet with a ten foot perimeter of quartz epoxy to handle the majority of their forklift traffic.

Future Considerations

According to the Sematech road map (Sematech is the industry website for the semiconductor industry), ESD will present a major reliability issue for semiconductor manufacturers over the next several years. Ted Dangelmayer, a widely recognized and respected ESD consultant, agrees. In the next five years, Dangelmayer predicts component sensitivity, which at one time was over 1000 volts, will drop to as little as 25 volts, due in part to new engineering designs. The internal protection devices in the traditional design made the components more robust, but encumbered circuit speed, inhibiting the production of faster, more capable components. According to Dangelmayer, the tradeoff for higher performance devices will be designs that are likely to be more vulnerable to ESD.

It stands to reason that more vulnerable sub-components will bring a concurrent need for more ESD-tolerant environments, not only in manufacturing areas, but

anyplace where electronic equipment is manufactured, handled or used. That need may be especially acute in places, such as the home office or media room, where people do not wear ESD preventative footwear. The need for reliable flooring will be particularly important in places where sophisticated electronics are used to protect life, perform secure transactions, protect our airspace or provide mission-critical services. To safely and dependably manufacture, handle or use these faster, more capable electronics, we'll need floors that not only ground out static charges, but robust, reliable ESD flooring surfaces that prevent static events from occurring in the first place.

About The Author

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