Static electricity is an electric charge caused by an imbalance of electrons on the surface of a material. It is most commonly caused by the contact and separation of materials. The area of contact, the speed of separation, relative humidity and other factors determine the amount of charge created in this process.

An example of this occurrence would be a person walking across the floor. Static electricity is generated as their shoe soles contact and separate from the floor surface. The amount of static electricity generated will increase due to the size of the sole surface, lower humidity and increased speed of movement.

The shock we receive upon touching another object is the transfer of the static charge or balancing of our charge to that of the object. This transfer is called Electrostatic Discharge or ESD.

Virtually all materials including water and dirt particles in the air are subject to this occurrence. The charge that is created, where it goes and how quickly is dependent on the materials characteristics and that of the materials it comes in contact with.

There are three basic types of Electrostatic Discharge (ESD).

1. *Direct ESD to a device* (Most Prevalent)
2. *ESD from a device*
3. *Field induced ESD*

Direct ESD to a device – A person walking generates a static charge then touches a device causing a transfer of the electrostatic charge. A similar occurrence can happen when an electro statically charged device is brought in contact with another object.

ESD from a device – Automated part movements within a device can generate an electrostatic charge, which will discharge when the device is brought in contact with another object.

Field induced EDS – Whenever an object becomes electro statically charged there is an electrostatic field associated with that charge. If a device is placed in that field, a charge may be induced on it. If the device is momentarily grounded while within that field a transfer of charge from the device will occur.

There are two categories of damage that an ESD can create.

1. Catastrophic – a complete functional breakdown of a device.
2. Latent Defect – a partial degrading of the device that will down grade its productivity and longevity.

Because we cannot eliminate the generation of static in the work place, it is necessary to safely dissipate or neutralize electrostatic charges that do occur. This can be accomplished by proper grounding in conjunction with the use of *Conductive* or *Anti-Static* (dissipative) mats.

Materials are rated as Conductive if their surface resistively is 10^1 to 10^5 ohm, Anti-Static (Static Dissipative) – 10^5 to 10^{12} ohm and Non-Conductive (Insulator) higher than 10^{12} ohm. The fastest neutralization of ESD being 10^1 ohm and the slowest is jus under 10^{12} ohm.

Conductive Mats (10^1 to 10^5 ohm) have a low electrical resistance, which allows ESD to flow across its surface. When attached to an earth grounding point the ESD will flow to ground and the excess charge on the mat and individual will be neutralized.

Anti-Static Mats (10^5 to 10^{12} ohm) have a higher electrical resistance than conductive mats. Like conductive mats they will allow ESD to flow across its surface but in at a slower rate. This slower neutralization of ESD prevents damage to microcircuit devices, which cannot tolerate a sudden flow of static charge from the device to a grounded mat.

Non-Conductive Mats (Insulator) (10^{12} ohm or higher) prevent the flow of ESD across its surface. These mats are used in high voltage environments where the movement of electrical charges is not desired. In this case the movement or attraction of electricity could be life threatening.
It is important to note that an ungrounded Conductive or Anti-Static Mat will retain an ESD and transfer the charge to the next object it comes in contact with.

It is also recommended that all devices, Conductive and Anti-Static Mats be grounded to the same common point ground. This essentially brings all components to the same electrical potential.

Selecting the proper type of ESD neutralizing mat is determined by the following factors:

·***Rate of Neutralization*** **– For most applications anti-static mats that neutralize ESD in the range of 10^5 to 10^{11} ohm will effectively handle most static situations in the work environment. Dissipation of static electric charges will occur at a rapid but controlled rate.**

Purpose **– This addresses other criteria such as anti-fatigue, slip resistant and décor.**

***Environment* – Takes into consideration the type of floor the mat will be placed on, carpeted or hard surface. Use of the wrong type of mat on a carpeted floor can create a trip hazard or a mat that is constantly moving. Most rubber and vinyl Conductive and Anti-Static Mats will not withstand the use of chairs or carts. The weight plus the action of the wheels will cause the mats to move and prematurely breakdown. Only static control mats specifically designed for use on carpeting or under chairs should be used for these situations.**

***Cost* – The most expensive mat may not be the best solution to the problem. Conductive mats, the most expensive, can damage devices containing microcircuits by draining static charges too rapidly.**

Wrist & Shoe Straps - These items are designed to provide the highest level of contact with an individual and a static dissipative control device (floor mat, work surface, ground plug, etc.) They serve strictly as a channel for removing static electricity. Simply wearing a strap accomplishes nothing unless proper contact to a grounded static removal device or object is made.

Determining the proper product for a situation can usually be determined by comparing your requirements to the information we have listed. While it would be wonderful to be able to purchase one product to eliminate every static electricity problem, there is no such product. Every static problem is unique because of numerous factors, many of which are distinct to each individual problem. The best method of dealing with static electricity problems is to implement solutions that are least intrusive to individuals such as a floor mat. Often this will completely solve the problem but sometimes it only decreases it. It is may be necessary to institute additional remedies in the order of least intrusive too most intrusive (work surface to heel grounders to wrist straps).

Faraday cage

A **Faraday cage** or **Faraday shield** is an enclosure formed by conducting material or by a mesh of such material. Such an enclosure blocks external static and non-static electric fields. Faraday cages are named after the English scientist Michael Faraday, who invented them in 1836.[1]

A Faraday cage's operation depends on the fact that an external static electrical field causes the electric charges within the cage's conducting material to be distributed such that they cancel the field's effect in the cage's interior. This phenomenon is used, for example, to protect electronic equipment from lightning strikes and electrostatic discharges.

Faraday cages cannot block static or slowly varying magnetic fields, such as the Earth's magnetic field (a compass will still work inside). To a large degree, though, they shield the interior from external electromagnetic radiation if the conductor is thick enough and any holes are significantly smaller than the wavelength of the radiation. For example, certain computer forensic test procedures of electronic systems that require an environment free of electromagnetic interference can be carried out within a ***screen room***. These rooms are spaces that are completely enclosed by one or more layers of a fine metal mesh or perforated sheet metal. The metal layers are grounded in order to dissipate any electric currents generated from external or internal electromagnetic fields, and thus they block a large amount of the electromagnetic interference. See also electromagnetic shielding.

The reception or transmission of radio waves, a form of electromagnetic radiation, to or from an antenna within a Faraday cage are heavily attenuated or blocked by a Faraday cage.

A Faraday cage is best understood as an approximation to an ideal hollow conductor. Externally or internally applied electromagnetic fields produce forces on the charge carriers (usually electrons) within the conductor; the charges are redistributed accordingly (that is, electric currents are generated). Once the charges have rearranged so as to cancel the applied field inside, the currents stop.

If a charge is placed inside an ungrounded Faraday cage, the internal face of the cage becomes charged (in the same manner described for an external charge) to prevent the existence of a field inside the body of the cage. However, this charging of the inner face re-distributes the charges in the body of the cage. This charges the outer face of the cage with a charge equal in sign and magnitude to the one placed inside the cage. Since the internal charge and the inner face cancel each other out, the spread of charges on the outer face is not affected by the position of the internal charge inside the cage. So for all intents and purposes, the cage generates the same DC electric field that it would generate if it were simply affected by the charge placed inside. The same is not true for electromagnetic waves.

If the cage is grounded, the excess charges will go to the ground instead of the outer face, so the inner face and the inner charge will cancel each other out and the rest of the cage will retain a neutral charge.

Effectiveness of shielding of a static electric field depends upon the geometry of the conductive material. In the case of a nonlinear varying electric field, and hence an accompanying varying magnetic field, the faster the variations are (i.e., the higher the frequencies), the better the material resists penetration, but on the other hand, the better it passes through a mesh of given size. In this case the shielding also depends on the electrical conductivity of the conductive materials used in the cages, as well as their thicknesses.

Examples

- A microwave oven is an example of an inside out Faraday cage, keeping the RF energy within the cage rather than keeping it out. [3]

- Elevators and other rooms with metallic conducting frames famously simulate a Faraday cage effect, leading to a loss of signal and "dead zones" for users of cellular phones, radios, and other electronic devices that require electromagnetic external signals. Small, physical Faraday cages are used by electronics engineers during testing to simulate such an environment in order to make sure that the device gracefully handles these conditions.

- The shield of a screened cable, such as USB cables or the coaxial cable used for cable television, protects the internal conductors from external electrical noise and prevents the RF signals from leaking out.

- A booster bag (shopping bag lined with aluminium foil acts as a Faraday cage. It is often used by shoplifters to steal RFID-tagged items.[4]

A home-made Faraday cage at the University of Arizona in Dr. Michael Heien's Lab

- Plastic bags are included with electronic toll collection devices which are impregnated with metal to allow motorists to place them in the bag so that a toll charge is not registered or a device will not register a charge while being shipped to a customer's home after ordering in a delivery truck.

- Some electrical linemen wear Faraday suits, which allow them to work on live, high voltage power lines without risk of electrocution. The suit prevents electrical current from flowing through the body, and has no theoretical voltage limit. Linemen have successfully worked even the highest voltage (Kazakhstan's Ekibastuz–Kokshetau line 1150 kV) lines safely.

- The scan room of a Magnetic Resonance Imaging (MRI) machine is designed as a Faraday cage. This prevents external RF (radio frequency) signals from being added to data collected from the patient, which would affect the resulting image. Radiographers are trained to identify the characteristic artifacts created on images should the Faraday cage be damaged.

- Faraday cages are routinely used in analytical chemistry to reduce noise while making sensitive measurements. A home-made Faraday cage used for simultaneous microscopy and electrochemistry is shown to the right.

- A Faraday cage was used in 2013 by the Vatican to shield the Sistine Chapel from electronic eavesdropping during the secret papal conclave to elect the next pope.[5]