Controlling ESD on Holding Fixtures and Extractors

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A. Overview of ESD

1. ESD

ESD stands for electrostatic discharge. We have all experienced electrostatic discharges in every day life from the spectacular lightning bolts in a thunderstorm to the zap we receive from the car door handle after sliding across the seats of our car.

2. Static Electricity

Static electricity can be defined as a charge imbalance or a separation of charge. What we usually observe as static electricity in common every day life occurs when the charge differential between two items or even two points on one item becomes separated far enough that it can be measured or its effect can be observed. One of the most common situations that can generate static electricity is the separating of two solids or the rubbing of them together and then the separating of them. (The rubbing doesn't cause the separation of charge but can enhance the process by removing impurities or otherwise making the contact more intimate) The action of separating the solids causes the removal of electrons from the atoms/molecules of one material (leaving it positively charged) along with the addition of electrons to the surface of the other material (leaving it negatively charged). How much electric potential is created is a function of the types of materials as well as other variables such as humidity. If there is no conductive path between the separated solids, the electrostatic charge will remain on each solid and a measurable electrostatic potential (voltage) will exist between them, i.e., static electricity.

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All of us have probably experienced making static electricity when we rubbed our feet on a carpet on a dry day and then witnessed an "ESD event" when a spark jumped from our finger to a doorknob. We created a surprisingly high static potential (measured in volts) and we didn't even know it! 5,000 volts will easily cause a little spark and dragging feet on the "right carpet" on the "right day" can generate upwards of 35,000 volts! Some of us might be surprised that the high voltage did not hurt us (other than a little sting). That zap we felt when we touched the knob was the result of an admittedly high electrostatic potential (voltage), but the current flow (amperes) in the spark was very low, therefore the power (watts) was low (voltage times amperes). So it probably did not kill us unless it took out our solid-state pacemaker.

3. ESD Events can be Destructive

These separated positive and negative electrostatic charges are naturally attracted to each other. If a conductive or even a slightly conductive path is provided between them, the electrostatic charge will travel that path to neutralize itself. If the path happens to be through your integrated circuit, damage to the circuit is a high probability. If the path contains a small air gap and the electrostatic potential (voltage) is high enough to jump the gap with what we call a spark, any explosive atmosphere may cause a disaster.

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4. Getting Rid of Static Electricity

Actually you don't "get rid of static electricity". However, you can force all the materials in a given area to the same electrostatic potential, then there is no tendency for the charges to move around and cause a problem (like a spark). So you must cleverly provide combinations of conductive paths (and slightly conductive paths) between the various materials (with their various potentials) and allow the materials to come to the same electrostatic potential. If this is done with something electrically conductive, such as a wire, and if it is done **before** any static charges have been generated, the static potential will be continually drained back to a common potential between the various materials. If, however, the wire is connected to the materials **after** the static charge has been generated, a potentially high electric current spike can flow through the wire—possibly enough to cause damage to nearby solid-state electronics, or worse. If during the connection a spark occurs, the possibility of initiating an explosion will be a major concern in places like coal mines, at gas wells, in grain elevators or at your neighborhood filling station. But if the connection is made to the charged items with a **slightly** conductive path (wire in series with a properly sized resister) the electric current will be low enough to neither damage IC's or create a spark.

5. Designing an EPA

The following considerations should be, at minimum, reviewed prior to setting up an "electrostatic protected area" (EPA).

a. Many of the objects in an "electrostatic protected area" (EPA) **must** be grounded to a common safety ground per the National Electric Code (NEC). How and when these items are grounded is critical to preventing an ESD event.

b. Work surfaces may be covered in "electrostatic dissipative" materials that are in turn grounded. These materials fall between conductive and insulative in their electrical conductivity. They allow static charge to flow to ground, but at a slow rate, so that the charge is bled off more slowly instead of in a current spike, which, among other things, could cause a spark. Static dissipative materials are very useful in EPA's. However, static dissipative materials cannot be used in such a way that they compromise the safety ground per the NEC.

c. Grounded wrist straps are often used to ground humans. They can effectively neutralize the electrostatic charge on a human body, but they must not be the only part of your EPA design. Also realize that they are made to very strict standards and are to be used only according to the manufacturers instructions and the relevant ESD codes. Most are not to be used around voltages of more that 250 VAC. This is because they incorporate resisters in the grounding wire of about 1 meg-ohm in order to limit the possible current through the wearers body to below that which would be lethal should he accidentally touch 250 VAC.

d. In some applications, especially clean rooms, air ionization and humidity control may be necessary to properly control electrostatic generation.

e. Finally, but **most importantly**, proper ESD procedures must be set up for the EPA, personnel trained and qualified to the procedures for the area, and verification that the procedures are continuing to be followed must be periodically accomplished.

Designing an "electrostatic protected area" (EPA) may be complicated and can be hazardous to personnel and sensitive equipment if it isn't done correctly**.** Proceed cautiously and study up on the subject.

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The **Electrostatic Discharge Association** (ESDA) (see www.esda.org) has an excellent introduction to ESD called the *Fundamentals of Electrostatic Discharge*. Read it and understand it before doing any other research. They also have issued many standards for ESD design including *ANSI/ESD S20.20-1999 The development of an Electrostatic Discharge Control Program for Protection of Electrical and Electronic Parts, Assemblies and Equipment (Excluding Electrically Initiated Explosive Devices).*

Another good source is the **Joint Electron Device Engineering Council** (JEDEC) (see www.jedec.org). One of the many relevant standards developed by JEDEC includes *JESD625-A Requirements for Handling Electrostatic-Discharge-Sensitive (ESDS) Devices.* If you just need to get copies of applicable standards see **Global Engineering Documents** (www.global.ihs.com).

If you need to design to International standards, look up the International Electrotechnical Commission (IEC) (www.iec.ch/) and the IEC 61340 series of standards or try CENELEC at (www.cenelec.org) whose standards are similar to the IEC's.

Depending on your customer requirements, whether it be domestic or international, commercial or military, many different standards, specifications and handbooks, etc, (literally hundreds exist) may need to be reviewed, understood and followed.

B. FLOTRON Holding Fixtures, Extractors and ESD

1. ESD Options

FLOTRON holding fixtures and extractors are designed with ESD in mind. Standard options on the holding fixtures include: **drag chains, grounding lugs and ESD wheels**. On the extractors, an optional **ESD handle** is available. However, do not order any product until it is determined that it fits properly into the overall EPA design. Make sure all safety grounding as well as all ESD grounding is done properly and that the two types of grounding work properly and that one does not negate the function of the other. EPA's will also require special procedures and training of personnel in those procedures.

a. Holding Fixtures

FLOTRON holding fixtures can be ordered with the ESD option (E). It includes a grounding lug on one frame plus on the FLOTRON floor units, drag chains. Depending on the design of the EPA, the ground lug will be attached to either the safety ground or the ESD ground. The drag chains, which drag on the floor, can effectively dissipate static potential into ESD flooring. For components, which are extremely sensitive to even low voltage ESD events, the *component itself* should be attached to a properly designed grounding point.

On the 300, 400, 500, 600 and 700 holding fixtures, ESD casters with conductive wheels are available as a option (C5EX or C2). These casters will effectively create an ESD ground between the fixture and either a conductive floor or an ESD floor. It must be remembered, however, that the conductivity of the contact point between the wheel and the floor can be seriously reduced by oil, wax, polish, cleaning materials, dust or dirt accumulation or in some cases by the aging of the rubber in the wheel. Oil will also be injurious to the wheel compound on ESD casters.

b. Extractors

FLOTRON extractor tools can be ordered with an ESD handle made of conductive plastic. Although many electronic assembly and repair facilities effectively control static potential with a combination of standard ESD precautions, many are now also specifying ESD handles on their FLOTRON extractors. The conductive handle allows an ESD ground path from the metal extractor components (that interface with the sensitive electronic boards) to the operator's hand (which must be grounded with an ESD wrist strap). Although the electronic chassis and boards are usually resting on an ESD grounded work surface and the FLOTRON extractor is usually picked up from the same work surface and the personnel handling the parts usually must have ESD grounded wrist straps, the extra ground path afforded by the FLOTRON ESD handle gives an added measure of ESD safety.

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