ESD Open Forum

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Question:

My company is establishing an ESD control program according to ANSI/ESD S20.20 but we are having some difficulty when it comes to understanding what we need to do regarding static protective packaging, what should we do?

Answer:

ANSI/ESD S20.20 says that ESD protective packaging must be defined for movement of ESD susceptible items within an ESD protected area (EPA), between EPA's and from an EPA to any type of external operation. The referenced standard for protective packaging is ANSI/ESD S541 (S541) – *Packaging Materials for ESD Sensitive Items*.

If packaging or containers are needed within an EPA to carry, store or physically protect sensitive items, they must be low charging and dissipative as a minimum. Shielding materials are not required in areas that meet the definition of an EPA since there will be no electrical fields above a defined level in the area. In addition, all conductors in the EPA must be grounded by definition so there will be no charge transfer to sensitive parts by contact. Movement of sensitive items outside of the EPA requires low charging and dissipative materials for intimate contact and static discharge shielding to make sure static discharges and electrical fields do not interact with the sensitive items.

The concepts described in S541 represent a "tried and true" philosophy that has worked well in the electronics industry for well over 30 years.

- The surfaces of packaging materials that contact sensitive items shall be low charge generating and dissipative or conductive. This concept is required inside an EPA as well as outside of an EPA.
- For movement of sensitive items outside of an EPA, the packaging structure must provide the functions cited above, and additionally, electrostatic discharge shielding.

Low Charging:

Low charging is the most complex feature to specify and evaluate. To determine if a material is low charging requires answering the question: Low charging against what? There are no standards or published test methods that provide specific answers or well-defined procedures. The guidance document ESD ADV 11.2 – *Triboelectric Charge Accumulation Testing* suggests numerous evaluation techniques that may provide useful information if you need to determine whether or not a specific material has a low charging propensity.

Charge generation testing requires a Faraday Cup or Pail to measure the electrostatic charge directly (typically in nanocoulombs), or at least an electrostatic field meter to estimate the surface potential in volts on the surface of a material. Both instruments report a result after an interaction (contact and separation) between the material of interest and some other item. A common procedure is to shake parts around in a bag and then deposit them into a Faraday Cup to measure the charge. Dropping an item with known voltage into the cup and recording the charge will allow the determination of capacitance of the item from the relationship C = Q/V. With capacitance known, all the similar sized items of interest can be measured and the voltage estimated by the relationship V =Q/C. Measuring voltage on items of interest is usually easier to do and easier for most to interpret. It is important to determine the level of charge generation between actual parts and the packaging materials that are used in a process.

The low charging specification for a given process can be speculative but when some fundamental measurements are made on typical materials found in the work environment, the ESD control program manager should be able to quickly sort out good from poor materials. Armed with real data, it is not too difficult to set material specifications, even for the elusive charge generation property. If there is difficulty in specifying the allowable voltage on a packaging material, something on the order of 100-200 volts should be a place to start. However, this has absolutely no correlation to device sensitivity test models so other research may be needed.

Dissipation:

The second desirable characteristic for packaging is electrical conductivity. Most often, the static dissipative range is specified for intimate contact with sensitive items but there are also many applications where more conductive materials are actually preferred, such as device lead shunting. The dissipative range for packaging material is defined in S541 for both surface and volume conductive materials (go to www.esda.org for the free download).

Measurements of surface and volume resistance are defined in the test methods ANSI/ESD STM11.11 and STM11.12 respectively. These methods are widely accepted and used in the industry, especially by those companies that manufacture static dissipative and conductive packaging materials. It should be noted that most of the materials that have low charging propensity also are at least somewhat dissipative. However, dissipative and conductive materials may not be low charging and often are not. Testing is always necessary to verify both of these properties.

Static Discharge Shielding:

When sensitive items are moved outside of an EPA, static discharge shielding is required and can be accomplished using several different techniques:

- Metallized laminate films, wraps and bags (semi-transparent, metal coated laminate films, low charging and dissipative interior surface)
- Thick conductive boxes with covers (<1000 Ω-cm/mm of thickness and best to have low charging and dissipative materials for intimate contact)
- Air gap of several inches (sensitive item inside of a container separated from the walls by several inches along with low charging and dissipative materials for intimate contact)

The static discharge shielding concept provides two important functions: Attenuation of electrical fields on the exterior of the package; and prevent the current from a static discharge from entering the package. These properties prevent electrical fields and direct discharge from affecting enclosed sensitive items.

Summary:

All of the various forms of packaging are impacted by the considerations discussed here. Any packaging material that contacts sensitive items needs to be low charging and dissipative. This includes tape and reel, bags, wraps, boxes and any other form that has intimate contact with sensitive parts. If some kind of packaging is needed for physical containment within an EPA, the principles discussed here need technical consideration.

Movement outside of the EPA requires the additional protection provided by shielding since the environments are unknown and electrical fields and discharges may occur.

About the author:

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