Packaging Materials

The key to understanding when to use a material is to first understand how its characteristics are defined.

Q. What is the difference between antistatic, conductive, and static-dissipative packaging materials?

A. The terms *conductive* and *static dissipative* typically refer to resistance or resistivity ranges used in describing or evaluating ESD-control materials and products. Definitions for these terms are usually found in ESD Association or other standards. Although the formal definitions cite both surface and volume resistivity, current usage is to define materials by resistance.

A *conductive material* is traditionally defined as having a surface resistivity less than $1.0 \cdot 10^5$ Ω/□ or a volume resistivity less than $1.0 \cdot 10^4$ Ω-cm.[1] With a low electrical resistance, electrons flow easily across the surface or through the bulk. Charges go to ground or to another conductive object.

A *static-dissipative material* is defined as having a surface resistivity equal to or greater than $1.0 \cdot 10^5$ Ω/□ but less than $1.0 \cdot 10^{12}$ Ω/□ or a volume resistivity equal to or greater than $1.0 \cdot 10^4$ Ω-cm but less than $1.0 \cdot 10^{11}$ Ω-cm.[1] Charges flow to ground more slowly and in a somewhat more controlled manner than with conductive materials.

Electrostatic shielding materials have a conductive layer with a surface resistivity of less than $1.0 \cdot 10^4$ Ω/□, or a volume resistivity of less than $1.0 \cdot 10^3$ Ω-cm per millimeter of thickness.[2] These materials provide Faraday cage protection from dc field coupling with ESD-sensitive devices.

Insulative materials are defined as those having a surface resistivity of at least $1.0 \cdot 10^{12}$ Ω/□ or a volume resistivity of at least $1.0 \cdot 10^{11}$ Ω-cm.[1] Such material prevents or limits the flow of electrons across its surface or through its volume. These materials have a high electrical resistance and cannot be grounded to easily dissipate charges. Charges remain in place for a long time.

Today, packaging materials are evaluated using surface resistance rather than surface resistivity. A simple conversion factor is applied, dividing the resistivity ranges by 10, or subtracting one decade. Therefore, *conductive* becomes less than $1.0 \cdot 10^4$ Ω and *static dissipative* becomes $1.0 \cdot 10^4$ to $1.0 \cdot 10^{11}$ Ω, provided that the appropriate electrodes with the correct geometric conversions are used. ESD STM 11.11 provides additional information on this issue.[3]

Antistatic materials are not defined by resistance or resistivity. At one time, the term referenced a resistance value, but it was severely misused, and today the term no longer represents any resistance range. *Antistatic* refers to the property of a material that inhibits triboelectric charging. A material's antistatic characteristic is not necessarily correlated with its resistivity or resistance.[1]

References

1. ESD-ADV1.0, Glossary, ESD Association, Rome, NY.
2. EIA-541, "Packaging of Electronic Products for Shipment," Electronic Industries Alliance, Arlington, VA.
3. ESD STM 11.11, "Surface Resistance Measurement of Static Dissipative Planar Materials," ESD Association, Rome, NY.

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