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TECHNICAL REPORT

colour inside

Electrostatics –
Part 5-5: Protection of electronic devices from electrostatic phenomena – Packaging systems used in electronic manufacturing

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CONTENTS

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ELECTROSTATICS –

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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IEC TR 61340-5-5, which is a Technical Report, has been prepared by IEC technical committee 101: Electrostatics and IEC technical committee 40: Capacitors and resistors for electronic equipment.

The text of this Technical Report is based on the following documents:

Draft TR	Report on voting
101/564/DTR	101/575/RVDTR

Full information on the voting for the approval of this Technical Report can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts in the IEC 61340 series, published under the general title *Electrostatics*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

Packaging materials used within an electrostatic discharge (ESD) control programme often are defined by an electrical resistance measurement. Packaging material manufacturers rely on industry standardized test methods to ensure that the materials they supply meet industry defined specifications. However, other attributes provided by a packaging material often are difficult to quantify, leading to confusion between packaging material manufacturers and the end users.

Increased use of automated handling equipment for the manufacture of electronic products has resulted in changes in the design and form of packaging materials that contain electronic parts and components. In particular, very small profile parts such as surface mount resistors and capacitors are contained within pocket tape reels that are unloaded by automatic equipment. Small dimension parts require small dimension packaging materials. Small dimension packaging materials cannot be evaluated for electrical properties by the existing industry accepted test methods.

Several types of packaging are used within the electronics industries that do not have the basic properties generally associated with electrostatic control, such as paper tape. Industry best practices involving these standard packaging material forms are discussed. Other forms of packaging for non-ESDS (electrostatic discharge sensitive items) that are brought into the ESD protected area (EPA) and considerations for handling such packaging forms are described. This document has been prepared by a joint working group so that the considerations of electrostatics and the application of protective measures are compatible with the concerns of those who provide or use small dimension electronic components.

ELECTROSTATICS –

Part 5-5: Protection of electronic devices from electrostatic phenomena – Packaging systems used in electronic manufacturing

1 Scope

This part of IEC 61340 discusses packaging material requirements for electrostatic discharge sensitive items (ESDS) as well as non–ESDS which can apply to packaging materials such as embossed carrier tape, trays, tubes (stick magazines), rails and others used in back end line processing and parts handling where test methods described in other standards are, for the most part, inadequate. Issues related to electrostatic charge generation, electrostatic attraction and repulsion are included. The recommendations and discussions within this document can also be applicable to other types of packaging that cannot be evaluated by other means.

This document discusses the issues related to

1) technical considerations for packaging material selection and packaging system design,
2) packaging material specifications for electrostatic control,
3) existing test methods and their limitations for packaging materials,
4) suggestions for the evaluation of small dimension packaging materials, and
5) industry common practices.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1.1
electrostatic protective packaging
containers and other enclosures that have properties and functionality to limit electrostatic charge generation, dissipate electrostatic charge, or limit interior electrostatic fields

3.1.2
intimate packaging
materials that come into direct contact with ESD sensitive items

3.1.3
proximity packaging
materials or items that cover or surround intimate packaging materials

3.1.4
conductive material
material with surface or volume conductive properties generally specified by electrical resistance lower than dissipative materials

3.1.5
dissipative material
material with surface or volume conductive properties with an electrical resistance greater than conductive materials but less than insulative materials

3.1.6
insulative material
material with electrical resistance high enough to impede charge flow to some degree

3.1.7
low charging
antistatic
property of a material that limits electrostatic charge transfer by contact and separation (triboelectrification)

3.1.8
surface resistance
ratio of DC voltage to the current flowing between two electrodes of specified configuration that contact the same side of a material

Note 1 to entry: Surface resistance is expressed in Ω.

3.1.9
surface resistivity
for electric current flowing across a surface, ratio of DC voltage drop per unit length to the surface current per unit width

Note 1 to entry: In effect, the surface resistivity is the resistance between two electrodes on the opposite sides of a square and is independent of the size of the square or its dimensional units.

Note 2 to entry: Surface resistivity is expressed in Ω. It is common practice to express surface resistivity in ohms/square to distinguish from surface resistance.

3.1.10
volume resistance
ratio of the DC voltage per unit thickness to the amount of current per unit area passing through a material

Note 1 to entry: Volume resistance is expressed in Ω.

3.1.11
electrostatic discharge shielding
materials that attenuate an electrostatic field and limit energy penetration induced by an electrostatic discharge

3.1.12
electrostatic field shielding
materials that attenuate an electrostatic field

3.2 Abbreviated terms

CDM charged device model

CPM charged plate monitor

EPA ESD protected area

ESD electrostatic discharge

ESDS electrostatic discharge sensitive item

HBM human body model

4 Role of electrostatic protective packaging

4.1 Analysis of electrostatic risks (what can cause problems to ESDS)

The risk to electronic parts, assemblies and equipment (collectively referred to as "ESDS") from electrostatic phenomenon takes several forms and can be summarized as direct electrostatic discharge from a charged conductor to the ESDS or electrostatic discharge from the ESDS to another conductor (at a different potential) or ground if the ESDS becomes excessively charged. Damage to an ESDS will always be the result of an excessive flow of current through the ESDS.

It is necessary to note that the transfer of electrostatic charge (separation of charge) will happen every time two materials come into contact and separate. The resulting separation of charge will yield an equal positive and negative charge on the opposing surfaces. The differences in interactions include how much charge is separated and where the charge goes after it is separated, which is controlled by the electrical properties of the material. Charged materials with the ability to conduct electricity can be neutralized (charge dissipation) by contact with ground (earth). The rate of this charge neutralization/dissipation is controlled by the electrical resistance of the material and the contact resistance between the material and ground. The higher the resistance of the material and its contact resistance to ground, the longer it will take to come to charge neutrality. A positively charged material will gain missing electrons from ground while a negatively charged object will drain electrons to ground.

The amount of discharge an ESDS can tolerate is determined by a number of factors including part sensitivity, assembly layout, rate of the charge transfer through the ESDS, total energy in the discharge and environmental influences.

Discharge to an ESDS can occur by contact from a charged conductor, including a person, machine component, tool or fixture or any other charged conductor involved in a process. Reducing the probability of a damaging discharge to an ESDS is one of the principle methods of electrostatic control. The risk of damage from charged conductors is reduced when all the conductive materials and items are electrically bonded to ground. A grounded conductor cannot hold an electrostatic charge.

Discharge from a charged ESDS to ground is controlled by reducing the charge accumulation on the ESDS itself. Once an ESDS is charged, it is difficult to remove the charge without some risk of excessive current flow through the ESDS. Therefore, one of the key factors in packaging design is to reduce the charge generation propensity between an ESDS and the container used for storage and shipment.

Charge generation cannot be reduced to "zero" but can be limited to below the threshold that will cause excessive risk to the ESDS by the design of contacting surfaces, chemical changes or additives placed in materials to alter surface charging characteristics and usually by providing some level of electrical conductivity to allow charges to dissipate.

4.2 Charge generation (separation)

Triboelectric charging is the primary way that materials become charged. This process is described by the actions of contact between dissimilar materials and then their separation. The resulting charge level is influenced by the intimacy of contact, the speed of separation and any rubbing motions that can be part of the contacting process before separation. The physical properties of the surfaces of the contacting materials also influence the charging process. Reducing the surface area of contact is one of the ways that triboelectric charging can be reduced. Chemical additives to the material surfaces can also reduce charge generation by decreasing the friction between the surfaces. Adding dissipative agents can