

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electrostatics –
Part 5-3: Protection of electronic devices from electrostatic phenomena –
Properties and requirements classification for packaging intended for
electrostatic discharge sensitive devices**

**Électrostatique –
Partie 5-3: Protection des dispositifs électroniques contre les phénomènes
électrostatiques – Classification des propriétés et des exigences relatives à
l'emballage destiné aux dispositifs sensibles aux décharges électrostatiques**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROSTATICS –

**Part 5-3: Protection of electronic devices from electrostatic phenomena –
Properties and requirements classification for packaging intended for
electrostatic discharge sensitive devices**

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IEC 61340-5-3 has been prepared by IEC technical committee 101: Electrostatics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2015. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) reference to IEC 61340-4-10¹ [1]² was removed;
- b) material resistance property "electrostatic field shielding" was removed;

¹ Withdrawn.

² Numbers in square brackets refer to the bibliography.

- c) the requirement for electrostatic discharge shielding was changed from 50 nJ to 20 nJ;
- d) Table 1 – footnote "b" was changed to mention the two-point probe in IEC 61340-2-3;
- e) "shall be marked" was changed to "should be marked" in 7.2.2 and 7.2.3;
- f) Table 3 – the classification symbol and the primary function code F was removed;
- g) Table A.2 – references to IEC TS 61340-5-4 [2] and IEC TR 61340-5-5 [3] were added;
- h) Annex C – guidance regarding electric field shielding was added;
- i) Annex D – low charging material property was added.

The text of this International Standard is based on the following documents:

Draft	Report on voting
101/649/FDIS	101/660/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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 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.

INTRODUCTION

Packaging is necessary to protect electrostatic discharge sensitive devices (ESDSs) from static electricity and electrostatic discharge (ESD) damage as well as physical and environmental damage during manufacture, transportation and storage.

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ELECTROSTATICS –

Part 5-3: Protection of electronic devices from electrostatic phenomena – Properties and requirements classification for packaging intended for electrostatic discharge sensitive devices

1 Scope

This part of IEC 61340 defines the ESD protective packaging properties required to protect ESD sensitive devices (ESDSs) through all phases of production, rework and maintenance, transport and storage. Test methods are referenced to evaluate packaging and packaging materials for these product and material properties. Performance limits are provided.

This document does not address protection from electromagnetic interference (EMI), electromagnetic pulsing (EMP) or protection of electrically initiated explosive materials or devices.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61340-2-3, *Electrostatics – Part 2-3: Methods of test for determining the resistance and resistivity of solid materials used to avoid electrostatic charge accumulation*

IEC 61340-4-8, *Electrostatics – Part 4-8: Standard test methods for specific applications – Electrostatic discharge shielding – Bags*

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 discharge

ESD

rapid transfer of charge between bodies at different electrostatic potentials

3.1.2

ESD sensitive device

ESDS

sensitive device, integrated circuit or assembly that can be damaged by electrostatic fields or electrostatic discharge

Note 1 to entry: See Clause B.2 and Clause B.3 in Annex B.

3.1.3

ESD protected area

EPA

area in which an ESDS can be handled with acceptable risk of damage caused by electrostatic discharge or fields

SEE: Figure A.1 in Annex A.

3.1.4

unprotected area

UPA

area outside an EPA

SEE: Figure A.1 in Annex A.

3.1.5

intimate packaging

material which makes contact with an ESDS

3.1.6

proximity packaging

material not making contact with an ESDS and which is used to enclose one or more devices

3.1.7

secondary packaging

material used primarily to give additional physical protection to the outside of proximity packaging

3.1.8

volume resistance

R_V

ratio of a DC voltage (V) applied between two electrodes placed on two (opposite) surfaces of a specimen and the current (A) between the electrodes

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

3.1.9

point-to-point resistance

R_{p-p}

ratio of a DC voltage (V) applied between two electrodes on a surface of a specimen and the current (A) between the electrodes

Note 1 to entry: The electrode configuration for point-to-point resistance measurements is usually a pair of circular faced electrodes with a defined distance apart.

Note 2 to entry: Point-to-point resistance is expressed in Ω .

3.1.10**surface resistance** R_S

ratio of a DC voltage (V) applied between two electrodes in a defined configuration on a surface of a specimen and the current (A) between the electrodes

Note 1 to entry: The electrode configuration for surface resistance measurement is usually a pair of parallel rectangular electrodes or a pair of circular concentric electrodes.

Note 2 to entry: Surface resistance is expressed in Ω .

3.2 Abbreviated terms

CDM	charged device model
EMI	electromagnetic interference
EMP	electromagnetic pulsing
EPA	ESD protected area
ESD	electrostatic discharge
ESDS	electrostatic discharge sensitive device
HBM	human body model
UPA	unprotected area

4 Tailoring

This document, or portions thereof, does not necessarily apply to all applications. Tailoring is accomplished by evaluating the applicability of each requirement for the specific application. Upon completion of the evaluation, requirements may be added, modified or deleted.

Tailoring decisions, including rationale, shall be documented.

5 Packaging application requirement**5.1 General**

Transportation and storage of ESDSs require packaging that provides protection from electrostatic hazards (for example from an electrostatic discharge). Within an EPA in which all ESD risks are well controlled, it is possible that ESD protective packaging will not be necessary.

5.2 Inside an EPA

Packaging used within an EPA shall consist of dissipative or conductive materials for intimate contact.

Additional protection can be necessary for items sensitive to < 100 V for HBM, < 200 V for CDM and < 35 V for isolated conductors, depending on application and program plan requirements.

NOTE Dissipative materials are preferred for intimate packaging in situations where charged device model (CDM) damage is a concern.

5.3 Outside an EPA

Transportation and storage of sensitive products outside of an EPA shall be done in packaging that provides both

- dissipative or conductive materials for intimate contact,
- a structure that provides electrostatic discharge shielding.

If electrostatic field shielding materials are used to provide discharge shielding, a material that provides a barrier to current flow should be used in combination with the electrostatic field shielding material.

NOTE Dissipative materials are preferred for intimate packaging in situations where charged device model (CDM) damage is a concern.

6 Classification of ESD packaging material properties

6.1 General

Materials and packaging that are useful in preventing damage to ESD sensitive devices exhibit certain properties. These properties include:

- a) resistance properties:
 - conductive;
 - dissipative;
- b) shielding properties:
 - electrostatic discharge;
 - electrostatic field;
- c) low charging properties:

See Annex D.

6.2 Material resistance properties

6.2.1 General

Most standard packaging materials are electrically insulating and insulating materials retain charge. Making the packaging less insulating provides a path for the charge to dissipate from the packaging to a material at a lower potential.

Specific ranges of resistance are useful for different purposes. Packaging can be classified by these resistance ranges of the material used in its construction.

6.2.2 Resistance of conductive materials

Conductive materials can be surface conductive, volume conductive or both.

a) Surface conductive materials

Surface conductive materials shall have a surface resistance of $< 1 \times 10^4 \Omega$.

b) Volume conductive materials

Volume conductive materials shall have a volume resistance of $< 1 \times 10^4 \Omega$.

NOTE The thickness of the material can have a significant influence on the measured value of volume resistance.

6.2.3 Resistance of dissipative materials

Dissipative materials can be surface dissipative, volume dissipative or both.

a) Surface dissipative materials

Surface dissipative materials shall have a surface resistance $\geq 1 \times 10^4$ and $< 1 \times 10^{11} \Omega$.

b) Volume dissipative materials

Volume dissipative materials shall have a volume resistance $\geq 1 \times 10^4$ and $< 1 \times 10^{11} \Omega$.

NOTE The thickness of the material can have a significant influence on the measured value of volume resistance.

6.2.4 Resistance of insulating materials

Electrostatic insulating materials can be surface insulating, volume insulating or both.

a) Surface insulating materials

Electrostatic surface insulating materials have a surface resistance $\geq 1 \times 10^{11} \Omega$.

b) Volume insulating materials

Electrostatic volume insulating materials have a volume resistance $\geq 1 \times 10^{11} \Omega$.

6.3 Material electrostatic shielding properties

NOTE Electrostatic shielding materials protect packaged ESDSs from the effects of electrostatic discharges and fields that are external to the packaging.

6.3.1 Electrostatic discharge shielding

Electrostatic discharge shielding packaging is capable of attenuating an electrostatic discharge. The calculated energy allowed inside an electrostatic discharge shielding bag shall be less than 20 nJ when tested according to IEC 61340-4-8 or equivalent test method modified to accommodate the product.

6.3.2 Electrostatic field shielding

Electrostatic field shielding packaging is capable of attenuating an electrostatic field.

See Annex C.

7 Technical requirements for ESD protective packaging

7.1 Packaging and material properties

Table 1 and Table 2 provide test methods for determining material classifications for finished packaging and materials. When possible, testing shall be performed on the finished packaging. When testing cannot be performed on a finished packaging, the material classification shall be defined by the bulk material used for the production of the final packaging.

Other probes (electrodes) may be used providing the results correlate with the specified probes (electrodes). In case of dispute, the probe (electrode) assemblies specified in IEC 61340-2-3 shall be used.

Table 1 – Test methods for electrostatic protective packaging

Material classification	Test method ^a	Method description	Limits
Surface conductive	IEC 61340-2-3 ^e	R_S Surface resistance	$< 1 \times 10^4 \Omega$
	IEC 61340-2-3 ^{b,e}	R_{p-p} Point-to-point resistance	$< 1 \times 10^4 \Omega^c$
Volume conductive	IEC 61340-2-3 ^e	R_V Volume resistance	$< 1 \times 10^4 \Omega^d$
Surface dissipative	IEC 61340-2-3 ^e	R_S Surface resistance	$\geq 1 \times 10^4$ to $< 1 \times 10^{11} \Omega$
	IEC 61340-2-3 ^{b,e}	R_{p-p} Point-to-point resistance	$\geq 1 \times 10^4$ to $< 1 \times 10^{11} \Omega^c$
Volume dissipative	IEC 61340-2-3 ^e	R_V Volume resistance	$\geq 1 \times 10^4$ to $< 1 \times 10^{11} \Omega^d$
Surface insulating	IEC 61340-2-3 ^e	R_S Surface resistance	$\geq 1 \times 10^{11} \Omega$
	IEC 61340-2-3 ^{b,e}	R_{p-p} Point-to-point resistance	$\geq 1 \times 10^{11} \Omega^c$
Volume insulating	IEC 61340-2-3 ^e	R_V Volume resistance	$\geq 1 \times 10^{11} \Omega^d$
^a For product qualification of packaging materials, the environmental conditions for preconditioning and testing shall be $23^\circ\text{C} \pm 2^\circ\text{C}$ and $12\% \pm 3\%$ relative humidity. The preconditioning before the measurement shall be ≥ 48 h.			
^b IEC 61340-2-3 describes point-to-point resistance measurements using two 2,5 kg electrodes. It also describes a two-point probe for point-to-point resistance measurements for non-planar materials and products with small structures. Either of these two test methods may be used.			
^c The results of a measurement of R_{p-p} according to IEC 61340-2-3 can be different compared to the results of a measurement of R_S according to IEC 61340-2-3 due to the usage of different probes.			
^d The thickness of the material can have a significant influence on the values of a measured volume resistance. The requirement is the same despite the thickness of the material.			
^e IEC 61340-2-3 describes test methods for the determination of the electrical resistance and resistivity of solid materials in the range from $10^4 \Omega$ to $10^{12} \Omega$, and refers to other standards for measurements outside this range. However, it is possible that the other test methods referred to will not be appropriate for measuring packaging materials or products. Therefore, for the purposes stated in this table, any of the electrodes specified in IEC 61340-2-3 shall be used. The instrumentation used shall be able to measure to below $10^3 \Omega$; it is acceptable for the open circuit voltage or voltage under load of the instrumentation used to be less than 10 V.			

Table 2 – Test methods and requirements for electrostatic discharge shielding packaging

	Packaging system	
	Shielding bags	Other ESD shielding packaging design
Test method	IEC 61340-4-8	User defined
Requirement	Energy < 20 nJ	- intimate packaging shall be dissipative or conductive - a barrier layer or a defined air gap attenuating ESD energy shall be included ^a
^a No component of the packaging system shall cause ESD risk when taken within an EPA.		

7.2 Packaging marking

7.2.1 Classification symbol

ESD protective packaging should be marked with the ESD classification symbol given in IEC 60417-6202:2013-06 [4] and as shown in Figure 1 or in accordance with customer contracts, purchase orders, drawings or other documentation.



Figure 1 – Example of packaging label (*Primary function code)

7.2.2 Packaging classification

The primary function code should be marked below the ESD classification symbol given in IEC 60417-6202:2013-06 [4] and as shown in Table 3:

- S electrostatic discharge shielding;
- C electrostatic conductive;
- D electrostatic dissipative.

Table 3 – Primary function code and ESD classification symbol

Primary function code *	Primary function	ESD classification symbol
S	Electrostatic discharge shielding	
C	Electrostatic conductive	
D	Electrostatic dissipative	

7.2.3 Traceability

Packaging should be supplied with information that allows traceability to the packaging manufacturer and to the manufacturer's date and lot code information.