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INTERNATIONAL STANDARD

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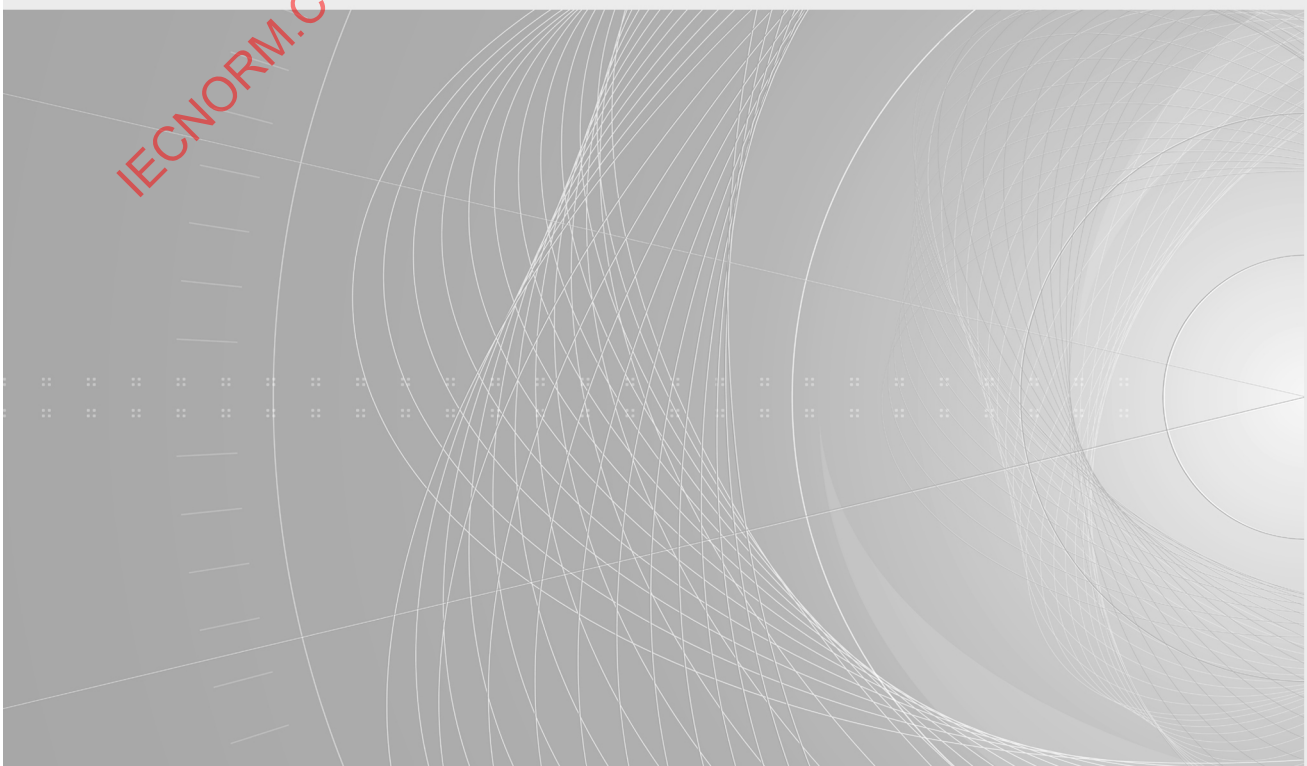
Electrostatics –
Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements



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ELECTROSTATICS –

Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements

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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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 61340-5-1 has been prepared by IEC technical committee 101: Electrostatics.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

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

a) Technical requirements were changed to align IEC 61340-5-1 with other industry ESD standards;
b) Reference documents were updated to reflect newly released IEC standards;
c) A section on product qualification was added;
d) Table 4 was deleted and detailed packaging requirements were deferred to IEC 6134053;
e) Clause A.1 was removed and is now included in IEC 61340-4-6.

The text of this standard is based on the following documents:

FDIS	Report on voting
101/505/FDIS	101/508/RVD

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

This publication 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 publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

The contents of the corrigendum of May 2017 have been included in this copy.

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 publication using a colour printer.

INTRODUCTION

This part of IEC 61340 covers the requirements necessary to design, establish, implement and maintain an electrostatic discharge (ESD) control program for activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 V human body model (HBM), 200 V charged device model (CDM) and 35 V on isolated conductors. Isolated conductors were historically represented by machine model (MM). The 35 V limit is related to the level achievable using ionizers specified in this standard. The MM test is no longer required for qualification of devices, only the HBM and CDM tests are. The MM test is retained in this standard for process control of isolated conductors only.

Any contact and physical separation of materials or flow of solids, liquids, or particle-laden gases can generate electrostatic charges. Common sources of ESD include charged: personnel, conductors, common polymeric materials, and processing equipment. ESD damage can occur when:

- a charged person or object comes into contact with an ESD sensitive device (ESDS);
- an ESDS comes into direct contact with a highly conductive surface while exposed to an electrostatic field;
- a charged ESDS comes into contact with another conductive surface which is at a different electrical potential. This surface may or may not be grounded.

Examples of ESDS are microcircuits, discrete semiconductors, thick and thin film resistors, hybrid devices, printed circuit boards and piezoelectric crystals. It is possible to determine device and item susceptibility by exposing the device to simulated ESD events. The ESD withstand voltage determined by sensitivity tests using simulated ESD events does not necessarily represent the ability of the device to withstand ESD from real sources at that voltage level. However, the levels of sensitivity are used to establish a baseline of susceptibility data for comparison of devices with equivalent part numbers from different manufacturers. Three different models have been used for qualification of electronic components – human body model (HBM), machine model (MM), and charged device model (CDM). In current practice devices are qualified only using HBM and CDM susceptibility tests.

This standard covers the ESD control program requirements necessary for setting up a program to handle ESDS, based on the historical experience of both military and commercial organizations. The fundamental ESD control principles that form the basis of this standard are as follows.

- Avoid a discharge from any charged, conductive object (personnel and especially automated handling equipment) into the ESDS. This can be accomplished by bonding or electrically connecting all conductors in the environment, including personnel, to a known ground or contrived ground (as on board ship or on aircraft). This attachment creates an equipotential balance between all conducting objects and personnel. Electrostatic protection can be maintained at a potential different from a “zero” voltage ground potential as long as all conductive objects in the system are at the same potential.
- Avoid a discharge from any charged ESD sensitive device. Charging can result from direct contact and separation or it can be induced by an electric field. Necessary insulators in the environment cannot lose their electrostatic charge by attachment to ground. Ionization systems provide neutralization of charges on these necessary insulators (circuit board materials and some device packages are examples of necessary insulators). ~~Assessment of~~ The ESD hazard created by electrostatic charges on the necessary insulators in the work place is ~~required~~ assessed to ensure that appropriate actions are implemented, according to the risk.
- Once outside of an electrostatic discharge protected area (hereinafter referred to as an EPA) it is ~~often~~ generally not possible to control the above items, therefore, ESD protective packaging may be required. ESD protection can be achieved by enclosing ESD sensitive products in static protective materials, although the type of material depends on

the situation and destination. Inside an EPA, static dissipative materials may provide adequate protection. Outside an EPA, static discharge shielding materials are recommended. Whilst all of these materials are not discussed in this standard, it is important to recognize the differences in their application. For more information see IEC 61340-5-3.

Each company has different processes, and so will require a different blend of ESD prevention measures for an optimum ESD control program. ~~It is vital that these~~ Measures ~~are~~ should be selected, based on technical necessity and carefully documented in an ESD control program plan, so that all concerned can be sure of the program requirements.

Training is an essential part of an ESD control program in order to ensure that the personnel involved understand the equipment and procedures they are to use in order to be in compliance with the ESD control program plan. Training is also essential in raising awareness and understanding of ESD issues. Without training, personnel are often a major source of ESD risk. With training, they become an effective first line of defence against ESD damage.

Regular compliance verification checks and tests are essential to ensure that equipment remains effective and that the ESD control program is correctly implemented in compliance with the ESD control program plan.

~~Any contact and physical separation of materials or flow of solids, liquids, or particle-laden gases can generate electrostatic charges. Common sources of ESD include charged: personnel, conductors, common polymeric materials, and processing equipment. ESD damage can occur when:~~

- ~~a charged person or object comes into contact with an ESDS;~~
- ~~an ESDS comes into direct contact with a highly conductive surface while exposed to an electrostatic field;~~
- ~~a charged ESDS comes into contact with another conductive surface which is at a different electrical potential. This surface may or may not be grounded.~~

~~Examples of ESDS are microcircuits, discrete semiconductors, thick and thin film resistors, hybrid devices, printed circuit boards and piezoelectric crystals. It is possible to determine device and item susceptibility by exposing the device to simulated ESD events. The level of sensitivity, determined by test using simulated ESD events, may not necessarily relate to the level of sensitivity in a real life situation. However, they are used to establish a baseline of susceptibility data for comparison of devices with equivalent part numbers from different manufacturers. Three different models are used for characterization of electronic components - human body model (HBM), machine model (MM), and charged device model (CDM).~~

ELECTROSTATICS –

Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements

1 Scope

This part of IEC 61340 applies to activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment ~~susceptible to damage by electrostatic discharges greater than or equal to 100 V human body model (HBM)~~ with withstand voltages greater than or equal to 100 V HBM, 200 V CDM and 35 V for isolated conductors. ESDS with lower withstand voltages may require additional control elements or adjusted limits. Processes designed to handle items that have lower ESD withstand voltage(s) can still claim compliance to this standard.

This standard provides the requirements for an ESD control program. ~~The user should refer to~~ IEC TR 61340-5-2 [9][1] ~~for~~ provides guidance on the implementation of this standard.

This standard does not apply to electrically initiated explosive devices, flammable liquids, gases and powders.

The purpose of this standard is to provide the administrative and technical requirements for establishing, implementing and maintaining an ESD control program (hereinafter referred to as the “program”).

NOTE Isolated conductors were historically represented by MM.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60364 (all parts), *Low-voltage electrical installations*~~

~~IEC/TS 60479-1, *Effects of current on human beings and livestock – Part 1: General aspects*~~

~~IEC/TS 60479-2, *Effects of current on human beings and livestock – Part 2: Special aspects*~~

~~IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*~~

~~IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*~~

~~IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*~~

[1] Numbers in square brackets refer to the bibliography.

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

IEC 61340-4-1, *Electrostatics – Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors*

IEC 61340-4-3, *Electrostatics – Part 4-3: Standard test methods for specific applications – Footwear*

IEC 61340-4-5, *Electrostatics – Part 4-5: Standard test methods for specific applications – Methods for characterizing the electrostatic protection of footwear and flooring in combination with a person*

IEC 61340-4-6, *Electrostatics – Part 4-6: Standard test methods for specific applications – Wrist straps*

IEC 61340-4-7, *Electrostatics – Part 4-7: Standard test methods for specific applications – Ionization*

IEC 61340-4-9, *Electrostatics – Part 4-9: Standard test methods for specific applications – Garments*

~~IEC/TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*~~

IEC 61340-5-3, *Electrostatics – Part 5-3: Protection of electronic devices from electrostatic phenomena – Properties and requirements classification for packaging intended for electrostatic discharge sensitive devices*

~~ANSI/ESD S1.1, *Standard Test Method for the protection of electrostatic charge susceptible items – Wrist Straps*~~

~~ANSI/ESD STM2.1, *Standard Test Method for the protection of electrostatic discharge susceptible items – Garments*~~

~~ANSI/ESD STM3.1, *Standard Test Method for the electrostatic discharge susceptible items – Ionization*~~

~~ANSI/ESD STM11.31, *Standard Test Method for evaluating the performance of electrostatic discharge shielding materials – Bags*~~

3 Terms and definitions

For the purposes of this document, the following terms and definitions ~~in the future IEC 61340-1-2 as well as the following,~~ apply.

NOTE For the purposes of this document “earth” and “ground” have the same meaning.

3.1
charged device model
CDM
ESD stress model that approximates the discharge event that occurs when a charged component is quickly discharged to another object at a different electrostatic potential

Note 1 to entry: Charged device model is described in ANSI/ESDA/JEDEC JS-002-2014 [1].

Note 2 to entry: This note only applies to the French language.

3.2
common ground point
grounded device or location where the conductors of two or more ESD control items are bonded

3.3
common connection point
device or location where the conductors of two or more ESD control items are connected in order to bring the ESD protective items to the same electrical potential through equipotential bonding

3.4
equipotential bond
electrical connection of ~~exposed~~ conductive parts (or items used to control ESD) so that they are at substantially the same voltage under normal and fault conditions

3.5
electrostatic discharge
ESD
rapid transfer of charge between bodies that are at different electrostatic potentials

Note 1 to entry: This note only applies to the French language.

3.6
ESD control items
materials or products designed to prevent the generation of static charge and/or dissipate static charges that have been generated so as to prevent damage to ESD sensitive devices

3.7
ESD protected area
EPA
area in which an ESDS can be handled with accepted risk of damage as a result of electrostatic discharge or fields

Note 1 to entry: This note only applies to the French language.

3.8
ESD sensitive device
ESDS
sensitive device, integrated circuit or assembly that may be damaged by electrostatic fields or electrostatic discharge

3.9
ESD withstand voltage
highest voltage level that does not cause device failure

Note 1 to entry: The device passes all tested lower voltages.

3.10
functional ground
terminal used to connect parts to ~~earth~~ ground for reasons other than safety

3.11
human body model
HBM
ESD stress model that approximates the discharge from the fingertip of a typical human being onto a pin of a device with another pin grounded

Note 1 to entry: Human body model is described in IEC 60749-26 [2].

Note 2 to entry: This note only applies to the French language.

3.12
machine model
MM
ESD stress model that approximates the discharge to a device pin due to contact of equipment or tools such as those found in the manufacturing line

Note 1 to entry: Machine model is described in IEC 60749-27 [3].

Note 2 to entry: This note only applies to the French language.

3.13
organization
company, group or body that handles ESDS

3.14
protective earth
terminal used to connect parts to earth for safety reasons

4 Personnel safety

The procedures and equipment described in this standard may expose personnel to hazardous electrical conditions. Users of this standard are responsible for selecting equipment that complies with applicable laws, regulatory codes and both external and internal policy. Users are cautioned that this standard cannot replace or supersede any requirements for personnel safety.

Electrical hazard reduction practices ~~should~~ shall be exercised and proper grounding instructions for equipment ~~must~~ shall be followed.

5 ESD control program

5.1 General

5.1.1 ESD control program requirements

~~An ESD control program, that has been established using the technical limits required by this standard, will minimize ESD related damage to devices that have an ESD sensitivity greater than or equal to 100 V HBM as determined through testing using IEC 60749-26.~~ The ESD control program shall include all the administrative and technical requirements of this standard. The ESD control program shall document the lowest ESD withstand voltage(s) that can be handled. The organization shall establish, document, implement, maintain and verify the compliance of the program in accordance with the requirements of this standard.

5.1.2 ESD coordinator

A person shall be assigned by the organization with the responsibility for implementing the requirements of this standard including establishing, documenting, maintaining and verifying the compliance of the program.

5.1.3 Tailoring

This standard, or portions of it, may not 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 and technical justification, shall be documented.

5.2 ESD control program administrative requirements

5.2.1 ESD control program plan

The organization shall prepare an ESD control program plan that addresses each of the requirements of the program. Those requirements ~~concern~~ are:

- training,
- product qualification,
- compliance verification,
- grounding/bonding systems,
- personnel grounding,
- EPA requirements,
- packaging systems,
- marking.

The plan is the principal document for implementing and verifying the program. The goal is a fully implemented and integrated program that conforms to internal quality system requirements. The plan shall apply to all applicable facets of the organization's work.

5.2.2 Training plan

The training plan shall define all personnel that are required to have ESD awareness and prevention training. At a minimum, initial and recurrent ESD awareness and prevention training shall be provided to all personnel who handle or otherwise come into contact with any ESDS ~~items~~. Initial training shall be provided before personnel handle ESD sensitive devices. The type and frequency of ESD training for personnel shall be defined in the training plan. The training plan shall include a requirement for maintaining employee training records and shall document where the records are stored. Training methods and the use of specific techniques are at the organization's discretion. The training plan shall include methods used by the organization to ensure trainee comprehension and training adequacy.

5.2.3 Product qualification

The organization shall qualify all ESD control items that are selected for use as part of the ESD control program. Tables 2 and 3 list the required product qualification test methods, associated limits for each ESD control item and other requirements as stated in this standard.

Acceptable evidence of product qualification includes:

a) Product data sheets published by the manufacturer of the ESD control item:
   1) The data sheet shall reference the required IEC test method for that item.
   2) The data sheet limits shall, at a minimum, comply with the limits for that ESD control item
b) Test reports from an independent laboratory: the test report shall reference the applicable IEC test method and the limits shall comply with the limits for that item as specified in this standard.
c) Test reports generated internally by the organization for its own use: the test report shall reference the applicable IEC test method and the limits shall comply with the limits for that item.
d) For ESD control items that were installed by the organization before the adoption of this standard, on-going compliance verification records can be used as evidence of product qualification.

For ESD control items that are not listed in Tables 2 and 3, but are considered to be a part of the ESD control program, the organization using such items shall qualify these products prior

to use. The test method used for product qualification and the user defined acceptance limits for each item shall be documented in the ESD control program plan.

NOTE IEC TR 61340-5-2 contains guidance for items not listed in Tables 2 and 3 of this document.

5.2.4 Compliance verification plan

A compliance verification plan shall be established to ensure the organization's fulfilment of the requirements of the plan. Process monitoring (measurements) shall be conducted in accordance with a compliance verification plan that identifies the technical requirements to be verified, the measurement limits and the frequency at which those verifications ~~must~~ shall occur. The compliance verification plan ~~must~~ shall document the test methods used for process monitoring and measurements. If the organization uses different test methods ~~that differ from the standards referenced in~~ to replace those of this standard, the organization ~~must~~ shall be able to show that the results achieved correlate with the referenced standards. Where test methods are devised for testing items not covered in this standard, these shall be adequately documented including corresponding test limits. Compliance verification records shall be established and maintained to provide evidence of conformity to the technical requirements.

The test equipment selected shall be capable of making the measurements defined in the compliance verification plan.

Consideration should be taken regarding the lowest relative humidity levels experienced by the organization; some of the measurements should be made under these conditions.

5.3 ESD control program plan technical requirements

5.3.1 General

The following subclauses describe the essential technical requirements used in the development of an ESD control program.

The required limits are based on the test methods or standards listed in Table 1, Table 2 and Table 3. The compliance verification plan ~~must~~ shall document the methods used to verify the limits. These procedures may or may not be based on the test methods in each table. Test methods and corresponding limits used by the organization that differ from the test methods or references in Tables 1 to 3 shall be documented with a technical justification that supports their use.

Some of the technical elements listed in Tables 1 to 3 do not have a defined lower resistance limit. However, a minimum resistance value may be required for safety reasons.

See relevant national requirements and/or IEC 60364[4] series, IEC TS 60479-1[5], IEC TS 60479-2[6], IEC 61010-1[7] and IEC 61140[8].

5.3.2 Grounding/equipotential bonding systems

In order to eliminate ESD damage, it is necessary to eliminate differences in potential between ESDS ~~items~~ and other conductors that ESDS might come into contact with such as personnel, automated handling equipment, fixtures and mobile equipment. ~~All conductive and dissipative items shall be connected to ground or to each other (equipotential bonding) in order to eliminate differences in potential.~~ All items that come into contact with ESDS and are capable of conducting electricity shall be connected to ground or electrically bonded in order to eliminate differences in potential. This can be achieved in three different ways:

- Grounding using protective earth

  The first and preferred ESD ground is protective earth if available. In this case, the ESD control elements and grounded personnel are connected to protective earth (see Figure 1).

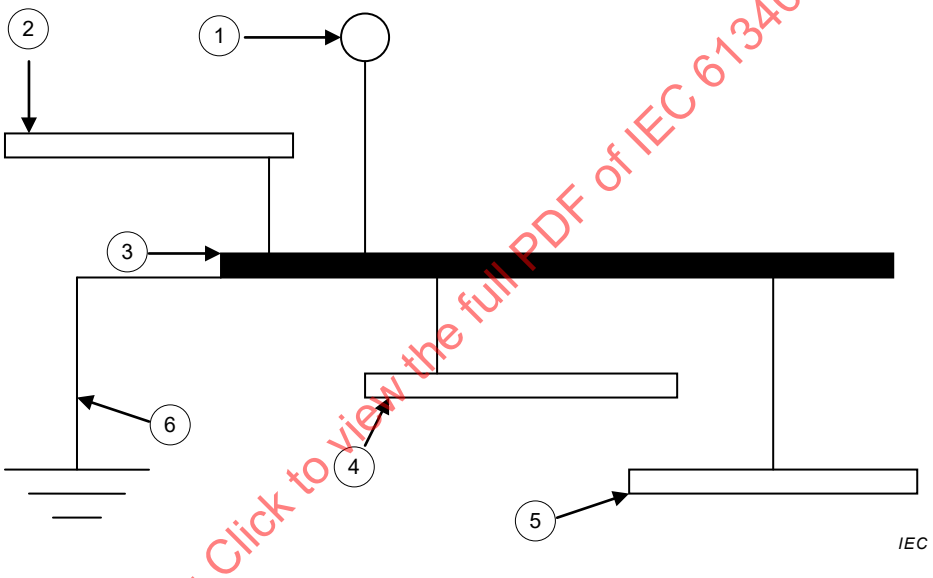
- Grounding using functional ground

  The second acceptable ESD ground is achieved through the use of a functional ground. This conductor can be a ground rod, stake ~~that is used for grounding the ESD control items in use at a facility~~ or a separate wiring system that is bonded to the AC ground at the main service panel (see Figure 1); in order to eliminate differences in potential between protective earth and the functional ground system, ~~it is highly recommended that the two systems be electrically bonded together (see Figure 1)~~ the two systems shall be electrically bonded together where possible.

- Equipotential bonding

  In the event that a ground facility is not available, ESD protection can be achieved by connecting all of the ESD control items together at a common connection point (see Figure 2). The maximum resistance between any protective item and the common connection point ~~must~~ shall comply with the limits established for the protective items as per Tables 2 and 3.

Whichever grounding/bonding system is selected, it shall be referred to as "ground" in the remainder of this standard.



Key

1 Wrist strap (band and ground cord)

2 Work surface

3 ~~example of~~ Common ground point

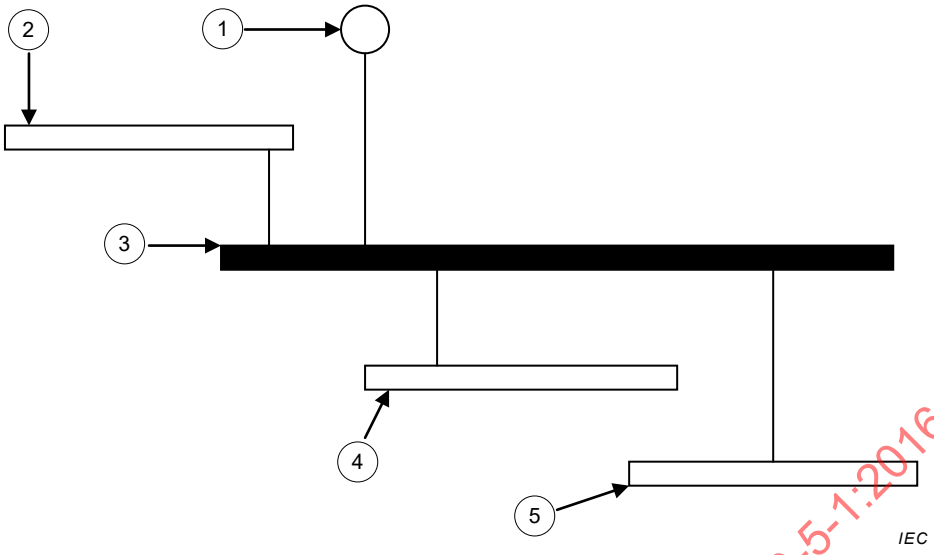
4 ~~ESD~~ Floor mat

5 ~~ESD~~ Floor

6 Protective earth or functional ground (functional ground, if used, ~~should~~ shall be bonded to protective earth)

Figure 1 – Schematic of an EPA with a ground reference

CAUTION: Users are advised to consult local and national electrical codes and regulations before making any connections to facility electrical wiring systems.



Key

1 Wrist strap and cord
2 Work surface
3 Common connection point
4 ~~ESD~~ Floor mat
5 ~~ESD~~ Floor

Figure 2 – Schematic of an equipotential bonding system

Table 1 – Grounding/bonding requirements

Technical requirement	Grounding method	Test method/standard	Required limit(s)
Grounding/bonding system	Protective earth	National electrical system standard	National electrical code limits
	Functional ground	National electrical system standard	National electrical code limits If the national electrical code does not specify a requirement, then the resistance between functional ground and protective earth shall not exceed 25 Ω
	Equipotential bonding	See applicable implementing process from Tables 2 and 3	See limits for each ESD control item from Tables 2 and 3

5.3.3 Personnel grounding

All personnel shall be grounded or equipotentially bonded according to the requirements below when handling ESDS. When personnel are seated at ESD protective workstations, they shall be connected to ground via a wrist strap system.

For standing operations, personnel can be grounded via a wrist strap system or by a footwear-flooring system. When a footwear-flooring system is used, ~~either of~~ personnel shall wear ESD footwear on both feet and the two following conditions shall be met:

- the total resistance of the system (from the person, through the footwear and flooring to ~~equipment~~ ground) shall be less than ~~3,5 × 10^{7}~~ 1,0 × 10^{9} Ω;
- the maximum body voltage generation shall be less than 100 V ~~and the total resistance of the system shall be less than 1 x10^{9}Ω~~.

Table 2 – Personnel grounding requirements

Technical requirement	ESD control item	Product qualification		Compliance verification	
		Test method	Limits[b]	Test method	Limits[b]
Personnel grounding	Wrist straps (bands and ground cords)	~~ANSI/ESD S1.1 (5.1)~~ IEC 61340-4-6	$R < 5 \times 10^{6}$ Ω or user defined value	See wrist strap system	
	Wrist band resistance	~~ANSI/ESD S1.1 (5.2)~~ IEC 61340-4-6			
		– interior	≤ 1 × 10^{5} Ω	Not applicable	
		– exterior	> 1 × 10^{7} Ω	Not applicable	
	Wrist strap system[a]	Not applicable		~~IEC 61340-5-1 Clause A.1~~ IEC 61340-4-6 Wrist strap continuity test	$R < 3{,}5 \times 10^{7}$ Ω
	Footwear	IEC 61340-4-3[c]	~~Conductive: <1x10^{5} Ω~~ ~~Dissipative: 1x10^{5} ≤R≤1x10^{8} Ω~~ $R \leq 1 \times 10^{8}$ Ω	See person/footwear system	
				~~See person/footwear system~~	
	Person/footwear/flooring system	IEC 61340-4-5	~~R_g<3,5x10^{7} Ω~~ ~~OR~~ ~~R_g<1,0x10^{9} Ω and body voltage <100 V (average of 5 highest peaks)~~ $R_g < 1{,}0 \times 10^{9}$ Ω and absolute value of body voltage < 100 V (average of 5 highest peaks)	IEC 61340-4-5	$R_g < 1{,}0 \times 10^{9}$ Ω[d,f]
	Person/footwear system	Not applicable		~~IEC 61340-5-1 Clause A.2~~ See Annex A[e]	~~R<3,5x10^{7} Ω~~ $R_{gp} < 1{,}0 \times 10^{8}$ Ω

[a] For situations where an ESD garment is used as part of the wrist strap grounding path, the total system resistance including the person, garment and grounding cord should be less than 3,5 × 10^{7} Ω.

[b] Symbols used in this table: R_g refers to resistance to ground, R_{gp} refers to resistance to groundable point

[c] For the product qualification of footwear, the environmental conditions for testing, using IEC 61340-4-3 should be (12 ± 3) % RH and 23 °C ± 2 °C.

[d] A periodic body voltage generation test should be done to verify the voltage is less than 100 V

[e] The resistance limit applies to measuring each foot one by one, not two in parallel.

[f] The required limit of < 1,0 × 10^{9} Ω is the maximum allowed value. The user should establish an upper limit from the resistance values that were measured for product qualification for the footwear and the floor to comply with the < 100 V body voltage generation and use these resistances for compliance verification.

5.3.4 ESD protected areas (EPA)

5.3.4.1 Handling ESDS and access to EPA

Handling of ESDS without ESD protective covering or packaging shall be performed in an EPA. The boundaries of the EPA shall be clearly identified as EPA boundaries (e.g, caution signs indicating the existence of the EPA ~~shall~~ can be posted and ~~clearly visible~~ conspicuous to personnel prior to entry to the EPA.)

NOTE ~~1~~ An EPA can, for example, consist of a building, an entire room or a single workstation.

Access to the EPA shall be limited to personnel who have completed appropriate ESD training. Untrained individuals shall be escorted by trained personnel while in an EPA.

5.3.4.2 Insulators

All non-essential insulators and items (plastics and paper), such as coffee cups, food wrappers and personal items shall be removed from the workstation or any operation where unprotected ESDS are handled.

The ESD threat associated with process essential insulators or electrostatic field sources shall be evaluated to ensure that:

- the electrostatic field at the position where the ESDS are handled shall not exceed ~~10 000~~ 5 000 V/m;

or

- if the electrostatic potential measured at the surface of the process required insulator exceeds 2 000 V, the item shall be kept a minimum of 30 cm from the ESDS; and
- if the electrostatic potential measured at the surface of the process required insulator exceeds 125 V, the item shall be kept a minimum of 2,5 cm from the ESDS.

If the measured electrostatic field or surface potential exceeds the stated limits, ionization or other charge mitigating techniques shall be used.

Some of the measurements should be taken at the lowest expected relative humidity experienced by the facility.

NOTE 1 These measurements are made based on the frequency defined in the compliance verification plan.

NOTE 2 An ESD threat is considered a metal to metal contact while the ESDS is in the presence of the field

NOTE 3 The accurate measurement of electrostatic fields requires that the person making the measurement is familiar with the operation of the measuring equipment. Most hand held meters require that the reading be taken at a fixed distance from the object. They also normally specify that the object has a minimum dimension of fixed size in order to obtain an accurate reading.

5.3.4.3 Isolated conductors

When establishing an ESD control plan, if a conductor that comes into contact with an ESDS item cannot be grounded or equipotentially bonded together, then the process shall ensure that the difference in potential between the conductor and the contact of the ESDS item is less than 35 V.

This can be accomplished by measuring the ESDS item and the conductor by using: a non-contact electrostatic voltmeter or a high impedance contact electrostatic voltmeter.

NOTE The 35 V limit is related to the level achievable using ionizers specified in this standard.

5.3.4.4 ESD control items

An EPA shall be established wherever ESD sensitive products are handled without ESD protective covering or packaging. However, there are many different ways to establish an ESD control program. Table 3 lists some optional ESD control items which can be used to control static electricity. For those ESD control items that are selected for use in the ESD control program, the required range for that item becomes mandatory.

~~NOTE 2~~ If the limits in Table 3 are exceeded, the ESD control program ~~must~~ shall include a tailoring statement as required by 5.1.3.

Table 3 – EPA requirements

EPA requirements	ESD control item	Product qualification[a]		Compliance verification[b]	
		Test method	Limits[c]	Based on test method	Limits[c]
	Working surfaces, storage racks and trolley[g]	IEC 61340-2-3	$R_{gp} < 1 \times 10^9\ \Omega$ $R_{p\text{-}p} < 1 \times 10^9\ \Omega$[f]	IEC 61340-2-3	$R_g < 1 \times 10^9\ \Omega$
	Wrist strap bonding point				$R_g < 5 \times 10^6\ \Omega$
	Flooring	IEC 61340-4-1[d,e]	$R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-4-1	$R_g < 1 \times 10^9\ \Omega$
	Ionization	~~ANSI/ESD STM3.1~~ IEC 61340-4-7	Decay (1 000 V to 100 V and –1 000 V to –100 V) < 20 s Offset voltage < ±~~50~~ 35 V	~~ANSI/ESD STM3.1~~ IEC 61340-4-7	Decay (1 000 V to 100 V and –1 000 V to –100 V) < 20 s or user defined Offset voltage < ±~~50~~ 35 V
	Seating	IEC 61340-2-3 (resistance to groundable point measurements)	~~$R_{gp} < 1 \times 10^{10}\ \Omega$~~ $R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-2-3 ~~(8.6.3 with exception that the measurement is to ground)~~ (resistance to ground measurements)	~~$R_{gp} < 1 \times 10^{10}\ \Omega$~~ $R_g < 1 \times 10^9\ \Omega$
	~~Garments~~	~~ANSI/ESD STM 2.1~~	~~$R_{p\text{-}p} < 1 \times 10^{12}\ \Omega$~~	~~ANSI/ESD STM 2.1~~	~~$R_{p\text{-}p} < 1 \times 10^{12}\ \Omega$~~
	~~Garments (groundable)~~ ~~(see NOTE 7)~~	~~ANSI/ESD STM 2.1~~	~~$R_{p\text{-}p} < 1 \times 10^9\ \Omega$~~	~~ANSI/ESD STM 2.1~~	~~$R_{p\text{-}p} < 1 \times 10^9\ \Omega$~~
	Static control garments	IEC 61340-4-9	$R_{p\text{-}p} < 1 \times 10^{11}\ \Omega$	IEC 61340-4-9	$R_{p\text{-}p} < 1 \times 10^{11}\ \Omega$
		or	or	or	or
		user defined method	user defined limit	user defined method	user defined limit
	Groundable static control garments	IEC 61340-4-9	$R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-4-9	$R_{gp} < 1 \times 10^9\ \Omega$

[a] For product qualification, the environmental conditions for testing should be (12 ± 3) % RH and 23 °C ± 2 °C. When not specified in the referenced IEC standard, the minimum environmental conditioning time for product qualification should be 48 hours.

[b] The test methods in the compliance verification column refer to the basic test procedure only. It is not expected that the test method will be followed in its entirety.

[c] Symbols used in this table: $R_{p\text{-}p}$ refers to point to point resistance. R_g refers to resistance to ground and R_{gp} refers to resistance to groundable point.

[d] The maximum test voltage allowed for measuring ESD flooring that should be used for an ESD program complying with this standard is 100 V.

[e] If flooring is used for grounding personnel that handle ESDS refer to the system requirements in Table 2.

[f] In situations where charged device model (CDM) damage is a concern, a minimum point to point resistance limit of $1 \times 10^4\ \Omega$ is recommended.

~~NOTE 7 If a groundable garment is used as par of the person's primary ground path (person is connected to a garment which is connected to a grounding cord that is attached to ground) then the maximum resistance from the person's body to ground should be $3{,}5 \times 10^7\ \Omega$.~~

[g] Worksurfaces are defined as any surface on which an unprotected ESD sensitive item is placed.

5.3.5 Packaging

ESD protective packaging and package marking shall be in accordance with customer contracts, purchase orders, drawing or other documentation. When the contract, purchase order, drawing or other documentation does not define ESD protective packaging, the organization shall define ESD protective packaging requirements for ESDS ~~items~~ within the plan based on IEC 61340-5-3. Packaging, when required, shall be defined for all material movement within EPAs, between EPAs, between job sites, field service operations and to the customer.

~~The following table and the associated test methods shall be used to classify ESD protective packaging materials that are chosen for use with ESD sensitive products.~~

~~**Table 4 – Packaging**~~

~~Technical requirement~~	~~ESD control item~~	~~Test method (see NOTE 2)~~	~~Required range~~
~~Packaging~~	~~Static dissipative~~	~~IEC 61340-2-3~~	~~$1x10^5 \leq R_s < 1x10^{11}$ Ω (see NOTE 1)~~
	~~Conductive~~	~~IEC 61340-2-3~~	~~$1x10^2 \leq R_s < 1x10^5$ Ω~~
	~~Insulator~~	~~IEC 61340-2-3~~	~~$R_s \geq 1x10^{11}$ Ω~~
	~~Discharge shielding (bags)~~	~~ANSI/ESD STM 11.31~~	~~<50 nJ~~
~~NOTE 1 Refer to IEC 61340-2-3 and use the surface resistance (R_s) procedure to make these measurements.~~ ~~NOTE 2 For product qualification of packaging materials, the environmental conditions for testing should be 12 % RH and 23 °C.~~			

5.3.6 Marking

ESDS, system or packaging marking shall be in accordance with customer contracts, purchase orders, drawing or other documentation. When the contract, purchase order, drawing or other documentation does not define ESDS, system or packaging marking, the organization, in developing the ESD control program plan, shall consider the need for marking. If it is determined that marking is required, it shall be documented as part of the plan.

Annex A
(normative)

Test methods

A.1 Measurement method for wrist strap testing

The operator shall wear the wrist strap in the normal position and plug the free end of the cord into the test apparatus. The hand contact plate shall be pressed to verify that the wrist strap system resistance is within acceptable parameters. The test apparatus can be an integrated, commercially available tester or other instrumentation that is capable of measuring resistance from $5{,}0 \times 10^4$ Ω to at least $1{,}0 \times 10^8$ Ω. The tester open-circuit voltage is typically between 9 V d.c. and 100 V d.c. An example of a typical test apparatus can be found in Figure A.1.

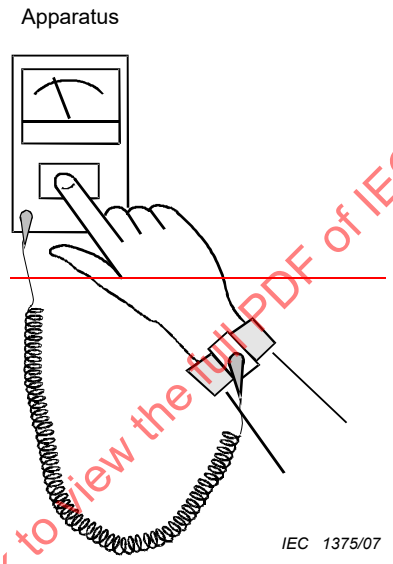


Figure A.1 – Wrist strap testing

A.2 Measurement procedure for footwear testing (example)

The operator shall stand with one foot on the conductive footwear electrode. The hand contact plate shall be pressed to verify that the person/footwear system resistance is within acceptable parameters (see Figure A.1). The test shall be repeated for the other foot. The test apparatus can be an integrated, commercially available tester or other instrumentation that is capable of measuring resistance from $5{,}0 \times 10^4$ Ω to at least $1{,}0 \times 10^9$ Ω. The tester open-circuit voltage is typically between 9 V d.c. and 100 V d.c.

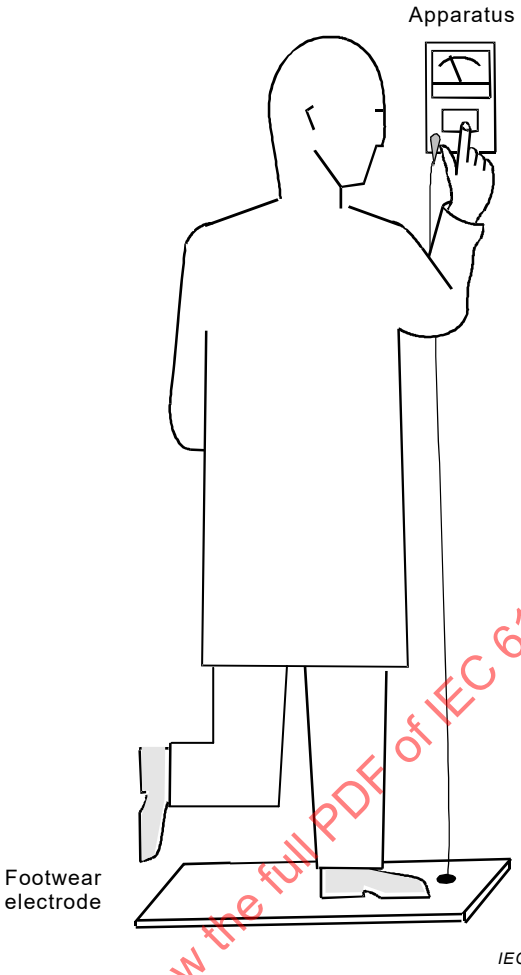


Figure A.1 – Footwear functional testing (example)

Bibliography

[1] ANSI/ESDA/JEDEC JS-002-2014, *ESDA/JEDEC Joint Standard for Electrostatic Device Sensitivity Testing – Charged Device Model (CDM) – Device Level*

[2] IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*

[3] IEC 60749-27, *Semiconductor devices – Mechanical and climatic test methods – Part 27:Electrostatic discharge (ESD) sensitivity testing – Machine model (MM)*

[4] IEC 60364 (all parts), *Low-voltage electrical installations*

[5] IEC TS 60479-1, *Effects of current on human beings and livestock – Part 1: General aspects*

[6] IEC TS 60479-2, *Effects of current on human beings and livestock – Part 2: Special aspects*

[7] IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*

[8] IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

~~[9] IEC 61340-1-2, *Electrostatics – Part 1-2: Definitions of all parts of the electrostatics series 61340-1-2 (under consideration)*~~

[9] IEC TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

IEC 61340-5-1

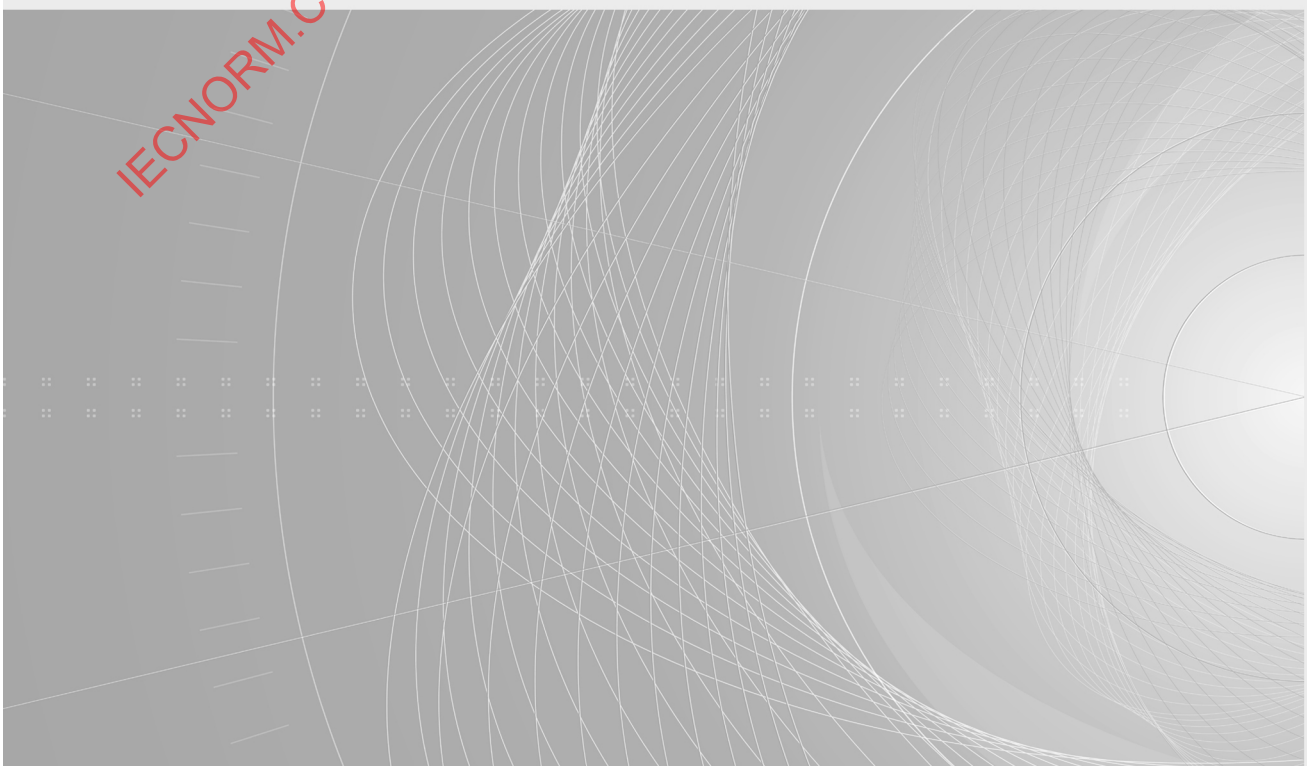
Edition 2.0 2016-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electrostatics –
Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements

Électrostatique –
Partie 5-1: Protection des dispositifs électroniques contre les phénomènes électrostatiques – Exigences générales



IEC 61340-5-1:2016-05(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTROSTATICS –

Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements

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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International Standard IEC 61340-5-1 has been prepared by IEC technical committee 101: Electrostatics.

This second edition cancels and replaces the first edition published in 2007. This edition constitutes a technical revision.

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

a) Technical requirements were changed to align IEC 61340-5-1 with other industry ESD standards;
b) Reference documents were updated to reflect newly released IEC standards;
c) A section on product qualification was added;
d) Table 4 was deleted and detailed packaging requirements were deferred to IEC 61340-5-3;

e) Clause A.1 was removed and is now included in IEC 61340-4-6.

The text of this standard is based on the following documents:

FDIS	Report on voting
101/505/FDIS	101/508/RVD

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

This publication 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 publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

The contents of the corrigendum of May 2017 have been included in this copy.

INTRODUCTION

This part of IEC 61340 covers the requirements necessary to design, establish, implement and maintain an electrostatic discharge (ESD) control program for activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 V human body model (HBM), 200 V charged device model (CDM) and 35 V on isolated conductors. Isolated conductors were historically represented by machine model (MM). The 35 V limit is related to the level achievable using ionizers specified in this standard. The MM test is no longer required for qualification of devices, only the HBM and CDM tests are. The MM test is retained in this standard for process control of isolated conductors only.

Any contact and physical separation of materials or flow of solids, liquids, or particle-laden gases can generate electrostatic charges. Common sources of ESD include charged: personnel, conductors, common polymeric materials, and processing equipment. ESD damage can occur when:

- a charged person or object comes into contact with an ESD sensitive device (ESDS);
- an ESDS comes into direct contact with a highly conductive surface while exposed to an electrostatic field;
- a charged ESDS comes into contact with another conductive surface which is at a different electrical potential. This surface may or may not be grounded.

Examples of ESDS are microcircuits, discrete semiconductors, thick and thin film resistors, hybrid devices, printed circuit boards and piezoelectric crystals. It is possible to determine device and item susceptibility by exposing the device to simulated ESD events. The ESD withstand voltage determined by sensitivity tests using simulated ESD events does not necessarily represent the ability of the device to withstand ESD from real sources at that voltage level. However, the levels of sensitivity are used to establish a baseline of susceptibility data for comparison of devices with equivalent part numbers from different manufacturers. Three different models have been used for qualification of electronic components – human body model (HBM), machine model (MM), and charged device model (CDM). In current practice devices are qualified only using HBM and CDM susceptibility tests.

This standard covers the ESD control program requirements necessary for setting up a program to handle ESDS, based on the historical experience of both military and commercial organizations. The fundamental ESD control principles that form the basis of this standard are as follows.

- Avoid a discharge from any charged, conductive object (personnel and especially automated handling equipment) into the ESDS. This can be accomplished by bonding or electrically connecting all conductors in the environment, including personnel, to a known ground or contrived ground (as on board ship or on aircraft). This attachment creates an equipotential balance between all conducting objects and personnel. Electrostatic protection can be maintained at a potential different from a “zero” voltage ground potential as long as all conductive objects in the system are at the same potential.
- Avoid a discharge from any charged ESD sensitive device. Charging can result from direct contact and separation or it can be induced by an electric field. Necessary insulators in the environment cannot lose their electrostatic charge by attachment to ground. Ionization systems provide neutralization of charges on these necessary insulators (circuit board materials and some device packages are examples of necessary insulators). The ESD hazard created by electrostatic charges on the necessary insulators in the work place is assessed to ensure that appropriate actions are implemented, according to the risk.
- Once outside of an electrostatic discharge protected area (hereinafter referred to as an EPA) it is generally not possible to control the above items, therefore, ESD protective packaging may be required. ESD protection can be achieved by enclosing ESD sensitive products in static protective materials, although the type of material depends on the situation and destination. Inside an EPA, static dissipative materials may provide

adequate protection. Outside an EPA, static discharge shielding materials are recommended. Whilst all of these materials are not discussed in this standard, it is important to recognize the differences in their application. For more information see IEC 61340-5-3.

Each company has different processes, and so will require a different blend of ESD prevention measures for an optimum ESD control program. Measures should be selected, based on technical necessity and carefully documented in an ESD control program plan, so that all concerned can be sure of the program requirements.

Training is an essential part of an ESD control program in order to ensure that the personnel involved understand the equipment and procedures they are to use in order to be in compliance with the ESD control program plan. Training is also essential in raising awareness and understanding of ESD issues. Without training, personnel are often a major source of ESD risk. With training, they become an effective first line of defence against ESD damage.

Regular compliance verification checks and tests are essential to ensure that equipment remains effective and that the ESD control program is correctly implemented in compliance with the ESD control program plan.

ELECTROSTATICS –

Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements

1 Scope

This part of IEC 61340 applies to activities that: manufacture, process, assemble, install, package, label, service, test, inspect, transport or otherwise handle electrical or electronic parts, assemblies and equipment with withstand voltages greater than or equal to 100 V HBM, 200 V CDM and 35 V for isolated conductors. ESDS with lower withstand voltages may require additional control elements or adjusted limits. Processes designed to handle items that have lower ESD withstand voltage(s) can still claim compliance to this standard.

This standard provides the requirements for an ESD control program. IEC TR 61340-5-2 [9][1] provides guidance on the implementation of this standard.

This standard does not apply to electrically initiated explosive devices, flammable liquids, gases and powders.

The purpose of this standard is to provide the administrative and technical requirements for establishing, implementing and maintaining an ESD control program (hereinafter referred to as the “program”).

NOTE Isolated conductors were historically represented by MM.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 planar materials used to avoid electrostatic charge accumulation*

IEC 61340-4-1, *Electrostatics – Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors*

IEC 61340-4-3, *Electrostatics – Part 4-3: Standard test methods for specific applications – Footwear*

IEC 61340-4-5, *Electrostatics – Part 4-5: Standard test methods for specific applications – Methods for characterizing the electrostatic protection of footwear and flooring in combination with a person*

IEC 61340-4-6, *Electrostatics – Part 4-6: Standard test methods for specific applications – Wrist straps*

[1] Numbers in square brackets refer to the bibliography.

IEC 61340-4-7, *Electrostatics – Part 4-7: Standard test methods for specific applications – Ionization*

IEC 61340-4-9, *Electrostatics – Part 4-9: Standard test methods for specific applications – Garments*

IEC 61340-5-3, *Electrostatics – Part 5-3: Protection of electronic devices from electrostatic phenomena – Properties and requirements classification for packaging intended for electrostatic discharge sensitive devices*

3 Terms and definitions

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

NOTE For the purposes of this document "earth" and "ground" have the same meaning.

3.1
charged device model
CDM
ESD stress model that approximates the discharge event that occurs when a charged component is quickly discharged to another object at a different electrostatic potential

Note 1 to entry: Charged device model is described in ANSI/ESDA/JEDEC JS-002-2014 [1].

Note 2 to entry: This note only applies to the French language.

3.2
common ground point
grounded device or location where the conductors of two or more ESD control items are bonded

3.3
common connection point
device or location where the conductors of two or more ESD control items are connected in order to bring the ESD protective items to the same electrical potential through equipotential bonding

3.4
equipotential bond
electrical connection of conductive parts (or items used to control ESD) so that they are at substantially the same voltage under normal and fault conditions

3.5
electrostatic discharge
ESD
rapid transfer of charge between bodies that are at different electrostatic potentials

Note 1 to entry: This note only applies to the French language.

3.6
ESD control items
materials or products designed to prevent the generation of static charge and/or dissipate static charges that have been generated so as to prevent damage to ESD sensitive devices

3.7
ESD protected area
EPA
area in which an ESDS can be handled with accepted risk of damage as a result of electrostatic discharge or fields

Note 1 to entry: This note only applies to the French language.

3.8
ESD sensitive device
ESDS
sensitive device, integrated circuit or assembly that may be damaged by electrostatic fields or electrostatic discharge

3.9
ESD withstand voltage
highest voltage level that does not cause device failure

Note 1 to entry: The device passes all tested lower voltages.

3.10
functional ground
terminal used to connect parts to ground for reasons other than safety

3.11
human body model
HBM
ESD stress model that approximates the discharge from the fingertip of a typical human being onto a pin of a device with another pin grounded

Note 1 to entry: Human body model is described in IEC 60749-26 [2].

Note 2 to entry: This note only applies to the French language.

3.12
machine model
MM
ESD stress model that approximates the discharge to a device pin due to contact of equipment or tools such as those found in the manufacturing line

Note 1 to entry: Machine model is described in IEC 60749-27 [3].

Note 2 to entry: This note only applies to the French language.

3.13
organization
company, group or body that handles ESDS

3.14
protective earth
terminal used to connect parts to earth for safety reasons

4 Personnel safety

The procedures and equipment described in this standard may expose personnel to hazardous electrical conditions. Users of this standard are responsible for selecting equipment that complies with applicable laws, regulatory codes and both external and internal policy. Users are cautioned that this standard cannot replace or supersede any requirements for personnel safety.

Electrical hazard reduction practices shall be exercised and proper grounding instructions for equipment shall be followed.

5 ESD control program

5.1 General

5.1.1 ESD control program requirements

The ESD control program shall include all the administrative and technical requirements of this standard. The ESD control program shall document the lowest ESD withstand voltage(s) that can be handled. The organization shall establish, document, implement, maintain and verify the compliance of the program in accordance with the requirements of this standard.

5.1.2 ESD coordinator

A person shall be assigned by the organization with the responsibility for implementing the requirements of this standard including establishing, documenting, maintaining and verifying the compliance of the program.

5.1.3 Tailoring

This standard, or portions of it, may not 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 and technical justification, shall be documented.

5.2 ESD control program administrative requirements

5.2.1 ESD control program plan

The organization shall prepare an ESD control program plan that addresses each of the requirements of the program. Those requirements are:

- training,
- product qualification,
- compliance verification,
- grounding/bonding systems,
- personnel grounding,
- EPA requirements,
- packaging systems,
- marking.

The plan is the principal document for implementing and verifying the program. The goal is a fully implemented and integrated program that conforms to internal quality system requirements. The plan shall apply to all applicable facets of the organization's work.

5.2.2 Training plan

The training plan shall define all personnel that are required to have ESD awareness and prevention training. At a minimum, initial and recurrent ESD awareness and prevention training shall be provided to all personnel who handle or otherwise come into contact with any ESDS. Initial training shall be provided before personnel handle ESD sensitive devices. The type and frequency of ESD training for personnel shall be defined in the training plan. The training plan shall include a requirement for maintaining employee training records and shall document where the records are stored. Training methods and the use of specific techniques are at the organization's discretion. The training plan shall include methods used by the organization to ensure trainee comprehension and training adequacy.

5.2.3 Product qualification

The organization shall qualify all ESD control items that are selected for use as part of the ESD control program. Tables 2 and 3 list the required product qualification test methods, associated limits for each ESD control item and other requirements as stated in this standard.

Acceptable evidence of product qualification includes:

a) Product data sheets published by the manufacturer of the ESD control item:
   1) The data sheet shall reference the required IEC test method for that item.
   2) The data sheet limits shall, at a minimum, comply with the limits for that ESD control item
b) Test reports from an independent laboratory: the test report shall reference the applicable IEC test method and the limits shall comply with the limits for that item as specified in this standard.
c) Test reports generated internally by the organization for its own use: the test report shall reference the applicable IEC test method and the limits shall comply with the limits for that item.
d) For ESD control items that were installed by the organization before the adoption of this standard, on-going compliance verification records can be used as evidence of product qualification.

For ESD control items that are not listed in Tables 2 and 3, but are considered to be a part of the ESD control program, the organization using such items shall qualify these products prior to use. The test method used for product qualification and the user defined acceptance limits for each item shall be documented in the ESD control program plan.

NOTE IEC TR 61340-5-2 contains guidance for items not listed in Tables 2 and 3 of this document.

5.2.4 Compliance verification plan

A compliance verification plan shall be established to ensure the organization's fulfilment of the requirements of the plan. Process monitoring (measurements) shall be conducted in accordance with a compliance verification plan that identifies the technical requirements to be verified, the measurement limits and the frequency at which those verifications shall occur. The compliance verification plan shall document the test methods used for process monitoring and measurements. If the organization uses different test methods to replace those of this standard, the organization shall be able to show that the results achieved correlate with the referenced standards. Where test methods are devised for testing items not covered in this standard, these shall be adequately documented including corresponding test limits. Compliance verification records shall be established and maintained to provide evidence of conformity to the technical requirements.

The test equipment selected shall be capable of making the measurements defined in the compliance verification plan.

Consideration should be taken regarding the lowest relative humidity levels experienced by the organization; some of the measurements should be made under these conditions.

5.3 ESD control program plan technical requirements

5.3.1 General

The following subclauses describe the essential technical requirements used in the development of an ESD control program.

The required limits are based on the test methods or standards listed in Table 1, Table 2 and Table 3. The compliance verification plan shall document the methods used to verify the limits. These procedures may or may not be based on the test methods in each table. Test

methods and corresponding limits used by the organization that differ from the test methods or references in Tables 1 to 3 shall be documented with a technical justification that supports their use.

Some of the technical elements listed in Tables 1 to 3 do not have a defined lower resistance limit. However, a minimum resistance value may be required for safety reasons.

See relevant national requirements and/or IEC 60364[4] series, IEC TS 60479-1[5], IEC TS 60479-2[6], IEC 61010-1[7], and IEC 61140[8].

5.3.2 Grounding/equipotential bonding systems

In order to eliminate ESD damage, it is necessary to eliminate differences in potential between ESDS and other conductors that ESDS might come into contact with such as personnel, automated handling equipment, fixtures and mobile equipment. All items that come into contact with ESDS and are capable of conducting electricity shall be connected to ground or electrically bonded in order to eliminate differences in potential. This can be achieved in three different ways:

- Grounding using protective earth

  The first and preferred ESD ground is protective earth if available. In this case, the ESD control elements and grounded personnel are connected to protective earth (see Figure 1).

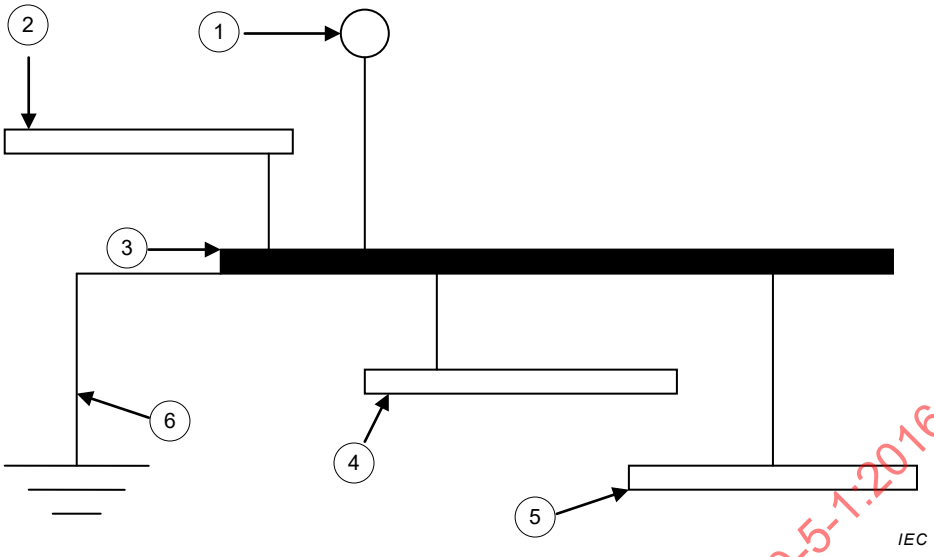
- Grounding using functional ground

  The second acceptable ESD ground is achieved through the use of a functional ground. This conductor can be a ground rod, stake or a separate wiring system that is bonded to the AC ground at the main service panel (see Figure 1); in order to eliminate differences in potential between protective earth and the functional ground system, the two systems shall be electrically bonded together where possible.

- Equipotential bonding

  In the event that a ground facility is not available, ESD protection can be achieved by connecting all of the ESD control items together at a common connection point (see Figure 2). The maximum resistance between any protective item and the common connection point shall comply with the limits established for the protective items as per Tables 2 and 3.

Whichever grounding/bonding system is selected, it shall be referred to as “ground” in the remainder of this standard.



Key

1 Wrist strap (band and ground cord)

2 Work surface

3 Common ground point

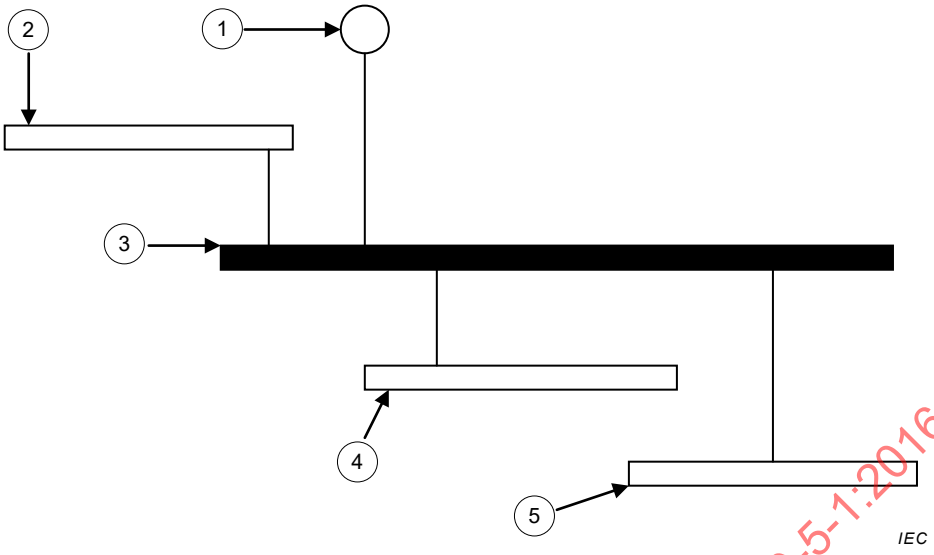
4 Floor mat

5 Floor

6 Protective earth or functional ground (functional ground, if used, shall be bonded to protective earth)

Figure 1 – Schematic of an EPA with a ground reference

CAUTION: Users are advised to consult local and national electrical codes and regulations before making any connections to facility electrical wiring systems.



Key

1 Wrist strap and cord
2 Work surface
3 Common connection point
4 Floor mat
5 Floor

Figure 2 – Schematic of an equipotential bonding system

Table 1 – Grounding/bonding requirements

Technical requirement	Grounding method	Test method/standard	Required limit(s)
Grounding/bonding system	Protective earth	National electrical system standard	National electrical code limits
	Functional ground	National electrical system standard	National electrical code limits If the national electrical code does not specify a requirement, then the resistance between functional ground and protective earth shall not exceed 25 Ω
	Equipotential bonding	See applicable implementing process from Tables 2 and 3	See limits for each ESD control item from Tables 2 and 3

5.3.3 Personnel grounding

All personnel shall be grounded or equipotentially bonded according to the requirements below when handling ESDS. When personnel are seated at ESD protective workstations, they shall be connected to ground via a wrist strap system.

For standing operations, personnel can be grounded via a wrist strap system or by a footwear-flooring system. When a footwear-flooring system is used, personnel shall wear ESD footwear on both feet and the two following conditions shall be met:

- the total resistance of the system (from the person, through the footwear and flooring to ground) shall be less than $1{,}0 \times 10^9\ \Omega$;
- the maximum body voltage generation shall be less than 100 V.

Table 2 – Personnel grounding requirements

Technical requirement	ESD control item	Product qualification		Compliance verification	
		Test method	Limits[b]	Test method	Limits[b]
Personnel grounding	Wrist straps (bands and ground cords)	IEC 61340-4-6	$R < 5 \times 10^6\ \Omega$ or user defined value	See wrist strap system	
	Wrist band resistance	IEC 61340-4-6			
		– interior	$\leq 1 \times 10^5\ \Omega$	Not applicable	
		– exterior	$> 1 \times 10^7\ \Omega$	Not applicable	
	Wrist strap system[a]	Not applicable		IEC 61340-4-6 Wrist strap continuity test	$R < 3{,}5 \times 10^7\ \Omega$
	Footwear	IEC 61340-4-3[c]	$R \leq 1 \times 10^8\ \Omega$	See person/footwear system	
	Person/footwear /flooring system	IEC 61340-4-5	$R_g < 1{,}0 \times 10^9\ \Omega$ and absolute value of body voltage < 100 V (average of 5 highest peaks)	IEC 61340-4-5	$R_g < 1{,}0 \times 10^9\ \Omega$[d,f]
	Person/footwear system	Not applicable		See Annex A[e]	$R_{gp} < 1{,}0 \times 10^8\ \Omega$

[a] For situations where an ESD garment is used as part of the wrist strap grounding path, the total system resistance including the person, garment and grounding cord should be less than $3{,}5 \times 10^7\ \Omega$.

[b] Symbols used in this table: R_g refers to resistance to ground, R_{gp} refers to resistance to groundable point

[c] For the product qualification of footwear, the environmental conditions for testing, using IEC 61340-4-3 should be (12 ± 3) % RH and 23 °C ± 2 °C.

[d] A periodic body voltage generation test should be done to verify the voltage is less than 100 V

[e] The resistance limit applies to measuring each foot one by one, not two in parallel.

[f] The required limit of $< 1{,}0 \times 10^9\ \Omega$ is the maximum allowed value. The user should establish an upper limit from the resistance values that were measured for product qualification for the footwear and the floor to comply with the < 100 V body voltage generation and use these resistances for compliance verification.

5.3.4 ESD protected areas (EPA)

5.3.4.1 Handling ESDS and access to EPA

Handling of ESDS without ESD protective covering or packaging shall be performed in an EPA. The boundaries of the EPA shall be clearly identified as EPA boundaries (e.g, Caution signs indicating the existence of the EPA can be posted and conspicuous to personnel prior to entry to the EPA.)

NOTE An EPA can, for example, consist of a building, an entire room or a single workstation.

Access to the EPA shall be limited to personnel who have completed appropriate ESD training. Untrained individuals shall be escorted by trained personnel while in an EPA.

5.3.4.2 Insulators

All non-essential insulators and items (plastics and paper), such as coffee cups, food wrappers and personal items shall be removed from the workstation or any operation where unprotected ESDS are handled.

The ESD threat associated with process essential insulators or electrostatic field sources shall be evaluated to ensure that:

- the electrostatic field at the position where the ESDS are handled shall not exceed 5 000 V/m;

or

- if the electrostatic potential measured at the surface of the process required insulator exceeds 2 000 V, the item shall be kept a minimum of 30 cm from the ESDS; and
- if the electrostatic potential measured at the surface of the process required insulator exceeds 125 V, the item shall be kept a minimum of 2,5 cm from the ESDS.

If the measured electrostatic field or surface potential exceeds the stated limits, ionization or other charge mitigating techniques shall be used.

Some of the measurements should be taken at the lowest expected relative humidity experienced by the facility.

NOTE 1 These measurements are made based on the frequency defined in the compliance verification plan.

NOTE 2 An ESD threat is considered a metal to metal contact while the ESDS is in the presence of the field

NOTE 3 The accurate measurement of electrostatic fields requires that the person making the measurement is familiar with the operation of the measuring equipment. Most hand held meters require that the reading be taken at a fixed distance from the object. They also normally specify that the object has a minimum dimension of fixed size in order to obtain an accurate reading.

5.3.4.3 Isolated conductors

When establishing an ESD control plan, if a conductor that comes into contact with an ESDS item cannot be grounded or equipotentially bonded together, then the process shall ensure that the difference in potential between the conductor and the contact of the ESDS item is less than 35 V.

This can be accomplished by measuring the ESDS item and the conductor by using: a non-contact electrostatic voltmeter or a high impedance contact electrostatic voltmeter.

NOTE The 35 V limit is related to the level achievable using ionizers specified in this standard.

5.3.4.4 ESD control items

An EPA shall be established wherever ESD sensitive products are handled without ESD protective covering or packaging. However, there are many different ways to establish an ESD control program. Table 3 lists some optional ESD control items which can be used to control static electricity. For those ESD control items that are selected for use in the ESD control program, the required range for that item becomes mandatory.

If the limits in Table 3 are exceeded, the ESD control program shall include a tailoring statement as required by 5.1.3.

Table 3 – EPA requirements

EPA requirements	ESD control item	Product qualification[a]		Compliance verification[b]	
		Test method	Limits[c]	Based on test method	Limits[c]
	Working surfaces, storage racks and trolley[g]	IEC 61340-2-3	$R_{gp} < 1 \times 10^9\ \Omega$ $R_{p\text{-}p} < 1 \times 10^9\ \Omega$[f]	IEC 61340-2-3	$R_g < 1 \times 10^9\ \Omega$
	Wrist strap bonding point				$R_g < 5 \times 10^6\ \Omega$
	Flooring	IEC 61340-4-1[d,e]	$R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-4-1	$R_g < 1 \times 10^9\ \Omega$
	Ionization	IEC 61340-4-7	Decay (1 000 V to 100 V and −1 000 V to −100 V) < 20 s Offset voltage < ± 35 V	IEC 61340-4-7	Decay (1 000 V to 100 V and −1 000 V to −100 V) < 20 s or user defined Offset voltage < ± 35 V
	Seating	IEC 61340-2-3 (resistance to groundable point measurements)	$R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-2-3 (resistance to ground measurements)	$R_g < 1 \times 10^9\ \Omega$
	Static control garments	IEC 61340-4-9 or user defined method	$R_{p\text{-}p} < 1 \times 10^{11}\ \Omega$ or user defined limit	IEC 61340-4-9 or user defined method	$R_{p\text{-}p} < 1 \times 10^{11}\ \Omega$ or user defined limit
	Groundable static control garments	IEC 61340-4-9	$R_{gp} < 1 \times 10^9\ \Omega$	IEC 61340-4-9	$R_{gp} < 1 \times 10^9\ \Omega$

[a] For product qualification, the environmental conditions for testing should be (12 ± 3) % RH and 23 °C ± 2 °C. When not specified in the referenced IEC standard, the minimum environmental conditioning time for product qualification should be 48 hours.

[b] The test methods in the compliance verification column refer to the basic test procedure only. It is not expected that the test method will be followed in its entirety.

[c] Symbols used in this table: $R_{p\text{-}p}$ refers to point to point resistance. R_g refers to resistance to ground and R_{gp} refers to resistance to groundable point.

[d] The maximum test voltage allowed for measuring ESD flooring that should be used for an ESD program complying with this standard is 100 V.

[e] If flooring is used for grounding personnel that handle ESDS refer to the system requirements in Table 2.

[f] In situations where charged device model (CDM) damage is a concern, a minimum point to point resistance limit of $1 \times 10^4\ \Omega$ is recommended.

[g] Worksurfaces are defined as any surface on which an unprotected ESD sensitive item is placed.

5.3.5 Packaging

ESD protective packaging and package marking shall be in accordance with customer contracts, purchase orders, drawing or other documentation. When the contract, purchase order, drawing or other documentation does not define ESD protective packaging, the organization shall define ESD protective packaging requirements for ESDS within the plan based on IEC 61340-5-3. Packaging, when required, shall be defined for all material movement within EPAs, between EPAs, between job sites, field service operations and to the customer.

5.3.6 Marking

ESDS, system or packaging marking shall be in accordance with customer contracts, purchase orders, drawing or other documentation. When the contract, purchase order,

drawing or other documentation does not define ESDS, system or packaging marking, the organization, in developing the ESD control program plan, shall consider the need for marking. If it is determined that marking is required, it shall be documented as part of the plan.

Annex A
(normative)

Test methods

The operator shall stand with one foot on the conductive footwear electrode. The hand contact plate shall be pressed to verify that the person/footwear system resistance is within acceptable parameters (see Figure A.1). The test shall be repeated for the other foot. The test apparatus can be an integrated, commercially available tester or other instrumentation that is capable of measuring resistance from $5{,}0 \times 10^4$ Ω to at least $1{,}0 \times 10^9$ Ω. The tester open-circuit voltage is typically between 9 V d.c. and 100 V d.c.

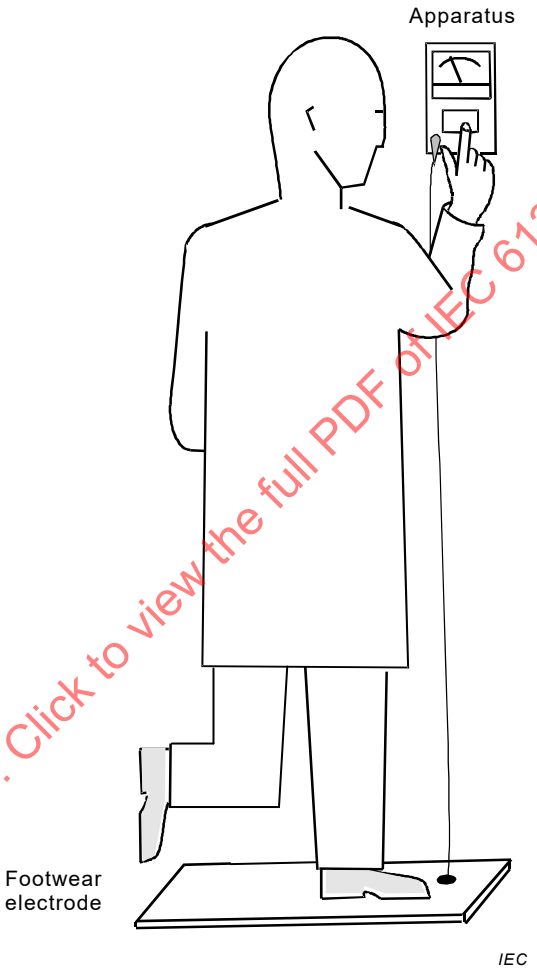


Figure A.1 – Footwear functional testing (example)

Bibliography

[1] ANSI/ESDA/JEDEC JS-002-2014, *ESDA/JEDEC Joint Standard for Electrostatic Device Sensitivity Testing – Charged Device Model (CDM) – Device Level*

[2] IEC 60749-26, *Semiconductor devices – Mechanical and climatic test methods – Part 26: Electrostatic discharge (ESD) sensitivity testing – Human body model (HBM)*

[3] IEC 60749-27, *Semiconductor devices – Mechanical and climatic test methods – Part 27:Electrostatic discharge (ESD) sensitivity testing – Machine model (MM)*

[4] IEC 60364 (all parts), *Low-voltage electrical installations*

[5] IEC TS 60479-1, *Effects of current on human beings and livestock – Part 1: General aspects*

[6] IEC TS 60479-2, *Effects of current on human beings and livestock – Part 2: Special aspects*

[7] IEC 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use – Part 1: General requirements*

[8] IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

[9] IEC TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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ÉLECTROSTATIQUE –

Partie 5-1: Protection des dispositifs électroniques contre les phénomènes électrostatiques – Exigences générales

AVANT-PROPOS

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La Norme internationale IEC 61340-5-1 a été établie par le comité d'études 101 de l'IEC: Electrostatique.

Cette deuxième édition annule et remplace la première édition parue en 2007. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) Des exigences techniques ont été modifiées afin d'aligner l'IEC 61340-5-1 avec les autres normes de l'industrie relatives aux décharges électrostatiques (ESD);
b) Les documents de référence ont été mis à jour afin de refléter les normes IEC récemment publiées;

c) Un paragraphe sur la qualification produit a été ajouté;

d) Le Tableau 4 a été supprimé, et les exigences relatives aux emballages sont désormais décrites dans l'IEC 61340-5-3;

e) L'Article A.1 a été supprimé et figure désormais dans l'IEC 61340-4-6.

Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
101/505/FDIS	101/508/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 61340, publiées sous le titre général *Electrostatique*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives à la publication recherchée. A cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

Le contenu du corrigendum de mai 2017 a été pris en considération dans cet exemplaire.

INTRODUCTION

La présente partie de l'IEC 61340 couvre les exigences nécessaires à la conception, à l'établissement, à la mise en œuvre et à la maintenance d'un programme de maîtrise des décharges électrostatiques (ESD) pour les activités concernant: la fabrication, le traitement, l'assemblage, l'installation, l'emballage, l'étiquetage, l'entretien, l'essai, l'examen, le transport ou bien la manipulation des pièces, des ensembles et des équipements électriques ou électroniques susceptibles d'être endommagés par des décharges électrostatiques supérieures ou égales à 100 V sur le modèle du corps humain (HBM), 200 V sur le modèle de dispositif chargé (CDM) et 35 V sur les conducteurs isolés. Les conducteurs isolés étaient représentés traditionnellement par le modèle de machine (MM). La limite de 35 V se rapporte au niveau réalisable en utilisant les ioniseurs spécifiés dans la présente norme. L'essai du modèle de machine n'est plus exigé pour la qualification des dispositifs; seuls les essais des modèles HBM et CDM le sont. L'essai du MM est conservé dans la présente norme uniquement aux fins de contrôle de processus des conducteurs isolés.

Tout contact et toute séparation physique de matériaux ou flux de solides, liquides ou gaz chargés de particules peuvent produire des charges électrostatiques. Des sources courantes d'ESD comprennent: le personnel, les conducteurs, les matériaux polymères courants et le matériel de traitement. Les ESD peuvent engendrer des dommages lorsque:

- une personne ou un objet chargé entre en contact avec un dispositif sensible aux décharges électrostatiques (ESDS);
- un ESDS entre en contact direct avec une surface très conductrice alors qu'elle est exposée à un champ électrostatique;
- un ESDS chargé entre en contact avec une autre surface conductrice qui est à un potentiel électrique différent. Cette surface peut ne pas être mise à la terre.

Les microcircuits, les semiconducteurs discrets, les résistances à couche rigide et mince, les dispositifs hybrides, les cartes de circuits imprimés et les cristaux piézoélectriques constituent des exemples d'ESDS. La susceptibilité du dispositif et de l'élément peut être déterminée en exposant le dispositif à des événements ESD simulés. La tension de tenue aux ESD, déterminée par l'essai de sensibilité utilisant des événements ESD simulés, ne représente pas nécessairement l'aptitude du dispositif à résister aux ESD issues de sources réelles à ce niveau de tension. Cependant, les niveaux de sensibilité sont utilisés afin d'établir une référence pour les données de susceptibilité lors de la comparaison de dispositifs possédant des références de pièce équivalentes provenant de différents fabricants. Trois modèles différents ont été utilisés pour la qualification des composants électroniques: modèle du corps humain (HBM), modèle de machine (MM) et modèle de dispositif chargé (CDM). En pratique, les dispositifs sont qualifiés uniquement par le biais d'essais de susceptibilité HBM et CDM.

La présente norme couvre les exigences du programme de maîtrise des ESD nécessaires à l'établissement d'un programme pour la manipulation des ESDS, en se fondant sur l'expérience historique d'organisations tant militaires que commerciales. Les principes fondamentaux de maîtrise des ESD qui constituent la base de la présente norme sont les suivants.

- Eviter une décharge de tout objet chargé, conducteur (personnel et en particulier les équipements de manutention automatisée) dans l'ESDS. Cela peut être réalisé en reliant ou en raccordant électriquement tous les conducteurs de l'environnement, y compris le personnel, à une terre existante ou provoquée (comme à bord d'un navire ou d'un avion). Cette fixation crée un équilibre équipotentiel entre tous les objets conducteurs et le personnel. La protection électrostatique peut être maintenue à un potentiel différent d'un potentiel de terre de tension "zéro" tant que tous les objets conducteurs du système sont au même potentiel.
- Eviter une décharge de tout dispositif sensible aux ESD qui est chargé. La charge peut résulter d'un contact direct et d'une séparation, ou peut être induite par un champ électrique. Les isolants nécessaires dans l'environnement ne peuvent pas perdre leur charge électrostatique par liaison à la terre. Les systèmes d'ionisation assurent une

neutralisation des charges sur ces isolants nécessaires (les matériaux de cartes de circuits et certains emballages de dispositifs constituent des exemples d'isolants nécessaires). Le danger d'ESD provoqué par les charges électrostatiques sur les isolants nécessaires sur le lieu de travail est évalué pour s'assurer que les actions adéquates sont mises en œuvre, en fonction du risque.

- Une fois à l'extérieur d'une zone protégée contre les décharges électrostatiques (ci-après dénommée "EPA"), les éléments ci-dessus ne peuvent généralement pas être contrôlés; de ce fait, un emballage de protection contre les ESD peut être exigé. La protection contre les ESD peut être effectuée en enfermant les produits sensibles aux ESD dans des matériaux de protection contre les décharges électrostatiques, bien que le type de matériau dépende de la situation et de la destination. A l'intérieur d'une EPA, les matériaux antistatiques peuvent fournir une protection adéquate. A l'extérieur d'une EPA, les matériaux de blindage contre les décharges statiques sont recommandés. Alors que tous ces matériaux ne sont pas examinés dans la présente norme, il est important de reconnaître les différences concernant leur application. Pour plus d'informations, se reporter à l'IEC 61340-5-3.

Dans la mesure où chaque société possède des processus distincts, un ensemble différent de mesures de prévention contre les ESD est nécessaire pour accomplir un programme de maîtrise des ESD optimal. Il convient de choisir ces mesures en se fondant sur la nécessité technique et de les documenter avec soin dans le cadre d'un plan de programme de maîtrise des ESD, de telle sorte que toutes les parties concernées puissent être sûres des exigences du programme.

La formation constitue une partie essentielle du programme de maîtrise des ESD en s'assurant que le personnel concerné a une bonne connaissance de l'équipement, ainsi que des procédures qu'il doit utiliser afin de respecter le plan du programme de maîtrise des ESD. La formation joue également un rôle important pour accroître la sensibilisation aux problématiques des ESD et leur compréhension. Sans formation, le personnel constitue souvent une source majeure de risque d'ESD. En suivant une formation, le personnel devient une première ligne efficace de défense contre les dommages liés aux ESD.

Des vérifications de la conformité et des essais réguliers sont essentiels pour s'assurer que l'équipement demeure efficace, mais également que le programme de maîtrise des ESD est mis en œuvre de manière correcte conformément au plan du programme de maîtrise des ESD.

ÉLECTROSTATIQUE –

Partie 5-1: Protection des dispositifs électroniques contre les phénomènes électrostatiques – Exigences générales

1 Domaine d'application

La présente partie de l'IEC 61340 s'applique aux activités concernant: la fabrication, le traitement, l'assemblage, l'installation, l'emballage, l'étiquetage, l'entretien, l'essai, l'examen, le transport ou bien la manipulation des pièces, des ensembles et des équipements électriques ou électroniques présentant des tensions de tenue supérieures ou égales à 100 V sur le modèle du corps humain (HBM), 200 V sur le modèle de dispositif chargé (CDM) et 35 V sur les conducteurs isolés. Des ESDS possédant des tensions de tenue inférieures peuvent nécessiter des éléments de contrôle supplémentaires ou des limites ajustées. Les processus conçus pour manipuler des éléments présentant une ou plusieurs tensions de tenue aux ESD inférieures peuvent toujours déclarer être conformes à la présente norme.

La présente norme fournit les exigences nécessaires à un programme de maîtrise des ESD. L'IEC TR 61340-5-2 [9][1] donne des lignes directrices pour la mise en œuvre de la présente norme.

La présente norme ne s'applique pas aux dispositifs explosifs à déclenchement électronique ni aux liquides, gaz et poudres inflammables.

L'objectif de la présente norme est de fournir les exigences administratives et techniques pour l'établissement, la mise en œuvre et la maintenance d'un programme de maîtrise des ESD (ci-après dénommé "programme").

NOTE Les conducteurs isolés étaient traditionnellement représentés par le modèle de machine (MM).

2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 61340-2-3, *Electrostatique – Partie 2-3: Méthodes d'essais pour la détermination de la résistance et de la résistivité des matériaux planaires solides destinés à éviter les charges électrostatiques*

IEC 61340-4-1, *Electrostatique – Partie 4-1: Méthodes d'essai normalisées pour des applications spécifiques – Résistance électrique des revêtements de sol et des sols finis*

IEC 61340-4-3, *Electrostatique – Partie 4-3: Méthodes d'essai normalisées pour des applications spécifiques – Chaussures*

IEC 61340-4-5, *Electrostatique – Partie 4-5: Méthodes d'essai normalisées pour des applications spécifiques – Méthodes de caractérisation de la protection électrostatique des chaussures et des revêtements de sol par rapport à une personne*

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1 Les chiffres entre crochets se réfèrent à la bibliographie.

IEC 61340-4-6, *Electrostatique – Partie 4-6: Méthodes d'essai normalisées pour des applications spécifiques – Bracelets de conduction dissipative*

IEC 61340-4-7, *Electrostatique – Partie 4-7: Méthodes d'essai normalisées pour des applications spécifiques – Ionisation*

IEC 61340-4-9, *Electrostatique – Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques – Vêtements*

IEC 61340-5-3, *Electrostatique – 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*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

NOTE Pour les besoins du présent document, les termes "terre" et "masse" ont la même signification.

3.1
modèle de dispositif chargé
CDM
modèle de contraintes ESD se rapprochant de l'événement de décharge qui survient lorsqu'un composant chargé est déchargé rapidement sur un autre objet possédant un potentiel électrostatique différent

Note 1 à l'article: Le modèle de dispositif chargé est décrit dans ANSI/ESDA/JEDEC JS-002-2014 [1].

Note 2 à l'article: L'abréviation "CDM" est dérivée du terme anglais développé correspondant "charged device model".

3.2
point de terre commun
dispositif ou emplacement relié à la terre, où ont reliés les conducteurs de deux éléments de maîtrise des ESD ou plus

3.3
point commun de connexion
dispositif ou emplacement, où sont reliés les conducteurs de deux éléments de maîtrise des ESD ou plus de manière à porter les éléments de maîtrise des ESD au même potentiel électrique à travers une liaison équipotentielle

3.4
liaison équipotentielle
connexion électrique de parties conductrices (ou d'éléments utilisés pour la maîtrise des ESD) de manière à ce qu'elles soient pratiquement à la même tension dans des conditions normales ou de défaut

3.5
décharge électrostatique
ESD
transfert rapide de charges entre des corps ayant des potentiels électrostatiques différents

Note 1 à l'article: L'abréviation "ESD" est dérivée du terme anglais développé correspondant "electrostatic discharge".