IEC 61340-5-1

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Withdrawn

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

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

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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ELECTROSTATICS –

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

FOREWORD

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

This first edition cancels and replaces the technical specification published in 1998. It constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

This version of IEC 61340-5-1 focuses on the requirements for an ESD control program. In addition, this version of IEC 61340-5-1 has been aligned with other major ESD control program standards used throughout the world.

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

FDIS	Report on voting
101/249/FDIS	101/251/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, 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 maintenance result date indicated on the IEC web site 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- withdrawn;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.

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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). This standard covers the ESD control program requirements necessary for setting up a program to handle ESD-sensitive devices (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 field induced. 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 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 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.

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 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.

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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).

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ELECTROSTATICS –

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

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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).

This standard provides the requirements for an ESD control program. The user should refer to IEC 61340-5-2 for 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”).

2 Normative references

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

IEC 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*

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*

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

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 terms and definitions in the future IEC 61340-1-2 as well as the following, apply.

3.1
common ground point
grounded device or location where the conductors of two or more ESD control items are bonded

3.2
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

3.3
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

3.4
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

3.5
functional ground
terminal used to connect parts to earth for reasons other than safety

3.6
organization
company, group or body that handles ESDS

3.7
protective earth
terminal used to connect parts to earth for safety reasons

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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 be exercised and proper grounding instructions for equipment must 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 program shall include both administrative and technical requirements as described in this standard. 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

– training,
– 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.

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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 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 occur. The compliance verification plan must document the test methods used for process monitoring and measurements. If the organization uses test methods that differ from the standards referenced in this standard, the organization must be able to show that the results achieved correlate with the referenced standards. 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.

5.3 ESD control program plan technical requirements

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 each table of this subclause. The compliance verification plan must 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 through 4 shall be documented with a technical justification that supports their use.

Some of the technical elements listed in Tables 1 through 4 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 61010-1, IEC/TS 60479-1, IEC/TS 60479-2, IEC 61140 and IEC 60364 series.

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5.3.1 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. 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);

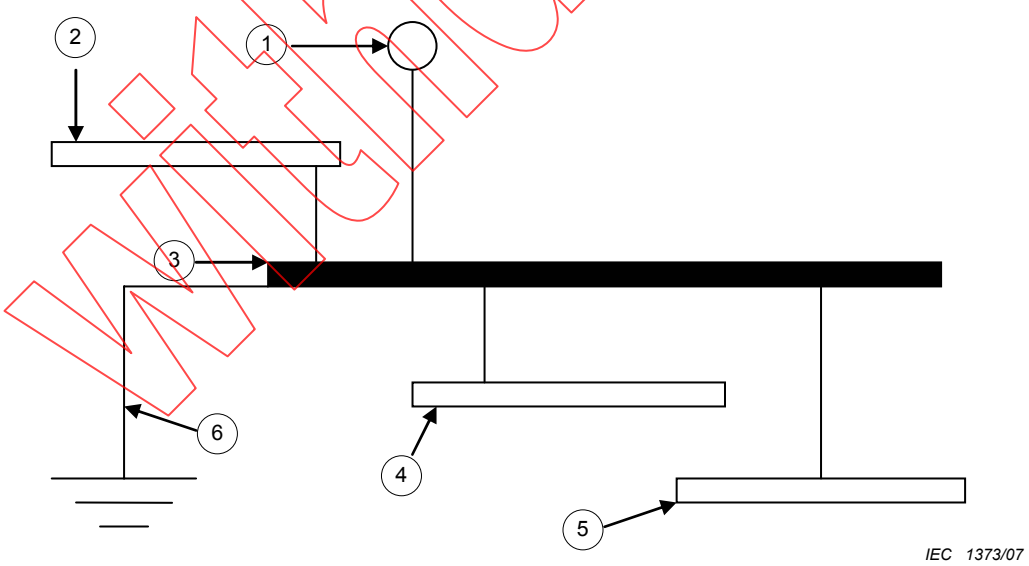
– grounding using functional ground:

  the second acceptable ESD ground is achieved through the use of a functional ground. This conductor can be a ground rod or stake that is used for grounding the ESD control items in use at a facility. 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);

– 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 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 and cord

2 work surface

3 example of common ground point

4 ESD floor mat

5 ESD floor

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

Figure 1 – Schematic of an EPA with a ground reference

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