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Electrostatics –
Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

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The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a technical report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

IEC TR 61340-5-2, which is a Technical Report, 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:

This second edition of IEC TR 61340-5-2 has been modified to provide guidance for users of IEC 61340-5-1:2016. The text has been arranged to follow the requirements of

IEC 61340-5-1:2016 as closely as possible as well as providing specific guidance on each of the requirements of IEC 61340-5-1:2016.

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

Enquiry draft	Report on voting
101/532/DTR	101/543/RVDTR

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

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

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

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

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- withdrawn,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

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

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

INTRODUCTION

This user guide has been produced for individuals and organizations that are faced with controlling electrostatic discharge (ESD). It provides guidance that can be used for developing, implementing and monitoring an electrostatic discharge control program in accordance with IEC 61340-5-1.

This user guide applies to activities that manufacture, process, assemble, install, package, label, service, test, inspect or otherwise handle electrical or electronic parts, assemblies and equipment susceptible to damage by electrostatic discharges greater than or equal to 100 V using the human body model (HBM), 200 V charged device model (CDM) or 35 V on isolated conductors. Isolated conductors were historically represented by the machine model (MM). The MM test is no longer used for qualification of devices, only HBM and CDM. The MM is retained in this document for process control of isolated conductors. These three levels were selected for IEC 61340-5-1 as the baseline susceptibility threshold, since a large majority of the ESD products on the market have a sensitivity of greater than 100 V HBM, 200 V CDM and 35 V for isolated conductors. If ESD sensitive devices (ESDS) of less than these values are being handled, additional controls can be implemented or some of the technical control item requirements can be adjusted.

The requirements established for each of the ESD control items are specified for an ESD control program designed for 100 V HBM, 200 V CDM and 35 V for isolated conductors. The 100 V HBM value is predicated on maximum voltage levels attainable on an individual when they are grounded via techniques accepted throughout the electronics industry as outlined in IEC 61340-5-1.

For organizations concerned with charged device model damage, IEC 61340-5-1 establishes requirements concerning the use of insulators in the ESD protected area (EPA) based on maximum electrostatic field limits.

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, 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.

The general principles described in IEC 61340-5-1 are not limited in their applicability to ESDS with ESD sensitivities defined in IEC 61340-5-1 (e.g. 100 V HBM). For organizations that handle ESDS with withstand voltages higher or lower than those defined in IEC 61340-5-1, the general principles of IEC 61340-5-1 can still be used. The organization can modify some of the required limits specified in Tables 2 to 3 of IEC 61340-5-1:2016. The program documentation identifies the lowest ESDS withstand voltage(s) that can be handled,

and if different to those defined in IEC 61340-5-1, appropriate changes to the limits specified in IEC 61340-5-1 can be made in the program documentation.

The fundamental ESD control principles that form the basis of IEC 61340-5-1 are as follows:

a) Avoid a discharge from any charged, conductive object (personnel, equipment) into the sensitive device:

   It is preferred that all conductors that may come into contact with ESDS including personnel, are bonded or electrically connected to a known ground or contrived ground (as on shipboard or on aircraft). This attachment creates an equipotential balance between all items and personnel. Electrostatic protection can be maintained at a potential different from “zero” voltage ground potential, as long as all items in the system are at the same potential. If a conductor that cannot be grounded (e.g. isolated conductor) comes into contact with an ESDS, the ESD risk should be evaluated and if necessary mitigated.

b) Avoid a discharge from any charged ESD sensitive device (the charging process that can lead to a discharge can result from direct contact and separation or can be field induced):

   Insulators cannot lose their electrostatic charge by grounding. It is preferred that insulators should be removed from the vicinity of ESDS. Some insulators are essential to the process or product and cannot be removed from the vicinity of the ESDS. Ionization or other mitigating techniques can provide neutralization of charges on these essential insulators (circuit board materials and some device packages are examples of essential insulators). Assessment of the ESD hazard created by electrostatic charges on the essential insulators in the work place is done to ensure that appropriate actions are implemented, according to the risk.

c) Once outside of an electrostatic discharge protected area (hereafter referred to as an EPA) it is generally not possible to control the above items, therefore, ESD protective packaging can be used. 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, low charging and static discharge shielding materials are recommended. While all of these materials are not discussed in this document, it is important to recognize the differences in their application. Requirements and associated test methods for ESD protective packaging are specified in IEC 61340-5-3.

Each organization has different processes, and so there will be 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.

ELECTROSTATICS –

Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide

1 Scope

This part of IEC 61340, which has been developed to support IEC 61340-5-1, 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. Additional control elements or adjusted limits can be applicable for ESDS with lower withstand voltages.

NOTE Isolated conductors were historically represented by MM.

2 Normative references

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

IEC 61340-5-1:2016, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*