

TECHNICAL REPORT

RAPPORT TECHNIQUE

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

**Electrostatique –
Partie 5-2: Protection des dispositifs électroniques contre les phénomènes
électrostatiques – Guide d'utilisation**

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

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ELECTROSTATICS –

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

FOREWORD

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IEC 61340-5-2, which is a technical report, has been prepared by IEC technical committee 101: Electrostatics.

This version cancels and replaces the first edition, which was issued as a technical specification in 1999. It constitutes a technical revision.

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

This version of IEC 61340-5-2 has been modified to provide guidance for users of IEC 61340-5-1. The text has been arranged to follow the requirements of IEC 61340-5-1 as closely as possible as well as providing specific guidance on each of the requirements of IEC 61340-5-1.

The text of this technical report is based on the following documents:

Enquiry draft	Report on voting
101/219/CDV	101/233/RVC

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- withdrawn,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.

The contents of the corrigendum of May 2009 have been included in this copy.

INTRODUCTION

This user guide and 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). The 100 V HBM limit was 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.

The limits established for each of the ESD control items are specified for an ESD program designed for 100 V HBM devices. The 100 V 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. This topic is addressed in more detail in 4.6.

The general principals described in IEC 61340-5-1 are not limited in their applicability to ESDS with ESD sensitivities of 100 V or greater. For companies that handle ESDS with sensitivities of less than 100 V (HBM), the general principals of IEC 61340-5-1 can still be used. The organization may have to modify some of the required limits specified in Tables 2 to 4. The program documentation would then identify that ESDS with sensitivities of less than 100 V HBM were being handled and that this required a change to the limits established in IEC 61340-5-1.

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 device:

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 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.

- b) Avoid a discharge from any charged ESD sensitive device (the charging can result from direct contact and separation or 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.

- c) Once outside of an electrostatic discharge protected area (hereafter 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, low charging and 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 standard, it is important to recognize the differences in their application.

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ELECTROSTATICS –

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

1 Scope

This technical report has been developed to support IEC 61340-5-1.

The controls and limits referenced in this standard were developed to protect devices that are susceptible to discharges of 100 V or greater using the human body model test method. However, the general concepts are still valid for devices that are susceptible to discharges of less than 100 V.

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

IEC 61340-2-1 – *Electrostatics – Part 2-1: Measurement methods – Ability of materials and products to dissipate static electric charge*

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

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61340-5-1 apply.

4 ESD control program plan

This clause outlines a step-by-step approach that can be used to establish an ESD control Program.

4.1 Developing an ESD control program plan

4.1.1 Assignment of an ESD coordinator

In order to have a well thought out and implemented ESD program an ESD coordinator must be assigned. The ESD coordinator is responsible for all aspects of ESD in the facility. In order to be effective the ESD coordinator needs:

- a) the full support of management;
- b) a good understanding of electrostatics and how ESD sensitive devices can be damaged. The ESD coordinator will often need to attend educational classes or seminars related to ESD in order to maintain or update their knowledge;
- c) a thorough understanding of IEC 61340-5-1 and all of the organization's processes related to the handling of ESD sensitive devices.
- d) access to measuring equipment for the purposes of performing compliance verification audits as well as testing new ESD products and materials for use in the ESD program;
- e) depending on the size of the facility, the ESD coordinator might also need to have auditors assigned to conduct the ESD audits.

Finally, management must provide the ESD coordinator with the authority and funding necessary to ensure that the ESD control program is maintained and enforced.

4.1.2 Determination of part ESD sensitivity

The next step in developing an ESD control program plan is to determine the part, assembly or equipment sensitivity level under which the plan is to be developed. Although the requirements outlined in IEC 61340-5-1 are effective for handling parts sensitive to 100 V HBM or higher, the organization may choose to develop an ESD program based on ESD sensitivities that are greater or less than 100 V HBM. In this situation, the organization must develop an ESD control program plan that clearly states the ESD sensitivity that the program is based on.

The organization can use various methods to determine the ESD sensitivity of the products that are to be handled. Some of the methods include:

- assumption that all ESD products have an HBM sensitivity of 100 V;
- actual testing of ESD sensitive devices to establish the ESD sensitivity thresholds using IEC 60749-26;
- referencing ESD sensitivity data in published documents such as manufacturer's published data sheets.

4.1.3 Initial process and organizational assessment

Before the ESD control program plan can be developed, an initial assessment of the processes and organizations impacted by an ESD control program should be conducted. Organizations and processes that might be affected include:

- purchasing;

- design engineering;
- receiving inspection;
- quality assurance;
- manufacturing;
- testing;
- maintenance;
- packaging and shipping;
- field service;
- failure analysis;
- repair services;
- spare parts storage;
- material handling and parts conveyance;
- receiving.

An assessment of each area where ESDS parts are handled should be conducted in order to determine ESD hazards and possible ESD process procedures. The information accumulated throughout these steps forms the basis for developing the ESD control program plan.

4.1.4 Documentation of ESD control program plan

After gathering the above information, the organization is in a position to begin documenting the program plan. The plan should state the scope of the program which includes the tasks, activities and procedures necessary to protect the ESD sensitive items at or above the ESD sensitivity level chosen for the plan. Although the primary focus of the plan is to outline strategies for meeting the administrative and technical elements of IEC 61340-5-1, other items may be beneficial to incorporate as well. These additional items might include:

- organizational responsibilities;
- defined roles and responsibilities between the organization and subcontractors and suppliers;
- strategies for monitoring product yields and processes that might be important in determining the effectiveness of ESD control measures currently in place or in assessing whether additional measures should be taken;
- approaches for ensuring continual improvement of the ESD program;
- a list of approved ESD control products and materials.

The administrative and technical elements of IEC 61340-5-1 that need to be addressed in the plan (unless tailored) include:

- training plan;
- compliance verification plan;
- technical requirements;
- grounding/bonding systems;
- personnel grounding;
- protected areas;
- packaging;
- marking.

4.1.5 Tailoring

It is possible that portions of IEC 61340-5-1 may not apply to all areas within an organization. In these situations it is acceptable for the organization to document an exception to one or more of the required elements of IEC 61340-5-1 as long as there is a valid, substantiated and documented justification for the exception. An example of an acceptable exception to IEC 61340-5-1 can be found in the sample ESD program at the end of this standard.

4.2 Development of a training plan

4.2.1 Personnel training

Personnel training is a critical element in the implementation of an ESD control program. A sustained commitment and mindset among all personnel that ESD prevention is a valuable, on-going effort by everyone is one of the primary goals of training.

One of the first decisions that must be made is who will be required to take the ESD training course. IEC 61340-5-1 requires that, at a minimum, initial and recurrent ESD training shall be provided to all personnel that handle or otherwise come into contact with ESD sensitive items. This decision seems straight-forward but care shall be taken to ensure that all people that handle ESD sensitive devices receive adequate training. One example is the finance department. Many people will immediately state that this group should be exempt from ESD training. However, in some companies the finance department personnel are involved in the annual physical inventory where parts are counted. In these situations, the finance employees are touching ESD sensitive parts and therefore must receive ESD training in order for the organization to be in compliance with IEC 61340-5-1.

Although it is not a requirement of IEC 61340-5-1, the organization may want to consider providing some form of ESD training to personnel who do not handle ESD sensitive parts such as:

- managers, who may need to understand the implications of, and necessity for ESD prevention;
- cleaning and maintenance personnel who may need to work within the EPA; and
- purchasing personnel responsible for buying ESD susceptible parts and ESD equipment.

For visitors to the EPA, the person escorting the visitor is responsible for ensuring that they are wearing the ESD equipment required by the organization and that they understand what they may and may not do within the EPA.

Although personnel training can take several forms (i.e. instructor, computer based, etc.), the preferred technique for initial training is through the use of an instructor. Special care should be exercised in finding a "suitable" instructor. The instructor should have a good understanding of ESD theory and the organization's ESD control program and the processes, procedures and materials prescribed within. In addition, if manufacturing spans more than one culture, careful consideration shall be given to customs and religious beliefs. Besides cultural differences, other factors such as education, experience and age should be considered. All training should be carried out in a secure, non-threatening environment.

One of the first steps is to determine the type(s) of ESD training methods that will work best for the organization. Some possible training methods include:

- in-house, instructor-led ESD class;
- in-house, consultant-led class;
- computer based training;
- industry symposia, tutorials and workshops.

The initial training program should cover the fundamentals of ESD, the details of the organization's ESD control program plan, and each person's role in the ESD program. The training program should answer the following basic questions:

- what is static electricity?
- how does it occur?
- how does ESD affect product quality?

A careful explanation of the protection process as part of company policy should be included. No matter which type of training method is chosen, the program should be designed so that all trainee questions that arise can be answered. In addition, a knowledgeable person in the organization should be available to answer trainee questions once they have begun working. Opening the lines of communication is the beginning of a successful ESD training program. This type of communication should continue in the workplace and form the basis for an ongoing education process. It is a requirement in IEC 61340-5-1 that initial ESD training is provided before personnel handle ESD sensitive devices.

Because ESD control programs cover such a variety of job disciplines and educational levels, it may be necessary to develop special job specific training modules. Advanced modules should emphasize the main concerns of each discipline. Course emphasis should be tailored to each group's specific needs. For example, the modules developed for management, engineering, technicians, cleaning staff and field service could differ significantly because their day-to-day concerns and responsibilities are much different.

Ongoing or refresher training is also vital to any organization's training plan. It should reinforce the basic fundamentals taught during initial training, but also should incorporate program updates and changes and the reasons for those changes. As with the initial training, the organization shall decide which type of training will be used and how frequently the recurring training will be required. The method chosen should keep everyone informed, renewing his or her commitment to the total ESD effort. Recurring training is also a good feedback loop for monitoring the program's effectiveness. Personnel should be encouraged to discuss issues, and make suggestions for improvement in these sessions. Actions can then be assigned to improve the organization's overall ESD control program.

After training (initial or recurring) sessions have been completed, it is important to ensure that the trainee understands and has retained the ESD control program concepts taught during these sessions. IEC 61340-5-1 requires that an objective evaluation technique be incorporated as part of the training plan. This can be accomplished in a number of ways that include written tests, question and answer sessions with an instructor or multiple choice questions at the conclusion of a computer based training session. Regardless of the method selected, the organization should establish a pass/fail criterion for the testing to ensure adequate training has been accomplished. Records of all test results should be maintained. The test records should be stored such that they are readily available to management and customers who want objective evidence that the training portion of the ESD control program plan is being adhered to.

Finally, since IEC 61340-5-1 requires recurring or "refresher" training, a system should be established to highlight when employees are due for retesting and/or recertification.

A repository or central information source of educational ESD control materials should be kept for reference at anytime by organization employees. This repository might include:

- material from initial and recurring training sessions;
- ESD bulletins or newsletters;
- videos or CDs;
- computer-based training materials;
- technical papers, studies, standards and specifications;