

Electrostatics —

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

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61340-5-1:2001
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National foreword

This British Standard is the official English language version of EN 61340-5-1:2001. It is identical with IEC 61340-5-1:1998, including Corrigendum February 1999 and Corrigendum December 2002. It supersedes BS EN 100015-1:1992, BS EN 100015-2:1994, BS EN 100015-3:1994 and BS EN 100015-4:1994.

NOTE Additional information on how to use this standard is contained in BS EN 61340-5-2:2001, which the user of this standard is strongly recommended to obtain.

The UK participation in its preparation was entrusted by Technical Committee GEL/101, Electrostatics, to Subcommittee GEL/101/1, Handling of electrostatic sensitive devices, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Cross-references

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, the EN foreword page, the IEC title page, pages ii to viii, pages 1 to 61 and a back cover.

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

(IEC 61340-5-1:1998 + corrigendum 1999)

Electrostatique —
Partie 5-1: Protection des dispositifs électroniques
contre les phénomènes électrostatiques —
Prescriptions générales
(CEI 61340-5-1:1998 + corrigendum 1999)

Elektrostatik —
Teil 5-1: Schutz von elektronischen Bauelementen
gegen elektrostatische Phänomene — Allgemeine
Anforderungen
(IEC 61340-5-1:1998 + corrigendum 1999)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The text of the Technical Report IEC 61340-5-1:1998 + corrigendum February 1999, prepared by IEC TC 101, Electrostatics, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 61340-5-1 on 2000-08-01 without any modification.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2001-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2003-08-01

Annexes designated “normative” are part of the body of this standard.

Annexes designated “informative” are given for information only.

In this standard Annex A and Annex ZA are normative and Annex B and Annex C are informative.

Annex ZA has been added by CENELEC.

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Electrostatique –

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

Electrostatics –

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



Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

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Foreword

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.

3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but no immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example “state of the art”.

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61340-5-1, which is a technical report of type 2, has been prepared by IEC technical committee 101: Electrostatics.

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

Committee draft	Report on voting
101/18/CDV	101/38/RVC

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 is issued in the type 2 technical report series of publications (according to G.3.2.2 of part 1 of the IEC/ISO Directives) as a “prospective standard for provisional application in the field of protection of electronic devices from electrostatic phenomena” because there is an urgent requirement for guidance on how standards in this field should be used to meet an identified need.

This document is not to be regarded as an “International Standard”. It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the IEC Central Office.

A review of this type 2 technical report will be carried out not later than three years after its publication, with the options of either extension for a further three years or conversion into an International Standard or withdrawal.

Annex A forms an integral part of this technical report.

Annex B and Annex C are for information only.

IEC 61340 consists of the following parts, under the general title: *Electrostatics*.

- *Part 1: General*;
- *Part 2-1: Measurement methods in electrostatics — Chargeability*;
- *Part 2-2: Measurement methods in electrostatics — Resistances and resistivities*;
- *Part 3-1: Methods for simulating electrostatic effects — Electrostatic discharge simulation — Human Body Model (HBM)*;
- *Part 3-2: Methods for simulating electrostatic effects — Electrostatic discharge simulation — Machine Model (MM)*;
- *Part 3-3: Methods for simulating electrostatic effects — Electrostatic discharge simulation — Charged Device Model (CDM)*;
- *Part 4-1: Standard test methods for specific applications — Electrostatic behaviour of floor coverings and installed floors*;
- *Part 4-2: Under consideration*;
- *Part 4-3: Standard test methods for specific applications — Test methods for the characterisation of electrostatic protective footwear*;
- *Part 5-1: Protection of electronic devices from electrostatic phenomena — General requirements*;
- *Part 5-2: Protection of electronic devices from electrostatic phenomena — User guide*.

Introduction

Compliance with this technical report concerns the installation of new equipment only. Existing equipment should be replaced as soon as is practical. For the duration of the changeover period, extra precautions should be considered.

Some of the effects of static electricity have been known for several thousands of years. In more recent times, their properties have been understood and have been used to advantage in many applications. Unfortunately some properties of static electricity cause problems, particularly in the electronics industry. This technical report gives rules which, if followed, will minimize the unwanted effects of electrostatic discharge. Additional information on how the technical report should be applied is contained in IEC 61340-5-2 (user guide).

When the requirements of this technical report are applied, they will provide a low risk of damage to the vast majority of components and assemblies used in the electronics industry, particularly for devices which have a damage threshold of greater than 100 V (human body model). Where ultra-sensitive devices are used, additional specialist precautions will need to be applied.

The definitions used in this technical report apply for this document, and different definitions or ranges may apply in some other areas of electrostatics.

1 Scope

This technical report specifies the general requirements for the protection of electrostatic discharge sensitive devices (ESDS) from electrostatic discharges and fields. It applies only to the manufacture and use of electronic devices.

This technical report specifies how to design, use and control a protected area to ensure that electrostatic sensitive devices, having a withstand threshold voltage of 100 V (human body model) or higher, can be handled with a minimum risk of damage resulting from electrostatic phenomena.

Normal precautions given in this report are applicable for areas with clean room types in excess of ISO 14644-1 class 5. Alternative precautions may be required in clean rooms of ISO 14644-1 class 5 or less if contamination is formed as a result of using the procedures specified in this technical report.

Although this technical report does not include requirements for personnel safety, attention is drawn to the need for all concerned to comply with relevant local statutory requirements regarding the health and safety of all persons in all places of work, including those covered by this technical report. Generally, there is no minimum value of resistance for the protection of ESDS (see 3.2). However, a minimum resistance value may be required for the safety of personnel. See the relevant requirements and/or publications IEC 61010-1, IEC 60479, IEC 60536, IEC 60364.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61340. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 61340 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*.

IEC 60167:1964, *Methods of test for the determination of the insulation resistance of solid insulating materials*.

IEC 60364 (all parts), *Electrical installations of buildings*.

IEC 60417:1973, *Graphical symbols for use on equipment — Index, survey and compilation of the single sheets*.

IEC 60479-1:1994, *Effects of current on human beings and livestock — Part 1: General aspects*.

IEC 60479-2:1987, *Effects of current on human beings and livestock — Part 2: Special aspects*.

IEC 60536:1976, *Classification of electrical and electronic equipment with regard to protection against electric shock*.

IEC 61010-1:1990, *Safety requirements for electrical equipment for measurement, control and laboratory use — Part 1: General requirements*.

IEC 61340-4-1:1998, *Electrostatics — Part 4-1: Standard test methods for specific applications — Electrostatic behaviour of floor coverings and installed floors*.

IEC 61340-5-2—, *Electrostatics — Part 5-2: Protection of electronic devices from electrostatic phenomena — User guide*¹⁾.

ISO 14644-1—, *Clean rooms and associated controlled environment — Part 1: Classification of air cleanliness*¹⁾.

3 Definitions

For the purpose of this technical report, the following definitions apply.

3.1

electrostatic discharge (ESD)

transfer of charge between bodies at different electrostatic potentials caused by direct contact or induced by electrostatic field

3.2

electrostatic discharge sensitive device (ESDS)

discrete device, integrated circuit or assembly that may be damaged by electrostatic fields or electrostatic discharge encountered in routine handling, testing or transit

3.3

bonding

connecting together of non-insulating elements by means of a conductor

3.4

clean room

area with a specified maximum number and size of airborne particles per unit volume

3.5

device hazardous voltage

voltage capable of damaging an ESDS

3.6

ESD protected area (EPA)

area in which ESDS can be handled with accepted risk of damage as a result of electrostatic discharge or fields

3.7

EPA ground bonding point (EBP)

dedicated point to which an EPA equipment may be connected

3.8

EPA ground

uniform potential established in the work area which ensures that the electrical potential of the items handled and of everything with which they are likely to come into contact is the same

3.9

EPA ground cord

electrical connection between the EPA bonding point, work surface or other apparatus and the EPA ground facility

3.10

EPA ground facility

common facility to which elements in the ESD protected area are electrically connected

¹⁾ To be published.

3.11**ESDS threshold voltage sensitivity**

maximum voltage at which the ESDS does not suffer any ESD damage

3.12**ESDS threshold voltage sensitivity of an assembly**

most sensitive ESDS on an assembly

3.13**field work**

handling ESDS within a temporary EPA

3.14**garment**

coat, jacket, smock, hood, trousers, overall or cap

3.15**ground**

conducting mass of the earth whose electric potential at any point is conventionally taken at zero

3.16**groundable point**

dedicated point which can be connected to EPA ground

3.17**materials for packaging**

materials in which ESDS are packed for transportation or storage including bags, boxes, crates, wraps, magazines, cushions, foams, loose fill, etc.

3.17.1**intimate packaging**

material which makes contact with ESDS

3.17.2**proximity packaging**

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

3.17.3**secondary packaging**

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

3.18**packaging characteristics**

NOTE For test conditions see Annex A.

3.18.1**low charging**

packaging exhibiting properties which minimize any charge generation

NOTE The terms astatic and antistatic should be avoided due to the different existing meanings, hence low charging has been used in this publication.

3.18.2**electrostatic discharge shielding**

barrier or enclosure that limits the passage of current and attenuates the energy resulting from an electrostatic discharge such that the maximum energy from 1 000 V human body model discharge is less than or equal to 50 nJ

NOTE See A.6.

3.18.3**electrostatic conductive**

packaging with a surface resistance $\geq 1 \times 10^2 \Omega$ and $< 1 \times 10^5 \Omega$

3.18.4

electrostatic dissipative

packaging with a surface resistance $\geq 1 \times 10^5 \Omega$ and $< 1 \times 10^{11} \Omega$

3.18.5

insulating

packaging with a surface resistance $\geq 1 \times 10^{11} \Omega$

3.19

tribo-electric charging

electrical charging process in which charge is generated by the contact and separation of two surfaces which may be solid, liquid or particulate-carrying gases

4 Signs and markings

4.1 Markings

4.1.1 ESDS marking

When the ESDS are marked, the mark shall be in accordance with Figure 1, Figure 2, or Figure 3. Additional information may be added, but not in a manner that detracts from the warning symbol.

4.1.2 Packaging marking

Packaging permitted for use in an EPA shall be identified, as shown in Figure 4. Where practical, the following identification shall be on the packaging and shall mention:

- a) manufacturer's name or logo;
- b) batch identification number, which shall be traceable to the date of manufacture.

4.1.3 Equipment marking

Equipment or other items defined in Clause 5 which may be regularly moved across an EPA boundary shall be marked in accordance with Figure 5.

4.2 Documentation

Where practical all documentation relating to the use, specification, design, procurement and movement of ESDS shall contain details to advise or warn the recipient that the subject matter is ESDS.

4.3 Signs for ESD protected areas (EPA)

4.3.1 EPA without exposed conductors with a potential in excess of 250 V a.c. or 500 V d.c.

Sign(s) as shown in Figure 6 shall be clearly visible to personnel before they enter the EPA and, where applicable, from inside the EPA. Where applicable, signs in accordance with Figure 8 shall mark the EPA boundary.

The signs shall contain at least all elements shown; additional information may be added, but not in a manner that detracts from the basic warning.

NOTE When appropriate, signs as shown in Figure 10 should be clearly visible to personnel before leaving the EPA. Signs shall have a minimum size of 300 mm × 150 mm.

4.3.2 EPA with exposed conductors with a potential in excess of 250 V a.c. or 500 V d.c.

Sign(s) as shown in Figure 7 shall be clearly visible to personnel before they enter the EPA.

NOTE When appropriate, signs as shown in Figure 10 should be clearly visible to personnel before leaving the EPA.

4.4 Marking of EPA bonding points (EBP)

All EBP shall be marked or labelled (see Figure 9).

5 ESD protected area (EPA)

5.1 Configuration

5.1.1 General

All permanent EPA shall have defined boundaries. No item or activity within an EPA shall cause significant damage to ESDS.

An EPA may take many forms, including the following:

- a bench;
- a store;
- an area of work;
- a field work area;
- a work station and equipment (for example, a solder flow machine).

5.1.2 Responsibilities

The ESD co-ordinator (see **9.2**) shall be responsible for the definition of boundaries, selection of items and construction and certification of each EPA.

The design of an EPA and the selection of equipment, materials and items used shall be the responsibility of the ESD co-ordinator.

When used, the equipment shall meet the requirements of **5.2**.

5.1.3 High-voltage EPA

EPA which have exposed conductors with potentials in excess of 250 V a.c. or 500 V d.c. shall have warning labels compliant with relevant national legislation.

5.2 Requirements for specific ESD protective items

5.2.1 General

Specific ESD protective items when used within an EPA shall have the characteristics described in **5.2.2** to **5.2.11**, which shall be measured in accordance with test methods described in Annex A and shall have the characteristics described in **5.2.2** to **5.2.11**, measured at the highest and lowest expected or rated humidity values. In the remaining parts of this technical report, such items are called ESD protective items.

5.2.2 Working surfaces and storage racks

All working surfaces and storage racks on which unprotected ESDS may be placed shall be capable of being connected to EPA ground and shall have a point-to-point resistance and resistance to EPA ground in accordance with Table 1.

5.2.3 Floors

All floor surfaces shall have a surface-to-EPA ground resistance in accordance with Table 1.

5.2.4 Seating

The resistance from all areas of seating which may have human body contact when in normal use, to either a floor contact point or a groundable point, shall be as specified in Table 1.

When the floor is used as part of a grounding system, a minimum of two wheels or two feet shall provide a path to EPA ground.

5.2.5 Garments

Coats, jackets, smocks and overalls shall completely cover all clothing in the area of the arms and torso.

There shall be electrical continuity between all parts of the garment. Garments shall have characteristics on the outward facing surface in accordance with Table 1.

Garments complying with ESD requirements shall be clearly marked.

NOTE Marking with the ESD symbol in Figure 5 is recommended.

5.2.6 Gloves and finger cots

Gloves and finger cots, as worn, shall be in compliance with Table 1.

5.2.7 Wrist strap

The wrist strap shall consist of a band that fits snugly around the wrist and a cord to connect the band to an EBP. The wrist strap shall incorporate a quick release connection.

The wrist band shall be made of material having a resistance between the inner surface and its groundable point in accordance with Table 1.

The cord shall be connected electrically to the inner surface of the band when connected. The conducting parts of the connecting system shall be shrouded in insulating or dissipative materials when the band and cord are connected together.

The cord shall be made of a conductor covered with an insulating or dissipative material.

The cord shall have a termination compatible with the EBP and shall incorporate at least one insulated current-limiting resistor. The end-to-end resistance shall be in accordance with Table 1. For cords with one resistor, the resistor shall be incorporated into the identified wrist end of the cord.

The total resistance from hand to EBP shall be in accordance with Table 1.

Where the cord is likely to be used in an EPA which contains exposed conductors with potentials in excess of 250 V a.c. or 500 V d.c., the maximum rated potential shall be identified on the cord.

5.2.8 Footwear

Footwear shall be constructed in such a way that for each item, the resistance to EPA ground from wearer shall be in accordance with Table 1.

5.2.9 Ionizers

Ionizers shall enable either polarity of charge on items to be brought down and maintained to less than 100 V in accordance with Table 1.

5.2.10 Tools, machinery, dispensers and test equipment

Tools intended for use within the EPA shall, as far as is practicable, be so constructed that they do not generate or hold an electrostatic charge and are in compliance with Table 1.

All tools and machinery, for example electrical, mechanical or pneumatic, shall be so constructed that any non-insulating part of the tool or machine which may touch an ESDS shall be at EPA ground potential.

All electric solder irons used within the EPA shall be fitted with a grounded tip.

5.2.11 Trolleys and carts

When used for transporting unprotected ESDS or as portable work surfaces, they shall conform to the requirements of 5.2.2 and shall contain a groundable point.

5.3 Construction of an EPA

5.3.1 General

An example of a typical EPA is shown in Figure 11. The schematic of such an EPA grounding system is shown in Figure 12.

5.3.2 EPA ground facility

The EPA ground facility shall be connected to EPA ground and provide a low resistance path to EPA ground ($<2\ \Omega$). When available, the mains protective earth shall be used.

5.3.3 EPA ground bonding point (EBP)

An easily accessible dedicated EBP for the wrist strap shall be established adjacent to each working area, or working surface.

A sufficient number of EBP shall be provided for operators and visitors.

An EBP shall be connected to the EPA ground facility through a resistance not exceeding $1\ \text{M}\Omega$ (see Figure 12). The earth bonding point connection system shall not be compatible with any other connecting system used for any purpose other than grounding in the EPA.

The electrical conducting parts of the connecting interface shall be such that they are shrouded by insulating material when the cord is connected to the earth bonding point and in use.

The EBP shall be clearly marked, as shown in Figure 9.

5.3.4 EPA ground cords

EPA ground cords shall be used to make electrical connections between groundable points and the EPA ground facility.

Where a single resistor is used in the EPA ground cord, this shall be located near the groundable point. Where more than one resistor is used, a resistor of a minimum resistance value of one half the total resistance shall be located near the groundable point.

When accessible, the EPA ground cord and its groundable point connection shall be shrouded by insulating material.

5.3.5 Electrostatic fields

See IEC 61340-5-2.

5.3.6 Certification of conformance

Once the EPA is constructed or modified, the ESD co-ordinator shall audit the facility in accordance with Clause 10 and Table 3, to confirm that the requirements of Clause 5 are met, and shall ensure that an initial certificate of conformance is issued before the EPA is used. An example of a certificate of conformance is shown in Figure 13. A list and location of all EPA equipment shall be prepared and maintained, as shown in the example given in Table 4.

Any instances where this technical report has been compromised in order to satisfy the working requirements shall be recorded on the certificate of conformance, together with any extra equipment and/or specified procedures required to provide the necessary precautions.

5.4 Field work

All field work shall adhere to the requirements specified for permanent EPA with respect to the material quality, training, labelling, packaging and personal responsibilities.

Field work shall be carried out in accordance with the requirements of 5.3.

The operator, any temporary work surface and flooring and the equipment being serviced shall be bonded and, where practical, connected to EPA ground (see Figure 14 and Figure 15).

When ESDS are removed from equipment and transferred to a temporary work surface away from the equipment, the ESDS shall be placed in protective packaging as in Table 2.

Faulty ESDS which may be required for failure analysis or repair shall be placed in protective packaging prior to removal from the EPA.

5.5 EPA working practices

The primary means of grounding personnel shall normally be by a wrist strap connected to an EBP. When the use of a wrist strap system is impractical, the floor (see 5.2.3 and Table 1) and footwear (see 5.2.8) shall be the primary means of ESD control.

When used, garments in accordance with 5.2.5 shall be worn and shall be properly fastened at all times.

All persons, including visitors, entering the EPA shall comply with the requirements of this subclause.

ESDS found to be faulty shall be protected in the same manner as any other ESDS up to the time of disposal.

All non-ESDS items brought into EPA shall be packed in accordance with Table 2.

Paperwork inside the EPA shall either be kept in containers conforming to the requirements of Table 2 or shall not generate a field in excess of that specified in 5.3.5.

Only cleaning materials or processes which do not degrade the properties of the ESD protective items, shall be used.

6 Protective packaging

Packaging shall have the characteristics described in Table 2, measured at the highest and lowest expected or defined relative humidity.

The outer surface of all proximity packaging brought into an EPA shall not be insulating.

The electrical properties in Table 2 shall be maintained during use, storage, transit, distribution or application to the point of re-use.

The primary functions of protective packaging outside the EPA are to:

- limit tribo-electric charging;
- provide shielding against electrostatic fields and discharges.

The packaging shall be capable of providing charge drainage to EPA ground when brought into an EPA.

NOTE This can be achieved using separate items or combined into one package for example “static shielding bags”.

Protective packaging shall be marked in accordance with 4.1.2.

Characteristics required in Table 2 shall be measured in accordance with test methods described in Annex A.

7 Purchase, receipt, storage and handling

7.1 General

Electrostatic handling precautions shall be applied at all stages from goods inward to final dispatch.

In addition to the training requirements of Clause 8, all goods inward personnel shall be instructed how to recognize and handle ESDS. The meaning of markings and signs in this technical report shall be explained to all personnel.

7.2 Purchase

All procurement orders for components and items related to electrostatic special handling activities shall quote the requirements of this technical report (see 9.3). Packaging materials and packaging actions shall both be covered by these requirements. All procurement personnel shall receive training appropriate to their activities (see 8.2).

7.3 Receipt and storage

ESDS received without packaging, including warning notices in accordance with this technical report, shall be treated as non-compliant and appropriate action shall be taken.

On receipt, packages shall have outer packaging removed down to ESD warning labels. Non-ESD protective packaging material shall not be taken into an EPA.

Packages showing ESDS warning labels shall be taken to an EPA before removing any further wrapping.

7.4 Unpacking, inspection and storage within an EPA

Warning labels shall be used on all packages containing ESDS. Where these have been removed to gain access to the contents, fresh warning labels shall be used to re-seal the packages.

8 Training

8.1 Relevant structured ESD training

Relevant structured ESD training shall be provided for all personnel who specify, procure, design, mark or handle ESDS in any way or are likely to do so, including those who manage and supervise them. Special emphasis shall be placed on training of personnel who are to undertake field work (see 5.4). Subcontractors, cleaners and temporary personnel shall receive awareness or appropriate training to their activities. Visitors shall be made aware of local ESD handling procedures.

8.2 Personnel training

Personnel shall be trained to employ effectively the materials, equipment and procedures provided in accordance with this technical report and to understand why electrostatic precautions are needed.

8.3 Introduction courses

Training shall be part of employee introduction courses.

8.4 Items for consideration in training

- theory of the causes of charging;
- some basic knowledge about electrostatic discharge;
- special handling procedures;
- protective items;

- identification of ESDS in equipment;
- limits of the protection used;
- ESDS sensitivity;
- personnel shall be trained in the use of new techniques, processes and equipment prior to implementation;
- conflicts with safety requirements;
- high-voltage precautions where EPA includes exposed conductors with a potential in excess of 250 V a.c. or 500 V d.c.;
- awareness of this technical report.

8.5 Retraining

Retraining shall be provided at documented intervals determined to be appropriate for the organization by the ESD co-ordinator (see 9.2).

8.6 Register of trained personnel

A register shall be maintained of those personnel who have been trained in accordance with the requirements of this technical report.

8.7 Training provided by the ESD co-ordinator

Training shall be provided by the ESD co-ordinator or by persons authorized by him/her.

9 Quality responsibilities

9.1 Responsibilities

9.1.1 General management

The general management is responsible for the implementation of all precautions set out in this technical report, and for the appointment of an ESD co-ordinator.

9.1.2 Personnel

In the working environment, people are the greatest source of electrostatic generation and therefore all personnel shall have a prime responsibility to take the precautions defined in this technical report.

It is the responsibility of all those involved with ESDS to be aware of the electrostatic threat to the reliability of electronic products. They shall notify the ESD co-ordinator (see 9.2) of any aspects of electrostatic handling that are considered to be unsatisfactory and, where appropriate, make suggestions for corrective action.

9.1.3 Management

Management is responsible for ensuring that:

- all relevant personnel have been trained and that the training is appropriate within appropriate fields of application;
- the periodicity of refresher training shall be in accordance with 8.5;
- a register of trained personnel shall be maintained and kept up to date;
- the inspection, supervision and maintenance of the EPA, and all matters relating to ESDS handling are carried out (see 9.1).

9.2 ESD co-ordinator

At all sites there shall be a named ESD co-ordinator responsible for all matters relating to the protection of ESDS and the implementation of this technical report. The co-ordinator shall do this by:

- producing and maintaining a list of all approved ESD protective items and equipment (see Table 4);
- ensuring that training conforms to the requirements of Clause 8;
- ensuring that this technical report or an in-house procedure meeting the requirements of this technical report shall be available to all relevant staff;
- providing assistance where ESD-related problems are found or expected.

The ESD co-ordinator shall appoint deputies if required.

9.3 Procurement of ESD protective items

9.3.1 Approval of ESD protective items

The responsibility for the selection criteria of ESD protective items shall be defined to ensure that:

- all ESD protective material and products being considered for use shall comply with the requirements of this technical report;
- the items actually delivered comply with the requirements of this technical report and are capable of performing the required task under the conditions existing within a given facility;
- the products in use continue to perform in accordance with this technical report during the intended lifetime.

9.3.2 Qualified protective items

The ESD protective items may be qualified by any of the methods below:

- user's in-house qualification;
- third-party qualification;
- supplier's qualification testing and the provision of certificates of conformance;
- confidence in supplier supported by data.

9.3.3 Procurement records

The procurer shall maintain a record of the current ESD protective items and their selected sources. ESD protective items shall have been selected by the process in **9.3.1** prior to inclusion in this record.

9.3.4 Procurement of ESDS and subcontracted work

Those responsible for the procurement of ESDS shall ensure that:

- the appropriate requirements of this technical report are incorporated in all acquisitions relating to the handling of all ESDS;
- all subcontractors and suppliers of ESDS comply, in the areas of their individual responsibilities, with the requirements of this technical report or other requirements considered acceptable to the ESD co-ordinator.

9.4 Checking of electrostatic precautions

Checks, where appropriate, shall be made in accordance with:

- subclauses **9.6**, **9.7**, **9.8** and **9.9**; or
- relevant constant monitoring; or
- statistical sampling methods.

In undertaking routine control and monitoring of the working environment, the ESD co-ordinator shall be responsible for ensuring that the requirements of **9.6**, **9.7**, **9.8** and **9.9** are met, and that records of the required checks are made and maintained in accordance with individual company policy.

Any non-compliance with these requirements that cannot be corrected immediately through the resources available to the person(s) responsible for this routine monitoring and control shall be reported to the ESD co-ordinator, who shall ensure that prompt corrective actions are undertaken.

9.5 Limits and checks

All limits for checks are specified in Table 1. All methods and procedures are defined in Annex A.

9.6 Daily checks

9.6.1 Visual check

A visual check shall be made to verify that all EPA and packaging precautions are in apparent working order. These checks shall be documented at the discretion of the ESD co-ordinator.

9.6.2 Wrist strap

All wearers shall check that their wrist strap meets the requirements of **5.2.7**. Wrist straps shall be checked before use. Each check shall be made with the wrist band worn in contact with the wearer's skin and with the ground cord attached to the appropriate tester.

9.6.3 *Non-permanent footwear*

All wearers shall check that their heel and toe straps meet the requirements of 5.2.8. The check shall be made before entering the EPA.

9.6.4 *Permanent footwear used as primary means of grounding*

All wearers shall check that their permanent footwear (for example, ESD protective shoes) meet the requirements of 5.2.8. The check shall be made before entering the EPA.

9.7 Monthly checks

9.7.1 *Earth bonding*

The electrical continuities of the work surfaces, EBP, floors, chairs, trolleys, field service kits, mats, work stations, racks and separately grounded equipment shall be checked on a sample basis.

9.7.2 *Ionization system*

The ionization system, if fitted, shall be verified for functionality.

9.8 Six-monthly checks

9.8.1 *General*

These checks shall be performed on a sample basis.

9.8.2 *Electrostatic fields*

There shall be no electrostatic fields greater than those defined in 5.3.5.

9.8.3 *Signs and labels*

Signs and labels shall be of the specified types and situated in the specified places (see Clause 4).

9.8.4 *Non-disposable garments*

Non-disposable garments covered by 5.2.5 shall be electrically tested.

9.8.5 *Permanent footwear*

All wearers shall check that their permanent footwear, while worn, meets the requirements of 5.2.8.

9.9 Disposable garments

Disposable garments shall be checked on a sample basis at incoming inspection.

10 Periodic audit instructions

10.1 Periodic audits

Periodic audits of facilities, procedures and practices in accordance with the instructions given in 10.2 to 10.17 and in conjunction with the periodic checks of Clause 9 shall be undertaken by a nominated person or team using appropriate measuring equipment where required. A check shall be carried out on the adequacy and availability of records.

Where appropriate, random checks shall be carried out.

These audits shall be performed at intervals not exceeding those defined by the ESD co-ordinator.

All audit measurements shall be carried out under the normal operating environment, and the temperature and relative humidity shall be recorded.

10.2 Checks in areas with power potentials greater than 250 V a.c. or 500 V d.c.

Checks shall be carried out to ensure that, in areas which may have exposed power conductors with potentials greater than 250 V a.c. or 500 V d.c., the additional precautions required in 4.3.2, 5.1.3, 5.2.6, 8.4 and Table 1 are taken.

10.3 Checks of EPA labels

Checks shall be carried out to ensure that EPA display the notices, labels and signs specified in Clause 4.