# IEC 61340-4-5

Edition 2.0 2018-01
REDLINE VERSION

# INTERNATIONAL STANDARD



colour inside

**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 61340-4-5:2018-01 RLV(en)

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# 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

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International Standard IEC 61340-4-5 has been prepared by IEC technical committee 101: Electrostatics.

This second edition cancels and replaces the first edition published in 2004. This edition constitutes a technical revision.

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

a) normative references have been updated;
b) Figure 2 has been improved and expanded to include actual examples of body voltage recordings, and text has been added to explain how to interpret recordings;
c) an alternative walking pattern has been added in an informative annex.

The text of this International Standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 101/545/FDIS | 101/552/RVD |

Full information on the voting for the approval of this International Standard 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 the 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- withdrawn,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.

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# 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

## 1 Scope

This part of IEC 61340 specifies test methods for evaluating electrostatic protection provided by a system of footwear and flooring in combination with a person.

Test results are valid only for the specific footwear and flooring combination tested.

The test methods are not intended for individual ~~material or system classification~~ product qualification purposes.

## 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 60093, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*~~

IEC 62631-3-1, *Dielectric and resistive properties of solid insulating materials – Part 3-1: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – General method*

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

ISO 1957, *Machine-made textile floor coverings – Selection and cutting of specimens for physical tests*

## 3 Terms and definitions

~~For the purposes of this document, the terms and definitions given in IEC 61340-1-2 apply.~~

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

## 4 Principle

The characterization of a system is achieved by measuring electrical resistance and chargeability of the footwear and flooring in combination with a person. Chargeability is determined using a walking test.

WARNING – Test procedures described in this document ~~may~~ can expose personnel to potentially hazardous electrical conditions. Appropriate electrical hazard reduction practices should be exercised, and proper earthing instructions for the equipment used should be followed when performing tests.

## 5 Atmosphere for conditioning and testing

The following requirements supersede any other specification for the atmosphere for conditioning and testing that may be given in one or more of the documents referred to in this document.

Unless otherwise agreed, the atmosphere for conditioning and testing for laboratory evaluations shall be (23 ± 2) °C and (12 ± 3) % relative humidity. The conditioning time prior to testing shall be at least 48 h. Textile floor coverings are preferably pre-conditioned for at least 24 h at (20 ± 2) °C and (65 ± 3) % relative humidity prior to conditioning and testing.

During pre-conditioning and conditioning, specimens shall be placed on a rack or other suitable support that allows free circulation of air around them.

Whenever tests are made in uncontrolled conditions, for example tests on installed floors, the ambient temperature and relative humidity at the time of measurement shall be recorded.

## 6 Test methods for footwear and flooring in combination with a person

### 6.1 Floor covering sampling and specimen preparation for laboratory tests

Sampling and selection of specimens for laboratory tests shall be carried out according to the principles specified in ISO 1957. For the purposes of this document, the general principles of ISO 1957 apply to all types of floor covering. From each sample, select a specimen measuring (2 ± 0,1) m × (1 ± 0,1) m or, in the case of tiles, select sufficient tiles and/or part tiles to make up a single specimen area of (2 ± 0,1) m × (1 ± 0,1) m.

For tests on floor coverings that will be installed with specific earth connections, a groundable point shall be attached to the test specimen in accordance with the manufacturer's instructions, or as otherwise agreed, and in a way that simulates end use earthing methods. For chargeability tests on floor coverings that will be installed without specific earth connections, groundable points shall not be attached to the test specimen.

Sensible electrical resistance measurements cannot be made in the laboratory on floor coverings that will be installed without specific earth connections. Measurement of the electrical resistance of footwear and flooring in combination with a person shall only be made on such floor coverings once installed.

The test specimen shall be mounted or loose-laid on nominal ~~6,3~~ 6 mm tempered or standard hardboard, according to the manufacturer's instructions or as otherwise agreed. When mounted or loose-laid on the hardboard, there shall be a gap of at least 10 mm between each edge of the specimen and the corresponding edge of the hardboard.

The hardboard shall be clean, smooth and have a point-to-point resistance of greater than $10^{11}$ Ω when tested under the environmental conditions specified in Clause 5 and according to the test method specified in IEC 61340-4-1.

Floor finishes shall be tested in conjunction with floor coverings representative of the type for which the finishes are intended. The floor covering shall be prepared and mounted as detailed above. The finish under test shall then be applied to the floor covering in accordance with the manufacturer's instructions or as otherwise agreed. In cases where the manufacturer recommends the use of additional groundable points on the surface of the floor covering, these shall be installed as per the manufacturer's instructions prior to application of the finish, or as otherwise agreed.

~~NOTE~~ Test results can be significantly affected by the presence of dirt or other contaminants on the surface of floor coverings. Any cleaning performed on floor coverings shall be carried out as per the manufacturer's instructions prior to conditioning.

Generally, tests are performed on floor coverings as received, i.e. with finishes and special treatments as appropriate. If the permanency of such finishes and treatments is being investigated, specimens may be submitted to a cleaning process or to practical wear conditions before testing, either for laboratory evaluations or on installed floor coverings.

## 6.2 Cleaning of footwear for laboratory evaluations and for test on installed floor coverings

### 6.2.1 General

Test results can be significantly affected by the presence of dirt or other contaminants on the soles of footwear. Any cleaning performed on footwear prior to and during testing shall be as follows. If it is required to test footwear "as received" or "as used", then cleaning shall be omitted from the test procedure.

### 6.2.2 Cleaning materials

#### 6.2.2.1 Sandpaper

P280 grade sandpaper.

#### 6.2.2.2 Scoured cotton cloth

The cloth shall be free from finish and detergent.

#### 6.2.2.3 Ethanol

Concentration ≥ 95 %.

### 6.2.3 Cleaning procedure

Scrub the sole of each item of footwear using a piece of scoured cotton (6.2.2.2) wetted with ethanol (6.2.2.3) to remove any chemical substance from the surface.

When using ethanol, personal protective equipment is advised.

When the soles are dry, abrade with a fine sandpaper (6.2.2.1), then remove the dust using a dry piece of scoured cotton. Finally, scrub the sole of each item of footwear again using a fresh piece of scoured cotton wetted with ethanol. This final stage only shall be repeated between each set of measurements. Ensure soles are dry before making measurements.

### 6.3 Measurement of electrical resistance

#### 6.3.1 Apparatus

##### 6.3.1.1 Resistance measuring apparatus

###### 6.3.1.1.1 General

A self-contained DC resistance meter (ohmmeter) or DC power supply and current meter in the appropriate configuration for resistance measurement, with a ±10 % accuracy, and fulfilling the following requirements.

~~NOTE~~ For safety reasons, it should be ensured that the maximum current of the measuring circuit does not exceed 5 mA.

###### 6.3.1.1.2 For laboratory evaluations

The apparatus shall have a circuit voltage while under load of 10 V ± 0,5 V for resistance below $1,0 \times 10^6$ Ω, and 100 V ± 5 V for resistance of $1,0 \times 10^6$ Ω and above. The measuring range of the apparatus shall be at least one order of magnitude either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures unintended earth paths do not influence measurements.

###### 6.3.1.1.3 For acceptance testing

The apparatus shall have an open circuit voltage of 10 V ± 0,5 V for resistance below $1,0 \times 10^6$ Ω, and 100 V ± 5 V for resistance of $1,0 \times 10^6$ Ω and above. The measuring range of the apparatus shall be at least one order of magnitude either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures unintended earth paths do not influence measurements.

Laboratory evaluation equipment as specified in 6.3.1.1.2 may also be used for acceptance testing. In case of dispute, only a laboratory evaluation apparatus shall be used.

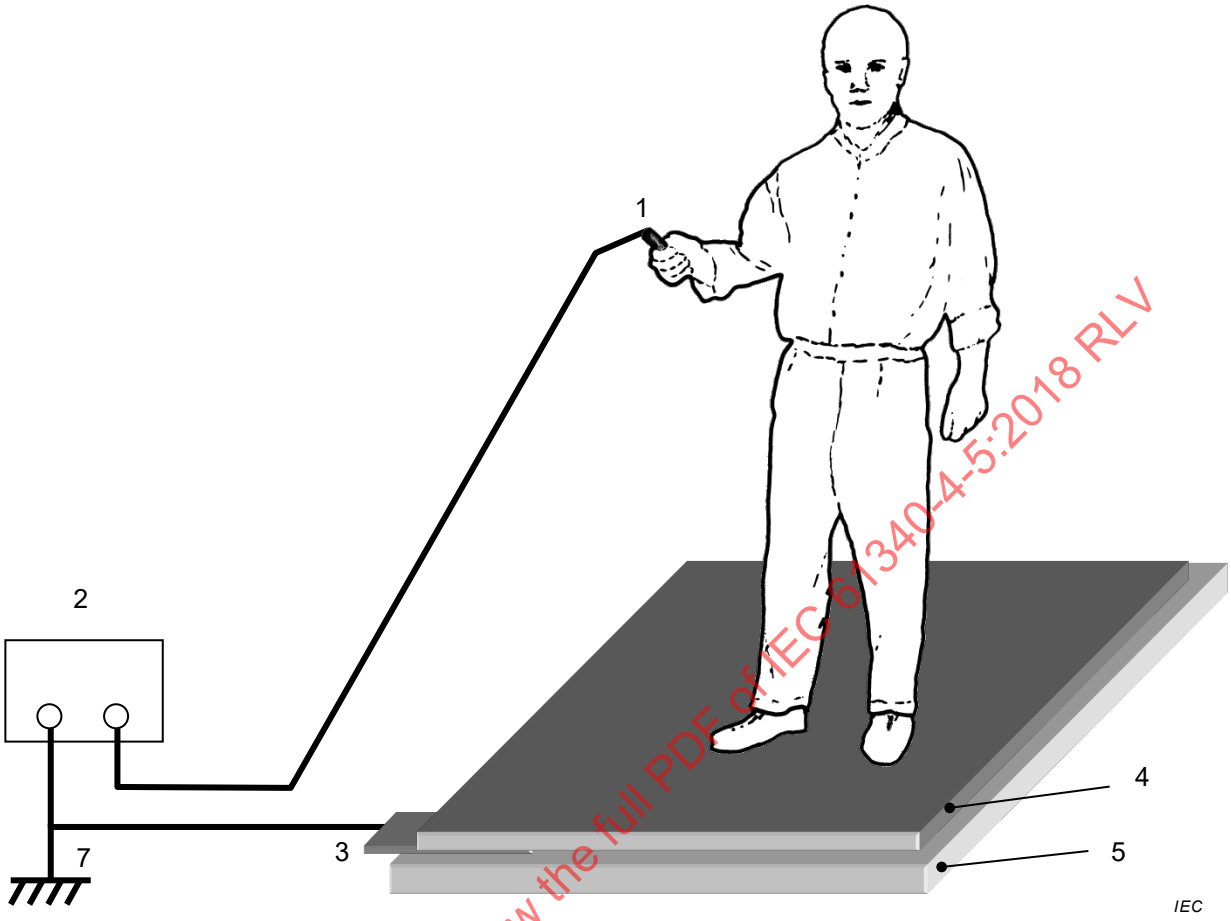
##### 6.3.1.2 Hand-held electrode

A stainless steel round stock or tube, approximately 25 mm diameter and 75 mm in length with a banana plug receptacle or screw connector attached to one end of the cylinder.

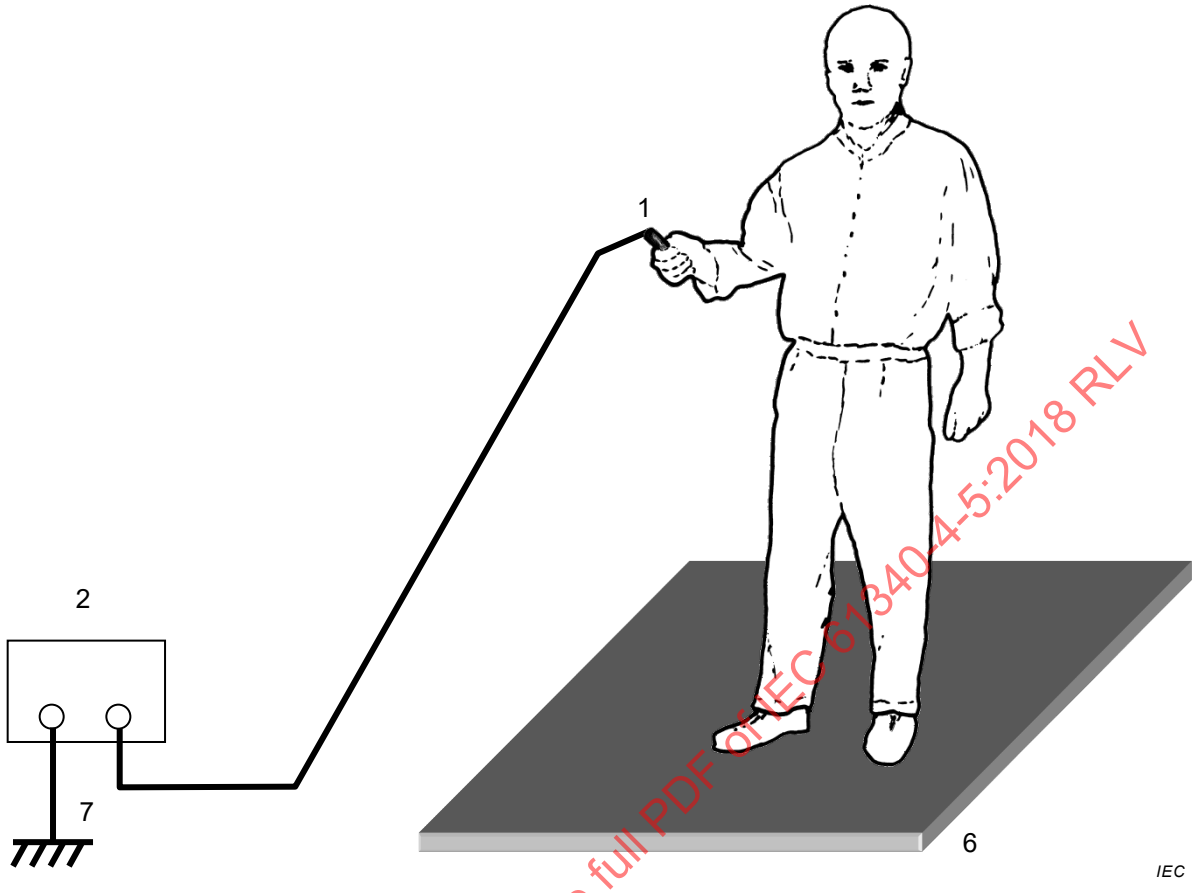
#### 6.3.2 Test procedure

Wear the test footwear on both feet for at least 10 min prior to the commencement of testing.

Connect the negative lead of the resistance measuring apparatus (6.3.1.1) to the groundable point of the test floor covering (laboratory tests) or to earth (tests on installed floor coverings). Connect the other lead to the hand-held electrode (6.3.1.2). Stand with both feet on the test floor covering and firmly grasp the hand-held electrode – see Figure 1 a) and Figure 1 b).




**a) – Laboratory set-up**




**b) – Test set-up for installed flooring**

**Key**

1 hand-held electrode (6.3.1.2)
2 resistance measuring apparatus (6.3.1.1)
3 groundable point (6.1)
4 floor covering under test
5 support material (6.1)
6 installed flooring
7 building earth

**Figure 1 – Set-ups for measuring electrical resistance of footwear and flooring in combination with a person**



Starting with the voltage set to 10 V, take a reading of the resistance 15 s ± 2 s after applying the test voltage. If the value exceeds $10^6\ \Omega$, select 100 V and repeat the measurement. Record the reading which matches the voltage and resistance range specified in 6.3.1.1. If the resistance falls below $10^6\ \Omega$ when making a measurement using 100 V, this reading shall be the one recorded.

Repeat the measuring procedure with only the left foot in contact with the test floor covering and with the right foot held in the air about 150 mm above the floor covering.

Repeat the measuring procedure with only the right foot in contact with the test floor covering and with the left foot held in the air about 150 mm above the floor covering.

For laboratory tests, measurements shall be made at five different locations distributed evenly over the area of the test specimen.

For tests on installed floor coverings, at least five measurements shall be made for each floor covering material. For large floor areas, at least five measurements per 500 $m^2$ of each floor covering material shall be made. Where there is evidence of wear, chemical or water spillage or visible dirt, then at least three measurements shall be made on such affected areas.

### 6.4 Measurement of chargeability

#### 6.4.1 Apparatus

##### 6.4.1.1 Body voltage measuring system

An electrostatic voltmeter, a hand-held electrode (6.3.1.2) and an autographic recorder meeting the following requirements:

a) input resistance of electrostatic voltmeter ≥ $10^{14}$ Ω;

b) input capacitance of electrostatic voltmeter, hand-held electrode and connecting leads ≤ 30 pF;

c) system response time shall be such that full-scale deflection on the recorder is reached within 0,25 s;

d) system resolution shall be at least one-tenth of the voltage level concerned; for example, for the comfort of personnel, body voltages of several kilovolts are considered, in which case the resolution of the measuring system shall be 0,1 kV; in the electronics industry, body voltages of 100 V are considered, in which case the resolution of the measuring system shall be 10 V;

e) system accuracy of ±10 %.

##### 6.4.1.2 Ionizing source

Capable of eliminating electrostatic charge from the surface of footwear and floor covering specimens.

~~NOTE~~ All relevant safety precautions and regulations should be observed.

#### 6.4.2 Test procedure

##### 6.4.2.1 General

For laboratory evaluations on floor coverings that will be installed with specific earth connections, measurements shall be made on specimens fitted with suitable groundable points (see 6.1) and connected to earth. When carrying out laboratory evaluations on floor coverings that will be installed without specific earth connections, groundable points shall not be attached to test specimens, which shall remain isolated from earth whilst measurements are made.

For laboratory evaluations, the procedures described in 6.4.2.2 to 6.4.2.5 inclusive shall be carried out three times for each combination of footwear and floor covering to be tested.

For tests on installed floor coverings, the procedures described in 6.4.2.2 to 6.4.2.5 inclusive shall be carried out at least five times for each combination of footwear and floor covering to be tested. For large floor areas, procedures 6.4.2.2 to 6.4.2.5 inclusive shall be carried out at least five times per 500 $m^2$ of each floor covering material. Where there is evidence of wear, chemical or water spillage or visible dirt, then at least three of these measurements shall be made on such affected areas. For verification of the body voltage measurement system, see Annex A.

##### 6.4.2.2 Discharging test items

Eliminate any residual electrostatic charge on the footwear and floor covering using the ionizing source (6.4.1.2). Loose-laid specimens for laboratory evaluations shall be discharged

on both sides before re-positioning them carefully without sliding on the support material (6.1).

#### 6.4.2.3 Donning footwear

The operative shall don the footwear whilst sitting on a nearby seat. The operative shall be earthed and the soles of the footwear discharged using the ionizing source (6.4.1.2). The operative then stands on the floor covering without sliding.

Footwear shall be fastened securely as in normal use.

#### 6.4.2.4 Zeroing the system

The operative shall take hold of the hand-held electrode connected to the body voltage measuring system (6.4.1.1) and shall momentarily touch an earth bonding point to zero the system.

#### 6.4.2.5 Walking

There are many ways one could choose to walk. The walking pattern described here simulates forward and backward movements typical of workers in a number of disciplines. However, other walking patterns are acceptable (see Annex B) assuming that they simulate actual walking patterns in the intended installation.

Users of this test method should choose a walking pattern typical of the majority of the workers within the intended installation.

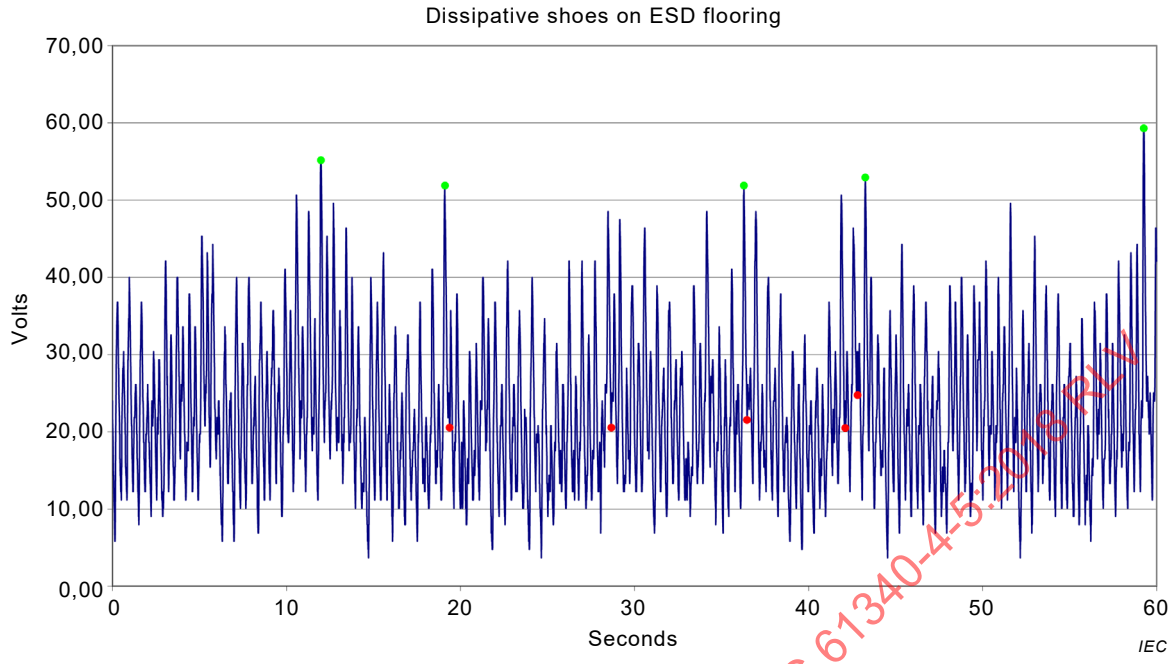
If no other walking pattern is specified, the following shall be used.

The operative shall walk on the floor covering at a rate of two steps per second whilst maintaining the body facing in the same direction throughout the test. The operative shall cover as much of the test area as possible by walking forwards and backwards, but avoiding scuffing or pivoting. The test area is the whole area of the floor covering specimen for laboratory evaluations, or an equivalent size area of installed flooring. The stepping action shall maintain the sole of the footwear parallel to the floor covering specimen at all times while lifting the footwear between 50 mm and 80 mm. For laboratory evaluations, the operative shall not come closer than 0,5 m to the wall, or any object in the room, and shall continue walking until the peak voltage ceases to rise, or for 60 s, whichever occurs first.

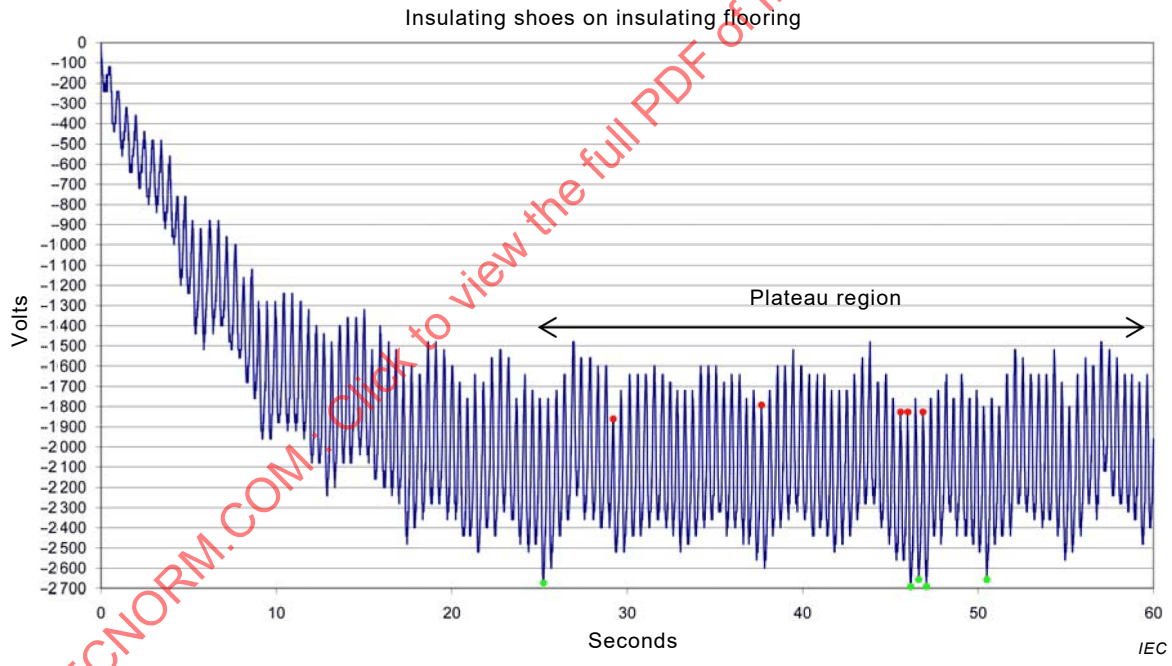
After walking, the operative shall remove the footwear and, if required, clean the soles (6.2).

#### 6.4.3 Calculation and expression of results

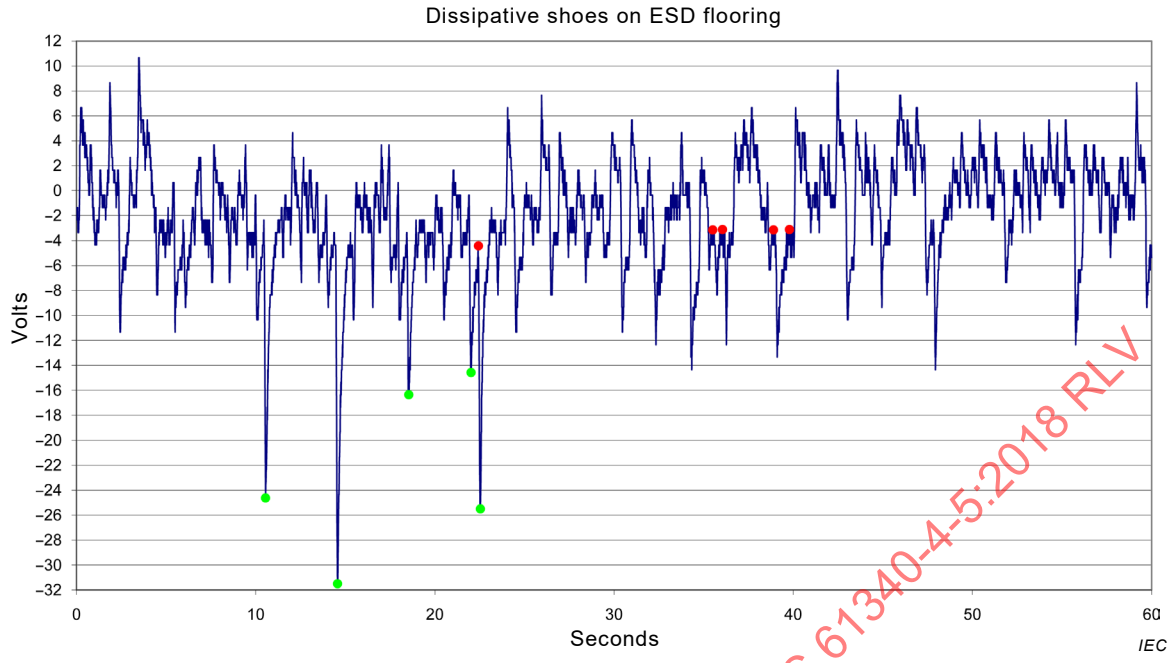
For each walking measurement, the arithmetic mean of the five highest valleys and the arithmetic mean of the five highest peaks shall be calculated (see Figure 2). The results shall be expressed in relation to the voltage of concern and the resolution of the measuring system. For example, for personnel comfort, the results may be expressed in kilovolts to the nearest 0,1 kV, or for the electronics industry, the results may be expressed in volts to the nearest 10 V.




**a) – Positive polarity body voltage recording**




**b) – Negative polarity body voltage recording**




**c) – Body voltage recording with positive and negative data points**

**Key**

- five highest peaks
- five highest valleys

**Figure 2 – Examples of body voltage recordings showing points used in calculating mean values**

In footwear/flooring systems where there is minimal charge dissipation from the operator, average body voltage tends to increase at the start of the test but after some time reaches a plateau, as shown in the example in Figure 2 a) and Figure 2 b). In cases such as this, the highest valleys and highest peaks means shall be taken from the plateau region.

In footwear/flooring systems where minimal charge is generated, or in which there is significant charge dissipation, the measured body voltage can change polarity, as shown in the example in Figure 2 c). It is clear in this example that the magnitude of the negative peaks is greater than the magnitude of the positive peaks. Therefore, the five highest negative valleys and five highest negative peaks shall be taken.

In cases where there are both positive and negative data points in one recording, and there is no clear difference in the magnitude of positive and negative data point, arithmetic means shall be calculated for the five highest positive valleys, the five highest positive peaks, the five highest negative valleys and the five highest negative peaks.



## 7 Test report

The test report shall include at least the following information:

a) reference to this document;
b) all the information necessary for complete identification of test samples;
c) identification of instrumentation used;
d) date of testing;
e) atmosphere for pre-conditioning, conditioning and testing as follows:

- for laboratory evaluations: temperature and relative humidity during pre-conditioning (if used), conditioning and testing, and the duration of any pre-conditioning and conditioning;
- for tests on installed floors: temperature and relative humidity during testing;

f) details of any cleaning or finishing procedures for both footwear and floor covering materials;

g) details of procedures and materials used to fix specimens to hardboard;

h) details of procedures and materials used to fix groundable points to specimens;

i) type of measurement: electrical resistance or chargeability;

j) for chargeability, the pattern and rate of walking;

k) all individual results for each type of measurement on each specimen;

l) average of all results for each type of measurement on each sample;

m) any operations not specified in this document, or in any standard to which normative reference is made, or regarded as optional, which might have affected the results.

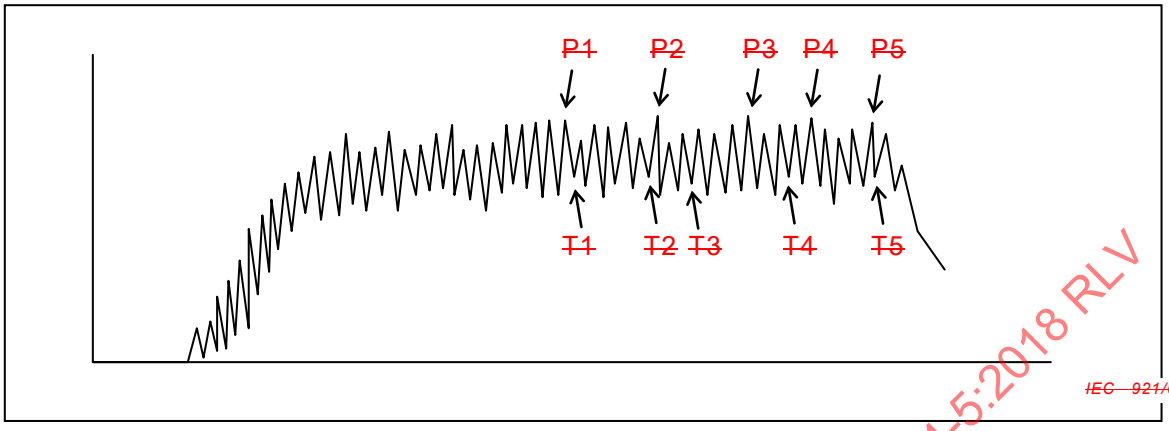



**Figure 2a – Positive polarity body voltage recording**

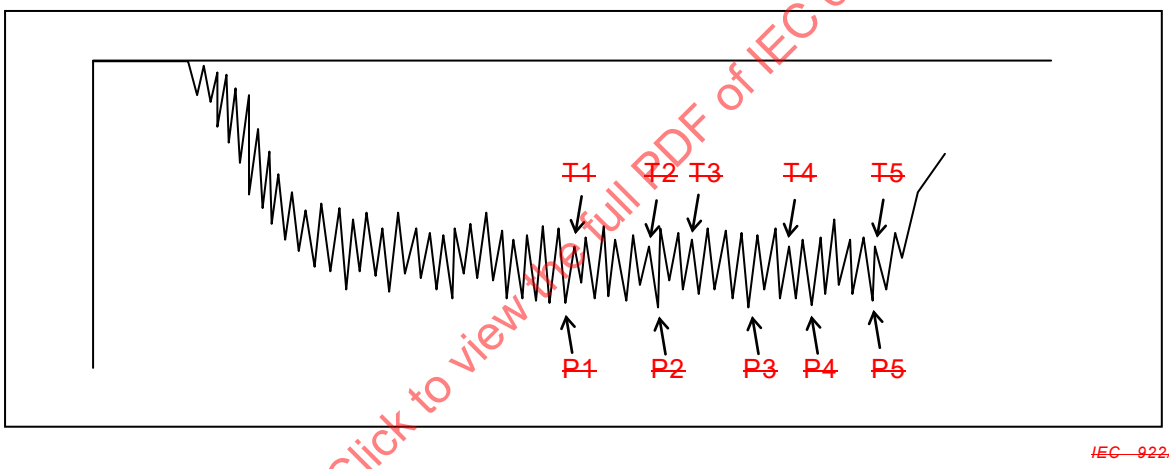



**Figure 2b – Negative polarity body voltage recording**

**Key**

P1 to P5: five highest peaks

T1 to T5: five highest valleys

**Figure 2 – Typical body voltage recordings showing points used in calculating mean values**

# Annex A
(normative)

# Method of ~~checking calibration~~ verification of body voltage measuring system

## A.1 Static ~~calibration~~ verification

The body voltage measuring system zero voltage point is checked by connecting the hand-held electrode to an earth bonding point. After being disconnected from the earth bonding point, the system is then checked by connecting the hand-held electrode to an output terminal of a stable DC voltage supply. At least three voltage levels of both positive and negative polarity shall be confirmed, for example 1 kV, 2 kV and 5 kV; or 100 V, 200 V and 500 V.

## A.2 Dynamic ~~calibration~~ verification

### A.2.1 General

The body voltage measuring system is ~~calibrated~~ verified by a dynamic method using either a signal generator or a manual switching procedure.

### A.2.2 Signal generator method

The hand-held electrode is connected to the output terminal of a signal generator with an output amplitude appropriate to the body voltages to be measured, for example 1 kV ± 0,1 kV or 100 V ± 10 V. The output frequency shall be 2 Hz with a rise/fall time of not greater than 2 ms. The procedure is carried out with both positive and negative polarity. Any overshoot or undershoot in the autographic recording of the voltage shall not exceed 10 % of the applied voltage amplitude.

### A.2.3 Manual switching method

The voltage supply for this procedure shall have a suitable over-current protection circuit. Additional protection for the operative may be obtained by placing a high voltage tolerant resistor of 1 MΩ to 10 MΩ in series with the output of the voltage supply.

An operative gripping the hand-held electrode in one hand stands on an insulating platform of volume resistivity ≥ $10^{14}$ Ωm, measured according to IEC ~~60093~~ 62631-3-1. With the other hand, the operative alternately touches an output terminal from a stable DC voltage supply and then an earth bonding point. The output from the voltage supply is set as appropriate to the body voltages to be measured, for example 1 kV ± 0,1 kV or 100 V ± 10 V. The operative charges and discharges at a rate of two cycles per second. A metronome is used to provide the cycle for switching. The procedure is carried out with both positive and negative polarity. Any overshoot or undershoot in the autographic recording of the voltage shall not exceed 10 % of the applied voltage amplitude.

# Annex B
(informative)

# Alternative walking pattern

## B.1 Measurement of chargeability

## B.2 Walking

The operative shall walk on the floor covering at a rate of two steps per second whilst maintaining the body facing in the same direction throughout the test. The following walking pattern is followed (see Figure B.1).

1) The operative shall begin (starting position) with the left foot at position 5 and right foot at position 6.
2) From this position, the operative will move the left foot to position 1 and right foot to position 2.
3) Without pausing, the operative will move the left foot from position 1 to position 3 and right foot from position 2 to position 4.
4) Without pausing, the operative will move the left foot from position 3 to position 5 and right foot from position 4 to position 6.
5) At this position (starting position), the operative will pause for 2 seconds.
6) Repeat steps 1 through 6 for ten (10) cycles.

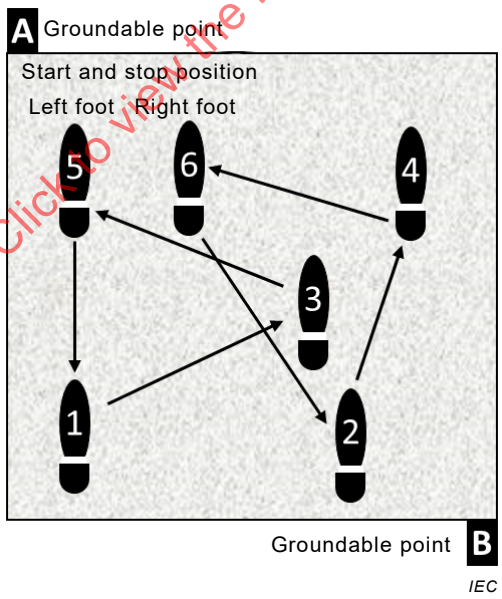



**Figure B.1 – Description of walking pattern**

## Bibliography

~~IEC 61340-1-2, *Electrostatics – Part 1-2: Definitions of all parts of the IEC 61340 series* [1]~~

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

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~~[1] Under consideration.~~

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# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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## 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

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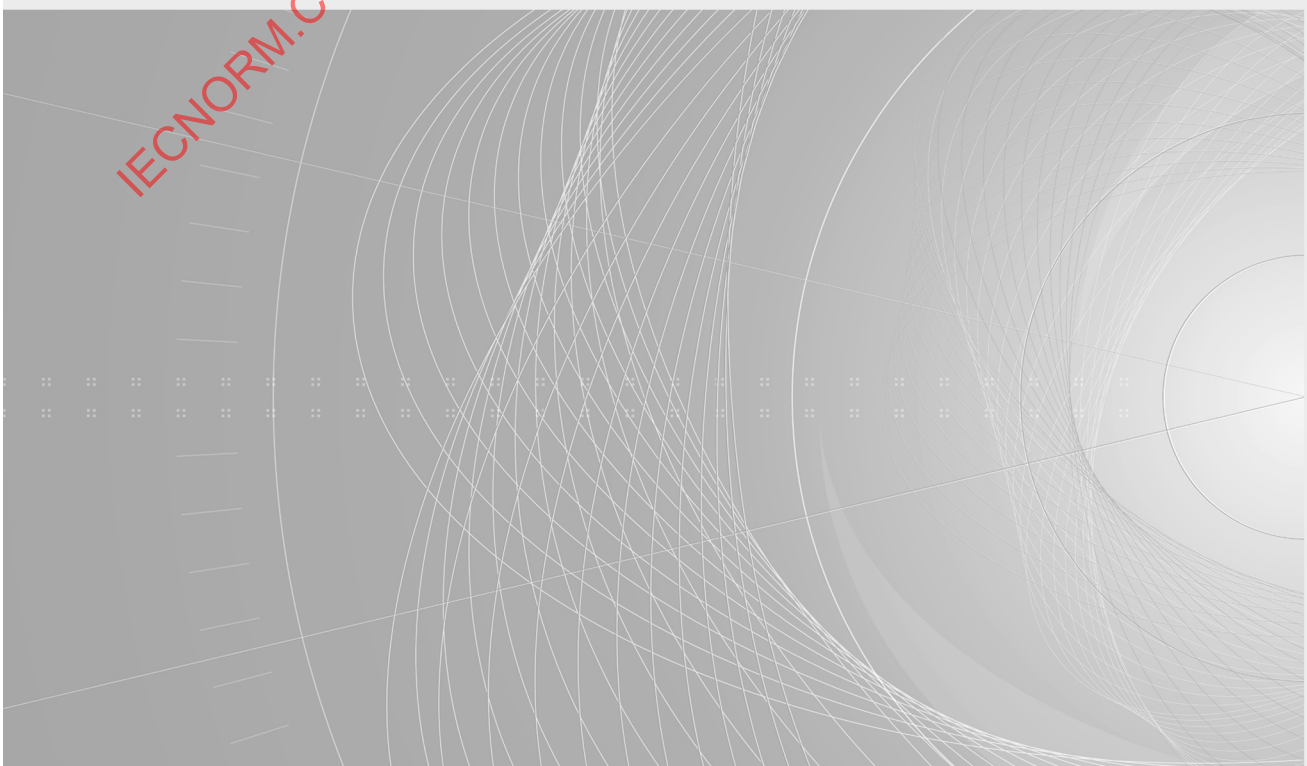

IEC 61340-4-5:2018-01(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# 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

## 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 61340-4-5 has been prepared by IEC technical committee 101: Electrostatics.

This second edition cancels and replaces the first edition published in 2004. This edition constitutes a technical revision.

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

a) normative references have been updated;
b) Figure 2 has been improved and expanded to include actual examples of body voltage recordings, and text has been added to explain how to interpret recordings;
c) an alternative walking pattern has been added in an informative annex.

The text of this International Standard is based on the following documents:

| FDIS | Report on voting |
|---|---|
| 101/545/FDIS | 101/552/RVD |

Full information on the voting for the approval of this International Standard 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 the 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.

**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.**

# 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

## 1 Scope

This part of IEC 61340 specifies test methods for evaluating electrostatic protection provided by a system of footwear and flooring in combination with a person.

Test results are valid only for the specific footwear and flooring combination tested.

The test methods are not intended for individual product qualification purposes.

## 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 62631-3-1, *Dielectric and resistive properties of solid insulating materials – Part 3-1: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – General method*

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

ISO 1957, *Machine-made textile floor coverings – Selection and cutting of specimens for physical tests*

## 3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

## 4 Principle

The characterization of a system is achieved by measuring electrical resistance and chargeability of the footwear and flooring in combination with a person. Chargeability is determined using a walking test.

WARNING – Test procedures described in this document can expose personnel to potentially hazardous electrical conditions. Appropriate electrical hazard reduction practices should be

exercised, and proper earthing instructions for the equipment used should be followed when performing tests.

## 5 Atmosphere for conditioning and testing

The following requirements supersede any other specification for the atmosphere for conditioning and testing that may be given in one or more of the documents referred to in this document.

Unless otherwise agreed, the atmosphere for conditioning and testing for laboratory evaluations shall be (23 ± 2) °C and (12 ± 3) % relative humidity. The conditioning time prior to testing shall be at least 48 h. Textile floor coverings are preferably pre-conditioned for at least 24 h at (20 ± 2) °C and (65 ± 3) % relative humidity prior to conditioning and testing.

During pre-conditioning and conditioning, specimens shall be placed on a rack or other suitable support that allows free circulation of air around them.

Whenever tests are made in uncontrolled conditions, for example tests on installed floors, the ambient temperature and relative humidity at the time of measurement shall be recorded.

## 6 Test methods for footwear and flooring in combination with a person

### 6.1 Floor covering sampling and specimen preparation for laboratory tests

Sampling and selection of specimens for laboratory tests shall be carried out according to the principles specified in ISO 1957. For the purposes of this document, the general principles of ISO 1957 apply to all types of floor covering. From each sample, select a specimen measuring (2 ± 0,1) m × (1 ± 0,1) m or, in the case of tiles, select sufficient tiles and/or part tiles to make up a single specimen area of (2 ± 0,1) m × (1 ± 0,1) m.

For tests on floor coverings that will be installed with specific earth connections, a groundable point shall be attached to the test specimen in accordance with the manufacturer's instructions, or as otherwise agreed, and in a way that simulates end use earthing methods. For chargeability tests on floor coverings that will be installed without specific earth connections, groundable points shall not be attached to the test specimen.

Sensible electrical resistance measurements cannot be made in the laboratory on floor coverings that will be installed without specific earth connections. Measurement of the electrical resistance of footwear and flooring in combination with a person shall only be made on such floor coverings once installed.

The test specimen shall be mounted or loose-laid on nominal 6 mm tempered or standard hardboard, according to the manufacturer's instructions or as otherwise agreed. When mounted or loose-laid on the hardboard, there shall be a gap of at least 10 mm between each edge of the specimen and the corresponding edge of the hardboard.

The hardboard shall be clean, smooth and have a point-to-point resistance of greater than $10^{11}$ Ω when tested under the environmental conditions specified in Clause 5 and according to the test method specified in IEC 61340-4-1.

Floor finishes shall be tested in conjunction with floor coverings representative of the type for which the finishes are intended. The floor covering shall be prepared and mounted as detailed above. The finish under test shall then be applied to the floor covering in accordance with the manufacturer's instructions or as otherwise agreed. In cases where the manufacturer recommends the use of additional groundable points on the surface of the floor covering, these shall be installed as per the manufacturer's instructions prior to application of the finish, or as otherwise agreed.

Test results can be significantly affected by the presence of dirt or other contaminants on the surface of floor coverings. Any cleaning performed on floor coverings shall be carried out as per the manufacturer's instructions prior to conditioning.

Generally, tests are performed on floor coverings as received, i.e. with finishes and special treatments as appropriate. If the permanency of such finishes and treatments is being investigated, specimens may be submitted to a cleaning process or to practical wear conditions before testing, either for laboratory evaluations or on installed floor coverings.

## 6.2 Cleaning of footwear for laboratory evaluations and for test on installed floor coverings

### 6.2.1 General

Test results can be significantly affected by the presence of dirt or other contaminants on the soles of footwear. Any cleaning performed on footwear prior to and during testing shall be as follows. If it is required to test footwear "as received" or "as used", then cleaning shall be omitted from the test procedure.

### 6.2.2 Cleaning materials

#### 6.2.2.1 Sandpaper

P280 grade sandpaper.

#### 6.2.2.2 Scoured cotton cloth

The cloth shall be free from finish and detergent.

#### 6.2.2.3 Ethanol

Concentration ≥ 95 %.

### 6.2.3 Cleaning procedure

Scrub the sole of each item of footwear using a piece of scoured cotton (6.2.2.2) wetted with ethanol (6.2.2.3) to remove any chemical substance from the surface.

When using ethanol, personal protective equipment is advised.

When the soles are dry, abrade with a fine sandpaper (6.2.2.1), then remove the dust using a dry piece of scoured cotton. Finally, scrub the sole of each item of footwear again using a fresh piece of scoured cotton wetted with ethanol. This final stage only shall be repeated between each set of measurements. Ensure soles are dry before making measurements.

## 6.3 Measurement of electrical resistance

### 6.3.1 Apparatus

#### 6.3.1.1 Resistance measuring apparatus

##### 6.3.1.1.1 General

A self-contained DC resistance meter (ohmmeter) or DC power supply and current meter in the appropriate configuration for resistance measurement, with a ±10 % accuracy, and fulfilling the following requirements.

For safety reasons, it should be ensured that the maximum current of the measuring circuit does not exceed 5 mA.

#### 6.3.1.1.2 For laboratory evaluations

The apparatus shall have a circuit voltage while under load of 10 V ± 0,5 V for resistance below $1,0 \times 10^6$ Ω, and 100 V ± 5 V for resistance of $1,0 \times 10^6$ Ω and above. The measuring range of the apparatus shall be at least one order of magnitude either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures unintended earth paths do not influence measurements.

#### 6.3.1.1.3 For acceptance testing

The apparatus shall have an open circuit voltage of 10 V ± 0,5 V for resistance below $1,0 \times 10^6$ Ω, and 100 V ± 5 V for resistance of $1,0 \times 10^6$ Ω and above. The measuring range of the apparatus shall be at least one order of magnitude either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures unintended earth paths do not influence measurements.

Laboratory evaluation equipment as specified in 6.3.1.1.2 may also be used for acceptance testing. In case of dispute, only a laboratory evaluation apparatus shall be used.

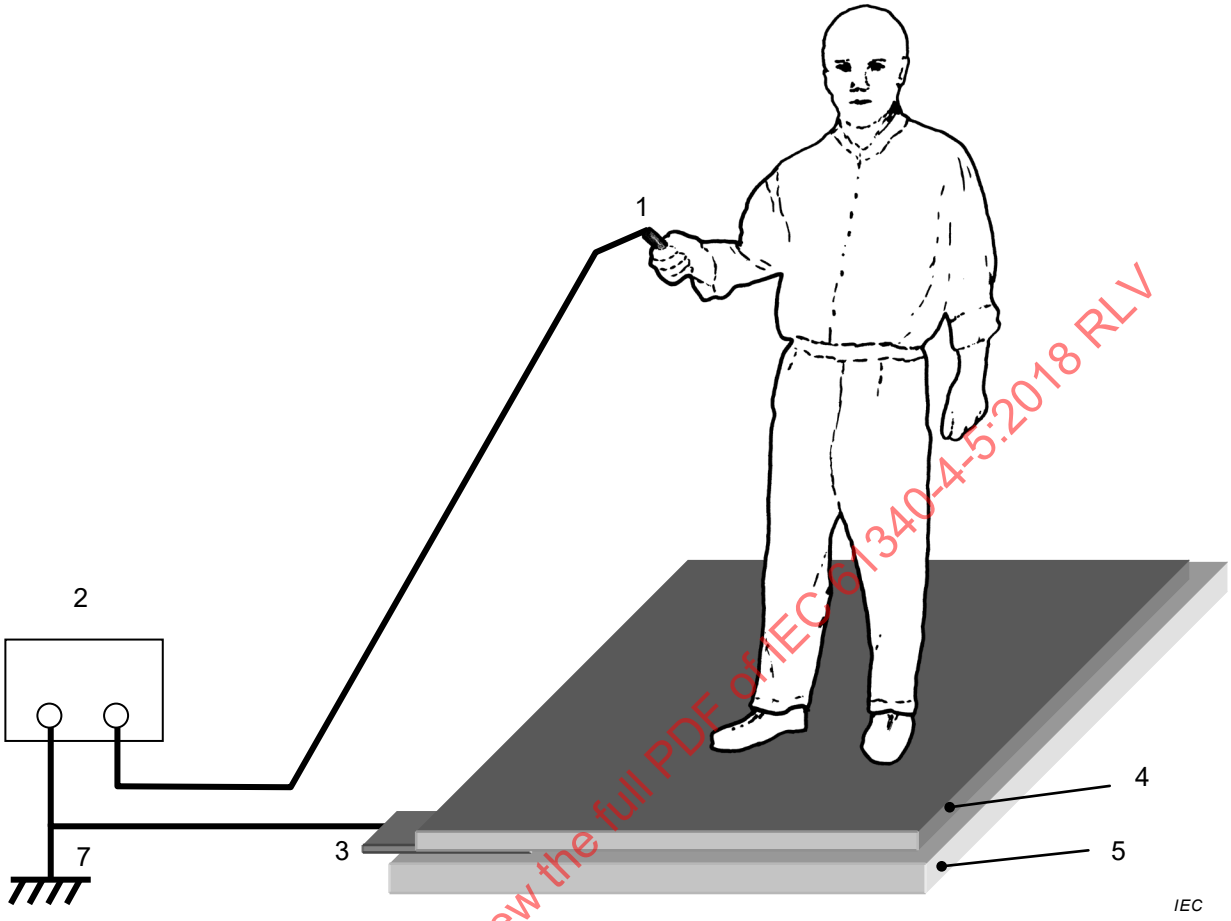
### 6.3.1.2 Hand-held electrode

A stainless steel round stock or tube, approximately 25 mm diameter and 75 mm in length with a banana plug receptacle or screw connector attached to one end of the cylinder.

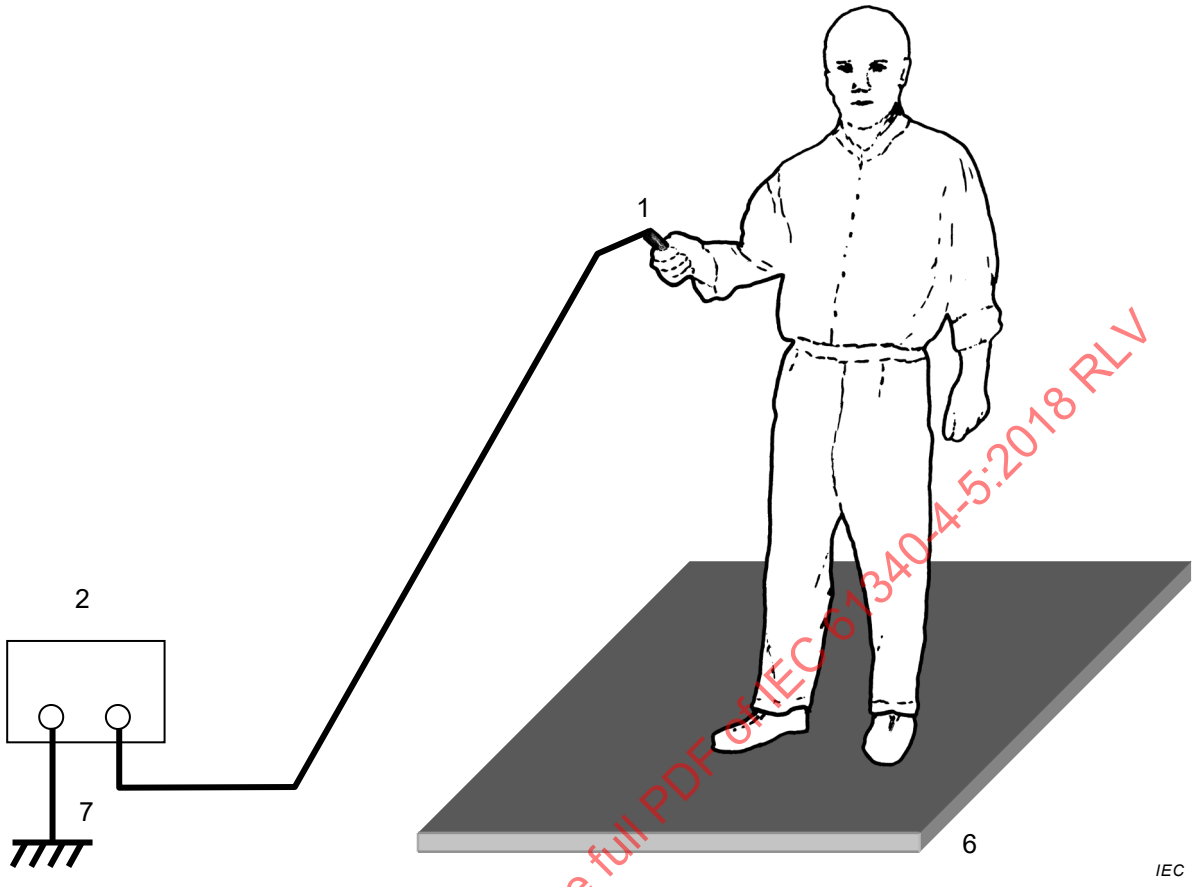
### 6.3.2 Test procedure

Wear the test footwear on both feet for at least 10 min prior to the commencement of testing.

Connect the negative lead of the resistance measuring apparatus (6.3.1.1) to the groundable point of the test floor covering (laboratory tests) or to earth (tests on installed floor coverings). Connect the other lead to the hand-held electrode (6.3.1.2). Stand with both feet on the test floor covering and firmly grasp the hand-held electrode – see Figure 1 a) and Figure 1 b).




**a) – Laboratory set-up**




b) – Test set-up for installed flooring

**Key**

1 hand-held electrode (6.3.1.2)
2 resistance measuring apparatus (6.3.1.1)
3 groundable point (6.1)
4 floor covering under test
5 support material (6.1)
6 installed flooring
7 building earth

**Figure 1 – Set-ups for measuring electrical resistance of footwear and flooring in combination with a person**



Starting with the voltage set to 10 V, take a reading of the resistance 15 s ± 2 s after applying the test voltage. If the value exceeds $10^6\ \Omega$, select 100 V and repeat the measurement. Record the reading which matches the voltage and resistance range specified in 6.3.1.1. If the resistance falls below $10^6\ \Omega$ when making a measurement using 100 V, this reading shall be the one recorded.

Repeat the measuring procedure with only the left foot in contact with the test floor covering and with the right foot held in the air about 150 mm above the floor covering.

Repeat the measuring procedure with only the right foot in contact with the test floor covering and with the left foot held in the air about 150 mm above the floor covering.

For laboratory tests, measurements shall be made at five different locations distributed evenly over the area of the test specimen.

For tests on installed floor coverings, at least five measurements shall be made for each floor covering material. For large floor areas, at least five measurements per 500 $m^2$ of each floor covering material shall be made. Where there is evidence of wear, chemical or water spillage or visible dirt, then at least three measurements shall be made on such affected areas.

### 6.4 Measurement of chargeability

#### 6.4.1 Apparatus

##### 6.4.1.1 Body voltage measuring system

An electrostatic voltmeter, a hand-held electrode (6.3.1.2) and an autographic recorder meeting the following requirements:

a) input resistance of electrostatic voltmeter ≥ $10^{14}$ Ω;

b) input capacitance of electrostatic voltmeter, hand-held electrode and connecting leads ≤ 30 pF;

c) system response time shall be such that full-scale deflection on the recorder is reached within 0,25 s;

d) system resolution shall be at least one-tenth of the voltage level concerned; for example, for the comfort of personnel, body voltages of several kilovolts are considered, in which case the resolution of the measuring system shall be 0,1 kV; in the electronics industry, body voltages of 100 V are considered, in which case the resolution of the measuring system shall be 10 V;

e) system accuracy of ±10 %.

##### 6.4.1.2 Ionizing source

Capable of eliminating electrostatic charge from the surface of footwear and floor covering specimens.

All relevant safety precautions and regulations should be observed.

#### 6.4.2 Test procedure

##### 6.4.2.1 General

For laboratory evaluations on floor coverings that will be installed with specific earth connections, measurements shall be made on specimens fitted with suitable groundable points (see 6.1) and connected to earth. When carrying out laboratory evaluations on floor coverings that will be installed without specific earth connections, groundable points shall not be attached to test specimens, which shall remain isolated from earth whilst measurements are made.

For laboratory evaluations, the procedures described in 6.4.2.2 to 6.4.2.5 inclusive shall be carried out three times for each combination of footwear and floor covering to be tested.

For tests on installed floor coverings, the procedures described in 6.4.2.2 to 6.4.2.5 inclusive shall be carried out at least five times for each combination of footwear and floor covering to be tested. For large floor areas, procedures 6.4.2.2 to 6.4.2.5 inclusive shall be carried out at least five times per 500 $m^2$ of each floor covering material. Where there is evidence of wear, chemical or water spillage or visible dirt, then at least three of these measurements shall be made on such affected areas. For verification of the body voltage measurement system, see Annex A.

##### 6.4.2.2 Discharging test items

Eliminate any residual electrostatic charge on the footwear and floor covering using the ionizing source (6.4.1.2). Loose-laid specimens for laboratory evaluations shall be discharged

on both sides before re-positioning them carefully without sliding on the support material (6.1).

#### 6.4.2.3 Donning footwear

The operative shall don the footwear whilst sitting on a nearby seat. The operative shall be earthed and the soles of the footwear discharged using the ionizing source (6.4.1.2). The operative then stands on the floor covering without sliding.

Footwear shall be fastened securely as in normal use.

#### 6.4.2.4 Zeroing the system

The operative shall take hold of the hand-held electrode connected to the body voltage measuring system (6.4.1.1) and shall momentarily touch an earth bonding point to zero the system.

#### 6.4.2.5 Walking

There are many ways one could choose to walk. The walking pattern described here simulates forward and backward movements typical of workers in a number of disciplines. However, other walking patterns are acceptable (see Annex B) assuming that they simulate actual walking patterns in the intended installation.

Users of this test method should choose a walking pattern typical of the majority of the workers within the intended installation.

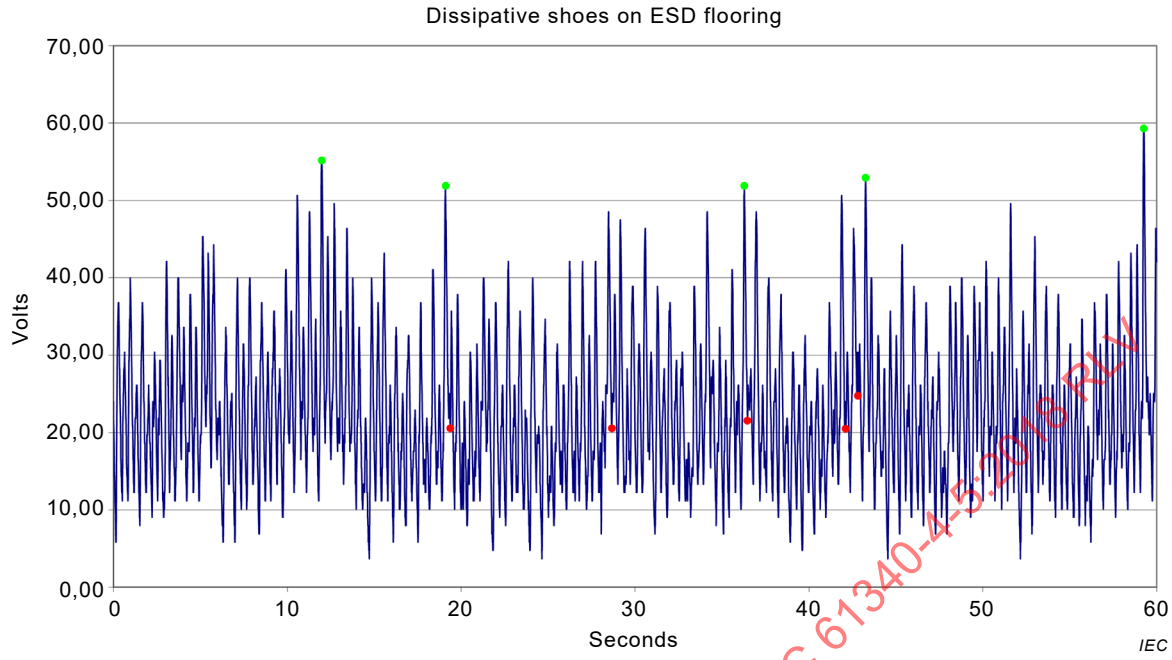
If no other walking pattern is specified, the following shall be used.

The operative shall walk on the floor covering at a rate of two steps per second whilst maintaining the body facing in the same direction throughout the test. The operative shall cover as much of the test area as possible by walking forwards and backwards, but avoiding scuffing or pivoting. The test area is the whole area of the floor covering specimen for laboratory evaluations, or an equivalent size area of installed flooring. The stepping action shall maintain the sole of the footwear parallel to the floor covering specimen at all times while lifting the footwear between 50 mm and 80 mm. For laboratory evaluations, the operative shall not come closer than 0,5 m to the wall, or any object in the room, and shall continue walking until the peak voltage ceases to rise, or for 60 s, whichever occurs first.

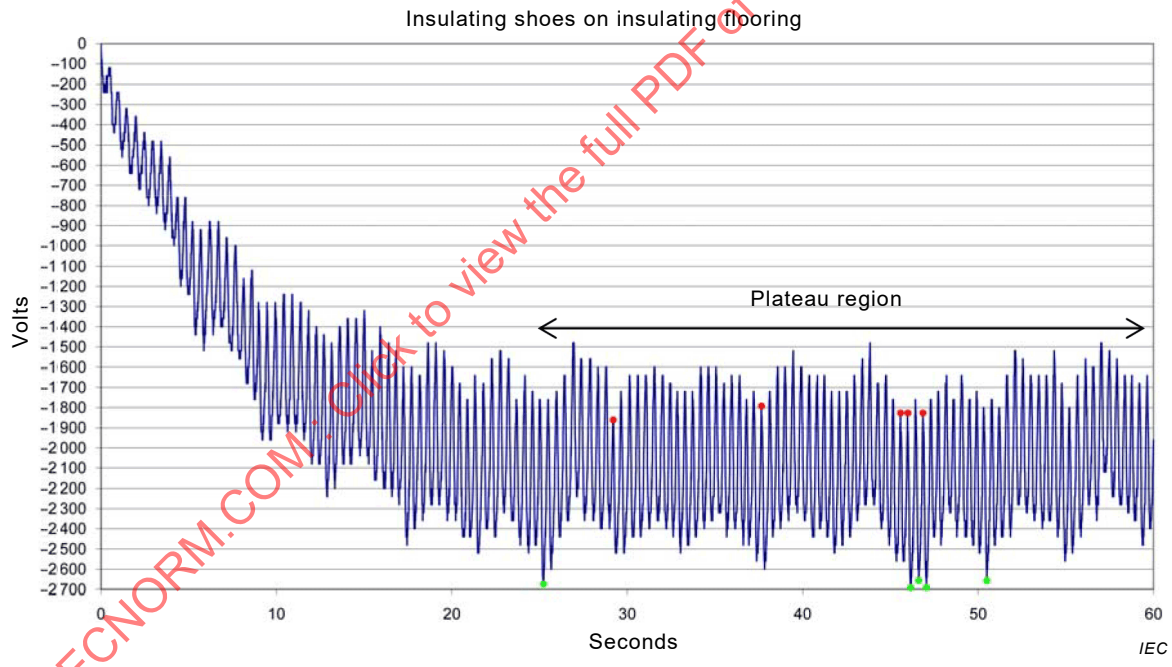
After walking, the operative shall remove the footwear and, if required, clean the soles (6.2).

#### 6.4.3 Calculation and expression of results

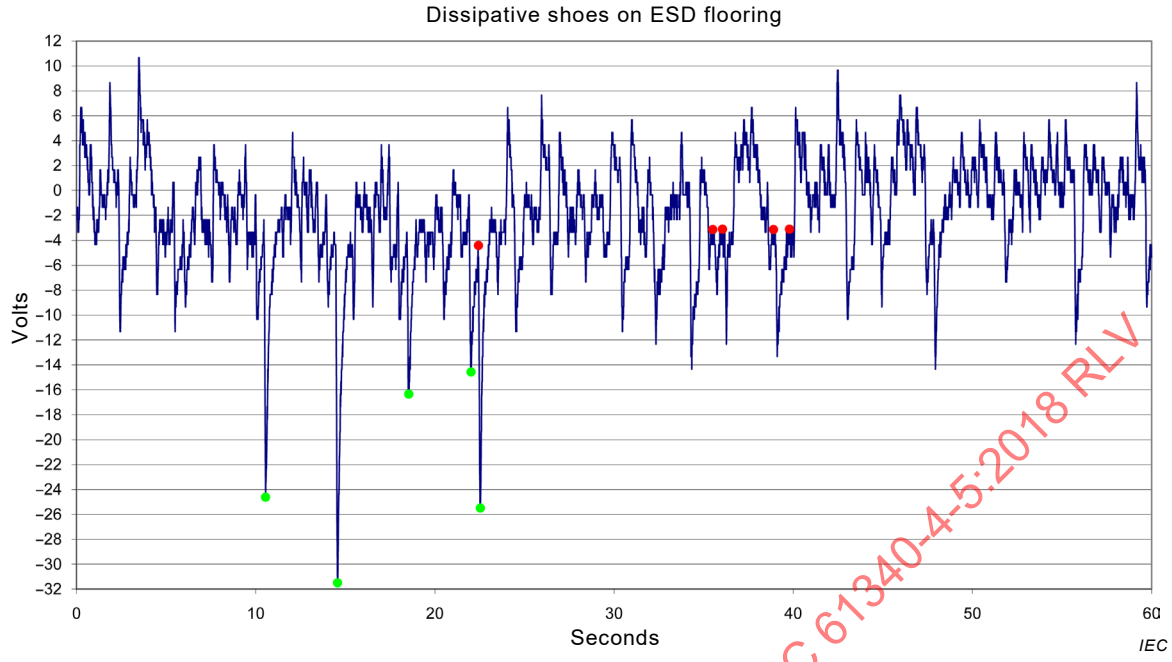
For each walking measurement, the arithmetic mean of the five highest valleys and the arithmetic mean of the five highest peaks shall be calculated (see Figure 2). The results shall be expressed in relation to the voltage of concern and the resolution of the measuring system. For example, for personnel comfort, the results may be expressed in kilovolts to the nearest 0,1 kV, or for the electronics industry, the results may be expressed in volts to the nearest 10 V.




**a) – Positive polarity body voltage recording**




**b) – Negative polarity body voltage recording**




**c) – Body voltage recording with positive and negative data points**

**Key**

- five highest peaks
- five highest valleys

**Figure 2 – Examples of body voltage recordings showing points used in calculating mean values**

In footwear/flooring systems where there is minimal charge dissipation from the operator, average body voltage tends to increase at the start of the test but after some time reaches a plateau, as shown in the example in Figure 2 a) and Figure 2 b). In cases such as this, the highest valleys and highest peaks means shall be taken from the plateau region.

In footwear/flooring systems where minimal charge is generated, or in which there is significant charge dissipation, the measured body voltage can change polarity, as shown in the example in Figure 2 c). It is clear in this example that the magnitude of the negative peaks is greater than the magnitude of the positive peaks. Therefore, the five highest negative valleys and five highest negative peaks shall be taken.

In cases where there are both positive and negative data points in one recording, and there is no clear difference in the magnitude of positive and negative data point, arithmetic means shall be calculated for the five highest positive valleys, the five highest positive peaks, the five highest negative valleys and the five highest negative peaks.

## 7 Test report

The test report shall include at least the following information:

a) reference to this document;

b) all the information necessary for complete identification of test samples;

c) identification of instrumentation used;

d) date of testing;

e) atmosphere for pre-conditioning, conditioning and testing as follows:

  - for laboratory evaluations: temperature and relative humidity during pre-conditioning (if used), conditioning and testing, and the duration of any pre-conditioning and conditioning;
  - for tests on installed floors: temperature and relative humidity during testing;

f) details of any cleaning or finishing procedures for both footwear and floor covering materials;

g) details of procedures and materials used to fix specimens to hardboard;

h) details of procedures and materials used to fix groundable points to specimens;

i) type of measurement: electrical resistance or chargeability;

j) for chargeability, the pattern and rate of walking;

k) all individual results for each type of measurement on each specimen;

l) average of all results for each type of measurement on each sample;

m) any operations not specified in this document, or in any standard to which normative reference is made, or regarded as optional, which might have affected the results.

# Annex A
(normative)

# Method of verification of body voltage measuring system

## A.1 Static verification

The body voltage measuring system zero voltage point is checked by connecting the hand-held electrode to an earth bonding point. After being disconnected from the earth bonding point, the system is then checked by connecting the hand-held electrode to an output terminal of a stable DC voltage supply. At least three voltage levels of both positive and negative polarity shall be confirmed, for example 1 kV, 2 kV and 5 kV; or 100 V, 200 V and 500 V.

## A.2 Dynamic verification

### A.2.1 General

The body voltage measuring system is verified by a dynamic method using either a signal generator or a manual switching procedure.

### A.2.2 Signal generator method

The hand-held electrode is connected to the output terminal of a signal generator with an output amplitude appropriate to the body voltages to be measured, for example 1 kV ± 0,1 kV or 100 V ± 10 V. The output frequency shall be 2 Hz with a rise/fall time of not greater than 2 ms. The procedure is carried out with both positive and negative polarity. Any overshoot or undershoot in the autographic recording of the voltage shall not exceed 10 % of the applied voltage amplitude.

### A.2.3 Manual switching method

The voltage supply for this procedure shall have a suitable over-current protection circuit. Additional protection for the operative may be obtained by placing a high voltage tolerant resistor of 1 MΩ to 10 MΩ in series with the output of the voltage supply.

An operative gripping the hand-held electrode in one hand stands on an insulating platform of volume resistivity ≥ $10^{14}$ Ωm, measured according to IEC 62631-3-1. With the other hand, the operative alternately touches an output terminal from a stable DC voltage supply and then an earth bonding point. The output from the voltage supply is set as appropriate to the body voltages to be measured, for example 1 kV ± 0,1 kV or 100 V ± 10 V. The operative charges and discharges at a rate of two cycles per second. A metronome is used to provide the cycle for switching. The procedure is carried out with both positive and negative polarity. Any overshoot or undershoot in the autographic recording of the voltage shall not exceed 10 % of the applied voltage amplitude.

# Annex B
(informative)

# Alternative walking pattern

## B.1 Measurement of chargeability

## B.2 Walking

The operative shall walk on the floor covering at a rate of two steps per second whilst maintaining the body facing in the same direction throughout the test. The following walking pattern is followed (see Figure B.1).

1) The operative shall begin (starting position) with the left foot at position 5 and right foot at position 6.
2) From this position, the operative will move the left foot to position 1 and right foot to position 2.
3) Without pausing, the operative will move the left foot from position 1 to position 3 and right foot from position 2 to position 4.
4) Without pausing, the operative will move the left foot from position 3 to position 5 and right foot from position 4 to position 6.
5) At this position (starting position), the operative will pause for 2 seconds.
6) Repeat steps 1 through 6 for ten (10) cycles.

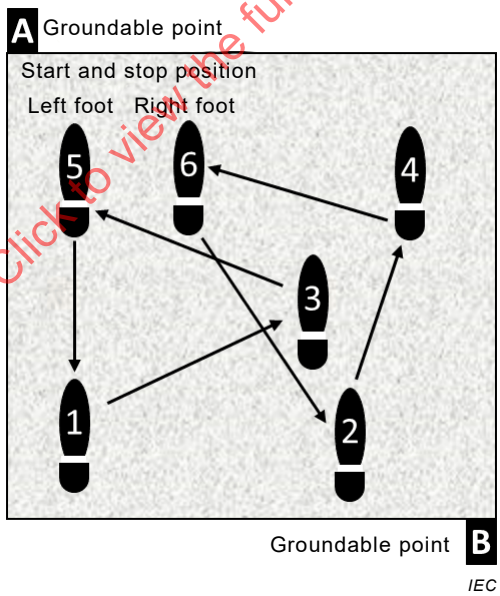



**Figure B.1 – Description of walking pattern**

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

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# SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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# ÉLECTROSTATIQUE –

# 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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La Norme internationale IEC 61340-4-5 a été établie par le comité d'études 101 de l'IEC: Electrostatique.

Cette deuxième édition annule et remplace la première édition parue en 2004. Cette édition constitue une révision technique.

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

a) les références normatives ont été mises à jour;

b) la Figure 2 a été améliorée et développée afin d'inclure des exemples d'enregistrement de la tension du corps, et du texte a été ajouté pour expliquer la manière d'interpréter les enregistrements;

c) un modèle de marche alternatif a été ajouté dans une annexe informative.

Le texte de cette norme internationale est issu des documents suivants:

| FDIS | Rapport de vote |
|---|---|
| 101/545/FDIS | 101/552/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 internationale.

Ce document a été rédigé 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 ce document 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, le document sera

- reconduit,
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# ÉLECTROSTATIQUE –

# 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

## 1 Domaine d'application

La présente partie de l'IEC 61340 spécifie des méthodes d'essai pour l'évaluation de la protection électrostatique fournie par un système de chaussures et de revêtement de sol par rapport à une personne.

Les résultats des essais ne sont valides que pour la combinaison spécifique de chaussures et de revêtement soumise à l'essai.

Ces méthodes d'essai ne sont pas destinées à la qualification des produits individuels.

## 2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. 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 62631-3-1, *Propriétés diélectriques et résistives des matériaux isolants solides – Partie 3-1: Détermination des propriétés résistives (méthodes en courant continu) – Résistance transversale et résistivité transversale – Méthode générale*

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*

ISO 1957, *Revêtements de sol textiles fabriqués à la machine – Sélection et prélèvement des éprouvettes en vue des essais physiques*

## 3 Termes et définitions

Aucun terme n'est défini dans le présent document.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse http://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse http://www.iso.org/obp

## 4 Principe

Un système est caractérisé en mesurant la résistance électrique et l'aptitude à la charge des chaussures et des revêtements de sol par rapport à une personne. L'aptitude à la charge est déterminée en utilisant un essai de marche.

AVERTISSEMENT – Les procédures d'essai décrites dans le présent document peuvent exposer le personnel à des conditions électriques potentiellement dangereuses. Il convient de recourir à des pratiques appropriées de réduction des risques électriques et de suivre les instructions adaptées pour relier l'équipement utilisé à la terre pendant les essais.

## 5 Atmosphère pour conditionnement et essais

Les exigences suivantes annulent toutes les autres spécifications concernant l'atmosphère pour le conditionnement et les essais qui peuvent être données dans un ou plusieurs documents cités en référence dans le présent document.

Sauf accord contraire, l'atmosphère pour le conditionnement et les essais dans le cadre des évaluations en laboratoire doit présenter une température de (23 ± 2) °C et une humidité relative de (12 ± 3) %. Le temps de conditionnement avant les essais doit être d'au moins 48 h. Les revêtements de sol en textile sont de préférence préconditionnés pendant au moins 24 h à (20 ± 2) °C et avec une humidité relative de (65 ± 3) % avant le conditionnement et les essais.

Pendant le préconditionnement et le conditionnement, les éprouvettes doivent être placées sur une baie ou sur un autre support adapté qui permet une libre circulation de l'air autour d'elles.

Lorsque des essais sont effectués dans des conditions non contrôlées, par exemple des essais sur des sols finis, la température ambiante et l'humidité relative au moment de la mesure doivent être enregistrées.

## 6 Méthodes d'essai des chaussures et des revêtements de sol par rapport à une personne

### 6.1 Echantillonnage du revêtement de sol et préparation de l'éprouvette pour les essais de laboratoire

L'échantillonnage et le choix des éprouvettes pour les essais en laboratoire doivent être réalisés conformément aux principes spécifiés dans l'ISO 1957. Pour les besoins du présent document, les principes généraux de l'ISO 1957 s'appliquent à tous les types de revêtements de sol. Prélever sur chaque échantillon une éprouvette mesurant (2 ± 0,1) m × (1 ± 0,1) m ou, dans le cas de dalles, choisir suffisamment de dalles et/ou de parties de dalles pour réaliser une zone éprouvette unique de (2 ± 0,1) m × (1 ± 0,1) m.

Pour les essais sur les revêtements de sol qui sont installés avec des liaisons à la terre spécifiques, un point pouvant être relié à la terre doit être fixé à l'éprouvette conformément aux instructions du fabricant ou à tout autre accord conclu d'une manière qui simule les méthodes de mise à la terre en utilisation finale. Pour les essais de l'aptitude à la charge sur les revêtements de sol qui sont installés sans liaisons à la terre spécifiques, des points de mise à la terre ne doivent pas être fixés à l'éprouvette.

Des mesures de résistance électrique sensibles ne peuvent pas être réalisées en laboratoire sur les revêtements de sol qui sont installés sans liaisons à la terre spécifiques. Des mesures de la résistance électrique des chaussures et des revêtements de sol par rapport à une personne ne doivent être réalisées sur de tels revêtements de sol qu'après installation.

L'éprouvette doit être montée ou posée librement sur un panneau dur normal ou trempé de dimension nominale de 6 mm, conformément aux instructions du fabricant ou à tout autre accord conclu. Qu'elle soit montée ou posée librement sur le panneau dur, il doit y avoir un espace d'au moins 10 mm entre chaque bord de l'éprouvette et le bord correspondant du panneau dur.

Le panneau dur doit être propre, lisse et avoir une résistance point à point supérieure à $10^{11}\ \Omega$ lorsque l'essai est effectué dans les conditions environnementales spécifiées à l'Article 5 et conformément à la méthode d'essai spécifiée dans l'IEC 61340-4-1.

Les finitions des sols doivent être soumises aux essais avec des revêtements de sol représentatifs du type pour lequel ces finitions sont prévues. Le revêtement de sol doit être préparé et monté comme indiqué plus haut en détails. La finition en essai doit ensuite être appliquée au revêtement conformément aux instructions du fabricant ou selon tout autre accord conclu. Lorsque le fabricant recommande l'utilisation de points supplémentaires de mise à la terre sur la surface du revêtement de sol, ceux-ci doivent être installés selon les instructions du fabricant avant application de la finition ou selon tout autre accord conclu.

Les résultats d'essai peuvent être affectés de manière importante par la présence de saleté ou d'autres contaminants sur la surface des revêtements de sol. Tout nettoyage réalisé sur les revêtements de sol doit être effectué selon les instructions du fabricant avant le conditionnement.

Généralement, les essais sont réalisés sur les revêtements de sol tels qu'ils sont reçus, c'est-à-dire avec les finitions et traitements spéciaux, le cas échéant. Si la permanence de telles finitions et traitements est étudiée, les éprouvettes peuvent être soumises, avant l'essai, à un processus de nettoyage ou à des conditions d'usure comme ce qui existe dans la pratique, soit pour les évaluations en laboratoire, soit sur les revêtements de sol finis.

## 6.2 Nettoyage des chaussures pour les évaluations de laboratoire et pour les essais sur les revêtements de sol finis

### 6.2.1 Généralités

Les résultats d'essai peuvent être affectés de manière importante par la présence de saleté ou d'autres contaminants sur les semelles des chaussures. Tout nettoyage des chaussures avant et pendant les essais doit être réalisé comme suit. S'il est exigé que les chaussures subissent l'essai "dans l'état de réception" ou "telles qu'elles sont utilisées", alors le nettoyage doit être ignoré dans la procédure d'essai.

### 6.2.2 Matériaux de nettoyage

#### 6.2.2.1 Papier abrasif

Papier abrasif P280.

#### 6.2.2.2 Tissu de coton décontaminé

Ce tissu ne doit pas présenter de traces de finition ou de détergent.

#### 6.2.2.3 Ethanol

Concentration ≥ 95 %.

### 6.2.3 Procédure de nettoyage

Frotter la semelle de chaque chaussure au moyen d'une pièce de coton décontaminée (6.2.2.2) imbibée d'éthanol (6.2.2.3) afin d'éliminer toute substance chimique de la surface.

Lors de l'utilisation d'éthanol, un équipement de protection individuelle est conseillé.

Lorsque les semelles sont sèches, les frotter avec un papier abrasif fin (6.2.2.1), puis retirer la poussière avec une pièce de coton décontaminée et sèche. Enfin, frotter de nouveau la semelle de chaque chaussure avec une nouvelle pièce de coton décontaminé imbibée

d'éthanol. Seule cette dernière étape doit être répétée entre chaque série de mesures. S'assurer que les semelles sont sèches avant de réaliser les mesures.

### 6.3 Mesure de la résistance électrique

#### 6.3.1 Appareil

##### 6.3.1.1 Appareillage de mesure de la résistance

###### 6.3.1.1.1 Généralités

Un appareil de mesure de la résistance en courant continu autonome (ohmmètre) ou une alimentation en courant continu et un compteur dans la configuration appropriée pour la mesure de résistance, avec une précision de ±10 % et capable de remplir les exigences suivantes.

Pour des raisons de sécurité, il convient de s'assurer que le courant maximal du circuit de mesure ne dépasse pas 5 mA.

###### 6.3.1.1.2 Pour les évaluations de laboratoire

L'appareillage doit présenter une tension de circuit en charge de 10 V ± 0,5 V pour une résistance inférieure à 1,0 × $10^6$ Ω, et de 100 V ± 5 V pour une résistance de 1,0 × $10^6$ Ω et supérieure. La plage de mesure de l'appareillage doit être au moins d'un ordre d'amplitude de chaque côté de la plage prévue de la résistance mesurée. L'appareillage doit être utilisé de manière à assurer que des cheminements à la terre non voulus n'influencent pas les mesures.

###### 6.3.1.1.3 Pour les essais de réception

L'appareillage doit présenter une tension de circuit ouvert de 10 V ± 0,5 V pour une résistance inférieure à 1,0 × $10^6$ Ω, et de 100 V ± 5 V pour une résistance de 1,0 × $10^6$ Ω et supérieure. La plage de mesure de l'appareillage doit être au moins d'un ordre d'amplitude de chaque côté de la plage prévue de la résistance mesurée. L'appareillage doit être utilisé de manière à assurer que des cheminements à la terre non voulus n'influencent pas les mesures.

L'appareillage d'évaluation de laboratoire spécifié en 6.3.1.1.2 peut également être utilisé pour les essais de réception. En cas de litige, seul l'appareillage d'évaluation de laboratoire doit être utilisé.

##### 6.3.1.2 Electrode tenue à la main

Une barre ronde ou un tube en acier inoxydable, d'environ 25 mm de diamètre et de 75 mm de longueur avec une embase pour fiche banane ou un connecteur à vis fixé à une extrémité du cylindre.

#### 6.3.2 Procédure d'essai

Porter les chaussures d'essai aux deux pieds pendant au moins 10 min avant de commencer les essais.

Brancher le fil négatif de l'appareil de mesure de la résistance (6.3.1.1) au point qui peut être relié à la terre du revêtement de sol d'essai (essais de laboratoire) ou à la terre (essais sur les revêtements de sol finis). Brancher l'autre fil à l'électrode tenue à la main (6.3.1.2). Se tenir debout avec les deux pieds sur le revêtement de sol d'essai et saisir fermement l'électrode tenue à la main – voir Figure 1 a) et Figure 1 b).