

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



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

**Electrostatique –**  
**Partie 4-1: Méthodes d'essai normalisées pour des applications spécifiques –**  
**Résistance électrique des revêtements de sol et des sols finis**

<https://standards.iteh.ai/catalog/standards/iec/7a7888c1-3d27-4361-b3d-fd1078d60b77/iec-61340-4-1-2003>





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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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**ELECTROSTATICS –**

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

FOREWORD

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**IEC 61340-4-1 edition 2.1 contains the second edition (2003-12) [documents 101/162/FDIS and 101/170/RVD] and its amendment 1 (2015-04) [documents 101/461/FDIS and 101/469/RVD].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through. A separate Final version with all changes accepted is available in this publication.**

International Standard IEC 61340-4-1 has been prepared by IEC technical committee 101:Electrostatics.

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

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## ELECTROSTATICS –

### Part 4-1: Standard test methods for specific applications – Electrical resistance of floor coverings and installed floors

#### 1 Scope

This part of IEC 61340 specifies test methods for determining the electrical resistance of all types of floor coverings and installed floors with resistance to ground, point-to-point resistance and vertical resistance of between  $10^4 \Omega$  and  $10^{13} \Omega$ . Laboratory evaluations carried out under controlled environmental conditions can be used for classification or quality control purposes. Tests on installed floors under uncontrolled ambient conditions can be used to determine correct installation or as part of an ongoing system verification.

**NOTE** Although this standard does not include requirements for personal safety, attention is drawn to the fact that all concerned might need to comply with the relevant local statutory requirements regarding the health and safety of all persons in all places of work that use floor coverings defined by the test method of this standard.

#### 2 Normative references

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

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

#### 3 Terms and definitions

[IEC 61340-4-1:2003](https://standards.iteh.ai/catalog/standards/iec/7a7888c1-3d27-4361-b3d-fd1078d60b77/iec-61340-4-1-2003)

For the purposes of this document, the following terms and definitions apply.

##### 3.1

##### **acceptance testing**

testing carried out on flooring immediately after installation or on production samples prior to initial acceptance by the customer

##### 3.2

##### **geometric mean**

$n$ th root of the product of  $n$  numbers,  $\sqrt[n]{y_1 \cdot y_2 \cdot \dots \cdot y_n}$

##### 3.3

##### **groundable point**

attachment to a floor covering that facilitates its connection to ground

##### 3.4 **insulating material**

material having a vertical resistance greater than  $10^{14} \Omega$

##### 3.5

##### **laboratory evaluations**

measurements carried out under controlled laboratory conditions

**3.6****resistance to ground**

electrical resistance measured between ground or a groundable point and a single electrode placed on the use-surface

**3.7****point-to-point resistance**

electrical resistance measured between two electrodes placed on the use-surface

**3.8****vertical resistance**

electrical resistance measured between **the counter-electrode on** the back of the material under test and a single electrode placed on the use-surface

**4 Principle**

The resistance across the use-surface of the test material and through the test material is measured using a high-resistance meter, or other suitable equipment. Point-to-point resistance measurements are appropriate for evaluating a floor covering's ability to conduct charge across its use-surface or to act as a charge sink. Measurements of resistance through floor coverings, i.e. resistance to ground and vertical resistance, are appropriate for evaluating their ability to conduct charge from the use-surface or from conductors in contact with the use-surface, to a charge sink beneath the floor covering. A simulation of the resistance-to-ground measurement is made under laboratory conditions by attaching a groundable point to the back of the floor covering under test.

**5 Apparatus****5.1 Resistance measuring apparatus**

This apparatus consists of a self-contained resistance meter (ohmmeter) or power supply and current meter in the appropriate configuration for resistance measurement, with a  $\pm 10\%$  accuracy, and capable of the following requirements.

**5.1.1 Laboratory evaluations**

The apparatus shall have a circuit voltage while under load of

- $10\text{ V} \pm 0,5\text{ V}$  for resistance below  $1,0 \times 10^6\ \Omega$
- $100\text{ V} \pm 5\text{ V}$  for resistance between  $1,0 \times 10^6\ \Omega$  and  $1,0 \times 10^{11}\ \Omega$
- $500\text{ V} \pm 25\text{ V}$  for resistance above  $1,0 \times 10^{11}\ \Omega$

The measuring range of the apparatus shall be at least one order of magnitude on either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures that unintended ground paths do not influence measurements.

**5.1.2 Acceptance testing**

A laboratory evaluation apparatus shall be used for acceptance testing or an apparatus with an open-circuit voltage of

- $10\text{ V} \pm 0,5\text{ V}$  for resistance below  $1,0 \times 10^6\ \Omega$
- $100\text{ V} \pm 5\text{ V}$  for resistance between  $1,0 \times 10^6\ \Omega$  and  $1,0 \times 10^{11}\ \Omega$
- $500\text{ V} \pm 25\text{ V}$  for resistance above  $1,0 \times 10^{11}\ \Omega$ .

The measuring range of the apparatus shall be at least one order of magnitude on either side of the expected range of resistance being measured. The apparatus shall be used in a manner that ensures that unintended ground paths do not influence measurements.

In case of dispute, laboratory evaluation apparatus shall be used.

## 5.2 Measuring electrodes

The measuring electrodes consist of two cylindrical metal electrodes (preferably stainless steel) with terminals for connecting to the resistance measuring apparatus. Examples of suitable electrodes are shown in Figure 1. Each electrode shall have a flat circular contact area of  $65 \text{ mm} \pm 5 \text{ mm}$  in diameter. For measurements on hard, non-conformable surfaces, the contact area shall be a conductive rubber pad with a Shore A durometer hardness of  $60 \pm 10$ . The contact resistance of each measuring electrode fitted with a conductive rubber pad shall be less than  $1\,000 \, \Omega$ , measured by placing the measuring electrode directly on the counter-electrode (see 5.3). For conformable surfaces, textile floor coverings, for example, the conductive rubber pad need not be used, the contact area then being the bottom surface of the metal electrode. The total mass of each measuring electrode shall be either

- a)  $2,5 \text{ kg} \pm 0,25 \text{ kg}$  for measurements on hard, non-conformable surfaces; or
- b)  $5,0 \text{ kg} \pm 0,25 \text{ kg}$  for measurements on all other surfaces.

NOTE A circular disc of insulating material with vertical resistance greater than  $10^{14} \, \Omega$  may be used as a support platform for additional weights (see Figure 1).

## 5.3 Counter-electrode

The counter-electrode consists of a flat stainless steel plate,  $600 \text{ mm} \pm 10 \text{ mm}$  square and of 1 mm (nominal) thickness, with a terminal for connection to the resistance measuring apparatus.

## 5.4 Support plates

For point-to-point resistance measurements, where required (see Clause 6) and resistance to ground measurements: support plates shall be equal in area to the test specimens, of sufficient rigidity to hold specimens together for testing, and made from insulating material with a vertical resistance **at least one order of magnitude greater than the expected value or if the expected value is unknown**, greater than  $10^{14} \, \Omega$ .

For vertical resistance measurements, where required (see Clause 6): flat metal plates, equal in area to the test specimens and of sufficient rigidity to hold specimens together for testing, shall be used.

## 5.5 Insulating plate

For vertical resistance measurements: a flat plate  $640 \text{ mm} \pm 10 \text{ mm}$  square,  $5 \text{ mm} \pm 1 \text{ mm}$  thick, made from insulating material with a vertical resistance greater than  $10^{14} \, \Omega$  shall be used. For point-to-point and resistance to ground measurements: a flat plate  $1\,300 \text{ mm} \pm 10 \text{ mm}$  by  $600 \text{ mm} \pm 10 \text{ mm}$ ,  $5 \text{ mm} \pm 1 \text{ mm}$  thick, made from insulating material with a vertical resistance **at least one order of magnitude greater than the expected value or if the expected value is unknown**, greater than  $10^{14} \, \Omega$  shall be used.

## 6 Sampling for laboratory evaluations

Selection and sampling of test materials shall be carried out according to ISO 1957. Although ISO 1957 is intended for textile floor coverings, its principles are relevant to other types of floor covering.

For vertical resistance measurements, three specimens shall be tested, each being 500 mm ± 50 mm square.

For point-to-point and resistance to ground measurements, two specimens shall be tested, each being 1 200 mm ± 50 mm by 500 mm ± 50 mm. Where directional differences may exist, one specimen shall have its long side parallel to the machine direction and the other specimen with its long side parallel to the cross-direction. For resistance to ground measurements, a groundable point shall be attached to the underside of each specimen according to the manufacturer's instructions or as otherwise agreed.

It may be convenient to use the same specimens for both point-to-point and resistance to ground measurements. If this is the case, the groundable points shall be attached to the specimens but shall remain isolated from ground during point-to-point measurements.

For tiles smaller than the size required for testing, several tiles may be combined together, cutting where necessary to achieve the required area. Support plates (see 5.4) may be required. If so, they shall be attached to the tiles, and the edges of adjacent tiles joined according to the manufacturer's instructions or as otherwise agreed. **If tiles are used to form the test specimen, measurements shall include a test across a minimum of one joint.** Groundable points shall be attached to one or more tiles before application of the support plates, bearing in mind the requirement for a minimum distance of 1 000 mm ± 50 mm between a groundable point and the positions of measuring resistance to ground (see 9.4).

In some cases, it is required to test samples other than tiles fixed to metal support plates using conductive adhesive. In such cases, mounting of the specimens to support plates shall be done according to manufacturer's instructions or as otherwise agreed.

## 7 Preparation of test specimens

If considered necessary, specimens shall be cleaned before conditioning and testing. Cleaning shall be carried out according to the manufacturer's instructions or as otherwise agreed.

Mounting of specimens to support plates, where necessary, shall be done before conditioning and testing.

## 8 Atmosphere for conditioning and testing

Unless otherwise agreed or specified, the atmosphere for conditioning and testing shall be 23 °C ± 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 °C ± 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.

## 9 Test procedures

### 9.1 Cleaning electrodes

Prior to each test sequence, clean the contact area of the measuring and counter-electrodes using a low-linting cloth moistened with either ethanol or propan-2-ol (≥95 % concentration). Allow the surfaces to dry before making measurements.

NOTE Users of this standard should take account of any local regulations governing the handling of solvents.

## 9.2 Point-to-point resistance

For laboratory evaluations, place the test specimen with its use-surface uppermost on the insulating plate (see 5.5). Place the two measuring electrodes (see 5.2) on the test specimen 300 mm ± 10 mm distance centre to centre. If tiles are used to form the test specimen, place the measuring electrodes so that they do not contact joints between adjacent tiles. Ensure that any groundable points attached to the test specimens remain isolated from ground.

For tests on installed floors, the electrodes shall be placed on the floor surface with the same distance between them as for laboratory evaluations.

Connect the measuring electrodes to the resistance measuring apparatus (see 5.1). 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<sup>6</sup> Ω, select 100 V and repeat the measurement. If the value for this second measurement exceeds 10<sup>11</sup> Ω, select 500 V and make a final measurement. Record the reading which matches the voltage and resistance range specified in 5.1, unless either of the following situations occur:

- a) the measured resistance at 10 V is greater than 1,0 × 10<sup>6</sup> Ω and the measured resistance at 100 V is less than 1,0 × 10<sup>6</sup> Ω; or
- b) the measured resistance at 100 V is greater than 1,0 × 10<sup>11</sup> Ω and the measured resistance at 500 V is less than 1,0 × 10<sup>11</sup> Ω.

In which case the resistance measurement made at the higher voltage level shall be recorded.

For laboratory evaluations, repeat the measurement procedure at other positions with the electrodes no closer than 100 mm from any previous measurement position. Measurements shall be made in rectilinear directions, i.e. measurements with the electrodes placed in line parallel to the direction of manufacture and separate measurements with the electrodes in line orthogonal to the direction of manufacture. A total of at least six measurements per specimen shall be made.

For tests on installed floors, the number of measurements shall be chosen so as to be representative of the floor in question, but in any case shall be at least six.

## 9.3 Vertical resistance (laboratory evaluations only)

Place the counter-electrode (see 5.3) on the insulating plate (see 5.5). Place the specimen with its use-surface uppermost on the counter-electrode. Place one measuring electrode (see 5.2) on the test specimen with its centre no closer than 100 mm to the test specimen's edges. If tiles are used to form the test specimen, place the measuring electrode so that it does not contact joints between adjacent tiles.

Connect the measuring and counter-electrode to the resistance measuring apparatus (see 5.1). 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<sup>6</sup> Ω, select 100 V and repeat the measurement. If the value for this second measurement exceeds 10<sup>11</sup> Ω, select 500 V and make a final measurement. Record the reading which matches the voltage and resistance range specified in 5.1, unless either of the following situations occur:

- a) the measured resistance at 10 V is greater than 1,0 × 10<sup>6</sup> Ω and the measured resistance at 100 V is less than 1,0 × 10<sup>6</sup> Ω; or
- b) the measured resistance at 100 V is greater than 1,0 × 10<sup>11</sup> Ω and the measured resistance at 500 V is less than 1,0 × 10<sup>11</sup> Ω.

In this case, the resistance measurement made at the higher voltage level shall be recorded.

Repeat the measurement procedure so that a total of at least six measurements are made on each specimen. The position of the electrode shall be at least 100 mm from any previous measurement position.

#### 9.4 Resistance to ground

For laboratory evaluations, place the test specimen with its use-surface uppermost on the insulating plate (see 5.5). Place one measuring electrode (see 5.2) on the test specimen with its centre no closer than 100 mm to any of the test specimen's edges. If tiles are used to form the test specimen, place the measuring electrode so that it does not contact joints between adjacent tiles.

Connect the measuring electrode and groundable point to the resistance measuring apparatus (see 5.1). Starting with the voltage set to 10 V, take a reading of the resistance  $15 \text{ s} \pm 2 \text{ s}$  after applying the test voltage. If the value exceeds  $10^6 \Omega$ , select 100 V and repeat the measurement. If the value for this second measurement exceeds  $10^{11} \Omega$ , select 500 V and make a final measurement.

Record the reading which matches the voltage and resistance range specified in 5.1, unless either of the following situations occur:

- a) the measured resistance at 10 V is greater than  $1,0 \times 10^6 \Omega$  and the measured resistance at 100 V is less than  $1,0 \times 10^6 \Omega$ ; or
- b) the measured resistance at 100 V is greater than  $1,0 \times 10^{11} \Omega$  and the measured resistance at 500 V is less than  $1,0 \times 10^{11} \Omega$ .

In this case, the resistance measurement made at the higher voltage level shall be recorded.

Repeat the measurement procedure so that a total of at least six measurements are made on each specimen. At least one measurement per specimen shall be made with the electrode positioned directly above the groundable point and one measurement per specimen with the electrode positioned  $1\,000 \text{ mm} \pm 50 \text{ mm}$  from the groundable point. The position of the electrode shall be at least 100 mm from any previous measurement position.

For measurements on installed floors, a measuring electrode is placed on the surface of the floor covering and the resistance measuring apparatus is connected to the electrode and the building ground or other suitable ground point. If the positions of groundable points are known, make at least one measurement with the electrode positioned directly above the groundable point and one measurement with the electrode positioned  $1\,000 \text{ mm} \pm 50 \text{ mm}$  from the groundable point.

The number of measurements shall be chosen so as to be representative of the floor in question, but in any case shall be at least **one measurement per 100 m<sup>2</sup> with a minimum of six measurements.**

#### 10 Calculation and expression of results

For each sample and each type of measurement, calculate the geometric mean of the individual readings. Express both the individual results and the geometric means to two significant figures.

#### 11 Test report

The test report shall include at least the following information:

- a) reference to this International Standard, i.e. IEC 61340-4-1;
- b) all the information necessary for complete identification of test samples;