INTERNATIONAL STANDARD

ISO 6356

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Textile floor coverings — Assessment of static electrical propensity — Walking test

Revêtements de sol textiles — Évaluation de la propension à l'accumulation des charges électrostatiques — Essai du marcheur

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 6356 was prepared by Technical Committee ISO/TC 219, *Floor coverings*.

This first edition of ISO 6356 cancels and replaces ISO/TR 6356:1982, which has been technically revised.

Annexes A, B, C and E form a normative part of this International Standard. Annex D is for information only.

Introduction

This test is a measurement of the electric potential (voltage) due to the accumulation of static charge on a person walking on the surface of a textile floor covering under controlled conditions. It is important that this measurement be made under carefully controlled conditions to minimize test variability.

Textile floor coverings — Assessment of static electrical propensity — Walking test

1 Scope

This International Standard describes a method of evaluating the electrostatic propensity of all types of textile floor coverings under controlled conditions. Since the potential generated varies with humidity, shoe materials, walk surface and individuals' mannerisms, the values generated by this test will not necessarily duplicate actual field experience, but will provide a relative comparison of the performance of different surfaces.

For classification purposes and in cases of dispute the measurement procedure specified in this International Standard can be used under controlled conditions specified in the relevant classification standard or agreed between disputing parties. There may be occasions where measurements are required under non-controlled conditions, e.g. *in situ* measurements on installed floor coverings. The principle of measurement using the equipment specified in this International Standard can be used to make measurements, either with the standard footwear specified or with specific footwear relevant to the end use.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard 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.

ISO 48:1994, *Rubber, vulcanized or thermoplastic — Determination of hardness (hardness between 10 IRHD and 100 IRHD)*.

ISO 1957:—[1], *Machine-made textile floor coverings — Sampling and cutting specimens for physical tests.*

ISO 2424:1992, *Textile floor coverings — Vocabulary.*

ISO 9407:1991, *Shoe sizes — Mondopoint system of sizing and marking.*

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

ASTM D394-59[2], *Standard method of Test for Abrasion Resistance of Rubber Compounds*.

3 Terms and definitions

For the purposes of this International Standard the terms and definitions given in ISO 2424 shall apply.

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1) To be published. (Revision of ISO 1957:1986)

2) Withdrawn in 1970.

4 Principle

The difference in electrical potential, in relation to the earth's potential (zero), produced by a person walking:

a) on the textile floor covering under test;

b) with standardized footwear;

c) in a prescribed manner;

d) under controlled atmospheric conditions

is measured and used to evaluate the risk of a person experiencing the discomfort of static electrical shock from in-service use of this textile floor covering.

5 Apparatus

5.1 Earthed metal base plate, measuring at least 2 000 mm × 1 000 mm.

WARNING: The use of either an earthed metal plate on the floor of the test room or an entire metal floor may constitute a hazard where electricity supply lines are present. It is recommended that all electrical supply sources be protected by suitable earth fault circuit breakers.

5.2 Rubber mat, of dimensions 2 200 mm × 1 200 mm, thickness 4,5 mm ± 0,5 mm and vertical resistance $\geqslant 10^{13}\ \Omega/\text{cm}^2$, measured in accordance with IEC 60093:1980.

5.3 Sandals, made in accordance with the requirements in annex A and reserved specifically for this test method. Sole material shall be XS-664P Neolite[3)] in accordance with annex B. The resistance between the metal base plate and an operative standing on it wearing the sandals shall be between $10^{10}\ \Omega$ and $10^{11}\ \Omega$ as measured in accordance with annex C.

NOTE For tests with conductive footwear, sandals with BAM rubber[4)] soles may be used.

5.4 Means of cleaning footwear.

5.4.1 P280 sandpaper.

5.4.2 Scoured cotton cloth, free of finish or detergent.

5.4.3 Ethanol, ⩾ 95 % concentration.

5.5 Ionizing source, capable of eliminating electrostatic charge from the surface of the specimen.

NOTE All the manufacturer's safety precautions should be observed.

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3) The Neolite material may be obtained from AATCC Technical Center; P.O. Box 12215; Research Triangle Park; NC 27709; USA. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they can be shown to lead to the same results.

4) The BAM rubber material is available from BAM, Berlin, Germany. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they can be shown to lead to the same results.

5.6 Two standard reference carpets[5], reserved specifically for this test method and meeting the following requirements:

a) one specimen of unprotected carpet, free from finish, giving body voltage of – 9,0 kV ± 5,0 kV when tested under conditions of 25 % relative humidity, and – 9,5 kV to – 13,7 kV when tested under conditions of 20 % relative humidity;

b) one specimen of static protected carpet, free from finish, giving body voltage of – 1,5 ± 0,4 kV when tested under conditions of 25 % relative humidity, and – 2,7 kV ± 0,3 kV when tested under conditions of 20 % relative humidity.

5.7 Body voltage measuring system, consisting of a d.c. static voltmeter, an autographic recorder and a hand electrode meeting the following requirements:

a) input resistance of voltmeter and hand electrode system: $\geqslant 10^{14}\ \Omega$;

b) input capacitance of hand electrode: $\leqslant$ 20 pF;

c) response time of electrode/voltmeter/recorder system such that full scale deflection on the recorder is reached within 0,25 s.

See annex D for an example of a suitable hand electrode system.

5.8 Relative humidity measuring instrument, capable of determining relative humidity to an accuracy of ± 1 % RH.

6 Atmosphere for conditioning and testing

The specimens shall be conditioned and the test conducted in a specified standard atmosphere and the test conditions used shall be stated in the test report. Commonly specified test conditions include:

a) 23 °C ± 1 °C and 25 % RH ± 3 % RH

b) 23 °C ± 1 °C and 20 % RH ± 3 % RH

NOTE Several standard atmospheres are specified by various regional authorities based upon the severity of conditions the floor covering normally experiences in service. Values determined under one set of conditions cannot be compared to those using another set of test conditions.

7 Sampling and selection of specimens

Carry out sampling and selection of specimens in accordance with ISO 1957. From each sample select a specimen measuring 2 000 mm × 1 000 mm.

NOTE Generally, the test is performed on the textile floor covering as received, i.e. with finishes and special treatments as appropriate. If the permanency of such finishes and treatments is being investigated, the specimen may be submitted to a cleaning process or to practical wear conditions before testing.

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[5] Available from AATCC, P.O. Box 12215, Research Triangle Park, NC 27709, USA. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they can be shown to lead to the same results.

8 Conditioning of specimens, reference carpets, rubber mats and sandals

Condition the specimens from the “wet side” (higher humidity than test chamber) in the atmosphere specified in clause 6 for at least 7 d, placing them on a rack that ensures free air circulation.

The rubber mat (5.2), sandals (5.3) and reference carpets (5.6) shall not be used for any other purpose and should be permanently maintained in the test atmosphere. If this is not possible, the rubber mat and sandals shall be conditioned for 2 d prior to testing and the reference carpets shall be conditioned for 7 d.

NOTE Care should be taken to ensure specimens and equipment are adequately conditioned, particularly where certain finishes can lead to slow conditioning.

9 Test procedure

9.1 Preparation

9.1.1 Cleaning the sandals

Before beginning a test series, scrub the sole material using a piece of scoured cotton (5.4.2) wetted with ethanol (5.4.3) to remove any chemical substance from the surface. When the soles are dry, abrade with a fine sandpaper (5.4.1), then remove the dust using a dry piece of scoured cotton fabric. Repeat the ethanol cleaning procedure prior to testing each specimen. Confirm the soles are dry before testing.

NOTE If the sole material becomes severely contaminated it may be necessary to use more rigorous cleaning procedures prior to commencing a test series. The efficacy of cleaning procedures can be checked by testing the reference carpets.

9.1.2 Recording the testing atmosphere

Measure and record the temperature and humidity of the test chamber immediately before and after each test series, using the relative humidity measuring instrument (5.8).

9.1.3 Verification of the measuring system

Before each series of measurements the measuring system shall be verified by testing the reference carpets (5.6) before beginning specimen testing. See annex E for the calibration procedure for the voltmeter, electrode and recorder.

NOTE It is recommended that an additional set of sandals be kept and reserved exclusively for verifying the reference carpets.

9.1.4 Discharging the specimen and testing materials

9.1.4.1 Eliminate any residual static charge using the ionizing source (5.5). Treat the rubber mat (5.2) in its operating position on the metal base plate (5.1) and the front and back of the specimen while it is hanging freely. Carefully lay the specimen on the rubber mat ensuring that it neither slides on the mat nor comes into contact with the metal base plate.

9.1.4.2 Eliminate any residual charge on the operative and sandals by connecting the operative to earth (zero potential) while wearing the sandals and standing on the specimen immediately prior to walking on the specimen.

9.2 Performing the test

9.2.1 The operative shall place the sandals on the specimen, then step into them. The sandals shall be fastened securely to ensure that the operative’s feet remain in constant contact with the insoles of the sandals.

9.2.2 The operative shall walk on the specimen at the rate of 2 steps per second while maintaining the body facing in the same direction throughout the test. The operative shall cover as much of the specimen as possible by walking forward and backwards, but avoiding scuffing or pivoting. The stepping action should maintain the sole of the sandal parallel to the specimen at all times while lifting the sandal between 50 mm and 80 mm. The operative shall not come closer than 0,5 m to the wall or any object in the room and continue walking until the peak voltage ceases to rise or for 60 s, whichever occurs first.

9.2.3 The operative shall remove the sandals, clean the soles and repeat the procedures 9.1.4 and 9.2.1 and 9.2.2 to complete a set of three walks on each specimen.

Specimens used in previous tests shall be stored so any residual charge does not affect subsequent tests.

The first specimens tested each day shall be the reference carpets in order to assure that the test is generating accurate results.

10 Calculation and expression of results

From the recorder chart the arithmetic mean of the five highest valleys shall be determined and all results in kilovolts expressed to the nearest 0,1 kV.

NOTE A common deviation to this calculation is used when the measuring system incorporates damping to reduce the difference between peaks and valleys on the recording trace. The mid-point of the chart trace when it reaches maximum value is determined visually. This practice gives slightly higher values than determining the “highest valleys”.

11 Precision statement

A programme of testing involving ten laboratories and resulting in 60 individual analyses on each of a range of textile floor covering samples showed that the coefficient of variation for the type of floor covering normally evaluated by this International Standard ranged from 15 % to 25 %, with an average value of 21 %.

12 Test report

The test report shall include the following information:

a) a statement that the tests were performed in accordance with this International Standard;

b) the identification of each sample, including type of pretreatment (if any);

c) the exact testing atmosphere;

d) the identity of the operative performing the test;

e) the individual body voltages for each walk;

f) the average of the individual body voltages;

g) details of any deviations from this test method.

Annex A
(normative)

Specification of the sandals[6)]

A.1 General

The sandals shall be Mondopoint size 270/100 (see ISO 9407:1991), with open toe, adjustable heel and instep strap on the forepart. These straps shall be lasted to the insole to which a wedge heel is attached and the whole provided with an outer sole made in one piece. A complete sock lining shall be stuck to the insole.

A stainless steel plate shall be inserted centrally near the front, and aluminum rivets inserted at both front and back to provide a conductive contact between outer sole and operative (see Figures A.1 and A.2). All rivets shall make good contact with either the outer sole or the steel plate at the bottom and the foot at the top.

A.2 Lasts

The sandals shall be made on lasts with a good fit. The last bottom, also called the “insole model”, shall meet with the requirements of the insole pattern shown in Figure A.1, which also gives the positioning of the steel plate and aluminum rivets.

The upper part of the lasts shall be made so the footwear can be manufactured with a good fit for this specific purpose.

A.3 Materials

The materials required are given in Table A.1.

A.4 Construction procedure

The upper shall be composed of four straps positioned so the joint instep and heel of the foot are well enclosed. The straps shall be fastened by means of contact fastener tape (e.g. “Velcro”) fixed to the straps, in order that the sandal be adaptable to a wide range of foot sizes.

Attach the contact fastener tape to the straps by adhesion, then secure it with a single row of stitching. To avoid creasing, stick the upper leather and lining to one another in the fit of the last. Complete the uppers by trimming the straps and under edge, then finish all edges.

Press-cut the side of the insole to the right side and paint it. Cement-last the upper to the insole, then roughen the last margin and insole and remove all dust so a good base is formed for attaching the wedge and outer sole.

Attach the wedge heel to the lasted sandal, then stick the sock lining to the insole, since at this stage the steel plate and aluminium rivets are to be fitted. After attaching them, stick the sole under the sandals and finish the edges.

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6) Sandals made to this specification are available from TNO Centre for Textiles, 2600 JH, Delft, The Netherlands. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by ISO of the product. Equivalent products may be used if they meet the same specification.

Table A.1 — Materials for the sandals

Material	Description
Upper leather	Full grain chrome tanned side leather, 1,5 mm to 1,6 mm thick.
Lining leather	Fattened calf, 1,2 mm to 1,4 mm thick
Sock lining	Fattened calf, 0,7 mm thick
Insole leather	Leather Goodyear shoulder, 3 mm thick.
Contact fastener tape (“Velcro type”)	30 mm wide
Stitching thread	R 75/3 type
Wedge heels	Microcel rubber, hardness ≈ 60 IRHD (see ISO 48:1994).
Outer soles	a) Butt leather (allowing stitching and adhesive binding). b) Standardized sole material, see 5.3 and annex B.
Adhesion used for: – lining attachment – sock lining – attachment of Velcro tape – cement lasting – attachment of wedge heel – sole attachment	 Cement (rubber adhesive) Polyvinyl acetate emulsion adhesive Cement (rubber adhesive) Neoprene adhesive Neoprene adhesive Neoprene adhesive
Rivets	Blind aluminium rivets, flat-headed, approximately 9 mm diameter head. – front, 4 mm diameter × 7,4 mm length with cadmium-plated washer, 9 mm diameter, 4,2 mm hole, 0,6 mm thick. – heel, 4,8 mm diameter × 25,4 mm length with cadmium-plated washer, 12 mm diameter, 5,2 mm hole, 0,7 mm thick.

NOTE In order to ensure good contact, the heads of the aluminium rivets should not come into contact with the adhesive, either from above or below. It is essential there be direct contact between the foot and the aluminium rivets on one side and between the aluminium rivets and the outer sole or the steel plate on the other.

