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Footwear — Test methods for uppers, linings and insocks — Abrasion resistance

Chaussures — Méthodes d'essai des tiges, des doublures et des premières de propreté — Résistance à l'abrasion

Reference number
ISO 17704:2004(E)

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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Foreword

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The main task of technical committees is to prepare International Standards. 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 document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 17704 was prepared by the European Committee for Standardization as EN 13520:2001. This International Standard includes corrigendum EN 13520:2001/AC:2003 and was adopted under a special “fast-track procedure” by Technical Committee ISO/TC 216, *Footwear* in parallel with its approval by the ISO member bodies.

Throughout the text of this document, read “...this European Standard...” to mean “...this International Standard...”.

1 Scope

This standard specifies a test method for determining the resistance of uppers, linings and insocks irrespective of the material, to wet and dry abrasion, in order to assess the suitability for the end use.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text, and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 12222, *Footwear - Standard atmospheres for conditioning and testing of footwear and components for footwear.*

3 Terms and definitions

For the purposes of this European Standard, the following term and definition apply.

3.1
abrasion resistance uppers, linings and insocks
surface resistance shown by an upper, lining or insock test piece when rubbed with an abradant fabric in a Martindale machine

4 Apparatus and material

The following apparatus and material shall be used:

4.1 Abrasion machine, with one or more test stations each including the following:

4.1.1 Circular specimen carrier with a clamping ring which grips the test specimen around its edge leaving an exposed raised flat circular portion of area 645 $mm^2 \pm 5$ mm^2.

4.1.2 Horizontal abradant table of sufficient size to incorporate a square central test area of side 88 mm. Typically, the abradant tables are circular and of minimum diameter 125 mm.

4.1.3 Means of holding the exposed flat portion of the test specimen carrier (4.1.1) in contact with the abradant table (4.1.2) whilst allowing the test specimen carrier to rotate freely in the plane of the abradant table.

4.1.4 Means of producing relative movement between the specimen carrier (4.1.1) and the abradant table (4.1.2) which forms a Lissajous figure occupying an area of 60 mm ± 1 mm × 60 mm ± 1 mm (see Figure 1). Each Lissajous figure requires 16 eliptical motions (revolutions) of the test specimen carrier and the speed of operation of the tester shall be 5 rad/s ± 0,4 rad/s [1)] .

NOTE – For a speed of operation of 5 rad/s ± 0,4 rad/s, the speed of rotation of outer hubs of tester is 48 rev/min ± 2 rev/min.

4.1.5 Means of maintaining a constant pressure of 12 kPa ± 0,2 kPa between the specimen carrier (4.1.1) and the abradant table (4.1.2). The corresponding mass of the test specimen carrier and associated fitments is 795 g ± 5 g.

1) 1 rad ≈ 0,16 rev.

4.1.6 The parallelism of the abradant table (4.1.2) and the test specimen holder (4.1.1) shall be maintained within ± 0,05 mm throughout each Lissajous figure. A dial gauge fitted in place of the specimen carrier can be used to verify the parallelism of the abradant table.

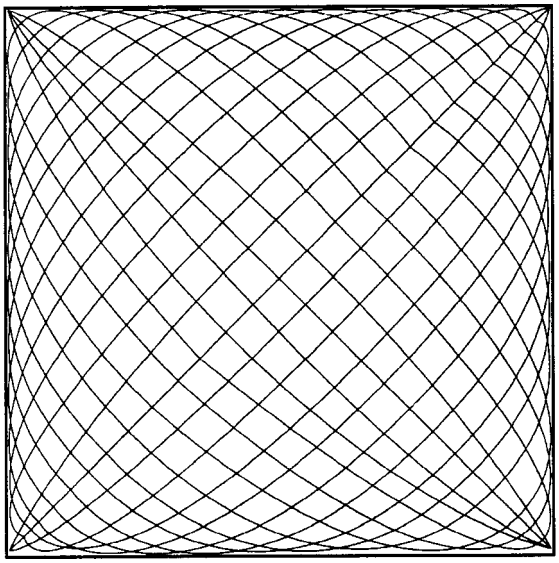

Figure 1 — Lissajous figure

4.1.7 The circumferential parallelism between the test specimen holder (4.1.1) and the abradant table shall be better than 0,05 mm. This can be verified by attempting to insert slip gauges of thickness less than 0,05 mm under the edges of the flat face of the test specimen carrier.

4.1.8 Means of counting the number of abrasion cycles completed in terms of revolutions [16 revolutions [2)] (100 rad) per cycle].

4.2 Four pieces of crossbred worsted spun, plain woven fabric, to be used as the abradant in the test, each of size sufficient to be clamped over the abradant table (4.1.2). The fabric shall comply with the following specification:

Characteristic	**Warp**	**Weft**
Yarn linear density	(R63 ± 2) tex/2	(R74 ± 2) tex/2
Threads per unit length	(1,7 ± 0,1)/mm	(1,3 ± 0,1)/mm
Singles twist	(540 ± 20) tpm‘Z’	(500 ± 20) tpm‘Z’
Twofold twist	(450 ± 20) tpm‘S’	(350 ± 20) tpm‘S’
Fibre diameter	(27,5 ± 2) µm	(29 ± 2) µm
Minimum mass per unit area	190 gm^{-2}	

The two faces of the abradant fabric do not necessarily have the same abrasive characteristics and when supplied it should be noted which face the supplier recommends for use, this is normally the slightly smoother face of the fabric. Stocks of the fabric shall be controlled to ensure that only this face is used in testing.

4.3 Abradant paper. A technical standard of 36 grit is recommended.

2) 1 rad ≈ 0,16 rev.

4.4 Pressing mass of suitable dimensions to place over the entire surface of the abradant table to ensure that the abradant fabric is held flat whilst it is clamped in position. The mass shall apply a pressure of 2 kPa $\pm$ 0,2 kPa.

4.5 Cutting device such as a press knife of a sufficient size to produce test specimens that will be held firmly in the specimen holders (4.1.1). The exact size of the device depends on the design of the clamping system of the test specimen carrier.

4.6 Four pieces of table felt, mass/unit area 575 gm^{-2} to 800 gm^{-2}, and thickness 2 mm to 3,5 mm.

Both sides of the felt may be used. The felt may be re-used until both sides are either discoloured, or the thickness has been reduced to less than 2 mm, but felt used in wet tests shall only be re-used in wet tests.

4.7 Polyurethane foam of thickness (3 ± 1) mm, density (30 ± 3) kgm^{-3} and indentation hardness 5,8 kPa ± 0,8 kPa determined in accordance with annex A, for testing materials with a mass per unit area of less than 500 gm^{-2}.

4.8 Water jet. A rubber tube with one end restricted and the other attached to a cold water tap at mains pressure is suitable.

5 Sampling and conditioning

5.1 At least two test specimens of sufficient size to allow them to be fixed firmly within the test specimen carriers (see 4.1.1) are required for each of the dry and wet tests.

5.2 Cut test specimens from various positions on the sheet material avoiding areas within 50 mm of any manufactured edges.

NOTE Test specimens can be taken either from materials likely to be used for uppers or from made-up uppers or finished footwear.

5.3 If testing woven fabrics, ensure that no two test specimens have the same warp or weft threads.

5.4 Select test specimens of patterned fabric so that each part of the pattern is tested. This can mean that more than two test specimens are required for each of the dry and wet tests.

NOTE It may be helpful to cut an extra sample of the test material to be used as a reference when comparing any damage or discolouration of the abraded test specimens.

6 Test method

6.1 Principle

Four circular test specimens are rubbed against pieces of a standard abradant fabric or a standard abradant paper under a constant pressure, with two of the pieces of abradant dry and two wet. The relative movement between the abradant and specimen is a complex cyclic pattern (a Lissajous figure) which produces rubbing in all directions. The test is stopped after a prescribed number of cycles and the damage to the specimen is assessed.

6.2 Procedure

6.2.1 Place the test specimens in a conditioned atmosphere as specified in EN 12222 for at least 24 h prior to testing and carry out the test in this environment. Test specimens for wet tests need not be conditioned prior to test.

6.2.2 For the wet test, fully saturate the abradant cloth (see 4.2 and 4.3) and table felt (see 4.6) by directing the water jet (see 4.8) to and for over their surfaces until full saturation can be seen by a uniform darkening in colour. Never spray the water jet onto materials, which are fixed to the Martindale instrument.

6.2.3 Place the test specimen in the test specimen carrier clamping rings (see 4.1.1), so that the surface of the test specimen to be abraded is facing outwards.

6.2.4 If testing materials with a mass per unit area of less than 500 gm^{-2} then place a similar size piece of the polyurethane foam (see 4.7) in each of the test specimen carrier clamping rings (see 4.1.1) as a backing for the test specimen.

6.2.5 Clamp the test specimen in the carrier so that it is not baggy, creased or distorted in any way.

6.2.6 Place a piece of dry or wet table felt onto the abrading table depending on whether dry or wet test conditions are being used.

6.2.7 Place a corresponding dry or wet piece of the abradant cloth or abradant paper over each piece of table felt with the test face uppermost.

6.2.8 Place the pressing weight (4.4) on top of the abradant cloth or abradant paper and clamp the abradant in position so that it is free of wrinkles.

6.2.9 Repeat the procedure in clauses 6.2.1 to 6.2.7 for any other test stations.

6.2.10 Fit the filled test specimen carrier into the abrasion machine so that the test specimen is resting on the abradant.

6.2.11 Apply a vertical downward force to the test specimen carrier to provide the required 12 kPa $\pm$ 0,2 kPa pressure between the test specimen and the abradant.

6.2.12 Operate the abrasion machine until the first inspection stage is reached, see Table 1:

Table 1 — Recommended inspection and abradant rewetting stages

Number of revolutions	Inspect specimen	Re-wet abradant
1 600	Yes	No
3 200	Yes	No
6 400	Yes	Yes
12 800	Yes	Yes
25 600	Yes	Yes
38 400	No	Yes
51 200	Yes	No

6.2.13 Remove the test specimen carrier(s) (see 4.1.1) from their holders and inspect the test specimen(s) under bright indirect lighting conditions for signs of damage. If possible compare each specimen with a piece of the same material which has not been tested. Record any abrasion, pilling and discolouration which has occurred and rate these by using one of the descriptions: None, very slight, slight, moderate, severe, almost complete, complete. Record whether a hole has worn through the test specimen or whether surface layers have been removed creating, in the case of pile fabrics and similar, a bald patch or a colour change.

6.2.14 Return each test specimen carrier to the same holder/abradant table and restart the machine.

6.2.15 Stop the machine at each inspection point and repeat the procedure given in 6.2.13.

6.2.16 Re-wet the abradant cloth or abradant paper and table felt at each wet test station at the points shown in Table 1. With the cloth, or paper, and felt still clamped over the abradant table, gradually pour up to 30 g of water onto the surface while lightly rubbing in the water with the finger tips. Stop pouring the water when it stops being absorbed and excess water is seen to accumulate on the surface. Place the pressing weight (see 4.4) onto the top of each abradant for 10 s ± 2 s and then remove.

7 Test report

The test report shall include the following information:

a) For each test specimen:

- Whether it was abraded with an abradant fabric (4.2) or abradant paper (4.3).
- Whether it was abraded with a wet or dry abradant.
- The total number of revolutions completed.
- The amount, type and level of damage at the end of the test and, if required, at intermediate inspection stages.

b) A description of the material, including commercial references (style codes etc.).

c) Reference to the method of test.

d) Date of testing.

e) Any deviation from this test method.

Annex A
(normative)

Method for measuring the indentation hardness of foam

A.1 Apparatus

A.1.1 Set of ten weights of mass, 50 g $\pm$ 0,01 g.

A.1.2 Small lightweight pan or tray, of known mass (approximately 50 g) to hold the weights.

A.1.3 Thickness gauge that exerts a downward pressure of 2,0 kPa $\pm$ 0,2 kPa on a presser foot of diameter 25 mm $\pm$1 mm.

A.1.4 Laboratory timer reading, in seconds.

A.2 Procedure

A.2.1 Cut two squares of foam, each approximately 50 mm $\times$ 50 mm.

A.2.2 Place one piece on top of the other and place the composite on the base of the thickness gauge.

A.2.3 Lower the foot and record the thickness immediately as *T*, in mm.

A.2.4 Place the pan or tray (A.1.2) onto the thickness gauge's own weight and immediately record the thickness of the foam, in mm.

A.2.5 Place the first weight (50 g) on the pan and immediately start the laboratory timer.

A.2.6 After 30 s $\pm$ 1 s record the thickness, in mm, of the foam.

A.2.7 Repeat the procedure in A.2.5 and A.2.6 until all the masses have been added.

A.2.8 Prepare a plot of mass added (not forgetting the mass of the pan or tray, A.1.2), in g, against thickness of the foam, in mm, and draw a horizontal line which dissects the curve at a thickness equal to 60 % of the thickness *T*.

A.2.9 Draw a vertical line which also dissects the curve at this point and read from the graph the corresponding added mass.

A.2.10 Calculate the increase in pressure corresponding to this mass using the equation:

$$pressure = \frac{w \cdot 9{,}81}{a}$$

where:

w is the mass determined in A.2.9, in g;

a is the area of the pressure foot of the thickness gauge, in mm^2.

Bibliography

[1] EN 13400, *Footwear – Sampling location, preparation and duration of conditioning of samples and test pieces.*

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