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ISO 17702

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Footwear — Test methods for uppers — Water resistance

Chaussures — Méthodes d'essai des tiges — Résistance à l'eau

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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 2.

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 17702 was prepared by CEN (as EN 13518:2001) 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.

For the purposes of international standardization, a list of corresponding International and European Standards for which equivalents are not given in EN 13518 has been added as Annex ZZ.

Contents

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 309 "Footwear", the secretariat of which is held by AENOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 2002, and conflicting national standards shall be withdrawn at the latest by June 2002.

This European Standard is based on the IULTCS/IUP 10 method.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard specifies a test method for determining the resistance of a footwear upper material to water penetration on flexing, 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.*

EN ISO 3696 *Water for analytical laboratory use – Specification and test methods (ISO 3696:1987).*

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

3 Terms and definitions

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

3.1
water resistance
resistance of a footwear upper material to water penetration on flexing

3.2
upper
materials forming the outer face of the footwear which is attached to the sole assembly and covers the upper dorsal surface of the foot. In the case of boots this also includes the outer face of the material covering the leg. Only the materials that are visible are included, no account should be taken of underlying materials

3.3
complete upper assembly
finished upper, fully seamed, joined or laminated as appropriate, comprising the centre material and any lining(s) together with all components such as interlinings, adhesives, membranes, foams or reinforcements, but excluding toe puffs and stiffeners

NOTE The complete upper assembly may be flat, 2-dimensional or comprise lasted upper in the final construction.

4 Apparatus and material

The following apparatus and material shall be used:

4.1 Test machine including the following:

4.1.1 One or more pairs of cylinders onto which the test specimens are clamped, each of diameter 30,0 mm ± 0,5 mm, mounted with their axes horizontal and coaxially aligned.

4.1.2 A maximum separation of the cylinders (4.1.1) in each pair of 40 mm ± 0,5 mm.

4.1.3 Means of reducing the separation of the cylinders (4.1.1) in each pair by a throw of 2,0 mm ± 0,1 mm; 3,0 mm ± 0,2 mm; 4,0 mm ± 0,4 mm; or 6,0 mm ± 0,6 mm and returning them back to their original separation at a rate of 50 cycles / min ± 1 cycles / min under a simple harmonic motion.

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4.1.4 Ring shaped clamps of internal diameter adjustable between 30 mm and 40 mm to fit around each cylinder.

4.1.5 Means of containing a fixed quantity of water (4.9) around the pair(s) of cylinders so that the water level can be adjusted to a maximum of 5 mm above the axes of the cylinders.

4.2 Press knife, or other cutting device, capable of cutting rectangular test specimens 75 mm ± 2 mm × 60 mm ± 1 mm.

4.3 Apparatus to measure the stiffness of the test specimen having:

4.3.1 Two cylinders of diameter (30,0 ± 0,5) mm mounted with their axes aligned and a maximum separation of 40,0 mm ± 0,5 mm.

4.3.2 Means of moving the cylinders (see 4.3.1) together.

4.3.3 Means of measuring the reduction in distance between the two cylinders (4.3.1) to the nearest 0,5 mm.

4.3.4 Means of measuring the force resisting movement along the axis of the cylinders (4.3.1) to the nearest 5 N.

4.3.5 Ring shaped clamps of internal diameter adjustable between 30 mm and 40 mm, to fit around each cylinder (4.3.1).

4.4 Standard laboratory balance capable of measuring mass to the nearest 10 mg.

4.5 Abrasive paper, grade 180.

4.6 Pieces of soft absorbent lint free material.

4.7 Laboratory timer capable of recording time to the nearest second over a 5 s period.

4.8 Clock capable of recording time to the nearest minute over a 24 h period.

4.9 Distilled or deionised water complying with grade 3 of EN ISO 3696.

5 Sampling and conditioning

5.1 Use the knife (see 4.2) to cut two rectangular test specimens 75 mm ± 2 mm × 60 mm ± 1 mm. Cut one with its longer edges parallel to the along direction (X-axis as defined in EN13400 for shoe uppers, the backbone direction for leather and the machine direction for other materials) of the material and cut the other test specimen perpendicular to this.

For non-leather materials, cut test specimens from a range of positions across the full usable width and length of the sheet material. For a material with a woven structure this will prevent any two specimens containing the same warp or weft threads.

5.2 Mark the principal direction of the material on each test specimen.

5.3 Unless otherwise specified, buff the outer surface of each test specimen lightly by rubbing it with the abrasive paper (4.5) until the central 50 % of its surface area shows evidence of mild abrasion (scratching and matting) damage.

NOTE Very thin surface finishes with low abrasion resistance are likely to be completely removed in some areas by this treatment whilst thicker and more abrasion resistant finishes and coatings may be scratched and dulled only.

5.4 Store the test specimens in a conditioned atmosphere as specified in EN 12222 for at least 24 h prior to test.

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

6 Test method

6.1 Principle

A rectangular test specimen is bent partly round, and secured between, two cylindrical clamps so as to form a trough. The trough is then immersed in water and the clamps oscillate at a constant speed so that the specimen is repeatedly flexed. The time taken for water penetration through the test specimen to occur is recorded. The mass of water absorbed by, and transmitted through, the test specimen can also be measured.

6.2 Procedure

6.2.1 Stiffness: If the throw (see 4.1.3) to be used in the water resistance test has not been specified then it is necessary to determine the throw to be used based on the stiffness of the material:

6.2.1.1 Adjust the apparatus (4.3) so that the pair of cylinders (4.3.1) are at their maximum separation.

6.2.1.2 Bend, without creasing, the test specimen along its longer edges to form a trough. Loosely fit a ring shaped clamp (4.3.5) over each end of the test specimen. Bend, without creasing, one of the test specimens around, and between, the cylinders (4.3.1) so that its outer surface is facing outwards, its shorter edges are parallel to the axis of the cylinders and it overlaps each cylinder by approximately 10 mm.

The specimen forms a trough between the cylinders, open at the top and closed at the bottom.

6.2.1.3 Slide the ring shaped clamps (see 4.3.5) along the specimen until their inner edges are aligned with the facing ends of the two cylinders. Fully tighten one of clamps, ensure that the test specimen is not slack, and then fully tighten the other clamp.

6.2.1.4 Over a time of 5 s ± 2 s move the cylinders 2,0 mm ± 0,1 mm closer to each other, and watch the specimen to ensure that the centre section folds upwards. If this is not the case apply gentle pressure to the underside of the test specimen midway between the clamps as the clamps move together to encourage formation of an upward fold in the centre of the test specimen.

6.2.1.5 Immediately move the cylinders back to their original positions at the same speed.

6.2.1.6 Repeat the procedure in 6.2.1.4 and 6.2.1.5 recording the force, F_1, between the cylinders, at the point where the separation between the cylinders has been decreased by 2,0 mm $\pm$ 0,1 mm, to the nearest 5 N.

6.2.1.7 Repeat the procedure in 6.2.1.4 to 6.2.1.6 this time moving the cylinders together by 4,0 mm ± 0,2 mm and recording the force between the cylinders, F_2, when their separation has been reduced by 4,0 mm $\pm$ 0,2 mm, to the nearest 5 N.

6.2.1.8 If arithmetic mean of F_1 and F_2, F_a, calculated according to 7.1.1, is greater than 100 N then record the required throw X as 2,0 mm ± 0,1 mm. This is equivalent to 5 % of the test length or,

6.2.1.9 If F_a is between 50 N and 100 N then record X as 3,0 mm ± 0,2 mm. This is equivalent to 7,5 % of the test length or,

6.2.1.10 If F_a is less than 50 N, then repeat the procedure in 6.2.1.4 to 6.2.1.6 this time moving the cylinders together by 6,0 mm ± 0,6 mm and recording the force between the cylinders, F_3, when their separation has been reduced by 6,0 mm $\pm$ 0,6 mm, to the nearest 5 N.

6.2.1.11 If arithmetic mean of F_1, F_2 and F_3, F_b, calculated according to 7.1.2, is greater than 20 N then record X as 4,0 mm ± 0,4 mm (this is equivalent to 10 % of the test length) or,

6.2.1.12 If F_b is less than 20 N then record X as 6,0 mm ± 0,6 mm (this is equivalent to 15 % of the test length).

6.2.1.13 Repeat the procedure in 6.2.1.1 to 6.2.1.12 for the second test specimen. Use the higher of the recorded values for X when carrying out the test described below.

6.2.2 Initial penetration: If the mass of water absorbed or transmitted by the test specimen is also required, then refer to 6.2.3 and 6.2.4 respectively before proceeding further.

6.2.2.1 Set the test machine (see 4.1) so that the throw (movement between the two cylinders) is equal to *X* as determined in 6.2.1.

6.2.2.2 Adjust the test machine (see 4.1) so that the pairs of cylinders (see 4.1.1) are at their maximum separation.

NOTE If water penetrates through the lateral edges, repeat the test with the specimen having sealed the edges by appropriate means (PUR, neoprene, wax, vaseline, etc.).

6.2.2.3 Bend, without creasing, the test specimen along its longer edges to form a trough. Loosely fit a ring shaped clamp (see 4.1.4) over each end of the test specimen. Bend, without creasing, one of the test specimens around, and between, the cylinders (see 4.1.1) so that its outer surface is facing outwards, its shorter edges are parallel to the axis of the cylinders and it overlaps each cylinder by approximately 10 mm.

The test specimen forms a trough between the cylinders, open at the top and closed at the bottom.

6.2.2.4 Slide the clamping rings along the specimen until their inner edges are aligned with the facing ends of the two cylinders.

6.2.2.5 Fully tighten one of clamping rings, ensure that the test specimen is not slack, and then fully tighten the other clamping ring.

6.2.2.6 Slowly move the two cylinders together and watch the specimen to ensure that the centre section folds upwards. If this is not the case apply gentle pressure to the underside of the test specimen midway between the clamps as the clamps move together. This will encourage formation of an upward fold in the centre of the test specimen.

6.2.2.7 If the test machine has more than one pair of cylinders, repeat the procedure in 6.2.2.2 to 6.2.2.6 for the other test specimen and any additional materials that are to be tested at the same time.

6.2.2.8 With the cylinders moved together to minimum separation, fill the container (see 4.1.5) with water (see 4.9) and adjust the level so that it is higher than the centre of the upward fold (see 6.2.2.6) in the test specimen. During this stage it is recommended that a piece of the absorbent material (see 4.6) is put in the trough formed by the clamped test specimen as a precaution against accidentally splashing water into it. The absorbent material should be removed from the specimen after the water level has been adjusted.

6.2.2.9 Immediately start the test machine and record the time shown by the clock (see 4.8) as T_0, in min.

6.2.2.10 Inspect visually the interior of the clamped test specimen(s) for signs of water penetration. It is usual for this to initially occur at the two ends of the centre fold and take the form of a damp patch at the surface of the material, or a globule of water exuding from it.

6.2.2.11 Ignore water seeping between the test specimen and the cylinders. The clamps may need to be tightened to reduce this leakage but continue the test until valid penetration through the test specimen occurs. If the amount of seepage through the clamps is enough to put the test at risk, stop the machine and mop it up using an absorbent tissue.

6.2.2.12 Continue to inspect the test specimen(s) by repeating the procedure in 6.2.2.10 to 6.2.2.11 for approximately 15 min or until the test specimen(s) show signs of initial water penetration. Do not stop the machine when making the inspections.

6.2.2.13 If penetration has not occurred after approximately 15 min, then record that there has been no penetration after 15 min and then continue the inspections (as described in 6.2.2.10 and 6.2.2.11) gradually increasing the interval between inspections from every few minutes to every quarter of an hour or more if the material continues to resist penetration.

6.2.2.14 At the first sign of valid water penetration through the test specimen(s) record the time T_1, in min, shown by the clock (see 4.8). When penetration occurs between intermittent inspections, record the time T_1, in min, of the last inspection stage before penetration and the time T_2, in min, of the first inspection stage after penetration.

6.2.2.15 Continue the test until penetration of all test specimens has occurred.

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6.2.2.16 If no penetration has occurred after 24 h, stop the test.

6.2.2.17 Record the penetration time for each individual test specimen T_1, in min, or if penetration occurs between intermittent inspections as between T_1, in min, and T_2, in min.

6.2.3 Absorption: If the mass of water absorbed by the test specimen over a specified period of time T_3, in min, is required then:

6.2.3.1 Measure the masses, in g, of the test specimens M_0 after conditioning (see 5.4) using the balance (see 4.4) and record these to the nearest 0,01 g.

6.2.3.2 Proceed in accordance with 6.2.2.

6.2.3.3 After the specified time of T_3, in min, remove the test specimens from the machine.

6.2.3.4 Gently blot any excess water from the surface of the test specimens using a piece of the absorbent material (see 4.6).

6.2.3.5 Measure the mass of the test specimens M_1, in g, using the balance (see 4.4) and record these to the nearest 0,01g.

6.2.4 Transmission: If the mass of water transmitted through the test specimen over a specified period of time T_4, in min, is required then:

6.2.4.1 Measure the mass M_2, in g, of a piece of absorbent material (see 4.6) using the balance (see 4.4) and record this to the nearest 0,01 g.

6.2.4.2 Proceed in accordance with 6.2.2.

6.2.4.3 After initial penetration has occurred place the piece of absorbent material (see 6.2.4.1) inside the trough formed by the test specimen.

6.2.4.4 Continue to test the specimen(s) until the total time of test, from time T_0, in min, is equal to the required time T_4, in min.

6.2.4.5 Remove the piece of absorbent material from the trough formed by the test specimen and use it to mop up any excess water inside the trough.

6.2.4.6 Measure the mass M_3, in g, of the piece of absorbent material removed in 6.2.4.5 and record this to the nearest 0,01 g.

7 Expression of results

7.1 Stiffness

7.1.1 Calculate the arithmetic mean F_a of the two forces recorded in 6.2.1.6 and 6.2.1.7 on the cylinders using the formula:

$$F_a = \frac{(F_1 + F_2)}{2}$$

where:

F_1 is the force between the cylinders recorded in 6.2.1.6, in N.

F_2 is the force between the cylinders recorded in 6.2.1.7, in N.

7.1.2 Calculate the arithmetic mean F_b of the three forces recorded in 6.2.1.6, 6.2.1.7 and 6.2.1.10 using the formula:

$$F_b = \frac{(F_1 + F_2 + F_3)}{3}$$

where:

F_1 is the force between the cylinders recorded in 6.2.1.6, in N.

F_2 is the force between the cylinders recorded in 6.2.1.7, in N.

F_3 is the force between the cylinders recorded in 6.2.1.10, in N.

7.2 Absorption

For each test specimen, calculate the mass, in g, of water absorbed during time T_3, in min, as a percentage of the original mass of the specimen *WA* by using the formula:

$$WA = \frac{(M_1 - M_0)}{M_0} x100$$

where:

M_0 is the mass measured in 6.2.3.1, in g.

M_1 is the mass measured in 6.2.3.5, in g.

7.3 Transmission

For each test specimen, calculate the mass of water transmitted through the test specimen M_T, in g, in time T_4, in min, by using the formula:

$M_T = M_3 - M_2$

where:

M_2 is the mass measured in 6.2.4.1, in g.

M_3 is the mass measured in 6.2.4.6, in g.

8 Test report

The test report shall include the following information:

a) for each test specimen report:

- the test direction;
- the time taken for initial water penetration to occur, as recorded in 6.2.2.14;
- if required:
  - The water absorption in time T_3, in min, as calculated in 7.2, in percentage of the original mass.
  - The water transmission in time T_4, in min, as calculated in 7.3, in g.

b) a description of the material including commercial references (style codes etc.) and the flexing throw used;

c) reference to the method of test;

d) date of testing;

e) any deviations from this test method, such as no buffing (see 5.3).

Annex ZZ
(normative)

Corresponding International and European Standards for which equivalents are not given in the text

EN 12222:1997	ISO 18454:2001, *Footwear — Standard atmospheres for conditioning and testing of footwear and components for footwear*
EN 13400:2001	ISO 17709:—[1)], *Footwear — Sampling location, preparation and duration of conditioning of samples and test pieces*

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