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**Footwear — Test methods for uppers and
lining — Flex resistance**

*Chaussures — Méthodes d'essai pour les tiges et les doublures —
Résistance à la flexion*

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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 17694 was prepared by CEN (as EN 13512:2001) 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 13512 has been added as Annex ZZ.

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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of an identical text or by endorsement, at the latest by May 2002, and conflicting national standards shall be withdrawn at the latest by May 2002.

This European Standard is based on the IULTCS/IUP 20 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.

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1 Scope

This European Standard specifies a test method for determining the flex resistance of uppers and linings irrespective of the material, 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 13400, *Footwear - Sampling location, preparation and duration of conditioning of samples and test pieces*.

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

3 Term and definition

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

3.1

flex resistance

resistance of a material to crack or otherwise fail at flexing creases

4 Apparatus and material

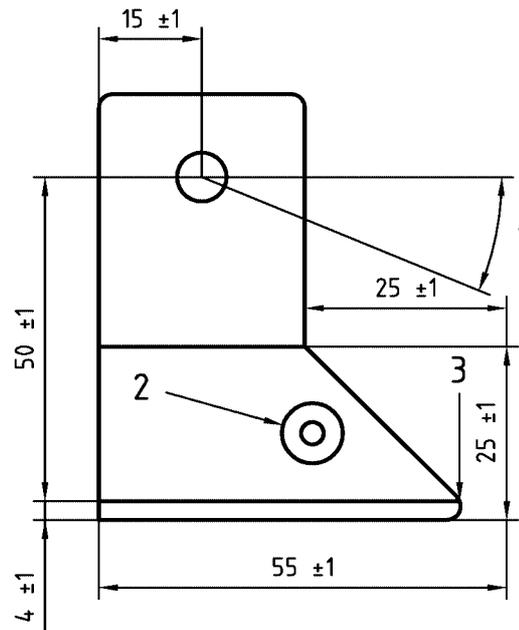
The following apparatus and material shall be used:

4.1 Test machine, including the following:

4.1.1 At least four pairs of clamps. The upper clamp consists of a pair of flat plates as shown in Figure 1.

The lower clamp is fixed and lies in the same vertical plane as the upper clamp.

Dimensions in millimetres

**Key**

- 1 Flexing angle $22^{\circ}30' \pm 0^{\circ}30'$
- 2 Clamp tightening screw
- 3 2 mm radius

Figure 1 — Upper clamp dimensions

4.1.2 Means of applying a simple harmonic reciprocating action to repeatedly move the upper clamp through an angle of $22^{\circ}30' \pm 0^{\circ}30'$. The speed of oscillation shall be $100 \text{ cycles/min} \pm 5 \text{ cycles/min}$.

The distance between the upper and lower clamp, when the upper clamp is in the horizontal position, shall be $25 \text{ mm} \pm 1 \text{ mm}$.

4.1.3 Means of counting the total number of cycles

4.2 For conducting cold tests, a cabinet capable of maintaining an internal atmospheric temperature of at least $-5^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and large enough to contain the test machine. If required, temperatures down to -30°C can be used.

4.3 Press knife ($70 \text{ mm} \pm 1 \text{ mm}$) x ($45 \text{ mm} \pm 1 \text{ mm}$) or similar for cutting test specimens.

4.4 For wetting test specimens:

4.4.1 Pipette, with a capacity greater than 1 cm^3 .

4.4.2 Clean hard flat water resistant surface greater than $71 \text{ mm} \times 65 \text{ mm}$.

4.4.3 Glass rod or scraper.

4.4.4 Distilled or deionised water complying with Grade 3 of EN ISO 3696.

4.5 Optical magnifier or stereoscopic microscope, with a magnification of approximately 10 times.

5 Sampling and conditioning

5.1 Cut out the required number (see Table 1) of rectangular test specimens ($70 \text{ mm} \pm 1 \text{ mm}$) x ($45 \text{ mm} \pm 1 \text{ mm}$). Cut half the required number of test specimens with the longer edge parallel with the along direction of the material

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(backbone direction for leather and selvedge (warp) or machine direction for non-leather materials) and half perpendicular to this. For test specimens cut from uppers the along direction is the X axis as defined in EN 13400.

For uppers, cut a test specimen from the centre of the forepart so that the centre of the test specimen aligns with the point of most flexing in the shoe.

For 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 shall prevent any two test specimens containing the same warp or weft threads.

It can be that it is impossible to cut a test specimen of sufficient size from certain types of footwear especially children's. The test specimen size may be reduced slightly but it is preferred to test the materials themselves and if necessary introduce perforations or seams (or other design features) similar to that found in the forepart the shoe.

Table 1 — Standard test conditions and number of test specimens

Type of material being tested	Testing conditions		
	Dry	Wet	Cold
Grain leather	2	2	-
Coated leather	2	2	2
Suede	-	2	-
Coated fabric	4	-	4
Fabric	4	-	-

5.2 Place all the test specimens which will be tested dry in a standard controlled atmosphere complying with EN 12222 for at least 24 h prior to test.

6 Test method

6.1 Principle

A rectangular test specimen is clamped in a flexing machine. The mounting of the test specimen is complex. One end of the test specimen is held in an upper clamp with the face or grain surface folded inwards so that these surfaces touch and the fold line is horizontal. It is then turned inside out and bent through 90° before being inserted in the lower clamp. In the lower clamp the test specimen is folded so that the reverse or flesh surface of the test specimen touch and the fold line is vertical. The test simulates the damage caused by the inward folding of the vamp of the upper but does not readily reproduce damage occurring on outward folds.

During the test the clamps oscillate at a constant speed so that the test specimen is repeatedly flexed. The tests can be carried out with either wet or dry test specimens at room temperature, or dry test specimens at sub-zero temperatures. After a predetermined number of cycles the tests are stopped and the test specimen is visually examined for signs of damage or salt spue.

6.2 Procedure

6.2.1 Mark on the back of each test specimen the along direction of the material, e.g. with an arrow, and determine the required testing conditions. It should be noted that linings will be tested face down and uppers face up.

6.2.2 Carry out the test in the conditioned standard atmosphere specified in EN 12222.

6.2.3 Place any test specimens that are to be tested wet onto the surface (see 6.1) with their reverse face uppermost. Spot 1 cm³ of water from a pipette onto the reverse side of the test specimen and use the glass rod (see 4.4.3) to work it uniformly into the material, to within 5 mm of the edge of the test specimen. It usually takes between 1 min and 2 min for the water to be absorbed. When testing leather two of the four test specimens shall normally be tested wet.

6.2.4 If conducting a cold test, ensure that the atmosphere surrounding the flexing machine is at the required temperature (usually $-5\text{ °C} \pm 2\text{ °C}$). Flexing of the test specimens shall commence 10 min \pm 1 min after they are placed in the cold environment. Therefore the procedure for loading the test specimens onto the flexing machine shall not take longer than 11 min.

6.2.5 Load each test specimen as follows:

6.2.5.1 Set the machine so that each upper clamp is horizontal, i.e. until it is at the upper extremity of its flexing stroke.

6.2.5.2 Unscrew the clamping plates of the upper clamp so that they are separated by a distance that is approximately twice the thickness of the material being tested.

6.2.5.3 Fold the test specimen with the face or grain surface inwards, so that the two longer edges of the test specimen are brought together. Insert one end of the folded test specimen between the clamping plates of the upper clamp so that the fold line is horizontal and rests on the ledge of the clamp (see Figure 2).

6.2.5.4 Tighten the clamping plates of the upper clamp to hold the test specimen in place.

6.2.5.5 Fold the test specimen inside out round the upper clamp to bring the reverse or flesh sides of the material into contact (see Figure 2).

6.2.5.6 Bend the test specimen through 90° and insert the free end of the test specimen (folded so that the reverse or flesh surface of the specimen touch) in the lower clamp, see Figure 2. Tighten the plates of the lower clamp to hold the test specimen in place ensuring that the specimen is taut and there is no bagginess around the top clamp.

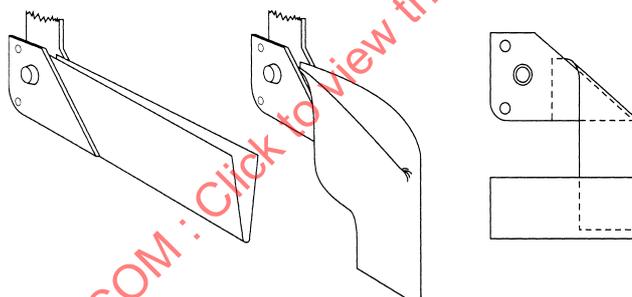


Figure 2 — Loading of test specimens

6.2.6 Run the machine until the first inspection stage, see Table 2.

6.2.7 In addition to the normal inspection stages wet test specimens shall be removed from the machine after every 6 000 cycles and assessed for salt spue before rewetting by repeating the procedure in 6.2.3.

Table 2 — Suitable inspection stages

	Dry	Wet	Sub zero
1 000	NO	YES	YES
2 000	NO	YES	YES
5 000	NO	YES	YES
10 000	YES	YES	YES
25 000	YES	NO	NO
50 000	YES	NO	NO
100 000	YES	NO	NO

The inspection stages used during each individual test will depend on the total time available for the test and the expected performance of the material.

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6.2.8 Stop the test and remove the test specimens. Use both the unaided eye and the optical magnifier (see 4.5) to assess the flexing damage. When looking for damage inspect the specimen both folded and flat. Inspect the inward fold (i.e. the central fold close to the edge of the upper clamp) of each test specimen and record any signs of damage. Any damage to the parts of the test specimen held within either clamp of the flexing machine shall be ignored as shall any damage caused by rubbing of the test specimen on the clamps.

6.2.9 For materials with a continuous surface coating record the following:

- a) whether the specimen shows slight or heavy creasing in the fold;
- b) the number of cracks in fold;
- c) the depth of the deepest crack in the fold using the terms:
 - into but not through the surface finish;
 - extending through the surface finish to expose an underlying layer - state whether the exposed layer is a contrasting colour;
 - extending through the surface finish to expose the underlying material substrate;
- d) whether there is any delamination or flaking of the surface finish.

6.2.10 For fabric, where it is feasible to do so, count and record the number of broken yarns and state whether the yarns were warp or weft and whether the damage was on inward or outward folds.

6.2.11 For leather test specimens which are being assessed specifically for salt spue grade the amount of spue as "light", "marked", or "heavy", as judged by the unaided eye.

6.2.12 Replace the test specimens, start the flexing machine, and repeat the procedure in 6.2.8 to 6.2.12 at a number of suitable intervals, see Table 2, throughout the test.

7 Test Report

The test report shall include the following information:

- a) for each test specimen record:
 - whether it was tested wet or dry;
 - the temperature and if relevant, the humidity of the surrounding environment;
 - the testing direction and whether face up or face down;
 - the severity of flexing damage or salt spue and total number of flexing cycles at each inspection stage;
 - the total number of flexes;
- b) if testing finished footwear or uppers, a description of the style of shoe tested including commercial style codes;
- c) a description of the material tested, including commercial reference if known;
- d) reference to the method of test;
- e) date of testing;
- f) any deviations from this test method.