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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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

ISO 17694 was prepared by the European Committee Standardization (CEN) Technical Committee CEN/TC 309, *Footwear*, in collaboration with ISO Technical Committee TC 216, *Footwear*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 17694:2003), which has been technically revised.

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

## 1 Scope

This International 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

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

ISO 3696, *Water for analytical laboratory use — Specification and test methods*

ISO 5402-1:2011, *Leather — Determination of flex resistance — Part 1: Flexometer method*

ISO 17709<sup>1)</sup>, *Footwear — Sampling location, preparation and duration of conditioning of samples and test pieces*

ISO 18454<sup>2)</sup>, *Footwear — Standard atmospheres for conditioning and testing of footwear and components for footwear*

## 3 Terms and definitions

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

### 3.1

#### **flex resistance**

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

### 3.2

#### **surface**

visible site of the material during the use at the shoe

Note 1 to entry: The visible site of the material can be by upper the grain site of the leather or the coated site of a coated textile, by lining the site of the material visible from the inside of the shoe.

## 4 Short description

Test specimens are cut from a shoe vamp or from material for shoes, folded and inserted in the test machine. 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. It is carried out humid, dry or in a cold climate.

## 5 Apparatus and material

The following apparatus and material shall be used.

1) EN 13400 is equivalent to ISO 17709.

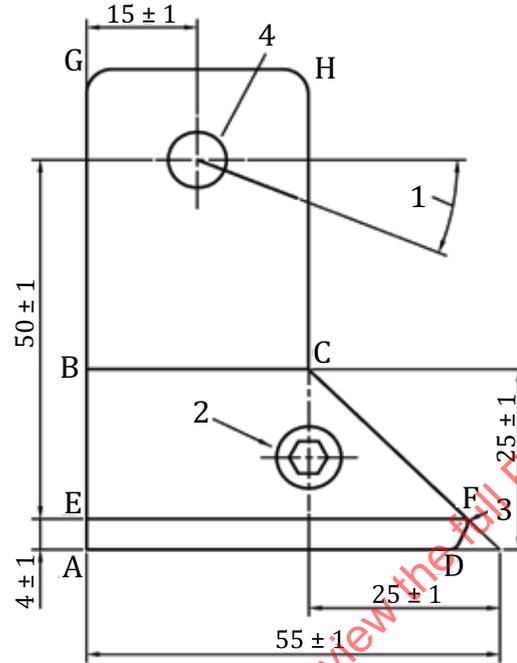
2) EN 12222 is equivalent to ISO 18454.

5.1 **Test machine**, in accordance with ISO 5402-1:2011, 4.1 including the following.

5.1.1 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
- 4 horizontal axle

**Figure 1 — Upper clamp dimensions**

5.1.2 **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  $(100 \pm 5)$  cycles/min.

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

5.1.3 **Means of counting**, the total number of cycles.

5.2 **Press knife**,  $(70 \pm 1)$  mm  $\times$   $(45 \pm 1)$  mm or similar for cutting test specimens.

5.3 **Optical magnifier**, with a magnification of approximately four to six times.

5.4 **For wetting test specimens.**

5.4.1 **Glass dish**, minimum of 100 mm diameter and 25 mm depth.

5.4.2 **Distilled or deionised water**, complying with Grade 3 of ISO 3696.

### 5.4.3 Filter paper.

5.4.4 **Desiccator** or another container, able to evacuate.

5.4.5 **Vacuum pump**, for reducing the pressure within the desiccator to below 4 kPa.

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

## 6 Sampling and conditioning

### 6.1 General

Cut out the required number (see [Table 1](#)) of rectangular test specimens with the press knife. Cut half the required number of test specimens with the longer edge parallel with the along direction of the material [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 ISO 17709.

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 at width only; the length  $(70 \pm 1)$  mm shall not be reduced. However, 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 of 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	—	—

### 6.2 Dry tests

Place all the test specimens which will be tested dry in a standard controlled atmosphere complying with ISO 18454 for at least 24 h prior to test.

### 6.3 Wet tests

Place any test specimens that are to be tested wet in a glass dish. Fill in distilled or deionised water until a minimum water depth of 10 mm. Place the glass dish in the desiccator. Reduce the pressure for 2 min under less the 4 kPa. The normal pressure has to be re-established after the 2 min. Repeat this process two times. Take the test specimens out of the desiccator and remove the rest of water with filter paper and start the wet tests immediate.

## 6.4 Cold tests

The test machine shall be placed in a cold cabinet. Place the test specimens in the test machine. Close the cabinet and start the cooling until the desired temperature. The test shall start after 30 min in the cold atmosphere.

Warm the cold chamber slowly to room temperature after flexing to avoid condensation effects. After replacing the specimens cool the chamber and start the flexometer 30 min after reaching the desired temperature again.

## 7 Test method

### 7.1 Principle

A rectangular test specimen is clamped in a flexing machine. One end of the test specimen is held in an upper clamp with the 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.

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.

### 7.2 Procedure

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.

**7.2.1** Carry out the test in the conditioned standard atmosphere specified in ISO 18454.

**7.2.2** If conducting a wet test, use the prepared test specimen (6.3).

**7.2.3** If conducting a cold test, follow the instruction of 6.4 and start the tests. Ensure that the atmosphere surrounding the flexing machine is at the required temperature [usually  $(-5 \pm 2) ^\circ\text{C}$ ].

**7.2.4** Load each test specimen as follows.

**7.2.4.1** Open the upper and the lower clamp up to the twice thickness of specimen, at least.

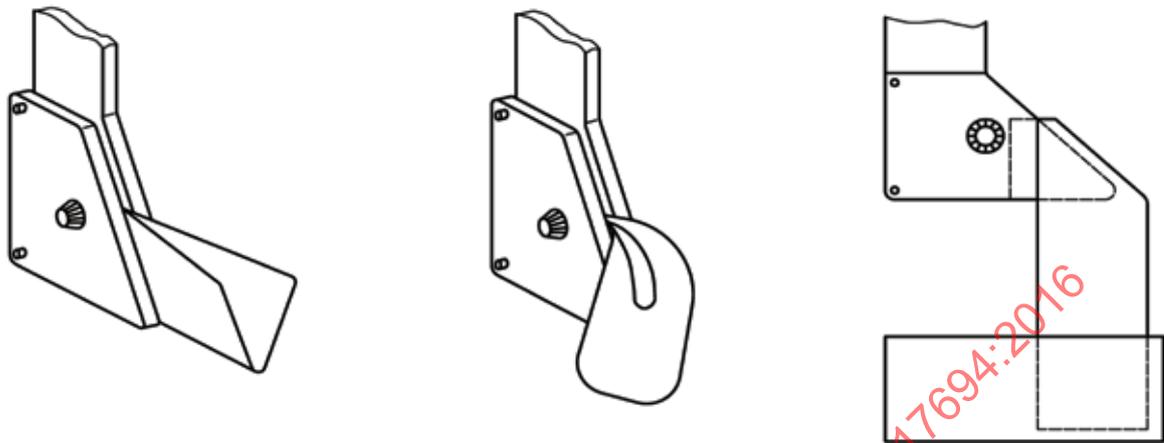
**7.2.4.2** Turn the motor as far as the lower edge of the upper clamp stands parallel to the upper edge of the fixed lower clamp.

**7.2.4.3** Fold the test specimen with the surface inwards, so that the two longer edges of the test specimen are brought together. Insert the folded test specimen with the fold edge against the stripe and the end of the test specimen against the stop of the clamp appropriate [see Figure 2 a)].

**7.2.4.4** Fold the free edges of the test specimen inside out and down round the upper clamp to bring the reverse or flesh sides of the material into contact [see Figure 2 b)].

**7.2.4.5** Insert the free end of the test specimen in the lower clamp [see Figure 2 c)]. This part of the folded test specimen shall be placed vertical in the lower clamp. 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.



a) Sample in upper clamp

b) Sample folded back

c) Sample fully clamped

**Figure 2 — Loading of test specimens**

7.2.5 Run the machine until the first inspection stage (see [Table 2](#)).

7.2.6 In addition to the normal inspection stages, wet test specimens shall be removed from the machine after every 5 000 cycles and assessed for salt spue before rewetting by repeating the procedure in [6.3](#).

**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 type of material and end-application.

NOTE For certain applications, extended flexing intervals may be applied.

7.2.7 Stop the test and remove the test specimens. Use both the unaided eye and the optical magnifier ([5.3](#)) 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.

7.2.8 For materials with a continuous surface coating, record the following:

- whether the specimen shows slight or heavy creasing in the fold;
- cracks — visible with unaided eye; fine cracks — visible with the optical magnifier;