भारतीय मानक

Indian Standard

IS 8085 (Part 20) : 2023
ISO 17694 : 2016

फुटवियर की परीक्षण पद्धतियाँ

भाग 20 अपर और लाइनिंग के लिए फ्लेक्स प्रतिरोध

Methods of Test for Footwear

Part 20 Flex Resistance for Uppers and Lining

ICS 61.060

भारतीय मानक ब्यूरो
BUREAU OF INDIAN STANDARDS
मानक भवन, 9 बहादुर शाह ज़फर मार्ग, नई दिल्ली - 110002
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI - 110002
www.bis.gov.in www.standardsbis.in

August 2023 **Price Group 6**

Footwear Sectional Committee, CHD 19

NATIONAL FOREWORD

This Indian Standard (Part 20) which is identical with ISO 17694 ‘Footwear — Test methods for upper and lining: Flex resistance’ issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Footwear Sectional Committee and approval of the Chemical Division Council.

This Indian Standard published as a part of IS 8085 under the general title ‘Method of test for footwear’. This part is an adoption of ISO 17694 : 2016 which 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.

The other parts of this Indian Standard are:

IS	*Title*
IS 8085	Methods of test for footwear
(Part 1) : 1986	Dimensions, fitting, adhesion test, peel test, heat resistance test and ageing test (*first revision*)
(Part 2) : 1999	Footwear performance test, stiffness test for shanks, lastometer test for cracking of uppers; and performance test for upper fabrics, coated fabrics, sock lining and other lining materials.
(Part 3) : 2021	Upper sole adhesion
(Part 4) : 2019	Resistance to crack initiation and growth — Belt flex method
(Part 5) : 2019	Longitudinal stiffness of shanks
(Part 6) : 2021	Abrasion resistance of uppers, linings and insocks
(Part 7) : 2021	Deformability of upper
(Part 8) : 2019	Delamination resistance of uppers
(Part 9) : 2023	Tear strength of uppers linings and insocks
(Part 10) : 2023	Heel attachment for whole shoe
(Part 11) : 2023	Attachment strength of straps, trims and accessories
(Part 12) : 2023	Tensile performance of elastic materials
(Part 13) : 2023	Seam strength for uppers, lining and insocks
(Part 14) : 2023	Water vapour permeability and absorption for uppers and lining
(Part 15) : 2023	Washability in a domestic washing machine for whole shoe
(Part 16) : 2023	Flexing durability for whole shoe
(Part 17) : 2023	Abrasion resistance for accessories shoe laces
(Part 18) : 2023	Peel strength before and after repeated closing for accessories touch and close fasteners
(Part 19) : 2023	Shear strength before and after repeated closing for accessories touch and close fasteners

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Indian Standard

METHODS OF TEST FOR FOOTWEAR

PART 20 FLEX RESISTANCE FOR UPPERS AND LINING

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[1)], *Footwear — Sampling location, preparation and duration of conditioning of samples and test pieces*

ISO 18454[2)], *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.

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1) EN 13400 is equivalent to ISO 17709.

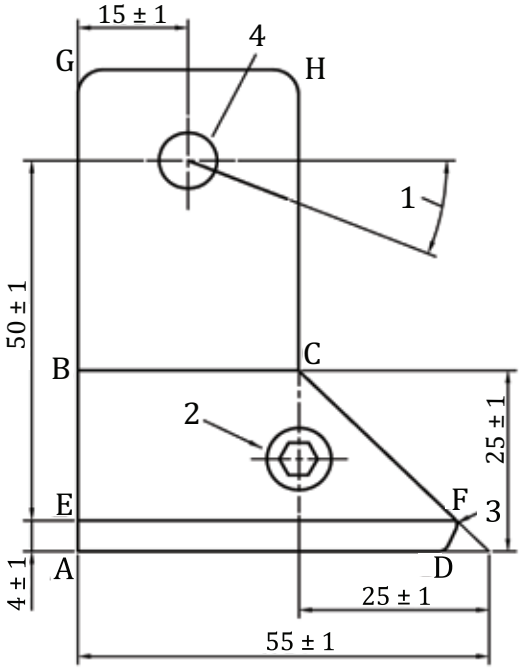
2) EN 12222 is equivalent to ISO 18454.

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°30’ ± 0°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°30’ ± 0°30’. The speed of oscillation shall be (100 ± 5) cycles/min.

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

5.1.3 Means of counting, the total number of cycles.

5.2 Press knife, (70 ± 1) mm × (45 ± 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 ± 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 ± 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 ± 2) °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.

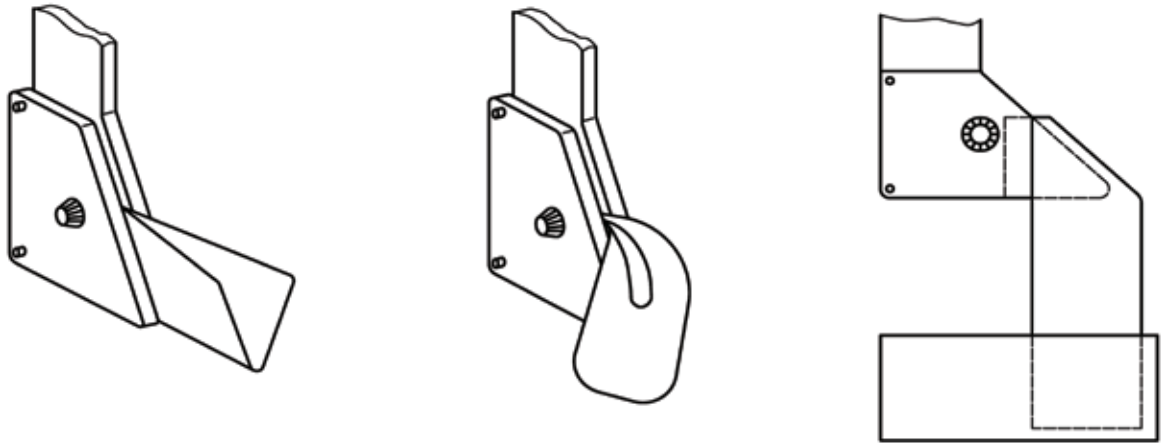
7.2.4.2 Turn the motor as far as the lower edge of the upper clamp stands parallel to the upper edge of the fixed lower clamp.

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:

a) whether the specimen shows slight or heavy creasing in the fold;

b) cracks — visible with unaided eye; fine cracks — visible with the optical magnifier;

c) loss of adhesion between material layers (e. g. between leather and finish);

d) greying;

e) powdering or flacking of coatings.

7.2.9 For fabrics, record if there are broken yarns (warp and weft).

7.2.10 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.

7.2.11 Replace the test specimens, in exactly the same position ignoring any effect of permanent elongation, start the flexing machine and repeat the procedure in 7.2.7 to 7.2.11 at a number of suitable intervals (see Table 2) throughout the test.

8 Test report

The test report shall include the following information:

a) for each test specimen record:

- labelling;
- whether it was tested wet or dry or cold;
- the temperature and if relevant, the humidity of the surrounding environment;
- the testing direction and whether surface up or surface 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) a reference to this International Standard, i.e. ISO 17694:2016;

e) the date of testing;

f) any deviations from this test method.

(*Continued from second cover*)

The text of ISO standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions and terminologies are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words `This document' appear referring to this standard, they should be read as `Indian Standard'; and
b) Comma (,) has been used as a decimal marker in the International Standard, while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, the reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards, which are to be substituted in their respective places, are listed below along with their degree of equivalence for the editions indicated:

International Standards	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 5402-1 Leather — Determination of flex resistance — Part 1: Flexometer method	IS 5914 (Part 6/Sec 1) : 2023/ISO 5402-1 : 2022 Methods of physical testing of leather: Part 6 Determination of flex resistance, Section 1 Flexometer method	Identical
ISO 17709 Footwear — Sampling location, preparation and duration of conditioning of samples and test pieces	IS 2051 : 1976 Method for sampling of leather footwear (*first revision*)	Not equivalent

In this adopted standard, the reference appears to certain International Standards for which Indian Standards do not exist. So, the technical committee has reviewed the provisions of the following International Standards/ documents referred in this adopted standard and has decided that they are acceptable for use in conjunction with this Standard:

International Standard	*Title*
ISO 3696	Water for analytical laboratory use — Specification and test methods
ISO 18454	Footwear — Standard atmospheres for conditioning and testing of footwear and components for footwear

In this adopted standard, reference appears to certain International Standards where the standard atmospheric conditions to be observed are stipulated which are not applicable to tropical/subtropical countries. The applicable standard atmospheric conditions for Indian conditions are (27 ± 2) °C and (65 ± 5) percent relative humidity and shall be observed while using this standard.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 2016 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.gov.in

Regional Offices:		*Telephones*
Central	: 601/A, Konnectus Tower -1, 6th Floor, DMRC Building, Bhavbhuti Marg, New Delhi 110002	2323 7617
Eastern	: 8th Floor, Plot No 7/7 & 7/8, CP Block, Sector V, Salt Lake, Kolkata, West Bengal 700091	2367 0012 2320 9474
Northern	: Plot No. 4-A, Sector 27-B, Madhya Marg, Chandigarh 160019	265 9930
Southern	: C.I.T. Campus, IV Cross Road, Taramani, Chennai 600113	2254 1442 2254 1216
Western	: Plot No. E-9, Road No.-8, MIDC, Andheri (East), Mumbai 400093	2821 8093

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