

खेल के जूते

भाग 1 सामान्य प्रयोजन

(पहला पुनरीक्षण)

Sports Footwear

Part 1 General Purpose

(First Revision)

ICS 13.340.50, 97.220.01

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FOREWORD

This Indian Standard (Part 1) (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Footwear Sectional Committee had been approved by the Chemical Division Council.

Realizing the growing demand and use of sports footwear in the country and the potentiality of the development, the footwear sectional committee decided to formulate a standard on the product. Different types of materials are used as components for construction of sports footwear. This standard applies to sport footwear where it is necessary to minimize fatigue and to impart useful life to the footwear in different performance requirement of sporting activity.

This standard was originally published in 2010. The committee, while reviewing IS 15844 : 2010 decided to revise the standard keeping in line with the recent development that has taken place in the field and publish this standard in three parts based on the uses of Sports Footwear:

Part-1 General purpose

Part-2 Performance sports footwear

Part-3 Professional sports footwear

The composition of the Committee responsible for the formulation of this standard is given in Annex S.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'. The number of significant places retained in the rounded off value should be same as that of the specified value in this standard.

Indian Standard

SPORTS FOOTWEAR

PART 1 GENERAL PURPOSE

(*First Revision*)

1 SCOPE

1.1 This standard prescribes the performance requirements of sports footwear used for general purposes (for example fitness, exercising, walking and light sports activities etc).

1.2 This standard does not cover the performance requirement for following:

- a) Performance sports footwear (jogging, running including trail running, adventure sport, trekking, climbing and etc); and
- b) Professional sports footwear.

2 REFERENCES

The standards listed in Annex A contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated in Annex A.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 2050 and the following shall apply.

3.1 Toe Spring — Toe spring refers to the degree of upward curvature of the sole under the toes or forefoot (front of the foot). Its purpose is to facilitate forward motion through the front of the shoe.

3.2 Composite Sole — is a multilayer sole and may be made out of multiple materials.

3.2 Cellular Sole — Sole below 0.90 g/cm³ density

3.3 Solid Sole — Sole 0.90 g/cm³ density and above

4 REQUIREMENTS

4.1 Sampling and Conditioning

4.1.1 Wherever, possible test pieces shall be taken from the whole footwear unless otherwise stated.

4.1.2 If it is not possible to obtain test pieces from footwear large enough to comply with tests requirements, then samples may be taken from the

material from which the component has been manufactured. However, this should be reported in the test report.

4.1.3 All tests pieces shall be conditioned at 27 °C ± 2 °C and 65 percent ± 5 percent relative humidity (RH) for 24 hours.

4.2 Construction

4.2.1 Sports footwear shall be such that it would bend easily from any direction and shall retain its original shape after release of force.

4.2.2 Sports footwear may be reinforced suitably at counter with reinforcement such that it neither collapses nor losses shape retention property and shall be flexible.

4.3 Whole Footwear

4.3.1 An insole, if used may be present in such a way that it cannot be removed without damaging the footwear.

4.3.2 The toe spring height of the sports footwear shall be minimum 2 mm and shall be measured as per Fig. 1 of Annex B.

4.3.3 *Upper to Mid Sole/Out Sole Bond Performance*

When footwear is tested according to method given in Annex C, the bond strength between upper to mid sole or upper to out sole shall be not less than 2.5 N/mm, unless there is tearing of the material, in which case the bond strength shall be not less than 2.0 N/mm.

4.3.4 *Upper to Composite Sole Bond Performance (Applicable Only When the Sole is Composite)*

When footwear is tested according to method given in Annex C, the bond strength between upper to mid sole or upper to out sole shall be not less than 2.5 N/mm, unless there is tearing of the material, in which case the bond strength shall be not less than 2.0 N/mm.

4.3.5 *Out Sole to Mid Sole (Multilayer) Bond Performance*

When footwear is tested according to method given in Annex C, in case of footwear having multilayer soles, the bond strength of each layer shall be not

less than 2.5 N/mm, unless there is tearing of the material, in which case the bond strength shall be not less than 2.0 N/mm.

4.3.6 Energy Absorption at Seat Region

When tested in accordance with the method given in IS 15298 (Part 1), the energy absorption of the seat region shall not be less than 15 J.

4.3.7 Complete Shoe Flexing

When footwear is tested in accordance with the method given in 'IS 8085 (Part 16)/ISO 24266' (Method A) at an angle of 45 degrees at 100 000 cycles, no change in upper (for example crack, thread breakage, fabric broken), sole cracking, bond opening shall occur.

4.3.8 Washability (Optional Requirement)

When footwear is tested in accordance with the method given in IS 8085 (Part 15)/ISO 19954 : 2003, there shall not be any bond opening, coating

separation, and grey scale rate shall be minimum 3 grey scale.

If the sports footwear is claimed as washable shoe, then washability test has to be carried out and shall be suitably marked with 'W'.

4.3.9 Slip Resistance

When tested in accordance with the method given in Annex E, the coefficient of friction shall not be less than 0.3 at both dry and wet condition on clay tiles.

4.4 Upper

The upper of sports footwear made of leather material shall conform to the requirements as specified in Table 1, whereas upper of sports footwear made of coated fabric/textile or combinations thereof shall conform to the requirements as specified in Table 2.

Table 1 Upper Material – Leather
(Clause 4.4)

SI No.	Characteristics	Requirements	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Flexing resistance,		
	a) Dry condition	No crack to leather or film till 100 000 cycles	IS 5914 (Part 6/Sec 1)/ISO 5402-1
	b) Wet condition	No crack to leather or film till 200 00 cycles	
ii)	Tear strength (average force), <i>Min</i> , N	50	IS 5914 (Part 5/Sec 2)/ISO 3377-2
iii)	Colour fastness rubbing (To and fro) Grey scale rate, <i>Min</i>		
	a) Dry: (rubbing) Rating: (Marring and staining)	150 3 grey scale	IS 6191 (Part 4)
	b) Wet: (rubbing) Rating: (Marring and staining)	50 3 grey scale	
iv)	a) Water vapour permeability, mg/cm ² h, <i>Min</i>	0.8	IS 15298 (Part 1)
	b) Water vapour coefficient, mg/cm ² , <i>Min</i>	15	IS 15298 (Part 1)

Table 1 (Concluded)

SI No.	Characteristics	Requirements	Method of Test, Ref to
(1)	(2)	(3)	(4)
v)	Stitch tear strength (double hole), N/mm, <i>Min</i>	50	LP 8 of IS 5914
vi)	Colour fastness to light (Optional) Grey scale rate, <i>Min</i> Rating: (Marring)	4	IS/ISO 105B02

Table 2 Upper Material – Material Other than Leather

(Clause 4.4)

SI No.	Characteristics	Requirements	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Breaking strength, N/mm, <i>Min</i>	6.0	
ii)	Elongation at break, percent <i>Min</i> a) Tighter direction b) Stretch direction	7 15	IS 7016 (Part 2) Method 1
iii)	Tear strength, N, <i>Min</i> <i>For Fabric:</i> <i>For all other materials:</i>	20 30	IS 15298 (Part 1)
iv)	Flexing resistance, (Applicable for coated fabrics) a) Dry condition b) Wet condition	No damage to coating/ lamination till 100 000 flexes No damage to coating/ lamination till 20 000 flexes	ISO 17694
v)	a) Water vapour permeability, mg/cm ² h, <i>Min</i> b) Water vapour coefficient, mg/cm ² <i>Min</i> (Applicable for textile upper)	0.8 15.0	IS 15298 (Part 1)
vi)	Hydrolysis resistance (After ageing at 70 °C and 95 percent RH for 7 days) (Applicable only for material having PU)	No damage/crack to coating/lamination till 100 000 flexes	IS 16645/ISO 5423 : 1992
vii)	Bursting Strength, kg/cm ² , <i>Min</i> (Additional test required for Knitted Fabrics)	8	IS 1966 (Part 2)/ISO 13938-2 : 2019

4.5 Lining

The lining material, if used in the sports footwear shall conform to requirement as prescribed in Table 3.

Table 3 Lining Material – All Materials

(Clause 4.5)

SI No.	Properties	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Tear strength, N, <i>Min</i>	15	IS 15298 (Part 1)
ii)	Abrasion resistance, cycles		IS 15298 (Part 1)
	a) Dry condition	Shall not develop any hole before 12 800 cycles	
	b) Wet condition	Shall not develop any hole before 6400 cycles	
iii)	Colour fastness to rubbing (crocking), Grey scale rate with 10 rubs on dry or wet, <i>Min</i>		IS/ISO 105-X12
	Rating: (Staining)	3	
iv)	Colour fastness to perspiration (contact method) Grey scale rate, <i>Min</i>		IS 6191 (Part 6)/ISO 11641
	Rating: (Staining)	3	
v)	a) Water vapour permeability, mg/cm ² h, <i>Min</i>	2.0	IS 15298 (Part 1)
	b) Water vapour coefficient, mg/cm ² , <i>Min</i> (excluding coated fabric)	20.0	IS 15298 (Part 1)

4.6 Insole

The insole, if used in sports footwear shall conform to requirement as prescribed in Table 4.

Table 4 Insole - All Materials*(Clause 4.6)*

Sl No. (1)	Properties (2)	Requirement (3)	Method of Test, Ref to (4)
i)	Thickness, mm, <i>Min</i>	0.8	IS 15298 (Part 1)
ii)	Flexing index, <i>Min</i> (Only applicable for cellulose board)	2.7	Annex 'F'
iii)	Abrasion resistance, at 400 cycles	No surface tearing	IS 15298 (Part 1)
iv)	a) Water Absorption, mg/cm ² , <i>Min</i>	60	IS 15298 (Part 1)
	b) Water Desorption, percent, <i>Min</i>	70	IS 15298 (Part 1)

4.7 In-sock

The in-sock used in the sports footwear shall conform to requirement as prescribed in Table 5.

Table 5 In-sock- All Materials*(Clause 4.7)*

Sl No. (1)	Properties (2)	Requirement (3)	Method of Test, Ref to (4)
i)	Thickness, mm, <i>Min</i> (including foam)	1.5	IS 15298 (Part 1)
ii)	Abrasion resistance, cycles		
	a) Dry condition	Shall not develop any hole before 12 800 cycles	IS 15298 (Part 1)
	b) Wet condition	Shall not develop any hole before 6 400 cycles	IS 15298 (Part 1)
iii)	a) Water Absorption, mg/cm ² , <i>Min</i>	10	IS 15298 (Part 1)
	b) Water Desorption, percent <i>Min</i>	50	IS 15298 (Part 1)

4.8 Out Sole

The outsole used in the sports footwear shall conform to requirement as prescribed in Table 6.

Table 6 Out Sole (All Material)*(Clause 4.8)*

SI No. (1)	Properties (2)	Requirement (3)	Method of Test, Ref to (4)
i)	Abrasion resistance (Volume loss), mm ³ , <i>Max</i> ¹		
	a) Cellular sole (load 5 N)	500	IS 3400 (Part 3)/ISO4649
	b) Solid Sole (load 10 N)	350	
ii)	Flexing resistance Belt Method at 90 diameter Mandrel	No crack at 30 000 flexes	IS 8085 (Part 4)
	or		
	Bennewart method, cut growth, <i>Max</i>	6 mm	Annex D
iii)	Hydrolysis resistance, cut growth after 150 000 flexes, in mm, <i>Max</i> (Only for PU out sole)	6.0	IS 15298 (Part 1)
NOTES			
1 Cellular Sole – Sole with density less than 0.90 g/cm ³ density.			
Solid Sole – Sole with density 0.90 g/cm ³ and above.			

4.9 Mid Sole

The midsole, if used in the sports footwear shall conform to requirement as prescribed in Table 7.

Table 7 Mid Sole*(Clause 4.9)*

SI No. (1)	Properties (2)	Requirement (3)	Method of Test, Ref to Annex (4)
i)	Compression set, percent, <i>Max</i>		Annex G
	<i>For EVA</i>	60	
	<i>For all other materials</i>	50	
ii)	Split tear strength, kg/25 mm, <i>Min</i>	1.5	Annex H
iii)	Heat shrinkage, percent, <i>Max</i>	5.0	Annex J

4.10 Counter Stiffener

The counter Stiffener, if used in the sports footwear shall conform to requirement as prescribed in Table 8.

Table 8 Counter Stiffener

(Clause 4.10)

SI No.	Properties	Requirement	Method of Test, Ref to Annex of IS 7554
(1)	(2)	(3)	(4)
i)	First dry collapsing load, hardness, N, <i>Min</i>	15	A-3.2.6
ii)	Resilience, percent, <i>Min</i>	50	A-3.4
iii)	Moisture resistance, percent, <i>Min</i>	40	A-3.5
iv)	a) Initial dry area shape retention, percent, <i>Min</i>	55	A-3.1
	b) Area shape retention after 10th collapse, dry, percent, <i>Min</i>	45	A-3.3

4.11 Velcro Fastener

The Velcro fastener, if used in the sports footwear shall conform to requirement as prescribed in Table 9.

Table 9 Velcro Fastener

(Clause 4.11)

SI No.	Properties	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Peel strength, N/mm, <i>Min</i>		
	a) Initial	0.10	IS 8085 (Part 18)/ISO 22777
	b) After 5 000 wear cycles	0.08	
ii)	Shear strength, kPa, <i>Min</i>		
	a) Initial	75	ISO 22776
	b) After 5 000 wear cycles	65	

4.12 Elastic Tape

The elastic tape, if used in the sports footwear shall conform to requirement as prescribed in Table 10.

Table 10 Elastic Tape

(Clause 4.12)

SI No.	Properties	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Limit of useful extension, percent, <i>Min</i>	90	IS 8085 (Part 12)/ISO 10765

4.13 Fasteners (Lace/ Buckle/Eyelet/D-Ring/Ski-Hook/Metal trims)

The fasteners for gripping (not for decorative purpose), if used in the sports footwear shall conform to requirement as prescribed in Table 11.

Table 11 Fasteners (Lace/ Buckle/Eyelet/D-Ring/Ski-Hook/Metal trims)

(Clause 4.13)

SI No.	Properties	Requirement	Method of Test, Ref to
(1)	(2)	(3)	(4)
i)	Breaking strength of lace, N, <i>Min</i>	250	Annex 'K'
ii)	Lace tag strength, N, <i>Min</i>	100	Annex 'L'
iii)	Lace to lace abrasion,	No breakage or damage before 4 000 cycles	IS 8085 (Part 17)/ ISO 22774
iv)	Colour fastness to water (for lace) (Contact method) Gray Scale Rate, <i>Min</i> Rating:	3	IS 6191 (Part 2)
v)	Strength of Buckle/Ski hook, N, <i>Min</i>	250	Annex 'M'
vi)	Corrosion resistance (Metal parts)	Not worse than slight uniform change	IS 17098

4.14 Chemical Requirement on Complete Product for all Types of Sports Shoe

All the components of Sports footwear shall comply with the Table 1 of IS 17011 for critical substances Category I and Category II as specified under clause 3.6 of IS 17011.

5 MARKING AND PACKING

5.1 Marking

The sports footwear shall be marked legibly and indelibly with the following:

- a) Size; and
- b) Identification of the source of manufacturer or brand name.

5.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the standard mark.

5.3 Packing

The sports footwear shall be packed as agreed to between the purchaser and the manufacturer. Each individual package shall contain Shoes of one size only and may be marked with the name of the item, size, colour, type, identification of the source of manufacture and batch number and any other marking if so desired.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	Title	IS No.	Title
IS 3400 (Part 3) : 2021/ISO 4649 : 2017	Methods of test for vulcanized rubbers: Part 3 Abrasion resistance using a rotating cylindrical drum device (<i>third revision</i>)	(Part 12)/ISO 10765 : 2010	Tensile Performance of elastic materials (<i>under preparation</i>)
IS 5914 : 1970	Methods of physical testing of leather:	(Part 15)/ISO 19954 : 2003	Washability in a domestic washing machine for whole shoe (<i>under preparation</i>)
(Part 5/Sec 2)/ISO 3377-2 : 2016	Determination of tear load, Section 2 Double edge tear (<i>under preparation</i>)	(Part 16)/ISO 24266 : 2020	Flexing durability for whole shoe (<i>under preparation</i>)
(Part 6/Sec 1)/ISO 5402-1 : 2022	Determination of flex resistance, Section 1 Flexometer method (<i>under preparation</i>)	(Part 17)/ISO 22774 : 2004	Abrasion resistance for accessories shoe laces (<i>under preparation</i>)
(Part 6/Sec 2)/ISO 5402-2 : 2015	Determination of flex resistance, Section 2 Vamp flex method (<i>under preparation</i>)	(Part 18)/ISO 22777 : 2004	Peel strength before and after repeated closing for accessories touch and close fasteners (<i>under preparation</i>)
IS 6191 : 1971	Methods of micro-biological colour fastness and microscopical tests for leather:	IS 15298 (Part 1) : 2015	Personal protective equipment: Part 1 Test methods for footwear (<i>second revision</i>)
(Part 2) : 2017/ISO 11642 : 2012	Colour fastness to water	IS 17011 : 2018	Chemical requirements for footwear and footwear materials
(Part 4) : 2018/ISO 11640 : 2012	Colour fastness to cycles of to-and-fro rubbing	IS 17098 : 2019/ISO 22775 : 2004	Footwear — Test methods for accessories: Metallic accessories — Corrosion resistance
(Part 6)/ISO 11641 : 2012	Colour fastness to perspiration (<i>under preparation</i>)	IS 16645 : 2018/ISO 5423 1992	Moulded plastics footwear — Lined or unlined polyurethane boots for general industrial use” specification
IS 7016 (Part 2) : 2015/ISO 1421 : 2016	Methods of test for coated and treated fabrics: Part 2 Determination of tensile strength and elongation at break (<i>second revision</i>)	ISO 22776 : 2004	Footwear — Test methods for accessories: Touch and close fasteners — Shear strength before and after repeated closing
IS 7554 : 2009	Toe puff and counter stiffener — Specification (<i>first revision</i>)	IS/ISO 105 B02 : 2014	Textiles — Tests for colour fastness: Part B02 Colour fastness to artificial light: Xenon arc fading lamp test
IS 8085	Methods of test for footwear:		
(Part 4) : 2019/ISO 16177 : 2012	Part 4 Resistance to crack initiation and growth — Belt flex method		

ANNEX B
(Clause 4.2.1)

The toe spring height of the sports footwear shall be measured as shown in Fig. 1.



FIG. 1 TOE SPRING

ANNEX C
(Clauses 4.3.2 and 4.3.3)
ADHESION TEST

C-1 DESCRIPTION

This method measures the peel strength of bonds between the outsole, midsole, and upper components of assembled shoes.

C-2 MATERIALS

C-2.1 Assembled Shoes, or Assembled Midsole/Outsole Units

C-3 EQUIPMENT

C-3.1 Tensile testing machine (load cell shall have a capacity of less than or equal to 50 kg with jaw separation speed of 100 mm/min \pm 10 mm/min).

C-3.2 Clamping Jaws for the Tensile Tester

C-3.3 Razor or Sharp Knife

C-3.4 Steel Scale, capable of measuring to 0.5 mm.

C-3.5 Sample Press

C-3.6 Humidity Chamber, capable of controlling the temperature to 70.0 $^{\circ}$ C \pm 1.0 $^{\circ}$ C, and the relative

humidity to 95 percent \pm 3 percent.

C-3.7 Air-Circulating Oven, capable of controlling the temperature to 50.0 $^{\circ}$ C \pm 1.0 $^{\circ}$ C.

C-4 SAMPLE PREPARATION

C-4.1 If the test sample is a whole shoe, the entire upper portion of the shoe must be removed by slicing with a razor blade or sharp knife along the midsole/upper joint. It will also be necessary to remove the heel counter, sockliner, and any threads used to stitch the upper to the outsole.

NOTE — It is very important that this step be undertaken with care so that no damage to the bond line occurs.

C-4.2 If a midsole to upper bond is being tested, draw a line around the perimeter of the top side of the midsole/upper which has a width of 1.0 cm \pm 0.1 cm from the edge. Where the upper material bonds directly to the outsole in the toe area, the width shall be reduced to 0.5 cm \pm 0.05 cm.

C-4.3 If the outsole to midsole bond is being tested, draw a line around the perimeter of the bottom side

of the midsole/outsole which has a width of 1.0 cm ± 0.1 cm from the edge.

C-4.4 Using a razor blade or sharp knife, accurately cut along this perimeter line so that the cut completely penetrates through the upper or outsole component and into the midsole.

NOTE — Once the perimeter cut has been made, it may be easiest to initiate a peeling location by cutting through the upper or outsole material perpendicular to the perimeter. This cut should be made in the shank area of the shoe. Peel the 1.0 cm wide upper or outsole strip away from the midsole for a distance of about 2 cm.

C-4.5 For reference purposes only, place a mark on the testing sample approximately every 2 cm and number these locations starting at the initiation point in ascending order around the entire perimeter of the shoe. (A corresponding number will be written onto the chart recorder plot, as testing proceeds. By doing this, the location on the shoe will have a corresponding location on the chart recorder).

C-5 TEST PROCEDURE

C-5.1 Standard Test

C-5.1.1 Equip the tensile testing machine with suitable jaws which are capable of clamping the test samples firmly in place such that no slippage occurs during testing.

C-5.1.2 Zero and calibrate the tensile testing machine. Set the crosshead speed to 150 mm/min and the load range to 20 kg, and a jaw gap of approximately 40 mm.

C-5.1.3 Zero and calibrate the chart recorder. Set the chart speed to 50 mm/min and the load range to 20 kg (adjust the load range as necessary dependent on the strength of the bond).

C-5.1.4 Centrally and vertically, clamp the test sample in the jaws of the tensile tester as follows:

<i>Stationary Jaw</i>	<i>Moving Jaw</i>
Rubber	Leather, Synthetic, Fabric
Rubber	Ethyl vinyl acetate
Rubber	Leather, Synthetic, Fabric

For other material combinations, the stretcher material is always clamped to the stationary jaw.

C-5.1.5 Operate the tensile machine at a crosshead speed of 150 mm/min.

NOTES

1 Do not allow the jaws to separate more than 300 mm, before returning the jaws to their starting point and re-clamping the test sample.

2 It will be necessary to cut the materials back to the bond line as testing proceeds. Also, do not use data which is produced while cutting is being performed. Do not cut the test sample while bond delamination is occurring.

3 It will also be necessary to continuously mark the chart recorder to identify the location on the test sample, areas where cutting back to the bond line had occurred, and the type of failure that is:

- a) AF: Adhesive failure or failure at the adhesive/substrate interface;
- b) CF: Cohesive failure or internal failure of the adhesive; and
- c) SF: Substrate failure or tearing/breaking of one of the substrate materials.

C-5.1.6 Identify and record the minimum peak values on the chart recorder plot, to the nearest 0.1 kg (l). Do not evaluate any area where cutting back to the bond line was being performed.

C-5.1.7 Measure the width of the sample at the point which corresponds to the minimum peak, to the nearest 0.05 cm (W).

C-6 INTERPRETATION OF TEST RESULTS

The peel strength is measured utilizing only peaks and plateaus on the stress-strain plots from the chart recorder. A peak is defined as any point on the plot at which the load decreases, immediately preceding and following this point (*see* Fig. 2). A plateau is defined as any location on the plot where the load neither increases or decreases for a distance of 5 mm or more (*see* Fig. 3).

Failure points on a shoe are measured based on the distance, which the plot line travels, below a specified level of peel strength. The length of the plot line is measured starting from the first peak or plateau, which falls below a specified level of peel strength. Follow the line until it rises above the specified level of peel strength. Mark this point, and then move backward along the line to the last peak or plateau, which lies below the specified level of peel strength. The overall length of the line is determined by measuring between the first and the last peak or plateau, which falls below the specified level of peel strength. In addition, the mode of failure should be noted as follows:

- a) AF = Failure at the adhesive/substrate interface or the adhesive/primer interface;
- b) CF = Cohesive failure of the adhesive (failure within the adhesive or between the two layers of adhesive);
- c) PF = Failure at the primer/substrate interface; and

- d) SF = Failure of the substrate, including the location of the failure within the substrate.

If identified, the reason for bond failure shall also be reported. For example, insufficient roughing (IR), insufficient activation temperature (IT), inadequate pressing (IP), under application of adhesive (UA) or primer (UP), etc.

C-7 CALCULATION

$$\text{Peel strength, N/mm} = \frac{L}{W}$$

C-8 REPORT

- Determine, from the load/deformation graph, the average load in newtons and divide by the average width to give the bond strength in N/mm;
- Determine the bond strength at three different areas that is toe area, inside, outside; and
- Final result shall be the average of the results at (b).

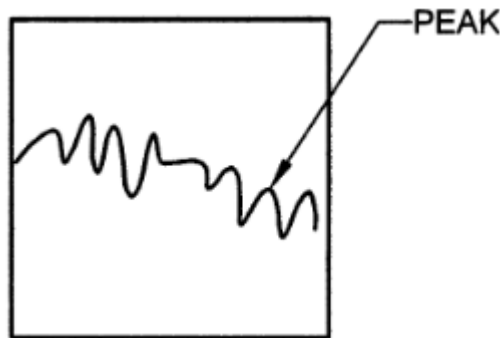


FIG. 2 GRAPH DEPICTING PEAK FOR ADHESION TEST

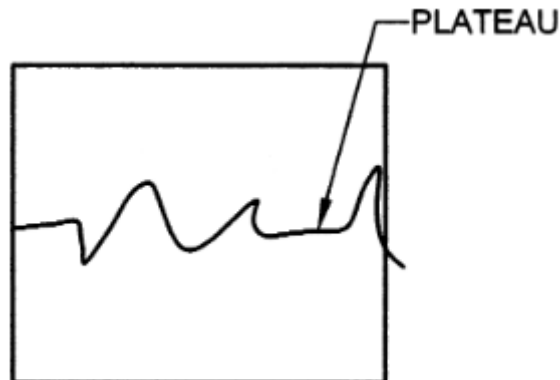


FIG. 3 GRAPH DEPICTING PLATEAU FOR ADHESION TEST

ANNEX D

(Table 6 Clause 4.8)

BENNEWART FLEX TEST – RESISTANCE TO CUT GROWTH ON FLEXING

D-1 SCOPE

This method is intended to determine the resistance of a component or material to cut growth during repeated flexing. It can also be used to assess the effect of surface patterns on crack initiation and growth. This method is especially applicable to the outsoles of footwear, but may also be used with certain other flexible components.

D-2 PRINCIPLE

D-2.1 Cut Growth of a Footwear Outsole

The flexing line of test outsole during normal wear or use is determined. In the sample, three standard cuts are made parallel to the flexing line and through the thickness of the outsole at points which are considered to experience the highest tensional strains which will be at or close to the flexing line.

The cut growth is measured by repeated flexing through 90° on the flexing line for a fixed number of cycles.

D-2.2 Crack Initiation and Growth

Test is conducted in the same way as described in 2.1, except that no cuts are made in the sample specimen. Number of cracks formed and their severity is recorded at regular intervals throughout the test.

D-2.3 Cut Growth of Material

A standard cut is made through the full thickness of a rectangular specimen of a material. The cut growth is measured by repeated flexing through 90° for a fixed number of cycles.

D-3 APPARATUS

D-3.1 A flexing machine, [see Fig. 4 (a) and Fig. 4

(b)] with a mandrel of diameter 30 mm ± 1 mm around which the specimens are flexed. The length of this mandrel may be 150 mm ± 1 mm.

D-3.1.1 A means of firmly clamping the specimen at both ends so that the flexing line is aligned with the axis of mandrel. These clamps should be 110 mm ± 1 mm apart when in unclamped position and have a length of 155 mm ± 1 mm. One of the clamps should be fixed and the other should move forwards and backwards in the same plane from the unflexed position by 41.5 mm ± 0.5 mm.

D-3.1.2 A means of counting the total number of flexing cycles.

D-3.1.3 A means of flexing the specimens at a rate of 125 to 150 cycles per minute through an angle of 90° ± 2° about the axis of the mandrel.

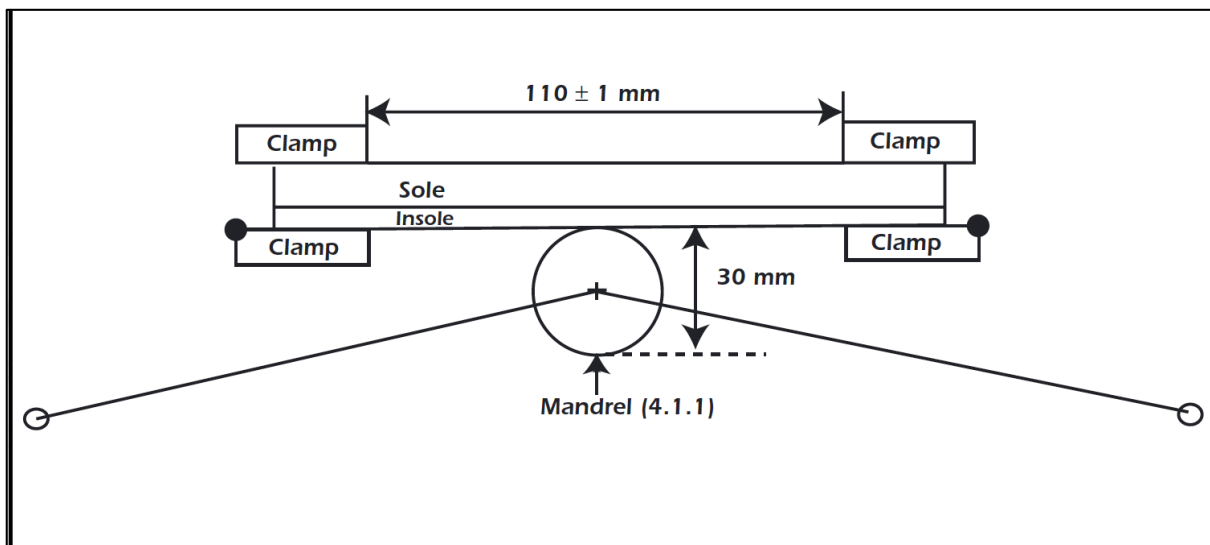


FIG. 4 (a) THE SPECIMEN IN UNFLEXED STATE

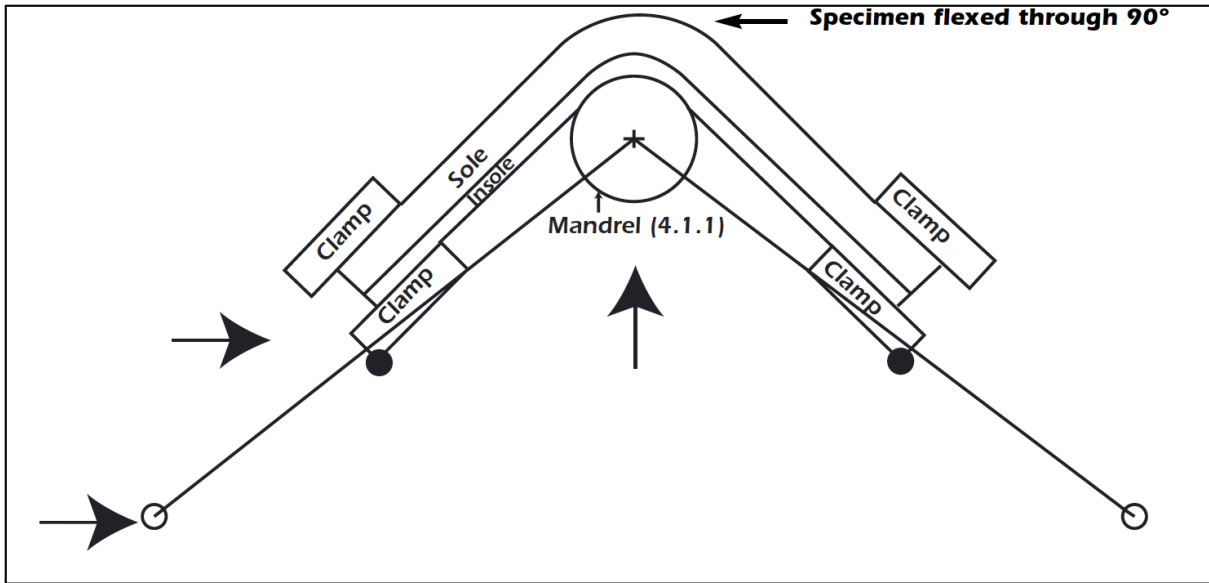


FIG. 4 (b) FULLY FLEXED TEST SPECIMEN

D-3.2 Vernier Callipers

D-3.3 Chisel (*see* Fig. 5)

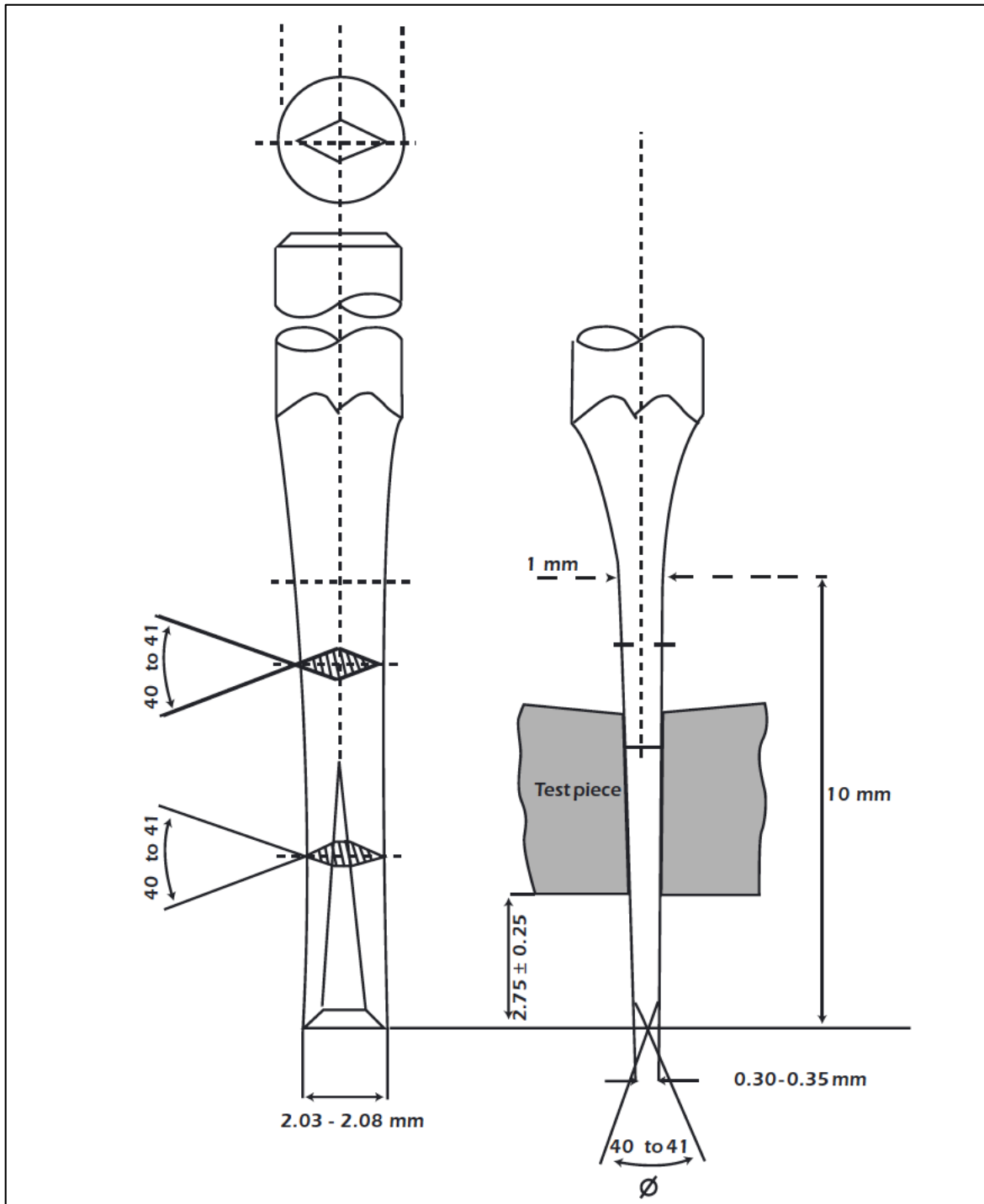


FIG. 5 CHISEL

D-3.4 A device for measuring the temperature of environment surrounding the test specimen to an accuracy of ± 1 °C.

D-3.5 A standard thickness guage for rubber.

D-4 PREPARATION OF TEST SPECIMENS

D-4.1 Sole Taken from Complete Footwear

D-4.1.1 Carefully cut the upper of shoe from sole without disturbing any insole and lasted margin attached.

D-4.1.2 If the sole has a raised edge to its upper surface such as a lip or an imitation welt, this should be carefully scoured off the forepart area down to, but not beyond the insole surface.

D-4.1.3 A line XY needs to be drawn on the outsole from heel to toe, *see* Fig. 6 and measure it to the nearest mm.

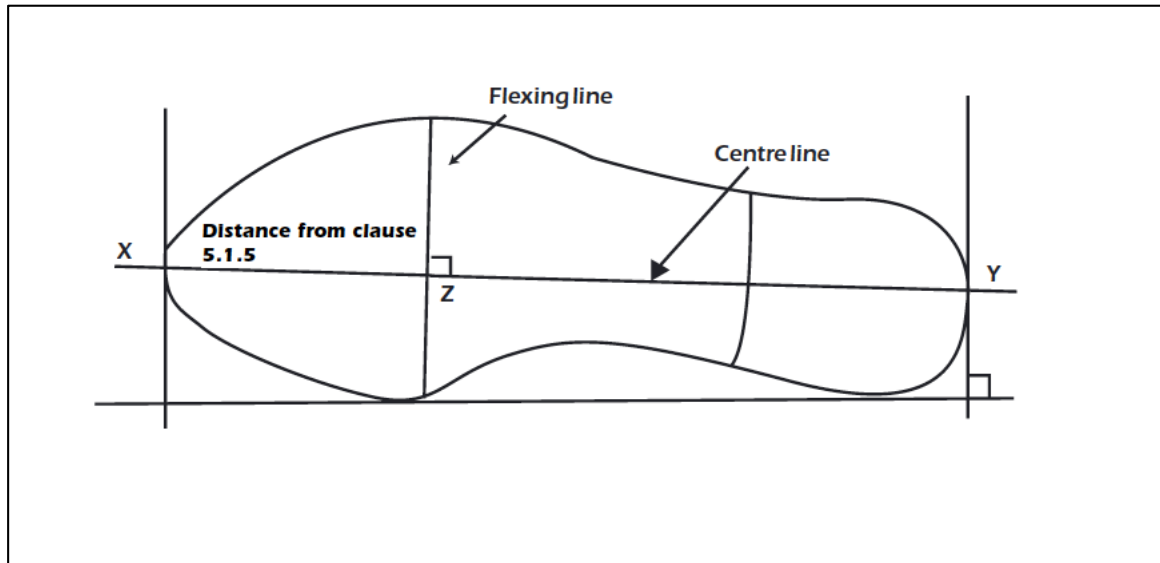


FIG. 6 LOCATION OF THE FLEXING LINE OF SOLE

D-4.1.4 Measure to a point one third of the distance from the toe end of the outsole, and mark this point Z.

D-4.1.5 Draw a line across the width of the outsole through the point Z and at 90° to the line XY which is hereafter referred as the flexing line.

D-4.1.6 Remove the heel from the sole, if necessary, leaving sufficient of the waist to clamp it in the flexing machine with flexing line located over the centre of the flexing mandrel. If the sole is too long to allow the flexing line to be aligned with the flexing mandrel then cut away some of the toe of the sole unit to enable it to be fitted.

D-4.2 If a sole has not been attached to a shoe cut a suitable insole of correct size and shape to fit the test specimen. Attach this with adhesive. Allow to dry for 24 hours and then follow the procedure in 5.1.2 to 5.1.6. Use the type of insole material intended to be used in finished footwear if possible, where this is not possible a 2 mm thick cellulose board can be used.

D-4.3 If specimens are to be cut from sheet of a material, cut six rectangular specimens of 150 mm ± 5 mm × 20.0 mm ± 0.5 mm, three with their longer edge parallel to the principal or along direction of the material and three at 90° to this in the across direction. In the case of materials intended for footwear soles it should be bonded to insole material *see* 5.2.

D-5 PROCEDURE

D-5.1 Cut Growth of a Footwear Outsole

D-5.1.1 Mark three cut positions on the test

specimen using a marking pen of different colour or as close as possible to the flexing line. Marks must be positioned midway between two adjacent cleats and be parallel to the flexing line with one being close to the flexing line as possible. The other two cuts are positioned so that the centre of the cut is 10 mm ± 1 mm from either edge of the outsole. If it is not possible to meet this criteria the cut positions may be made in front of the flex line, or, if closer, behind the flex line (*see* Fig. 7). If the cuts move off the original flexing line too far, then use a new flexing line of best average for three cuts.

D-5.1.2 Adjust the flexing machine so that the clamps and the top surface of the mandrel are in same plane.

D-5.1.3 Both ends of the test specimen should be firmly clamped in the flexing machine. Make sure that the test specimen is as flat as possible and its inner surface is as close as possible to the mandrel.

D-5.1.4 Adjust the machine slowly until the test specimen is flexed through the maximum angle of 90° ± 2°.

D-5.1.5 Push the chisel through the thickness of the outsole, until resistance from the insole occurs, at the centre of each of the three points marked in section D-5.1.1. It is important that the chisel is angled towards the central axis of the flexing mandrel. The cuts made by chisel should be parallel to the flexing line and be at midpoint between the cleats.

D-5.1.6 Use vernier callipers to measure the initial length of each cut, [L₀], in millimetres while the test specimen is in fully flexed position and record these

to an accuracy of 0.1 mm as $[L_o]$. Use optical magnifier to locate the edge of the cut.

D-5.1.7 Use the device **D-3.4** to measure the temperature of the atmosphere surrounding the test specimen and reduce the value to nearest 1 °C. Operate the flexing machine for 30 000 flexing cycles.

D-5.1.8 Measure the final cut length, by repeating the procedure in section **D-5.1.6** and record the values as $[L_f]$. Determine and record the cut growth, $[G]$ for each test specimen by using the formula.

$$[G] = [L_f] - [L_o]$$



FIG. 7 TEST SPECIMEN

D-5.2 Crack Initiation and Growth

D-5.2.1 Load the test specimen into the flexing machine as described in **D-5.1.2** and **D-5.1.3**.

D-5.2.2 Use the device **D-4.4** to measure the temperature of the atmosphere surrounding the test specimen to nearest 1 °C and start the flexing machine.

D-5.2.3 Slowly adjust the test specimen so that it is in maximum flexed position after every 10 000, 20 000 and 30 000 flexing cycles.

D-5.2.4 Examine the surface of the test specimen for signs of cracking each time when the machine is stopped to adjust the specimen to its maximum flexed position. If any cracks are found, record their position, their length and their severity as:

Superficial	Up to 0.5 mm deep
Shallow	0.5mm to 1.5 mm
Moderate	1.5 mm to half thickness of the test specimen
Deep	Greater than half the thickness of the test specimen.

D-5.3 Cut Growth of Sheet Material

D-5.3.1 Mark the centre point of the outer surface of each of the test specimens using a marking pen.

D-5.3.2 Use gauge to measure the thickness of each test specimen in millimeters to an accuracy of 0.1. If insole board is to be attached this step must be carried out first.

D-5.3.3 Load two test specimens into each station of

the flexing machine following the procedure in sections **D-5.1.2** to **D-5.1.4**.

D-5.3.4 Follow the procedure in section **D-5.1.5** to make single cut through the full thickness of each specimen. Each cut should be parallel with the

shorter edge of the test specimen and through the point marked in section **D-5.3.1**.

D-5.3.5 Follow the procedure in sections **D-5.1.6** to **D-5.1.8**.

ANNEX E

(Clause 4.3.8)

SLIP RESISTANCE (FRICTION) OF FOOTWEAR AND QUARRY FLOOR

E-1 SCOPE

This method determines the coefficient of friction between footwear and test floors under conditions simulating those experienced in the phases of a typical walking step when slip is most likely to occur.

The method is applicable to all types of footwear, such as outsole units (except leather soles), heel top-pieces (top-lifts) and sheet soling materials, Quarry test floor, Dry condition and surface contaminants such as liquid water.

This method is not applicable for special purpose footwear or fittings containing spikes, metal studs or similar fittings.

E-2 PRINCIPLE

The footwear item and the test floor are brought into contact, subjected to a specified vertical force for a short period of static contact and then moved horizontally relative to one another at a constant speed. The horizontal frictional force is measured at a given time after movement starts and the dynamic coefficient of friction is calculated for the particular conditions of the test.

E-3 REFERENCES

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 48-2 : Rubber, vulcanized or thermoplastic 2018 — Determination of hardness — Part 2: Hardness between 10 IRHD and 100 IRHD.

ISO 4662 : Rubber, vulcanized or thermoplastic. 2017 Determination of rebound resilience.

ISO 3696 : Water for analytical laboratory use. 1987 Specification and test methods.

ISO 13287 : Personal protective equipment — 2012 Footwear — Test methods for slip resistance.

ISO 4287 : Geometrical Product Specifications 1997 (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters

E-4 APPARATUS AND MATERIALS

E-4.1 A slip resistance test machine incorporates elements that is sufficiently stiff to avoid vibration during use, and a secure attachment point for the footwear, sole unit, slider or other test specimen, hereafter referred to as the footwear item, after mounting as specified in Annex N.

NOTE — The term 'slider' refers to flat rectangular specimens used in calibrating floorings and other underfoot surfaces (*see* Annex P) and circular or other shaped test specimens prepared from footwear sheet materials (*see* Annex Q).

E-4.2 A flat, rigid, horizontal mounting table, of minimum width 150 mm and minimum length 450 mm, onto which the test underfoot surface, hereafter referred to as the test floor, is mounted (*see* Annex P).

E-4.3 Adjusting the height or thickness of the test floor so that its surface is in the plane of the horizontal force measuring device within a tolerance of ± 5 mm. One or more packing plates of length and width at least equal to that of the test floor and of suitable thickness for building up the height of its surface have been found to be suitable. The packing plates shall be incompressible under the pressure applied by the test. If this tolerance cannot be achieved then the discrepancy shall be measured and reported as a deviation from the standard method. A means of preventing movement of the test floor relative to the mounting table during the test.

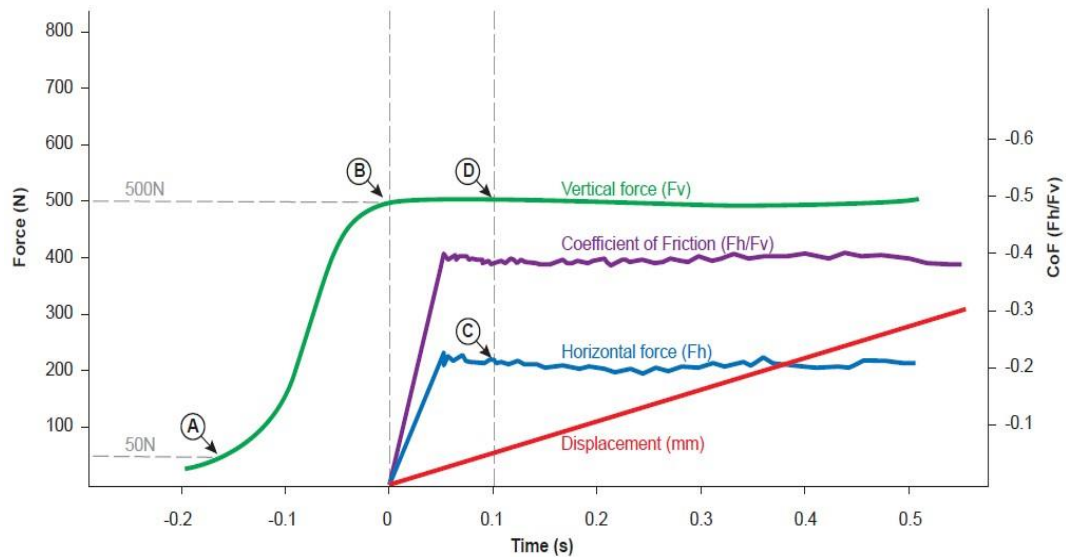
E-4.4 Holding the footwear item clear of the test floor between test measurements without contact with any other surfaces. Adjusting the angle between the footwear item and the test floor so that the required contact angle can be achieved (*see* Annex N), and of adjusting the contact point horizontally with respect to the line of action of the downward vertical force.

E-4.5 For lowering the footwear item onto the test floor and applying a steadily increasing downward vertical force through the center of the area of contact of the footwear item with the test floor, including the weight of the footwear item and its

mounting, at a rate that enables the required full force either $400\text{ N} \pm 20\text{ N}$ or $500\text{ N} \pm 25\text{ N}$, see Table 13, to be achieved within 0.2 s of reaching 50 N and maintaining this force throughout the test.

E-4.6 Sliding the test floor relative to the footwear item a distance of at least 40 mm at a speed of $0.3\text{ m/s} \pm 0.03\text{ m/s}$, commencing within 0.2 s after a vertical force of 50 N is achieved and maintaining

this speed throughout the test. Sliding shall not start until full vertical force is achieved as see Fig. 8. The footwear item may be constrained while the test floor is moved relative to it, or vice versa. Zero time is defined as the start of horizontal movement of the driven item, either footwear item or test floor as see in Fig. 11. A measuring time resolved to an accuracy of 0.01 s or better.



Key
A: 50N reached.
B: Full force achieved and relative movement started within 0.2s after A.
C: Snapshot value of horizontal force taken at 0.1s ($\pm 0.01\text{s}$) after the start of sliding movement.
D: Snapshot value of vertical force taken at 0.1s ($\pm 0.01\text{s}$) after the start of sliding movement.
NB: the vertical axis scale for displacement (mm) is not shown.

FIG. 8 TEST CHART SHOWING SEQUENCE OF EVENTS IN A TYPICAL TEST RUN

E-4.7 Measuring and Recording

The vertical force (F_v) and horizontal frictional (F_h) exerted on the footwear item, with an accuracy of 2 percent or better, exerted on the footwear item measured in the plane of the surface of the test floor. The displacement of the moving item, either test floor or footwear item, to the nearest 1 mm.

E-4.8 Dry, Absorbent Paper Towel

NOTE — Subsidiary items of apparatus and materials are also specified in Annexes N – R.

E-5 PREPARATION OF TEST SPECIMENS

E-5.1 For test floors and contaminants – Specification and calibration – see Annex P.

E-5.2 Footwear items – Specification and calibration – see Annex Q.

NOTE — Either the footwear item or the test floor may be the subject of the test. Appropriate test floors and footwear items respectively are selected as the reference materials against which the subject item is tested.

E-5.2 When testing all footwear items, except leather soles against a test floor in both a dry and a wet condition, two footwear items are required, one footwear item shall be tested first in the dry and then in the wet. The second footwear item shall be tested first in the wet and then in the dry. In this way both dry and wet measurements will be made on the footwear item in fresh condition as well as in slightly abraded condition from preceding measurements. For testing on more than one floor, it will be necessary to use a fresh footwear item for each test,

otherwise for the second and subsequent floors the footwear items will already be slightly abraded from the preceding floor(s), regardless of the dry-wet test order.

E-5.3 All test specimens, both footwear (except leather soles) and flooring, shall be cleaned prior to testing and conditioning, but in all other respects they shall be tested in the condition as supplied unless otherwise specified (*see* Annex R).

E-6 CONDITIONING OF TEST SPECIMEN

All test specimens shall be conditioned for at least 3 hours prior to testing at $23\text{ °C} \pm 2\text{ °C}$ and 50 percent \pm 5 percent RH unless otherwise specified (*see* Annex R). The test shall be carried out at $23\text{ °C} \pm 2\text{ °C}$ or within 30 minutes of removal from the conditioned atmosphere, unless otherwise specified.

E-7 PROCEDURE

E-7.1 Fit and secure the prepared test floor onto the

mounting table, adjusting its height or thickness using the device, so that its surface is in the plane of the horizontal force measuring device within a tolerance of $\pm 5\text{ mm}$. Lay the surface with its calibrated direction in the direction of slip. The test floor should be positioned to achieve a test track run of at least 40 mm without the footwear item contact area crossing a join. Securely fit the prepared footwear item to an appropriate mounting (*see* Annex N). Lower the footwear item into contact with the test floor under its own weight. Adjust the alignment and angle of the footwear item to conform to one of the test modes (*see* Annex N).

E-7.1.1 Fully tighten all mounting adjustments and lift the footwear item away from the test floor. Apply a lubricant or contaminant if required (*see* Annex P). Activate the recording system. Bring the footwear item into contact with the test floor (noting the contact position so that it may be re-established for repeat test runs) and apply the required vertical force as specified in Table 13.

Table 13 Vertical Force to be Applied in Slip Test Run

(Clause E-7.1)

Sl No.	Footwear Item	Full Force to be Applied (N)
(1)	(2)	(3)
i)	Footwear and finished soles of European size 40 (UK size 7, Mondo point 255) and above	500 ± 25
ii)	Footwear and finished soles of European size below 40 (UK size 7, Mondo point 255)	400 ± 20
iii)	Top-pieces and sole materials intended for men's footwear of unknown size	500 ± 25
iv)	Top-pieces and sole materials intended for women's, children's and infants' footwear of unknown size	400 ± 20

E-7.2 Activate the sliding movement as specified. Stop the test and the recording system after a sliding distance of at least 40 mm has been achieved. Lift the footwear item away from the test floor and support it so that it is NOT brought into contact with any other surface. Reset the apparatus so that it is ready to take another measurement from the same original contact position.

NOTE — Some equipment will automatically reset the start position or it may conveniently be the end-stop position of the mounting table.

E-7.3 Restore the test floor surface to its specified condition if possible and note any marking or damage caused by testing. If testing in the dry condition, wipe the test floor with clean dry, absorbent paper towel to remove any visible loose deposits. If testing in a contaminated condition, re apply contaminant to the contact starting position. The previous contaminant will usually have been

displaced along the test floor but need not be wiped away unless It has evidently been changed by the action of the test, for example if it contains soiling or debris. Repeat the procedure a further four times. Examine the tested surface of the footwear item and note any physical changes that have occurred (for example, abrasion of the finish on leather).

E-7.4 For each test run, determine the value at a time of $0.10\text{ s} \pm 0.01\text{ s}$ (or the time averaged value within the interval $0.09\text{ s} - 0.11\text{ s}$) after the start of sliding movement of:

- The vertical contact force between the two surfaces [F_v] in newtons; and
- The horizontal frictional force [F_h] in newtons.

E-7.5 For each test run calculate the coefficient of friction to two or more decimal places as follows:

Coefficient of friction [CoF] = Horizontal force
[F_h]/Vertical Force [F_v]

NOTE — Some equipment will automatically display a trace of the coefficient of friction and state the required value at 0.10 s ± 0.01 s.

E-7.6 Examine The Test Results

If the five consecutive results show a systematic increase or decrease of more than 10 percent of the initial reading:

- a) Carry out one or more further test runs until a consecutive sequence of five are obtained that do not show a systematic increase or decrease of greater than 10 percent CoF; and
- b) Where apparent, record the cause of variation, for example, abrasion of finish on resin rubber soling. Record the CoF value for the first run in the first sequence of measurements, representing the initial surface condition of the material, and the value for the fifth run of the last sequence, representing its changed condition after repeated testing.

E-7.7 Calculate the arithmetic mean CoF of the last five consecutive results and report this to two decimal places. If the cause of variation cannot be identified, the test specimens (footwear item or test floor depending on what is the subject of the test) may be contaminated. In this case repeat the test using a fresh or re-cleaned test specimen (footwear item or test floor).

E-7.8 In some circumstances the phenomenon of slip-stick may occur which manifests itself in a friction trace, *see* Fig. 7, as high amplitude vibration or oscillation of the horizontal and vertical force traces, and CoF trace if available. Where this occurs the average value of CoF between the peaks and troughs on the trace in the measurement interval 0.09 s to 0.11 s should be recorded with a description of the shape of the trace.

E-7.9 Occasionally the CoF trace may show a steady increase or decrease which may reflect a genuine behavior of the particular combination of footwear item and test floor. In these cases, the result should be recorded but with a description of the shape of the trace.

E-7.10 Repeat procedure **E-7.1** to **E-7.7** as explained above if other test modes and further footwear items with further test floors as

appropriate, until the required total number of specimens has been tested.

NOTE — It is equally permissible to complete all the testing on each footwear item before commencing the next footwear item or to test both footwear items of a pair for each test mode in turn, for example left and right for heel mode followed by left and right for forepart mode.

E-8 TEST REPORT

The test report contains the following information:

E-8.1 Reference to this test method.

E-8.2 A full description of the test specimens [footwear item(s) and test floor(s)] as follows, including any manufacturer's reference, and of any standard reference materials (test floor or footwear items respectively) used.

E-8.3 Footwear Items

A description and photograph of the footwear item(s) noting any indication of previous wear and, if so, whether this is judged as light, moderate or heavy. Include: size, whether left or right and, where applicable, relevant details of bottom construction (for example, heel height, whether a midsole is present and type if known) and in the case of footwear, the type (for example, sandal, boot).

E-8.4 For sheet materials, the thickness of the material.

E-8.5 For sole facer materials, details of the backer, if used.

E-8.6 Details of the cleaning regime used and any other pre-treatment such as solvent wiping or preparatory abrasion of the wearing surface before testing.

E-8.7 Underfoot conditions (test floor and contaminants): A description of the test floor, noting any indication of previous wear or damage and, if noted, whether this is judged as light, moderate or heavy. A description and photograph of any surface texture or profiling.

E-8.8 Details of any surface polish or resin that has been applied, if known.

E-8.9 Details of the cleaning regime used and any non-standard pre-treatment of the wearing surface before testing.

E-8.10 Description of the contaminant used.

E-8.11 Conditioning of test specimen and tested condition.

ANNEX F

[Clause 4.6, Table 4, Sl no. (ii)]

FLEXING INDEX

F-1 PRINCIPLE

A specimen is held in tension and repeatedly flexed through 180° until failure occurs. The base 10 logarithm of the number of flexing cycles to failure is calculated to give the flexing index of the material.

F-2 APPARATUS AND MATERIALS

F-2.1 A flexing machine with at least six pairs of jaws that each have one jaw with a taper angle of $(76 \pm 4)^\circ$ and an internal tip radius of $0.8 \text{ mm} \pm 0.1 \text{ mm}$.

F-2.2 A means of rotating the jaw cyclically under simple harmonic motion, about an axis which is projected from the jaw tips (*see* Fig. 9), between two points $(90 \pm 2)^\circ$ each side of the vertical at a rate of $60 \text{ cycles/min} \pm 10 \text{ cycles/min}$.

F-2.3 A second jaw with a means of maintaining a standard tensional force on the test specimen of $19.6 \text{ A} \pm 0.1 \text{ A}$. A weight attached to the jaw so that a total mass of $(2\ 000 \pm 10) \text{ g}$ is suspended from the test specimen is a convenient method of achieving this.

F-2.4 A method of counting the number of oscillations of the rotating jaw up to failure of the specimen.

F-2.5 A means, such as a tongue wrench, of controlling the clamping force of the rotating jaw.

F-3 PREPARATION OF TEST SPECIMENS

F-3.1 Place the uncut sheet material into a standard

controlled environment of $(27 \pm 2)^\circ\text{C}$ and 65 percent ± 2 percent relative humidity for at least 48 h.

F-3.2 Cut six rectangular test specimens, $70 \text{ mm} \pm 10 \text{ mm} \times 10.0 \text{ mm} \pm 0.1 \text{ mm}$ three with their length parallel to the principal or along direction of the material and three at 90° to this in the across direction.

F-4 PROCEDURE

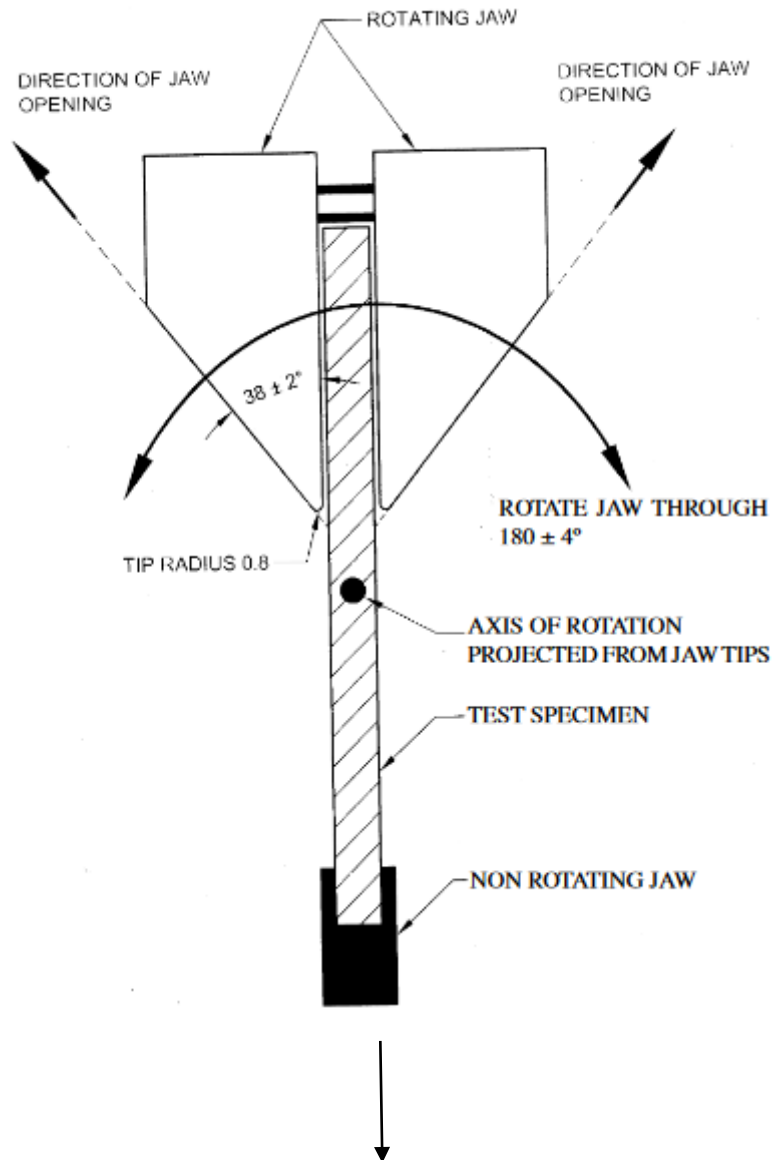
F-4.1 Ensure that the atmosphere surrounding the test machine is at a temperature of $(27 \pm 2)^\circ\text{C}$ and a relative humidity of 65 percent ± 2 percent relative humidity.

F-4.2 Place each test specimen between a pair of jaws and on the flexing machine so that the longer edges of the specimen are perpendicular to the clamping edge of both jaws.

F-4.3 Tighten each rotating jaw until it exerts a clamping force of $2.4 \text{ kN} \pm 0.4 \text{ kN}$ on the test specimen.

F-4.4 For each non-rotating jaw, apply a tensioning force of $19.6 \text{ N} \pm 0.1 \text{ N}$ to the jaw.

F-4.5 Tighten the jaw onto a test specimen until it exerts a clamping force, which is sufficient to prevent it slipping. The clamping force should not be unnecessarily high as this may damage the test specimen.



All dimensions in millimetres.

FIG. 9 FLEXING MACHINE

F-4.6 Operate the flexing machine and record the total number of flexing cycles as each specimen fails. When all the test specimens have failed, stop the flexing machine.

F-4.7 For each test specimen, calculate the base 10 logarithm of the total number of flexing cycles to failure.

F-4.8 Calculate the arithmetic mean of the logarithms for each of the principal directions of the material. These two values are termed the flexing indices.

F-5 TEST REPORT

F-5.1 The logarithm of the number of flexing cycles to failure for each test specimen, as calculated in F-4.7.

F-5.2 The flexing index for each principal direction as calculated in F-4.8.

F-5.3 Any deviations from this standard test method.

ANNEX G

[Clause 4.9, Table 7, Sl No. (i)]

COMPRESSION SET (STATIC)

The two methods used to measure compression set at constant stress that is, method A and method B.

In case of any dispute, method A shall be the referee method.

METHOD A

COMPRESSION SET – CONSTANT STRESS METHOD

G-1.1 SCOPE

This method is intended to determine the compression set of a material. This is a measure of retention of shape and elastic properties. The method is mainly applicable to solid and cellular footwear soling materials, but can be used with any type of compressible material.

G-1.2 PRINCIPLE

The percentage change in thickness of a test specimen is calculated after it has been compressed by a predefined pressure for a set time and allowed to recover for a further set time.

G-1.3 APPARATUS AND MATERIALS

G-1.3.1 A standard laboratory dial thickness gauge for means of applying a pressure of $22 \text{ kPa} \pm 5 \text{ kPa}$ for materials of hardness equal to or greater than 35 IRHD (International Rubber Hardness Degree) or a pressure of $10 \text{ kPa} \pm 2 \text{ kPa}$ for materials of hardness less than 35 IRHD with the capability of measuring to the nearest 0.01 mm.

G-1.3.2 A platen press, which is capable of applying and maintaining for a period of $24.0 \text{ h} \pm 0.2 \text{ h}$ a pressure of

For Solid materials: $11.1 \text{ MPa} \pm 0.2 \text{ MPa}$.

For Cellular materials: $0.69 \text{ MPa} \pm 0.02 \text{ MPa}$.

to the surface of three test specimens with the dimensions specified, spring loaded press, for which the force/spring compression relationship is known.

G-1.3.3 For testing several types of material at the same time, rigid spacer plates are required to be placed between the different types of specimen. These should be at least three times the diameter of the test specimen across their smallest dimension.

G-1.3.4 A rotating circular cutter of diameter:

For Solid materials: $14.5 \text{ mm} \pm 0.5 \text{ mm}$.

For Cellular materials: $29.0 \text{ mm} \pm 0.5 \text{ mm}$.

G-1.4 PREPARATION OF TEST SPECIMENS

G-1.4.1 Select the appropriate thickness for the test material, and use the procedure mentioned in **1.4.2**

and **1.4.3** to prepare the material and reduce its thickness to the required level.

G-1.4.1.1 For each material to be tested, use the appropriate circular cutter to cut a sufficient number of circular test specimens of diameter:

For Solid materials: $14.5 \text{ mm} \pm 0.5 \text{ mm}$.

For Cellular materials: $29.0 \text{ mm} \pm 0.5 \text{ mm}$.

G-1.4.2 To produce three stacks each of height:

G-1.4.2.1 Method 1 — Solid materials: $6.3 \text{ mm} \pm 0.3 \text{ mm}$, by using:

(One test specimen of thickness $6.3 \text{ mm} \pm 0.3 \text{ mm}$ or two test specimens of thickness $3.2 \text{ mm} \pm 0.1 \text{ mm}$ or three test specimens of thickness $2.1 \text{ mm} \pm 0.1 \text{ mm}$).

G-1.4.2.2 Method 2 — Cellular materials: $9.5 \text{ mm} \pm 0.5 \text{ mm}$, by using:

(One test specimen of thickness $9.5 \text{ mm} \pm 0.5 \text{ mm}$ or two test specimens of thickness $4.8 \text{ mm} \pm 0.2 \text{ mm}$ or three test specimens of thickness $3.2 \text{ mm} \pm 0.1 \text{ mm}$).

G-1.4.2.2.1 The faces of the test specimens must be flat and parallel and the walls should not be markedly tapered, cupped or barreled.

G-1.4.3 If more than one test specimen is required to produce a stack of sufficient height, then place the appropriate number of test specimens centrally on top of each other. As far as possible, test specimens should be selected and grouped so that the total thickness of each of the stacks is similar. The test specimens in each stack should be kept together in the same order, without reversal or rotation relative to one another. The stacks will subsequently be referred to as test specimen stacks.

G-1.4.4 Check the surfaces of the presser foot and anvil of the dial thickness gauge and clean them if necessary. Set the gauge so that it reads zero.

G-1.4.5 Store the test specimens or test specimen stacks in a standard controlled environment of either $(23 \pm 2) ^\circ\text{C}$ or $(20 \pm 2) ^\circ\text{C}$ for at least 5 h before testing and carry out the test in this environment. Include details of the conditions used in the test report.

G-1.5 PROCEDURE

G-1.5.1 Check the surfaces of the presser foot and anvil of the dial thickness gauge and clean them if necessary. Set the gauge so that it reads zero.

G-1.5.2 Position a test specimen, or test specimen stack centrally between the presser foot and anvil of the appropriate thickness gauge.

G-1.5.3 Gently lower the presser foot onto the centre of the surface of the test specimen, wait for $5 \text{ s} \pm 1 \text{ s}$ and then record the reading on the thickness gauge to the nearest 0.01 mm.

G-1.5.4 Repeat the procedure for the remaining test specimens, or test specimen stacks.

G-1.5.5 For each material being tested, calculate the arithmetic mean of the thickness readings made and record this value as (T_0) to the nearest 0.01 mm.

G-1.5.6 Place the three test specimens, or test specimen stacks, on the lower platen of the press so that the centres of the test specimens form an equilateral triangle, with the edges of adjacent test specimens approximately 5 mm apart and the centre of the triangle aligned with the centre of the platen, see Fig. 10.

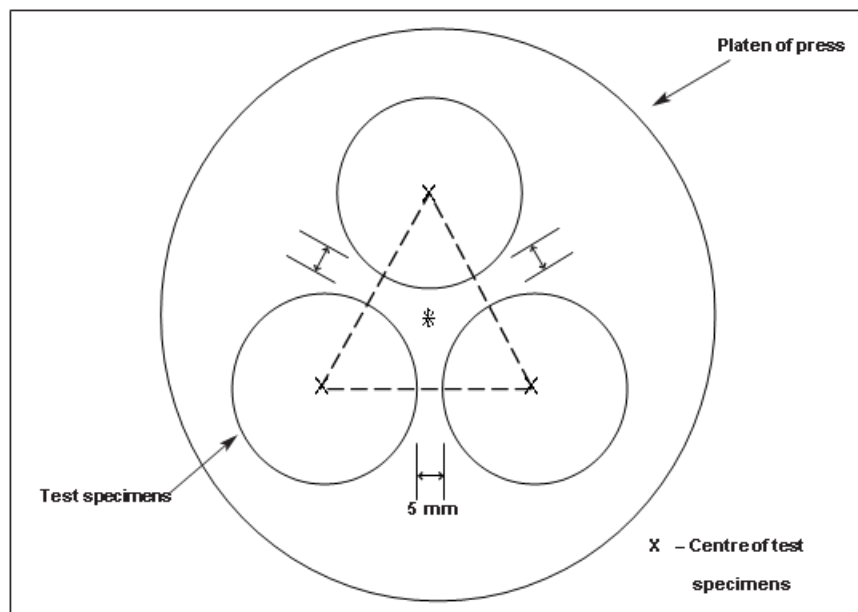


FIG. 10 PLAN VIEW OF TEST SPECIMENS AND PLATEN

G-1.5.7 Several materials can be tested at the same time provided that they are either all solid materials or all cellular materials. If testing several materials at the same time then place a spacer plate on top of the test specimens and repeat the procedure as said earlier.

G-1.5.8 Placing three test specimens, or test specimen stacks, on top of the spacer plate instead of the lower platen. Each layer shall only consist of test specimens cut from one material.

G-1.5.9 Repeat the procedure for any remaining materials to be tested using a spacer plate between each layer of test specimens.

Operate the press to apply a nominal pressure, assuming the test specimen to be of target diameter

For Solid materials: $11.1 \text{ MPa} \pm 0.2 \text{ MPa}$

For Cellular materials: $0.69 \text{ MPa} \pm 0.02 \text{ MPa}$

to each test specimen, or test specimen stack. For a

spring loaded press such as the force (F) applied between the platens will be indicated by the compression of the springs. If (A) is the area of each test specimen in mm^2 then the force in Newton required producing a pressure of (P) in mega Pascal's can be calculated by using the formula:

$$(F) = (P) \times 3 \times (A)$$

This gives, for the standard test specimen diameters:

For Solid materials: $(F) = 5\,500 \text{ N} \pm 100 \text{ N}$

For Cellular materials: $(F) = 1\,370 \text{ N} \pm 40 \text{ N}$

After $24.0 \text{ h} \pm 0.2 \text{ h}$ release the press and remove the test specimens.

Allow the test specimens to recover for $1.0 \text{ h} \pm 0.1 \text{ h}$.

For each material tested, repeat the procedure as stated earlier but record the thickness as (T_1) to the nearest 0.01 mm.

For each material tested, calculate the percentage compression set, to the nearest one percent, using the formula:

G-1.6 CALCULATIONS

Percentage of compression set

$$= (T_0) - (T_1)/(T_0) \times 100$$

where

T_0 = Arithmetic mean of the thickness of test piece in mm before compression; and

T_1 = Arithmetic mean of the thickness of test piece in mm after compression.

G-1.7 REPORT

Reference to this test method

The version of the test used: Method 1 or method 2.

A description of the material(s) tested.

The compression set, as calculated.

Any deviations from this standard test method.

G-1.8 ADDITIONAL NOTE

G-1.8.1 Preparation of the Test Specimens

Reduce the original material, which may be in the

form of sheets, or cut or moulded soles, to its test thickness using either a band knife splitter or a surface grinder.

The preparation of test pieces from soling materials for physical testing. During preparation, check the thickness of the soling with the rubber dial thickness gauge.

G-1.8.2 Solid solings with a smooth wearing surface: Remove all the excess material from the reverse surface.

Solid solings with a surface pattern: First remove this pattern completely and then remove the rest of the excess material from the reverse side until the required thickness is obtained. The surface pattern must still be removed even if the final thickness of the sheet will be below the standard test thickness.

G-1.8.3 Cellular soling with a smooth solid surface skin on the wearing surface: Remove a layer of 0.5 mm thick from this surface or a little more if some of the skin remains. Then remove the rest of the excess material from the reverse surface. If however, the wearing surface is already an exposed cellular layer, do not remove the 0.5 mm layer. Where the cellular soling has a surface pattern, remove this completely before removing the 0.5 mm layer.

METHOD - B

DETERMINATION OF COMPRESSION SET AT CONSTANT STRESS

G-2.1 COMPRESSION SET AT CONSTANT STRESS

G-2.1.1 Apparatus

The compression apparatus shall consist of two parallel flat, rigid plates between which the test pieces may be compressed and the means of applying slowly a load of 140 kg \pm 1 kg to the plates and maintaining the load for a period of at least 24 hours. Alternatively, the single loading spring may be replaced by a set to three equivalent springs placed symmetrically around the central axis.

G-2.1.2 Test Piece

Cut three discs of diameter 30 mm \pm 0.2 mm of any thickness from sheets soles.

G-2.1.3 Procedure

Condition the test pieces at 27 °C \pm 2 °C and 65 percent \pm 5 percent relative humidity for 24 hours. Measure the initial thickness of each test piece at the

centre using the gauge with part-Spherical contact. Note the arithmetic mean of the three readings as the initial thickness. Place the three test pieces symmetrically between the parallel plates of the compression apparatus and subject to a compression load of 140 kg \pm 1 kg for 24 hours. Then release the load, remove the test pieces and allow to recover. After one hour remeasure the thickness and note the arithmetic mean as the final thickness.

G-2.1.4 Expression of Results

The compression set is the difference between the original thickness of the test piece and that after recovery expressed as a percentage of the initial thickness.

$$\text{Compression set, percent} = (t_0 - t_1)100/t_1$$

where

t_0 = the initial thickness in mm; and

t_1 = the final thickness in mm.

ANNEX H

[Clause 4.9, Table 7, Sl No. (ii)]

SPLIT TEAR STRENGTH

H-1 DESCRIPTION

This method measures the load required to tear a material along its cross-section.

H-2 MATERIALS

H-2.1 Midsole Made of Foam Material

H-3 EQUIPMENT

H-3.1 Tensile Testing Machine, with chart recorder.

H-3.2 Clamping Jaws, preferably rubber-faced.

H-4 SAMPLE PREPARATION

- Die or hand cut a test sample as described in Fig. 7. Sample thickness shall be $10.0 \text{ mm} \pm 1.0 \text{ mm}$.
- Draw a tear line lengthwise, at the midpoint of the thickness of the foam (*see* Fig. 11).
- Using a sharp blade or razor, hand cut a slit at each end of the test sample which is approximately 25 mm in length, as described in Fig. 11.

H-5 REPETITIONS

Test one sample per material and make two measurements for the sample.

H-6 TEST PROCEDURE

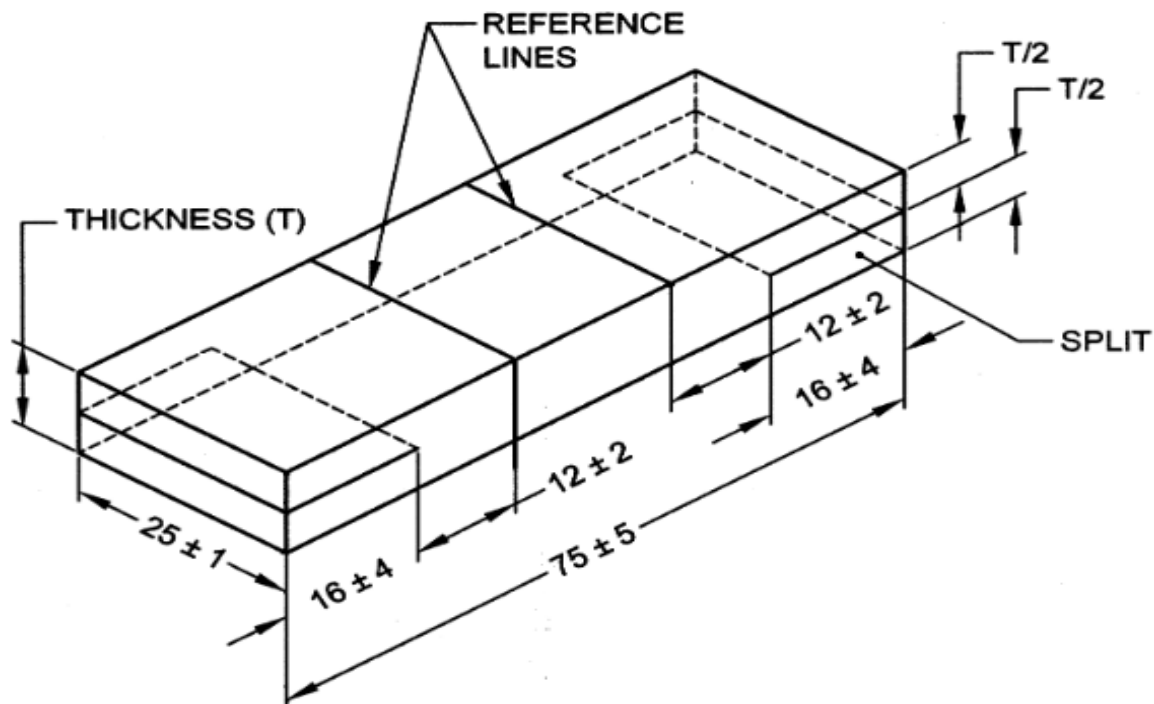
H-6.1 Zero and calibrate the tensile testing machine.

H-6.2 Set the tensile testing machine to a crosshead speed of 50 mm/min, and a jaw gap of $40 \text{ mm} \pm 5 \text{ mm}$.

H-6.3 Fold back the two tabs at one end of the test sample. Insert and clamp one tab centrally in each of the top and bottom jaws, such that a minimal amount of tension is present on the tear line, and the sample points to the rear of the tensile testing machine.

H-6.4 Operate the tensile testing machine at a crosshead speed of 50 mm/min.

H-6.5 Using a sharp blade, cut the foam as necessary to maintain a tear line, which is always within 2.0 mm of the midpoint line.



NOTE — For laminar materials only one end of the test specimen is split.

All dimensions in millimetres

FIG. 11 SAMPLE FOR SPLIT TEAR STRENGTH

NOTE — Do not take measurements while cutting back to the midpoint line.

H-6.6 Allow the sample to tear for a distance of 50 mm.

H-6.7 Record the maximum load (L) reached during the test.

H-6.8 Clamp the other end of the sample in the same manner described in **H-6.3** and repeat **H-6.4** to **H-6.6**.

H-7 CALCULATION

$$\text{Split tear strength, kg/cm} = \frac{L}{2.5}$$

H-8 REPORT

The average of the two split tear measurements to the nearest 0.1 kg/cm.

ANNEX J

[Clause 4.9, Table 7, Sl No. (iii)]

HEAT RESISTANCE, SHRINKAGE LINEAR

J-1 DESCRIPTION

This method measures the amount of shrinkage, which a midsole/insole/sockliner material undergoes as a result of exposure to heat for a specified time period.

J-2 EQUIPMENT

J-2.1 Air-circulating oven, capable of maintaining a temperature of $70.0\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$. Calibrate to ensure temperature being maintained at $70.0\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$.

J-2.2 Steel scale, capable of measuring to 0.5 mm.

J-3 SAMPLE PREPARATION

J-3.1 Wherever possible, use a whole midsole, insole or sockliner unit.

J-3.2 If unable to use a complete unit, die or hand cut samples which are at least 100 mm long, and having a width of 25.4 mm.

NOTE — Midsole test samples should be $10.0\text{ mm} \pm 1.0\text{ mm}$ in thickness, unless compression-molded midsole foam is being evaluated. For compression-molded midsole foams, the entire thickness of the midsole should be used, preferably from an area of the midsole, which is nearest to 10 mm in thickness.

J-3.3 For whole midsole, insole or sockliner units, draw a line along the entire length of the sample. For die-cut test samples, draw a line along each of the samples as shown in Fig. 12.

Test two samples per material.

J-4 TEST PROCEDURE

J-4.1 For Foam Based Material Only

Using a vernier caliper, measure the length of line L to the nearest 0.1 mm (L_1). Place the test sample in an oven at $70.0\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$ for $60\text{ min} \pm 3\text{ min}$.

Remove the test sample from the oven, and allow it to cool for $30\text{ min} \pm 2\text{ min}$ at $27.0\text{ }^{\circ}\text{C} \pm 2.0\text{ }^{\circ}\text{C}$. Re-measure the length of line L to the nearest 0.1 mm (L_2).

J-4.2 For All Midsoles or Insoles

Use a steel scale which is stiff enough that it will not bend when taking a length measurement.

Place the bottom edge of the steel scale on the midsole or insole such that the steel scale contacts the foam at both point E and point F of line L as shown in Fig. 13. The length (L_1) is measured from the inside edge of lines AB and CD as shown in Fig. 13. Measure to the nearest 0.5 mm. Place the test sample in an oven at $70.0\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$ for $60\text{ min} \pm 1\text{ min}$. Remove the test sample from the oven, and allow it to cool for at least 30 min at $27.0\text{ }^{\circ}\text{C} \pm 2.0\text{ }^{\circ}\text{C}$. Using a steel scale, re-measure the length (L_2) to the nearest 0.5 mm.

NOTE — Length measurements must be taken using the bottom edge of the steel scale (to prevent it from bending).

J-4.3 For Sockliners

Using a vernier caliper, measure the length of line L to the nearest 0.1 mm (L_1). Place the test sample in an oven at $70.0\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$ for $60\text{ min} \pm 1\text{ min}$. Remove the test sample from the oven, and allow it to cool for at least 30 min at $27.0\text{ }^{\circ}\text{C} \pm 2.0\text{ }^{\circ}\text{C}$. Using a vernier caliper, re-measure the length of line L to the nearest 0.1 mm (L_2).

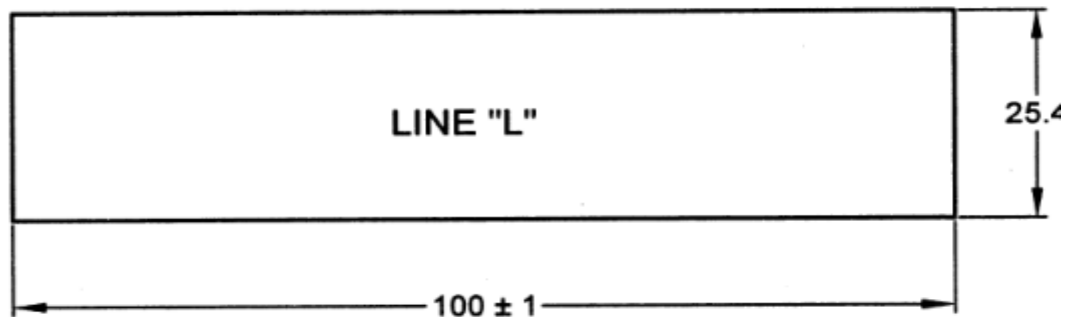
J-5 CALCULATION

Shrinkage in the length direction, percent

$$= \frac{L_1 - L_2}{L_1} \times 100$$

J-6 REPORT

The higher of the two measurements to the nearest 0.1 percent.



All dimensions in millimetres

FIG. 12 SAMPLE FOR SHRINKAGE DUE TO HEAT

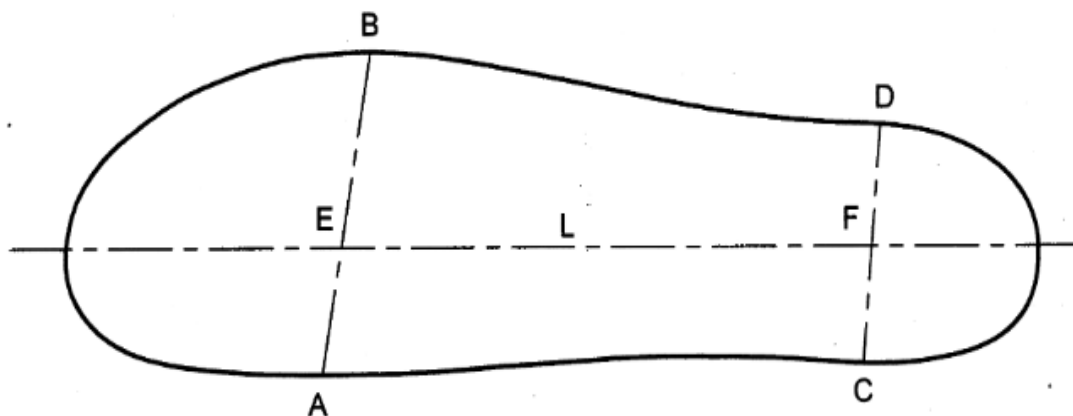


FIG. 13 LINEAR SHRINKAGE

ANNEX K

[Clause 4.13, Table 11, SI No. (i)]

BREAKING FORCE AND EXTENSION AT BREAK OF SHOE LACES

K-1 SCOPE

This method is intended to determine the breaking force and extension at break of shoe laces. The test can be carried out with both wet and dry specimens. The method is applicable to all types of shoe lace.

K-2 PRINCIPLE

A length of wet or dry shoe lace is extended until it breaks using a tensile testing machine. The force required to break the shoe lace and, if required, its extension at break are measured.

K-3 APPARATUS AND MATERIALS

K-3.1 A tensile testing machine with jaw separation rate of 100 mm/min ± 10 mm/min. Gripping the test laces securely: Half capstan bollard test jaws, *see* cover photograph, are ideal. In this case the length of lace in contact with each bollard but not

clamped should be known to the nearest 1 mm. alternatively rubber faced clamps can be used provided that they do not cause an undue number of jaw breaks. A preliminary test may be necessary to determine the better method of gripping the lace.

K-3.2 Breaking force of recording the maximum force [F] to an accuracy of 2 percent as specified by Class 2 of EN ISO 7 500-1 and a force range appropriate to the specimen under test: 0 N to 1 000 N is suitable for most laces though some of the strongest may give breaking strengths of up to 2 000 N.

K-3.3 Extension at break [E] of continuously recording jaw separation with accuracy of 0.1 mm.

K-3.4 Wet tests – distilled or deionized water at 23 °C ± 2 °C.

K-4 PREPARATION OF TEST SPECIMENS

K-4.1 For each form of test, wet or dry, cut three test specimens of length sufficient to enable satisfactory clamping in the jaws while leaving a test length of 200 mm ± 2 mm between them.

K-4.2 If the test material is supplied as three or more made-up laces, cut each test specimen from a different lace. If only one length of lace is supplied, cut one test specimen from close to each end and one from the centre.

K-4.3 Store the three specimens to be tested dry in an environment of 23 °C ± 2 °C/50 percent ± 4 percent RH for at least 48 hours before testing, and carry out the test in this atmosphere. Specimens to be tested wet do not need to be conditioned. If an alternative atmosphere is used, include details of the conditions used in the test report.

K-5 PROCEDURE

K-5.1 Adjust the jaw separation of the tensile testing machine, so that there is a distance of 200 mm ± 2 mm between the clamping edges of the two grips. For the bollard type clamps the 200 mm must include the length of lace in contact with each bollard.

K-5.2 Insert a lace test specimen between the two grips, so that it is just taut and approximately the same length is clamped at each end.

K-5.3 Operate the tensile testing machine so that the jaws separate at a rate of 100 mm/min ± 10 mm/min until the test lace fails. Record the maximum force obtained in newtons [F] to the nearest 0.1 N and, if required, the extension [E] to the nearest mm at this force. If the test lace is constructed from several component parts, such as a case and a core, carefully watch the test specimen as it is extended and record the force and extension when each of these component parts fails. If there is multiple maxima on the force/extension curve the first maximum (at first damage) must be recorded as the 'breaking force' and, if required, 'breaking extension' even if subsequent maxima are higher.

K-5.4 If the test lace breaks within 5 mm of a clamping edge, reject the result and cut a fresh test specimen. If measuring breaking extension, also reject any results where the test specimen slipped in the clamp.

K-5.5 Repeat the procedure in Sections [a – d] until three valid results have been obtained.

K-5.6 If extension at break is required, for each test specimen calculate the percentage extension at break using the formula:

K-5.7 Extension at break (percent) = $[E] \times 100/200$

K-5.8 For each type of valid failure, calculate the arithmetic mean of three valid breaking forces recorded in section [c].

K-5.9 Calculate the arithmetic mean of the 3 percentage extension at break [percent E] values [g]

K-5.10 If testing the lace when wet condition then:

K-5.11 Place the three test specimens in a sufficient quantity of deionized water at (23 ± 2) °C to ensure complete immersion of the test specimens for (60 ± 50) min. If an alternative temperature is used, include details of the conditions in the test report. If the lace is difficult to wet then add 1 g of non-ionic wetting agent to each litre of deionized water.

K-5.12 Immediately test the specimens, while they are still wet, by repeating the procedure in sections [a-d].

K-6 TEST REPORT

The test report contains the following information:

K-6.1 Reference to this test method.

K-6.2 A full description of the test specimen.

K-6.3 For each version of the test, wet or dry, carried out:

K-6.4 The mean breaking force(s).

K-6.5 If required, the mean percentage extension at break.

K-6.6 Any deviations from this test method.

ANNEX L

[Clause 4.13, Table 11, Sl No. (ii)]

GRIPPING STRENGTH OF TAGS

L-1 APPARATUS

L-1.1 Tensile strength testing machine, power-driven with a rate of traverse of 115 mm/min ± 12 mm/min.

L-1.2 Slotted Plate

A rigid metal plate of suitable dimensions with a vertical edge tapered slot along the length of the

plate. In conjunction with the sloped plate *see* Fig. 14, use the upper jaw of the testing machine to keep the slot at right- angle to the direction of application of load during the test.

L-2 PROCEDURE

Move the conditioned test specimen with one of its tags uppermost horizontally along the slot until both sides of the base of the tag rest on the top of the

slotted plate. Centre the plate so that longitudinal axis of the test specimen is along the axis of the application of the load. Apply by hand an initial tension sufficient to strengthen the lace. Clamp the free end of the straightened specimen in the pulling jaw so that the free distance between the upper grip and the pulling jaw is 100 mm at the start of the test. Operate the machine and record the highest load, in kg, registered before the tag is pulled from the lace.

Discard the result and test another specimen if,

- a) The tag comes through the slot without being removed from the fabric lace; and/or
- b) The tag buckles at the base or the tag is scrapped without being removed from the lace before the specified minimum gripping strength is reached.

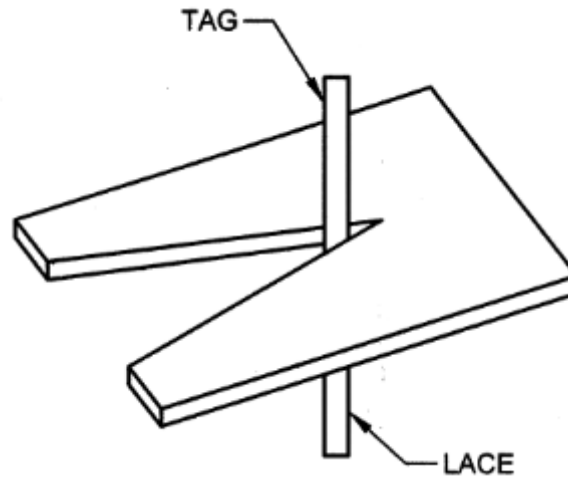


FIG. 14 SLOTTED PLATE

ANNEX M

[Clause 4.13, Table 11, Sl No. (v)]

STRENGTH OF FASTENED BUCKLES

M-1 SCOPE

This test method is intended to determine the strength of buckles under conditions which correspond to the fully fastened state in wear. The method is applicable to all types of buckle.

M-2 PRINCIPLE

The buckle bar, or its chape, is attached to a strip of upper leather or a shoe lace. A second strip of leather, corresponding to the buckle strap, is inserted in the normal way through the buckle. The two strips are then pulled apart in a tensile testing machine until some part of the buckle fails. The force at failure and the type of failure are recorded.

M-3 APPARATUS AND MATERIALS

M-3.1 A tensile testing machine with a jaw separation rate of 100 mm/min \pm 10 mm/min. The capability of measuring forces up to 1 kN to an accuracy of better than 2 percent and the facility to record the force throughout the test.

M-3.2 A cutting device such as a sharp knife or scissors.

M-3.3 Upper leather, thickness about 2 mm.

M-3.4 For buckles with a chape, nylon or polyester shoe laces, or suitable chape rivets and a clenching device.

M-4 PREPARATION OF TEST SPECIMENS

M-4.1 Use three buckles as test specimens. Three further buckles may be required if repeat tests are necessary.

M-4.2 For each test specimen use the device to cut from the upper leather a strip 'A' (see Fig.15) of length about 120 mm and width slightly less than the buckle bar to which the buckle prong is attached. Insert a hole through this strip of sufficient size to take the buckle prong, on its centre line and at a distance from one end of the strip equal to the length of the buckle plus 10 mm. Mark this end as the leading end to be inserted into the buckle.

M-4.3 If the buckle does not have a chape attached to it, use the device to cut a second strip 'B' (see Fig.15) of the upper leather of length about 150 mm and width slightly less than the buckle bar to which the buckle prong is attached. Make a hole in the centre of the strip which is just large enough for the buckle prong to go through.

M-4.4 If the buckle has a chape, select a nylon or polyester shoe lace, of minimum length 200 mm, which can be inserted through the rivet hole in the chape where suitable chape rivets and a clenching device are available, and it is preferred to use these, cut a strip 'C' (see Fig.15) of the upper leather of length about 100 mm and width $25 \text{ mm} \pm 2 \text{ mm}$. Punch a hole, large enough to accept the chape attaching rivet, in the strip on its centre line and $12.5 \text{ mm} \pm 2.5 \text{ mm}$ from one end.

M-5 PROCEDURE

M-5.1 Hold a test specimen buckle horizontally, with the buckle prong uppermost, and attach the leather strips and shoe lace as follows:

- If the buckle has no chape, insert leather strip 'B' through one side of the buckle frame near the buckle bar. Insert the buckle prong through the hole in the strip, then insert the strip down through the frame on the other side of the bar, see Fig. 11; and
- If the buckle has a chape, insert the nylon or polyester lace through the chape rivet hole so that the two ends are of approximately equal length, or insert a chape rivet through the chape hole and the corresponding hole punched in leather strip

'C' and clench the rivet firmly in the clenching device.

M-5.2 For All Types of Buckle:

- Insert the marked leading end of leather strip 'A' up through the buckle between the centre bar and the end of the buckle frame on which the tip of the buckle prong rests when the buckle is fastened;
- Insert the buckle prong through the hole in strip 'A', then insert the leading edge of the strip down through the buckle between the bar and the other, keeper, end of the frame;
- Holding the buckle frame, pull on the rear end of this strip so as to bring the tip of the buckle prong over to rest on the end of the buckle frame. The leading edge of this strip should then protrude about 10 mm beyond the keeper, see Fig. 15;
- Clamp strip 'A' in the upper jaws of the tensile testing machine, so that the edge of the buckle is 10 mm to 15 mm from the jaws, see Fig. 15.

M-5.3 If the buckle does not have a chape, clamp both ends of strip 'B' in the lower jaws of the tensile testing machine so that the keeper end of the buckle is 10 mm to 15 mm from the jaws, see Figure 15.

M-5.4 If the buckle has a chape, clamp the two ends of the shoe lace or the leather strip 'C' attached to the chape in the lower jaws of the tensile testing machine so that the keeper end of the buckle is 10 mm to 15 mm from the jaws, Figure 15.

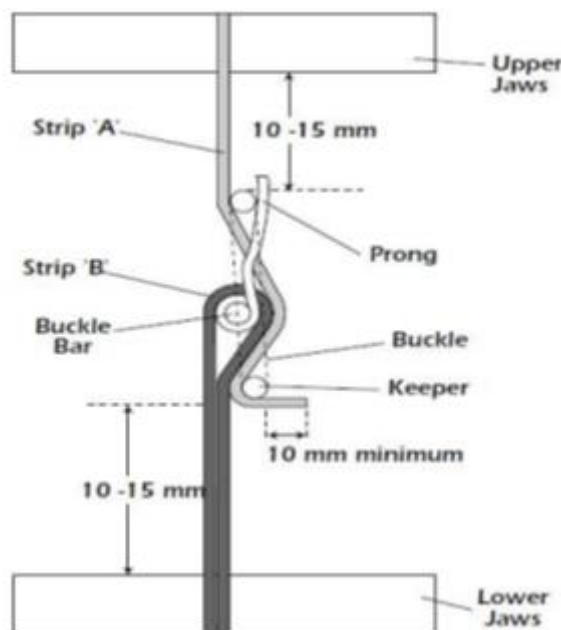


FIG. 15 TEST SPECIMEN IN TENSILE TEST APPARATUS

M-5.5 Operate the tensile testing machine so that the jaws separate at a rate of 100 mm/min \pm 10 mm/min and it records a force/displacement trace.

M-5.6 Stop the tensile testing machine when either the buckle or straps fail. Record the maximum force as [F], in newton's to the nearest 0.1 N.

M-5.7 Record the type of failure. Valid types of failure are:

- a) Breakage of the buckle bar;
- b) Breakage of some part of the buckle frame;
- c) Bending of the buckle frame or prong so that the prong tip no longer engages on the frame; and
- d) Disengagement of the chape from the buckle bar.

M-5.8 The following types of failure are invalid unless the value of [F] is significantly above a specified value for fastened buckle strength.

- a) Failure of the chape rivet or pulling out of the chape rivet from leather strip 'C'. If necessary, repeat the test using a larger rivet size or a shoe lace inserted through the chape hole.; and
- b) Breakage of the shoe lace or failure of one of the leather strips, including tearing at the prong or chape rivet. If necessary, repeat the test with a fresh test specimen using a stronger lace or leather strip.

M-5.9 Repeat the procedure in sections **M-5.1**

to **M-5.6** for the remaining test specimens.

M-5.10 If test specimens show different types of failure, repeat the test, following the procedure in sections **M-5.1** to **M-5.8**, using three further test specimens.

M-5.11 For each type of failure, calculate and record the arithmetic mean of the values of [F] as the fastened buckle strength together with the corresponding number of test specimens. Include all valid results from initial and any repeat tests. Where a mean value of [F] is associated with an invalid type of failure, *see* section **M-5.10**, record the fastened buckle strength as 'greater than' this value.

M-5.12 If there is only one result for a particular type of failure and it is lower than the other values then it may be appropriate to test further buckles to establish whether there is a proportion of weak ones in the batch.

M-6 TEST REPORT

Test reports contain the following information:

M-6.1 Reference to this test method.

M-6.2 A description of the buckles tested.

M-6.3 The number of test specimens.

M-6.4 The fastened buckle strength.

M-6.5 Type of failure of each specimen.

M-6.6 Any deviations from this standard test method.

ANNEX N

(Clause 4.3.8)

MOUNTING FOOTWEAR ITEMS AND SETTING UP TEST MODES

N-1 APPARATUS AND MATERIAL

N-1.1 A1 for tests using whole footwear, sole units, sole facers or other materials intended to be used in the forepart of footwear bottoms.

N-1.2 A selection of shoemaking lasts, each incorporating a means of attachment to the attachment point of the slip resistance test machine that will accommodate the footwear sizes to be tested.

N-1.3 A steel rule or similar straight edge device of similar length to the largest last.

N-1.4 A means of attaching the soles or other soling specimens securely to the shoe making lasts that will:

- a) prevent movement between the sole surface and the last surface during the test; and

- b) Not interfere with the test.

NOTE — The soles may be attached by adhesive means such as double-sided tape or by mechanical means such as screws, wire or cable ties provided that the requirements are met.

N-1.5 For Tests with Sole Facer Units:

A midsole and/or heel block as appropriate to represent underlying sole material. This may be fabricated from sheets of microcellular EVA of hardness 40 IRHD \pm 10 IRHD and specific gravity 0.25 \pm 0.05 or by using other materials as specified.

The midsole and/or heel block shall be sufficiently thick to enable the thickness of the end-product to be replicated where this is known. If the thickness of the end-product is not known, the midsole and/or heel block shall be sufficiently thick to produce an assembly that is at least 5 mm thick throughout its length.

A means of securely bonding the midsole and/or heel block to the back of the sole facer material that prevents movement between the midsole/heel block surface and the sole facer surface during the test.

N-1.6 For Tests with Top-Pieces and Sheet Material to Be Used as Top-Pieces

A flat rigid backing plate of minimum dimensions 160 mm × 80 mm, with its length aligned with the axis of the test floor. This may be incorporated into (or securely attached to) the lower surface of a rectangular box or securely attached to a suitably sized shoemaking last.

N-1.7 A Rectangular, metal box that

- a) is approximately 180 mm long, 90 mm wide, 90 mm deep and sufficiently rugged to resist distortion under the applied test forces;
- b) incorporates a secure means of attachment to the attachment point of the slip resistance test machine; and
- c) where the backing plate is not incorporated into the box, a means of attachment for the backing plate that will prevent movement between the plate and the surface of the box during the test.

A suitably-sized shoemaking last that incorporates a secure means of attachment to the attachment point of the slip resistance test machine together with a means of attachment for the backing plate that will prevent movement between the plate and the last surface during the test.

A means of securely bonding, or otherwise attaching, the top-pieces or sheet material sliders to the backing plate that will:

- a) prevent movement between the backing plate surface and the surface of the top-

pieces or sheet material sliders during the test; and

- b) not interfere with the test.

NOTE — A good quality double-sided adhesive tape may provide a satisfactory means of bonding the slider. However, when the slider is very small, for example, less than 300 mm², problems may be experienced. Bonding the slider with an appropriate adhesive to a larger piece of thin stiff material, such as resin rubber, which in turn is fixed to the rigid mounting with double-sided adhesive tape, is an alternative approach that is generally successful. When using this technique, it is vital that care is taken to avoid contamination of the test surface with adhesive.

N-1.8 For Top-Pieces with Mounting Spigots, Lugs or Other Protrusions

A means of removing the mounting spigots, lugs or other protrusions prior to mounting that does not damage the top-piece.

An intermediate mounting block in wood or other suitable material with holes to accommodate the mounting spigots, lugs or other protrusions together with a means of securely attaching the top-piece to the intermediate block.

For top-pieces only, an alignment aid or other means of aligning the longitudinal centre line of the top-piece at an angle of $(10 \pm 2)^\circ$ to the direction of movement of the test floor relative to the top-piece.

A rigid wedge having an angle of $(7.0 \pm 0.5)^\circ$ between its upper and lower surfaces and of minimum dimensions 80 mm wide by 120 mm long. The tip of the wedge, *see* Fig. 16, shall be truncated to a maximum height of 0.5 mm as judged by graduated eyepiece or equivalent means.

NOTE — The purpose of the wedge is to ensure that the footwear item is elevated by no more than approximately 1 mm above the test surface when the contact angle is being set. To facilitate this, the wedge may be marked with a line parallel to, and approximately 4 mm from, the truncated edge at the position where the wedge has a height of approximately 1 mm, as shown in Fig. 16.

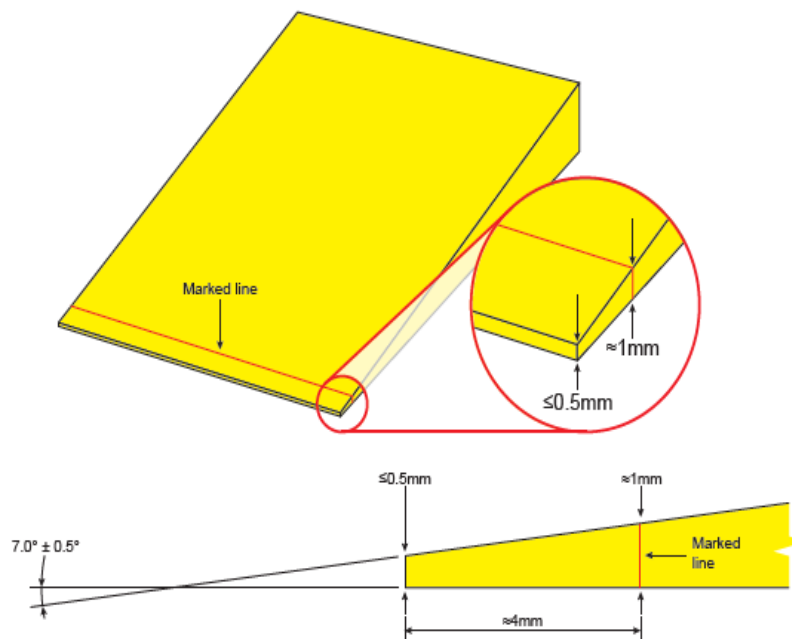


FIG. 16 DIMENSIONS OF RIGID WEDGE

N-1.9 Mounting Procedure - Footwear Items

N-1.9.1 Whole Footwear:

Remove any in-sock or foot bed from the footwear item. Contoured foot beds in particular may affect the fit of the footwear item on the last. If the sole is moulded with a concave heel seat, for example, as found in some Wellingtons, fill the concavity with a suitable material to present a flat surface against the bottom of the last.

Select a shoemaking last of the largest size that will fit tightly inside the footwear item without distorting it. This is usually the last marked as being the same size as the footwear item or one size smaller.

Fit the footwear item over the last, cutting or trimming the upper if necessary. It is important that the shoemaking last does not move within the footwear item during the test. If the shoemaking last is a poor fit, use pieces of crumpled tissue paper or similar material to fill any gaps at the toe or heel to prevent movement. Whenever possible, secure the footwear item's fastening system.

N-1.9.2 Sole Units and Other Sole Specimens:

Firmly attach sole units or other sole specimens to the lower surface of a suitably sized last using a suitable adhesive or by mechanical means. Where a sole facer unit is to be tested, bond an appropriate backing material to the back of the material using a suitable adhesive in order to simulate a complete sole unit before attaching the sole facer/backing

material assembly to the lower surface of the last.

Locate the rear edge of the sole units on the rear edge of the last.

Ensure that the centre of the forepart of the sole unit or other forepart specimen, coincides with the centre of the forepart of the last so correct contact is achieved with the test floor.

NOTE — With oversized caster sole units it may be necessary to trim around the unit to ensure correct heel and forepart positioning.

N-1.10 Top-Pieces and Sheet Material for Top-Piece Use

If no mounting spigot, lugs or other protrusions are present, proceed to clause. If such protrusions are present, either remove them using a suitable means or accommodate them within an intermediate mounting block.

Securely fix top-pieces, intermediate mounting blocks where appropriate, or sheet material sliders to the flat backing plate using a suitable adhesive

If necessary, securely attach the backing plate to the base of the rectangular box.

NOTE — If the backing plate forms part of the rectangular box, will not be necessary.

N-1.11 Setting Footwear Test Modes

Selection of test mode:

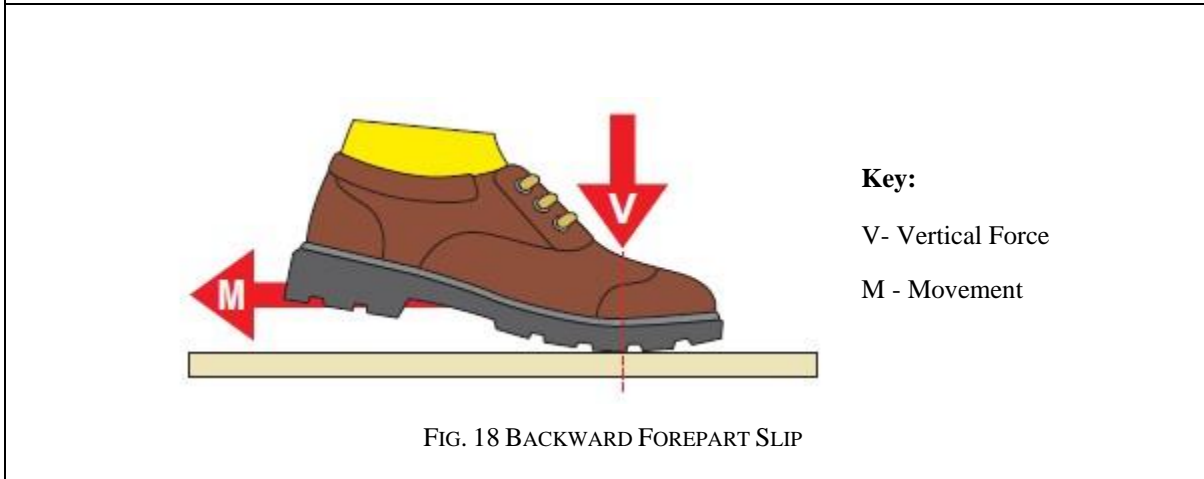
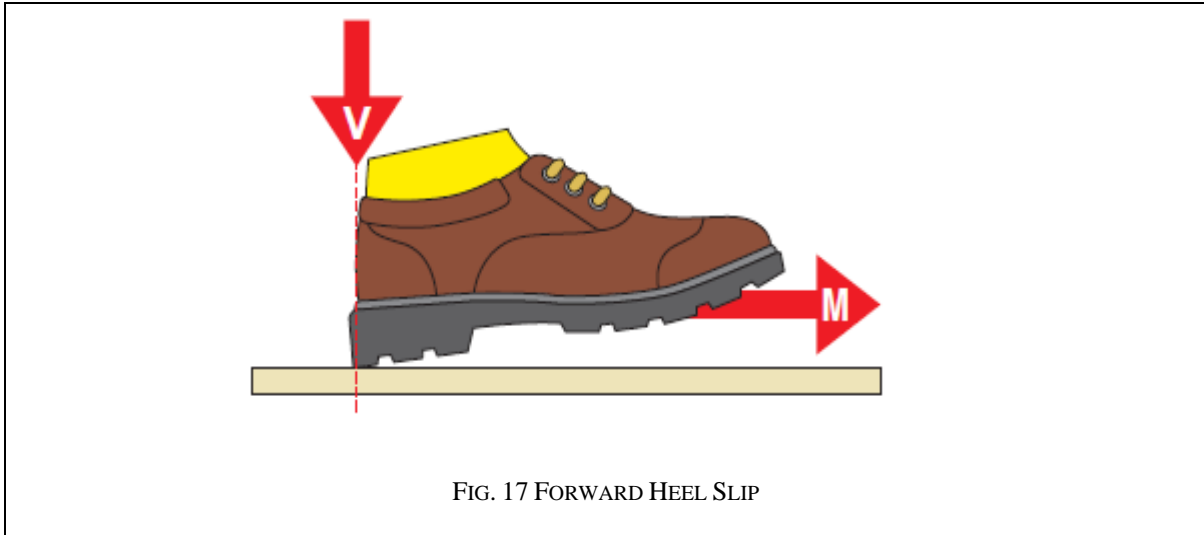
Footwear items may be tested in one or more of the

following modes:

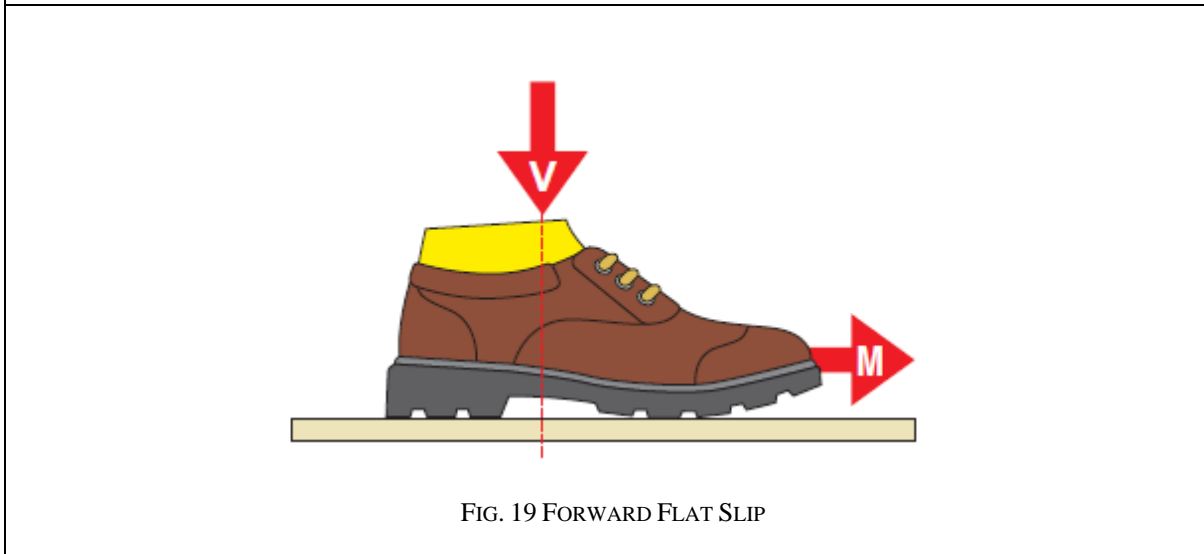
- a) Forward heel slip at angled contact, *see* Fig. 17;
- b) Backward forepart slip, *see* Fig. 18; and

- c) Forward flat slip, *see* Fig. 19.

Other orientations, such as sideways slip, may be tested as required and full details recorded in the test report.



Key:
 V - Vertical Force
 M - Movement



Top-pieces may be tested in forward heel slip at angled contact mode, *see* Fig. 17. Sheet materials may be tested in forward heel slip at angled contact mode, *see* Fig. 18, or backward forepart slip mode, *see* Fig. 19, depending upon their intended use.

When testing footwear or sole units in the above test modes, *see* Fig. 17 to 19, align the inside tangent of the shoemaking last, (as defined by the straight edge [19], placed against the heel swell and joint swell) on the inside or medial face of the last, parallel $\pm 2^\circ$, to the direction of movement, *see* Fig. 19.

When testing top-pieces, align the longitudinal

centre line of the top-piece at an angle of $10^\circ \pm 2^\circ$ to the direction of movement, *see* Fig. 24, using the alignment aid.

N-1.12 Forward heel slip mode, *see* Fig. 17.

When testing top-pieces and sliders, ‘heel’ shall be taken to refer to the top-piece or slider as appropriate.

Position the rigid wedge on the test floor with the thin end of the wedge under the rear edge of the heel, also *see* Fig. 20.

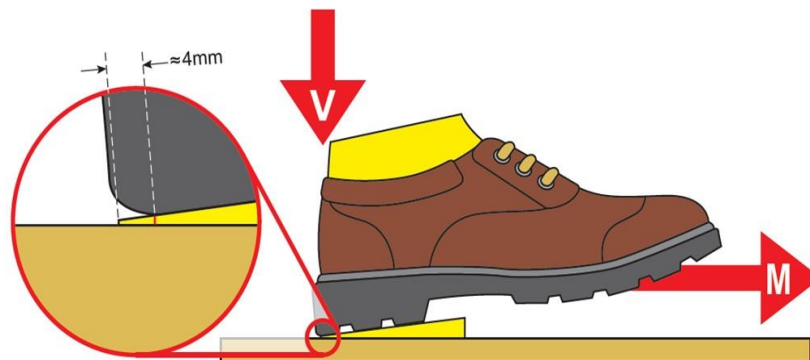


FIG. 20 POSITION THE RIGID WEDGE ON THE TEST FLOOR WITH THE THIN END OF THE WEDGE UNDER THE REAR EDGE OF THE HEEL

Lower the mounted footwear item onto the wedge under its own weight. Adjust the positions of the both wedge and footwear item until:

- a) The heel sits flat on the angled face of the wedge;
- b) Approximately 4 mm of the thin end of the wedge protrudes beyond the rearmost contact point of the heel with the face of the wedge as judged by eye, *see* Fig. 20;
- c) No contact is made between the forepart and the wedge or test floor; and
- d) The centre of the area of contact between the heel and floor will be vertically below the line of action of the vertical force when the wedge is removed, as judged by eye.

Raise the mounted footwear item, remove the wedge and then lower the mounted footwear onto the test floor under its own weight.

Check that the centre of the area of contact between the heel and floor is vertically below the line of action of the vertical force as judged by eye and adjust the position of the mounted foot if necessary.

Once the required alignment has been achieved, proceed to as per **E-7.1.1**.

N-1.13 Backward Forepart Slip Mode, *see* Fig. 19.

When testing sliders, ‘flexing area of the forepart’ and ‘flexing area’ shall be taken to refer to the slider.

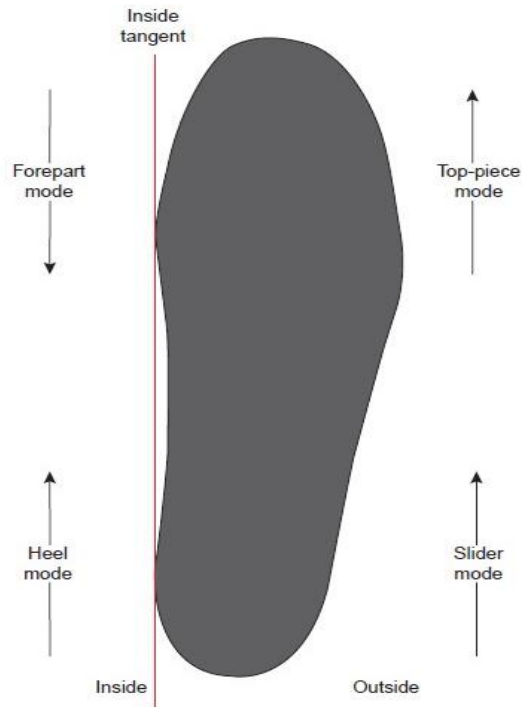


FIG. 21

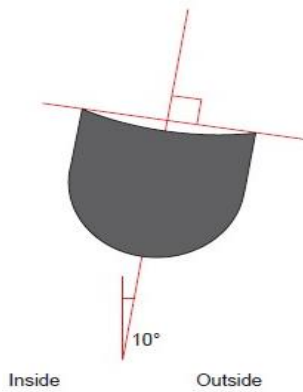


FIG. 22



FIG. 23

FIG. 21, 22 AND 23: ORIENTATION OF FOOTWEAR ITEMS WITH RESPECT TO DIRECTION OF MOVEMENT

Set the angle of the mounted footwear item to a level judged by eye that will enable the flexing area of the forepart to make contact with the test floor when lowered.

Lower the mounted footwear item onto the test floor under its own weight.

Adjust the angle of the mounted footwear item and its position relative to the test floor until:

- a) The centre of the flexing area (namely the centre of the flex line) is in the centre of the contact area;
- b) The line of action of the vertical force passes through the approximate centre of the contact area as judged by eye; and
- c) No contact is made between the heel, if present, and the test floor. Once the

required alignment has been achieved, proceed to E-7.1.1.

N-1.14 Forward Flat Slip, see Fig. 19.

Lower the mounted footwear item onto the test floor under its own weight.

Ensure that both the heel and forepart are in contact with the surface of the test floor.

Adjust the position of the footwear item relative to the test floor until the line of action of the vertical force passes through the midpoint between the centres of the heel and forepart contact areas as judged by eye.

Once the required alignment has been achieved, proceed to E-7.1.1.

N-1.15 Unconventional Footwear

For footwear with curved outsoles, set the angle of the shoemaking last such that the vertex is approximately the foremost or rearmost point of contact (depending on test mode and slipping direction) between the outsole and the floor under full normal force, see Fig. 20, location 3. The vertex being defined as the central point of contact between the outsole and floor when the footwear is rested horizontally on the floor without additional force that is, without last.

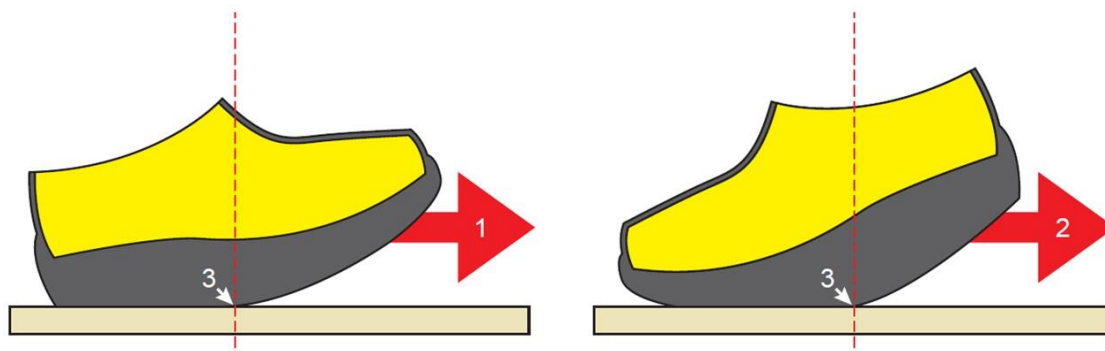


FIG. 24 HOW TO MOUNT FOOTWEAR HAVING A CURVED OUTSOLE. DIRECTION 1 SHOWS THE FORWARD HEEL SLIP TEST MODE AND DIRECTION 2 SHOWS THE BACKWARD FOREPART SLIP TEST MODE. LOCATION 3 IS THE VERTEX OF THE CURVED OUTSOLE

ANNEX P

(Clause 4.3.8)

TEST FLOORS, LUBRICANTS AND CONTAMINANTS – SPECIFICATION AND CALIBRATION

P-1 GENERAL

Any type of test floor may be used provided it:

- a) is flat and of a uniform thickness, allowing for any surface pattern;
- b) can be securely mounted on the mounting table;
- c) has a thickness (or can be built up with backing plates) such that its surface is in the plane of the horizontal force measuring device with a tolerance of ± 5 mm; and
- d) is wider than the footwear item and long enough to allow a sliding distance of at least 40 mm without crossing a join. Minimum dimensions of 220 mm \times 120 mm normally suffice.

Any type of tightly specified lubricant or

contaminant may be used.

P-2 EXTRUDED OR ROLLED PRODUCTS

Where possible, specimens shall be cut in each of the three following directions:

- a) parallel to the processing direction;
- b) perpendicular to the process direction; and
- c) at approximately 45° to the process direction.

Where the process direction is not known, reference the direction(s) in relation to some other distinguishing feature on the product.

NOTE — When evaluating worn floor surfaces it may be appropriate to measure these items in directions aligned with any patterns of wear in addition to the normal modes of testing.

P-3 CALIBRATION OF SPECIMENS TO BE USED AS REFERENCE FLOORS FOR TESTING FOOTWEAR ITEMS OR FOOTWEAR MATERIALS

Specimens shall be calibrated in the direction in which they are to be used by either:

- a) determination of the standard CoF test values when tested using Slider 96 rubber or; and
- b) determination of surface roughness.

NOTE — Slider 96 rubber has been developed as a standard reference material for slip tests and represents a hard heel material. It was formerly known as 'Four S' rubber (Standard Simulated Shoe Sole).

Characterize other test floors used for comparing the performance of footwear items or footwear materials, except transient forms, by testing them using Slider 96 rubber to establish the nominal performance level of the surface which shall be retained for future reference.

Store all test floors carefully: Do NOT stack test floors on top of each other. When handling test floors, hold them by the edges and do NOT touch the test surfaces.

Cleaning procedures for floorings are given in Annex R.

P-4 STANDARD QUARRY TILES FLOOR

Standard clay quarry tiles (Calibrated Floor Tiles) conform to the calibration values specified in Table 14 when calibrated using the Slider 96 rubber method and may be used when assessing footwear items against the slip resistance guidelines.

Table 14 Required Calibration Coefficient of Friction Values for Standard Quarry Tiles

SI No.		Dry CoF	Wet CoF
(1)	(2)	(3)	(4)
i)	Minimum	0.57	0.43
ii)	Maximum	0.63	0.49

The calibration direction is marked on standard clay quarry tiles to aid users to correctly align tiles when preparing the test floor.

Tiles shall be recalibrated after every 50 slip runs or prior to each day of testing, whichever is the more frequent, to ensure that they are not being worn smooth or otherwise damaged. However, if experience shows that the friction properties of the test floor are NOT strongly influenced by repeated testing then calibration intervals may be extended.

P-5 SURFACE LUBRICANTS

Where required, sufficient lubricant shall be applied to the test floor in order to thoroughly cover the

surface unless otherwise specified and to create a visually continuous pool covering the whole contact area between the footwear item and the test floor in the area of initial contact.

NOTE — A trough or similar device may be used to entrap lubricant within the footwear/surface contact area so as to ensure that the required minimum depth of lubricant is reached.

Distilled or deionized water, ISO 3696 – grade 1, 2 or 3.

Detergent solution, containing a mass fraction of 0.5 percent sodium lauryl sulphate (CAS Number 151-21-3), general Laboratory grade in distilled or deionized water.

P-6 APPARATUS AND MATERIALS FOR CALIBRATION FOR FLOORINGS BY SLIDER 96 RUBBER METHOD

Slider 96 rubber of hardness 96 IRHD \pm 2 IRHD and rebound resilience of 24 percent \pm 2 percent when measured at 23 °C \pm 2 °C according to ISO 48-2 and ISO 4662 respectively.

The specimens, hereafter referred to as S96 sliders, shall be 25.4 mm \pm 1.0 mm wide, at least 50 mm long, greater than 5 mm thick and shall have vertical walls and square edges as judged by eye.

NOTE — The storage temperature of the S96 slider rubber should be below 25 °C and preferably below 15 °C. The rubber may be stored in a refrigerator as a means of extending its service life. Whatever the storage temperature, moist conditions should be avoided, and conditions should be such that condensation does NOT occur. When in storage the rubber should be protected from light, particularly direct sunlight and strong artificial light, and from circulating air by wrapping or storing in air tight containers (paper and polythene are both suitable, however, plasticized PVC film shall NOT be used. It is recommended that S96 sliders are discarded 12 months after purchase.

A rigid, rectangular backing plate with dimensions at least as wide as the S96 sliders and at least 50 mm long. This may be incorporated into (or securely attached to) the lower surface of a rectangular box or securely attached to a suitably sized shoemaking last.

Or

A rectangular metal box suitably sized shoemaking last.

A means of securely attaching the S96 slider to the backing plate that shall prevent movement between the S96 slider surface and the backing plate surface during slip runs. Suitable adhesives include: epoxy resins, cyanoacrylate or solvent based contact adhesives.

400 grit silicon carbide abrasive paper mounted on a flat, rigid surface.

A test floor as specified in Annex P.

Methylated spirits or other mild solvent.

P-8 APPARATUS AND MATERIALS FOR CALIBRATION FOR FLOORINGS BY THE SURFACE ROUGHNESS METHOD

A suitable roughness tester that has a stylus of radius 5 µm is capable of sampling over a 4 mm length of test surface divided into 5 cut-off lengths of 0.8 mm and is capable of measuring the maximum peak to valley height within each of the five cut-off lengths and reporting the average value, Rz, as specified in EN ISO 4287.

P-9 PREPARATION OF TEST SPECIMENS

P-9.1 Preparation of S96 slider and floor surface

If the S96 slider has been stored at low temperature, allow it to reach room temperature. If the S96 slider has been stored at room temperature.

Lightly abrade the bonding surface of the S96 slider with abrasive paper. Clean by blowing with clean air or by wiping with a suitable solvent such as methylated spirits then allow to dry at 23 °C ± 2 °C and 50 percent ± 5 percent RH.

Attach the S96 slider to the backing plate using adhesive.

Holding the S96 slider assembly by the backing plate and applying a light, evenly distributed pressure, abrade the exposed surface of the S96 slider against the abrasive paper until a visually even level of abrasion is achieved and the surface is parallel with the backing plate. For this procedure alternately use a backward and forward linear movement in a direction parallel to the long side of the S96 slider, and a side-to-side movement in a perpendicular direction with the final direction of abrasion parallel to the long side.

Remove any debris from the S96 slider surface by lightly brushing with dry, absorbent paper towel.

NOTES

1 The condition of the S96 slider must be restored at intervals as repeated use will cause the edges to become rounded and a concave chamfer to develop across the tested edge. It is suggested that this should be after a sequence of 15 dry runs or 10 dry runs and 10 wet runs to restore the S96

slider to the correct condition and/or cut away the affected end section of material ensuring that the new cut edge is vertical and flat, and maintaining a minimum length of 50 mm.

2 Either end of the S96 slider may be used provided that the end used is in the correct condition.

3 When the thickness of the S96 slider has been reduced to 5 mm or the length to less than 50 mm, it should be replaced.

4 Clean the test floor in accordance with Annex R.

P-10 CALIBRATION PROCEDURES

P-10.1 Calibration procedure for the S96 slider and test floor:

P-10.1.1 Condition the test floor and the prepared S96 slider for at least 3 hours at 23 °C ± 2 °C and 50 percent ± 5 percent RH.

P-10.1.2 Mount the conditioned test floor on the mounting table of the slip resistance test machine ensuring that its surface is in the plane of the horizontal force measuring device and positioning it so that the S96 slider, when set up as below shall contact and move along the area where the slip resistance measurements for footwear items will actually be made (in general along the centre line). In the case of standard clay quarry tiles they should also be placed so that the ribs on the reverse side are aligned with the direction of sliding. The edge facing the operator should be marked and the surface be given a unique reference.

P-10.1.3 If necessary, securely attach the backing plate of the S96 slider to the rectangular box or last.

NOTE — If the backing plate forms part of the rectangular box, **P-4.1.3** will not be necessary.

P-10.1.4 Securely attach the box or last to the attachment point of the slip resistance test machine so that the 25.4 mm ± 1 mm edge of the S96 slider is perpendicular to the direction of sliding movement and the line of action of the vertical force passes through the S96 slider – floor contact area.

P-10.1.5 Set the face of the S96 slider at a contact angle of 7.0° ± 0.5° to the test floor using wedge *see* Fig. 25.

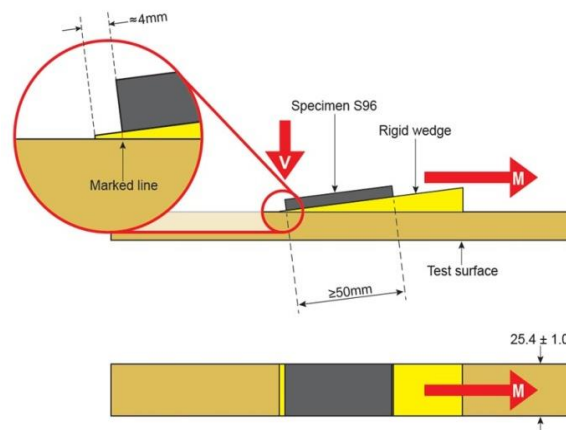


FIG. 25: USE OF RIGID WEDGE TO ACHIEVE CORRECT ORIENTATION AND CONTACT ANGLE OF S96 SLIDER

P-10.1.6 Apply the test conditions specified in Annex N for the forward heel slip mode, applying a $500\text{ N} \pm 25\text{ N}$ normal force.

P-10.1.7 Carry out the procedure defined in E-7 and determine the coefficient of friction of the tile in a single test run.

P-10.1.8 If the CoF is outside the specified range (Table 14 for the standard clay quarry tiles), terminate the calibration and reject the tile.

P-10.1.9 If the CoF is within the specified range (Table 14 for standard clay quarry tiles), record the values obtained and lubricate the test floor with distilled or deionised water. Repeat P-11.

P-10.1.10 Lubricate the floor surface with water in accordance with E-7. Repeat the test procedures P-10.1.6 to P-10.1.9.

P-10.1.11 After calibrating a wet surface, the S96

slider shall be thoroughly dried before being used for further calibration tests, whether dry or wet.

P-10.1.12 After completing the calibration tests, clean the S96 slider with distilled or deionised water and allow to dry before returning to storage.

P-11 CALIBRATION PROCEDURE FOR FLOORINGS BY THE SURFACE ROUGHNESS METHOD

Measure the surface roughness R_z according to EN ISO 4287 but with a sample length of $0.8\text{ mm} \pm 0.1\text{ mm}$ in 10 locations in the area where slip measurements are made in the direction parallel to the sliding movement taking five sampling lengths per location (evaluation length $4.0\text{ mm} \pm 0.5\text{ mm}$).

Calculate and record the overall mean value for R_z from all 10 locations.

ANNEX Q

(Clause 4.3.8)

FOOTWEAR ITEMS — SPECIFICATION AND CALIBRATION

Q-1 GENERAL

All specimen shall be marked with unique reference.

Q-2 APPARATUS AND MATERIALS

Cutting specimen of the dimensions specified in Q-4.1 – Q-4.3.

NOTE — Some methods of cutting, for example with shoemaking press knives, may produce specimens with concave walls and will require a supplementary means of trimming.

A 150 mm steel rule with 0.5 mm graduations.

Q-3 TEST SPECIMEN REQUIRED

Two items are required for each of the following:

a) Footwear;

- b) Sole units or direct moulded soles which have been stripped from footwear (NB not all sole units include a heel part);
- c) Sole facers for dual density soles (*see note below*);
- d) Sheet materials used for forepart of sole (for example, resin rubber, leather, crepe, any other sole sheet); and
- e) Test plates of moulded material (for example, vulcanized rubber, TR, PVC, TPU, Polyurethane or EVA intended either for sole units or direct moulded soles). Such sheets or plates may be patterned or plain and are normally formed in sizes. The sliders may represent

sole foreparts, or the heels of moulded soles, or top-pieces;

Four specimen required for the following:

- a) Top-pieces; and
- b) Sheet material for Top piece.

NOTE — Sole facers may only be tested without their associated midsole if they have a plain flat foot side face as it is not possible to satisfactorily mount facer test items which have a cored or otherwise contoured foot side. Sole facers having a plain foot side face can be tested as per Q-4.1 and Q-3.3.

Q-4 SLIDERS CUT FROM SHEET MATERIAL OR MOULDED TESTPLATES

Q-4.1 Sheet Material or from Test Plates to Be Used for Top Piece in the Heel Slip Mode:

The sliders shall be discs $76 \text{ mm} \pm 1 \text{ mm}$ in diameter unless the material is specifically intended for top-pieces on women's high heeled footwear in which case the diameter of the sliders may be reduced in order to better reflect the size of the heel. The diameter of such sliders shall be included in the test report. Sliders shall have.

- a) Minimum thickness of 5 mm unless the material is specifically intended to be used at a lower thickness, in which case the slider thickness shall be the same as that to be used in the finished footwear. Measure and record the thickness of the slider in millimetres to the nearest 0.5 mm using the steel rule; and
- b) Vertical edge as judged by eye. If the material is thinner than required for the test.

Q-4.2 Sheet Material or from Test Plates for Testing in the Forepart Slip Mode:

Sliders shall be sections of a suitable size and shape to fit the base of the last from the toe backwards over at least half of the overall length of the last (to ensure that the rear edge of the section is outside the contact area during the test).

Sliders shall have a minimum thickness of 5 mm unless the material is specifically intended to be used at a lower thickness, in which case the slider thickness shall be the same as that to be used in the finished footwear. Measure and record the thickness

of the slider in millimetres to the nearest 0.5 mm using the steel rule. If the material is thinner than required for the test.

Q-4.3 Thin Test Materials:

Thin layers may be laminated together or bonded to a suitable midsole material, as appropriate to the end product. Measure and record the thickness of each laminated slider in millimetres to the nearest 0.5 mm using the steel rule.

Q-4.4 Worn footwear:

Worn footwear items may be tested. In addition to the normal modes of testing, it may be appropriate to test these items at angles and orientations complementary to the wear pattern on the heel or sole direction in order to assess those particular location.

Footwear, sole unit and sheet material items to be used as a standard or reference for comparing the friction properties of different test floors:

Footwear items other than S96 slider rubber. When using S96 slider rubber for calibrating test floors, follow the procedures described in P-11.

The footwear, sole and sheet material shall be tested on dry and wet quarry tiles according to the test procedure in order to characterize the friction properties of the item.

Record the supplier's name, reference and, if applicable, method of surface preparation used.

Sliders prepared from sheet materials shall be rectangles $25.4 \text{ mm} \pm 1.0 \text{ mm}$ wide, at least 50 mm long and greater than 5.0 mm thick. The sliders shall have vertical walls and square edges as judged by eye.

The effect of repeated use on the condition of the slider surface shall be monitored at intervals based on experience of its use. When the condition has changed sufficiently to affect the frictional properties of the slider, appropriate action shall be taken.

It may be possible to restore a worn slider to the correct condition by using the abrasion method provided this does not reduce the thickness to 5.0 mm or less, and/or by cutting away the affected end section, ensuring that the new cut edge is vertical and flat and maintaining a minimum length of 50 mm.

ANNEX R

(Clause 4.3.8)

PREPARATION OF FOOTWEAR TEST ITEMS AND TEST FLOORS

R-1 APPARATUS AND MATERIALS

A hand scrubbing brush of medium stiffness.

Distilled or deionised water, ISO 3696 – grade 1, 2 or 3.

Detergent solution containing 5 percent w/w sodium lauryl sulphate (CAS Number 151-21-3), general laboratory grade, in distilled or deionised water [R-1.2].

Propanone (acetone) (CAS Number 67-64-1) or butan-2-one (MEK) (CAS Number 78-93-3), general laboratory grade.

Silicon carbide abrasive paper, 400 grit size, mounted on the face of 100 mm long, 70 mm wide rigid block of mass $1\,200\text{ g} \pm 120\text{ g}$.

NOTE — This mass can be achieved using steel to make a block of the specified dimensions approximately 22 mm thick.

Grease-free and lint-free cotton wool.

A source of clean compressed air or a clean, dry, soft brush.

R-2 PREPARATION OF TEST SPECIMENS**R-2.1 Footwear Sole Units and Sliders:**

All footwear items shall be tested in the new condition so as to take account of the surface finish. Worn footwear may be tested and the degree of wear shall be reported.

Unless otherwise specified all footwear items shall be cleaned prior to testing. Additionally, the following procedures may be used.

NOTE — Worn footwear may be tested in the condition in which it is received.

Wash footwear items by scrubbing with detergent solution, rinse in clean running water and then dry completely by using dry, absorbent paper towel.

Certain types of polyurethane (PU) soling may also

be tested after solvent wiping the surface in order to remove mould release agent which may be present (a greasy residue transferred to the sole from the inside of the metal mould). Solvent wiping is mainly applicable to reaction moulded PU soles which have been direct moulded to the shoe upper. Such soles shall first be tested after a wash and then again not less than 16 hours after thoroughly wiping with grease-free and lint free cotton wool wetted with solvent. At the end of 16 hours and before the test, the sole shall be washed.

NOTE — As the wiping action will transfer grease into the cotton wool it will be necessary to use several fresh pieces in order to remove all the grease without transferring any back on to the sole.

Any type of polymeric soling which has been spray painted may also be tested after solvent wiping the surface in order to remove the paint. Such soles shall first be tested after a wash and then again not less than 16 hours after thoroughly wiping with grease-free and lint free cotton wool wetted with solvent]. At the end of 16 hours, and before the test, the sole shall be washed.

Preparatory abrading may be used when it is wished to test a sole, for example leather, after simulated light wear. Either of the following two techniques may be used.

Prepare the sole of the shoe by rubbing it with silicon carbide paper wrapped around a rigid block exerting minimal pressure, *see* Fig. 26. Only superficial abrasion shall be applied so that it does not significantly change the tread pattern nor the surface texture of the sole, and that produces a final visually uniform appearance over the whole area of the sole that will be in contact with the floor during the test. Any debris should be removed by suitable means such as clean compressed air or a clean, dry, soft brush.

NOTE — When using compressed air, wear suitable eye protection and ensure that any debris disturbed by the air blast is not directed toward other persons present.



FIG. 26 ABRASION OF SOLE

Simulating real wear by abrading the sole of the shoe by means of using the standard concrete paving slab and one or more multiples of 2 000 cycles (1 hour).

After preparing the footwear items it is important not to recontaminate them with poor handling. Rest footwear items on their side or inverted, or place them on clean dry, absorbent paper towel. Care should be taken to ensure that footwear items are NOT contaminated during any subsequent step in the test method.

Prior to testing, condition the footwear items according to conditioning as specified.

R-2.2 Floorings of All Types:

All test floors (except transient floors) shall be

cleaned using the following procedures unless such cleaning will adversely affect the condition of the test surface.

NOTE — Worn, polished or contaminated test floors may be tested in the condition in which they are received.

Wash the test floors by scrubbing with detergent solution], rinse by scrubbing in clean running water and then dry completely. It may not be appropriate to wash textile flooring materials, these may be tested in the condition received.

After preparing the test floors it is important NOT to recontaminate them by poor handling. Care should also be taken to ensure that test floors are NOT contaminated during mounting to the mounting table.

ANNEX S

(Foreword)

COMMITTEE COMPOSITION

Footwear Sectional Committee, CHD 19

<i>Organization</i>	<i>Representative(s)</i>
In Personal Capacity (<i>Flat F1, Bhoopathy Apartment, 10, Ethiraj Street, Palipattu, Chennai – 600113</i>)	DR B. N. DAS (<i>Chairperson</i>)
Atharva Labs, Noida	APARNA PARVATIKAR SHRI V. B. PARVATIKAR (<i>Alternate</i>)
Bata India Limited, Kolkata	SHRI HITESH KAKKAR SHRI ANOOP SHUKLA (<i>Alternate</i>)
Bihar Rubber Company Ltd, Ranchi	SHRI JAYANTA KUMAR LAHIRI
Bureau of Police Research and Development, Delhi	SHRI JAGIR CHAND
Central Institute for Mining and Fuel Research, Dhanbad	DR J. K. PANDEY
Central Leather Research Institute, Chennai	DR R. MOHAN SHRI SATHYARAJ (<i>Alternate</i>)
Central Reserve Police Force, Ministry of Home Affairs, New Delhi	RANDHIR KUMAR JHA SHRI R. K. THAKUR (<i>Alternate</i>)
Confederation of Indian Footwear Industries, New Delhi	SHRI NAND KISHORE
Council for Footwear Leather and Accessories	(CFLA) EXECUTIVE DIRECTOR SHRI RAJEEV SHARMA (<i>Alternate</i>)
Defence Institute of Physiology and Allied Science, New Delhi	DR MADHUSUDAN PAL
Directorate General Factory Advice Service and Labour Institutes, Mumbai	DR BRIJ MOHAN SHRIMATI M. K. MANDRE (<i>Alternate</i>)
Directorate General of Mines Safety, Dhanbad	SHRI SAIFULLAH ANSARI SHRI A. RAJESHWAR RAO (<i>Alternate</i>)
Directorate General of Quality Assurance, Kanpur	SHRI S. CHAKRABORTY SHRI SANJAY VERMA (<i>Alternate</i>)
Footwear Design & Development Institute, Noida	SHRI SHAILENDAR SAXENA SHRI SAROJ KUMAR PANDA (<i>Alternate</i>)
Indian Footwear Components Manufacturers' Association (IFCOMA), Noida	SHRI MANI ALMAL MS RASHMI (<i>Alternate</i>) SHRI S. K. VERMA (<i>Alternate</i>)
Intertek India Private Limited, Gurugram	SHRIMATI RASHMI ASTHANA
Lancer Footwear India Pvt Ltd, New Delhi	SAURABH GUPTA
Liberty Shoes Ltd, (P U Division), Karnal	SHRI ADESH GUPTA SHRI S. S. LAHIRI (<i>Alternate</i>)
M B Rubber Private Limited	SHRI VIPAN MEHTA
MSME Technology Development Centre (PPDC), Meerut	SHRI ADITYA PRAKASH SHARMA SHRI TULARAM BHARTI (<i>Alternate</i>)

<i>Organization</i>	<i>Representative(s)</i>
Mangla Plastics	SHRI J. BASAK
Ministry of Commerce and Industry, Department for Promotion of Industry and Internal Trade, New Delhi	SHRI NAND LAL
Pinza Footwear, New Delhi	SHRI PREM MEHANI
Prolific Engineers	SHRI G. P. KEDIA
Steel Authority of India Ltd, Bhilai	SHRI V. K. AGARWAL SHRI A. K. SAHA (<i>Alternate</i>)
Top Lasts	SHRI DEEPAK MANCHANDA SHRI ANURAG SHARMA (<i>Alternate</i>)
XO Footwear, Delhi	SHRI NALIN GUPTA SHRI MANOJ KUMAR (<i>Alternate</i>)
BIS Directorate General	SHRI AJAY KUMAR LAL, SCIENTIST 'F'/SENIOR DIRECTOR AND HEAD (CHEMICAL) [REPRESENTING DIRECTOR GENERAL (<i>Ex-Officio</i>)]

Member Secretary
MS PREETI PRABHA
SCIENTIST 'C'/DEPUTY DIRECTOR
(CHEMICAL), BIS

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