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INTERNATIONAL STANDARD

ISO 2023

Second edition
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Rubber footwear — Lined industrial vulcanized-rubber boots — Specification

Articles chaussants en caoutchouc — Bottes doublées en caoutchouc vulcanisé à usage industriel — Spécifications

Reference number
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Contents

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 2023 was prepared by Technical Committee ISO/TC 45, *Rubber and rubber products*.

This second edition cancels and replaces the first edition (ISO 2023:1973), which has been technically revised.

Annexes A, B, C, D and E form an integral part of this International Standard. Annex F is for information only.

Rubber footwear — Lined industrial vulcanized-rubber boots — Specification

1 Scope

This International Standard specifies requirements for lined industrial vulcanized-rubber ankle, half-knee, short-knee and knee-height boots, for men and women, and lined rubber boots of three-quarter and full-thigh height for men.

The standard does not cover the style of boot.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 37:1994, *Rubber, vulcanized or thermoplastic — Determination of tensile stress-strain properties.*

ISO 132:1983, *Rubber, vulcanized — Determination of flex cracking (De Mattia).*

ISO 188:1982, *Rubber, vulcanized — Accelerated ageing or heat-resistance tests.*

ISO 815:1991, *Rubber, vulcanized or thermoplastic — Determination of compression set at ambient, elevated or low temperatures.*

ISO 10335:1990, *Rubber and plastics footwear — Nomenclature.*

3 Definitions

For definitions of footwear terms, see ISO 10335.

4 Design requirements

4.1 Boot upper

The boot upper shall consist of one or more plies of rubber and fabric.

4.2 Minimum thickness

At no point shall the thickness of the boot be less than the appropriate value given in table 1, when measured as described in annex A.

In the case of heels with internal cavities, the thickness from the outer surface of the heel to the start of the cavity, over any cleat, including pattern, shall be not less than 9,0 mm.

4.3 Materials and components

4.3.1 Mandatory requirements

4.3.1.1 Laces

When tested in accordance with the method described in annex B, laces shall have an average abrasion resistance of not less than 11 000 cycles.

When tested in accordance with the method described in annex C, laces shall have an average breaking force of not less than 500 N.

Table 1 — Minimum thickness

Dimensions in millimetres

Measurement	Height			
		Over cleat	Between cleats	Non-cleat
Boot upper Foxing strip at the toe Foxing strip at the heel Foxing strip in other areas	4,5 3,0 4,0 2,5			
Insole, filler and soling (men's)		13,0		9,0
Insole, filler and soling (women's)		11,0		9,0
Cleated soling (men's)		9,0	3,0	
Cleated soling (women's)		7,0	2,5	
Non-cleated soling				5,0
Cleated heel (men's)		25,0		
Cleated heel (women's)		20,0		
Non-cleated heel				20,0

4.3.1.2 Metal components

If footwear is to be used in potentially flammable or explosive atmospheres, no metal component shall be of aluminium, magnesium or titanium; neither shall any alloy containing one or more of these constituents be used unless both the total content of these three constituents does not exceed 15 % by mass, and the content of magnesium and titanium together does not exceed 6 % by mass.

NOTE 1 These limitations have been imposed to avoid the hazards of sparking due to friction between rusted steel or iron and the metals described.

4.3.2 Optional requirements

Boot heights

Suggested ranges for heights of boots are given in annex F.

5 Physical properties

5.1 Breaking force of the boot upper

When tested as described in annex D, the breaking force shall be in accordance with table 2.

Table 2 — Minimum breaking force of boot upper

	Minimum breaking force — length and breadth directions N/25 mm
Woven material	250
Knitted fabric	180

5.2 Resistance to flexing of boot upper after ageing

Four test pieces shall be cut from the boot length, two along the length and two across the breadth, and, after ageing for 168 h at 70 °C ± 1 °C in accordance with the ISO 188 air-oven method, shall be tested as described in annex E.

All four test pieces shall withstand the number of continuous flex cycles shown in table 3 without showing pinholes or cracking when viewed with the unaided eye, and shall meet the requirements of grade 1 or grade 2 of ISO 132.

For this purpose, only those parts of the test piece shall be observed which are under tension during the test, i.e. the folds which form a diamond shape. The centre fold of the test piece, pinholes or cracking associated with machine damage shall be ignored.

Table 3 — Minimum number of flex cycles of boot upper

Thicknesses of individual test piece mm	Number of flexes	
	Hand-built type	Moulded type
⩽ 2,0	125 000	75 000
> 2,0 but ⩽ 2,25	110 000	50 000
> 2,25	90 000	40 000

5.3 Tensile strength and elongation at break of outsole and heel

The outsole and heel shall be reduced to sheets or pieces either by careful buffing or by careful slitting. The sheets or pieces shall be of sufficient size and thickness to be able to stamp a maximum of ten standard-size test pieces. The tensile strength and elongation at break of the outsole and heel shall then be determined in accordance with ISO 37. The type of dumb-bell used shall be stated when quoting results. Of the ten test pieces, five shall be aged prior to testing.

Three test pieces shall be tested and the median value of the three test results shall be in accordance with table 4. If the median value of the results is below the appropriate value given in table 4, and at the same time the highest value is above the appropriate value given in table 4, then the other two test pieces shall be tested.

Table 4 — Tensile strength and elongation at break of outsole and heel

Outsole thickness mm	Tensile strength (min.) MPa	Elongation at break (min.) %
⩽ 9,0	8,5	250
> 9,0 but ⩽ 10,0	8,0	225
> 10,0 but ⩽ 11,0	7,5	200
> 11,0	7,0	200
Heel	7,0	200

After submission to the ageing treatment described in table 5, the median value for tensile strength and elongation at break shall not show changes, from the corresponding unaged median values, greater than the amount given in table 5.

Table 5 — Changes in value of tensile strength and elongation at break after ageing of outsole and heel

Ageing treatment	Maximum change after ageing	
	Tensile strength	Elongation at break
168 h at 70 °C ± 1 °C in accordance with ISO 188 air-oven method	± 20 % of unaged value	− 30 % to + 10 % of unaged value

5.4 Compression set of heel

When tested in accordance with ISO 815 at 70 °C ± 1 °C for 24 h using lubricated small test pieces, samples taken from the heel shall have a compression set of not more than 50 %.

6 Leakage and immersion requirements

6.1 Requirements

When boots are tested as described in 6.2, there shall be no leakage of air. In the case of ankle boots, leakage of air in the vicinity of either the eyelets or gusset shall not constitute a failure but such boots shall then be subjected to an immersion test as described in 6.3, when there shall be no water penetration to the inside of the boot.

6.2 Leakage test procedure

Seal the top of the boots and force air into the boot at a pressure of 10 kPa. Immerse the boot in water to within 75 mm of the top and examine the boot for escape of air bubbles.

6.3 Immersion test for ankle boots

Immerse the boot in water to within 75 mm of the top for a period of 16 h. Remove the boot and examine to see if water has penetrated to the inside.

7 Marking

Each article of footwear shall be indelibly and legibly marked with the following:

a) size, stamped on the inside or moulded or impressed on the waist of the outsole;

b) manufacturer's or supplier's identification mark;

c) country of origin;

d) the number of this International Standard, stamped on the inside of the boot;

e) the suffix letter "H" if the requirements of 4.3.1.2 for metal components are complied with.

Annex A
(normative)

Measurement of minimum thickness

A.1 Apparatus

The appropriate measuring apparatus shall be chosen from those given in A.1.1 to A.1.4.

A.1.1 Micrometer dial gauge, accurate to within 0,1 mm.

A.1.2 Travelling microscope, accurate to within 0,1 mm.

A.1.3 Optical magnifier, with a scale graduated in divisions of 0,1 mm.

A.1.4 Steel rule, graduated in millimetres.

A.2 Preparation for measurement of insole, filler, soling and heel

Cut the boot completely longitudinally and perpendicular to the surface, through the centre of the sole, on a line drawn from the centre of the toecap to the centre of the heel.

Determine the centreline, illustrated in figure A.1, by placing the boot on a horizontal surface and against a vertical plane so that it touches the edge of the sole at points A and B on the inner side of the boot. Construct two further vertical planes at right angles to the first vertical plane so that they meet the sole at points X and Y. Draw a line through X and Y. This line shall constitute the centreline for the forepart of the boot.

A.3 Procedure

A.3.1 Boot upper

Take four measurements of the combined thickness of rubber and fabric symmetrically round the top of the boot not less than 3 mm and not more than 15 mm below the top binding. In the case of a boot with an extension take the measurements not less than 3 mm and not more than 15 mm below the joint strip.

A.3.2 Foxing strip at the toe

Measure the combined thickness of rubber and fabric, excluding any pattern, within 6 mm of the centreline of the boot at the toe.

When a protective toecap is incorporated in the boot, measure the combined thickness of the rubber and fabric, excluding any pattern, from the outside surface of the protective toecap.

A.3.3 Foxing strip at the heel

Measure the combined thickness of rubber and fabric, excluding any pattern, within 6 mm of the centreline at the heel.

A.3.4 Foxing strip in other areas

Take four measurements of the combined thickness of rubber and fabric, excluding any pattern, at points symmetrically round the boot in the foxing-strip area but not in either the heel or toe areas.

A.3.5 Insole, filler and soling

Measure the combined thickness of the insole, filler and soling on the cut section from the upper surface of the insole to the outer surface of the outsole. Take the measurements over and between cleats, including any pattern, at three widely separated points.

A.3.6 Soling

Measure the thickness of the soling on the cut section over and between cleats, including any pattern, from the lower surface of the insole and filler, at three widely separated points.

A.3.7 Heel

Measure the heel thickness on the cut section over any cleat or pattern perpendicularly from the lower surface of the insole and filler to a point 10 mm from the bottom of the back edge of the heel.

A.4 Expression of results

Express all results individually in millimetres to the nearest 0,1 mm.

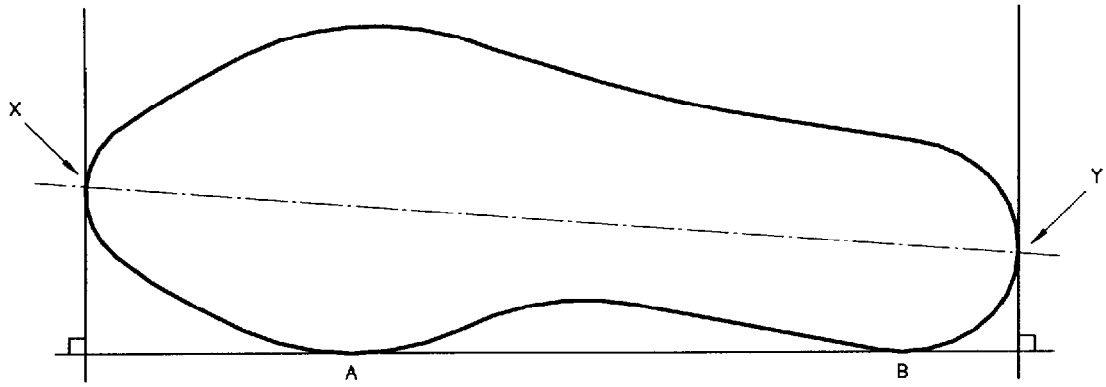

Figure A.1 — Centreline of boot

Annex B
(normative)

Determination of resistance to abrasion of laces

B.1 Apparatus

B.1.1 Machine capable of abrading laces, as illustrated in figure B.1.

The machine is designed so that one piece of the lace under test can be formed into a loop and held in a clamp (A) which can be moved horizontally backwards and forwards with a stroke of 35 mm by a crank worked by a wheel rotating at a uniform speed of 60 rev/min. One end of a second piece of the lace is fixed in a clamp (B) which is 310 mm away from clamp A when they are at their nearest point. The other end is passed through the fixed loop and over a support (C). A 250 g weight (W) is suspended from the end of the lace so that the lace is held under tension for the whole of the abrasion cycle. Each test position is fitted with a counter which stops when the test piece breaks. The machine is also be fitted with a pre-set counter switch so that when desired the machine can be made to stop after a pre-set number of cycles.

B.2 Conditioning and test atmosphere

Condition the laces for 48 h at 23 °C ± 1 °C and (65 ± 2) % relative humidity. Carry out the test in the same atmosphere.

B.3 Test pieces

From the conditioned laces, cut six pairs of test pieces, one of each pair being about 200 mm long and the other about 500 mm long. If sufficient laces are available, cut each test piece from a separate lace.

B.4 Procedure

Subject each of the six test pieces in turn to the following procedure. Before clamping a test piece, turn the driving mechanism by hand until clamps A and B are at their nearest position. Clamp the test piece in the test machine as described in B.1. When all the stations of the machine have been loaded, turn the machine through a cycle by hand to check that one test piece is being rubbed by the other for the whole cycle.

Start the machine and leave it to run continuously until a test piece breaks. Record the number of cycles necessary for the test piece to be abraded through.

B.5 Expression of results

Calculate the arithmetic mean of the six measurements, and record this result as the number of cycles to break.

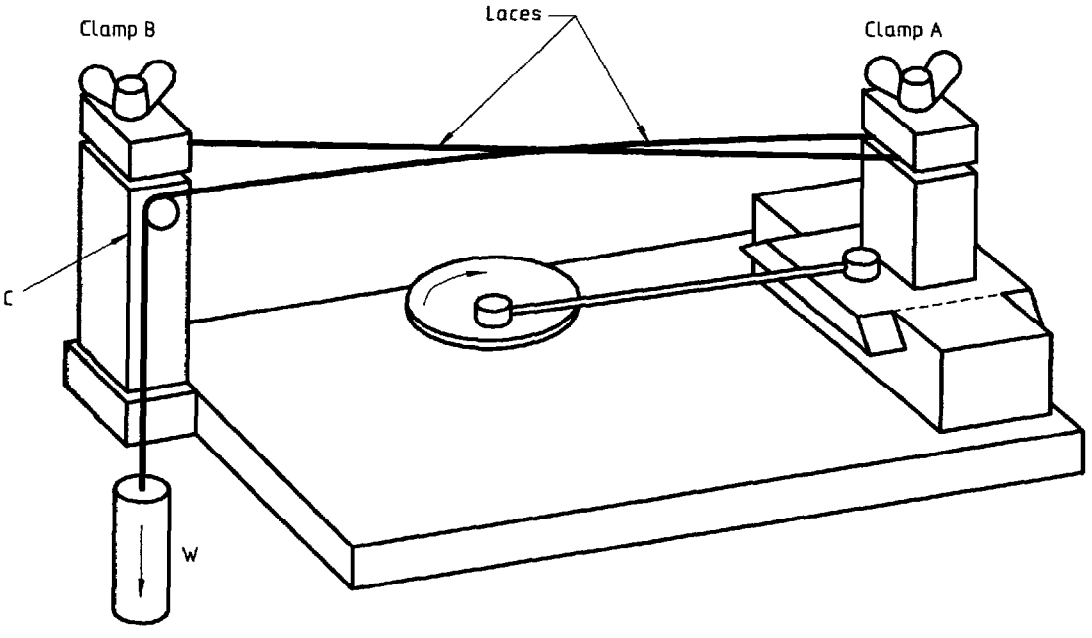

Figure B.1 — Lace-abrading machine

Annex C
(normative)

Determination of breaking force of laces

C.1 Apparatus

C.1.1 Tensile-testing machine, with a constant rate of traverse of 100 mm/min ± 20 mm/min, and a force range of 0 N to 1 000 N. The machine shall have means for gripping the laces securely (either jaws or bollard-type grips). Where jaws are used, they shall not be of a type which causes an undue number of jaw breaks.

C.2 Test pieces

Cut three lengths of lace sufficient to allow for a test length of 200 mm between the grips. If the test material is supplied as made-up laces, cut each test piece from a different lace.

C.3 Conditioning and test atmosphere

Condition the test pieces for 48 h at 23 °C ± 1 °C and (65 ± 2) % relative humidity. Carry out the test in the same atmosphere.

C.4 Procedure

Clamp a test piece in the bollards or jaws so that there is a distance of 200 mm between the centres of the bollards or the edges of the jaws. Run the machine at a constant rate of traverse of 100 mm/min and record the force required to break the test piece.

If any of the test pieces break at the jaws, reject these results and carry out further tests on new test pieces.

C.5 Expression of results

Calculate the arithmetic mean of the three measurements, and record this result as the breaking force of the sample, in newtons.

Annex D
(normative)

Determination of breaking force of boot upper

D.1 Apparatus

D.1.1 Tensile-testing machine, with a constant rate of traverse and with means for indicating or preferably recording the maximum load applied to the test piece at rupture. The central points of the two jaws of the machine shall be in the line of pull, the front edges shall be perpendicular to the line of pull and their clamping faces shall be in the same plane. The jaws shall be capable of holding the test piece without allowing it to slip, and shall be so designed that they do not cut or otherwise weaken the test piece and shall be wider than the prepared test piece. The rate of traverse of the pulling jaw shall be 100 mm/min ± 10 mm/min.

D.2 Test pieces

Cut test pieces from the boot upper above the vamp so that they are 25 mm wide and of a convenient length to allow a distance of 75 mm between the jaws of the tensile-testing machine.

Cut three test pieces in the length direction and three test pieces in the breadth direction of the fabric. Where the height of the product does not permit a test piece to be cut to give a free length of 75 mm between the jaws, use a free length of 25 mm.

D.3 Procedure

Place each of the test pieces in the tensile-testing machine in turn and measure the force required to break each test piece.

D.4 Expression of results

Express the breaking force of the boot upper in both the length and breadth directions as the mean value, in newtons, of the breaking force recorded for each of the three test pieces. Record the dimensions of the test piece used.

Annex E
(normative)

Determination of resistance to flexing

E.1 Apparatus

E.1.1 Micrometer dial gauge, accurate to within 0,1 mm.

E.1.2 Flexing machine, the essential features of which shall be as follows:

The machine shall have an adjustable stationary part with grips 25 mm in width for holding one end of the test piece in a fixed position, and a similar reciprocating part for holding the other end of the test piece.

The reciprocating part shall be mounted so that its motion is in the direction of, and in the same plane as, the centreline between the grips, and its travel adjusted so that the reciprocating part approaches the stationary grip to a distance of 13 mm ± 1 mm and recedes to a distance of 57 mm ± 1 mm.

The cam which actuates the reciprocating part shall be driven by a constant-speed motor to give 340 flexes/min to 400 flexes/min, and with sufficient power to flex at least six and preferably twelve test pieces at one time.

The test pieces shall be arranged in two equal groups, so that one group is being flexed while the other is being straightened, thus reducing the vibration in the machine. The grips shall hold the test pieces firmly, and shall enable individual adjustments to be made to each test piece.

The test equipment shall be kept away from any ozone source.

E.2 Test pieces

The test pieces shall have the dimensions shown in figure E.1. Cut four test pieces from the thinnest portion of the boot upper containing the fewest plies of fabric.

Take care to ensure that the test pieces are cut cleanly from the sample material.

Measure the thickness of the test pieces with a micrometer dial gauge at each corner and in the centre and take the median of the five readings as the thickness of the individual test piece to the nearest 0,1 mm.

E.3 Fitting the test pieces in place

Fold the test piece symmetrically about its major axis so that the rubber surface is outwards. In the folded condition, insert one tapered end into the stationary grip so that the central axis of the test piece is midway between the stationary and reciprocating grips when these are at their greatest separation. Both folded tapered ends shall be aligned with the edges of their respective grips. For convenience, the tapered ends of the test piece may be marked at the gripping points in order to align the test piece correctly in the grips. Tighten the grip, insert the other end of the test piece into the reciprocating grip and tighten.

It is essential that the test piece is not under tension.

Figure E.2 shows the arrangement of the apparatus and test piece during the flexing cycle.

E.4 Procedure

Carry out the required number of flex cycles. Record the number of completed flex cycles by using a trip counter operated by one of the reciprocating grips. A complete to-and-fro movement of the reciprocating grip shall be counted as one flex cycle. The ambient temperature during testing shall be 23 °C ± 2 °C.

Remove the test piece and examine for pin holes and cracking.

E.5 Expression of results

Record the number of flex cycles completed, the thickness of the test piece and whether any pinholes or cracks were visible with the unaided eye, for each test piece tested.

Dimensions in millimetres

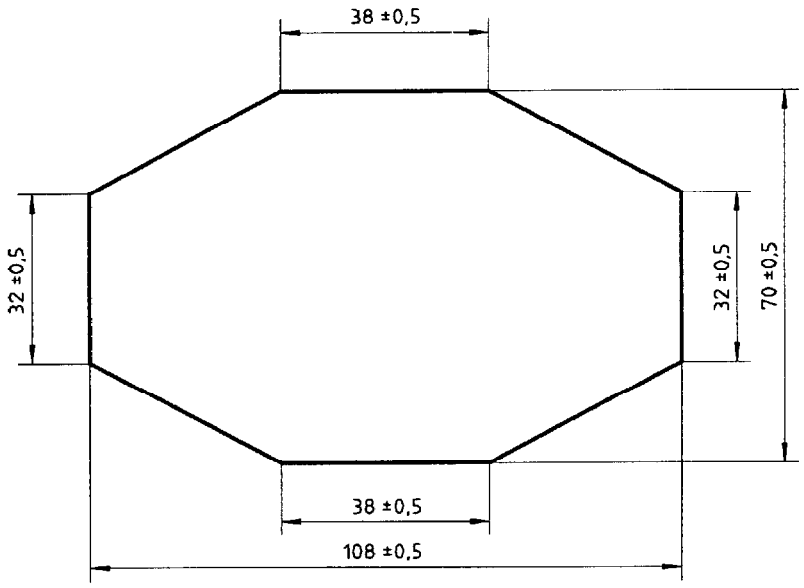

Figure E.1 — Test piece for flexing test

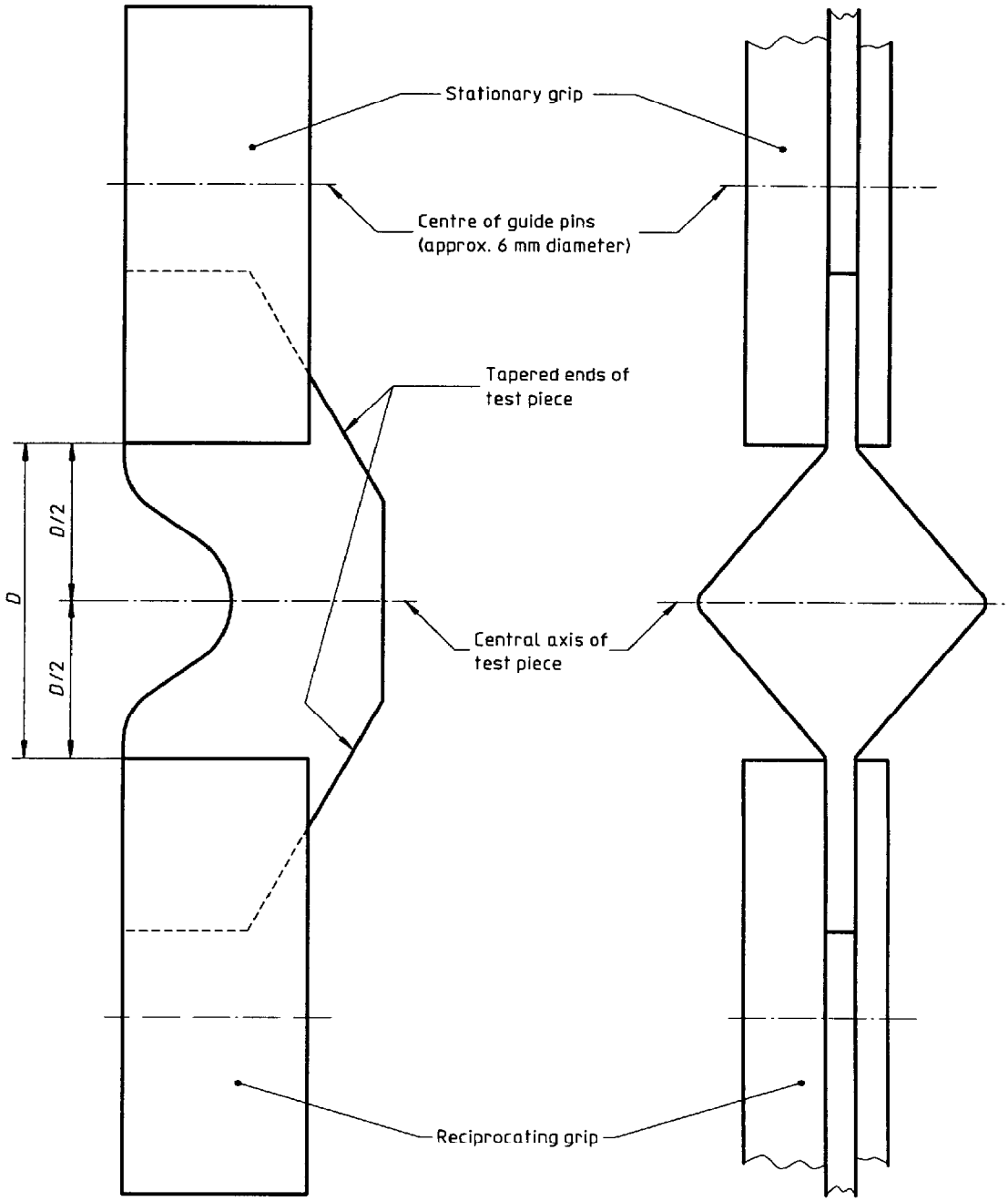

Figure E.2 — Arrangement of apparatus and test piece during the flexing cycle

Annex F
(informative)

Boot heights

Suggested ranges for the height of boots covered by this International Standard are given in table F.1. The heights should be measured on the inside at the back of the boot from the insole upwards, including any flexible extension.

Table F.1 — Boot heights

Dimensions in millimetres

Measurement	Height	
	Men's	Women's
Ankle	115 to 179	115 to 152
Half knee	180 to 239	153 to 203
Short knee	240 to 329	204 to 279
Knee	330 to 429	280 to 380
Three-quarter thigh	640 to 699	—
Full thigh	700 minimum	—

NOTE — Agreement between the interested parties on the nominal boot height and permitted tolerances is common commercial practice.

ICS 13.340.10

Descriptors: rubber products, footwear, protective footwear, boots, specifications, tests, marking.

Price based on 14 pages