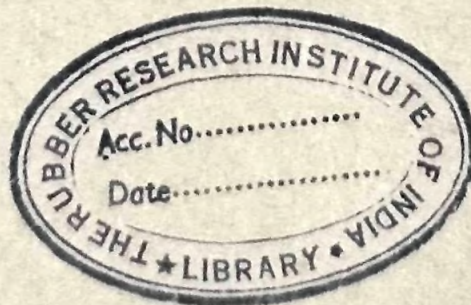


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IS : 3738 - 1966

Indian Standard
SPECIFICATION FOR
RUBBER KNEE BOOTS

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MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
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SPECIFICATION FOR RUBBER KNEE BOOTS

Footwear Sectional Committee, CDC 40

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0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 20 June 1966, after the draft finalized by the Footwear Sectional Committee had been approved by the Chemical Division Council.

0.2 Rubber knee boots are a type of moulded or assembled footwear that are made of rubber in combination with cotton fabric. They are also known popularly in the trade as gum boots. The upper portion of this footwear extends almost up to knee height and its soles are so designed as to prevent slipping. These boots are meant to protect feet and legs below knee against rain during monsoon, while working in slushy areas.

0.3 Considering the ever-increasing home consumption as well as the potentiality of export market, Footwear Sectional Committee, CDC 40, decided to lay down basic requirements for this type of footwear.

0.4 The Committee, while finalizing this standard, decided to prescribe only physical requirements for the various rubber components used in the construction of footwear and to make provision for the use of natural as well as the synthetic rubber components, provided they fulfil the necessary physical and functional tests. For flexing endurance test, for soles and heels, Ross flexing machine has been prescribed whereas De-mattia type of machine has been prescribed for upper flexing. Ross flexing machine enables testing of soles and heels directly cut from footwear which facilitates checking of the effect of the design on the sole. Footwear soles in service bend by an angle of 60° to 90° without much stress. Similar type of flexing by 90° can be best achieved by the Ross flexing machine.

0.5 In the preparation of this standard, considerable assistance has been derived from the valuable practical data and research experiences of the footwear laboratories of the Chief Inspectorate of Textiles and Clothing, Ministry of Defence (DGI), Kanpur and the Bata Shoe Co (Private) Ltd, Calcutta. Assistance has also been derived from the following publications :

IND/TC 3801 : 1960 Boots, Rubber, Knee. Ministry of Defence, Government of India.

B.S. 903 : 1950 Method of testing vulcanized rubbers. British Standards Institution.

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ASTM : D 1052-1955 Resistance of vulcanized rubber or synthetic elastomers to cut growth by the use of Ross flexing machine. American Society for Testing and Materials.

0.6 This standard contains clauses **3.1.1**, **3.2.6**, **3.2.6.1**, **3.7.1** and **4.2** which call for an agreement between the purchaser and the supplier.

0.7 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 : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This specification prescribes the requirements, methods of sampling and test for boots of half knee, short knee and knee height for general purposes, made of rubber used for protection of foot and legs against rain slush and knee deep waters.

2. TERMINOLOGY

2.1 For the purpose of this standard, definitions given in IS : 2050-† shall apply.

3. REQUIREMENTS

3.1 Shape and Design

3.1.1 The boots shall be made to the pattern, shape and design as shown in Fig. 1. Any other pattern, shape or design shall be subject to agreement between the purchaser and the supplier.

3.2 Material

3.2.1 *Upper Materials (Intermediate Foot Vamp, Anklet, Outside Vamp, Outside Counter and Leg)* — shall be of rubber conforming to physical requirements given in Table 1 backed by cloth lining.

3.2.2 The first leg lining shall be of Variety No. 2 cotton drill conforming to IS : 177-1965‡ or Variety No. 2 dosuti conforming to IS : 179-1965§.

3.2.3 The foot lining shall be of bleached cotton drill conforming to Variety No. 1 of IS : 177-1965‡.

3.2.4 The insole cover shall be Variety No. 2 cotton drill conforming to IS : 177-1965‡ or Variety No. 2 dosuti conforming to IS : 179-1965§.

*Rules for rounding off numerical values (*revised*).

†Glossary of footwear terms (under preparation).

‡Specification for cotton drills (*revised*).

§Specification for dosuti (*revised*).

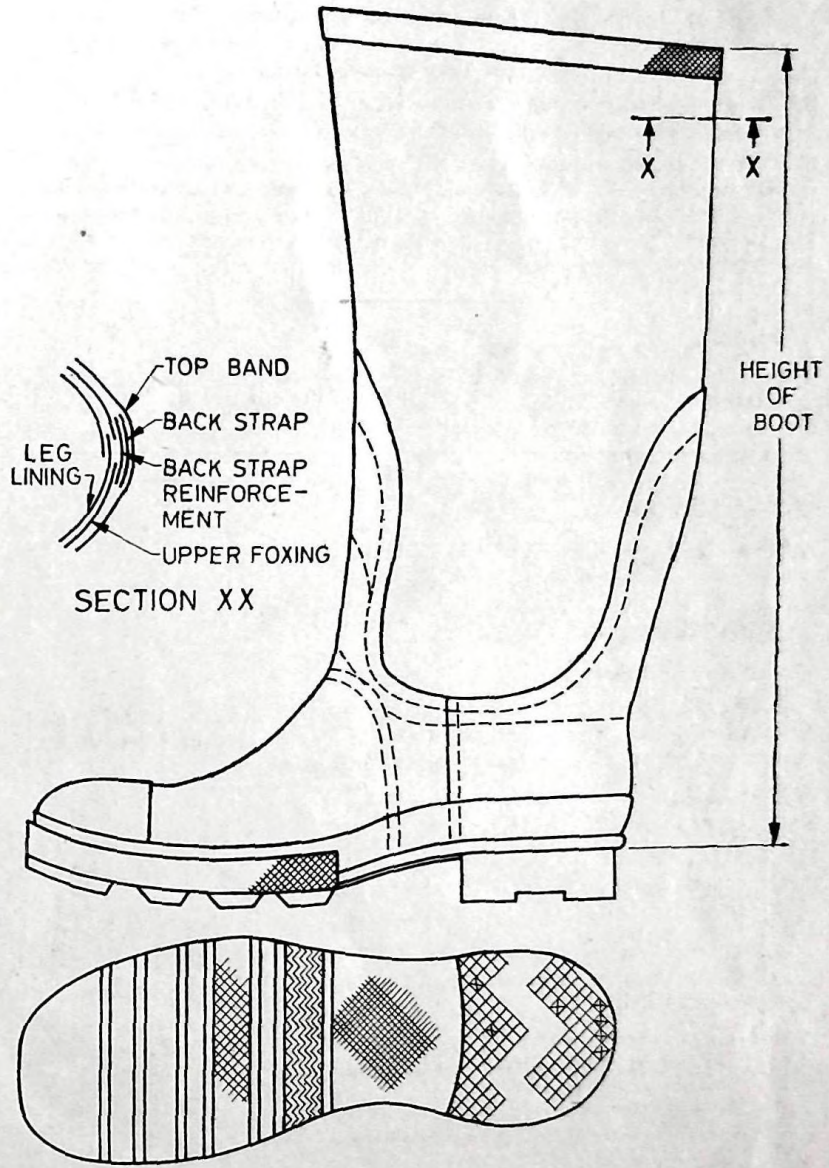


FIG. 1 RUBBER KNEE BOOT

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3.2.5 The stiffener and toe puff shall be of white or black rag.

3.2.6 Bottom Material — The rubber-mix of bottom material shall be natural rubber, synthetic rubbers or a combination of both as agreed to between the purchaser and the supplier.

3.2.6.1 The anti-slip design of the sole and heel shall be as agreed to between the purchaser and the supplier. A recommended design is shown in Fig. 1.

3.2.7 Thread — Bleached cotton sewing thread conforming to Variety No. 15 or No. 16 of IS : 1720-1960* shall be used.

3.2.8 Bottom Filling Material — The bottom filling material shall consist of black or white rag.

3.3 Components

3.3.1 Individual components of the rubber knee boots shall comply with the material and thickness requirements prescribed in Table 1.

TABLE 1 MATERIAL AND THICKNESS REQUIREMENTS OF INDIVIDUAL COMPONENTS OF RUBBER KNEE BOOTS

Sl. No.	COMPONENT	MATERIAL	THICKNESS	TOLERANCE ON THICKNESS
(1)	(2)	(3)	(4) mm	(5) mm
i)	First leg lining	Dosuti	—	—
ii)	Second leg lining	"	—	—
iii)	Inner counter	Scoured sheeting	1.5	±0.1
iv)	Inner vamp	"	1.0	±0.1
v)	Inner toe cap	"	1.0	±0.1
vi)	Back strap	"	1.0	±0.1
vii)	Foot lining	Dosuti or bleached cotton drill	—	—
viii)	Insole cover	"	—	—
ix)	Intermediate foot vamp	Rubber	0.6	±0.1
x)	Anklet	"	0.6	±0.1
xi)	Outside vamp	"	1.0	±0.1
xii)	Outside counter	"	1.0	±0.1
xiii)	Leg	"	1.5	±0.1
xiv)	Stiffener from upper foxing	Bleached or black rag	2.0	±0.1
xv)	Insole	"	1.5	±0.1
xvi)	Bottom filling	"	1.5	—
xvii)	Shank	"	—	—
xviii)	Outer sole in	Rubber	9.5	±0.5
	a) fore part	"	4.5	±0.2
	b) at the heel	"	2.3	±1
xix)	Heel	"	—	—

*Specification for cotton sewing thread, bleached or dyed.

3.3.2 The rubber components shall comply with the physical requirements prescribed in Table 2.

TABLE 2 PHYSICAL REQUIREMENTS FOR INDIVIDUAL RUBBER COMPONENTS

Sl. No.	CHARACTERISTIC	BODY	FOXING	SOLE	HEEL	METHOD OF TEST ACCORDING TO
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Specific gravity, <i>Max</i>	1.4	1.4	1.5	1.35	A-1
ii)	Hardness, IRHD	55 ± 5	55 ± 5	65 ± 5	65 ± 5	IS : 3400 (Part II)-1965*
iii)	Abrasion index, <i>Min</i>	—	—	65	80	IS : 3400 (Part III)-1965†
iv)	Flex resistance, No. of cycles, <i>Min</i>					
	a) Initial crack	1,50,000	—	50 000	—	A-2 for sole and heel
	b) 600 percent cut growth	—	—	65 000	—	A-3 for body
v)	Change in initial hardness after accelerated ageing at 100° ± 1°C for 24 hours, IRHD	+8 -0	+8 -0	+10 -0	+10 -0	IS : 3400 (Part IV)-1965‡ IS : 3400 (Part II)-1965*

NOTE — Footwear standard reference compound 'D' as prescribed in IS : 3400 (Part III)-1965† shall be used while testing for abrasion index.

*Methods of test for vulcanized rubbers : Part II Hardness.

†Methods of test for vulcanized rubbers : Part III Abrasion.

‡Methods of test for vulcanized rubbers : Part IV Accelerated ageing.

3.4 Weathering Test — All rubber components shall be capable of withstanding, without developing any brittleness or tackiness, ageing in an air-oven at a temperature of 100° ± 1°C for a period of 24 hours according to the details, prescribed in IS : 3400 (Part IV)-1965*.

NOTE — For the purpose of this test, the test pieces may be entire articles or pieces cut from them.

3.5 Leakage Proof — On immersion in water to a depth of not less than 25 cm for 24 hours, boots shall show no sign of leakage in the form of damp patches on the inside surface when tested in accordance with the method prescribed in A-4.

3.6 Manufacture

3.6.1 The boots shall be made on metallic lasts for rubber boots.

3.6.2 The rubber vamp shall be applied to form a complete covering of the inner stock by a uniform layer of rubber throughout.

*Methods of test for vulcanized rubbers : Part IV Accelerated ageing.

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3.6.3 The anklet shall be assembled between the two leg linings.

3.6.4 The outer stock and the inner stock shall be securely adhered together. The rubber foxing strip shall extend round each side of the sole to the waist and shall be properly secured by means of adhesive.

3.6.5 The fabric leg lining shall be properly closed by machine stitching using cotton thread Variety No. 15 or 16 of IS : 1720-1960*.

3.6.6 The leg lining and foot lining shall be closed over the instep or the leg lining shall be securely adhered over the foot lining.

3.6.7 The cover of the insole shall be properly adhered.

3.6.8 The boots shall be properly vulcanized.

3.6.9 The minimum height of the foot, when measured on the inside at the back of the boot from the insole to the top (*see* Fig. 1) shall be in accordance with Table 3.

TABLE 3 HEIGHT OF BOOT

TYPE	HEIGHT, mm	
	Men's	Women's
Half knee	190	190
Short knee	279	267
Knee	355	305

3.7 Finish

3.7.1 In appearance, general workmanship, finish and all other respects not defined in this specification, the boots shall be equal to that of the sample approved between the purchaser and the supplier.

4. MARKING AND PACKING

4.1 Marking — The size of the boot shall be legibly stamped on the inside of the leg at the top. The manufacturer's name or recognized trade-mark together with the year of supply shall also be stamped legibly on the inside of the leg at the top.

4.2 Packing — The boots shall be packed in paper bags or in wooden cases or otherwise as agreed to between the purchaser and the supplier.

*Specification for cotton sewing thread, bleached or dyed with amendment No. 1.

4.2.1 The boots may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act, and the Rules and Regulations made thereunder. Presence of this mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard, under a well-defined system of inspection, testing and quality control during production. This system, which is devised and supervised by ISI and operated by the producer, has the further safeguard that the products as actually marketed are continuously checked by ISI for conformity to the standard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

5. SAMPLING

5.1 Representative samples of rubber knee boots shall be drawn as prescribed in IS : 2051-1962*.

APPENDIX A

(Table 2 and Clause 3.5)

TEST METHODS

A-1. SPECIFIC GRAVITY DETERMINATION

A-1.1 Principle of the Method — The weights of the test piece in air and in water are determined. The weight when immersed in water is less than that in air by the weight of water displaced, the volume of water displaced being equal to that of the test piece.

A-1.2 Apparatus

A-1.2.1 Balance — weighing to 1 mg.

A-1.2.2 Balance Straddle — A pan straddle of convenient size to support the beaker and permit determination of the weight of the test piece in water.

A-1.2.3 Beaker — of 250 ml capacity or smaller, if necessitated by the design of the balance.

A-1.2.4 Copper Wire — of approximately 0.1 mm diameter.

A-1.3 Procedure

A-1.3.1 Test Piece — Prepare a test piece of the rubber from the relevant component with smooth surfaces, free from crevices and dust, weighing at least 5 g.

*Method of sampling for leather footwear.

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A-1.3.2 Suspend the test piece from the hook on one side of the balance using a suitable length of wire so that the bottom of the test piece is about 25 mm above the straddle. The wire may be tared previously by a length of wire on the other pan. Weigh the test piece to the nearest mg. Repeat the weighing with the test piece immersed in freshly boiled and cooled distilled water (see IS : 1070-1960*) at $27^{\circ} \pm 2^{\circ}\text{C}$ (see IS : 196-1966†) contained in a beaker placed on the straddle. Allow sufficient time for the test piece to attain the temperature of the water, adjusting the latter as necessary. Remove air bubbles adhering to the test piece with a piece of fine wire or with a camel hair brush, if necessary, and determine the weight to the nearest milligram, the pointer watching for a few seconds to make sure that it does not drift gradually on account of convection or because the test piece has not attained the temperature of the water.

NOTE — The main sources of error are (a) air bubbles adhering to the outer surfaces of the test piece during weighings in water; (b) surface tension effects on the wire; and (c) convection currents in the water in which the test piece is suspended. To minimize these, the temperature of the water and of the air in the balance case should be the same.

A-1.4 Calculation — Calculate the specific gravity of rubber at 27°C as follows:

$$\text{Specific gravity in air at } 27^{\circ}/27^{\circ}\text{C} = \frac{W_1}{W_1 - W_2}$$

where

W_1 = weight of the test piece in air, and

W_2 = weight of the test piece in water.

A-2. FLEXING RESISTANCE TEST FOR SOLE

A-2.1 Outline of the Method — This method of test determines resistance to initial cracking and to 600 percent cut growth of rubber components of footwear, cut out directly from the material, by the Ross flexing machine.

A-2.2 Apparatus

A-2.2.1 Ross Flexing Machine — A schematic diagram of Ross flexing machine is given in Fig. 2. The machine allows the fixed area of the specimen to bend freely over a rod of approximately 9.5 mm in diameter through an angle of 90° .

A-2.2.2 Piercing Tool and Holder — The piercing tool and holder shall be as shown in Fig 3.

*Water, distilled quality (revised).

†Atmospheric conditions for testing (revised).

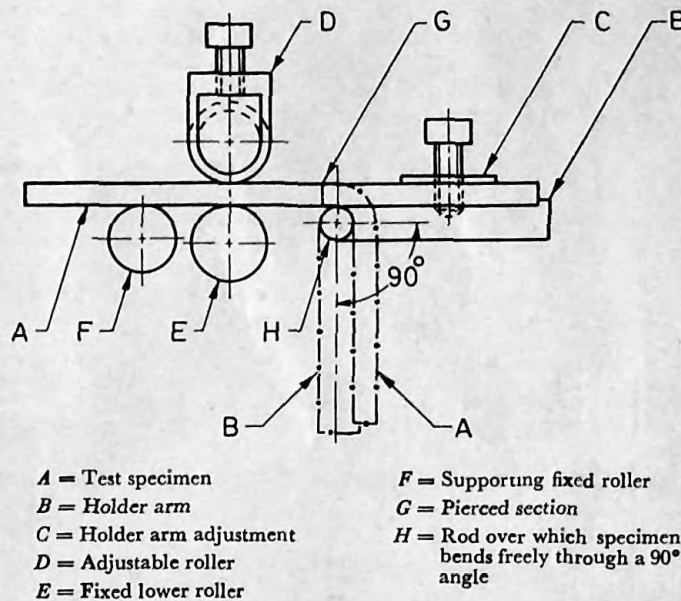


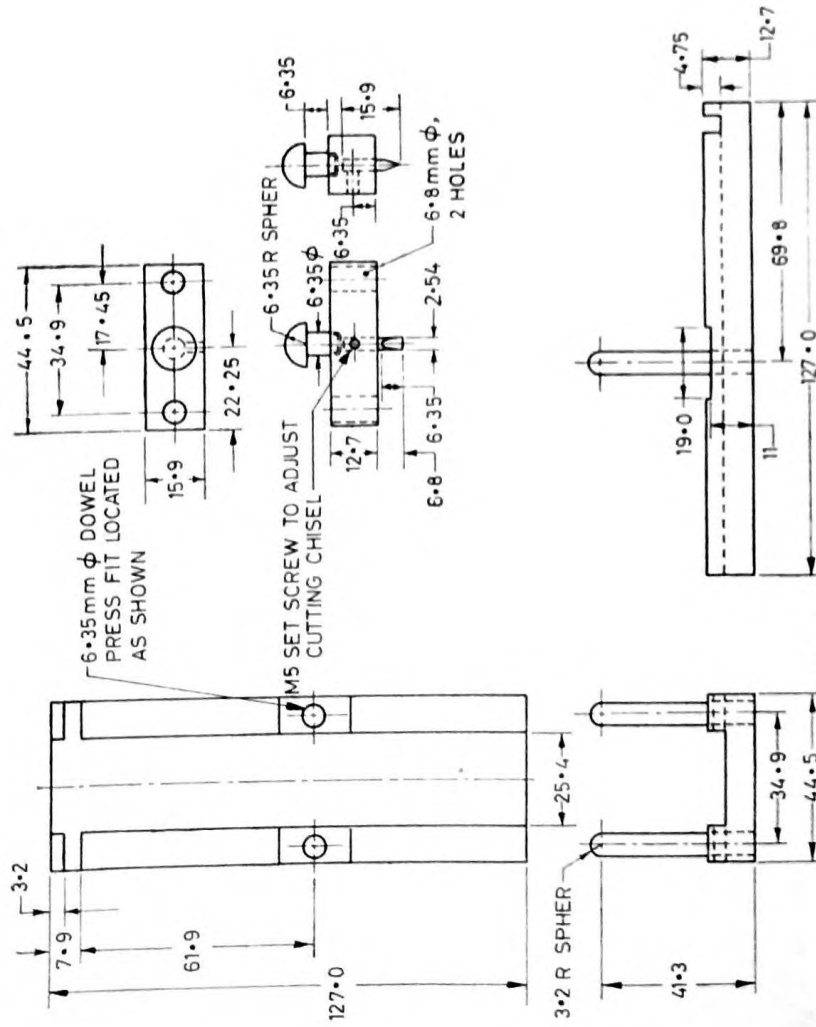
FIG. 2 ROSS FLEXING MACHINE (SCHEMATIC)

A-2.2.3 Rule — A rule of suitable length, graduated in steps of 0.25 mm is used for measuring the length of cut growth.

A-2.3 Procedure

A-2.3.1 Test Specimen — Cut out directly from the outer soles, test specimens of dimensions 25 ± 1 mm width and a minimum of 150 mm in length, by the standard knife for cutting samples of Ross flexing machine.

A-2.3.2 Procedure — Thoroughly clean the inner surface of the sole layer without damaging the skin of the sole layer. Pierce one of the test specimens by the use of piercing tool. For this, adjust the piercing tool in the holder with the cutting edge projecting 7.25 ± 0.25 mm from the base of the holder so that piercing tool will pierce completely through the test specimens when tapped. Before piercing the test specimen, lubricate the test specimen with a solution of soap, which does not react with the compound. The test specimen is placed with the designed surface of the sole on the top and is cut by the piercing tool parallel to the width of the test specimen, at a right angle to and across the longitudinal centre line of the specimen, at a point 61.9 ± 0.1 mm from the clamped end.



All dimensions in millimetres.
 FIG. 3 PIERCING TOOL AND HOLDER

A-2.3.2.1 Clamp unpierced test specimens to the holder arm of the flexing machine in such a position that the designed surface of the sole could be flexed at 90° . The holder arm shall be in a horizontal position when the test specimens are attached. Let down the adjustable top rollers until they just touch the holder and lock in this position by means of the wing nuts, permitting free travel of the test specimens between the rollers during the bending movement.

A-2.3.2.2 After the test specimens have been attached as described, start the machine at 100 ± 5 cycles per minute. Make frequent observations and record the number of cycles at the initial crack. Record the number of cycles by the use of the counter.

A-2.3.2.3 Clamp the pierced sample as described in **A-2.3.2.1** and start the machine at 100 ± 5 cycles per minute. Make frequent observations, recording the number of cycles and increase in the cut length for the purpose of determining the rate of increase in the cut length. When observing the cut growth, the holder arm shall be at an angle approximately 45° vertically. Continue the test until the cut length has increased 500 percent, that is, until the combined length of the cut and crack has increased to a total of 18.25 mm.

NOTE — In some cases the cut growth is not in a straight line as the continuation of the cut made by the piercing tool, and 'star shaped' cracking may develop. In this event, the cut growth shall be measured as the length of the longest continuous crack, regardless of its direction.

A-2.4 Report — Report the results from observation of at least two test specimens, averaged and reported as the number of cycles for crack and also for 600 percent cut growth.

A-3. FLEXING RESISTANCE FOR BODY

A-3.1 Apparatus — The machine has an adjustable stationary part, provided with grips 25.0 mm across for holding one end of each of the test pieces in a fixed position and a similar but reciprocating part for holding the other end of each of the test pieces. The reciprocating part is arranged so that its motion is in the direction of, and in the same plane as the centre line between the grips. Its travel is adjusted so that the two sets of grips approach each other to a distance of 13 mm and separate to a distance of 57 mm. The eccentric which actuates the reciprocating part is driven by a constant speed motor to give 340 to 400 flexing cycles per minute. The motor should have sufficient power to flex at least six and preferably twelve test pieces at one test. The test pieces should be arranged in two equal groups, so that one group is being flexed while the other group is being straightened, thus reducing the vibration in the machine. The grips shall hold the test pieces firmly and enable individual adjustment to be made to the test pieces.

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A-3.2 Procedure

A-3.2.1 Test Piece — The test piece shall have the dimensions shown in Fig. 4. Where the size and the style of the footwear permits, take four test pieces from one article of footwear. In other cases take three or two test pieces, whichever is possible, from one article of footwear. Cut the test pieces from the thinnest portion of the upper containing the fewest plies of fabric. Take care to ensure that the test pieces are cut out cleanly from the sample material.

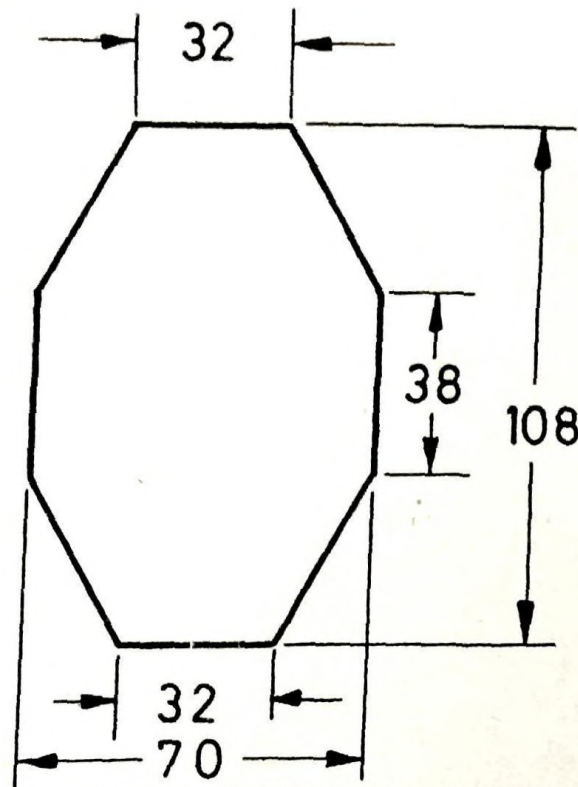


FIG. 4 TEST (DE MATTIA TYPE) PIECE FOR FLEXING TEST

A-3.2.2 Fitting — 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 fixed central grip and push in until the sample touches the grip pins. Tighten this fixed grip. Take out the corresponding movable grip to its fullest extent; insert the test piece and pull flat and tighten the grip. It is recommended that clips may be used to keep the edges

together during the insertion of the test piece in the grips, but their removal is essential before flexing commences.

NOTE — The test piece should not be under tension.

A-3.3 Expression of Results — A complete to-and-fro movement of the grip is counted as one flex cycle. Calculate the length of test in flex cycles and not in time units. The flex cycle may be determined by using a trip counter operated by one of the movable grips. The ambient temperature during testing shall be not more than 27°C.

A-4. LEAKAGE TEST

A-4.1 Place a plug, fitted with an air pressure gauge and an air supply line, in the mouth of the knee boot. The fitting between the boot and the plug shall be sufficiently air-tight to maintain internal pressures up to 0.14 kg/cm². Connect the air line to the source of air pressure and place the boot in a vessel of water. Subject the boot to a pressure of 0.1 kg/cm² for at least five seconds and during this period examine for signs of leakage.

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