भारतीय मानक

Indian Standard

IS 384 (Part 1) : 2023

रंग रोगन और वार्निश के लिए सपाट ब्रश — विशिष्टि

भाग 1 हैवी ड्यूटी

(सातवाँ पुनरीक्षण)

Brushes, Paints and Varnishes, Flat — Specification

Part 1 Heavy Duty

(Seventh Revision)

ICS 87.040; 87.100

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Price Group 9

Brushware, Polishes, Lac & Lac Products Sectional Committee, CHD 23

FOREWORD

This Indian Standard (Seventh Revision) was adopted by the Bureau of Indian Standards after the draft finalized by the Brushware, Polishes, Lac & Lac Products Sectional Committee had been approved by the Chemical Division Council.

IS 384 was first published in 1954 and subsequently revised in 1961, 1964, 1971, 1979, 2002 & 2012. In this revision, test method for identification of rubber sample has been suitably included along with Burn test, Tapering test and Tear test. Also, all amendments have been incorporated in the Standard. Further, Packing and Marking clause has been updated.

IS 384 is intended to be used for general painting and varnishes of flat surfaces irrespective of type of painting work whether heavy or light. However, the Committee decided to revise it by splitting into two parts. The other part in the series is:

Part 2 Household purposes

This standard specifies the requirements of flat brushes to be used primarily in the industrial area for house building and structural paints and varnishing. Part 2 of this standard is for use in the area of household consumers, small sign painters, art designers as well as for application of lubricants on machine parts and for cleaning of machinery, etc.

There is no ISO Standard on this subject.

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

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 shall be same as that of the specified value in this standard.

Indian Standard

BRUSHES, PAINTS AND VARNISHES, FLAT — SPECIFICATION

PART 1 HEAVY DUTY

(Seventh Revision)

1 SCOPE

This standard (Part 1) prescribes requirements and methods of sampling and test for flat brushes for paints and varnishes, made from bristles and set in suitable cement.

2 REFERENCES

The standards listed in Annex A contains 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 revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards.

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 707, IS 5060 and the following shall apply.

3.1 Approved Tender Sample — The sample accepted by the indentor or inspection authority as basis for supply.

NOTE — When a sample is tested and approved by the purchaser or an inspection authority, the results of such tests as will permit the supplier to meet the limits imposed by the specification for deliveries shall be made available to the supplier. However, all tests need to be carried out on the tender sample.

4 REQUIREMENTS

4.1 Materials

The brushes shall be manufactured from the following materials.

4.1.1 *Bristles*

4.1.1.1 The bristles used shall only be obtained from hogs, pigs or boars and shall satisfy the following description.

4.1.1.2 *Description*

Selected, properly straightened, natural black colour, soft or semi-stiff bristles only (*see* IS 1844) shall be used. As regards colour, luster and stiffness, the bristles shall match those used in the approved tender sample.

4.1.1.3 The solid dressing of bristles used shall be as per the approved tender sample, if so agreed to by the indentor; otherwise it shall comply with the provisions given in IS 1844.

NOTE — IS 1844 does not give the qualitative characteristics of bristles. It only defines the solidity of bristles (tops).

4.1.1.4 *Burn test*

A few filaments shall be chosen at random. Each single filament of the material when burnt at the flag-end shall burn with glowing globular mass at the ignited end. Vegetable fibres burn off without this and the burning progresses rapidly towards the other end. In case of synthetic filaments, a polip will be formed and the droplets will fall down. Further, in case of mixtures of nylon with natural bristles, the bristles will separate individually after burning whereas in case of mixtures, the same will stick together.

4.1.1.5 *Tapering test*

A few filaments shall be chosen at random. Each single filament of the material shall be held between the thumb and forefinger midway between the flag-end and root-end and rolled with a view to bringing the root-end within the grip. This action in the case of bristles will be in the direction of the taper thus always getting the flat-end within the grip.

4.1.1.6 In addition to the tests given in **4.1.1.4** and **4.1.1.5**, bristles also have a characteristic tearing pattern described below. However, it may be noted that this test is not considered as confirmatory. Therefore, this test shall be carried out in conjunction with tests prescribed in **4.1.1.4** and **4.1.1.5**.

4.1.1.7 *Tear test*

When two tips at the flag-end of a bristle are separately held and torn apart they shall tear, without breaking, right up to the root-end. In the case of hair or vegetable fibres because of their internal

morphology this complete tearing apart is not possible. In addition to this, Burn test must be conducted to ensure that the material used is natural bristles (as in case of Nylon/PET the same will pass the Tear test).

4.1.2 *Timber*

4.1.2.1 Any of the timber species listed in Annex B as declared by the supplier shall be used for the manufacture of the handle.

4.1.2.2 The timber shall be reasonably straight-grained along length and well seasoned to a moisture content not exceeding 15 percent, when tested by either electronic moisture meter or by oven drying method as specified in Annex C. However, in case of dispute oven drying method shall be referred.

4.1.2.3 The timber shall be free from brashness, any kind of biological or non-biological deterioration, insect attack, centre-heart (pit), knots (except live pin knots), cracks warp and any other defect which may reduce the life of the brush or affect its utility. The handle must be clear lacquered.

4.1.3 *Ferrule*

Thickness of tin plate for making ferrule for the sizes up to 50 mm shall be minimum 0.25 mm and for sizes above 50 mm shall be minimum 0.40 mm.

4.1.4 *Wedge*

A suitable non-metallic wedge shall be used along with the bristles inside the ferrule.

4.1.5 *Pins*

4.1.5.1 *Connecting pins*

The connecting pins shall be round head steel pins 1.00 mm to 1.40 mm in diameter.

4.1.5.2 *Securing pins*

The securing pins shall be flat or round head brass or steel pins 1.00 mm to 1.40 mm in diameter.

4.2 Sizes

The flat brushes for paints and varnishes shall be of the sizes 12 mm, 25 mm, 38 mm, 50 mm, 63 mm, 75 mm and 100 mm.

NOTE — The size of the brush indicates the internal width of the ferrule (*see* Fig. 1).

4.3 Dimensions and Tolerances

4.3.1 *Dimensions*

The brushes shall conform to the dimensions given in Table 1.

4.3.2 *Tolerances*

4.3.2.1 The tolerance on the linear dimensions of handle and ferrule shall be as given in Table 2.

4.3.2.2 A tolerance of ± 3.0 mm may be allowed on the diameter of handle.

4.3.2.3 The above tolerance shall not apply to bristles for which minimum lengths have been prescribed in Table 1.

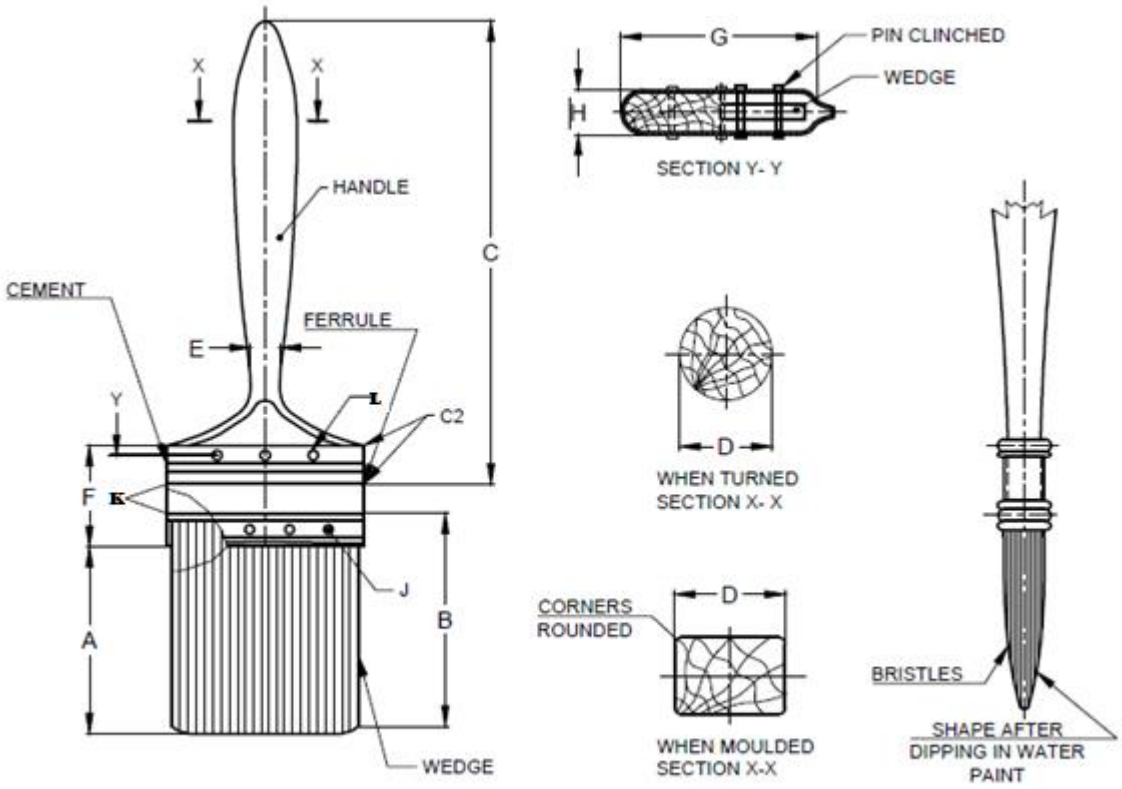

FIG. 1 SHAPE AND DESIGN OF BRUSHES, PAINTS AND VARNISHES, FLAT

Table 1 Requirements of Brushes, Paints and Varnishes, Flat Grade 1

(*Clauses* 4.3.1 *and* 4.3.2.3)

dimensions in millimetres

Sl No.	Size	Bristle		Handle				Ferrule			No. of connective pins	Empty Space Between Cements and Handles	No. of securing Pins	Mass of Bristles per Finished Brush (g)
		Protrusion *Min*	Overall Length *Min*	Overall Length	Inside Ferrule *Max*	Diameter		Length	Internal Width	Internal Thickness		***Max***		
		A	*B*	*C*	*C2*	*D*	*E*	*F*	*G*	*H*	*J*	*K*	*L*	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	12	38	51	106	14	16	9	32	12	9	1	8	3	2.5
ii)	25	44	57	155	18	18	10	32	25	12	2	6	3	8.0
iii)	38	50	63	155	18	19	12	32	38	12	2	6	4	15.0
iv)	50	56	69	160	20	22	12	38	50	16	3	8	4	30.0
v)	63	63	76	165	21	22	14	38	63	16	3	6	4	45.0
vi)	75	69	82	180	24	25	14	38	75	16	4	6	6	60.0
vii)	100	75	88	185	24	27	17	38	100	19	6	6	6	85.0

Table 2 Tolerance on the Dimensions

(*Clause* 4.3.2.1)

Sl No.	Nominal Dimension mm	Tolerance mm
(1)	(2)	(3)
i)	Up to 15	± 1.0
ii)	Over 15 but below 40	± 2.0
iii)	40 and above	± 3.0

4.4 Manufacture/Purchaser

4.4.1 The brushes shall generally conform to the shape and design as shown in Fig. 1.

4.4.2 The handle shall be shaped to suit the ferrule.

4.4.3 The ferrule shall be lapped and soldered or spot welded. Alternatively, it may be hook jointed.

4.4.3.1 The ferrule if lapped, shall be properly soldered. The lapping shall be not less than 3 mm.

4.4.3.2 The ferrule shall be grooved as shown in Fig. 1.

4.4.4 The bristles with wedge shall be properly set and firmly cemented into the ferrule. There shall be no loose bristles and the cement shall not flow out of the ferrule.

4.4.4.1 *Bevelling of working edge*

The working edge of the brush shall be bevelled as shown in Fig. 1.

4.4.5 The handle shall be inserted into the ferrule and secured by means of requisite number of securing pins as shown in Fig. 1 and these shall be driven into the ferrule alternately from opposite sides.

4.4.6 The connecting pins shall be properly inserted and neatly clinched on the opposite side of the ferrule or riveted.

4.4.7 *Cement/Setting of Bristles*

4.4.7.1 Bristles shall be introduced from the bottom of the ferrule; the wedge shall be placed in the proper position and the entire mass shall be firmly set in the

ferrule with any suitable cement.

4.4.7.2 In case of rubber set brushes, the rubber compound shall be vulcanized. The test method for identification of rubber sample is given at Annex G.

4.4.7.3 In no case the setting (the cementing materials or the wedge) shall appear out of the ferrule.

4.4.7.4 The test to check whether the cement has flown on the bristle portioncan be done by thumb test as well as an all pin test. The area immediately outside the ferrule and hair portion will be hard like a rock in case cement has flown out which can be felt with the thumb press. The alternative test for the same can be done with an all pin that is, the all pin should go right through the bristle part ensuring cement is not out.

4.5 Pull Test

The following two methods shall be utilized for pull test when tested as prescribed in Annex D;

a) Method A — The force required for pulling out an individual tuft shall not be less than 5 kg for 1 min when tested according to the method given in Annex D; and

b) Method B — When a small bunch of bristles is subjected to a straight pull using of thumb and finger grip, these shall not come out.

Method B shall be for routine testing, and Method A shall be referee method in case of any dispute.

4.6 Benzene Alcohol Test (for ensuring bristles hold to the ferrules)

Immerse the bristles portion (cement part of the brush) for 48 h in a mixture of benzene (*see* IS 534) and denatured spirit (*see* IS 321) (1 : 1 by volume) maintained at temperature (27 ± 2) °C. The cement part of the brush must be totally immersed in the benzene alcohol mixture. On completion of this test, the brushes shall show no sign of loosening when used as a brush without paint on a plane surface.

4.7 Oven Test (for ensuring bristles hold to the ferrules)

4.7.1 *For Non-rubber Set Brushes*

The brush, without handle, when suspended in an oven with the protruding bristle end upward and subjected to a temperature of (60 ± 2) °C for 4 h, shall show no appreciable creeping of the cement. Further, after cooling the brush in air for 30 min, the anchorage of bristles shall not become loose inside the ferrule and the cement shall not become loose inside the ferrule and the cement shall satisfy the pull test prescribed in **4.5**.

4.7.2 *For Rubber Set Brushes*

The brush, without handle, when suspended in an oven with the protruding bristle end upward, and subjected to a temperature of (132 ± 2) °C for 2 h, shall show no appreciable creeping of the cement. Further, after cooling the brush in air for 30 min, the anchorage of bristles shall not become loose inside the ferrule and the cement shall satisfy the pull test prescribed in **4.5**.

4.8 Mass of Bristles per Finished Brush

The mass of bristles, as determined by the method prescribed in Annex E shall be as specified in col (15) of Table 1. A tolerance of ± 5 percent shall be allowed on the mass of the filling material provided the average mass of the filling material per brush in any lot, is not below the specified value (*see* **G-2.2**).

4.9 Processing of Bristles

The processing of the bristles when tested by the method given in Annex F of this standard shall be considered as satisfactory, if not less than 85 percent of the bristles by mass are of categories b) as prescribed in **E-3.2** (a) and (b) and out of these 60 percent shall belong to category **E-3.2** (a).

4.10 Wear and Tear of the Bristles

The test is required to determine the wear and tear of the bristles during practical use of the brush in the shops. The length of the bristles both before and after the practical use of the brush shall be measured. The brush shall be kept horizontally on a table. A steel strip about 50 mm wide shall be held vertically over one of its large edges at the bristles end of the brush in such a way that the bristles are just touching the strip. The distance between the lower end of the ferrule and the edge of the strip shall be measured to give the length of the bristles. The length of the bristles shall also be measured at the end of the practical use in the manner described above. Wear and tear of the bristle is the difference of length in the bristle of the above two readings that is before and after use for 60 h shall not exceed 5 mm.

4.11 Detection of Dyed Bristles

4.11.1 The following two methods shall be utilized for detection of dyed bristles when tested as prescribed in Annex B of IS 1844:

a) Method A — Microscopic examination; and
b) Method B — Sandpaper test.

4.11.2 Method B shall be for routine testing, and Method A shall be referee method in case of any dispute.

4.12 Workmanship and Finish

4.12.1 The handle shall be finished smooth all over and shall be properly varnished or lacquered.

4.12.2 The ferrule shall be free from sharp edges.

4.12.3 In general workmanship and finish, the brushes shall match the approved tender sample.

4.13 Shelf-Life

The brushes shall have a minimum shelf-life, of one year, from the date of manufacture, when properly stored under shade and adequate precautions for preservation, as given under **3** of IS 3451 (Part 1) are taken.

5 PRESERVATION

The bristles of the brushes shall be liberally dusted, before packing with a mixture of 5 parts (by mass) of BHC dusting powder and 95 percent by mass of French chalk (*see* IS 380). Alternatively, naphthalene balls (*see* IS 539) shall be used in the packing box for the brushes.

6 PACKING AND MARKING

6.1 Packing

6.1.1 The bristle portion of the brush along with the ferrule shall be neatly covered with butter paper or cellulose film and secured by a rubber band.

6.1.2 The brushes shall be packed as agreed to between the indentor or inspection authority and the supplier.

6.2 Marking

6.2.1 Unless otherwise agreed to between the indentor or inspection authority and the supplier, each brush shall be legibly and indelibly marked or stamped with the following:

a) Name of the manufacturer or his registered trade-mark;
b) Month and year of the manufacture;
c) Size of the brush; and
d) Type of setting — 'Rubber set or non-rubber set'.

6.2.2 The rubber set brushes shall, in addition to the marking specified under **6.2.1**, be marked on ferrule or handle with the words 'Rubber Set'.

6.2.3 *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 there under, and the products may be marked with the Standard Mark.

7 SAMPLING AND CRITERIA FOR CONFORMITY

7.1 Samples

The supplier shall submit four identical tender samples of brushes of each size for approval.

7.1.1 The indentor or inspection authority shall retain one of the four approved tender samples against each item till the completion of the order.

7.2 Sampling

The method of drawing representative samples of the brushes and the criteria for conformity shall be as prescribed in Annex H.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
IS 321 : 1964	Specification for absolute alcohol (*first revision*)
IS 380 : 1978	French chalk, technical (*second revision*)
IS 534 : 2021	Benzene — Specification (*fifth revision*)
IS 539 : 1974	Specificifation for naphthalene (*second revision*)
IS 707 : 2011	Timber technology and utilization of wood, bamboo and cane — Glossary of terms (*third revision*)
IS 1844 : 1993	Bristles (*second revision*)
IS 3400 : 2021	Methods of test for vulcanized rubber: Part 1 Tensile stress-strain properties (*fourth revision*)
IS 3451 (Part 1) : 1978	Code of practice for care and maintenance of brushes: Part 1 Pan set brushes (*first revision*)
IS 4905 : 2015/ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)
IS 5060 : 1969	Glossary of terms used in brushware industry
IS 5691 : 1970	Specification for lacquer, cellulose, nitrate, pigmented, finishing, glossy

ANNEX B

(*Clause* 4.1.2.1)

SPECIES OF TIMBER FOR MANUFACTURE OF HANDLE

B-1 The list of species of timber approved for the manufacture of handles for brushes, is given below:

Trade Name		*Botanical Origin*
Roman	Devanagari	
Aini	ऐनी	*Artocarpus hirsutus* Lam., fam. *Moraceae*
Banati	बनति	*Lophopetalum wightianum* Arn., fam. *Celastraceae*
Bijasal	बीजासाल	*Pterocarpus marsupium* Roxb., fam. *Fabaceae*
Jam (Black Berry)	जैम	*E. cymosa* Roxb., Fl Ind.
Champak	चम्पक	*Michelia champaca* Linn., fam. *Magnoliaceae*
Chickrassi	चिकरसी	*Chukrasia tabularis* A. Juss., fam. *Meliaceae*
Dhaman	धमानी	*Grewia tiliifolia* Vahl., fam. *Tiliaceae*
Gamari (gumhar)	गमरी (गुम्हार)	*Gmelina arborea* Roxb., L., fam. *Verbenaceae*
Krishnachura (Gold Mohar)	कृष्णाचुरा	*Poinciana pulcherrima* Roxb., fam. *Fabaceae*
Haldu	हल्दु	*Adina cordifolia* Hook f. fam. *Rubiaceae*
Kadam	कदम	*Nauclea cadamba* (Roxb.), fam. *Rubiaceae* *Sarcocephalus cadamba* Kurz
Kaim	कैमो	*Mitragyna parvifolia* (Roxb.) Korth. Syn. *Stephegyne parvifolia* Korth, fam. *Rubiaceae*
Kanju	कांजू	*Holoptelea integrifolia* (Roxb.) Planch fam. *Ulmaceae*
Karanja	करंज	*Galedupa indica* Lam., fam. *Fabaceae*
Kathal	कटहल	*Artocarpus heterophyllus* Lam. Syn. *A integrifolia* Auct., fam. *Moracea*
Kuthan	कुथानी	*Hymenodictyon excelsum* Wall, fam. *Rubiaceae* *Planchonella longipetiolata* H.J. Lam., Syn.
Lambapatti	लम्बापट्टी	*Sideroxylon longipetiolata* King and Prain, fam. *Sapotaceae*
Aam (Mango)	आम	*Mangifera indica* Linn., fam. *Anacardiaceae*
Mehagini	मेहगिनी	*Swietenia spp.*
Nim-chameli	निम-चमेली	*Millingtonia hortensis* Linn. F. fam. *Bignoniaceae*

Trade Name		*Botanical Origin*
Roman	Devanagari	
Kodapalai (piney)	कोडापलाई (पाइनी)	*Kingiodendron pinnatum* Harms, Syn. *Hardwickia pinnata* Roxb., fam. *Leguminosae*
Saibabla	साईबब्ला	*Mimosa arabica* Roxb. Fl. Ind.
Sirish	शिरीष	*Mimosa sirisa* Roxb. Fl. Ind
Toon	तून	*Toona ciliata* Roem., Syn. *Cedrela toona* Roxb., fam. *Meliaceae*

ANNEX C

(*Clause* 4.1.2.2)

DETERMINATION OF MOISTURE CONTENT OF TIMBER

C-1 TEST SPECIMEN

The entire block used in brush may form the test specimen for determination of moisture content or a coupon cut from the test specimen may as well be used. When for any reason additional determination ofmoisture content is required separate samples shall be prepared from the sample material. Smaller specimens may be used when deemed necessary. The test shall be carried out immediately after cutting the specimen.

C-2 PROCEDURE

Weigh accurately each test specimen. Dry in a ventilated oven at a temperature of (105 ± 2) °C. The weight shall be recorded at regular intervals. The drying shall be considered to be complete when the variation between last two weighings, does not exceed 0.002 g. The final weight shall be taken as oven dry weight.

C-3 CALCULATION

C-3.1 The moisture content, expressed as percent of the dry mass, is given by the following formula:

Moisture content,
percent of the dry mass = $\frac{M_1 - M_0}{M_0} \times 100$

where

M_1 = Initial mass of the test specimen, in g; and
M_0 = Dry mass of the test specimen, in g.

ANNEX D

(*Clause* 4.5)

DETERMINATION OF PULL STRENGTH

D-1 GENERAL

D-1.1 A simple instrument as shown in Fig. 2 can be used for testing the pull strength. This unit is suitable for mounting on wall. It consists of dial force gauge/weighing scale (0 kg to10 kg) operating on spring (A) mounted on wooden plate (B). A tubular tuft holder (C) is hung on the hook of dial gauge. A clamp for holding brush (E) is provided which is movable downward and upward with a screw (F). The dial force gauge/weighing scale shall be calibrated having traceability to NPL.

NOTE — Any other appropriate instrument for determination of the pull strength available may also be used.

D-2 PROCEDURE

D-2.1 Fix a brush with bristles in upward direction in the brush holder with the help of screw (G). Divide the bristles into segments of about 10 mm length.

D-2.2 Insert all bristles of one segment in the hole provided at the bottom of tubular tuft holder (C).

Care should be taken not to allow bristles from adjacent segment to enter in to the hole. Fix the bristles firmly with the help of screw (D).

D-2.3 Adjust the pointer on dial to zero by adjustment of screw (F).

D-2.4 Move down the brush holder slowly with screw (F) watching the pointer on dial carefully till it reaches 5 kg mark and keep it there for 1 min. Then remove the brush from the gadget and examine. The bristles of any segment shall not come out of the cement during the test.

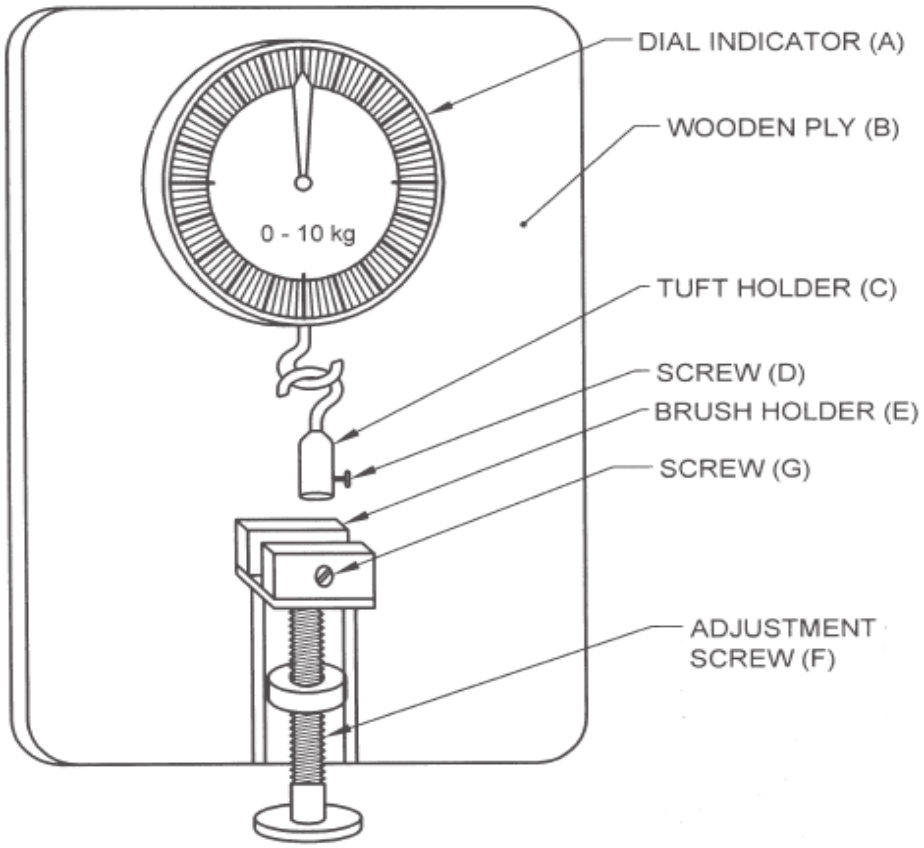

FIG. 2 INSTRUMENT FOR DETERMINATION OF PULL STRENGTH

ANNEX E

(*Clause* 4.8)

DETERMINATION OF MASS OF BRISTLES

E-1 GENERAL

For determining the mass of bristles in a brush, they are detached by gentle hammering as described under **D-2.1** or, if the bristles are set in vulcanized rubber, by soaking in a solvent and detaching the bristles from the cement as described under **E-2.2**.

E-2 PROCEDURE

E-2.1 For Cement Other than Vulcanized Rubber

Remove all connecting pins as well as those securing the handle. Cut the ferrule right through its length on any one of the sides by means of a chisel. Open the ferrule and remove the bristles. Hammer the root ends of the bristles gently with a raw hide mallet to reduce the cement to powder and shake the bristles. Repeat this process till all traces of cement are removed. Dry the bristles in an oven at (100 ± 2) °C for 30 min. Cool for 24 h in air and weigh under prevalent atmospheric conditions.

E-2.2 For Vulcanized Rubber Setting

Open the ferrule as described under **E-2.1** and remove the bristles, soak the setting in an appropriate solvent until it is sufficiently friable to be broken down. This would normally take 12 h to 18 h. Remove the bristles from the solvent mixture and gently knead between the fingers so as to separate the bristles from the block into which they are mounted, but taking care that no undue force is used which may break the bristles. Repeat this process until the bristles are free from vulcanized rubber setting. Dry the bristles in an oven at (100 ± 2) °C for 30 min. Cool for 24 h in air and weigh under prevalent atmospheric conditions.

ANNEX F

(*Clause* 4.9)

TEST FOR PROCESSING OF BRISTLES

F-1 GENERAL

The objective of this test is to determine whether the processing of the bristles, for elimination of their natural tendency to curve, has been adequate or not.

F-2 TEST SAMPLE

A bunch of bristles, freed from cement as prescribed under Annex E and consisting of at least 10 percent of the total mass of the filling material of the brush, shall constitute the test sample.

F-3 PROCEDURE

F-3.1 Tie the test sample of the sealing material with thread of linen, tape at one end and suspend it in water maintained at (70 ± 2) °C for 10 min. Remove the bristles from the water and shake to remove as much water as possible. Untie the knot and spread out all the bristles on a large sheet of blotting paper in a warm place. Allow to dry at room temperature for 48 h.

F-3.2 The bristles shall then be examined and categorized as given below:

a) Bristles which are straight;
b) Bristles which have curvature whose radius is 230 mm or more (*see* Fig. 3); and
c) Remainder.

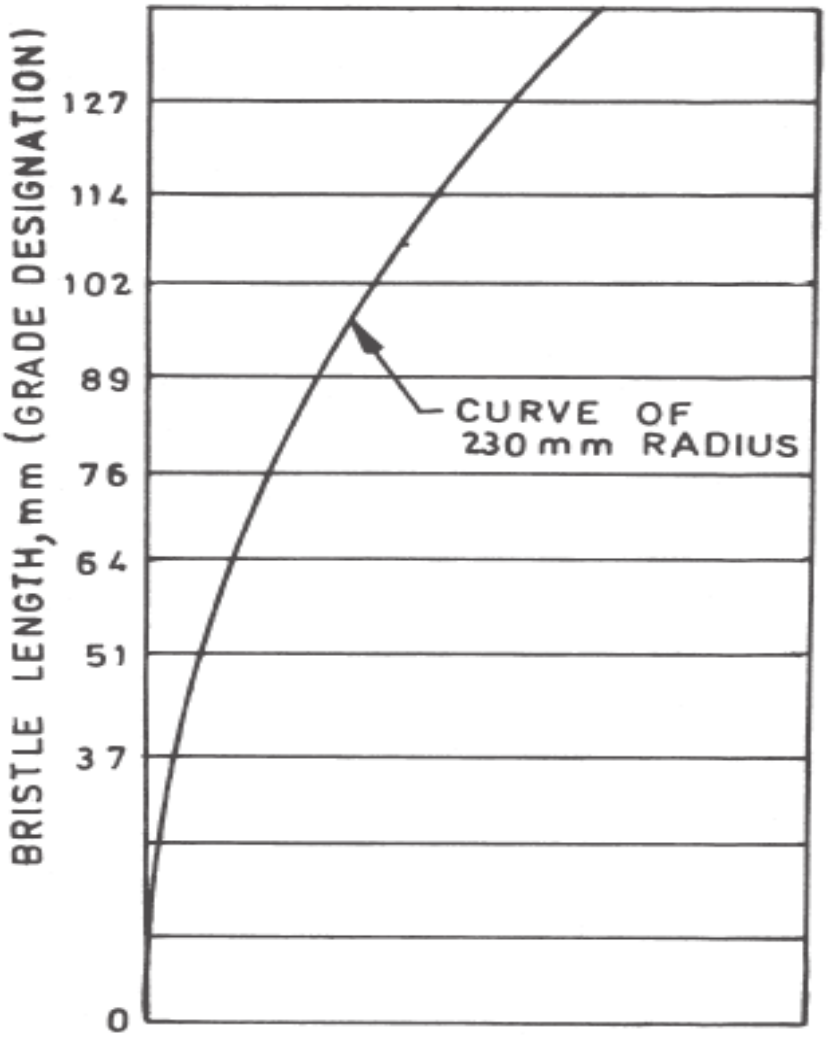

FIG. 3 CURVING OF BRISTLES

ANNEX G

(*Clause* 4.4.7.2)

TEST METHOD FOR IDENTIFICATION OF RUBBER SAMPLE

G-1 ANALYSIS OF THE GIVEN RUBBER SAMPLE

G-1.1 To check rubber set or not, for rubber set cementing the same will have elasticity properties of rubber. In case of vulcanized rubber set, the cementing would be rough and dark brown in uniformity that is, the same color would be observed inside the ferrule all over and not any shades of red or light brown since in case of vulcanization, the same would have been baked at a constant temperature. In case of vulcanized rubber set, the cementing will not be brittle and would be stretchable/elastic. IS 3400 with regard to vulcanized rubber may further be referred in case of any clarification.

G-1.2 Flame Test

Take about 0.02 g of sample in a clean, dry nickel spatula and introduce into Bunsen flame. Remove the burning sample from the flame after 1 min.

Observation: The sample is found to burn continuously with a yellow sooty flame.

Inference: May be SBR (marigold smell of styrene was not observed) or NBR.

G-2 ELEMENTARY ANALYSIS

G-2.1 Sodium Fusion Extract Test

Take a small piece of pure sodium into an ignition tube and add a small quantity of sample to be tested and heat the tube gently until the ignition tube turn red hot. Plunge the tube into distilled water (10 ml) in a porcelain dish, cool and filter. The filtration is sodium fusion extract.

G-2.2 Nitrogen Test

Boil 3 ml of the extract with 3 ml of freshly prepared 5 percent ferrous sulphate solution and cool. Add 10 ml of 5 N sulphuric acid and then two drops of 0.5 N aqueous ferric chloride.

Observation: A blue precipitate of ferric ferrocyanide is obtained.

Inference: Presence of nitrogen.

G-2.3 Sulphur Test

Add a few drops of sodium nitroprusside to sodium fusion extract (SFE).

Observation: The appearance of a deep violet color.

Inference: Presence of sulphur.

G-3 DISINTEGRATION TEST

Boil a sample of about 0.05 g with concentrated HNO_3 (2 ml) for a few minutes and note whether it disintegrates or not.

Sl No.	*Materials*	*Observation*	*Inference*
(1)	(2)	(3)	(4)
i)	IIR, NR, NBR, EPDM, CR, SBR	It disintegrates	Belongs to group A
ii)	Polybutadiene rubber, Silicone rubber	It does not disintegrate	Belongs to group B

G-4 CONFIRMATORY TESTS

G-4.1 NBR

Take about 0.1 g of sample and heat in an ignition tube, and transfer the brown portion of the sample into 0.5 N of aqueous NaOH with 5 percent $FeSO_4$ and add 0.5 N of sulphuric acid. Boil the solution for a few seconds and then add 0.5 N of aqueous ferric chloride.

Observation: Blue precipitate is obtained.

Inference: NBR is confirmed.

G-4.2 SBR

Reflux the given sample with concentrated HNO_3 (10 ml) for 30 min, using a long air condenser. Then the mixture is poured into 25 ml of water, then extracted with 12.5 ml diethyl ether, the ethyl extract is washed with 1 N aqueous NaOH. The ethereal layer is extracted and acidified with 10 ml of concentrated HCl, 2.5 ml of granulated zinc, dissolved in 10 ml of HCl for 20 min. Then the mixture is cooled below 5 °C, added a freshly prepared aqueous solution of sodium nitrate (0.1 g of sodium nitrate in 5 ml of H_2O). The resulting solution is poured into 0.05 g of β-naphthol in 10 ml of 5 N sodium hydroxide.

Observation: Vivid Scarlet Red colour is obtained.

Inference: SBR is confirmed.

G-5 FOURIER TRANSFORM INFRA-RED SPECTROSCOPY (FTIR)

FTIR involves the absorption of electromagnetic radiation in the infrared region of the spectrum, which results in changes in the vibrational energy of the molecule. Since, usually, all molecules will be having vibrations in the form of stretching and bending, etc, the absorbed energy will be utilized in changing the energy levels associated with them. It is a valuable and formidable tool in identifying the compounds which have polar chemical bonds (such as OH, NH, and CH) with good charge separation (strong dipoles). It finds extensive use in the identification and structural analysis of the synthesized materials, natural products, polymers, rubbers etc. The presence of a particular functional group in a given organic compound can be identified. Since every functional group has unique vibrational energy, the IR spectra can be seen as their fingerprints. The infrared spectrum of the rubber mixed with KBr is recorded on ATR-Fourier transform-infrared spectroscopy. The spectrum is collected in the range from 500 cm-1 to 4 000 cm-1 with a resolution of 3 cm-1 by 100 scans, as shown in Fig. 4.

Attenuated total reflection (ATR) is a simple technique to take and confirm the sampling, and samples are examined directly in solid, film, powder and liquid state without preparation of KBr pellet. The polymers or rubber are characterized through FTIR and ATR method (Fig. 5), film polymer is analyzed by ATR method, faster sampling, improving spectrum to better quality database building for the more precise material verification and identification. ATR is clearly an extremely robust and reliable technique.

G-5.1 Fourier Transform Infra-Red Spectroscopy (FTIR) by KBr (Potassium Bromide) Method

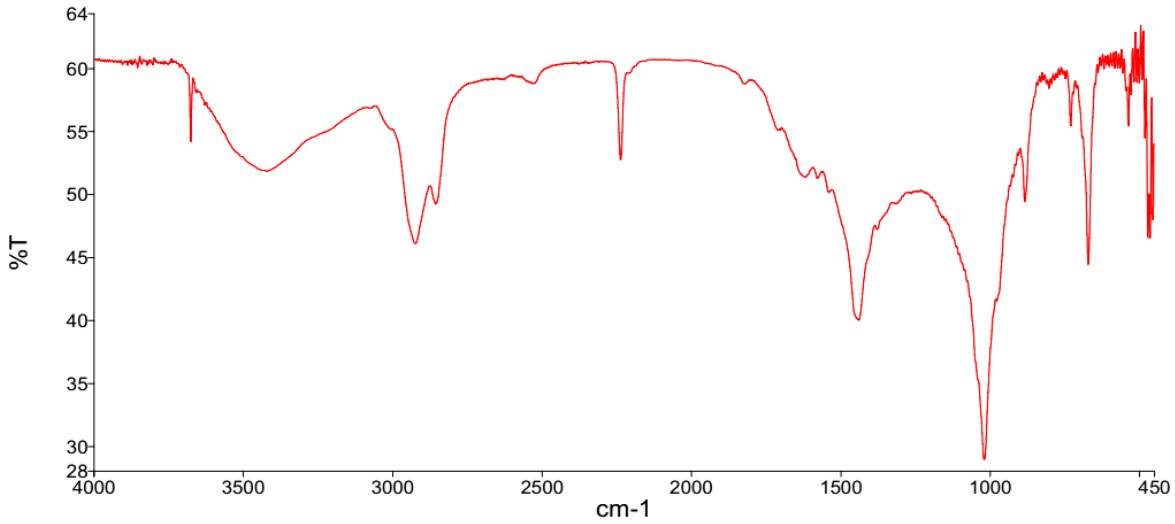

FIG. 4 FTIR OF CROSSLINKED RUBBER

G-5.2 Attenuated Total Reflection (ATR) – FTIR

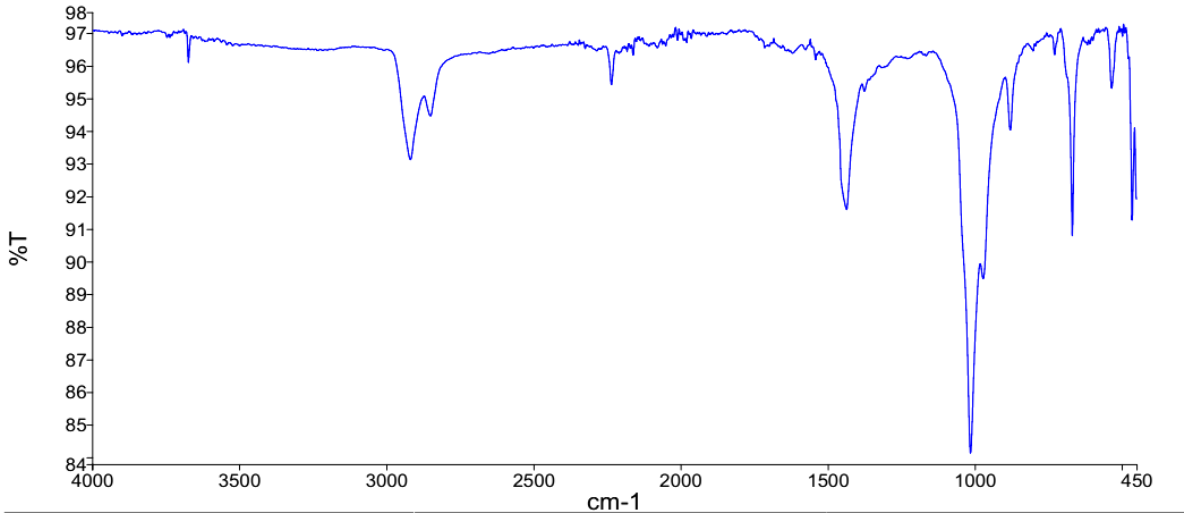

FIG. 5 ATR-FTIR OF CROSSLINKED RUBBER

Observation from FTIR

From Fig. 4 and Fig.5, there is a sharp peak observed at 2237 cm-1 is responsible for the alkyl group present in the rubber. Based on this, it is confirmed that the rubber is NBR rubber.

G-6 DIFFERENTIAL SCANNING CALORIMETRY (DSC)

This technique is more or less similar to DTA except that it measures the amount of heat absorbed or released by a sample as it is heated or cooled or kept at a constant temperature (isothermal). Here the sample and reference material are simultaneously heated or cooled at a steady rate. The difference in temperature between them is proportional to the difference in heat flow (from the heating source that is, furnace), between the two materials. This technique is applied to most of the polymers in evaluating the curing process of the thermoset materials as well as in determining the heat of melting and melting point of thermoplastic polymers and rubbers, glass transition temperature (Tg), endothermic and exothermic behaviour and crystallization temperature. Through the adjunct process of isothermal crystallization, it provides information regarding the molecular weight and structural differences between very similar materials. The instrumentation is precisely identical to that of DTA except for the difference in obtaining the results. The thermal transition temperatures were determined by differential scanning calorimetric (DSC) analyses using NETZSCH DSC 214, at 5 °C and 10 °C per min under an inert nitrogen (N_2) atmosphere from 0 °C to 250 °C, given in Fig. 6 and Fig. 7.

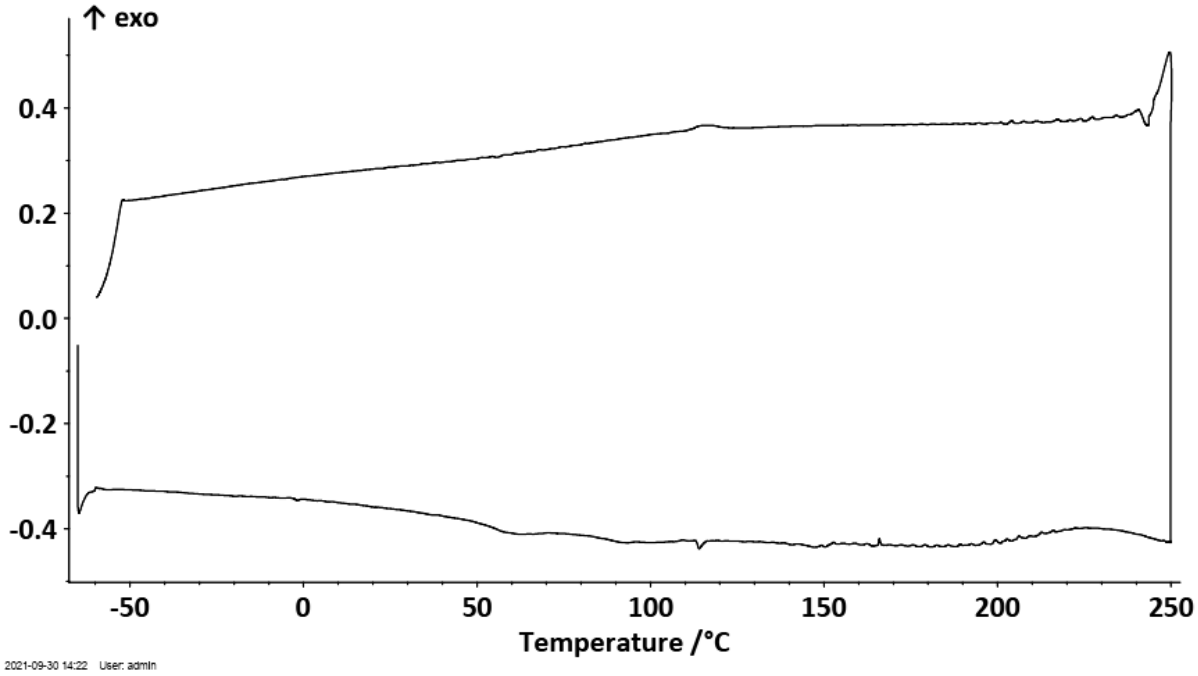

FIG. 6 DSC OF CROSSLINKED RUBBER (HEATING RATE: 10 ˚C/MIN, IN NITROGEN ATMOSPHERE)

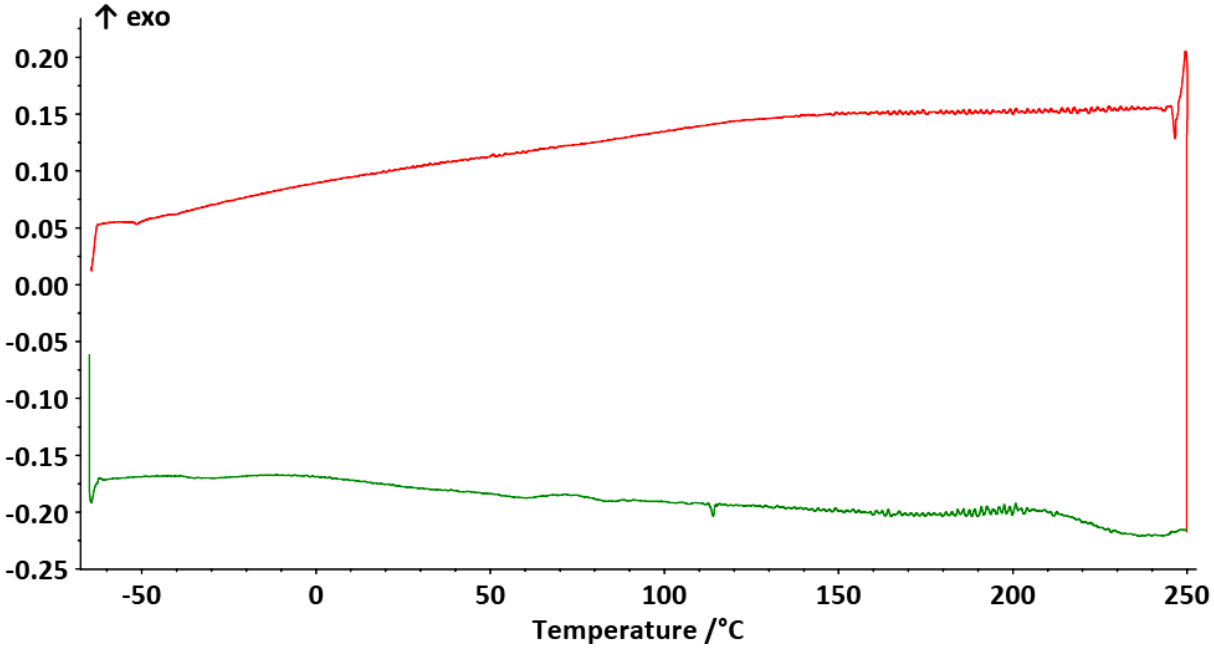

FIG. 7 DSC OF CROSSLINKED RUBBER (HEATING RATE: 5 °C/MIN, IN NITROGEN ATMOSPHERE)

Observation: The glass transition temperature (Tg) of the NBR (*see* Fig 7) is -36.5, The literature value for the NBR Tg is -38.0 °C.

G-7 CONCLUSION

a) The rubber is NBR based on the FTIR and DSC results;
b) The rubber Nitrile rubber (NBR) is possible to crosslinked with peroxide/sulphur. In the elemental analysis, a partial sulphur content was determined; and
c) Methods at **G-1**, **G-2** and **G-3** shall be for routine testing and Methods **G-4**, **G-5** and **G-6** shall be referee methods in case of any dispute. In case any sample is failing under any of the Methods **G-1**, **G-2** or **G-3**, the same will be treated as rejected.

ANNEX H

(*Clause* 7.2)

SAMPLING AND CRITERIA FOR CONFORMITY

H-1 SCALE OF SAMPLING

H-1.1 Lot

In any consignment, all the brushes of same size, same type, similar dimensions and manufactured from the same type of material, shall be divided into groups of 1 000 and each such group shall constitute a lot. Care shall be taken to ensure that brushes included in a lot do not differ in construction, as far as possible.

H-1.2 For ascertaining the conformity of the brushes to the requirements of this standard, samples shall be tested from each lot separately.

H-1.3 The number of brushes to be selected from a lot shall depend on the size of the lot and shall be in accordance with col (2) and col (3) of Table 3.

H-1.3.1 The brushes shall be selected at random. In order to ensure the randomness of selection, procedures given in IS 4905 may be followed. To ensure randomness of selection, a random number table as agreed to between the purchaser and the supplier shall be used. In case such a table is not available, the following procedure shall be used:

a) If all the brushes in a lot are packed in one box, then starting from any brush, count them in any suitable order as 1, 2 ..., up to *r* and so on, where *r* is the integral part of *N*/*n* (*N* and *n* being the lot size and sample size respectively). Every r^{th} brush thus counted shall be withdrawn to constitute the sample, or

b) If the brushes in a lot are packed in more than one box, approximately equal number of brushes shall be picked up at random from as many boxes as possible so as to obtain the required number of brushes as specified in Table 3.

H-2 NUMBER OF TESTS AND CRITERIA FOR CONFORMITY

H-2.1 All the brushes selected according to **H-1.3** shall be examined for constructional requirements given in **4.1** to **4.4**, **4.12** and Fig. 1. A brush failing in one or more of these requirements shall be considered as defective.

Table 3 Scale of Sampling and Permissible Number of Defective Brushes

(*Clauses* H-1.3, H-1.3.1 *and* H-2.1.1)

Sl No.	No. of Brushes in the Lot	No. of Brushes to be Selected	Permissible No. of Defective Brushes
(1)	(2)	(3)	(4)
i)	Up to 25	3	0
ii)	26 to 100	5	0
iii)	101 to 300	7	0
iv)	301 to 500	9	0
v)	501 to 1 000	13	1

H-2.1.1 The lot shall be declared as conforming to these requirements, if the number of defective found in the sample is less than or equal to the permissible number of defective given in col (4) of Table 3.

H-2.2 The lot having been found satisfactory according to **H-2.1.1** shall further be subjected to tests given under **4.5** to **4.11**. For this purpose, three brushes shall be selected from a lot containing 500 or less brushes and six brushes from a lot containing more than 500 brushes. These brushes may, however, be taken from those already examined and found satisfactory according to **H-2.1**.

H-2.2.1 Pull test, benzene alcohol test and oven test shall be performed first, on each of the brushes selected according to **H-2.2** and then these brushes shall be subjected to mass of bristles per finished brush, processing of bristles and detection of dyed brushes in this order, according to methods given in **4.8**, **4.9** and **4.11** respectively.

H-2.2.2 The lot shall be deemed to have met the requirements for these tests, if no failure occurs under **H-2.2**; otherwise not.

H-3 CRITERIA FOR CONFORMITY

The lot shall be declared as conforming to the requirements of this standard, if **H-2.1** and **H-2.2** are satisfied.

NOTE — For description of bristles (*see* **4.1.1.2**) and workmanship and finish (*see* **4.12**), the brushes selected according to **H-1.3.1** shall be matched with the approved tender sample which is suitably stamped and sealed by the purchaser or the inspection authority and kept at a place agreed to between the two.

ANNEX J

(*Foreword*)

COMMITTEE COMPOSITION

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