IS 2046 (1995): Decorative Thermosetting Synthetic Resin Bonded Laminated Sheets [PCD 12: Plastics]

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IS 2046 : 1995
(Reaffirmed 2005)

भारतीय मानक

सजावटी थर्मोसेटिंग संश्लिष्ट रेजिनबद्ध परतदार चादरें — विशिष्टि

(दूसरा पुनरीक्षण)

Indian Standard

DECORATIVE THERMOSETTING SYNTHETIC RESIN BONDED LAMINATED SHEETS — SPECIFICATION

(Second Revision)

UDC 678·6·066-419

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Price Group 14

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Plastics Sectional Committee had been approved by the Petroleum, Coal and Related Products Division Council.

Decorative, high pressure laminates (HPL) are characterized by their decorative surfaces, which are relatively hard and resistant to wear, scratching, impact, boiling water, domestic stains and moderate heat. They are intended for interior applications and are ready for use. The back surface of sheets having only one decorative face is manufactured so that it is suitable for adhesive bonding to a substrate. They are usually made by hot pressing under high pressure in multi-daylight presses. Thin single faced decorative laminates usually less than 2 mm thick are intended for bonding to a supporting substrate. Compact decorative laminates, single or double faced, between 2 mm and approx 5 mm thick need to be rigidly supported without necessarily being bonded to a substrate. Compact laminates thicker than 5 mm are usually double faced and are self-supporting. The thickness are selected according to application requirements for panel dimensions.

This standard was originally published in 1962 which was subsequently revised in 1969 to meet the general demand for a standard to cover the use of synthetic resin bonded sheets as a decorative material having a surface which is characterized by its hardness and the materials covered were suitable for use as wall panels or as veneer for wood or other surfaces. These laminated sheets require no additional decorative finish. Laminates with metal foil were not, however, covered. Laminated sheets in which the only filler is paper were covered and sheets with a core of any other material, namely hardboard were not covered. When used by itself, the materials covered were not intended for load bearing applications. The test for resistance to surface wear was not mandatory due to lack of adequate technical data on the reproducibility and repeatability of the method.

The first revision of this standard was largely based on BS 3794 : 1964 'Specification for decorative laminated plastics sheets' issued by the British Standards Institution which has since been withdrawn and superseded by BS EN 438 Part 1 : 1991 after being harmonized with EN 438-1 'Decorative high pressure laminates (HPL) — Sheets based on thermosetting resins — Part 1 : Specification' published by the European Committee for Standardization (CEN). This European standard has, however, been drawn up based on ISO 4586-1 : 1987 'Decorative high-pressure laminates (HPL) — Sheets based on thermosetting resins — Part 1 : Specification' issued by International Organization for Standardization (ISO). The priciple modifications compared with the ISO 4586-1 : 1987 are the definitions for sheets of decorative high-pressure laminates (HPL) and the introduction of a correlation table between the two systems of alphabetical and numerical classification of decorative high pressure laminates.

The present revision of IS 2046 : 1969 has been necessitated to harmonize the standard with EN 438-1 : 1991 and EN 438-2 : 1992 issued by the European Committee for Standardization (CEN), with a view to promote export markets in the European Committee. Accordingly, various types of materials and their requirements specified therein have been modified. Requirements are specified for those types of materials that are most generally used, but additional types may be added as required. The limit values specified apply to the most commonly used types of materials, but within each classification, it may be possible to obtain variants having much higher performance figures. These materials are characterized by their decorative surfaces, which are relatively hard and resistant to wear, scratching, impact, boiling water, domestic stains and moderate heat. They are intended for interior applications.

The requirements for reaction to fire are determined by the fire regulations. No test has, therefore, been included in this standard and reference must be made to the various requirements when appropriate. Suitable test or tests, however, will be included at a later date as and when the same is established.

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 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

DECORATIVE THERMOSETTING SYNTHETIC RESIN BONDED LAMINATED SHEETS — SPECIFICATION

(Second Revision)

1 SCOPE

This standard prescribes the requirements and the methods of sampling and test for decorative laminated sheets (HPL) classified according to their performance and main recommended fields of application and provides also for materials of special characteristics, for example post formability or defined reaction to fire. They are intended for interior applications.

2 NORMATIVE REFERENCES

The following standards 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 revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	*Title*
1998 : 1962	Methods of test for thermosetting synthetic resin bonded laminated sheets
4905 : 1968	Methods for random sampling (with Amendment No. 1)
8543 (Part 4/ Sec 1) : 1984	Methods of testing plastics : Part 4 Short term mechanical properties, Section 1 Determination of tensile properties
13411 : 1992	Glass reinforced polyester dough moulding compounds

3 TERMINOLOGY

For the purpose of this standard the definitions given under **2** of IS 1998 : 1962 and the following shall apply.

3.1 Decorative High-pressure Laminated Sheet (HPL)

A sheet consisting of layers of fibrous sheet material (for example, paper) impregnated with thermosetting resins and bonded together by means of heat and a pressure of not less than 7 MPa (1 MPa = $1MN/m^2$), the outer layer or layers on one or both sides having decorative colours or designs.

Decorative high-pressure laminated sheet (HPL) as defined in this standard is made from core layers impregnated with phenolic and/or aminoplastic resins and a surface layer or layers impregnated with aminoplastic resins (mainly melamine resins).

4 CLASSIFICATION

A classification system consists of a material type describing the general characteristics of the laminate together with three index numbers describing levels of performance. This system has been developed to cover the many HPL product variants now available.

An alphabetical classification system can be used as an alternative (*see* **4.5**) and Table 1 compares the two systems and shows how they relate to some typical applications.

4.1 Index Numbers for Specifying HPL Properties

Index 1 = Resistance to surface wear (Table 2);

Index 2 = Resistance to impact by small diameter ball (Table 3);

Index 3 = Resistance to scratching (Table 4).

4.2 Special Characteristic — Material Type

The classes of materials listed in Table 1 are all available as standard type decorative laminated sheet (Type S).

For some classes of materials, additional types (Type P and Type F), are also available, possessing the special properties described below.

4.2.1 *Type P — Postformable Decorative Laminated Sheet*

Type P sheet is similar to type S, but it can also be formed in accordance with the manufacturers' recommendation.

4.2.2 *Type F — Decorative Laminated Sheets Having Defined Reaction to Fire*

Type F sheet is similar to type S, but it also meets special requirements of specified fire tests, which may vary according to the application of the material.

4.3 Application Characteristics

Materials are available in the classes shown in Table 1. The list of typical applications given for each category is for guidance only and is not intended to be comprehensive.

Other combinations of properties are possible and can be classified by the numerical index system.

4.4 Index Numbers

Index numbers are used to specify three important HPL properties.

Table 1 Classification System and Typical Applications

(*Clause* 4)

Sl No.	Performance Category	Type	Index Number			Equivalent Alphabetical Classification	Typical Applications
			Wear	Impact	Scratch		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Thick materials of high performance for special use in horizontal and vertical application requiring particularly high impact and moisture resistance	Compact S or Compact F	3	2	3	CGS (Compact general purpose standard) CGF (Compact general purpose flame retardant)	Doors, partitions, walls, various self-supporting components construction and transportation
ii)	Very high resistance to surface wear High impact resistance Very high resistance to scratching	S or F	4	3	4	HDS (Horizontal heavy duty standard) HDF (Horizontal heavy duty flame retardant)	Countertops, flooring on special substrates
iii)	High resistance to surface wear High resistance to impact High resistance to scratching	S, P or P	3	3	3	HGS (Horizontal general purpose standard) HGF (Horizontal general pu pose post forming)	Kitchen working surfaces, restaurants and hotel tables, heavy duty doors and wall coverings, interior walls of public transport vehicles
iv)	High resistance to surface wear Mode- rate resistance to impact High resistance to scratching	S, F or P	3	2	3	—	Horizontal applications for office (Computer tables) and bathroom furniture
v)	Moderate resistance to surface wear High resistance to impact Moderate resistance to scratching	S or F	2	3	2	VGS (Vertical general purpose standard) VGF (Vertical general purpose flame retardant)	—
vi)	Post forming material with moderate resistance to impact	P	2	2	2	VGP (Vertical general purpose post forming)	Front panels for kitchen, office and bathroom furniture, wall coverings, shelves
vii)	Low resistance to surface wear Moderate resistance to impact and scratching	S, F or P	1	2	2	—	Special decorative surface effects for vertical use in kitchen showroom, etc
viii)	Low resistance to surface wear and scratching Moderate resistance to impact	S	1	2	1	VLS (Vertical light duty standard)	Exposed side components of cupboards

4.4.1 *Resistance to Surface Wear (First Index Number)*

Table 2 Index for Resistance to Surface Wear

(*Clause* 4.1)

Index Number	Number of Revolutions	
	Initial Wear Point (IP)	Initial Wear Point (IP) + Final Wear Point (FP)
1	0	≥ 50
2	≥ 50	≥ 150
3	≥ 150	≥ 350
4	≥ 350	≥ 1 000

4.4.2 *Resistance to Impact by Small Diameter Ball (Second Index Number)*

Table 3 Index for Resistance to Impact

(*Clause* 4.1)

Index Number	Spring Force (N)
1	≥ 12
2	≥ 15
3	≥ 20
4	≥ 25

NOTE — Applies only to materials less than 2 mm thick.

4.4.3 *Resistance to Scratching (Third Index Numbers)*

Table 4 Index for Resistance to Scratching

(*Clause* 4.1)

Index Number	Load (N)
1	≥1.50
2	≥1.75
3	≥2.00
4	≥3.00

4.5 Nomenclature

In addition to the prefix HPL and the number of this standard, materials can be specified either by the type and index number system, or by the alphabetical classification system.

For example, horizontal general purpose post forming laminate can be specified as, HPL – IS 2046 – P 333 or HPL – IS 2046 – HGP.

5 REQUIREMENTS

5.1 Colour and Pattern

When inspected in daylight (or D 65 standard illuminant and again under a tungsten illuminant) there shall be no significant difference between a standard agreed by the supplier and the specimen under test.

5.2 Surface Finish

5.2.1 When inspected at a different viewing angles, there shall be no significant difference between a standard agreed by the supplier and the specimen under test.

5.2.2 *Reverse Side/Bonding*

The reverse side of sheets having only one decorative surface shall be suitable for adhesive bonding if so required.

5.3 Thickness

No requirements for nominal thickness are specified for individual types of materials listed in Table 7, however, variations from the nominal thickness supplies shall at no point exceed the limits shown in Table 5.

Table 5 Permitted Variations of Thickness

All values in millimetres.

Sl No.	Nominal Thickness, t	Maximum Variation
(1)	(2)	(3)
i)	$0.5 \le t \le 1.0$	± 0.10
ii)	$1.0 < t \le 2.0$	± 0.15
iii)	$2.0 < t \le 2.5$	± 0.18
iv)	$2.5 < t \pm 3.0$	± 0.20
v)	$3.0 < t \le 4.0$	± 0.25
vi)	$4.0 < t \le 5.0$	± 0.30
vii)	$5.0 < t$	As agreed

5.3.1 Thickness shall be measured using a ratchet-type micrometer or dial gauge indicator having two flat parallel measuring surfaces of diameter at least 6 mm and capable of being read to 0.01 mm. When the thickness of a decorative laminated sheet is being measured, the two surfaces shall exert a pressure of 10 to 100 kPa upon each other.

The specimen shall be the sheet under test, as received. After checking the gauge for accuracy the thickness of the sheet shall be determined to the nearest 0.02 mm. It is recommended that the thickness should be measured at a minimum of four points and at a distance of at least 20 mm from the edge of the sheet.

5.4 Appearance

The following inspection requirements are intended as a general guide, indicating the minimum acceptable quality for laminates supplies as full size sheets. Cut-to-size panels and certain applications involving full size sheets may call for special quality requirements which can be negotiated between the supplier and the purchaser; in such cases the following requirements may be used as a basis for discussion. It should be noted that only a small percentage of sheets in a batch should be of the minimum acceptable quality.

5.4.1 *Surface Defects*

When inspected for surface appearances under standardized conditions of lighting and viewing at a distance

of 1.5 m, the surface defects stated in **5.4.1.1** to **5.4.1.3** in decorative laminated sheets are permissible.

The sheets shall be inspected for defects such as smudges, smears, finger-prints, scratches, foreign particles, damage or any other form of blemishes evident within the decorative surface by placing the sheet, decorative face uppermost, on a horizontal inspection table of height approximately 700 mm and large enough to accommodate largest sheet to be inspected under overhead fluorescent light of colour temperature approximately 5 000 K and giving an intensity of 800 to 1 000 lx over the whole area of the largest sheet to be inspected.

The inspector shall have normal vision corrected, if necessary. No magnifying glass shall be used in viewing the sheet.

The test specimen shall be the sheet under test, as received.

5.4.1.1 *Spots, dirt and similar surface defects*

The admissible size of defects is based on a maximum contamination area equivalent to 1.0 mm^2/m^2 laminate and is proportional to the sheet size under inspection.

The total admissible area of contamination may be concentrated in one spot or dispersed over an unlimited amount of smaller defects.

5.4.1.2 *Fibres, hairs, scratches*

The admissible length of defects is based in a maximum contamination length of 10 mm/m^2 laminate and is proportional to the sheet size under inspection.

The total admissible length of contamination may be concentrated in one defect or dispersed over an unlimited amount of smaller defects.

5.4.1.3 *Accumulated (combinations) of surface defects*

When defects of the types described in **5.4.1.1** and **5.4.1.2** occur in the same sheet, then the maximum level for each of the two types of defect shall not exceed half of the levels prescribed in **5.4.1.1** and **5.4.1.2**.

5.4.2 *Edge Defects*

Visual defects (for example, moisture marks, lack of gloss, etc) can be present on all four edges of the laminate provided that the defect free length and width are not more than 20 mm shorter than the nominal length and width.

5.4.3 *Broken Corners*

One broken corner of ≤30 mm or two broken corners of ≤15 mm are allowed.

These values refer to the distance between the original corner and the fracture line (*see* Fig. 1).

5.4.4 *Sanding Defects*

Slight chatter marks are allowed.

5.4.5 *Warping (Flatness)*

The flatness of laminates is dependent on atmospheric conditions within the storage area. Provided that the laminates are stored in the conditions recommended by the manufacturer, they shall not show a departure of the surface from a straightedge of 1 mm length in any position, of more than the limits listed in Table 6 when the laminate is laid concave side up on a flat surface.

Table 6 Permitted Departure from Flatness

All values in millimetres.

Sl No.	Composition	Thickness, t	Maximum Warp
(1)	(2)	(3)	(4)
i)	Single-faced	$t < 2.0$	120
ii)	Laminate	$2.0 \leq t < 5.0$	50
iii)	Double-faced	$2.0 \leq t < 5.0$	10
iv)	Laminate	$5.0 \leq t$	5

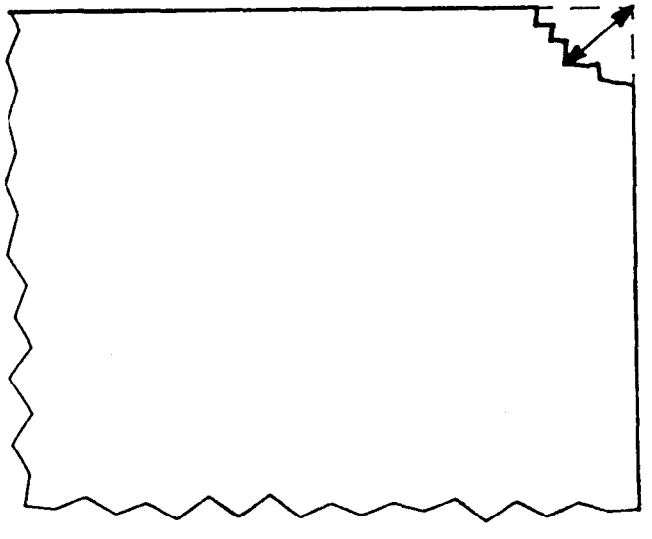


FIG. 1 BROKEN CORNER

5.4.6 *Length and Width of a Full-Size Laminate*

The laminate shall be of the nominal size with a tolerance of $^{+10}_{-0}$ mm.

5.4.7 *Straightness of Edges*

The edges shall be straight within a tolerance of 1.5 mm per metre length of the edge (value '*a*' in Fig. 2). The edge being measured shall be at least as long as the 1 mm straightedge.

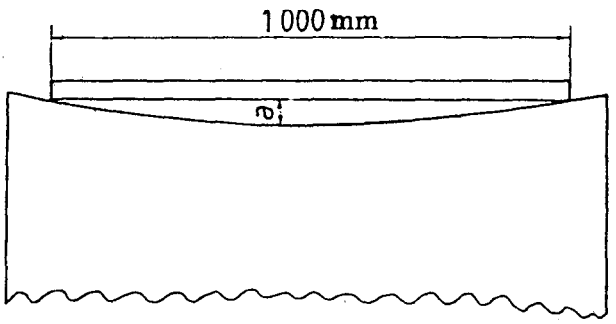


FIG. 2 MEASUREMENT OF STRAIGHTNESS

5.4.8 *Squareness of the Laminates*

The panel shall be rectangular within a tolerance of 1.5 mm per metre length of the edge (value '*b*' in Fig. 3). The edge being measured shall be at least as long as the 1 m straightedge.

5.5 Other Properties

When tested by the appropriate methods, the properties for each type of material shall satisfy the requirements listed in Tables 1 and 7.

6 COMPLIANCE

In order to comply with the requirements of this standard, materials of each type shall meet the requirements of every property for which a value of requirement is specified in **5**.

Two methods of test are given for the measurement of dimensional stability, impact resistance, resistance to colour changes in artificial light, formability and resistance to cigarette burns. When there is a choice of method, material satisfying the requirements of either method shall be deemed to comply with the specification for that property; however, the choice of method may be agreed between the interested parties available at the manufacturer's end. The method selected shall be stated in the test report.

7 PACKING AND MARKING

7.1 Packing

The material shall be supplied in packages as agreed to between the purchaser and the supplier.

7.2 Marking

The consignment shall be marked suitably with the following information:

a) Indication of the source of manufacture and recognized trade mark, if any;
b) Type and class of the material;
c) Month and year of manufacture; and
d) Batch number and code number.

7.2.1 *BIS Certification Marking*

The product may also be marked with the Standard Mark.

7.2.1 The use of the Standard Mark is governed by the provisions of Bureau of Indian Standards Act, 1986 and the Rules and Regulations made thereunder. The details of conditions under which the licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

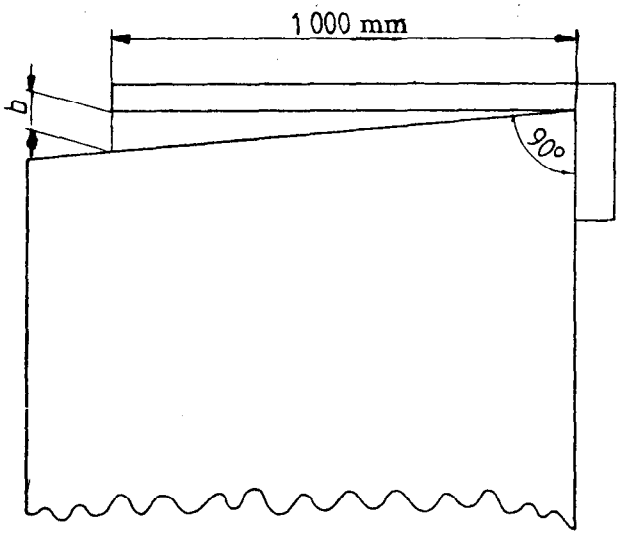


FIG. 3 MEASUREMENT OF SQUARENESS

Table 7 Property Requirements

(*Clause* 5.5)

Sl No.	Property	Property Attribute	Unit *Max/Min*	Materials Type										Test Method Ref to Annex of This Standard
				HDS HDF	HGS	HGP	HGF	VGS	VGP	VGF	VLS	CGS	CGF	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
i)	Resistance to surface wear	Wear resistance	Revolutions *Min*	← *See* Tables 1 and 2 →								d	d	C
ii)	Resistance to immersion in boiling water	Mass increase	Percent, *Max*	← *See* Curve 1, Annex A →										D
		Thickness increase	Percent, *Max*	← *See* Curve 2, Annex A →										D
		Appearance	Grade (not worse than)	4	4	3	4	4	3	4	3	4	4	D
iii)	Resistance to dry heat at 180°C	Appearance :	Grade (not worse than)											
		Gloss		3	3	3	3	x	x	x	x	3	3	E
		Others		4	4	4	4	x	x	x	x	4	4	E
iv)	Dimensional stability at deviated temperature	Cumulative	Percent, *Max* (L)	← *See* Curve 3/ Annex A →										F
		Dimensional change	Percent, *Max* (T)											(alternative)
v)	Dimensional stability at 20°C	Cumulative	Percent, *Max* (L)	← *See* Curve 4/ Annex A →										G[y]
		Dimensional change	Percent, *Max* (T)											(alternative)
vi)	Resistance to impact by small diameter ball	Spring force	*N, Min*	← *See* Tables 1 and 3 →								a	a	H[u]
vii)	Resistance to impact by large diameter balls (self-supporting compact laminates)	Drop height	cm, *Min*	a	a	a	a	a	a	a	a	c	c	J
		Diameter of indentation	mm, *Max*	a	a	a	a	a	a	a	a	10	10	J
viii)	Resistance to cracking (thin laminates)	Appearance	Grade (not worse than)	4	4	4	4	4	4	4	4	a	a	K[u]
ix)	Resistance to scratching	Load	N, *Min* (*see* Annex B)	← *See* Tables 1 and 4 →								e	e	L
x)	Resistance to staining	Appearance:	Grade (not worse than)											
		Group 1 and 2		5	5	5	5	5	5	5	5	5	5	M[f]
		Group 3 and 4		4	4	3	4	4	3	4	4	4	4	M[f]
xi)	Resistance to colour change													
	in xenon arc light	Wool standards	*Min*	6	6	6	6	6	6	6	6	6	6	N
												b	b	(alternative)
	in enclosed carbon arc light	do	*Min*	5	5	5	5	5	5	5	5	5	5	O
												b	b	(alternative)

xii)	Resistance to cigarette burns	Appearance	Grade (not worse than)	3	3	3	3	x	x	x	x	3	3	P (alternative)
		Time to failure	S, *Min*	110	110	100	100	x	x	x	x	110	100	Q (alternative)
xiii)	Formability :													
	Method A	Radius	mm, *Max*	a	a	15z	a	a	10z	a	a	a	a	R
	Method B	do	mm, *Max*	a	a	15z	a	a	10z	a	a	a	a	R
xiv)	Resistance to blistering :													
	Method A	Time to blister ($t_z - t_1$)	S, *Min*	a	a	15	a	a	10	a	a	a	a	S
	Method B		S, *Min*	a	a	15	a	a	10	a	a	a	a	S
xv)	Resistance to steam	Appearance	Grade (not worse than)	4	4	3	4	4	3	4	3	4	4	T
xvi)	Resistance to crazing (thick laminates)	Susceptibility	Grade (not worse than)	a	a	a	a	a	a	a	a	4	4	N
xvii)	Resistance to moisture (Double faced compact laminates)	Appearance	Grade (not worse than)	a	a	a	a	a	a	a	a	4	3	Y
xviii)	Flexural modulus	Stress	MPa, *Min*	a	a	a	a	a	a	a	a	10,000	9,000	Annex F of IS 13401 : 1992
xix)	Flexural strength	Stress	MPa, *Min*	a	a	a	a	a	a	a	a	100	80	do
xx)	Tensile strength	Stress	MPa, *Min*	a	a	a	a	a	a	a	a	70	60	IS 8543 (Part 4/ Sec 1) : 1984

Key to letters used in the Table 7:

a — Not applicable.

b — Test sample shall be reduced by machining to a thickness of < 3 mm.

c — Under consideration.

d — Test samples shall be reduced by machining to a thickness of < 15 mm.

e — Test samples shall be reduced by machining to a thickness of < 8 mm.

f — Acids and alkalis in concentrations stronger than those shown in Group 3, which can be contained in commercial cleaning agents, can cause surface damage or marking even with very short contact times. Any spillage of such material must be washed of the laminate surface immediately.

L — In the longitudinal (or machine) direction of the fibrous sheet material (normally the direction of the longest dimension of the laminated sheet).

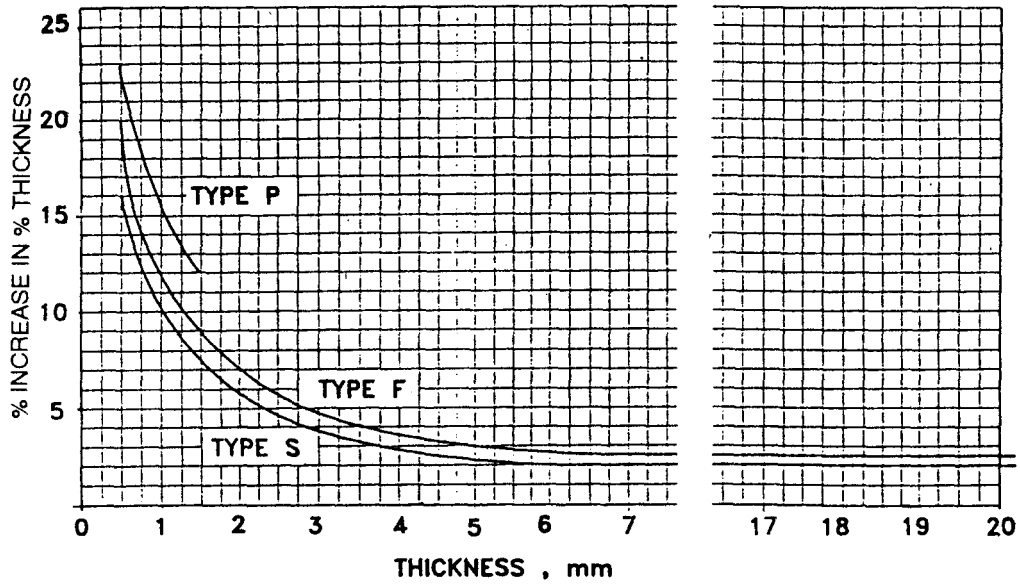
T — In the cross-longitudinal (or cross-machine) direction of the fibrous sheet material (at right angles to the direction L).

u — Applies only to materials less than 2 mm thick.

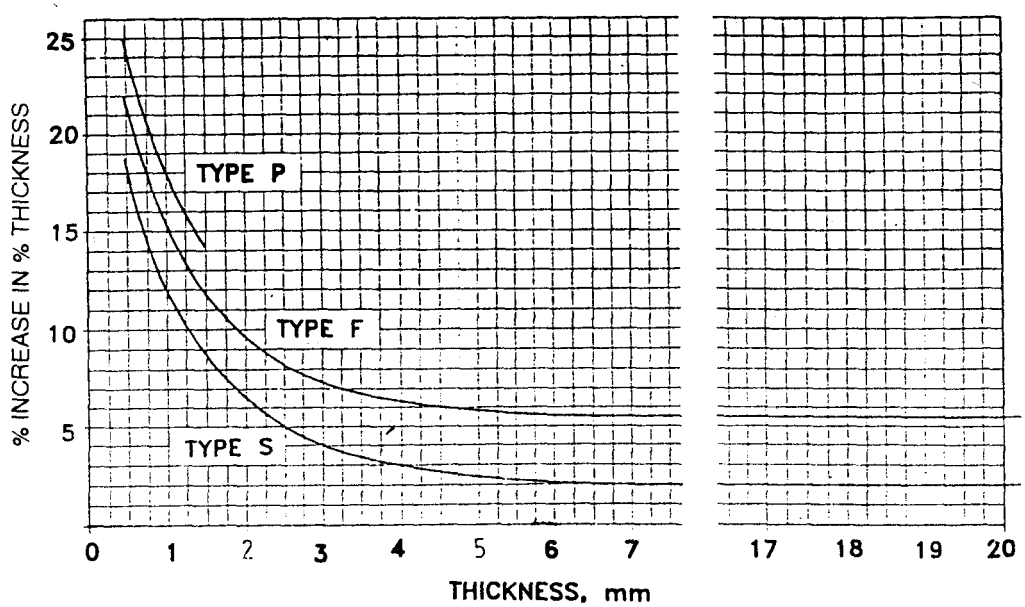
x — No requirement.

y — Intended to indicate performance under climatic conditions.

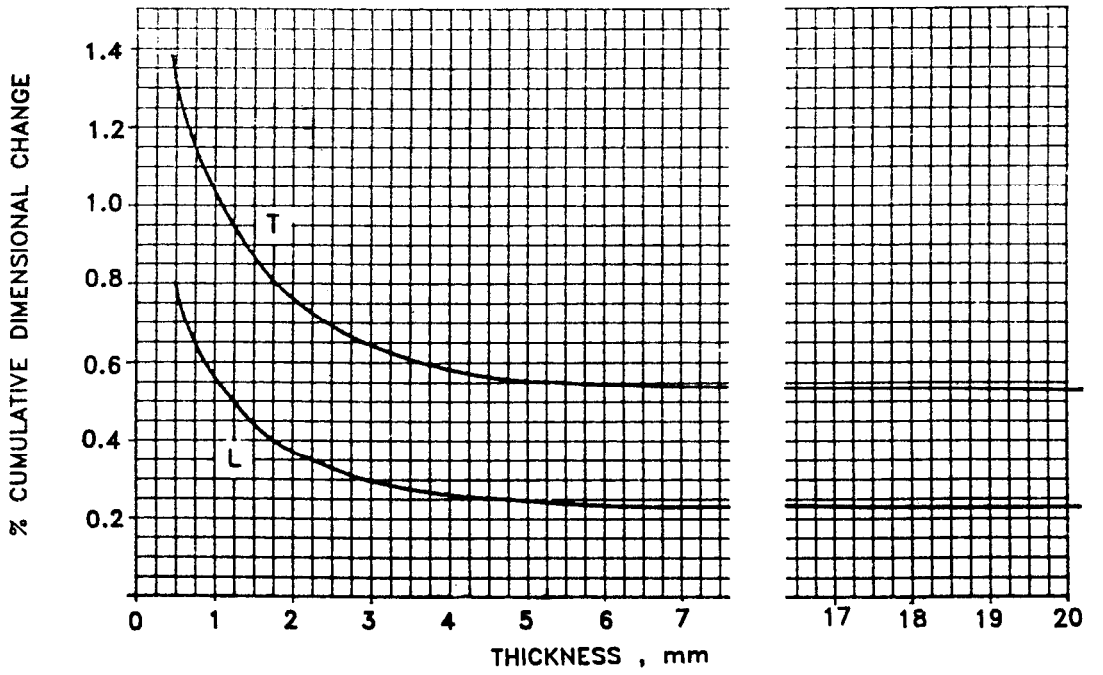
z — Limits for laminates > 1.5 mm shall be agreed between the interested parties.



CURVE 1 RESISTANCE TO IMMERSION IN BOILING WATER

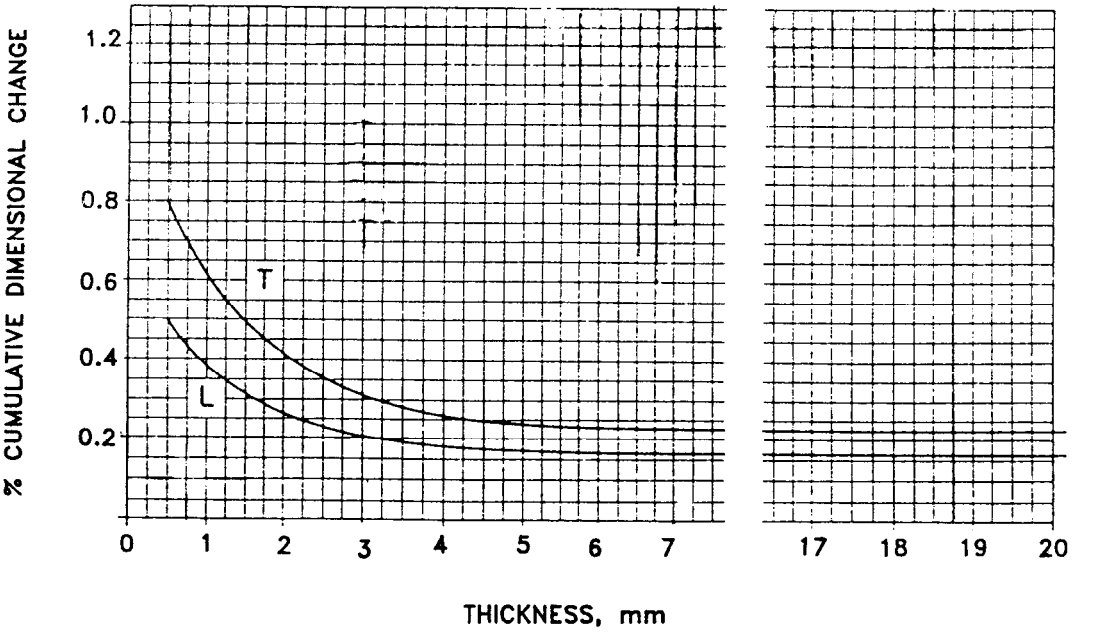


CURVE 2 RESISTANCE TO IMMERSION IN BOILING WATER



T = Cross-Longitudinal (or Cross-Machine) Direction
L = Longitudinal (or Machine) Direction

CURVE 3 DIMENSIONAL STABILITY TEST METHOD 9, TYPES S, F AND P



T = Cross-Longitudinal (or Cross-Machine) Direction
L = Longitudinal (or Machine) Direction

CURVE 4 DIMENSIONAL STABILITY TEST METHOD 10, TYPES S, F AND P

8 SAMPLING AND CRITERIA FOR CONFORMITY

8.1 Lot

All the decorative thermosetting synthetic resin bonded laminated sheets of the same group and type, produced under uniform conditions of manufacture shall constitute a lot.

8.1.1 *Number of Samples*

For ascertaining the conformity of the materials in a lot to the requirements of the specification, tests shall be carried out on each lot separately. The number of packages to be selected from the lot shall depend upon the size of the lot and shall be in accordance with Table 8.

Table 8 Scale of Sampling

Sl No.	Lot Size (Number of Packages)	Number of Packages Selected in a Sample
(1)	(2)	(3)
i)	Up to 150	3
ii)	151 to 500	4
iii)	501 and above	5

8.1.2 Each package in the sample shall be selected at random from each lot. For this purpose reference may be made to IS 4905 : 1968.

9 NUMBER OF TESTS

9.1 From each package selected in the sample, the sheets shall be tested for colour and pattern (**5.1**), surface finish (**5.2**), thickness (**5.3**) and appearance (**5.4**).

9.2 The sheets having been found satisfactory as per **9.1**, shall then be tested for the various requirements given in Tables 1 to 7. For this purpose the requisite number of sheets shall be selected at random, approximately equal in number, from each package selected as per col. 2 of Table 8. The number of test specimens shall be cut from different portions of the sheets, which shall be sufficient to carry out all the above tests.

10 CRITERIA FOR CONFORMITY

10.1 Any sample sheet failing in one or more requirements of the specification shall be termed as defective.

10.2 No defective sheet shall be found in the sample for the lot to be considered as conforming to the specification.

ANNEX A

[*Table* 7, *Sl No.* (iv) and (v)]

DIMENSIONAL STABILITY

A-1 In Table 7, reference is made to curves 1 to 4 in specifying resistance to boiling water and dimensional stability.

The characteristics are dependent on laminate thickness, and the curves provide more complete information than discrete limits.

A-2 The curves give the maximum limiting values for each laminate type (S, P and F). No attempt has been made to prescribe specific laminate thicknesses to the various fields of application, but in determining the quality of a laminate of a given thickness, it is important to know where these properties lie in relation to appropriate limit curves.

A-3 In knowing the expected performance, the customers can select the thickness of laminate which will best meet the requirements of a particular application.

ANNEX B

[*Table* 7, *Sl No.* (ix)]

SCRATCH RESISTANCE

B-1 The scratch resistance of decorative laminates is influenced by surface finish and colour, and the limits given in Table 7 indicate the minimum acceptable performance for each laminate type. However, values which are much higher than these limits can be achieved by selecting particular combinations of colour print and surface finish.

B-2 In general terms, light colour show a better resistance to scratching then dark colours; for a given colour, prints are better than plain colours and textured surface

finishes have a better scratch resistance than plain surfaces.

B-3 Figure 4 gives an indication of the effect of surface finish and colour on the scratch resistance performance of laminates. The choice of surface finish, colour and print can be made to suit the particular application.

For example, with a deep, rough structure in white, values of about 10 N can be obtained.

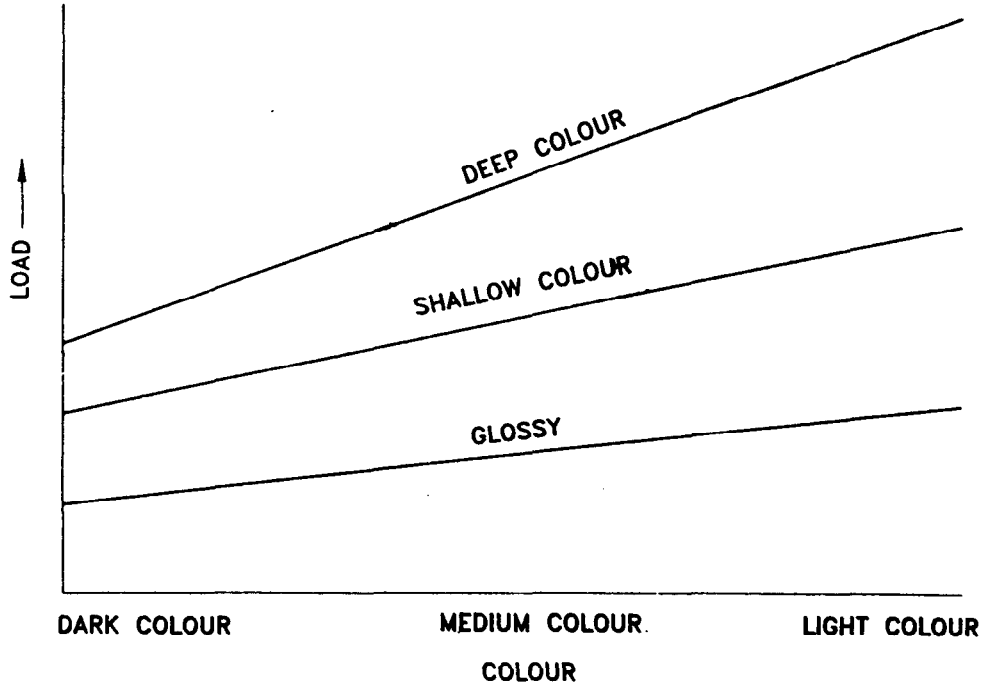


FIG. 4 EFFECTS OF SURFACE FINISH AND COLOUR ON SCRATCH RESISTANCE

ANNEX C

[*Table* 7, *Sl No.* (ii)]

RESISTANCE TO SURFACE WEAR

C-1 GENERAL

The test measures the ability of the decorative surface of the sheet under test to resist abrasive wear through to the sub-layer. Abrasion is achieved by rotating a specimen in contact with a pair of loaded cylindrical wheels covered with abrasive paper. The wheels are positioned so that their cylindrical faces are equidistant from the specimen's axis of rotation but not tangential to it. As they are turned by the rotating specimen, they abrade an annular track on the specimen's surface.

The number of revolutions of the specimen required to cause a defined degree of abrasion is used as a measure of resistance to surface wear.

C-2 MATERIALS

C-2.1 Calibration Plates of Rolled Zinc Sheet, having a thickness of 0.8 ± 0.1 mm and a Brinell hardness of 48 ± 2 when tested with the ball diameter of 5 mm and load of 360 N.

NOTE — May be made available from Taber Instruments, A Teledyne Company, North Tonawanda, N.Y., Catalog No. S-34 or the equivalent.

C-2.2 Abrasive Paper Strips, of width 12.7 mm and length about 160 mm, having the following composition:

a) Paper of grammage 70 to 100 g/m^2;

b) Powdered aluminium oxide having a particle size such that it will pass through a sieve of aperture 100 µm and remain on a sieve having an aperture of 63 µm; and

c) Adhesive backing (optional).

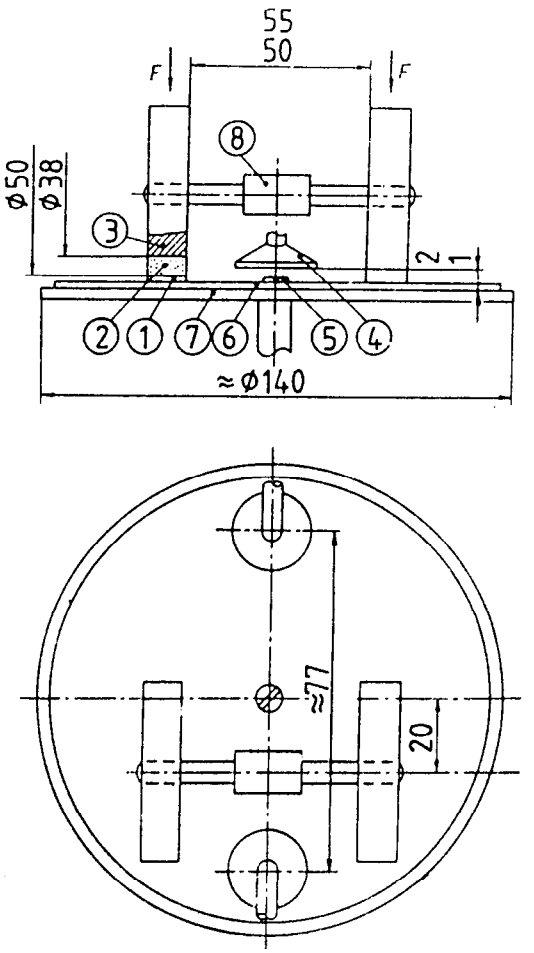
NOTE — May be made available from 3M Company, St. Paul, Minnesota; # 400 pressure-sensitive tape or the equivalent.

C-2.3 Double-Sided Adhesive Tape, only required if the abrasive paper has no adhesive backing.

C-3 APPARATUS

C-3.1 Testing Machine — consisting of the following items (*see* Fig. 5).

NOTE — A typical machine may be made available from Taber Instruments, A Teledyne Company, North Tonawanda, N.Y; Model 503 or equivalent.



All dimensions in millimetres.

FIG. 5 TYPE OF APPARATUS FOR MEASURING ABRASION RESISTANCE

C-3.1.1 *Specimen Holder* — in the form of a disc (7) which rotates in a horizontal plane at a frequency of 58 to 62 r/min and to which the test specimen (6) can be clamped flat (5).

C-3.1.2 *Abrasive Wheels* (3), two cylindrical rubber-covered wheels of width 12.7 mm and diameter 50 mm which rotate freely about a common axis. The curved surface of the wheels, to a depth of 6 mm, shall be of rubber (2) of hardness 50 to 55 IRHD. The inside faces of the wheels shall be 50 to 55 mm apart, and their common axis shall be 20 mm from the vertical axis of the specimen holder. The wheels shall be positioned symmetrically in a plane containing the axis of the specimen holder.

C-3.1.3 *Holding and Lifting Device* (8), for the abrasive wheels, so constructed that each wheel exerts a force of 5.4 ± 0.2 N on the test specimen.

C-3.1.4 *Revolution Counter*

C-3.1.5 *Suction Device,* so fitted that two nozzles (4) are over the abraded section of the specimen under test. One nozzle shall be situated between the wheels, the other diametrically opposite. The centres of the nozzles shall be 77 mm apart and 1 to 2 mm from the surface of the test specimen. When the nozzles are closed, there shall be a vacuum of 1.5 to 1.6 kPa.

C-3.2 Conditioning Chamber — with a standard atmosphere of 27 ± 2°C and relative humidity (65 ± 5) percent.

NOTE — May be made available from Taber instruments; Catalog No. S-32 or the equivalent.

C-4 TEST SPECIMEN

Each test specimen shall be a piece of the sheet under test, shaped to fit the type of clamping device used. It will usually be a disc of diameter about 130 mm, or a square of about 120 mm with its corners rounded to give a diagonal of about 130 mm, and it will usually have a hole of diameter 6 mm in its centre. Three specimens shall be prepared.

C-5 PREPARATION OF TEST SPECIMENS AND ABRASIVE PAPER

Clean the surface of the test specimens with an organic solvent which is immiscible with water, for example 1, 1, 1-trichloroethane. Precondition the test specimens and the abrasive strips for at least 72 h in the conditioning atmosphere (*see* C-3.2) before testing.

C-6 PROCEDURE

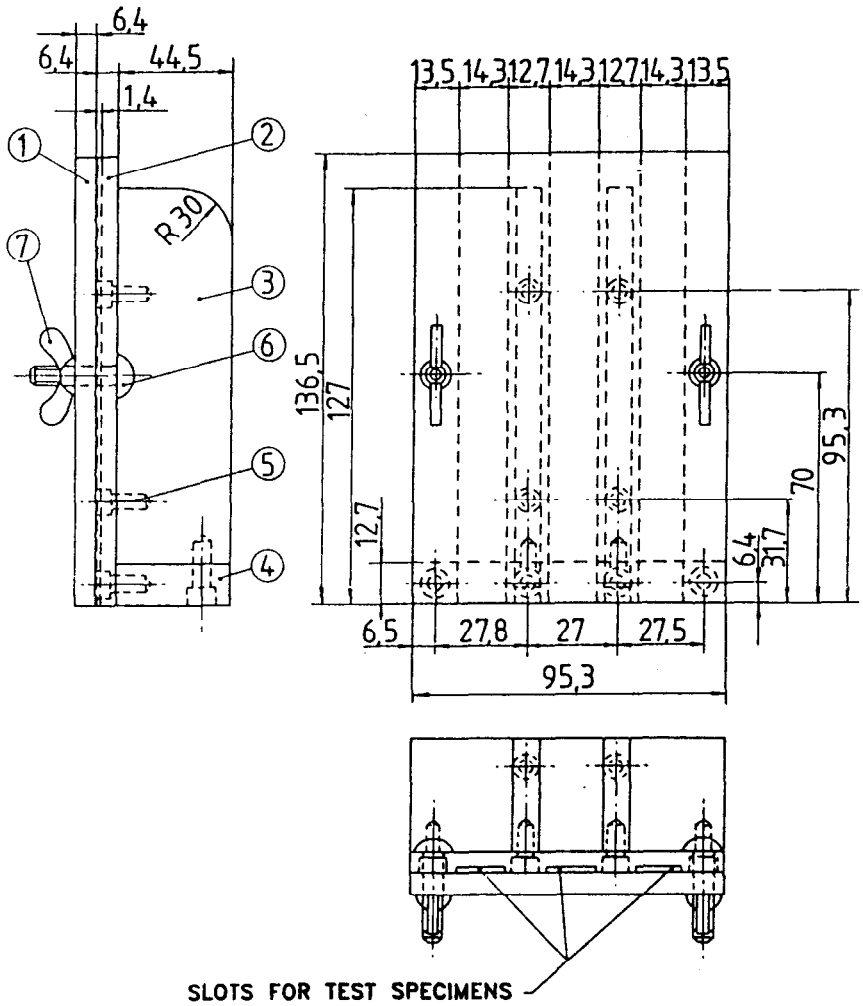
C-6.1 Preparation of Abrasive Wheels

Bond a strip of preconditioned abrasive paper (*see* C-2.2) to each of the rubber-covered wheels using either the adhesive backing, if present, or the double-sided adhesive tape (*see* C-2.3), in such a way that the cylindrical surface is completely covered, but without any overlapping of the abrassive paper [*see* Fig. 5A].

C-6.2 Calibration of Abrasive Paper

Prepare two abrasive wheels with unused strips of abrasive paper from the batch to be used for testing (*see* C-6.1).

Clamp a zinc plate (*see* C-2.1) in the specimen holder (*see* C-3.1.1), operate the suction device (*see* C-3.1.5), and abrade the zinc plate for 500 revolutions. Wipe the zinc plate clean and weigh to the nearest 1 mg. Replace the abrasive paper on the wheels with unused strips from the same batch, clamp the same zinc plate in the



List of Items

Item	*Material*	*Name*	*Dimensions* (mm)	*Number Required*
1	Stainless steel	Face plate	6.4 x 95.3 x 135.5	1
2	Stainless steel	Back plate	6.4 x 95.3 x 135.5	1
3	Stainless steel	Brace	6.4 x 44.5 x 114.3	2
4	Stainless steel	Base	12.7 x 44.5 x 95.3	1
5	Brass	Cheese head screw		10
6	Brass	Round head screw		2
7	Brass	Wing nut		2

All dimensions in millimetres.

FIG. 5A TYPICAL HOLDING JIG FOR DETERMINATION OF DIMENSIONAL CHANGE

specimen holder, lower the abrasive wheels and operate the suction device. Abrade the zinc plate for a further 500 revolutions, then wipe it, clean and reweigh it to the nearest 1 mg. Its loss in mass shall be 130 ± 20 mg. Any batch of abrasive paper which causes a loss in mass of the zinc plate outside this permitted range shall not be used for testing.

C-6.3 Abrasion of Test Specimen

Perform the test immediately after removal of the test specimen and calibrated abrasive paper from the preconditioning atmosphere.

Prepare sufficient abrasive wheels for the test using previously unused abrasive paper. Fit two wheels to the machine and set the revolution counter (**C-3.1.4**) to zero.

Clamp the specimen in the holder, ensuring that its surface is flat. Lower the abrasive wheels on to the specimen, operate the suction device and allow the specimen to rotate. Examine the specimen for wear after each 25 revolutions and examine the abrasive paper for clogging with abraded particles. Replace the abrasive paper if it becomes clogged, or after 500 revolutions, whichever happens first.

Continue the test in this way until the initial wear point (IP) is reached. Record the number of revolutions and resume the test until the final wear point (FP) is reached. Record the number of revolutions again.

The initial wear point (IP) is that point at which the first clearly recognizable wear-through of the print, pattern, plain colour coating or solid paper appears and the sub-layer becomes exposed in each of the four quadrants. The sub-layer for printed patterns is the background on which the pattern is printed; for plain colours it is the first sub-layer of different colour.

The final wear point (FP) occurs in the case of a patterned laminate when about 95 percent of the pattern is removed in the abraded area, and in the case of a plain colour laminate when an underlayer of a different colour is exposed over about 95 percent of the abraded area.

Calculate the resistance to surface wear for each sample using the following formula:

$$\text{Resistance to surface wear (revs.)} = \frac{IP + FP}{2}$$

C-7 EXPRESSION OF RESULTS

The initial point (IP of the sample under test shall be the average of the IP values obtained on the three specimens.

The wear resistance of the sample under test shall be the average of the wear values obtained on the three test specimens, rounded to the nearest 50 revolutions.

ANNEX D

[*Table 7, Sl No.* (ii)]

RESISTANCE TO IMMERSION IN BOILING WATER

D-1 GENERAL

The effect of immersion in boiling water for 2 h is determined by the increase in mass and thickness of a test specimen and by noting the occurrence of any blistering or delamination.

D-2 APPARATUS

D-2.1 Balance — accurate to 1 mg.

D-2.2 Oven — capable of being controlled at 50 ± 2°C.

D-2.3 Vessel — containing boiling distilled water.

D-2.4 Vessel — containing distilled water at 27 ± 2°C.

D-2.5 Desiccator

D-2.6 Micrometer — thickness gauge.

D-2.7 Suitable Heating Apparatus — (for example, electric hot-plate).

D-2.8 Specimen Holder — to hold specimens vertically during immersion and prevent contact with other specimens or the vessel.

D-3 TEST SPECIMENS

Each test specimen shall be 50 ± 1 mm square, the thickness of the sheet, and cut in such a way that no appreciable heat is generated and the edges are free from cracks. Cut edges shall be smooth. Three specimens shall be used.

D-4 PROCEDURE

Dry the three test specimens for 24 ± 1 h in the oven (**D-2.2**) controlled at 50 ± 2°C, allow to cool in the desiccator (**D-2.5**) to 17 ± 2°C, and weigh each specimen to the nearest 1 mg (mass m_1).

Measure the thickness of each specimen as specified in **5.3.1**, but at the centres of its four edges (d_1, d_2, d_3, d_4) and with the external edge of the micrometer anvil approximately 5 mm from each edge. Mark the measuring points so that subsequent measurements can be made in the same places.

Place the specimens in the vessel of boiling distilled water (D-2.3). Take care to prevent the specimens from making contact over any substantial area with one another or with the vessel.

After 2 h ± 5 min, remove the specimens from the boiling water and allow to cool for 15 ± 5 min in the vessel of distilled water maintained at 27 ± 2°C (D-2.4). Take them from the water and remove all surface water with a clean dry cloth or with filter paper. Weigh the specimens again to the nearest 1 mg (mass m_2) within 1 min of taking them from the water.

Determine the thickness of each test specimen to the nearest 0.01 mm at the same points as before (d_5, d_6, d_7, d_8).

Examine each test specimen visually for change in appearance.

D-5 EXPRESSION OF RESULTS

The boiling water absorbed by each test specimen is given, as a percentage by mass, by the formula:

$$\frac{m_2 - m_1}{m_1} \times 100$$

where

m_1 = the mass of the specimen before immersion; and

m_2 = the mass of the specimen after immersion.

The percentage increase in thickness at the measuring points of each test specimen is given by the formula:

$$\frac{d_5 - d_1}{d_1} \times 100$$

$$\frac{d_6 - d_2}{d_2} \times 100, \text{ etc}$$

where

d_1, d_2, d_3 and d_4 = the thicknesses measured before immersion; and

d_5, d_6, d_7 and d_8 = the thicknesses measured after immersion.

The percentage by mass of boiling water absorbed by the sample under test shall be the average of the values obtained on the three test specimens.

The percentage increase in thickness of the sample under test shall be the average of the twelve values obtained at the four measuring points on all three specimens.

The effect on the surface of the specimen is expressed in accordance with the following rating scale:

Degree 5 : No visible change.

Degree 4 : Slight change of gloss and/or colour, only visible at certain viewing angles.

Degree 3 : Moderate change of gloss and/or colour.

Degree 2 : Marked change of gloss and/or colour.

Degree 1 : Blistering and/or delamination.

ANNEX E

[*Table* 7, *Sl No.* (iii)]

RESISTANCE TO DRY HEAT

E-1 GENERAL

A specimen taken from the sheet under test, bonded to wood chipboard to simulate service conditions, is subjected to dry heat by contact with a vessel of defined heat capacity, initially at 180°C but cooling during the 20 min of contact. Resistance to the test conditions is assessed by visual examination.

The test is intended to determine the suitability of decorative laminated sheets for use in kitchens where contact with moderately hot cooking utensils is to be expected.

E-2 MATERIALS

E-2.1 Glycerol Tristearate — or any other material of similar specific heat which will produce the same result. To minimize health and safety risks, metal blocks can be used if it can be shown that similar results will be obtained.

NOTE — The same glycerol tristearate or other material may normally be used for at least twenty tests, but if it has been heated to a temperature above 200°C, or in case of dispute, fresh material should be used.

E-2.2 Fine-faced Wood Chipboard — 230 ± 5 mm square, 18 to 20 mm nominal thickness with a tolerance of ± 0.3 mm, density 650 to 700 kg/m^3 and moisture content (9 ± 2) percent.

E-2.3 Urea-formaldehyde Adhesive — containing approximately 15 percent filler, or an adhesive with equivalent performance.

E-3 APPARATUS

E-3.1 Cast Cylindrical Aluminium or Aluminium Alloy Vessel — without a lid, the bottom of which has been machined flat. It shall have an external diameter of 100 ± 1.5 mm and an overall height of 70 ± 1.5 mm. The wall thickness shall be 2.5 ± 0.5 mm and the base thickness $2.5\ ^{+0.5}_{-0}$ mm.

E-3.2 Heat Source — for heating the vessel (*see* E-3.1) uniformly.

E-3.3 Suitable Inorganic Heat — Insulating Board — of thickness about 2.5 mm and 150 mm square. Asbestos cement shall not be used.

E-3.4 Thermometer — range -5°C + 250°C.

E-3.5 Fixed Frame — to hold the specimen flat.

E-2.6 Stirrer

E-4 TEST SPECIMEN

The test specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (*see* **E-2.2**) using the specified adhesive (*see* **E-2.3**). One specimen 230 ± 5 mm square shall be used. The bonded specimen shall be preconditioned for at least 7 days at 27 ± 2°C and (65 ± 5) percent relative humidity before being used for the test.

For materials of thickness greater than 2 mm, the effect of bonding the specimen is insignificant and the test may be conducted with the specimen resting in close contact with the chipboard. This technique is also acceptable for routine quality control testing of laminates less than 2 mm thick. However, in case of dispute, laminates less than 2 mm thick shall be bonded to chipboard.

E-5 PROCEDURE

Fill the vessel (*see* **E-3.1**) with glycerol tristearate (*see* **E-2.1**). Fix the thermometer (*see* **E- 3.4**) centrally in the vessel with its bulb about 6 mm from the bottom. Raise the temperature of the glycerol tristearate to approximately 185°C, stirring from time to time. Transfer the vessel to the heat-insulating board (*see* **E-3.3**) and allow the temperature to fall to 180 ± 1°C, stirring continuously.

Immediately place the vessel of hot glycerol tristearate on the surface of the test specimen and allow to stand for 20 minutes without further stirring.

At the end of this period, remove the vessel and allow the specimen to cool for a period of 45 minutes. Examine the specimen for surface disturbance, for example blistering, crazing, discolouration or loss in gloss visible to the naked eye, corrected, if necessary, allowing the light to fall on the specimen at various angles of incidence.

The effect on the surface of the specimen is expressed in accordance with the following rating scale:

Degree 5 : No visible change.

Degree 4 : Slight change of loss and/or colour, only visible at certain viewing angles.

Degree 3 : Moderate change of gloss and/or colour.

Degree 2 ; Heavy change of gloss and/or colour.

Degree 1 : Surface distortion and/or blistering.

ANNEX F

[*Table* 7, *Sl No.* (iv)]

DIMENSIONAL STABILITY AT ELEVATED TEMPERATURES

F-1 GENERAL

The test measures the lateral dimensional changes of specimens from the sheet under test over an extreme range of relative humidities at elevated temperatures.

F-2 APPARATUS

F-2.1 Oven — capable of being controlled at 70 ± 2°C.

F-2.2 Conditioning Chamber — with an atmosphere of relative humidity within the range 90 percent to 95 percent and a temperature of 40 ± 2°C.

NOTE — This relative humidity occurs at a temperature of 40°C in equilibrium above a saturated solution of sodium tartrate [$CHOHCOONa)_2 : 2H_2O$].

F-2.3 Conditioning Chamber — with a standard atmosphere of 27 ± 2°C and relative humidity 65 ± 5 percent.

F-2.4 Bedplate and Mounted Dial Gauge — or other apparatus capable of measuring to an accuracy of 0.02 mm.

F-2.5 Rigid Jig — for holding the specimen straight during measurement. A typical jig is shown in Fig. 6.

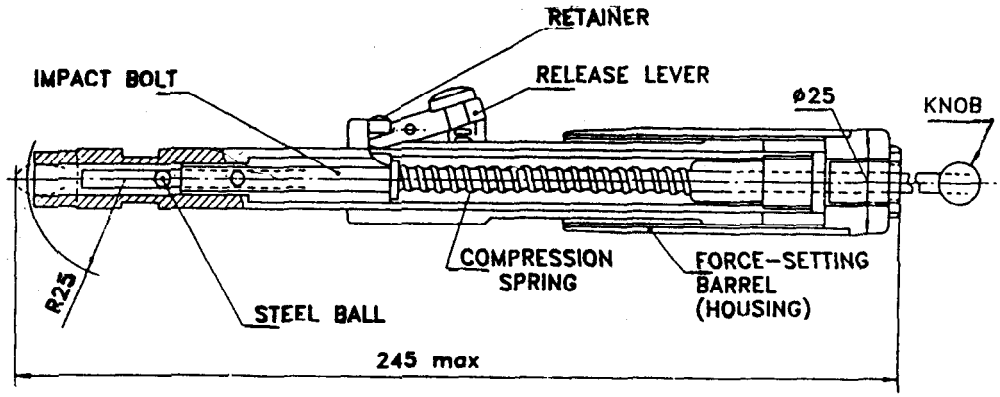
F-2.6 Desiccator — of suitable size.

F-3 TEST SPECIMENS

Each test specimen shall be 140 ± 0.8 mm long, 12.7 ± 0.4 mm wide and of the thickness of the sheet under test. The edges shall be free from cracks and shall be made smooth with fine abrasive paper or cloth. Machining and abrading operations shall be slow enough to avoid heating the material appreciably.

Twelve test specimens shall be tested, six of them with their major axes parallel to the machine direction of the fibrous sheet material (for example, paper) from which the sheet has been made, and fix with their major axes at right angles to the machine direction. Three specimens from each direction shall be used for the low humidity test and three for the high humidity test.

NOTE — If the machine directions is not known, carry out flexural strength tests at various angles. The highest value will usually be given by the test specimen cut parallel to the machine direction.



All dimensions in millimetres.

FIG. 6 IMPACT TESTER SHOWN WITH SPRING COMPRESSED

Before making the first measurements, all specimens shall be kept for 4 days in a standard atmosphere of 27 ± 2°C and 65 ± 5 percent relative humidity.

F-4 PROCEDURE

Make all the measurements of length to the nearest 0.02 mm with the test specimen vertical in the jig (*see* **F-2.5**), the lower end in contact with the bedplate and the upper end in contact with the foot of the dial gauge (*see* **F-2.4**). When any test specimen is measured for the second time, take care to ensure that it is located in the jig in the same relative position as when it was first measured. Make all measurements within 5 min after removal from the conditioning atmosphere.

F-4.1 Dry Heat Test

Measure the length of each of the six specimens and then place them in the oven (*see* **F-2.1**) controlled at 70 ± 2°C. At the end of 24 h, remove them and allow them to cool to ambient temperature in the desiccator (*see* **F-2.6**) for 1 h. Again measure the length of each specimen.

F-4.2 High Humidity Test

Measure the length of each of the six specimens and then place them in the conditioning chamber (*see* **F-2.2**) at 40 ± 2°C and relative humidity within the range 90 percent to 95 percent. After 96 ± 4 h, remove each specimen, wipe it free of surface water with a cloth and again measure its length.

F-5 EXPRESSION OF RESULTS

Calculate the change as a percentage of the initial length of each specimen.

Calculate the mean percentage change for each of the four sets of three test specimens, to the nearest 0.05 percent.

Calculate the cumulative dimensional change for each direction of the sheet. It is the sum of the average absolute dimensions; changes in each of the low and high humidity tests if the movements are in opposite directions. If they are in the same direction, the larger of the two average changes shall be taken as the cumulative dimensional change. The absolute figure shall be reported.

ANNEX G

[*Table 7, Sl No.* (v)]

DIMENSIONAL STABILITY AT 20°C

G-1 GENERAL

The test measures the lateral dimensional changes of specimens from the sheet under test due to changes of humidity at 20°C.

G-2 APPARATUS

G-2.1 Conditioning Chambers — maintaining the following three atmospheres:

20 ± 2°C, relative humidity (32 ± 3) percent

20 ± 2°C relative humidity (90 ± 3) percent

27 ± 2°C, relative humidity (65 ± 5) percent

G-2.2 Means for Measuring Lengths — of 200 mm to the nearest 0.05 mm.

G-3 TEST SPECIMENS

Four test specimens approximately 250 mm x 50 mm shall be cut from the sheet under test in both the machine and cross-directions of the fibrous sheet material (for example, paper) from which the sheet was manufactured. If these directions are not known, they may be determined as specified in **F-3**. Measuring marks shall be made on the decorative face of the specimens approximately 200 mm apart and 25 mm from each end.

G-4 PROCEDURE

Precondition the specimen, end for 7 days in a standard atmosphere of 27 ± 2°C and (65 ± 5) percent relative humidity.

Measure the distance between the marks on all eight specimens to the nearest 0.05 mm with the specimens laid out flat.

Keep four specimens, two cut in the lengthwise and two in the crosswise direction, for 7 days at 20 ± 2°C and (32 ± 3) percent relative humidity.

Keep the remaining four specimens for 7 days at 20 ± 2°C and (90 ± 3) percent relative humidity.

Remeasure the distance between the marks as before within 1 min after removal from the conditioning atmosphere.

G-5 EXPRESSION OF RESULTS

Calculate the change in measured length of each specimen as a percentage of the initial measured length.

Calculate the mean percentage change in measured length for each of the four pairs of specimens to the nearest 0.05 percent.

Calculate the cumulative dimensional change for each direction of the sheet. It is the sum of the mean absolute percentage changes in each of the low and high humidity tests. The absolute figure shall be reported.

Fill the vessel (*see* **M-3.3**) with water (to within 15 mm of the top) and heat it until the water boils vigorously. Discontinue heating and immediately place the vessel containing the boiling water on the surface of the test specimen directly over the pool of test material.

After the specified contact time, remove the vessel and wash the test specimen with water containing a suitable wetting agent (*see* **M-3.6**) and then with ethanol (*see* **M-3.7**) or other solvents as required to clean the surface. A suitable brush (*see* **M-3.9**) may be used to remove staining material from textured surfaces.

One hour after washing, place the specimen on the inspection surface (*see* **M-3.5**) and view it from various angles at a distance of 400 mm.

ANNEX H

[*Table* 7, *Sl No.* (vi)]

RESISTANCE TO IMPACT BY SMALL DIAMETER BALL

H-1 GENERAL

A specimen from the sheet under test is bonded to wood chipboard to simulate service conditions and its decorative surface is subjected to the impact of a 5 mm steel ball mounted at one end of a springloaded bolt. The minimum spring force needed to cause visible damage is used as a measure of resistance to impact.

H-2 MATERIALS

H-2.1 High-Quality Fine-faced Wood Chipboard, 18 to 20 mm nominal thickness with a tolerance of ± 0.3 mm, density 650 to 700 kg/m^3 and moisture content 9 ± 20 percent.

Where the specimen is bonded to chipboard, the test actually measures the impact resistance of the whole composite material, that is, laminate, adhesive and substrate. The correct choice of chipboard quality is therefore very important in achieving good reproducibility with this test. In case of dispute the same test shall be carried out on chipboards from three different suppliers.

H-2.2 Urea-formaldehyde Adhesive, containing approximately 15 percent filler, or an equivalent.

H-2.3 Solution of Dye in Alcohol, Graphite or Talcum, to contrast with the colour of the sheet under test (optional).

H-3 APPARATUS

3.1 Impact Tester (*see* Fig. 6), consisting of an impact bolt with a 5 mm steel ball mounted at one end, which is projected once against the surface under test by the release of a compression spring. The spring compression force before release can be adjusted continuously from 0 to 90 N by means of a force-setting barrel (housing).

The N/m scale also provided on the tester is only to be used for orientation, as the introduction of a non-linear scale involves relatively great inaccuracies.

The compression spring is 100 mm long when released and has a constant of 1962 ± 50 N/m. It is compressed by drawing back the impact bolt and is held in the loaded position by a retainer which engages in the bolt. It is released to deliver the impact blow by a release unit which withdraws the retainer.

H-3.2 Arrangement (for example, a Scale-Pan and Weights), capable of being suspended from the impact bolt to exert a compressive force on the spring.

H-3.3 Support Fixture (*see* Fig. 7) which clamps to the shaft of the impact tester and provides a convenient mounting of sufficient mass for the tester to be held at right angles to the surface of the test specimen and to avoid recoil following the release of the impact bolt.

H-3.4 Steel Plate, having dimensions approximately 300 mm x 300 mm x 50 mm.

H-3.5 Hand Lens, with approximately 6 x magnification (optional).

H-4 TEST SPECIMENS

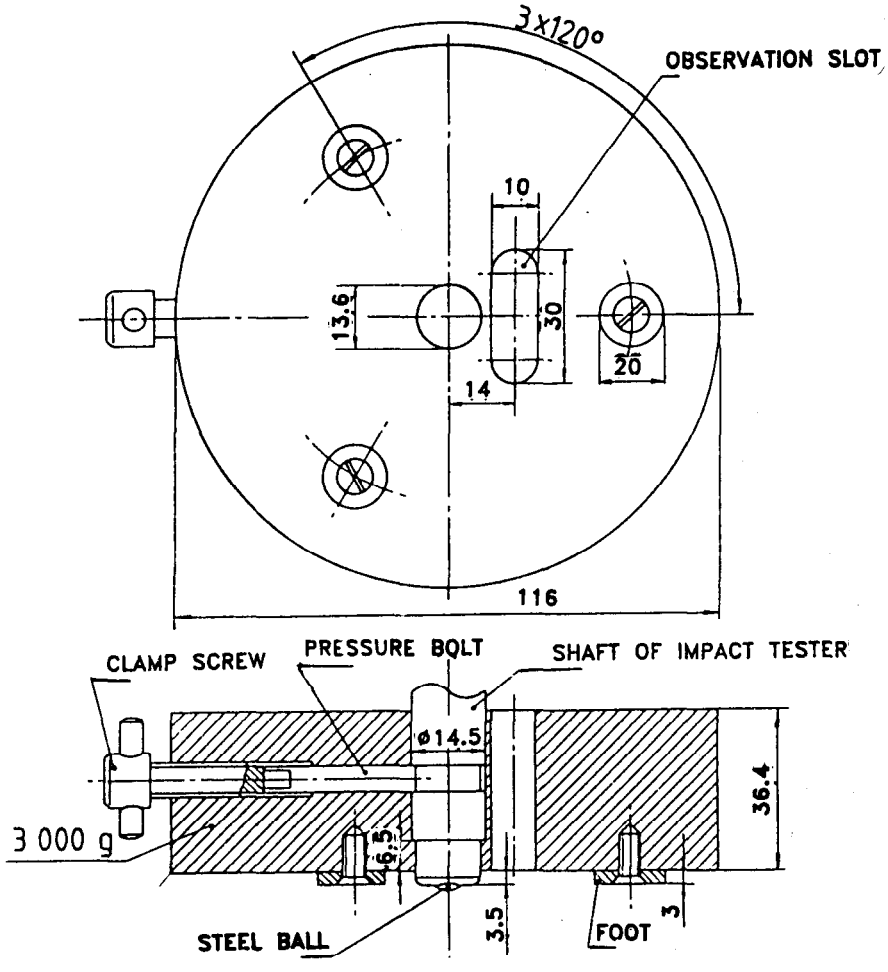
Test specimens shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (*see* **H-2.1**) using the specified adhesive (*see* **H-2.2**). About ten specimens, each 200 ± 5 mm square shall be prepared. The bonded specimens shall be preconditioned for at least 7 days at 27 ± 2°C and 65 ± 5 percent relative humidity before being used for the test.

H-5 CALIBRATION OF THE IMPACT TESTER

Suspend the tester with the impact bolt pointing upwards so that its longitudinal axis is free to hang vertically under gravity.

Set the force-setting barrel, which serves to vary the impact force, to zero on the scale. Compress the spring by a force F_e (calibration force) using a suitable arrangement (for example weights in a scale-pan) suspended from the knob used to draw back the impact bolt, ensuring that the bolt is clear of the retainer of the release unit.

Turn the force-setting barrel until the retainer of the release unit is just in contact with the impact bolt. This position can be determined by increasing or decreasing the compressing force very slightly to observe whether the retainer is just in contact. Record the indicated force F_x on the scale of the instrument corresponding to the calibration force F_e.



All dimensions in millimetres.

FIG. 7 SUPPORT FIXTURE FOR IMPACT TESTER

Repeat this calibration procedure for various values of F_x in the range required, and draw a graph relating values of the scale reading F_x to values of the calibration force F_e (*see* Fig. 8 for example).

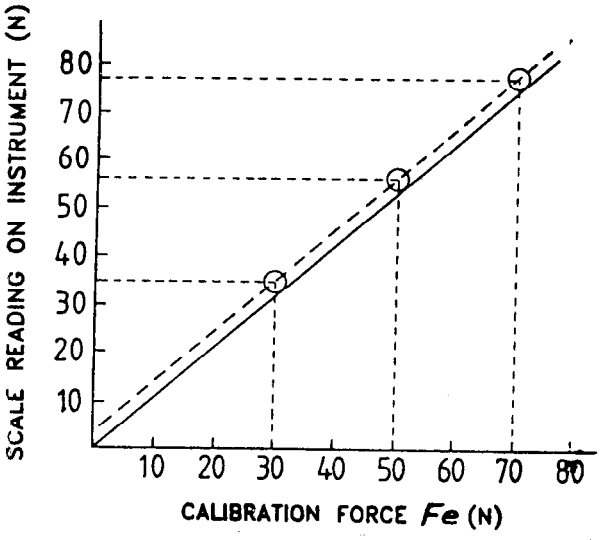


FIG. 8 EXAMPLE OF CALIBRATION GRAPH RELATING ACTUAL FORCE TO SCALE VALUE

The graph will be an approximately straight line which will not pass through the origin, because a constant but undetermined force is exerted during the calibration procedure by the mass of the impact bolt and any suspension arrangement (for example, a scale-pan). Draw a second line passing through the origin and parallel to the first line. This second line is the calibration graph of the instrument and shall be used to correct every indicated force F_x employed in testing.

Prepare a new calibration graph after every 500 tests.

H-6 PROCEDURE

The test shall be carried out in the laboratory atmosphere, and in case of dispute it shall be carried out at 27 ± 2°C.

Place the steel plate on a convenient rigid horizontal surface and locate the test specimen on it with its decorative surface uppermost. Fix the impact tester in its support fixture, load the tester, place the assembly on the test specimen and release the impact bolt. Start preliminary tests with a spring force of 10 N and increase by 5 N on each occasion to determine the minimum spring force at which the surface of the specimen shows damage due to impact stress.

Test at least five additional specimens for the final determination of the maximum force at which no damage occurs. For this purpose, start with the spring force determined in the preliminary test and reduce it in stages, for example 1 N, after every five tests.

To make the damage more easily visible, the surface of the specimen may be rubbed after test with a solution of dye in alcohol or with graphite or talcum (depending on the colour of the decorative surface). A magnifier with 6 x magnification may also be used.

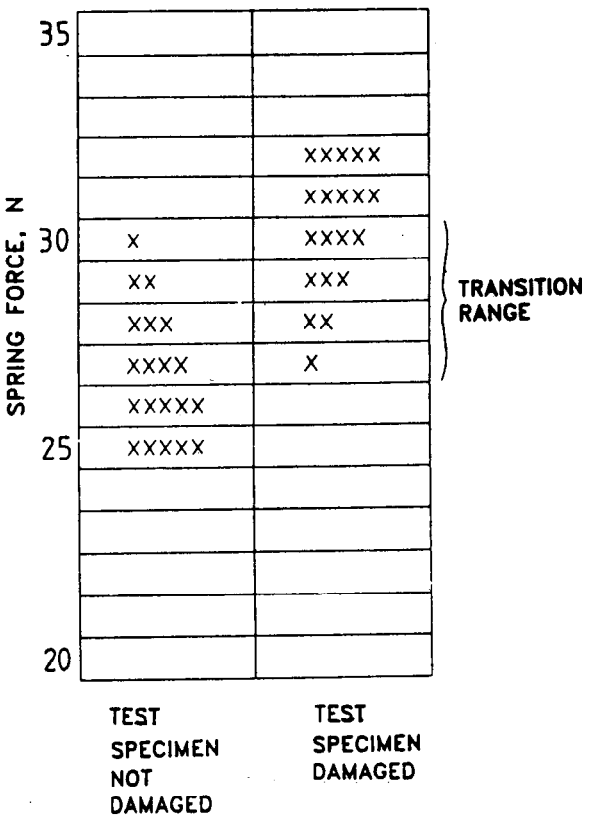
The distance between points of impact shall be at least 20 mm and between points of impact and the edge of the test specimen at least 30 mm.

Examine the specimen for damage at the points of impact. For the purpose of this test, damage is defined by the presence of fine hairline cracks (which are frequently concentric), continuous cracks or flaking of the decorative surface. Indentations without cracks do not count as damage.

If the test is only conducted to determine whether the impact strength of a material exceeds a limiting value, the test specimen shall sustain no damage after ten successive individual impact blows with the prescribed spring force.

H-7 EXPRESSION OF RESULTS

Enter the results of the series of tests into an evaluation diagram (*see* Fig. 9 for example) in which they are subdivided into "Test specimen not damaged" and "Test specimen damaged", for each value of spring force used. This results in a transition range in which some specimens are damaged and some undamaged. The impact strength of the material is the maximum value of the spring force, in newtons, for which no damage occurs in a series of five tests.



NOTE — In the example, the impact strength of the material is 26 N.

FIG. 9 EXAMPLE OF EVALUATION DIAGRAM FOR ASSESSING THE EFFECT OF IMPACT BLOWS WITH AN IMPACT TESTER

ANNEX J

[*Table 7, Sl No.* (vii)]

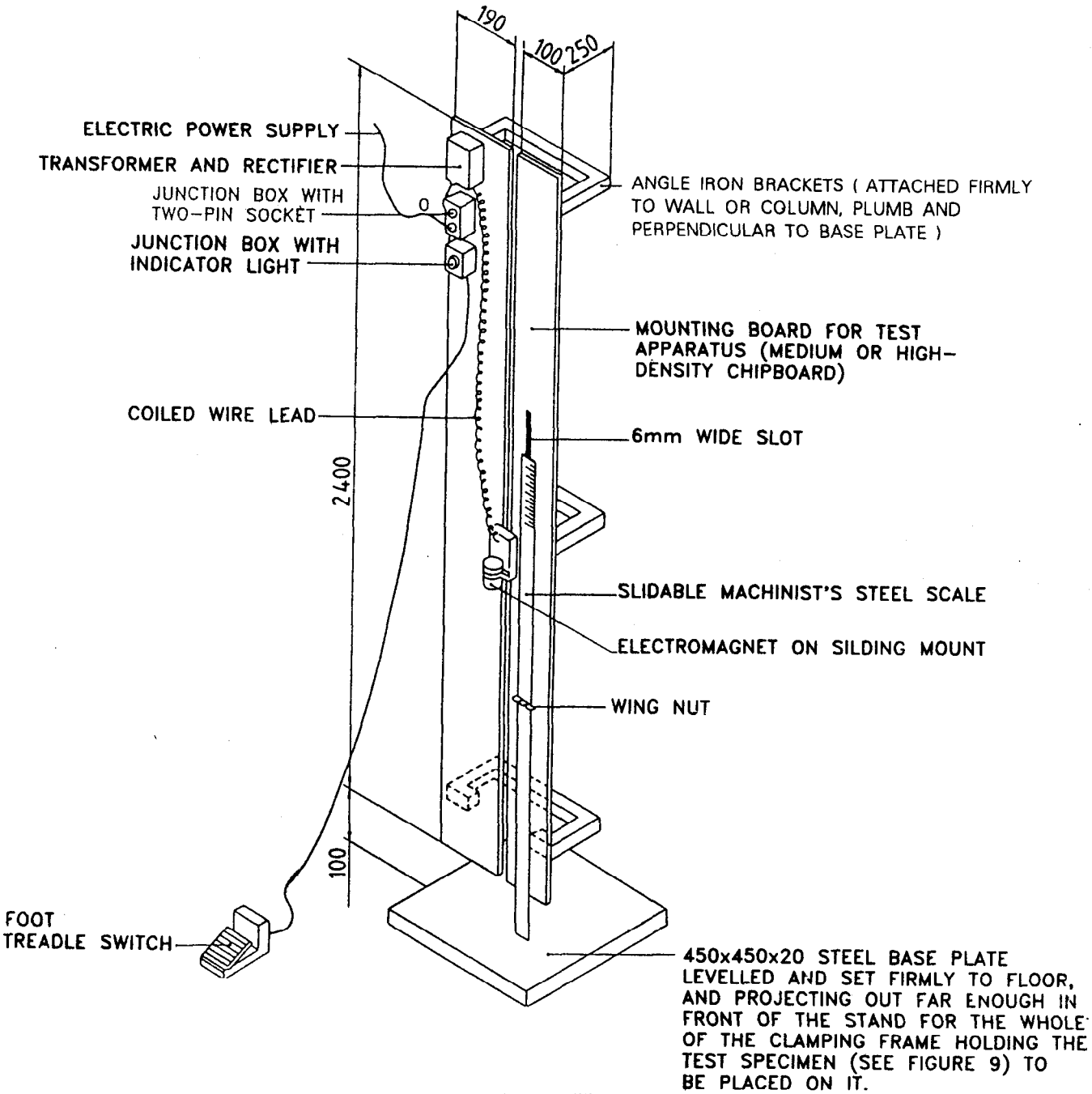
RESISTANCE TO IMPACT BY LARGE DIAMETER BALL (SELF SUPPORTING COMPACT LAMINATES)

J-1 GENERAL

A specimen from the sheet under test is covered with a sheet of carbon paper and subjected to the impact of a steel ball which is allowed to fall from a known height. Impact resistance is expressed as the maximum drop height which can be achieved without incurring visible surface cracking or producing an imprint greater than a specified maximum diameter.

J-2 APPARATUS

J-2.1 Free-fall Test Apparatus, of the type shown in Fig. 10 or an equivalent which will produce the same result.



All dimensions in millimetres.

FIG. 10 RESISTANCE TO IMPACT BY LARGE DIAMETER BALL

J-2.2 Polished Steel Ball, of mass 324 ± 5.0 g and diameter 42.8 ± 0.2 mm, having no damaged or flattened areas on its surface.

J-2.3 Specimen Clamping Frame, conforming to Fig. 11.

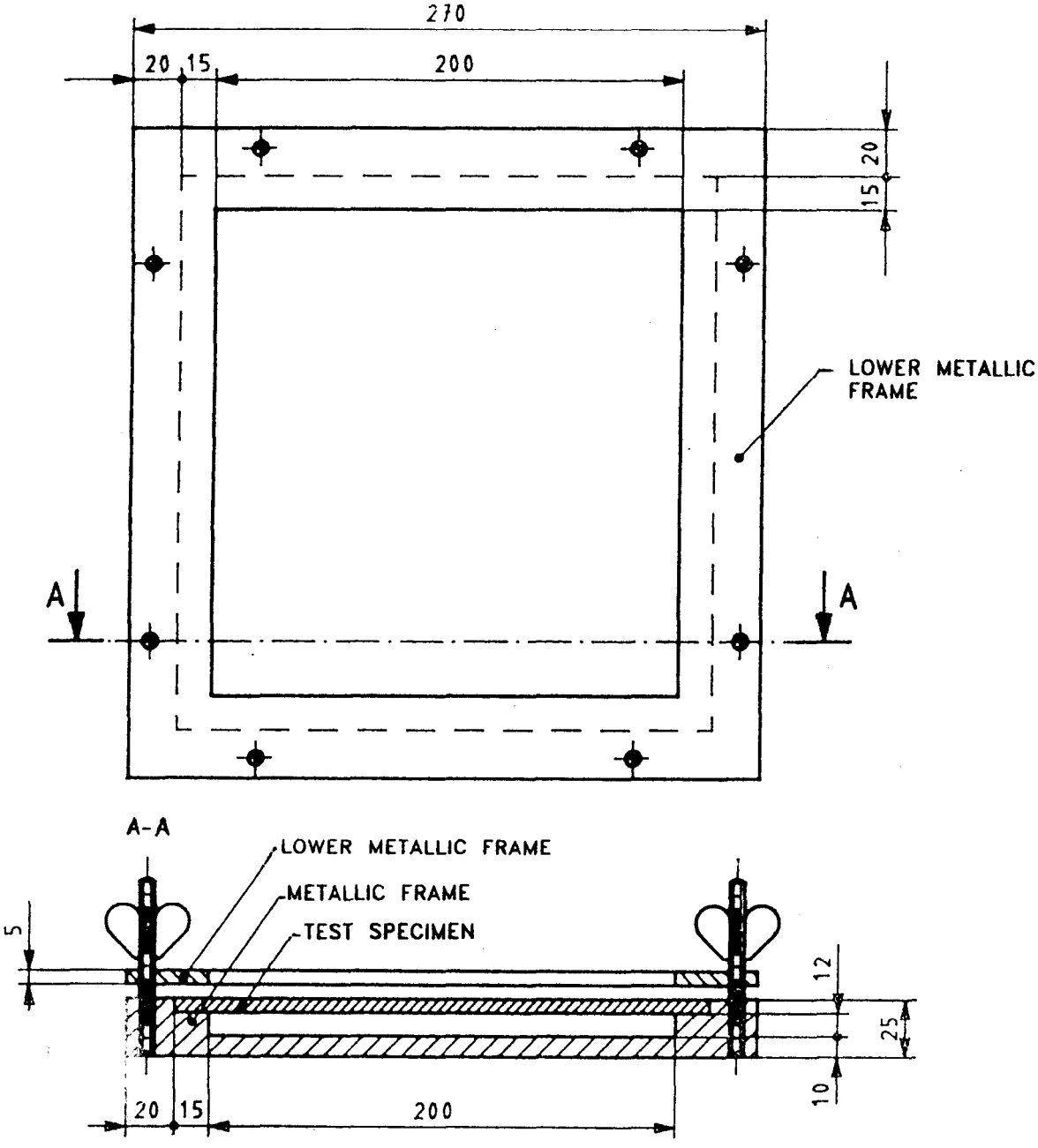
J-3 TEST SPECIMENS

The test specimens shall be 230 ± 5 mm square. The thickness is that of the sample under test, but must not be less than 5.0 mm.

J-4 PROCEDURE

The test shall be carried out in the laboratory atmosphere and in cases of dispute it shall be carried out at 27 ± 2°C.

Clamp the test specimen in the clamping frame **J-2.3**



All dimensions in millimetres.

FIG. 11 CLAMPING FRAME

and place the assembly on the solid base of the free-fall test apparatus in such a position that the ball will strike the specimen near to its centre.

Cover the specimen with a sheet of carbon paper with its coated face in contact with the decorative surface. Adjust the height scale so that its base is touching the face of the test specimen.

Position the electromagnet at any arbitrary height (the specification limit for the material under test is a useful starting point).

Place the steel ball on the energized electromagnet. Operate the release mechanism so that the ball falls on the specimen, catching the ball on the first rebound so that multiple impacts do not occur.

Examine the impact spot. If cracking is evident, or the carbon imprint is greater than the diameter specified, lower the electromagnet and repeat the test. If no cracking is evident and the imprint is smaller than the specified diameter, raise the electromagnet and repeat the test. The distance between points of impact, and between points of impact and the edge of the test specimen shall be at least 50 mm. For referee purposes only one impact per test specimen shall be made.

Repeat the above procedure as necessary to determine the impact resistance which is defined as the maximum height for which no visible surface cracking or imprint greater than the specified diameter occurs in five successive strikes.

ANNEX K

[*Table 7, Sl No.* (viii)]

RESISTANCE TO CRACKING (THIN LAMINATES)

K-1 GENERAL

Rigidly clamping a test specimen taken from the sheet under test in a steel fixture under slight curvature with the decorative face in tension. Imposition of additional stress by heating the clamped specimen at 80°C for 20 h, and assessment of the resistance to cracking by visual examination.

K-2 APPARATUS

K-2.1 Clamping Device, as shown in Fig. 12.

K-2.2 Conditioning Chamber, with a standard atmosphere of 27 ± 2°C and relative humidity 65 ± 5 percent.

K-2.3 Electrically Heated Oven, provided with air circulation and capable of being controlled at 80 ± 2°C.

K-2.4 Hand Lens, with approximately 6 x magnification.

K-2.5 Lighting, of intensity 800 to 1 000 lx.

K-3 TEST SPECIMENS

The test specimens shall be 120 ± 2 mm x 50 ± 2 mm and of the thickness of the sheet under test. The lengthwise direction of the specimen shall coincide with the direction of the greatest change in dimensions as determined according to Annex F or Annex G. Two specimens shall be used.

K-4 PROCEDURE

Precondition the test specimen for 48 h at 27 ± 2°C and 65 ± 5 percent relative humidity before testing.

Clamp the specimen at 27 ± 2°C with the decorative side uppermost (that is, in tension) in the clamping device (*see* **K-2.1**). It is essential that the specimen does not slip in the clamp during the test.

Transfer the clamped specimen to the oven (*see* **K-2.3**), controlled at 80 ± 2°C and leave for 20 ± 1 h.

After removal from the oven and cooling to ambient temperature with the test specimen still clamped in position, examine the surface with the naked eye, corrected if necessary, and under 6 x magnification (*see* **K-2.4**) for the presence of any cracking. The light intensity during the examination shall be 800 to 1 000 lx.

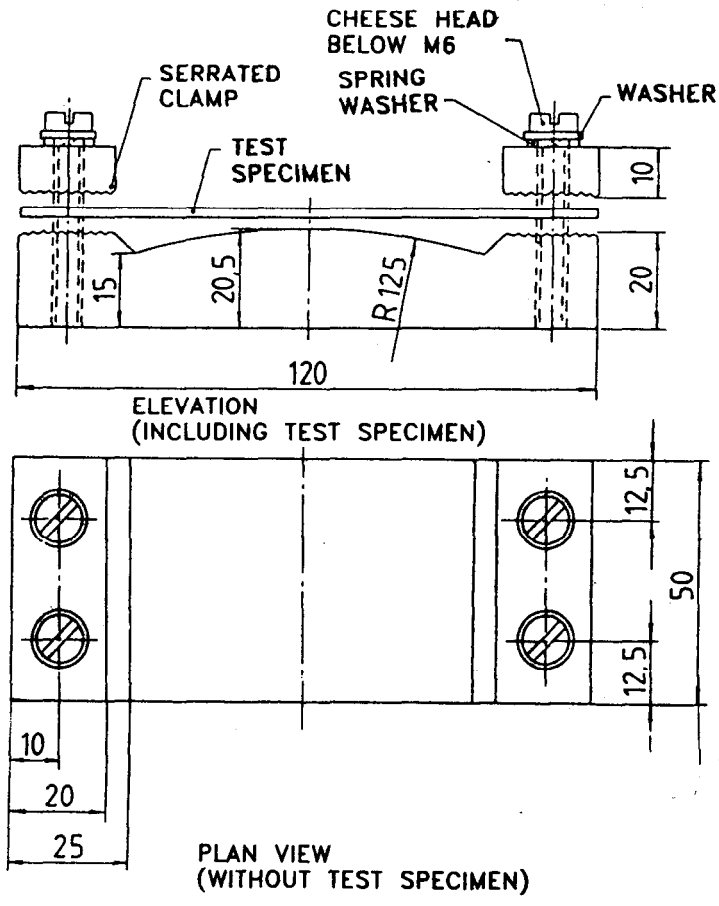
Carry out the test on both specimens.

K-5 EXPRESSION OF RESULTS

Express the result of the examination according to the following rating scale:

Degree 5 : Decorative surface unchanged from as received condition, no hariline cracks.

Degree 4 : Hairline cracks only visible under 6 x magnification, irregularly distributed across the surface.



All dimensions in millimetres.

FIG. 12 STEEL CLAMPING DEVICE FOR TESTING RESISTANCE TO CRACKING
(Coefficient of linear thermal expansion = 11 x 10^{-6} K^{-1})

Degree 3 : In addition to degree 4 faults, cracks (normally parallel to the short edge of the specimen) visible to naked eye, corrected if necessary.

Degree 2 : A gaping crack which may extend right across the specimen.

Degree 1 : Specimen broken into separate parts.

ANNEX L

[*Table 7, Sl No.* (ix)]

RESISTANCE TO SCRATCHING

L-1 GENERAL

The minimum load applied to a diamond scratching point of defined geometry, which produces a continuous surface mark visible to the naked eye, corrected if necessary, is the resistance to scratching of the decorative laminated sheet under test.

This minimum load is determined by applying successively decreasing loads to the diamond point and examining the marks produced.

L-2 APPARATUS

L-2.1 Scratch Testing Apparatus (*see* Fig. 13) consisting of the following parts.

L-2.1.1 Stand with a device to indicate the horizontal for example a spirit level.

L-2.1.2 *Freely Rotating Supporting Turntable* (A), for the test specimen. This shall rotate about a vertical axis without play and is preferably motor driven. The rotational frequency shall be 5 ± 1 r/min. Rotation by hand, within the speed range is permissible but uniform speed is essential.

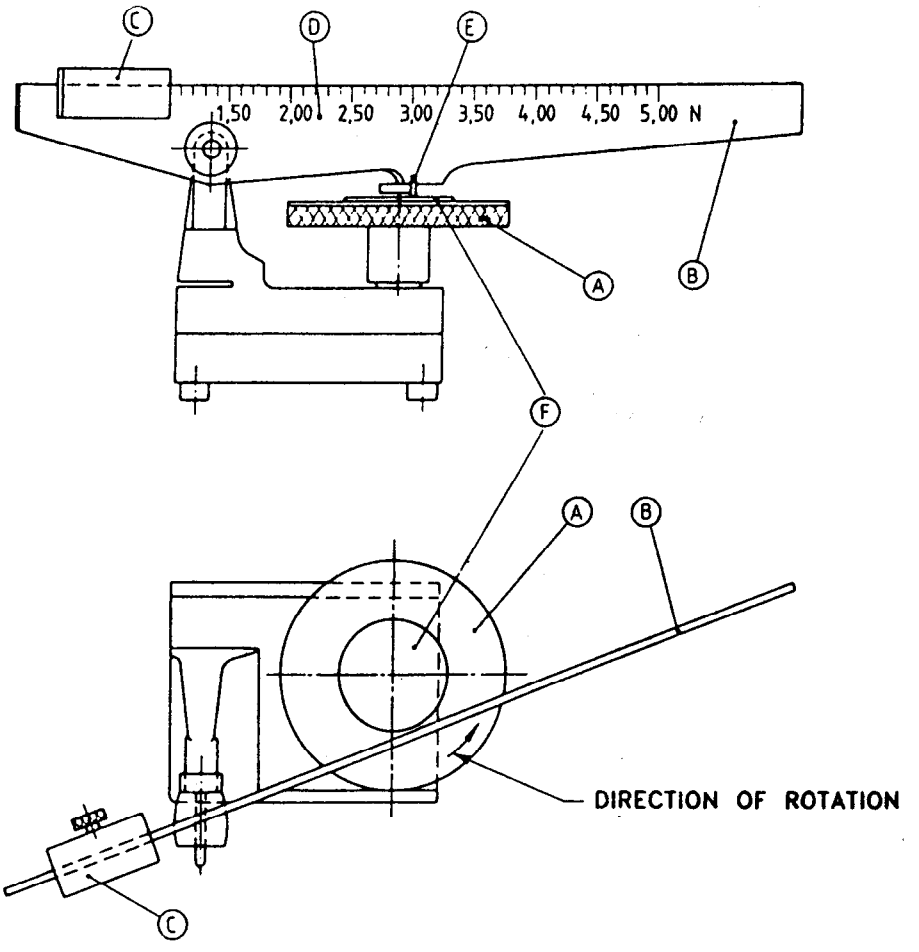


FIG. 13 TYPE OF APPARATUS FOR MEASURING THE RESISTANCE TO SCRATCHING

L-2.1.3 *Arm* (B), carrying the holder for the diamond mounted on a ball bearing with a horizontal axis. The height of this axis shall be adjustable so that the arm is exactly horizontal when the scratching point rests on the test specimen.

L-2.1.4 *Means of Applying a Known Load*, with an accuracy of ± 0.01 N to the scratching point with weights (C + D).

L-2.1.5 *Hemispherical Diamond Scratching Point* (E), with a point radius of 0.090 ± 0.003 mm and an included angle of 90° ± 1° (*see* Fig. 14). The diamond shall be mounted in the holder with the flat part on the leading side of the shank facing the working direction. Diamonds for use shall be certified by the Darmstadt laboratory through the manufacturer and shall also be standardized before use as specified in L-3[1].

[1] Diamond points conforming with these dimensions and profile are available from CIEWEINZ, Indusrie Edelstein Fabrik-Post Fach 2470-D6580 IDAR-OBERSTEIN and certified by the Darmstadt Laboratory.

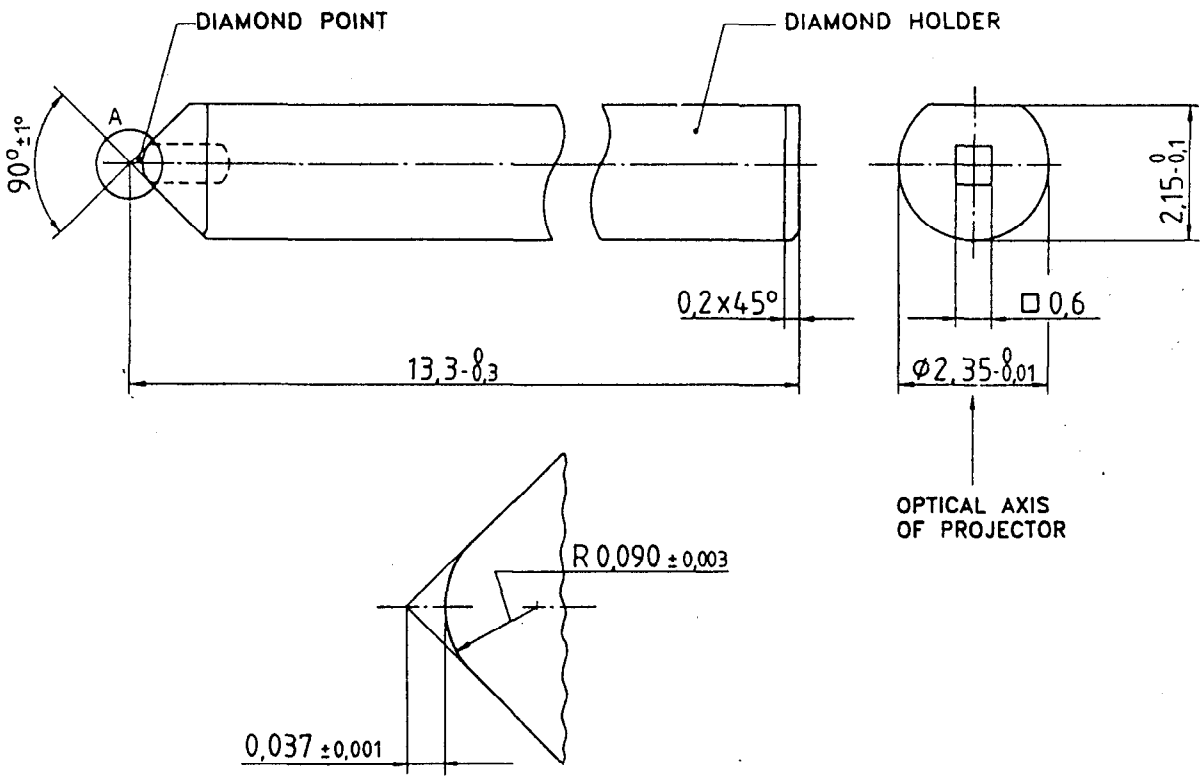
L-2.1.6 *Clamping Disc* (F), to keep the test specimen flat.

L-2.2 Viewing Enclosure, having a matt black interior and a light source (defined below) located at the top. Its dimensions shall be such that the test specimen is located vertically below the light source and at a distance of 600 mm. An aperture in the front shall allow inspection of the test specimen at various angles from a distance of 400 ± 10 mm. A diagram of a suitable enclosure is shown in Fig. 15.

The light source consists of a 100 W frosted bulb mounted in a white reflector having an aperture of approximately 140 mm diameter and processing an illumination of 800 to 1 000 lx at the specimen surface.

L-2.3 Conditioning Chamber, with a standard atmosphere of 23 ± 2°C and relative humidity 50 ± 5 percent.

L-2.4 Viewing Mash (*see* Fig. 16) made from thin flat opaque sheet material such as thin metal sheet or plastic card.



NOTE — The crystal axis of the diamond shall be parallel to the longitudinal axis of the diamond holder.

All dimensions in millimetres.

FIG. 14 SCRATCHING POINT

L-3 STANDARDIZATION OF THE DIAMOND POINT

Use a disc cut from poly (methyl methacrylate) cast sheet of minimum thickness 3 mm (4 mm preferred). Fasten the disc to the supporting table instead of the laminate. Apply loads of 1.5 to 4.0 N in steps of 0.5 N in turn and rotate the disc at 5 ± 1 r/min.

The high molecular weight cast poly (methy methacrylate) shall be vacuum predried 24 h at 80°C and shall have a Vicat softening temperature of at least 112°C.

Make one complete revolution for each load. Measure the depth of penetration with a suitable measuring apparatus at four points spaced 90° apart on the same scratch and calculate the arithmetical mean depth for each load.

Diamonds which give a penetration depth of 4 µm or more for a load of 4.0 N are unsatisfactory. Only diamonds which give penetration values as defined by the limit curves shown in Fig. 15 shall be used to test decorative laminates.

Any irregularity in the curvature of the diamond point shall cause it to be rejected and all diamond points used shall be rechecked after each tests.

L-4 TEST SPECIMEN

Cut a specimen of the shape and dimensions shown in Fig. 18 from the sheet under test.

Wipe the specimen surface using cotton fabric impregnated with a solvent such as acetone. It is important that, once cleaned, the surface is not fingered in the test area.

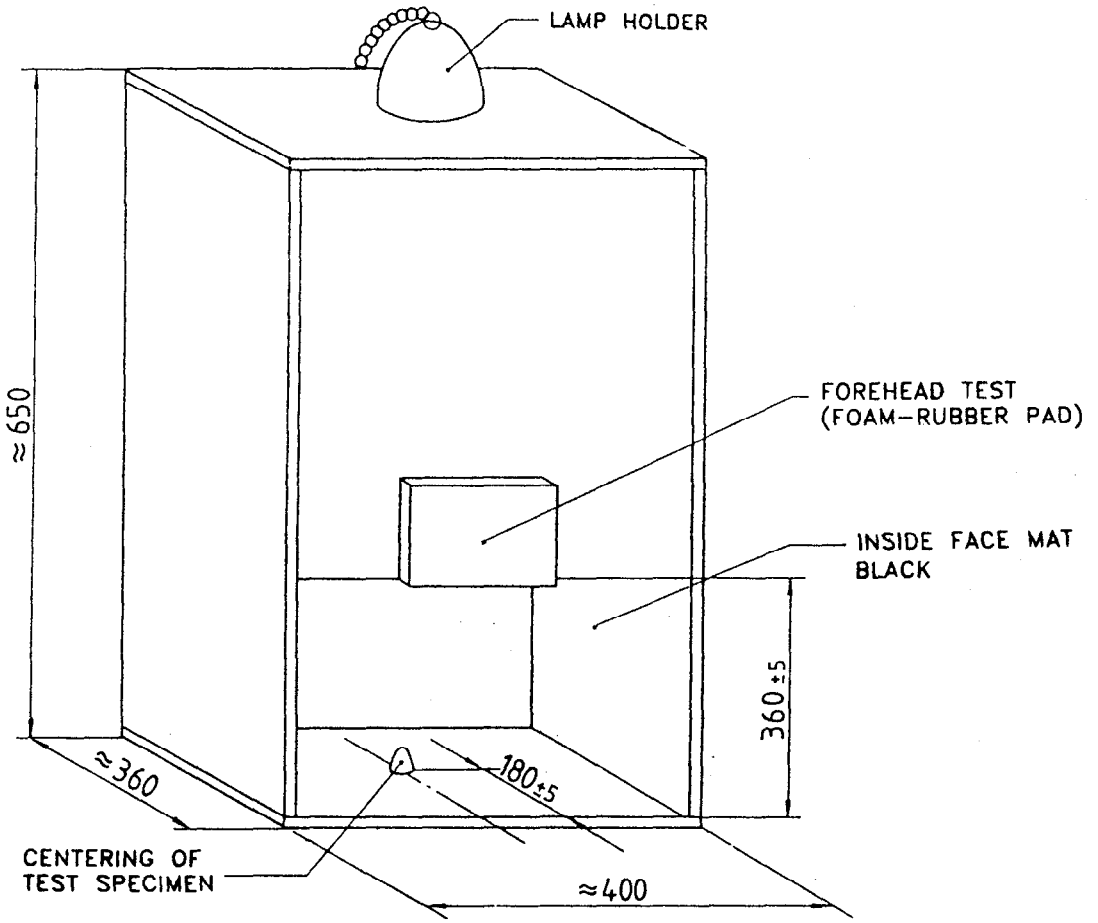
Before making the scratch test, store the specimen for 4 days in the standard atmosphere specified in **L-2.3**.

L-5 PROCEDURE

Make sure that the stand of the test apparatus is standing horizontally.

Adjust the height of the arm (B) so that it is horizontal when the diamond point rests on the test specimen.

Start the test with a load of 5.0 N. Place the arm (B) in a vertical position. Fix the test specimen with the locking disc (F) and secure it correctly to avoid any slipping.



All dimensions in millimetres.

FIG. 15 EXAMPLE OF SUITABLE VIEWING ENCLOSURE

Lower the arm (B) and place the diamond point in contact with the test specimen, taking care to avoid any impact.

Start rotating the turntable anticlockwise for a complete revolution at a uniform rotational frequency of 5 ± 1 r/min.

Stop the turntable and inspect the specimen. If a continuous mark is visible at a load of 5.0 N, continue the test using other tracks on the test specimen concentric with the first and spaced at least 2 mm apart, decreasing the load in increments of 0.5 N down to a load of 2.0 N.

If a continuous mark is visible at a load of 2.0 N, continue testing by reducing the load in 0.25 N increments. For loads below 1.0 N, continue testing by reducing the load in 0.10 N increments.

If no continuous mark is visible at a load of 5.0 N, slide the moveable load (C) back to zero, add a fixed load of 5.0 N to the arm (B) and continue testing by adjusting the moveable load to increase the total load in increments of 0.5 N.

If a large number of tracks is required to determine the end point, it may be necessary to continue the test on a second test specimen taken from the same sheet.

Place the scratched samples in a standard atmosphere as specified in **L-2.3** for 24 h before final inspection.

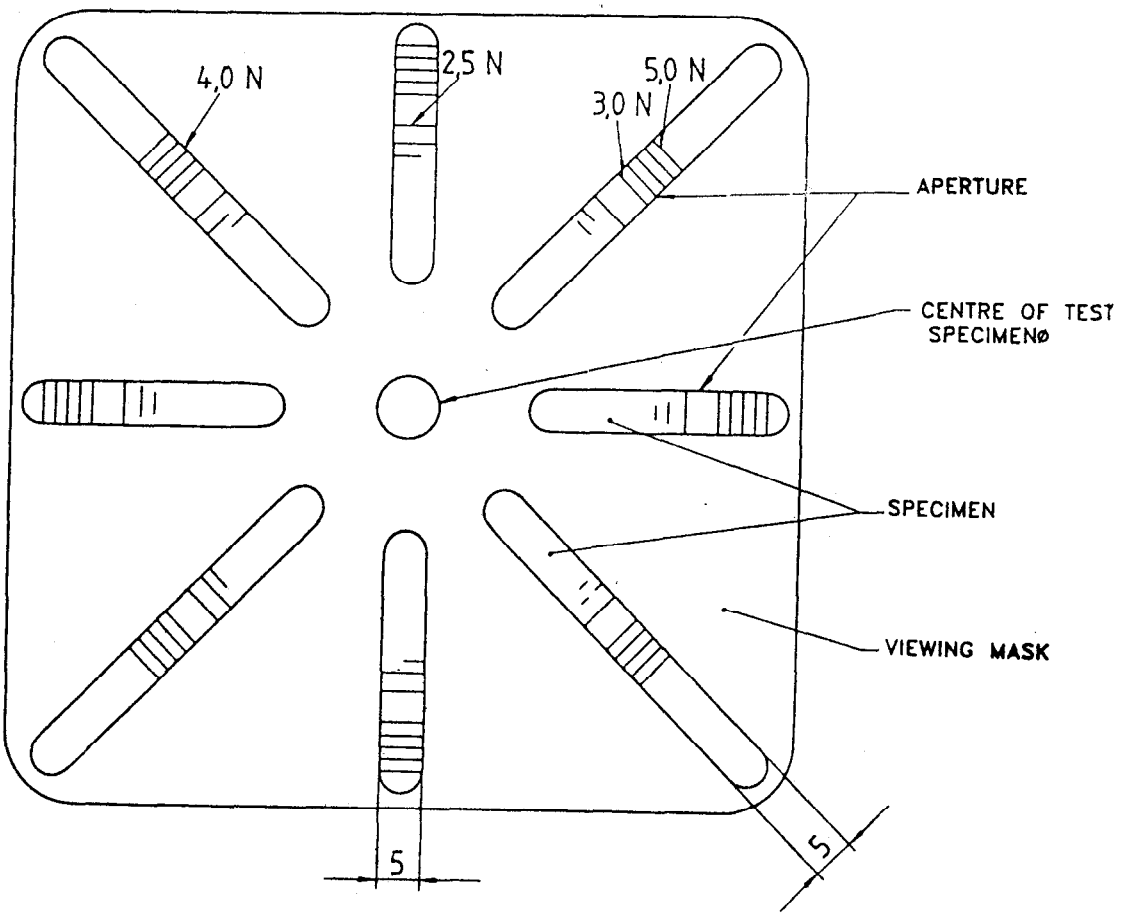
Clean the surface of the test specimen. With the mask in place on the surface of the specimen, place specimen and mask on the viewing point in the viewing enclosure with one aperture of the mask in the 12 o'clock position. Tilt at any angle without rotating the specimen or mask, and observe each aperture in turn with the naked eye, corrected if necessary.

NOTE — In judging the lowest load producing a continuous mark, care must be taken to ensure that the mark selected as the end point is truly continuous in all eight apertures in the viewing mask. The operator should guard against mentally bridging gaps in the marks.

L-6 EXPRESSION OF RESULTS

Record the minimum load giving a continuous mark visible after 24 h in the standard atmosphere. An example of a test result of 2.5 N is shown in Fig. 16.

In cases of dispute, three observers shall view the specimen and report their results independently. The final result shall be the average of the three reported values.



NOTE — The result here is 2.5 N.
All dimensions in millimetres.

FIG. 16 EXAMPLE OF SCRATCHING TEST

ANNEX M

[*Table 7, Sl No.* (x)]

RESISTANCE TO STAINING

M-1 GENERAL

Test specimens are left in contact with a series of staining agents which are likely to be encountered in everyday use. The time and conditions of contact are specified for each staining agent. At the end of the specified contact period, the specimens are washed and examined for residual surface marks.

If the product under test meets specification requirements when tested with each of the six materials marked with an asterisk, then it is deemed to comply with the specification for stain resistance. The other test materials are included for information only. In the case of a specific complaint, the material in question (selected from Group 1, 2 or 3) shall be used to verify the quality of the laminate.

M-2 STAINING MATERIALS

Test Material	*Test Conditions*	*Contact Time*
Group 1 *Acetone Trichloroethane Other organic solvents Toothpaste Hand cream Urine Alcoholic beverages Natural fruit and vegetable juices Lemonade and fruit drinks Meats and sausages Animal and vegetable fats and oils Water Yeast suspension in water Salt (NaCl) solutions Mustard Lyes, soap solution Cleaning solution 23 percent dodecylbenzolsulfonate 10 percent alkylarylpolyglyolether 67 percent water Phenol and chloramine T disinfectants Stain or paint remover based on organic solvents Citric acid (10 percent solution)	M-5 Procedure A. Apply test material at ambient temperature	16 to 24 h
Group 2 *Coffee (120 g of coffee per litre of water) Black tea (9 g of tea per litre of water) Milk (all types) Cola beverages Wine vinegar Alkaline-based cleaning agents diluted to 10% concentration with water Hydrogen peroxide (3 percent solution) Ammonia (10 percent solution of commercial concentrate) Nail varnish Nail varnish remover Lipstick Water colours Laundry marking inks Ball point inks	M-5 Procedure A. Apply test material at approximately 80°C. M-5 Procedure A. Apply test material at ambient temperature	16h

Test Material	*Test Conditions*	*Contact Time*
Group 3[1)] *Sodium hydroxide (25 percent solution) *Hydrogen peroxide (30 percent solution) Concentrated vinegar (30 percent acetic acid) Bleaching agents and sanitary cleaners containing them Hydrochloric acid based cleaning agents (< 3 percent HCl) Acid-based metal cleaners Mercurochrome (2-7 dibromo-4-hydroxyme-curifluorescein disodium salt) *Shoe polish Hair colouring and bleaching agents Iodine Boric acid Lacquers and adhesives (except fast-curing materials) Amidosulfonic acid scaling agents (<10 percent solution)	M-5 Procedure A. Apply test material at ambient temperature	10 min
Group 4 *Citric acid (10 percent solution) Acetic acid (5 percent solution)	M-5 Procedure B	20 min

[1)] Acid and alkalies, in concentrations stronger than those shown in Group 3, which can be contained in commercial cleaning agents can cause surface damage or marking, even with very short contact time. Any spillage of such materials shall be washed off immediately.

M-3 APPARATUS AND MATERIALS

M-3.1 Glass Covers (for example watch glasses), to restrict evaporation.

M-3.2 Thermometer, range 0 to 100°C.

M-3.3 Flat-Bottomed Aluminium Vessel, in accordance with **E-3.1.**

M-3.4 Hot-Plate, or other suitable heat source.

M-3.5 Horizontal Inspection Surface, illuminated by overhead and low-angle daylight or white fluorescent light of intensity 800 to 1 000 lx.

M-3.6 Wetting Agent, for example, domestic detergent.

M-3.7 Ethanol, 95 percent (*v/v*), Acetone, MEK, Tricholroethane, etc (*see* **M-5**).

M-3.8 Soft Clean Cloth

M-3.9 Hard Nylon Bristle Brush (for example nail brush).

M-4 TEST SPECIMENS

Individual test specimens of any suitable size shall be used, cut from the sheet under test.

Alternatively a single piece of laminate, large enough to allow the staining materials to be applied side by side, can be used. Keep the specimen flat during the test.

In case of dispute, specimens shall be bonded to chipboard (*see* **E-4**) particularly for procedure B.

M-5 PROCEDURES

M-5.1 Procedure A

The specimens shall be initially at ambient temperature.

Apply a small quantity (for example 2 or 3 drops) of test material to two specimens. The test material shall be at the temperature specified in **M-2.** Cover the material on one of the two specimens with a glass cover.

After the specified contact time has elapsed, if necessary remove the staining material with a suitable solvent (for example butyl acetate to remove nail varnish), then wash with water containing a suitable wetting agent (*see* **M-3.6**), and finally with ethanol (*see* **M-3.7**) or other solvents as required to clean the surface. A suitable brush (*see* **M-3.9**) may be used to remove staining material from textured surfaces.

One hour after washing, place the specimen on the inspection surface (*see* **M-3.5**) and view it from various angles at a distance of 400 mm.

M-5.2 Procedure B

The specimen shall be prepared in accordance with **E-4.**

Apply a small quantity (for example, 2 or 3 drops) of the test material to the specimen. The test material shall be at ambient temperature.

Fill the vessel (*see* **M-3.3**) with water (to within 15 mm of the top) and heat it until the water boils vigorously. Discontinue heating and immediately place the vessel containing the boiling water on the surface of the test specimen directly over the pool of test material.

After the specified contact time, remove the vessel and wash the test specimen with water containing a suitable wetting agent (*see* **M-3.6**) and then with ethanol (*see* **M-3.7**) or other solvents as required to clean the surface. A suitable brush (*see* **M-3.9**) may be used to remove staining material from textured surfaces.

One hour after washing, place the specimen on the inspection surface (*see* **M-3.5**) and view it from various angles at a distance of 400 mm.

M-6 EXPRESSION OF RESULTS

The effect on the surface of the specimen shall be expressed in accordance with the following rating scale for each of six mandatory test materials:

Rating 5 : No visible changes

Rating 4 : Slight change of gloss and/or colour, only visible at certain viewing angles

Rating 3 : Marked change of gloss and/or colour

Rating 2 : Marked change of gloss and/or colour.

Rating 1 : Surface distortion and/or blistering.

ANNEX N

[*Table* 7, *Sl No.* (xi)]

DETERMINATION OF RESISTANCE TO COLOUR CHANGE IN XENON ARC LIGHT

N-1 PRINCIPLE

Partial exposure of a test specimen taken from the sheet under test, together with standard blue wool specimens, to the light of a xenon arc lamp. Determination of the light dosage by the effect on the wool specimens and assessment of the effect on the test specimen at a specified light dosage by the contrast between exposed and unexposed portion of the specimen.

N-2 APPARATUS

N-2.1 Xenon Arc Lamp

The Xenon arc lamp emits radiation in a range which extends from below 270 nm in the ultra-violet through the visible spectrum and into the infra-red. For exposure tests, light from the lamp is filtered to reduce shorter wave-length emissions and also to remove as much of the infra-red as possible, so that radiation reaching specimens exposed to it has a spectral power distribution that closely matches sunlight. The facility may also be available to reduce shorter wavelength energy further so that an alternative spectrum, similar to that of solar radiation as received behind window glass, may be obtained. These two modes of operation are often available on the same equipment, using different filter systems.

The characteristics of xenon arcs and filters are subject to changes in use due to ageing, and they shall be replaced at appropriate intervals. Further, they are subject to changes due to the accumulation of dirt, and they shall be cleaned at appropriate intervals as agreed between the interested parties.

The irradiance at the test specimen face in the wavelength range 300 to 890 nm shall normally be 1 000 ± 200 W/m^2. If, exceptionally, other intensities are used, this shall be stated in the test report. Irradiance below 300 nm shall not exceed 1 W/m^2. The irradiance shall not vary by more than ± 10 percent over the whole test specimen areas.

N-2.2 Test Enclosure

The enclosure contains a cylindrical frame carrying specimen holders, with provision for passing air over the specimens for control of temperature. If the lamps lead to the production of ozone, it is essential to ensure that this does not come into contact with the test specimens by venting the cooling air outside the building.

NOTE — Care should also be taken to protect laboratory staff from the effects of ozone.

The lamp is so placed that the amount of radiation received by the specimen does not vary more than ±10 percent over the entire area in which the specimens are exposed.

To reduce the effect of any eccentricity in the lamp, or when more than one lamp is used in a single enclosure to increase the amount of radiation, the radiation distribution shall be improved by rotating the frame carrying the specimens around the light source and, if necessary, by periodically changing the position of each specimen vertically.

The specimen holders rotate on their own axes as well as rotating with the frame, thus exposing to the direct radiation of the light source the side of the specimen holder that was previously in the dark. This method helps to maintain a low black panel temperature on the specimens. Alternatively, dark cycles may be produced by cycling the source on and off. If either of these cycles is used, it shall be fully reported.

N-2.3 Black Panel Thermometer, to indicte the test temperature (*see* Note 1).

It consists of a blackened absorbing metal plate that approximates the absorption characteristics of a 'black body'. The plate shall be at least 4 mm thick and of a size to fit the specimen holders. The temperature of the plate is indicated by a suitable thermometer or thermocouple making good thermal contact.

The black panel thermometer is mounted in a specimen holder with the blackened metal side frame facing the lamp, and readings are taken after sufficient time for the temperature to become steady.

The black panel temperature is controlled by adjustment of the cooling air circulation (*see* Note 2).

NOTES

1 The black panel temperature represents the highest specimen surface temperature likely to be achieved. Specimens of lighter colours, and thinner specimens where some cooling from the back occurs will have lower temperatures.

2 This can be conveniently achieved by means of a thermostat whose sensor is placed in the test enclosure. When it is necessary to minimize the variation of temperature to within ±1°C, care must be taken to place the sensor in the best position so that it responds to the temperature variations as fast as possible.

N-2.4 Specimen Holders

Specimens holders may be in the form of an open frame, leaving the back of the specimen exposed, or they may provide the specimen with solid backing. They shall be made from inert materials that will not affect the test results, for example aluminium or stainless steel. Brass, steel or copper shall not be used in the vicinity of the test specimens.

The backing used may affect the results, particularly with transparent specimen, and shall be agreed between the interested parties.

N-2.5 Means of Determining Radiation Dosage

Blue dyed wool standards No. 1 to No. 7 and the grey slab for assessing change in colour.

N-3 TEST SPECIMENS

Use rectangular strips the surface dimension of which are at least 15 mm and compatible with the particular apparatus used for the exposure.

At least two specimens shall be tested. It may be necessary to use more for products where the colour is not uniform or the sensitivity to exposure is irregular. A further test specimen shall be stored in the dark and shall constitute the reference standard for assessment of colour changes.

N-4 TEST CONDITIONS

Test conditions shall be 60 ± 5°C, (50 ± 5) percent relative humidity.

N-5 PROCEDURE

Attach the specimens to the specimen holders in the equipment in such a manner that the specimens are not subjected to any applied stress.

Expose the blue dyed wool standards in a similar manner to the test specimens for determination of exposure stage.

It is desirable to vary the position of the specimen in the apparatus from time to time to reduce any local inequalities of exposure.

Expose a set of blue dyed wool standards comprising one strip each from No. 1 to No. 7 simultaneously.

Use the standards to determine the stages of radiation dosages (exposure stages) as follows by comparing the difference in colour between the exposed and unexposed blue standards with the contrast No. 4 on the grey scale. Thus, stage 1/1 is reached when standard 1 gives a contrast equal to No. 4 on the grey scale; 2/1 when standard shows similar contrast and in the same manner to stage 7/1 showing a contrast of 4 on the grey scale.

NOTE — The duration of stage 7/1 is about 1 year in natural daylight in temperature climates.

Inspect the blue standards as frequently as necessary to determine when each exposure stage is reached.

At stage 7/1, discard the blue standards, mount a second fresh standard 7 and continue exposure until this second standard 7 shows a contrast whith the unexposed standard 7 equal to No. 4 on the grey scale. This stage is designated 7/2.

Then discard the second standard 7 and mount a third fresh standard 7. Stage 7/3 is reached when this standard in turn gives a contrast of 4. Repeat this procedure as often as required, giving stages 7/4 to 7/*n*.

Exposure Stages

Stage	*Description*
1/1	Blue standard 1 to grey scale contrast 4.
2/1	Blue standard 2 to grey scale contrast 4.
3/1	Blue standard 3 to grey scale contrast 4.
4/1	Blue standard 4 to grey scale contrast 4.
5/1	Blue standard 5 to grey scale contrast 4.
6/1	Blue standard 6 to grey scale contrast 4.
7/1	First blue standard 7 to grey scale contrast 4.
7/2	Second blue standard 7 to grey scale contrast 4.
7/*n*	*n*th blue standard 7 to grey scale contrast 4.

Carry out the test using the single exposure and discontinue the exposure when blue wool standard No. 6 shows a contrast between exposed and unexposed portion equal to Grade 4 of the grey scale.

N-6 EVALUATION AND EXPRESSION OF RESULTS

Examine the contrast between exposed and unexposed portions of the test specimen and record it in terms of

grades on the grey scale.

Express the result in relation to the resistance to colour change of Blue Wool Standard No. 6 as one of the following:

Specimen Contrast (Grey Scale Grade No.)	*Resistance to Colour Change* (Blue Wool Standard No.)
> 4	> 6
4	6
< 4	< 6

ANNEX O

[*Table* 7, *Sl No.* (xi)]

DETERMINATION OF RESISTANCE TO COLOUR CHANGE IN ENCLOSED CARBON ARC LIGHT

O-1 APPARATUS

O-1.1 Enclosed Carbon Arc Lamp

The lamp comprises an arc formed between pure carbon and electrodes solid at one pole and cored at the other, and has aromatic carbon feed.

NOTE — The carbon red in normal usage need changing about every 24 h, but rods of longer life which need changing after 48 h are presently available and thus facilitates ease of running over week-ends and minimize the dark periods necessitated by the changing of carbons.

The arc is enclosed in a globe made of heat-resistant glass transmitting less than 1 percent light at 275 nm and shorter wavelengths, and approximately 90 percent from 370 nm throughout the visible spectrum.

The globe fits securely, it is clean and free from chips or cracks and it is so maintained at each change of electrodes. The characteristics of the glass filter are subject to changes in use due to ageing, and the globes shall be discarded at appropriate intervals as agreed between the interested parties and immediately when any noticeable discolouration or cloudiness (as compared with an unused globe) occurs.

It is useful to provide a means to minimize the formation of the deposits of ash from the burnt carbon on the globe. One such device uses a permanent magnet, suitably positioned at the top of the globe, which collects most of the ash.

The irradiance at the test specimen face in wavelength range 300 to 750 nm shall normally not exceed 500 W/m^2. If, exceptionally, higher intensities are used, this shall be stated in the test report. Irradiance below 300 nm shall not exceed 1W/m^2.

O-1.2 Test Enclosure

Same as that described in **N-2.2.**

O-1.3 Black Panel Thermometer

Same as that described in **N-2.3.**

O-1.4 Specimen Holder

Same as that described in **N-2.4.**

O-1.5 Means of Determining Radiation Dosage

Same as that described in **N-2.5.**

O-2 TEST SPECIMENS

Same as that described in **N-3.**

O-3 TEST CONDITIONS

Test conditions shall be 60 ± 5°C without any control of humidity.

O-4 PROCEDURE

Carry out the test using the single exposure and discontinue the exposure when Blue Wool Standard No. 5 shows a contrast between exposed and unexposed portions equal to Grade 4 of the grey scale.

O-5 EVALUATION AND EXPRESSION OF RESULTS

Examine the contrast between exposed and unexposed portions of the test specimen and record it in terms of grades on the grey scale.

Express the result in relation to the resistance to colour changes of Blue Wool Standard No. 5 as one of the following:

Specimen Contrast (Grey Scale Grade No.)	*Resistance to Colour Change* (Blue Wool Standard No.)
> 4	> 5
4	5
< 4	< 5

ANNEX P

[*Table* 7, *Sl No.* (xii)]

RESISTANCE TO CIGARETTE BURNS

P-1 GENERAL

Specimens from the sheet under test are bonded to wood chipboard to simulate service conditions and subjected to heat from burning cigarettes placed on their surfaces. The test result is expressed in terms of any resultant damage.

P-2 MATERIALS

P-2.1 Fine-Faced Wood Chipboard — 100 ± 5 mm square, 18 to 20 mm nominal thickness ± 0.3 mm, density 650 to 700 kg/m^3 and moisture content (9 ± 2) percent.

P-2.2 Urea-Formaldehyde Adhesive — containing approximately 15 percent filler, to an adhesive with equivalent performance.

P-2.3 Pale Tobacco Cigarettes Without Filters — from each of three well-known brands, each with a mass of 1.0 to 1.1 g for a length of 70 mm and with the tobacco evenly distributed over its length. They shall be kept in the standard atmosphere (*see* **P-4**) for at least 24 h before being used for the test.

P-2.4 Ethanol — 95 percent (*v/v*).

P-2.5 Soft Cloth

P-3 TEST SPECIMEN

The test specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (*see* **P-2.1**) using the specified adhesive (*see* **P-2.2**). The bonded specimen shall be kept in the standard atmosphere (*see* **P-4**) for at least 7 days before being used for the test. Three specimens 100 ± 5 mm square shall be prepared.

P-4 APPARATUS

Conditioning chamber, with a standard atmosphere of 27 ± 2°C and relative humidity of (65 ± 5) percent.

P-5 PROCEDURE

Ignite one cigarette from each of the brands and smoke it to consume a length of approximately 10 mm.

Place one of the burning cigarettes in full-length contact with the horizontal surface of a test specimen in a draught-free area so that the glued seam of the cigarette is not in contact with the specimen. Allow the cigarette to continue burning until a further 20 mm length is consumed. If the cigarette goes out before this occurs, repeat the test.

Follow the same procedure with the other two cigarettes.

Examine the surface of each specimen to determine whether the combustion residue can be removed with a cloth moistened with a alcohol and whether the cleaned surface reveals any changes such as discolouration, cracks or blisters.

The effect on the surface of the specimen is expressed in accordance with the following rating scale:

Rating 5 : No visible change.

Rating 4 : Slight change of gloss only visible at certain viewing angles and/or slight brown stain.

Rating 3 : Moderate change of gloss and/or moderate brown stain.

Rating 2 : Severe brown marks, but no destruction of surface.

Rating 1 : Blistering and/or cracks.

ANNEX Q

[*Table* 7, *Sl No.* (xii)]

RESISTANCE TO CIGARETTE BURNS (SIMULATED TEST USING ELECTRIC HEATER)

Q-1 GENERAL

Subjection of test specimens taken from the sheet under test, and bonded to wood chipboard to simulate service conditions, to local radiant heat from an electric heater. Assessment of the resistance of the material in terms of the duration of exposure needed to cause visible damage.

Q-2 MATERIALS

Q-2.1 Fine-faced Wood Chipboard, 18 to 20 mm nominal thickness ± 0.3 mm, density 650 to 700 kg/m^3 and moisture content (9 ± 2) percent.

Q-2.2 Urea-formaldehyde Adhesive, containing approximately 15 percent filler, or an adhesive with equivalent characteristics.

Q-3 APPARATUS

Q-3.1 Heating Element Support (C) (*see* Fig. 19), consisting of electrically non-conducting laminated sheet.

Q-3.2 Heating Element (D) (*see* Fig. 19), of iron-

aluminium alloy, having the following characteristics:

— cross-section of flat wire : 1.6 mm x 0.25 mm,
— wire length : 480 mm, and
— electrical resistance : 1.8 ± 0.1.

This heating element shall be in the form of a spiral (outside diameter approximately 15 mm, external ring not included).

Q-3.3 Adjustable Mounting, for the heating element (*see* Fig. 19), consisting of an externally threaded brass sleeve located vertically by two knurled brass nuts.

Q-3.4 Calibration Block (E) (*see* Fig. 18), of electrically insulating laminate, on which are mounted:

a) a disc support (F), made from homogeneous heat insulating diatomaceous-earth/asbestos sheet material of bulk density 512 to 576 kg/m^3 and thermal conductivity 0.10 to 0.12 W/(m.K.) in the temperature range 0 to 300°C.
b) a stainless steel disc (G), to the bottom of which is silver-soldered an iron constantan thermocouple. The surface of the disc shall be highly polished and flat, and shall be in the same plane as the surface of the disc support. The disc shall be clamped firmly on its support.

Q-3.5 Glass Windowed Cover (H), (*see* Fig. 21).

Q-3.6 Stopwatch

Q-3.7 Power Source, producing a constant current for the heating element. This source may be either:

a) a series of well-charged accumulators with elements in good condition, able to provide the heating element with a power greater than 20 W, or
b) an electrical unit powered from the mains supply.

Q-3.8 Control Circuit (J), to adjust and maintain the power consumption of the heating element with an accuracy of ± 0.1 percent. Measurements are made by means of a voltmeter and an ammeter. A circuit for use with a 115 V mains supply is shown in Fig. 22.

Q-3.9 Potentiometer, for measuring the temperature of the stainless steel disc.

Q-3.10 Cotton Wick, saturated with liquid paraffin.

Q-3.11 Conditioning Chamber, with a standard atmosphere of 27 ± 2°C and relative humidity of (65 ± 5) percent.

Q-4 TEST SPECIMENS

The test specimen shall be prepared by uniformly bonding a piece of the sheet under test to the wood chipboard (*see* **Q-2.1**) using the specified adhesive (*see* **Q-2.2**). The bonded specimen shall be kept in the conditioning chamber (*see* **Q-3.11**) for at least 7 days before being used for the test. Three specimens, 230 ± 2 mm x 80 ± 1 mm, shall be prepared.

Q-5 PROCEDURE

Q-5.1 Calibration

The bottom of the heating element shall be flat. Adjust the heating element so that the distance between its lower side and the disc is 8 ± 0.1 mm (without including the edging ring).

Stand the heating element support (**Q-3.1**) on its end and adjust the power input to approximately 20 W.

Allow to heat for 30 min.

Blacken the stainless steel disc with the flame from the burning paraffin-saturated wick to produce a uniform coating of carbon. The insulating support shall be kept clean.

Place the heating element support on the calibration block so that the heating element covers the disc.

Cover the assembly to exclude draughts.

Allow the heating element to warm the disc for 10 min so as to produce a final temperature of approximately 285°C.

It is not necessary to record the intermediate temperatures. If the final temperature is not 285°C, adjust the power input. Lift up the heating element support without disconnecting the power supply and stand it in the vertical position.

Keep the calibration block under the cover until the disc cools to 40 ± 0.5°C then replace the heating element support on the calibration block and cover immediately.

Start the stopwatch when the heating element support and the calibration block touch. Measure and record the temperature at 1 min intervals for a period of 10 min.

The calibration curve shall be within the following limits:

Time min	*Temperature* °C
0	40 ± 0.5
1	215 ± 3
2	251 ± 3
3	265 ± 3
4	274 ± 3
5	279 ± 3
6	282 ± 3
7	284 ± 3
8	285 ± 3
9	286 ± 3
10	287 ± 3

During the calibration, the current shall not fluctuate. If necessary, adjustment shall be made and further calibration carried out until the desired curve is obtained (each time allowing the calibration block to cool to 40 ± 0.5°C).

When the calibration curve is obtained, proceed with the test.

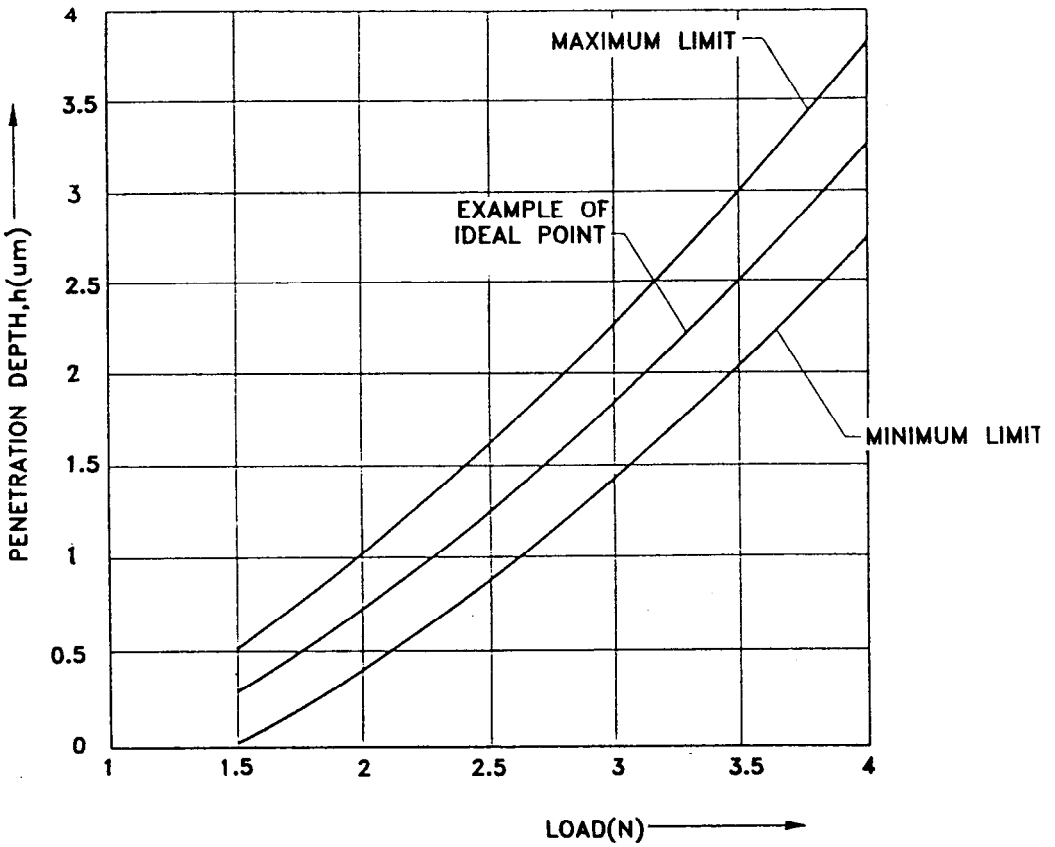
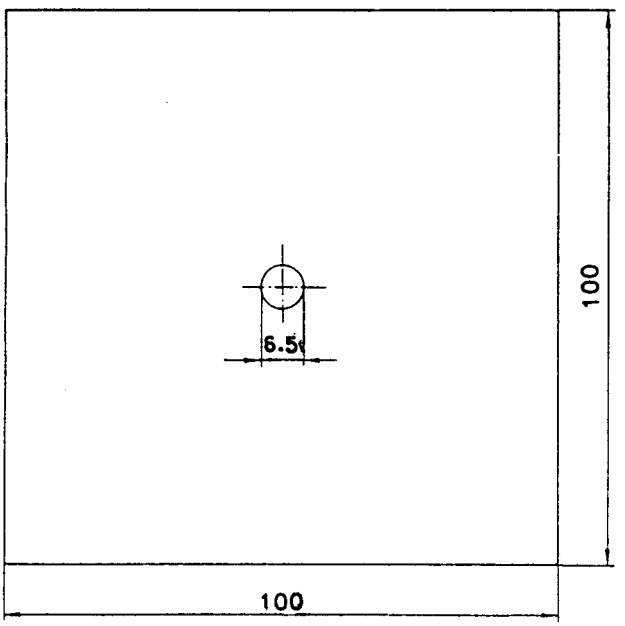
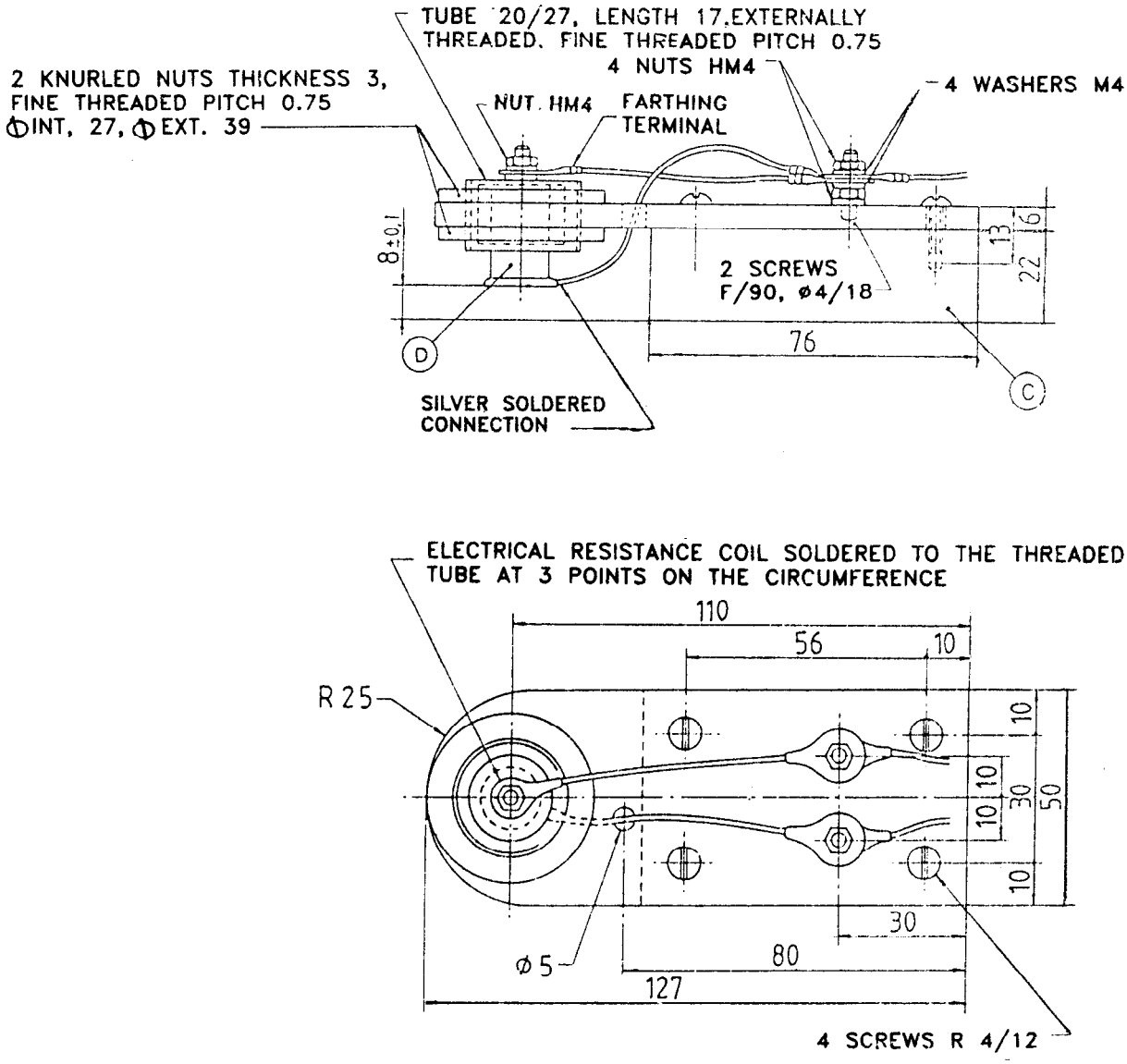


FIG. 17 LIMIT CURVES FOR STANDARDIZATION OF DIAMOND POINT



All dimensions in millimetres.

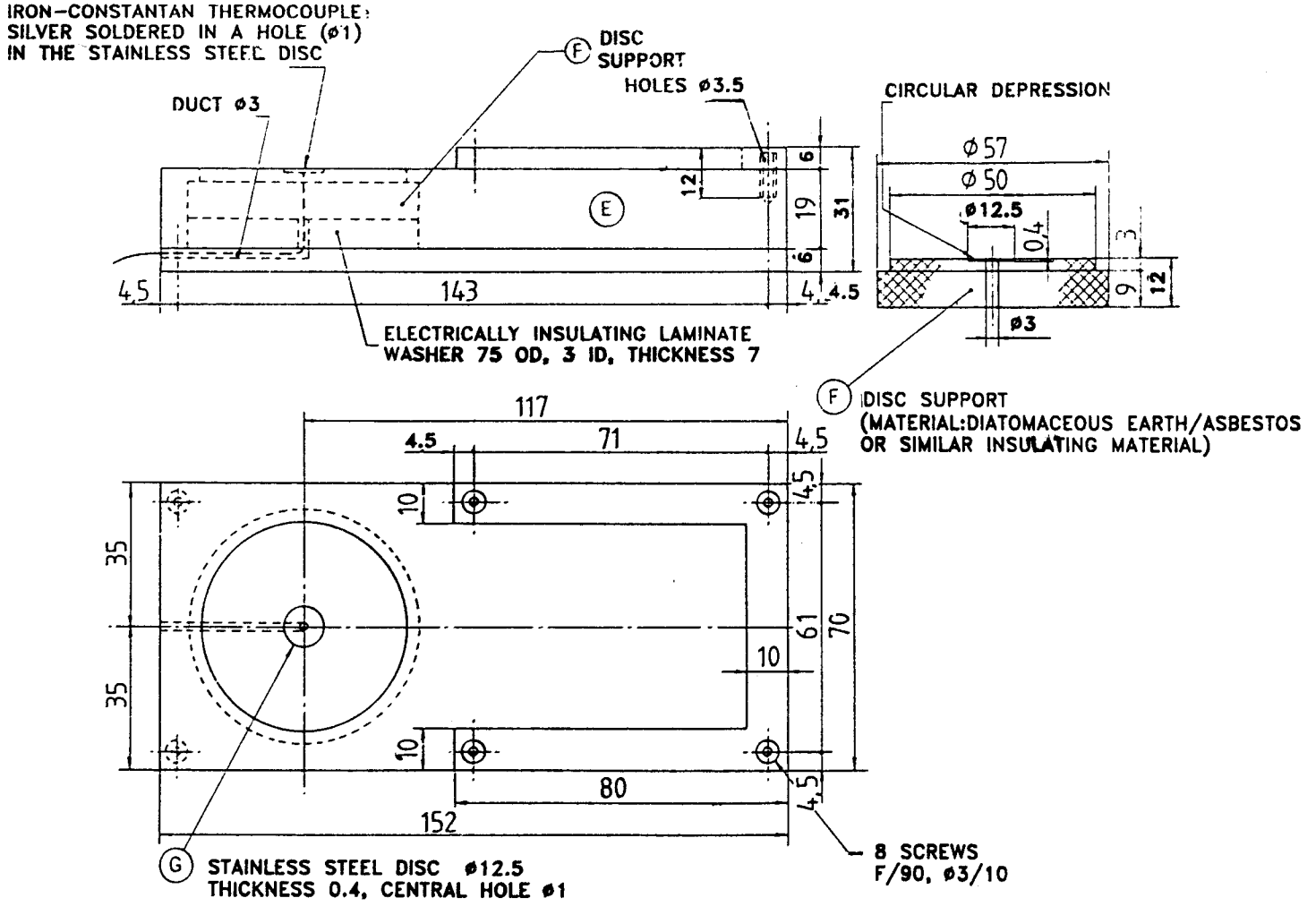
FIG. 18 TEST SPECIMEN



Materials : Electrically insulating laminate, screws and threaded tube.

All dimensions in millimetres.

FIG. 19 HEATING ELEMENT SUPPORT (C) FOR CIGARETTE TEST



All dimensions in millimetres.

FIG. 20 CALIBRATION BLOCK (E) FOR CIGARETTE TEST

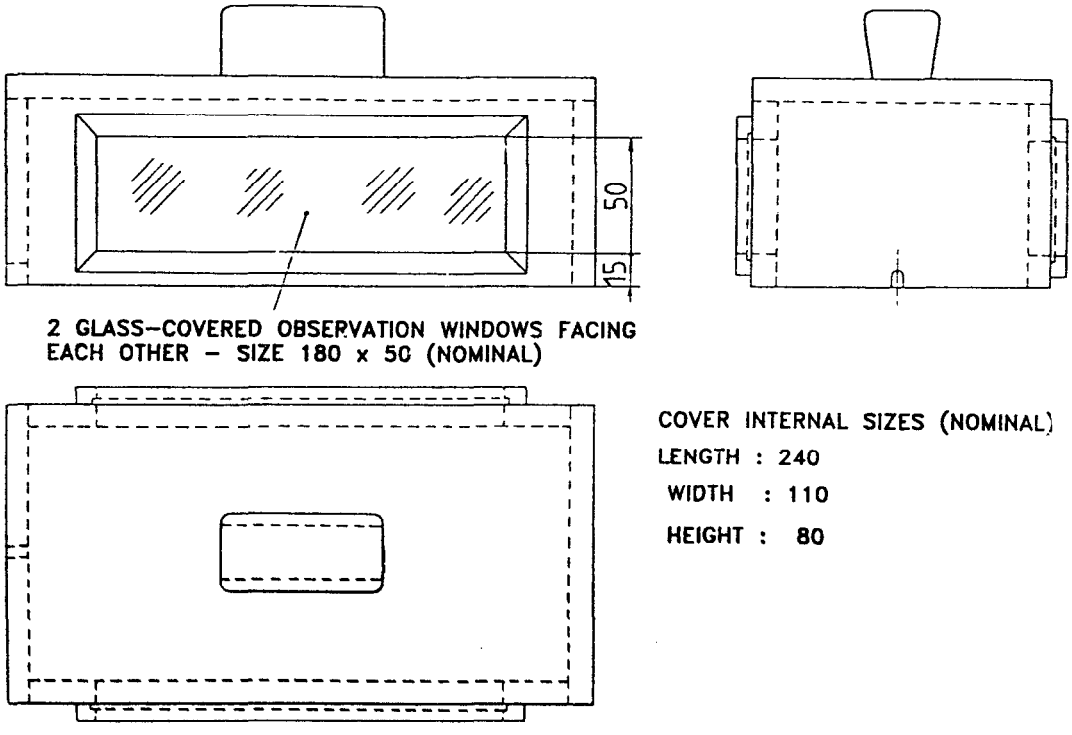


FIG. 21 APPARATUS COVER (H) FOR CIGARETTE TEST

Q-5.2 Test

Position the heater on the specimen so that the resistance coil is at least 40 mm from the nearest edge, start the timer at the same time, and cover the assembly with the enclosure within 2 s.

Continue the test until the specimen fails or for 10 min. Failure is defined for this purpose as blistering, charring, permanent discolouration or crazing. If failure occurs in less than 10 min record the time of failure.

The test shall be invalid if

a) the heating element is moved during the test or is not positioned 8 ± 0.1 mm above the surface of the specimen;

b) the power input to the heating element does not remain constant at the level of last calibration;

c) the cover is removed at any time during the test.

Repeat the test on further specimens to obtain three valid results.

The calibration of the heating element shall be checked at least once per hour, and at any time that irregular results or an unsteady power input are observed.

Q-6 EXPRESSION OF RESULTS

Report the result as the average of the three times to failure, in seconds.

If one or two tests are discontinued without failure, their results shall be taken as 600 s for the purpose of calculating the average. If all three tests are discontinued without failure, the result shall be recorded as "no failure in 600 s".

ANNEX R

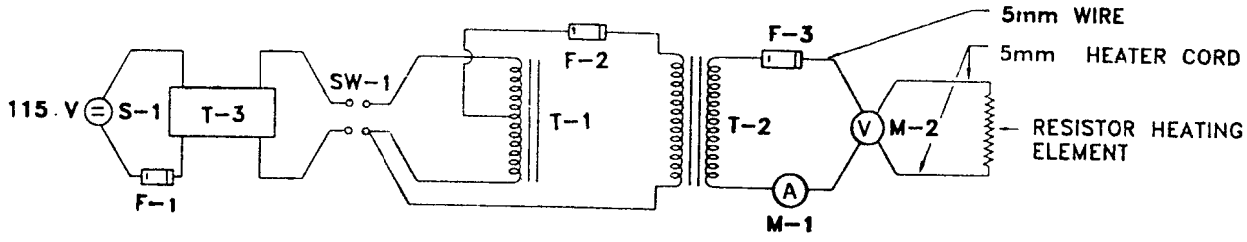
[*Table 7, Sl No.* (xiii)]

FORMABILITY (METHOD A)

R-1 GENERAL

The test specimen is subjected to radiant heat on its decorative face until the reverse side reaches a predetermined temperature. It is then formed in a jig to a specified radius and angle, and cooled before examining for signs of failure on the bend line.

The test is carried out with specimens cut in the longitudinal and transverse directions of the sheet and with the decorative face on both the outside and inside of the bend.



List of Items

Symbol	*Function*	*Description*
F-1	Line fuse Line fuse mounting	5 A
F-2	Control fuse Control fuse mounting	1 A Extractor post
F-3	Power fuse Power fuse mounting	10 A Extractor post
M-1	Ammeter	0.10 A alternating current
M-2	Voltmeter	0 to 6 V alternating current (452/V)
S-1	Line connector	Male connector
SW-1	Line switch	DPST toggle switch
T-1	Autotransformer	Primary : 115 V Seconday : 0.130 V; 5 A
T-2	Power transformer	Primary : 115 V; Secondary : 5.25 V; 22 A
T-3	Voltage stabilizer	100 V.A; 115 V output ±1 percent

FIG. 22 WIRING DIAGRAM OF CONTROL CIRCUIT (J) FOR CIGARETTE TEST

This method is an alternative test method to be used when so designated by the national authority or by agreement between the supplier and the purchaser.

R-2 APPARATUS

R-2.1 Radiant Heater, consisting of two electrically heated sheathed elements of 1 500 W total rating, mounted parallel and in a horizontal plane in a metal-lined trough approximately 110 mm wide and 125 mm deep (inside dimensions), the height of the heating elements above the bottom of the trough being such that, when a test specimen is laid across the trough, the test specimen is at a distance of 76 ± 1.0 mm above the heating elements. A windscreen enclosure to surround three sides and the top is advisable.

R-2.2 Variable Output Transformer, to control the potential difference across the heater (input voltage) with a suitable voltmeter to check the applied voltage.

R-2.3 Temperature Indicators (Thermal Crayons or Waxes), with melting points covering the required range of temperatures. Other types of temperature indicator with equal or better precision may also be used for example, infra-red thermometer, colour change indicators).

R-2.4 Stopwatch, or other suitable timer.

R-2.5 Forming Apparatus (*see* Fig. 23) forming blocks machined from straight-grained wood.

It is recommended that a fitting be placed on top of the male forming blocks which can be securely attached to the ram or spindle of the press used in conjunction with these blocks.

R-2.6 Conditioning Chamber, with a standard atmosphere of 27 ± 2°C and relative humidity of (65 ± 5) percent.

R-2.7 Strips of Solid-Colour White Laminate, conforming to the specifications of HGP given in the standard measuring 200 mm × 50 mm and with the major axis in the machine direction of the fibrous sheet material (for example paper from which the laminate was made), to be used for calibration purposes. The non-decorative surface of each strip shall be sanded.

R-3 TEST SPECIMENS

The test specimens shall have dimensions approximately 200 mm × 50 mm, shall be of the thickness of the sheet under test and shall be sanded smooth at the long edges to remove hairline cracks.

Eight specimens shall be tested, four with their major axis in the machine direction of the fibrous sheet material (for example paper) for which the laminate was made, and four at right angles to this direction. The specimens shall be conditioned for at least 24 h at 27 ± 2°C and (65 ± 5) percent relative humidity before testing.

R-4 PROCEDURE

R-4.1 Calibration of Test Apparatus

Turn on the heating element 0.5 h prior to conducting the test, with the variable transformer at full-line voltage.

Use a temperature indicator with a melting point of 163°C to make several marks about 100 mm long near the centre of the sanded surface of several calibration strips.

Place a calibration strip on the heating trough so that the heat is applied to the decorative face. Adjust the input voltage by means of the variable transformer so that the time taken to reach 163°C is 1 s per 0.025 mm of calibration strip thickness, accurate to within ± 2 s.

After three or more consecutive calibration strips reach 163°C within the prescribed time ± 2 s, begin the test and maintain and record the voltage setting.

R-4.2 Test Procedure

Place the male forming block with radius as recommended by the laminate manufacturer or as required by the standard into the forming apparatus (**R-2.5**).

Measure the thickness of the sheet as specified in **5.3** and record.

Use a temperature indicator with a melting point as recommended by the laminate manufacturer to make several marks about 100 mm long on the surface that will be the inside of the bend and near the centre of each test specimen.

Place a test specimen on the heating trough so that the heat is applied to the side opposite the side marked with the temperature indicator and start the timer.

Remove the specimen when the temperature indicator is completely melted in the area to be formed, stop the timer, place the specimen within 5 s in the bending jig and carry out the forming test.

The closing time of the male forming block after the initial contact with the specimen shall be 0.5 to 1 s. Allow the specimen to cool in the closed bending jig.

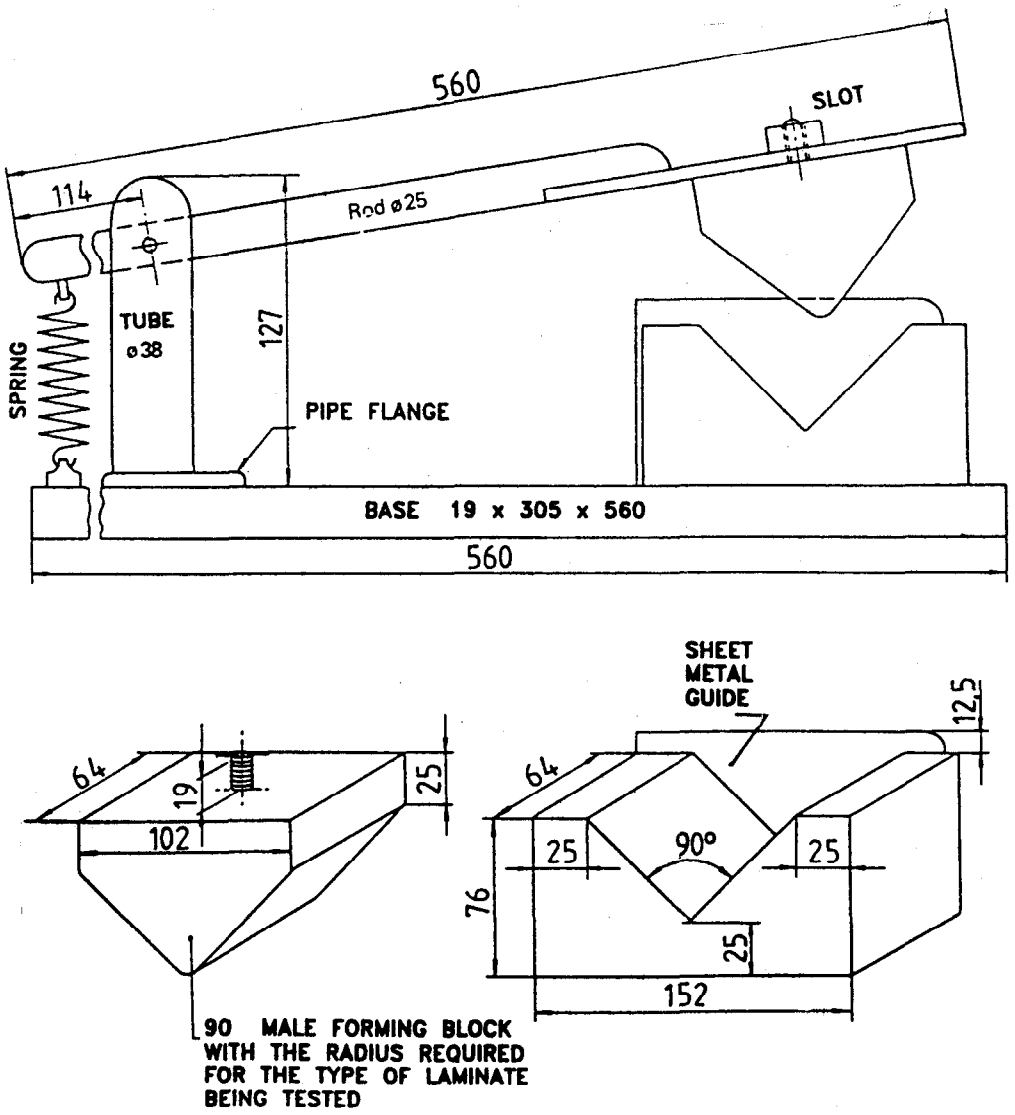
Remove and inspect the specimen after allowing it to cool for not less than 60 s. Failure to form satisfactorily shall be defined by the presence of cracks, blisters or delamination.

Carry out the test to assess the formability in both the longitudinal and transverse directions of the sheet and with the decorative face on both the inside and the outside of the bend, testing two specimens in each case.

R-5 FORMABILITY (Method B)

R-5.1 General

A specimen from the sheet under test is subjected to infra-red radiation until the heated face reaches a predetermined temperature. It is then formed on a jig made of wood (for example premachined chipboard) to a specified radius, allowed to cool and examined for signs of failure. The test is repeated with specimens cut in each direction of the sheet and with the decorative face on both the outside and inside of the bend. The formability is assessed in terms of the success or failure



All dimensions in millimetres.

FIG. 23 FORMING APPARATUS (RADIANT HEAT TEST) (METHOD A)

of the forming process at the specified radius.

The method (very close to industrial practice) allows for adjustment of all the test variables in order to establish the optimum conditions for the forming of individual materials, and it is to be expected that different laminate types, thicknesses and colours/patterns, even from the same manufacturer, will require different conditions for satisfactory forming. The conditions shall be specified by the laminate manufacturer, and the requirements shall be considered to be satisfied if the forming operation is successful under these conditions.

R-5.2 Apparatus

R-5.2.1 *Radian Heater Element*[1], fitted with a reflector[1], the distance and orientation relative to the test sample being adjustable (*see* Fig. 24).

This heater units is mounted on hinged support allowing it to be quickly moved away to the rear.

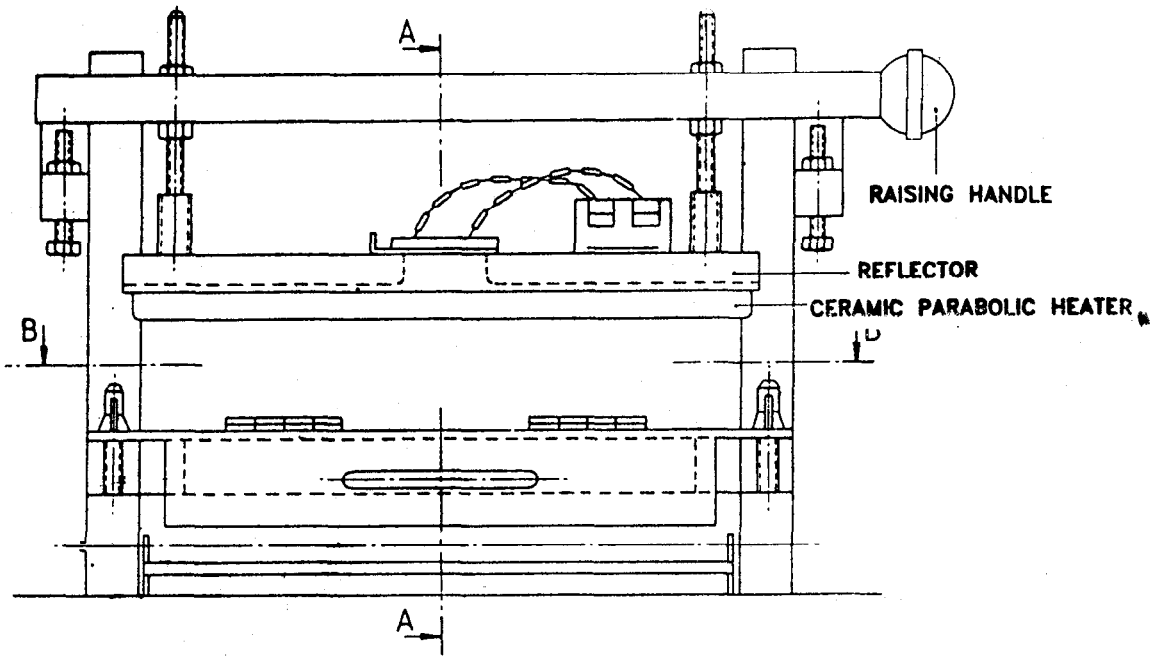
R-5.2.2 *Forming Jig*, of wood, chipboard or other material having a similar thermal conductivity, the front of which is rounded to a specified radius. The jig is easily replaceable, and it is possible to use a series of forming jigs machined to specified radii (for example 8, 9, 10, 11, 12 mm).

R-5.2.3 *Clamping Device*, for the test sample.

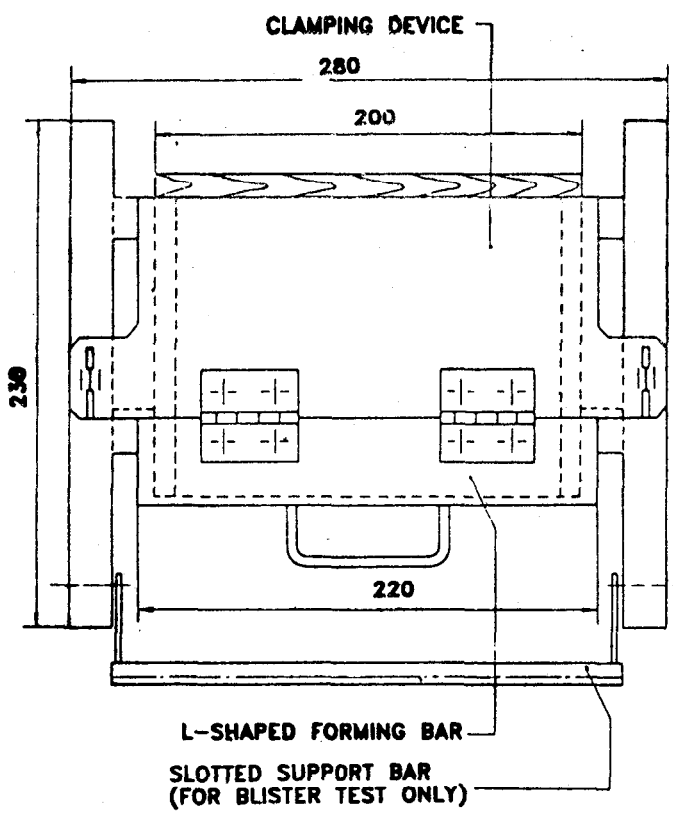
R-5.2.4 *L-shaped Forming Bar*, with a handle.

[1] For example, Eistein Type FSR 650 W 220 V r 245 mm x 60 mm).

[1] For example, Eistein Type REO 250 mm.



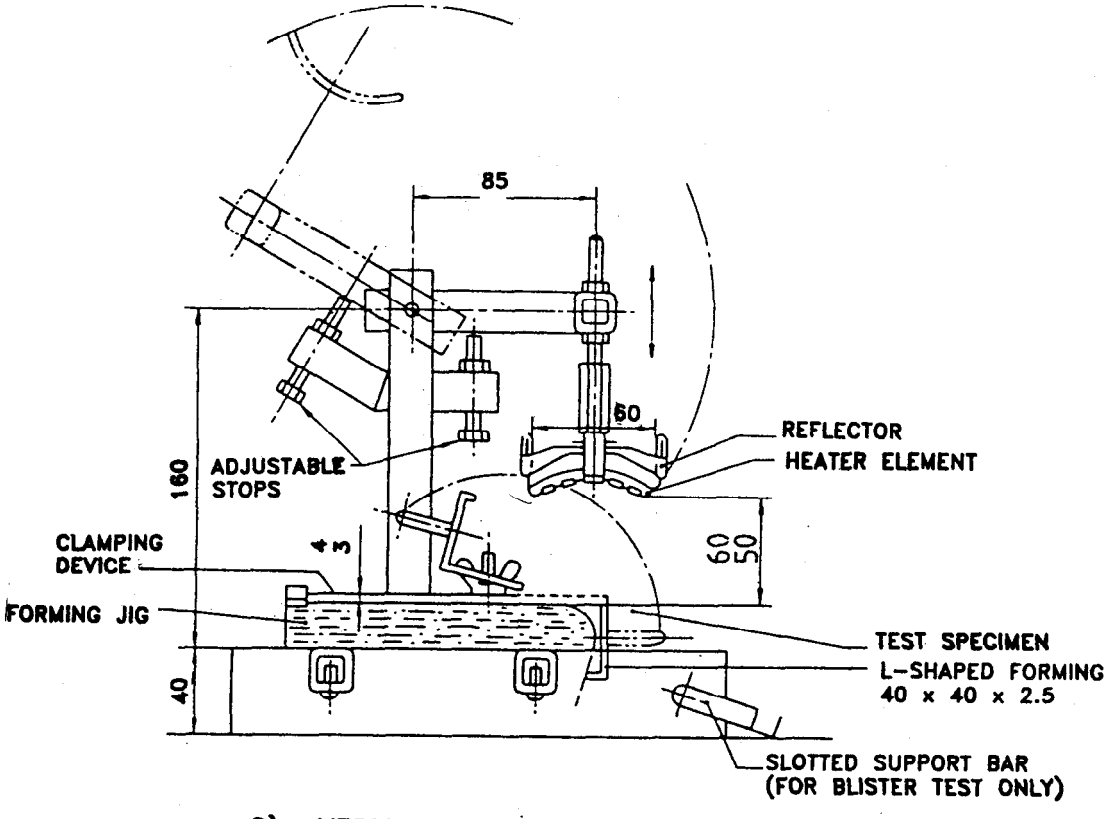
A) PROFILE



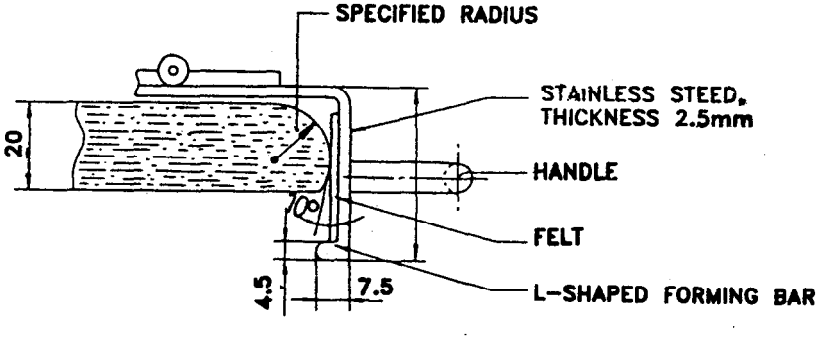
B) PLAN VIEW B–B

All dimensions in millimetres.

FIG. 24 FORMING APPARATUS (METHOD B) – *(Contd)*



C) . VERTICAL SECTION A–A



D) DETAILS OF L-SHAPED FORMING BAR

All dimensions in millimetres.

FIG. 24 FORMING APPARATUS (METHOD B)

R-5.2.5 *Temperature Indicators (Thermal Crayons or Waxes)*, with melting points covering the required range of temperatures. Other types of temperature indicator with equal or better precision may also be used (for example, infra-red thermometers, colour change indicators).

R-5.2.6 *Stopwatch*, or other timer.

R-5.2.7 *Thickness Gauge* (ratchet-type micrometer) (*see* **5.3**).

R-5.2.8 *Conditioning Chamber*, with a standard atmosphere of 27 ± 2°C and relative humidity of (65 ± 5) percent.

R-5.3 Test Specimens

The test specimens shall measures approximately 180 mm x 90 mm and be of the thickness of the sheet under test. They shall be sanded smooth at the edges to remove any hairline cracks.

At least twelve specimens shall be prepared, six with their major axes in the machine direction of the fibrous sheet material (for example paper) from which the laminate was made, and six at right angles to this direction.

The specimens shall be conditioned for 24 h at 27 ± 2°C and (65 ± 5) percent humidity before testing.

R-5.4 Procedure

Measure the thickness of the test specimens as specified in **5.3**.

Use the forming jig corresponding to the radius specified in the standard.

Turn on the heating element at least 20 min prior to starting the test.

R-5.4.1 *Calibration of Test Apparatus*

Clamp a specimen on the forming jig.

Using a 163°C temperature indicator crayon (*see* **R-5.2.5**), make a mark on the upper face in the area to be formed.

Lower the heating element over the test specimen and start the timer immediately. The time to reach 163°C shall be 30 ± 5 s.

Move the heating element quickly to the rear.

If the time to reach 163°C is not 30 ± 5 s adjust the height of the heating element relative to the test sample until the setting is found where the indicator melts in this time.

R-5.4.2 *Test Procedure*

Clamp the test specimen on the forming jig.

Make a mark on the upper face in the area to be formed, using a temperature indicator crayon (*see* **R-5.2.5**) in the temperature range recommended by the laminate manufacturer.

Lower the heating element over the test sample and start the timer immediately.

Watch the temperature indicator crayon mark for signs of melting. When it melts completely, stop the timer, which indicates the heating time required for the test specimen to reach the forming temperature.

Move the heating element quickly to the rear.

Using the handle lower immediately but smoothly the forming bar. The forming time should not exceed 1 s.

Keep the bar lowered for 1 min to allow the formed specimen to cool in the forming apparatus.

Raise the bar, and release and remove the formed specimen.

Carry out the test on specimens cut in both the machine and cross directions, and with the decorative face on both inside and outside of the bend, to obtain three results under the conditions specified.

If the dimensions of the equipment permit, several test specimens can be formed side by side simultaneously.

Observe the formed specimens with the naked eye, corrected, if necessary.

A material has failed if one or more of the twelve test samples does not form to the prescribed minimum forming radius or shows cracking, blistering, crazing or discolouration.

ANNEX S

[*Table* 7, *Sl No.* (xiv)]

RESISTANCE TO BLISTERING (METHOD A)

S-1 GENERAL

This test measures the ability of postforming-type high-pressure decorative laminate to resist blistering during the forming process. This is a companion test to that described in Annex B. This method is an alternative test method to be used when so designated by the national authority or by agreement between the supplier and the purchaser.

S-2 APPARATUS

The same as in **R-2** plus an additional timer.

S-3 TEST SPECIMENS

The test specimens shall measure approximately 200 mm x 50 mm, shall be the thickness of the sheet under test and shall be cut from the right edge, centre and left edge of the sheet as manufactured. The non-decorative surface of each test specimen shall be sanded.

Three test specimens shall be tested, one from each of the sections of the sheet as stated.

The specimens shall be conditioned for at least 24 h at 27 ± 2°C and (65 ± 5) percent relative humidity before testing.

S-4 PROCEDURE

S-4.1 Calibration of Test Apparatus

Calibrate the apparatus as specified in **R-4.1.**

S-4.2 Test Procedure

Measure the thickness of the sheet as specified in **5.3** and record.

Use a temperature indicator with a melting point as recommended by the laminate manufacturer to make several marks about 100 mm long on the sanded surface and near the centre of the test specimen.

Place the test specimen on the heating trough so that the heat is applied to the decorative side, and start both timers immediately.

Watch the temperature indicator marks on the test specimen for signs of melting. When they have melted completely, stop the first timer. Allow the second timer to run until blistering occurs and then stop it. Blistering is detected visually or audibly or both.

Remove the specimen and allow it to cool in air; record the times, in seconds, and reset the timers.

S-5 RESISTANCE TO BLISTERING (METHOD B)

S-5.1 General

This test measures the ability of postforming-type high-pressure decorative laminate to resist blistering.

S-5.2 Apparatus

The same as in **R-5.2** plus an additional timer.

S-5.3 Test Specimens

Test specimens shall be approximately 180 mm x 180 mm and of the thickness of the sheet under test.

Three test specimens shall be tested.

The specimens shall be conditioned for 24 h at 27 ± 2°C and (65 ± 5) percent relative humidity before testing.

S-5.4 Procedure

Any forming jig radius can be used.

S-5.4.1 *Calibration of Test Apparatus*

Calibrate the apparatus as specified in **R-5.4.1.**

S-5.4.2 *Test Procedure*

Measure and record the thickness of the sheet as specified in **5.3.**

Clamp a test specimen on the forming jig, decorative face up. Raise the slotted support bar (*see* Fig. 25) to support the free end of the specimen and prevent it from warping during the test.

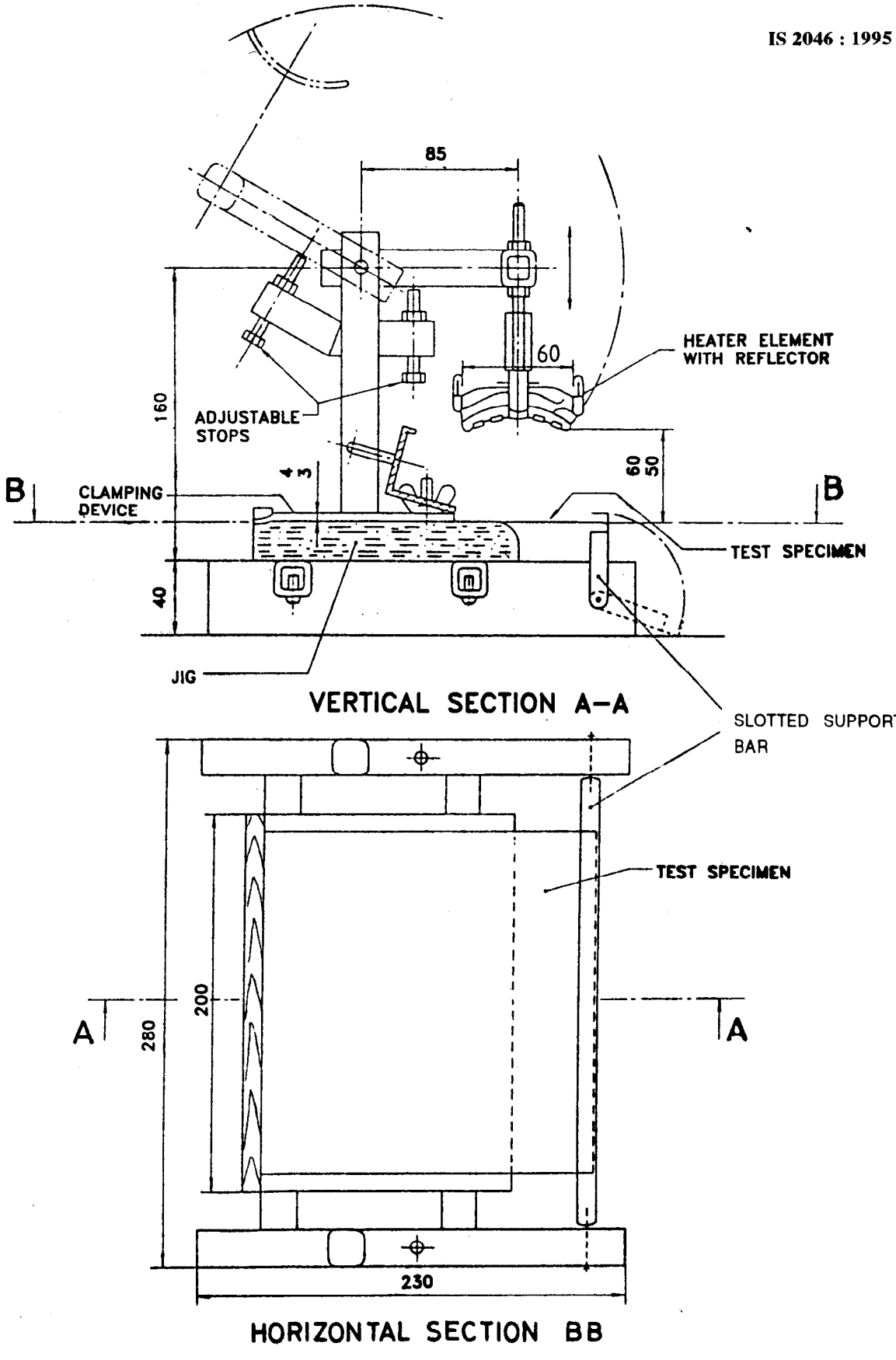
Make a mark on the upper face in the bending area using a temperature indicator crayon (*see* **R-5.2.5**) corresponding to the forming temperature recommended by the laminate manufacturer.

Lower the heating element over the test specimen and start the two timers immediately.

Watch the temperature indicator crayon mark for signs of melting. When it melts completely, stop the first timer. Allow the second timer to run until blistering occurs and stop it immediately. Blistering is detected visually or audibly or both.

Move the heating element to the rear.

Remove the test specimen, and allow the forming jig to cool before clamping the next specimen.



All dimensions in millimetres.

FIG. 25 BLISTER APPARATUS (METHOD B)

ANNEX T

[*Table 7, Sl No.* (xv)]

RESISTANCE TO STEAM

T-1 GENERAL

A specimen from the sheet under test is held in place over the neck of a flask containing boiling water, so that the decorative surface of the specimen is exposed to the steam. After 1 h, the specimen is removed and allowed to recover for 24 h in normal ambient conditions before examination for any change in appearance.

T-2 MATERIALS

T-2.1 Erlenmeyer Flask, wide-necked, of capacity 250 ml.

T-2.2 Specimen Holder and Heat-Resistance Screen (*see* Fig. 26).

T-2.3 Non-fibrous Filter Paper

T-2.4 Hand Lens, with 6 x magnification.

T-2.5 Electric hot-plate, or other suitable heat source.

T-3 TEST SPECIMEN

One test specimen, measuring 100 mm x 100 mm x the thickness of the sheet under test, is required.

T-4 PROCEDURE

Place approximately 200 ml of water in the flask (*see* **T-2.1**) and bring it to the boil on the electric hot-plate (**T-2.5**). Place the heat resistant screen (**T-2.2**) in position around the neck of the flask, and place the test specimen, decorative face down, centrally over the mouth of the flask and fix it in position by the wire specimen holder (*see* Fig. 26).

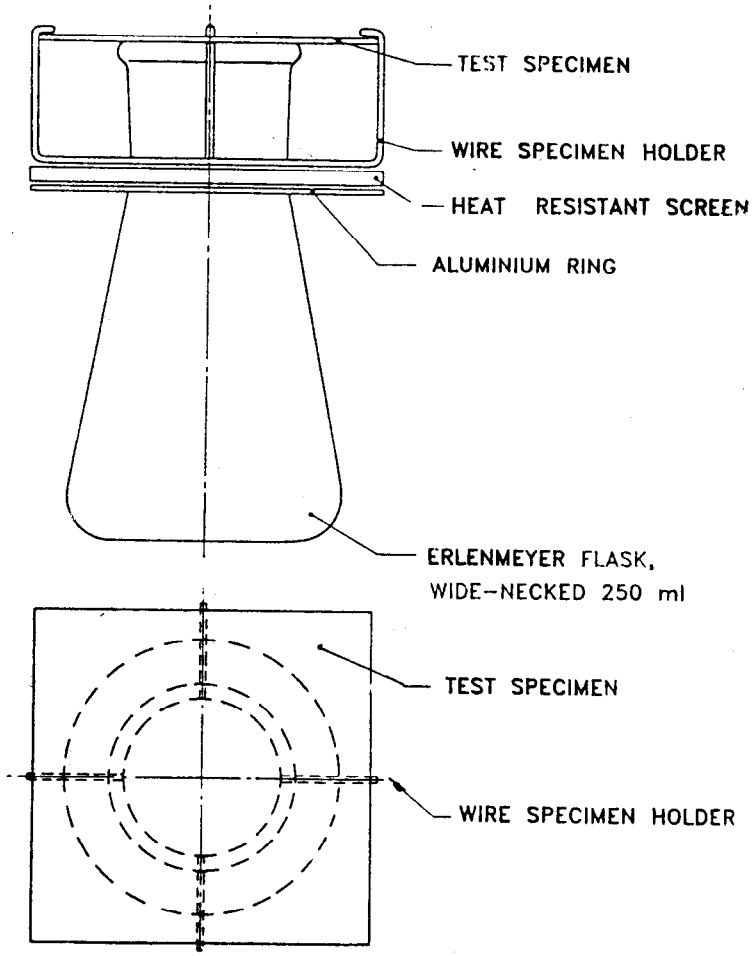


FIG. 26 APPARATUS FOR RESISTANCE TO STEAM

NOTE — The specimen holder should be heavy enough to prevent the specimen from curling away from the mouth of the flask.

After the decorative face has been exposed for 1 h to the steam from the boiling water, remove the specimen and use the non-fibrous filter paper (**T-2.3**) to remove excess water from the surface of the specimen.

Allow the test specimen to recover for 24 h in normal ambient conditions and then examine the central area of the specimen with the naked eye, corrected if necessary, and under 6 x magnification using the hand lens (**T-2.4**) for any change in appearance.

The effect on the surface of the specimen is expressed in accordance with the following rating scale:

Rating 5 : No visible change.

Rating 4 : Slight change of gloss and/or colour, only visible at certain viewing angles.

Rating 3 : Moderate change of gloss/or colour.

Rating 2 : Marked change of gloss and/or colour.

Rating 1 : Blistering and/or delamination.

ANNEX W

[*Table* 7, *Sl No.* (xvi)]

RESISTANCE TO CRAZING (THICK LAMINATES)

W-1 GENERAL

A specimen from the sheet under test is placed in dry heat at 80°C for 20 h and resistance to crazing is then assessed by visual examination after cooling.

W-2 APPARATUS

W-2.1 Specimen Holder, to hold specimens vertically during the test and prevent contact with other specimens or the oven.

W-2.2 Electrically Heated Oven, provided with air circulation and capable of being controlled at 80 ± 2°C.

W-2.3 Hand Lens, with approximately 6 x magnification.

W-2.4 Lighting, of intensity 800 to 1 000 lx.

W-2.5 Conditioning Chamber, with a standard atmosphere of 27 ± 2°C and relative humidity of (65 ± 5) percent.

W-3 TEST SPECIMENS

The test specimens shall be 250 ± 2 mm square and of the thickness of the sheet under test and shall be sanded smooth at the edges to remove any hairline cracks.

Two specimens shall be used and shall be conditioned for at least 72 h at 27 ± 2°C and (65 ± 5) percent relative humidity before testing.

W-4 PROCEDURE

Place the specimens in the holder (**W-2.1**) and then place the holder in the oven (**W-2.2**) controlled at 80 ± 2°C, and leave for 20 ± 1 h.

At the end of 20 ± 1 h, remove the holder and specimens and allow to cool for 3 h at ambient temperature. After the cooling period, examine the surfaces and edges with the naked eye, corrected if necessary, and under 6 x magnification using the hand lens (**W-2.3**) to determine the presence and extent of any cracking. The light intensity during the examination shall be 800 to 1 000 lx.

W-5 EXPRESSION OF RESULTS

The result of the examination shall be expressed in accordance with the following rating scale:

Rating 5 : Decorative surfaces and edges unchanged from "as received" condition, no hairline cracks.

Rating 4 : Hairline cracks irregularly distributed across the surface and/or edges; on the surface, only visible under 6 x magnification.

Rating 3 : Surface cracks visible to the naked eye and or moderate edge cracking.

Rating 2 : A gaping crack which may extend right across the specimen and/or severe edge cracking.

Rating 1 : Specimen broken into separate parts.

ANNEX Y

[*Table* 7, *Sl No.* (xvii)]

MOISTURE RESISTANCE (DOUBLE FACED COMPACT LAMINATES)

Y-1 GENERAL

Specimens taken from the sheet under test are totally immersed in water at 65°C for 48 h and then assessed by visual examination after cooling.

Y-2 APPARATUS

Y-2.1 Water Bath, capable of being maintained at 65°C ± 2°C.

Y-2.2 Specimen Holder, to prevent specimens from touching one another during immersion.

Y-2.3 Vessel, containing distilled water at 23°C ± 2°C.

Y-3 TEST SPECIMENS

The test specimens shall be 150 mm ± 1 mm square and be of the thickness of the sheet under test. The cut edges must be smooth and free from cracks. Three specimens shall be used.

Y-4 PROCEDURE

Place the specimens in the specimen holder **(27.2.2)**, and place the specimen holder in the water bath **(27.2.1)** so that all specimens are totally immersed in water at 65°C ± 2°C.

After 48 h, remove the specimens from the water bath and allow to cool for 15 min ± 5 min in the vessel **(27.2.3)** containing distilled water maintained at 23°C ± 2°C.

Remove the specimens from the water and use a clean dry cloth or filter paper to remove all surface water.

Examine each test specimen visually with the marked eye, corrected if necessary, for any change in appearance, blistering and/or delamination.

Y-5 EXPRESSION OF RESULTS

Express the change of appearance of the specimens in accordance with the following rating scale:

Degree 5 : No visible change.

Degree 4 : Slight change of gloss/colour, of slight edge swell, or hairline edge cracks.

Degree 3 : Moderate change of gloss/colour or moderate edge swell, or slight edge cracks.

Degree 2 : Severe change of gloss/colour, and/or severe edge swell, or edge cracks.

Degree 1 : Blistering and/or delamination.

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TO
IS 2046 : 1995 DECORATIVE THERMOSETTING SYNTHETIC RESIN BONDED LAMINATED SHEETS — SPECIFICATION

(Second Revision)

[*Page* 2, *Table* 1, *Sl No.* (iii), *col* 3) — Substitute 'S, P or F' *for* 'S, P or P'.

[*Page* 2, *Table* 1, *Sl No.* (iii), *col* 7]— Substitute the following for the existing:

'HGS (Horizontal general purpose standard)

HGF (Horizontal general purpose fire retardant).

HGP (Horizontal general purpose postforming)'.

[*Page* 7, *Table* 7, *Sl No.* (xvi), *col* 15] — Substitute 'W' *for* 'N'.

[*Page* 7, *Table* 7, *Sl No.* (xviii), *col* 15] — Substitute 'IS 13411 : 1982' *for* 'IS 13401 : 1992'.

(*Page* 8, *Curve* 1, *Y axis*) — Substitute the following for the existing:

'% INCREASE IN MASS'.

(*Page* 8, *Curve* 2, *Y axis*) — Substitute the following for the existing:

% INCREASE IN THICKNESS'

(*Page* 9, *Curve* 3 *and Curve* 4) — Substitute 'ANNEX F' *for* 'METHOD 9'; and 'ANNEX B' *for* 'METHOD 10'.

(*Page* 18, *Annex* G, *clause* **G-5**, *paras* 4, 5 and 6) — Delete.

(PCD 12)

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