IS 14856 (2000): Glass Fibre Reinforced Plastic (GRP) Panel Type Door Shutters for Internal Use - [CED 11: Doors, Windows and Shutter]

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IS 14856 : 2000
(Reaffirmed 2006)

भारतीय मानक

आंतरिक उपयोग के लिए काँच रेशा प्रबलित प्लास्टिक (जी आर पी) के बख्तेनुमा दरवाजों के शटर — विशिष्टि

Indian Standard

GLASS FIBRE REINFORCED PLASTIC (GRP) PANEL TYPE DOOR SHUTTERS FOR INTERNAL USE — SPECIFICATION

ICS 83.120; 91.060.50

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Price Group 7

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standard after the draft finalized by the Doors, Windows and Shutters Sectional Committee had been approved by the Civil Engineering Division Council.

GRP is an engineering plastic finding application in a variety of fields ranging from aircraft and rocket components to consumer durables. Its entry into the applications in building industry in our country was made when Indian Standards were drawn up for corrugated and plain roofing sheets and GRP Squatting pans.

The product has a higher initial cost, which is more than offset as it is virtually maintenance free. When subjected to a value engineering analysis or its life cycle cost analysis, it turns out to be very economical, too. Therefore, with a view to serve the larger national objective of protection of our environment and to improve the quality of life of the product (when no maintenance is needed), this standard is evolved for GRP door shutters for internal use, particularly for use in bathrooms/toilets and kitchens.

Composition of the technical committee responsible for the formulation of this standard is given in Annex J.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant place retained in the rounded off values should be the same as that of the specified value in this standard.

Indian Standard

GLASS FIBRE REINFORCED PLASTIC (GRP) PANEL TYPE DOOR SHUTTERS FOR INTERNAL USE — SPECIFICATION

1 SCOPE

1.1 This specification lays down requirements regarding types, sizes, material, construction, workmanship, finish, performance requirements and sampling of Fibre Glass Reinforced Plastic Door shutters for use in residential and industrial buildings.

1.2 This specification does not cover large size door shutters for industrial and special buildings such as workshops, garages, godowns, etc.

2 REFERENCES

The Indian Standards and other Standards listed in Annex A are necessary adjuncts to 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.

3 TERMINOLOGY

3.1 For the purpose of this specification, the definitions given below shall apply (*see also* Fig. 1 for illustrations of the components of door shutters).

3.1.1 *Aggregate Defects*

Presence of impurities such as pin holes, impurities and traces of mending more than 5 each or 5 in aggregate for defects at localized place.

3.1.2 *Blistering*

Air or solvent entrapped during moulding.

3.1.3 *Colour Blots*

Colour blots occurring on account of uneven distribution of colouring material.

3.1.4 *Crazing*

Fine hair cracks on the surface.

3.1.5 *Defective Impregnation*

Imperfect impregnation of glass fibre with unsaturated polyester resin.

3.1.6 *Gelcoat*

A gelcoat of UV stabilized, fire retardant, isophthalic quality mixed with 15 percent by weight, aerosil powder (500 micron ground silica) suitably formulated to high viscosity given to exposed exterior sections of the moulded door shutter to provide a smooth glossy finish, enhance aesthetics and improve weathering and water resistant properties of the moulded door shutter. The thickness of the coat shall be between 0.35 to 0.40 mm.

3.1.7 *Impurities*

Foreign matter present, other than specified.

3.1.8 *Laminate*

A reinforced resin sheet or moulding.

3.1.9 *Pin Holes*

Pores of size less than 1 mm appearing on the surface.

3.1.10 *Small Pores*

Pores of size more than 1 mm appearing on the surface.

3.1.11 *Wrinkle*

A slight ridge or furrow on surface.

3.1.12 *Base Block*

A wooden or suitable material provided within the door/shutter frame to facilitate fixing of fittings and other accessories.

3.1.13 *RTM Process*

Resin Transfer Moulding includes all forms of resin injections, resin infusion vacuum infusion and vacuum press moulding. Moulding is done in a closed mould under differential pressure.

3.1.14 *Hand Lay Up*

Hand Lay up process consist of laying gelcoat with appropriate layers of Chop Strand Mat (CSM) and resin in open moulds.

4 HANDING

Handing and direction of closing of shutters shall be designated in accordance with IS 4043.

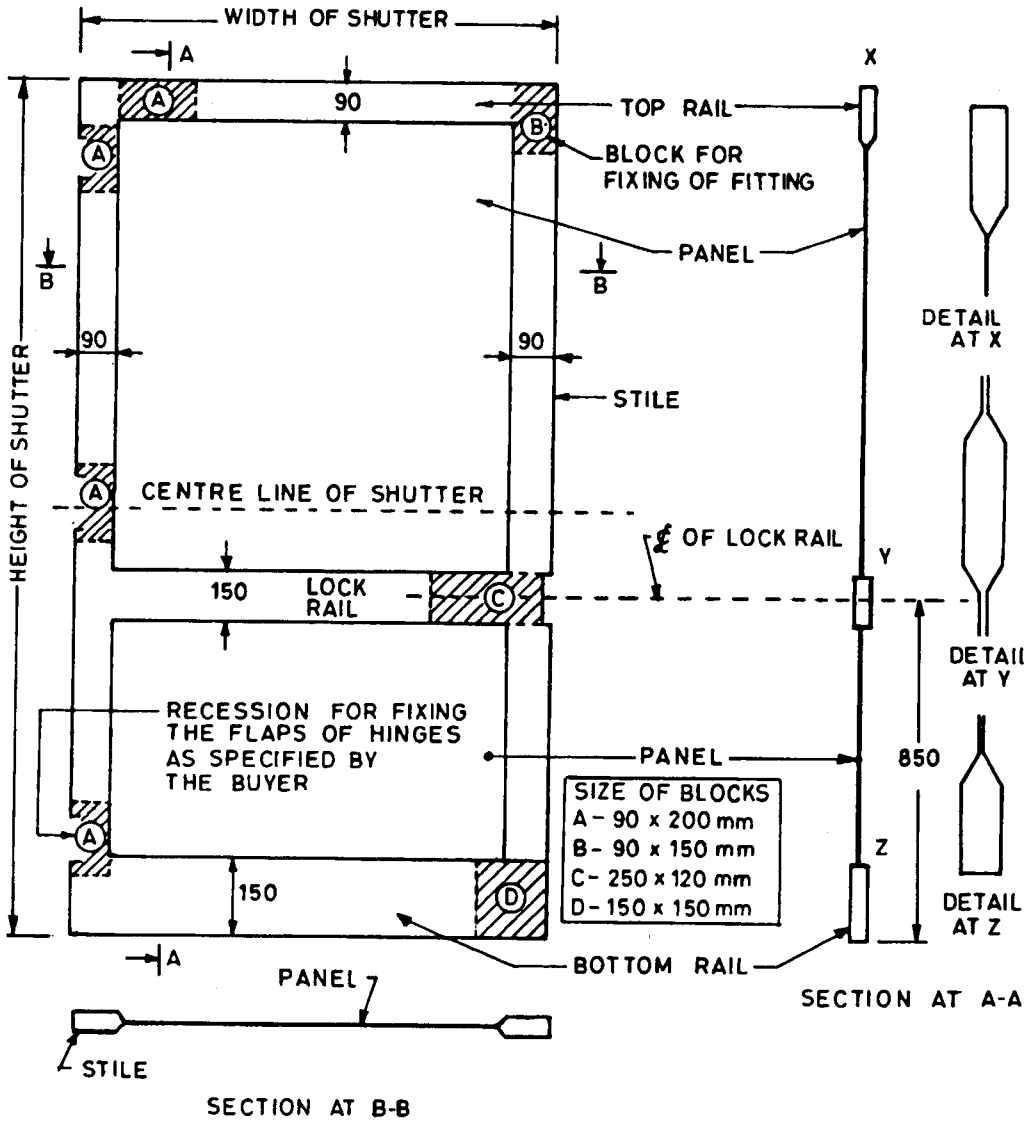
5 MATERIAL

5.1 Glass Fibre Chopped Strand Mat (CSM)

The glass fibre chopped strand mat used shall be as per IS 11551.

5.2 Glass Fibre Rovings

The glass fibre rovings shall be as per IS 11320.



All dimensions in millimetres.

FIG. 1 TYPICAL SKETCH OF FRP DOOR SHUTTERS

5.3 Isophthalic Resin

Isophthalic resin shall be of fire retardant grade as per IS 6746.

5.4 Curing Agents

5.4.1 Catalyst used shall be Methyl Ethyl Ketone Peroxide (MEKP), benzyl peroxide, acetyl aceto peroxide, etc.

5.4.2 Accelerator used shall be cobalt napthalate, cobalt octonate, N.N. dinethyl anilene, etc.

5.5 Fillers and Additives

5.5.1 Permissible fillers are french chalk powder (Talc) and calcium carbonate.

5.5.2 Aluminium trihydrite, antimony trioxide, minimum 5 percent, by weight of isophthalic resin, shall be used for fire retardancy.

5.5.3 The fillers and additives content shall not exceed 10 percent by weight of isophthalic resin.

5.6 Auxiliary Chemical

Polyvinyl alcohol (PVA) or other semipenetrant release agents and wax shall be used as a mould release agent.

5.7 Pigments

Pigments compatible with isophthalic resin and gelcoat shall be used to obtain the shade of finish as mutually agreed between the manufacturer and the purchaser.

5.8 Base Blocks

Base blocks for fixing fixtures in shutter with screws

shall be of seasoned and treated hard wood or any other suitable material.

5.9 Polyurethene Foam

Slabs of minimum density of 32 kg/m^3 and of thickness 4 mm less than the shutter thickness with ± 0.5 mm tolerance shall be used.

6 CONSTRUCTION/FABRICATION

6.1 The GRP shutter shall have hollow rails and stiles monolithically cast with panels.

6.2 The shutters shall be contact moulded by either hand lay up or Resin Transfer Moulding (RTM) process in two pieces as shown in Fig. 1. The process shall consist of laying gelcoat of 0.35 mm to 0.40 mm thickness laid over with three layers of GRP mat (one layer of 300 CSM mat and two layers of 450 CSM) for each of the web (panel) portion and four layers of GRP mat for the flange (rails and stiles) portion (one layer of 300 CSM mat and three layers of 450 CSM mat). While closing the two pieces, additional layer of 450 CSM mat shall be provided in the web portion. The CSM mat shall be bonded with isophthalic resin in the ratio not less than 1:2 (one part of mat to two parts of isophthalic resin and fillers and additives) by weight. The edges shall be sealed with gelcoat and FRP mat to obtain smooth finish. Sufficient rovings shall be laid in the corners to have smooth curve while laying the CSM mat. If the shutter is moulded using the RTM process, then moulding shall be done either by laying gelcoat followed by laying of the GRP mat. Core material shall be placed in location in the hollow sections. The GRP mat shall be bonded by injecting under pressure isophthalic resin in a ratio not less than 1:2 (one part of mat to two parts of isophthalic resin). Alternatively, if the shutter is moulded without using gelcoat then the process is to lay the FRP mat in the mould with the core material blocks in location in the hollow section. The GRP mat shall then be bonded by injecting under pressure, isophthalic resin in a ratio not less than 1:2 (one part of mat to two parts of isophthalic resin).

6.3 Blocks of any seasoned hard wood of bulk density not less than 450 kg/m^3 at 12 percent moisture content or any other material of sufficient thickness and length shall be provided inside the shutter at suitable place to hold fittings and fixtures such as aldrops, tower bolt, handle sliding door bolt, mortice lock, etc. Blocks for hinges shall be provided at three locations, unless otherwise specified by the purchaser. One at the centre and other two at 200 mm from the top and the bottom of the shutter.

6.4 Blocks shall be provided at predetermined places in the shutter so as to fix hinges, mortice locks, tower bolts, aldrops, door closures, etc.

6.5 The finished surface shall be buffed and polished with wax.

7 DIMENSIONS, SIZES AND TOLERANCES

7.1 Dimensions of Components and Tolerances

7.1.1 The finished dimensions and tolerances of the different components of door shutter shall be as given in Table 1.

Table 1 Dimensions and Tolerances of Components of Door Shutters

Sl No.	Description	Width, mm	Thickness, mm
i)	Vertical stile, top and freeze rail	90±3	30±1 or 35±1
ii)	Lock rail	120±3	30±1 or 35±1
iii)	Bottom rail	150±3	30±1 or 35±1

7.1.2 Minimum thickness of GRP laminate of hollow rails and stiles shall be 3 mm.

7.1.3 Minimum thickness of GRP laminate used for panel in the shutter shall be 5 mm.

7.2 Sizes and Types

Sizes and types of the shutters shall generally conform to the modular sizes specified in Table 2 (*see also* Fig. 2). Sizes other than modular sizes as agreed to between the manufacturer and the purchaser, may also be permitted.

Table 2 Dimensions of Door Shutters

Designation of Doors	Width, mm	Height, mm
(1)	(2)	(3)
8 DS 20	700	1 905 (1 945)
8 DS 21	700	2 005 (2 045)
9 DS 20	800	1 905 (1 945)
9 DS 21	800	2 005 (2 045)
10 DS 20	900	1 905 (1 945)
10 DS 21	900	2 005 (2 045)
12 DT 20	1 100[1)]	1 905 (1 945)
12 DT 21	1 100[1)]	2 005 (2 045)

NOTES

1 The dimensions refers to modular sizes of door openings. First number stands for width and the last for height in module (M = 100 mm). Alphabet 'D' refers to doors , 'S' to single shutter and 'T' to double leaf shutter.

2 Standard sizes of door frames are covered in IS 4021 and IS 4351.

3 The Standard widths and heights for panel doors are arrived at as shown in Fig. 2. In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket.

[1)] Combined width of double leaf shutters.

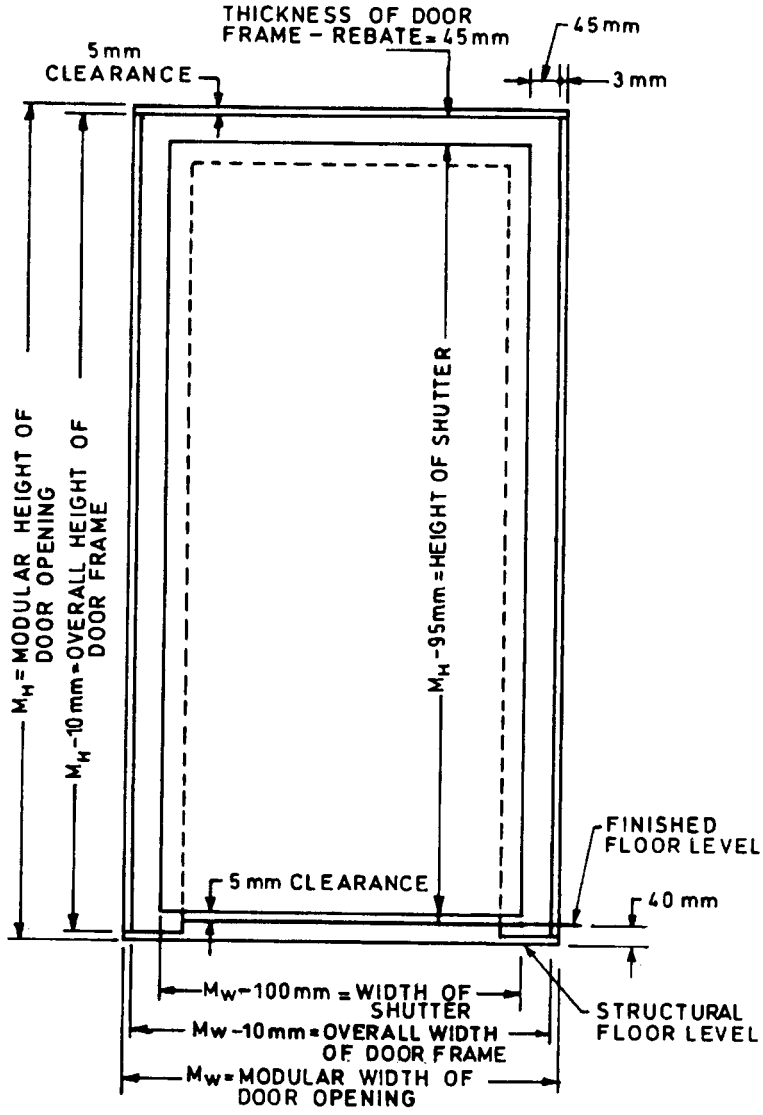


FIG. 2 SKETCH ILLUSTRATING DIMENSIONS OF SHUTTER

7.3 Tolerances

Tolerances on the sizes of door shutters shall be $^{0}_{-4}$ mm.

8 LOCATIONS OF FITTINGS AND ACCESSORIES

8.1 The lock rail of door shutters shall be so placed that its centre line is at a height 850 ± 5 mm from the bottom of the shutter.

8.2 Each door shutter shall be fixed to the frame with three hinges, unless otherwise specified by the purchaser, of the type specified. These location shall be, one at the centre and other two at 200 mm from the top and the bottom of the shutter, where blocks have already been provided and suitable indication, by depressing the profile (*see* Fig. 1), has been made.

8. 3 Other fixtures shall also be provided at locations where blocks have already been provided (*see* Fig. 1 for sizes and locations of blocks.)

9 FINISH

9.1 The surface of the moulded shutters shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregate defects.

9.2 Scattered pin holes duly repaired and finished by applying resin and not noticeable shall be acceptable.

9.3 Panels, railsand stiles of the door shutters shall be flat and shall have smooth and level surface.

9.4 Shutter shall be finished in colour and design as required by the purchaser.

10 TESTS

10.1 Tests on Material

10.1.1 Tests as per Table 3 shall be conducted on FRP laminate (without removing gel coat) cut from door shutter. The method of carrying out the test shall be as per the reference code mentioned against each test. Acceptable criteria shall be as mentioned against each test.

Table 3 Tests on GRP Laminate

Sl No.	Test	Test Method	Acceptable Value
(1)	(2)	(3)	(4)
i)	Fibre glass content	Annex B	25 percent (*Min*)
ii)	Barcol hardness	Annex C	30 BHU (*Min*)
iii)	Tensile strength (MPa)	Annex D	100 (*Min*)
iv)	Bending strength (MPa)	Annex E	120 (*Min*)
v)	Elastic modulus in bend (MPa)	Annex F	1 500 (*Min*)
vi)	Water absorption	Annex G	0.5 percent (*Max*)
vii)	Fire retardancy	Annex H	100 mm length of the specimen shall not burn within 60 seconds

10.2 Requirements on Shutters

The following tests in accordance with IS 4020 (Parts 1 to 16) shall be conducted on the door shutters :

a) Dimensions and squareness test

b) General flatness test

c) Local planeness test

d) Impact indentation test

e) Edge loading test

f) Shock resistance test

g) Buckling

h) Slamming test

j) Misuse test

10.2.1 *Dimensions and Squareness Test*

Door shutters, when tested in accordance with IS 4020 (Part 2), the dimensions of nominal width and height shall be within a limit of ± 5mm. The door shutter shall not deviate by more than 1 mm on a length of 500 mm. The thickness of the door shutter shall be uniform throughout with the permissible variation of not more than 0.8 mm between any two points. The nominal thickness of the shutter shall be within a limit of ± 1.5 mm.

10.2.2 *General Flatness Test*

Door shutters, when tested in accordance with IS 4020 (Part 3), the twist, cupping and warping shall not exceed 6 mm.

10.2.3 *Local Planeness Test*

Door shutters, when tested in accordance with IS 4020 (Part 4), the depth of deviation measured at any point shall not be more than 0.5 mm.

10.2.4 *Impact Indentation Test*

Door shutters, when tested in accordance with IS 4020 (Part 5), shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

10.2.5 *Edge Loading Test*

Door shutters, when tested in accordance with IS 4020 (Part 7), the deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm, failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

10.2.6 *Shock Resistance Test*

10.2.6.1 Door shutters, when tested in accordance with **2.1** of IS 4020 (Part 8), there shall be no visible damage in any part of the door after twenty-five blows on each end.

10.2.6.2 Door shutters, when tested in accordance with **3.1** of IS 4020 (Part 8), the normally hung shutter, with hangings, fixings and fastenings should withstand without any significant permanent deformation and without deterioration the five impacts on both sides of the shutter.

10.2.7 *Buckling Test*

Door shutters, when tested in accordance with IS 4020 (Part 9), shall not show any deterioration and any residual deformation more than 5 mm after 15 min of unloading and the initial deflection also shall not be more than 50 mm.

10.2.8 *Slamming Test*

10.2.8.1 Anyone of the following tests given in **10.8.2** and **10.8.3** shall be used.

10.2.8.2 Door shutters, when tested in accordance with **2.1** of IS 4020 (Part 10), shall not have any

visible damage in any part of the door at the end of 50 successive impacts.

10.2.8.3 Door shutters, when tested in accordance with **3.1** of IS 4020 (Part 10), shall not have any visible damage in any part of the door at the end of 100 successive impacts.

10.2.9 *Misuse Test*

Door shutters, when tested in accordance with IS 4020 (Part 11), there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

11 SAMPLING AND CRITERIA FOR CONFORMITY

The sampling and criteria for conformity shall be in accordance with IS 4020 (Part 1).

12 MARKING

12.1 All door shutters conforming to this specification shall be marked with the following information :

a) Name of manufacturer or trade-mark, if any; and

b) Lot number/date of manufacture for identification.

12.2 BIS Certification Mark

12.2.1 The shutters may also be marked with the Standard Mark.

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

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
4020 (Parts 1 to 16) : 1998	Door shutters — Methods of tests (*third revision*)
4043 : 1969	Recommendations for symbolic designation of direction of closing of faces of doors, windows and shutters
4021 : 1995	Specification for timber door, window and ventilator frames (*third revision*)
4351 : 1976	Specification for steel door frames (*first revision*)
6523 : 1983	Specification for precast reinforced concrete door and window frames (*first revision*)
6746 : 1994	Unsaturated polyester resin systems (*first revision*)
11320 : 1997	Glass fibre rovings for reinforcement of polyester and epoxide resin systems
11551 : 1996	Glass fibre chopped strand mat for the reinforcement of polyester resin systems
12406 : 1988	Specification for medium density fibre board for general purposes

ANNEX B
(*Table* 3)

DETERMINATION OF GLASS CONTENT OF GLASS-REINFORCED LAMINATES

B-1 APPARATUS

a) A weighing balance with an accuracy of ± 10 mg,

b) A muffle furnace,

c) A crucible of appropriate dimensions, and

d) A desiccator.

B-2 TEST SPECIMEN

Two specimens shall be tested for sample containing no filler and colouring agent according to **B-3** (a). Three specimens shall be tested for sample containing filler and/or colouring agent according to **B-3** (b).

The specimen may be of any convenient shape provided that it is representative of the material under test and that its mass is not less than 5 g. A rectangular specimen, with a face of area not less than 400 m^2 and whose shorter edges are not less than 12 mm long, is usually suitable.

B-3 PROCEDURE

A crucible of appropriate dimensions shall be heated in a muffle furnace at 575 ± 25°C for 15 min, cooled in a dessicator and weighed (W_1). The test specimens shall be placed in the crucible and the crucible and contents heated in an oven at 105°C to 110°C for 2 h. The crucible and contents shall then be cooled in a desiccator, weighted and returned to the oven for a further 30 min, cooled and reweighed. This procedure shall be repeated until the mass (W_2) of crucible and specimen becomes constant to within 0.01g.

a) Sample containing no filler and colouring agent.

The crucible and contents shall then be heated in a ventilated muffle furnace at a temperature of 575 ± 25°C for 30 min. or more, until the residue of glass fibre is white in colour. The crucible and contents shall then be removed from the furnace, allowed to cool in a desiccator and weighted. This process of heating, cooling and weighing shall then be repeated until the mass (W_3) becomes constant to within 0.01 g.

b) Sample containing filler and/or colouring agent.

The crucible and contents shall be heated in a ventilated muffle furnace at a temperature of 575 ± 25°C to burn out the resin completely (by repeating the process of heating and weighing as above), leaving behind the glass, filler and colouring agent. Water shall then be added to the residue and the mixture shall be filtered through a tared standard sieve of 200 mesh size. Wash the residue with water till the filtrate is clear.

The glass residue shall then be heated at 105° to 110°C for 3 h or more until the mass of the glass residue (W_4) becomes constant to within 0.01g.

B-4 CALCULATION

B-4.1 For samples determined according to **B-3** (a)

$$\text{Percentage glass content} = \frac{100\,(W_3 - W_1)}{(W_2 - W_1)}$$

where

W_1 = mass of crucible,
W_2 = mass of sample + crucible, and
W_3 = mass of glass residue + crucible.

B-4.2 For samples determined according to **B-3** (b)

$$\text{Percentage glass content} = \frac{100\,W_4}{(W_2 - W_1)}$$

where

W_1 = mass of crucible,
W_2 = mass of sample + crucible, and
W_4 = mass of glass residue.

The glass content of the material under test shall be reported as the arithmatic mean of the results obtained on the test specimens.

ANNEX C
(*Table* 3)

DETERMINATION OF BARCOL HARDNESS

C-1 APPARATUS

C-1.1 Indentor

The indentor shall consist of a hardened steel turncated cone having an angle of 26° with a flat tip of 0.157 mm in diameter. It shall fit into a hollow spindle and be held down by a spring loaded plunger. (*see* Fig. 3).

C-1.2 Indicating Device

The indicating dial shall have 100 divisions, each representing a depth of 0.007 6 mm penetration.

C-2 TEST SPECIMENS

Number of test specimen shall be taken as five.

The testing area shall be smooth and free from mechanical damage.

Test specimens shall be at least 1.5 mm thick and large enough to ensure a minimum distance of 3 mm in any direction from the indentor point to the edge of the specimen.

The hardness of the material under test shall be reported as the arithmetic average of the hardness of the test specimens.

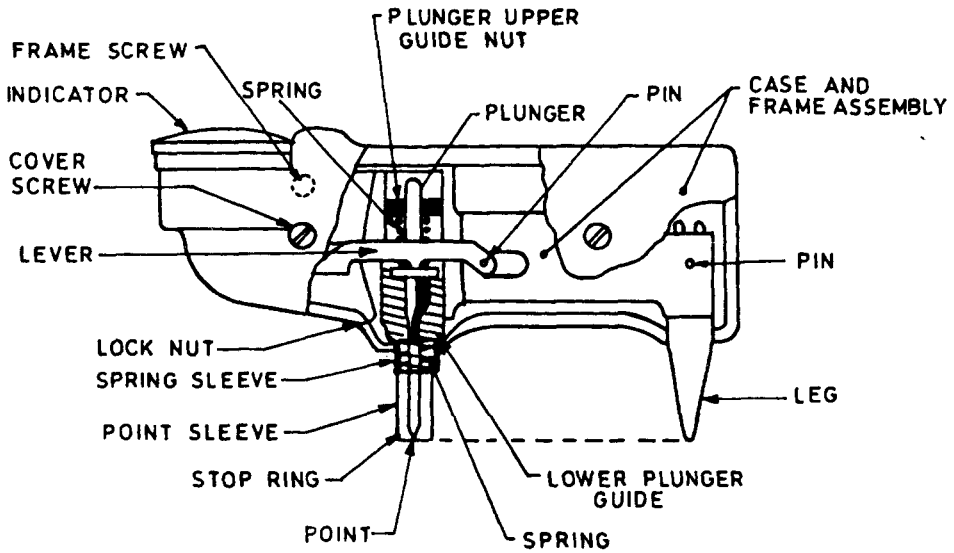


FIG. 3 DIAGRAM OF BARCOL IMPRESSOR

ANNEX D
(*Table* 1)

DETERMINATION OF TENSILE STRENGTH

D-1 APPARATUS

A testing machine that can be operated at constant rate of cross-head motion.

D-2 TEST SPECIMEN

Five specimens shall be used for this test.

The test specimen shall be a rectangular strip not less than 230 mm long and 25 ± 0.5 mm wide with four rectangular end pieces, as shown in Fig. 4, bonded to it with a cold-hardening epoxy resin. The thickness of the rectangular strip shall be that of the sheet under test. The faces shall be parallel to within 0.15 mm.

The four end pieces of any one test specimen shall be of the same thickness, which shall be not less than 3 mm. They shall be prepared from material similar to that under test.

NOTES

1 Before the adhesive is applied to the surfaces to be bonded it should be slightly roughened with a fine grade of abrasive paper and thoroughly cleaned with solvent. It is recommended that the assembly should be allowed to stand over night while under pressure.

2 Test specimens can be sawn from the blank (*see* Fig. 4 and 5) by means of a carbide-tipped fine toothed circular saw or a nylon-bonded carborundum wheel. The sawing operation must not overheat the specimen and the sawn edges must be free from imperfections as it is essential that the edges of the specimen are not finished by hand.

D-3 PROCEDURE

The test shall be carried out at 27 ± 2°C after conditioning the test specimen at this temperature for two hours.

The mean width and mean thickness of the specimen between the end pieces shall be measured to the nearest 0.05 mm.

The specimen shall be clamped in the serrated jaws of a tensile testing machine. The jaws shall grip the entire faces of the end pieces and the specimen shall be in axial alignment with the direction of pull. The specimen shall be loaded by separating the grips at a substantially constant rate such that fracture occurs in 30 to 90 s. The maximum load shall be noted and shall not differ from the true load by more than 2 percent.

D-4 CALCULATION

$$\text{Tensile strength } (TS) = \frac{L_B}{A}$$

where

TS = tensile strength, MPa;

L_B = load at break, N; and

A = original cross-sectional area, mm^2.

Results obtained on specimen that break within the area of the end pieces shall be disregarded and additional specimen tested in their place. The tensile strength of the material under test shall be reported as the arithmetic mean of the tensile strengths of the test specimen.

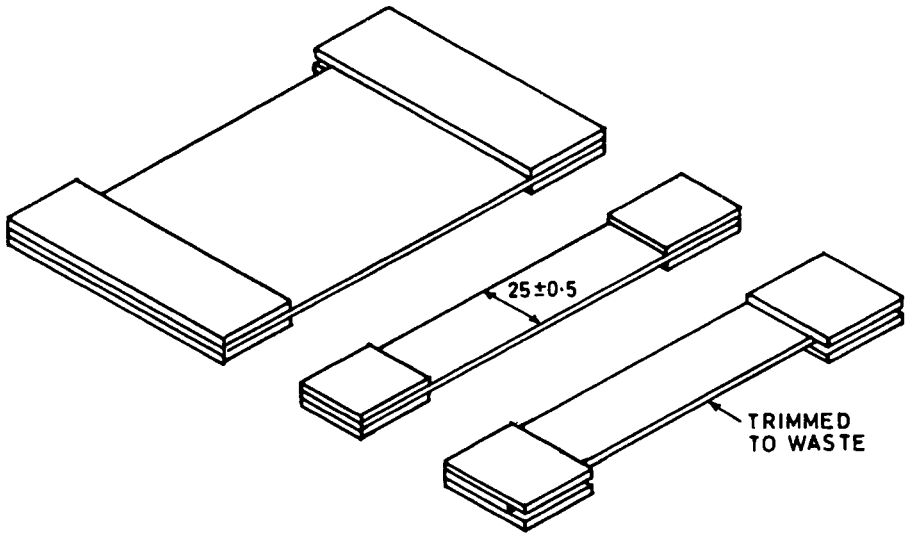


FIG. 4 METHOD OF PREPARING SPECIMENS WITH ATTACHED END PIECE FROM TEST BLANK

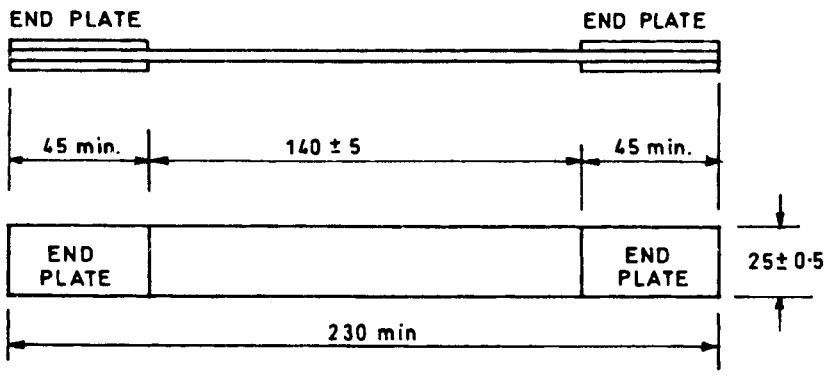


FIG. 5 TEST SPECIMEN

ANNEX E
(*Table* 3)

DETERMINATION OF BENDING STRENGTH

E-1 APPARATUS

A testing machine that can be operated at constant rate of cross-head motion and in which the error in the load measuring system shall not exceed ± 1 percent of the maximum load expected to be measured. The radius of the load blocks and supports shall be at least 3.0 mm.

E-2 TEST SPECIMEN

Five test specimens shall be used for this test. Each specimen shall be a rectangular bar 12.70 ± 0.50 mm wide and of length 24 to 30 times its thickness. The thickness of the specimen shall be the thickness of the panel under test.

E-3 PROCEDURE

The test shall be carried out at a temperature of 27 ± 2 °C.

The breadth (b) and thickness (d) of the specimen shall be measured to the nearest 0.01 mm.

The specimen shall be placed symmetrically across two parallel U-shaped supports, the distance (L) between the supporting edges being 16 times the measured thickness of the specimen, to the nearest 1 mm.

A load shall be applied squarely across the breadth of the specimen by means of a third U-shaped block parallel to end midway between the supporting blocks. The contact edges of the supporting blocs and the block applying the load shall have a radius of at least 3.0 mm. The crosshead speed shall be set to 5.0 mm/min. The load of fracture (P) shall be noted.

E-4 CALCULATION

The bending strength of the test specimen shall be computed as follows:

$$S = \frac{3PL}{2bd^2}$$

where

S = bending strength, MPa;
P = load at fracture, N;
L = support span, m;
b = breadth of specimen, m; and
d = thickness of specimen in mm.

ANNEX F
(*Table* 3)

DETERMINATION OF ELASTIC MODULUS IN BEND

F-1 APPARATUS

A testing machine that can be operated at constant rate of cross-head motion.

F-2 TEST SPECIMEN

Two test specimens shall be used for this test. Each specimen shall be a rectangular bar. The length of the specimen shall be not less than 24 times its thickness and breadth shall be 10 to 25 mm. The thickness of the specimen shall be equal to the thickness of the corresponding panel.

F-3 PROCEDURE

The test shall be carried out at a temperature of 27 ± 2°C.

The breadth and thickness of the specimen shall be measured to the nearest 0.01 mm.

The specimen shall be placed symmetrically across two parallel supports. The edges making contact across the specimen shall have radii of 1.5 to 3.5 mm. The distance (L) between the lines of contact of the supports with the specimen shall be 16 times the thickness of the specimen, accurate to the nearest 1 mm.

A load shall be applied squarely across the breadth of the specimen by means of a loading nose of radius 5 mm and parallel with and midway between the two supports. The rate at which the specimen shall

be deflected, that is, the rate of travel of the loading nose relative to the supports on which the specimen rests shall be 5mm/min. For a series of values of force the corresponding deflections shall be noted and from there a load-deflection curve shall be drawn.

F-4 CALCULATION

The elastic modulus in bending of the specimen shall be calculated from the initial straight part of the load deflection curve as follows :

$$\text{Elastic modulus in bend } E_{MOD} = \frac{PL^3}{4bd^3D}$$

where

E_{MOD} = elastic modulus in bending, MPa;

P = load selected from the straight part of the curve;

L = distance between supports, mm;

b = breadth of specimen, mm;

d = thickness of specimen, mm; and

D = deflection corresponding to the load, mm.

The elastic modulus of the material under test shall be reported as the arithmetic average of the elastic modulus of the test specimens.

The bending strength of the material under test shall be reported as the arithmetic average of the bending strength of the test specimens.

NOTE — The above calculation is not valid if the specimen is slipping excessively between the supports. Care should be taken to ensure that there is no slippage.

ANNEX G
(*Table* 3)

DETERMINATION OF WATER ABSORPTION

G-1 APPARATUS

A weighing balance with an accuracy of ± 10 mg.

G-2 TEST SPECIMEN

Two specimens shall be used for this test.

The specimen shall be $38\ ^{+0.5}_{0}$ mm square and shall have smooth edges. The thickness of the specimen shall be the thickness of the sheet under test.

The surfaces of all specimens shall be free from dust, oil or other matter that might interfere with the absorption of water.

G-3 PROCEDURE

The thickness of the test specimen shall be measured to the nearest 0.025 mm. The specimen shall then be weighted (W_1) and immersed for 24 ± 1 h in distilled water at 23 ± 2°C. Precautions shall be taken to prevent specimens from making contact over any substantial area with one another or with the container.

The specimen shall be dried with a clean cloth or filter paper and, not more than 2 min after removal from the water, shall be reweighed (W_2).

G-4 CALCULATION

The absorption coefficient shall be determined from the following:

$$A = \frac{W_2 - W_1}{W_1} \times 100$$

where

A = absorption coefficient (percent);

W_2 = mass of specimen after immersion in water, mg; and

W_1 = mass of specimen before immersion in water, mg.

The water absorption of the material under test shall be reported as the average of the water absorption of the test specimens.

ANNEX H

(*Table* 3)

DETERMINATION OF FIRE RETARDANCY

A bar 125 ± 5 mm in length by 12.5 ± 0.2 mm in width and of the thickness of material (normally supplied) from the composite product to be tested shall be taken as a sample. A mark shall be scribbled at a length of 100 mm from one end. From the other end, the sample shall be supported horizontally at one end. The free end of the specimen shall be exposed to a Bunsen burner gas flame for 30 sec. Time and extent of burning shall be measured and reported if the specimen does not burn 100 mm. An average burning rate shall be reported for a material if it burns to the 100 mm mark from ignited end. The above experiments shall be repeated for at least 10 specimen (samples). The results to be observed in line with the following criteria.

a) Burning Rate : If two or more specimens have burnt to the 100 mm gauge mark, average burning rate (cm/min) shall be reported as the average of the burning rates of all specimens which have burnt to the mark.

b) Average time of burning and average extent of burning of the sample shall be reported if none of ten or not more than one of twenty specimens have burnt to the 100 mm mark.

ANNEX J

(Foreword)

COMMITTEE COMPOSITION

Doors, Windows and Shutters Sectional Committee, CED 11

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