IS 15878 (2010): Coir Hardboard for General Purposes -Specification [CED 20: Wood and other Lignocellulosic products]

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Indian Standard

COIR HARDBOARD FOR GENERAL PURPOSES — SPECIFICATION

ICS 79.060.20

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

January 2010 **Price Group 6**

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Wood and Other Lignocellulosic Products Sectional Committee had been approved by the Civil Engineering Division Council.

Coir hardboard is a panel product manufactured from coir and other lignocellosic materials, combined with synthetic resin or other suitable binder and is a recent development in the panel industry. The technology utilized to manufacture coir hardboard is an improvisation of that used by the existing hardboard industry and has been developed by Central Institute of Coir Technology, Bangalore — a research institute of Coir Board (Govt of India). Coir hardboards find application wherever fibre hardboards of various types are being used, such as in the construction of bus bodies, prefabricated houses, panelling, partitions, furniture, etc.

In the formulation of this standard, due weightage has been given to the climatic conditions and practices in the country.

A scheme of labelling environment friendly products to be known as ECO-Mark has been introduced at the instance of the Ministry of Environment and Forests (MEF), Government of India. The ECO-Mark shall be administered by the Bureau of Indian Standards (BIS) under the *BIS Act*, 1986 as per the Resolution No. 71 dated 21 February 1991 and Resolution No. 425 dated 20 October 1992 published in the Gazette of the Government of India. For a product to be eligible for ECO-Mark, it shall also carry the Standard Mark of the BIS besides meeting additional environment friendly requirements. For this purpose, the Standard Mark of BIS would be a single mark being a combination of the ISI Mark and the ECO logo. Requirements to be satisfied for a product to qualify for the BIS Standard Mark for eco-friendliness will be optional. Manufacturing units will be free to opt for ISI Mark alone also.

The ECO-Mark criteria are based on the Gazette Notification No. 170 dated May 16, 1996 for Wood Substitutes as Environment Friendly Products published in the Gazette of Government of India. The manufacturer shall provide documentary evidence by way of certificate or declaration to this effect to Bureau of Indian Standards while applying for ECO-Mark.

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

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

Indian Standard

COIR HARDBOARD FOR GENERAL PURPOSES — SPECIFICATION

1 SCOPE

1.1 This standard covers the essential requirement of general purpose coir hardboard for use in dry as well as humid conditions.

1.2 This standard does not cover the requirement of medium density coirboards, coir veneer boards, soft boards, insulation boards, wood particle boards and similar boards.

2 REFERENCES

The standards listed in Annex A 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 in Annex A.

3 TERMINOLOGY

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

3.1.1 *Coir Hardboards* — Coir based panel material with a nominal thickness of 1.5 mm or greater, manufactured from coir needled felt (non-woven) with or without the combination of other lignocellosic materials like jute fibres, paper, etc, by the application of heat and pressure. The primary bond is usually derived from the felting of the fibres. Bonding materials and/or additives may be added.

4 CLASSIFICATION

4.1 Coir hardboards are generally classified into the following three types according to their method of manufacture, density and other related mechanical and physical properties.

a) Medium coir hardboard,
b) Standard coir hardboard, and
c) Tempered coir hardboard.

4.1.1 *Medium Coir Hardboard*

Coir hardboard having uniform thickness and a density between 350 kg/m^3 and 800 kg/m^3.

4.1.2 *Standard Coir Hardboard*

Coir hardboard having uniform thickness and a density exceeding 800 kg/m^3.

4.1.3 *Tempered Coir Hardboard*

Coir hardboard which has been further treated in order to improve or modify one or more of their properties (this may have the effect of altering the density) and having a density exceeding 800 kg/m^3.

5 MATERIAL

5.1 Coir

Coir fibre layer used in the manufacture of coir hardboard shall be uniform with a minimum mass of 600 g/m^2.

5.2 Jute/Other Fine Fibre

Jute fibre layer or any other finer fibre used in the manufacture of coir hardboard shall be uniform with a minimum mass of 60 g/m^2.

5.3 Paper

Paper used in the manufacture of coir hardboard shall be uniform with a minimum mass of 40 g/m^2.

5.4 Adhesive

Any suitable type of synthetic resin adhesive confirming to IS 848 may be used for the purpose of bonding to comply with physical and mechanical requirements given in Table 1.

6 MANUFACTURE

Coir fibres manufactured by mechanical process as per IS 9308 (Part 2) or IS 9308 (Part 3) are processed through needled felt plant (non-woven system) to make uniform mats in different densities according to the requirement. If required to give a smooth surface finish, finer fibres of any other lignocellosic material may be added such as jute fibres, paper, etc. These fibre mats thus produced are impregnated with resin and pressed into panels by passing into a press under controlled temperature, pressure and time.

For ECO-Mark, other finer fibres of lignocelluloses

material when used shall be only from species of wood sources other than natural forest such as wood from industrial and social forestry plantations, etc and shade trees from tea and coffee estates, wood residues or agricultural wastes.

7 DIMENSIONS AND TOLERANCE

7.1 The boards shall be rectangular and unless otherwise specified, shall have square edges. The lengths of the two diagonals of the board shall not differ by more than ±3.0 mm/m length of the diagonals. The edge straightness and squareness of the hardboards when tested in accordance with the method described in Annex B shall meet the requirements specified in Table 1.

7.2 Width and Length

Unless otherwise specified, the width and length of coir hardboards shall be as given below:

a) Width : 1.52, 1.22 m
b) Length : 3.05, 2.44, 1.83, 1.22 m

Tolerance on length and width shall be ±3 mm/m.

NOTE — Any other dimension as agreed to between the manufacture and the purchaser may be used.

7.3 Thickness

The thickness of coir hardboards and tolerances thereon shall be as given in Table 1. The mean thickness shall be determined by the method described in Annex B.

8 PHYSICAL AND MECHANICAL REQUIREMENTS

The requirements of density, moisture content, water absorption, swelling in thickness, modulus of rupture, breaking load, resistance to spread of flames, drop impact test and flexibility test of coir hardboards as described in Annexes B, C, D, E, F, G, H, J, and K, respectively, shall be as given in Table 1.

9 WORKABILITY AND FINISH

9.1 Workability

The coir hardboards shall not crack split or chip when drilled, sawed or nailed perpendicularly to the surface.

9.2 Finish

The coir hardboards shall be of uniform thickness subject to the tolerances given in Table 1. They shall be free from warp. The surface shall be flat, free from cracks and lumps. At least one face shall be smooth.

10 SAMPLING AND CRITERIA FOR CONFORMITY

10.1 Scale of Sampling

10.1.1 *Lot*

In any consignment, all coir hardboards of the same type and thickness shall be grouped together to constitute a lot.

10.1.2 The conformity of a lot to the requirements of this standard shall be ascertained on the basis of tests on coir hardboards selected from it.

10.1.3 The number of coir hardboards to be selected from the lot shall be in accordance with the following:

Lot Size	*Number of Coir Hardboards to be Selected*
N	*n*
Up to 50	2
51-150	3
151-300	4
301-500	7
501 and above	10

10.1.4 These coir hardboards shall be selected at random. In order to ensure randomness of selection, all coir hardboards in the lot may be arranged in a serial order and every *r*th coir hardboard may be selected till the requisite number of coir hardboard is obtained, *r* being the integral part of *N*/*n* where *N* is the lot size and *n* the sample size.

10.2 Criteria for Conformity

10.2.1 A lot shall be considered as conforming to this specification if the requirements stipulated under **7**, **8** and **11.4.1** to **11.4.12** are satisfied.

10.2.2 If the samples selected as specified in **10.1.3** are not found fully complying with the requirement of **7**, **8** and **11.4.1** to **11.4.12**, a further similar set of samples shall be selected at random from the same lot and subjected to all tests. If any of the samples in the second set is also found not to comply with requirements of this specification, all the boards in the lot represented by the samples shall be rejected.

11 TESTS

11.1 The length and the width of each of the coir hardboard selected as given in **10.1.3** shall be measured in accordance with **B-1** before cutting them for obtaining test units.

11.2 Test Unit

From each selected coir hardboard, a length of 750 mm shall be cut. From such length, a rectangular test unit

of 900 mm × 450 mm shall be cut in such a way that no part of the unit lies within 150 mm of the edges from which it is cut. Each test unit shall be conditioned in accordance with **11.3** and shall be tested for thickness in accordance with **B-2**.

11.3 Conditioning of Test Unit

All the test units shall be conditioned by being freely exposed for at least 72 hours to the atmosphere of a well ventilated room. This period may be reduced to 48 hours or 16 h if the change in mass is within ±10 percent.

In case of disagreement and in any event if either the purchaser or the manufacturer so specifies, this shall be conditioned in an atmosphere maintained at a relative humidity of 65 ± 5 percent and at a temperature of 27 ± 2°C until the mass is substantially constant. The method of conditioning adopted shall be recorded with the test results.

11.4 Tests

11.4.1 *Thickness*

The thickness of each of the test specimens shall be measured in accordance with Annex B. This may be done after the test unit has been marked for cutting or after the test specimen has been cut, provided the material under test is in properly conditioned state when the measurements are made.

11.4.2 *Density*

For measurement of density, two square specimen of size 100 mm ± 1 mm shall be cut from the test panel. The edges of the test specimen shall be smoothened with sand paper. The density shall be determined as described in Annex B on two test specimens and the average value shall meet the requirements specified in Table 1.

11.4.3 *Moisture Content*

For determination of moisture content two square test specimens of size 100 ± 1 mm shall be cut from the test panel. Other specimen size may be used when deemed necessary. The moisture shall be determined as described in Annex C. The average moisture content of the specimens shall be as specified in Table 1.

The moisture content may also be determined using a calibrated electronic moisture meter in which case the use of moisture meter should be indicated while reporting the test results. The moisture content values obtained by methods described in Annex C shall be deemed authentic in the event of dispute.

11.4.4 *Water Absorption Test*

For the water absorption test, three square test specimens of size 100 ± 1 mm shall be cut from the test panel. These specimens shall be cut leaving 150 mm from the edge of the sheet. The water absorption test shall be carried out as described in Annex D. Three test specimens shall be subjected to this test and average value of water absorption shall meet the requirement specified in Table 1.

11.4.5 *Swelling in Thickness After Immersion in Water*

For the determination of swelling in thickness after immersion in water, 3 square specimens of size 50 ± 1 mm shall be cut from the test unit. The edges of the test specimen shall be smoothened with a sand paper. Swelling in thickness after immersion in water shall be measure as described in Annex E. Average swelling in thickness of the test specimens shall not exceed the value given in Table 1.

11.4.6 *Tensile Strength Parallel to Surface*

For the determination of tensile strength parallel to surface three test specimens shall be cut from the test unit. The tensile strength parallel to surface of the samples when tested in accordance to Annex F shall not be less than the value given in Table 1.

11.4.7 *Modulus of Rupture and Modulus of Elasticity*

For the determination of modulus of rupture and modulus of elasticity, four rectangular test specimens shall be cut from each test unit having all edges square. The modulus of rupture and modulus of elasticity of the samples when tested in accordance with the methods in Annex G shall meet the requirements specified given in Table 1.

11.4.8 *Modulus of Rupture After 8 h Boiling*

For the determination of modulus of rupture after 8 h of boiling, four rectangular test specimens shall be cut with all edges square from each test unit. The modulus of rupture of the samples when tested in accordance to Annex G after immersion in boiling water for 8 h shall meet the requirements specified given in Table 1.

11.4.9 *Breaking Load Test for Tempered Coir Hardboard*

For determination of breaking load of tempered coir hardboards, three rectangular test specimens shall be cut from each test unit having all edges square. The breaking load of the samples when tested in accordance with the method in Annex G shall meet the requirements specified given in Table 1.

11.4.10 *Resistance to Spread of Flame*

Three test specimens when subjected, shall pass the test in accordance with the Annex H.

Table 1 Requirements of Coir Hardboards
(*Clauses* 5.4, 7.3, 8, 9.2 *and* 11.4.2 *to* 11.4.9)

Sl No.	Properties	Medium Coir Hardboard	Standard Coir Hardboard	Tempered Coir Hardboard
(1)	(2)	(3)	(4)	(5)
i)	Bulk density, kg/m³	350 – 850	≥ 800	≥ 800
ii)	Thickness and tolerance, mm	1.5 ± 0.4	1.5 ± 0.4	1.5 ± 0.4
		2.0 ± 0.4	2.0 ± 0.4	2.0 ± 0.4
		3.0 ± 0.4	3.0 ± 0.4	3.0 ± 0.4
		4.0 ± 0.5	4.0 ± 0.5	4.0 ± 0.5
		6.0 ± 0.5	6.0 ± 0.5	6.0 ± 0.5
		8.0 ± 0.7	8.0 ± 0.7	8.0 ± 0.7
		10.0 ± 0.7	10.0 ± 0.7	10.0 ± 0.7
		12.0 ± 0.9	12.0 ± 0.9	12.0 ± 0.9
iii)	Squareness (*Max*), mm/m	3	3	3
iv)	Edge straightness (*Max*), mm/m	2	2	2
v)	Moisture content, Percent	5 – 15	5 – 15	5 – 15
vi)	Water absorption (*Max*), percent, after 24h soaking	65	40	25
vii)	Swelling in thickness (*Max*), 24 h immersion in water, Percent	25	25	5
viii)	Tensile strength parallel to surface (*Min*), N/mm²	—	—	0.25
ix)	Modulus of rupture (*Min*), N/mm²:			
	a) Up to and including 3.0 mm	12	30	50
	b) 4.0 to 12.0 mm	16	30	50
x)	Modulus of elasticity (*Min*), N/mm²	2 000	3 000	4 000
xi)	Modulus of rupture after 8 h boiling (*Min*), N/mm²:			
	a) Up to and including 3.0 mm	5	15	30
	b) 4.0 to 12.0 mm	8	15	30
xii)	Breaking load (*Min*) both along the length and width, N	—	—	360
xiii)	Tensile strength (*Min*), N/mm²	—	—	25
xiv)	Resistance to spread of flame	—	—	To pass the test
xv)	Drop impact test	—	—	To pass the test
xvi)	Flexibility	—	—	To pass the test

11.4.11 *Drop Impact Test*

Three test specimens shall be tested and the mid value taken into consideration shall meet the requirement given in Annex J.

11.4.12 *Flexibility Test*

Three test specimen shall be subjected to flexibility test and each specimen tested shall pass the test as given in Annex K.

12 ADDITIONAL REQUIREMENT FOR ECO-MARK

12.1 General Requirement

12.1.1 Coir hardboards manufactured shall meet the requirements of the standard.

12.1.2 The manufacturer shall produce to BIS environmental consent clearance from State Pollution Control Board, as per the provisions of *Water* (*Prevention and Control of Pollution*) *Act*, 1974 and *Air* (*Prevention and Control of Pollution*) *Act*, 1981 and *Water* (*Prevention and Control of Pollution*) *Cess Act*, 1977 along with the authorization, if required under the *Environment (Protection) Act*, 1986 while applying for ECO-Mark appropriate with enforced rules and regulations of forest department.

13 MARKING

Each coir hardboard shall be legibly marked near any of its corners with the following:

a) Name of the manufacturer,
b) Type of coir hardboards,
c) Dimension and thickness,
d) Date of manufacture, and
e) The criteria for which coir hardboard has been labelled as ECO-Mark.

14 BIS CERTIFICATION MARKING

Each coir hardboard may also be marked with the Standard Mark.

14.1 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. The details of conditions under which a license for the use of Standard Mark may be granted to manufacturers or producers may be obtained from Bureau of Indian Standards.

ANNEX A
(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*	*IS No.*	*Title*
707 : 1976	Glossary of terms applicable to timber technology and utilization (*second revision*)	9308 (Parts 1 to 3) : 1987	Specification for mechanically extracted coir fibres (*first revision*)
848 : 2006	Synthetic resin adhesives for plywood (phenolic and amino plastics) (*second revision*)		

ANNEX B
(*Clauses* 7.1, 7.3, 8, 11.4.1 *and* 11.4.2)

MEASUREMENT OF DIMENSIONS AND DENSITY

B-1 DETERMINATION OF LENGTH AND WIDTH

The length and width of each coir hardboard shall be measured to an accuracy of ±1 mm.

B-2 DETERMINATION OF THICKNESS

B-2.1 The thickness of each of the test specimens obtained from the test units (*see* **11.2**) shall be measured, in mm, to an accuracy of 0.05 mm. The measurement shall be done at points representing the points of intersection of the diagonals.

B-2.2 The contact surfaces of the measuring instruments shall be flat and shall have a contact area of 2 ± 0.04 cm^2. While taking measurement of thickness, care shall be taken that the surfaces of the board are not deformed. The graduation of the measuring instrument shall be accurate to 0.01mm.

B-3 TEST FOR EDGE STRAIGHTNESS AND SQUARENESS

B-3.1 Procedure for Edge Straightness

The straightness of the edges and ends of veneered particle board shall be verified against a straight edge not less than the full length of the veneered particle board. If the edge on the end of the veneered particle board is convex, it shall be held against the straight edge in such a way as to give approximately equal gap at each end. The largest gap between the straight edge and the edge shall be measured to the nearest millimetre and recorded.

B-3.2 Procedure for Squareness

The squareness of veneered particle board shall be checked with a square with arms 500 mm long, by applying one arm of the square to the veneered particle board. The maximum width of the gap shall be recorded.

B-4 DETERMINATION OF DENSITY

B-4.1 The mass of each test specimen shall be measured to an accuracy of ±0.1g. The length and width of each test specimen shall be measured to an accuracy of ±0.1 mm. The density of each specimen shall be calculated as follows:

$$\text{Density} = \frac{m \times 10^6}{l \times b \times t} \text{ kg/m}^3$$

where

m = mass of the test specimen, in g;

l = length, in mm;

b = width, in mm; and

t = mean thickness, in mm.

B-4.2 The following information shall be reported:

a) Density of each of the two specimen from a test unit, and

b) Average density of both specimens from a test unit. This average shall represent the density of the test unit.

ANNEX C
(*Clauses* 8 *and* 11.4.3)

METHOD OF TEST FOR MOISTURE CONTENT

C-1 PROCEDURE

Each specimen shall be weighed to an accuracy of not less than 0.01 g. Test specimen shall then be dried in a ventilated oven at a temperature of 103 ± 2°C until the mass is constant (variation of ± 0.02 percent between two successive weighments made at an interval of not less than an hour).

C-2 EXPRESSION OF RESULTS

C-2.1 The moisture content expressed as percentages of oven dry mass is given by the formula:

$$\text{Moisture content} = \frac{m_1 - m_0}{m_0} \times 100$$

where

m_1 = initial mass, in g; and

m_0 = oven dry mass, in g.

C-2.2 The moisture content determined by calculating the arithmetic mean of all the test specimens taken from the same board and is expressed in percentage nearest to the first decimal.

NOTE — A calibrated electronic moisture meter may be used when deemed necessary, if agreed to between the purchaser and the manufacturer.

ANNEX D
(*Clauses* 8 *and* 11.4.4)

METHOD OF TEST FOR WATER ABSORPTION

D-1 PROCEDURE

D-1.1 Three test specimens each of 100 mm × 100 mm shall be cut from a sheet. These specimens shall then be cut leaving 150 mm from the edges of the sheet. The edges of the specimens shall be smoothened with sand paper but not sealed. The specimens shall be conditioned in an atmosphere maintained at a relative humidity of 65 ± 5 percent and at a temperature of 27 ± 2°C until the weight is substantially constant. After this, each of the test specimens shall be weighed to an accuracy of ±0.1 g. These shall then be kept fully submerged in water, clear of the bottom of the container and maintained at 27 ± 2°C for 24 h. At the conclusion of 24 h immersion period, the test specimens shall be withdrawn from water and all excess water shall be wiped with a damp cloth and finally with dry tissue paper. Each of the specimens shall again be weighed to an accuracy of ± 0.1 g. For each of the specimens the increase in weight, expressed as percentage of its weight before immersion, shall be calculated.

D-1.2 Three test specimens shall be subjected to this test and average value shall be taken for consideration. The test specimen should also not show any sign of warping, deformation and de-lamination.

D-1.3 The following information shall be reported:

a) Water absorption of each of the three specimens from a test unit (expressed as percentage of its mass before immersion), and

b) Average water absorption of three specimens from a test unit, which shall represent the water absorption of the test unit.

ANNEX E
(*Clauses* 8 *and* 11.4.5)

DETERMINATION OF SWELLING IN THICKNESS AFTER IMMERSION IN WATER

E-1 The thickness at the edge of each test specimen shall be measured to an accuracy of 0.05 mm at two places along each edge. The points at which the thickness is measured shall be carefully and indelibly marked.

E-2 Each of the test specimens are immersed in fresh clear water having a *p*H of 6.5 ± 1. The test pieces shall be separated from each other and from the bottom and sides of water bath. The upper edges of test pieces should be covered by 25 ± 5 mm water through out the test.

E-3 At the end of 24 h each test specimen shall be withdrawn from the water, wiped off with damped cloth and allowed to stand at normal room condition for 1 h with its bottom edge resting on a glass sheet. Thickness of each test specimen shall be measured at the same points marked earlier with the same degree of accuracy.

E-4 The swelling in thickness of each test piece G_t expressed, as percentage of original thickness shall be calculated according to the following formula.

$$G_t = \frac{t_2 - t_1}{t_1} \times 100$$

Where t_1 is the thickness of test piece before immersion, in mm, and t_2 is the thickness of the test piece after immersion, in mm. Swelling in thickness shall be expressed to one decimal place.

E-5 The swelling in thickness of a board is the arithmetic mean of the results of all test pieces taken from that board and shall be expressed in percent to one decimal place.

ANNEX F
(*Clauses* 8 *and* 11.4.6)

METHOD OF TEST FOR TENSILE STRENGTH PARALLEL TO SURFACE

F-1 PROCEDURE

F-1.1 The tensile strength test shall be carried out on test specimen of 25 mm wide × 200 mm long and of the actual thickness of the board. These specimens shall be cut along the length and width of the board. Specimens with clear-cut edges only shall be used. Specimens with irregularities in the cut edges shall be rejected. The rate of traverse of the moving jaws of the tensile testing machine shall be 20 ± 5 mm/min.

F-1.2 Three test specimens shall be tested and mid value taken for consideration.

ANNEX G
(*Clauses* 8, 11.4.7, 11.4.8 *and* 11.4.9)

METHOD OF TEST FOR MODULUS OF ELASTICITY, MODULUS OF RUPTURE AND BREAKING LOAD TEST

G-1 GENERAL

G-1.1 This test shall be performed on the test specimens after conditioning (*see* **11.3**). The test specimens shall be preferably tested with the same face uppermost.

G-1.2 Specimens

The test specimens shall have the following dimensions:

Length of 25 times the thickness + 50 mm and width of 75 mm

G-2 PROCEDURE

G-2.1 Each test specimen shall be simply supported on horizontal parallel rollers, their length being 80 mm and the diameter 15 mm ± 0.5 mm for specimens of thickness 7 mm or less, and 30 mm ± 0.5 mm for specimens of thickness more than 7 mm. The span of the specimen between rollers shall be equal to 25 times the nominal thickness of the test piece. The rollers should be arranged as to be free to rotate on ball or roller bearings. The load shall then be applied at the centre of the span along a line parallel to the roller by means of a bar rounded to a radius of 15 mm ± 0.5mm. The load shall be applied at the rate of 30 mm ± 3 mm/min.

G-2.2 The following information shall be reported:

a) The failing load and modulus of rupture/ modulus of elasticity (*see* Note) of each test specimen; and

b) The mean failing load and mean modulus of rupture/modulus of elasticity of the four specimens from a test unit.

NOTE — The modulus of rupture shall be calculated by the following formula:

1) Modulus of rupture, $\text{MPa} = \frac{3WL}{2bt^2}$

where

W = failing load, in N;

L = span, in mm;

b = width of specimen, in mm; and

t = thickness of specimen, in mm.

2) Modulus of elasticity, $\text{N/mm}^2 = \frac{PL^3}{4bh^3\Delta}$

where

P = load at proportional limit which shall be taken as the point in load-deflection curve above which the graph deviates from the straight line, in N;

L = span, in mm;

b = width of the specimen, in mm;

h = thickness of the specimen, in mm; and

Δ = deflection at proportional limit, in mm (which is corresponding to P in the load-deflection graph).

G-2.3 For modulus of rupture after 8 h boiling, the test specimens shall be boiled for 8 h. After the completion of 8 h boiling modulus of rupture for each test specimen shall be performed as per **G-2.1**.

G-3 BREAKING LOAD TEST FOR TEMPERED COIR HARDBOARD

G-3.1 The breaking load test for tempered coir hardboards shall be carried out on a universal testing machine on a specimen of 200 mm long × 75 mm wide. The distance between supports shall be 100 mm, with a bending shank of 25 mm diameter. The loading shall be completed between 30 to 60 s and the load at which fracture occurs shall be recorded.

G-3.1.1 Three test specimens shall be tested and mid value taken for consideration.

ANNEX H
(*Clauses* 8 *and* 11.4.10)

METHOD OF TEST FOR RESISTANCE TO SPREAD OF FLAME

H-1 PROCEDURE

H-1.1 The test for resistance to spread of flame shall be carried out in the following manner:

a) A test specimen measuring about 150 mm × 25 mm shall be subjected to the luminous batswing flame, preferably supplied by a Bunsen burner. The specimen shall be held with the flat side up at an angle of 45° to the horizontal. The flame shall be 25 mm in width across the tips.

b) The flame shall be applied to the specimen at the lower end for 30 s and removed for similar period and then applied again to the same end for a second period of 30 s and then again removed. This test shall be carried out with the finished surface facing upward as also the finished surface facing downward.

c) Should the specimen get ignited, it shall not continue to burn for more than 20 s after the flame has been finally removed.

H-1.2 Three test specimens shall be tested and each of the test specimens shall confirm to the requirement.

ANNEX J
(*Clauses* 8 *and* 11.4.11)

METHOD OF TEST FOR DROP IMPACT TEST

J-1 PROCEDURE

J-1.1 The drop impact test shall be carried out with a falling weight type of impact type of tester, which shall essentially consist of the following:

a) A rigid metallic base preferably with levelling screws. The base shall have a hole or a ring of 25 mm inside diameter attached to it for supporting the test specimen on it. The ring/ hole should be so situated that its axis coincides with the line of fall of the striker. A device for clamping the test specimen to hold it in position while under impact shall also be provided.

b) A striker consisting of 19 mm diameter hardened steel ball ended plummet capable of being clamped, released and falling freely in the guiders. The spherical striking surface of the plummet shall be free from faults or any other imperfections. The entire striker assembly shall weigh 900 g. The line of fall of the plummet shall be perpendicular to the specimen surface and shall be concentric to the axis of the ring.

c) Superstructure shall consist of rigid frame with guides to adjust the height of the striker. The height of the frame shall be such that the maximum height of fall of the striker is not less than 300 mm and the frame shall be calibrated from 0 to 300 mm.

J-1.2 The test specimen of size 100 mm × 100 mm, supported on the ring shall be subjected to drop impact. The material shall not puncture in drop impact test with a drop height of 130 mm. Minor cracks on the reverse side, if any, should confine to the point of indentation only and shall not propagate beyond an area with 20 mm diameter.

J-1.3 Three test specimens shall be subjected to test and each of the test specimens shall conform to the requirements.

ANNEX K
(*Clauses* 8 *and* 11.4.12)

METHOD OF TEST FOR FLEXIBILITY

K-1 PROCEDURE

K-1.1 For flexibility test, samples 400 mm long × 75 mm wide shall be cut from the sheet both along the length and width leaving 150 mm from the edges of the sheet. The flexibility test shall be conducted in as received conditions. These samples shall be capable of being bent through 180° around a mandrel of 250 mm diameter, without showing any visible crack.

K-1.2 Three test specimens shall be subjected to flexibility test and each shall pass the test.

ANNEX L
(*Foreword*)

COMMITTEE COMPOSITION

Wood and Other Lignocellulosic Products Sectional Committee, CED 20

Organization	*Representative(s)*
Indian Plywood Industries Research & Training Institute, Bangalore	Dr C. N. Pandey (***Chairman***)
Bamboo Society of India, Bangalore	Shri N. S. Adkoli Shri A. S. Sadashivaiah (*Alternate*)
Building Materials & Technology Promotion Council, New Delhi	Shri J. K. Prasad Shri A. K. Tiwari (*Alternate*)
Central Building Research Institute, Roorkee	Dr L. K. Agarwal Dr B. S. Rawat (*Alternate*)
Central Public Works Department, New Delhi	Shri Surinder Kumar Shri S. K. Verma (*Alternate*)
Century Plyboard India Ltd, Kolkata	Shri Ajay Baldawa Shri Nikhilesh Roy Chowdhury (*Alternate*)
Coir Board, Bangalore	Shri M. Sudhakaran Pillai Shri R. Vasu Dev (*Alternate*)
Directorate General of Supplies & Disposals, Hyderabad	Shri M. Gangaraju
Directorate of Standardization, New Delhi	Dr (Shrimati) Indu Gupta Shri G. K. Sharma (*Alternate*)
Engineer-in-Chief's Branch, New Delhi	Shri N. B. Shelar Shri Sanjay Mittal (*Alternate*)
Federation of Indian Plywood & Panel Industry, New Delhi	Shri Jayadeep Chitlangia Shri Ajay Baldawa (*Alternate*)
Forest Research Institute, Dehra Dun	Director
Housing and Urban Development Corporation, New Delhi	Representative
Indian Academy of Wood Science, Dehra Dun	Secretary Joint Secretary (*Alternate*)
Indian Plywood Industries Research & Training Institute, Bangalore	Shri K. Shyamasundar Shri M. Venugopal Naidu (*Alternate*)
Institute of Wood Science & Technology, Bangalore	Director
Jolly Board, Mumbai	Shri Arvind Jolly Shri P. K. Das Gupta (*Alternate*)
Kerala State Bamboo Corporation Ltd, Ernakulam	Shri M. R. Anil Kumar
Kutty Flush Door & Furniture Co Pvt Limited, Chennai	Col Y. G. Krishnan Shri K. Shankarkrishnan (*Alternate*)
Mangalam Timber Products Limited, Bangalore	Shri G. S. Gupta Shri R. Krishnan (*Alternate*)
Ministry of Defence (DGQA), Kanpur	Shri Gautam Gupta Shri Nusrat Ullah (*Alternate*)
Ministry of Defence (R&D), New Delhi	Shri Ravinder Kumar
Ministry of Railways, Lucknow	Director STDS (Carriage) Assistant Director (*Alternate*)
National Mission on Bamboo Application, New Delhi	Shri Sunil Pandey
National Test House, Kolkata	Shri Alok De Shri S. Thirumalai Kolundu (*Alternate*)
Northern India Plywood Manufacturer Association, Jalandhar	Shri N. K. Tiwari Shri Anil Goel (*Alternate*)
Nuchem Limited, New Delhi	Shri Sudev Barar Shri P. B. Venkat Sastry (*Alternate*)

Organization	*Representative(s)*
Permalli Wallace Limited, Bhopal	Shri S. K. Kadesia Shri B. S. Parmar (*Alternate*)
Rajiv Gandhi Rural Housing Corporation Ltd, Bangalore	Shri Mahadeva Prasad
The South Indian Plywood Manufacturers Association, Chennai	Shri K. Sankarakrishnan
The Western India Plywood Limited, Kannur	Shri P. K. Mohamed Shri K. Raghunathan (*Alternate*)
Timber Development Association of India, Dehradun	Representative
Timpack Pvt Limited, Byrnihat	Director
BIS Directorate General	Shri A. K. Saini, Scientist 'F' & Head (CED) [Representing Director General (*Ex-officio*)]

Member Secretary
Shri J. Roy Chowdhury
Scientist 'E' (CED), BIS

Wood, Other Lignocellulosic Based Building Boards and Speciality Wood Products Subcommittee, CED 20 : 6

In personal capacity (*573, 23rd Cross, 14th Main, Banashankari, 2nd Stage, Bangalore 560070*)	Dr H. N. Jagadeesh (***Convener***)
Arunachal Plywood Industries Limited, Kolkata	Shri M. M. Jalan Shri J. Prashad (*Alternate*)
Bharat Heavy Electricals Limited, Piplani	Shri M. V. Prabhakar Shri S. K. Gupta (*Alternate*)
Central Building Research Institute, Roorkee	Dr L. K. Aggarwal Shri B. Singh (*Alternate*)
Central Institute of Coir Technology, Kalavooor	Shri M. Sudhakaran Pillai
Coir Industrial Products Co-operative Society Limited, Bangalore	Shri Manoj Kumar Shri Vijay Ghorpade (*Alternate*)
DGS&D, New Delhi	Shri I. N. K. Upadhyay
ECO Board Industries Limited, Pune	Shri I. A. V. V. Raghva Charrya Shri Siva Sankar Kalive (*Alternate*)
Engineer-in-Chief's Branch, New Delhi	Shrimati P. Meenakshi Col N. A. Kumar (*Alternate*)
Federation of Indian Plywood & Panel Industry, New Delhi	Shri Arvind Jolly Shri Moiz S. Vagh (*Alternate*)
Forest Research Institute (Forest Products Division), Dehra Dun	Head of Department Dr S. P. Khale (*Alternate*)
Godrej & Boyce Manufacturing Company Limited, Mumbai	Shri Girish V. Nalavade Shri Manubhai M. Shah (*Alternate*)
Indian Plywood Industries Research and Training Institute, Bangalore	Shri M. Venugopal Naidu Shrimati D. Sujatha (*Alternate*)
Indian Plywood Industries Research & Training Institute, Bangalore	Dr S. K. Nath Shri M. Venugopal Naidu (*Alternate*)
Institute of Wood Science and Technology, Bangalore	Dr R. V. Rao Dr Ajay Karmakar (*Alternate*)
Integral Coach Factory, Chennai	Representative
Jolly Board Limited, Mumbai	Shri Arvind Jolly Shri P. K. Das Gupta (*Alternate*)
Kerala State Bamboo Corporation, Cochin	Shri M. R. Anil Kumar
Kutty Flush Doors & Furniture Co Pvt Limited, Chennai	Shri K. Sankarakrishnan Col Y. G. Krishnan (*Alternate*)

Organization	*Representative(s)*
Kanara Wood & Plywoods Industries Limited, Mangalore	Shri P. H. G. Reddy Shri Y. Mohammed Farhaad (*Alternate*)
Mangalam Timber Products Limited, Kolkata	Shri G. S. Gupta Shri R. Krishnan (*Alternate*)
Ministry of Defence (DGQA), Kanpur	Shri Gautam Gupta Shri Nusrat Ullah (*Alternate*)
Ministry of Defence (R&D), Kanpur	Shri P. S. Srivastava Shri Ravindra Kumar (*Alternate*)
Ministry of Railways, Lucknow	Deputy Director Standards (Carriage) Assistant Director (*Alternate*)
Natura Fibretech Pvt Limited, Bangalore	Shri Tommy Mathew Shri Sunil Vargeese (*Alternate*)
NCL Industries Limited, Hyderabad	Shri M. Krishna Prasad Shri Prakash Raju (*Alternate*)
North India Plywood Manufacturing Association, Jalandhar	Shri Surinder Arora Shri Naresh Tiwari (*Alternate*)
Novopan India Limited, Hyderabad	Shri S. A. Naqui
Nuchem Limited, Faridabad	Shri Sudev Barar Shri P. B. Venkat Sastry (*Alternate*)
Permali Wallace Limited, Bhopal	Shri S. K. Kodesia Shri B. S. Parmar (*Alternate*)
The Gurdit Institute Pvt Limited, Dharwad	Shri Yaskaran Singh Lauly Shri P. Hosmai (*Alternate*)
The Mysore Chipboards Limited, Mysore	Shri A. Ananthachar
The South Indian Plywood Manufacturers' Association, Kottayam	Shri K. Sankarakrishnan Secretary (*Alternate*)
The Western India Plywood Limited, Kannur	Shri K. P. Kamaluddin Shri C. A. Gafoor (*Alternate*)
In personal capacity (*5/6, 1st Floor, 13th Main, HAL, 2nd Stage, Indira Nagar, Bangalore 560008*)	Shri P. K. Bagchi

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