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Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

"जानने का अधिकार, जीने का अधिकार"
Mazdoor Kisan Shakti Sangathan
"The Right to Information, The Right to Live"

"पुराने को छोड़ नये के तरफ"
Jawaharlal Nehru
"Step Out From the Old to the New"

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IS 1658 (2006): Fibre hardboards -Specification [CED 20:
Wood and other Lignocellulosic products]
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"ज्ञान से एक नये भारत का निर्माण"
Satyanarayan Gangaram Pitroda
"Invent a New India Using Knowledge"

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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भारतीय मानक

फाइबर हार्डबोर्ड — विशिष्टि

(तीसरा पुनरीक्षण)

Indian Standard

FIBRE HARDBOARDS — SPECIFICATION

(Third Revision)

ICS 790.060.20

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

FOREWORD

This Indian Standard (Third Revision) 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.

Fibre hardboards of various types are being used in increasing quantities in the construction of bus bodies, prefabricated houses, panelling, partitions, furniture, etc. The standard was first published in 1960 with a view of guiding the developing industry for fibre hardboard and was subsequently revised in 1966 and 1977. In this revision the dimensions and tolerances have been rationalized and the requirements of density, moisture content, water absorption and modulus of rupture redefined. Besides, additional requirements of modulus of elasticity, swelling in thickness and tensile strength have also been incorporated.

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 28 October 1992, published in the Gazette of the Government of India. 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 is based on the Gazette Notification No. 170 dated 18 May 1996 for wood substitutes as environment friendly products published in the Gazette of the Government of India.

In the formulation of this standard due weightage has been given to international co-ordination among the standards and practices prevailing in different countries in addition to relating it to the practices in the field in this country.

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

FIBRE HARDBOARDS — SPECIFICATION

(Third Revision)

1 SCOPE

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

1.2 This standard does not cover the requirements of medium density fibre boards, soft boards, insulation boards, particle boards of wood and other lignocellulosic materials and similar boards.

1.3 The values listed in this standard relate to product properties but they are not characteristic values to be used in design calculations.

2 REFERENCE

The following standard contains provision which through reference in this text, constitutes provisions of this standard. At the time of publication, the edition indicated was 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 edition of the standard indicated below:

IS No.	Title
707 : 1976	Glossary of terms applicable to timber technology and utilization (*second revision*)

3 DEFINITIONS

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

3.2 Fibre Hardboard — Wood based panel material with a nominal thickness of 1.5 mm or greater manufactured from fibres of lignocellulosic material by the application of heat and pressure. The primary bond is usually derived from the felting of fibres and their inherent adhesive properties. Bonding material and/or additives may be added.

4 CLASSIFICATION

Fibre hardboards are classified into the following three types according to their method of manufacture, thickness, density, specific properties, conditions of use or application purposes:

    a) *Medium Hardboard* — Homogenous fibre hardboard having uniform thickness and

having density above 350 kg/m^3 but below 800 kg/m^3,

    b) *Standard Hardboard* — Homogenous fibre hardboard having uniform thickness and density of 800 kg/m^3 to $1\ 025 \text{ kg/m}^3$, and

    c) *Tempered Hardboard* — Hardboard, which has been further treated to improve or modify one or more properties of the final board and having a density of 800 kg/m^3 to $1\ 025 \text{ kg/m}^3$.

5 MANUFACTURE

Wood or any other lignocellulosic material is cut into small chips in a suitable chipping machine. The chips are sent to defibrating machine where they are cooked in a preheater at $170 - 200°C$ and defibrated to yield pulp. The pulp is conveyed over perforated conveyor to the board forming machine to form wet lap of moisture content between 68 to 72 percent. The wet lap is conveyed to a hydraulic press and pressed into panels under controlled conditions of pressure, temperature and time. The pressed panels of uniform thickness and density are cut to required sizes in the trimming machine.

For ECO-Mark, the hardboards shall be manufactured from only species of wood sources other than natural forests such as wood from rubber, coconut, cashew, industrial and social forestry plantations, etc and shade trees from tea and coffee estates, wood residues or agricultural wastes.

6 WORKABILITY AND FINISH

6.1 The hardboards shall not crack, split or chip when drilled, sawed or nailed perpendicular to the plane of the board.

6.2 The surfaces of the board shall be free from stains, cracks, blisters and deformations.

7 DIMENSIONS AND TOLERANCES

7.1 Unless otherwise specified or agreed to between the manufacturer and the purchaser, the length, width and thickness of the boards and the tolerances thereof shall be as given in Table 1. The dimensions (length, width and thickness) shall be measured according to the procedure given in Annex A.

7.2 The squareness and edge straightness of the boards when measured according to the procedure given in Annex B shall be as given in Table 1.

Table 1 Dimensions and Tolerances

(Clauses 7.1 *and* 7.2)

Sl No. (1)	Dimensional Requirement (2)	Type (3)	Nominal Dimension (4)	Tolerance (5)
i)	Length, m	a) Medium hardboard b) Standard hardboard	1.2, 1.83, 2.44, 3.00 and 3.66	±3 mm/m
		c) Tempered hardboard	4.26, 4.85, 5.00	±5 mm/m
ii)	Width, m	a) Medium hardboard b) Standard hardboard c) Tempered hardboard	1.22	±3 mm/m
iii)	Thickness, mm	a) Medium hardboard	6 8, 10 12	±0.5 ±0.7 ±0.9
		b) Standard hardboard	2.5, 3 4, 5, 6 7	±0.4 ±0.5 ±0.7
		c) Tempered hardboard	2.5, 3 4, 5, 6	±0.4 ±0.5
iv)	Squareness, *Max*, mm/m	a) Medium hardboard b) Standard hardboard c) Tempered hardboard	—	3
v)	Edge straightness, *Max*, mm/m	a) Medium hardboard b) Standard hardboard c) Tempered hardboard	—	2

8 PHYSICAL AND MECHANICAL REQUIREMENTS

Fibre hardboards shall comply with the requirements given in Table 2.

9 SAMPLING AND CRITERIA FOR CONFORMITY

9.1 Scale of Sampling

9.1.1 *Lot*

In any consignment, all hardboards of the same type, dimensions and manufactured under similar conditions shall be grouped together to constitute a lot.

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

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

Lot Size	No. of Hardboards to be Selected
N	n
Up to 50	2
51 to 150	3
151 to 300	4
301 to 500	7
501 and above	10

9.1.4 The hardboard shall be selected at random. In order to ensure randomness in selection, all hardboards in the lot may be arranged in a serial order and every rth board is selected till the required number is obtained, where r is the integral part of N/n (N and n being the lot size and the corresponding sample size, respectively). The procedure shall be stopped as soon as the required number of hardboards are obtained in the sample.

9.2 Criteria for Conformity

A lot shall be considered as conforming to the requirements of this standard if the requirements stipulated under **6.1, 6.2, 7.1, 7.2** and **8** are met.

9.2.1 If the samples selected as specified in **9.1.3** fail to conform to the requirements of **6.1, 6.2, 7.1, 7.2** and **8**, a further similar set of samples shall be selected at random from the same batch and subjected to the tests. If any of the samples in the second set is also found not to comply with the requirements of this standard, all the boards in the batch represented by the samples shall be rejected.

10 TESTING OF SAMPLES

10.1 Test Unit

From each selected hardboard, a length 1 000 mm shall be cut. Out of this length, a rectangular test unit of

Table 2 Physical and Mechanical Requirements

(Clauses 8, 10.4.1, 10.4.2, 10.4.3, 10.4.4, 10.4.5 *and* 10.4.6)

Sl No.	Properties	Types of Hardboards			Method of Test, Ref to Annex
		Medium Hardboard	Standard Hardboard	Tempered Hardboard	
(1)	(2)	(3)	(4)	(5)	(6)
i)	Density, kg/m³	> 350 and < 800	800 - 1 025	800 - 1 025	C
ii)	Moisture content, percent	5-15	5 - 15	5 - 15	D
iii)	Water absorption, percent, *Max* 24 h immersion in water	45	a) Nominal thickness 2.5, 3 and 4 mm } 45 b) Nominal thickness 5, 6 and 7 mm } 35	20	E
iv)	Swelling in thickness, percent, *Max* 24 h immersion in water	25	25	20	F
v)	Tensile strength perpendicular to the plane of the board, N/mm², *Min*	0.25	1.0	1.5	G
vi)	Modulus of rupture, N/mm²: a) Minimum individual b) Average	 5.5 6	 27 30	 45 50	H
vii)	Modulus of elasticity, N/mm²: a) Minimum individual b) Average	 550 600	 2 700 3 000	 2 700 3 000	H

900 mm × 450 mm shall be cut in such a way that no part of the unit lies within 150 mm of the edges of the panel from which it is cut.

10.2 Conditioning of Test Unit

The test units shall be conditioned by freely exposing them for a least 72 h after manufacture to atmosphere in a well-ventilated room. This period may be reduced to 48 h or 16 h, if the change of mass is within ±10 percent.

In case of disagreement and if the purchaser so specifies; the test units shall be conditioned in an atmosphere of relative humidity 65 ± 5 percent at a temperature 27 ± 2°C until the mass is substantially constant. The method adopted for conditioning shall be recorded along with the test results.

10.3 Number of Tests

The sheets selected as prescribed in **9.1.3** shall be inspected for appearance; length, width, thickness; edge straightness and squareness; as specified in **6.2**, **7.1** and **7.2**.

For the remaining characteristics the test specimens shall be cut to the specified sizes. The test shall be conducted on them as specified in **10.4**.

10.4 Tests

10.4.1 *Test for Density*

For measurement of density, three square test specimens of size 100 ± 1 mm shall be cut from the test panel. The edges of the test specimen should be smoothened with sand paper.

The average density of each of the specimens shall meet the requirements specified in Table 2 (*see also* **8**), when tested in accordance with the method specified therein.

10.4.2 *Test for Moisture Content*

For determination of moisture content three square test specimens of size 100 ± 1 mm shall be cut from the test panel. Other specimen sizes may be used when deemed necessary. The average moisture content of the specimens shall meet the requirements specified in Table 2 (*see also* **8**), when tested in accordance with the method specified therein.

10.4.3 *Test for Water Absorption*

For determination of water absorption three square test specimens of size 100 ± 1 mm shall be cut from the test panel. The edges of the test specimen shall be smoothened with sand paper, but not sealed.

The water absorption of each of the specimens shall meet the requirements specified in Table 2 (*see also* **8**), when tested in accordance with the method specified therein.

10.4.4 *Test for Swelling in Thickness After Immersion in Water*

For determination of swelling in thickness after immersion in water, three square test specimens of size 50 ± 1 mm shall be cut from the test panel. The edges of the test specimens shall be smoothened with sand paper. The mean swelling in thickness of the test specimens shall not exceed the value given in Table 2 (*see also* **8**), when tested in accordance with the method specified therein.

10.4.5 *Test for Tensile Strength Perpendicular to the Plane of the Board (Internal Bond Strength)*

For determining tensile strength perpendicular to the plane of the board, three square test specimens of size 50 ± 1 mm and of the thickness of the board shall be cut from the test panel. The edges shall be smoothened with sand paper. The tensile strength of the specimens shall not be less than the values specified in Table 2 when tested in accordance with the method specified therein.

10.4.6 *Modulus of Elasticity and Modulus of Rupture*

For determination of modulus of elasticity and modulus of rupture, eight rectangular specimens shall be cut. The length of the specimen shall be $20\,t \pm 50$ mm (where t is the nominal thickness of the test panel) subject to a maximum length of 1 050 mm and a minimum length of 100 mm. The width of the specimen shall be 75 ± 1 mm. The thickness shall be the full thickness of the board.

Four test specimens shall be prepared with long dimension parallel and four specimens with long dimension perpendicular to the machine direction of the board from which the specimens have been cut.

Determination of modulus of elasticity shall be carried on two specimens cut along the length of the board and two specimens cut perpendicular to the length of the board and the minimum individual and average value determined.

Determination of modulus of rupture shall be carried out on two specimens cut along the length of the board and two specimens cut perpendicular to the length of the board and the minimum individual and average value determined.

The average value of modulus of elasticity and modulus of rupture shall not be less than the value specified in

Table 2 (*see also* **8**) when tested in accordance with the method specified therein.

11 ADDITIONAL REQUIREMENTS FOR ECO-MARK

11.1 General Requirements

11.1.1 Fibre hardboards shall conform to the requirements as specified in the standard.

11.1.2 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 the ECO-Mark, appropriate with enforced rules and regulations of Forest Department.

11.2 Specific Requirement

The fibre hardboards shall conform to the specific requirements given for ECO-Mark under relevant clauses of the standard.

NOTE — The manufacturer shall provide documentary evidence by way of certificate or declaration to Bureau of Indian Standards while applying for ECO-Mark.

12 MARKING

Each hardboard shall be legibly and indelibly marked with the following information:

a) Manufacturer's name, trade-mark or identification mark;

b) Type of the hardboard (*see* **4**);

c) Nominal dimensions (length, width and thickness, in mm);

d) Date of manufacture; and

e) Criteria for which the hardboard has been labelled as ECO-Mark.

13 BIS CERTIFICATION MARKING

The hardboard may also be marked with the Standard Mark.

13.1 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 license 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* 7.1)

MEASUREMENT OF DIMENSIONS

A-1 MEASUREMENT OF NOMINAL LENGTH AND WIDTH

The length and width of boards shall be measured to an accuracy of ±1 mm parallel to each edge of the board at a distance 100 mm from the edges. Both measurements shall be recorded. The average for each board shall be reported separately to the nearest 1 mm.

A-2 MEASUREMENT OF NOMINAL THICKNESS

The thickness of the boards shall be measured by using a micrometer or similar measuring instrument having flat and parallel circular measurement surfaces of 16 ± 1 mm diameter and an operating force of 4 ± 1 N. The thickness is measured to an accuracy of 0.05 mm. Eight readings are taken approximately 20 mm inside the edges of test panel, at four corners and in the middle of each edge. The mean thickness of each one of the boards shall be reported separately to the nearest 0.1 mm.

ANNEX B

(*Clause* 7.2)

MEASUREMENT OF STRAIGHTNESS AND SQUARENESS

B-1 The straightness of a board shall be measured by means of straight edge. The straight edge shall be held against the edge of the board. The largest gap between the straight edge and board edge shall be measured nearest to 1 mm and recorded. The measured value shall be expressed separately for width and length, in mm/m and is obtained by dividing the largest value of measured deviations by the dimension of the appropriate edge of the board. The departure from straightness of any edge of a board shall not exceed the value given in Table 1.

B-2 The squareness of a board shall be measured by means of a mechanical square having arms 1 000 ± 1 mm. One arm of the square shall be placed against one side of the board and the gap between the other arm of the square and the edge of the board shall be measured to the nearest mm. The maximum gap shall be recorded. The measurement shall be carried out at the four corners of the board. The mean of the four measurements shall be reported separately. The departure from squareness at any corner of a board shall not exceed the value given in Table 1.

ANNEX C

[*Table* 2, *Sl No.* (i)]

DETERMINATION OF DENSITY

C-1 DETERMINATION OF LENGTH AND WIDTH

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

C-2 DETERMINATION OF THICKNESS

The thickness of test specimen shall be measured to an accuracy of 0.05 mm. Four readings are taken approximately 20 mm inside the edges of the test panel, at the centre of each edge. The mean of the four readings shall be taken to be the thickness of the specimen.

C-3 PROCEDURE

Each specimen shall be weighed to an accuracy of 0.01 g.

C-4 EXPRESSION OF RESULTS

The density of a test specimen in kg/m³ shall be calculated from the following formula:

$$\text{Density} = \frac{\text{Mass of the test specimen, g} \times 10^6}{\substack{\text{Length, mm} \times \text{Width, mm} \times \\ \text{Mean thickness, mm}}} \text{ kg/m}^3$$

C-5 The density of a board shall be obtained by calculating the arithmetic mean of the densities of all the test specimens taken from the same board and expressed to the nearest 5 kg/m^3.

ANNEX D

[*Clause* 2, *Sl No.* (ii)]

DETERMINATION OF MOISTURE CONTENT

D-1 PROCEDURE

Each specimen shall be weighted to an accuracy of not less than 0.01 g. The specimen shall then be dried in a ventilated oven at a temperature of $103 \pm 2°C$ until the mass is constant (± 0.2 percentage between two successive weighings made at an interval of not less than an hour).

D-2 EXPRESSION OF RESULTS

The moisture content expressed as percentage 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, and

M_0 = oven dry mass.

D-3 The moisture content of a board shall be 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.

ANNEX E

[*Table* 2, *Sl No.* (iii)]

DETERMINATION OF WATER ABSORPTION

E-1 PROCEDURE

Each specimen shall be weighed to an accuracy of not less than 0.01 g. The specimen shall then be submerged horizontally under 25 mm fresh clean water maintained at a temperature $27 \pm 2°C$. The specimens shall be separated by at least 15 mm from each other and from the bottom and sides of the container. The period of immersion shall be 24 h or the period for which absorption value is needed. The test specimen shall be taken out from the water bath at the end of the appropriate period and excess water shall be wiped off with damped cloth. Each specimen shall then be re-weighed to an accuracy of 0.01 g.

E-2 EXPRESSION OF RESULTS

The water absorption of a test specimen in percent shall be calculated from the following formula:

$$A = \frac{M_2 - M_1}{M_1} \times 100$$

where

M_1 = mass of the test specimen before immersion in g; and

M_2 = mass of the test specimen after immersion in g.

E-3 The following information shall be reported:

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

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

ANNEX F

[Table 2, *Sl No.* (iv)]

DETERMINATION OF SWELLING IN THE THICKNESS
AFTER IMMERSION IN WATER

F-1 PROCEDURE

F-1.1 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.

F-1.2 The test specimens shall be immersed in fresh clean water having a *p*H 7 ± 1 and at a temperature 27 ± 2°C. The test specimens shall be separated from each other and from the bottom and sides of water bath. The top surface of the test pieces should be under 25 ± 5 mm of water throughout the test.

F-1.3 At the end of 24 h or such other period as may be specified, each test specimen shall be withdrawn from the water, wiped off with damp 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.

F-2 EXPRESSION OF RESULTS

F-2.1 The swelling in thickness of each test specimen, 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 specimen before immersion in mm, and t_2 is the thickness of the test specimen after immersion, in mm. Swelling in thickness shall be expressed to one decimal place.

F-2.2 The swelling in thickness of a board is the arithmetic mean of the results of all test specimens taken from that board and shall be expressed in percent, to one decimal place.

ANNEX G

[Table 2, *Sl No.* (v)]

DETERMINATION OF TENSILE STRENGTH PERPENDICULAR TO THE PLANE
OF THE BOARD (INTERNAL BOND STRENGTH)

G-1 DETERMINATION OF LENGTH AND WIDTH

The length and width of each test specimen shall be measured to the accuracy of ±1 mm.

G-2 PROCEDURE

Each test specimen shall be bonded to loading blocks using a suitable adhesive on the 50 mm square faces of the ten specimens.

The test shall be carried out only after the adhesive has set and cured completely. The test assembly is placed in the grips of self-aligning fixtures of a suitable testing machine. The direction of loading shall be as nearly perpendicular to the face as possible and the centre of load shall be passed through the centre of the specimen.

G-3 EXPRESSION OF RESULTS

Tensile strength perpendicular to the board of each piece F_u expressed, in N/mm^2 to two decimal places is calculated according to the following formula:

$$F_u = \frac{F_{Max}}{a \times b}$$

where F_{Max} is the breaking load, in Newtons and *a* and *b* are the length and width of the test pieces respectively, in mm.

The tensile strength of the board is the mean value of three results obtained from test pieces from the board, expressed, in N/mm^2 to two decimal places.

ANNNX H

[Table 2, Sl No. (vi) *and* (vii)]

DETERMINATION OF MODULUS OF ELASTICITY AND MODULUS OF RUPTURE

H-1 DETERMINATION OF LENGTH AND WIDTH

The length and width of each test specimen shall be measured to the accuracy of ±1 mm.

H-2 DETERMINATION OF THICKNESS

The thickness of each test specimen shall be measured to an accuracy of 0.05 mm. The measurement shall be done at eight points, namely, at four corners and at the middle of each edge. The mean of the eight readings shall be the thickness of the test specimen.

H-3 PROCEDURE

H-3.1 Span for each test shall be 20 times the nominal thickness. The supports shall be such that the specimens are not crushed during test. The supports shall be rounded such that the diameter of horizontal parallel roller shall be 15 ± 0.5 mm. The roller should be so arranged as to be free to rotate on roller bearings.

H-3.2 The test piece shall be placed on the supports with its longitudinal axis at right angle to that of the supports with the centre point under the load.

H-3.3 The load shall be applied at constant rate of cross head movement throughout the test. The rate of loading shall be adjusted so that the maximum load is reached within 60 ± 30 s.

H-3.4 Deflection shall be measured in the middle of the test piece below the loading block by means of a dial gauge to an accuracy of 0.01 mm. Deflection shall be measured at convenient incremental readings so that there are least 6 readings before reaching the proportional limits. Thereafter the dial gauge shall be removed. The test shall be continued until the specimen completely fails. The maximum load at the time of failure should be recorded.

H-4 EXPRESSION OF RESULTS

H-4.1 Modulus of elasticity E_m, in N/mm² of each test piece is calculated from the following formula:

$$E_m = \frac{L^3 (F_2 - F_1)}{4\, bt^3\, (a_2 \times a_1)}$$

where

L = distance between the centres of the supports, in mm;

b = width of the test piece, in mm;

t = thickness of the test piece, in mm;

$F_2 - F_1$ = increment of load on the straight line part of the load deflection curve, in Newtons; and

$a_2 - a_1$ = increment deflection at the mid length of the test piece (corresponding to $F_2 - F_1$). The modulus of elasticity for each test piece shall be expressed to three significant figures.

H-4.2 The modulus of elasticity for each group of test pieces taken from the same board is the arithmetic mean of the modulus of elasticity of the appropriate test pieces expressed to three significant figures.

H-5 MODULUS OF RUPTURE

H-5.1 The modulus of rupture F_m (in N/mm²) of each test piece is calculated from the following formula:

$$\text{Modulus of rupture} = \frac{3\, F_{Max}\, L}{2\, b\, t^2}$$

where

F_{Max} = maximum load, in Newtons; and

L, b and t = length, width and thickness of each test specimen, in mm.

The bending strength of each test piece shall be expressed to three significant figures.

H-5.2 The modulus of rupture of each group of test pieces taken from the same board is the arithmetic mean of the bending strength of the appropriate test pieces expressed to three significant figures.