IS 1708-1 to 18 (1986): Methods of testing of small clear specimens of timber [CED 9: Timber and Timber Stores]

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Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

(Second Revision)

UDC 674·03 : 620·1

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

Gr 11 *October* 1986

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

(Second Revision)

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AMENDMENT NO. 1 JULY 1993
TO
IS 1708 (Parts 1 to 18) : 1986 METHODS OF TESTING SMALL CLEAR SPECIMENS OF TIMBER

(Second Revision)

(*Cover page, pages* 1 *and* 3, *and first page of individual parts of the standard*) — Delete the word 'clear' from the title of the standard.

(*Page* 3, *contents*) — Substitute 'cleavage' *for* 'clearage' against the title for IS 1708 (Part 14) : 1986.

(*Page* 5, *clause* **0.2**) — Substitute 'density, effect' *for* 'density effect' in line 2 and delete the word 'being' in line 11.

(*Page* 5, *clause* **0.3**, *second sentence*) — Substitute the following for the existing sentence:

'For standard evaluation of physical and mechanical properties of a species from a locality, at least ten trees are chosen at random from the locality and sampling of material for different tests is done in accordance with IS 2455 : 1990*.'

(*Page* 5, *foot-note marked with* '*' *mark*) — Substitute the following for the existing foot-note:

'*Method of sampling of model trees and logs and their conversion for timber testing.'

(*Page* 6, *clause* **0.5**) — Substitute the word 'controlled' after 'under' in line 6 and insert the word 'value' after 'specified' in the last line.

(*Page* 6, *clause* **0.6**, *line* 4) — Insert the words 'average is' between 'and' and 'recorded'.

(*Page* 12, *clause* **4.2**, *matter on the right hand side of* '=') — Substitute the following for the existing matter:

'Specific gravity at moisture content $m \times 1\,000$.'

(*Page* 13, *clause* **3.2**, *last line*) — Insert the word 'immersion' between 'by' and 'method'.

(*Page* 15, *clause* **4.1**, *first line on the right hand side of* '=' *against* 'W_T *and* V_T') — Delete the word 'initial'.

(*Page* 21, *clause* **3.1**, *line* 7) — Substitute '75 mm' *for* '75 cm'.

[*Page* 22, *clause* 3.3 (a), *line* 2] — Substitute 'neutral' *for* 'netural'.

[*Page* 23, *clause* 4.2 (ii)] — Substitute '$\frac{3\,P'l'}{2\,bh^2}$' *for* '$\frac{3\,Pl'}{2\,bh^2}$'.

(*Page* 26, *clause* **4.3**) — Substitute the following for the existing clause:

'**4.3** In the absence of suitable planimeter the work shall be calculated by the following formulae:

Work to limit of proportionality

$$(\,Wk \text{ to } LF\,) = \frac{P\,\Delta}{2\,lbh}$$

Work to maximum load

$$(\,Wk \text{ to } ML\,) = \frac{0{\cdot}6}{lbh}\left\{\,P\Delta_m + P'\,(\Delta_m - \Delta\,)\,\right\} - 0{\cdot}018$$

$$\text{Total work} = Wk \text{ to } ML + \frac{d}{2\,lbh}\,(\,P' + P''\,) + 2\,(\,P_1 + P_2 \ldots P_k\,),$$

when readings are taken at suitable intervals of deflection.

$$\text{Total work} = \frac{0{\cdot}34}{lbh}\left\{\,P\Delta_m + P'\,(\,\Delta_t - \Delta\,) + P''\,(\,\Delta_t - \Delta_m\,) + 0{\cdot}46,\right.$$

when readings are taken at suitable intervals of load.

where

m = deflection in cm at maximum load,

d = common difference of deflection between successive load readings beyond maximum load in cm,

P'' = final load of 100 kg or 20 kg or load equivalent to 15 cm or 6 cm deflection as mentioned in para **3.3(c)**,

$P_1 \ldots P_k$ = loads (ordinates) at fixed intervals of deflection between P' and P'', and

Δ_t = final deflection of 15 cm or 6 cm or deflection corresponding to final load of 100 kg or 20 kg as mentioned in 3.3(c).'

(*Page* 28, *Fig.* 1) — Delete dial gauges from the figure.

(*Page* 29, *clause* **4.2**, *Sl No.* 5) — Substitute '$\frac{3\,P'}{4\,bh}$' *for* '$\frac{3\,P}{4\,bh}$'.

(*Page* 31, *clause* **3.1**, *line* 10) — Substitute '75 mm' *for* '75 cm'.

(*Page* 33, *clause* **4.2**, *line* 1) — Substitute 'drop (*H*)' *for* 'drop'.

(*Page* 33, *clause* **4.3**) — Substitute '*H*″ ' *for* '*H*' in Sl No. (i) and (v); and substitute 'limit of proportionality' *for* 'limit at proportionality' in the last line.

(*Page* 36, *clause* **3.4**, *line* 4) — Substitute 'appearance' *for* 'apperance' and 'fractured' *for* 'frictured'.

(*Page* 36, *clause* **4.1**) — Substitute '(*CS* at *LP*)' *for* '(*CS* at *ML*)' in Sl No. (i), '(*CS* at *ML*)' *for* '(*CS* at *LP*)' in Sl No. (ii) and (*M* of *E* in Compression II)' *for* '(*M* of *E* in Compression II)' in Sl No. (iii).

(*Page* 37, *at the top right corner of page*) — Substitute 'IS : 1708 (Part 8)-1986' *for* 'IS 1708 (Part 6)-1986'.

(*Page* 40, *clause* **4.1**) — Substitute '(*M* of *E* in compression 1)' *for* '(*M* of *E* in compression)' in Sl No. (iv) and '2×2 cm' *for* '5×2 cm' in the right hand side of '=' against '*A*'.

(*Page* 41, *clause* **3.1**) — Substitute 'coller or' *for* 'coller, a' in line 5 and 'indentation' *for* 'identation' in line 6.

(*Page* 43, *clause* **3.1**, *line* 5) — Substitute 'sheared' *for* 'shared'.

(*Page* 43, *clause* **3.2**) -- Insert the words 'for both the sizes' at the end.

(*Page* 43, *clause* **4.1**, *last line*) — Delete the words 'for both sizes'.

(*Page* 44, *Fig.* 1) — Substitute the figure given on page 4 for the existing figure,

(*Page* 45, *Fig.* 1) — Insert '1A' above the title of the figure.

(*Page* 46, *Fig.* 1) — Insert '1B' above the title of the figure.

(*Page* 46, *clause* **3.3**, *line* 3) — Substitute 'are' *for* 'and'.

(*Page* 52, *Fig.* 1B) — Substitute '22 mm' *for* '20 mm' for the dimension between the centre of 4 mm diameter drilled hole to the end.

(*Page* 53, *clause* **3.1**, *line* 3) — Substitute 'screws' *for* 'scrcws'.

(*Page* 55, *clause* **4.3**, *line* 1) — Delete the word 'maximum'.

(*Page* 59, *clause* **3.1**) — Substitute 'the' *for* 'to' in line 4 and 'swing' *for* 'owing' in last line.

(*Page* 61, *clause* **2.1**) — Substitute 'diameter' *for* 'radius' in line 3 and insert the words 'diameter of' between 'The' and 'end' in line 4.

(*Page* 61, *Fig.* 1) — Substitute '30/15 ϕ' *for* '30 ϕ' and '25/12 ϕ' *for* '25 ϕ'.

AMENDMENT NO. 2 APRIL 2001
TO
IS 1708 (Parts 1 to 18) : 1986 METHODS OF TESTING OF SMALL SPECIMENS OF TIMBER

(Second Revision)

(*Page* 57, *clause* 3.1, *line* 2) — Insert 'of appropriate capacity not more than 20 Joules' between 'machine' and 'such'.

(*Page* 59, *clause* 3.1, *line* 2) — Insert 'of appropriate capacity not more than 20 Joules' between 'machine' and 'up'.

(CED 9)

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

(Second Revision)

0. FOREWORD

0.1 This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 30 April 1986, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 The evaluation of basic properties of timber, such as strength, density effect of various treatments on strength, etc, and the establishment of design functions for structural timbers has been done on the basis of tests carried out on small clear specimens of timber. A clear specimen is one which is free from defects, such as knots and shakes. The comparison of strength properties of different timber species is also done on the basis of the tests carried out on clear specimens. In the actual design of timber structures as also in structural grading, the effect of different kinds of defects on clear specimens is assessed and after making necessary allowances for the defects, the resultant values are used. This standard is being published in parts dealing with the methods of testing small clear specimens of timber for their strength properties.

0.3 In order to obtain a good average figure, which is truly representative of the species, it is necessary to take samples from green timber as well as from seasoned timber and also from sapwood, heartwood and from different parts of the same tree. For standard evaluation of physical and mechanical properties of a species from a locality, at least ten trees are chosen at random from the locality and sampling of material for different test is one in accordance with IS : 2455-1974*. When material from a depot is required to be tested, the sampling of material for different tests is done in accordance with IS : 8720-1978†.

*Method of sampling of model trees and logs for timber testing and their conversion.

†Method of sampling of timber scantlings from depots and their conversion for testing.

0.4 This standard was first published as Part 1 in 1960 and Part 2 in 1963. It was revised in 1969 in which these two parts were combined besides other modifications. With the introduction of fast grown and various exotic species, sufficient number of samples for tests in 5 × 5 cm cross-sectional dimensions are not generally available. Hence a need has arisen to test timber specimens in 2 × 2 cm cross-sectional dimensions. In various international standards also, the dimensions of standard test specimens have now been recommended as 2 × 2 cm cross-sectional dimensions. Thus this standard has been revised to lay down test methods for both the dimensions, that is, 2 × 2 cm and 5 × 5 cm and the sizes have been rationalized.

0.5 Almost all the mechanical properties of seasoned timber vary with moisture content and it is therefore necessary that the moisture content of timber and its specific gravity be determined at the time of tests, preferably immediately after the tests. Provisions for these tests have therefore, been included. Before testing, the material of seasoned timber shall be brought practically to constant weight by storage under conditions at 27 ± 2°C temperature and 65 ± 5 percent relative humidity. Change in moisture content during preparation of test specimens shall be avoided. As the mechanical properties of timber vary with the rate of application of load, it is desirable that specific rates mentioned in the standard should be adhered to in order to obtain comparable results. Where the testing machine is of a type which does not permit the specified rate of loading, actual rate of loading employed should be recorded along with the results so that those results may be suitably corrected where required for comparison of the mechanical properties. It is generally recommended that rate of loading shall not vary by more than ± 20 percent from the specified.

0.6 The approximate percentage of sapwood, if any, by volume shall be estimated and recorded. Defects like knots, splits, etc, shall also be recorded. The number of growth rings shall be counted in the radial direction on each of the cross-section of test specimen and recorded as number of rings per centimetre.

0.7 For the purpose of comparison of the data collected on 2 × 2 cm dimensions with that of 5 × 5 cm dimensions the adjusting factors have also been given in respective part of the specification where available. The adjusting factors have been obtained from the publication 'Mechanical tests for wood-comparison of test results on large and small size specimens', by S. S. Rajput, N. K. Shukla & R. R. Sharma, Holzforschung and Holzverwertung 32(5), 117-120, 1980.

0.8 For reporting the results of tests done according to this standard, IS : 8745-1978* shall be referred to.

*Method for presentation of data of physical and mechanical properties of timber.

0.9 In the preparation of this standard considerable assistance has been rendered by Forest Research Institute and Colleges, Dehra Dun which has supplied the valuable data.

0.10 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, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Rules for rounding off numerical values (*revised*).

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 1 DETERMINATION OF MOISTURE CONTENT

(Second Revision)

1. SCOPE

1.1 This standard (Part 1) covers the method of test for determining moisture content of timber.

2. TEST SPECIMEN

2.1 The test specimen for determining moisture content shall generally be taken from the tested specimens immediately after completion of each mechanical test and as far as possible near the place of failure. It shall be about 2·5 cm in length and of full section as the tested piece. In the case of shear test, the detached portion of the section 5 × 5 cm or 2 × 2 cm shall be taken for determination of moisture content. When only moisture content is to be determined the dimensions shall be taken as 2·5 cm in length and 2 × 2 cm or 5 × 5 cm in cross-section.

3. PROCEDURE

3.1 The sample shall be weighed with accuracy of 0·001 g in a weighing balance and then dried in a well vantilated oven at temperature of 103 ± 2°C. The weight shall be recorded at regular intervals. The drying shall be considered to be complete when the variation between last two weighings, does not exceed 0·002 g. The final weight shall be taken as oven dry weight.

3.2 Great care shall be taken to prevent any change in moisture content between the cutting of the specimen and the first weighing, and between the removal from the oven and subsequent weighings.

4. CALCULATION

4.1 The loss in weight expressed as a percentage of the oven dry weight, shall be taken as the moisture content of the test specimen. The formula for calculation shall be as given below:

$$\text{Percentage of moisture content} = \frac{W_1 - W_0}{W_0} \times 100$$

where

W_1 = weight of sample at test in g, and

W_0 = oven dry weight of sample in g.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 2 DETERMINATION OF SPECIFIC GRAVITY

(Second Revision)

1. SCOPE

1.1 This standard (Part 2) covers method of test for determining specific gravity of timber.

2. TEST SPECIMEN

2.1 The specific gravity of all the specimens for mechanical tests shall be calculated as described in **4**.

2.2 When only specific gravity is to be determined the test specimens shall be 5 × 5 cm in cross-section and 15 cm in length or 2 × 2 cm in cross-section and 6 cm in length. When rectangular specimens are not obtained, a specimen of about 10 cc volume shall be taken.

3. PROCEDURE

3.1 The specimen shall be weighed correct to 0·001 g. The dimensions of rectangular specimen shall be measured correct to 0·01 cm and volume shall be calculated by multiplying all the three dimensions. The volume of irregular specimen shall be determined by mercury volumeter. The level of mercury in the volumeter shall be raised to the given mark on the capillary tube and reading shall be noted. The level shall then be brought down and specimen shall be inserted in the volumeter. After raising the level to the given mark, the reading shall be taken again. Care shall be taken that no air bubble is entraped in the volumeter. The difference of the two readings shall be the volume of the specimen.

4. CALCULATION

4.1 Specific gravity shall be calculated as given below:

a) Specific gravity at test $= \dfrac{W_1}{V_1}$

b) Adjusted specific gravity $= \frac{W_1}{V_1} \times \frac{100}{100 + m}$

where

W_1 = weight in g of test specimen,

V_1 = volume in cm^3 of test specimen, and

m = percentage moisture content of the test specimen determined as prescribed in **4** of Part 1 of this standard.

NOTE — If initial condition of the specimen is 'green' (that is well above the fibre saturation point) adjusted specific gravity, calculated by formula **4.1** (b) is known as standard specific gravity; and if the specimen is dry, the specific gravity is called 'dry specific gravity'.

4.2 If weight at a given moisture content is required to be calculated, the same shall be calculated as below:

Weight in kg/m^3 at a given moisture content m = Specific gravity at moisture content, $m \times 1\,000$.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 3 DETERMINATION OF VOLUMETRIC SHRINKAGE

(Second Revision)

1. SCOPE

1.1 This standard (Part 3) covers the method of test for determining volumetric shrinkage of timber.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 15 cm in length or 2 × 2 cm in cross-section and 6 cm in length.

3. PROCEDURE

3.1 The specimen shall be weighed initially (usually green) correct to 0·001 g and the volume shall be determined by immersion method correct to 0·01 cc. A suitable vessel, half filled with water, shall be kept on the pan of a weighing balance and weighed correct to 0·001 g. The specimen shall be then completely dipped in water by means of a needle as shown in Fig. 1 and weighed again. Care shall be taken that no air bubble sticks to the specimen and the specimen may not touch the vessel. The difference of the two readings shall be volume of the specimen.

3.2 The specimen shall be taken out from water wiped with dry cloth and end-coated by immersion in hot paraffin and allowed to air-season under room conditions and weighed periodically until moisture content of about 12 percent is reached. The volume shall again be determined by method.

3.3 The specimen shall then be kept in an oven at 103 ± 2°C until an approximately constant weight is reached.

3.4 After oven-drying, the specimen shall again be weighed and, while still warm, shall be immersed in hot paraffin-wax bath, care being taken to remove it quickly to ensure only a thin coating.

3.5 The volume of the paraffin-coated specimen shall be determined by immersion as before.

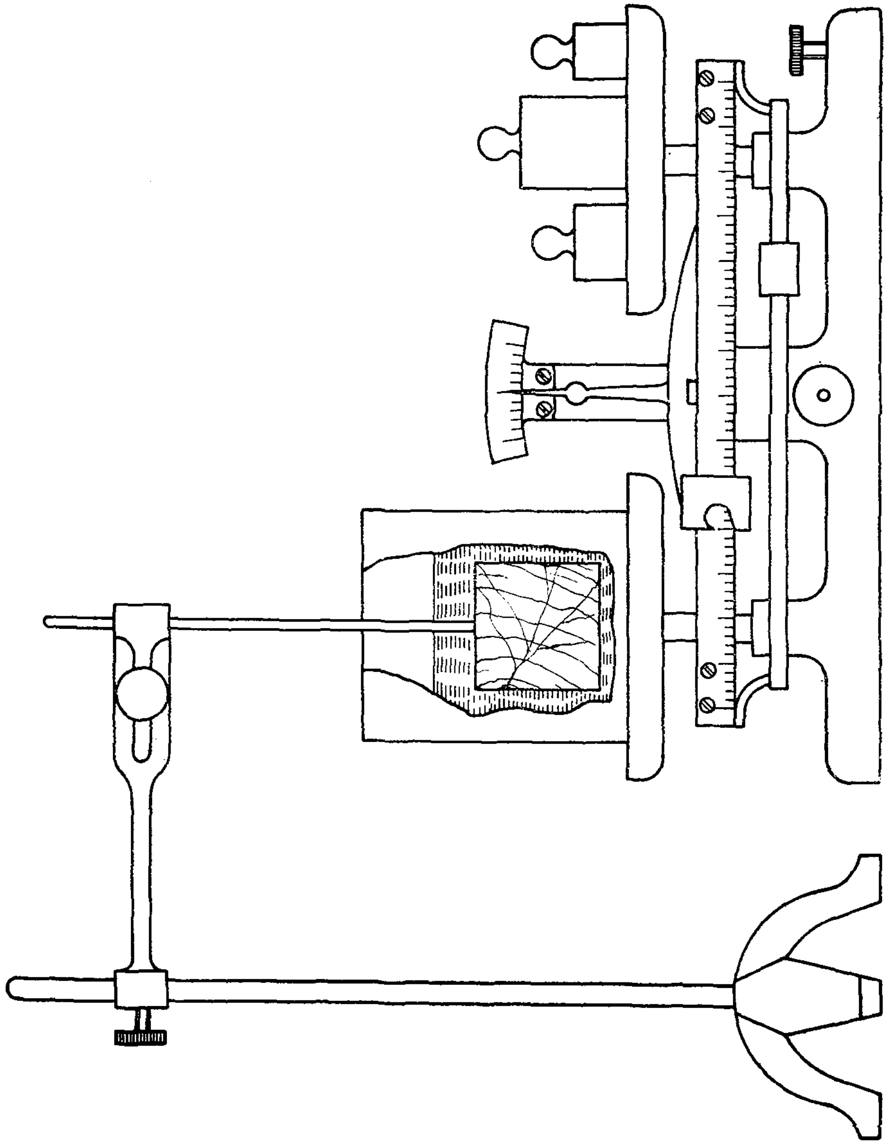


FIG. 1 APPARATUS FOR DETERMINATION OF VOLUMETRIC SHRINKAGE

4. CALCULATION

4.1 Volumetric shrinkage from initial condition to required dry condition $= \dfrac{V_1 - V_r}{V_1} \times 100$ percent of volume in original condition

Moisture content, percent $= \dfrac{W_r - W_o}{W_o} \times 100$

where

W_1 and V_1 = weight in g and volume in cc at initial condition (usually green)

W_r and V_r = weight in g and volume in cc at the initial required dry condition at r percent moisture content (usually 12 percent moisture content or oven dry condition)

4.2 If oven dry specific gravity is required, the same shall be calculated as given below:

Oven dry specific gravity $= \dfrac{W_o}{V_o}$

where

W_o and V_o = weight in g and volume in cc at the oven dry condition.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 4 DETERMINATION OF RADIAL AND TANGENTIAL SHRINKAGE AND FIBRE SATURATION POINT

(Second Revision)

1. SCOPE

1.1 This standard (Part 4) covers the method of test for determining radial and tangential shrinkage and evaluation of fibre saturation point.

2. TEST SPECIMEN

2.1 Test specimen for radial or tangential shrinkage shall be 2 × 2 cm in cross-section and 5 cm in length. These shall be cut truely radial or tangential as the case may be in lengthwise direction.

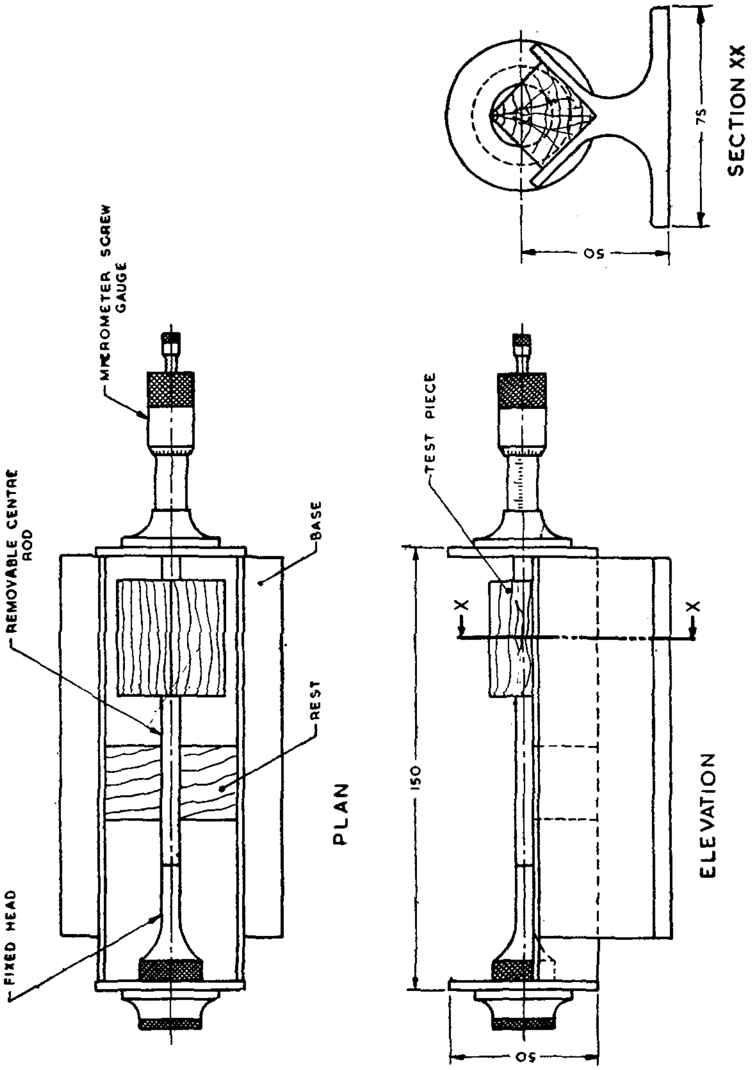
3. PROCEDURE

3.1 The specimen shall be weighed initially (usually green) correct to 0·001 g and the length of the specimen shall be measured correct to 0·002 cm by means of a special screw gauge shown in Fig. 1.

3.2 Situable marks should be placed on the corners and centre of the specimens so that they may be placed in the same position and measurements taken at the same points during all subsequent measurements.

3.3 The specimens shall be allowed to air-season and periodically weighed and measured to the same accuracy as given in **3.1**, until a uniform moisture content of nearly 12 percent is reached.

3.4 The specimens shall then be dried in an oven at 103 ± 2°C until an approximately constant weight is attained. The specimen shall then be weighed and measured finally.



All dimensions in millimetres.

FIG. 1 APPARATUS FOR RADIAL AND TANGENTIAL SHRINKAGES

4. CALCULATION

4.1 The radial and tangential shrinkage shall be calculated from the following formulae:

a) Shrinkage, s, tangential or radial from green to the required dry condition $= \dfrac{l_1 - l_r}{l_1} \times 100$ percent

b) Moisture content, r, percent $= \dfrac{W_r - W_o}{W_o} \times 100$ percent

where

W_1 and l_1 = weight in g and length in cm in the initial condition (usually green),

W_r and l_r = weight in g and length in cm at r percent moisture content, and

W_o = weight in g at the oven dry condition.

c) A graph shall be plotted between r as the ordinate and s as the abscissa. From this graph the moisture content at which shrinkage commences appreciably is noted. This is known as Υ_0 point. The average value of the Υ_0 point in the radial and tangential shall be taken as fibre saturation point.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 5 DETERMINATION OF STATIC BENDING STRENGTH

(Second Revision)

1. SCOPE

1.1 This standard (Part 5) covers the method of test for determining static bending strength of timber under central loading.

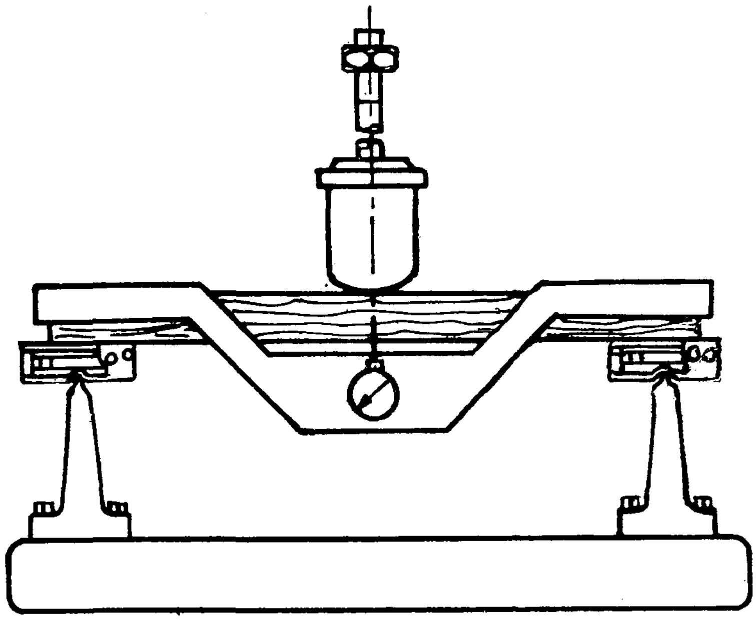
2. TEST SPECIMEN

2.1 The specimen for static bending test shall be 5 × 5 cm in cross-section and 75 cm in length or 2 × 2 cm in cross-section and 30 cm in length. The specimens shall be free from any defect and shall not have a slope of grain more than 1 in 20 parallel to longitudinal edges.

3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on a suitable testing machine. The test specimen shall be so placed on a rig that the load is applied through a loading block to the tangential surface nearer to the heart. The specimen shall be supported on the rig in such a way that it will be quite free to follow the bending action and will not be restrained by friction (Fig. 1). The bottom surface of the loading block shall be cylindrical having radius equal to 75 cm in case of 5 × 5 cm cross-section and 30 mm in case of 2 × 2 cm cross-section of the specimen. Load shall be applied centrally on a span of 70 cm for 5 × 5 cm cross-section and 28 cm for 2 × 2 cm cross-section. Thin metal plate shall be placed between the loading block and the specimen so as not to cause indentation.

3.2 Rate of Loading — The load shall be applied continuously throughout the test such that the movable head of the testing machine moves at a constant rate of 2·5 mm per minute in case of 5 × 5 × 75 cm and 1·0 mm per minute in case of 2 × 2 × 30 cm.



All dimensions in millimetres.

FIG. 1 EQUIPMENT FOR STATIC BENDING

3.3 Measurement of Load and Deflection

a) Deflections of the neutral plane at the centre of the length shall be taken with respect to the points in the netural plane above the supports.

b) Deflections of the neutral axis shall be measured at the centre of the beam to the following accuracy either by a suitable deflectometer or by means of a dial gauge, or by telescope and scale:

Up to 30 mm correct to 0·02 mm

Over 30 mm correct to 0·2 mm

c) Deflection shall be measured at suitable load intervals such that about 8-10 readings are available up to limit of proportionality. Beyond the limit of proportionality up to maximum load or beyond maximum load as the case may be, the load and deflection shall be measured either at suitable intervals of load or of deflection. Beyond maximum load the test shall be continued until a deflection of 15 cm for 5 × 5 × 75 cm and 6 cm for 2 × 2 × 30 cm is reached or the specimen fails to support 100 kg for 5 × 5 × 75 cm or 20 kg for 2 × 2 × 30 cm, whichever is earlier.

d) The load and deflection at the first failure, the maximum load and the points of sudden changes in deflection and load shall be recorded even if they may not occur at any of the regular load or deflection increments.

3.4 Record of Failure — The failure of the specimen shall be recorded according to its appearance and development as indicated in Fig. 2.

4. RECORDING OF DATA AND CALCULATION

4.1 The readings of deflections and the loads shall be recorded as explained in **3.3** and a load-deflection curve shall be drawn. While drawing a load deflection curve, the following rules shall be adopted:

a) The straight line of proportionality shall be drawn in such a way that maximum number of points shall be on the straight line or nearest to it.

b) For the above purpose, the initial two or three points need not be given much importance.

c) When the straight line does not pass through the origin, a parallel line shall be drawn through the origin and the deflection and load at the limit of proportionality shall be measured on this line.

d) If a planimeter is used for finding the areas up to the maximum load or the final load, the planimeter shall pass through the point where the load deflection curve actually ends and then extended in a line parallel to *Y*-axis until it cuts the abscisca.

e) The points beyond the elastic limit and up to maximum load may be connected by a smooth curve but the points beyond the maximum load shall be joined from point to point for evaluating total work.

4.2 The various characteristics shall be determined by the following formulae and from the load-deflection curve. The area shall be measured by a calibrated planimeter:

Sl No.	*Characteristic*	*Unit*	*Formula*
i)	Fibre stress at limit of proportionality (FS at LP)	kg/cm^2	$\frac{3\,Pl}{2\,bh^2}$
ii)	Equivalent fibre stress at maximum load (modulus of rupture — *M* of *R*)	kg/cm^2	$\frac{3\,Pl}{2\,bh^2}$
iii)	Modulus of elasticity (*M* of *E*)	kg/cm^2	$\frac{Pl^3}{4\Delta\,bh^3}$

iv)	Horizontal shear (HS) stress on neutral plan at limit of proportionality (LP) (HS at PL)	kg/cm^2	$\frac{3P}{4bh}$
v)	Horizontal shear stress at maximum load (*ML*) (*HS* at *ML*)	kg/cm^2	$\frac{3P'}{4bh}$
vi)	Work (*Wk*) to limit of proportionality (elastic resilience) (*Wk* to *LP*)	kg.cm/cm^3	$\frac{CA}{lbh}$
vii)	Work to maximum load (*Wk* to *ML*)	kg.cm/cm^3	$\frac{CA'}{lbh}$
viii)	Total work	kg.cm/cm^3	$\frac{CA''}{lbh}$

where

P = load in kg at the limit of proportionality which shall be taken as the point in load-deflection curve above which the graph deviates from the straight line;

l = span of the test specimen in cm;

b = breadth of the test specimen in cm;

h = depth of the test specimen in cm;

P' = maximum load in kg;

Δ = deflection in cm at the limit of proportionality;

C = area constant in kg.cm (that is, the energy represented by one square centimetre which is equal to load in kg, represented by one centimetre ordinate multiplied by deflection in centimetres, represented by one centimetre abscissa);

A = area in cm^2 of load-deflection curve up to limit of proportionality;

A' = area in cm^2 up to maximum load; and

A'' = area in cm^2 up to the final reading when total work is required.

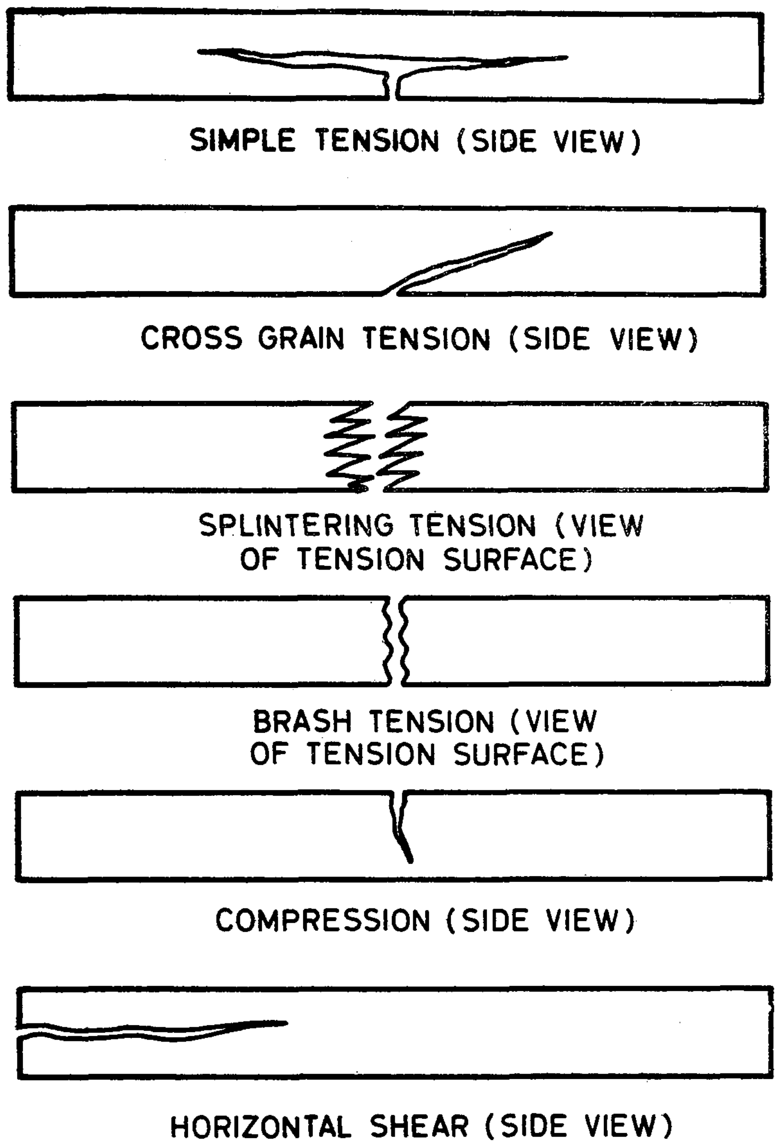


Fig. 2 Failure of Specimen Under Static Bending Test

4.3 In the absence of suitable planimeter the work shall be calculated by the following formulae:

$$\text{Work to limit of proportionality } (Wk \text{ to } LP) = \frac{P}{2lbh}$$

$$\text{Work to maximum load } (Wk \text{ to } ML) = \frac{0 \cdot 6}{lbh}\left\{P\Delta_{m} + P'(\Delta m - \Delta) - 0 \cdot 03\right\}$$

$$\text{Total work} = Wk \text{ to } ML + \frac{d}{2lbh}\left\{(P' + P'') + 2(P_1 + P_2 + \ldots P_K)\right\}$$

where

Δm = deflection in cm at maximum load,

d = common difference of deflection between successive load readings beyond maximum load in cm,

P'' = final load of 100 kg or 20 kg or load equivalent to 15 cm or 6 cm deflection as mentioned in para **3.3** (c), and

$P_1 \ldots\ldots P_K$ = loads (ordinates) at fixed intervals of deflection btweeen P' and P''.

5. RATIO

5.1 For the purpose of comparison, the ratios of results of static bending tests on 5 × 5 cm to those on 2 × 2 cm cross-section shall be taken as given below:

a) Fibre stress at limit of proportionality = 0·92

b) Modulus of rupture = 0·93

c) Modulus of elasticity = 1·06

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 6 DETERMINATION OF STATIC BENDING STRENGTH UNDER TWO-POINT LOADING

(Second Revision)

1. SCOPE

1.1 This standard (Part 6) covers the method of determination of static bending strength of timber under two-point loading.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 100 cm in length or 2 × 2 cm in cross-section and 40 cm in length. The specimen shall be free from defect and shall not have a slope of grain more than 1 in 20 parallel to its longitudinal edge.

3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on a suitable testing machine. The specimen shall be supported on a rig in such a way that it will be quite free to follow the bending action and will not be restrained by friction. The specimen shall be so placed that the load is applied at two points equidistant from supports through the loading block to the tangential surface nearer to the heart. The bottom surface of both the loading blocks shall be cylindrical having radius equal to 50 mm in case of 5 × 5 cm and 20 mm in case of 2 × 2 cm cross-section. The distance between points of supports (span) shall be 90 cm in case of 5 × 5 cm and 36 cm in case of 2 × 2 cm cross-section. The distance between points of appplication of the load and the supports (*a*) (*see* Fig. 1) shall be 15 cm for 5 × 5 cm and 6 cm for 2 × 2 cm cross-section.

3.2 Rate of Loading — The load shall be applied continuously throughout the test such that the movable head of the testing machine moves at a constant rate of 3 mm per minute and 1·5 mm per minute in the two cases respectively.

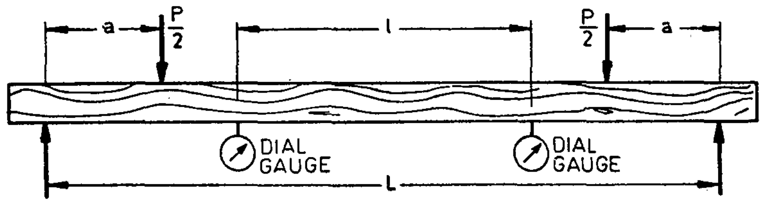


FIG. 1 SPECIMEN UNDER THE TWO POINT STATIC BENDING

3.3 Measurement of Load and Deflection — Deflection of neutral axis shall be measured at the mid span between two points equidistant from mid span to an accuracy of 0·01 mm by means of a suitable equipment fitted at these two points and having a dial gauge or deflectometer. The distance (L) between these two points (also called as gauge length) shall be 40 cm and 16 cm for 5 × 5 cm and 2 × 2 cm cross-section respectively. The deflection shall be measured at suitable load intervals such that 8-10 readings are available up to limit of proportionality and continued up to maximum load.

3.4 Record of Failure — The failure of the specimen shall be recorded according to its appearance and development as indicated in Fig. 2 of Part 5 of this standard.

4. CALCULATION

4.1 A curve between load as ordinate and deflection as abscissa shall be drawn and the limit of proportionality, that is, the point at which the curve deviates from straight line shall be evaluated observing the rules explained in **4.1** of Part 5 of this standard.

4.2 The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristics*	*Unit*	*Formula*
1.	Fibre stress (FS) at limit of proportionality (LP) (FS at LP)	kg/cm^2	$\frac{3Pa}{bh^2}$
2.	Equivalent fibre stress at maximum load (modulus of rupture *M* of *R*)	kg/cm^2	$\frac{3P'a}{bh^2}$
3.	Modulus of elasticity (*M* of *E*)	kg/cm^2	$\frac{3\,Pal^2}{4\,bh^3\triangle}$
4.	Horizontal shear (HS) stress on neutral plan at limit of proportionality (*HS* at *PL*)	kg/cm^2	At centre = 0 At ends = $\frac{3\,P}{4\,bh}$

Sl No.	*Characteristics*	*Unit*	*Formula*
5.	Horizontal shear stress at maximum load (ML) (*HS* at *ML*)	kg/cm^2	At centre = 0 At ends = $\frac{3P}{4bh}$
6.	Work (Wk) to limit of proportionality (elastic resilience) (*WK* to *PL*)	kg.cm/cm^3	$\frac{P\triangle}{2lbh}$

where

P = load in kg at limit of proportionality,

P' = maximum load in kg,

b = breath of specimen in cm,

h = depth of specimen in cm,

$\triangle$ = deflection in cm at the limit of proportionality,

a = distance between points of application of load and support in cm (15 cm or 6 cm as the case may be),

l = distance between two fixed points for which deflection is recorded in cm (gauge length) (40 cm or 16 cm for the two sizes respectively), and

L = span in cm (90 cm and 36 cm respectively).

5. RATIO

5.1 If data of static bending test under central loading is required to be compared with that of two point loading following ratio shall be taken as for the cross-section of 5 × 5 cm:

a) Modulus of rupture = 0·86, and

b) Modulus of elasticity = 1·16.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 7 DETERMINATION OF IMPACT BENDING STRENGTH

(Second Revision)

1. SCOPE

1.1 This standard (Part 7) covers the method of test for determining impact bending strength of timber.

2. TEST SPECIMEN

2.1 The specimen for impact bending test shall be 5 × 5 cm in cross-section and 75 cm in length or 2 × 2 cm in cross-section and 30 cm in length. The specimens shall be free from defects and shall not have a slope of grain more than 1 in 20 parallel to longitudinal edges.

3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on a suitable impact bending machine consisting of a mechanism to drop hammer from different height and a specimen holder holding the specimen in such a way that the hammer may fall at the centre of the specimen and the specimen may remain free to move on the impact and follow bending action on the fixed span. The span shall be 70 cm in case of 5 × 5 × 75 cm and 28 cm in case of 2 × 2 × 30 cm specimens. The weight of the hammer shall be 25 kg and 1·5 kg for the two sizes respectively. The bottom surface of the hammer shall be cylindrical of radius 75 cm and 30 mm respectively. The impact shall be on the tangential surface nearer to heart. When necessary, for stronger species, heavier hammer of double the weight having the same cylindrical surface shall be used. In such cases the height shall be doubled for purpose of calculation.

3.2 Measurement of the Static Deflection — Static deflection (x) due to the weight of the hammer shall be measured at the centre of the specimen to the nearest 0·02 mm by suitably placing the dial gauge under the specimen with hammer resting on the surface of the specimen.

3.2 Marking of Datum Line and Recording of Deflection — For recording of deflection a drum shall be provided which can be brought in contact with a stylus attached to hammer and can be rotated on a vertical axis. On the drum a paper shall be fixed by means of sticking tape, under which a carbon paper shall be placed inverted for recording the impressions. First a datum line shall be marked by placing the hammer to rest on the specimen and rotating the drum with stylus touching it. After that the hammer shall be dropped from different heights and deflection recorded on the paper fixed on the drum. The first drop of hammer shall be from a height of 5 cm after which the height of the successive drops shall be increased by 2·5 cm until a height of 25 cm is reached, and thereafter increment in height shall be 5 cm until complete failure occurs or 15 cm or 6 cm deflection is reached for the two sizes respectively.

Deflections due to successive drops are recorded as shown Fig. 1. For this purpose, at the drop of the hammer, the drum is to be rotated as the hammer rebounds.

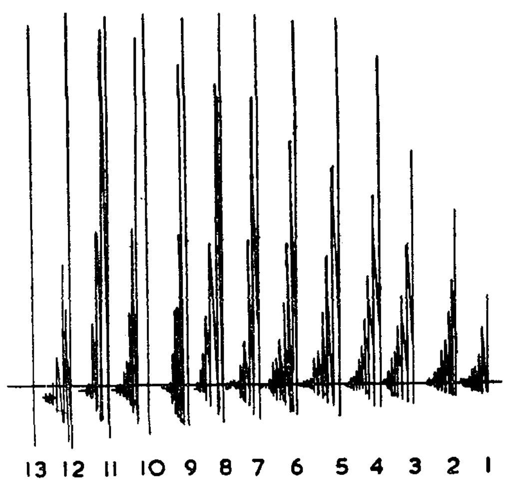


Fig. 1 Records of Deflection Due to Impact Bending

3.4 Recording of Failure — The failure of the specimen shall be recorded according to its appearance and developments as indicated in Fig. 2 of Part 5 of this standard.

4. CALCULATION

4.1 From the tracing on the drum record the actual deflection (y) at each drop (that is, the distance from the lowest point to the datum line) is measured with the help of a pair of dividers and diagonal scale to the accuracy of 0·1 mm.

4.2 A graph shall then be plotted with the exact height of drop plus maximum deflection at that drop $H + (x + y)$ as the ordinate and $(y + x)^2$ as the abscissa. Rules explained in **4.1** of Part 5 of this standard shall be observed. The point at which the curve deviates from a straight line shall be taken as limit of proportionality.

4.3 The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristics*	*Unit*	*Formula*
i)	Maximum height of drop	cm	H
ii)	Height of drop at limit of proportionality	cm	H'
iii)	Fibre stress (*FS*) at limit of proportionality (*LP*) (*FS* at *LP*)	kg/cm²	$\frac{3H'Wl}{bh^2\triangle}$
iv)	Modulus of elasticity (*M* of *E*)	kg/cm²	$\frac{H'Wl^3}{2bh^3\triangle^2}$
v)	Work to limit of proportionality	kg cm/cm³	$\frac{H'W}{l\,bh}$

where

H = maximum height of drop in cm under the given weight,

H' = height of drop in cm at the limit of proportionality read from the curve (inclusive of deflection $x + y$),

W = weight of the hammer in kg,

l = span of the test specimen in cm,

b = breadth of the test specimen in cm,

h = depth of the test specimen in cm, and

$\triangle$ = $(y + x)$ at limit at proportionality from the curve.

4.4 The size of the specimen shall also be reported while reporting the results of this test.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 8 DETERMINATION OF COMPRESSIVE STRENGTH PARALLEL TO GRAIN

(Second Revision)

1. SCOPE

1.1 This standard (Part 8) covers the method of determining compressive strength parallel to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 20 cm in length or 2 × 2 cm in cross-section and 8 cm in length. The specimen shall be free from defects and shall not have a slope of grain more than 1 in 20 parallel to its longitudinal edges. The end planes of the specimen shall be perfectly at right angles to the length of the specimens.

3. PROCEDURE

3.1 Placing the Specimen — The tests shall be carried out on a suitable testing machine. At least one platen of the testing machine shall be equipped with a hemispherical bearing to obtain uniform distribution of load over the ends of the specimen. The specimen shall be so placed that the centre of the movable head is vertically above the centre of the cross-section of the specimen.

NOTE — It is essential that the ends of the rectangular test specimen are smooth and parallel and normal to the axis and that the testing machines are of such construction that the surfaces between which the test specimen is placed are parallel to each other and remain so during the whole period of test.

3.2 Rate of Loading — The load shall be applied continuously during the test such that the movable head of the testing machine travels at a constant rate of 0·6 mm per minute for both the sizes.

3.3 Measurement of Load and Deformation — For 5 × 5 × 20 cm specimen a load of 250 kg shall initially be applied to set the specimen. Deformation under compression shall then be measured correct to 0·002 mm by means of a suitable compressometer over a central gauge length of 15 cm. Where possible direct points shall be obtained on a graph sheet. The reading shall be continued well beyond the proportional limit. The final reading at the maximum load shall be recorded. It would be preferable to remove the compressometer before the maximum load. The deformation shall be read at suitable load intervals such that 8 to 10 readings are obtained before limit of proportionality is reached. For 2 × 2 × 8 cm specimen final reading of the maximum load shall only be recorded. In case deformation readings are also required for evaluation of modulus of elasticity under compression the same shall be recorded correct to 0·01 mm by means of a dial gauge. The deformation shall be read at suitable load intervals such that 10 to 15 readings are obtained before proportional limit is reached. If required a load not more than 20 kg shall initially be applied to set the specimen.

3.4 Record of Failures — To obtain satisfactory and uniform results the failure may be made to develop on the body of the specimen by continuing the machine to run for a longer time. Compression failures shall be recorded according to the apperance of the frictured surface as shown in Fig. 1. In case two or more kinds of failures develop, they shall be described in the order of their occurrence (for example, shearing followed by crushing).

4. CALCULATION

4.1 The load deformation curves shall be drawn observing the rules explained in **4.1** of Part 5 of this standard. Load and deformation at limit of proportionality shall then be read accordingly.

The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristic*	*Unit*	*Formula*
i)	Compressive stress (*S*) at limit of proportionality (*LP*) (*CS* at *ML*)	kg/cm²	$\frac{P}{A}$
ii)	Compressive stress at maximum load (*ML*) (*CS* at *LP*)	kg/cm²	$\frac{P'}{A}$
iii)	Modulus of elasticity (*M* of *E*) in compression parallel to grain (*M* of *E* in Compression II)	kg/cm²	$\frac{LP}{\Delta A}$

where

P = load at the limit of proportionality in kg,

A = cross-sectional area in cm^2,

P' = maximum crushing load in kg,

L = gauge length between compressometer points in cm (for 2 × 2 × 8 cm L shall be the length of specimen in cm), and

Δ = deformation at the limit of proportionality in cm.

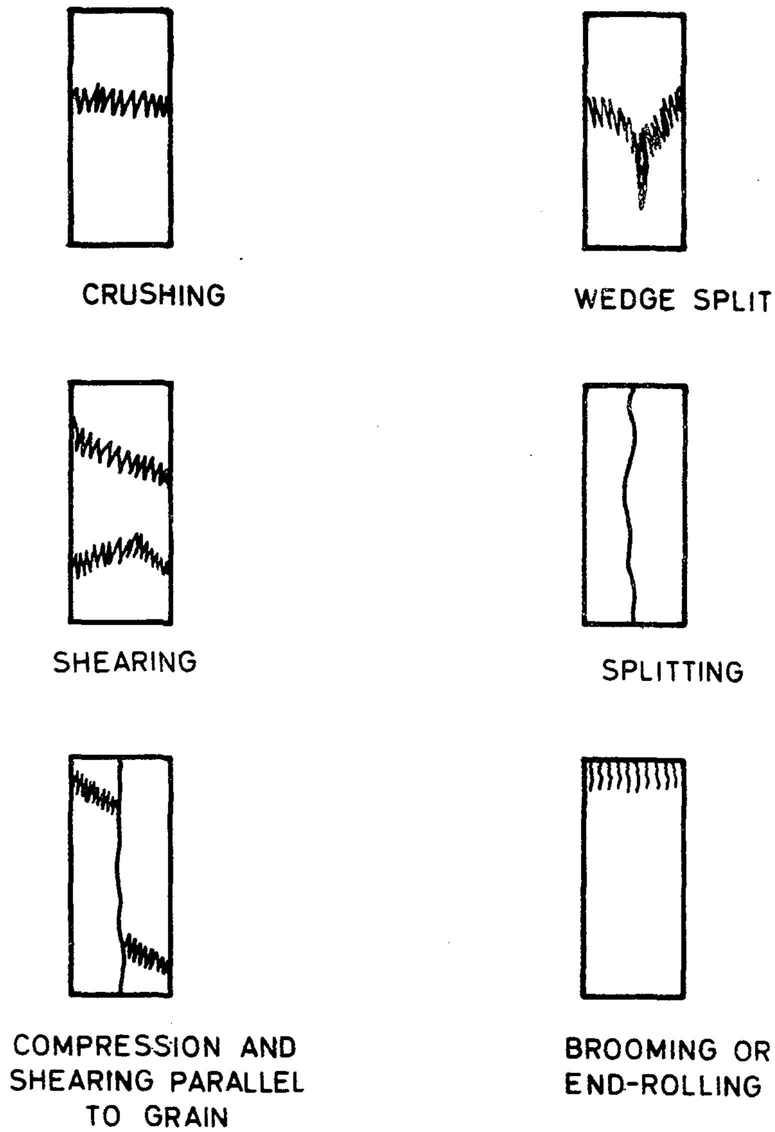


FIG. 1 FAILURE OF SPECIMEN UNDER COMPRESSION PARALLEL TO GRAIN

5. RATIO

5.1 For the purpose of comparison the ratio of results of 5 × 5 cm and 2½ × 2 cm cross-section shall be taken as 0·98.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 9 DETERMINATION OF COMPRESSIVE STRENGTH PERPENDICULAR TO GRAIN

(Second Revision)

1. SCOPE

1.1 This standard (Part 9) covers the method of determining compressive strength perpendicular to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 15 cm in length or 2 × 2 cm cross-section and 10 cm in length. The specimen shall be free from defects and faces shall approach closely to the true radial and tangential direction.

3. PROCEDURE

3.1 Placing the Specimen — The tests shall be carried out on a suitable testing machine. The load shall be applied through metal bearing plate 5 cm in width of at least 15 mm thickness placed centrally across the upper surface of the specimen at equal distances from the ends and at right angles to the length. The load shall be applied to the radial surface.

3.2 Rate of Loading — The load shall be applied continuously throughout the test such that the movable head of the testing machine travels at a constant rate of 0·6 mm per minute for both the sizes.

3.3 Measurement of Load and Deformation — A small load not more than 50 kg on 5 × 5 × 15 cm and 10 kg on 2 × 2 × 10 cm specimen shall initially be applied to set the specimen. The deformation then shall be measured correct to 0·02 mm by means of dial gauge or mirror and scale technique at suitable load intervals so that 8 to 10 readings are available up to limit of proportionality and is continued up to a deformation of 2·5 mm. If a maximum load is reached at some lesser value of compressive deformation, the same shall be recorded along with corresponding deformation.

4. CALCULATION

4.1 A curve between load and deformation shall be drawn observing the rules explained in **4.1** of Part 5 of this standard. The load and deformation at limit of proportionality is then read. Load at 2·5 mm compression shall also be recorded. The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristic*	*Unit*	*Formula*
i)	Compressive stress (*CS*) at limit of proportionality (*LP*) (*CS* at *LP*)	kg/cm²	$\frac{P}{A}$
ii)	Compressive stress at compression of 2·5 mm	kg/cm²	$\frac{P'}{A}$
iii)	Crushing strength at maximum load (*ML*) (*CS* at *ML*)	kg/cm²	$\frac{P_0}{A}$
iv)	Modulus of elasticity (*M* of *E*) in compression perpendicular to grain (*M* of *E* in compression)	kg/cm²	$\frac{P}{A} \times \frac{h}{\Delta}$

where

P = load at limit of proportionality in kg,

A = area of the cross-section normal to the direction of load in cm² (5 × 5 cm or 5 × 2 cm),

P' = load at 2·5 mm compression in kg,

P_0 = maximum load if reached at a compression less than 2·5 mm in kg,

h = height of the specimen in cm, and

$\triangle$ = deformation at the limit of proportionality in cm.

5. RATIO

5.1 For the purpose of comparison of compressive stress perpendicular to grain at elastic limit the ratio of the results of 5 × 5 cm and 2 × 2 cm cross-section shall be taken as 1·07.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 10 DETERMINATION OF HARDNESS UNDER STATIC INDENTATION

(Second Revision)

1. SCOPE

1.1 This standard (Part 10) covers the method of determining hardness of timber under static identation.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 15 cm in length or 2 × 2 cm in cross-section and 10 cm in length. The specimen shall be free from defects and the faces shall approach closely to the true radial and tangential directions.

3. PROCEDURE

3.1 Placing of the Specimen — The test shall be carried out on a suitable testing machine equipped with a special device to penetrate into the specimen a steel bar with hemispherical end or steel ball of 1·128 cm diameter to a depth of 0·564 cm, that is, the projected area of the maximum circle is 1 sq cm. The device shall have a mechanical coller, a microswitch to enable determination of identation up to specified depth of 0·564 cm. The specimen shall be so placed on the machine that two penetrations are made on the radial face, two on the tangential face and one on each end in case of 5 × 5 × 15 cm size. The penetration shall be far enough from each other and from the edges to prevent splitting or chipping. In case of 2 × 2 × 10 cm size one penetration shall be made on tangential and one on radial face, care shall be taken that the penetration on one face may be at sufficient distance from the penetration on the other face and the results of one may not effect the results of other. Care shall also be taken to prevent any splitting or chipping in the specimen due to penetration. If required the specimen shall be placed in a lightly tightened clamp.

3.2 Rate of Loading — The load shall be applied continuously such that the movable head of the machine travels at a constant rate of 6 mm per minute for both sizes.

4. RECORDING OF DATA AND CALCULATION

4.1 The load in kg required to penetrate the standard steel ball or hemispherical end of the steel bar (1·128 cm dia) to the specified depth of 0·564 cm shall be recorded for tangential, radial and end surfaces. Where two penetrations on one surface or one panetration on both ends have been made, average shall be taken. The average of radial and tangential hardness is denoted as side hardness.

5. RATIO

5.1 For the purpose of comparison of side hardness, the ratio of the results of 5 × 5 cm and 2 × 2 cm cross-section shall be taken as 1·11.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 11 DETERMINATION OF SHEAR STRENGTH PARALLEL TO GRAIN

(Second Revision)

1. SCOPE

1.1 This standard (Part 11) covers the method of determining shear strength parallel to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 6 cm in length or 2 × 2 cm in cross-section and 3 cm in length. The specimens shall be notched on one end as shown in Fig. 1 to produce shear failure on 5 × 5 cm or 2 × 2 cm surface in the radial or tangential plane.

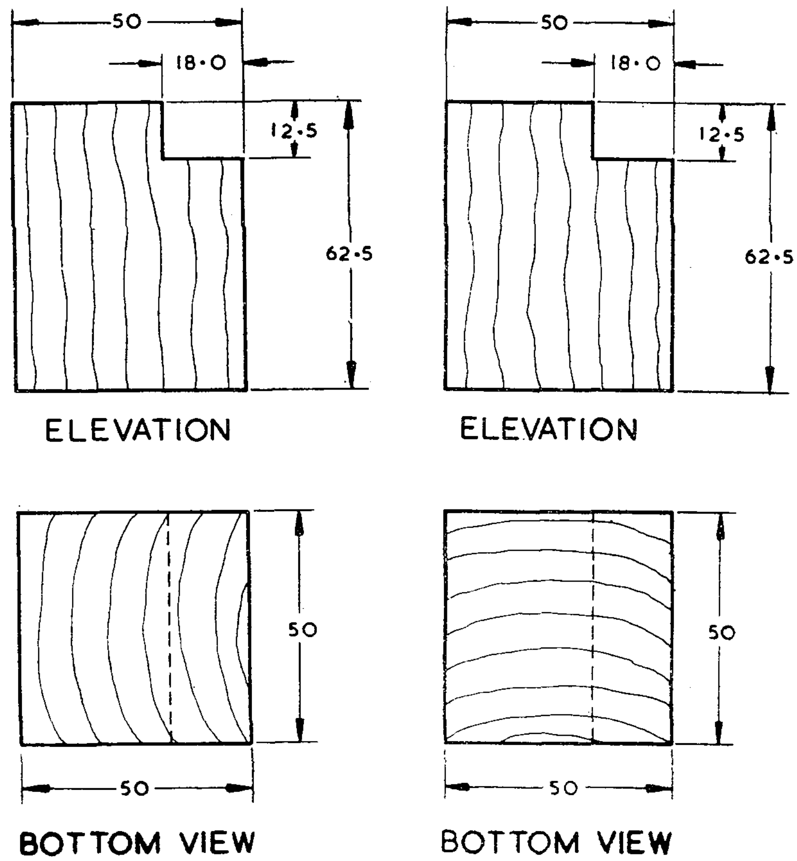
3. PROCEDURE

3.1 Placing of the Specimen — The test shall be carried out on a suitable testing machine with the help of a shearing tool in a rig. The specimen shall be supported in the rig by means of a cross bar such that the edges of the specimen are vertical and part of end surface not to be shared off rests on the support through out the test. The shearing tool shall rest on the notch. The direction of shearing shall be parallel to the longitudinal direction.

3.2 Rate of Loading — The load shall be applied continuously during the test such that the movable head travels at a constant rate of 0·4 mm per minute.

4. RECORDING OF DATA AND CALCULATION

4.1 The maximum load required for shearing the area shall be recorded. The load divided by the area gives the maximum shearing stress (MSS) in the concerned plane (radial or tangential) for both sizes.



1A Radial Specimen
1B Tangential Specimen

All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR SHEAR PARALLEL TO GRAIN

5. RATIO

5.1 For the purpose of comparison of maximum shearing stress parallel to grain (average of radial and tangential), the ratio of the results of 5 × 5 cm and 2 × 2 cm cross-section shall be taken as 0.87.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 12 DETERMINATION OF TENSILE STRENGTH PARALLEL TO GRAIN

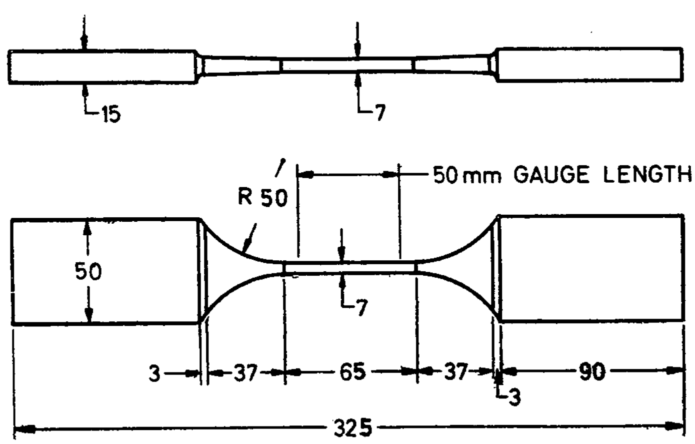
(Second Revision)

1. SCOPE

1.1 This standard (Part 12) covers the method of determining the tensile strength parallel to grain of timber.

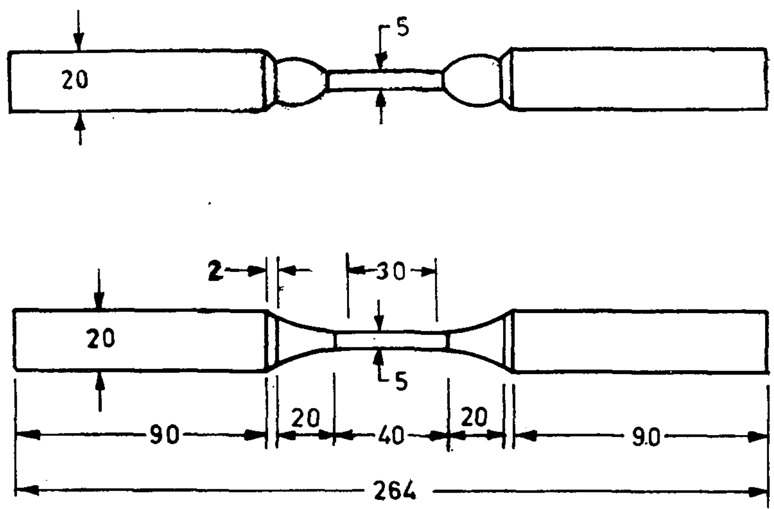
2. TEST SPECIMEN

2.1 The test specimen for the two sizes shall have the shape and size as shown in Fig. 1A and 1B. The cross-section of the central portion of the specimen shall be 7 × 7 or 5 × 5 mm for the specimen in Fig. 1A and Fig. 1B respectively. The gauge length shall be 5 cm and 3 cm for the two sizes respectively. The annual rings on the ends shall be perpendicular to the greater cross sectional dimension in case specimen described in Fig. 1A.



All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR TENSION PARALLEL TO GRAIN — *Contd*



1B

All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR TENSION PARALLEL TO GRAIN

3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on any testing machine provided with suitable types of grips to hold the specimen firmly without any slip during the test. The specimen shall be held firmly in the grips and the suitable elongation measuring device shall be attached to the gauge length.

3.2 Rate of Loading — The load shall be applied continuously during the test such that the movable head travels at a constant rate of one millimetre per minute for both sizes.

3.3 Measurement of Loads and Elongation — Elongation shall be measured correct to 0·002 mm at suitable load intervals such that 8-10 readings and available up to limit of proportionality. Readings shall be continued well beyond the proportional limit and the final reading of load at failure shall be recorded. It would be preferable to remove the elongation measuring device before the maximum load is reached.

4. CALCULATION

4.1 Load elongation curves shall be drawn observing the rules explained in **4.1** of Part 5 of this standard. Load and elongation at proportional limit shall then be read.

The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristic*	*Unit*	*Formula*
i)	Tensile stress at proportional limits (*TS* at *PL*)	kg/cm^2	$\frac{P}{A}$
ii)	Tensile stress at maximum load (*TS* at *ML*)	kg/cm^2	$\frac{P'}{A}$
iii)	Modulus of elasticity in tension parallel to grain (*M* of *E* in tension)	kg/cm^2	$\frac{LP}{\Delta A}$

where

P = load at the limit of proportionality in kg,

A = cross-sectional area in cm^2,

P' = maximum load to cause the failure of the specimen in kg,

L = gauge length between extensometer points in cm, and

Δ = deformation at the limit of proportionality in cm.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 13 DETERMINATION OF TENSILE STRENGTH PERPENDICULAR TO GRAIN

(Second Revision)

1. SCOPE

1.1 This standard (Part 13) covers the method of determination of tensile strength perpendicular to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen for the two sizes shall have the shape and size as shown in Fig. 1A and 1B. The notches shown in Fig. 1A and 1B shall be so made as to produce a failure on 50 × 20 mm area (Fig. 1A) or 20 × 10 mm area (Fig. 1B) in the radial or tangential surface as desired.

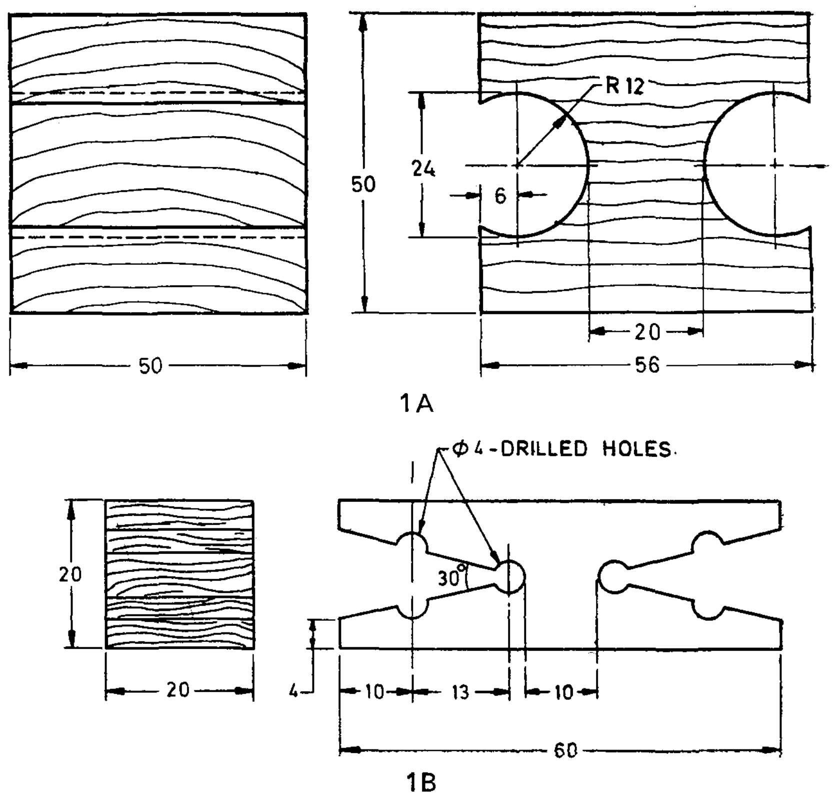
3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on a testing machine provided with suitable grips to hold the specimen. These grips shall have cushioning springs for prevention of damage to the machine when the specimens suddenly breaks. The specimen shall be placed in the grips.

3.2 Rate of Loading — The load shall be applied continuously througout the test so that the movable head moves at a constant rate of 2·5 mm per minute until the maximum load is reached for both sizes.

4. RECORDING OF DATA AND CALCULATION

4.1 The maximum load required for failure perpendicular to grain shall be recorded. The load divided by the area gives the maximum tensile stress perpendicular to grain in the concerned plane (radial or tangential).



All dimensions in millimetres.

FIG. 1 TEST SPECIMENS FOR TENSION PERPENDICULAR TO GRAIN

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 14 DETERMINATION OF CLEAVAGE STRENGTH PARALLEL TO GRAIN

(Second Revision)

1. SCOPE

1.1 This standard (Part 14) covers the method of determining cleavage strength parallel to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen for the two sizes shall have the shape and size as shown in Fig. 1A and 1B. The notches shown in Fig. 1A and 1B shall be such as to fail the specimen in radial or tangential surface as desired.

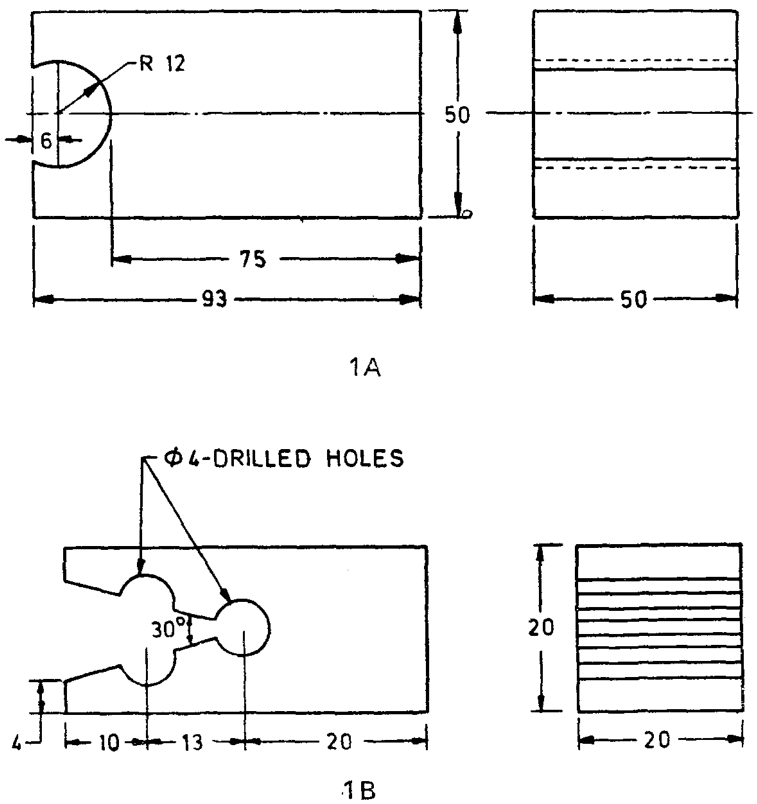
3. PROCEDURE

3.1 Placing of the Specimen — The test shall be conducted on a testing machine provided with suitable grips to hold the specimen. The specimen shall be placed in the grips.

3.2 Rate of Loading — The load shall be applied continuously throughout the test so that movable head moves at a constant rate of 2·5 mm per minute until the maximum load is reached for both sizes.

4. RECORDING OF DATA AND CALCULATION

4.1 The maximum load required for failure shall be recorded. The load divided by the width gives the maximum cleavage resistance kg/cm in the concerned plane (radial or tangential).



All dimensions in millimetres.

FIG. 1 TEST SPECIMENS FOR CLEAVAGE

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 15 DETERMINATION OF NAIL AND SCREW HOLDING POWER

(Second Revision)

1. SCOPE

1.1 This standard (Part 15) covers the method of determining nail and screw holding power of timber.

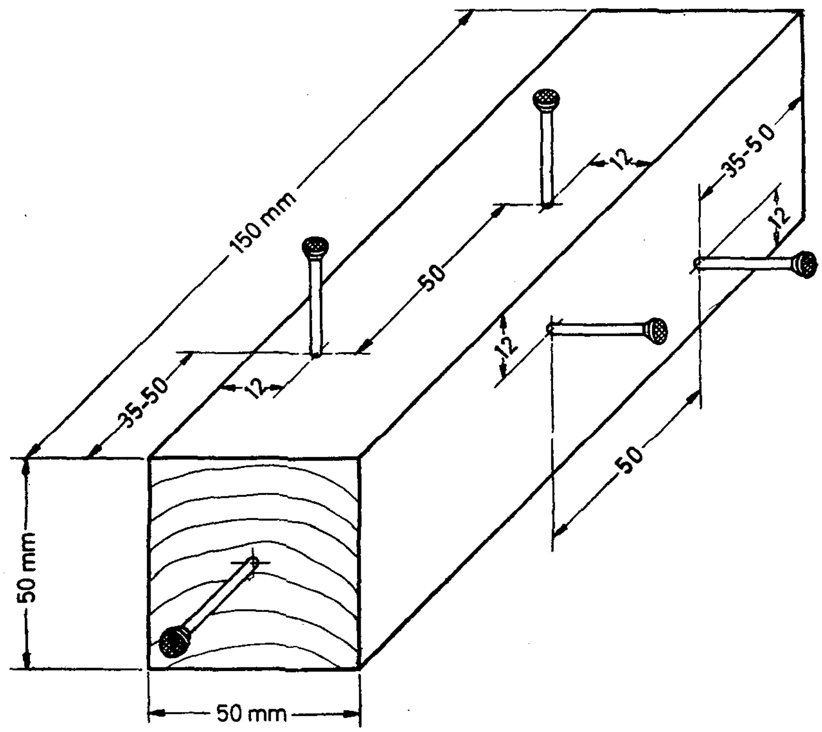
2. TEST SPECIMEN

2.1 The test specimen shall be 5 × 5 cm in cross-section and 15 cm in length. Where this cross-section is not available, sticks of 2 × 2 cm or more in cross-section shall be glued together to make the cross-section of at least 4 × 4 cm. Care shall be taken that the grain direction may be same in all the glued sticks of the specimen. The length shall however be 15 cm.

3. PREPARATION OF TEST SPECIMEN

3.1 Nail and screws as specified in **3.2** and **3.3** shall be driven exactly at right angle to the face of the specimen to a total penetration of 25 mm. In the case of screws, a prebore 2·5 mm in diameter shall be made. In each specimen, the nails or screws shall be driven in such a way that there are one nail and one screw on both the radial as well as tangential surface and one nail on one end and one screw on the other end. On radial and tangential surfaces the nails and screws shall be driven at a distance not less than 35 mm from the ends and 12 mm from the edges. Nails and screws shall not be driven in a line parallel to the length of the specimen or less than the projected length of 50 mm apart. These shall be staggered as shown in the Fig. 1. At the ends, the screw or nails shall be in the centre. In the case of glued specimen care shall be taken that the nails or screws may not be driven on the glue line.

3.2 Nail shall be 50 mm long of 2·50 mm shank diameter and shall be bright, galvanized, diamond pointed and shall have plain heads. Each nail shall be used only once.



All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR NAIL AND SCREW HOLDING POWER

3.3 Screws shall be No. 8 (IS : 451-1961*) shall be galvanized gimlet pointed. The length shall be 50 mm. Each screw shall be used only once.

4. PROCEDURE

4.1 Placing of the Specimen — The test shall be conducted on a testing machine provided with a suitable device to grip the test piece to the fixed head and the nail or screw to the movable head of the machine. The specimen prepared as per **3.1** shall be held firmly on the machine, with the nail or screw gripped in gripping device.

*Specification for wood screws.

4.2 Rate of Loading — The load shall be applied continuously throughout the test so that the movable head moves at a constant rate of 2 mm per minute until the nail or screw is pulled out completely.

4.3 Recording of Data — The maximum load required to pull out the nails or screws shall be recorded for radial, tangential and end surfaces. The average values for radial and tangential surfaces shall be taken as 'side values'.

NOTE — Nails or screws holding power are usually determined for the following conditions:

a) Nails and screws driven in green condition of the material and pulled at once,

b) Nails and screws driven in green condition of the material and pulled when the wood becomes dry to 12 percent moisture content, and

c) Nails and screws driven in dry condition (12 percent moisture content) and pulled at once.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 16 DETERMINATION OF BRITTLENESS BY IZOD IMPACT

(Second Revision)

1. SCOPE

1.1 This standard (Part 16) covers the method of determining brittleness of wood by Izod impact.

2. TEST SPECIMEN

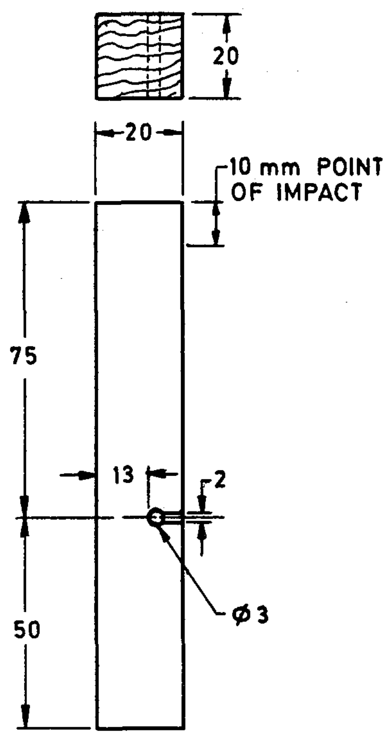
2.1 The test specimen shall be 20 × 20 mm in cross-section and 125 mm in length. A saw notch 2 mm in width and 7 mm in depth shall be made on the radial face of the specimen at a distance of 50 mm from one end so as to produce maximum concentration of impact stress on a cross-section of 20 × 13 mm as shown in Fig. 1.

3. PROCEDURE

3.1 The specimen shall be held vertical tightly clamped as a cantilever in a swinging pendulum machine such that 50 mm length of the specimen shall be under the clamp. The machine shall have a calibrated dial so as to give direct reading of energy absorbed in breaking the specimen in a single blow. The specimen shall be so clamped that the blow is given in the radial face on the side of notch. The pendulum of the machine shall be so adjusted that on release from the intitial position it may strike the specimen at the lowest point of swing (horizontally) at a distance of 10 mm from the upper end.

4. RECORDING OF DATA

4.1 The impact blow shall be given by releasing the pendulum and the reading on calibrated dial in kg.cm shall be recorded. Care shall be taken that the pendulum may strike the specimen freely and break it in a single blow. Care shall also be taken that the specimen may be tightly clamped in the machine otherwise the results will be affected.



All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR BRITTLENESS (IZOD IMPACT)

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 17 DETERMINATION OF BRITTLENESS BY CHARPY IMPACT

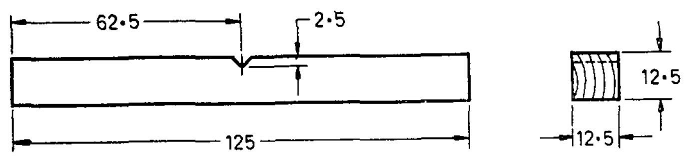
(Second Revision)

1. SCOPE

1.1 This standard (Part 17) covers the method of determining brittleness of wood by charpy impact.

2. TEST SPECIMEN

2.1 The test specimen shall be 12·5 × 12·5 mm in cross-section and 125 mm in length with the notch at the centre on the radial face. The notch shall be *V* type, 2·5 mm in depth and 5 mm in width as shown in Fig. 1 so as to produce maximum concentration of impact stress in a cross-section of 12·5 × 10 mm.



All dimensions in millimetres.

FIG. 1 SPECIMEN FOR BRITTLENESS TEST (CHARPY TEST)

3. PROCEDURE

3.1 The specimen shall be freely supported horizontally with the notch vertical on the base of a swinging pendulum machine up to 10 mm on both ends. The machine shall have a calibrated dial so as to give direct reading of energy absorbed in breaking to specimen on a single blow. The blow shall be given on the opposite side of the notch at the centre of specimen. The pendulum of the machine shall be so arranged that on release from the initial position it may strike the specimen at the lowest point of owing (horizontally).

4. RECORDING OF DATA

4.1 The impact blow shall be given by releasing the pendulum and the reading on calibrated dial in kg.cm shall be recorded. Care shall be taken that the pendulum may strike the specimen freely and break it in a single blow.

Indian Standard

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER

PART 18 DETERMINATION OF TORSIONAL STRENGTH

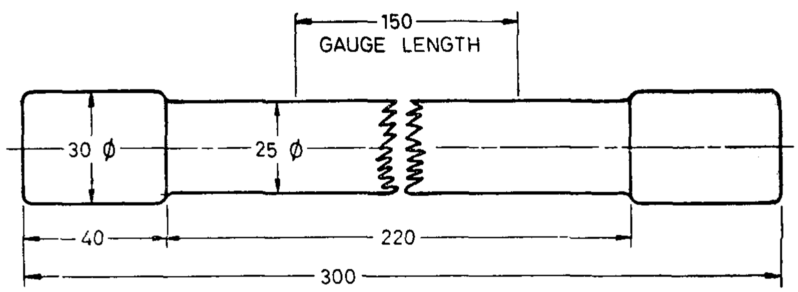
(Second Revision)

1. SCOPE

1.1 This standard (Part 18) covers the method of determining torsional shear strength of timber.

2. TEST SPECIMEN

2.1 The test specimen for both the sizes shall be cylindrical in shape and of dimensions as shown in Fig. 1. The central cylinder shall be 22 cm in length for both sizes but the radius shall be 2·5 cm and 1·2 cm respectively. The end portions for holding the specimen shall be 3 cm and 1·5 cm respectively and 4 cm in length for both the sizes.



All dimensions in millimetres.

FIG. 1 TEST SPECIMEN FOR TORSION

3. PROCEDURE

3.1 Placing the Specimen — The test shall be conducted on a torsion testing machine provided with suitable types of grips to hold the specimen during test firmly on one end and free to rotate at the other end. The specimen shall be mounted on the machine and the strain (angular twist) measuring device shall be attached to the specimen at the centre on a gauge length of 15 cm.

3.2 Rate of Loading — The torque shall be applied gradually by turning the wheel of the machine at a uniform rate so as to produce a torque of about 50 kg.cm per minute.

3.3 Measurement of Torque and Angular Twist — Angular twist shall be measured in radians or degrees correct to 0·5 minute on the specified gauge length of 15 cm at regular intervals of torque such that 8 to 10 readings are available up to the limit of proportionality. Readings shall be continued well beyond the proportional limit and final reading of torque at failure shall be recorded. It would be preferable to remove the strain measuring device before the maximum torque is reached.

4. CALCULATION

4.1 The torque-twist curve shall be drawn observing the rules explained in **4.1** of Part 5 of this standard. The torque and angular twist at proportional limit shall be read from the curve.

The various characteristics shall be determined by the following formulae:

Sl No.	*Characteristic*	*Unit*	*Formula*
i)	Torsional shear stress at proportional limit (*TSS* at *PL*)	kg/cm^2	$\frac{2M}{\pi r^3}$
ii)	Torsional shear stress at maximum torque (*TSS* at *MT*)	kg/cm^2	$\frac{2M'}{\pi r^3}$
iii)	Torsional modulus of rigidity	kg/cm^2	$\frac{2ML}{\pi r^4}$

where

M = torque at the limit of proportionality in kg.cm,

r = radius of the portion of the specimen under gauge in cm,

M' = maximum torque in kg.cm,

L = gauge length in cm, and

π = the angular twist of one end relative to the other end at a distance of L and expressed in radians.

(*Continued from page* 2)

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INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	Unit	Symbol
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic *temperature*	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	Unit	Symbol
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	Unit	Symbol	Definition
Force	newton	N	$1\ N = 1\ kg.m/s^2$
Energy	joule	J	$1\ J = 1\ N.m$
Power	watt	W	$1\ W = 1\ J/s$
Flux	weber	Wb	$1\ Wb = 1\ V.s$
Flux density	tesla	T	$1\ T = 1\ Wb/m^2$
Frequency	hertz	Hz	$1\ Hz = 1\ c/s\ (s^{-1})$
Electric conductance	siemens	S	$1\ S = 1\ A/V$
Electromotive force	volt	V	$1\ V = 1\ W/A$
Pressure, stress	pascal	Pa	$1\ Pa = 1\ N/m^2$

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