IS 8745 (1994): Methods of presentation of data of physical and mechanical properties of timber [CED 9: Timber and Timber Stores]

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IS 8745 : 1994
(Reaffirmed 2003)

भारतीय मानक

लकड़ी के भौतिक व यांत्रिक गुणधर्मों के आरेखों की प्रस्तुतीकरण पद्धतियाँ

(पहला पुनरीक्षण)

Indian Standard

METHODS OF PRESENTATION OF DATA OF PHYSICAL AND MECHANICAL PROPERTIES OF TIMBER

(First Revision)

UDC 674·03 : 539·3/·8 (083·54)

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

February 1994

Price Group 5

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.

Evaluation of basic properties of timber is an important base for establishing design functions of structural timber. For this purpose small clear specimens and specimens in structural sizes are tested according to standard procedures laid down in IS 1708 (Parts 1 to 18) : 1986 'Method of testing of small clear specimens of timber (*second revision*)' and IS 2408 : 1963 'Method of static tests of timber in structural sizes'. In order to obtain a good average figure which is truly representative of the species, it is necessary to take samples from different trees and further from different logs. IS 2455 : 1990 'Method of sampling of model trees and logs for timber testing and their conversion (*second revision*)' contains information pertaining to sampling of model trees and logs for timber testing and their conversion; and IS 8720 : 1978 'Methods of sampling timber scantlings from depots and their conversion for testing' provides information with respect to timber scantling. This standard covers the methods of presentation of data of physical and mechanical properties of timber.

This standard was first published in 1978. Among important modifications, in this first revision the tables for presenting the physical and mechanical properties of timber have been modified to include cleavage (resistance to splitting) and nail and screw withdrawal resistance. Table 3, giving units and scheme for rounding off, has been modified accordingly to take care of these additional properties.

The composition of the technical committee responsible for formulation of this standard is given in Annex A.

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 '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

METHODS OF PRESENTATION OF DATA OF PHYSICAL AND MECHANICAL PROPERTIES OF TIMBER

(First Revision)

1 SCOPE

1.1 This standard outlines the methods of presentation of physical and mechanical properties of timber for the purpose of comparison, reduction and adjustment for different design values and utilization for various industrial uses.

1.1.1 It, however, does not include the methods of computation of timber testing data.

2 REFERENCES

The Indian Standards listed below are necessary adjuncts to this standard:

IS No.	*Title*
707 : 1976	Glossary of terms applicable to timber technology and utilization (*second revision*)
1708 (Parts 1 to 18) : 1986	Methods of testing small clear specimens of timber (*first revision*)
2455 . 1990	Methods of sampling of model trees and logs for timber testing and their conversion (*second revision*)
8720 : 1978	Methods of sampling of timber scantlings from depots and their conversion for testing

3 TERMINOLOGY

3.1 For the purpose of this standard, definitions given in IS 707 : 1976 and IS 2455 : 1990 shall apply.

4 PRESENTATION OF DATA IN GREEN CONDITION

4.1 The tests shall be carried out as specified in IS 1708 (Parts 1 to 18) : 1986 and the results shall be presented as given in Table 1 and Table 1A in case of logs selected as recommended in IS 2455 : 1990. If the material for the tests is taken for depot as recommended in IS 8720 : 1978, the results shall be presented as given in Table 2.

4.2 Tables 1, 1A and 2 shall have proper heading and shall be self-explantory and indicative of conditions and limitations of the results.

4.3 Tables 1, 1A and 2 shall include the details mentioned in **4.3.1** to **4.3.5**.

4.3.1 *Average*

The average of all sticks in a bolt or tree shall be called as 'tree average'. Similarly, the average of all sticks in a scantling shall be called 'scantling average'. The average of 'tree average' or 'scantling average' shall be called 'species average' of the locality. Usually the 'species average' of the locality shall be reported in Tables 1, 1A and 2 under respective conditions of test, that is, green, kiln-dry, air dry or at any moisture content (*see* **5**).

4.3.2 While reporting the results, the values shall be rounded off according to the scheme mentioned in Table 3.

4.3.3 Besides physical and mechanical properties the following details shall also invariably be recorded:

a) Locality,
b) Rings per cm,
c) Size of the logs (in case of logs),
d) No. of trees or scantlings, and
e) No. of specimens for individual tests.

4.3.4 As in green condition the moisture content has no influence on strength properties, the average moisture content of all the tests shall be reported.

4.3.5 *Measure of Variability*

For all data in timber testing a measure of variability shall be given. The scheme given in Table 4 is recommended for reporting the measure of variability for different purposes.

5 PRESENTATION OF DATA UNDER DRY CONDITION

5.1 All the 'tree average' or 'scantling average' in respect to strength in the dry condition shall be adjusted to 12 percent by the formula:

$$\frac{S_{12}}{S_g} = \left(\frac{S_d}{S_g}\right)^{\left(\frac{f-12}{f-d}\right)}$$

where

S_{12} = strength required at 12 percent moisture content;

S_d = strength observed at d percent moisture content in dry condition, that is, moisture content below fibre saturation point;

f = fibre saturation point;

S_g = strength in green condition; and

d = observed moisture content in dry condition.

5.2 If the fibre saturation point is not available the strength value (tree or scantling average) shall be reduced to 12 percent by the formula:

$$S_{12} = \frac{dS_d}{12}, \text{ provided } (12 - d) \text{ is within a limit of } \pm 2 \text{ percent}$$

5.3 The impact bending values or values determined under dynamic condition shall not be adjusted to 12 percent but averaged and reported at that moisture content.

5.4 While averaging the test data from specimens of a single bolt or scantling conditioned to a given moisture content care shall be taken that the moisture content shall not vary by more than 1 percent.

5.5 When it is required to compare data in different conditions (say green and dry), care shall be taken that the data correspond to matched samples of equal numbers in each condition. Alternatively, it will be neeessary to adjust data of one condition to suit the data in other condition by giving due weightage to the number of samples tested and by evaluating the average ratio of the values in the condition from known matched material.

Example:

Let the species average of five bolts in the green conditions be given by K and that of five individual bolts in the green condition by S_1, S_2, S_3, S_4, and S_5. If values of only three matched bolts in dry condition are known as S_1', S_2' and S_3', then the species average K' in the dry condition for all the five bolts is given by:

$$K' = K \times \frac{1}{3}\sum_{1}^{3} \frac{S'}{S}$$

5.6 An improvement factor which is the average percentage of improvement of strength values from green to dry condition (at 12 percent) shall also be reported.

Table 1 Physical and Mechanical Properties of Timbers in Green (G) and in Air Dry (AD) Condition

(Logs Selected According to IS 2455 : 1990)

(*Clauses* 4.1, 4.2, 4.3 *and* 4.3.1)

Sl No.	Species and Trade Name	Locality From Where Tested	Consignment No.	Values	Specific Gravity Based on Mass, Oven-Dry and						Shrinkage Percent Green to Oven-Dry			Static Bending					Impact Bending					Compression Parallel to Grain		Compression Perpendicular to Grain	Hardness Load in N (kgf) to Embed 1·128 cm Diameter Ball to Half Dia		Shear Parallel to Grain	Tension Perpendicular to Grain		Cleavage (Resistance to Splitting)		Tension Parallel to Grain			Torsion			Remarks
					No. of Trees	Average Dia (Dbh) mm	Rings per cm	Volume, at Test	Volume (Oven-Dry)	Moisture Content percent	Mass in kg/m³	Radial	Tangential	Volumetric	Fibre Stress at Elastic Limit, N/mm² (kgf/cm²)	Modulus of Rupture, N/mm² (kgf/cm²)	Modulus of Elasticity, N/mm² (1000 kgf/cm²)	Work to Elastic Limit	To Maximum Load	Total	Impact Bending Value, N/mm² (kgf/cm²)	Maximum Height of Drop in 22·7 kg Hammer, mm	Modulus of Elasticity, N/mm² (100 kgf/cm²)	Work to Elastic Limit, 10⁻³ J/mm² (kgf cm/cm²)	Brittleness Work Modulus, J (kgf cm)	Compressive Stress at Elastic Limit, N/mm² (kgf/cm²)	Maximum Crushing Stress, N/mm² (kgf/cm²)	Modulus of Elasticity, N/mm² (1000 kgf/cm²)	Compressive Stress at Elastic Limit, N/mm² (kgf/cm²)	Radial	Tangential	Total	Radial, N/mm² (kgf/cm²)	Tangential, N/mm² (kgf/cm²)	Radial, N/mm² (kgf/cm²)	Tangential, N/mm² (kgf/cm²)	Radial, N/mm (kgf/cm width)	Tangential, N/mm width (kgf/cm width)	Tensile Stress at Elastic Limit, N/mm² (kgf/cm²)	Maximum Tensile Stress, N/mm² (kgf/cm²)	Modulus of Elasticity, N/mm² (1000 kgf/cm²)	Shear Stress at Elastic Limit, N/mm² (kgf/cm²)	Maximum Shear Stress, N/mm² (kgf/cm²)	Modulus of Rigidity, N/mm² (100 kgf/cm²)	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47
				Green, Average, Maximum, Minimum, Standard Deviation, Coefficient of Variation, Air-dry																																								

Table 1 (A) Nail and Screw Withdrawal Resistance

(*Clauses* 4.1, 4.2, 4.3 *and* 4.3.1)

Sl No.	Species	Locality From Where Tested	Consignment No.	Values	Nail/Screw Withdrawal Resistance N (kgf)																	
					Condition A Nail/screw driven in green condition and pulled at once						*Condition B* Nail/screw driven in green condition and pulled in dry condition						*Condition C* Nail/screw driven in dry condition and pulled at once					
					Nail			Screw			Nail			Screw			Nail			Screw		
					Radial	Tangential	End	Radial	Tangential	End	Radial	Tangential	End	Radial	Tangential	End	Radial	Tangential	End	Radial	Tangential	End
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
				Average																		
				Maximum																		
				Minimum																		

Table 2 Physical and Mechanical Properties of Timbers
(Scantlings Selected According to IS 8720 : 1978)
(*Clauses* 4.1, 4.2, 4.3 *and* 4.3.1)

SI No.	Species and Trade Name	Locality From Where Tested	Consignment No.	Values	No. of Scantlings	Rings per cm	Specific Gravity Based on Mass, Oven-Dry and: Volume, at Test	Specific Gravity Based on Mass, Oven-Dry and: Volume, Oven-Dry	Moisture Content, Percent	Mass in kg/m³	Static Bending: Fibre Stress at Elastic Limit, N/mm² (kgf/cm²)	Static Bending: Modulus of Rupture, N/mm² (kgf/cm²)	Static Bending: Modulus of Elasticity, N/mm² (1 000 kgf/cm²)	Static Bending: Work 10⁻³ J/mm³ (kgf cm/cm³): To Elastic Limit	Static Bending: Work 10⁻³ J/mm³ (kgf cm/cm³): To Maximum Load	Static Bending: Work 10⁻³ J/mm³ (kgf cm/cm³): Total	Impact Bending: Fibre Stress at Elastic Limit, N/mm² (kgf/cm²)	Impact Bending: Maximum Height of Drop of 22·7 kg Hammer, mm	Impact Bending: Modulus of Elasticity, N/mm² (1 000 kgf/cm²)	Impact Bending: Work to Elastic Limit, 10⁻³ J/mm³ (kgf cm/cm³)	Impact Bending: Brittleness Work Absorbed, J (kgf/cm²)	Compression Parallel to Grain: Compressive Stress at Elastic Limit, N/mm² (kgf/cm²)	Compression Parallel to Grain: Maximum Crushing Stress, N/mm² (kgf/cm²)	Compression Parallel to Grain: Modulus of Elasticity, N/mm² (1 000 kgf/cm²)	Compression Perpendicular to Grain: Compressive Stress at Elastic Limit, N/mm² (kgf/cm²)	Hardness Load in N (kgf) to Embed 11·28 mm Diameter Ball to Half Dia: Radial	Hardness Load in N (kgf) to Embed 11·28 mm Diameter Ball to Half Dia: Tangential	Hardness Load in N (kgf) to Embed 11·28 mm Diameter Ball to Half Dia: End	Shear Parallel to Grain: Radial, N/mm² (kgf/cm²)	Shear Parallel to Grain: Tangential, N/mm² (kgf/cm²)	Tension Perpendicular to Grain: Radial, N/mm² (kgf/cm²)	Tension Perpendicular to Grain: Tangential, N/mm² (kgf/cm²)	Cleavage Resistance to Splitting: Radial, N/mm Width (kgf/cm Width)	Cleavage Resistance to Splitting: Tangential, N/mm Width (kgf/cm Width)	Tension Parallel to Grain: Tensile Stress at Elastic Limit, N/mm² (kgf/cm²)	Tension Parallel to Grain: Maximum Tensile Stress, N/mm² (kgf/cm²)	Tension Parallel to Grain: Modulus of Elasticity, N/mm² (1 000 kgf/cm²)	Torsion: Shear Stress at Elastic Limit, N/mm² (kgf/cm²)	Torsion: Maximum Shear Stress, N/mm² (kgf/cm²)	Torsion: Modulus of Rigidity, N/mm² (100 kgf/cm²)	Nail Withdrawal Resistance: Radial, N (kgf)	Nail Withdrawal Resistance: Tangential, N (kgf)	Nail Withdrawal Resistance: End, N (kgf)	Screw Withdrawal Resistance: Radial, N (kgf)	Screw Withdrawal Resistance: Tangential, N (kgf)	Screw Withdrawal Resistance: End, N (kgf)	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
				Average, Maximum, Minimum, Standard Deviation, Coefficient of Variation																																														

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Table 3 Units and Scheme for Rounding Off Numerical Values

(*Clause* 4.3.2)

Sl No.	Property	Unit	Scheme of Rounding Off
(1)	(2)	(3)	(4)
i)	*General*:		
	Average diameter of logs	mm	Nearest integral figure
	Specific gravity	—	Correct to 3 places of decimal
	Moisture content	Percent	Correct to one place of decimal
	Mass	kg/m^3	Nearest integral figure
	Shrinkage	Percent	Correct to one place of decimal
ii)	*Static Bending*:		
	Fibre stress at elastic limit and modulus of rupture	N/mm^2 (kgf/cm^2)	Nearest integral figure
	Modulus of elasticity	N/mm^2 (1 000 kgf/cm^2)	Correct to one place of decimal
	Work to elastic limit	10^{-3} J/mm^3 ($kgf\ cm/cm^3$)	Correct to 3 places of decimal
	Work to maximum load and total work	10^{-3} J/mm^3 ($kgf\ cm/cm^3$)	Correct to 2 places of decimal
iii)	*Impact Bending*:		
	Fibre stress at elastic limit	N/mm^2 (kgf/cm^2)	Nearest integral figure
	Maximum height of drop	mm	Nearest integral figure
	Modulus of elasticity	N/mm^2 (1 000 kgf/cm^2)	Correct to one place of decimal
	Work to elastic limit	10^{-3} J/mm^3 ($kgf\ cm/cm^3$)	Correct to 3 places of decimal
	Brittleness	J (kgf cm)	Nearest integral figure
iv)	*Compression Parallel to Grain*:		
	Compressive stress of elastic limit and maximum crushing strength	N/mm^2 (kgf/cm^2)	Nearest integral figure
	Modulus of elasticity	N/mm^2 (1 000 kgf/cm^2)	Correct to one place of decimal
v)	*Compression Perpendicular to Grain*:		
	Crushing stress at elastic iimit	N/mm^2 (kgf/cm^2)	Nearest integral figure
vi)	*Hardness*:		
	Radial, Tangential, End	N (kgf)	Nearest integral figure
vii)	*Shear*:		
	Radial, Tangential	N/mm^2 (kgf/cm^2)	Correct to one place of decimal
viii)	*Tension Perpendicular to Grain*:		
	Radial, Tangential	N/mm^2 (kgf/cm^2)	Correct to one place of decimal
ix)	*Tension Parallel to Grain*:		
	Tensile stress at elastic limit, Maximum tensile stress	N/mm^2 (kgf/cm^2)	Nearest integral figure
	Modulus of elasticity	N/mm^2 (100 kgf/cm^2)	Correct to one place of decimal
x)	*Cleavage Resistance*:		
	Radial, Tangential	N/mm width (kgf/cm width)	Nearest integral figure
xi)	*Torsion* :		
	Shear stress at elastic limit, Maximum shearing strength	N/mm^2 (kgf/cm^2)	Correct to one place of decimal
	Modulus of rigidity	N/mm^2 (100 kgf/cm^2)	Correct to one place of decimal
xii)	Y_0 (*Intersection-point*)	Percent	Correct to one place of decimal
xiii)	*Nail and Screw Withdrawal Resistance*	N (kgf)	Nearest integral figure

Table 4 Scheme for Measure of Variability

(*Clause* 4.3.5)

Sl No.	Average	Measure of Variability
(1)	(2)	(3)
i)	When sticks are taken from a lot for testing the lot average of all sticks shall be reported	Range of observations, that is, maximum and minimum value of all the observations in a test shall be given as measure of variability
ii)	When the data is collected from a particular locality the species average of the locality shall be given	Standard deviation or coefficient of variation or both shall be given as measure of variability. It shall be calculated as follows: a) When five or more trees or scantlings are tested from the locality, tree or scantling average shall only be considered for calculating standard deviation or coefficient of variation b) However, if less than five trees or scantlings are tested from a locality, all the observations in a test shall be considered for calculating standard deviation and coefficient of variation of the property
iii)	For the data of entire geographical region, the species average of the region shall be reported	Standard deviation or coefficient of variation or both shall be given as measure of variability. It shall be calculated as follows: a) These shall be calculated from the tree or scantling averages if less than five different localities are involved in the region b) However, if five or more localities are involved in a region the standard deviation or coefficient of variation shall be calculated from the locality averages only

ANNEX A

(*Foreword*)

COMPOSITION OF THE TECHNICAL COMMITTEE

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Handbook' and 'Standards Monthly Additions'.

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