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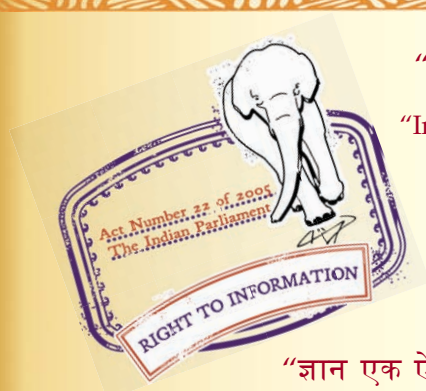
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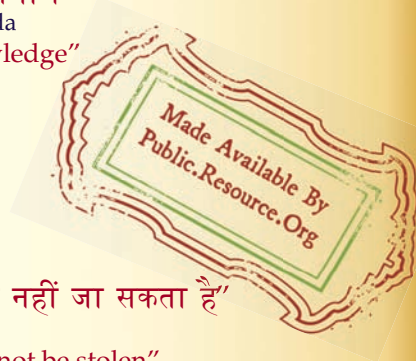
IS 9188 (1979): Performance requirements for adhesive for structural laminated wood products for use under exterior exposure condition [CED 20: Wood and other Lignocellulosic products]



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“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

PERFORMANCE REQUIREMENTS FOR ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS FOR USE UNDER EXTERIOR EXPOSURE CONDITIONS

UDC 665.93 : 691.116



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

Price Rs 7-00



February 1980

Indian Standard

PERFORMANCE REQUIREMENTS FOR ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS FOR USE UNDER EXTERIOR EXPOSURE CONDITIONS

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Indian Standard

PERFORMANCE REQUIREMENTS FOR ADHESIVES FOR STRUCTURAL LAMINATED WOOD PRODUCTS FOR USE UNDER EXTERIOR EXPOSURE CONDITIONS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 30 May 1979, after the draft finalized by the Wood Products Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Adhesives find one of the most important uses in the plywood industry and wood work and joinery industry. The selection of the adhesives and their correct use are important factors controlling the quality of the plywood or the joinery work produced. It has, therefore, been found necessary to lay down this standard governing the quality of raw materials and the performance expected from the prepared glues. This standard has, therefore, been prepared to cover requirements for adhesives for structural laminated wood products for use under exterior exposure conditions.

0.3 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.

0.4 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*. 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*).

1. SCOPE

1.1 This standard covers performance requirements of adhesives suitable for the bonding of wood, including treated wood, into structural laminated wood products for general constructions or for other uses where a waterproof bond is required.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions and those given in IS : 707-1976* shall apply.

2.1 Laminated Wood Products — A fabricated wood assembly resulting from the bonding together of two or more laminations and with the direction of the grain essentially parallel to form a larger piece, such as a structural member.

2.2 Delamination — Separation of the wood surfaces at the bonded joints caused by a cohesive failure in the adhesive or a failure of the adhesive at the wood surface.

2.3 Assembly Time

2.3.1 Open Assembly Time — The time elapsing between the application of the adhesive and assembly of joint components.

2.3.2 Closed Assembly Time — The time elapsing between assembly of the joint components and application of pressure.

2.4 Gap Filling Adhesive — An adhesive suitable for use in those joints where the surfaces to be joined may or may not be a close or continuous contact owing to impossibility of applying adequate pressure or to slight inaccuracies in machining.

2.5 Filler — An inert substance like wood flour, shell flour, etc, added to alter the characteristics, for example, to reduce brittleness of a synthetic resin.

3. MATERIAL

3.1 The adhesive shall consist substantially of reaction products of phenol and/or resorcinol with an aldehyde.

4. CLASSIFICATION

4.1 The adhesive shall be classified by the manufacturer as to the general type, that is, whether it includes phenol, resorcinol or phenol-resorcinol.

*Glossary of terms applicable to timber technology and utilization (*second revision*).

5. TESTS

5.1 Acidity and Alkalinity (pH) — The cured adhesive film shall develop a pH value of not less than 4 when tested as described in Appendix A.

5.2 Resistance to Shear by Compression Loading

5.2.1 Selection and Preparation of Wood for Testing Adhesive — Selection and preparation of wood for test members shall be made according to the provisions of Appendix B (*see B-1*).

5.2.2 Preparation of Laminated Wood Test Members — The laminated wood test members for resistance to shear by compression loading test shall be prepared according to the provisions of Appendix B (*see B-2*).

5.2.3 Testing — Resistance to shear by compression loading of test specimen prepared under **5.2.1** and **5.2.2** shall be tested as described in Appendix C. The average shear strength for each group of laminated wood members made under one set of manufacturing conditions shall not be less than 20 N/mm² (200 kg/cm²) in the dry condition and 12 N/mm² (120 kg/cm²) after boiling.

5.2.4 The average wood failure for each group of laminated wood members made under one set of conditions and tested shall be not less than 75 percent both in the dry and wet conditions.

5.2.5 If the strength requirements of **5.2.3** are not satisfied in either the dry or wet test but the wood failure value is 95 percent or more, then the adhesive shall be retested.

5.3 Resistance to Delamination During Cyclic Test

5.3.1 Resistance to delamination during cyclic test shall be carried out as given in Appendix D. When tested according to Appendix D the average delamination for each manufacturing condition shall not exceed 5 percent.

5.3.2 If the requirements of **5.3.1** are not satisfied in any one laminated wood member then one additional member may be tested. If all the requirements are met in the retest, the results of the original test may be disregarded.

6. SAMPLING

6.1 Lot — All the containers in a single consignment belonging to the same classification and batch of manufacture shall constitute a lot.

6.2 Tests for determining the conformity of the lot to the requirements of this standard shall be done on each lot separately. The number of containers to be sampled from a lot shall be in accordance with col 1 and 2 of Table 1. The containers shall be selected at random from the lot and in order to ensure the randomness of selection, use of random number tables shall be made (see IS : 4905-1968*).

TABLE 1 NUMBER OF CONTAINERS TO BE SELECTED FOR SAMPLING

LOT SIZE	NUMBER OF CONTAINERS TO BE SELECTED
(1)	(2)
2 to 50	2
51 to 150	3
151 to 300	4
301 and above	5

6.3 Composite Sample — From each selected container, draw with an appropriate sampling instrument, a small portion of the material from different parts of the container. Thoroughly mix all portions of the material drawn from the same container. The total quantity of the material drawn from each container shall be about 0.25 kg, which shall represent the selected sample container. Out of these representative portions of all selected containers, equal quantities shall be taken and mixed up well together so as to form a composite sample weighing not less than 0.5 kg representing the lot as a whole.

6.4 Criterion for Conformity — The composite sample as obtained in 6.3 representing the lot shall be tested for all the requirements of this standard. The lot shall be considered to conform to the requirements of this standard if the composite sample meets all the requirements of this standard.

7. MARKING

7.1 Each container shall be legibly and indelibly marked with the following:

- a) Manufacturer's name or distinguishing mark,
- b) Description of material,
- c) Batch number,
- d) Date of manufacture,

*Methods for random sampling.

- e) The date beyond which the adhesive or adhesive components shall not be used when stored under conditions recommended by the manufacturer,
- f) Reference to manufacturer's instructions for use, and
- g) The words 'To be stored in a cool dry place'.

7.1.1 Each container may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

8. INSTRUCTIONS FOR USE

8.1 The adhesive manufacturer shall furnish written instruction stating the general chemical type of adhesive, its storage and mixing procedure and any other data which may be pertinent to the use of the adhesive in the manufacture of laminated wood products.

8.2 Applications — Guidance on the following points shall also be given:

- a) Range of moisture content of wood at the time of gluing;
- b) Preparation of wood surfaces;
- c) Method(s) of application, such as single or double spread;
- d) Minimum spread for commonly encountered stock and mill conditions;
- e) Maximum and minimum open and closed assembly times;
- f) Recommended range of pressure in N/mm^2 (kg/cm^2); and
- g) Minimum cure time and temperature of glue line for complete cure.

APPENDIX A

(Clause 5.1)

DETERMINATION OF ACIDITY AND ALKALINITY (pH VALUE)

A-1. PREPARATION OF SPECIMEN

A-1.1 100 g of the adhesive shall be prepared according to the manufacturer's instructions. If water is to be used in the mixing, only distilled water shall be used.

A-2. PROCEDURE

A-2.1 The mixture shall be stirred thoroughly. After stirring, about 20 ml of the mixed adhesive shall be spread in a thin, even coat of 0.5 mm on a sheet of clean glass to cover an area approximately 15 × 15 cm. The adhesive shall be cured at the temperature and for a length of time recommended for gluing by the manufacturer after which the cured film shall be peeled from the glass and ground in a mortar to a fineness so as to pass through 40-mm IS Sieve. Immediately after grinding 2.0 g of the ground particles accurately weighed shall be placed in a clean vial and 10 ml of freshly boiled, cooled distilled water shall be added and thoroughly stirred. The glass container shall be kept stoppered at all times except when pH determinations are being made. The mixture shall be allowed to stand for 72 hours at room temperature after which time the mixture shall be stirred and the pH value determined by means of a suitable pH meter.

A-3. REPORT

A-3.1 The determination of pH value shall be repeated at intervals of 24 hours until the difference between the consecutive readings is not more than 0.05 pH units. The last reading taken shall be reported as the equilibrium film pH value for the adhesive.

APPENDIX B

(Clauses 5.2.1 and 5.2.2)

PREPARATION OF LAMINATED WOOD TEST MEMBERS

B-1. SELECTION AND PREPARATION OF WOOD FOR TESTING ADHESIVE

B-1.1 The adhesive shall be tested on *Gurjan* [*Dipterocarpus* spp. (other than *D. Macrocarpus*)] or *Hollong* (*Dipterocarpus macrocarpus*) treated with acid cupric-chromate composition to a penetration of 8 to 12 kg/m³ according to IS : 401-1967*.

The wood shall have a slope of grain not steeper than 1 in 15 on any face or any edge. The wood shall contain no knots larger than 3.0 mm in diameter and shall be free from decay, machining defects, and any drying defects, such as case hardening, collapse, splits or checks. Only flat grained wood shall be used.

B-1.2 The specimens shall be conditioned at $27 \pm 2^{\circ}\text{C}$ and a relative humidity of 50 to 70 percent until a moisture content of 9 to 12 percent has been obtained.

B-1.3 The specimens when conditioned as above shall have a specific gravity of not less than 0.62.

B-1.4 Each lamination shall be freshly surfaced before bonding with the adhesive to be tested. The machining tolerances for each lamination used in preparing the test samples shall be ± 0.25 mm.

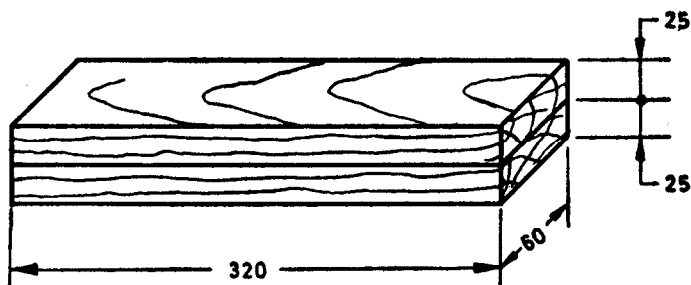
B-2. PREPARATION OF LAMINATED WOOD TEST MEMBERS

B-2.1 Preparation of Laminated Wood Members

B-2.1.1 Each of the two pieces of wood shall be nominal 25 mm thick lumber at least 60 mm in width and 320 mm long as shown in Fig. 1. The direction of the annular growth rings (whenever possible to identify) when viewed on end of the lamination in the test beams shall be oriented so that they are alternated.

B-2.1.2 The adhesive shall be applied uniformly to the contacting faces of each lamination in accordance with the manufacturer's instructions. The laminated wood members shall be placed under pressure for a period of time and the glue line temperature maintained as specified by the manufacturer of the adhesive.

*Code of practice for preservation of timber (second revision).

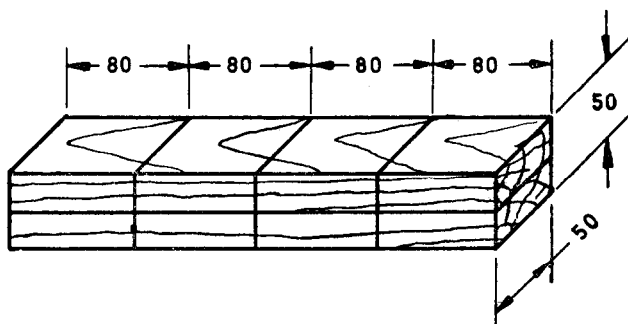


All dimensions in millimetres.

FIG. 1 PREPARATION OF LAMINATED WOOD MEMBER

B-2.1.3 The laminated wood member shall be re-conditioned at $27 \pm 2^\circ\text{C}$ and a relative humidity of 50 to 70 percent for the minimum time recommended by the manufacturer for each curing temperature used during the pressure period and tested immediately.

B-2.2 Preparation of Test Members — The laminated wood members shall be dressed on the sides to a uniform width of 50 mm at the completion of conditioning period. The beam shall be cut into 80 mm sections as shown in Fig. 2 for conducting tests on resistance to shear by compression loading and resistance to delamination during cyclic tests.



All dimensions in millimetres.

FIG. 2 PREPARATION OF TEST MEMBERS

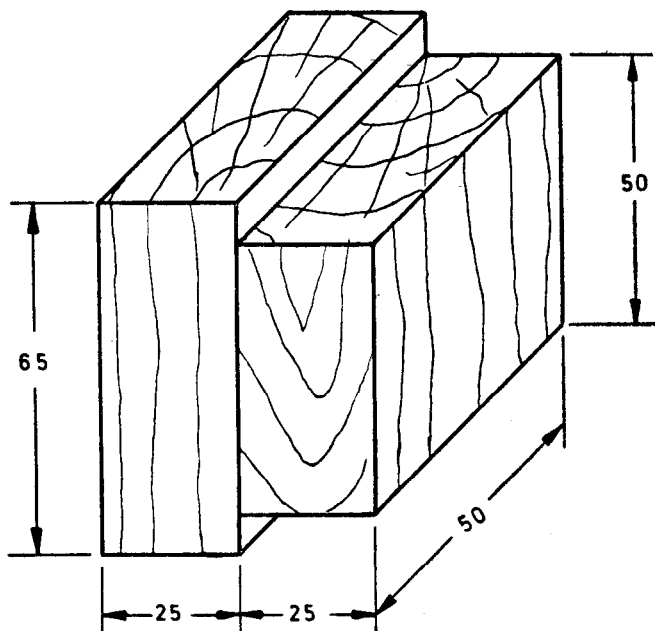
APPENDIX C

(Clause 5.2.3)

RESISTANCE TO SHEAR BY COMPRESSION LOADING

C-1. TEST SPECIMEN

C-1.1 Four samples from each of the laminated member (see B-2.2) shall be prepared for testing in shear by compression loading both under dry condition as well as after boiling for 72 hours in water. The specimens shall be cut as shown in Fig. 3 from each of the 80 mm section. The specimen shall conform to the form and dimensions shown in Fig. 3. Care shall be taken in preparing the test specimens to ensure that the grain direction in the wood is parallel to the direction of loading during test. The loaded surfaces shall be smooth and parallel to each other and perpendicular to the height. When sawing the bonded assembly, care shall be taken to ensure that the saw cuts are up to but not beyond the adhesive line. The width and height of the specimens shall be measured at the adhesive line to the nearest 0.25 mm to determine the shear area.



All dimensions in millimetres.

FIG. 3 SPECIMEN FOR TESTING RESISTANCE TO SHEAR BY COMPRESSION LOADING

C-2. PROCEDURE

C-2.1 The testing machine shall be fitted with a shearing tool containing a self-aligning seat to ensure uniform application of load on the entire shearing area as shown in Fig. 4. The machine shall be capable of maintaining a uniform rate of loading such that the load may be applied with a continuous motion of the movable head to a maximum rate of loading not to exceed 1.25 cm per minute. The testing machine shall be located in an atmosphere such that the moisture content of test specimens developed in accordance with **B-1.2** is not noticeably altered during testing.

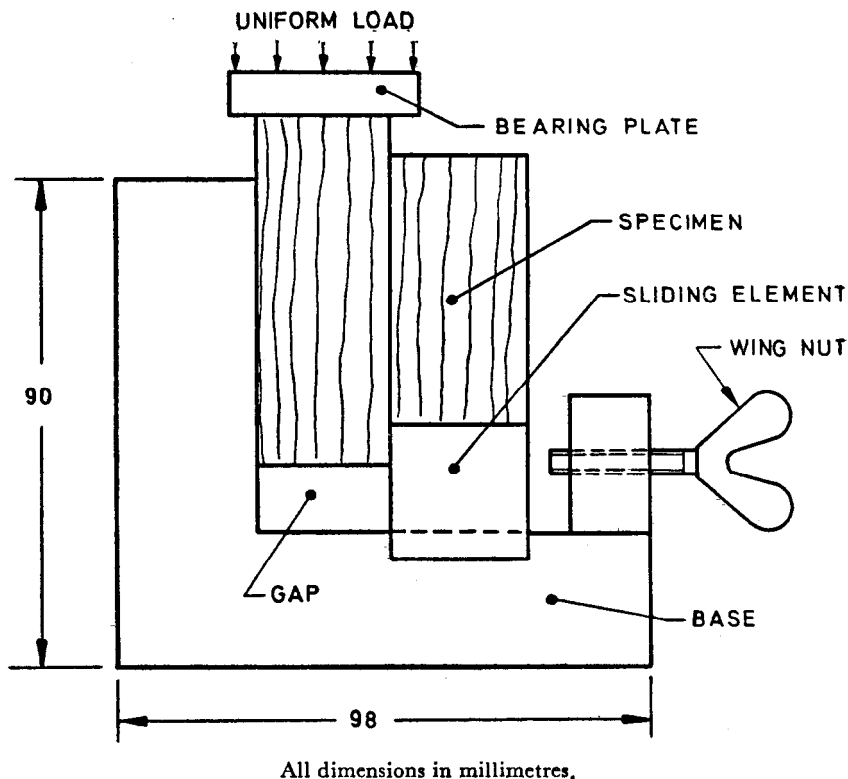


FIG. 4 ARRANGEMENT FOR DETERMINATION OF RESISTANCE TO SHEAR BY COMPRESSION LOADING

C-3. REPORT

C-3.1 Specimens shall be tested to destruction. The shear strength calculated in N/mm^2 (kg/cm^2) shall be reported based on the bonded area (25 cm^2) together with the estimated percentage of wood failure.

APPENDIX D

(Clause 5.3.1)

RESISTANCE TO DELAMINATION DURING CYCLIC TEST

D-1. TEST SPECIMEN

D-1.1 Four specimens shall be prepared as described in **C-1.1**.

D-1.2 The specimen shall be submerged in boiling water for 4 hours, cooled in water at room temperature and then dried for 20 hours at $63 \pm 3^\circ\text{C}$ in an oven. This completes the first cycle. The cycle shall be repeated making a total test period of 5 days and the data recorded.

D-2. PROCEDURE

D-2.1 At the end of the final drying period specified in **D-1.2**, the total length of delamination at the ends shall be immediately measured. Failure in the wood due to either checking or other causes, such as small isolated knots shall not be reported as delamination. A feeler gauge 0.125 mm thick and 2.5 mm wide shall be used for the purpose. Isolated delamination which is less than 2.5 mm long and which is more than 5.0 mm away from the nearest delamination shall be ignored. The total length of delamination, if any, on the two ends of each specimen shall be added.

D-3. REPORT

D-3.1 The length of the delaminated portions divided by the total length of the bonded line multiplied by 100 shall be reported as percentage delamination.

INDIAN STANDARDS
ON
ADHESIVES

IS:

- 848-1974 Adhesives for plywood (phenolic and aminoplastic)
- 849-1957 Cold setting casein glue for wood
- 850-1957 Natural sour (lactic) casein for glue manufacture
- 851-1978 Adhesives for construction work in wood (*first revision*)
- 1508-1972 Extenders for use in synthetic resin adhesives (urea-formaldehyde) for plywood (*first revision*)
- 4835-1979 Polyvinyl acetate dispersion based adhesives for wood (*first revision*)