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Indian Standard

**SPECIFICATION FOR
SYNTHETIC RESIN ADHESIVES FOR
PLYWOOD (PHENOLIC AND
AMINOPLASTIC)**

(First Revision)

(Incorporating Amendment Nos. 1, 2, 3, 4, & 5)

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

Price Group 4

Indian Standard

SPECIFICATION FOR
SYNTHETIC RESIN ADHESIVES FOR
PLYWOOD (PHENOLIC AND
AMINOPLASTIC)

(*First Revision*)

Wood Products Sectional Committee, BDC 20

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'Bharadwaaja'
41 (116-B), 4th Main Road
Jayamahall Extension
Bangalore 6

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Indian Standard

SPECIFICATION FOR
SYNTHETIC RESIN ADHESIVES FOR
PLYWOOD (PHENOLIC AND
AMINOPLASTIC)

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 8 February 1974, after the draft finalized by the Wood Products Sectional Committee had been approved by the Civil Engineering Division Council.

0.2 Adhesives form one of the most important raw materials used in the plywood industry and wood working and joinery industry. The selection of the adhesive and its correct use are important factors controlling the quality of the plywood or the joinery work produced. The raw materials for adhesives are not all found in this country; a large quantity of raw materials and synthetic resin adhesives is imported. In the context of this background of the industry, it has been found necessary to lay down specifications governing the quality of the raw materials and the performance expected from the prepared glues. Such standards, it is believed, would guide further development of the adhesives industry on sound lines and lead towards the achievement of self sufficiency in regard to the country's requirements.

0.3 This standard was first published in 1957. The first revision is based on the experience gained in the manufacture and use of synthetic resin adhesives over these years. In this revision, therefore, besides giving certain guidance to the users in regard to the recommended use of various types of adhesives included in the specification, certain modifications have been made in the provisions relating to the method of test.

0.4 This standard contains clauses **6.5** and **B-2.2** which permit the purchaser to use his option for selection to suit his requirements at the time of placing orders.

0.5 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.

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0.6 This edition 2.5 incorporates Amendment No. 1 (May 1983), Amendment No. 2 (February 1986), Amendment No. 3 (April 1992), Amendment No. 4 (November 1998) and Amendment No. 5 (May 2002). Side bar indicates modification of the text as the result of incorporation of the amendments.

0.7 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.

1. SCOPE

1.1 This standard prescribes the requirements for phenolic and aminoplastic synthetic resin adhesives used in the plywood industry.

2. TERMINOLOGY

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

2.1.1 *Assembly Time*

2.1.1.1 *Open assembly time* — The time elapsing between the application of the adhesive and assembly of joint components.

2.1.1.2 *Closed assembly time* — The time elapsing between assembly of the joint components and the application of pressure.

2.1.2 *Adhesive*

2.1.2.1 *Closed contact adhesive* — A non-gap-filling adhesive suitable for use only in those joints where the surfaces to be joined may be brought into close contact by means of adequate pressure, and where glue line exceeding 0.12 mm may be avoided with certainty.

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

2.1.3 *Extender* — A substance added to the adhesive either to reduce the cost of gluing or to reduce penetration through the veneers or both.

2.1.4 *Filler* — An inert substance, such as wood flour, added to alter the characteristics, for example, to reduce brittleness of a synthetic resin sometimes loosely and incorrectly used as interchangeable with 'extender'.

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

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

2.1.5 Fortifier — A substance used primarily to increase the boil resistance and durability of hot setting urea resins.

2.1.6 Hardener — A material used to promote the setting of the resin. It may be either in liquid or powder form. It is an essential part of the adhesive, the properties of which depend upon using the resin and hardener as directed.

2.1.7 Pot Life — The time between the mixing of the constituent parts of an adhesive and its reaching the age when it is no longer usable.

2.1.8 Shelf-Life — The period for which the adhesive or adhesive components may be stored without affecting their suitability for use in accordance with the standard.

2.1.9 Spread of Adhesive — The area of surface covered by 1 kg of adhesive mix prepared in accordance with the manufacturer's instructions.

2.1.10 Synthetic Resin — Amorphous organic materials produced by the polymerization or condensation of one, two or, less frequently, three relatively simple compounds. The term is also applied now a days to chemically modified natural resins. The properties of synthetic resins can vary widely depending upon their basic raw materials, proportions, and conditions of manufacture. All synthetic resins are classified broadly as thermosetting or thermoplastic.

2.1.10.1 Phenolic synthetic resin — A phenolic synthetic resin is derived from the reaction of phenol with an aldehyde.

2.1.10.2 Aminoplastic synthetic resin — An aminoplastic synthetic resin is derived from the reaction of urea, thio-urea, melamine, or allied compounds, or mixtures of these compounds with formaldehyde.

2.1.11 Synthetic Resin Adhesive — A composition, substantially consisting of a synthetic resin of either the phenolic or aminoplastic type but including any hardening agent, fortifier, filler or extender, which may be required to be added before use according to the manufacturer's instructions.

3. TYPES

3.1 Depending upon their degree of resistance, synthetic resin adhesives for plywood shall be of the three types as specified in Table 1. The characteristics of each type shall be as given in Table 1. For the guidance of users in selecting the grade of resin adhesive satisfying the requirements for particular work, recommended use of each type is also indicated.

TABLE 1 CHARACTERISTICS OF DIFFERENT TYPES OF SYNTHETIC RESIN ADHESIVES

(Clauses 3.1, 6.3, 6.4, 6.5, and B-2.1)

Sl. No.	TYPE	GLUE SHEAR STRENGTH IN DRY STATE (Min)		RESISTANCE TO MICRO-ORGANISM (FUNGI) (Min)		RESISTANCE TO MOISTURE				RECOMMENDED USE
		Average	Individual	Average	Individual	Temperature of Water Under Normal Atmospheric Pressure in Which Test Pieces shall be Immersed	Time of Immersion of Test Pieces	Glue Shear Strength (Min)		
								Average	Individual	
(1)	(2)	(3) kg	(4) kg	(5) kg	(6) kg	(7)	(8)	(9) kg	(10) kg	(11)
i)	BHP (Boiling Water Proof)	135	110	100	80	110°C (or at the boiling point of water)	*72	100	80	Adhesives of the type have been proved to make joints highly resistant to weather, micro-organisms, cold and boiling water, steam and dry heat
ii)	BWR (Boiling Water Resistant)	135	110	100	80	-do-	8	100	80	Joints made of this type adhesive will survive exposure to weather for only a few years. They will withstand cold water indefinitely and boiling water for a limited period. They are highly resistant to micro-organisms
iii)	MR (Moisture Resistant)	100	80	80	65	60 ± 2°C	3	80	65	Joint made with these adhesives will withstand cold water for a long period and hot water for a limited time, but fail in the boiling water test. They are resistant to attack by micro-organisms

*The 72 hours may be the aggregate of shorter period, the test pieces being left in cold water between such periods.

4. KEEPING QUALITIES

4.1 The keeping qualities of adhesives shall be as follows:

- a) *Liquid Adhesives* — The adhesives shall comply with the requirements specified under **6** after the resin and hardener have been stored in the original closed containers, according to the manufacturer's instructions up to the date recommended by the manufacturer.
- b) *Film Adhesives* — The film shall comply with the requirements specified under **6** after it has been stored in accordance with the manufacturer's written instructions up to the date recommended by the manufacturer.

5. INSTRUCTIONS FOR USE

5.1 The manufacturer shall furnish written instructions detailing the manner in which each resin or recommended combination of resin(s), hardener(s), filler, fortifier and extender shall be used. The instructions shall give information in the manner indicated under **5.2** to **5.6**, where applicable.

5.2 Shelf-Life of Adhesive or Adhesive Components — The manufacturer shall specify the shelf-life of the adhesive or adhesive components.

5.3 Preparation for Use — The preparation of resin, hardener, fortifier, filler and extender, methods of mixing, recommended types of mixing, apparatus and necessary precautions of any kind shall be stated.

5.4 Usable Life of Mixed Adhesive or Pot Life — The maximum time shall be stated during which the adhesive maintained at temperatures of 15, 20, 25, 30, 40 and 45°C would remain fit for use so as to comply with the requirements of this standard.

5.5 Application — Guidance on the following points shall 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) Normal amounts of spread for single glue line;
- e) Maximum and minimum open and closed assembly times;
- f) Recommended range of pressures in kg/cm²;
- g) Post-treatment of finished products;
- h) Cleaning of containers; and
- j) Tests.

5.6 Setting Times and Conditions — The recommended range of temperature to which the adhesives in any glue line may be subjected and also the minimum and maximum times for which pressure shall be maintained on flat panels at temperatures within the range shall be stated.

6. TESTS

6.1 Sampling — A representative sample shall be drawn from each batch of adhesive. Such samples shall in each case be tested separately, and not be bulked with other samples or otherwise averaged.

6.2 Preparation of Test Pieces — The test pieces shall be prepared according to the instructions given in Appendix A. Veneers used for the preparation of test pieces shall comply with the requirements specified in A-1.

6.3 Dry Strength — The average failing load of a set of six test pieces, prepared in accordance with 6.2, when tested by the method given in IS: 1734 (Part IV) - 1983 shall not be less than the values specified in Table 1.

6.4 Resistance to Water — The resistance of an adhesive to water shall be such that a set of six test pieces prepared in accordance with 6.2, when tested in accordance with Appendix B shall show an average glue shear strength not less than the values specified in Table 1.

6.5 Resistance to Micro-Organism — The resistance of adhesive to micro-organism shall be such that a set of six test pieces when tested in accordance with IS : 1734 (Part IV)-1983* after treatment in accordance with IS : 1734 (Part VII)-1983† shall show an average glue shear strength of not less than the values specified in Table 1.

NOTE — The mycological test shall be carried out only when required by the purchaser.

6.6 Acidity and Alkalinity (pH) - The pH of the adhesive when set shall be not less than 2.0. The pH shall be determined by the method described in Appendix C.

7. RETEST

7.1 In the event of failure to comply with any of the requirements specified under 6.3 to 6.6 the batch of material concerned shall be retested in respect of such requirement(s). In the event of failure of retest, the batch shall be rejected.

*Methods of tests for plywood : Part 4 Determination of glue shear strength (*second revision*).

†Methods of tests for plywood : Part 7 Micological test (*second revision*).

8. MARKING

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

- a) Manufacturer's name or distinguishing mark,
- b) Description of material,
- c) Manufacturer's reference number,
- d) Batch number,
- e) Date of manufacture,
- f) The date beyond which the adhesive or adhesive components shall not be used when stored under conditions recommended by the manufacturer,
- g) Reference to the manufacturer's instructions for use, and
- h) The words 'To be stored in a cool dry place'.

8.1.1 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.

APPENDIX A

(Clause 6.2)

METHOD OF PREPARATION OF TEST PIECES

A-1. VENEERS FOR TEST PIECES

A-1.1 Veneers shall be from any species with density not less than 0.6 g/cm^3 .

A-1.2 The veneers shall be smooth cut on both faces, straight grained and free from all defects, at least over the area that will form the middle 50 mm length of the test pieces, and may be lightly sanded. Elsewhere, the occurrence of slight defects, such as small uplifts, small live knots and short grain may be disregarded. The moisture content of

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the veneers when determined by the method described in IS : 1734 (Part I)-1983*, shall be 6.0 ± 2.0 percent for phenolic resin and 8.0 ± 2.0 percent for aminoplastic resin when used in liquid adhesive form and 12.0 ± 2.0 percent for film adhesive, or as may be recommended by the manufacturer.

A-2. PREPARATION OF ADHESIVE

A-2.1 The adhesive shall be prepared and used according to the instructions supplied by the manufacturer.

A-3. CONSTRUCTION OF TEST BOARDS

A-3.1 Test boards shall be constructed by bonding together three veneers of species as specified in **A-1.1**. The size of the board shall be such that all the test pieces required for testing can be taken out of the same board leaving a margin of 25 mm on all the four edges. The grain of the core veneer shall be at right angles to that of the two face veneers. The prepared adhesive may be applied to both sides of the core, or to the inner surface of each face veneer, or as directed by the manufacturer, but care shall be taken in all cases to ensure that the adhesive is uniformly spread and the surfaces are completely coated. The veneers shall then be assembled and loaded in a flat platen press within the time specified in the manufacturer's instructions. The pressing conditions shall be as recommended by the manufacturer. Film glues shall be employed by simple inter-leaving and in accordance with the manufacturer's instructions.

A-4. CONDITIONING OF TEST BOARDS

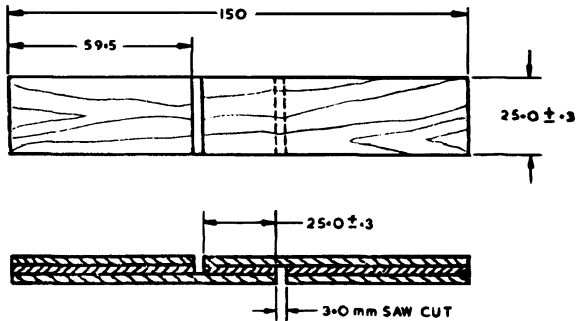
A-4.1 Immediately after removal from the press, the boards shall be given a special treatment (such as dipping in water) stipulated by the manufacturer. The boards shall then be exposed at prevailing laboratory atmospheric conditions in a manner to ensure a free circulation of air around them for six to nine days, or for such time as the manufacturer may direct, except in the case of test boards to be employed in the mycological test where the conditioning period shall, in no case, be less than six days.

A-5. PREPARATION OF TEST PIECES

A-5.1 After conditioning of the test boards, six test pieces as shown in Fig. 1 shall be prepared for each of the tests required, care being taken that the depth of the saw-cut does not impinge upon the third ply. The

*Methods of tests for plywood: Part 1 Determination of density and moisture content (*second revision*).

length of the test pieces shall be along the direction of the grain of the outer plies.



All dimensions in millimetres.

FIG 1 3-PLY TEST PIECE FOR ADHESIVE STRENGTH

APPENDIX B

(Clause 6.4)

WATER RESISTANCE TEST

B-1. TEST PIECES

B-1.1 Six test pieces shall be prepared by the method as described in Appendix A.

B-2. PROCEDURE

B-2.1 The test pieces shall be completely immersed in water at the temperature and for the time appropriate to the type (see Table 1) in such a manner that water shall have free access to all the surfaces. While testing MR adhesive, care shall be taken to ensure that water circulates freely around them. At the conclusion of the specified time, the test pieces shall be quickly transferred from the hot water and submerged in cold water. The test pieces shall then be plunged into water at $27 \pm 2^{\circ}\text{C}$ and cooled.

B-2.2 The test pieces, while still wet, shall be subjected to shear strength test as described in IS : 1734 (Part IV)-1983*.

*Methods of tests for plywood : Part 4 Determination of glue shear strength (second revision).

A P P E N D I X C

(*Clause 6.6*)

**DETERMINATION OF *pH* VALUE (HYDROGEN ION
CONCENTRATION) OF LIQUID OR POWDERED
RESIN ADHESIVES**

C-1. DETAIL

C-1.1 At least 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. 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 × 25 cm. The adhesive shall be cured at the temperature and for the length of time recommended for gluing by the manufacturer, after which the cured film shall be peeled from the glass and ground in a clean mill or mortar to a fineness so as to pass 425 micron IS Sieve. Immediately, after grinding, 2.0 g of the ground particles, accurately weighed, shall be placed in a clean vial or small heat-resisting glass flask 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 h at room temperatures after which time the mixture shall be stirred and the *pH* value determined by means of a suitable *pH* meter. The determination of *pH* value shall be repeated at intervals of 24 h until the difference between the consecutive readings is not more than 0.05 *pH* units. The last reading taken shall be regarded as the equilibrium film *pH* value for the adhesive.

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<i>Members</i>	<i>Representing</i>
DR JOSEPH GEORGE	Indian Plywood Industries Research Institute, Bangalore
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BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.
Telephones: 323 01 31, 323 33 75, 323 94 02

Telegrams: Manaksanstha
(Common to all offices)

Regional Offices:

	Telephone
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	{ 323 76 17 323 38 41
Eastern : 1/14 C. I. T. Scheme VII M, V. I. P. Road, Kankurgachi KOLKATA 700054	{ 337 84 99, 337 85 61 337 86 26, 337 91 20
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