BRITISH STANDARD

BS 1203:2001

Hot-setting phenolic and aminoplastic wood adhesives — Classification and test methods

ICS: 83.180

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to PRI/52, Adhesives, upon which the following bodies were represented:

Consumer Policy Committee of BSI

Contract Flooring Association

European Resin Manufacturer's Association

SATRA

UK Steel Association

University of Bristol

National Physical Laboratory

DETR — represented by BRE

TRADA

BASA

TWI

British Woodworking Federation

The Tile Association

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Foreword

This British Standard has been prepared under the direction of the Adhesives Standards Policy Committee. The standard is based on the British Standard BS 1203:1979 (amended by AMD 6284:1990), *Synthetic resin adhesives (phenolic and aminoplastic) for plywood*, which is now withdrawn. However, the scope has been extended to cover hot setting wood adhesives for any application involving thin glue-lines, and the designation of the durability classes has been changed.

Data on the durability of joints under various natural conditions of exposure have been obtained over a number of years and results of these long-term trials have been linked with the performance of standard test pieces following immersion in cold, hot or boiling water. These wet tests are used in this standard to differentiate between various types of a phenolic and aminoplastic resins. Resins of other chemical formulations that comply with the test requirements would not necessarily attain equal durability in service, and their performance should be confirmed by field trials.

The four durability classes specified in this standard provide a scale of durability ranging from adhesives suitable for interior use (H1) to full exterior use (H4). However, it is important to appreciate that bond-line durability depends not only on the type of adhesive, but also on the correct application of pressure and temperature for the appropriate time.

The standard timber, European beech (*Fagus sylvatica*), although not commonly used for many structural applications, is eminently suitable for discriminatory testing work.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 5 and a back cover.

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1 Scope

This British Standard specifies the technical requirements and methods of test for adhesives based on synthetic resins of the phenolic and aminoplastic types, with or without additional hardeners and extenders. The standard does not in any way apply to adhesives based on resins of types other than phenolic or aminoplastic and should not be quoted for these other materials.

The properties of the adhesives are determined by tests made on beechwood joints with thin gluelines. The failing forces obtained on the test pieces prescribed cannot be converted into terms of stress values (i.e. pascals) for structural calculations.

Resins sometimes require a hardener to be added by the user. In this situation, this standard covers the combination of resin and hardener. If the resin and hardener are sold separately, neither by itself can be said to conform to any of the specified durability classes.

2 Normative references

This standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For undated references, the latest edition of the publication referred to applies.

BS EN 923, *Adhesives — Terms and definitions.*

BS 5214-1, *Rubber and plastics test equipment — Part 1: Tensile flexural and compression types.* [ISO 5893]

BS EN 350-1, *Durability of wood and wood-based products — Natural durability of solid wood — Part 1: Guide to the principles of testing and classification of the natural durability of wood.*

BS EN 635-2, *Plywood — Classification by surface appearance — Part 2: Hardwood.*

3 Terms and definitions

For the purposes of this standard, the terms and definitions given in BS EN 923 apply.

4 Categories of adhesive

Requirements are specified for four durability classes of adhesive, the designation and characteristics of each being as follows.

H1 Joints made with these adhesives are resistant to cold water but are not required to withstand attack by micro-organisms. Such adhesives are typically used for interior applications.

H2 Joints made with these adhesives will survive full exposure to weather for only a few years. They will withstand cold water for a long period and hot water for a limited time, but fail under the test for resistance to boiling water. They are resistant to attack by micro-organisms.

H3 Joints made with these adhesives have good resistance to weather and to the test for resistance to boiling water, but fail under the very prolonged exposure to weather that type H4 adhesives will withstand. The joints will withstand cold water for many years and are highly resistant to attack by micro-organisms.

H4 Adhesives which, by systematic tests and by their records in service over many years, have been proved to make joints highly resistant to weather, micro-organisms, cold and boiling water, steam and dry heat.

For the purpose of this specification, the four durability classes are distinguished by their performance in the wet tests described in clause **6** of this standard.

5 Requirements

5.1 Requirements for an adhesive's resistance to moisture and attack by micro-organisms

Tests for moisture resistance are given in **6.2**, **6.3** and **6.4**. The test for micro-organism resistance is given in **6.5**. Performance in these tests is measured by the mean failing force of 10 lap joints. Details of the lap joints are given in **6.1**. The mean failing forces following the various water treatments and micro-organism test for each class of adhesive described in clause **4** are given in Table 1.

Table 1 — Requirements for adhesives in moisture resistance tests

Durability class	Test			
	Boiling water resistance 6 h boil (See **6.2**)	**Hot water resistance** 3 h at 67 °C (See **6.3**)	**Cold water resistance** 16 to 24 h at 15 °C (See **6.4**)	**Micro-organism resistance** (See **6.5**)
	Minimum mean failing force kN	**Minimum mean failing force** kN	**Minimum mean failing force** kN	**Minimum mean failing force** kN
H1	Not applicable	Not applicable	1.10	Not applicable
H2	Not applicable	0.90	1.10	1.10
H3	0.45	Not applicable	1.10	1.10
H4	0.90	Not applicable	1.10	1.10

5.2 Shelf-life of components

The adhesive shall comply with the appropriate requirements of Table 1 after its components have been stored for the maximum time specified by the manufacturer under the storage conditions agreed between the manufacturer and the user.

6 Test methods

6.1 Method of preparing test pieces

6.1.1 *Veneers*

Prepare the test pieces from veneers constructed of veneers of European beech according to the following specification. The veneers shall have the growth rings approximately parallel to the face. They shall be (1.5 ± 0.10) mm thick and they shall be at least 325 mm × 325 mm in size (see **6.1.5**).

In quality, the veneers shall be without joints and shall comply with the requirements for Grade 1 veneers given in BS EN 635-2.

Unless otherwise recommended by the adhesive manufacturer, the moisture content of the veneers shall be (10 ± 2.5) %, as determined by the method given in **6.1.3**.

NOTE This corresponds with that attained during storage in a normally heated room.

Moisture contents outside of this range shall be reported in the test report.

6.1.2 *Adhesive*

The manufacturer shall provide instructions detailing the manner in which each adhesive shall be used with beech.

6.1.3 *Method for the determination of moisture content of veneers*

6.1.3.1 *Apparatus*

6.1.3.1.1 *Oven*, capable of being controlled at 100 °C to 105 °C.

6.1.3.1.2 *Balance*, capable of measuring the mass of a veneer to the nearest 0.001 g.

6.1.3.2 *Procedure*

Take a representative sample of the veneers and weigh each to the nearest 0.001 g.

Dry the veneers in the oven at a temperature of 100 °C to 105 °C until their mass is constant.

Calculate the percentage of moisture using the formula:

$$\text{Percentage of moisture} = \frac{M_1 - M_0}{M_0} \times 100$$

where

M_1 is the mass of the veneer before heating;

M_0 is the mass of the veneer after heating.

Report the moisture content as the mean of the results.

NOTE Care should be taken to prevent change in moisture content between the cutting of the veneers and the first weighing, and between removal of the veneers from the oven and the subsequent weighing.

6.1.4 *Preparation of adhesive*

Prepare and use the adhesive according to the instructions supplied by the manufacturer.

6.1.5 *Construction of the test boards*

Construct test boards of not less than 325 mm × 325 mm in size by bonding together three veneers with the grain of the core veneer 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 the manufacturer directs, but in all cases ensure that the adhesive is uniformly spread and the surfaces are completely coated. Use film adhesives by simple interleaving and in accordance with the manufacturer's instructions. Press the test boards using the adhesive manufacturer's recommended settings for temperature, pressure and time.

6.1.6 *Conditioning of the test boards*

Follow any special instructions regarding conditioning of the boards provided by the adhesive manufacturer. In the absence of any special instructions by the adhesive manufacturer, freely expose the boards to air under normal room conditions for a period of at least 16 h before testing.

6.1.7 *Preparation of the test pieces*

After conditioning the test boards, cut test pieces from them as shown in Figure 1, for each of the tests required. Prepare a sufficient number of test pieces to provide 10 valid results for each test condition to be applied. Take care that the saw cut does not impinge on the third ply.

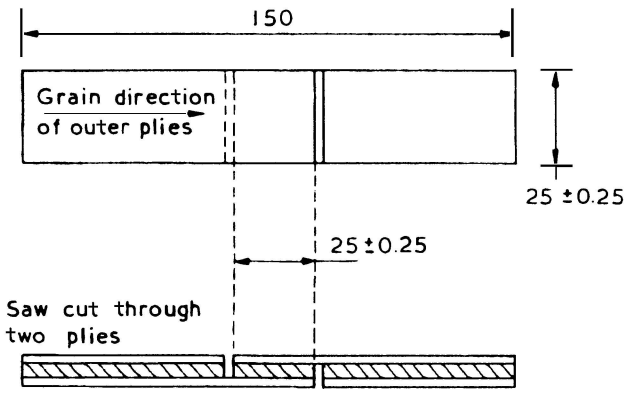

Figure 1 — Test piece

6.2 Treatment for testing resistance to cold water

Immerse the test pieces completely in water at (15 ± 5) °C for 16 h to 24 h. During the treatment, ensure that the water has full access to the surfaces and edges of every test piece. Remove the test pieces and immediately test them, without drying, by the method described in **6.6**.

6.3 Treatment for testing resistance to hot water

Immerse the test pieces completely in water at (67 ± 2) °C for 3 h. By the use of suitable racks to hold the test pieces, ensure that the water has free access to all surfaces, and ensure that it is at the specified temperature during the whole period for which the test pieces are immersed.

After this high temperature treatment, cool the test pieces immediately by immersing them in water at room temperature. Leave them in this water for at least 1 h and no longer than 2 h until they are tested as described in **6.6**.

6.4 Treatment for testing resistance to boiling water

Immerse the test pieces completely in boiling water for 6 h. By the use of suitable racks to hold the test pieces, ensure that the water has free access to all surfaces, and ensure that it is at the specified temperature during the whole period for which the tests pieces are immersed.

After this high temperature, cool the test pieces immediately by immersing them in water at room temperature. Least them in this water for at lease 1 h and no longer than 2 h until they are tested as described in **6.6**.

6.5 Treatment for testing resistance to micro-organisms

6.5.1 *Apparatus and materials*

6.5.1.1 *Dish*, of enamelled iron, glass or porcelain 30 mm to 40 mm deep and sufficiently large to accommodate 10 test pieces.

6.5.1.2 *Sawdust*, made from the sapwood of any timber, or from both heartwood and sapwood of species classed as "not durable" as defined in BS EN 350-1, such as ash, beech, birch, poplar or willow. It is essential that the material shall be free from preservatives, insecticides and added substances that inhibit or retard mould growth.

6.5.1.3 *Domestic sugar solution*. Dissolve 15 g of sugar in 1 000 ml of water.

6.5.1.4 *Culture medium*. Moisten the sawdust with the sugar solution so that it is saturated but not so wet that water can be squeezed out by hand.

NOTE Normally a ratio of 1:3 by weight of dry sawdust to solution is required.

Put a 25 mm layer of this preparation into the dish, cover the dish with a sheet of glass and seal this in place with material such as modelling clay to prevent loss of moisture. Keep the dish and contents at (25 ± 2) °C for one week.

6.5.2 *Pretreatment of test pieces*

Immerse 10 test pieces for one week in cold water to remove any free formaldehyde or other mould-inhibiting materials from the wood. During this treatment, ensure that the water has full access to all surfaces and that the water is changed daily.

6.5.3 *Procedure*

Remove the cover from the dish and press the wet test pieces into the sawdust so that their upper faces are level with the surface. Replace and re-seal the cover, and incubate the dish and contents at (25 ± 2) °C for four weeks. At the end of this period, remove the test pieces, wash them in cold water and immediately test them as described in **6.6**.

6.6 Method of determining the failing force

6.6.1 *Apparatus and materials*

6.6.1.1 *Tensile testing machine,* with the following characteristics.

a) Requirements.

i) *Accuracy*. The testing machine shall conform to the requirements of BS 5214-1.

ii) *Rate of application of load*. The load shall be applied at either:

— a rate of increase of load of 1.3 kN/min to 2.7 kN/min; or

— a rate of separation of the straining heads of 6 mm/min to 12 mm/min.

b) *Type of jaw assembly*. The jaws shall grip the test piece with a wedge action. Each pair of jaws shall be attached by loose fitting pin joints that in turn are fitted by ball-and-socket joints to the straining heads. In a machine mounted horizontally the dead weight of the jaw assembly shall be carried by freely moving cross-members. This shall not affect the freedom of the jaws.

Alternatively, one of the pairs of jaws shall be attached rigidly to the testing machine and the other jaws shall be suspended from a ball-and-socket joint allowing sufficient sideways movement of the jaw to permit self-alignment of this jaw whilst the test pieces are being pulled.

6.6.2 *Test procedure*

Insert the test piece so that the length between the wedge grips is within the range 45 mm to 55 mm.

Apply the force by the method appropriate to the type of testing machine until the test piece is broken.

The machine shall be adjusted to operate with a scale range that permits the fracture force to be quoted to the nearest 5 N or better.

Results from which failure occurred in the wood at values below the specified minimum, rather than at the bond, or in which visual examination shows that the adhesive was not correctly applied shall be considered to be invalid.

Record the breaking force of each test piece (whether valid or not) to the nearest 5 N.

6.7 Expression of results

Express the result of the test as the mean failing force of 10 valid test pieces. Round the mean to the nearest 0.1 kN.

6.8 Test report

The following information shall be recorded in the test report.

The adhesive:

a) the chemical nature and origin of the of the sample;

b) manufacturer's name and batch number or other means of uniquely identifying the sample;

c) number of components and method of preparation and application;

d) the durability class or classes (H1, H2 etc.) for which tests are being applied.

Preparation of the test pieces and testing procedure:

a) any special treatment of the bonded panels;

b) mean moisture content of the veneers used to manufacture the test panels;

c) method of making the bond (i.e. open assembly time, temperature, pressure and pressing time);

d) test conditions applied;

e) method of applying the test load.

Test results:

a) that the test was carried out in accordance with this standard;

b) the fracture load of every tested test piece (valid or invalid);

c) the mean fracture load from 10 valid test pieces and the corresponding classification of the adhesive;

d) any factors that might have affected the results.

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