Adhesives — Wood 
adhesives for 
non-structural 
applications — 
Determination of 
tensile shear strength of lap joints
English version

Adhesives - Wood adhesives for non-structural applications -
Determination of tensile shear strength of lap joints.

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Foreword

This document (EN 205:2003) has been prepared by Technical Committee CEN/TC 193, "Adhesives", the secretariat of which is held by AENOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2003, and conflicting national standards shall be withdrawn at the latest by September 2003.

This document supersedes EN 205:1991.

Annex A is informative.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Romania, Slovakia, Spain, Sweden, Switzerland and the United Kingdom.
Introduction

European Standards giving a common classification with respect to durability classes for wood adhesives will allow considerable improvement in consumer protection in any future product liability system with regard to properties guaranteed by the adhesive manufacturer.

The methods described in this standard are suitable for the following and other applications:

- assessing the usability and quality of adhesives for wood and derived timber products;

- classifying these adhesives into the durability classes D1 to D4 of EN 204 (thermoplastic adhesives) and C1 to C4 of EN 12765 (thermosetting adhesives);

- assessing effects on the bond strength resulting from the bonding conditions chosen, the various conditioning sequences and the treatment of the test pieces before and after bonding;
1 Scope
This European Standard describes tests for adhesives for wood and derived timber products for the assessment of their resistance to hot and cold water. It can be used for the assessment of the strength of bonds with a thin or thick bond-line. It does not apply to adhesives for structural use or to the manufacture of particle boards, fibreboard's and plywood. It does not replace tests on finished products.

2 Normative references
This European 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 dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

EN 204, Classification of thermoplastic wood adhesives for non-structural applications.
EN 923:1998, Adhesives —Terms and definitions
EN 12765, Classification of thermosetting wood adhesives for non-structural applications
ISO 5893, Rubber and plastics test equipment — Tensile, flexural and compression types (constant-rate-of-traverse) — Specification.

3 Terms and definitions
For the purposes of this European Standard, the terms and definitions given in EN 923:1998 and the following apply.

3.1 thin bond line
close contact adhesive joint where the adhesive layer is nominally 0.1 mm thick

3.2 thick bond line
gap filled joint where the adhesive layer is (1.0 ± 0.1) mm thick

4 Principle
A symmetrical bonded single lap joint between two symmetrical wooden adherends subjected to specified conditioning treatments and strained to rupture by a tensile force parallel to the grain.

5 Safety
Persons using this standard shall be familiar with normal laboratory practice.

This standard does not purport to address all the safety problems, if any, associated with its use.

It is the responsibility of the user to establish health and safety practices and to ensure compliance with any European or national regulatory conditions.
6 Apparatus

The testing machine shall be a constant-rate-of-traverse machine as described in ISO 5893.

If a constant-rate-of-traverse machine is not available, a constant-rate-of-loading machine shall be used causing a rupture within the time limits specified in 7.5.

The jaws shall grip the test pieces with a wedge action and permit self alignment whilst the test pieces are being pulled.

7 Procedure

7.1 Preparation of bonded assemblies

7.1.1 General

Prepare two panels (see Figure 1) from a thick unsteamed, conditioned, straight-grained board of beech (Fagus sylvatica L.) with a nominal density of (700 ± 50) kg/m³ with a moisture content of (12 ± 1) %. It is permissible to prepare panels from different boards unless it is essential to minimize differences in the wood in order to conduct special comparative tests (see note 1).

Ensure that the angle between the growth rings and the surface to be bonded is between 30° and 90°.

Cut the panels across the direction of the grain to a length equal to a multiple of 300 mm with the necessary allowance for cross-cutting and along the grain to a width of approximately 130 mm making an allowance for the width of cut as shown in Figure 1.

For tests on thin bond-lines, use two panels of (5,0 ± 0,1) mm thickness.

For tests on thick (1,0 ± 0,1) mm bond-lines, use one thick panel of (6,0 ± 0,1) mm thick and one panel of (5,0 ± 0,1) mm thick. Make grooves (1,0 ± 0,1) mm deep and (14 ± 1) mm wide in the 6 mm thick panel as shown in Figure 1.

NOTE 1 When comparing the strength of an adhesive in thick and thin bond-lines, the differences in bond strength caused by differences in the wood should be minimized. In such cases, it is recommended that the panels to be tested are cut from the same board in the direction of the grain in the following order: two 5 mm panels for thin bond-lines; one 5 mm panel and one 6 mm panel for thick bond-lines. The panels are usually cut slightly oversize and planed down to the required thickness before use.
Dimensions in millimetres.

Figure 1 — Example of a bonded panel marked for division into individual test pieces using 2,5 mm saw cuts

Key

- \( a = 1,0 \pm 0,1 \) : thickness of bond-line
- \( l_1 = 150 \pm 5 \) : length of test piece
- \( b = 20,0 \pm 0,2 \) : width of test piece
- \( s = 5,0 \pm 0,1 \) : thickness of the panels
- \( c \) = grooves for thick bond-line
For conventional tests, condition the panels at a temperature of either (20 ± 2) °C and (65 ± 5) % relative humidity or (23 ± 2) °C and (50 ± 5) % relative humidity subsequently referred to as the standard atmosphere (20/65) or (23/50) for a minimum of 7 days.

NOTE 2 For special materials or service conditions, conditioning environments other than that given above can be used if recommended by the manufacturer of the adhesive.

Prepare bonded assemblies using thin (approximately 0,1 mm) bond-lines and if specified thick ((1,0±0,1)mm) bond-lines.

Not more than 24 h before bonding, either lightly plane or lightly sand each surface to be bonded (using an abrasive paper of grain size P100 complying with FEPA 43-1984 is recommended). Remove any dust carefully. Do not touch or soil the prepared surfaces.

Comply with the adhesive manufacturer's instructions regarding the processing conditions, including the preparation of the adhesive, the amount of adhesive to be applied, whether the adhesive is to be applied on one or both surfaces, the open and closed assembly time and the magnitude and duration of the assembly pressure and report them in the test report.

Bond the panels with the pressure uniformly distributed over the bonded surface.

7.1.2 Thin bond-lines (Close contact joints)

Assemble under pressure two 5 mm thick panels as shown in Figure 1.

7.1.3 Thick bond-lines (Gap joints)

Pour sufficient adhesive into the grooves of the grooved panel so that excessive adhesive will be squeezed out when pressure is applied. Assemble under pressure one 6 mm thick grooved panel with one 5 mm thick ungrooved panel as shown in Figure 1.

7.2 Preparation of test pieces

After pressing and before cutting and testing, condition the assembly for a minimum of 7 days in a standard atmosphere.

NOTE A longer conditioning time can be used if recommended by the adhesive manufacturer.

Cut five strips of width \( b = (20 \pm 0,2) \) mm from each bonded assembly along the grain, avoiding areas within 7,5 mm of the outside long edges of the panel as shown in Figure 1. Cut these strips into test pieces of length \( l_1 = (150 \pm 5) \) mm as shown in Figure 2.

Make flat bottomed cuts of (2,5 ± 0,5) mm wide in the bonded sections across the grain so that an overlap of width \( l_2 = (10,0 \pm 0,2) \) mm is defined in the middle section (see Figure 2). The cuts are to separate the wood layers. Take care that the cuts completely cut through the bond line but only penetrate as little as possible into the other part of the joint.
Dimensions in millimetres.

a) with thin bond line

b) with thick bond-line

Key

\[ l_1 = 150 \pm 5 \]: total length of test piece;

\[ b = 20,0 \pm 0,2 \]: width of test piece (width of tested surface);

\[ l_2 = 10,0 \pm 0,2 \]: length of overlap (length of tested surface);

\[ s = 5,0 \pm 0,1 \]: thickness of the panels:

\[ \alpha = 30^\circ \text{ to } 90^\circ \]: angle between growth ring and surfaces to be bonded;

\[ a = 1,0 \pm 0,1 \]: thickness of the thick bond-line

Figure 2 — Lap joint test pieces
7.3 Number of test pieces

Test a sufficient number of test pieces to provide 10 valid results for each of the conditioning sequences chosen. Results from tests in 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 invalid.

7.4 Treatment prior to tensile shear testing

After cutting the test pieces from the conditioned bonded assemblies, subject them to the appropriate conditioning sequences, ensuring that the test pieces are in a horizontal plane, not touching each other and supported so that no stress is applied to them.

NOTE For classifying an adhesive in accordance with EN 204, or EN 12765, the appropriate conditioning sequences are given in Table 2 of these standards.

7.5 Tensile shear test

Test the test pieces shown in Figures 2 and A1 in a tensile testing machine.

Clamp the ends of the test pieces in the jaws of the tensile testing machine up to a length of 40 mm to 50 mm. Ensure that the force is applied centrally and in the plane of the bond. Load the test piece until rupture. Record the applied maximum force $F_{\text{max}}$ in Newton (N).

For comparative tests of adhesives and for assigning an adhesive to the durability classes specified in EN 204 or EN 12765 conduct the test at a rate of traverse of approximately $50\text{mm/min}$ for thermoplastic adhesives (EN 204) or $6-12\text{mm/min}$ for thermosetting adhesives (EN 12765) respectively.

If a constant-rate-of-traverse machine is not available a constant-rate-of-loading machine shall be used causing a rupture after 5 to 15 seconds for thermoplastic glues (EN 204) and 30 s to 60 s for thermosetting glues (EN 12765).

8 Expression of results

Calculate the strength $\tau$ in Newton per square millimetre (N/mm$^2$) using equation

$$\tau = \frac{F_{\text{max}}}{A} = \frac{F_{\text{max}}}{l_2 \cdot b}$$

where

- $F_{\text{max}}$ = the applied maximum force in Newton (N)
- $A$ = the bonded test surface in square millimetres (mm$^2$)
- $l_2$ = the length of the bonded test surface in millimetres (mm)
- $b$ = the width of the bonded test surface in millimetres (mm)

9 Test report

The following items shall be reported:

a) Data about the adhesive:
   - type and origin of the adhesive;
   - batch number or other marking of uniquely identifying the adhesive used;
b) Preparation of the test pieces and testing:
- species of wood with botanical name;
- moisture content of wood relative to oven-dry mass;
- characteristic data relating to the bonding procedure (for instance information about the amount of glue applied, the open and closed assembly time, pressing pressure, pressing temperature, pressing time);
- special treatment of the surface of the boards to be bonded;
- time between the termination of pressing and the cutting of the test pieces;
- indication whether test pieces with a thin (0,1 mm) bond-line or with a thick (1 mm) bond-line have been used;
- number of bonded test pieces;
- conditioning sequences applied;
- rate of traverse or the time required to rupture;

c) Test results and data about the durability class:
- strength $\tau$ in N/mm$^2$ of 10 valid test pieces rounded to 0,1 N/mm$^2$;
- indication of the estimated portion of wood failure as a percentage graded as follows: 0, 25, 50, 75, 100 % breakage of wood (mean value of all test pieces);
- description of further peculiarities of the appearance of the break;
- if necessary, deviations from this standard
- indication of durability class specified in EN 204, or EN 12765;
- date of issue of the report;
Annex A
(informative)

Single lap joint test pieces

For in-house tests and for quick-setting adhesives, single-lap joint test pieces as shown in Figure A.1 can be used rather than the test pieces shown in Figures 1 and 2. When clamping these test pieces into the tensile testing machine, ensure that the applied force is in the plane of the bond line and centrally applied by using either shims or appropriately designed clamps.

Selection and the bonding of the wood should be in accordance with 7.1 and 7.2.

When bonding test pieces in accordance with Figure A.1 it is recommended that two cuts be laid one on top of the other in such a way that the angles of the growth rings run in opposite directions.

Key
- \( l_1 \) = length of test piece (150 ± 2) mm
- \( b \) = width of test piece (20 ± 0,2) mm
- \( l_3 \) = length of test slip (80 ± 2) mm
- \( s \) = thickness of test slip (5 ± 0,1) mm
- \( l_2 \) = length of overlap (10 ± 0,2) mm

Figure A.1 — Lap joint test piece for in-house test
(single lap joint test piece for tensile shear test)
Bibliography

FEPA 43-1984¹, Fédération Européenne des Fabricants de Produits Abrasifs

¹ FEPA 43-1984 is available from:
British Abrasive Federation, Fair Green House, Sawbridgeworth, Herts, OX21 9AJ, England
Fachverband Electrokorund-und Siliziumkarbid-Hersteller e.V. (FES), Karlstrasse 21, D-60329 Frankfurt, Germany
Fédération Européene des Fabricants de Produits Abrasifs, 20 Avenue Reille, F-75014 Paris, France