INTERNATIONAL STANDARD

ISO 19210

First edition
2017-07

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

Adhésifs — Colles pour bois à usages non structuraux — Détermination du pouvoir adhésif des collages longitudinaux par l'essai de cisaillement

Reference number
ISO 19210:2017(E)

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

ISO 19210 was prepared by CEN/TC 193 as EN 205:2016 and was adopted (without modification) by Technical Committee ISO/TC 61, *Plastics*, Subcommittee SC 11, *Products*.

Introduction

International Standards giving a common classification with respect to durability classes for wood adhesives 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 document 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 ISO 19210 (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.

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

SAFETY STATEMENT — Persons using this document should be familiar with the normal laboratory practice, if applicable. This document does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to ensure compliance with any regulatory conditions.

ENVIRONMENTAL STATEMENT — It is understood that some of the material permitted in this document may have negative environmental impact. As technological advantages lead to acceptable alternatives for these materials, they will be eliminated from this document to the extent possible. At the end of the test, it is essential that the user of this document take care to carry out an appropriate disposal of the wastes according to local regulation.

1 Scope

This document specifies 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 bond line. It does not apply to adhesives for structural use or to the manufacture of particleboards, fibreboards and plywood. It does not replace tests on finished products.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 5893, *Rubber and plastics test equipment — Tensile, flexural and compression types (constant rate of traverse) — Specification*

ISO 19209, *Adhesives — Classification of thermoplastic wood adhesives for non-structural applications*

EN 923, *Adhesives — Terms and definitions*

EN 12765, *Classification of thermosetting wood adhesives for non-structural applications*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 923 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at http://www.iso.org/obp

3.1
thin bond line
close contact adhesive joint where the adhesive layer is nominally 0,1 mm thick

3.2
thermoplastic wood adhesive
adhesive whose main constituent is a thermoplastic resin and which has been formulated for bonding wood

3.3
thermoset wood adhesive
monomer, polymer or copolymer, which when cured, changes into a substantially infusible and insoluble product and which has been formulated for bonding wood

4 Principle

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

5 Safety

Persons using this document shall be familiar with normal laboratory practice.

This document 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 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 while the test pieces are being pulled.

7 Procedure

7.1 Preparation of bonded assemblies

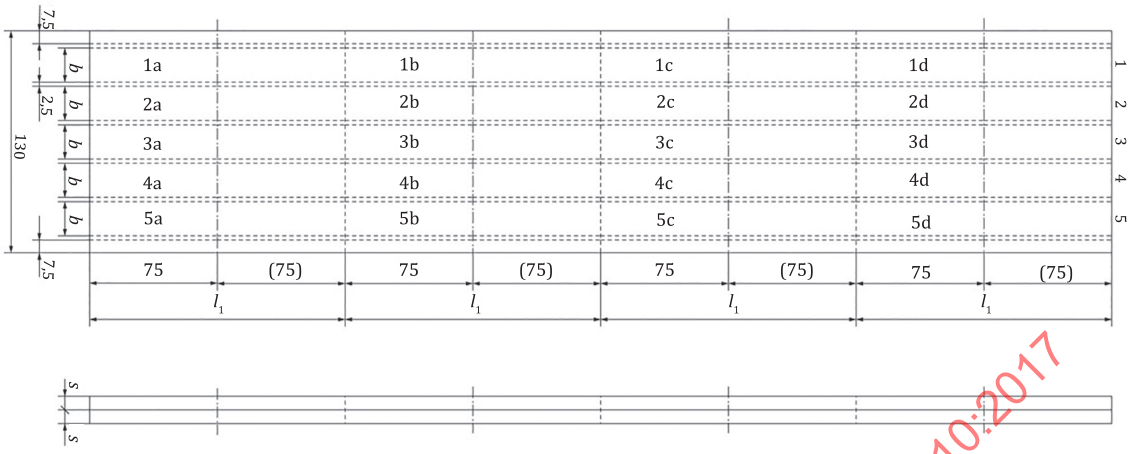
Prepare two panels (see Figure 1) from a thick unsteamed, conditioned, straight-grained board of beech (*Fagus sylvatica* L.) with a nominal density of (700 ± 50) kg/m^3 with a moisture content of (12 ± 1) %. It is permissible to prepare panels from different boards unless it is essential to minimize differences in the wood in order to conduct special comparative tests.

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, use two panels of (5,0 ± 0,1) mm thickness.

Dimensions in millimetres



Key

l_1 length of test piece: (150 ± 5) mm

b width of test piece: (20,0 ± 0,2) mm

s thickness of the panels: (5,0 ± 0,1) mm

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

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.

Prepare bonded assemblies using thin (approximately 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 ISO 6344-2 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.

Where no manufacturer's instructions are available, the following processing conditions shall be used:

— adhesive applied on both sides;

— adhesive spread: (150 ± 10) g/m^2;

— open assembly time: (120 ± 10) s;

— closed assembly time (180 ± 10) s;

— pressing pressure (0,7 ± 0,1) N/mm^2;

— pressing time: 2 h.

Bond the two 5 mm thick panels as shown in Figure 1 with the pressure uniformly distributed over the bonded surface.

7.2 Preparation of test pieces

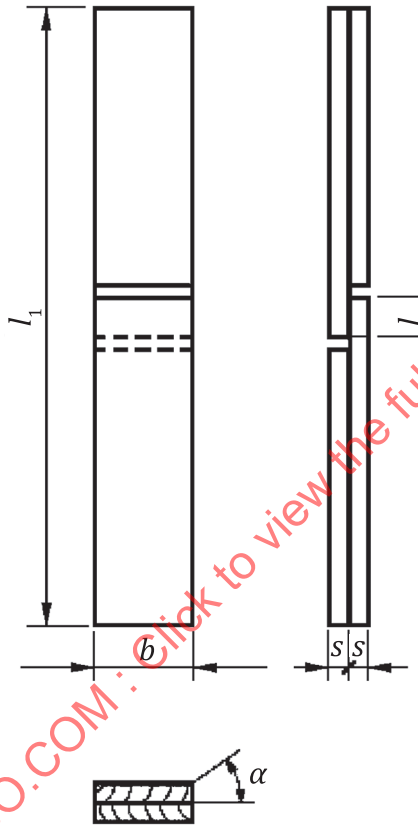
After pressing, condition the assembly for 7 days in standard atmosphere.

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

The test pieces shall not be cut earlier than 5 days after bonding.

Cut five strips of width b = (20 ± 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 ± 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 length l_2 = (10,0 ± 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.



Key

l_1 total length of test piece: (150 ± 5) mm
l_2 length of overlap (length of tested surface): (10,0 ± 0,2) mm
s thickness of the panels: (5,0 ± 0,1) mm
b width of test piece (width of tested surface): (20,0 ± 0,2) mm
α angle between growth ring and surfaces to be bonded: 30° to 90°

Figure 2 — Lap joint test pieces with a thin bond line

7.3 Number of test pieces

Test 20 test pieces for each of the conditioning sequences chosen.

7.4 Treatment prior to tensile shear testing

Subject the test pieces from conditioned bonded assemblies as in 7.2 to the appropriate conditioning sequences.

Ensure that the test pieces are in a horizontal plane, not touching each other and are supported in such a way that no stress is applied to them.

NOTE For classifying an adhesive in accordance with ISO 19209 or EN 12765, the appropriate conditioning sequences are given in Table 2 of ISO 19209:2017 or EN 12765:2016.

7.5 Tensile shear test

Test the test pieces shown in Figure 2 and Figure A.1 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_{max}, in newtons (N).

For comparative tests of adhesives and for assigning an adhesive to the durability classes specified in ISO 19209 or EN 12765, conduct the test at a rate of traverse of approximately 50 mm/min for thermoplastic adhesives (see ISO 19209) or 6 mm/min to 12 mm/min for thermosetting adhesives (see 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 s to 15 s for thermoplastic glues (see ISO 19209) and 30 s to 60 s for thermosetting glues (see EN 12765).

8 Expression of results

Calculate the strength, τ, in newtons per square millimetre (N/mm^2) using Formula (1):

$$\tau = \frac{F_{max}}{A} = \frac{F_{max}}{l_2 \times b} \quad (1)$$

where

F_{max} is the applied maximum force in newtons (N);

A is the bonded test surface in square millimetres (mm^2);

l_2 is the length of the bonded test surface in millimetres (mm);

b is the width of the bonded test surface in millimetres (mm).

9 Test report

The following items shall be reported:

a) Data about the adhesive:

   1) type and origin of the adhesive;

   2) batch number or other marking of uniquely identifying the adhesive used;

   3) number of components and working methods (procedure of preparing and applying of adhesive);

   4) durability class (for information only);

b) Preparation of the test pieces and testing:

   1) species of wood with botanical name;

   2) moisture content of wood relative to oven-dry mass;

3) 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);

4) special treatment of the surface of the boards to be bonded;

5) time between the termination of pressing and the cutting of the test pieces;

6) number of bonded test pieces;

7) conditioning sequences applied;

8) rate of traverse or the time required to rupture;

c) Test results and data about the durability class:

1) strength τ in N/mm^2 of 20 test pieces rounded to 0,1 N/mm^2;

Results from tests in which failure occurred in the wood at values below the specified minimum are invalid. Test pieces that are twisted, bended or showing other irregularities in form are valid if they reach the requirements; otherwise, or if visual examination shows that the adhesive was not correctly applied, the results are invalid. All results, valid or invalid, shall be reported. Explanation of the invalid values shall be reported

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);

3) description of further peculiarities of the appearance of the break;

4) if necessary, deviations from this document;

5) indication of durability class specified in ISO 19209 or EN 12765;

6) date of issue of the report.