

Plywood — Bonding quality —

Part 1: Test methods

The European Standard EN 314-1:2004 has the status of a
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National foreword

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Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 20, an inside back cover and a back cover.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 314-1:2004) has been prepared by Technical Committee CEN/TC 112 "Wood based panels", the secretariat of which is held by DIN.

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of an identical text or by endorsement, at the latest by June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005..

This document supersedes EN 314-1:1993.

In the revised version the following modifications have been made as compared to EN 314-1:1993:

- the standard contains not only test methods for veneer plywood but also for blockboard and laminboard;
- the normative annex A "Determination of the percentage of apparent cohesive wood failure by comparison" has been extended;
- a new informative annex B "Guidelines for the evaluation of glue bond of insulating core plywood" has been added.

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

1 Scope

This document specifies methods for determining the bonding quality of veneer plywood, blockboard and laminboard by shear testing.

The relevant requirements are specified in EN 314-2.

This document is suitable for insulating core plywood as defined in Annex B.

Annex A is normative. Annex B is informative.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 314-2, *Plywood — Bonding quality — Part 2: Requirements*

EN 326-1, *Wood-based panels — Sampling, cutting and inspection — Part 1: Sampling and cutting of test pieces and expression of test results.*

3 Test pieces

3.1 Sampling

Sampling shall be according to EN 326-1.

Test pieces shall be without any manufacturing defects or characteristics inherent in wood (see EN 635-1) in the testing area.

3.2 Shape and sizes

The test pieces of veneer plywood shall be prepared as shown in Figure 1.

Each test piece shall be cut so that the grain direction of the layer between the gluelines under test is perpendicular to the length of the test piece.

The test pieces have to be prepared and the nicking is made to allow the examination of each glueline of the panel.

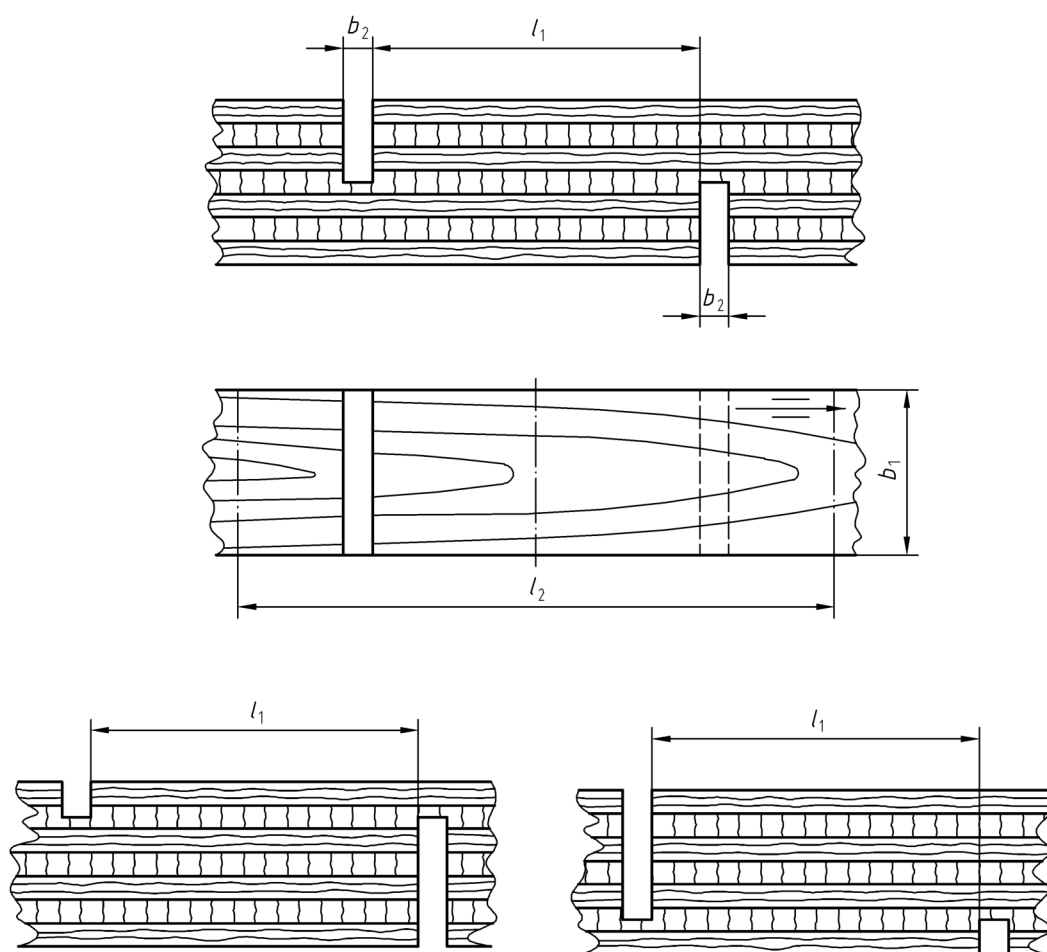
The saw cuts shall extend into the layer between the gluelines under test, as shown in Figure 1.

Full panel thickness test pieces may be used for veneer plywood with 3 to 9 layers.

For panels of more than 9 layers, excess layers may be removed by planing, cutting or sanding.

Similar procedure can be used for determining the bonding quality of blockboard and laminboard (Figure 2) or thin faces veneered plywood (Figure 3). The saw cuts shall extend into one of the layers between the gluelines under test between face layers and core layers, as shown in Figures 2 and 3.

NOTE For insulating core plywood, see Annex B.

**Key**

b_1 (25 ± 0,5) mm (shear width of test piece)

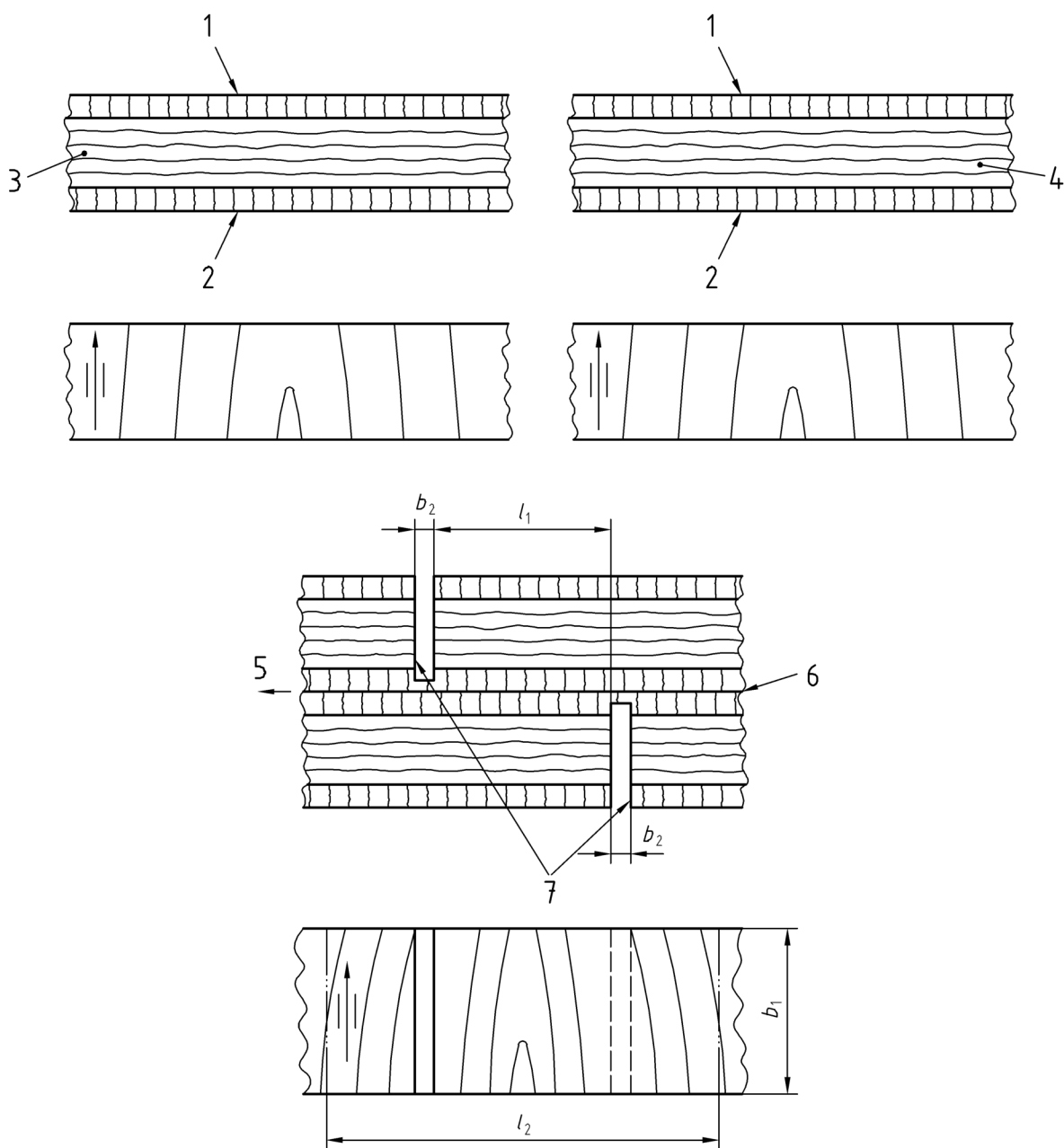
b_2 2,5 mm to 4 mm (saw cut width)

l_1 (25 ± 0,5) mm (shear length)

l_2 50 mm min (distance between clamps)

→ along the grain direction

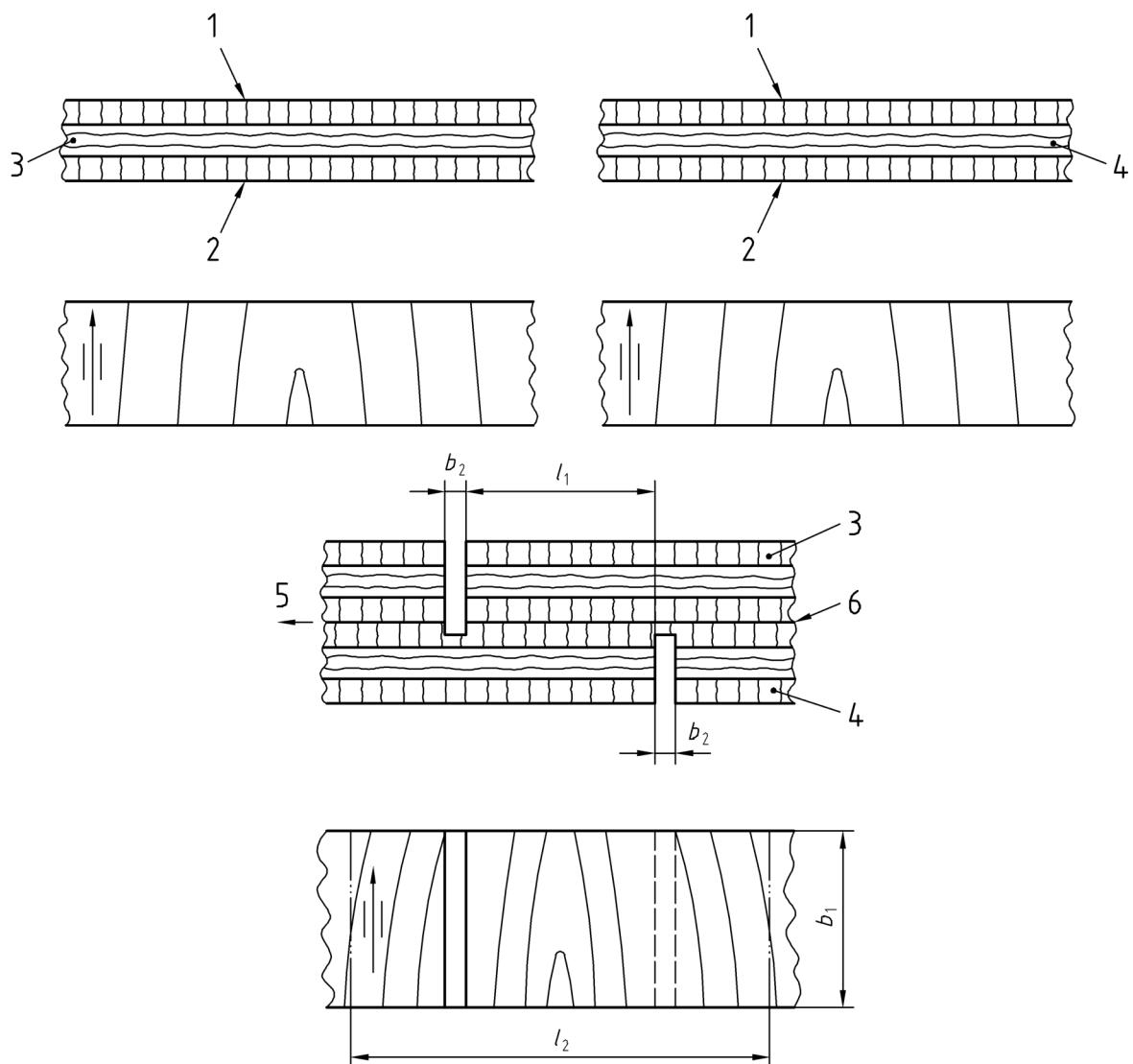
Figure 1 — Test piece example for a 7 ply veneer plywood



Key

- 1 Face
- 2 Back face
- 3 Part 1
- 4 Part 2
- 5 Faces of part 1 and part 2, the same set-up shall be made for the back face of part 1 and part 2
- 6 Glueline not subject to the shear test
- 7 Saw cuts throughout the face layers
- b_1 ($25 \pm 0,5$) mm (shear width)
- b_2 (2,5 to 4) mm (saw cut width)
- l_1 ($25 \pm 0,5$) mm (shear length)
- l_2 50 mm min (distance between clamps)
- \longrightarrow along the grain direction

Figure 2 — Composite test piece for blockboard and laminboard

**Key**

- 1 Face
- 2 Back face
- 3 Part 1
- 4 Part 2
- 5 Faces of part 1 and part 2, the same set-up shall be made for the back face of part 1 and part 2
- 6 Glueline not subject to the shear test
- b_1 (25 ± 0,5) mm (shear width)
- b_2 (2,5 to 4) mm (saw cut width)
- l_1 (25 ± 0,5) mm (shear length)
- l_2 50 mm min (distance between clamps)

→ along the grain direction

Figure 3 — Composite test piece for thin face plywood panel

4 Apparatus

4.1 Physical test

- Thermostatically controlled water-bath suitable for immersing test pieces and capable of maintaining a temperature of $(20 \pm 3) ^\circ\text{C}$.
- Boiling tank enabling the test piece to be immersed in boiling water.
- Ventilated drying oven capable of maintaining a temperature of $(60 \pm 3) ^\circ\text{C}$ at all points.
- Measuring instrument of lengths with an accuracy of 0,1 mm.
- A lens with a magnification of 10.

4.2 Shear test

A tensile testing machine with suitable serrated grips capable of operating continuously and measuring the applied load to an accuracy of $\pm 1 \%$.

5 Pre-treatments

5.1 Sequence of pre-treatment

- 5.1.1** Immersion for 24 h in water at $(20 \pm 3) ^\circ\text{C}$.
- 5.1.2** Immersion for 6 h in boiling water followed by cooling in water at $(20 \pm 3) ^\circ\text{C}$, for at least 1 h.
- 5.1.3** Immersion for 4 h in boiling water, then drying in the ventilated drying oven for 16 h to 20 h at $(60 \pm 3) ^\circ\text{C}$, then immersion in boiling water for 4 h, followed by cooling in water at $(20 \pm 3) ^\circ\text{C}$ for at least 1 h.
- 5.1.4** Immersion for (72 ± 1) h in boiling water, followed by cooling in water at $(20 \pm 3) ^\circ\text{C}$ for at least 1 h.

5.2 Choice of pre-treatment

EN 314-2 gives information on pre-treatments for particular plywood types.

5.3 Positioning of test pieces

The test pieces shall be placed, well separated, in a suitable rack or wire basket. During soaking, each test piece shall remain completely immersed in water.

6 Procedure

6.1 Determination of behaviour of bonding by shear test

- Before the water treatment, the length and width of the shear area shall be measured to an accuracy of 0,1 mm and recorded.
- The shear test shall be carried out on wet test pieces from which a wiping can be realized.
- The shear test pieces shall be arranged in the centre of the clamping devices in such a way that the load can be transmitted from the testing machine, via the ends of the test pieces, to the shear area without any transverse loads. If slipping occurs it is only allowed in the initial stage of the loading. This clamping is made on faces.
- The load shall be applied at a constant rate of motion so that rupture occurs within (30 ± 10) s.
- The breaking load shall be determined to an accuracy of 1 %. The shear strength shall be calculated in Newton per square millimetre (N/mm^2) according to clause 7.
- After the shear test, the apparent cohesive wood failure shall be determined according to 6.2.

6.2 Determination of the percentage of apparent cohesive wood failure

The failure should normally occur in the wood, or in the glue-lines between the saw cuts, i.e. within the shear test area. When failure occurs outside the test area, or if by cross-grain breaking within 50 % or more of the surface of a face veneer, the result shall be rejected and the test shall be repeated with a shear length of 25 mm by using the procedure for plywood with faces made of thin veneers in Figure 3.

With the exception of results from test pieces containing tape, the results of failures arising from the presence of strength reducing defects shall be excluded. Test pieces with such defects should normally be identified and replaced during the cutting operation. If the number of test pieces rejected exceeds 20 %, it will be necessary to resample. If the resampling is also rejected on this basis, then the batch shall be rejected.

The test pieces shall be allowed to dry before the determination of apparent cohesive wood failure.

The apparent cohesive wood failure percentage shall be recorded by use of the written guidelines and comparison with the pictures in Annex A (determination of apparent cohesive wood failure percentage, if possible by 5 % increment from 0 % to 100 %).

7 Expression of results

The shear strength f_v of each test piece in Newtons per square millimetre (N/mm^2) is calculated from the following equation:

$$f_v = \frac{F}{l_1 \times b_1}$$

where

F is the failing force of the test piece, in Newton;

l_1 is the length of the shear area in millimetres;

b_1 is the width of the share area in millimetres.

NOTE l_1 and b_1 are measured before pre-treatment.

Calculate the mean shear strength to $0,01 \text{ N/mm}^2$ and the standard deviation.

Also determine the average cohesive wood failure percentage value to an accuracy of 5 %.

8 Test report

As described in EN 326-1, and:

- a) the mean shear strength value and the standard deviation in Newton per square millimetre (N/mm²);
- b) the average apparent cohesive wood failure percentage value;
- c) details of pre treatments applied according to 5.1.

Annex A

(normative)

Determination of the percentage of apparent cohesive wood failure by comparison

Determine the percentage of apparent cohesive wood failure of the dried individual specimen to the nearest 10 % by comparison to the reference illustrations (see Figures A.1 to A.3). The determination consists of an area assessment and a determination of the texture of the failure surface.

For photo technical reasons, the illustrations are only for plywood bonded with a brown glue.

In the determination of failure texture, both deep and superficial failures in the veneers, the same weighting shall be given as apparent cohesive wood failures.

- The texture of the broken surfaces should be determined by use of the following guidelines:
- Sufficient light and a lens (x 10 magnification) are necessary to appreciate the correct texture of the failure surfaces
- Areas of the broken surfaces lying entirely in the veneer adjacent to the tested gluelines or areas of the tested gluelines covered with opaque bundles of fibres should count as apparent cohesive wood failure.
- A failure surface having a shaggy/downy appearance due to covering of the gluelines with fine fibres should count as apparent cohesive wood failure.
- A thin transparent layer of fine fibres on the glueline should also be counted as apparent cohesive wood failure, as long as the general appearance shows covering with fibres.
- Glue bond visible through a covering with fine fibres should only be recorded as glue bond failure, in case the glue bond is revealed as distinct patches on this general covering.
- Areas of the glueline, where no glue has been present at the time of bonding, should be counted as gluebond failure.

The determination of percentage of wood fibres is subjective and is a skill not instantly acquired. While trained and experienced operators obtain accurate and reproducible results, differences between operators and laboratories may occur. To minimise this possibility, it is essential to adhere to the above guidelines.

NOTE Dispersion in interpretation of result with visual examination can exceed 10 % in usual practice.



Figure A.1 — Wood fibre failure 0 % to 30 % reference illustrations



Figure A.2 — Wood fibre failure 40 % to 60 % reference illustrations

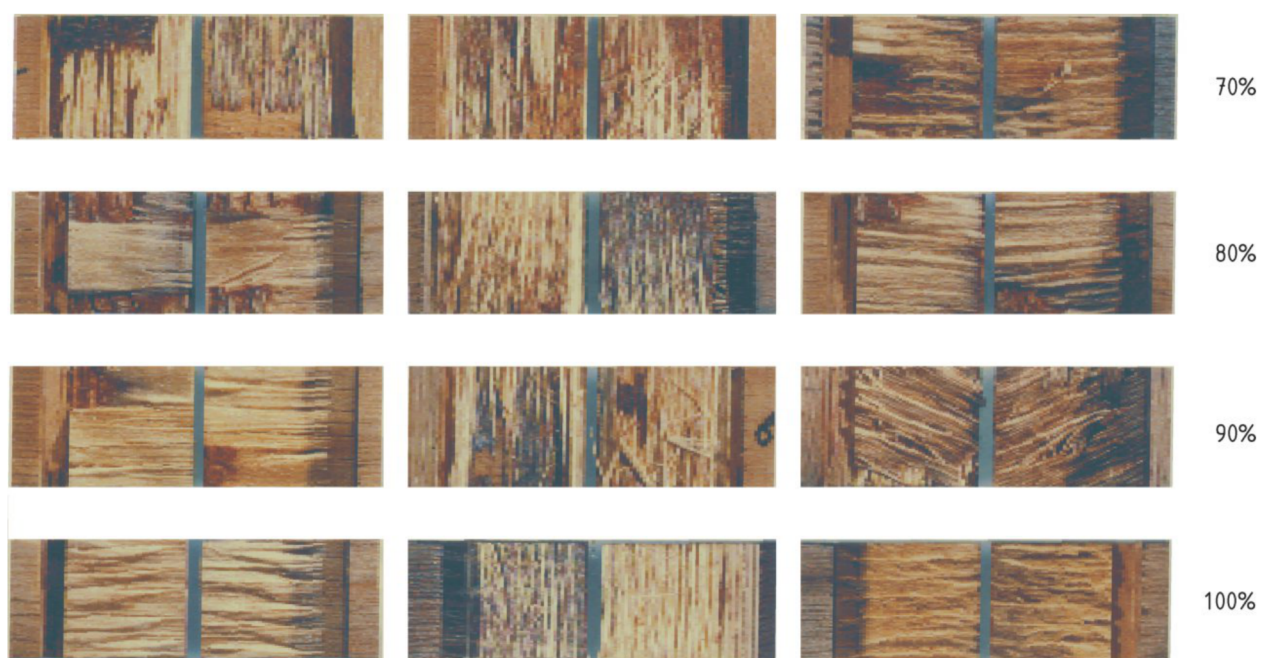


Figure A.3 — Wood fibre failure 70 % to 100 % reference illustrations

Annex B (informative)

Guidelines for the evaluation of glue bond of insulating core plywood

B.1 Scope

This test method applies to insulating panels made of two plywood panels bonded to a non-hygroscopic¹⁾ core insulating material having an internal bond²⁾ of $\geq 0,1 \text{ N/mm}^2$.

B.2 Principle

The glue bond of insulating core plywood is determined by measuring the mean bond strength of two sets of matched test pieces. One set is tested after conditioning at room temperature, the other after one of the pre-treatments specified in EN 314-2. The glue bond is expressed as the ration of these two sets of mean bond strengths.

1) A specimen of the core material immersed in cold water for 24 h not increased in thickness by more than 2 %.

2) Determined according to EN 319.

B.3 Test piece

B.3.1 Definition

Its main features are (see Figure B.1):

- dimension b_1 equal to (50 ± 1) mm;
- dimension l equal to the thickness of the core but not less than 50 mm;
- width n of the notches so as to allow proper failure of the core (at least equal to 5 mm);
- distance g between nearest edge of nearest notch and end: at least 50 mm;
- the lay-up of the plywood is such that the length of the two layers bonded to the core shall be across the length of the test piece.

NOTE

Dimension n

It depends on:

- dimension t_c
- the elongation capacity to failure of the core.

Therefore, preliminary testing is necessary to determine n .

That is to ensure a similar wetting through the end grain wood of the layers on both faces of the core; otherwise wetting may vary with the length of the layers bonded to the core.

The cutting of the ends is square (tolerance not exceeding 2 % of the dimensions of the cross section).

B.3.2 Sampling

20 test pieces are cut at random, per panel or sampling unit of 3 m².

B.3.3 Application of load

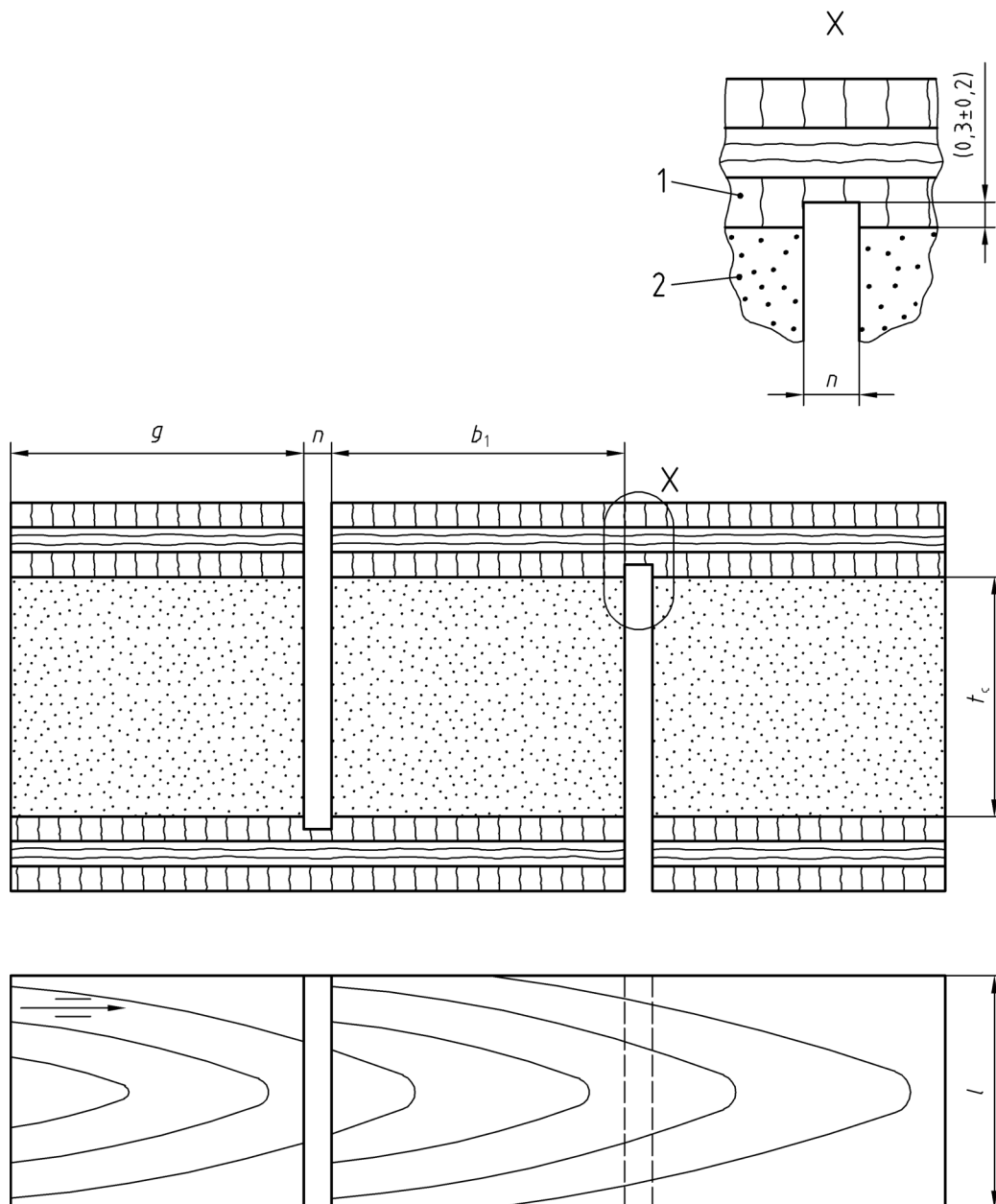
A compression jig is used (see Figure B.2). Its main features are:

- a steel corner support;
- a steel adjustable plate;
- a clamping system;
- an anti-friction system on both faces of the test pieces.

NOTE PTFE (polytetrafluoroethylin) plates are relevant as an anti-friction device.

When installing the test piece into the jig, clamping is adjusted so as to ensure contact of the faces of the test pieces against the anti-friction system inserted between the corner support and the adjustable plate.

Dimensions in millimetres



Key

1 Plywood layer

2 Core

b_1 50 mm min

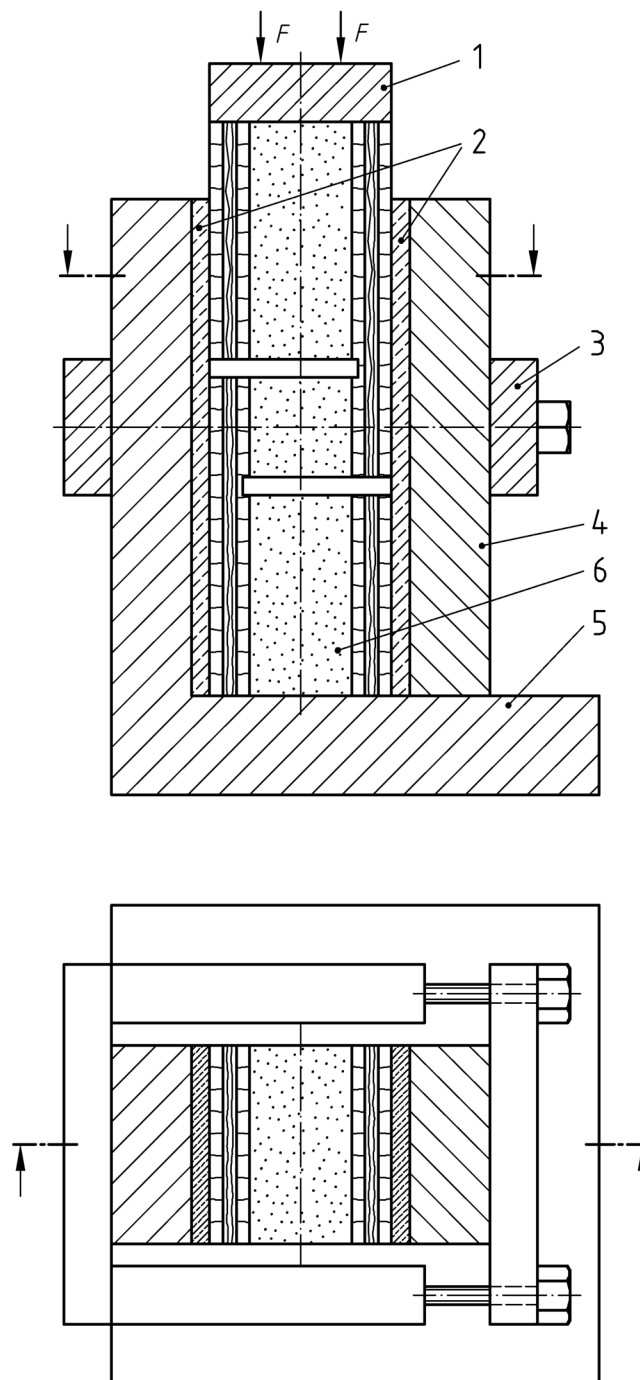
g ≥ 50 mm

l (50 ± 1) mm

n ≥ 5 mm

t_c 50 mm min, if $t_c > 50$ mm, the grain of the veneer bonded to the core is perpendicular to the length of the test piece.

Figure B.1 — Test piece for plywood with insulating core



Key

- | | |
|--|-------------------------|
| 1 Loading plate | 4 Adjustable plate |
| 2 PTFE plates or equivalent anti-friction system | 5 Support |
| 3 Clamping bar | 6 Material to be tested |

Figure B.2 — Principle of a compression shear jig for insulating core plywood

B.4 Pre-treatment

A set of 10 test pieces is selected at random to be pre-treated, in each batch of 20 test pieces.

The selection of the pre-treatments is made in relation to the intended service class. It is defined in EN 314-2.

B.5 Control of the test pieces

The sets of conditioned and pre-treated test pieces are controlled by compression shear. The procedure for loading is defined in B.3.3.

For each test piece:

- initial dimensions of the shear area;
- the maximum force leading to failure

are recorded.

The strength to failure is calculated according to equation in clause 7.

B.6 Evaluation of the results

B.6.1 General

Because of the uncertainty of evaluation of core adhesion to the plywood faces, the following system is applied.

B.6.2 Calculations

For each set of 10 test pieces,

- the mean value $\overline{f_v}$
- the standard deviation s_v
- the coefficient of variation $V = \frac{s_v}{\overline{f_v}}$

are calculated.

B.6.3 Specifications

They are based on:

- the coefficient of variation V after conditioning;
- the ratio of residual strength compared to the initial strength (after conditioning) according to:

$$r = \frac{\overline{f_v}_{\text{pretreated}}}{\overline{f_v}_{\text{conditioned}}}$$

A 95th percentile value should be determined for the coefficient of variation V after conditioning.

A 5th percentile should be determined for the ratio of residual strength r for each pre-treatment.

Bibliography

- [1] EN 319, *Particleboards and fibreboards — Determination of tensile strength perpendicular to the plane of the board.*
- [2] EN 635-1, *Plywood – Classification by surface appearance – Part 1: General.*

