



SLOVENSKI STANDARD
SIST EN 391:1996
01-avgust-1996

Lepljen lameliran les - Delaminacijski preskus lepljenih stikov

Glued laminated timber - Delamination test of glue lines

Brettschichtholz - Delaminierungsprüfung von Leimfugen

Bois lamellé collé - Essai de délamination des joints de collage

Ta slovenski standard je istoveten z: EN 391:1995

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ICS:

79.060.99 Druge lesne plošče Other wood-based panels

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EUROPEAN STANDARD

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Glued laminated timber - Delamination test of glue lines

Bois lamellé collé - Essai de délamination des joints de collage

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

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CENEuropean Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart, 36 B-1050 Brussels

Contents

	Page
Foreword	3
Introduction	3
1 Scope	3
2 Normative references	3
3 Definitions	3
4 Symbols	4
5 Requirements	4
6 Delamination test of glue lines	4
6.1 Principle	4
6.2 Apparatus	4
6.3 Preparation of test pieces	5
6.4 Procedures	6
6.5 Results	7
6.6 Test report	8

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Foreword

This European Standard was prepared by CEN TC 124 "Timber Structures" of which the secretariat is held by DS.

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of an identical text or by endorsement, at the latest by July 1995, and conflicting national standards shall be withdrawn at the latest by July 1995.

NOTE: It is considered desirable to maintain the same clause numbers consistently throughout this series of standards. Consequently, some clauses are void in this edition of this standard, but it is envisaged that future editions may need to include text in the clauses.

No existing European Standard is superseded.

In accordance with the CEN/CENELEC Internal Regulations, the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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Introduction

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Two delamination methods called A and B are suitable for adhesives of type I as defined in EN 301, and one method called C is suitable for adhesives of type II as defined in EN 301.

The two methods A and B have a duration of two days and a half day respectively, and method C requires four days. All are suitable for every day quality control.

1 Scope

This standard specifies three delamination methods for continuous quality control of the glue line integrity of glued laminated timber.

2 Normative references

None.

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1 delamination length: The sum of the lengths of open glue lines on both end-grain surfaces of each test piece.

3.2 glued laminated timber (glulam): Structural member formed by bonding together timber laminations with the grain essentially parallel.

4 Symbols

b	width of cross section, in millimetres;
h	depth of cross section, in millimetres;
$l_{\max, \text{delam}}$	maximum delamination length of one glue line in the test piece, in millimetres;
l_{glueline}	length of one glue line, normally the width b shown in figure 1, in millimetres;
$l_{\text{tot, delam}}$	delamination length of all glue lines in the test piece, in millimetres;
$l_{\text{tot, glueline}}$	entire length of glue lines on the two end-grain surfaces of each test piece, in millimetres.

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5 Requirements

None.

6 Delamination test of glue lines

6.1 Principle

A gradient is introduced in the moisture content of the wood to build up internal stresses. This will result in tensile stresses perpendicular to the glue lines so that inadequate bonding quality will result in delamination of the glue lines.

6.2 Apparatus

6.2.1 Pressure vessel

A pressure vessel designed to withstand safely a pressure of at least 600 kPa (700 kPa absolute pressure) and a vacuum of at least 85 kPa (15 kPa absolute pressure), and equipped with pumps or similar device capable of giving a pressure of at least 600 kPa (700 kPa absolute pressure) and of drawing a vacuum of at least 85 kPa (15 kPa absolute pressure).

6.2.2 Drying duct

A drying duct where air is circulating at a velocity of 2 m/s to 3 m/s, and at a temperature and a relative humidity as given in table 1.

Table 1: Climate in the drying duct for the different methods

	Method:		
	A	B	C
Temperature °C	60 to 70	65 to 75	25 to 30
Relative humidity %	< 15	8 to 10	25 to 35

6.2.3 Balance

A balance capable of determining mass to an accuracy of 5 g.

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6.3 Preparation of test pieces

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The test pieces shall be prepared or selected in such a manner that they are representative of the production run.

Each test piece shall be taken from a full cross section of the laminated member to be tested, prepared by cutting perpendicular to the grain of the wood. It shall be (75 ± 5) mm in length (along the grain). The end-grain surfaces of the test piece shall be cut with a sharp saw or tool that produces a smooth surface.

If the width b of the cross section is greater than 300 mm the test piece may be split into two or more test pieces each at least 130 mm wide. If the depth h is greater than 600 mm the test piece(s) may be cut into two or more pieces each with a depth of at least 300 mm, see figure 1.

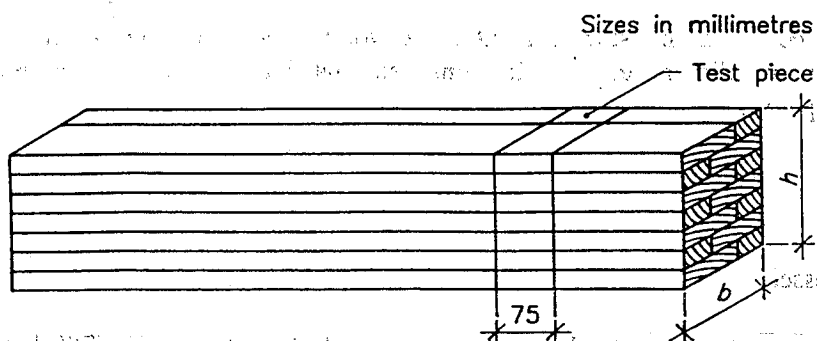


Figure 1: Test piece cut from a glulam member

6.4 Procedures

6.4.1 General

Measure the total length in millimetres of glue lines on the end-grain surfaces of the test pieces. Subject the test pieces to the appropriate test cycle described in 6.4.2, 6.4.3 or 6.4.4. The number of test cycles shall be as given in table 2.

Table 2: Number of test cycles to be used in the different test methods.

	Method:		
	A	B	C
Number of initial cycles	2	1	1
Number of extra cycles	1	1	0

An extra test cycle need only be carried out if the total delamination percentage according to 6.5.2 is larger than the prescribed maximum value.

At the end of the drying period, measure in millimetres the length of open glue lines on end-grain surfaces of the test pieces. Open glue lines at knots shall be ignored and failure in the wood due to checking or other causes shall not be included as delamination. Isolated delamination less than 3 mm long and more than 5 mm away from the nearest delamination shall also be ignored.

NOTE 1: When the separation is in the wood, even though very close to the glue line, it is termed wood failure or checking. Magnification is often necessary to determine whether the failure is in the adhesive or in the wood. A feeler gauge of 0,08 mm to 0,10 mm in thickness is convenient for probing into the joint to determine if separation actually exists.

NOTE 2: Since glue lines at knots and knotty areas in general are not durable under severe exposures, development of delamination at knots should be disregarded and not included in the measurements or calculations.

6.4.2 Test cycle for method A

6.4.2.1 Place the test pieces in the pressure vessel and weigh them down. Admit water at a temperature of 10 °C to 20 °C in sufficient quantity so that the pieces are completely submerged. Separate the test pieces by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water. Draw a vacuum of 70 kPa to 85 kPa (i.e. an absolute pressure of 15 kPa to 30 kPa at sea level) and hold it for 5 min. Then release the vacuum and apply a pressure of 500 kPa to 600 kPa (600 kPa to 700 kPa absolute pressure) for 1 h. Whilst the test pieces are still completely immersed, repeat this vacuum pressure cycle making a two-cycle impregnating period requiring a total of 130 min.

6.4.2.2 Dry the test pieces for a period of between 21 h and 22 h in air at 60 °C to 70 °C and a relative humidity not greater than 15 %, and circulating at a velocity of 2 m/s to 3 m/s. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to the stream of air.

6.4.3 Test cycle for method B

6.4.3.1 Weigh and record to the nearest 5 g the mass of each test piece. Place the test pieces in the pressure vessel and weigh them down. Admit water, at a temperature of 10 °C to 20 °C in sufficient quantity so that the pieces are completely submerged. Separate the test pieces by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water.

Draw a vacuum of 70 kPa to 85 kPa (i.e. an absolute pressure of 15 kPa to 30 kPa at sea level) and hold it for 30 min. Release the vacuum and apply a pressure of 500 kPa to 600 kPa (600 kPa to 700 kPa absolute pressure) for 2 h.

6.4.3.2 Dry the test pieces for a period of approximately 10 h to 15 h in air at 65 °C to 75 °C and a relative humidity of 8 % to 10 % and circulating at a velocity of 2 m/s to 3 m/s. During drying the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to the stream of air.

6.4.3.3 The actual time in the drying duct shall be controlled by the mass of the test pieces. Delamination shall be observed and recorded when the mass of the test pieces has returned to within 15 % of the original mass.

6.4.4 Test cycle for method C

6.4.4.1 Place the test pieces in the pressure vessel and weigh them down. Admit water at a temperature of 10 °C to 20 °C in sufficient quantity so that the pieces are completely submerged. Separate the test pieces by stickers, wire screens, or other means in such a manner that all end-grain surfaces are freely exposed to the water. Draw a vacuum of 70 kPa to 85 kPa (i.e. an absolute pressure of 15 kPa to 30 kPa at sea level) and hold it for 30 min. Then release the vacuum and apply a pressure of 500 kPa to 600 kPa (600 kPa to 700 kPa absolute pressure) for 2 h. Whilst the test pieces are still completely immersed, repeat this vacuum pressure cycle giving a two-cycle impregnating period requiring a total of 5 h.

6.4.4.2 Dry the test pieces for a period of 90 h in air at 25 °C to 30 °C and a relative humidity in the range of 25 % to 35 %, and circulating at a velocity of 2 m/s to 3 m/s. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to the stream of air.

6.5 Results

6.5.1 General

For each test piece the delamination percentages shall be calculated. If an extra cycle is performed calculate the results before and after the extra cycle.

6.5.2 Total delamination

The total delamination percentage of a test piece shall be calculated from the following formula:

$$100 \frac{l_{\text{tot,delam}}}{l_{\text{tot,glueline}}}$$

6.5.3 Maximum delamination

The maximum delamination percentage for a single glue line in a test piece shall be calculated from the