INTERNATIONAL STANDARD

ISO 12580

First edition
2007-10-01

Timber structures — Glued laminated timber — Methods of test for glue-line delamination

Structures en bois — Bois lamellé-collé — Méthodes d'essai de décollement des plans de collage

Reference number
ISO 12580:2007(E)

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Published in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 12580 was prepared by Technical Committee ISO/TC 165, *Timber structures*.

Introduction

This International Standard was developed by TC 165 as a factory quality-assurance test to be used for structural glulam. It is intended that it be used in conjunction with ISO 12578 and be applied to each production batch. The frequency of testing and the pass/fail criteria are detailed in ISO 12578. However, there is nothing in principle that would prevent the test method from being applied to non-structural glulam.

Timber structures — Glued laminated timber — Methods of test for glue-line delamination

1 Scope

This International Standard specifies five delamination methods for factory quality assurance of the glue line of glued laminated timber.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
delamination length
sum of the lengths of open glue lines on both end-grain surfaces of each test piece

2.2
glued laminated timber (glulam)
structural member formed by bonding together timber laminations with their grain essentially parallel

2.3
gauge pressure
NOTE Atmospheric pressure at sea level approximates 100 kPa.

3 Symbols and abbreviated terms

b: width of cross-section, in millimetres;

h: depth of cross-section, in millimetres;

$l_{max,\ delam}$: maximum delamination length of one glue line in the test piece, measured on both end grain surfaces of the test specimen, in millimetres, see Figure 1;

$l_{glue\ line}$: length of one glue line, normally the width b, in millimetres, see Figure 1;

$l_{tot,\ delam}$: delamination length of all glue lines on the two end-grain surfaces in the test piece, in millimetres;

$l_{tot,\ glue\ line}$: entire length of glue lines on the two end-grain surfaces of each test piece, in millimetres.

4 Principle

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

5 Apparatus

5.1 Pressure vessel for methods A, B, C

A pressure vessel designed to safely withstand a gauge pressure of at least 600 kPa and a gauge vacuum of at least 85 kPa, and equipped with pumps or similar devices capable of giving the required pressure and vacuum are required.

5.2 Boiling and cooling vessels for method D

Boiling and cooling vessels, of sufficient size to hold the specimens so that they are completely submerged, are required.

5.3 Drying duct for methods A, B, C, D, E

A drying duct capable of circulating air at a velocity of 2 m/s to 3 m/s at the temperatures and relative humidities given in Table 1 is required.

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

Method (see 7.2 to 7.6)	Drying temperature °C	Relative humidity %
A	60 to 70	< 15
B	65 to 75	8 to 10
C	25 to 30	25 to 35
D	67 to 73	8 to 10
E	67 to 73	8 to 10

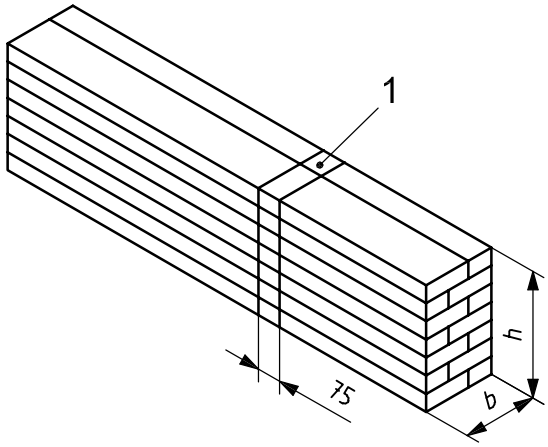
6 Preparation of test pieces

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 glued laminated timber 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, it is permissable to split the test piece 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 (Figure 1).

Dimensions in millimetres



Key

1 rectangular test specimen

Figure 1 — Test specimen cut from a glulam member

7 Procedure

7.1 General

The total length of glue lines on the end-grain surfaces of the test pieces shall be measured to the nearest millimetre.

The test pieces shall be weighed and subjected to the appropriate test cycle described in 7.2 to 7.6. 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	Number of initial cycles	Number of extra cycles
A	1	1
B	1	1
C	1	0
D	2	0
E	2	0

An extra test cycle shall be carried out for methods A and B, if the total delamination percentage according to 8.2 is larger than the prescribed maximum value upon completion of the required initial cycles.

Within a maximum of one h after the end of the final drying period, the length of open glue lines on the end-grain surfaces of the test pieces shall be measured. 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 When the separation is in the wood, even though it is 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.

Since glue lines at knots and knotty areas in general are not durable under severe exposure, development of delamination at knots should be disregarded and not included in the measurements or calculations of $l_{tot,delam}$.

7.2 Test cycle for method A

7.2.1 The test pieces shall be placed in the pressure vessel and weighted down.

7.2.2 Water shall be admitted at room temperature in sufficient quantity, so that the pieces are completely submerged.

7.2.3 The test pieces shall be separated by stickers, wire screens, or other means, in such a manner that all end-grain surfaces are freely exposed to the water.

7.2.4 A vacuum, of 70 kPa to 85 kPa gauge pressure, shall be drawn and held for 5 min.

7.2.5 The vacuum shall be released and a gauge pressure of 500 kPa to 600 kPa shall be applied and held for 1 h.

7.2.6 While the test pieces are still completely immersed, the vacuum-pressure treatment shall be repeated, giving two impregnating periods requiring a total of 130 min.

7.2.7 The test pieces shall be dried in air at 60 °C to 70 °C with a relative humidity of 15 % or less, circulating at a velocity of 2 m/s to 3 m/s until the mass returns to within 100 to 110 % of the initial mass. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to and exposed to the stream of air.

NOTE Drying for a period of approximately 21 h is usually needed to achieve the specified mass reduction.

7.3 Test cycle for method B

7.3.1 The test pieces shall be placed in the pressure vessel and weighted down.

7.3.2 Water shall be admitted at room temperature, in sufficient quantity, so that the pieces are completely submerged.

7.3.3 The test pieces shall be separated by stickers, wire screens, or other means, in such a manner that all end-grain surfaces are freely exposed to the water.

7.3.4 A gauge vacuum of 70 kPa to 85 kPa shall be drawn and held for 30 min.

7.3.5 The vacuum shall be released and a gauge pressure of 500 kPa to 600 kPa shall be applied and held for 2 h.

7.3.6 The test pieces shall be dried in air at 65 °C to 75 °C with a relative humidity of 8 to10 %, circulating at a velocity of 2 m/s to 3 m/s until the mass of the pieces returns to within 100 % to 115 % of the initial mass. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to and exposed to the stream of air.

NOTE Drying for a period of 10 h to 15 h is usually needed to achieve the specified mass reduction.

7.4 Test cycle for method C

7.4.1 The test pieces shall be placed in the pressure vessel and weighted down.

7.4.2 Water shall be admitted at room temperature in a sufficient quantity, so that the pieces are completely submerged.

7.4.3 The test pieces shall be separated by stickers, wire screens, or other means, in such a manner that all end-grain surfaces are freely exposed to the water.

7.4.4 A gauge vacuum of 70 kPa to 85 kPa shall be drawn and held for 30 min.

7.4.5 The vacuum shall be released and a gauge pressure of 500 kPa to 600 kPa shall be applied for 2 h.

7.4.6 While the test pieces are still completely immersed, this vacuum-pressure cycle shall be repeated giving a two-cycle impregnating period requiring a total of 5 h.

7.4.7 The test pieces shall be dried for a period of 90 h in air at 25 °C to 30 °C with a relative humidity of 25 to 35 %, 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 and exposed to the stream of air.

7.5 Test cycle for method D

7.5.1 The test pieces shall be immersed in boiling water for 4 h.

7.5.2 The test pieces shall be removed from the boiling water and immersed in a cooling bath of room temperature (10 to 25˚C) water for 1 h.

7.5.3 The test pieces shall be removed from the cooling bath and dried in air at 67 to 73 °C, with a relative humidity of 8 % to 10 %, circulating at a velocity of 2 m/s to 3 m/s until the mass of the pieces returns to within 100 % to 110 % of the initial mass. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to and exposed to the stream of air.

NOTE Drying for a period of approximately 24 h is usually needed to achieve the specified mass reduction.

7.6 Test cycle for method E

7.6.1 The test pieces shall be immersed in water at room temperature for 24 h.

7.6.2 The test pieces shall be removed from the water and dried in air at 67 to 73 °C, circulating at a velocity of 2 m/s to 3 m/s with a relative humidity of 8 % to 10 %, until the mass of the pieces returns to within 100 % to 110 % of the initial mass. During drying, the test pieces shall be placed at least 50 mm apart with the end-grain surfaces parallel to and exposed to the stream of air.

NOTE 1 Drying for a period of approximately 24 h is usually needed to achieve the specified mass reduction.

NOTE 2 Method E is appropriate for quality control purposes, but for conformity assessment it is only considered effective when used together with Method D.

8 Results

8.1 General

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