BS EN 302-3:2013

BSI Standards Publication

Adhesives for load-bearing timber structures — Test methods

Part 3: Determination of the effect of acid damage to wood fibres by temperature and humidity cycling on the transverse tensile strength

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National foreword

This British Standard is the UK implementation of EN 302-3:2013. It supersedes BS EN 302-3:2004, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/52, Adhesives.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2013.

ISBN 978 0 580 75257 5

ICS 83.180

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 April 2013.

Amendments issued since publication

Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 302-3

March 2013

ICS 83.180

Supersedes EN 302-3:2004

English Version

Adhesives for load-bearing timber structures - Test methods - Part 3: Determination of the effect of acid damage to wood fibres by temperature and humidity cycling on the transverse tensile strength

Adhésifs pour structures portantes en bois - Méthodes d'essai - Partie 3: Détermination de l'influence de l'attaque d'acide des fibres de bois, résultant de traitements cycliques en température et humidité sur la résistance à la traction transversale

Klebstoffe für tragende Holzbauteile - Prüfverfahren - Teil 3: Bestimmung des Einflusses von Säureschädigung der Holzfasern durch Temperatur- und Feuchtezyklen auf die Querzugfestigkeit

This European Standard was approved by CEN on 5 February 2013.

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Ref. No. EN 302-3:2013: E

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Foreword

This document (EN 302-3:2013) 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of an identical text or by endorsement, at the latest by September 2013 and conflicting national standards shall be withdrawn at the latest by September 2013.

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

This document supersedes EN 302-3:2004.

The following modification has been made:

— The amendment in A1 has been included in the standard.

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, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

This document is one of a series dealing with adhesives for use with timber structures, and is published in support of EN 1995, *Eurocode 5: Design of timber structures*. The series consists of three classification and performance requirements for adhesives for load-bearing timber structures, phenolic and aminoplastic adhesives (EN 301), one component polyurethane adhesives (EN 15425) and emulsion polymerised isocyanate adhesives (prEN 16254), and all together eleven test methods (EN 302 Parts 1 to 7 and EN 15416 Parts 2 to 5).

These European Standards have the following titles.

EN 301, *Adhesives, phenolic and aminoplastic, for load-bearing timber structures — Classification and performance requirements*

EN 15425, *Adhesives — One component polyurethane for load bearing — Classification and performance requirements*

prEN 16254, *Adhesives — Emulsion polymerized isocyanate (EPI) for load-bearing timber structures — Classification and performance requirements*

EN 302, *Adhesives for load-bearing timber structures — Test methods*

— *Part 1: Determination of longitudinal tensile shear strength*

— *Part 2: Determination of resistance to delamination*

— *Part 3: Determination of the effect of acid damage to wood fibres by temperature and humidity cycling on the transverse tensile strength*

— *Part 4: Determination of the effects of wood shrinkage on the shear strength*

— *Part 5: Determination of maximum assembly time under referenced conditions*

— *Part 6: Determination of the minimum pressing time under referenced conditions*

— *Part 7: Determination of the working life under referenced conditions*

EN 15416, *Adhesives for load bearing timber structures other than phenolic and aminoplastic — Test methods*

— *Part 2: Static load test of multiple bondline specimens in compression shear*

— *Part 3: Creep deformation test at cyclic climate conditions with specimens loaded in bending shear*

— *Part 4: Determination of open assembly time for one component polyurethane adhesives*

— *Part 5: Determination of conventional pressing time*

Safety statement

Persons using this document should be familiar with the normal laboratory practice, if applicable. This document cannot 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 standard can have a negative environmental impact. As technological advantages lead to better alternatives for these materials, they will be eliminated from this standard to the greatest extent possible.

At the end of the test, it is recommended that the user of the standard take care to carry out an appropriate disposal of the wastes, according to local regulations.

1 Scope

This European Standard specifies a method for determining the effect on bond strength of damage to wood fibres caused by the action of acids from the adhesive or primer used in the gluing process during climatic cycling.

It is suitable for the following applications:

a) for assessing the compliance of adhesives with EN 301, EN 15425 and prEN 16254;

b) for assessing the suitability and quality of adhesives for load-bearing timber structures;

c) for determining if the adhesive after bonding has a damaging influence on the strength of the wood due to chemical action.

This test is intended primarily to obtain performance data for the classification of adhesives for load-bearing timber structures according to their suitability for use in defined climatic environments. This test is carried out on Norway spruce (*Picea abies* L.).

This method is not intended for use to provide numerical design data and does not necessarily represent the performance of the bonded member in service.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 1245, *Adhesives — Determination of pH*

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

3 Principle

A joint between wooden adherends is submitted to defined temperature and humidity cycles and then strained to failure by a transverse tensile load.

4 Apparatus

4.1 Testing machine, which shall be either:

a) a constant rate of loading machine, capable of maintaining a rate of loading of (5 ± 1) kN/min; or

b) a constant rate of traverse machine as described in ISO 5893.

Special mounts are required (see Figure 1). One or both mounts shall be attached to the straining heads by a coupling, which permits self-alignment of the mounts whilst the test pieces are being pulled.

4.2 Climatic cabinets, which are enclosures with air circulation capable of maintaining the test pieces under the following conditions:

a) (10 ± 2) °C at approximately (87,5 ± 2,5) % relative humidity;

b) (50 ± 2) °C at approximately (87,5 ± 2,5) % relative humidity;

c) (50 ± 2)° C with relative humidity lower than 20%.

NOTE The velocity of the air circulation at a level of 0,5 m/s to 1,0 m/s has shown to be suitable.

4.3 Airtight glass enclosure, such as a desiccator with a lid is required, with the following dimensions:

a) Volume 2 l to 10 l;

b) Ratio of height to width between 1/1 and 2/1.

5 Method

5.1 Selection of timber

Carry out this test using Norway spruce (*Picea abies* L.) having a density of (450 ± 25) kg/m³ measured at 12 % moisture content.

Prepare one piece of spruce 60 mm x 60 mm in cross section and at least 1 600 mm in length or two pieces with a length of 800 mm that are free from knots, straight-grained and with growth rings not wider than 2 mm and at 30° to 60° to the surfaces of the specimen.

5.2 Preparation of the bonded assemblies

Cut the piece of wood lengthwise into two equal pieces of rectangular cross section and store them in standard climate [20/65] to constant mass. Constant mass is defined as the mass attained when the results of two successive weighings over an interval of 24 h differ by not more than 0,1 % of the mass of the specimen.

Condition the timber in standard atmosphere [20/65] ((20 ± 2) °C and (65 ± 5) % relative humidity) for at least 7 days prior to bonding, to achieve a moisture content of (12 ± 1) %.

Not more than 8 h before bonding, plane each surface to be bonded to the final thickness of 25 mm. Remove any dust carefully. Do not touch or soil the prepared surface.

For glue mixes, adhesive and hardener blended before application, the glue line thickness shall be 0,5 mm by using 0,5 mm thick spacers.

For separate application of adhesive and hardener, the glue line thickness shall be 0,1 mm by using 0,1 mm thick spacers.

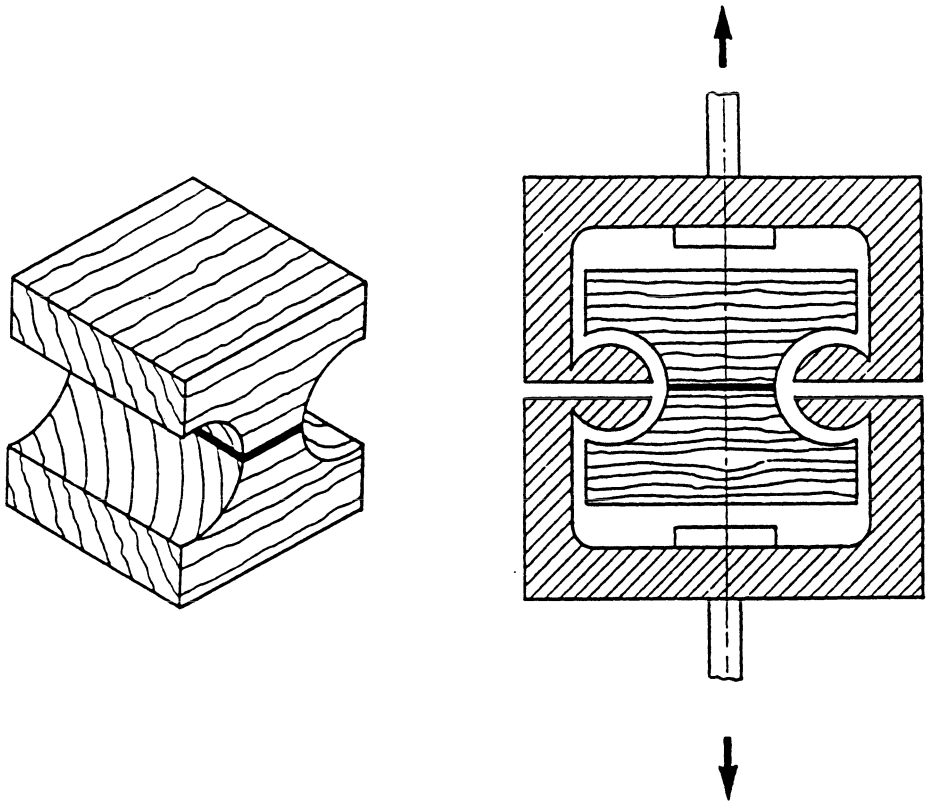

Figure 1 — Test piece and mounts for assessing the transverse tensile strength of bonded wooden assemblies

Dimensions in millimetres

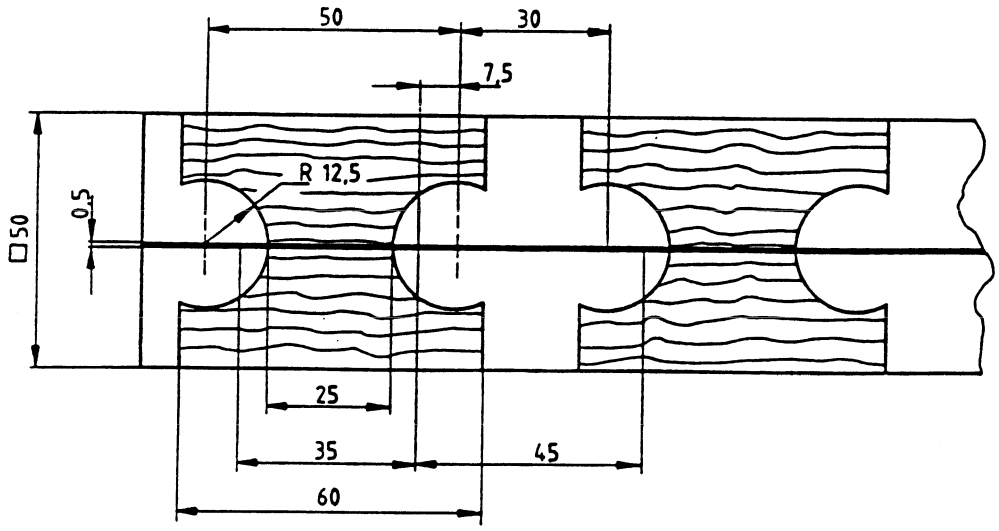

Figure 2 — Tensile test pieces cut out of the bonded wooden assembly

Prepare sufficient spacers 60 mm x 45 mm x (0,5 ± 0,05) mm or 60 mm x 45 mm x (0,1 ± 0,02) mm. (At least ten spacers will be required for a piece of wood 800 mm long.) Lay these on the cut surface of the wood spaced (35,0 ± 0,5) mm apart with the lengths across the width of the cut surface. Fill the gaps between the spacers with adhesive. Ensure that adhesive is not lost from the test area. Clamp the pieces of wood together with the same orientation with respect to each other as they had before cutting. Apply a pressure of

(0,6 ± 0,1) MPa relative to the area of the spacers. Maintain this pressure at (20 ± 2) °C and (65 ± 5) % relative humidity for the time recommended by the adhesive manufacturer, or 24 h.

After bonding and pressing, condition the assembly for a minimum of 7 days and a maximum of 14 days at (20 ± 2) °C and (65 ± 5) % relative humidity. A longer conditioning time may be used if recommended by the adhesive manufacturer.

Record the time elapsed between the preparation of the bonded assembly and the start of temperature cycling.

5.3 Preparation of the test pieces

Using a sharp 25 mm diameter wood drill and a piece of wood under the assembly to prevent fraying at the edges of the hole, drill holes along the length of the assembly in the plane of the bond at distances between centres of alternately (50,0 ± 0,5) mm and (30,0 ± 0,5) mm so that a series of bond lines (25 ± 1) mm in length is produced (see Figure 2). Take care to ensure that the holes are accurately positioned. Plane the assembly symmetrically to (50,0 ± 0,5) mm x (50,0 ± 0,5) mm and cut out the test pieces (60 ± 1) mm long as shown in Figure 2.

5.4 Number of test pieces

Test a sufficient number of test pieces to provide eight valid results for the cyclic treatment and eight valid test results for the control test pieces. Stop the test after eight valid results. Results from tests for all test pieces in which a solid wood failure occurred at strength values below the requirement, or in which visual examination shows that the adhesive was not correctly applied, are invalid and shall be disregarded.

5.5 Climatic and cyclic storage conditions

Store at least eight test pieces that are not from adjacent positions in the bonded assembly in the standard climate (20/65) until testing. Select at least eight test pieces for the cyclic treatment, which consists of four cycles, each of which comprises three treatments according to Table 1.

Table 1 — Climatic and cyclic storage conditions

Treatment	**Duration** h	**Temperature** °C	**Relative humidity** **%**
A	24	50 ± 2	87,5 ± 2,5
B	8	10 ± 2	87,5 ± 2,5
C	16	50 ± 2	≤ 20

5.6 Test procedure

Attach the mounts to the testing machine (4.1). Insert the test piece in the mounts and apply a tensile force until the test piece is broken either

a) at a rate of load increase of (5 ± 1) kN/min; or

b) if the test machine is not capable of applying a constant rate of load increase, a constant rate of crosshead separation such that the time required to reach the specified average failing load is not less than 30 s.

The failure types A, B and C shall be described as follows:

A: solid wood failure

B: failure along the glue line, with a fine cover of fibres visible in the failure zone

C: failure in or along the glue line, without a fine cover of fibres visible in the failure zone

For each sample, failure type A, B and C shall be estimated and rounded off to the nearest 10 %, summing up to a total of 100 % (for example 70 % failure type A, 20 % failure type B and 10 % failure type C).

6 Expression of results

Calculate the transverse tensile strength for every test piece according to the following formula:

$$f_{t,90,max} = \frac{F_{max}}{A}$$

where

$f_{t,90,max}$ is the transverse tensile strength in newtons per square millimetre;

F_{max} is the load at failure in newtons;

A is the area in square millimetres, 1250 mm².

Express the result of the test as the average (arithmetic mean) transverse testing strength of the eight valid tests.

7 Test report

The following items shall be recorded in the test report:

7.1 The adhesive

The following information about the adhesive shall be included in the test report:

a) chemical nature, pH value according to EN 1245 and origin of the sample;

b) manufacturer's name and batch number or other means of uniquely identifying the sample;

c) number of components and methods of preparation and application.

7.2 Preparation of test pieces and testing procedures

The following information about the preparation of the test pieces and the testing procedure shall be included in the test report:

a) wood density expressed in kg/m³ at 12 % moisture content;

b) the bonding procedure (i.e. adhesive spread, closed assembly time and pressure time);

c) time elapsed between the manufacture of the bonded assembly and the cyclic treatment;

d) method of test including type of tensile testing machine and rate of loading or jaw separation;

e) time elapsed between the cyclic treatment and the transverse tensile test.

7.3 Test results

The following information about the test results shall be included in the test report:

a) that the test was carried out in accordance with EN 302-3;

b) average transverse tensile strength expressed in N/mm² and rounded to the nearest 0,1 N/mm² for both control and climatically cycled test pieces;

c) loads at failure observed for the first eight valid results;

d) type of failure (type A, B and C), and the average of the estimated proportions of each failure type, rounded to the nearest 10 %;

e) date of issue of the report;

f) any other factors that may have affected the results.

Bibliography

[1] EN 301, *Adhesives, phenolic and aminoplastic, for load-bearing timber structures — Classification and performance requirements*

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