SLOVENSKI STANDARD
SIST EN 17334:2021

01-maj-2021

Vlepljene palice v lepljenih lesenih gradbenih proizvodih - Preskušanje, zahteve in klasifikacija strižne trdnosti spojev

Glued-in rods in glued structural timber products - Testing, requirements and bond shear strength classification

Eingeklebte Stangen in tragenden geklebten Holzprodukten - Prüfung, Anforderungen und Scherfestigkeitsklassifizierung

Goujons collés dans les produits en bois de structure collé - Essais, exigences et classification de la résistance au cisaillement du joint

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 17334:2021) has been prepared by Technical Committee CEN/TC 193 “Adhesives”, the secretariat of which is held by UNE.

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of an identical text or by endorsement, at the latest by September 2021, and conflicting national standards shall be withdrawn at the latest by September 2021.

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

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1 Scope

This document specifies test methods for the determination of the suitability of two component epoxy and two component polyurethane adhesives for glued-in steel rods in glued laminated timber (GLT) and glued solid timber (GST) according to EN 14080, cross laminated timber (CLT) according to EN 16351 and laminated veneer lumber (LVL) according to EN 14374.

NOTE 1 The English term "glued-in rods" has been chosen as the established term instead of "bonded-in rods".

It specifies performance requirements and the determination of characteristic bond strength values for such adhesives for the prefabrication under factory or factory-like conditions of joints between load-bearing timber products and steel rods only. This document does not cover the performance of adhesives for on-site gluing (except for factory-like conditions).

NOTE 2 Factory like conditions provide shelter from direct weathering and dirt, prevent undue movement of the joints during curing of the adhesive and provide temperature and relative humidity conditions and control as in factory production environment.

This document also covers glued–in rods in surface treated wood. It does not cover glued-in rods in modified and stabilized wood with considerably reduced swelling and shrinkage properties, e.g. acetylated wood, heat treated wood, polymer impregnated wood and preservative treated wood.

The joints are intended for load-bearing timber structures in service classes 1 and 2 according to EN 1995-1-1 which are loaded predominantly static or quasi static according to EN 1990 and EN 1991-1-1. The joints are intended for load-bearing timber structures which are not subjected to a prolonged exposure to temperatures over 60 °C.

A design procedure for glued-in rods in glued structural timber products is given in the informative Annex A.

NOTE 3 Several provisions of this document can apply to *in situ* repair and upgrading of existing timber structures including (cracked/fissured) solid wood beams. For adhesives for glued-in rods used in on-site repair or applications with solid timber additional provisions apply, e.g. related to rheology and site temperature conditions. Such provisions are not part of this document.

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.

EN 302-1, *Adhesives for load-bearing timber structures — Test methods — Part 1: Determination of longitudinal tensile shear strength*

EN 302-2, *Adhesives for load-bearing timber structures — Test methods — Part 2: Determination of resistance to delamination*

EN 302-4, *Adhesives for load-bearing timber structures — Test methods — Part 4: Determination of the effects of wood shrinkage on the shear strength*

EN 302-5, *Adhesives for load-bearing timber structures — Test methods — Part 5: Determination of maximum assembly time under referenced conditions*

EN 302-6, *Adhesives for load-bearing timber structures — Test methods — Part 6: Determination of the minimum pressing time under referenced conditions*

EN 302-7, *Adhesives for load-bearing timber structures — Test methods — Part 7: Determination of the working life under referenced conditions*

EN 302-8, *Adhesives for load-bearing timber structures — Test methods — Part 8: Static load test of multiple bond line specimens in compression shear*

EN 923, *Adhesives — Terms and definitions*

EN 10080, *Steel for the reinforcement of concrete — Weldable reinforcing steel — General*

EN 13183-1, *Moisture content of a piece of sawn timber — Part 1: Determination by oven dry method*

EN 14080:2013, *Timber structures — Glued laminated timber and glued solid timber — Requirements*

EN 14358, *Timber structures — Calculation and verification of characteristic values*

EN 14374, *Timber structures — Structural laminated veneer lumber — Requirements*

EN 16351, *Timber structures — Cross laminated timber — Requirements*

EN ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread (ISO 898-1)*

EN ISO 3506-1, *Fasteners — Mechanical properties of corrosion-resistant stainless steel fasteners — Part 1: Bolts, screws and studs with specified grades and property classes (ISO 3506-1)*

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 https://www.iso.org/obp

3.1
two component epoxy adhesive
thermosetting synthetic resin derived from a exothermic polymerization reaction of an epoxide group with amines, acid anhydrides, phenols, alcohols or thiols

3.2
two component polyurethane adhesive
urethane polymers which are cross-linked by the reaction between polyol or polyamine with isocyanate

3.3
service class 1
climatic conditions characterized by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 65 % for a few weeks per year

Note 1 to entry: In service class 1, which comprises typical indoor conditions, the average moisture content in most softwoods will not exceed 12 %.

[SOURCE: EN 1995-1-1:2004, 2.3.1.3, modified – Indoor conditions added in Note 1 to entry]

3.4
service class 2
climatic conditions characterized by a moisture content in the materials corresponding to a temperature of 20 °C and the relative humidity of the surrounding air only exceeding 85 % for a few weeks per year

Note 1 to entry: In service class 2, to which most covered exterior conditions belong, the average moisture content in most softwoods will not exceed 20 %.

[SOURCE: EN 1995-1-1:2004, 2.3.1.3, modified – Covered exterior conditions added in Note 1 to entry]

3.5
glue line
adhesive layer between the wood members

[SOURCE: EN 301:2017, 3.7]

3.6
thick glue line
glue line of nominal thickness in the range of 0,3 mm to 4,0 mm at the time of bonding

Note 1 to entry: Thick glue lines are achieved by using spacers, grooves or similar devices with a thickness of 0,3 mm to 4,0 mm when two plain members are glued together.

[SOURCE: EN 301:2017, 3.8, modified — Maximum thickness has been increased to 4 mm.]

3.7
close contact glue line
glue line thickness of maximum 0,1 mm

Note 1 to entry: Close contact glue line is considered to be achieved by pressing together two plane wood members with a clamping pressure of (0,8 ± 0,1) N/mm^2 without grooves, spacers or similar device.

[SOURCE: EN 301:2017, 3.9, modified — “considered to be” has been added.]

3.8
bond line
glue line including the two intermediate zones between adhesive and wood

[SOURCE: EN 15425:2017, 3.6]

4 Symbols

a	cross-section length of specimen, in millimetres (mm)
$a_{0,250}$	equation parameter, in newtons per square millimetre (N/mm²)
$a_{0,500}$	equation parameter, in newtons per square millimetre (N/mm²)
a_{200}	equation parameter, in newtons per square millimetre (N/mm²)
a_{400}	equation parameter, in newtons per square millimetre (N/mm²)
a_{500}	equation parameter, in newtons per square millimetre (N/mm²)
a_{600}	equation parameter, in newtons per square millimetre (N/mm²)
b	edge lengths of the net cross-section, in millimetres (mm)
c_{200}	equation parameter, in newtons per cubic millimetre (N/mm³)
c_{500}	equation parameter, in newtons per cubic millimetre (N/mm³)
d	nominal rod diameter, in millimetres (mm)
d_1	distance of displacement sensor to rod axis, in millimetre (mm)
d_2	distance of displacement sensor fixation vs. specimen and grain face, in millimetre (mm)
d_{drill}	diameter of drilled hole, in millimetres (mm)
$f_{t,app}$	apparent tensile strength, in newtons per square millimetre (N/mm²)
F_t	tension load in newtons (N)
$F_{t,max}$	maximum load in tensile test, in newtons (N)
$F_{v,max}$	maximum load in block shear test, in newtons (N)
F_{target}	target load (temperature resistance test), in newtons (N)
$F_{t,DOL}$	target load (creep rupture test at very high and low moisture content), in newtons (N)
f_v	block shear strength (monolithic adhesive specimen), in newtons per square millimetre (N/mm²)
f_{vr}	bond strength, in newtons per square millimetre (N/mm²)
$f_{vr,200,k}$	characteristic bond strength value of bond length of 200 mm
$f_{vr,250,k,dc}$	declared characteristic bond strength value (5 % quantile) of bond length range $l_a \leq 250$ mm, in newtons per square millimetre (N/mm²)
$f_{vr,400,k}$	characteristic bond strength value of bond length of 400 mm
$f_{vr,la\leq 500,k,dc}$	declared characteristic bond strength value (5 % quantile) of bond length range 250 mm < $l_a \leq$ 500 mm, in newtons per square millimetre (N/mm²)
$f_{vr,600,k}$	characteristic bond strength value of bond length of 600 mm
$f_{vr,la\leq 1000,k,dc}$	declared characteristic bond strength value (5 % quantile) of bond length range 500 mm < $l_a \leq$ 1 000 mm
$f_{vr,la,k}$	characteristic bond strength value of bond length range l_a
$f_{vr,la,2mm,mean}$	mean bond strength for a bond line thickness of 2 mm, in newtons per square millimetre (N/mm²)

$f_{vr,la,4mm,mean}$	mean bond strength for a bond line thickness of 4 mm, in newtons per square millimetre (N/mm²)
$f_{vr,la,6mm,mean}$	mean bond strength for a bond line thickness of 6 mm, in newtons per square millimetre (N/mm²)
$f_{vr,la,tB,k}$	characteristic bond strength value (5 % quantile), in newtons per square millimetre (N/mm²)
$f_{vr,la,tB,mean}$	arithmetic mean bond strength value in newtons per square millimetre (N/mm²)
$f_{vr,k,dc}$	declared characteristic bond shear strength (5 % quantile), in newtons per square millimetre (N/mm²)
$f_{vr,\rho}$	density influenced bond shear strength, in newtons per square millimetre (N/mm²)
$f_{vr,\rho ref}$	density corrected bond shear strength, in newtons per square millimetre (N/mm²)
$k_{d,la}$	bond strength ratio between two bond line thicknesses
l	total length of timber specimen, in millimetres (mm)
l_a	nominal bonded length of steel rod, in millimetres (mm)
$l_{a,dc,max}$	maximum declared rod length, in millimetres (mm)
$l_{a,dc,min}$	minimum declared rod length, in millimetres (mm)
$l_{clamping}$	length to fix the rod in the grips of the test machine, in millimetres (mm)
l_{drill}	length of drill hole, in millimetres (mm)
$l_{not\ bonded}$	length of the rod inside the drill hole that is not able to take load (e.g. spacers), in millimetres (mm)
l_m	distance between the grounds of the drilled holes in the specimen, in millimetres (mm)
l_v	edge lengths of the net cross-section, in millimetres (mm)
$l_{rod,tot}$	total rod length, in millimetres (mm)
ρ	density of the timber specimen at 12 % moisture content, in kilograms per cubic metre (kg/m³)
ρ_{ref}	reference density, in kilograms per cubic metre (kg/m³)
s	slip displacement
t_b	bond line thickness, in millimetres (mm) ($t_b = (d_{drill} - d)/2$)
t_B	total bond line thickness, in millimetres (mm) ($t_B = 2\ t_b$)
T	Temperature, in degrees Celsius (°C)
T_{app}	applied temperature, in degrees Celsius (°C)
$T_{bond,target}$	target temperature at bond line, in degrees Celsius (°C)
t	loading time
t_{cool}	cooling down period, in hours (h)
$t_{cycle,1}$	time of first heating-cooling-load-cycle, in hours (h)
$t_{cycle,2}$	time of second heating-cooling-load-cycle, in hours (h)
t_{heat}	heating period, in hours (h)

t_{total}	total time of both temperature-load cycles, in hours (h)
t_{ramp}	time of the attainment of the target load, in minutes
t_{rod60}	constant temperature period, in hours (h)
u_{target}	percentage target wood moisture content (%)
V	density correction exponent
Δu	difference in average moisture contents between the moist and dry state, in percent (%)

Additional symbols of Annex A:

A_{ef}	stress design relevant cross-section of steel rod, in square millimetres (mm^2)
a_1	minimum distance of axially loaded glued-in rods (in grain direction), in millimetres (mm)
a_2	minimum distance of axially loaded glued-in rods (perpendicular grain direction), in millimetres (mm)
$a_{1,c}$, $a_{2,c}$	minimum edge distance of axially loaded glued-in rods, in millimetres (mm)
$a_{3,t}$	minimum distance of axially loaded glued-in rods (loaded end grain face), in millimetres (mm)
$a_{3,c}$	minimum distance of axially loaded glued-in rods (unloaded end grain face), in millimetres (mm)
$a_{4,t}$	minimum distance of axially loaded glued-in rods (loaded edge), in millimetres (mm)
$a_{4,c}$	minimum distance of axially loaded glued-in rods (unloaded edge), in millimetres (mm)
γ_M	partial factor for material properties, also accounting for model uncertainties and dimensional variations
$F_{ax,Rd}$	design value for the withdrawal (pull-out) capacity, in newtons (N)
$F_{v,Ed,1}$, $F_{v,Ed,2}$	design values of shear force at both sides of the connection, in newtons (N)
$f_{vr,d}$	design value of bond shear strength, in newtons per square millimetre (N/mm^2)
$f_{vr,la,dc,k}$	declared characteristic bond strength value (5 % quantile) of bond length range l_a, in newtons per square millimetre (N/mm^2)
$f_{y,d}$	design value of yield strength of steel rod, in newtons per square millimetre (N/mm^2)
$F_{90,Rd}$, $F_{90,Rk}$	design value and characteristic value of resistance to tension perpendicular to grain of the loaded member, in newtons (N)
h, b	depth and width of timber member, in millimetres (mm)
h_e	projected rod embedment length perpendicular to grain, in millimetres (mm)
k_{mod}	modification factor for duration of load and moisture content
$l_{a,min}$	minimum bond length, in millimetres (mm)

5 General requirements

Adhesives for structural purpose shall produce joints of such strength and durability that the integrity of the bond in the glued-in rod joint is maintained throughout the expected lifetime of the structure.

6 Classification

6.1 Adhesive

If the adhesive meets the requirements of Clause 7 to Clause 10 it shall be classified as type I. The classification of the adhesive consists of:

— number of this document and year of publication;

— type of adhesive (I);

— bond temperature resistance, in degrees Celsius °C;

— maximum bond length, in millimetres;

— maximum bond line thickness, in millimetres;

— working properties (adhesives tested for working properties according to Clause 11 are specified by the letter “w” at the end of the designation code).

EXAMPLE EN 17334:2021-I-60-500-4 w

6.2 Rods, wood products and species

The type of rod (rebars, rods with metric thread), the tested rod dimensions d and l_a, the applicable wood product (GLT, GST, CLT including lay-up and LVL including lay-up) and wood species shall be declared.

7 Bond strength of the adhesive-wood interface

7.1 General

Adhesives complying with this document shall meet the performance requirements specified in 7.2.1 to 7.2.4 when tested in accordance with the following test methods:

a) tensile shear test (see 7.3.1) using bonded specimens made from beech (*Fagus sylvatica L.*);

b) delamination test (see 7.3.2) on bonded specimens made from Norway spruce (*Picea abies L.*). The test with Norway spruce also covers silver fir (*Abies alba*) and Scots pine (*Pinus sylvestris*). If the adhesive is to be used on wood from other conifers species, also prepare four laminated members using representative samples from those species and perform the delamination test according to 7.3.2;

c) shrinkage stress test (see 7.3.3) on bonded specimens made from Norway spruce (*Picea abies L.*);

d) multiple compression shear test (see 7.3.4) on bonded specimens made from beech (*Fagus sylvatica L.*).

These adhesives shall be applied according to the manufacturer's instructions.