Deutsches Institut für Bautechnik

Zulassungsstelle für Bauprodukte und Bauarten

Bautechnisches Prüfamt

Eine vom Bund und den Ländern
gemeinsam getragene Anstalt des öffentlichen Rechts

Mitglied der EOTA, der UEAtc und der WFTAO

National technical approval / General construction technique permit

Date: 28 Aug 2020

Reference: I 51-1.9.1-35/17

Number:

Z-9.1-899

Validity

from: **28 August 2020**

to: **28 August 2025**

Applicant:

Raimund Beck Nageltechnik GmbH
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AUSTRIA

Subject of decision:

Load-bearing timber connections using LignoLoc® wooden nails

The subject named above is herewith granted a national technical approval (*allgemeine bauaufsichtliche Zulassung*) / general construction technique permit (*allgemeine Bauartgenehmigung*). This decision contains ten pages and one annex.

Translation authorised by DIBt

I GENERAL PROVISIONS

1 This decision confirms the fitness for use and application of the subject concerned within the meaning of the Building Codes of the federal states (*Landesbauordnungen*).

2 This decision does not replace the permits, approvals and certificates required by law for carrying out construction projects.

3 This decision is granted without prejudice to the rights of third parties, in particular private property rights.

4 Notwithstanding further provisions in the 'Special Provisions', copies of this decision shall be made available to the user and installer of the subject concerned. The user and installer of the subject concerned shall also be made aware that this decision must be made available at the place of use or place of application. Upon request, copies of the decision shall be provided to the authorities involved.

5 This decision shall be reproduced in full only. Partial publication requires the consent of DIBt. Texts and drawings in promotional material shall not contradict this decision. In the event of a discrepancy between the German original and this authorised translation, the German version shall prevail.

6 This decision may be revoked. The provisions contained herein may subsequently be supplemented and amended, in particular if this is required by new technical findings.

7 This decision is based on the information and documents provided by the applicant. Alterations to this basis are not covered by this decision and shall be notified to DIBt without delay.

8 The general construction technique permit included in this decision also serves as a national technical approval for the construction technique.

II SPECIAL PROVISIONS

1 Subject concerned and field of use and application

1.1 Subject of approval and field of use

The subject of approval is the LignoLoc® wooden nail. LignoLoc® wooden nails are dowel-type fasteners made of synthetic resin densified wood with a circular cross-section and a diameter d ranging from 2.8 mm to 5.3 mm in accordance with Annex 1.

For load-bearing connections, LignoLoc® wooden nails are only used as multiple fasteners with at least 4 wooden nails.

LignoLoc® wooden nails treated with chemical wood preservatives or fire retardants are not covered by this decision.

1.2 Subject of permit and field of application

The subject of permit is the planning, design and execution of load-bearing, single-cut, shearing-stressed connections of boards made of solid softwood or of wood-based panels or gypsum fibreboards to timber products in accordance with Section 3.1 using LignoLoc® wooden nails. The application includes connections with LignoLoc® wooden nails for the production of stiffening and load-bearing wall panels, but not ceiling and roof panels.

The fitness for application of connections with LignoLoc® wooden nails has only been verified for static or quasi-static actions (see DIN EN 1990[1] and DIN EN 1991-1-1[2] in conjunction with DIN EN 1991-1-1/NA[3]). Fatigue-relevant loads shall be excluded.

Load-bearing connections using LignoLoc® wooden nails may be applied under the climatic environmental conditions of service classes 1 to 2 in accordance with DIN EN 1995-1-1[4].

2 Provisions for the construction product

2.1 Properties

LignoLoc® wooden nails are made of synthetic resin densified wood in accordance with the provisions deposited with DIBt. Shapes, dimensions and measurements of LignoLoc® wooden nails are specified in Annex 1.

The density of the wooden nails is 1,100 kg/m³ $\leq \rho \leq$ 1,300 kg/m³.

The characteristic load-carrying capacities of the LignoLoc® wooden nails are specified in Table 1.

For the intended use, LignoLoc® wooden nails meet the requirements for flammable (*normalentflammbar*) building materials in accordance with the Building Codes of the federal states.

1	DIN EN 1990:2010-12	Eurocode: Basis of structural design
2	DIN EN 1991-1-1:2010-12	Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
3	DIN EN 1991-1-1/NA:2010-12 + A1:2015-05	National Annex – Nationally determined parameters – Eurocode 1: Actions on structures – Part 1-1: General actions – Densities, self-weight, imposed loads for buildings
4	DIN EN 1995-1-1:2010-12+A2:2014-07	Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings

Table 1 Characteristic load-carrying capacities of LignoLoc® wooden nails

Diameter d in mm	2.8	3.7	4.7	5.3
Characteristic bending resistance $M_{u,k}$ in Nmm	700	1,400	2,250	3,560

2.2 Marking

The packaging and/or delivery note for the wooden nails shall be marked by the manufacturer with the national conformity mark (*Ü-Zeichen*) in accordance with the Conformity Marking Ordinances (*Übereinstimmungszeichen-Verordnungen*) of the federal states. The mark shall only be applied if the requirements given in Section 2.3 are met.

Furthermore, the packaging or the delivery note shall contain the following information:

– designation of the subject of approval 'LignoLoc®',

– diameter and length of the wooden nail.

2.3 Confirmation of conformity

2.3.1 General

The manufacturer shall confirm for each manufacturing plant that the LignoLoc® wooden nails comply with the provisions of the national technical approval included in this decision by way of a declaration of conformity based on factory production control and a certificate of conformity issued by a certification body recognised for these purposes as well as on regular external surveillance, including initial type-testing of the wooden nails, carried out in accordance with the following provisions.

To issue the certificate of conformity and for external surveillance, including the associated product testing, the manufacturer of the wooden nails shall use a certification body and an inspection body recognised for these purposes.

The declaration of conformity shall be submitted by the manufacturer through marking of the construction products with the national conformity mark including a statement of the intended use.

The certification body shall send a copy of the certificate of conformity issued by it to DIBt.

2.3.2 Factory production control

A factory production control system shall be set up and implemented in each manufacturing plant. Factory production control shall be understood to be continuous surveillance of production by the manufacturer to ensure that the manufactured construction products satisfy the provisions of the national technical approval included in this decision.

The factory production control shall at least include the following measures:

– Ensuring that the synthetic resin densified wood complies with the provisions deposited with DIBt.

– Verification of the dimensions of the wooden nails. The wooden nails shall comply with the dimensions specified in Annex 1.

– Verification of the density of the wooden nails. The requirement of Section 2.1 shall be complied with. No individual value of the density shall deviate from this requirement by more than 10%.

– Test of the characteristic bending resistance of the wooden nails. The required value given in Table 1 of this decision shall be met.

The results of factory production control shall be recorded and evaluated. The records shall include at least the following information:

- designation of the construction product or the starting material or the components,
- type of check or test,
- date of manufacture and testing of the construction product or the starting material or the components,
- results of the checks and tests as well as, if applicable, comparison with requirements,
- signature of the person responsible for factory production control.

The records shall be kept for at least five years and submitted to the inspection body used for external surveillance. They shall be submitted to DIBt and the competent supreme building authority upon request.

If the test result is unsatisfactory, the manufacturer shall immediately take the necessary measures to resolve the defect. Construction products which do not meet the requirements shall be handled in such a way that they cannot be confused with compliant products. After the defect has been remedied, the relevant test shall be repeated immediately – where technically feasible and necessary to show that the defect has been eliminated.

2.3.3 External surveillance

The factory production control system at each manufacturing plant shall be inspected regularly, i.e. at least twice a year, by means of external surveillance.

Initial type-testing of the wooden nails shall be carried out within the scope of external surveillance. Samples for random testing shall also be taken. Sampling and testing shall be the responsibility of the recognised inspection body. At least the bending resistance, the density and the dimensions of the wooden nails shall be checked.

The results of certification and external surveillance shall be kept for at least five years. They shall be presented by the certification or inspection body to DIBt and the competent supreme building authority upon request.

3 Provisions for planning, design and execution

3.1 Planning

3.1.1 General

Load-bearing connections using LignoLoc® wooden nails shall be designed in accordance with DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA, unless specified otherwise in this decision.

LignoLoc® wooden nails may be used for joining the following timber products:

- Solid timber made of softwood of at least strength class C24 in accordance with DIN EN 14081-1[5] in conjunction with DIN 20000-5[6]. Connected members shall be at least 24 mm thick. Their thickness shall not exceed 40 mm.

[5] DIN EN 14081-1:2011-05 Timber structures - Strength graded structural timber with rectangular cross section - Part 1: General requirements

[6] DIN 20000-5:2012-03 Application products in structures - Part 5: Strength graded structural timber with rectangular cross section

- Glued laminated timber and glued solid timber made of lamellas of at least strength class C24 in accordance with DIN EN 14080[7] in conjunction with DIN 20000-3[8] with $\rho_k \leq 460$ kg/m³.

LignoLoc® wooden nails may also be used to join the wood-based panels listed below to the aforementioned timber products:

- OSB boards (Oriented Strand Board) type OSB/3 and OSB/4 in accordance with DIN EN 13986[9] (DIN EN 300[10]) in conjunction with DIN 20000-1[11]. The density of the OSB boards shall be at least 500 kg/m³ and at most 700 kg/m³. The OSB panels shall be at least 15 mm thick. Their thickness shall not exceed 30 mm.
- Plywood made of softwood in accordance with DIN EN 13986 (DIN EN 636[12]) in conjunction with DIN 20000-1. The density of the plywood panels shall be at least 500 kg/m³ and at most 700 kg/m³. The plywood panels shall be at least 15 mm thick. Their thickness shall not exceed 40 mm.
- Solid wood panels made of softwood in accordance with DIN EN 13986 (DIN EN 13353[13]) in conjunction with DIN 20000-1. The density of the solid wood panels shall be at least 500 kg/m³ and at most 700 kg/m³. The solid wood panels shall be at least 15 mm thick. Their thickness shall not exceed 40 mm.

If the climatic environmental conditions of service class 1 are maintained, the wood-based panels or gypsum fibreboards listed below may also be connected to the aforementioned timber products:

- Fibreboards (MDF) in accordance with DIN EN 13986 (DIN EN 622-5[14]) in conjunction with DIN 20000-1. The density of the fibreboards shall be at least 500 kg/m³ and at most 700 kg/m³. The fibreboards (MDF) shall be at least 15 mm thick. Their thickness shall not exceed 22 mm.
- Gypsum fibreboards with European Technical Assessment in accordance with EAD No. 070006-00-0504[15]. The density of the gypsum fibreboards shall be at least 1,050 kg/m³ and shall not exceed 1,250 kg/m³. The gypsum fibreboards shall have a minimum thickness of 12.5 mm and a maximum thickness of 15 mm.

3.1.2. Minimum penetration depth and minimum thicknesses

The minimum penetration depth of the LignoLoc® wooden nails on the side of the nail tip shall be $8 \cdot d$. The minimum embedment depth of the wooden nails in the timber element to be fastened shall be $4 \cdot d$.

The minimum thicknesses of the timber products, wood-based panels and gypsum fibreboards shall be observed. These result from the minimum embedment depths or minimum penetration depths of the wooden nails and from the requirements in accordance with Section 3.1.

7	DIN EN 14080: 2013-09	Timber structures – Glued laminated timber and glued solid timber – Requirements
8	DIN 20000-3:2015-02	Application of construction products in structures - Part 3: Glued laminated timber and glued solid timber in accordance with DIN EN 14080
9	DIN EN 13986:2015-06	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
10	DIN EN 300:2006-09	Oriented Strand Boards (OSB) - Definitions, classification and specifications
11	DIN 20000-1:2017-06	Application of construction products in structures – Part 1: Wood-based panels
12	DIN EN 636:2015-05	Plywood – Specifications
13	DIN EN 13353:2011-07	Solid wood panels (SWP) – Requirements
14	DIN EN 622-5:2010-03	Fibreboards – Specifications – Part 5: Requirements for dry process boards (MDF)
15	EAD No. 070006-00-0504	Gypsum and expanded glass boards with fibrous reinforcement for sheathing and lining of building elements

For the minimum thicknesses of timber elements in accordance with national technical approvals/construction technique permits and/or European Technical Assessments, the provisions contained therein shall also apply.

3.1.3 Minimum spacings and distances

For LignoLoc® wooden nails penetrating into and/or embedded in softwood and wood-based panels, the minimum spacings/distances in accordance with DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA given therein for nails without predrilled holes shall be observed. The diameter d of the wooden nails in accordance with Annex 1 shall be used.

3.2 Design

3.2.1 General

Load-bearing connections using LignoLoc® wooden nails shall be designed in accordance with DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA, unless specified otherwise in this decision.

Due to the limited ductility of the connections, all actions that lead to stresses shall be considered.

3.2.2 Laterally loaded wooden nail

Laterally loaded wooden nails shall be designed in accordance with equation (1). Equation (1) applies to one wooden nail per shear joint.

$$F_{f,Rd} = \sqrt{\frac{2 \cdot \beta}{1+\beta}} \sqrt{1.5 \cdot M_{u,d} \cdot f_{h,1,d} \cdot d} \cdot min \begin{cases} 1 \\ t_1/t_{1,req} \\ t_2/t_{2,req} \end{cases} \qquad (1)$$

Whereby:

$F_{f,Rd}$ is the design load-carrying capacity per laterally loaded wooden nail for a shear joint

$f_{h,1,d}$ is the design embedment strength of timber element 1

$$f_{h,1,d} = \frac{k_{mod,1} \cdot f_{h,1,k}}{\gamma_M} \qquad (2)$$

$k_{mod,1}$ is the modification coefficient for load duration and moisture content of timber element 1 in accordance with DIN EN 1995-1-1, Section 3.1.3

$f_{h,1,k}$ is the characteristic embedment strength in timber element 1 in accordance with DIN EN 1995-1-1, European Technical Assessment or general construction technique permit [N/mm²]

The following applies to timber elements made of solid timber, glued laminated timber or glued solid timber:

$$f_{h,1,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{(1.35+0.015 \cdot d)\, sin^2\alpha + cos^2\alpha} \qquad (3)$$

ρ_k is the characteristic density of timber element 1 [kg/m³]

α is the angle between the force direction and grain direction

γ_M is the partial safety factor for a material property, $\gamma_M = 1.3$

$M_{u,d}$ is the design bending resistance of the wooden nail

$$M_{u,d} = \frac{k_{mod,M} \cdot M_{u,k}}{\gamma_M} \qquad (4)$$

$M_{u,k}$ is the characteristic bending resistance of the wooden nail in accordance with Table 1

$k_{mod,M}$ is the modification coefficient for load duration and moisture content of the LignoLoc® wooden nail in accordance with Table 2

Table 2 Modification coefficients of the LignoLoc® wooden nail $k_{mod,M}$ for a laterally loaded wooden nail

Service classes	Class of load duration				
	Permanent action	Long term action	Medium term action	Short term action	Instantaneous action
1 and 2	0.35	0.40	0.50	0.60	0.90

γ_M Partial safety factor for a material property, γ_M = 1.3

d Diameter of the wooden nail [mm]

$\beta = f_{h,2,d} \,/\, f_{h,1,d}$

$f_{h,2,d}$ is the design embedment strength of timber element 2

$$f_{h,2,d} = \frac{k_{mod,2} \cdot f_{h,2,k}}{\gamma_M} \tag{5}$$

$k_{mod,2}$ Modification coefficient for load duration and moisture content of timber element 2 in accordance with DIN EN 1995-1-1, Section 3.1.3

$f_{h,2,k}$ Characteristic embedment strength in timber element 2 in accordance with DIN EN 1995-1-1, European Technical Assessment or general construction technique permit [N/mm²]

The following applies to timber elements made of solid timber, glued laminated timber or glued solid timber:

$$f_{h,2,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{(1.35+0.015 \cdot d)\, sin^2\alpha + cos^2\alpha} \tag{6}$$

γ_M Partial safety factor for a material property, γ_M = 1.3

t_1 Penetration depth of the wooden nail in timber element 1

t_2 Penetration depth of the wooden nail in timber element 2

$t_{1,req}$ Threshold value for thickness of timber element 1

$$t_{1,req} = \left(\sqrt{\frac{\beta}{1+\beta}} + 1\right) \cdot \sqrt{\frac{4 \cdot M_{u,d}}{0.75 \cdot f_{h,1,d} \cdot d}} \tag{7}$$

$t_{2,req}$ Threshold value for thickness of timber element 2

$$t_{2,req} = \left(\sqrt{\frac{1}{1+\beta}} + 1\right) \cdot \sqrt{\frac{4 \cdot M_{u,d}}{0.75 \cdot f_{h,2,d} \cdot d}} \tag{8}$$

The calculation value of the slip modulus K_{ser} for the serviceability limit state verification for a laterally loaded connection may be assumed as follows per wooden nail and shear joint:

$$K_{ser} = \frac{F_{f,Rk}}{0.3\ mm} \tag{9}$$

$F_{f,Rk}$ Characteristic load-carrying capacity of a laterally loaded wooden nail for a shear joint. $F_{f,Rk}$ shall be calculated by means of the conditional equation for $F_{f,Rd}$, by using k_{mod} = 1 and γ_M = 1 for the timber products and wooden nails.

3.2.3 Wall panel design

Timber frame wall panels, whose sheets are fixed to the frame with LignoLoc® wooden nails, shall be designed in accordance with DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA. Deviating from this, the load-carrying capacity of the wall panel stressed by a horizontal force shall be determined in accordance with equation (10) with regard to the connection between the frame and the sheets.

$$F_{v,Rd}=\frac{F_{f,Rd}}{\ell_v\sqrt{\left(\frac{\ell_h}{n_v\cdot\ell_h^2+\frac{a_1^2\cdot(n_h^3-n_h)}{3}}\right)^2+\left(\frac{\ell_v}{n_h\cdot\ell_v^2+\frac{a_1^2\cdot(n_v^3-n_v)}{3}+\frac{a_{1i}^2\cdot(n_{vi}^3-n_{vi})}{6}}\right)^2}} \qquad (10)$$

Whereby:

$F_{f,Rd}$ is the design load-carrying capacity of a laterally loaded LignoLoc® wooden nail for a shear joint

ℓ_h is the effective width of the wall panel: horizontal distance between the two rows of fasteners on the vertical edge beams

ℓ_v is the effective height of the wall panel: vertical distance between the two rows of fasteners on the horizontal top and bottom beam of the frame

n_v is the number of wooden nails on a vertical edge beam

n_h is the number of wooden nails on a horizontal top or bottom beam

n_{vi} is the number of wooden nails on the vertical inner beam

a_1 is the distance of the wooden nails in the grain direction on the edge beams, top beams and bottom beams

a_{1i} is the distance of the wooden nails in the grain direction on the vertical inner beam

An increase of the load-carrying capacity of LignoLoc® wooden nails in accordance with DIN EN 1995-1-1, Section 9.2.4.2 (5) is not permitted.

Imperfections of a vertically stressed wall panel shall always be taken into account, e.g., in accordance with DIN EN 1995-1-1/NA NCI for 9.2.4.2 (NA.17). The provision in accordance with DIN EN 1995-1-1/NA NCI for 9.2.4.2 (NA.18) shall not be applied.

The load-carrying capacity of a wall assembly composed of several wall panels shall be determined in accordance with equation (11).

$$F_{v,Rd} = \sum_{i=1}^{n}\frac{F_{v,i,Rd}\cdot\ell_{h,i}}{\ell_{h,max}} \qquad (11)$$

Whereby:

$F_{v,Rd}$ is the design load-carrying capacity of a wall assembly composed of several wall panels

$F_{v,i,Rd}$ is the design load-carrying capacity of a wall panel with an effective width $\ell_{h,i}$

$\ell_{h,max}$ is the maximum value of the effective wall panel width $\ell_{h,i}$ within the wall assembly.

3.3 Execution

3.3.1 General

The standard DIN EN 1995-1-1 in conjunction with DIN EN 1995-1-1/NA applies to the execution of load-bearing connections using LignoLoc® wooden nails, unless specified otherwise in this decision.

The executing company shall provide a declaration of conformity in accordance with Section 16a(5) in conjunction with Section 21(2) of the MBO[16] to confirm the conformity of the construction technique with the general construction technique permit.

Load-bearing connections using LignoLoc® wooden nails shall be made in accordance with the design documents, taking into account the minimum penetration depths, minimum thicknesses and minimum spacings/distances in accordance with Sections 3.1.2 and 3.1.3.

3.3.4 Installation

Only the nailing tools recommended by the manufacturer shall be used for driving in the LignoLoc® wooden nails. The wooden nails shall be inserted flush with the surface.

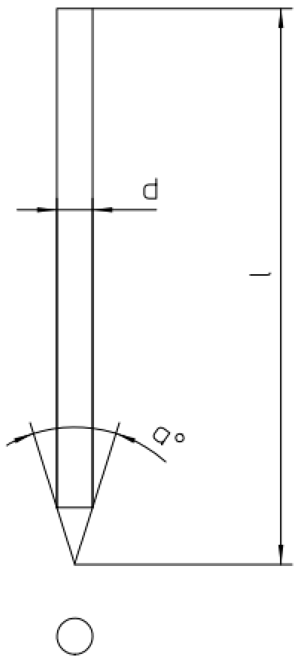
The wooden nails may only be driven in at a right angle to the grain direction of the timber elements and to the board plane of the wood-based panels or gypsum fibreboards.

Gerhard Breitschaft
President

Drawn up by
Dewitt

[16] MBO (*Musterbauordnung*) Model Building Code

d ±5%	2.8mm	3.7mm	4.7mm	5.3mm
l ±5%	34-65 mm	45-65 mm	57-90 mm	64-130 mm
a° ±5°	45°	45°	45°	45°



Load-bearing timber connections using LignoLoc® wooden nails	Annex 1
Shape and dimensions	