ETA-Danmark A/S
Göteborg Plads 1
DK-2150 Nordhavn
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet www.etadanmark.dk

Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-23/0041 of 2023/03/27

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	LignoLoc® wood-based dowel type fasteners
Product family to which the above construction product belongs:	Wood-based dowel-type fasteners
Manufacturer:	Raimund Beck Nageltechnik GmbH Raimund-Beck-Straße 1 A-5270 Mauerkirchen Internet www.beck-fastening.com
Manufacturing plant:	Raimund Beck Nageltechnik GmbH Raimund-Beck-Straße 1 A-5270 Mauerkirchen
This European Technical Assessment contains:	10 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	European Assessment document (EAD) no. EAD 130767-00-0603 “Wood-based dowel-type fasteners”.
This version replaces:	-

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Beck LignoLoc® Nails are made from densified laminated Beech wood in accordance with EN 61061-3-1 with minimum density of 1100 kg/m³. The shank is cylindrical and smooth. The nails do not have head.

Corrosion protection is not required. See Annex A for drawing including material and dimensions of the nails covered by this ETA.

Geometry
The range covers nails with a diameter between 2,8 mm and 5,3 mm. The length varies from 34 mm to 130 mm. Other dimensions appear from Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (hereinafter EAD)

The nails are used for timber-to-timber or panel-to-timber connections in load bearing timber structures with softwood members of for example solid timber, glued laminated timber, cross laminated timber, LVL and similar glued members or wood-based structural members.

Wood-based or gypsum panels shall only be located on the side of the blunt nail end. The following wood-based panels may be used for Beck LignoLoc® nails:

- Softwood Plywood according to EN 636 or ETA (minimum density 400 kg/m³ and maximum density 700 kg/m³),
- Oriented Strand Board, Type OSB/3 and OSB/4 according to EN 300 or ETA (minimum density 500 kg/m³ and maximum density 700 kg/m³),
- Fibreboard according to EN 622-5 and EN 13986 or ETA (minimum density 500 kg/m³ and maximum density 700 kg/m³, only in service class 1),
- Solid wood panels according to EN 13353 and EN 13986 or ETA (minimum density 400 kg/m³ and maximum density 700 kg/m³),
- Gypsum fibreboard according to ETA and EAD No. 070006-00-050415 (minimum density 1050 kg/m³ and maximum density 1250 kg/m³, only in service class 1)),

The nails shall be driven into the wood without pre-drilling and perpendicular to grain.

The design of the connections shall be based on the characteristic embedding strengths of the members and the characteristic ultimate bending moments of the nails. The design values shall be derived from the characteristic values in accordance with Eurocode 5 or an appropriate national code.

The nails are intended for use for connections subject to static or quasi static loading.

Axially loaded nails are only used for instantaneous, short-term or medium-term loading.

Due to the limited ductility of the connections, all actions leading to fastener loads must be considered in the design of connections with LignoLoc nails.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the Beck LignoLoc® Nails of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability*) (BWR1)	
Ultimate bending moment	See Annex B
Connection stiffness	See Annex B
Tensile capacity	Characteristic value $f_{tens,k}$: LignoLoc® nail d = 2,8 mm: $f_{tens,k}$ = 0,7 kN LignoLoc® nail d = 3,7 mm: $f_{tens,k}$ = 1,2 kN LignoLoc® nail d = 4,7 mm: $f_{tens,k}$ = 1,4 kN LignoLoc® nail d = 5,3 mm: $f_{tens,k}$ = 2,0 kN
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The nails are considered to satisfy the requirements for the following classes of the characteristic reaction to fire for plywood according to EN 636, in accordance with the provisions of EC Decision 2007/348/EC without the need for testing on the basis of its listing in that Decision: Class E, if used in wood-based materials of at least class E Class D-s2,d0, if used in wood-based materials of class D-s2,d0 or higher
3.3 General aspects related to the performance of the product	The nails have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service class 1 and 2

*) See additional information in section 3.4 – 3.6.

3.4 Mechanical resistance and stability

The load-carrying capacities for Beck LignoLoc® Nails are applicable to the wood-based materials mentioned in paragraph 2 even though the term timber has been used in the following.

The characteristic lateral load-carrying capacities and the characteristic axial withdrawal capacities of Beck LignoLoc® Nails should be used for designs in accordance with Eurocode 5 or an appropriate national code. The formulas for the load-carrying capacities are restricted to characteristic densities of the non-predrilled wood-based materials up to 460 kg/m³. Even though the non-predrilled wood-based material may have a larger density, this must not be used in the formulas.

The capacities stated below are applicable to timber-to-timber or panel-to-timber connections.

The diameter of the nails shall be greater than the maximum width of the gaps in the layers of the cross laminated timber.

ETAs for structural members or wood-based panels must be considered where applicable.

Withdrawal capacity

The design withdrawal capacity, $F_{ax,Rk}$, of a Beck LignoLoc® Nail in non-predrilled timber members shall be calculated from:

$$F_{ax,Rd} = \min\left\{1; \frac{t_{pen}}{8 \cdot d}\right\} \cdot \frac{f_{ax,k} \cdot k_{mod,ax}}{\gamma_{M_{pen}}} \cdot d \cdot t_{pen} \left(\frac{\rho_k}{350}\right)^{0,8} \text{ [N]}$$

Where:

$f_{ax,k}$ is the characteristic withdrawal parameter in N/mm², see Table 1

Table 1: Characteristic withdrawal parameters in N/mm² for Beck LignoLoc® Nails driven into timber members

Nail d [mm]	$f_{ax,k}$ [N/mm²]
2,8	5,0
3,7	7,0
4,7	7,0
5,3	7,0

$k_{mod,ax}$ is the modification factor for the nail, see Table 2, or the timber, the lower value governs

Table 2: Modification factors $k_{mod,M}$ and $k_{mod,ax}$ for Beck LignoLoc® Nails for service class 1 and 2

Load duration class	$k_{mod,M}$	$k_{mod,ax}$
Permanent	0,35	-
Long-term	0,40	-
Medium-term	0,50	0,40
Short-term	0,60	0,50
Instantaneous	0,90	0,80

d is the nominal diameter of the nail in mm,

t_{pen} is the point or blunt side penetration depth [mm]
Point side: $t_{pen} \geq 8 \cdot d$
Blunt side: $t_{pen} \geq 4 \cdot d$,

ρ_k is the characteristic density of the timber member in kg/m³, $\rho_k \leq 460$ kg/m³.

Lateral capacity

The design lateral load-carrying capacity, $F_{v,Rk}$, of a Beck LignoLoc® Nail in a timber-to-timber or panel-to-timber connection shall be calculated from:

$$F_{v,Rd} = \sqrt{\frac{2 \cdot \beta}{1+\beta}} \sqrt{1,5 \cdot M_{u,d} \cdot f_{h,1,d} \cdot d} \cdot \min \begin{cases} 1 \\ t_1 / t_{1,req} \\ t_2 / t_{2,req} \end{cases} \text{ [N]}$$

Where:

$f_{h,1,d}$ is the design embedding strength [MPa] of the timber or wood-based panel in member 1 according to EN 1995-1-1;

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

$k_{mod,1}$ is the modification factor for the load duration class and the service class of member 1

$f_{h,1,k}$ is the characteristic embedding strength in member 1 according to EN 1995-1-1 or ETA
For timber members:

$$f_{h,1,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{(1,35 + 0,015 \cdot d)\sin^2 \alpha + \cos^2 \alpha}$$

ρ_k is the characteristic density of the timber member in kg/m³, $\rho_k \leq 460$ kg/m³
α is the angle between load and grain direction

γ_M is the partial factor for the material property according to EN 1995-1-1 or national provisions

$M_{u,d}$ is the design value of the ultimate bending moment of the LignoLoc® nail

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

$k_{mod,M}$ is the modification factor for the load duration class and the service class of the LignoLoc® nail according to Table 2

β $= f_{h,2,d}/f_{h,1,d}$

$f_{h,2,d}$ is the design embedding strength [MPa] of the timber in member 2 according to EN 1995-1-1;

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

$k_{mod,2}$ is the modification factor for the load duration class and the service class of member 2

$f_{h,2,k}$ is the characteristic embedding strength in member 2 according to EN 1995-1-1 or ETA

$$f_{h,2,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{(1,35 + 0,015 \cdot d)\sin^2 \alpha + \cos^2 \alpha}$$

γ_M is the partial factor for the material property according to EN 1995-1-1 or national provisions

d is the nominal nail diameter [mm]

t_1 is the nail penetration length in member 1 [mm];

t_2 is the nail penetration length including the tip in member 2 [mm];

$t_{1,req}$ Required thickness member 1

$$t_{1,req} = \left(\sqrt{\frac{\beta}{1+\beta}} + 1\right) \cdot \sqrt{\frac{4 \cdot M_{u,d}}{0,75 \cdot f_{h,1,d} \cdot d}}$$

$t_{2,req}$ Required thickness member 2

$$t_{2,req} = \left(\sqrt{\frac{1}{1+\beta}} + 1\right) \cdot \sqrt{\frac{4 \cdot M_{u,d}}{0,75 \cdot f_{h,2,d} \cdot d}}$$

Ultimate bending moment

The characteristic ultimate moment $M_{u,k}$, of a Beck LignoLoc® Nail is stated in Table B.1 in Annex B depending on the nail diameter.

The following panel thicknesses apply for timber and the wood-based or gypsum panels in paragraph 2:

- Timber: $24 \text{ mm} \le t_1 \le 40 \text{ mm}$
- Plywood: $15 \text{ mm} \le t_1 \le 40 \text{ mm}$
- OSB/3 and OSB/: $15 \text{ mm} \le t_1 \le 30 \text{ mm}$
- MDF: $15 \text{ mm} \le t_1 \le 22 \text{ mm}$
- SWP: $15 \text{ mm} \le t_1 \le 40 \text{ mm}$
- GFB: $12,5 \text{ mm} \le t_1 \le 15 \text{ mm}$

Combined laterally and axially loaded nails

For nailed connections subjected to a combination of axial and lateral load, the following expression should be satisfied:

$$\frac{F_{ax,Ed}}{F_{ax,Rd}} + \frac{F_{v,Ed}}{F_{v,Rd}} \le 1$$

where

$F_{ax,Ed}$ axial design load of the nail

$F_{v,Ed}$ lateral design load of the nail

$F_{ax,Rd}$ design load-carrying capacity of an axially loaded nail

$F_{v,Rd}$ design load-carrying capacity of a laterally loaded nail

For LignoLoc® nails in members of solid softwood, glued laminated timber and similar products, the minimum spacing, end and edge distances are given in EN 1995-1-1 (Eurocode 5) clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes.

3.5 Aspects related to the performance of the product

3.5.1 Corrosion protection in service class 1 and 2 is not required.

3.6 General aspects related to the fitness for use of the product

The nails are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

The installation shall be carried out in accordance with Eurocode 5 or an appropriate national code unless otherwise is defined in the following. Instructions from Raimund Beck Nageltechnik GmbH should be considered for installation.

For structural members according to ETAs the terms of the ETAs must be considered.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 2003/640/EC of the European Commission1, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

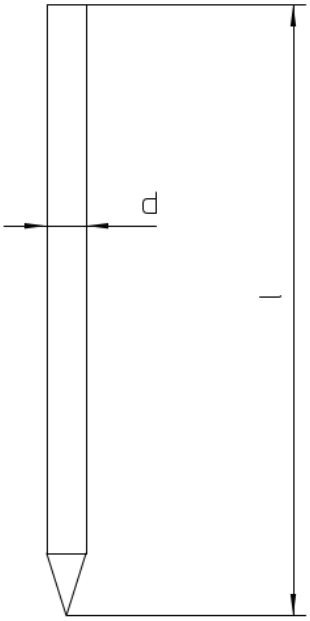
Issued in Copenhagen on 2023-03-27 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Drawing of Beck LignoLoc® Nails

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

Material:
-EN 61061
-min. 1100 kg/m³



Annex B
Characteristic ultimate moments and stiffness for Beck LignoLoc® Nails

Table B.1 Characteristic ultimate moments for Beck LignoLoc® Nails

Nail diameter [mm]	$M_{u,k}$ [Nmm]
2,8	700
3,7	1200
4,7	2200
5,3	3600

Connection stiffness

The following slip modulus K_{ser} is to be used for laterally loaded Beck LignoLoc® nails:

$$K_{ser} = \frac{F_{v,Rk}}{0,3\,\text{mm}} \qquad \text{(B.1)}$$

Annex C - informative
Design of wall diaphragms with Beck LignoLoc® Nails

The simplified method given in this Annex should only be applied to wall diaphragms with a tie-down at their end, that is the vertical member at the end is directly connected to the construction below.
The design load-carrying capacity $F_{v,Rd}$ (the design racking resistance) under a force $F_{v,Ed}$ acting at the top of a cantilevered panel secured against uplift (by vertical actions or by anchoring) should be determined using the following simplified method of analysis for walls made up of one or more panels, where each wall panel consists of a sheet fixed to one side of a timber frame, provided that:

- the spacing of fasteners is constant along the perimeter of every sheet
- the width of each sheet is at least h/4.

For a wall made up of several wall panels, the design racking load-carrying capacity of a wall should be calculated from:

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

Where:
$F_{v,wp,i,Rd}$ Design load-carrying capacity of a wall panel with length $\ell_{h,i}$ according to equation (C.2)
$\ell_{h,i}$ Effective shear wall panel width: horizontal distance between the fastener rows in the vertical outer ribs of wall panel i
$\ell_{h,max}$ Maximum effective length of wall panels

$$F_{v,wp,i,Rd} = \frac{F_{v,Rd}}{\ell_v \cdot \sqrt{\left(\frac{\ell_h}{n_v \cdot \ell_h^2 + \frac{a_v^2 \cdot (n_h^3 - n_h)}{3}}\right)^2 + \left(\frac{\ell_v}{n_h \cdot \ell_v^2 + \frac{a_v^2 \cdot (n_v^3 - n_v)}{3} + \frac{a_{vi}^2 \cdot (n_{vi}^3 - n_{vi})}{6}}\right)^2}} \qquad (C.2)$$

$F_{v,Rd}$ Lateral design capacity of an individual LignoLoc® nail loaded parallel to grain;
ℓ_v Effective wall panel depth: vertical distance between the fastener rows in the horizontal head and foot ribs
ℓ_h Effective wall panel width: horizontal distance between the fastener rows in the vertical outer ribs
n_v Number of fasteners on a vertical outer rib
n_h Number of fasteners on a horizontal head or foot rib
n_i Number of fasteners on the vertical inner rib
a_v Fastener spacing on the outer, head and foot ribs
a_{vi} Fastener spacing on the inner vertical rib.

For wall panels with sheets on both sides the following rules apply:

- if the sheets, fasteners, and fastener arrangement are of the same type and dimension then the total racking load-carrying capacity of the wall should be taken as the sum of the racking load-carrying capacities of the individual sides

- if different types of sheets are used, 50 % of the racking load-carrying capacity of the weaker side may be taken into consideration.