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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-20/0527 of 2020/08/13

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:	SPAX Connector screws and connector nails
Product family to which the above construction product belongs:	Nails and screws for use in nailing plates in timber structures
Manufacturer:	SPAX International GmbH & Co. KG Kölner Strasse 71-77 DE-58256 Ennepetal Tel. +49 23 33 799-0 Fax + 49 23 33 799-199 Internet www.spax.com
Manufacturing plant:	SPAX International production facilities
This European Technical Assessment contains:	12 pages including 2 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:	EAD 130033-00-0603 - Nails and screws for use in nailing plates in timber structures
This version replaces:	

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product
SPAX Connector Nails are made from cold formed steel thread. The shank is cylindrical and made with annular rings on part of the shank.

SPAX Connector screws are self-tapping screws to be used in single shear steel-to-timber connections in timber structures. SPAX Connector screws shall be threaded over the full length.

The nails and screws shall be produced from carbon steel wire. Where corrosion protection is required, the material or coating shall be declared in accordance with the relevant specification given in EN 14592.

See Annex A for drawings including material and dimensions of the nails and screws covered by this ETA.

Geometry
The range covers nails with 2 different diameters; 4,0 mm and 6,0 mm and screws with a diameter of 5,0 mm. For nails with a diameter of 4 mm the length varies from 35 mm to 100 mm. For nails with a diameter of 6 mm the length varies from 60 mm to 100 mm. These nails are all ring shanked nails. For screws with a diameter of 5,0 mm the length varies from 25 mm to 70 mm. Other dimensions appear from Annex A.

The screws covered by this ETA have a bending angle, α, of at least $(45/d^{0,7} + 20)$ degrees.

2 Specification of the intended use in accordance with the applicable EAD

The nails are used for steel and aluminium nailing plates and three-dimensional steel and aluminium nailing plates up to 6 mm thick for connections in load bearing timber structures with members of for example solid timber, glued laminated timber, cross laminated timber and similar glued members of wood-based structural members, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

Steel plates shall only be located on the side of the nail or screw head. The following wood-based panels may be used for SPAX Connector screws or nails:

- Plywood according to EN 636 or ETA
- Solid wood panels according to EN 13353 and EN 13986 and cross laminated timber according to ETA
- Laminated Veneer Lumber according to EN 14374 or ETA
- FST according to ETA-14/0354
- Engineered wood products according to ETA if the ETA of the product includes provisions for the use of self-tapping screws, the provisions of the ETA of the engineered wood product apply

The following wood-based panels may be used only for SPAX Connector screws:

- Particleboard of technical classes P4 to P7 according to EN 312 or ETA
- Oriented Strand Board OSB/3 and OSB/4 according to EN 300 or ETA

With the exception of Beech LVL or FST according to ETA-14/0354, the nails and screws shall be driven into the wood without pre-drilling.

The design of the connections shall be based on the characteristic load-carrying capacities of the nails or screws. The design capacities shall be derived from the characteristic capacities in accordance with Eurocode 5 or an appropriate national code.

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

The scope of the screws regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions. Section 3.10 of this ETA contains the corrosion protection for SPAX Connector screws and nails made from carbon steel.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the SPAX Connector screws and 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)	
Withdrawal and lateral load-carrying capacity	See Annex B
Tensile capacity	Characteristic value $f_{tens,k}$: SPAX Connector nail d = 4,0 mm: 6,9 kN SPAX Connector nail d = 6,0 mm: 11,4 kN SPAX Connector screw d = 5,0 mm: 8,5 kN
Torsional strength of screws	Characteristic value $f_{tor,k}$: SPAX Connector screw d = 5,0 mm: 5,0 Nm
Insertion moment	Ratio of the characteristic torsional strength to the mean insertion moment of SPAX Connector screws: $f_{tor,k} / R_{tor,mean} \geq 1,5$
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The nails and screws are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
3.8 General aspects related to the performance of the product	The nails and screws 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 3.8 – 3.9.

3.9 Mechanical resistance and stability

The load-carrying capacities for SPAX Connector nails and screws are applicable to the wood-based materials mentioned in paragraph 1 even though the term timber has been used in the following.
The characteristic lateral load-carrying capacities and the characteristic axial withdrawal capacities of SPAX Connector nails and screws 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 480 kg/m³ for SPAX Connector nails except SPAX Connector nails 4,0x35 and up to 600 kg/m³ for SPAX Connector screws. Even though the non-predrilled wood-based material may have a larger density, this must not be used in the formulas. For predrilled wood-based members, the characteristic density is limited to a maximum of 730 kg/m³.

The capacities stated below are applicable to connections with metal plates (steel-to-timber connections).

The inner thread diameter d_1 of the screws or the diameter of the nails shall be greater than the maximum width of the gaps in the layers of the cross laminated timber. The tip of the screw shall not be used in the withdrawal design of the screws when inserted in particleboards or OSB. The screw tip must penetrate the whole panel thickness.

ETA's for structural members or wood-based panels must be considered where applicable.

3.9.1 SPAX Connector nails

Withdrawal capacity
The characteristic withdrawal capacity, $F_{ax,Rk}$, of a SPAX Connector nail in non-predrilled members shall be calculated from:

$$F_{ax,Rk} = 7{,}5 \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \quad [N]$$

For 4,0 mm nails in non-predrilled Beech LVL or FST according to ETA-14/0354 the characteristic withdrawal capacity, $F_{ax,Rk}$, of a SPAX Connector nail with a maximum penetration length of 34 mm may be calculated from:

$$F_{ax,Rk} = 25 \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{730}\right)^{0,8} \quad [N]$$

For 4,0 mm nails in predrilled Beech LVL or FST according to ETA-14/0354 the characteristic withdrawal capacity, $F_{ax,Rk}$, of a SPAX Connector nail may be calculated from:

$$F_{ax,Rk} = 17 \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{730}\right)^{0,8} \quad [N]$$

Where:

ℓ_{ef}	is the nominal threaded length of the nail including the point in mm,
d	is the nominal diameter of the nail in mm,
ρ_k	is the characteristic timber density, $\rho_k \leq 480$ kg/m³ for nails with a penetration length of more than 34 mm in non-predrilled members

Lateral capacity
The characteristic lateral load-carrying capacity of a SPAX Connector nail shall be calculated from:

$$F_{v,Rk} = \min \begin{cases} 0{,}4 \cdot f_{h,k} \cdot t_1 \cdot d \\ 1{,}15 \cdot \sqrt{2 \cdot M_{y,Rk} \cdot f_{h,k} \cdot d} + \dfrac{F_{ax,Rk}}{2} \end{cases} \quad [N]$$

for thin metal plates, and

$$F_{v,Rk} = \min \begin{cases} f_{h,k} \cdot t_1 \cdot d \\ f_{h,k} \cdot t_1 \cdot d \left[\sqrt{2 + \dfrac{4 \cdot M_{y,Rk}}{f_{h,k} \cdot d \cdot t_1^2}} - 1 \right] + \dfrac{F_{ax,Rk}}{2} \\ 2{,}3 \cdot \sqrt{M_{y,Rk} \cdot f_{h,k} \cdot d} + \dfrac{F_{ax,Rk}}{2} \end{cases} \quad [N]$$

for thick metal plates.

For densities exceeding 480 kg/m³ thin metal plates must always be assumed and $F_{ax,Rk}$ shall be determined as:

$$F_{ax,Rk} = \min\left\{ f_{ax,k} \cdot d \cdot \ell_{ef} ; f_{tens,k} - \sqrt{6 \cdot M_{y,k} \cdot f_{h,k} \cdot d} \right\}$$

Where

$f_{h,k}$	is the characteristic embedding strength [MPa] of the timber or wood-based panel according to EN 1995-1-1. For 4,0 mm nails in Beech LVL or FST according to ETA-14/ 0354 the characteristic embedding strength may be calculated from $f_{h,k} = \dfrac{75}{\left(0{,}7 \cdot \sin^2\alpha + \cos^2\alpha\right) \cdot \left(1{,}2 \cdot \cos^2\beta + \sin^2\beta\right)}$
α	is the angle between load and grain direction,
β	is the angle between the nail axis and the LVL's wide face,
t_1	is the minimum of the nail penetration length including the tip or the timber thickness [mm],
d	is the nominal nail diameter [mm],
$M_{y,Rk}$	is the characteristic nail yield moment [Nmm],
$f_{tens,k}$	is the characteristic nail tensile strength [N];

Yield moment
The characteristic yield moment $M_{y,Rk}$, of a SPAX Connector Nail is stated in Table B.2 in Annex B depending on the nail diameter.

Thick metal plates may be assumed for the following plate thicknesses for nails in wood-based materials with a characteristic density up to 480 kg/m³:
SPAX Connector nail ∅ 4,0 mm: $t_{thick} \geq 1,5$ mm
SPAX Connector nail ∅ 6,0 mm: $t_{thick} \geq 3,0$ mm
The following plate thicknesses apply for thin metal plates for nails in wood-based materials with a characteristic density up to 480 kg/m³:
SPAX Connector nail ∅ 4,0 mm: $t_{thin} \geq 0,9$ mm
SPAX Connector nail ∅ 6,0 mm: $t_{thin} \geq 2,0$ mm

Minimum metal plate thicknesses are:
SPAX Connector nail ∅ 4,0 mm:

$$t_{min} = \max\left\{0,9\text{ mm}; \frac{F_{v,Rk}}{2 \cdot d \cdot f_{u,k}}\right\}$$

SPAX Connector nail ∅ 6,0 mm:

$$t_{min} = \max\left\{2,0\text{ mm}; \frac{F_{v,Rk}}{2 \cdot d \cdot f_{u,k}}\right\}$$

Where
$f_{u,k}$ is the characteristic tensile strength [MPa] of the metal plate.

For plate thicknesses between minimum thickness t_{min} and the thickness t_{thick} linear interpolation may be used.

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

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^2 + \left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 \leq 1$$

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

3.9.2 SPAX Connector screws

Withdrawal capacity
The characteristic withdrawal capacity, $F_{ax,Rk}$, of a SPAX Connector screw in non-predrilled members shall be calculated from:

$$F_{ax,Rk} = 10,5 \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \text{ [N]}$$

For screws in the wide face of predrilled Beech LVL or FST according to ETA-14/0354 the characteristic withdrawal capacity, $F_{ax,Rk}$, of a SPAX Connector screw may be calculated from:

$$F_{ax,Rk} = 35 \cdot d \cdot \ell_{ef} \cdot \left(\frac{\rho_k}{730}\right)^{0,8} \text{ [N]}$$

For screws in the edge face of LVL or FST according to ETA-14/0354 the characteristic withdrawal capacity shall be reduced by one third.

Where:
ℓ_{ef} is the nominal threaded length of the screw including the point in mm,
d is the nominal diameter of the screw in mm,
ρ_k is the characteristic timber density $\rho_k \leq 730$ kg/m³;
for OSB and particleboard ρ_k = 450 kg/m³ shall be assumed.

Lateral capacity
The characteristic lateral load-carrying capacity of a SPAX Connector screw shall be calculated from:

$$F_{v,Rk} = \min\begin{cases} 2 \cdot f_{h,k} \cdot t_1 \\ 257 \cdot \sqrt{f_{h,k}} + \dfrac{F_{ax,Rk}}{4} \end{cases} \text{ [N]}$$

for thin metal plates with t_{thin} = 1,5 mm, and

$$F_{v,Rk} = \min\begin{cases} f_{h,k} \cdot t_1 \cdot 5 \\ f_{h,k} \cdot t_1 \cdot 5\left[\sqrt{2 + \dfrac{4000}{f_{h,k} \cdot t_1^2}} - 1\right] + \dfrac{F_{ax,Rk}}{4} \\ 364 \cdot \sqrt{f_{h,k}} + \dfrac{F_{ax,Rk}}{4} \end{cases} \text{ [N]}$$

for thick metal plates with $t_{thick} \geq 2,0$ mm.

Minimum metal plate thicknesses are:

$$t_{min} = \max\left\{1,5\text{ mm}; \frac{F_{v,Rk}}{2 \cdot d \cdot f_{u,k}}\right\}$$

For densities exceeding 480 kg/m³ thin metal plates must always be assumed and $F_{ax,Rk}$ shall be determined as:

$$F_{ax,Rk} = \min\left\{f_{ax,k} \cdot d \cdot \ell_{ef}; f_{tens,k} - \sqrt{6 \cdot M_{y,k} \cdot f_{h,k} \cdot d}\right\}$$

Where
$f_{h,k}$ is the characteristic embedding strength [MPa] of the timber or wood-based panel according to

EN 1995-1-1,
For screws in Beech LVL or FST according to ETA-14/ 0354 the characteristic embedding strength may be calculated from

$$f_{h,k} = \frac{47}{\left(0,7 \cdot \sin^2 \alpha + \cos^2 \alpha\right) \cdot \left(1,2 \cdot \cos^2 \beta + \sin^2 \beta\right)}$$

α is the angle between load and grain direction,

β is the angle between the nail axis and the LVL's wide face,

t_1 is the minimum of the screw penetration length including the tip or the timber thickness [mm],

$f_{tens,k}$ is the characteristic screw tensile strength [N].

$M_{y,k}$ is the characteristic yield moment of the SPAX Connector screw d = 5,0 mm: 5000 Nmm

For plate thicknesses between minimum thickness t_{min} and the thickness t_{thick} linear interpolation may be used.

Combined laterally and axially loaded screws

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

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^2 + \left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 \leq 1$$

where

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

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

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

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

3.10 Aspects related to the performance of the product

3.10.1 Corrosion protection in service class 1 and 2.
The SPAX Connector nails and screws are produced from carbon wire. They are brass-plated, nickel-plated bronze finished or electrogalvanized and e.g. yellow or blue chromated. The minimum thickness of the zinc coating is 7µm.

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

The nails and screws 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 SPAX International GmbH & Co. KG should be considered for installation.
For structural members according to ETA's the terms of the ETA's must be considered.

For steel-to-timber connections with Beech LVL or FST according to ETA-14/0354 SPAX Connector nails with diameter 6 mm must not be used.

SPAX Connector nails with a penetration length exceeding 34 mm or SPAX Connector screws shall be driven into Beech LVL or FST according to ETA-14/0354 after predrilling with a drill hole diameter of 3,5 mm.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/176/EC of the European Commission, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

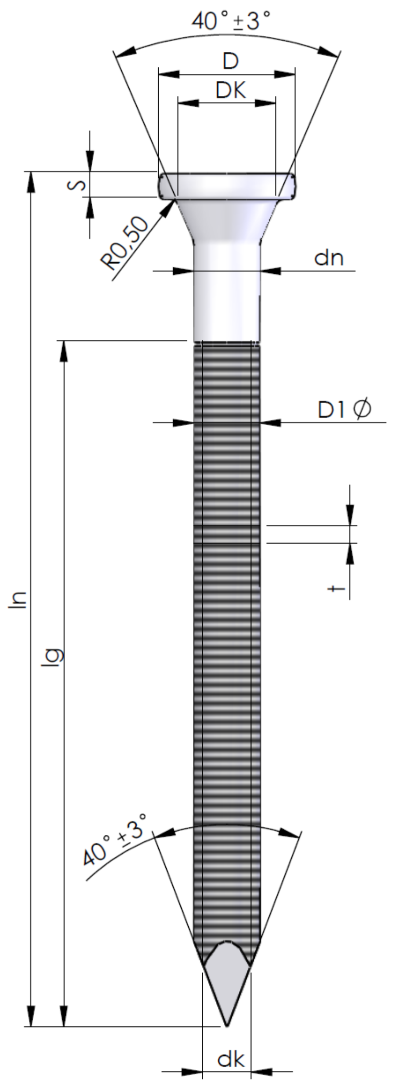
5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

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.

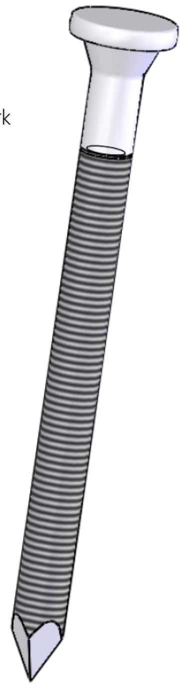
Issued in Copenhagen on 2020-08-13 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Drawings of SPAX Connector nails and screws



Alternatively:
Head stamp with
manufacturer's trade mark
" H " or

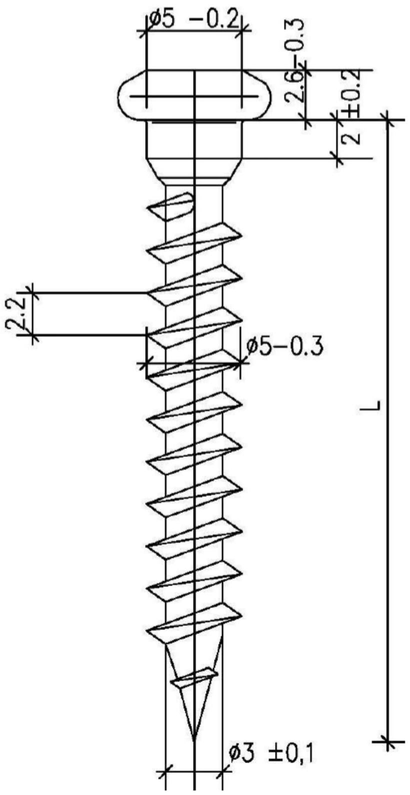


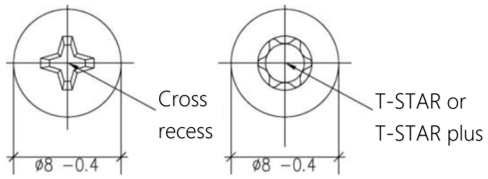
Werkstoff: C9D nach EN 10016
Zugfestigkeit: Fu>600N/mm2
Oberflache: > 7µm

Material: C9D according to EN 10016
Tensile strength: Fu > 600 N/mm2
Surface coating/plating: thickness > 7 µm

Abmessung Dimension	ln (mm)		lg (mm)		∅ dn (mm)		∅ d1 (mm)		∅ dk (mm)		t (mm)		∅ D (mm)		∅ DK (mm)		S (mm)	
4,0x35	35		25		4,0		4,4		3,6		1,3		8,0		5,4		1,4	
4,0x40	40		30		4,0		4,4		3,6		1,3		8,0		5,4		1,4	
4,0x50	50		40		4,0		4,4		3,6		1,3		8,0		5,4		1,4	
4,0x60	60		50		4,0		4,4		3,6		1,3		8,0		5,4		1,4	
4,0x75	75	±1,0	60	+5,0	4,0	±0,08	4,4	+0,05 -0,15	3,6	+0,20 -0,15	1,3	+0,20 -0,10	8,0	±0,3	5,4	+0,3 -0,2	1,4	±0,2
4,0x100	100		80		4,0		4,4		3,6		1,3		8,0		5,4		1,4	
6,0x60	60		50		6,0		6,5		5,5		1,5		12,0		7,5		2	
6,0x80	80		70		6,0		6,5		5,5		1,5		12,0		7,5		2	
6,0x100	100		80		6,0		6,5		5,5		1,5		12,0		7,5		2	

SPAX Connector nails





Alternatively:

Head stamp with manufacturer's trade mark 

Werkstoff: C20D nach EN 10016
Oberfläche ≥ 7 µm

Material: C20D according to EN 10016
Surface coating/plating: thickness >7 µm

Dimensions /

Abmessungen [mm]			
Ø		L	Tol.
5,0	x	25	+2,0/ -1,0
5,0	x	35	
5,0	x	40	
5,0	x	50	
5,0	x	60	
5,0	x	70	

Note: Thread length lg for calculations lg = L – 4 mm

SPAX Connector screw

Annex B
Characteristic capacities for SPAX Connector nails and SPAX Connector screws

Table B.1 Characteristic capacities for SPAX Connector nails

Characteristic capacities for a characteristic density of the timber members as indicated in Table B.1. The nail shall be driven completely into the wood or wood based material, which shall have a thickness of at least the length of the nail. The values given in Table B.1 presuppose that the threaded part of the nail is completely embedded in the wood or wood based material.

Nail non predrilled	C18 ρ_k = 320 kg/m³			C24/GL24c ρ_k = 350 kg/m³			C30/GL24h/GL28c ρ_k = 380 kg/m³			GL28h/GL32c ρ_k = 410 kg/m³			Kerto LVL ρ_k = 480 kg/m³		
	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] thin	$F_{v,Rk}$ [N] thick	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] thin	$F_{v,Rk}$ [N] thick	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] thin	$F_{v,Rk}$ [N] thick	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] thin	$F_{v,Rk}$ [N] thick	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] thin	$F_{v,Rk}$ [N] thick
4,0 x 35	698	945	1574	750	1033	1691	801	1122	1807	851	1210	1923	966	1417	2191
4,0 x 40	838	1083	1755	900	1185	1890	961	1286	2025	1021	1388	2159	1159	1625	2469
4,0 x 50	1117	1360	2102	1200	1488	2214	1282	1615	2322	1362	1743	2428	1545	2040	2662
4,0 x 60	1396	1637	2241	1500	1790	2364	1602	1944	2483	1702	2086	2598	1931	2302	2855
4,0 x 75	1675	1929	2381	1800	2041	2514	1922	2150	2643	2043	2257	2768	2317	2495	3049
4,0 x 100	2234	2208	2660	2400	2341	2814	2563	2471	2963	2724	2597	3109	3090	2881	3435
6,0 x 60	2094	2134	3722	2250	2334	4010	2403	2534	4296	2554	2734	4581	2897	3201	5172
6,0 x 80	2932	2870	4507	3150	3139	4755	3364	3408	4995	3575	3677	5229	4056	4304	5752
6,0 x 100	3351	3605	4716	3600	3943	4980	3845	4265	5236	4086	4476	5484	4635	4951	6041
Nail in Beech LVL or FST	ρ_k = 730 kg/m³ Non-predrilled Wide face			ρ_k = 730 kg/m³ Non-predrilled Edge face			ρ_k = 730 kg/m³ Predrilled Wide face			ρ_k = 730 kg/m³ Predrilled Edge face					
	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] 0°	$F_{v,Rk}$ [N] 90°	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] 0°	$F_{v,Rk}$ [N] 90°	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] 0°	$F_{v,Rk}$ [N] 90°	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N] 0°	$F_{v,Rk}$ [N] 90°			
4,0 x 35	2500	3521	4475	2500	3323	4140	1700	3121	4275	1700	2923	3940			
4,0 x 40	-	-	-	-	-	-	2040	3291	4360	2040	3093	4025			
4,0 x 50	-	-	-	-	-	-	2720	3631	4530	2720	3433	4195			
4,0 x 60	-	-	-	-	-	-	2812	3677	4553	3168	3657	4307			
4,0 x 75	-	-	-	-	-	-	2812	3677	4553	3168	3657	4307			
4,0 x 100	-	-	-	-	-	-	2812	3677	4553	3168	3657	4307			

$F_{ax,Rk}$ Characteristic withdrawal (axial) capacity per nail
Values for other densities (ρ_k) up to 480 kg/m³ may be calculated by multiplying the values for C24 with $(\rho_k/350)^{0,8}$

$F_{v,Rk}$ Characteristic load-carrying capacity per shear plane per nail
Thin refers to a plate thickness = 0,9 mm for d = 4,0 mm and a plate thickness = 2,0 mm for d = 6,0 mm
Thick refers to a plate thickness = 1,5 mm for d = 4,0 mm and a plate thickness = 3,0 mm for d = 6,0 mm
0° or 90°, respectively, refer to the load-grain angle

In non-predrilled Beech LVL or FST according to ETA-14/0354 the characteristic load-carrying capacities for nails 4,0 x 35 may be used for longer nails if the penetration length does not exceed 34 mm.

Table B.2 Characteristic yield moments for SPAX Connector nails

Nail diameter [mm]	$M_{y,Rk}$ [Nmm]
4,0	6500
6,0	19000

Table B.3 Characteristic capacities for SPAX Connector screws

Characteristic capacities for a characteristic density of the timber members as indicated in Table B.1. The screw shall be driven completely into the wood or wood based material, which shall have a thickness of at least the length of the screw. The values given in Table B.1 presuppose that the threaded part of the screw is completely embedded in the wood or wood based material.

Screw non-predrilled	C18 ρ_k = 320 kg/m³			C24/GL24c ρ_k = 350 kg/m³			C30/GL24h/GL28c ρ_k = 380 kg/m³		
	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]		$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]		$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]	
		thin	thick		thin	thick		thin	thick
5,0 x 25	1026	761	1319	1103	832	1412	1177	904	1504
5,0 x 35	1515	1085	1694	1628	1186	1826	1738	1288	1958
5,0 x 40	1759	1247	1896	1890	1364	2003	2019	1480	2099
5,0 x 50	2248	1571	2025	2415	1686	2134	2579	1772	2239
5,0 x 60	2737	1719	2147	2940	1817	2265	3140	1913	2380
5,0 x 70	3225	1841	2270	3465	1948	2397	3701	2053	2520

Screw non-predrilled	GL28h/GL32c ρ_k = 410 kg/m³			Kerto LVL ρ_k = 480 kg/m³			Microllam LVL ρ_k = 600 kg/m³		
	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]		$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]		$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]	
		thin	thick		thin	thick		thin	thick
5,0 x 25	1251	975	1596	1419	1141	1808	1697	1427	2169
5,0 x 35	1847	1390	2089	2095	1627	2316	2505	2034	2630
5,0 x 40	2145	1597	2193	2433	1870	2401	2909	2144	2731
5,0 x 50	2741	1856	2342	3109	2045	2569	3717	2346	2933
5,0 x 60	3337	2005	2491	3785	2214	2738	4525	2548	3135
5,0 x 70	3933	2154	2639	4461	2383	2907	5333	2750	3337

Screw predrilled Beech LVL or FST	ρ_k = 730 kg/m³ Wide face			ρ_k = 730 kg/m³ Edge face					
	$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]		$F_{ax,Rk}$ [N]	$F_{v,Rk}$ [N]				
		0°	90°		0°	90°			
5,0 x 25	3675	2162	3026	2450	1802	2536			
5,0 x 35	5425	3102	3463	3617	2513	2828			
5,0 x 40	5845	3224	3568	4200	2659	2973			
5,0 x 50	5845	3224	3568	5367	2951	3265			
5,0 x 60	5845	3224	3568	6076	3128	3443			
5,0 x 70	5845	3224	3568	6076	3128	3443			

$F_{ax,Rk}$ Characteristic withdrawal (axial) capacity per screw
Values for other densities (ρ_k) up to 600 kg/m³ may be calculated by multiplying the values for C24 with $(\rho_k/350)^{0,8}$

$F_{v,Rk}$ Characteristic load-carrying capacity per shear plane per screw
Thin refers to a plate thickness = 1,5 mm
Thick refers to a plate thickness = 2,0 mm
0° or 90°, respectively, refer to the load-grain angle