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European Technical Assessment ETA-12/0114 of 2020/01/07

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 self-tapping screws
Product family to which the above construction product belongs:	Screws for use in timber constructions
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 GmbH & Co. KG Kölner Strasse 71-77 DE-58256 Ennepetal
This European Technical Assessment contains:	103 pages including 5 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 130118-01-0603 "Screws and threaded rods for use in timber constructions"
This version replaces:	The previous ETA with the same number issued on 2017-10-12

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II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

SPAX screws are self-tapping screws to be used in timber structures. They shall be threaded over a part or over the full length. SPAX threaded rods shall be threaded over the full length. The screws shall be produced from carbon steel wire for nominal diameters of 2,5 mm to 12,0 mm and from stainless steel wire for nominal diameters of 3,0 mm to 12,0 mm. SPAX threaded rods shall be produced from carbon steel wire or from stainless steel wire for a nominal diameter of 16,0 mm. Where corrosion protection is required, the material or coating shall be declared in accordance with the relevant specification given in Annex A of EN 14592.

Geometry and Material

The nominal diameter (outer thread diameter), d, of SPAX screws shall not be less than 2,5 mm and shall not be greater than 12,0 mm. The nominal diameter of SPAX threaded rods is 16 mm. The overall length of the screws, ℓ , shall not be less than 20 mm and shall not be greater than 1000 mm. The overall length of the threaded rods, ℓ , shall not be greater than 3000 mm. Other dimensions are given in Annex A.

The ratio of inner thread diameter to outer thread diameter d_i/d ranges from 0,58 to 0,68.

The screws are threaded over a minimum length ℓ_g of 4·d (i.e. $\ell_g \ge 4$ ·d).

The lead p (distance between two adjacent thread flanks) ranges from $0,49 \cdot d$ to $0,61 \cdot d$.

No breaking shall be observed at a bend angle, α , of less than (45/d^{0,7} + 20) degrees.

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

The screws and threaded rods are used for connections in load bearing timber structures between members of solid timber (softwood), glued laminated timber (softwood), cross-laminated timber, and laminated veneer lumber (softwood), similar glued members, wood-based panels or steel. The screws are also used for connections in load bearing members of solid timber (hardwood), glued laminated timber (hardwood) or laminated veneer lumber (hardwood). SPAX screws with a thread over the full length and SPAX threaded rods are also used as tensile or compressive reinforcement perpendicular to the grain or as shear reinforcement in softwood members.

Furthermore, SPAX screws with diameters between 6 mm and 12 mm may also be used for the fixing of thermal insulation material on rafters.

Steel plates and wood-based panels except solid wood panels, laminated veneer lumber and cross laminated timber shall only be located on the side of the screw head. The following wood-based panels may be used:

- Plywood according to EN 636 or European Technical Assessment or national provisions that apply at the installation site
- Particleboard according to EN 312 or European Technical Assessment or national provisions that apply at the installation site
- Oriented Strand Board according to EN 300 or European Technical Assessment or national provisions that apply at the installation site
- Fibreboard according to EN 622-2 and 622-3 or European Technical Assessment (minimum density 650 kg/m³) or national provisions that apply at the installation site
- Cement bonded particleboard according to EN 634 or European Technical Assessment or national provisions that apply at the installation site
- Solid wood panels according to EN 13353 or European Technical Assessment or national provisions that apply at the installation site
- Cross laminated timber according to European Technical Assessment
- Laminated Veneer Lumber according to EN 14374 or European Technical Assessment
- Engineered wood products according to European Technical Assessment

The screws or threaded rods are intended to be used in timber connections for which requirements for mechanical resistance and stability and safety in use in the the sense of the Basic Works Requirements 1 and 4 of Regulation 305/2011 (EU) shall be fulfilled.

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

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

The zinc-coated screws and threaded rods are for use in timber structures subject to the dry, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1:2008 (Eurocode 5). The screws and threaded rods

made of stainless steel meet the requirements of Eurocode 5 (EN 1995-1-1:2008) for use in structures subject to the wet conditions defined as service class 3.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the screws 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.

aracteri		Assessment of characteristic	
	chanical resistance and stability*) (BWR1)		
	le strength	Characteristic value ftens,k:	
Screv	vs made of carbon steel	d = 2,5 mm:	1,8 kN
		d = 3,0 mm:	2,6 kN
		d = 3,5 mm:	3,8 kN
		d = 4,0 mm:	5,0 kN
		d = 4,5 mm or 4,6 mm:	6,4 kN
		d = 5,0 mm:	7,9 kN
		d = 5,6 mm:	9,9 kN
		d = 6,0 mm:	11 kN
		d = 7,0 mm:	13 kN
		d = 8,0 mm:	17 kN
		d = 10,0 mm:	28 kN
		d = 12,0 mm:	38 kN
Threa	aded rods made of carbon steel or stainless steel	d = 16,0 mm:	63 kN
Screv	vs made of stainless steel	d = 3,0 mm:	2,1 kN
		d = 3,5 mm:	2,9 kN
		d = 4,0 mm:	3,8 kN
		d = 4,5 mm or 4,6 mm:	4,2 kN
		d = 5,0 mm or 5,2 mm:	4,9 kN
		d = 5,6 mm:	6,2 kN
		d = 6.0 mm:	7,1 kN
		d = 7,0 mm:	10 kN
		d = 8,0 mm:	13 kN
		d = 10,0 mm:	20 kN
		d = 12,0 mm:	20 kN 28 kN
Insert	tion moment	Ratio of the characteristic torsi	•
		mean insertion moment: $f_{tor,k} / F_{tor,k}$	$R_{tor,mean} \ge 1,5$
Torsi	onal strength	Characteristic value f _{tor,k} :	
	vs made of carbon steel	d = 2,5 mm:	0,65 Nm
		d = 3,0 mm:	1,3 Nm
		d = 3,5 mm:	2,0 Nm
		d = 4.0 mm:	3,0 Nm
		d = 4,5 mm or 4,6 mm:	4,0 Nm
		d = 5.0 mm:	6,0 Nm
		d = 5,6 mm:	8,0 Nm
		d = 6,0 mm:	10,5 Nm
		d = 7,0 mm:	14,2 Nm
		d = 8,0 mm:	21 Nm 40 Nm
		d = 10,0 mm: d = 12,0 mm:	40 Nm 70 Nm
Screv	vs made of stainless steel	d = 3,0 mm:	1,0 Nm
		d = 3,5 mm:	1,7 Nm
		d = 4,0 mm:	2,4 Nm
		d = 4,5 mm or 4,6 mm:	3,2 Nm
		d = 5,0 mm or 5,2 mm:	4,6 Nm
		d = 5.6 mm:	5,6 Nm
		d = 6,0 mm:	7,0 Nm
		d = 7,0 mm:	8,7 Nm
		d = 8,0 mm:	17 Nm
		u = 0,0 mm.	
		d = 10 mm:	28 Nm

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

Char	acteristic	Assessment of characteristic
3.2	Safety in case of fire (BWR2)	
	Reaction to fire	The screws are made from steel classified as performance class A1 of the characteristic reaction to fire, in accordance with the provisions of Commission Delegated Regulation 2016/364 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC.
3.3	Hygiene, health and the environment (BWR3) Influence on air quality	The product does not contain/release dangerous substances specified in TR 034, dated October 2015 *
3.4	Safety in use (BWR4)	See aspects covered by BWR1
3.7	Sustainable use of natural resources (BWR7)	No Performance Assessed
3.8	General aspects related to the performance of the product	The 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 classes 1, 2 and 3
	Identification	See Annex A

^{*)} See additional information in section 3.9 - 3.12.

**) In addition to the specific clauses relating to dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

3.9 Mechanical resistance and stability

The load-carrying capacities for SPAX 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 screws or threaded rods should be used for designs in accordance with Eurocode 5 or an appropriate national code.

Point side penetration length must be $\ell_{ef} \ge 4 \cdot d$, where d is the outer thread diameter of the screw or threaded rod. For the fixing of thermal insulation material on top of rafters, point side penetration must be at least 40 mm, $\ell_{ef} \ge 40$ mm.

European Technical Assessments for structural members or wood-based panels must be considered where applicable.

Reductions in the cross-sectional area caused by SPAX screws or threaded rods with a diameter of 10 mm or more shall be taken into account in the member strength verification both, in the tensile and compressive area of members.

For screws in pre-drilled holes, the drill hole diameter should be considered in the member strength verification, for screws driven without pre-drilling, the inner thread diameter.

Lateral load-carrying capacity

The characteristic lateral load-carrying capacity of SPAX screws or threaded rods shall be calculated according to EN 1995-1-1 (Eurocode 5) using the outer thread diameter d as the nominal diameter of the screw. The contribution from the rope effect may be considered.

The characteristic yield moment shall be calculated from:

SPAX screws for 2,5 mm \leq d \leq 12,0 mm made of carbon steel: $M_{y,k} = 0,15 \cdot 600 \cdot d^{2,6}$ [Nmm]

SPAX threaded rods: $M_{y,k} = 140000$ [Nmm]

SPAX screws for 3,0 mm $\leq d \leq 12,0$ mm made of stainless steel: $M_{v,k} = 0.15 \cdot 400 \cdot d^{2.6}$ [Nmm] where

d outer thread diameter [mm]

The embedding strength for screws in non-pre-drilled holes arranged at an angle between screw axis and grain direction, $0^{\circ} \le \alpha \le 90^{\circ}$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha}$$
 [N/mm²]

for screws in pre-drilled holes:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha}$$
 [N/mm²]

for threaded rods in pre-drilled holes:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1-0,01 \cdot d)}{\left(2,5 \cdot \cos^2 \alpha + \sin^2 \alpha\right) \cdot \left(k_{90} \cdot \sin^2 \varepsilon + \cos^2 \varepsilon\right)}$$

 $[N/mm^2]$

Where

- ρ_k characteristic timber density [kg/m³];
- d outer thread diameter [mm];
- α angle between screw axis and grain direction;

 ϵ angle between force and grain direction;

k₉₀ according to equation (8.33) in EN 1995-1-1.

The embedding strength for screws arranged parallel to the plane of cross laminated timber, independent of the angle between screw axis and grain direction, $0^{\circ} \le \alpha \le 90^{\circ}$, shall be calculated from:

$$f_{h,k} = 20 \cdot d^{-0.5}$$

[N/mm²]

unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber.

Where

d outer thread diameter [mm]

The embedding strength for screws or threaded rods in the plane surface of cross laminated timber should be assumed as for solid timber based on the characteristic density of the outer layer. If relevant, the angle between force and grain direction of the outer layer should be taken into account.

The direction of the lateral force shall be perpendicular to the screw axis and parallel to the plane surface of the cross laminated timber.

For laterally loaded screws, the rules for multiple fastener connections in EN 1995-1-1, 8.3.1.1 (8) should be applied.

Axial withdrawal capacity

The characteristic axial withdrawal capacity of SPAX screws or threaded rods at an angle of $15^{\circ} \le \alpha \le 90^{\circ}$ to the grain in solid timber (softwood and hardwood with a maximum characteristic density of 730 kg/m³), glued laminated timber and cross-laminated timber members or at an angle of $30^{\circ} \le \alpha \le 90^{\circ}$ to the grain in laminated veneer lumber members (softwood and hardwood with a maximum characteristic density of 750 kg/m³) shall be calculated according to EN 1995-1-1:2008 from:

$$F_{ax,\alpha,Rk} = \frac{n_{ef} \cdot f_{ax,k} \cdot d \cdot \ell_{ef}}{1,2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}$$
[N]

Where

$F_{ax,\alpha,RK}$	characteristic withdrawal capacity of the		
	screw at an angle α to the grain [N]		
n _{ef}	effective number of screws according to		
	EN 1995-1-1:2008	-	
f _{ax,k}	Characteristic withdrawal parameter		
	$2,5 \text{ mm} \le d \le 6,0 \text{ mm}$:	$f_{ax,k} = 14,0 \text{ N/mm}^2$	
	6,0 mm \le d \le 8,0 mm:	$f_{ax,k} = 12,0 \text{ N/mm}^2$	
	d = 10,0 mm:	$f_{ax,k} = 11,5 \text{ N/mm}^2$	
	d = 12,0 mm:	$f_{ax,k} = 11,0 \text{ N/mm}^2$	
	d = 16,0 mm:	$f_{ax,k} = 10,0 \text{ N/mm}^2$	
d	outer thread diameter [mm]		
$\ell_{\rm ef}$	Penetration length of th	e threaded part	
	according to EN 1995-1-1 [mm]; for the		

according to EN 1995-1-1 [mm]; for the thread under the head including the head length

 α Angle between grain and screw axis

 ρ_k Characteristic density [kg/m³]

For screws penetrating more than one layer of cross laminated timber, the different layers may be taken into account proportionally.

The axial withdrawal capacity is limited by the head pullthrough capacity and the tensile or compressive capacity of the screw or threaded rod.

For SPAX screws or threaded rods, the withdrawal capacity of the thread in the member with the head may be taken into account instead of the head pull-through capacity.

For axially loaded screws in tension, where the external force is parallel to the screw axes, the rules in EN 1995-1-1, 8.7.2 (8) should be applied.

For inclined screws in timber-to-timber or steel-to-timber shear connections, where the screws are arranged under an angle $30^{\circ} \le \alpha \le 60^{\circ}$ between the shear plane and the screw axis, the effective number of screws n_{ef} should be determined as follows:

For one row of n screws parallel to the load, the load-carrying capacity should be calculated using the effective number of fasteners n_{ef} , where

$$n_{ef} = \max\{n^{0,9}; 0, 9 \cdot n\}$$

and n is the number of inclined screws in a row. If crossed pairs of screws are used in timber-to-timber connections, n is the number of crossed pairs of screws in a row.

Note: For screws as compression reinforcement or inclined screws as fasteners in mechanically jointed beams or columns or for the fixing of thermal insulation material, $n_{ef} = n$.

Head pull-through capacity

The characteristic head pull-through capacity of SPAX screws or threaded rods shall be calculated according to EN 1995-1-1:2008 from:

$$F_{ax,\alpha,Rk} =$$

$$\max\left\{\frac{\mathbf{f}_{ax,k}\cdot\mathbf{d}\cdot\boldsymbol{\ell}_{ef}}{1,2\cdot\cos^{2}\alpha+\sin^{2}\alpha};\mathbf{k}_{t}\cdot\mathbf{f}_{head,k}\cdot\mathbf{d}_{h}^{2}\right\}\cdot\mathbf{n}_{ef}\cdot\left(\frac{\boldsymbol{\rho}_{k}}{350}\right)^{0,8}$$
[IN]

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where:

$F_{ax,\alpha,RK}$	Characteristic head pull-through capacity
	of the connection at an angle $\alpha \ge 30^\circ$ to
	the grain [N]
n_{ef}	Effective number of screws according to
	EN 1995-1-1:2008
	For inclined screws:
	$\mathbf{n}_{\rm ef} = \max\left\{\mathbf{n}^{0.9}; 0, 9 \cdot \mathbf{n}\right\}$
	(see axial withdrawal capacity)
\mathbf{k}_{t}	Factor taking into account the head side
	member thickness t _h
	$k_t = 1 \text{ for } t_h/d_h < 3$
	$k_t = 1,3$ for $t_h/d_h \ge 3$
f _{head,k}	Characteristic head pull-through parameter
	[N/mm ²]
d _h	Diameter of the screw head or the washer
	[mm]. Outer diameter of heads or washers
	$d_h > 32$ mm shall only be considered with a
	nominal diameter of 32 mm.
ρ_k	Characteristic density [kg/m ³], for wood-
	based panels $\rho_k = 380 \text{ kg/m}^3$

Characteristic head pull-through parameter for SPAX screws with countersunk or hexagon head without flange in connections with timber and in connections with wood-based panels with thicknesses above 20 mm: $d_h \leq 16 \text{ mm}: f_{head,k} = 27,0 - d_h [N/mm^2]$

16 mm < $d_h \le 32$ mm: $f_{head,k} = 11,0-0,2 \cdot (d_h - 16)$ [N/mm²]

Characteristic head pull-through parameter for SPAX screws with washer head, pan head, hexagon head with flange, countersunk head with washer or with second thread under the head in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:

 $\begin{array}{ll} d_h \leq 16 \mbox{ mm: } & f_{head,k} = 29,0 \mbox{ - } d_h \ [N/mm^2] \\ 16 \mbox{ mm } < d_h \leq 22 \mbox{ mm: } & f_{head,k} = 13,0 \ [N/mm^2] \\ 22 \mbox{ mm } < d_h \leq 32 \mbox{ mm: } & f_{head,k} = 16,0 \mbox{ - } 0,5 \mbox{ (} d_h \mbox{ - } 16) \\ [N/mm^2] \end{array}$

Where

d_h head or washer diameter [mm]

Characteristic head pull-through parameter for screws in connections with wood-based panels with thicknesses between 12 mm and 20 mm: $f_{head,k} = 8 \text{ N/mm}^2$

Screws in connections with wood-based panels with a thickness below 12 mm (minimum thickness of the wood based panels of 1,2 d with d as outer thread diameter): $f_{head,k} = 8 \text{ N/mm}^2$

limited to $F_{ax,Rk} = 400 \text{ N}$

For partially threaded screws with smooth shank under the head, the head or washer diameter shall be equal or greater than $1,8 \cdot ds$, where ds is the smooth shank or the wire diameter. Otherwise the characteristic head pullthrough capacity $F_{ax,\alpha,Rk} = 0$ for screws with a smooth shank under the head.

The minimum thickness of wood-based panels according to the clause 2.1 must be observed.

In steel-to-timber connections the head pull-through capacity is not governing.

Tensile capacity

The characteristic tensile capacity $f_{tens,k}$ of SPAX screws made of carbon steel or threaded rods made of carbon steel or stainless steel is:

d = 2,5 mm:	1,8 kN
d = 3,0 mm:	2,6 kN
d = 3,5 mm:	3,8 kN
d = 4,0 mm:	5,0 kN
d = 4,5 mm or 4,6 mm:	6,4 kN
d = 5,0 mm or 5,2 mm:	7,9 kN
d = 5,6 mm:	9,9 kN
d = 6,0 mm:	11 kN
d = 7,0 mm:	13 kN
d = 8,0 mm:	17 kN
d = 10,0 mm:	28 kN
d = 12,0 mm:	38 kN

Threaded rods d = 16 mm: 63 kN

The characteristic tensile capacity $f_{tens,k}$ of SPAX screws made of stainless steel is:

d = 3,0 mm:	2,1 kN
d = 3,5 mm:	2,9 kN
d = 4,0 mm:	3,8 kN
d = 4,5 mm or 4,6 mm:	4,2 kN
d = 5,0 mm or 5,2 mm:	4,9 kN
d = 5,6 mm:	6,2 kN
d = 6,0 mm:	7,1 kN
d = 7,0 mm:	10 kN
d = 8,0 mm:	13 kN
d = 10,0 mm:	20 kN
d = 12,0 mm:	28 kN

The tear-off capacity of the screw head is greater than the tensile capacity of the screw.

Compressive capacity

The design compressive capacity $F_{ax,Rd}$ of SPAX screws or threaded rods with full thread along the length embedded in timber shall be calculated from:

$$F_{ax,Rd} = \min \left\{ \frac{f_{ax,d} \cdot d \cdot \ell_{ef}}{1, 2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} ; \frac{\kappa_c \cdot N_{pl,k}}{\gamma_{M1}} \right\}$$
[N]

where

$$\begin{split} \kappa_{c} &= \begin{cases} 1 & \text{for } \overline{\lambda}_{k} \leq 0, 2\\ \\ \frac{1}{k + \sqrt{k^{2} - \overline{\lambda}_{k}^{2}}} & \text{for } \overline{\lambda}_{k} > 0, 2 \end{cases}\\ k &= 0, 5 \cdot \left[1 + 0, 49 \cdot (\overline{\lambda}_{k} - 0, 2) + \overline{\lambda}_{k}^{2}\right] \end{split}$$

The relative slenderness ratio shall be calculated from:

$$\overline{\lambda}_k \ = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$$

Where

$$N_{pl,k} = \pi \cdot \frac{d_1^2}{4} \cdot f_{y,k}$$
 [N]

is the characteristic value for the axial capacity in case of plastic analysis referred to the inner thread cross section

Characteristic yield strength:

 $f_{y,k} = 1000 \ [N/mm^2]$

for SPAX screws made of carbon steel

 $\begin{array}{ll} f_{y,k} & = 500 \; [N/mm^2] \\ & \text{for SPAX threaded rods and SPAX screws made} \\ & \text{of stainless steel} \end{array}$

[N]

[mm]

Characteristic ideal elastic buckling load: $N_{ki,k} = \sqrt{c_h \cdot E_S \cdot I_S}$

Elastic foundation of the screw:

$$c_{h} = (0,19+0,012 \cdot d) \cdot \rho_{k} \cdot \left(\frac{\alpha}{180^{\circ}} + 0,5\right)$$

[N/mm²]

for screws in cross-laminated timber, the most unfavourable combination of α and ρ_k governs;

Modulus of elasticity:

$E_{s} = 210000$	[N/mm ²]
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 ρ_k = characteristic density [kg/m³]

Second moment of area:

 $I_{\rm S} = \frac{\pi}{64} \cdot d_1^4 \qquad [\rm mm^4]$

 $d_1 = inner thread diameter$

 $(d_2 in the drawings in the annex)$

 α = angle between grain and screw axis

Note: When determining design values of the compressive capacity it should be considered that $f_{ax,d}$ is to be calculated using k_{mod} and γ_M for timber according to EN 1995 while $N_{pl,d}$ is calculated using $\gamma_{M,1}$ for steel buckling according to EN 1993.

Combined laterally and axially loaded screws or threaded rods

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

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

where

 $\begin{array}{ll} F_{ax,Ed} & axial \ design \ load \ of \ the \ screw \ or \ threaded \ rod \\ F_{la,Ed} & lateral \ design \ load \ of \ the \ screw \ or \ threaded \ rod \\ F_{ax,Rd} design \ load-carrying \ capacity \ of \ an \ axially \ loaded \ screw \ or \ threaded \ rod \end{array}$

 $F_{la,Rd} \quad \mbox{design load-carrying capacity of a laterally} \\ \mbox{loaded screw or threaded rod}$

Slip modulus

The axial slip modulus K_{ser} of a screw for the serviceability limit state should be taken independent of angle α to the grain as:

$$C = K_{ser} = 25 \cdot d \cdot \ell_{ef} [N/mm]$$

Where

d outer thread diameter [mm]

 ℓ_{ef} penetration length in the structural member [mm]

Compression reinforcement

See annex C.

Tensile reinforcement See annex D.

Shear reinforcement

See annex E.

Thermal insulation material on top of rafters See annex F.

3.10 Related aspects of serviceability

3.10.1 Corrosion protection in service class 1, 2 and 3. The SPAX screws and threaded rods are produced from carbon wire. They are brass-plated, nickel-plated bronze finished or electro-galvanised and e.g. yellow or blue chromated with thicknesses of the zinc coating from $4 - 16 \,\mu\text{m}$ or have a zinc flake coating with thicknesses from $10 - 20 \,\mu\text{m}$. Steel no. 1.4016, 1.4062, 1.4401, 1.4567, 1.4578, 1.4529 and 1.4539 is used for screws made from stainless steel.

3.11 General aspects related to the intended use of the product

The screws or threaded rods are manufactured in accordance with the provisions of the European Technical Assessment using the automated manufacturing process as identified during the inspection of the plant by the assessment body issuing the ETA and the approved 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.

The screws or threaded rods are used for connections in load bearing members of solid timber (softwood), glued laminated timber (softwood), cross-laminated timber (minimum diameter d = 6,0 mm), and laminated veneer lumber, similar glued members, wood-based panels or steel members. The screws are also used for connections in load bearing members of solid timber (hardwood) or glued laminated timber (hardwood).

The screws or threaded rods may be used for connections in load bearing timber structures with structural members according to an associated European Technical Assessment, if according to the associated European Technical Assessment of the structural member a connection in load bearing timber structures with screws according to a European Technical Assessment is allowed.

SPAX fully threaded screws or threaded rods are also used as tensile or compressive reinforcement perpendicular to the grain or as shear reinforcement in softwood members.

Furthermore, the screws with diameters between 6 mm and 12 mm may also be used for the fixing of thermal insulation material on top of rafters.

A minimum of two screws or threaded rods should be used for connections in load bearing timber structures. This does not apply for reinforcements or other situations specified in National Annexes to EN 1995-1-1.

The minimum penetration depth in structural members made of solid, glued or cross-laminated timber is $4 \cdot d$.

Wood-based panels and steel plates should only be arranged on the side of the screw head. The minimum thickness of wood-based panels should be $1,2 \cdot d$. Furthermore, the minimum thickness for following wood-based panels should be:

- Plywood, Fibreboards: 6 mm
- Particleboards, OSB, Cement Particleboards: 8 mm
- Solid wood panels: 12 mm

For structural members according to European Technical Assessments the terms of the European Technical Assessments must be considered.

If screws with an outer thread diameter $d \ge 8$ mm are used in load bearing timber structures, the structural solid or glued laminated timber, laminated veneer lumber and similar glued members must be from spruce, pine or fir. This does not apply for screws or threaded rods in predrilled holes.

The screws shall be driven into softwood without predrilling or after pre-drilling. The screws shall be driven into hardwood with a maximum characteristic density of 750 kg/m³ and the threaded rods into softwood after predrilling. The drill hole diameters are:

Outer thread	Drill hole	diameter
diameter	Softwood	Hardwood
4,0	2,5	3,0
4,5	3,0	3,0
4,6	3,0	3,0
5,0	3,0	3,5
5,2	3,0	3,5
5,6	3,0	4,0
6,0	4,0	4,0
7,0	4,0	5,0

8,0	5,0	6,0
10,0	6,0	7,0
12,0	7,0	8,0
16,0	13,0	-

The hole diameter in steel members must be predrilled with a suitable diameter.

Only the equipment prescribed by SPAX GmbH & Co. KG shall be used for driving the screws.

In connections with screws with countersunk head according to Annex A the head must be flush with the surface of the connected structural member. A deeper countersink is not allowed.

Unless otherwise specified, minimum thickness for nonpredrilled structural members is t = 24 mm for screws with outer thread diameter d < 8 mm, t = 30 mm for screws with outer thread diameter d = 8 mm, t = 40 mm for screws with outer thread diameter d = 10 mm and t= 80 mm for screws with outer thread diameter d = 12mm.

Minimum distances from loaded or unloaded ends must be 15·d for screws in non-predrilled holes with outer thread diameter $d \ge 8$ mm and timber thickness t < 5·d.

Minimum distances from the unloaded edge perpendicular to the grain may be reduced to $3 \cdot d$ also for timber thickness t < $5 \cdot d$, if the spacing parallel to the grain and the end distance is at least $25 \cdot d$.

For Douglas fir members minimum spacing and distances parallel to the grain shall be increased by 50%.

For structural timber members, minimum spacing and distances for screws in predrilled holes are given in EN 1995-1-1:2008 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in predrilled holes. These minimum spacing and distances also apply for SPAX screws with CUT or 4CUT drill tip in non-predrilled holes. Here, the outer thread diameter d must be considered. For SPAX screws with CUT or 4CUT or 4CUT drill tip in non-predrilled holes the following conditions shall be fulfilled:

- $a_1 \ge 5 \cdot d$
- $a_{3,c} \ge 12 \cdot d$
- $a_{3,t} \ge 12 \cdot d$
- minimum cross-section $\ge 40 \text{ d}^2$
- screws with CUT drill tip: $t_{min} = max \{5 \cdot d; 20 \text{ mm}\} \text{ for } d \le 6 \text{ mm},$ $t_{min} = 7 \cdot d \text{ for } d \ge 8 \text{ mm}$
- screws with 4CUT drill tip: $t_{min} = max \{6 \cdot d ; 20 \text{ mm}\} \text{ for } d \le 6 \text{ mm},$ $t_{min} = 7 \cdot d \text{ for } d \ge 8 \text{ mm}$

For SPAX screws not fulfilling the above conditions or for screws in laminated veneer lumber, minimum spacing and distances are given in EN 1995-1-1:2008 clause 8.3.1.2 and Table 8.2 as for nails in nonpredrilled holes.

Alternatively, minimum distances and spacing for exclusively axially loaded SPAX screws with CUT or 4CUT drill tip or with $d \le 8$ mm in non-predrilled holes in members of solid timber, glued laminated timber or similar glued products with a minimum thickness t = 12·d may be taken as:

Spacing a_1 parallel to the grain $a_1 = 5 \cdot d$ Spacing a_2 perpendicular to the grain $a_2 = 5 \cdot d$ Distance $a_{3,c}$ from centre of the screw-part intimber to the end grain $a_{3,c} = 5 \cdot d$ Distance $a_{4,c}$ from centre of the screw-part intimber to the edge $a_{4,c} = 4 \cdot d$ Distance $a_{4,c}$ from centre of the screw-part intimber to the edge $a_{4,c} = 4 \cdot d$ Distance $a_{4,c}$ from centre of the screw-part intimber to the edge for screws with CUTor 4CUT drill tip only $a_{4,c} = 3 \cdot d$

Spacing a_2 perpendicular to the grain may be reduced from 5.d to 2,5.d, if the condition $a_1 \cdot a_2 \ge 25 \cdot d^2$ is fulfilled.

Alternatively, minimum distances and spacing for exclusively axially loaded SPAX screws in laminated veneer members (softwood) with a minimum thickness $t = 6 \cdot d$ may be taken as:

Spacing a ₁ parallel to the grain	$a_1 = 5 \cdot d$	
Spacing a ₂ perpendicular to the grain	$a_2 = 5 \cdot d$	
Distance a _{3,c} from centre of the screw-part in		
timber to the end grain	$a_{3,c} = 5 \cdot d$	
Distance a _{4,c} from centre of the screw-part in		
timber to the edge	$a_{4,c} = 3 \cdot d$	

Spacing a_2 perpendicular to the grain may be reduced from 5.d to 2,5.d, if the condition $a_1 \cdot a_2 \ge 25 \cdot d^2$ is fulfilled.

Unless specified otherwise in the technical specification (ETA or hEN) of cross laminated timber, minimum distances and spacing for screws in the plane surface of cross laminated timber members with a minimum thickness $t_{CLT} = 10 \cdot d$ may be taken as (see Annex B):

Spacing a_1 parallel to the grain $a_1 = 4 \cdot d$ Spacing a_2 perpendicular to the grain $a_2 = 2,5 \cdot d$ Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded end grain $a_{3,c} = 6 \cdot d$ Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded end grain $a_{3,t} = 6 \cdot d$ Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge $a_{4,c} = 2,5 \cdot d$ Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge

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a_{4,t} = 6 \cdot d
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Unless specified otherwise in the technical specification (ETA or hEN) of cross laminated timber, minimum distances and spacing for screws in the edge surface of cross laminated timber members with a minimum thickness $t_{CLT} = 10$ ·d and a minimum penetration depth perpendicular to the edge surface of 10·d may be taken as (see Annex B):

Spacing a ₁ parallel to the CLT plane	$a_1 = 10 \cdot d$		
Spacing a_2 perpendicular to the CLT plane $a_2 = 4 \cdot d$			
Distance $a_{3,c}$ from centre of the screw-part in			
timber to the unloaded end	$a_{3,c} = 7 \cdot d$		
Distance a _{3,t} from centre of the screw-part in			
timber to the loaded end	$a_{3,t} = 12 \cdot d$		
Distance a _{4,c} from centre of the screw-part in			
timber to the unloaded edge	$a_{4,c} = 3 \cdot d$		
Distance a _{4,t} from centre of the screw-part in			
timber to the loaded edge	$a_{4,t} = 6 \cdot d$		

For SPAX screws or threaded rods in predrilled holes the above requirements for minimum thickness do not apply.

For crossed screw couples the minimum spacing between the crossing screws is given in Annex B.

Minimum distances and spacings for SPAX screws in mechanically jointed beams are given in Annex B.

4 Attestation and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 97/176/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 3.

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 2020-01-07 on

Thomas Bruun Managing Director, ETA-Danmark

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Drawings, designation and material specification of SPAX screws

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40	38,5	41,0		22,0	36,0	23,0	35,0	23,0	35,0		34,0	25,0	35,0	27,0	34,0	
45	43,5	46,0		28,0	36,0	28,0	40,0	30,0	40,0	30,0	39,0	30,0	39,0	30,0	38,0	29,0
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45	43,5	46,0			36,0	28,0	40,0	30,0	42,5	30,0	42,0	30,0	41,0	30,0	41,0	29
50	48,5	51,0				28,0		32,0	47,5		47,0	32,5	46,0	32,0	46,0	32
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termediate	e lengths on	Ls possible														

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		PAX					Self-	tappin	ig scre	ew wit	h full	and p	artial t	thread		
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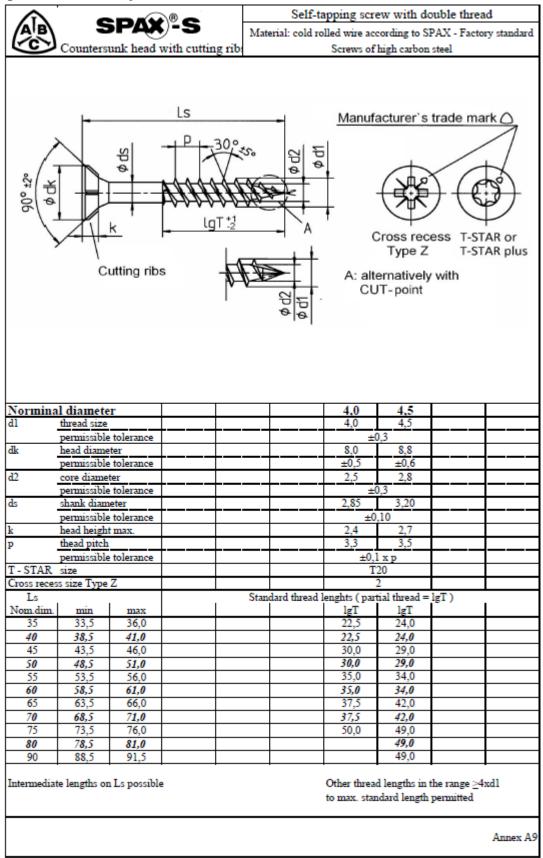
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30	28,5	30,5		18,0	26,0	18,0		18,0	25,0	18,0			25,0		24,0	
35	33,5	36,0		22,0	31,0	23,0	30,0	23,0	30,0	22,5		25,0	30,0		29,0	
40	38,5	41,0		22,0	36,0	23,0	35,0	23,0		22,5	34,0		35,0	27,0	34,0	
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65	63,5	66,0						40.0	50,0						58,0	
70	68,5	71,0						70,0							61,0	
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80	78,5	81,0								37,5		47,0			61,0	
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20	18,5	20,5	18,0	-	18,0		18,0		18,0							
25	23,5	25,5	23	18,0	23,0				23,0		22,5		22,0			
30	28,5	30,5	28,0		28,0				27,5		27,5		27,0		27,0	
35	33,5	36,0		22,0	33,0	23,0			32,5		32,5	25,0	32,0		32,0	
40	38,5	41,0		22,0	36,0	23,0	37,0	4	37,5	4	37,0	25,0			37,0	
45	43,5	46,0		28,0	36,0	28,0		30,0	42,5		42,0	30,0	41,0	30,0	41,0	29,
50	48,5	51,0				28,0		32,0	47,5	32,5	47,0	32,5	46,0	32,0	46,0	32,
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120	118,5	121,5												69,0		68
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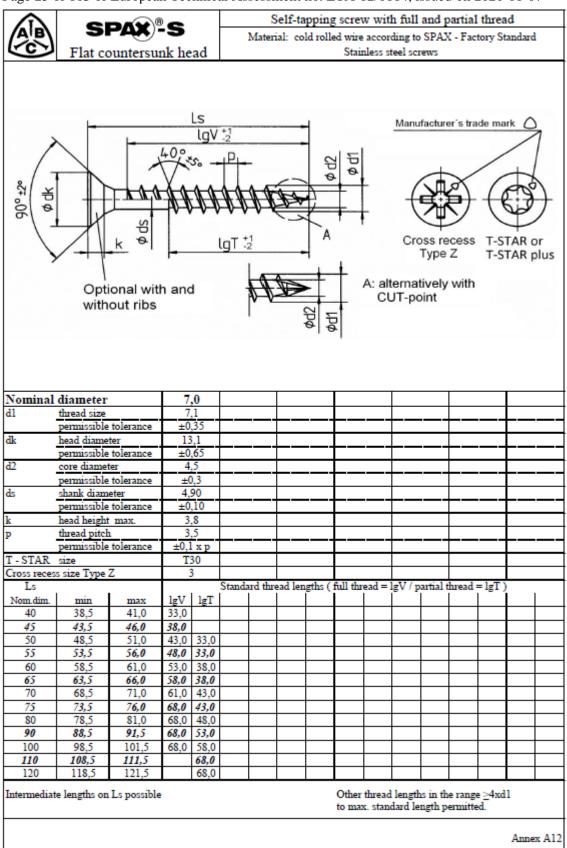


Countersunk with head hole Screws of high carbon steel Manufacture's trade mark Manufacture's trade mark $\frac{5}{6}$ $\frac{5}{6}$ $\frac{10}{6}$ $\frac{10}{10}$		SI	PAX®-S				w with ful			
Manudackurer's trade mark Is Manudackurer's trade mark Cross recess: T-STAR or Type Z Cross recess: T-STAR or Type Z Optional with and without ribs A: alternatively with CUT-point Nominal diameter 4.0 4.0 4.5 5.0 Cord second se	(25)						-	-	Standard	
Nominal diameter Cost recess: T-STAR or Type 2 Cost recess: T-STAR or Cost recess: T-STAR or Type 2 A: alternatively with CUT-point A: alternatively with CUT-point alternatively with CUT-point <th colspane<="" t<="" td=""><td>$\underline{\circ}$</td><td>Counters</td><td>sunk with head hole</td><td>e</td><td>S</td><td>crews of hig</td><td>h carbon ste</td><td>el</td><td></td></th>	<td>$\underline{\circ}$</td> <td>Counters</td> <td>sunk with head hole</td> <td>e</td> <td>S</td> <td>crews of hig</td> <td>h carbon ste</td> <td>el</td> <td></td>	$\underline{\circ}$	Counters	sunk with head hole	e	S	crews of hig	h carbon ste	el	
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ds2 shank diameter permissible tolerance 3,60 3,80 4,10 o k head height max. 2,4 2,7 2,9 3 p thread pitch permissible tolerance 2,0 2,2 2,5 3 p thread pitch permissible tolerance 2,0 2,2 2,5 3 Cross recess size Z 2 72 72 7 7 Ls Standard thread lengths (full thread = lgV) 720 7 7 Nom.dim min max 1gV 1gV 1gV 1 25 23,5 26,0 18,0 7 7 7 7 7 30 28,5 31,0 23,0 20,0 7				+	┝───	2,00			4,50	
permissible tolerance $\pm 0,10$ $\pm 0,2$ k head height max. $2,4$ $2,7$ $2,9$ 3 permissible tolerance $2,0$ $2,2$ $2,5$ 3 permissible tolerance $\pm 0,1 x p$ 2 0 $2,0$ $2,2$ $2,5$ 3 Cross recess size Z 2 2 2 $1 x p$ 2 $1 x p$ Ls Standard thread lengths (full thread = lgV) $1 gV$ <td></td> <td></td> <td></td> <td></td> <td></td> <td>3.60</td> <td></td> <td></td> <td>ohne</td>						3.60			ohne	
k head height max. 2,4 2,7 2,9 3 p thread pitch permissible tolerance 2,0 2,2 2,5 3 Cross recess size Z 2 2 1 x p 7 1 x p Cross recess size Z 1 1 1 1 1 1 Ls Standard thread lengths (full thread = lgV) 1				-+	<u>+</u> -				onne	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $		•		_					3,4	
permissible tolerance $\pm 0,1 ext{ x p}$ Cross recess size Z 2 T-STAR (plus) size T20 Ls Standard thread lengths (full thread = lgV) Nom.dim max 125 23,5 20,0 18,0 30 28,5 31,0 23,0 30 28,5 31,0 27,5 25,0 31,0 30 28,5 31,0 27,5 25,0 30,0 35 33,5 36,0 27,5 40 38,5 41,0 32,5 30,0 30,0 45 43,5 46,0 37,5 51,0 44,5 51,0 44,0 60 58,5 61,0 50,0 47,5 44,0 60 58,5 70 68,5 71,0 59,0 59,0 61,0									3,0	
Cross recess size Z 2 120 1 I-STAR (plus) size Standard thread lengths (full thread = lgV) IgV lgV lgV<										
Ls Standard thread lengths (full thread = lgV) Nom.dim min max lgV lgV <td>loss reces</td> <td>s size Z</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>-</td> <td>3</td>	loss reces	s size Z						-	3	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	C-STAR (p	lus) size							T30	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $				Sta	undard thread					
$\begin{array}{c c c c c c c c c c c c c c c c c c c $							lgV	lgV	lgV	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		4				· · · · · · · · · · · · · · · · · · ·	20.0			
$\begin{array}{c c c c c c c c c c c c c c c c c c c $										
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$								20.0		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		-								
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$		-						*	41,0	
60 58,5 61,0 50,0 49,0 49,0 55 65 63,5 66,0 54,0 54,0 55 70 68,5 71,0 59,0 61,0 66 75 73,5 76,0 59,0 61,0 66 80 78,5 81,0 59,0 61,0 66 90 88,5 91,5 59,0 61,0 66 100 98,5 101,5 61,0 66 69,0 61,0 66						-			46,0	
65 63,5 66,0 54,0 54,0 55 70 68,5 71,0 59,0 61,0 66 75 73,5 76,0 59,0 61,0 66 80 78,5 81,0 59,0 61,0 66 90 88,5 91,5 59,0 61,0 66 100 98,5 101,5 61,0 66 110 108,5 111,5 69,0 66									51,0	
70 68,5 71,0 59,0 61,0 60 75 73,5 76,0 59,0 61,0 6 80 78,5 81,0 59,0 61,0 6 90 88,5 91,5 59,0 61,0 6 100 98,5 101,5 61,0 6 110 108,5 111,5 69,0 6			-			-			56,0	
75 73,5 76,0 59,0 61,0 6 80 78,5 81,0 59,0 61,0 6 90 88,5 91,5 59,0 61,0 6 100 98,5 101,5 61,0 6 110 108,5 111,5 69,0 6		-					59,0	61,0	61,0	
90 88,5 91,5 59,0 61,0 6 100 98,5 101,5 61,0 6 110 108,5 111,5 69,0 6							59,0	61,0	61,0	
100 98,5 101,5 61,0 6 110 108,5 111,5 69,0 6			-				-		61,0	
110 108,5 111,5 69,0 6	90	~	4				59,0		61,0	
		-							61,0	
100 110 101 101 200 2								*	68,0	
	120	118,5	121,5					69,0	68,0	
									68,0	
									68,0	
									68,0	
160 158,0 162,0 6	160	158,0	102,0						68,0	

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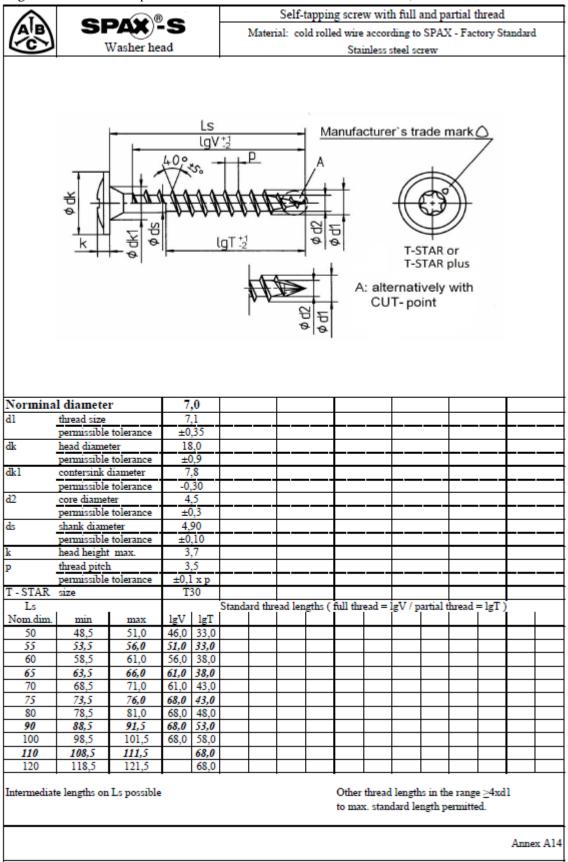
									screv							
AB	S	PAX	-S												andard	l
\odot	Flat co	ountersu	nk he	ad							teel sci					
000≠20		ptional w		££3	/ <u>*1</u> +P -			ød1 = v = 0 d2			Cross of Type	reces: e Z	s T-S	TAR C		
Nominal						,0	3		_	,0		,5		,0		,0
d1 .	thread size permissible	tolerance	┣—		3	,0	3,	,5	4	,0 +(<u>4</u>	,5	5	,1	6	,1
	head diame	ter			6	, 0	7	,0	8	,0		,8	9	,7	11	,6
	permissible						±0			_				0,6		
	core diamet permissible		┣──			,1 ,30	2	,4	2	8		.0).3	3	,4	3	,8
ds	shank diam					25	2,	60	3,	00		30	3,	75	4,	30
permissible tolerance ±0,10																
k head height max. 1,8 2,1 2,4 2,7 2,9 3,4																
р.	thread pitch permissible		┣──			,>		,ð	2		2 xp	,2	2	,)	3	,0
T-STAR	size	tolerance			Т	10	T15	/ T20			20		T	25	Т	30
Cross recess	s size Type (Z]	l					2					3
Ls									full thr							
Nom.dim. 15	min 14,0	max 15,5	Igv	lgT	lgV 12,5	lgT	lgV	IgI	Igv	lg1	Igv	IgT	Igv	IgT	lgV	lg1
16	16,0	17,5			14,0											
20	18,5	20,5			17,0		16,0		16,0							
25	23,5	25,5			21,0	18,0		18,0	21,0		20,0		20,0			
30	28,5	30,5			26,0	18,0	25,0			18,0	-		25,0		24,0	
35 40	33,5 38,5	36,0 41,0			31,0 36,0	23,0 23,0		23,0 23,0			30,0 34,0		30,0 35,0		29,0 34,0	24,0 24,0
45	43,5	46,0			36,0	28,0		30,0		30,0		30,0	39,0	30,0	38,0	29.0
50	48,5	51,0													43,0	
55	53,5	56,0				36,0					49,0				48,0	
60	58,5	61,0							50,0						53,0	
65 70	63,5 68,5	66,0 71,0	<u> </u>					40,0		37,5	59,0 59,0	42,0	59,0	41,0	58,0 61,0	41,0
75	73,5	76,0								37,5	59,0	42,0				
80	78,5	81,0								37,5		47.0				46,0
90	88,5	91,5										47,0	,-	61,0		61,0
100	98,5	101,5												61,0		61,0
110	108,5	111,5												69,0		68,0
120	118,5	121,5												69,0		68,0
130 140	128,0 138,0	132,0 142,0														68,0 68,0
140	138,0	142,0														68,0
160	158,0	162,0														68,0
Intermediate											length dard le				1	
															Anne	x A11

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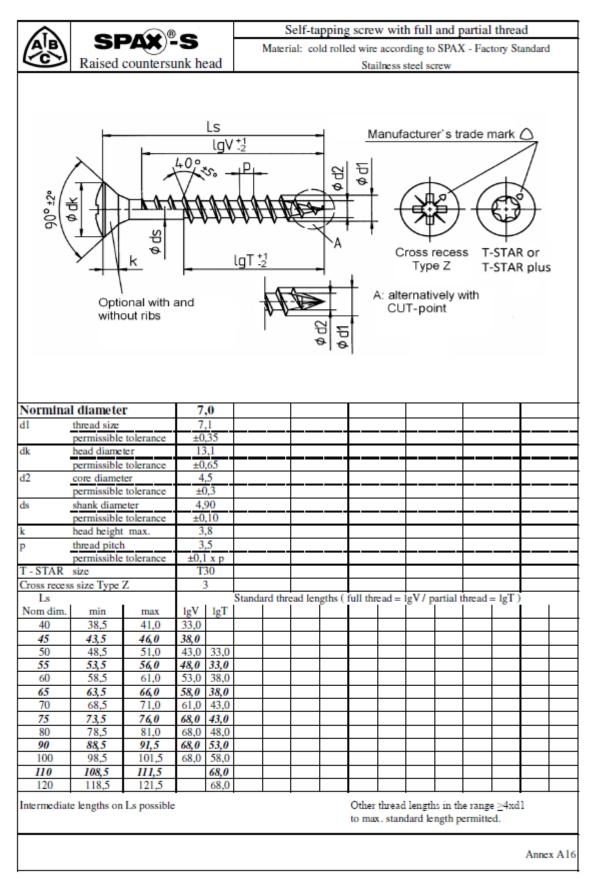
	~			Self	f-tapp	ing so	rew v	vith f	ull an	d part	tial th	read		
		AX®-S	М	aterial:	cold 1				-		Factory	Stand	lard	
Ś	Wa	sher head		1.2		5	stainles	is steel	screw	s				
	k2 alternativ geometry		edd edd edd edd	Ls IgV % + IgT			F+ -		Cross Typ atively wont	HECESS a Z	T-ST			
Nominal	diameter			3,0	3	,5		,0	4	,5	5	,0	6	,0
dl	thread size			3,0	3	,5	4	,0		,5	5	1	6	,1
-11-	permissible			10		~						~	1.	
dk	head diame			7.9	8	,6	9	,6),6	11	.,6		3,6 ,65
dkl	contersink			0,5 1,9	1	.9	<	.0	0,6	.4		.9		,65 .9
	permissible			,2	4	, 9	ر		.20	, •		2	0	2
dk2	diameter	. toterance		4.0	5	1	5	.2		3	6	.6	7	.5
	permissible	tolerance		.,				<u>-</u>	_	,		-	,	
d2	core diame			2,1	2	.4	2	.8	-	.0	3	.4	3	.8
	permissible			0.30					±					
ds	shank diam	eter		,25	2,	60	3,	00		30	3,	75	4,	30
	permissible	e tolerance						±0	,10					
kl	head height	t max.		1,5	1	,8	1	,9	2	,0	2	,2	2	,4
k2	head height		(0,9	-	,0	1	,3		5	1	,5		,0
k3	head height	t max.		1,2		,3				,5			_	,8
р	thread pitcl			1,5	1	,8	2	,0		,2	2	,5	3	,0
	permissible	e tolerance							l x p		_		_	
T - STAR			1	10	T15	/ T20		Т	20		T	25	T	30
	s size Type	Z							2					
Ls		.		lard thr	ead len					artial t		=lgT)		
Nom.dim.	min	max	lgV		lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT
12	12,0	13,5	13,0											
15	16,0	17,5	14,0											
16	16,0	17,5	15,0		15,0									
20	18,5	20,5	18,0	12,5	18,0		18,0							
25	23,5	25,5	23,0	18,0	23,0	18,0	23,0		22,5		22,0			
30	28,5	30,5	28,0	18,0	27,0	18,0	27,5	18,0	27,5		27,0		27,0	
35	33,5	36.0	33.0	-	32,0	23,0	32,5	23.0	32,5	25.0	32.0	25.0	32.0	24,0
40	38,5	41,0		23,0			37,5			<u> </u>			<u> </u>	
45	43,5	46.0		28.0			42,5							
50	48,5	51.0		28,0			47,5		47.0	32,5	46.0		46,0	
55	53,5	56,0	├ 	36.0			50,0		52.0	37.0	51.0			
60	58,5	61.0	+	20,0	<u> </u>		50,0				56,0			
65	63,5	66,0	+	-	<u> </u>	40.0	50,0	37,5		42,0			61,0	
70	68,5	71,0	+	-	-	40,0		37,5	59,0	42,0		41,0		
70	73,5	76,0	┼─╂──	+	<u> </u>			37,5	39,0	42,0			61,0	
			┼─╂──	+	<u> </u>			37,5						
80 90	78,5	81,0 01.5	+ $-$					37,3		47,0	61,0	46,0	61,0	46,0
	88,5	91,5	┼─┠──	-						47,0		61,0		61,0
100	98,5	101,5	┼─┠──	-								61,0		61,0
110	108,5	111,5	┼─┠──	-								69,0		68,0
120	118,5	121,5			L							69,0		68,0
130	128,5	131,5			L									68,0
140	138,5	141,5												68,0
150	148,5	151,5												68,0
160	158,5	161,5												68,0
Intermediat		Ls possible					Other	thread	length	s in th	e range	e>4xd	1	
	-	-					to max	x. stan	dard le	ngth p	ermitte	d		
													A	x A13
													Anne	AAD

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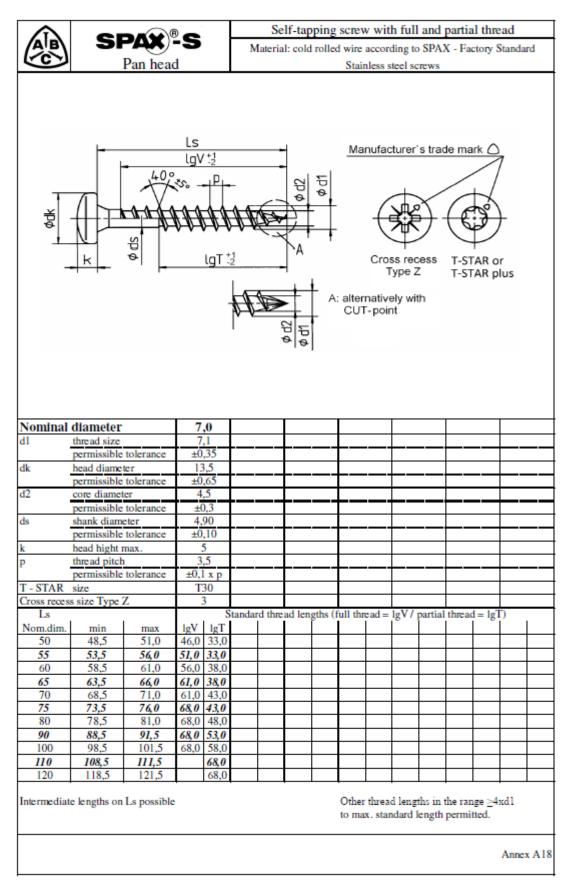
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AB	SF				S	elf-ta	pping	g screv ed wire	v wit	h full	and p	artial	threa	d	
60	Raised	countersu	ınk head					Stai	nless s	teel sci	rews				
	λ^{\uparrow}		Ls lg\ 40°,*% -	/ <u>*1</u>			al		nufact	turer's	s trade	e mari	× A		
90° ±2°	ă È				Ł		X 4d2	10¢	() {	E	s)		
	Y	k k		lgT 🏅	1		`A 			ss rec Type Z		T-ST/ T-ST/	AR or AR plu	JS	
		l tional with hout ribs	and		t E		¢ di			nativel point	y with				
Normina	l diameter	r		3	.0	3	,5	4	.0	4	,5	5	,0	6	,0
dl	thread size		L		,0 ,0	3	,5 ,5	4	0	4	,5	5			,1
permissible tolerance ±0,3 dk head diameter 6,0 7,0 8,0 8,8 9,7 11,6														6	
ar .	permissible				,0),5	0	<u>.</u>		,o		0,6		.,0
d2	core diamet				,1	2	,4	2	,8		,0	3	,4	3	,8
ds	permissible shank diam				,30 25	2	60	2	00),3 30	2	75	4	30
	permissible		<u> </u>	<u></u> ,	23	4,	00	э,		.10	50	э,	15	4,	50
k	- head hight 1	max.			,8		,1		,4		,7		,9		,4
	thread pitch		<u> </u>	1	,5	1	,8	2	0		,2	2	,5	3	,0
T - STAR	permissible size	tolerance		т	10	T15	/ T20			l x p 20		т	25	т	30
Cross reces		Z			1					2					3
Ls								full thr							
Nom.dim. 15	min 14,0	15,5		lgV 12,5	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT
16	16,0	17,5		14,0											
20	18,5	20,5		-	12,5	-		16,0							
25	23,5	25,5		22,0		21,0			10.0	20,0		20,0		24.0	
30 35	28,5 33,5	30,5 36,0		26,0 31,0			18,0 23.0	25,0 30,0			25.0	25,0 30.0	25.0	24,0 29,0	24.0
40	38,5	41,0						35,0							
45	43,5	46,0		36,0	28,0	40,0	30,0	40,0	30,0	39,0	30,0	39,0	30,0	38,0	29,0
50 55	48,5 53,5	51,0 56,0			28,0 36.0	40,0		45,0 50,0							
60	58,5	61,0			30,0					49,0 54,0	37,0			48,0 53,0	
65	63,5	66,0					40,0			59,0	42,0			58,0	
70	68,5	71,0							37,5	59,0	42,0		41,0		41,0
75 80	73,5 78,5	76,0 81,0						—	37,5 37,5		42,0 47,0		41,0 46,0	61,0 61,0	41,0 46,0
90	88,5	91,5							57,5		47,0	01,0	40,0 61,0	01,0	40,0 61,0
100	98,5	101,5											61,0		61,0
110	108,5	111,5											69,0		68,0
120 130	118,5 128,0	121,5											69,0		68,0 68,0
130	128,0	132,0 142,0		+											68,0
150	148,0	152,0													68,0
160	158,0	162,0													68,0
Intermediat	e lengths on	Ls possible								l length dard le				1	
														Anne	x A15



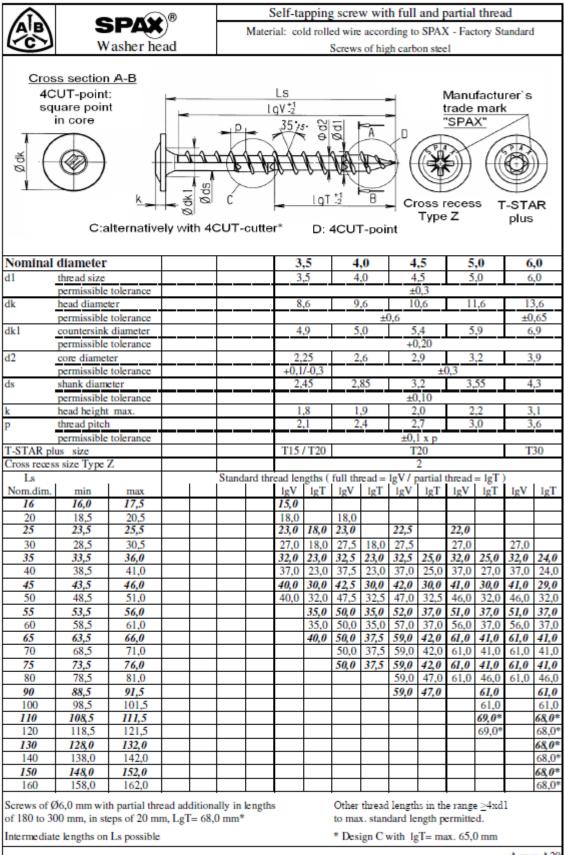
A B S	PAX -S															
S	Pan head		Stainless steel screws													
Ls Manufacturer's trade mark igV :1/2 igV :1/2 igV :1/2																
dl thread si	Nominal diameter				3,0 3,5 4,0 4,5 3,0 3,5 4,0 4,5 ±0,3 ±0,3 ±0,3 ±0,3						, 0 ,1		/			
	ble tolerance	,0							5	,.	0	4,0 3,0 T30 3 V lgT				
dk head dia	6	,0			8,			,0	9	,9	11	,9				
permissible tolerance			1	±0		-	0	-	0),6		0			
d2 core dia		,1 30	2,	4	2,	8		,0),3	3,4 3,8							
	ds shank diameter			2,60		3,00		3,30		3,75		4,30				
permissible tolerance								0,10								
k head hight max.			2,3		2,5		2,9		3,1		3,4					
·	p thread pitch			1,8		2,0		2,2		2,5		3,0				
T - STAR size	permissible tolerance T - STAR size			T10 T15/T2		±0,1 x p T20				T25		T30				
Cross recess size Ty	oe Z		1					2				-				
Ls		Standar	d thre	ad len	gths (f	ull thr	ead =	lgV/	partial							
Nom.dim. min 15 14.0	15,5	1gV 13,0	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lg∨	lgT			
16 16.0	17,5	15.0		15,0												
20 18,5	20,5		12,5	18,0		18,0										
25 23,5	25,5	23,0	18,0	23,0		23,0		22,5		22,0						
30 28,5 35 33,5	30,5 36,0	28,0 33,0	18,0 23,0	27,0 32,0		27,5 32,5,		27,5	25.0	27,0	25.0	27,0 32,0	24.0			
40 38,5	41,0	36,0	23,0					37,0		37,0		37,0				
45 43,5	46,0	36,0		51,0								41,0				
50 48,5	51,0		28,0		32,0	47,5	32,5	47,0	32,5	46,0	32,0	46,0	32,0			
55 53,5	56,0		36,0									51,0				
60 58,5 65 63,5	61,0 66,0				35,0 40.0	50,0			37,0 42,0			56,0 60,0				
70 68,5	71,0				,0		37,5	59,0			41,0					
75 73,5	76,0						37,5		42,0	61,0	41,0	60,0	41,0			
80 78,5	81,0						37,5		47,0	61,0		60,0				
90 88,5 100 98,5	91,5 101,5								47,0		61,0 61,0		61,0 61,0			
110 98,5											69,0		68,0			
120 118,5	121,5										69,0		68,0			
130 128,0													68,0			
140 138,0 150 148,0	142,0												<u>68,0</u>			
150 148,0 160 158,0													68,0 68,0			
Intermediate lengths		-	·						ths in t ength				x A17			

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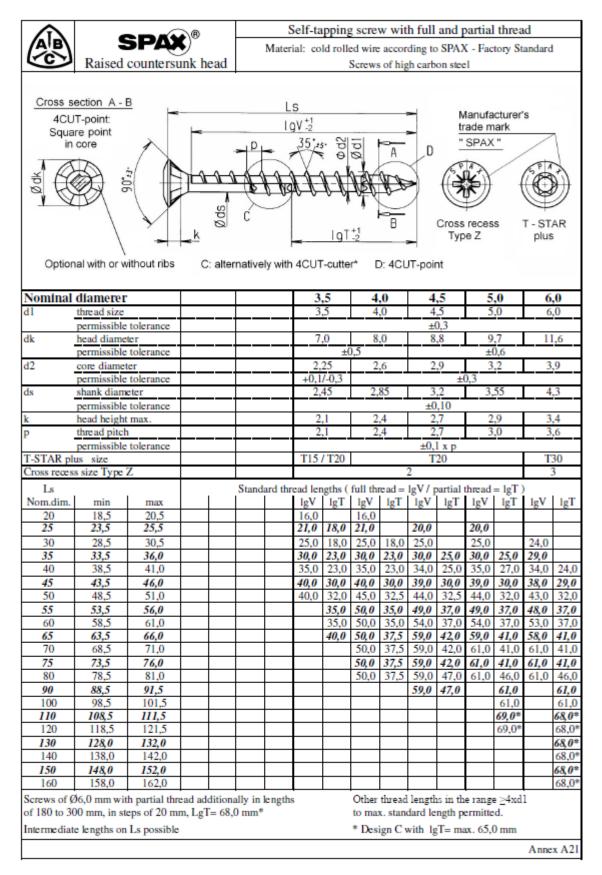


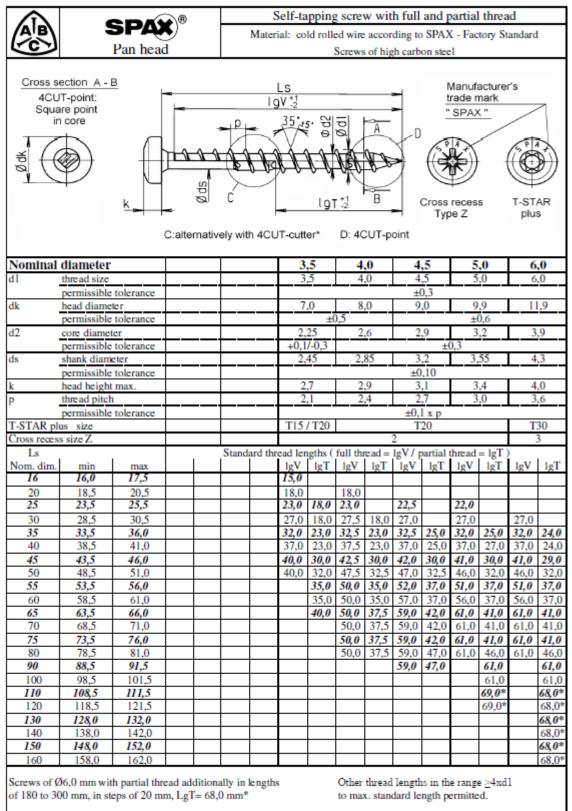
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(I)	<	5PAX	Self-tapping screw with full and partial thread Material: cold rolled wire according to SPAX - Factory Standard K head Screws of high carbon steel												
(AIB)		\sim													
0	Flat c	ountersun	k head				Serev	ws of h	igh car	bon st	eel				
	723				10										
	and a state of the	ction A - B		LS Manuf									5		
4CUT-point Square point					IgV 1 trade n "SPAX"										
	in	core	λ	-	P= 7	35:15	0 d2	ing t	A	0	- 27		/	. 1	
	XA	A .=/	Die	-0-0-	000	X	0.6	山谷	-	8 9	SE	A	6	The	
	ğ (£		HP-	a u u	BY NG	11	111		D)	((3))))	((@	\mathfrak{O}	
	1 4	F 1	A	ŝ	X		. 1	TY	1		Y	1	6	Ð	
	/		Y k	Øds	ć I		IgT:	1 1	B	C	ross re			STAR	
	/		-1-1-		5 I				-		Туре .	Z	- 0	plus	
	Optional	with or withou	t ribs	C: 8	Iternatively	y with 4	CUT-0	cutter*		D: 4CI	JT-poin	t			
												_			
	diameter					,5		,0		,5		,0		5,0	
d1	thread size				3	,5	4	,0		,5	5	,0		5,0	
dk	permissible head diame			-		10	1 0	0		0,3		~		1.7	
GK.	permissible	the state of a second s				,0	0.5	,0	8	,8		,6),6	11	1,6	
d2	core diame				2	25	_	.,6	2	0		.2		3,9	
permissible tolerance					+0,1/-0,3			2,0		2,9		:0,3			
ls	shank diam					45	2	.85	3.	20		55	4	.30	
permissible tolerance							1		±0,10		here the state of		Lannadiana		
¢	head height max.				2	,1	2,4		2,7		2,9		3,4		
p thread pitch					2	.,1	2,4			2,7 3,		0 3,6		3,6	
	permissible	tolerance				2010115		44 4		lxp	1000000				
T-STAR pl					T15	/T20				20			_	30	
	ss size Type	Z							2					3	
Ls Nom.dim.	1	í mar	1 1	Standar	d thread le							1.0.7		1.00	
20	min 18,5	max 20,5	-		lgV 16,0	lgT	lgV 16,0	lgT	lgV	lgT	lgV	lgT	lgV	lgʻl	
25	23,5	25,5	-		21,0	18,0	21,0	-	20,0		20,0		-		
30	28,5	30,5	-		25,0	18,0	25,0	18,0	25,0		25,0	-	24,0		
35	33,5	36,0			30,0	23,0	30,0		30,0	25,0	30,0	25,0	29,0		
40	38,5	41,0			35,0	23,0	35,0	23,0	34.0	25,0	35,0	27.0	34.0		
45	43,5	46,0			40,0	30,0	40,0	30,0	39,0	30,0	39,0	30,0	38,0	29,0	
50	48,5	51,0			40,0	32,0	45,0	32,5	44,0	32,5	44,0	32,0	43,0	32,0	
55	53,5	56,0				35,0	50,0	35,0	49,0	37,0	49,0	37,0	48,0	37,0	
60	58,5	61,0	_		_			35,0		37,0	54,0	37,0	53,0	Sector Sector	
65	63,5	66,0				40,0		37,5	59,0	42,0	59,0	41,0	58,0		
70	68,5	71,0			-			37,5	64,0	42,0	64,0	41,0	61,0		
75 80	73,5 78,5	76,0 81,0					50,0	37,5	69,0 74,0	42,0	69,0 74,0	41,0 46,0	<i>61,0</i> 61,0		
90	88,5	91,5	-		-		50,0	51,5	74,0	47,0	74,0	46,0	01,0	46,0	
100	98,5	101,5							04,0	47,0	94.0	61,0		61,0	
110	108,5	111,5									104,0			68,0	
120	118,5	121,5									114,0			68,0	
130	128,0	132,0												68,0	
140	138,0	142,0												68,0	
150	148,0	152,0												68,0	
160	158,0	162,0				-	1		-	8.2			1	68,0	
crews of Ø	06.0 mm wit	h partial threa	d additions	ally in le	noths		Other	thread	length	s in th	e range	>4xd1			
		eps of 20 mm,			- Child						ermittee				
1 100 10 30									1001100-000	Sec. P.		20.04			
1 100 10 50															
	e lengths on	Ls possible					* Desi	ign C v	vith lg	T= ma	x. 65,0	mm			



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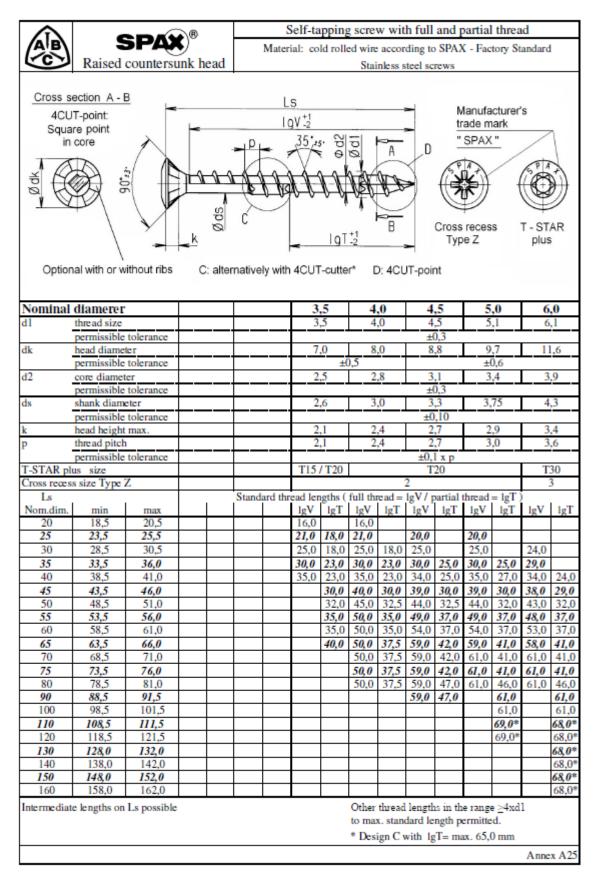
Intermediate lengths on Ls possible

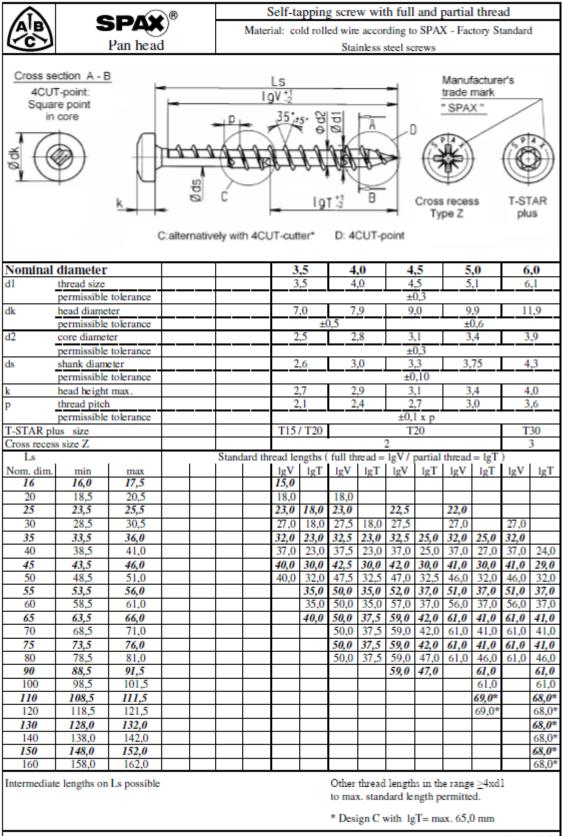
* Design C with 1gT= max. 65,0 mm

	-	Self-tapping screw with full and partial thread													
(A!B)	Flat countersunk head				Material: cold rolled wire according to SPAX - Factory Standard										
600	Flat co	Stainless steel screws													
Square in c	-point: point		C alternat	tal	35.45				D: 40		trac "SP reces pe Z	nufact de mar AX"	K T-ST	TAR	
Nominal o	liameter				3.	.5	4	.0	4	.5	5	.0	6	.0	
d1 <u>t</u>	hread Size				3			,0	4	,5		,1		,1	
<u> </u>	permissible				-	0	0	0		0,3		7			
	dk head diameter permissible tolerance				7,		8,0 0,5		8,8		9,7 ±0.6		11,6		
	core diamet				2,		-	,8	3	,1		,4	3	,9	
	permissible									0,3					
	shank diam				2,	,6	3	,0		,3	3,	75	4	,3	
	permissible head height				2	1	2	.4		,10 .7	2	.9	3	.4	
P thread pitch				2,1			2,4 2,7			3,0		3,6			
I	permissible									lxp					
T-STAR plu		7			T15/	/ T20				20				30	
Cross reeces Ls	s size Type	L	Standa	rd the	and lan	athe (full the	mad -	2 1aV / 1	artial	throad	- 1aT		3	
Nom.dim.	min	max	otanua	ia un	lgV	lgT	lgV	lgT	lgV	lgT	1gV		lgV	1gT	
20	18,5	20,5			16,0		16,0							-	
25	23,5	25,5			21,0		21,0		20,0		20,0				
30 35	28,5	30,5			25,0		25,0		25,0	25.0	25,0	25.0	24,0	<u> </u>	
40	33,5 38,5	36,0 41,0	$\left \right $		30,0 35,0		30,0 35,0	23,0 23,0	30,0 34,0	25,0 25,0	35,0	25,0 27,0	29,0 34,0	24,0	
45	43,5	46,0			40.0		40,0	30,0	39,0			30,0			
50	48,5	51,0			40,0	32,0	45,0	32,5	44,0	32,5	44,0	32,0	43,0	32,0	
55	53,5	56,0					50,0					37,0			
60 65	58,5	61,0	$\left \right $				50,0 50,0		54,0 59,0		54,0			37,0	
70	63,5 68,5	66,0 71,0	+			40,0			59,0	42.0	61.0	41,0 41,0	61.0	41,0	
75	73,5	76,0						37,5	59	42,0		41,0			
80	78,5	81,0					50,0	37,5		47,0	61,0	46,0	61,0	46,0	
90	88,5	91,5							59,0	47,0		61,0		61,0	
100 110	98,5 108,5	101,5 111,5	$\left \right $									61,0 69,0*		61,0 68,0*	
120	118,5	121,5	+								-	69,0*		68,0*	
130	128,0	132,0												68,0*	
140	138,0	142,0												68,0*	
150	148,0	152,0												68,0*	
160 Intermediate	158,0 lengths on	162,0 Ls possible							length dard le			e ≥4xd :d.	1	68,0*	
							* Desi	ign C v	vith lg	T= ma	ax. 65,	0 mm	Anne	x A23	

	-		B	5	Self-ta	pping	g screv	w wit	h full	and p	oartia	l threa	ıd	
		SPAX		Mater	ial: co	ld rolle			~		C - Fac	tory St	tandard	I
9	w	asher he	ad				Stai	nless s	teel sc	rews				
4C squ	C:a	it k	Iy with 40		Ls <u>av *1</u> <u>35</u> *	6 7 1 1 1 1	Ŵ	B T-poi	'	K	trade "SP/			
Nominal	diamatar					-	4	0	4	5		0	6	0
Nominal dl	thread size				3	, 5		,0 .0		,5 ,5				,0 .1
	permissible	tolerance				<u>, </u>	4	,0		0,3		,1	0	,1
dk	head diame				8	,6	9	,6	_),6	1	1,6	13	3,6
	permissible					-),6					,65
	countersink				4	9	5	,0		,4	5	,9	6	,9
L	permissible core diamet				0	,5	0	.8	+0	,20	2	4	2	.9
	permissible					,	2	,0		0.3		,4		,9
	shank diam				2	,6	3	,0	_	,3	3.	75	4	,3
	permissible	tolerance						-	±0	,10				
	head height				_	,8	_	,9		,0		-	_	,1
*	thread pitch				2	,1	2	,4		,7	5,0 5,1 11,6 5,9 3,4 3,75 2,2 3,0 2,2 3,0 5,0 2,2 3,0 5,0 10,0		3	,6
L	permissible	tolerance			7716	/ T20				l x p 20			т	30
T-STAR plu Cross recess	s size Type 2	7			115	120				20			1	50
Ls	said type			Standard thr	ead ler	gths (full th	read =	lgV/ r	artial	thread	= lgT)	
Nom.dim.	min	max			1gV	lgT	lgV	lgT	lgV	1gT	1gV	lgT	1gV	1gT
16	16,0	17,5			15,0									
20	18,5	20,5			18,0	10.0	18,0		22.5		22.0			
25	23,5	25,5			23,0		23,0	10.0	22,5				27.0	
30 35	28,5 33,5	30,5 36,0			27,0 32,0		27,5 32,5	18,0 23,0	27,5 32,5	25,0		25.0	27,0 32,0	24.0
40	38.5	41.0			37.0	23,0	37.5	23.0	37,0	25.0			37,0	
45	43,5	46,0			40,0	30,0	42,5		42,0	30,0			41,0	29,0
50	48,5	51,0			40,0	32,0	47,5	32,5	47,0	32,5	46,0	32,0	46,0	32,0
55	53,5	56,0						35,0	52,0				51,0	
60	58,5	61,0												
65 70	63,5 68,5	66,0 71,0			<u> </u>	40,0	50,0							
75	73,5	76,0		├ ─- ├ ──				37,5	59,0 59,0		_	_		
80	78,5	81,0					50,0	0140	59,0					46,0
90	88,5	91,5							59,0			61,0		61,0
100	98,5	101,5							-	-		61,0		61,0
110	108,5	111,5										69,0*		68,0*
120	118,5	121,5			I							69,0*	 	68,0*
130 140	128,0 138,0	132,0 142,0											<u> </u>	68,0* 68,0*
140	138,0	142,0												68,0*
160	158,0	162,0												68,0*
Intermediate		Ls possible		-	-		to ma	x. stan	dard le	ngth p	ermitte	:d.		x A24

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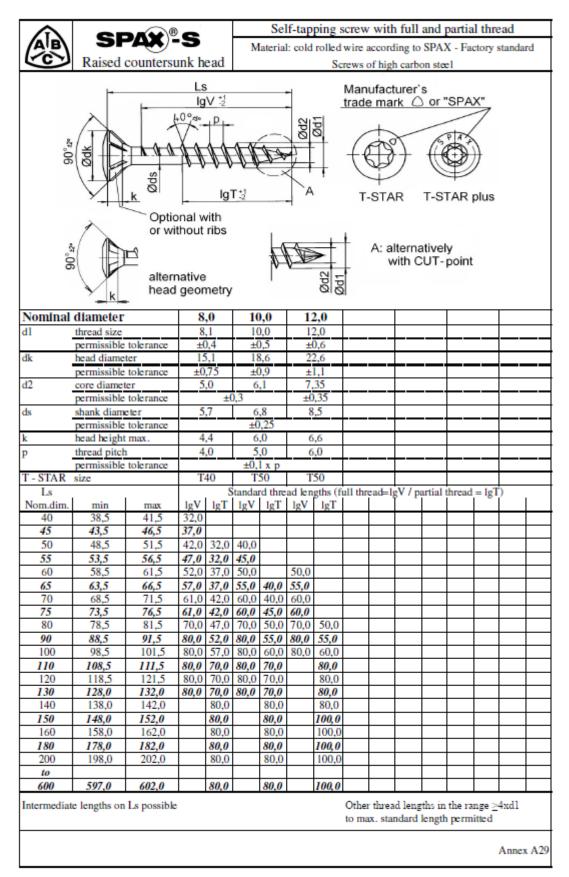


AIA	S	PAX	°-S											actory		-1
3		untersu				Materi	al: col			e acco s of hi	~			actory	standar	a
	1 100 00				I							DOIL 3				
			Ls	s gV <u>*</u> 1		-	-			factu mark		or "S	PAX			
	>	<u> </u>	<u>اي</u> 40°,عه		_		-		ue	main	0	01 0		1		
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		k QI	_	lg	T +1 -2		- `A		Т	-STA	٨R	T-S	TAR	plus		
	, li		'													
	. A	> Optic					_									
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	k				1		Ød1									
Vondere	diamata	-	0	0	14						_					
Nomina d1	diamete thread size	ſ		,0 .1	_),0),0		.,0			┢		+		+	
	permissible	tolerance),4),5		.,6			+				1	
dk	head diame		15	5,1	- 18	3,6		,6								
	permissible			,75		3,9	±									
12	core diamet permissible		5	,0 +(0.3	,1		35 ,35			+					
ds	shank diam		5	,7	_	.8	8				+		+		+	
	permissible					,25										
k	head height			,4		,0		,6								
p	thread pitch permissible		4	,0		<u>,0</u> Іхр	6	,0			┢					
T - STAR		torerance	Т	40		50	T	50			+		+		+	
Ls									full t	hread=	lgV/	partia	threa	d = lgT)	
Nom.dim. 40	min 38,5	41.5	1gV 32.0	lgT	1gV	lgT	lgV	lgT		_	_	_	_	_	-	-
40	43,5	41,5	37,0							+	+	+	+	+		+
50	48,5	51,5	42,0	32,0	40,0											
55	53,5	56,5	47,0		45,0											
60 65	58,5 63,5	61,5 66,5	52,0 57,0		50,0 55,0	40,0	50,0 55,0				-	+	-			-
70	68,5	71,5	61,0	-	-	40,0				+	\vdash	+	+	+	+	+
75	73,5	76,5	61,0	42,0	60,0	45,0	60,0									
80	78,5	81,5	70,0	47,0	70,0	50,0	70,0									
90 100	88,5 98,5	91,5 101,5	80,0 80,0			55,0 60,0		55,0 60.0			╟	+				
110	108,5	111,5	80,0			70,0	60,0	80,0 80,0		+	\vdash	+	-	+	+	-
120	118,5	121,5	80,0	70,0	80,0	70,0		80,0								
130	128,0	132,0	80,0	~	80,0	70,0		80,0								
140 150	138,0	142,0		80,0		80,0		80,0			-	+	-			-
160	148,0 158,0	152,0 162,0		80,0 80,0	-	80,0 80,0		100,0 100,0		-	\vdash	+	+		+	+
180	178,0	182,0		80,0		80,0		100,0								
200	198,0	202,0		80,0		80,0		100,0								
to 600	597,0	602,0		80,0		80,0		100,0			\vdash	+				
	ate lengths o		ole	00,0		00,0		100,0						nge ≥4: itted	xdl	1
									to m	ax. sta	ndard	lengt	perm	nted		

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$\langle \tilde{c} \rangle$				Self-tapping screw with full and partial thread Material: cold rolled wire according to SPAX - Factory standard										
		asher he		Materi				-		- Factory standard		d		
		asher ne	au						on stee	X - Factory sta el "SPAX" T-STAR plus thread = lgT)				
	 		Ls					cture						
	_ ⊢		lgV:₂			trac	de m	nark	∩or	'SPA	X"			
		40%	、 -+ ⊢ ₽	-	A					-	1			
1		L N	°	- V	(A	\rightarrow	_	52	42			
の 子		29.90	11111	1 × × ×		-4	(e	2))	L ((R	3)	}		
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4	Щ ⊽	e ds	1 – T +1	19	8 더 16		\searrow	1		0	Þ			
_	ktt ž	e	lgT 💱		9 9		T - S	TAR	Т	-STA	R plu	s		
			1											
				A De	FT A:	alter	nativ	elv						
			N			with			int					
			- I	¢ d2	•									
				164	¢ d1									
Iominal	diameter			8.0		10	0	1/	2.0					
	thread size			8,0 8,1),0),0		2,0 2,0					
	permissible	tolerance		±0,4),5		0,6	r-STAR plu				
	head diamet		18,0	20,0	22,0	25	5,0		9,0					
	permissible		±0,9	±1,0	±1,1		,25		,45	-STAR plus				
	countersink			9,0	0.00	12	2,0	14	4,0					
	permissible			5,0	+0,30	6	1	7	25					
	core diamete permissible	tolerance			0,3	6	,1		,35),35		—+			
	shamk diam			5,7	0,0	6	,8		,5					
	permissible				±0,25		,		,					
	head height			4,0		4			,6					
	thread pitch			4,0		5	,0	6	i , 0					
	permissible	tolerance		T40	±0,1 x p		т	50						
Ls	size		5		read lengths	(full th	-		artial f	bread	- 1eT)			
Nom.dim.	min	max	1gV		lgT			lgV						
40	38,5	41,5	37,0											
45	43,5	46,5	42,0											
50	48,5	51,5	46,0		32,0	50.0		50.0					<u> </u>	
55 60	53,5 58,5	56,5 61,5	51,0 56,0		32,0 37,0	50,0 55,0		50,0 55,0			$\left \right $		├	
65	63,5	66,5	61,0		37,0	-	40,0	60,0					\vdash	
70	68,5	71,5	61,0		42,0	60,0	40,0	60,0						
75	73,5	76,5	70,0		42,0	70,0	45,0	70,0						
80	78,5	81,5	70,0		47,0				50,0				<u> </u>	
90 100	88,5 98,5	91,5 101,5	80,0 80,0		52,0 57,0			80,0 80,0			$\left \right $			
110	108,5	111,5	80,0		70,0		70,0	00,0	80,0				\vdash	
120	118,5	121,5	80,0		70,0		70,0		80,0					
130	128,0	132,0	80,0		70,0		70,0		80,0					
140	138,0	142,0			80,0		80,0		80,0					
150	148,0	152,0			80,0 80,0		80,0 80,0		100,0 100,0					
160 180	158,0 178,0	162,0 182,0			80,0	-	80,0 80,0		100,0		$\left \right $		+	
200	198,0	202,0			80,0		80,0		100,0				\vdash	
to														
600	597,0	602,0			80,0		80,0		100,0					
ntermediate	e lengths on	Ls possible				Other	threa	d lengt	ths in th	ie ran	ge >4x	dl		
	0	1												
									- 1					
												Anne	x A	

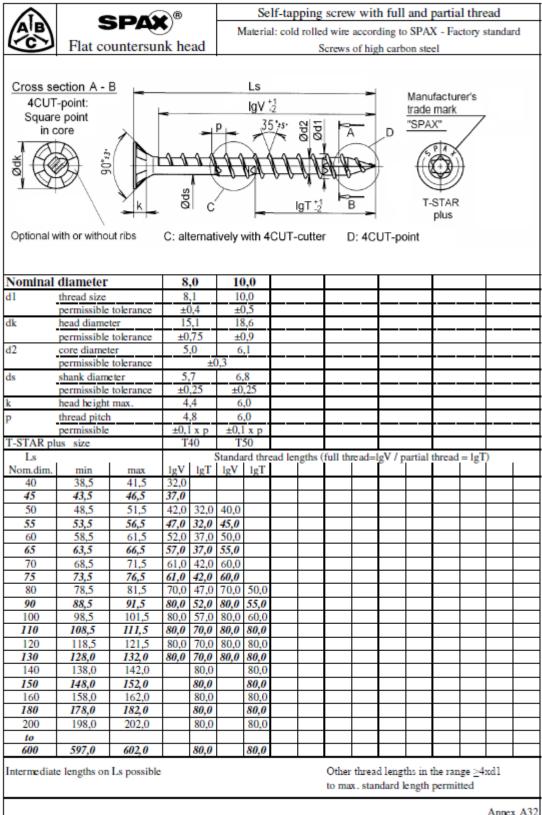
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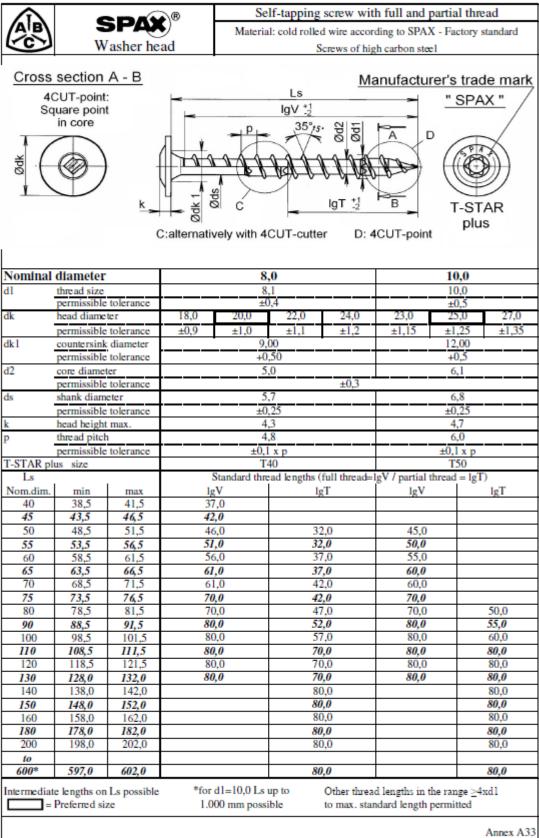


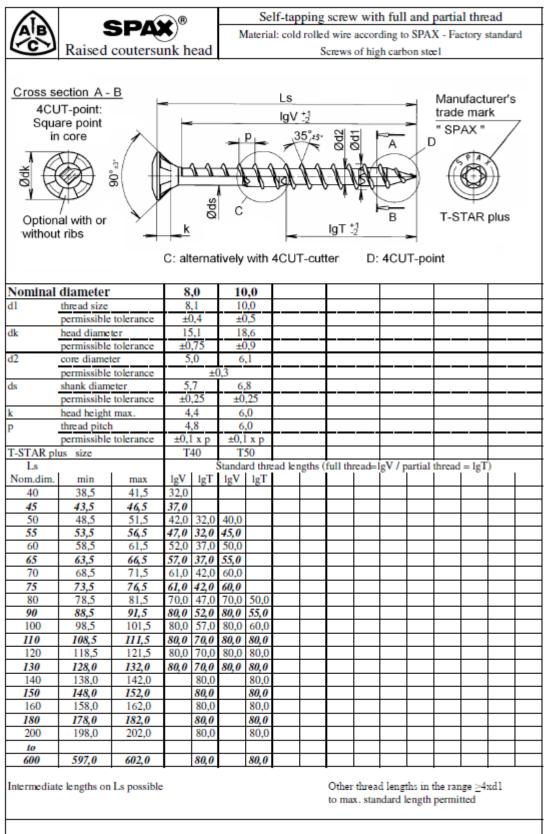
AB	SF		S		N				screw 1 wire							rd
\odot		Pan head							crews							
	-		Ls IgV	+1								urer		"CD	۰v"	
		1.00	١ġv			-		-	u	aue	ma	KL	ان ز	"SP		
- Ødk	K	40°	Ħ	gT 12	1E		× + 1002	1001	-(T-S	TAR	T	-STA	AR plu	JS	
					F	ра Срю	Ød1	A	: alte with			y oint				
	l diametei			,0),0		2,0								
	thread size			,1),0		2,0					<u> </u>			
dk	permissible head diame		±0),4 5,5),5),0		0,6 3,0								
uk	permissible			,75		,95		,15	┣─				·			
d2	core diamet			,0		,1		35								
	permissible),3			,35								
ds	shank diam		5	,7		,8	8	,5	L				<u> </u>		<u> </u>	
k	permissible head height		5	,7	_),25 .1	8	.5								
R	raised radiu			16,0 20,0				4,0					<u> </u>			
	thread pitch			4,0 5,0 6,0												
	permissible	tolerance				l x p										
T - STAR Ls	size		T	40		50		50	full thr		N/			1.1.7		
Nom.dim.	min	max	1øV	1øT			loV	lgT		cad=1	gv / p	artiai	linead		í	I I
40	38,0	41,5	37,0											<u> </u>		
45	43,0	46,5	42,0													
50	48,5	51,5		32,0												
55 60	53,5 58,5	56,5 61,5	51,0	32,0	50,0 55,0		50,0 55,0									
65	58,5 63,5	61,5 66,5			55,0 60,0	40.0	55,0 60,0						-			
70	68,5	71,5	61,0	42,0	60,0	40,0										
75	73,5	76,5	70,0	42,0	70,0	45,0	70,0									
80	78,5	81,5			70,0			50,0								<u> </u>
90 100	88,5 98,5	91,5 101,5			80,0 80,0			55,0 60,0					<u> </u>			
110	108,5	111,5			80,0 80,0		50,0	80,0					-	1	-	+
120	118,5	121,5			80,0			80,0								
130	128,0	132,0	80,0	70,0	80,0	70,0		80,0								
140	138,0	142,0		80,0		80,0		80,0								
150 160	148,0 158,0	152,0 162,0		80,0 80,0		80,0 80,0		100,0 100,0					<u> </u>			─
180	178,0	182,0		80,0		80,0		100,0						+	-	
200	198,0	202,0		80,0		80,0		100,0								
to																
600	597,0	602,0		80,0		80,0		100,0						1	Í	
Intermedia	te lengths of	n Ls possibl	e						Other to ma					nge≥4 itted	xdl	
															Anne	x A30

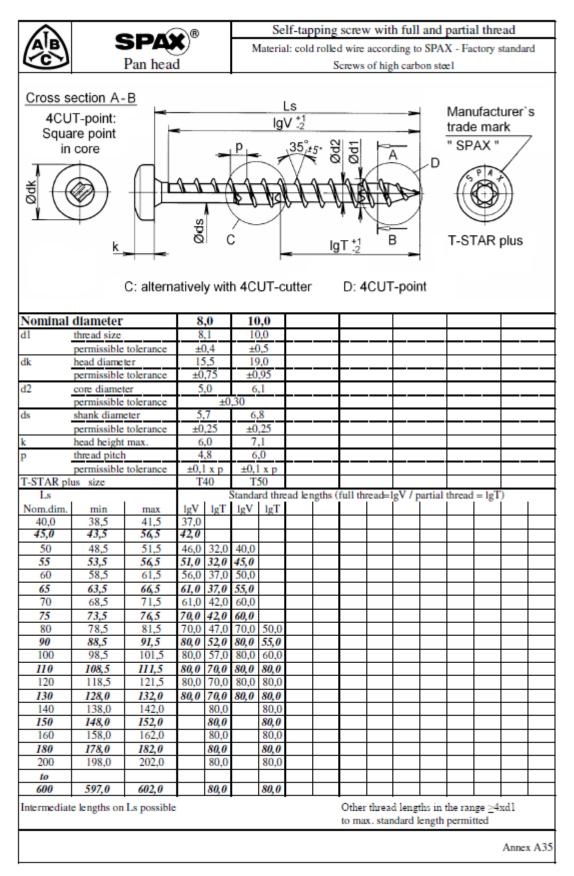
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	er		26			Sel	lf-tap	ping	screv	v with	h full	and p	partia	l threa	ad	
		l with/with		ance	N	lateria	l: cold				ling to h carbo			ctory st	andar	d
		Ls IgV3		A A					-	Dc = dk SW		Manu	Hex.	r's	-	
_			₽₽	-1	5	altern CUT-	point	y with	1							
						flang	_				thou		_			
	diameter			,0),0		2,0		,0),0		2,0		
dl	thread size		8			0,0		2,0		,1		0,0		2,0		
SW	permissible),4 0),5 3),6 6),4 0),5 3	-),6 6		
SW Dc	wrench size flange diam			0 7.0		.s).8		6 1,7	1	U	1	3	1	6		
	permissible			,0		1.0		.2								
d2	core diamet			,0,0		.1		.3	5	.0	6	.1	7	35		
	permissible						±0							,35		
ds	shank diam		5	,7	6	,8		,5	5	,7	6	,8	8	,5		
	permissible	tolerance			±0	,25					±0.	,25				
k	head height	max.	8	,5		,7		2,1	6,0		7,0		8	,0		
р	thread pitch		4	,0		,0	6,0		4,0		5,0		6	,0		
	permissible	tolerance				lxp						хр				
Ls						ird thre		- · · ·						i		
Nom.dim.	min	max	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT	lgV	lgT		┣
40	38,5	41,5	37,0						37,0							
45	43,5	46,5	42,0	22.0	15.0				42,0	22.0	15.0					⊢
50	48,5	51,5		32,0			50.0			32,0			50.0			
55 60	53,5 58,5	56,5 61,5	51,0 56,0	32,0 37,0	50,0		50,0 55,0			32,0 37,0			50,0 55,0	├		┣
65	63,5	66,5	56,0 61.0		55,0 60,0	40,0	55,0 60,0			37,0		40.0	55,0 60,0			\vdash
70	68,5	71,5	61.0	42,0		40,0	60,0		61.0	42,0	60,0	40.0	60,0	┝─┨		\vdash
75	73,5	76,5	70,0	42,0	70,0	45,0	70,0		70,0	42,0	70,0	45,0	70,0	┝─┨		
80	78,5	81,5	70,0		70,0	<u> </u>		50,0	<u> </u>		<u> </u>		70,0	50,0		
90	88,5	91,5	80,0	52,0	80,0	55,0	80,0		80,0	52,0	80,0	55,0	80,0	55,0		
100	98,5	101,5			80,0	60,0	80,0	60,0					80,0			
110	108,5	111,5	80,0	70,0		70,0		80,0		70,0		70,0		80,0		
120	118,5	121,5	80,0	70,0		70,0		80,0		70,0		70,0		80,0		<u> </u>
130	128,0	132,0	80,0	70,0	80,0	70,0		80,0	80,0	70,0	80,0	70,0 80,0		80,0 80,0		
140 150	138,0	142,0		80,0 80,0		80,0 80,0		80,0 100,0		80,0 80,0		80,0 80,0		80,0 100,0		
160	148,0 158,0	152,0 162,0		80,0		80,0		100,0		80,0		80,0		100,0		├
180	178,0	182,0		80,0		80,0		100,0		80,0		80,0		100,0		\vdash
200	198,0	202,0		80,0		80,0		100,0		80,0		80,0		100,0		\vdash
to																
600	597,0	602,0		80,0		80,0		100,0		80,0		80,0		100,0		
Intermediat	e lengths on	Ls possible											the ran permit	age ≥4a tted	cdl	

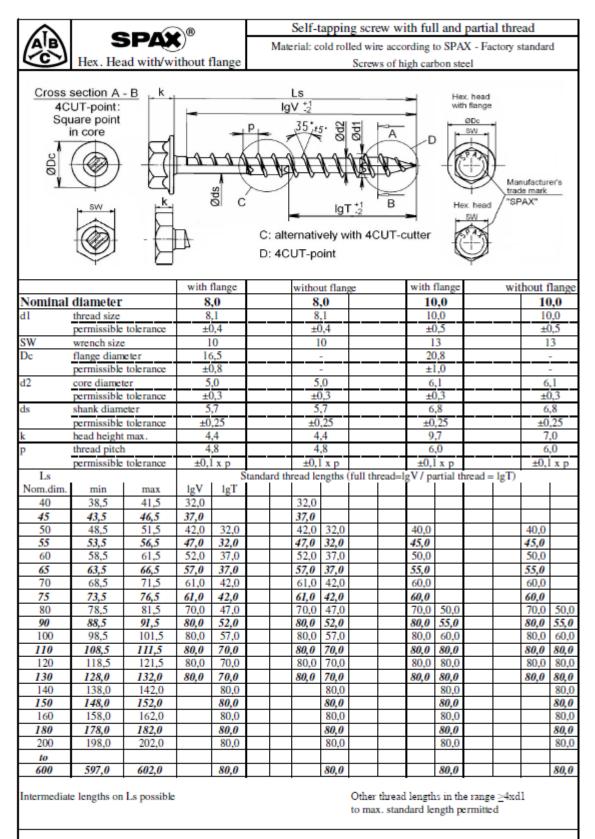


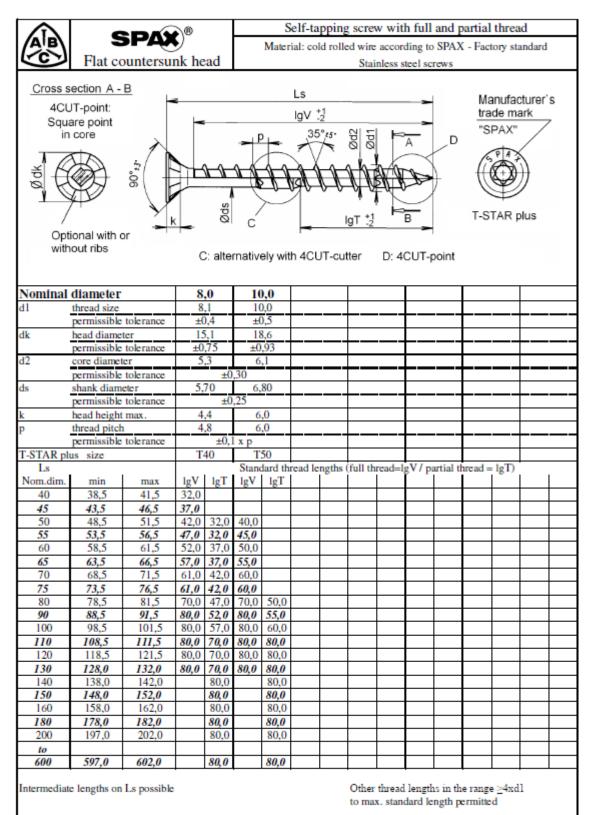


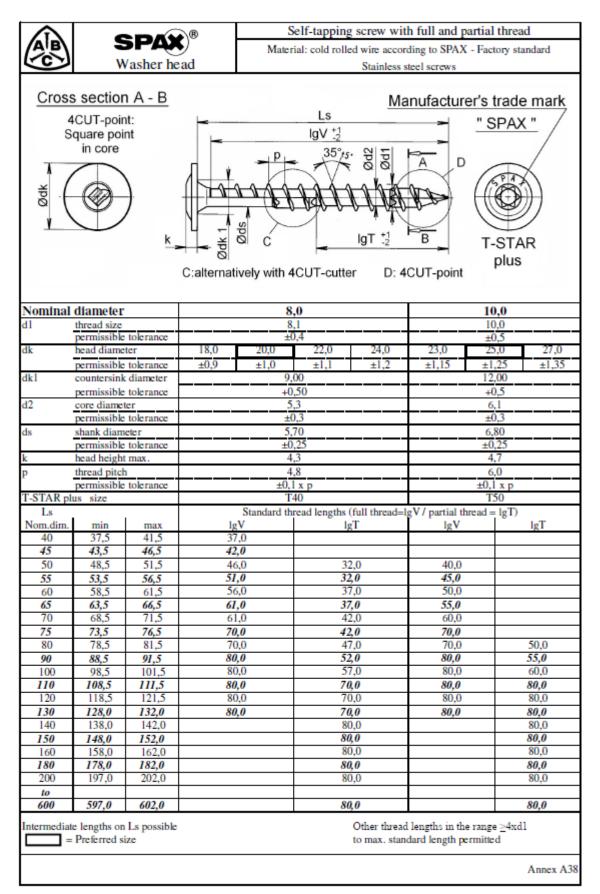


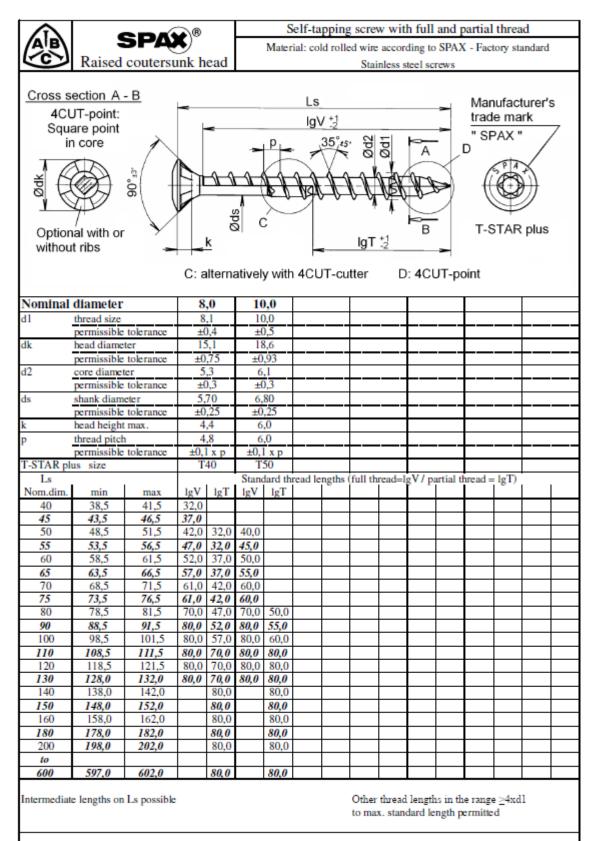


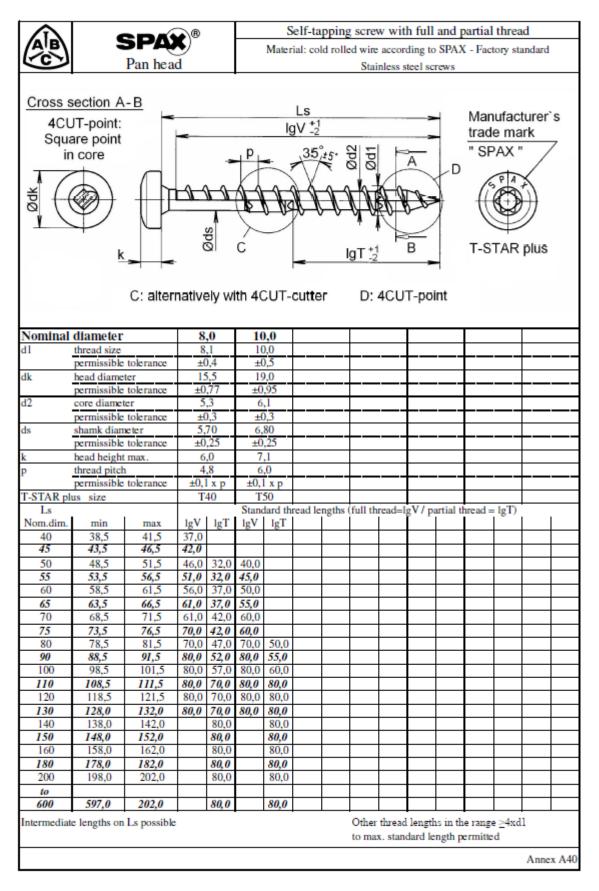
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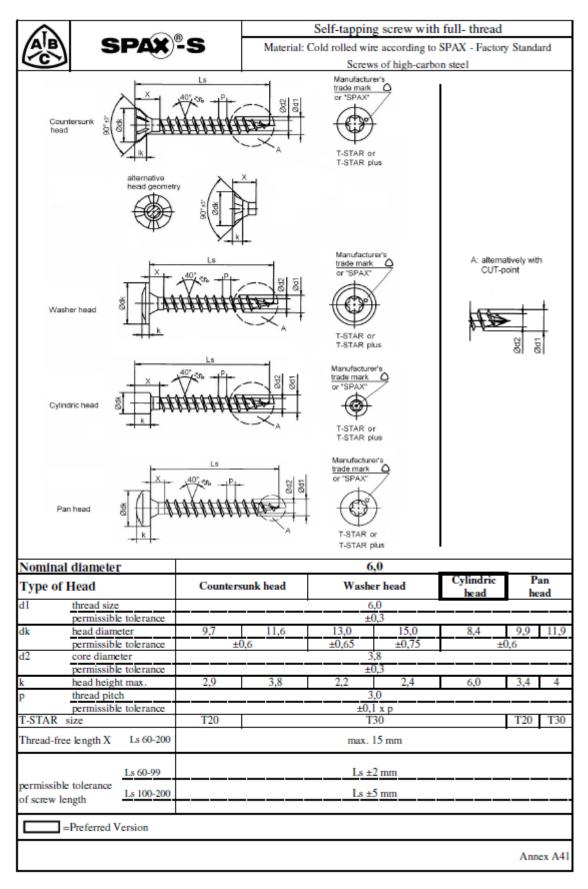


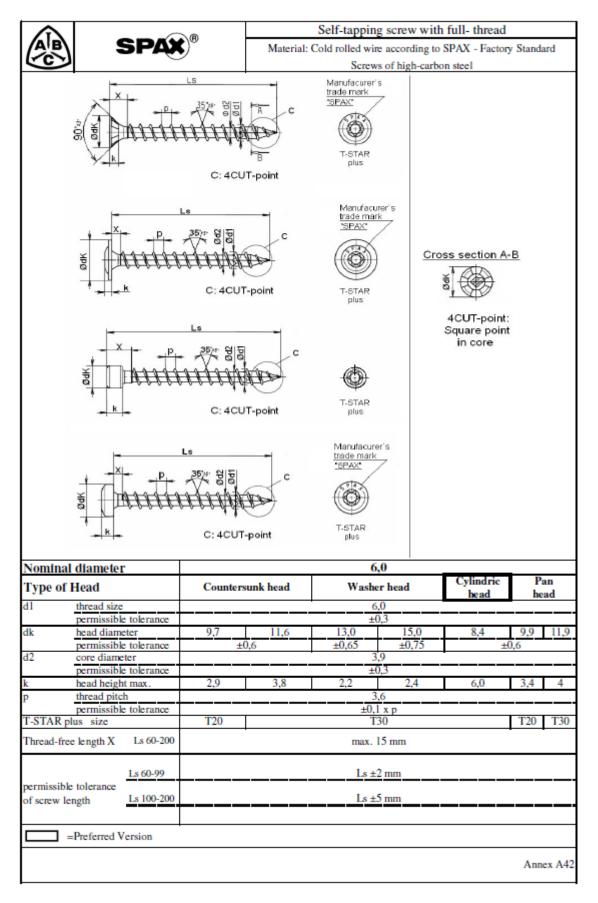


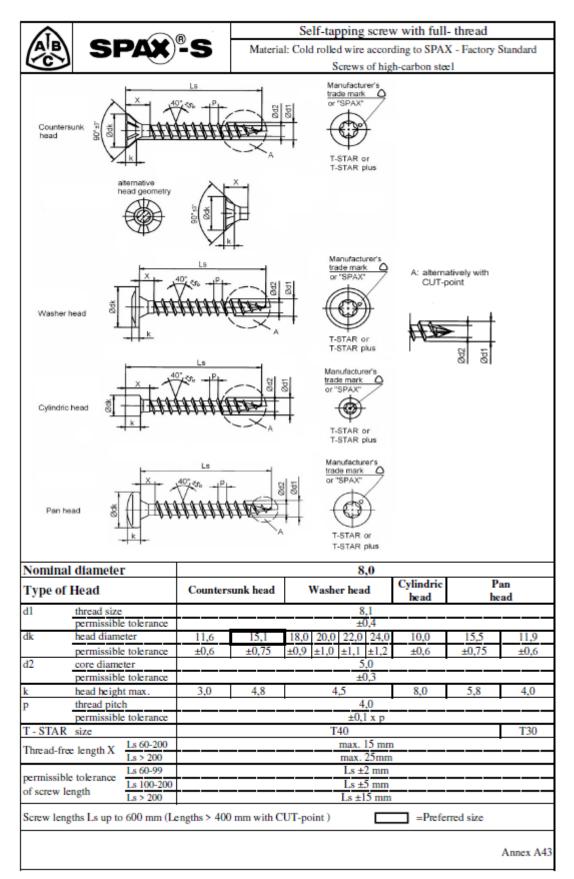


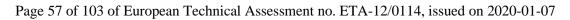




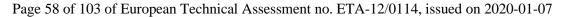


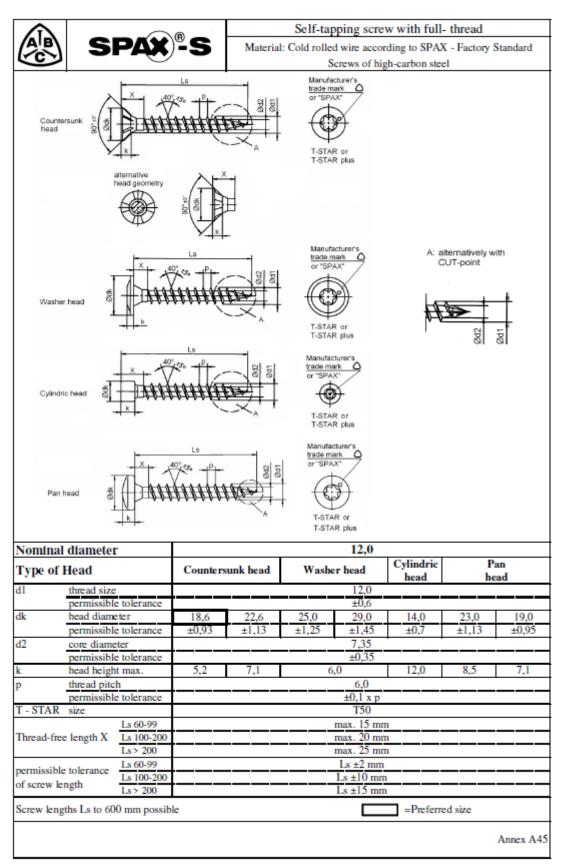


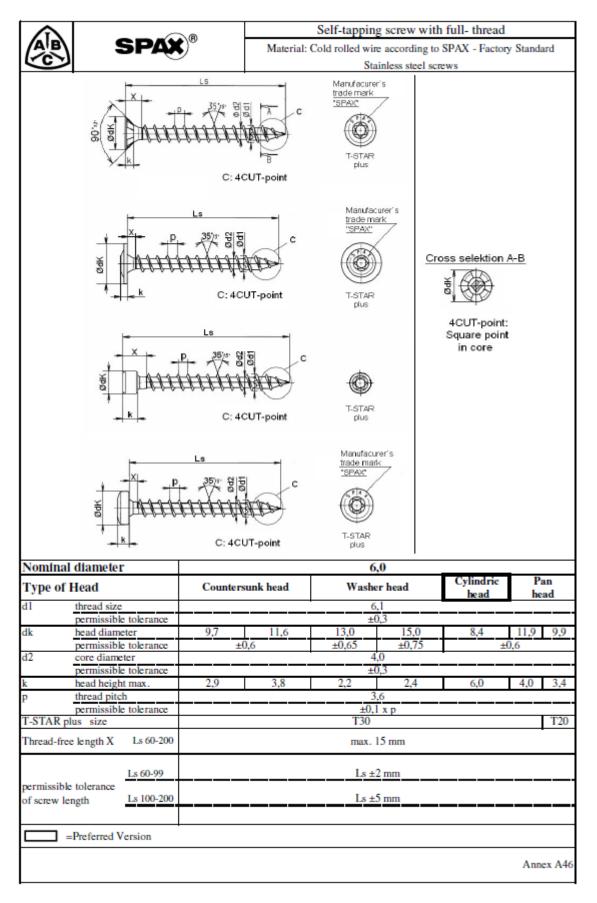


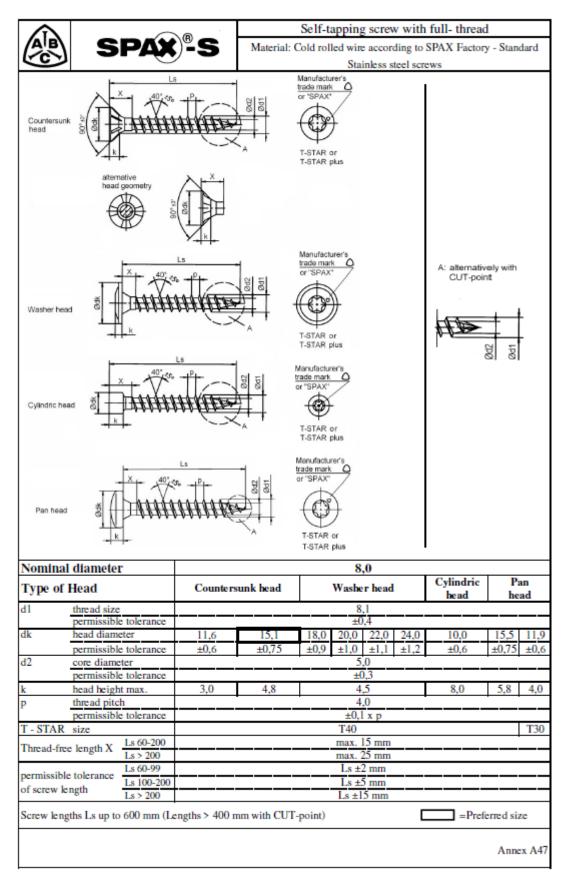


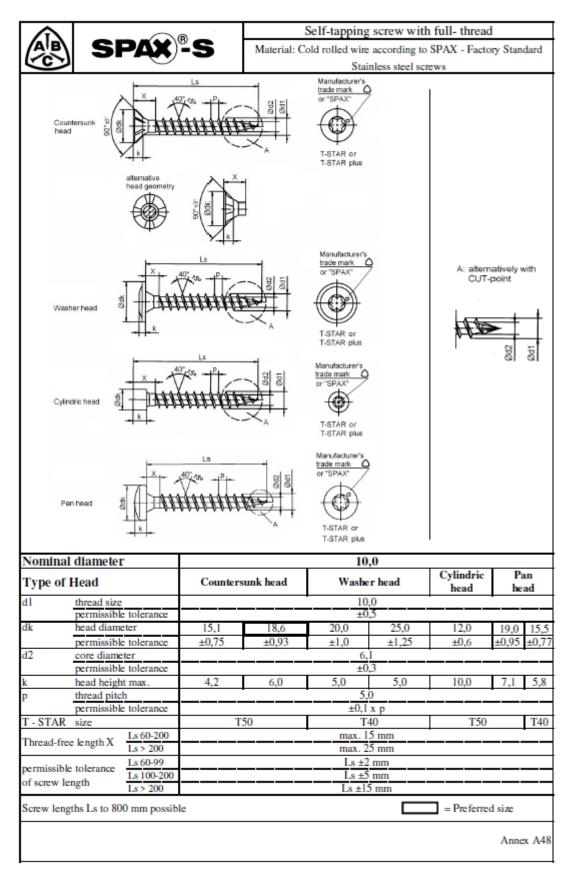
	- ·		Self-tapping	screw with	full-thread	1
	eee eee		old rolled wire			
				of high-carbo		.,
	Ls		Manufacturer's		711 SICC1	
×	40° ca . P.	-		9	1	
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Countersunk 7 3	10000000	the second second	(and			
head 8	++++++++++++++++++++++++++++++++++++++		Y			
	-	A	T-STAR or			
✓-+ ⁺ +-			T-STAR plus			
alternative	λ L×	-				
head geometry	1					
6833	a(\$ 🗊	4				
C#2	8/817					
4						
		-	Manufacturer's			
	Ls	-	trade mark	<u>ò</u>		atively with
	40% so +P+ .	위티	or "SPAX"	/	CUT-p	oint
1 11-1-1	Vindlin	000				
Washer head	1441444P		((€:₽))		1 _	
L.N.		XT	V		1100	
		A	T-STAR or			
			T-STAR plus		'	8d1 8d2
I	Ls		Manufacturer's			
×. t	*** +P+ -	50 E	trade mark	Ì		
The	Vandlin	100	or "SPAX"			
Cylindric head	<u>++++++++</u>		(©)			
k	-	\sim	ψ			
			T-STAR or T-STAR plus			
	Ls		Manufacturer's trade mark (2		
- ×	40° 50 -1P1-	워 등	or "SPAX"	7		
TALL	\mathcal{N}	88	(The second seco			
Pan head 💈 🕂 🕂	88888888	Read .	(\mathfrak{S})			
		14.11	Ð			
- k		A	T-STAR or			
			T-STAR plus			
Nominal diameter			10.	,0	C.F. L	D
Type of Head	Counters	sunk head	Washe	r head	Cylindric head	Pan head
dl thread size			10,			
permissible tolerance			±0.			
		18,6	20.0	25,0	12,0	19,0 15,5
dk head diameter	15,1		20,0			
dk head diameter permissible tolerance	±0,75	±0,93	±1,0	±1,25	±0,6	±0,95 ±0,7
dk head diameter permissible tolerance d2 core diameter			±1,0 6,	±1,25	±0,6	±0,95 ±0,7
dk head diameter permissible tolerance d2 core diameter permissible tolerance	±0,75	±0,93	±1,0 6, ±0	±1,25 I 3		
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max.			±1,0 6, ±0 5,0	±1,25 1 3 5,0	±0,6	
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch	±0,75	±0,93	±1,0 6, ±0, 5,0 5,0	±1,25 1 3 5,0		
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance	±0,75	±0,93 6,0	±1,0 6, ±0, 5,0 5,0 ±0,1	±1,25 1 3 5,0 0 x p	10,0	7,1 5,8
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance T - STAR size	±0,75	±0,93	±1,0 <u>±0</u> , 5,0 <u>5,0</u> ±0,1 T4	±1,25 1 3 5,0 0 x p 40		7,1 5,8
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance T - STAR size	±0,75	±0,93 6,0	±1,0 6, ±0 5,0 5,0 ±0,1 T4 max. 1	±1,25 1 3 5,0 0 x p 40 5 mm	10,0	7,1 5,8
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance Γ - STAR size Thread-free length X Ls 60-200 Ls > 200	±0,75	±0,93 6,0	±1,0 6, ±0, 5,0 5,0 ±0,1 T4 max. 1 max. 2	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm	10,0	7,1 5,8
head diameter permissible tolerance d2 core diameter permissible tolerance permissible tolerance k head height max. p thread pitch permissible tolerance Fread-free length X Ls 60-200 Ls 60-99 permissible tolerance Ls 60-99	4,2 T	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2 Ls ±2 Ls ±5	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0	7,1 5,8
head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance Is 60-200 Thread-free length X Ls 60-99 permissible tolerance Is 100-200	4,2 T	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0	7,1 5,8
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance T - STAR size Thread-free length X Ls 60-200 Ls 200 Ls 00-200 Ls 200	±0,75	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2 Ls ±2 Ls ±5	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0	7,1 5,8 T40
dk head diameter permissible tolerance d2 core diameter permissible tolerance k head height max. p thread pitch permissible tolerance T - STAR size Thread-free length X Ls 60-200 Ls 60-99 Ls 100-200	±0,75	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2 Ls ±2 Ls ±5	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0 T50	7,1 5,8 T40
Ik head diameter permissible tolerance 12 core diameter permissible tolerance permissible tolerance x head height max. p thread pitch permissible tolerance permissible tolerance T - STAR size Thread-free length X $\frac{\text{Ls 60-200}}{\text{Ls > 200}}$ permissible tolerance $\frac{\text{Ls 60-99}}{\text{Ls 100-200}}$ of screw length $\frac{\text{Ls 200}}{\text{Ls > 200}}$	±0,75	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2 Ls ±2 Ls ±5	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0 T50	7,1 5,8 T40
Ik head diameter permissible tolerance 12 core diameter permissible tolerance permissible tolerance 12 core diameter permissible tolerance permissible tolerance 14 permissible tolerance 15 thread pitch permissible tolerance Is 60-200 Chread-free length X Is 60-99 permissible tolerance Is 100-200 fs screw length Is > 200	±0,75	±0,93 6,0	±1,0 6, ±0. 5,0 5,0 ±0,1 T4 max. 1 max. 2 Ls ±2 Ls ±2 Ls ±5	±1,25 1 3 5,0 0 x p 40 5 mm 5 mm mm mm	10,0 T50	7,1 5,8 T40

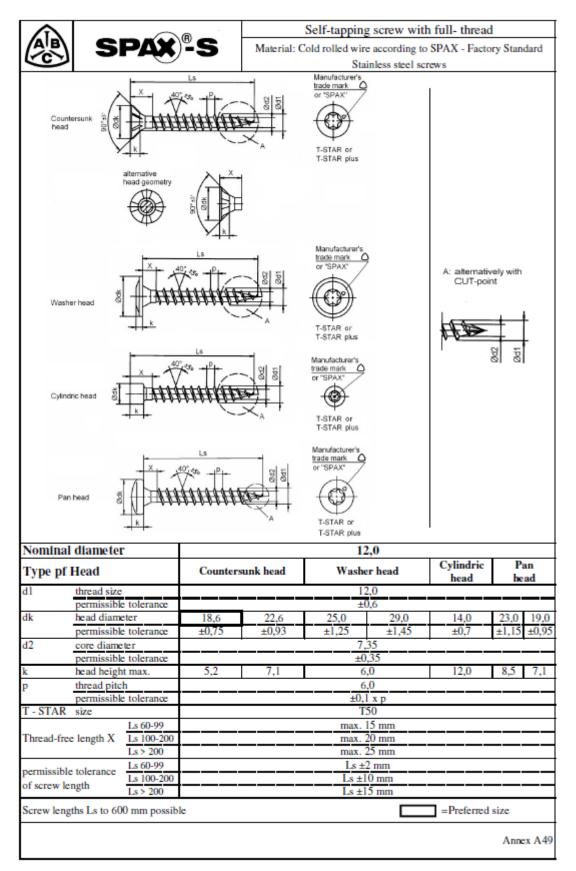


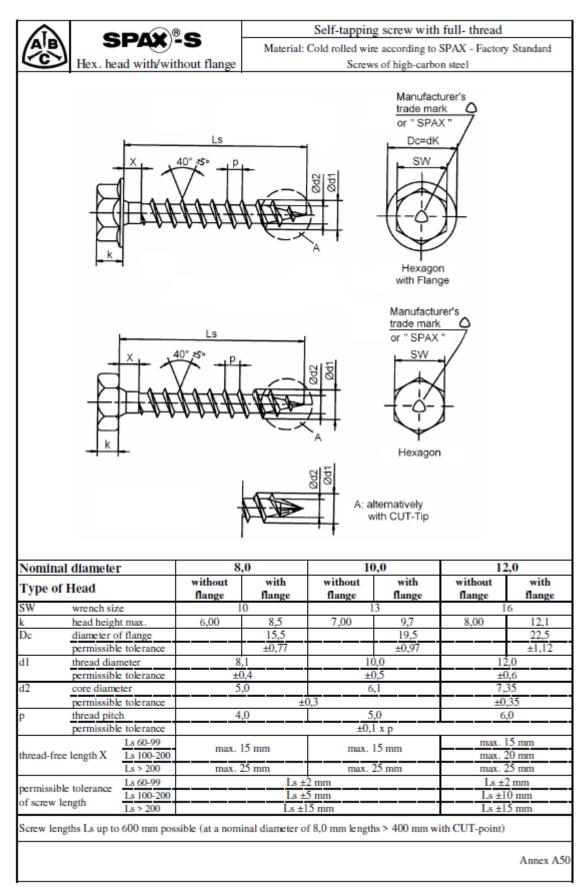


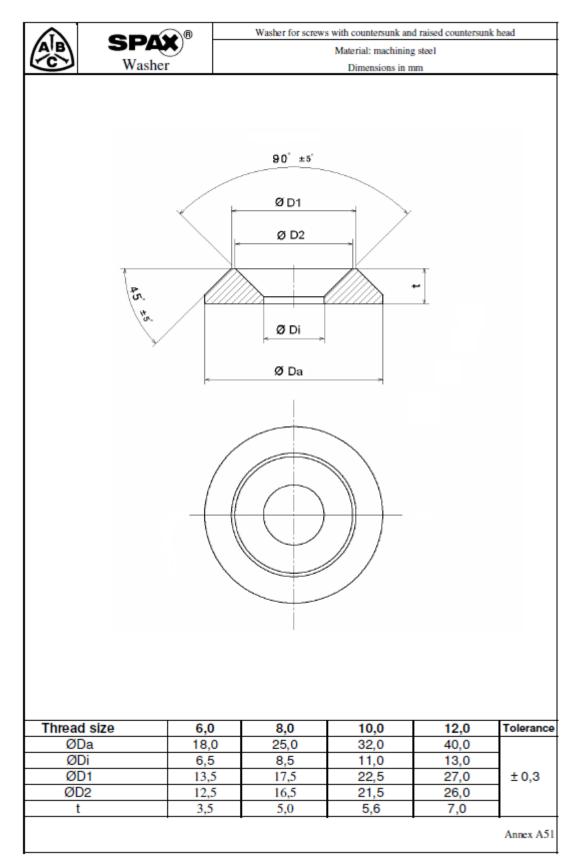


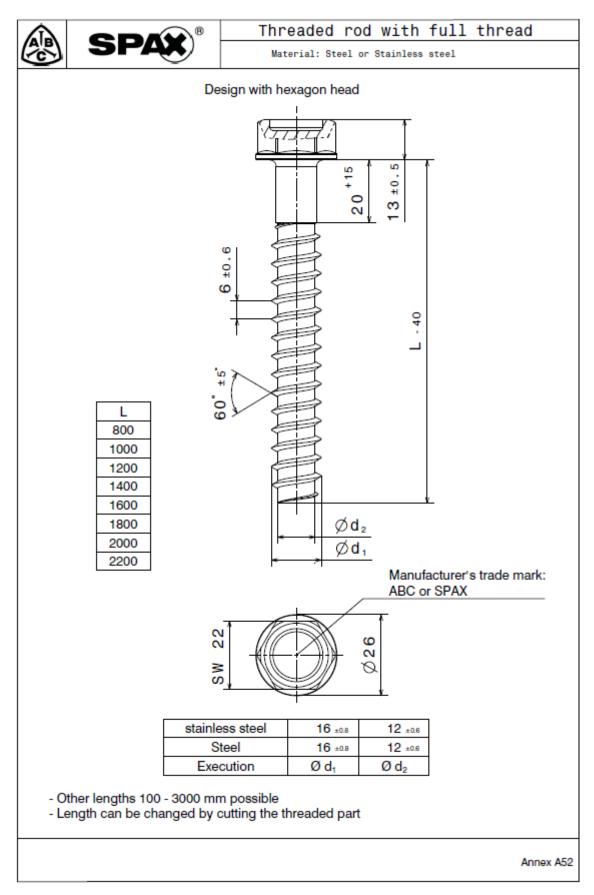


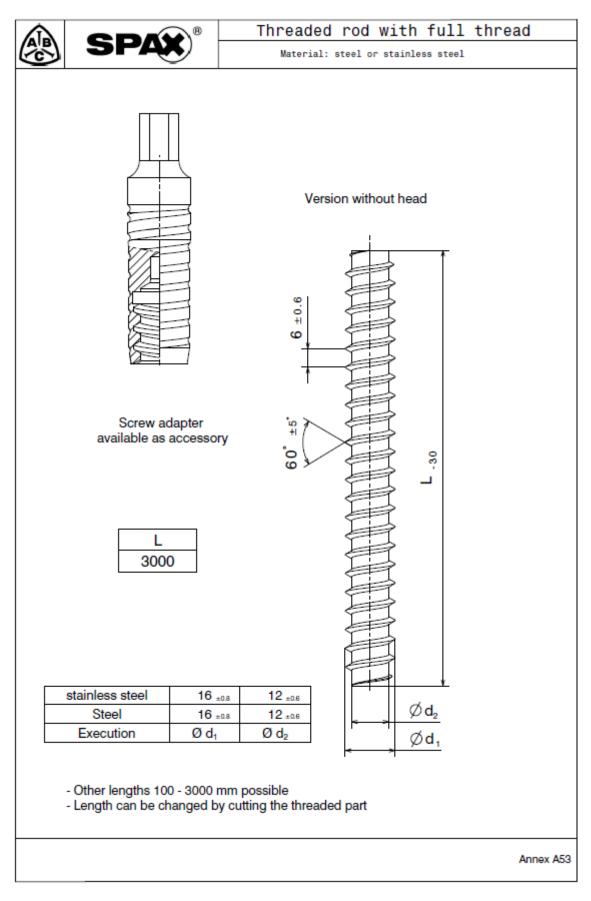


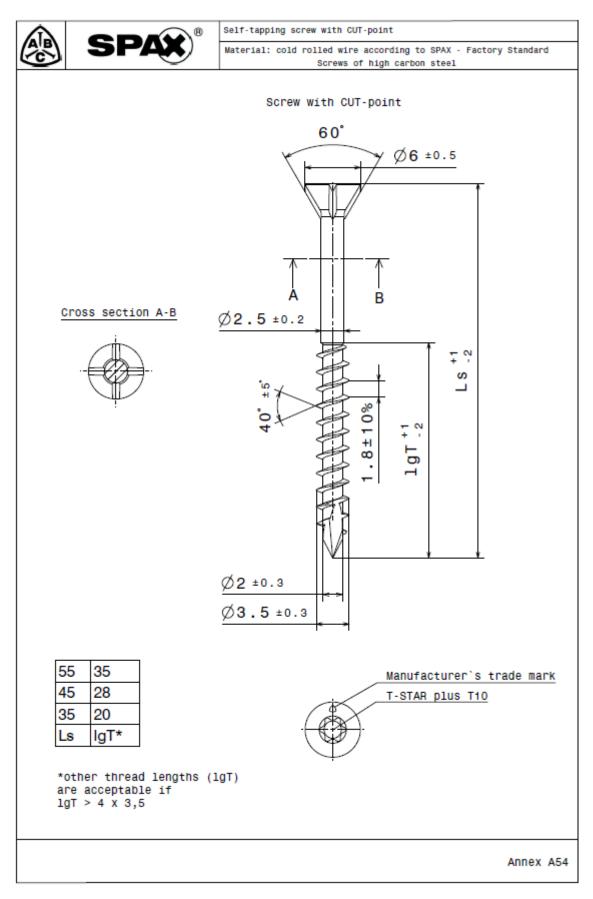


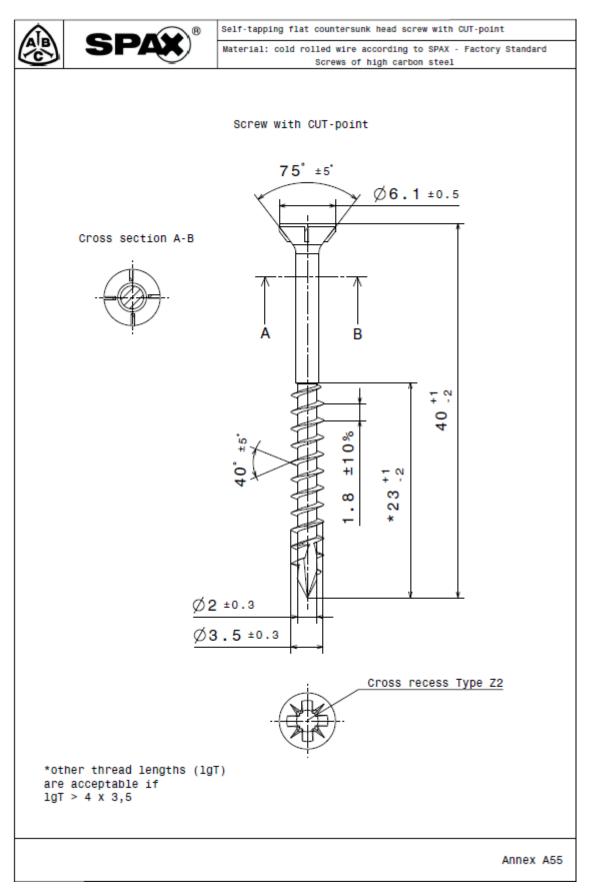




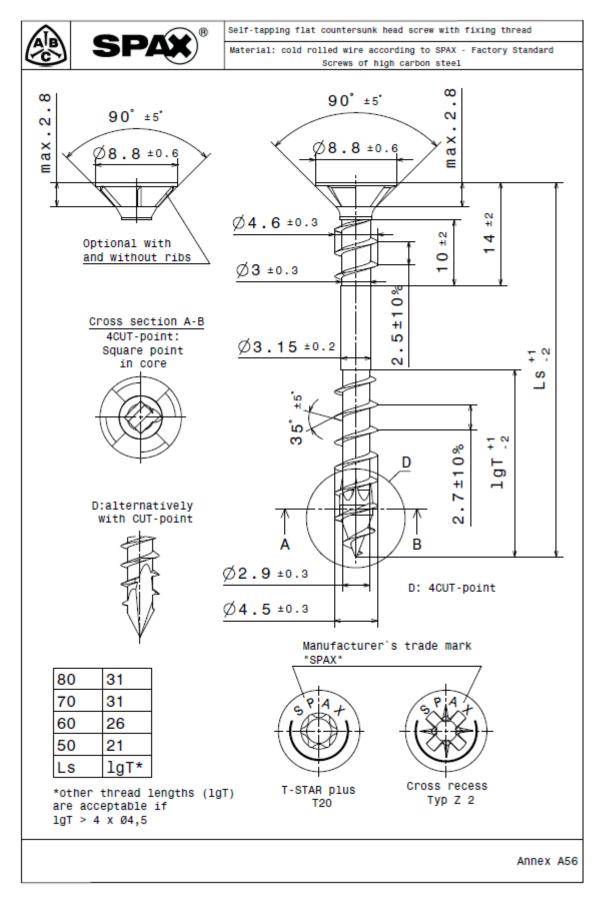




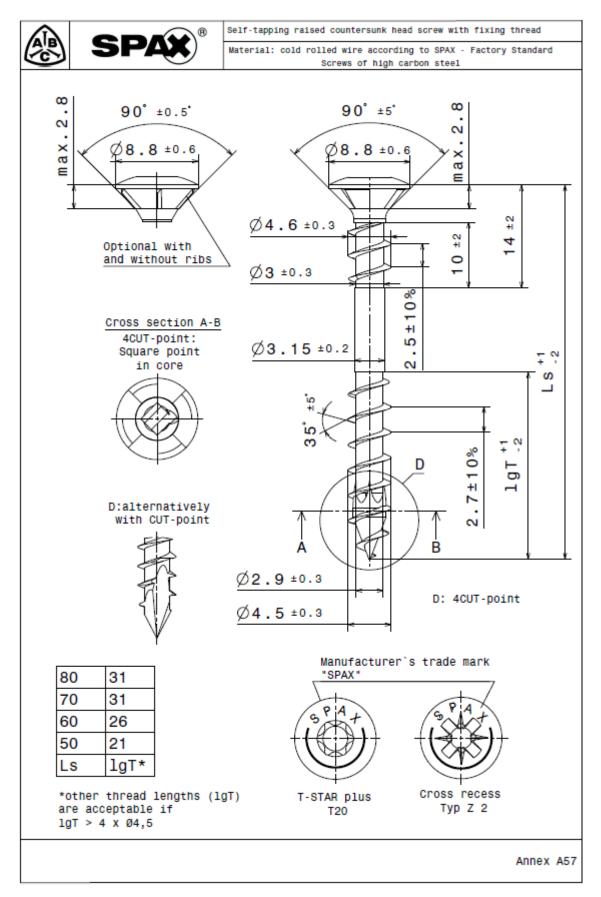




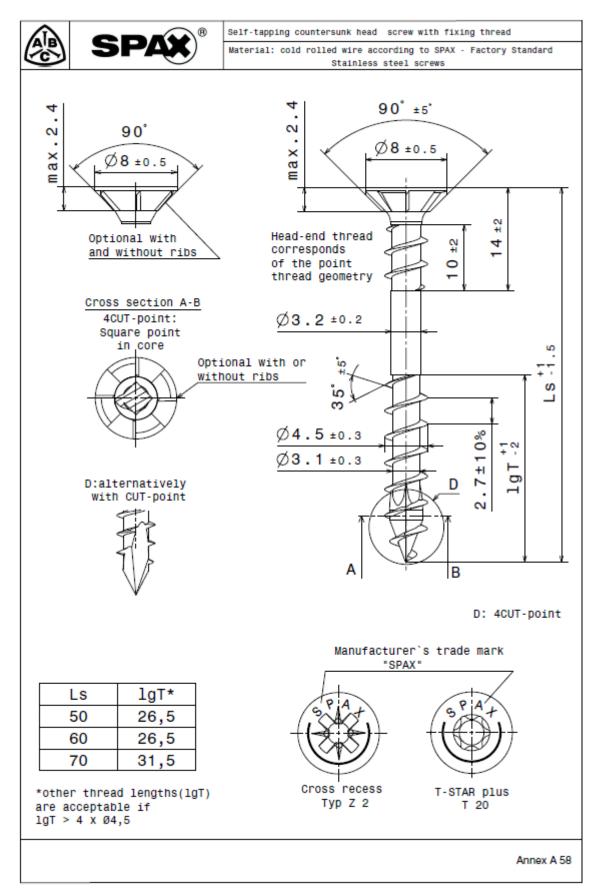
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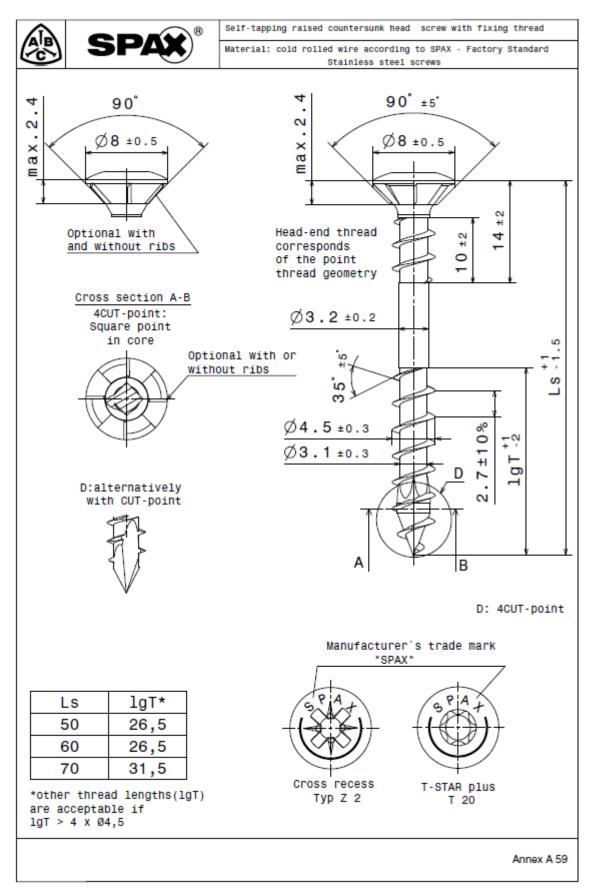
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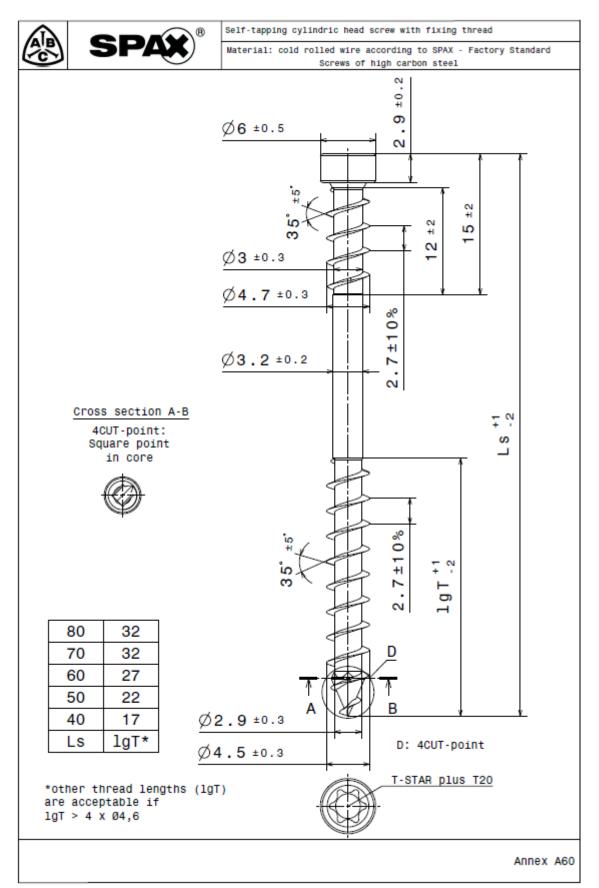


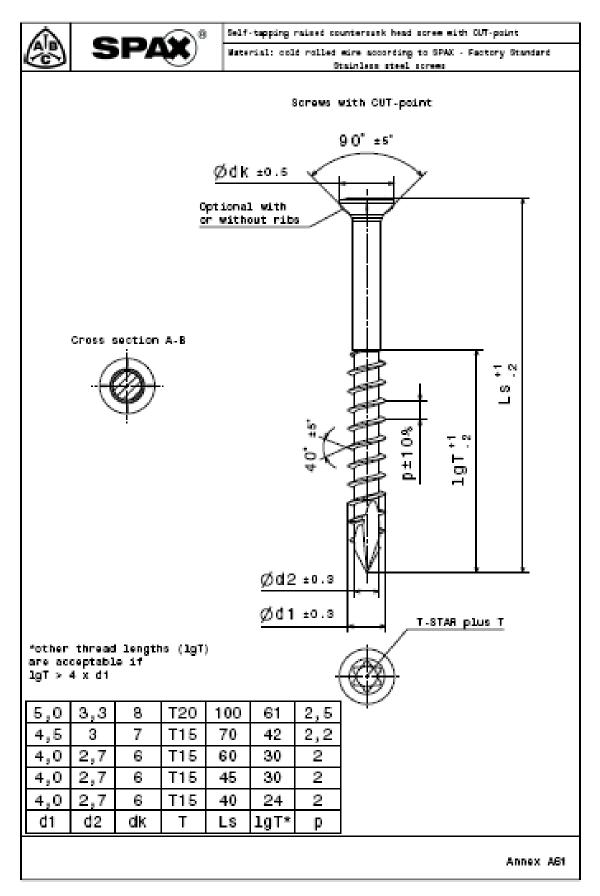
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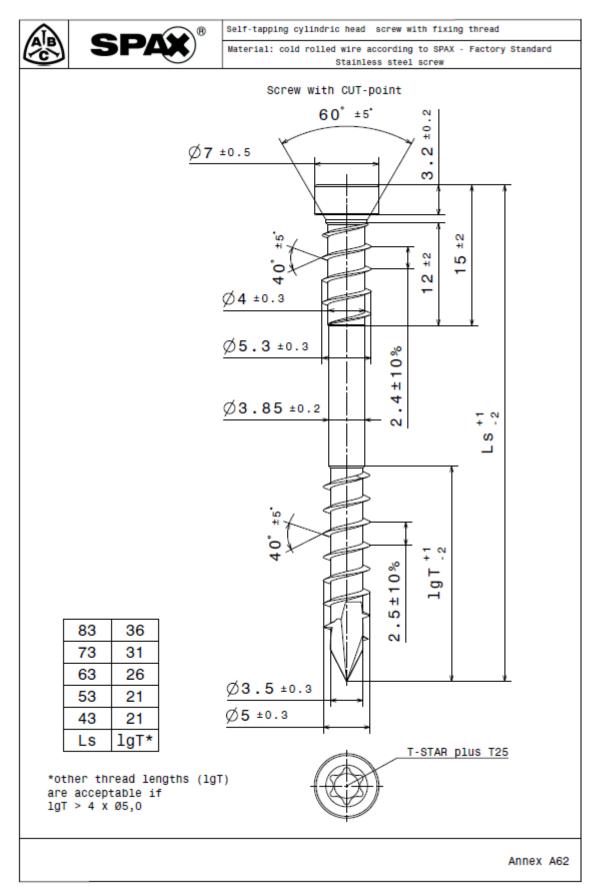


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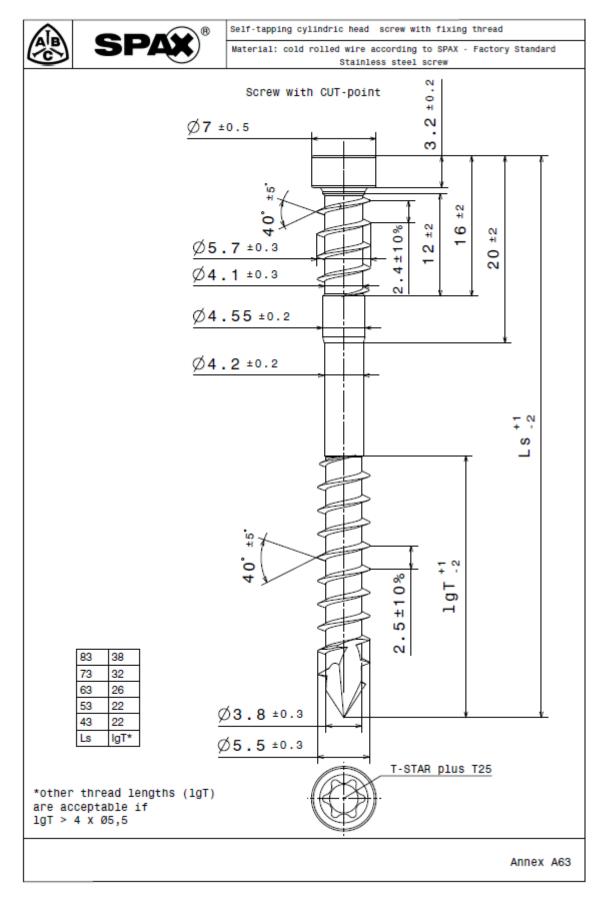


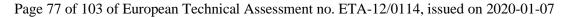


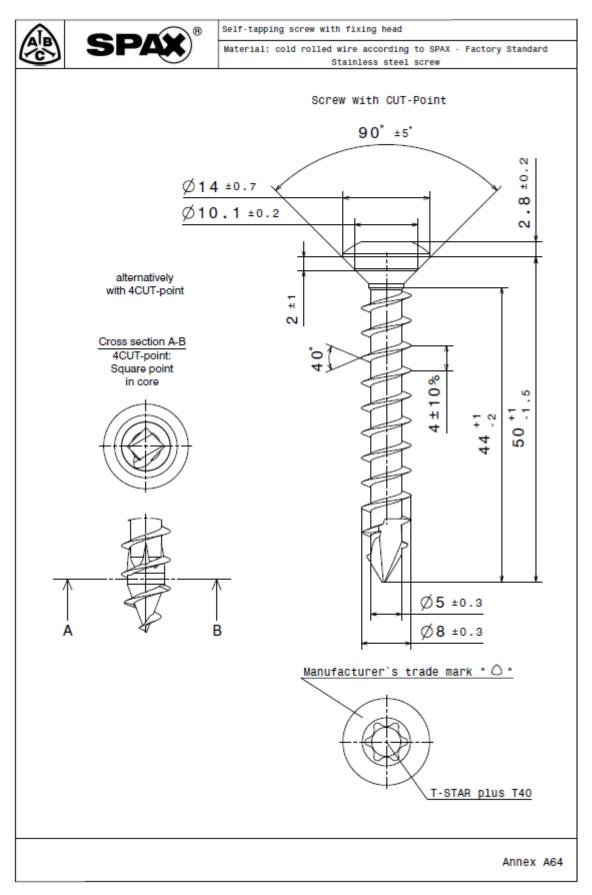


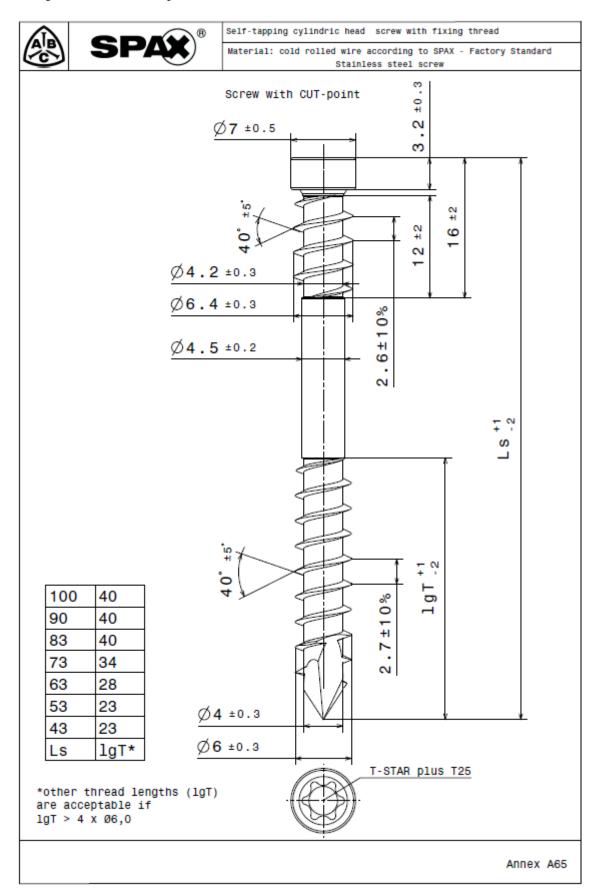
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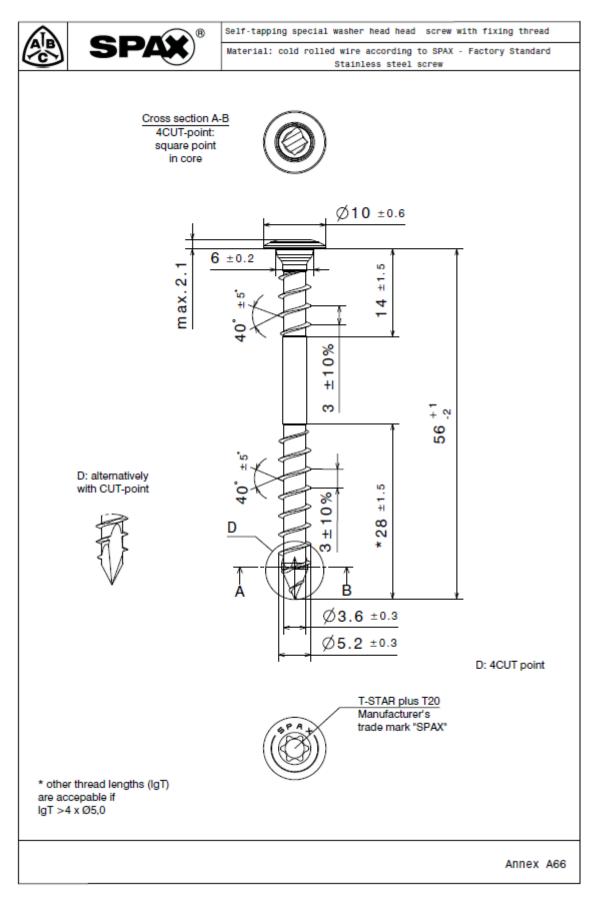
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								-			Туре Z		plus			
		C:alte	ernativ	ely wit	h 4CU	T-cutt	er*	D: 40	CUT-pe	pint						
Nominal	l diamete	r	3	.5	4	.0	4	,5	5	,0	6	.0	8	,0	10	0,0
dl	thread size		3	,5	4	,0		,5		,0	6	,0	8	,1	10),0
	permissible						_	±0,3),4),5
dk	head diame		8,7	7,0	10	8,0		8,8	11,6	9,7	13,6	11,6	20,0	15,1	25,0	
.11.1	permissible diameter	e tolerance		1			.0,6	2		6	±0,65	±0,5		±0,75		_
dkl	permissible	toleranec	<u> </u>	,1)	,2	0.3	,3	6	,6		,5	8 ±0	,8	13	3,5
d2	core diame		2	25	2	.6		9	3	.2	3	.9	_	.0	6	.1
	permissible			/-0,3	-	-		22			0,3	,				
ds	shank dian			45	2,	85		20	3,	55	-	30	5,	70	6,	80
	permissible	e tolerance					±	0,10						±0	,25	
k	head heigh		1,0 1,3		-	1,5			,5			2,5		3,0		
kl	l head height permissible tolerance			1,3 1,5 1,5 ±0,3					1,5 1,8				2,0 2,5 ±0,5			,٢
	thread pitcl		2	.1	2	.3		.7	2	.0	2	.6	4	.8	*	.0
р	permissible			,1	2	۵,	2	,/		,o lxp		,0	-	,o	0	,v
TCTAD							200				т	30	T	40	T	50
T-STAR p	ius size ss size Type	7	T20								1	20	T40 T50			50
Ls	ss size Type	- 2	Standard thread lengths						(6,11 +1	mead =	leV/r	nread = lgT)				
Nom.dim.	min	max	lgV	lgT		lgT			lgV			lgT			lgV	lgl
17	15,5	17,5	14,0	-0-		-6-		-0-	- 0 -	-0		-0-		-0-		
20	18,5	20,5	16,0		16,0											
25	23,5	25,5		18,0			20,0		20,0							
30	28,5	30,5	27,0	18,0	27,0	18,0	25,0		25,0		24,0					
35	33,5	36,0	32,0	23,0	30,0	23,0	30,0	20.0	30,0	20.0	29,0		22.0			<u> </u>
40	38,5 43,5	41,0 46.0	37,0 40.0	23,0 30.0	35,0 40.0	23,0 30.0	34,0 39,0	20,0	35,0 39,0	20,0	34,0 38.0		32,0 37,0			<u> </u>
45 50	43,5	51.0	40,0	32.0		32.5	44,0	25,0	44,0	25.0	43.0	24.0	42.0		40.0	
						35,0	~	~		27,0	48.0	27,0	47,0		45,0	
55	53,5	56,0		35,0	50,0	2290	49,0	27,5	49,0	21,0	TU,0	4/,0	47,0			
55 60	53,5 58,5	56,0 61,0					49,0 54,0		54,0	30,0	53,0	29,0	52,0		50,0	
60 65	58,5 63,5	61,0 66,0			50,0 50,0	35,0 37,5	54,0 59,0	30,0 32,5	54,0 59,0	30,0 32,0	53,0 58,0	29,0 32,0	52,0 57,0		55,0	
60 65 70	58,5 63,5 68,5	61,0 66,0 71,0		35,0	50,0 50,0 50,0	35,0 37,5 37,5	54,0 59,0 59,0	30,0 32,5 34,0	54,0 59,0 61,0	30,0 32,0 35,0	53,0 58,0 61,0	29,0 32,0 34,0	52,0 57,0 61,0	32,0	55,0 60,0	
60 65 70 75	58,5 63,5 68,5 73,5	61,0 66,0 71,0 76,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0	53,0 58,0 61,0 61,0	29,0 32,0 34,0 37,0	52,0 57,0 61,0 61,0	32,0 37,0	55,0 60,0 60,0	
60 65 70 75 80	58,5 63,5 68,5 73,5 78,5	61,0 66,0 71,0 76,0 81,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0	54,0 59,0 61,0	30,0 32,0 35,0 37,0 39,0	53,0 58,0 61,0 61,0 61,0	29,0 32,0 34,0 37,0 38,0	52,0 57,0 61,0 61,0 70,0	32,0 37,0 39,0	55,0 60,0 60,0 70,0	
60 65 70 75 80 90	58,5 63,5 68,5 73,5 78,5 88,5	61,0 66,0 71,0 76,0 81,0 91,5		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0	53,0 58,0 61,0 61,0 61,0 61,0	29,0 32,0 34,0 37,0 38,0 43,0	52,0 57,0 61,0 61,0 70,0 80,0	32,0 37,0 39,0 39,0	55,0 60,0 60,0 70,0 80,0	50
60 65 70 75 80	58,5 63,5 68,5 73,5 78,5	61,0 66,0 71,0 76,0 81,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0	53,0 58,0 61,0 61,0 61,0	29,0 32,0 34,0 37,0 38,0	52,0 57,0 61,0 61,0 70,0	32,0 37,0 39,0 39,0 47,0	55,0 60,0 70,0 80,0 80,0	
60 65 70 75 80 90 100	58,5 63,5 68,5 73,5 78,5 88,5 98,5	61,0 66,0 71,0 76,0 81,0 91,5 101,5		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0	53,0 58,0 61,0 61,0 61,0 61,0 61,0	29,0 32,0 34,0 37,0 38,0 43,0 48,0	52,0 57,0 61,0 70,0 80,0 80,0	32,0 37,0 39,0 39,0 47,0 47,0	55,0 60,0 70,0 80,0 80,0	50,
60 65 70 75 80 90 100 110	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0	53,0 58,0 61,0 61,0 61,0 61,0 61,0 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 43,0 53,0 56,0 61,0	52,0 57,0 61,0 70,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 47,0 57,0 61,0	55,0 60,0 70,0 80,0 80,0 80,0	50, 60, 60,
60 65 70 75 80 90 100 110 120 130 140	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0 138,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0 142,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0	53,0 58,0 61,0 61,0 61,0 61,0 68,0* 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 43,0 43,0 53,0 56,0 61,0 68,0*	52,0 57,0 61,0 70,0 80,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 47,0 57,0 61,0 70,0	55,0 60,0 70,0 80,0 80,0 80,0 80,0	50, 60, 60, 70,
60 65 70 75 80 90 100 110 120 130 140 150	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0	53,0 58,0 61,0 61,0 61,0 61,0 68,0* 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 43,0 53,0 56,0 61,0	52,0 57,0 61,0 70,0 80,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 47,0 57,0 61,0	55,0 60,0 70,0 80,0 80,0 80,0 80,0	50, 60,
60 65 70 75 80 90 100 110 120 130 140 150 10	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0 138,0 148,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0 142,0 152,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0	53,0 58,0 61,0 61,0 61,0 61,0 68,0* 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 48,0 53,0 56,0 61,0 68,0* 68,0*	52,0 57,0 61,0 70,0 80,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 57,0 61,0 70,0	55,0 60,0 70,0 80,0 80,0 80,0 80,0	50, 60, 60, 70, 70,
60 65 70 75 80 90 100 110 120 130 140 150	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0 138,0 148,0 158,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0 142,0 152,0 162,0		35,0	50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0	53,0 58,0 61,0 61,0 61,0 61,0 68,0* 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 43,0 43,0 53,0 56,0 61,0 68,0*	52,0 57,0 61,0 70,0 80,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 47,0 57,0 61,0 70,0	55,0 60,0 70,0 80,0 80,0 80,0 80,0	50, 60, 70, 70, 80,
60 65 70 75 80 90 100 110 120 130 140 150 160 600	58,5 63,5 68,5 73,5 78,5 88,5 98,5 108,5 118,5 128,0 138,0 148,0	61,0 66,0 71,0 76,0 81,0 91,5 101,5 111,5 121,5 132,0 142,0 152,0 162,0 602,0	rread a	35,0 40,0	50,0 50,0 50,0 50,0 50,0	35,0 37,5 37,5 37,5 37,5	54,0 59,0 59,0 59,0 59,0	30,0 32,5 34,0 37,0 39,0 44,0 49,0	54,0 59,0 61,0 61,0 61,0	30,0 32,0 35,0 37,0 39,0 44,0 49,0 54,0 59,0	53,0 58,0 61,0 61,0 61,0 61,0 61,0 68,0* 68,0*	29,0 32,0 34,0 37,0 38,0 43,0 48,0 53,0 56,0 61,0 68,0* 68,0*	52,0 57,0 61,0 70,0 80,0 80,0 80,0 80,0	32,0 37,0 39,0 47,0 47,0 57,0 61,0 70,0 80,0 80,0	55,0 60,0 70,0 80,0 80,0 80,0 80,0	50, 60, 70, 70,

Intermediate lengths on Ls possible =Preterred size * Design C with 1gT= max. 65,0 mm

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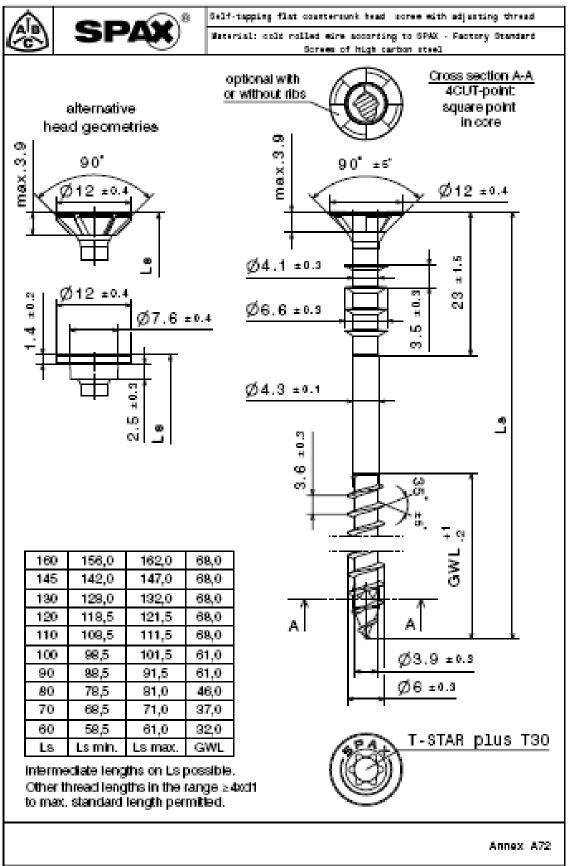
				Self-tapping screw v	vith parrtial thread				
AB	S	PAX	-S Material:	Material: Cold rolled wire according to SPAX - Factory Standard					
\odot	Spec	cial Washer l							
Ødk	k1			Manufacturer's trade mark or "SPAX" T-STAR plus or T-STAR	A: alternatively with CUT-point				
Nominal	diameter			12,0					
Type of l	Head			Special Washer he	ad				
dl	thread size			12,0					
	permissible	tolerance	·	±0,30					
dk	head diame	ter	18,6	25,0	29,0				
	permissible	tolerance	±0,93	±1,25	±1,45				
dkl	diameter			13,5	1				
	permissible	tolerance		±0,6					
d2	core diamet	ter		7,35					
	permissible	tolerance		±0,35					
k	head height	max.		4,0					
kl	head height			2,5					
	permissible	tolerance		±0,5					
р	thread pitch			6,0					
	permissible	tolerance		±0,1 x p					
T - STAR J	olus	size		T50					
Ls	_		Stand	lard thread lengths partia	l thread = lgT)				
Nom.dim.	min	max		lgT					
80	78,5	81,5		50,0					
90	88,5	91 ,5		55,0					
100	98,5	101,5		60,0					
110	108,5	111,5		80,0					
120	118,5	121,5		80,0					
130	128,0	132,0		80,0					
140	138,0	142,0		80,0					
	148,0	152,0		100,0					
150				100,0					
150 160	158,0	162,0		100.0					
160 180	178,0	182,0		100,0					
160				100,0					
160 180	178,0	182,0							

	SPAX®					Self-tapping screw with full and partial thread											
$\langle \hat{c} \rangle$		Material: cold rolled wire according to SPAX - Factory Standard															
\smile	Special Washer head						Stainless steel screw										
Cross section A-B 4CUT-point: square point in core					k1			12 15 / 10 - 52 10 - 10 - 10 - 10 - 10 - 10 - 10 - 10 -				Manufa trade n "SPAX"	mark	TAR			
		C	alterna	tivelly		CUT-a	utter*	D	: 4CU1	r-point	Тур	θZ	pl	us			
Nominal				,5	4	,0		,5		,0	6	,0	8	,0	10),0	
	thread size		3	,5	4	,0		,5	5	,0	6	,0	8	_		0,0	
dk	permissible head diam	e tolerance ator	8,7	7.0	10.0	8.0	10,6	-0,3 8.8	11.6	9.7	13.6	11.6	±0),4 15.1	±0 25.0),5 18,6	
	permissible		0,1	7,0	10,0		0.6	0,0	11,0	2,1	±0.65	±0.6		±0.75	±1,25		
	diameter	e toterance	5	.1	5	.2	6	.3	6	.6		±0,0		.8	-	3.5	
		e tolerance				<i>.</i>	0,3	~		~		~	±0	_			
d2	core diame	eter	2,	45	2,	75	3	,1	3	,4	3	,9	5	,3	6,1		
	permissibl			/-0,3							0,3						
	shank dian		2,	60	3	,1		30	3,	75	4,	30	- 5,	70		80	
	permissible			0	,	2		±0,1	,	5	2	0	-		,25	0	
	head heigh head heigh			,0 .3	_	,3 .5		5		<u>,5</u> .5		,0 .8		,5 .0		,0 .5	
	permissible		<u>,</u>	, . .	1	, , ,	1,5 ±0,3		1	<i></i>	1	.0	4).5	<u></u>	
	thread pite		2	,1	2,3 2,7				3	3,0 3,6				4,8 6,0			
	permissible tolerance									,l x p							
T-STAR p	T-STAR plus size					т	20				Т	30	T	40	Т	50	
Cross recess size Type Z				2								3					
Ls	-71		Standard thread lengths					ngths	(full ti	read =		artial th					
Nom.dim.	min	max	lgV	lgT			lgV		lgV	lgT	lgV	lgT			lgV	lgT	
17	15,5	17,5	14,0														
20	18,5	20,5	16,0		16,0		20.0		20.0							<u> </u>	
25	23,5	25,5	21,0	18,0	21,0	10.0	20,0		20,0		24.0						
30 35	28,5 33,5	30,5 36.0	27,0 32.0	18,0 23,0	27,0 30.0	18,0 23,0	25,0 30.0		25,0 30.0		24,0 29,0						
40	38.5	41.0	37.0	23.0	35,0	23,0	34,0	20,0	35,0	20.0	34.0		32.0				
45	43,5	46,0	40,0	30,0	40,0	30,0	39,0	22,5	39,0	22,0	38,0		37,0				
50	48,5	51,0	40,0	32,0	45,0	23,5	44,0	25,0	44,0	25,0	43,0	24,0	42,0		40,0		
55	53,5	56,0		35,0	50,0	35,0	49,0	27,5	49,0	27,0	48,0	27,0	47,0		45,0		
60	58,5	61,0					54,0			30,0	53,0		52,0		50,0		
65	63,5	66,0		40,0		37,5		32,5		32,0	58,0	32,0		32,0	55,0		
70 75	68,5 73,5	71,0					59,0 59,0	34,0		35,0	61,0 61,0	34,0 37,0		32,0			
80	78,5	76,0 81,0				37,5		39,0		37,0 39,0	61,0	38,0		37,0 39,0			
90	88.5	91,5			50,0	فواف	59.0	44,0	01,0	44,0	61.0	43,0	80.0	39.0	80,0		
100	98,5	101,5					2290	49,0		49,0	61,0	48,0	80,0			50.0	
110	108,5	111,5						54,0		54,0	68,0*	53,0	80,0	47,0	80,0		
120	118,5	121,5								59,0	68,0*	56,0	80,0	57,0	80,0		
130	128,0	132,0									68,0°	61,0	80,0	61,0	80,0	60,0	
140	138,0	142,0										68,0*		70,0		70,0	
150	148,0	152,0										68,0°		70,0		70,0	
160	158,0	162.0										68.0*		80.0		80,0	
600	597,0	602,0										00,0*		80.0		80,0	
		ith partial t	huesda	ddiffe	nall-+	n long	the	L	Other	thread	longthe	in the 1			I	30,0	
of 180 to 3 Intermedia	00 mm, in	steps of 20 on Ls possi	mm, L				uis		to max	s. stand	ard len	in the i gth pen `= max.	nitted.				

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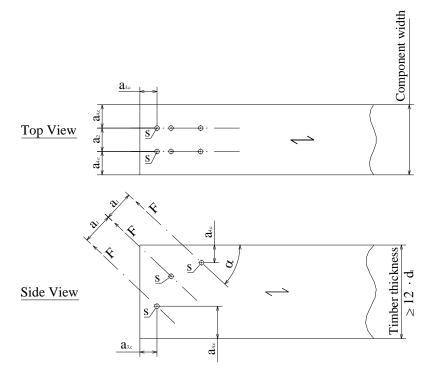
			Self-tapping screw with partial thread
(A!B)	5	PAX	 Material: Cold rolled wire according to SPAX - Factory Standar
\odot	Spec	cial Washer	Iead Stainless steel screw
Sdk	ki ki		A: alternatively with CUT-point CUT-point A: alternatively with CUT-point CUT-point CUT-point CUT-point
Nominal	diameter		12,0
Type of l	Head		Special Washer head
dl	thread size		12.0
	permissible	tolerance	±0,60
dk	head diame		18,6 25,0 29,0
	permissible	tolerance	±0,93 ±1,25 ±1,45
dkl	diameter		13,5
	permissible		±0,6
d2	core diame		7,35
	permissible		±0,35
k	head height		4,0
kl	head height		2,5
	permissible thread pitch		±0,5 6.0
р	permissible		±0,1 x p
T - STAR	•	size	150
Ls Is	pius	5126	Standard thread lengths partial thread = lgT)
Nom.dim.	min	max	lgT
80	78.5	81.5	50.0
90	88,5	91,5	55,0
100	98,5	101,5	60,0
110	108,5	111,5	80,0
120	118,5	121,5	80,0
130	128,0	132,0	80,0
140	138,0	142,0	80,0
	148,0	152,0	100,0
150			100.0
160	158,0	162,0	
160 180	178,0	182,0	100,0
160 180 200			
160 180	178,0	182,0	100,0

	Self-tapping screw with full and partial thread														
AB	AIB SPAX"					Material: cold rolled wire according to SPAX - Factory Standard									
605	Countersunk with head hole						Screws of high carbon steel								
Cross sec		h-			L	S			-		Manufa	cturer's	_		
Square		2	-15		1	gV t <u>3</u>			-		trade m		7		
in c	ore	\square		- P	-	35.55	Ød2	Â	- 🗸	D .	"SPAX"				
× A	A	: (¥let 🌢	+++++++++++++++++++++++++++++++++++++++	-	5		sh	ho	\leq	S	2	(°à	2		
ă E				16	Ľk	88	240	200		T)	57	TCC -	釰		
			Øds2	ā Z	_		loT‡]	' 두	-	Cross n	ecess	T-S1	TAR		
Optional with	or without ribs	, Y <u>k</u> ∏	-		native	ly with 4		tter*		Type 4CUT-poi		pi	us		
Nominal	diameter						.0		,5	5,		6	,0		
	thread size						.0		.5	5.			.0		
	permissible	tolerance					-		,-	±0,3			<u></u>		
dk	head diame				ļ		,0	8	,8	9,		11	1,6		
	permissible					±(),5),6				
	hole diamet permissible					— —–				2,50 0,15					
	core diamet					2	,6	2	,9	3,	2	3	,9		
	permissible									±0,3					
	shank diam					2,	85	3,	20	3,5	55	4,	30		
	permissible shank diam					3	60	3	± 80	0,10	0	oł	ine		
	permissible tolerance					±0,10 ±0,2						onne			
	head height					2,4 2,7			2,9		3,4				
	thread pitch					2	,4	2	,7	3,	0	3,6			
T-STAR plu	permissible	tolerance							±0 [20	,l x p		т	30		
Cross reeces		Z				2			2			3			
Ls			Stand	dard th	read l	engths	(full t	hread	= lgV /	partial	thread :	= lgT)			
Nom.dim.	min	max				-	lgT	lgV	lgT	lgV	lgT	lgV	lgT		
20 25	18,5 23,5	20,5 25,5				16,0 21.0		20.0		20.0					
30	28,5	30.5				25.0	18.0	25,0		25,0		24.0			
35	33,5	36,0				30,0	23,0	30,0	25,0	30,0	25,0	29,0	24,0		
40	38,5	41,0				35,0	23,0	34,0	25,0	35,0	27,0	34,0	24,0		
45 50	43,5 48,5	46,0 51.0				40,0 45.0	30,0 32,5	39,0 44.0	30,0 32,5	39,0 44.0	30,0 32,0	38,0 43.0	29,0 32.0		
55	53,5	56,0				50,0	35.0	49,0	37,0	49.0	37,0	48,0	37,0		
60	58,5	61,0							37,0	54,0	37,0	53,0	37,0		
65	63,5	66,0					37,5		42,0	59,0	41,0	58,0	41,0		
70 75	68,5 73,5	71,0 76,0					37,5 37,5		42,0 42,0	61,0 61,0	41,0 41,0	61,0 61,0	41,0 41,0		
80	78,5	81.0				50,0	37,5		42,0	61,0	46.0	61,0	46.0		
90	88,5	91,5				- 1-		59,0	47,0		61,0		61,0		
100	98,5	101,5									61,0		61,0		
110	108,5	111,5									69,0*		68,0*		
120 130	118,5 128,0	121,5 132,0									69,0*		68,0* 68,0*		
140	138,0	142,0											68,0*		
150	148,0	152,0											68,0*		
160	158,0	162,0											68,0*		
			ead addition:		ength	IS	Other	thread	length	is in the	range <u>></u>	4xd1			
of 180 to 30	0 mm, in st	eps of 20 mi	n, LgT= 68,	0 mm*			to max	s. stand	dard le	ngth per	mitted.				
Intermediate	e lengths on	Ls possible					* Desi	ign C v	vith lg	T= max	. 65,0 1	nm			
												Anne	ex A71		



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Minimum distances and spacing for exclusively axially loaded SPAX screws with CUT or 4CUT drill tip or with $d \le 8$ mm in non-predrilled holes in members of solid timber, glued laminated timber or similar glued products Single configuration



rightarrow grain direction

---- screw axis

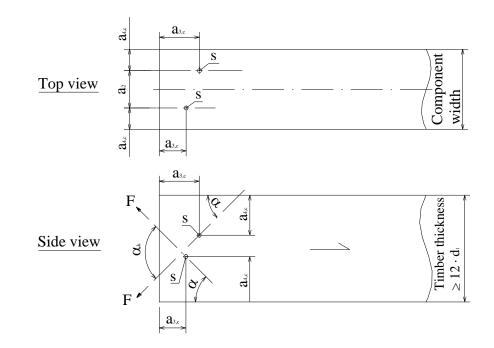
S centroid of the part of the screw in the timber

 $15^{\circ} \le \alpha \le 90^{\circ}$

 $\begin{array}{ll} a_1 & \geq 5 \cdot d \\ a_2 & \geq 2, 5 \cdot d \\ a_{3,c} \geq 5 \cdot d \\ a_{4,c} \geq 4 \cdot d \\ & \geq 3 \cdot d \\ a_1 \cdot a_2 \geq 25 \cdot d^2 \end{array} \qquad \mbox{for screws with CUT or 4CUT drill tip}$

Minimum distances and spacing see also 3.11

Minimum distances and spacing for exclusively axially loaded SPAX screws with CUT or 4CUT drill tip or with $d \le 8$ mm in non-predrilled holes in members of solid timber, glued laminated timber or similar glued products Crosswise configuration



____ grain direction

---- screw axis

S centroid of the part of the screw in the timber $15^{\circ} \le \alpha \le 90^{\circ}$

 $\begin{array}{ll} a_1 &\geq 5 \cdot d \\ a_2 &\geq 1, 5 \cdot d \\ &\geq 2, 5 \cdot d \cdot (1 - \alpha_k \,/\, 180^\circ) \end{array} & \text{for } 70^\circ < \alpha_k \leq 90^\circ \\ &\geq 2, 5 \cdot d \cdot (1 - \alpha_k \,/\, 180^\circ) & \text{for } 30^\circ \leq \alpha_k \leq 70^\circ \\ a_{3,c} \geq 5 \cdot d \\ a_{4,c} \geq 4 \cdot d \\ &\geq 3 \cdot d \end{array} & \text{for screws with CUT or 4CUT drill tip} \\ a_1 \cdot a_2 \geq 25 \cdot d^2 \end{array}$

Minimum distances and spacing see also 3.11

Mechanically jointed beams

SPAX screws with a full thread or threaded rods may be used for connections in structural members which are composed of several parts in mechanically jointed beams or columns.

The axial slip modulus K_{ser} of a screw or threaded rod with a full thread for the serviceability limit state in the direction of the screw axis should be taken independent of angle α to the grain as:

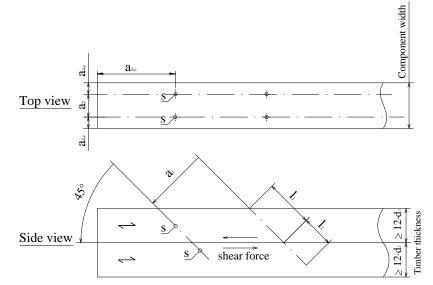
$$\begin{split} C &= K_{ser} = 25 \cdot d \cdot \ell_{ef} \quad [N/mm] \quad \text{for screws or threaded rods in softwood} \\ C &= K_{ser} = 30 \cdot d \cdot \ell_{ef} \quad [N/mm] \quad \text{for screws in pre-drilled hardwood} \end{split}$$

Where

d outer thread diameter [mm]

 ℓ_{ef} penetration length in the respective structural member [mm], $\ell_{ef} = \ell_1$ or ℓ_2

Axially loaded SPAX screws or threaded rods in solid or glued laminated timber or laminated veneer lumber Single configuration



rightarrow grain direction

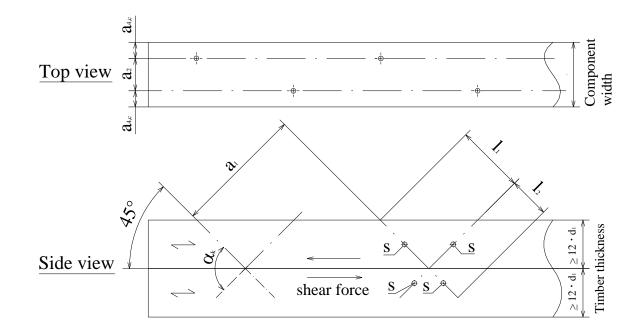
----- screw axis

S centroid of the part of the screw in the timber

 $\begin{array}{ll} a_1 &\geq 5 \cdot d \\ a_2 &\geq 2, 5 \cdot d \\ a_{3,c} \geq 5 \cdot d \\ a_{4,c} \geq 4 \cdot d \\ &\geq 3 \cdot d \\ a_1 \cdot a_2 \geq 25 \cdot d^2 \end{array} \text{ for screws with CUT or 4CUT drill tip}$

Minimum distances and spacing see also 3.11

Axially loaded SPAX screws or threaded rods in solid or glued laminated timber or laminated veneer lumber Crosswise configuration



____ grain direction

---- screw axis

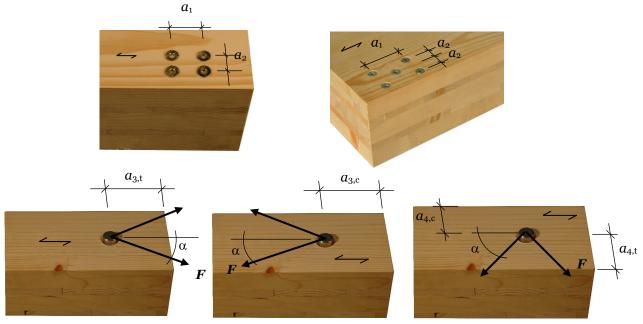
S centroid of the part of the screw in the timber

 $\begin{array}{ll} a_1 &\geq 5 \cdot d \\ a_2 &\geq 2,5 \cdot d \\ a_{3,c} \geq 5 \cdot d \\ a_{4,c} \geq 4 \cdot d \\ &\geq 3 \cdot d \\ a_1 \cdot a_2 \geq 25 \cdot d^2 \end{array} \qquad (a_2 \geq 1,5 \cdot d \text{ between the crossing screws of a screw couple})$

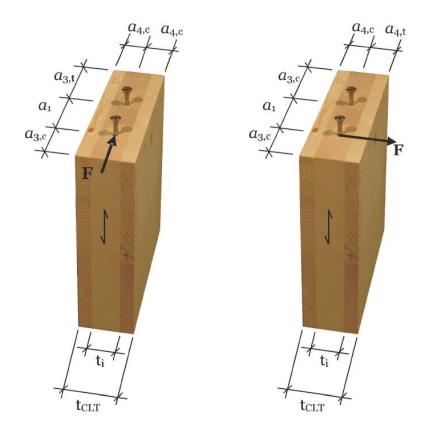
Minimum distances and spacing see also 3.11

Axially or laterally loaded screws in the plane or edge surface of cross laminated timber

Definition of spacing, end and edge distances in the plane surface unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber:



Definition of spacing, end and edge distances in the edge surface unless otherwise specified in the technical specification (ETA or hEN) for the cross laminated timber:



Annex C

Compression reinforcement

SPAX screws or threaded rods with a full thread may be used for reinforcement of timber members with compression stresses at an angle α to the grain of $45^\circ \le \alpha \le 90^\circ$. The compression force must be evenly distributed over all screws. An appropriate steel plate as intermediate layer between timber member and support has to be installed. The screws have to be driven into the timber member flush with the surface to provide both direct contact with the steel plate and direct contact between steel plate and timber.

The characteristic load-carrying capacity for a contact area with screws with a full thread at an angle α to the grain of $45^{\circ} \le \alpha \le 90^{\circ}$ shall be calculated from:

$$F_{90,Rd} = \min \begin{cases} k_{c,90} \cdot B \cdot \ell_{ef,1} \cdot f_{c,90,d} + n \cdot F_{ax,Rd} \\ B \cdot \ell_{ef,2} \cdot f_{c,90,d} \end{cases}$$
(C.1)

Where

F_{90,Rd} Design load-carrying capacity of reinforced contact area [N]

k_{c,90} factor for compression perpendicular to the grain according to EN 1995-1-1

B bearing width [mm]

 $\ell_{ef,1}$ effective length of contact area according to EN 1995-1-1 [mm]

 $f_{c,90,d}\;$ design compressive strength perpendicular to the grain [N/mm^2]

n number of reinforcement screws, $n = n_0 \cdot n_{90}$

 n_0 number of reinforcement screws arranged in a row parallel to the grain

- n₉₀ number of reinforcement screws arranged in a row perpendicular to the grain
- Fax,Rd Design compressive capacity [N], see page 7
- $\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]

 $\ell_{\rm ef,2} = \ell_{\rm ef} + (n_0 - 1) \cdot a_1 + \min(\ell_{\rm ef}; a_{3,c})$

for end-bearings [mm]

 $\ell_{ef,2} = 2 \cdot \ell_{ef} + (n_0 - 1) \cdot a_1$ for centre-bearings [mm]

- ℓ_{ef} point side penetration length [mm]
- a₁ spacing parallel to the grain [mm]

a_{3,c} end distance [mm]

If screws are driven into the member from top and bottom and the screws are overlapping at least 10·d, i.e. $\ell_{ef,top} + \ell_{ef,bottom} \ge H + 10 \cdot d$, the second condition in equation (C.1) may be disregarded.

Reinforcing screws or threaded rods for wood-based panels are not covered by this European Technical Assessment.

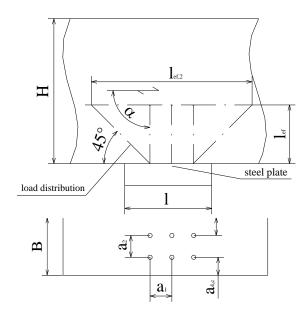
Reinforced centre-bearing

- H component height [mm]
- B bearing width [mm]
- $\ell_{\rm ef}$ point side penetration length [mm]
- $\ell_{ef,2}$ effective distribution length in the plane of the screw tips [mm]
 - = $2 \cdot \ell_{ef} + (n_0 1) \cdot a_1$ for centre-bearings

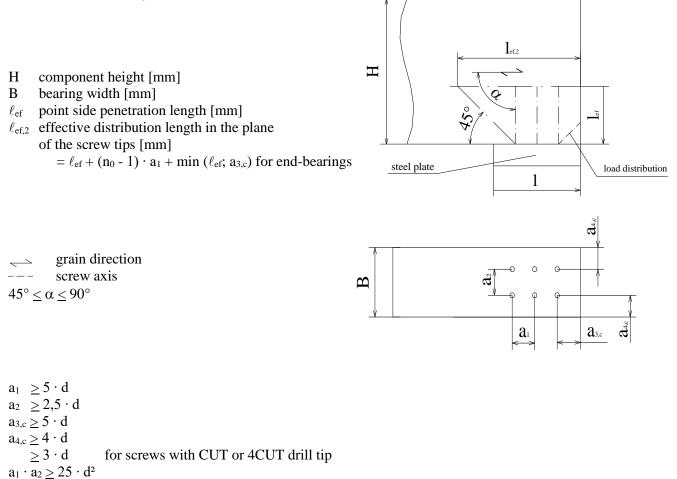
 $\$ grain direction

---- screw axis

 $45^\circ \le \alpha \le 90^\circ$



Reinforced end-bearing



The screw heads must be flush with the surface of the structural timber member.

Annex D Tensile reinforcement perpendicular to grain

Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a timber member loaded by a connection force perpendicular to the grain shall fulfil the following condition:

$$\frac{\left[1 - 3 \cdot \alpha^2 + 2 \cdot \alpha^3\right] \cdot F_{90,d}}{F_{ax,Rd}} \le 1$$

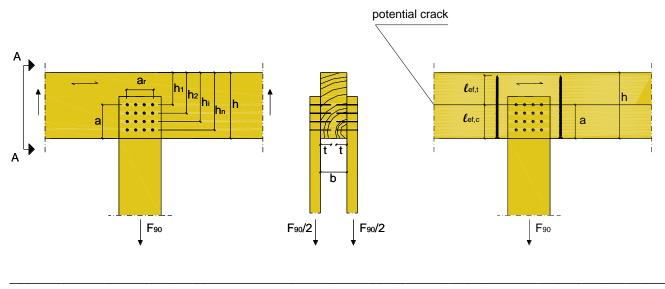
Where

F_{90,d} Design value of the force component perpendicular to the grain [N],

 $\alpha = a/h$

h = member depth [mm]

 $F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws or threaded rods where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack



Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a notched beam support shall fulfil the following condition:

$$\frac{1,3 \cdot V_d \cdot \left[3 \cdot \left(1-\alpha\right)^2 - 2 \cdot \left(1-\alpha\right)^3\right]}{F_{ax,Rd}} \le 1$$

Where

V_d Design value of the shear force [N],

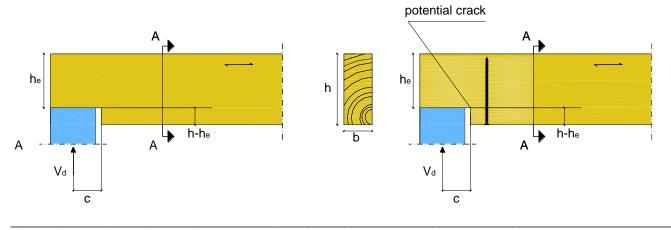
 $\alpha \qquad = h_{e} / h$

h = member depth [mm]

 $F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws or threaded rods where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack [N]

The minimum spacing a_2 of threaded rods used as reinforcement of a notched beam support is $a_2 = 3 \cdot d$, the minimum end or edge distance is $a_{3,c} = 2,5 \cdot d$ or $a_{4,c} = 2,5 \cdot d$.

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Unless specified otherwise in national provisions that apply at the installation site, the axial capacity of a reinforcement of a hole in a beam shall fulfil the following condition:

$$\frac{F_{t,V,d}+F_{t,M,d}}{F_{ax,Rd}}\!\leq\!1$$

Where

 $F_{t,V,d}$ Design value of the force perpendicular to the grain due to shear force [N]:

 $\mathbf{F}_{\mathrm{t,V,d}} = \frac{\mathbf{V}_{\mathrm{d}} \cdot \mathbf{h}_{\mathrm{d}}}{4 \cdot \mathbf{h}} \cdot \left[3 - \frac{\mathbf{h}_{\mathrm{d}}^2}{\mathbf{h}^2} \right]$

 V_d Design value of the member shear force at the hole end [N],

h = member depth [mm]

 h_d = hole depth for rectangular holes [mm]

 $h_d = 70 \%$ of hole diameter for circular holes [mm]

 $F_{t,M,d}$ Design value of the force perpendicular to the grain due to bending moment [N]:

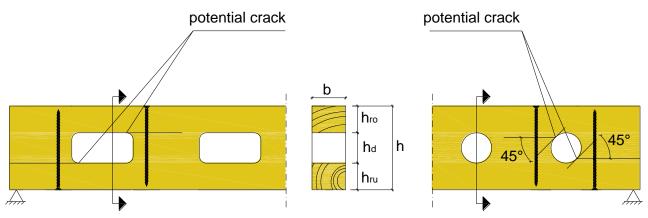
$$F_{t,M,d} = 0,008 \cdot \frac{M_d}{h_r}$$

M_d Design value of the member bending moment at the hole end [Nmm],

 $h_r = min (h_{ro}; h_{ru})$ for rectangular holes [mm]

 $h_r = min (h_{ro}; h_{ru}) + 0.15 \cdot h_d$ for circular holes [mm]

 $F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing screws or threaded rods where ℓ_{ef} is the smaller value of the penetration depth below or above the potential crack [N].



Apart from the reinforcement with screws, strength verification is required for the shear strength of the timber member in the vicinity of the hole.

Annex E Shear reinforcement

Unless specified otherwise in national provisions that apply at the installation site, the shear stress in reinforced areas of timber members with a stress component parallel to the grain shall fulfil the following condition:

$$\tau_d \leq \frac{f_{v,d} \cdot k_{\tau}}{\eta_H}$$

Where:

 τ_d is the design shear stress disregarding the reinforcement [N/mm²];

 $f_{v,d} \qquad \mbox{ is the design shear strength [N/mm^2];} \qquad \label{eq:fvd}$

$$k_{\tau} = 1 - 0.46 \cdot \sigma_{90,d} - 0.052 \cdot \sigma_{90,d}^2$$

 $\sigma_{90,d}$ is the design stress perpendicular to the grain (negative value for compression) [N/mm²];

$$\sigma_{90,d} = \frac{F_{ax,d}}{\sqrt{2} \cdot b \cdot a_1}$$

$$F_{ax,d} = \frac{\sqrt{2} \cdot (1 - \eta_H) \cdot V_d \cdot a_1}{h} [N]$$

$$\eta_H = \frac{G \cdot b}{G \cdot b + \frac{1}{2 \cdot \sqrt{2} \left(\frac{6}{\pi \cdot d \cdot h \cdot k_{ax}} + \frac{a_1}{EA_S}\right)}}$$

 V_d is the design shear force [N];

G is the shear modulus of the timber member, $G = 650 [N/mm^2]$,

b is the width of the timber member [mm],

d is the outer thread diameter [mm],

h is the depth of the timber member [mm],

 k_{ax} is the connection stiffness between rod or screw and timber member [N/mm³],

 $k_{ax} = 5 \text{ N/mm}^3$ for threaded rods d = 16 mm, $k_{ax} = 12,5 \text{ N/mm}^3$ for self-tapping screws d = 8 mm,

a₁ is the spacing parallel to the grain of the rods or screws arranged in one row [mm], for n parallel rows, an effective spacing $a_{1,ef} = a_1/n$ may be used,

EA_S is the axial stiffness of one rod or screw [N],

$$EA_{S} = \frac{E \cdot \pi \cdot d_{2}^{2}}{4} = 165.000 d_{2}^{2}$$

d₂ is the inner thread diameter of the rod or screw [mm],

 $d_2 = 12 \text{ mm}$ for threaded rods d = 16 mm, $d_2 = 5 \text{ mm}$ for screws d = 8 mm.

The axial capacity of a threaded rod or screw shall fulfil the following condition:

$$\frac{F_{ax,d}}{F_{ax,Rd}} \le 1$$

where: $F_{ax,Rd}$ Minimum of the design values of the withdrawal capacity and the tensile capacity of the reinforcing rods or screws. The effective penetration length is 50 % of the threaded length [N].

Outside reinforced areas (shaded area in Figure E.1) the shear design shall fulfil the conditions for unreinforced members.

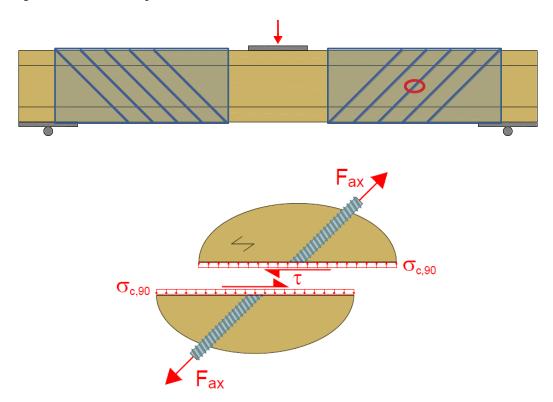


Figure E.1: Timber member with shear reinforcement; shaded areas: reinforced areas with screws arranged under 45°

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Annex F

Thermal insulation material on top of rafters

SPAX screws with an outer thread diameter $6 \text{ mm} \le d \le 12 \text{ mm}$ may be used for the fixing of Thermal insulation material on top of rafters.

The thickness of the insulation shall not exceed 400 mm. The rafter insulation must be placed on top of solid timber or glued laminated timber rafters or cross-laminated timber members and be fixed by battens arranged parallel to the rafters or by wood-based panels on top of the insulation layer. The insulation of vertical facades is also covered by the rules given here.

Screws must be screwed in the rafter through the battens or panels and the insulation without pre-drilling in one sequence.

The angle α between the screw axis and the grain direction of the rafter should be between 30° and 90°.

The rafter consists of solid timber (softwood) according to EN 338, glued laminated timber according to EN 14081, cross-laminated timber, or laminated veneer lumber according to EN 14374 or to European Technical Assessment or similar glued members according to European Technical Assessment and has a minimum width of 60 mm.

The battens must be from solid timber (softwood) according to EN 338:2003-04. The minimum thickness t and the minimum width b of the battens is given as follows:

Screws $d \le 8,0$ mm:	$b_{min} = 50 \text{ mm}$	$t_{min} = 30 \text{ mm}$
Screws $d = 10 \text{ mm}$:	$b_{min} = 60 \ mm$	$t_{min} = 40 \ mm$
Screws $d = 12 \text{ mm}$:	$b_{min} = 80 \ mm$	$t_{min} = 100 \text{ mm}$

Alternatively, to the battens, panels with a minimum thickness of 20 mm from plywood according to EN 636, particleboard according to EN 312, oriented strand board OSB/3 and OSB/4 according to EN 300 or European Technical Assessment and solid wood panels according to EN 13353 may be used. This only applies to the system with parallel inclined screws.

The insulation must comply with a European Technical Assessment.

Friction forces shall not be considered for the design of the characteristic axial capacity of the screws.

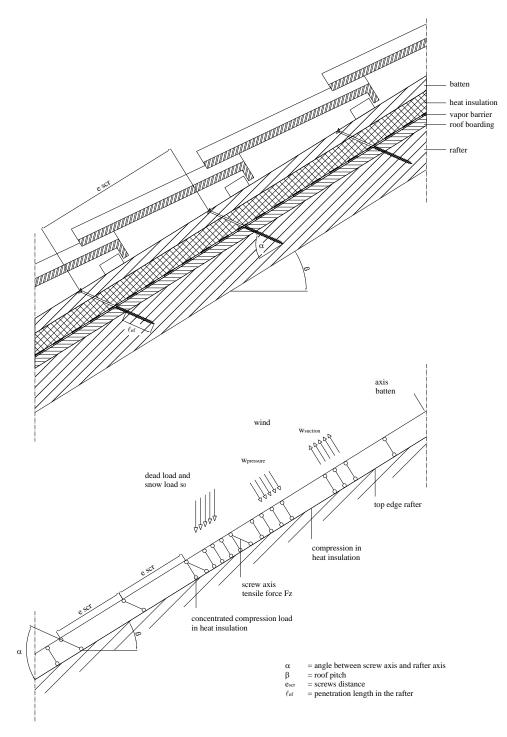
The anchorage of wind suction forces as well as the bending stresses of the battens or the boards, respectively, shall be considered in design. Additional screws perpendicular to the grain of the rafter (angle $\alpha = 90^{\circ}$) may be arranged if necessary.

The maximum screw spacing is $e_{Scr} = 1,75$ m.

Thermal insulation material on rafters with parallel inclined screws

Mechanical model

The system of rafter, Thermal insulation material on top of rafter and battens parallel to the rafter may be considered as a beam on elastic foundation. The batten represents the beam, and the Thermal insulation material on top of the rafter the elastic foundation. The minimum compression stress of the Thermal insulation material at 10 % deformation, measured according to EN 826¹, shall be $\sigma_{(10\%)} = 0.05$ N/mm². The batten is loaded perpendicular to the axis by point loads F_b. Further point loads F_s are from the shear load of the roof due to dead and snow load, which are transferred from the screw heads into the battens.



Design of the battens

The bending stresses are calculated as:

$$M = \frac{(F_b + F_s) \cdot \ell_{char}}{4}$$

Where

$$\ell_{\text{char}} = \text{characteristic length } \ell_{\text{char}} = 4 \sqrt{\frac{4 \cdot \text{EI}}{W_{\text{ef}} \cdot \text{K}}}$$

EI = bending stiffness of the batten [Nmm²]

K = coefficient of subgrade [N/mm³]

 w_{ef} = effective width of the Thermal insulation material [mm]

 F_b = Point loads perpendicular to the battens [N]

 F_s = Point loads perpendicular to the battens, load application in the area of the screw heads [N]

The coefficient of subgrade K may be calculated from the modulus of elasticity E_{HI} and the thickness t_{HI} of the Thermal insulation material if the effective width w_{ef} of the Thermal insulation material under compression is known. Due to the load extension in the Thermal insulation material the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the Thermal insulation material may be determined according to:

 $w_{ef} = w + t_{HI} / 2$

where

w = minimum width of the batten or rafter, respectively [mm]

 t_{HI} = thickness of the Thermal insulation material [mm]

$$\mathbf{K} = \frac{\mathbf{E}_{\mathrm{HI}}}{\mathbf{t}_{\mathrm{HI}}}$$

The following condition shall be satisfied:

$$\frac{\sigma_{m,d}}{f_{m,d}} = \frac{M_d}{W \cdot f_{m,d}} \le 1$$

For the calculation of the section modulus W the net cross section has to be considered.

The shear stresses shall be calculated according to:

$$V = \frac{(F_b + F_s)}{2}$$

The following condition shall be satisfied:

 $\frac{\tau_{d}}{f_{v,d}} \!=\! \frac{1,5 \cdot V_{d}}{A \cdot f_{v,d}} \!\leq\! 1$

For the calculation of the cross section area the net cross section has to be considered.

Design of the Thermal insulation material

The compressive stresses in the Thermal insulation material shall be calculated according to:

$$\sigma = \frac{1, 5 \cdot F_b + F_s}{2 \cdot \ell_{char} \cdot w}$$

The design value of the compressive stress shall not be greater than 110 % of the compressive stress at 10 % deformation calculated according to EN 826.

Design of the screws

The screws are loaded predominantly axially. The axial tension force in the screw may be calculated from the shear loads of the roof R_s :

$$T_{\rm S} = \frac{R_{\rm S}}{\cos \alpha}$$

The load-carrying capacity of axially loaded screws is the minimum design value of the axial withdrawal capacity of the threaded part of the screw, the head pull-through capacity of the screw and the tensile capacity of the screw.

In order to limit the deformation of the screw head for Thermal insulation material thicknesses over 200 mm or with compressive strength below 0,12 N/mm², respectively, the axial withdrawal capacity of the screws shall be reduced by the factors k_1 and k_2 :

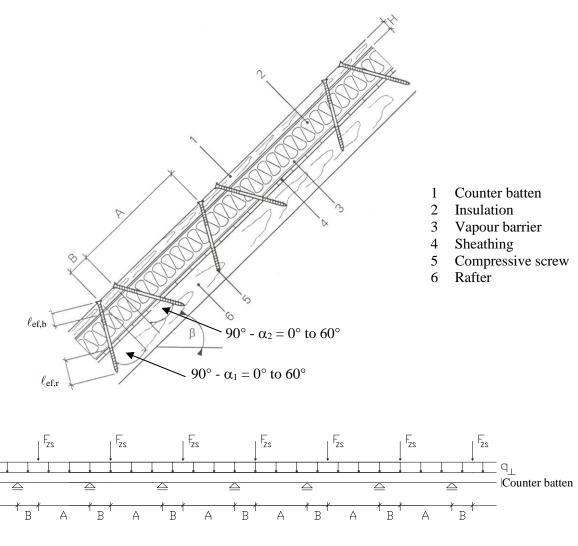
$$F_{ax,\alpha,Rd} = \min \left\{ \begin{aligned} \frac{f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}; f_{head,d} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0.8}; \frac{f_{tens,k}}{\gamma_{M2}} \end{aligned} \right\} \text{ for SPAX screws with partial thread} \\ F_{ax,\alpha,Rd} = \min \left\{ \begin{aligned} \frac{f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0.8}}{1,2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0.8} \end{aligned} \right\} \text{ for SPAX screws with full or double thread}$$

where:

 $\gamma_{M,2}$

where:	
$f_{ax,d}$	design value of the axial withdrawal parameter of the threaded part of the screw [N/mm ²]
d	outer thread diameter of the screw [mm]
ℓ_{ef}	Point side penetration length of the threaded part of the screw in the batten [mm], $l_{ef} \ge 40$ mm
$\ell_{ef,b}$	Penetration length of the threaded part of the screw in the batten [mm]
α	Angle between grain and screw axis [°] ($\alpha \ge 30^{\circ}$)
ρ_k	characteristic density of the wood-based member [kg/m ³]
$\mathbf{f}_{\text{head},\text{d}}$	design value of the head pull-through capacity of the screw [N/mm ²]
d_h	head diameter [mm]
$f_{\text{tens},k}$	characteristic tensile capacity of the screw [N]
γ _{M2}	partial factor according to EN 1993-1-1 or to the particular national annex
\mathbf{k}_1	min {1; $200/t_{HI}$ }
\mathbf{k}_2	min {1; $\sigma_{10\%}/0, 12$ }
t _{HI}	thickness of the Thermal insulation material [mm]
$\sigma_{10\%}$	compressive stress of the Thermal insulation material under 10 % deformation [N/mm ²]

If equation k_1 and k_2 are considered, the deflection of the battens does not need to be considered. Alternatively to the battens, panels with a minimum thickness of 20 mm from plywood according to EN 636 or an ETA or national provisions that apply at the installation site, particle board according to EN 312 or an ETA or national provisions that apply at the installation site, oriented strand board according to EN 300 or an ETA or national provisions that apply at the installation site and solid wood panels according to EN 13353 or an ETA or national provisions that apply at the installation site or cross laminated timber according to an ETA may be used.



Thermal insulation material on rafters with alternatively inclined screws

Mechanical model

Depending on the screw spacing and the arrangement of tensile and compressive screws with different inclinations the battens are loaded by significant bending moments. The bending moments are derived based on the following assumptions:

• The tensile and compressive loads in the screws are determined based on equilibrium conditions from the actions parallel and perpendicular to the roof plane.

These actions are constant line loads $q_{\perp} \text{ and } q_{||}$.

- The screws act as hinged columns supported 10 mm within the batten or rafter, respectively. The effective column length consequently equals the length of the screw between batten and rafter plus 20 mm.
- The batten is considered as a continuous beam with a constant span l = A + B. The compressive screws constitute the supports of the continuous beam while the tensile screws transfer concentrated loads perpendicular to the batten axis.

The screws are predominantly loaded in withdrawal or compression, respectively. The screw's normal forces are determined based on the loads parallel and perpendicular to the roof plane:

Compressive screw:
$$F_{c,Ed} = (A+B) \cdot \left(-\frac{q_{II}}{\cos \alpha_1 + \sin \alpha_1 / \tan \alpha_2} - \frac{q_{\perp} \cdot \sin(90^\circ - \alpha_2)}{\sin(\alpha_1 + \alpha_2)} \right)$$

Tensile screw:
$$F_{t,Ed} = (A+B) \cdot \left(\frac{q_{II}}{\cos \alpha_2 + \sin \alpha_2 / \tan \alpha_1} - \frac{q_{\perp} \cdot \sin(90^\circ - \alpha_1)}{\sin(\alpha_1 + \alpha_2)} \right)$$

The bending moments in the batten follow from the constant line load q_{\perp} and the load components perpendicular to the batten from the tensile screws. The span of the continuous beam is (A + B). The load component perpendicular to the batten from the tensile screw is:

$$F_{ZS,Ed} = (A+B) \cdot \left(\frac{q_{II}}{1/\tan\alpha_1 + 1/\tan\alpha_2} - \frac{q_{\perp} \cdot \sin(90^\circ - \alpha_1) \cdot \sin\alpha_2}{\sin(\alpha_1 + \alpha_2)}\right)$$

Where:

q_{II} Constant line load parallel to batten [N/mm]

 q_{\perp} Constant line load perpendicular to batten [N/mm]

 α_1 Angle between compressive screw axis and grain direction [°]

 α_2 Angle between tensile screw axis and grain direction [°]

A positive value for F_{ZS} means a load towards the rafter, a negative value a load away from the rafter.

Design of the screws

The load-carrying capacity of the screws shall be calculated as follows:

Screws loaded in tension:

$$F_{ax,\alpha,Rd} = \min\left\{\frac{f_{ax,d} \cdot d \cdot \ell_{ef,b}}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_{b,k}}{350}\right)^{0.8}; \frac{f_{ax,d} \cdot d \cdot \ell_{ef,r}}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_{r,k}}{350}\right)^{0.8}; \frac{f_{tens,k}}{\gamma_{M2}}\right\}$$

Screws loaded in compression:

$$F_{ax,\alpha,Rd} = min\left\{\frac{f_{ax,d} \cdot d \cdot \ell_{ef,b}}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_{b,k}}{350}\right)^{0.8}; \frac{f_{ax,d} \cdot d \cdot \ell_{ef,r}}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left(\frac{\rho_{r,k}}{350}\right)^{0.8}; \frac{\kappa_c \cdot N_{pl,k}}{\gamma_{M,l}}\right\}$$

where:

$\mathbf{f}_{ax,d}$	design value of the axial withdrawal capacity of the threaded part of the screw [N/mm ²]
d	outer thread diameter of the screw [mm]
$\ell_{ef,b}$	Length of the threaded part in the batten including the head for tensile and excluding the head for compressive force [mm]
$\ell_{ef,r}$	penetration length of the threaded part of the screw in the rafter [mm], $l_{ef} \ge 40$ mm
$\rho_{b,k}$	characteristic density of the batten [kg/m ³]
$\rho_{r,k}$	characteristic density of the rafter [kg/m ³]
α	angle α_1 or α_2 between screw axis and grain direction, $30^\circ \le \alpha_1 \le 90^\circ$, $30^\circ \le \alpha_2 \le 90^\circ$
$\mathbf{f}_{\text{tens},k}$	characteristic tensile capacity of the screw [N]
γм1, γм2	partial factor according to EN 1993-1-1 or to the particular national annex
$\kappa_c \cdot N_{\text{pl},k}$	Buckling capacity of the screw [N]

Free		Carbo	Stainle	ss steel		
screw	6,0 mm	8,0 mm	10,0 mm	12,0 mm	10,0 mm	12,0 mm
length [mm]	$\kappa_{c} \cdot N_{pl,k} [kN]$	$\kappa_{c} \cdot N_{pl,k} [kN]$	$\kappa_{c} \cdot N_{pl,k} [kN]$	$\kappa_{c} \cdot N_{pl,k} \left[kN \right]$	$\kappa_{c} \cdot N_{pl,k} \left[kN \right]$	$\kappa_{c} \cdot N_{pl,k} [kN]$
≤ 100	1,12	2,79	6,09	14,3	5,22	11,3
120	0,85	2,12	4,68	11,2	4,16	9,37
140	0,66	1,66	3,70	8,98	3,36	7,79
160	0,53	1,34	2,99	7,33	2,76	6,53
180	0,43	1,10	2,48	6,09	2,30	5,52
200		0,92	2,07	5,13	1,94	4,71
220		0,78	1,76	4,38	1,66	4,06
240		0,67	1,51	3,79	1,44	3,53
260		0,58	1,32	3,30	1,26	3,10
280		0,51	1,15	2,90	1,11	2,74
300		0,45	1,02	2,57	0,98	2,44
320		0,40	0,91	2,29	0,88	2,18
340		0,36	0,82	2,06	0,79	1,97
360		0,32	0,73	1,86	0,71	1,78
380		0,29	0,67	1,68	0,65	1,62
400		0,26	0,61	1,53	0,59	1,48
420		0,24	0,55	1,40	0,54	1,36
440		0,22	0,51	1,29	0,49	1,25
460		0,20	0,47	1,19	0,46	1,15
480		0,19	0,43	1,10	0,42	1,06

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