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and types of construction

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ETA-12/0063
of 1 June 2022

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General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

SFS self-tapping screws WT

Product family
to which the construction product belongs

Screws for use in timber constructions

Manufacturer

SFS Group Schweiz AG
Rosenbergsaustasse 10
CH - 9435 Heerbrugg
SCHWEIZ

Manufacturing plant

HW-1, HW-2

This European Technical Assessment
contains

19 pages including 5 annexes which form an integral part
of this assessment

This European Technical Assessment is
issued in accordance with Regulation (EU)
No 305/2011, on the basis of

EAD 130118-01-0603 – SCREWS AND THREADED
RODS IN TIMBER STRUCTURES

This version replaces

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Specific Part

1 Technical description of the product

SFS fasteners WT-T-6,5 and WT-T-8,2 are self-tapping screws made from special carbon steel. WT-S-6,5 are self-tapping screws made from stainless steel. The screws may have an anti-friction coating. The outer thread diameter is not less than 6.5 mm and not greater than 8.2 mm. The overall length of the screw is ranging from 65 mm to 330 mm (nominal dimension). Further dimensions are shown in Annex 5.

All SFS self-tapping screws WT achieve a bending angle α of at least $45/d^{0.7} + 20$, where d is the outer thread diameter of the screws.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the SFS fasteners are used in compliance with the specifications and conditions given in Annex 1 and 2.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the screws of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Dimensions	See Annex 5
Characteristic yield moment	See Annex 2
Bending angle	See Annex 2
Characteristic withdrawal parameter	See Annex 2
Characteristic head pull-through parameter	See Annex 2
Characteristic tensile strength	See Annex 2
Characteristic yield strength	See Annex 2
Characteristic torsional strength	See Annex 2
Insertion moment	See Annex 2
Spacings, end and edge distances of the screws and minimum thickness of the wood-based material	See Annex 2
Slip modulus for mainly axially loaded screws	See Annex 2
Durability against corrosion	See Annex 2

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

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3.3 Safety and accessibility in use (BWR 4)

Same as BWR 1.

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 130118-01-0603, the applicable European legal act is: 97/176/EC.
The system to be applied is: 3

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 1 June 2022 by Deutsches Institut für Bautechnik

Anja Dewitt
Head of Section

beglaubigt:
Blümel

Annex 1 Specifications of intended use

A.1.1 Use of the SFS self-tapping screws WT only for:

- static and quasi-static loads

A.1.2 Connection materials

The screws are used for connections in load-bearing timber structures between timber members or between timber members and steel members:

- Solid timber (softwood) in accordance with EN 14081-1¹,
- Solid timber of ash, beech or oak hardwood in accordance with EN 14081-1,
- Glued laminated timber (softwood) in accordance with EN 14080²,
- Glued laminated timber made of ash, beech or oak hardwood in accordance with European Technical Assessments,
- Glued solid timber in accordance with EN 14080,
- Laminated veneer lumber LVL made of softwood or beech in accordance with EN 14374³,
- Beam BauBuche GL75 in accordance with ETA-14/0354,
- Cross laminated timber (softwood) in accordance with European Technical Assessments.

The screws are used for connecting the following wood-based panels to the timber members mentioned above:

- Oriented strand boards (OSB) in accordance with EN 300⁴ and EN 13986⁵,
- Plywood in accordance with EN 636⁶ and EN 13986,
- Particleboards in accordance with EN 312⁷ and EN 13986,
- Cement-bonded particleboards in accordance with EN 634-2⁸ and EN 13986,
- Fibreboards in accordance with EN 622-2⁹, EN 622-3¹⁰ and EN 13986
- Solid wood panels (SWP) in accordance with EN 13353¹¹ and EN 13986.

Wood-based panels are only arranged on the side of the screw head.

SFS self-tapping screws WT may be used for reinforcing of timber structures perpendicular to the grain.

1	EN 14081-1:2005+A1:2011	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
2	EN 14080:2013	Timber structures – Glued laminated timber and glued solid timber – Requirements
3	EN 14374:2004	Timber structures – Structural laminated veneer lumber – Requirements
4	EN 300:2006	Oriented strand boards (OSB) – Definition, classification and specifications
5	EN 13986:2004+A1:2015	Wood-based panels for use in construction – Characteristics, evaluation of conformity and marking
6	EN 636:2012+A1:2015	Plywood – Specifications
7	EN 312:2010	Particleboards – Specifications
8	EN 634-2:2007	Cement-bonded particleboards – Specifications – Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions
9	EN 622-2:2004/AC:2005	Fibreboards – Specifications – Part 2: Requirements for hardboards
10	EN 622-3:2004	Fibreboards – Specifications – Part 3: Requirements for medium boards
11	EN 13353:2008+A1:2011	Solid wood panels (SWP) – Requirements

SFS self-tapping screws WT	Annex 1.1
Specifications of intended use	

A.1.3 Use conditions (environmental conditions)

The corrosion protection of SFS self-tapping screws WT is specified in Annex A.2.6.

A.1.4 Installation provisions

EN 1995-1-1¹² applies for the installation of SFS self-tapping screws WT.

A minimum of two screws is used for connections in load-bearing timber structures.

SFS self-tapping screws WT-T and WT-S are either driven into the timber member made of softwood without pre-drilling or in pre-drilled holes with a diameter given in Table A.1.

SFS self-tapping screws WT-T are either driven into timber members made of ash, beech or oak with a maximum mean density of 750 kg/m³ and into timber members made of beech LVL or Beam BauBuche GL75 in accordance with ETA-14/0354 with a maximum mean density of 850 kg/m³ without pre-drilling or in pre-drilled holes with a diameter given in Table A.1.

Table A.1 Diameter of the pre-drilled holes

Screw type	Diameter of the pre-drilled hole with a tolerance of ± 0.1 mm [mm]	
	Softwood and LVL made of softwood	Ash, beech or oak hardwood, LVL made of beech or Beam BauBuche GL75 in accordance with ETA-14/0354
WT-S-6,5	3.5	-
WT-T-6,5	3.5	4.5
WT-T-8,2	5.0	6.0 or 7.0

The maximum penetration length of the threaded part of SFS self-tapping screws WT-T in ash, beech or oak and beech LVL and Beam BauBuche GL75 in accordance with ETA-14/0354 is given in Table A.2. If SFS self-tapping screws WT-T are driven in two members, one consisting of ash, beech, oak or beech LVL or Beam BauBuche GL75 in accordance with ETA-14/0354 and the other of spruce, the added penetration length of the thread must not exceed the limit values given in Table A.2.

Table A.2 Maximum penetration length of the threaded part of SFS self-tapping screws WT-T in ash, beech, oak or beech LVL or Beam BauBuche GL75 in accordance with ETA-14/0354 or in combinations of ash, beech, oak or beech LVL or Beam BauBuche GL75 and spruce

Screw type	Diameter of the pre-drilled hole with a tolerance of ± 0.1 mm [mm]	Maximum penetration length of the threaded part of the screws in ash, beech, oak or beech LVL or Beam BauBuche GL75 [mm]		Maximum penetration length of the threaded part of the screws in combinations of ash, beech, oak or beech LVL or Beam BauBuche GL75 (max. 40 mm) and spruce [mm]
		With pre-drilling	Without pre-drilling	Without pre-drilling
WT-T-6,5	4.5	220	100	220
WT-T-8,2	6.0	220	70	180
WT-T-8,2	7.0	330	70	180

¹² EN 1995-1-1:2004/AC2006 Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings +A1:2008+A2:2014

SFS self-tapping screws WT	Annex 1.2
Installation provisions	

The screw holes in steel members are pre-drilled with an adequate diameter greater than the outer thread diameter d .

If screws with an outer thread diameter $d \geq 8$ mm are driven into the timber members without pre-drilling, the structural solid timber, glued laminated timber, glued solid timber, laminated veneer lumber and cross laminated timber is from spruce, pine, fir or ash, beech or oak hardwood or beech LVL/ Beam BauBuche GL75 in accordance with ETA-14/0354 considering the maximum penetration length given in Table A.2.

By fastening screws in wood-based members the head of the screws is flush with the surface of the wood-based member.

SFS self-tapping screws WT	Annex 1.3
Installation provisions	

Annex 2 Characteristic values of load-carrying capacities

Table A.2.1 Characteristic load-carrying capacities of SFS self-tapping screws WT

	WT-T-6,5 carbon steel	WT-S-6,5 stainless steel	WT-T-8,2 carbon steel
Outer thread diameter d [mm]	6.5	6.5	8.2
Characteristic yield moment $M_{y,k}$ [Nm]	12.5	8.0	25.0
Characteristic tensile strength $f_{tens,k}$ [kN]	12.5	8.5	22.0
Characteristic torsional strength $f_{tor,k}$ [Nm]	12.5	8.5	25.0

A.2.1 General

All SFS self-tapping screws WT achieve a bending angle α of at least $45/d^{0.7} + 20$, where d is the outer thread diameter of the screws.

The minimum penetration length of the threaded part of the screw in wood-based members l_{ef} is:

$$l_{ef} = \min \left\{ \begin{array}{l} \frac{4 \cdot d}{\sin \alpha} \\ 20 \cdot d \end{array} \right. \quad (2.1)$$

Where

α angle between screw axis and grain direction [°],

d outer thread diameter of the screw [mm].

The inner thread diameter d_1 of the screws is greater than the maximal width of the gaps in the layer of cross laminated timber.

A.2.2 Laterally loaded screws

A.2.2.1 General

The outer thread diameter d is used as effective diameter of the screw in accordance with EN 1995-1-1.

The embedding strength for the screws in timber members or in wood-based panels are taken from EN 1995-1-1, unless otherwise specified below.

A.2.2.2 Solid timber, glued laminated timber and glued solid timber

The embedding strength for screws in non-pre-drilled holes in softwood or in ash, beech or oak hardwood arranged at an angle between screw axis and grain direction of $0^\circ \leq \alpha \leq 90^\circ$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2] \quad (2.2)$$

SFS self-tapping screws WT	Annex 2.1
Characteristic values of the load-carrying capacities	

English translation prepared by DIBt

The embedding strength for screws in pre-drilled holes in softwood or in ash, beech or oak hardwood arranged at an angle between screw axis and grain direction of $0^\circ \leq \alpha \leq 90^\circ$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)}{2.5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2] \quad (2.3)$$

Where

- ρ_k characteristic density of the timber member [kg/m^3] for ash, beech and oak. $\rho_k \leq 590 \text{ kg/m}^3$,
- d outer thread diameter of the screw [mm],
- α angle between screw axis and grain direction, $0^\circ \leq \alpha \leq 90^\circ$.

A.2.2.3 Laminated veneer lumber

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

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.3}}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha)(1.5 \cdot \cos^2 \beta + \sin^2 \beta)} \quad [\text{N/mm}^2] \quad (2.4)$$

and accordingly for screws in pre-drilled holes in softwood LVL arranged at an angle between screw axis and grain direction, $0^\circ \leq \alpha \leq 90^\circ$:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot (1 - 0.01 \cdot d)}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha)(1.5 \cdot \cos^2 \beta + \sin^2 \beta)} \quad [\text{N/mm}^2] \quad (2.5)$$

Where

- ρ_k characteristic density of the softwood LVL [kg/m^3], $\rho_k \leq 500 \text{ kg/m}^3$,
- d outer thread diameter of the screw [mm],
- α angle between screw axis and grain direction ($0^\circ \leq \alpha \leq 90^\circ$),
- β angle between screw axis and the LVL's wide face ($0^\circ \leq \beta \leq 90^\circ$).

The embedding strength for screws in pre-drilled or in non-pre-drilled holes in beech LVL in accordance with EN 14374 or in Beam BauBuche GL75 in accordance with ETA-14/0354 arranged at an angle between screw axis and grain direction, $0^\circ \leq \alpha \leq 90^\circ$ is:

$$f_{h,k} = \frac{0.082 \cdot \rho_k \cdot d^{-0.15}}{(2.5 \cdot \cos^2 \alpha + \sin^2 \alpha) \cdot k_\varepsilon \cdot k_\beta} \quad [\text{N/mm}^2] \quad (2.6)$$

Where

- ρ_k characteristic density of beech LVL or Beam BauBuche GL75 [kg/m^3], $590 \text{ kg/m}^3 \leq \rho_k \leq 750 \text{ kg/m}^3$,
- d outer thread diameter of the screw [mm],
- α angle between screw axis and grain direction, $0^\circ \leq \alpha \leq 90^\circ$,

$$k_\varepsilon = (0.5 + 0.024 \cdot d) \cdot \sin^2 \varepsilon + \cos^2 \varepsilon, \quad (2.7)$$

- ε angle between load and grain direction, $0^\circ \leq \varepsilon \leq 90^\circ$,

$$k_\beta = 1.2 \cdot \cos^2 \beta + \sin^2 \beta, \quad (2.8)$$

- β angle between screw axis and wide face of LVL or Beam BauBuche GL75 member, $0^\circ \leq \beta \leq 90^\circ$.

SFS self-tapping screws WT	Annex 2.2
Characteristic values of the load-carrying capacities	

A.2.2.4 Cross laminated timber

The embedding strength for screws arranged in the narrow faces parallel to the plane of cross laminated timber may be assumed in accordance with equation (2.9) independent of the angle between screw axis and grain direction, $0^\circ \leq \alpha \leq 90^\circ$:

$$f_{h,k} = 20 \cdot d^{-0,5} \quad [\text{N/mm}^2] \quad (2.9)$$

unless otherwise specified in the technical specification of the cross laminated timber.

Where d is the outer thread diameter of the screws in mm.

Equation (2.9) is only valid for softwood layers. The provisions in the European Technical Assessment of the cross laminated timber apply.

The embedding strength for screws in the wide faces of cross laminated timber shall be assumed as for solid timber based on the characteristic density of the outer layer. Where applicable, the angle between force and grain direction of the outer layer shall be considered. The direction of the lateral force shall be perpendicular to the screw axis and parallel to the wide faces of the cross laminated timber.

A.2.3 Axially loaded screws

A.2.3.1 Slip modulus for mainly axially loaded screws

The axial slip modulus K_{ser} of the threaded part of a screw for the serviceability limit state per side is taken independent of angle α to the grain as:

$$K_{ser} = 25 \cdot l_{ef} \cdot d \quad [\text{N/mm}] \quad \text{for timber members made of softwood} \quad (2.10)$$

$$K_{ser} = 30 \cdot l_{ef} \cdot d \quad [\text{N/mm}] \quad \text{for timber members made of ash, beech or oak} \quad (2.11)$$

Where

d outer thread diameter of the screw [mm],

l_{ef} penetration length of the threaded part of the screw in the timber member [mm].

A.2.3.2 Axial withdrawal capacity – Characteristic withdrawal parameter

The characteristic withdrawal capacity of SFS self-tapping screws WT in solid timber (softwood or hardwood species ash, beech and oak), glued laminated timber (softwood or hardwood species ash, beech and oak), cross laminated timber or laminated veneer lumber members made of softwood or beech or Beam BauBuche GL75 in accordance with ETA-14/0354 at an angle of $0^\circ \leq \alpha \leq 90^\circ$ to the grain shall be calculated as:

$$F_{ax,\alpha,Rk} = \frac{n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef}}{k_{\beta}} \cdot \left(\frac{\rho_k}{\rho_a} \right)^{0,8} \quad (2.12)$$

Where

$F_{ax,\alpha,Rk}$ characteristic withdrawal capacity of a screw group at an angle α to the grain [N],

n_{ef} effective number of screws in accordance with EN 1995-1-1:2008, clause 8.7.2 (8),

k_{ax} factor, taking into account the angle α between screw axis and grain direction

$$k_{ax} = 1.0 \quad \text{for } 45^\circ \leq \alpha \leq 90^\circ$$

$$k_{ax} = a + \frac{b \cdot \alpha}{45^\circ} \quad \text{for } 0^\circ \leq \alpha < 45^\circ \quad (2.13)$$

SFS self-tapping screws WT	Annex 2.3
Characteristic values of the load-carrying capacities	

$$a = \begin{cases} 0.5 & \text{for LVL} \\ 0.3 & \text{for solid timber, glued solid timber, glued laminated timber and cross laminated timber} \end{cases}$$

$$b = \begin{cases} 0.5 & \text{for LVL} \\ 0.7 & \text{for solid timber, glued solid timber, glued laminated timber and cross laminated timber} \end{cases}$$

Equation (2.12) may be used for angles α between screw axis and grain direction $0^\circ \leq \alpha < 15^\circ$ if the following requirements are fulfilled:

1. The screws are inserted in solid timber, glued laminated timber, glued solid timber or laminated veneer lumber made from softwood or beech.
2. The penetration length of the threaded part of the screws is

$$l_{ef,req} = \min \begin{cases} \frac{4 \cdot d}{\sin \alpha} \\ 20 \cdot d \end{cases}$$

3. At least four screws are used in a connection.

$$k_\beta \quad k_\beta = 1.0 \quad \text{for solid timber, glued solid timber and glued laminated timber}$$

$$k_\beta = 1.5 \cdot \cos^2 \beta + \sin^2 \beta \quad \text{for laminated veneer lumber} \quad (2.14)$$

$f_{ax,k}$ characteristic withdrawal parameter at an angle $\alpha = 90^\circ$

- solid timber, glued solid timber, glued laminated timber, cross laminated timber and laminated veneer lumber made of softwood members with $\rho_a = 350 \text{ kg/m}^3$

$$f_{ax,k} = 12.8 \text{ N/mm}^2$$

The characteristic withdrawal parameter is also valid for softwood layers of cross laminated timber.

- beech LVL or Beam BauBuche GL75 (ETA-14/0354) members with $\rho_a = 730 \text{ kg/m}^3$

$$f_{ax,k} = 35.0 \text{ N/mm}^2 \quad \text{for SFS WT-T screws in non-predrilled members and for the head thread of screws WT-T-8,2 in pre-drilled members}$$

$$f_{ax,k} = 30.0 \text{ N/mm}^2 \quad \text{for SFS WT-T-6,5 screws and for the tip thread of WT-T-8,2 screws in pre-drilled holes with a diameter of 6 mm}$$

$$f_{ax,k} = 25.0 \text{ N/mm}^2 \quad \text{for the tip thread of WT-T-8,2 screws in pre-drilled holes with a diameter of 7 mm}$$

d outer thread diameter of the screw [mm],

l_{ef} penetration length of the threaded part of the screw [mm],

α angle between grain and screw axis ($0^\circ \leq \alpha \leq 90^\circ$),

β angle between screw axis and the LVL's wide face ($0^\circ \leq \beta \leq 90^\circ$),

ρ_k characteristic density of the timber member [kg/m^3] for softwood LVL $\rho_k \leq 500 \text{ kg/m}^3$, for hardwood $\rho_k \leq 590 \text{ kg/m}^3$, for beech LVL $590 \text{ kg/m}^3 \leq \rho_k \leq 750 \text{ kg/m}^3$,

ρ_a associated density for $f_{ax,k}$ [kg/m^3].

For screws penetrating more than one layer of cross laminated timber the different layers may be taken into account proportionally. In the narrow faces of the cross laminated timber the screws are fully inserted in one layer of cross laminated timber.

SFS self-tapping screws WT	Annex 2.4
Characteristic values of the load-carrying capacities	

A.2.3.3 Head pull-through capacity – Characteristic head pull-through parameter

The characteristic value of the head pull-through parameter of SFS self-tapping screws WT for solid timber (softwood or hardwood species ash, beech and oak), glued laminated timber (softwood or hardwood species ash, beech and oak), cross laminated timber, laminated veneer lumber members made of softwood or beech and wood-based panels like:

- Oriented strand boards (OSB) in accordance with EN 300 and EN 13986,
- Plywood in accordance with EN 636 and EN 13986,
- Particleboards in accordance with EN 312 and EN 13986,
- Cement-bonded particleboards in accordance with EN 634-2 and EN 13986,
- Fibreboards in accordance with EN 622-2, EN 622-3 and EN 13986,
- Solid wood panels (SWP) in accordance with EN 13353 and EN 13986.

with a thickness of more than 20 mm and for $\rho_a = 350 \text{ kg/m}^3$ is

$$f_{\text{head,k}} = 10.0 \text{ N/mm}^2.$$

For wood-based panels a maximum characteristic density of 380 kg/m^3 , for softwood LVL a maximum characteristic density of 500 kg/m^3 , for hardwood a maximum characteristic density of 590 kg/m^3 and for beech LVL a maximum characteristic density of 730 kg/m^3 shall be used in equation (8.40b) of EN 1995-1-1.

For wood-based panels with a thickness $12 \text{ mm} \leq t \leq 20 \text{ mm}$ the characteristic value of the head pull-through parameter for SFS screws is:

$$f_{\text{head,k}} = 8.0 \text{ N/mm}^2.$$

For wood-based panels with a thickness of less than 12 mm the characteristic head pull-through capacity for SFS self-tapping screws WT shall be based on a characteristic value of the head pull-through parameter of 8.0 N/mm^2 . The characteristic head pull-through capacity shall be limited to 400 N. A minimum thickness of the wood-based panels of $1.2 \cdot d$, where d is the outer thread diameter, and the values in Table A.2.2 shall be complied.

Table A.2.2 Minimum thickness of wood-based panels

Wood-based panel	Minimum thickness [mm]
Plywood	6
Fibreboards (hardboards and medium boards)	6
Oriented strand boards (OSB)	8
Particleboards	8
Cement-bonded particleboards	8
Solid wood panels (SWP)	12

For SFS self-tapping screws WT the withdrawal capacity of the thread in the timber member with the screw head may be taken into account instead of the head pull-through capacity.

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

SFS self-tapping screws WT	Annex 2.5
Characteristic values of the load-carrying capacities	

A.2.3.4 Compressive capacity of SFS self-tapping screws WT – Characteristic yield strength

The design axial compressive capacity $F_{ax,Rd}$ of SFS self-tapping screws WT embedded in solid timber, glued solid timber or glued laminated timber made from softwood with an angle between screw axis and grain direction of $30^\circ \leq \alpha \leq 90^\circ$ is the minimum of the axial resistance against pushing-in and the buckling resistance of the screw.

$$F_{ax,Rd} = \min \{ k_{ax} \cdot f_{ax,d} \cdot d \cdot l_{ef}; \kappa_c \cdot N_{pl,d} \} \quad (2.15)$$

k_{ax} factor, taking into account the angle α between screw axis and grain direction in accordance with clause A.2.3.2,

$f_{ax,d}$ design value of the withdrawal parameter of the threaded part of the screw [N/mm²],

d outer thread diameter of the screw [mm],

l_{ef} penetration length of the threaded part of the screw in the timber member [mm].

$$\kappa_c = 1 \quad \text{for } \bar{\lambda}_k \leq 0,2 \quad (2.16)$$

$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \bar{\lambda}_k^2}} \quad \text{for } \bar{\lambda}_k > 0,2 \quad (2.17)$$

$$k = 0,5 \cdot \left[1 + 0,49 \cdot (\bar{\lambda}_k - 0,2) + \bar{\lambda}_k^2 \right] \quad (2.18)$$

and a relative slenderness ratio $\bar{\lambda}_k = \sqrt{\frac{N_{pl,k}}{N_{ki,k}}}$ (2.19)

$N_{pl,k}$ characteristic plastic normal force related to the net cross section of the inner thread diameter

$$N_{pl,k} = \pi \cdot \frac{d_1^2}{4} \cdot f_{y,k}, \quad (2.20)$$

$f_{y,k}$ characteristic yield strength, $f_{y,k} = 870$ N/mm² for SFS self-tapping screws WT-T,
 $f_{y,k} = 550$ N/mm² for SFS self-tapping screws WT-S,

d_1 inner thread diameter of the screw [mm],

$$N_{pl,d} = \frac{N_{pl,k}}{\gamma_{M1}} \quad (2.21)$$

γ_{M1} partial factor in accordance with EN 1993-1-1¹³.

Characteristic ideal elastic buckling load:

$$N_{ki,k} = \sqrt{c_h \cdot E_s \cdot I_s} \quad [\text{N}] \quad (2.22)$$

Elastic foundation of the screw:

$$c_h = (0,19 + 0,012 \cdot d) \cdot \rho_k \cdot \left(\frac{90^\circ + \alpha}{180^\circ} \right) \quad [\text{N/mm}^2] \quad (2.23)$$

ρ_k characteristic density of the timber member [kg/m³],

α angle between screw axis and grain direction, $30^\circ \leq \alpha \leq 90^\circ$.

modulus of elasticity: $E_s = 210.000$ N/mm²,

second moment of area: $I_s = \frac{\pi \cdot d_1^4}{64} \quad [\text{mm}^4]. \quad (2.24)$

¹³ EN 1993-1-1:2005/AC:2009 Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings +A1:2014

SFS self-tapping screws WT	Annex 2.6
Characteristic values of the load-carrying capacities – Characteristic yield strength	

A.2.4 Spacings, end and edge distances of the screws and minimum thickness of the wood-based material

A.2.4.1 Laterally or laterally *and* axially loaded screws

Screws in pre-drilled holes

For SFS self-tapping screws WT in pre-drilled holes the minimum spacings, end and edge distances are given in EN 1995-1-1, clause 8.3.1.2 and Table 8.2 as for nails in pre-drilled holes. Here, the outer thread diameter d shall be considered.

Minimum thickness for structural timber members listed in Annex A.1.2 is $t = 30$ mm for screws with $d = 6.5$ mm and $t = 40$ mm for screws with $d = 8.2$ mm.

Screws in non pre-drilled holes

For SFS self-tapping screws WT in non-predrilled holes the minimum spacings, end and edge distances as well as the minimum member thickness are given in EN 1995-1-1, clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes. Here, the outer thread diameter d shall be considered.

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

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 $25 \cdot d$.

A.2.4.2 Only axially loaded screws

For SFS self-tapping screws WT loaded only axially the following minimum spacings, end and edge distances apply alternatively to clause A.2.4.1 for solid timber, glued laminated timber and glued solid timber made of softwood:

Spacing a_1 in a plane parallel to grain: $a_1 = 12 \cdot d$

Spacing a_2 perpendicular to a plane parallel to grain: $a_2 = 3 \cdot d$

End distance of the centre of gravity of the threaded part in the timber member: $a_{1,CG} = 8 \cdot d$

Edge distance of the centre of gravity of the threaded part in the timber member: $a_{2,CG} = 3 \cdot d$

For screws in non pre-drilled holes a minimum timber thickness of $10 \cdot d$ is required.

For a crossed screw couple in solid timber, glued laminated timber and glued solid timber made of softwood the minimum spacing between the crossing screws may be reduced by the factor $(1 - \alpha_k/180^\circ)$ with $0^\circ \leq \alpha_k \leq 90^\circ$, where α_k is the crossing angle of the screws. The minimum spacing shall be at least $1.5 \cdot d$. Appropriate means have to ensure that the crossed screws threads do not touch each other when being inserted in the timber member.

If the spacings, end and edge distances are less than the distances and thicknesses given in EN 1995-1-1 for the verification of resistance in accordance with EN 1995-1-1, clause 8.7.2 (1) the failure along the circumference of a group of screws has to be considered also for connections without steel plates.

A.2.5 Insertion moment

The ratio between the characteristic torsional strength $f_{tor,k}$ and the mean value of insertion moment $R_{tor,mean}$ fulfills the requirement for all screws.

A.2.6 Durability against corrosion

The screws are coated with the zinc flake system "Durocoat" or they are electrogalvanized (minimum thickness: 5μ) or they are zinc-nickel coated (minimum thickness: 8μ).

Steel no. 1.4301, 1.4462, 1.4539, 1.4529, 1.4567 or 1.4578 are used for screws WT-S-6,5.

SFS self-tapping screws WT	Annex 2.7
Spacings, end and edge distances, dimensions, insertion moment and durability against corrosion	

Annex 3 Compression reinforcement perpendicular to the grain

A.3.1 General

SFS self-tapping screws WT may be used for compression reinforcement perpendicular to the grain. The provisions are valid for reinforcing timber members made from solid timber, glued solid timber or glued laminated timber made of softwood.

The compression force shall be distributed evenly to the screws used as compression reinforcement.

The screws are driven into the timber member perpendicular to the contact surface under an angle between the screw axis and the grain direction of 45° to 90°. The screw heads must be flush with the timber surface.

A.3.2 Design

For the design of reinforced contact areas the following conditions must be met independent of the angle between the screw axis and the grain direction.

The design resistance of a reinforced contact area is:

$$R_{90,d} = \min \left\{ \begin{array}{l} k_{c,90} \cdot B \cdot l_{ef,1} \cdot f_{c,90,d} + n \cdot \min\{R_{ax,d}; K_c \cdot N_{pl,d}\} \\ B \cdot l_{ef,2} \cdot f_{c,90,d} \end{array} \right. \quad (3.1)$$

Where

$k_{c,90}$ parameter in accordance with EN 1995-1-1, clause 6.1.5,

B bearing width [mm],

$l_{ef,1}$ effective contact length in accordance with EN 1995-1-1, clause 6.1.5 [mm],

$f_{c,90,d}$ design compressive strength perpendicular to the grain [N/mm²],

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

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

n_{90} number of reinforcing screws arranged in a row perpendicular to the grain,

$$R_{ax,d} = f_{ax,d} \cdot d \cdot l_{ef} \quad [N], \quad (3.2)$$

$f_{ax,d}$ design value of the withdrawal parameter of the threaded part of the screw [N/mm²],

d outer thread diameter of the screw [mm],

K_c in accordance with annex A.2.3.4,

$N_{pl,d}$ in accordance with annex A.2.3.4 [N],

$l_{ef,2}$ effective contact length in the plane of the screw tips (see Figure A.3.1) [mm],

$$l_{ef,2} = \{l_{ef} + (n_0 - 1) \cdot a_1 + \min\{l_{ef}; a_{1,CG}\}\} \text{ for end supports (see Figure A.3.1 left),}$$

$$l_{ef,2} = \{2 \cdot l_{ef} + (n_0 - 1) \cdot a_1\} \text{ for intermediate supports (see Figure A.3.1 right),}$$

l_{ef} penetration length of the threaded part of the screw in the timber member [mm],

a_1 spacing a_1 in a plane parallel to grain, see chapter A.2.4.2 [mm],

$a_{1,CG}$ end distance of the centre of gravity of the threaded part in the timber member, see chapter A.2.4.2 [mm].

SFS self-tapping screws WT	Annex 3.1
Compression reinforcement perpendicular to the grain	

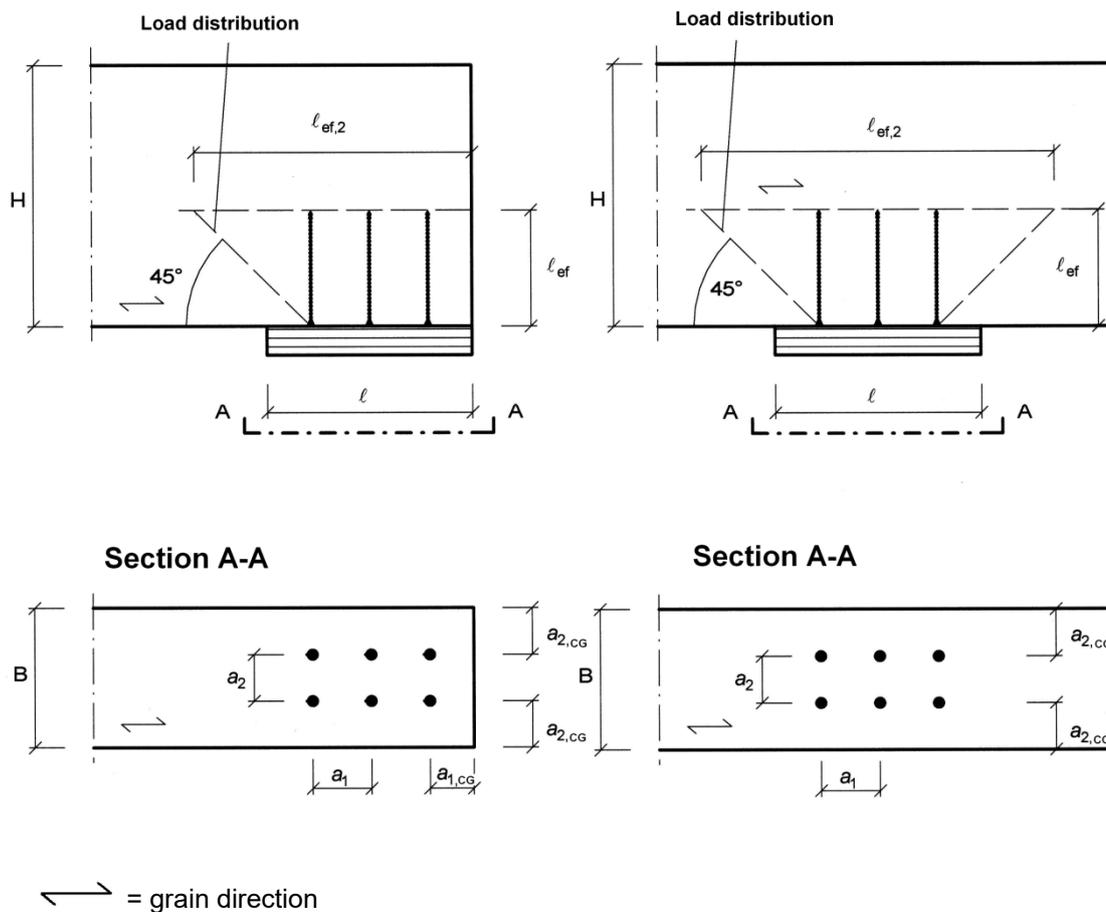


Figure A.3.1: Reinforced end support (left) and reinforced intermediate support (right)

SFS self-tapping screws WT	Annex 3.2
Compression reinforcement perpendicular to the grain	

Annex 4 Header-joist connections

The characteristic load-carrying capacity for SFS self-tapping screws WT for header-joist connections with inclined screws ($\alpha = 45^\circ$) should be calculated as:

$$F_{90,Rk} = \frac{1.25 \cdot n_{ef} \cdot f_{ax,k} \cdot d \cdot l_{ef}}{\sqrt{2}} \quad (4.1)$$

and for header-joist connections with a crossed screw couple ($\alpha = 45^\circ$):

$$F_{90,Rk} = \frac{2 \cdot n_{ef} \cdot f_{ax,k} \cdot d \cdot l_{ef}}{\sqrt{2}} \quad (4.2)$$

Where

α angle α between screw axis and grain direction, $\alpha = 45^\circ$,

n_{ef} effective number of inclined screws or crossed screw couples in the connection,

$$n_{ef} = \max \{ n^{0.9}; 0.9 \cdot n \},$$

n number of inclined screws or crossed screw couples in the connection,

$f_{ax,k}$ characteristic withdrawal parameter at an angle $\alpha = 90^\circ$ in accordance with clause A.2.3.2,

d outer thread diameter of the screws [mm],

l_{ef} penetration length of the threaded part of the screw near the screw head or near the screw tip in the timber member, whichever is the smaller [mm].

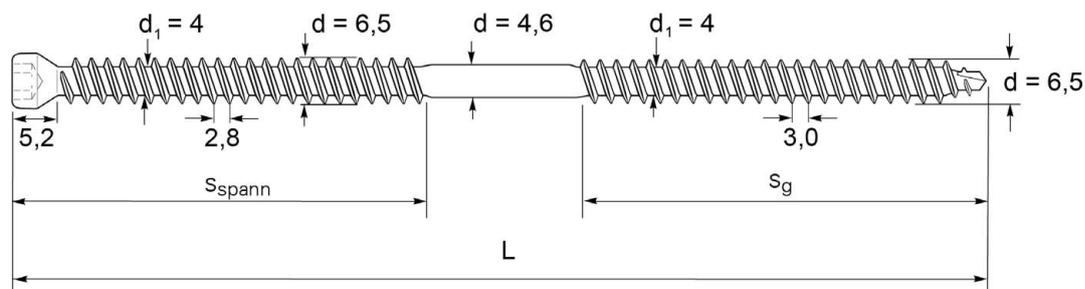
Equation (4.1) and (4.2) are only valid if the requirements given in Table A.4.1 are met.

Table A.4.1 Minimum spacings and distances of the screws and height of the joists

	SFS WT 6,5	SFS WT 8,2
Minimum end distance of the centre of gravity of the threaded part in the timber member $a_{1,CG}$	32 mm	40 mm
Minimum edge distance of the centre of gravity of the threaded part in the timber member $a_{2,CG}$	20 mm	24 mm
Minimum spacing a_2 perpendicular to a plane parallel to grain	25 mm	32 mm
Minimum spacing between crossing screws	10 mm	12 mm
Minimum height of the joists	76 mm	96 mm

SFS self-tapping screws WT	Annex 4.1
Header-joist connections	

WT-S-6,5 x L

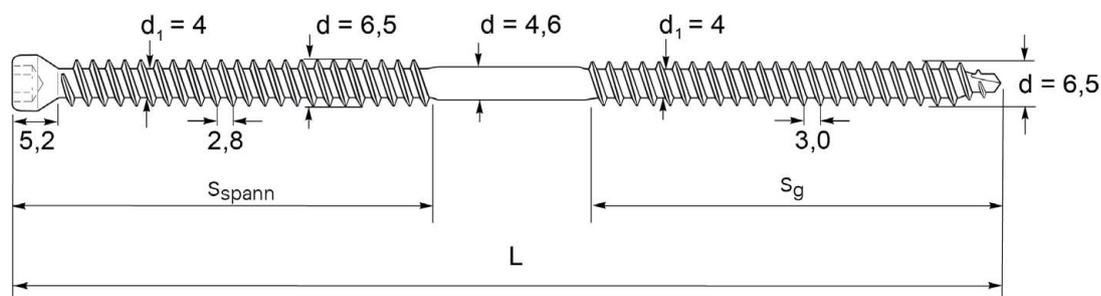


$$65 \text{ mm} \leq L \leq 130 \text{ mm}$$

$$28 \text{ mm} \leq s_{\text{spann}} \leq 55 \text{ mm}$$

$$28 \text{ mm} \leq s_g \leq 55 \text{ mm}$$

WT-T-6,5 x L



$$65 \text{ mm} \leq L \leq 220 \text{ mm}$$

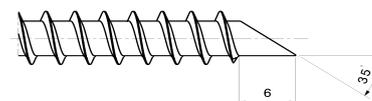
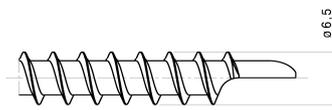
$$28 \text{ mm} \leq s_{\text{spann}} \leq 95 \text{ mm}$$

$$28 \text{ mm} \leq s_g \leq 95 \text{ mm}$$

Tolerances

Length	$\pm 5\%$
Diameter	$\pm 5\%$

Alternative screw tip for screws WT-T-6,5

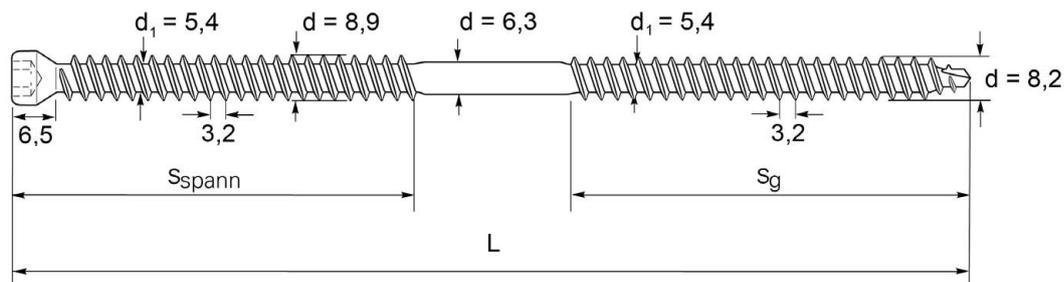
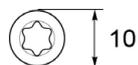


SFS self-tapping screws WT

Self-tapping screws WT-S-6,5 and WT-T-6,5
Dimensions

Annex 5.1

WT-T-8,2 x L



$160 \text{ mm} \leq L \leq 330 \text{ mm}$

$65 \text{ mm} \leq S_{\text{spann}} \leq 135 \text{ mm}$

$65 \text{ mm} \leq S_g \leq 135 \text{ mm}$

Tolerances	
Length	$\pm 5\%$
Diameter	$\pm 5\%$

Alternative screw tip for screws WT-T-8,2

