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to Article 29 of the Regulation (EU)  
No 305/2011 of the European  
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MEMBER OF EOTA



## European Technical Assessment ETA-23/0361 of 2024/04/23

### 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:**

WÜTOX / WÜPOFAST II TX screws

**Product family to which the above construction product belongs:**

Screws for use in timber constructions

**Manufacturer:**

Würth International AG  
Aspermontstrasse 1  
CH-7000 Chur  
Internet [www.wurth-international.com](http://www.wurth-international.com)

**Manufacturing plant:**

Würth International AG

**This European Technical Assessment contains:**

18 pages including 3 annexes which form an integral part of the document

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

European Assessment document (EAD) no. EAD 130118-01-0603 "Screws and threaded rods for use in timber constructions"

**This version replaces:**

The ETA with the same number issued on 2023-06-16

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## II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

### 1 Technical description of product

WÜTOX / WÜPOFAST II TX screws are screws to be used in timber structures. They are threaded over a part of the length of the screw. The screws are produced from carbon steel wire for nominal diameters between 5 mm and 10,0 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 WÜTOX / WÜPOFAST II TX screw is 5, 6, 8 and 10 mm. The overall length of the screws,  $L$ , shall not be less than 25 mm and shall not be greater than 600 mm. Other dimensions are given in Annex A.

The ratio of inner thread diameter to outer thread diameter  $d_1/d$  ranges from 0,60 to 0,71.

The screws are threaded over a minimum length  $L_1$  of  $4 \cdot d$  (i.e.  $L_1 \geq 4 \cdot d$ ).

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

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

The screws are used for connections in load bearing timber structures between members of solid timber (softwood), glued laminated timber, cross-laminated timber, and laminated veneer lumber, similar glued members, wood-based panels or steel.

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:

- Solid timber (softwood) according to EN 14081-1
- Glued laminated timber (softwood) according to EN 14080,
- Laminated veneer lumber LVL of softwood according to EN 14374, arrangement of the screws only perpendicular to the plane of the veneers,
- Glued solid timber (softwood) according to EN 14080 or national provisions that apply at the installation site,
- Cross-laminated timber (softwood) according to

European Technical Approvals/Assessments or national provisions that apply at the installation site.

- Plywood according to EN 636 and EN 13986,
- Oriented Strand Board, OSB according to EN 300 and EN 13986,
- Particleboard according to EN 312 and EN 13986,
- Fibreboards according to EN 622-2, EN 622-3 and EN 13986,
- Cement-bonded particle boards according to EN 634-2 and EN 13986,
- Solid-wood panels according to EN 13353 and EN 13986.
- Wood-based panels shall only be arranged on the side of the screw head.

WÜTOX / WÜPOFAST II TX screws with an outer thread diameter of at least 6 mm may be used for the fixing of thermal insulation material on top of rafters or on wood-based members in vertical façades.

The screws are driven into the wood-based member made of softwood without pre-drilling or in pre-drilled holes with a diameter not exceeding the inner thread diameter  $d_1$ . The screw holes in steel members shall be pre-drilled with an adequate diameter greater than the outer thread diameter.

If screws with an outer thread diameter  $d \geq 8$  mm are driven into the wood-based member without pre-drilling, the structural solid or glued laminated timber, laminated veneer lumber and similar glued members shall be from spruce, pine or fir.

In the case of fastening battens on thermal insulation material on top of rafters the screws shall be driven in the rafter through the battens and the thermal insulation material without pre-drilling in one sequence.

Countersunk head screws may be used with washers according to Annex A. After inserting the screws, the washers shall touch the surface of the wood-based member completely.

By fastening screws in wood-based members the head of the screws shall be flush with the surface of the wood based member. For pan head, wafer head, hex head or hex wafer head screws the head part remains unconsidered

The screws are intended to be used in timber connections for which requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation 305/2011 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. Regarding environmental conditions, national provisions at the building site shall apply considering the environmental conditions.

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

The zinc-coated screws 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 scope of the screws regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions.

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.

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

Characteristic	Assessment of characteristic
<b>3.1 Mechanical resistance and stability*) (BWR1)</b>	
Dimensions	See annex A
Characteristic yield moment	See section 3.4
Bending angle	No performance assessed
Characteristic withdrawal parameter	See section 3.4
Characteristic head pull-trough parameter of screws	See section 3.4
Tensile strength	Characteristic value $f_{\text{tens,k}}$ :
Screws made of carbon steel	d = 5,0 mm: 7,5 kN
	d = 6,0 mm: 9,5 kN
	d = 8,0 mm: 17,4 kN
	d = 10,0 mm: 25,0 kN
Characteristic yield strength	See section 3.4
Torsional strength	Characteristic value $f_{\text{tor,k}}$ :
Screws made of carbon steel	d = 5,0 mm: 5,8 Nm
	d = 6,0 mm: 9,0 Nm
	d = 8,0 mm: 22,0 Nm
	d = 10,0 mm: 40,0 Nm
Insertion moment	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{\text{tor,k}} / R_{\text{tor,mean}} \geq 1,5$
Spacing, end and edge distances of the screws or threaded rods and minimum thickness of the timber material	See annex B
Slip modulus for mainly axially loaded screws and threaded rods	See section 3.4
Durability against corrosion	See section 3.5
<b>3.2 Safety in case of fire (BWR2)</b>	
Reaction to fire	The screws are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
<b>3.3 General aspects related to the performance of the product</b>	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 and 2

\*) See additional information in section 3.4 – 3.7.

### 3.4 Mechanical resistance and stability

The load-carrying capacities for WÜTOX / WÜPOFAST II TX 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 WÜTOX / WÜPOFAST II TX screws should be used for designs in accordance with Eurocode 5 or an appropriate national code.

Point side penetration length must be  $\ell_{ef} \geq 4 \cdot d$ , where  $d$  is the outer thread diameter of the screw. For the fixing of rafters, point side penetration must be at least 40 mm,  $\ell_{ef} \geq 40$  mm.

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

#### Lateral load-carrying capacity

The characteristic lateral load-carrying capacity of WÜTOX / WÜPOFAST II TX screws 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 assumed as:

$d = 5,0$ mm:	$M_{y,k} = 5,5$ Nm
$d = 6,0$ mm:	$M_{y,k} = 9,5$ Nm
$d = 8,0$ mm:	$M_{y,k} = 18,3$ Nm
$d = 10,0$ mm:	$M_{y,k} = 36,0$ Nm

The embedding strength for screws in non-pre-drilled holes arranged at an angle between screw axis and grain direction,  $30^\circ \leq \alpha \leq 90^\circ$  is:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{2,5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2]$$

and accordingly for screws in pre-drilled holes:

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{2,5 \cdot \cos^2 \alpha + \sin^2 \alpha} \quad [\text{N/mm}^2]$$

Where

- $\rho_k$  characteristic timber density [ $\text{kg/m}^3$ ];
- $d$  outer thread diameter [mm];
- $\alpha$  angle between screw axis and grain direction;

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

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

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 in the wide face 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 wide face 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) shall be applied.

#### Bending angle

No performance assessed

#### Axial withdrawal capacity

The characteristic axial withdrawal capacity of WÜTOX / WÜPOFAST II TX screws at an angle of  $15^\circ \leq \alpha \leq 90^\circ$  to the grain in solid timber, glued laminated timber and cross-laminated timber members shall be calculated according to EN 1995-1-1 from:

$$F_{ax,\alpha,Rk} = n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef} \cdot \left( \frac{\rho_k}{350} \right)^{0,8} \quad [\text{N}]$$

Where

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

$n_{ef}$  effective number of screws according to EN 1995-1-1

$k_{ax}$  Factor, taking into account the angle  $\alpha$  between screw axis and grain direction  
 $k_{ax} = 1,0$  for  $45^\circ \leq \alpha < 90^\circ$

$$k_{ax} = 0,3 + \frac{0,7 \cdot \alpha}{45} \quad \text{for } 15^\circ \leq \alpha < 45^\circ$$

$f_{ax,k}$  Characteristic withdrawal parameter  
 $3,5 \text{ mm} \leq d \leq 5 \text{ mm}$ :  $f_{ax,k} = 12 \text{ N/mm}^2$   
 $6 \text{ mm} \leq d \leq 8 \text{ mm}$ :  $f_{ax,k} = 11 \text{ N/mm}^2$   
 $d \geq 10 \text{ mm}$ :  $f_{ax,k} = 10 \text{ N/mm}^2$

$d$  outer thread diameter [mm]

$\ell_{ef}$  Penetration length of the threaded part according to EN 1995-1-1 [mm]

$\alpha$  Angle between grain and screw axis

$\rho_k$  Characteristic density [ $\text{kg/m}^3$ ]

For screws arranged under an angle between screw axis and grain direction of less than 90°, the minimum threaded penetration length is:

$$\ell_{ef} \geq \min(4 \cdot d / \sin \alpha ; 20 \cdot d)$$

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 pull-through capacity and the tensile capacity of the screw.

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.

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

$$K_{ser} = 25 \cdot d \cdot \ell_{ef} \text{ [N/mm]} \text{ for fasteners in softwood}$$

Where

$d$  outer thread diameter [mm]

$\ell_{ef}$  penetration length in the timber member [mm]

### Head pull-through capacity

The characteristic head pull-through capacity of WÜTOX / WÜPOFAST II TX self-tapping screw shall be calculated according to EN 1995-1-1 from:

$$F_{ax,\alpha,Rk} = n_{ef} \cdot f_{head,k} \cdot d_h^2 \cdot \left( \frac{\rho_k}{350} \right)^{0,8} \quad \text{[N]}$$

where:

$F_{ax,\alpha,Rk}$  Characteristic head pull-through capacity of the connection at an angle  $\alpha \geq 30^\circ$  to the grain [N]

$n_{ef}$  Effective number of screws according to EN 1995-1-1:2008

$f_{head,k}$  Characteristic head pull-through parameter [N/mm<sup>2</sup>]

$d_h$  Diameter of the screw head or the washer [mm].

$\rho_k$  Characteristic density [kg/m<sup>3</sup>], for wood-based panels  $\rho_k = 380 \text{ kg/m}^3$

Characteristic head pull-through parameter for WÜTOX / WÜPOFAST II TX screw in connections with timber and in connections with wood-based panels with thicknesses above 20 mm:

$$f_{head,k} = 9,4 \text{ N/mm}^2$$

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):

$$f_{head,k} = 8 \text{ N/mm}^2 \text{ limited to } F_{ax,Rk} = 400 \text{ N}$$

For the calculation of the head pull-through capacity  $d_h$  is limited to 3.5 mm.

The head diameter  $d_h$  shall be greater than 1,8· $d_s$ , where  $d_s$  is the smooth shank or the wire diameter. Otherwise, the characteristic head pull-through capacity  $F_{ax,\alpha,Rk} = 0$ .

The minimum thickness of wood-based panels according to the clause 3.11 must be observed.

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

### Tensile capacity

The characteristic tensile strength  $f_{tens,k}$  is given in clause 3.1.

For screws used in combination with steel plates, the tear-off capacity of the screw head including a washer shall be greater than the tensile capacity of the screw.

### Combined laterally and axially loaded screws

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

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

where

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

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

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

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

### Thermal insulation material on top of rafters

WÜTOX / WÜPOFAST II TX screws with an outer thread diameter of  $d = 6 \text{ mm}, 8 \text{ mm}, 10 \text{ mm}$  and  $12 \text{ mm}$  may be used for the fixing of thermal insulation material on top of rafters.

The thickness of the insulation ranges up to 300 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 placed 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  $\alpha$  between the screw axis and the grain direction of the rafter should be between  $30^\circ$  and  $90^\circ$ .

The battens must be from solid timber (softwood) according to EN 338:2003-04. The minimum thickness of the battens is 80 mm and the minimum width 100 mm for screws with outer thread diameter  $d = 12$  mm. The minimum thickness of the battens is 40 mm and the minimum width 60 mm for screws with outer thread diameter  $d = 10$  mm. For screws with outer thread diameter  $d = 6$  mm and 8 mm the minimum thickness of the battens is 30 mm and the minimum width 50 mm.

Alternatively, to the battens, boards with a minimum thickness of 20 mm from plywood according to EN 636, particle board according to EN 312, oriented strand board OSB/3 and OSB/4 according to EN 300 or ETA and solid wood panels according to EN 13353 may be used.

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

The insulation must comply with an hEN or ETA.

The insulation must have a minimum compressive stress of  $\sigma_{10\%} = 0,05$  N/mm<sup>2</sup> at 10 % deformation according to EN 826:1996-05.

The analysis of the fixing of the insulation and battens or boards, respectively, may be carried out using the static model in Annex 12. The battens or boards, respectively, must have sufficient strength and stiffness. The maximum pressure between the battens or boards, respectively, and the insulation shall not exceed  $1,1 \cdot \sigma_{10\%}$ .

The characteristic axial withdrawal capacity of the screws for rafter or facade insulation shall be calculated from:

$$F_{ax,\alpha,RK} = \min \begin{cases} k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2 \cdot \left( \frac{\rho_k}{350} \right)^{0,8} \\ f_{head,k} \cdot d_h^2 \cdot \left( \frac{\rho_k}{350} \right)^{0,8} \\ f_{tens,d} \end{cases} \quad [N]$$

where

$F_{ax,\alpha,RK}$  Characteristic withdrawal capacity of the connection at an angle  $\alpha$  to the grain [N]

$k_{ax}$	Factor, taking into account the angle $\alpha$ between screw axis and grain direction $k_{ax} = 1,0$ for $45^\circ \leq \alpha < 90^\circ$ $k_{ax} = 0,3 + \frac{0,7 \cdot \alpha}{45}$ for $0^\circ \leq \alpha < 45^\circ$
$f_{ax,k}$	Characteristic withdrawal parameter [N/mm <sup>2</sup> ]
$d$	Outer thread diameter [mm]
$\ell_{ef}$	Point side penetration length of the treaded part according to EN 1995-1-1:2008 [mm]
$\alpha$	Angle between grain and screw axis ( $\alpha \geq 30^\circ$ )
$k_1$	$\min \{1; 220/t_{HI}\}$
$k_2$	$\min \{1; \sigma_{10\%}/0,12\}$
$t_{HI}$	Thickness of the thermal insulation material [mm]
$\sigma_{10\%}$	Compressive stress of the thermal insulation material under 10 % deformation [N/mm <sup>2</sup> ] $\sigma_{10\%} \geq 0,05$ N/mm <sup>2</sup>
$f_{head,k}$	Characteristic head pull-through parameter [N/mm <sup>2</sup> ]
$d_h$	Outer diameter of the screw head [mm]
$\rho_k$	Characteristic density [kg/m <sup>3</sup> ]
$f_{tens,k}$	Characteristic tensile capacity of the screw [N]

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

Screws for the anchorage of rafter insulation shall be arranged according to Annex C.

The maximum screw spacing is  $e_s = 1,75$  m.

### 3.5 Aspects related to the performance of the product

Corrosion protection in service class 1 and 2.

The WÜTOX / WÜPOFAST II TX screws are produced from carbon wire. Screws made from steel are electrogalvanised and yellow or blue chromate, brass plated, browned or nickel plated. The thickness of the zinc coating is minimum 5  $\mu$ m. Alternatively, the screws can be coated with a minimum 4  $\mu$ m zinc-nickel coating.

### 3.6 General aspects related to the intended use of the product

The screws 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 notified 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 the manufacturer should be considered for installation.

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

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

Furthermore, the screws with diameters between 6 mm and 12 mm may also be used for the fixing of insulation on top of rafters or at vertical facades.

A minimum of two screws should be used for connections in load bearing timber structures.

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 ETA's the terms of the ETA's must be considered.

If screws with an outer thread diameter  $d \geq 8$  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 in pre-drilled holes.

The minimum angle between the screw axis and the grain direction is  $\alpha = 30^\circ$ .

The screws shall be driven into the wood without pre-drilling or after pre-drilling with a diameter equal or less than the inner thread diameter.

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

Only the equipment prescribed by Würth AG 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.

For structural timber members, minimum spacing and distances for screws are given in EN 1995-1-1 (Eurocode 5) clause 8.3.1.2 and table 8.2 as for nails in predrilled or non-predrilled holes, respectively. Here, the outer thread diameter  $d$  must be considered.

For Douglas fir members minimum spacing 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  $3 \cdot d$ , if the spacing parallel to the grain and the end distance is at least  $25 \cdot d$ .

Unless specified otherwise in the technical specification (ETA or hEN) of cross laminated timber, minimum distances and spacing for screws in the wide face of cross laminated timber members with a minimum thickness  $t = 10 \cdot d$  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	$a_{4,t} = 6 \cdot d$

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  $t = 10 \cdot d$  and a minimum penetration depth perpendicular to the edge surface of  $10 \cdot d$  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 a crossed screw couple the minimum spacing  
between the crossing screws is  $1,5 \cdot d$ .

Minimum thickness for 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  $d$   
 $= 12$  mm.

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

##### **4.1 AVCP system**

According to the decision 97/176/EC of the European Commission<sup>1</sup>, 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 provided for 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

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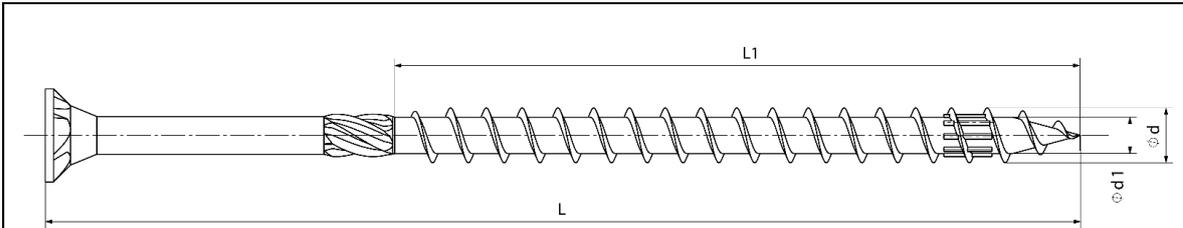


Thomas Bruun  
Managing Director, ETA-Danmark

**Annex A**  
**Drawings and material specification of WÜTOX / WÜPOFAST II TX screws**

**Würth WÜTOX / WÜPOFAST II TX**

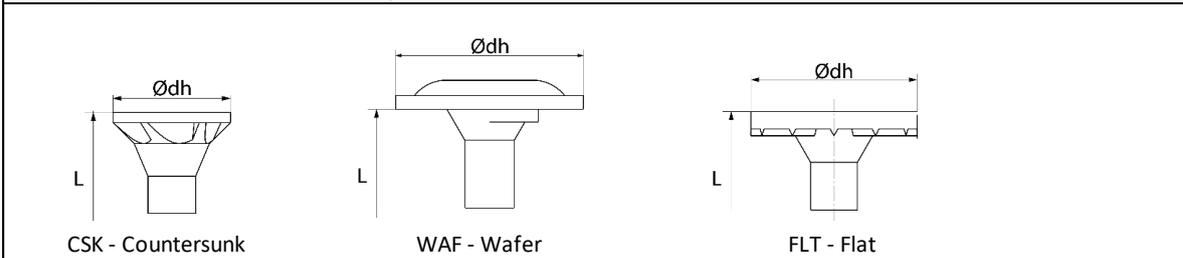
Screw Dimensions, Head Shapes and Point Options



- Thread Cutting Line: optional
- Shank Rips: optional; obligatory  $L \geq 220\text{mm}$
- Single or Double Thread  $d=6\text{mm}$

Nominal diameter		5,0	6,0	8,0	10,0
d	min	4,70	5,80	7,60	9,60
	max	5,00	6,20	8,25	10,25
d1	min	2,80	3,65	5,05	6,20
	max	3,30	4,00	5,50	6,70
L	$\pm 1,5\text{mm } L \leq 30$ $\pm 2,0\text{mm } L > 30$	25 - 120	40 - 300	40 - 600	80 - 600
L1	$\pm 1,5\text{mm } L1 \leq 30$ $\pm 2,0\text{mm } L1 > 30$	20 - 74	24 - 75	32 - 150	40 - 150

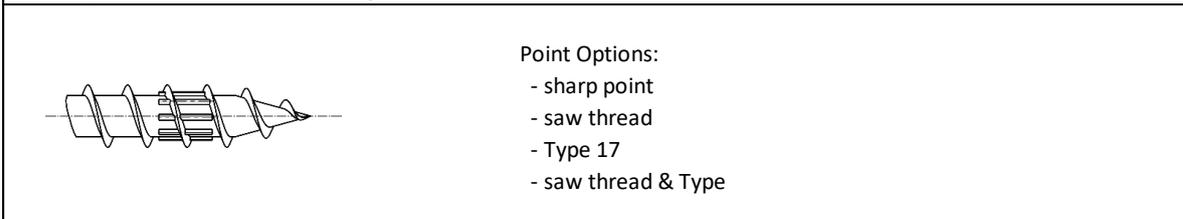
**WÜTOX / WÜPOFAST II TX - Head Shapes**



- Head Options:
- Under Head Construction: Rips or Pockets optional
  - Head Mark: optional
  - Recess: TX

Nominal diameter		5,0	6,0	8,0	10,0
CSK1	$8 < dh \leq 12\text{mm}$ $\pm 0,6\text{mm}$	9,8	11,8	14,5	17,5
CSK2		-	12,8	-	18,2
WAF1	$dh > 12\text{mm}$ $\pm 5\%$	-	15,2	21,5	24,7
WAF2		-	15,4	22,5	25,4
FLT1	-	-	14,0	17,8	21,0
FLT2	-	-	16,0	19,0	22,4

**WÜTOX / WÜPOFAST II TX - Point Options**

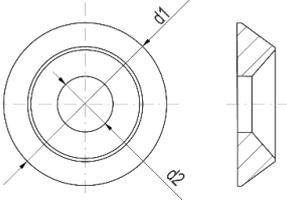
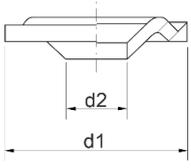


- Point Options:
- sharp point
  - saw thread
  - Type 17
  - saw thread & Type

All dimensions and tolerances in mm.

**Würth WÜTOX / WÜPOFAST II TX**

Washer

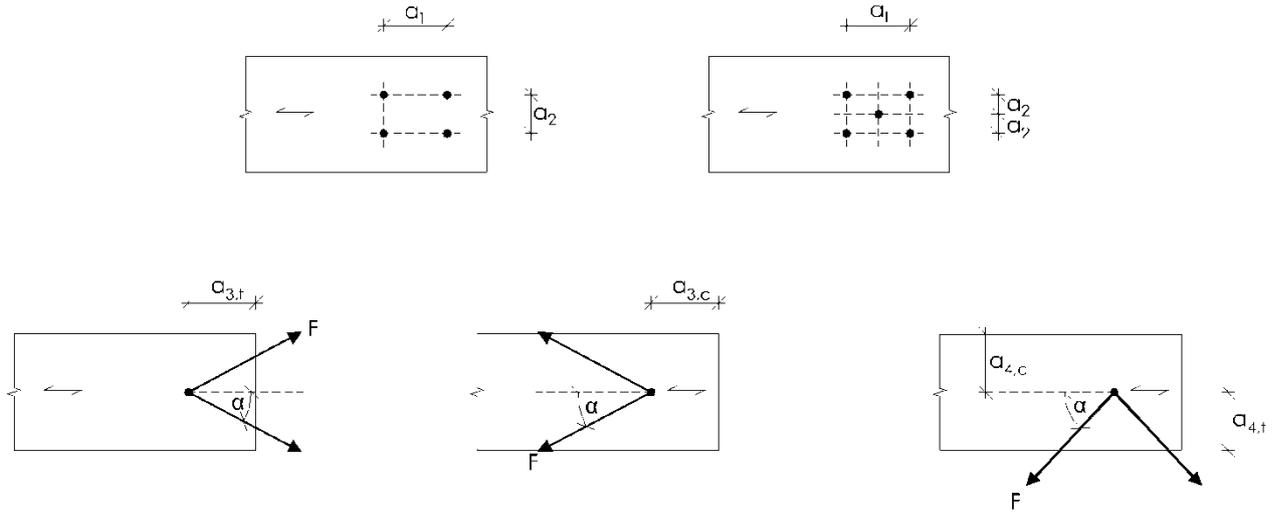
					
WSH1 - Washer 1		WSH2 - Washer 2			
		<b>Nominal diameter</b>	<b>6</b>	<b>8</b>	<b>10</b>
d1	WSH1	dn ≤8mm: ±0,5mm 8<dn ≤12mm: ±0,6mm dn >12mm: ±5%	22,0	25,0	30,0
	WSH2		22,0	28,0	33,0
d2	WSH1		6,5	8,5	10,5
	WSH2		6,5	8,5	10,5

All dimensions and tolerances in mm.

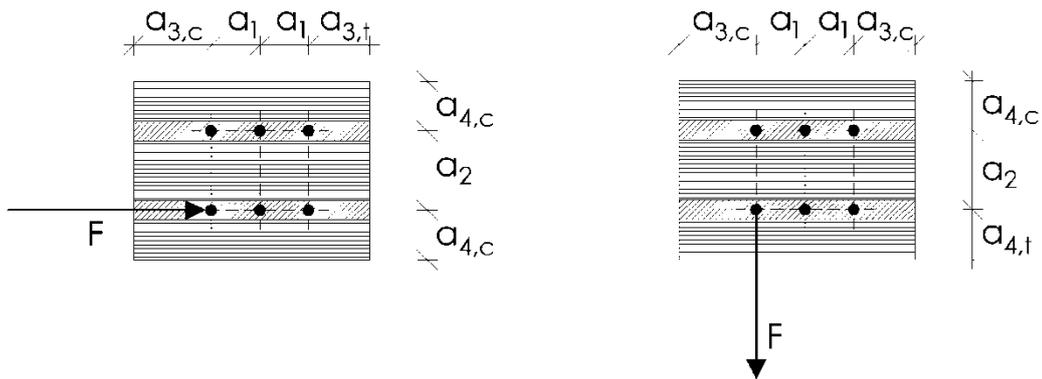
## Annex B Minimum distances and spacing

### 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:



For screws in the edge surface,  $a_1$  and  $a_3$  are parallel to the CLT plane face,  $a_2$  and  $a_4$  perpendicular to CLT plane face.

Table B1: Minimum spacing, end and edge distances of screws in the plane or edge surfaces of cross laminated timber

	$a_1$	$a_{3,t}$	$a_{3,c}$	$a_2$	$a_{4,t}$	$a_{4,c}$
Plane surface (see Figure 1)	$4 \cdot d$	$6 \cdot d$	$6 \cdot d$	$2,5 \cdot d$	$6 \cdot d$	$2,5 \cdot d$
Edge surface (see Figure 2)	$10 \cdot d$	$12 \cdot d$	$7 \cdot d$	$4 \cdot d$	$6 \cdot d$	$3 \cdot d$

## **Annex C**

### **Thermal insulation material on top of rafters**

WÜTOX / WÜPOFAST II TX self-tapping screw with an outer thread diameter of at least 6 mm may be used for the fixing of thermal insulation material on top of rafters.

The thickness of the insulation shall not exceed 300 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  $\alpha$  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 ETA or similar glued members according to ETA.

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  $d \leq 8,0$  mm:  $b_{\min} = 50$  mm       $t_{\min} = 30$  mm

Screws  $d = 10$  mm:  $b_{\min} = 60$  mm       $t_{\min} = 40$  mm

Screws  $d = 12$  mm:  $b_{\min} = 100$  mm       $t_{\min} = 80$  mm

The insulation must comply with an hEN or ETA. The thermal insulation material shall be applicable as insulation on top of rafters according to national provisions that apply at the installation site.

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

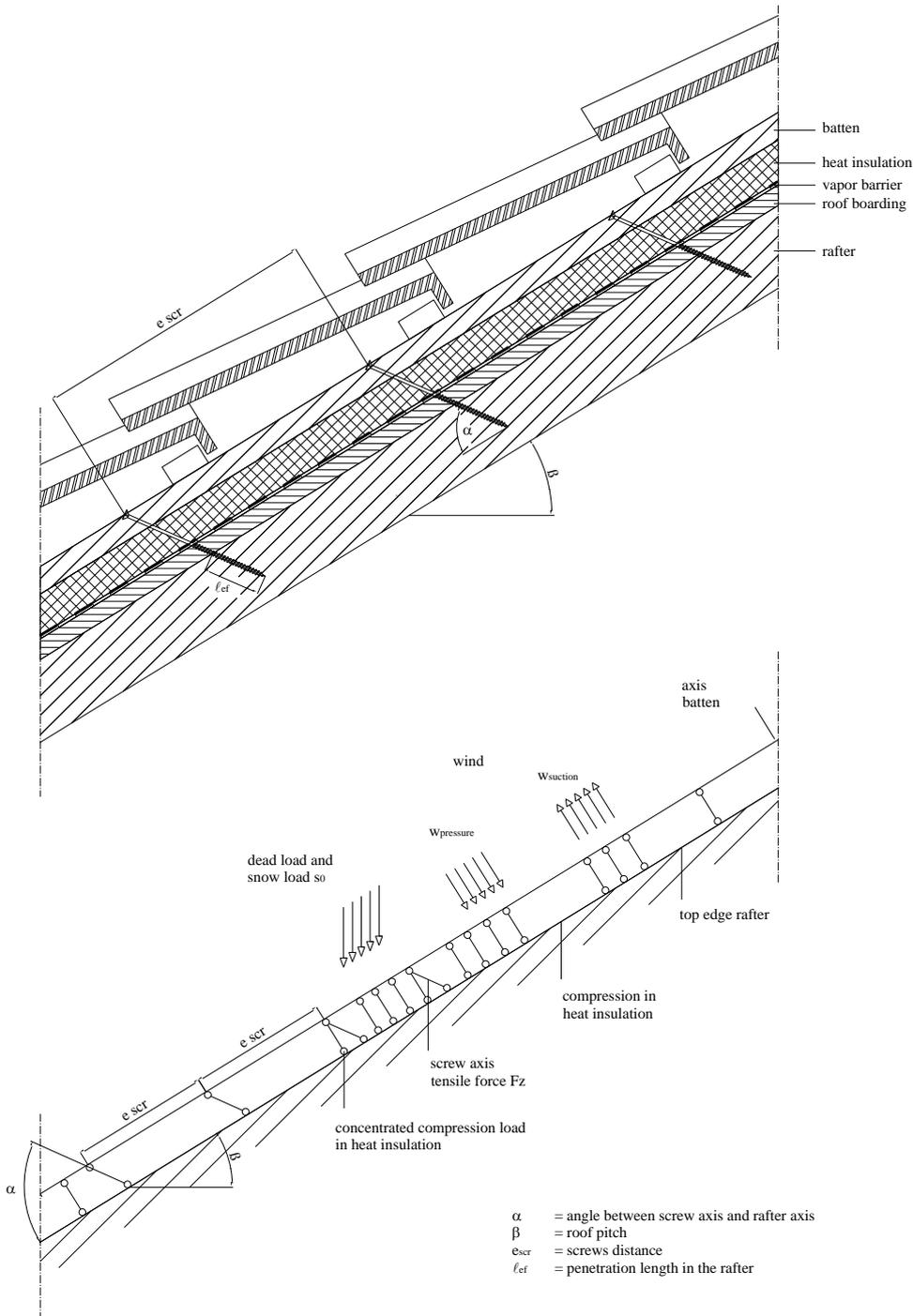
The anchorage of wind suction forces as well as the bending stresses of the battens or the boards, respectively, shall be considered in design. Additional screws perpendicular to the grain of the rafter (angle  $\alpha = 90^\circ$ ) may be arranged if necessary.

The maximum screw spacing is  $e_s = 1,75$  m.

## Thermal insulation material on rafters with parallel inclined screws and thermal insulation material in compression

### Mechanical model

The system of rafter, thermal insulation 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 on top of the rafter the elastic foundation. The minimum compression stress of the thermal insulation at 10 % deformation, measured according to EN 826<sup>1</sup>, shall be  $\sigma_{(10\%)} = 0,05 \text{ N/mm}^2$ . 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.



<sup>1</sup> EN 826:1996

**Design of the battens**

The bending stresses are calculated as:

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

Where

$$\ell_{\text{char}} = \sqrt[4]{\frac{4 \cdot EI}{w_{\text{ef}} \cdot K}}$$

$\ell_{\text{char}}$  = characteristic length

$EI$  = bending stiffness of the batten

$K$  = coefficient of subgrade

$w_{\text{ef}}$  = effective width of the thermal insulation

$F_b$  = Point loads perpendicular to the battens

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

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

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

where

$w$  = minimum width of the batten or rafter, respectively

$t_{\text{HI}}$  = thickness of the thermal insulation

$$K = \frac{E_{\text{HI}}}{t_{\text{HI}}}$$

The following condition shall be satisfied:

$$\frac{\sigma_{\text{m,d}}}{f_{\text{m,d}}} = \frac{M_{\text{d}}}{W \cdot f_{\text{m,d}}} \leq 1$$

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:

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

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

**Design of the thermal insulation**

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

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

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  $R_s$ :

$$T_s = \frac{R_s}{\cos \alpha}$$

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/mm<sup>2</sup>, respectively, the axial withdrawal capacity of the screws shall be reduced by the factors  $k_1$  and  $k_2$ :

$$F_{ax,\alpha,Rd} = \min \left\{ k_{ax} \cdot f_{ax,d} \cdot d \cdot \ell_{ef} \cdot k_1 \cdot k_2 \cdot \left( \frac{\rho_k}{350} \right)^{0.8} ; f_{head,d} \cdot d_h^2 \cdot \left( \frac{\rho_k}{350} \right)^{0.8} ; f_{tens,d} \right\} \text{ for WÜTOX / WÜPOFAST II TX}$$

Where:

$f_{ax,d}$	design value of the axial withdrawal parameter of the threaded part of the screw
$d$	outer thread diameter of the screw
$\ell_{ef}$	Point side penetration length of the threaded part of the screw in the batten, $\ell_{ef} \geq 40$ mm
$\alpha$	Angle between grain and screw axis ( $\alpha \geq 30^\circ$ )
$\rho_k$	characteristic density of the wood-based member [kg/m <sup>3</sup> ]
$f_{head,d}$	design value of the head pull-through capacity of the screw
$d_h$	head diameter
$f_{tens,d}$	design tensile capacity of the screw
$k_1$	$\min \{1; 200/t_{HI}\}$
$k_2$	$\min \{1; \sigma_{10\%}/0,12\}$
$t_{HI}$	thickness of the heat insulation [mm]
$\sigma_{10\%}$	compressive stress of the heat insulation under 10 % deformation [N/mm <sup>2</sup> ]

If  $k_1$  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 22 mm from plywood according to EN 636, particle board according to EN 312, oriented strand board according to EN 300 or European Technical Approval and solid wood panels according to EN 13353 or cross laminated timber may be used.