Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

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European Technical Assessment ETA-21/0826 of 14 October 2021

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General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws
Product family to which the construction product belongs	Screws for use in timber constructions
Manufacturer	Fuchs + Sanders Schrauben-Großhandels-GmbH + Co.KG Im Westerfeld 1 49504 Lotte DEUTSCHLAND
Manufacturing plant	Werk 3, Werk 4
This European Technical Assessment contains	26 pages including 4 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

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Specific Part

1 Technical description of the product

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws including screw types WBS TT (Top Thread) and WBS PB (Post Bracket) are self-tapping screws made from special carbon steel. The screws are hardened and they have a corrosion protection in accordance with Annex A.2.6. The outer thread diameter d is not less than 3.0 mm and not greater than 12.0 mm. The overall length of the screws is ranging from 16 mm to 600 mm. Further dimensions are shown in Annex 4.

The washers are made from carbon steel. The dimensions of the washers are given in Annex 4.

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws including screw types WBS TT and WBS PB 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 screws 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 4
Characteristic yield moment	See Annex 2.1
Bending angle	See Annex 2.1
Characteristic withdrawal parameter	See Annex 2.2
Characteristic head pull-through parameter	See Annex 2.3
Characteristic tensile strength	See Annex 2.1
Characteristic yield strength	No performance assessed
Characteristic torsional strength	See Annex 2.1
Insertion moment	See Annex 2.6
Spacings, end and edge distances of the screws and minimum thickness of the wood-based materials	See Annex 2.4
Slip modulus for mainly axially loaded screws	See Annex 2.2
Durability against corrosion	See Annex 2.6

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1

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 14 October 2021 by Deutsches Institut für Bautechnik

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beglaubigt:
Blümel

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Annex 1 Specifications of intended use

A.1.1 Use of the FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws only for:

– Static and quasi-static loads

A.1.2 Connection materials

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

– Solid timber (softwood) in accordance with EN 14081-1[1],
– Glued laminated timber in accordance with EN 14080[2],
– Glued solid timber in accordance with EN 14080,
– Laminated veneer lumber LVL (softwood) in accordance with EN 14374[3], arrangement of the screws only perpendicular to the plane of the veneers,
– 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 300[4] and EN 13986[5],
– Plywood in accordance with EN 636[6] and EN 13986,
– Particleboards in accordance with EN 312[7] and EN 13986,
– Cement-bonded particleboards in accordance with EN 634-2[8] and EN 13986,
– Fibreboards in accordance with EN 622-2[9], EN 622-3[10] and EN 13986,
– Solid wood panels (SWP) in accordance with EN 13353[11] and EN 13986.

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

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws with an outer thread diameter d of at least 6 mm are used for the fixing of thermal insulation material on top of rafters or on wood-based members in vertical façades.

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

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws	Annex 1.1
Specifications of intended use	

A.1.3 Use Conditions (environmental conditions)

The corrosion protection of the FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws is specified in Annex A.2.6.

A.1.4 Installation provisions

EN 1995-1-1[12] applies for the installation of FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws.

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

The screws are driven into wood-based members 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 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 wood-based members without pre-drilling, the solid timber, glued laminated timber, glued solid timber, laminated veneer lumber and cross laminated timber are from spruce, pine or fir.

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

Countersunk head screws may be used with washers in accordance with Annex 4. After inserting the screw, the washers shall touch the surface of the wood-based member completely.

By fastening screws in wood-based members the head of the screws are 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.

[12] EN 1995-1-1:2004/AC:2006 +A1:2008+A2:2014 Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings

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Annex 2 Characteristic values of the load-carrying capacities

Table A.2.1 Characteristic load-carrying capacities of FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws

Outer thread diameter [mm]	**3.0**	**3.5**	**4.0**	**4.5**	**5.0**	**6.0**	**8.0**	**10.0**	**12.0**
Characteristic yield moment $M_{y,k}$ [Nm]	1.6	2.3	3.3	4.5	5.9	9.5	20.0	36.0	58.0
Characteristic tensile strength $f_{tens,k}$ [kN]	2.5	4.0	5.0	6.0	8.0	9.5	19.0	25.0	42.0
Characteristic torsional strength $f_{tor,k}$ [Nm]	1.6	2.2	3.3	4.5	6.1	9.0	24.0	40.0	68.0

A.2.1 General

All FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws achieve a bending angle α of at least $45/d^{0.7}+ 20$, where d is the outer thread diameter of the screw.

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

$$l_{ef} = \min \begin{cases} \frac{4 \cdot d}{\sin \alpha} \\ 20 \cdot d \end{cases} \quad (2.1)$$

Where

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

d outer thread diameter of the screw [mm].

The outer thread diameter d of screws inserted in cross laminated timber is at least 6 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 shall be used as effective diameter of the screw in accordance with EN 1995-1-1.

The embedding strength for the screws in wood-based members or in wood-based panels shall be taken from EN 1995-1-1.

A.2.2.2 Cross laminated timber

The embedding strength for screws arranged in the narrow faces parallel to the plane of cross laminated timber may be assumed with equation (2.2) independent of the angle between screw axis and grain direction, $0° \le \alpha \le 90°$:

$$f_{h,k} = 20 \cdot d^{-0,5} \quad [N/mm^2] \qquad (2.2)$$

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 (2.2) 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 face 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 axially loaded screws for the serviceability limit state is independent of angle α to the grain:

$$K_{ser} = 780 \cdot d^{0,2} \cdot l_{ef}^{0,4} \quad [N/mm] \qquad (2.3)$$

Where

d outer thread diameter of the screw [mm],

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

A.2.3.2 Axial withdrawal capacity – Characteristic withdrawal parameter

The characteristic withdrawal parameter for FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws at an angle α = 90° to the grain based on a characteristic density of the wood-based member of 350 kg/m³ is:

$f_{ax,k}$ = 12.0 N/mm² for screws with 3.0 mm ≤ d ≤ 5.0 mm,

$f_{ax,k}$ = 11.0 N/mm² for screws with 6.0 mm ≤ d ≤ 8.0 mm,

$f_{ax,k}$ = 10.0 N/mm² for screws with d ≥ 10.0 mm.

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

For LVL a maximum characteristic density of 500 kg/m³ shall be used in equation (8.40a) of EN 1995-1-1.

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.

The characteristic axial withdrawal capacity for screws arranged parallel to the plane of cross laminated timber, independent of the angle between screw axis and grain direction, $0° \le \alpha \le 90°$, may be calcualted as:

$$F_{\alpha x,Rk} = 20 \cdot d^{0,8} \cdot l_{ef}^{0,9} \quad [N] \qquad (2.4)$$

Where

d outer thread diameter of the screw [mm],

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

Equation (2.4) is only valid for instantaneous and short action.

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

The characteristic value of the head pull-through parameter for FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws for a characteristic density of 350 kg/m³ of the timber and for 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,
- Cement-bonded particleboards in accordance with EN 634-2 and EN 13986,
- Particleboards in accordance with EN 312 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 is:

$f_{head,k}$ = 9.4 N/mm².

For wood-based panels a maximum characteristic density of 380 kg/m³ and for LVL a maximum characteristic density of 500 kg/m³ shall be used in equation (8.40b) of EN 1995-1-1.

The head diameter shall be equal to or greater than $1.8 \cdot d_s$, where d_s is the smooth shank or the inner thread diameter. Otherwise the characteristic head pull-through capacity in equation (8.40b) of EN 1995-1-1 is $F_{ax,\alpha,Rk}$ = 0 for all wood-based materials.

For wood-based panels with a thickness 12 mm ≤ t ≤ 20 mm the characteristic value of the head pull-through parameter for the screws is:

$f_{head,k}$ = 8.0 N/mm².

For wood-based panels with a thickness of less than 12 mm the characteristic head pull-through capacity for screws shall be based on a characteristic value of the head pull-through parameter of 8.0 N/mm². The characteristic head pull-through capacity shall be limited to 400 N. A minimum thickness of the wood-based panels of 1.2·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

Outer diameter of washers d_k > 32 mm shall not be considered.

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

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

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

Screws in pre-drilled holes

For FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws 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 wood members made of solid timber, glued laminated timber, glued solid timber, laminated veneer lumber and cross laminated timber is t = 24 mm for screws with an outer thread diameter of d < 8 mm, t = 30 mm for screws with an outer thread diameter of d = 8 mm, t = 40 mm for screws with an outer thread diameter of d = 10 mm and t = 80 mm for screws with an outer thread diameter of d = 12 mm.

Screws in non pre-drilled holes

For FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws non pre-drilled 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 loaded or unloaded ends parallel to the grain shall be at least 15·d for screws with outer thread diameter d ≥ 8 mm and thickness t < 5·d.

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

A.2.4.2 Only axially loaded screws

For FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws 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 predrilled or non-predrilled holes, depending on whether the wood members are pre-drilled or not, or clause 8.7.2 and Table 8.6.

A.2.4.3 Cross laminated timber

The minimum requirements for spacings, end and edge distances of screws in the wide and narrow faces of cross laminated timber are summarised in Table A.2.3. The definitions of spacings, end and edge distance are shown in Figure A.2.1 and Figure A.2.2. The minimum spacings, end and edge distances in the narrow faces are independent of the angle between screw axis and grain direction. They shall be used based on the following conditions:

- Minimum thickness of the cross laminated timber: 10·d
- Minimum penetration depth of the screws in the narrow faces of the cross laminated timber: 10·d

For load components perpendicular to the wide faces (see Figure A.2.2 right) the tensile stresses perpendicular to the grain should be transferred by reinforcing screws.

Table A.2.3: Minimum spacings, end and edge distances of screws in the wide and narrow faces of cross laminated timber

	a_1	$a_{1,t}$	$a_{1,c}$	a_2	$a_{2,t}$	$a_{2,c}$
Wide faces (see Figure A.2.1)	4·d	6·d	6·d	2.5·d	6·d	2.5·d
Narrow faces (see Figure A.2.2)	10·d	12·d	7·d	4·d	6·d	3·d

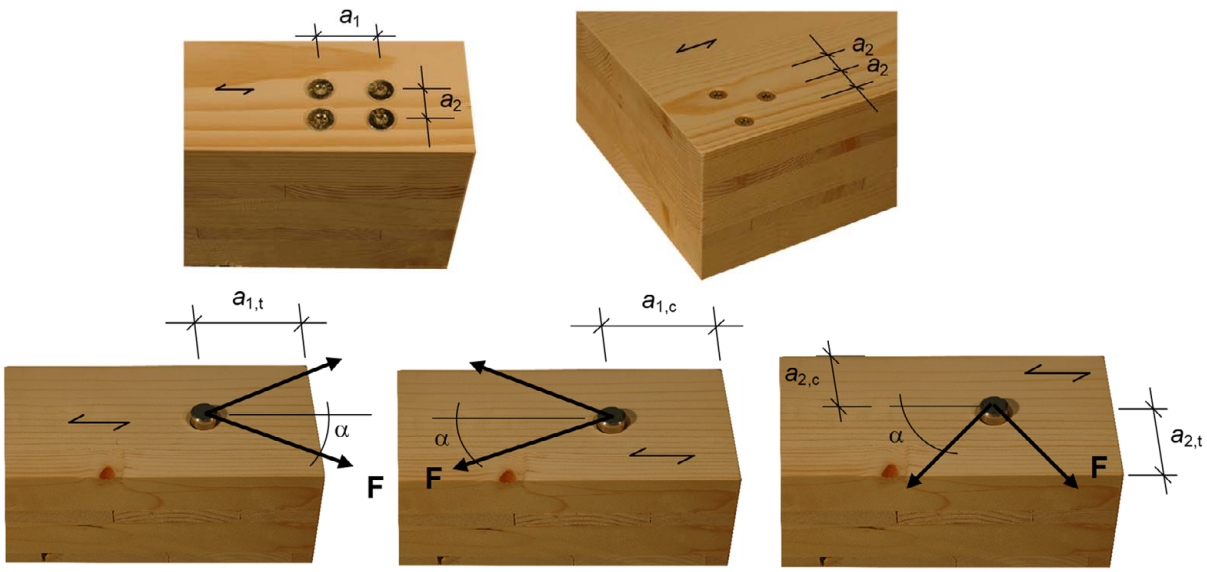

Figure A.2.1: Definition of spacings, end and edge distances in the wide faces

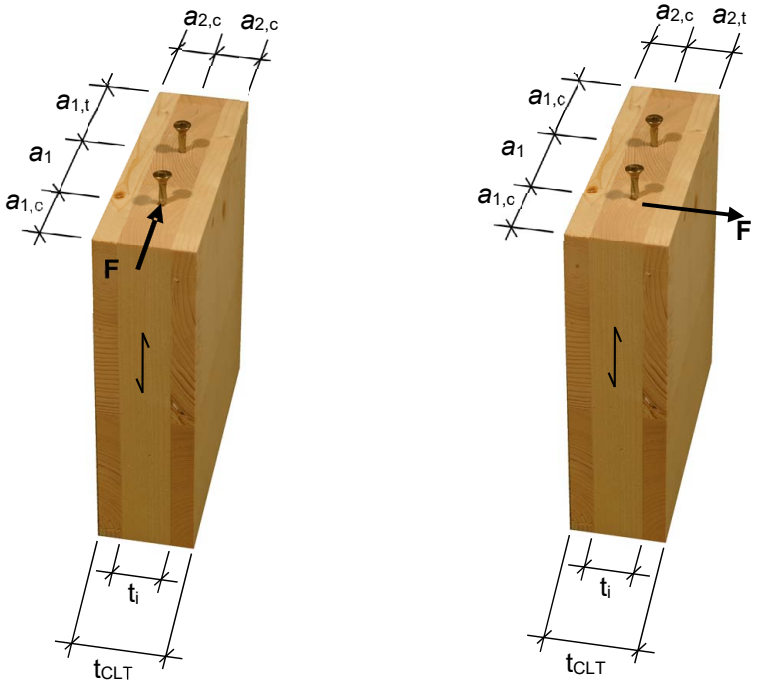

Figure A.2.2: Definition of spacings, end and edge distances in the narrow faces

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws	Annex 2.5
Spacings, end and edge distances	

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A.2.5 Insertion moment

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

A.2.6 Durability against corrosion

Screws and washers made from carbon steel have the coatings shown in Table A.2.4

Table A.2.4 Coatings of the FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws

Coating		**Minimum thickness of the coating [µm]**
electrolytically galvanised	blue chromated	5
	yellow chromated	
zinc-nickel coating		4
brass-plated		5
browned		5
nickel-plated		5

Annex 3 Fastening of thermal insulation material on top of rafters

A.3.1 General

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding 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. In the following, the meaning of the word rafter includes wood-based members with inclinations between 0° and 90°.

The thickness of the thermal insulation material is up to 300 mm. The thermal insulation material is applicable as insulation on top of rafters or for façades.

The counter battens are made of solid timber (softwood) in accordance with EN 14081-1. The minimum thickness t and the minimum width b of the counter battens shall be as given in Table A.3.1:

Table A.3.1 Minimum thickness and minimum width of the counter battens

Outer thread diameter d [mm]	**Minimum thickness** t [mm]	**Minimum width** b [mm]
6 and 8	30	50
10	40	60
12	80	100

Instead of counter battens the wood-based panels specified in chapter A.3.2.1 may be used. Only screws with countersunk head are used for fixing wood-based panels on rafters with thermal insulation material as interlayer.

The minimum width of the rafters is 60 mm.

The spacings between screws e_s is not more than 1.75 m.

Friction forces are not considered for the design of the characteristic axial load of the screws.

The anchorage of wind suction forces of the counter battens shall be considered for design. Screws perpendicular to the grain of the rafter shall be arranged where required considering the design of the counter battens.

A.3.2 Parallel inclined screws and thermal insulation material in compression

A.3.2.1 Mechanical model

The system of rafter, thermal insulation material on top of rafter and counter battens parallel to the rafter can be considered as a beam on elastic foundation. The counter batten represents the beam and the thermal insulation material on top of the rafter the elastic foundation. The minimum compressive stress of the thermal insulation material at 10 % deformation, measured in accordance with EN 826[13], shall be $\sigma_{(10\%)}$ = 0.05 N/mm². The counter batten is loaded perpendicular to the axis by point loads F_b. Further point loads F_s are caused by the shear load of the roof due to dead and snow load, which are transferred from the screw heads into the counter battens.

Instead of counter battens the following wood-based panels may be used to cover the thermal insulation material if they are applicable for that use:

- 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,
- Fibreboards in accordance with EN 622-2, EN 622-3 and EN 13986.

The minimum thickness of the wood-based panels is 22 mm.

The word counter batten includes the above-mentioned wood-based panels in the following.

13 EN 826:2013 Thermal insulating products for building applications – Determination of compression behaviour

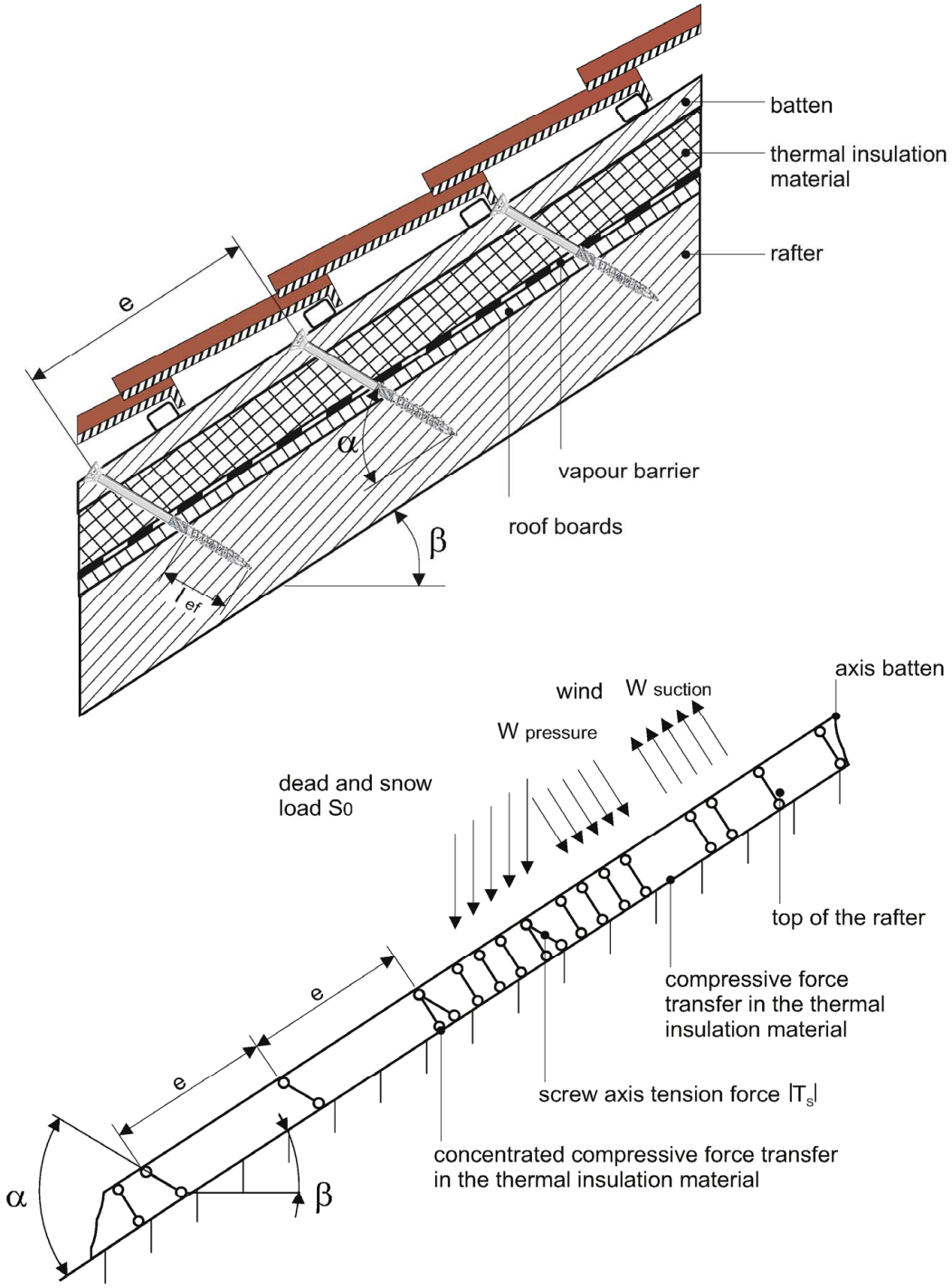


Figure A.3.1 Fastening of the thermal insulation material on top of rafters - Structural system for parallel arranged screws

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws	Annex 3.2
Fastening of thermal insulation material on top of rafters	

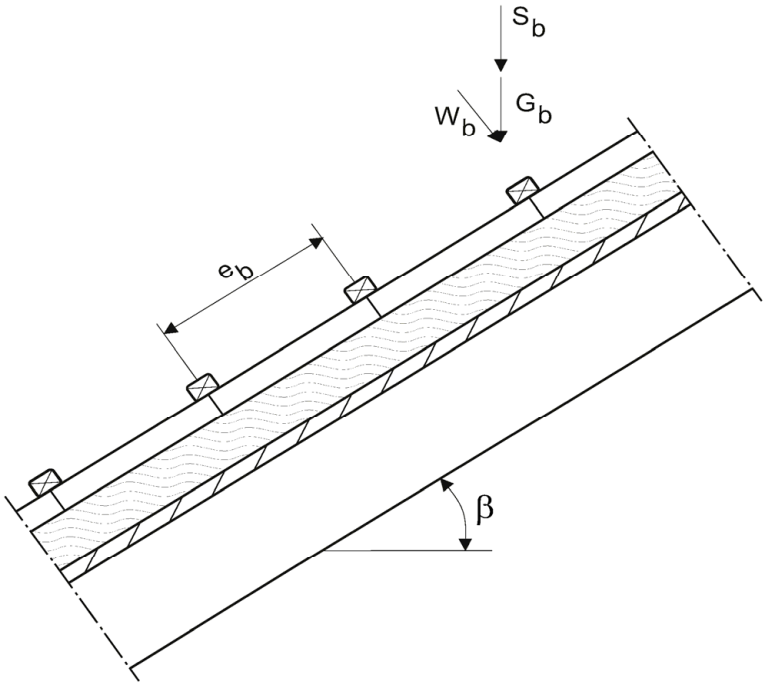


Figure A.3.2 Point loads F_b perpendicular to the counter battens

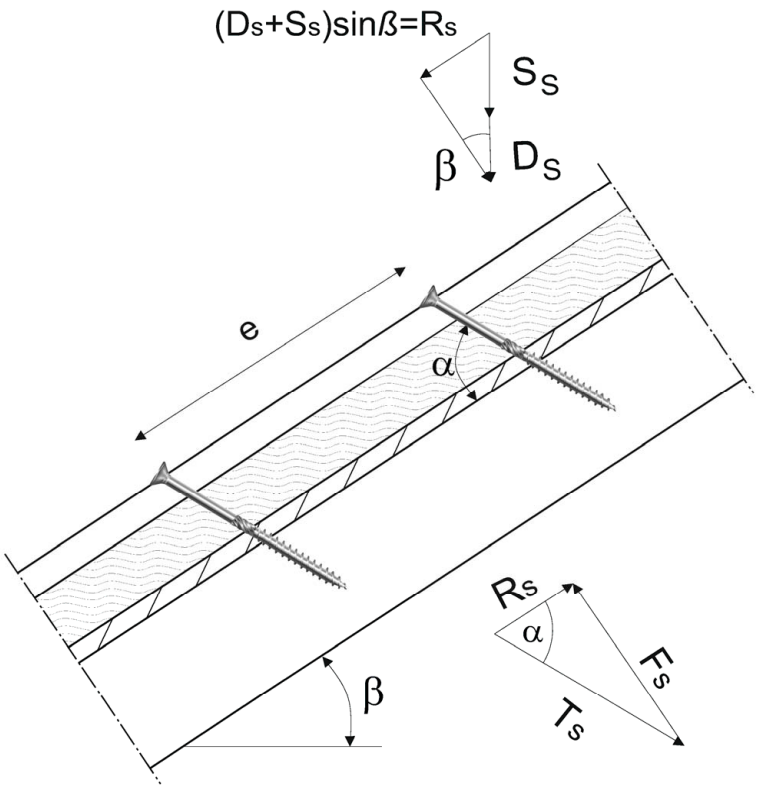


Figure A.3.3 Point loads F_s perpendicular to the counter battens, load application in the area of the screw heads

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws	Annex 3.3
Fastening of thermal insulation material on top of rafters	

A.3.2.2 Design of the counter battens

It is assumed that the spacings between the counter battens exceeds the characteristic length l_{char}.

The characteristic values of the bending stresses may be calculated as:

$$M_k = \frac{(F_{b,k} + F_{s,k}) \cdot l_{char}}{4} \quad (3.1)$$

Where

l_{char} characteristic length $l_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}}$ (3.2)

EI bending stiffness of the counter batten

K modulus of subgrade reaction

w_{ef} effective width of the thermal insulation material

$F_{b,k}$ point loads perpendicular to the counter battens

$F_{s,k}$ point loads perpendicular to the counter battens, load application in the area of the screw heads

The modulus of subgrade reaction 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 counter batten or rafter, respectively. For further calculations, the effective width w_{ef} of the thermal insulation material may be determined as:

$$w_{ef} = w + t_{HI} / 2 \quad (3.3)$$

Where

w minimum from width of the counter batten or rafter, respectively

t_{HI} thickness of the thermal insulation material

$$K = \frac{E_{HI}}{t_{HI}} \quad (3.4)$$

The following condition shall be satisfied:

$$\frac{\sigma_{m,d}}{f_{m,d}} = \frac{M_d}{W \cdot f_{m,d}} \leq 1 \quad (3.5)$$

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

The characteristic values of the shear stresses shall be calculated in accordance with:

$$V_k = \frac{(F_{b,k} + F_{S,k})}{2} \quad (3.6)$$

The following condition shall be satisfied:

$$\frac{\tau_d}{f_{v,d}} = \frac{1.5 \cdot V_d}{A \cdot f_{v,d}} \leq 1 \quad (3.7)$$

For the calculation of the cross section area the net cross section shall be considered.

A.3.2.3 Design of the thermal insulation material

The characteristic value of the compressive stress in the thermal insulation material may be calculated as:

$$\sigma_k = \frac{1.5 \cdot F_{b,k} + F_{s,k}}{2 \cdot l_{char} \cdot w} \qquad (3.8)$$

The design value of the compressive stress shall not be greater than 110 % of the compressive strength at 10 % deformation, calculated in accordance with EN 826.

A.3.2.4 Design of the screws

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

$$T_{S,k} = \frac{R_{S,k}}{\cos\alpha} \qquad (3.9)$$

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 accordance with Annex 2.

In order to limit the deformation of the screw head for thermal insulation material with thickness over 220 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:

$$F_{ax,\alpha,Rd} = \min \left\{ \frac{f_{ax,d} \cdot d \cdot l_{ef,r} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2\alpha + \sin^2\alpha} \cdot \left(\frac{\rho_k}{350}\right)^{0.8} ; f_{head,d} \cdot d_h^2 \cdot \left(\frac{\rho_k}{350}\right)^{0.8} ; \frac{f_{tens,k}}{\gamma_{M2}} \right\}$$

for FUSA-fast / F+S PRO CPS, WBS and WBS PB (3.10)

$$F_{ax,\alpha,Rd} = \min \left\{ \begin{array}{l} \dfrac{f_{ax,d} \cdot d \cdot l_{ef,r} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2\alpha + \sin^2\alpha} \cdot \left(\dfrac{\rho_k}{350}\right)^{0.8} \\ \max \left\{ f_{head,d} \cdot d_h^2 \cdot \left(\dfrac{\rho_k}{350}\right)^{0.8} ; \dfrac{f_{ax,d} \cdot d \cdot l_{ef,b}}{1.2 \cdot \cos^2\alpha + \sin^2\alpha} \cdot \left(\dfrac{\rho_k}{350}\right)^{0.8} \right\} \\ \dfrac{f_{tens,k}}{\gamma_{M2}} \end{array} \right\}$$

for FUSA-fast / F+S PRO WBS TT (3.11)

Where

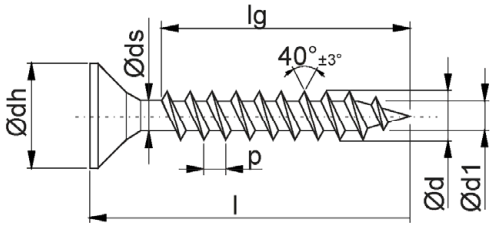
$f_{ax,d}$	design value of the axial withdrawal capacity of the threaded part of the screw in the rafter or in the counter batten in accordance with Annex A.2.3.1, $f_{ax,d}$ does not apply for wood-based panels [N/mm²]
d	outer thread diameter of the screw [mm]
$l_{ef,r}$	penetration length of the threaded part of the screw in the rafter [mm], $l_{ef} \geq 40$ mm [mm]
$l_{ef,b}$	penetration length of the threaded part of the screw in the counter batten [mm]
ρ_k	characteristic density of the wood-based member [kg/m³], for LVL the assumed characteristic density shall not exceed 500 kg/m³, for wood-based panels ρ_k = 350 kg/m³
α	angle α between screw axis and grain direction, $30° \leq \alpha \leq 90°$
$f_{head,d}$	design value of the head pull-through capacity of the screw [N/mm²]
d_h	head diameter of the screw [mm]

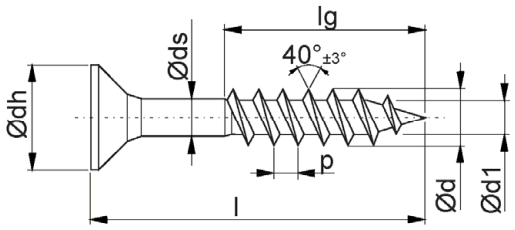
$f_{tens,k}$	characteristic tensile capacity of the screw in accordance with Annex 2 [N]
γ_{M2}	partial factor in accordance with EN 1993-1-1
k_1	min {1; 220/t_{HI}}
k_2	min {1; $\sigma_{10\%}$/0,12}
t_{HI}	thickness of the thermal insulation material [mm]
$\sigma_{10\%}$	compressive stress of the thermal insulation material under 10 % deformation [N/mm²]

If equation (3.10) or (3.11) is fulfilled, the deflection of the counter battens does not need to be considered when designing the load-carrying capacity of the screws.

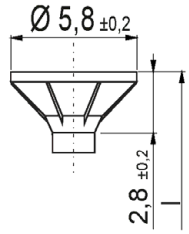
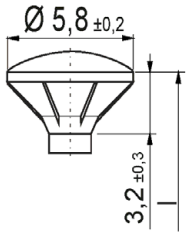
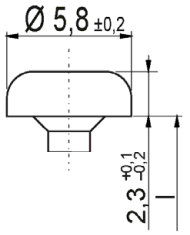
Deutsches Institut für Bautechnik DIBt

FUSA-fast / F+S PRO CPS - Self-drilling screw with full or part thread, material carbon steel



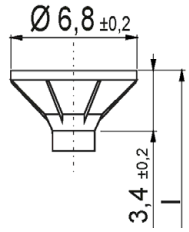
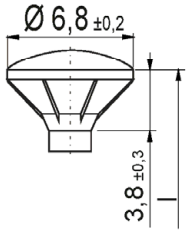
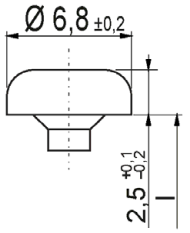


Head shapes and types of thread for Ø 3,0 mm — All sizes in mm

			[mm]	Min.	Max.
			d d1 ds p Pozi Tx	2,75 1,70 2,15 1,35 ±10% 1 10	3,00 2,10
Countersunk head with or without ribs under head	Raised Countersunk head with or without ribs	Pan head	Thread geometry		

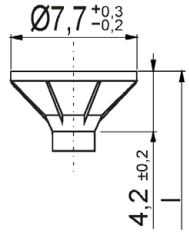
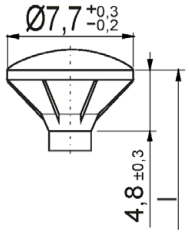
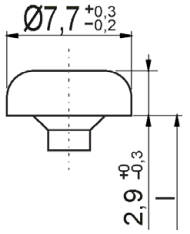
Lengths for Ø 3,0 mm: l=16 to 50 ± 1,0/2,0 lg=12 to 46 ± 1,0/2,0 Thread length between lg min and lg max possible

Head shapes and types of thread for Ø 3,5 mm — All sizes in mm

			[mm]	Min.	Max.
			d d1 ds p Pozi Tx	3,30 2,00 2,45 1,60 ±10% 2 10 or 15 or 20	3,50 2,20
Countersunk head with or without ribs under head	Raised Countersunk head with or without ribs	Pan head	Thread geometry		

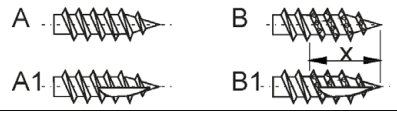
Lengths for Ø 3,5 mm: l=18 to 50 ± 1,0/2,0 lg=14 to 44 ± 1,0/2,0 Thread length between lg min and lg max possible

Head shapes and types of thread for Ø 4,0 mm — All sizes in mm

			[mm]	Min.	Max.
			d d1 ds p Pozi Tx	3,75 2,25 2,72 1,80 ±10% 2 15 or 20	4,00 2,50
Countersunk head with or without ribs under head	Raised Countersunk head with or without ribs	Pan head	Thread geometry		

Lengths for Ø 4,0 mm: l=20 to 70 ± 1,0/2,0 lg=16 to 64 ± 1,0/2,0 Thread length between lg min and lg max possible

Types of cone point



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

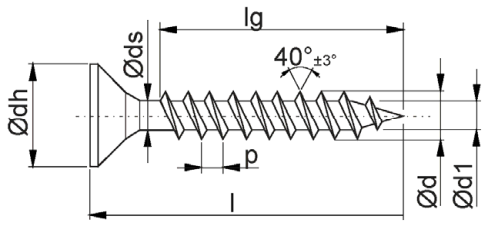
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

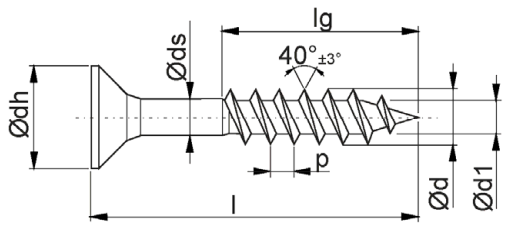
FUSA-fast / F+S PRO CPS Chipboard Screws ∅ 3.0 to ∅ 4.0 mm

Annex 4.1

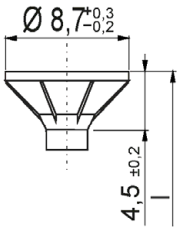
Deutsches Institut für Bautechnik DIBt

FUSA-fast / F+S PRO CPS - Self-drilling screw with full or part thread, material carbon steel

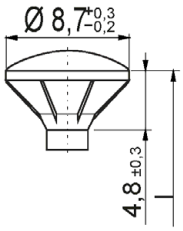




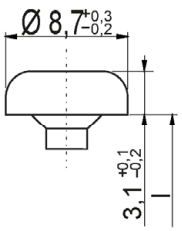
Head shapes and types of thread for Ø 4,5 mm — All sizes in mm



Countersunk head with or without ribs under head



Raised Countersunk head with or without ribs



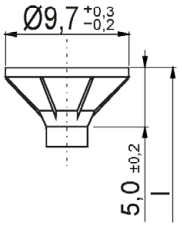
Pan head

[mm]	Min.	Max.
d	4,25	4,50
d1	2,45	2,70
ds	3,10	
p	2,00 ±10%	
Pozi	2	
Tx	20 or 25	

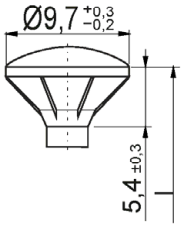
Thread geometry

Lengths for Ø 4,5 mm: l=25 to 80 ± 1,0 / 2,0 lg=18 to 74 ± 1,0 / 2,0 Thread length between lg min and lg max possible

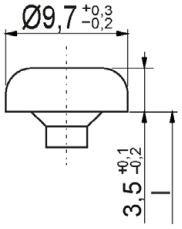
Head shapes and types of thread for Ø 5,0 mm — All sizes in mm



Countersunk head with or without ribs under head



Raised Countersunk head with or without ribs



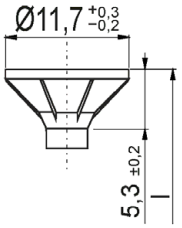
Pan head

[mm]	Min.	Max.
d	4,75	5,00
d1	2,70	3,00
ds	3,40	
p	2,20 ±10%	
Pozi	2	
Tx	20 or 25	

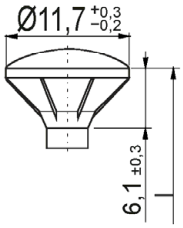
Thread geometry

Lengths for Ø 5,0 mm: l=25 to 120 ± 1,0 / 2,0 lg=20 to 75 ± 1,0 / 2,0 Thread length between lg min and lg max possible

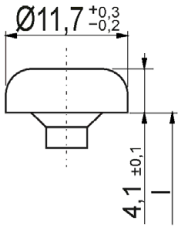
Head shapes and types of thread for Ø 6,0 mm — All sizes in mm



Countersunk head with or without ribs under head



Raised Countersunk head with or without ribs



Pan head

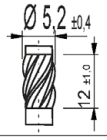
[mm]	Min.	Max.
d	5,80	6,00
d1	3,40	3,70
ds	4,20	
p	2,60 ±10%	
Pozi	3	
Tx	25 or 30	

Thread geometry

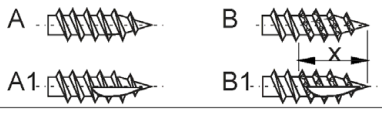
Lengths for Ø 6,0 mm: l=30 to 300 ± 1,0 / 2,0 lg=24 to 75 ± 1,0 / 2,0 Thread length between lg min and lg max possible

l=30 to 200 ± 1,0 / 2,0

with shank ribs:
l=220 to 300 ± 1,0 / 2,0



Types of cone point



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

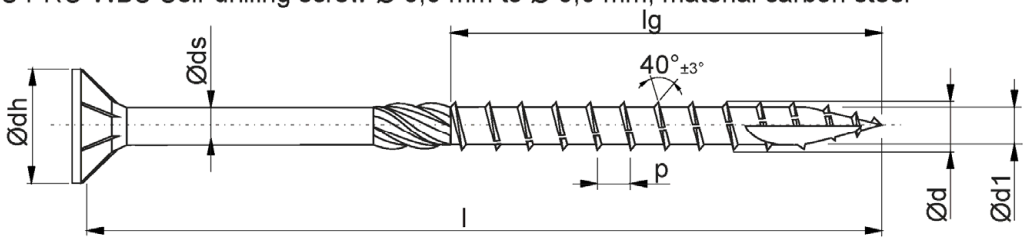
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO CPS Chipboard Screws ∅ 4.5 to ∅ 6.0 mm

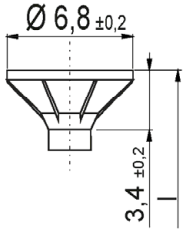
Annex 4.2

Deutsches Institut für Bautechnik DIBt

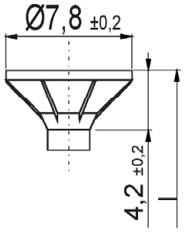
FUSA-fast / F+S PRO WBS Self-drilling screw Ø 3,5 mm to Ø 5,0 mm, material carbon steel



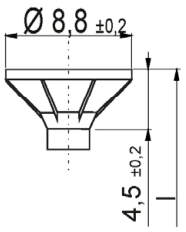
Head shapes for Ø 3,5 to Ø 5,0 mm — All sizes in mm



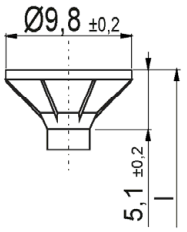
Head shape for Ø 3,5 mm



Head shape for Ø 4,0 mm

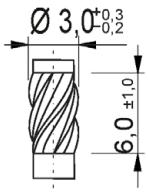


Head shape for Ø 4,5 mm

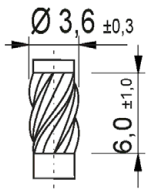


Head shape for Ø 5,0 mm

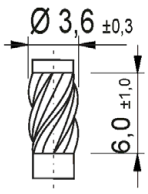
Shank ribs for Ø 3,0 mm to Ø 5,0 mm, optional for all lengths



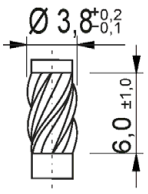
Shank ribs Ø 3,5 mm



Shank ribs Ø 4,0 mm



Shank ribs Ø 4,5 mm



Shank ribs Ø 5,0 mm

[mm]	Min.	Max.
d	3,20	3,50
d1	1,90	2,10
ds	2,50	
p	2,70 ±10%	
Tx	10, 15 or 20	

Type of thread Ø 3,5 mm

[mm]	Min.	Max.
d	3,70	4,00
d1	2,05	2,50
ds	2,80	
p	2,80 ±10%	
Tx	15 or 20	

Type of thread Ø 4,0 mm

[mm]	Min.	Max.
d	4,20	4,50
d1	2,40	2,90
ds	3,16	
p	3,10 ±10%	
Tx	20 or 25	

Type of thread Ø 4,5 mm

[mm]	Min.	Max.
d	4,70	5,00
d1	2,80	3,30
ds	3,47	
p	3,20 ±10%	
Tx	20 or 25	

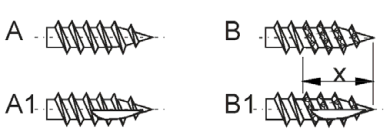
Thread geometry Ø 5,0 mm

Lengths for Ø 3,0 mm to Ø 5,0 mm, Thread length between lg min and lg max possible

Lengths for Ø 3,5 mm:	l=20 to 70 ± 1,0/2,0	lg=14 to 42 ± 1,0/3,0
Lengths for Ø 4,0 mm:	l=20 to 80 ± 1,0/2,0	lg=16 to 49 ± 1,0/3,0
Lengths for Ø 4,5 mm:	l=20 to 80 ± 1,0/2,0	lg=18 to 49 ± 1,0/3,0
Lengths for Ø 5,0 mm:	l=25 to 120 ± 1,0/2,0	lg=20 to 74 ± 1,0/3,0

Types of cone point

typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut



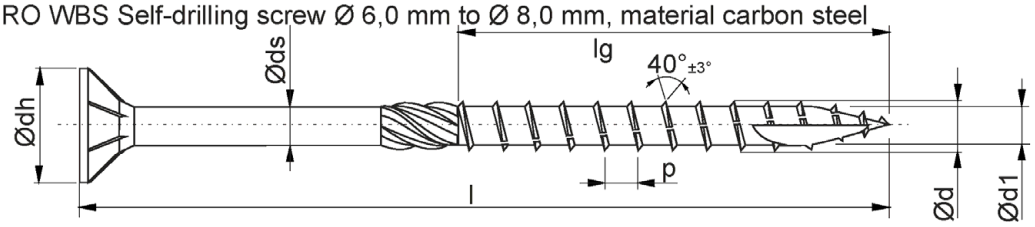
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO WBS Woodbuilding Screws ∅ 3.5 to ∅ 5.0 mm

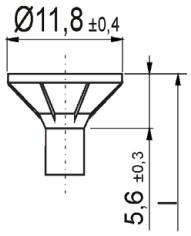
Annex 4.3

Deutsches Institut für Bautechnik DIBt

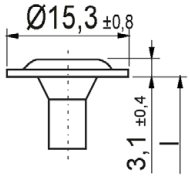
FUSA-fast / F+S PRO WBS Self-drilling screw Ø 6,0 mm to Ø 8,0 mm, material carbon steel



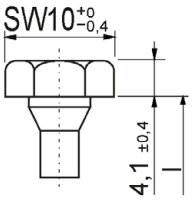
Head shapes for Ø 6,0 mm — All sizes in mm



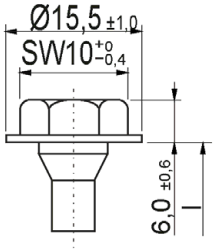
Countersunk head



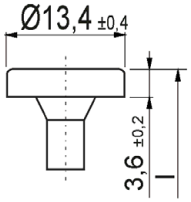
Wafer head



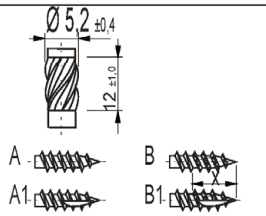
Hex head



Hex wafer head



Pan head



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	5,80	6,20
d1	3,65	4,00
ds	4,15	4,35
p	4,50 ±10%	
Tx	25 or 30	

Type of thread for Ø 6,0 mm

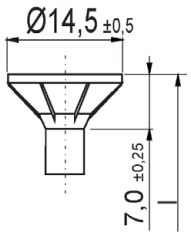
[mm]	Min.	Max.
l	40 ±2,0	300 ±2,0
lg	24 ±1,5	75 ±1,5

for l < 60 without shank ribs

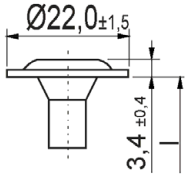
Thread length between lg min and lg max possible

Lengths for Ø 6,0 mm

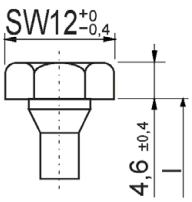
Head shapes for Ø 8,0 mm — All sizes in mm



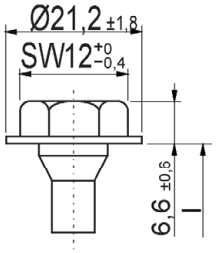
Countersunk head



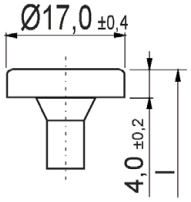
Wafer head



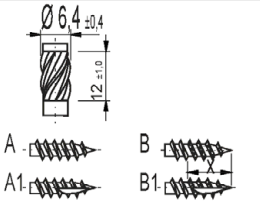
Hex head



Hex wafer head



Pan head



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	7,60	8,25
d1	5,05	5,50
ds	5,70	5,90
p	5,20 ±10%	
Tx	40	

Type of thread for Ø 8,0 mm

[mm]	Min.	Max.
l	40 ±2,0	600 ±2,0
lg	32 ±1,5	150 ±1,5

for < 60 without shank ribs

Thread length between lg min and lg max possible

Lengths for Ø 8,0 mm

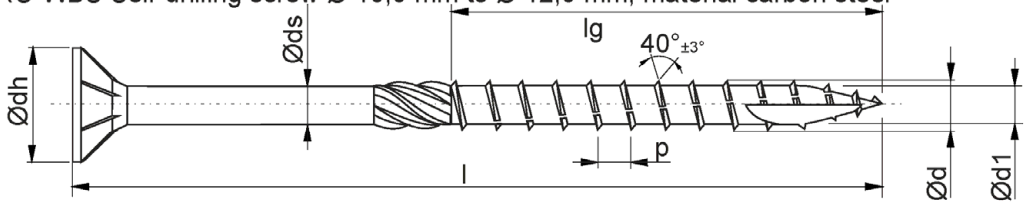
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO WBS Woodbuilding Screws ∅ 6.0 and ∅ 8.0 mm

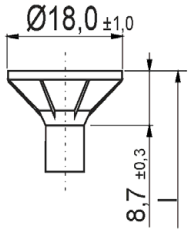
Annex 4.4

Deutsches Institut für Bautechnik DIBt

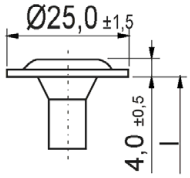
FUSA-fast / F+S PRO WBS Self-drilling screw Ø 10,0 mm to Ø 12,0 mm, material carbon steel



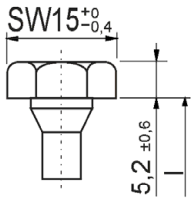
Head shapes for Ø 10,0 mm — All sizes in mm



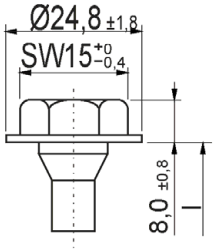
Countersunk head



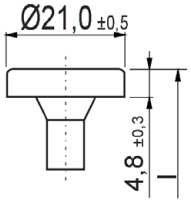
Wafer head



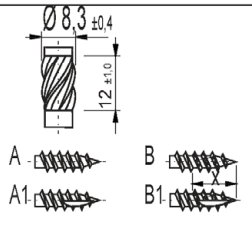
Hex head



Hex wafer head



Pan head



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	9,60	10,25
d1	6,20	6,70
ds	6,80	7,30
p	5,60 ±10%	
Tx	40	

Type of thread for Ø 10,0 mm

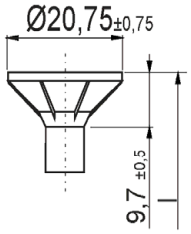
[mm]	Min.	Max.
l	50 ±2,0	600 ±2,0
lg	40 ±1,5	150 ±1,5

for l < 60 without shank ribs

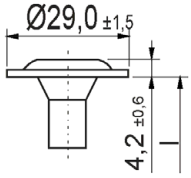
Thread length between lg min and lg max possible

Lengths for Ø 10,0 mm

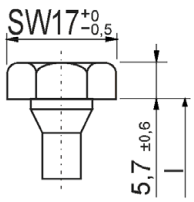
Head shapes for Ø 12,0 mm — All sizes in mm



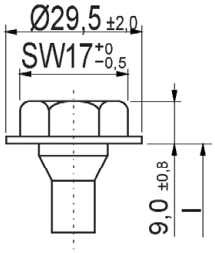
Countersunk head



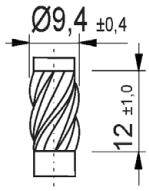
Wafer head



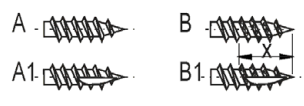
Hex head



Hex wafer head



Geometry of shank ribs and



typ A1 cut to end of cone point or shifted
typ B saw thread x=1/3 lg
typ B1 saw thread x=1/3 lg with cut

Types of cone point

[mm]	Min.	Max.
d	11,60	12,30
d1	7,00	7,50
ds	7,90	8,40
p	6,00 ±10%	
Tx	40 or 50	

Type of thread for Ø 12,0 mm

[mm]	Min.	Max.
l	80 ±2,0	600 ±2,0
lg	50 ±1,5	150 ±1,5

Thread length between lg min and lg max possible

Lengths for Ø 12,0 mm

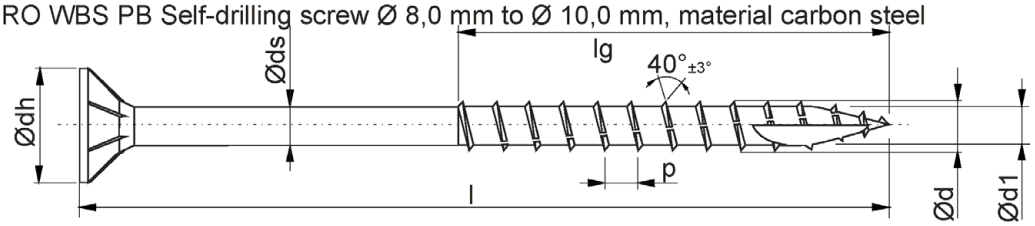
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO WBS Woodbuilding Screws ∅ 10.0 and ∅ 12.0 mm

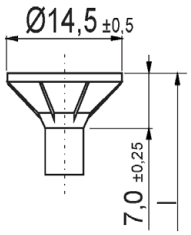
Annex 4.5

Deutsches Institut für Bautechnik DIBt

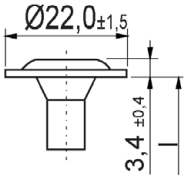
FUSA-fast / F+S PRO WBS PB Self-drilling screw Ø 8,0 mm to Ø 10,0 mm, material carbon steel



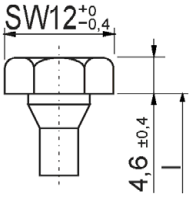
Head shapes for Ø 8,0 mm — All sizes in mm



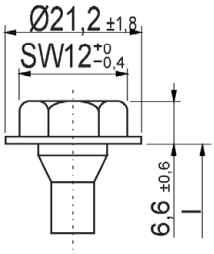
Countersunk head



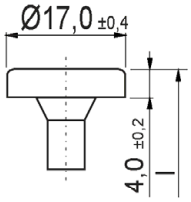
Wafer head



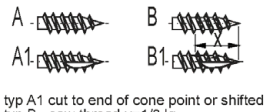
Hex head



Hex wafer head



Pan head



Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	7,60	8,25
d1	5,05	5,50
ds	5,70	5,90
p	5,20 ±10%	
Tx	40	

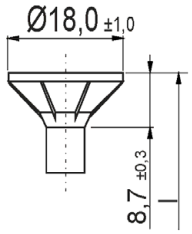
Type of thread for Ø 8,0 mm

[mm]	Min.	Max.
l	40 ±2,0	60 ±2,0
lg	32 ±1,5	52 ±1,5

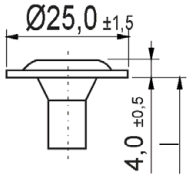
Thread length between lg min and lg max possible

Lengths for Ø 8,0 mm

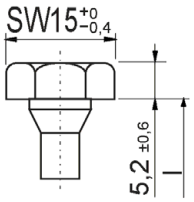
Head shapes for Ø 10,0 mm — All sizes in mm



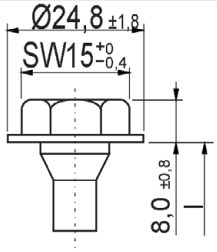
Countersunk head



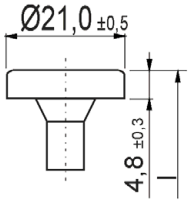
Wafer head



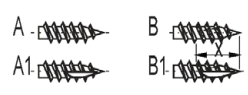
Hex head



Hex wafer head



Pan head



Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	9,60	10,25
d1	6,20	6,70
ds	6,80	7,30
p	5,60 ±10%	
Tx	40	

Type of thread for Ø 10,0 mm

[mm]	Min.	Max.
l	50 ±2,0	60 ±2,0
lg	40 ±1,5	52 ±1,5

Thread length between lg min and lg max possible

Lengths for Ø 10,0 mm

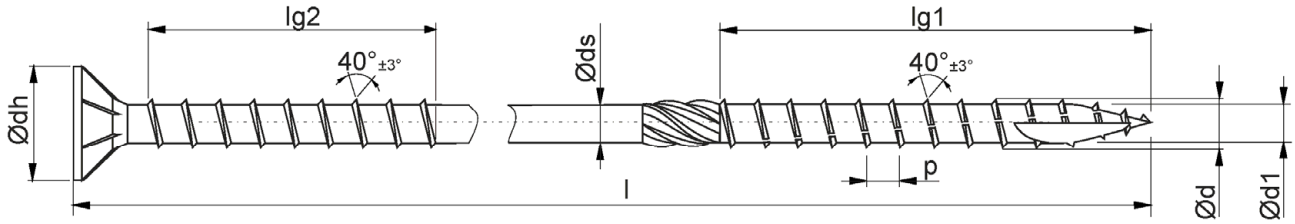
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO WBS PB (Post Bracket Screws) ∅ 8.0 mm and ∅ 10.0 mm

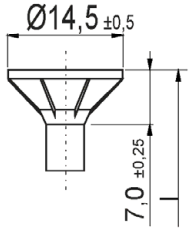
Annex 4.6

Deutsches Institut für Bautechnik DIBt

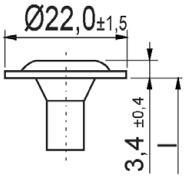
FUSA-fast / F+S PRO WBS TT Self-drilling screw Ø 8,0 mm, material carbon steel



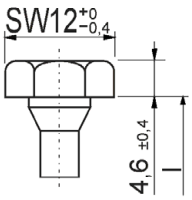
Head shape for Ø 8,0 mm — All sizes in mm



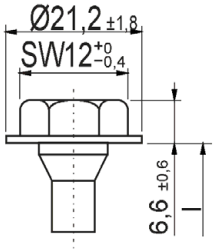
Countersunk head



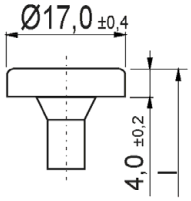
Wafer head



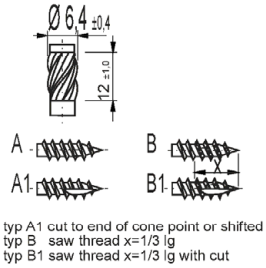
Hex head



Hex wafer head



Pan head



Geometry of shank ribs and types of cone point

[mm]	Min.	Max.
d	8,30	8,60
d1	5,40	5,70
ds	5,90	6,10
p	5,60	5,90
Tx	40	

Type of thread for Ø 8,0 mm

[mm]	Min.	Max.
l	80 ±2,0	600 ±2,0
lg1	98,5	101,5
lg2	58	60

Lengths for Ø 8,0 mm

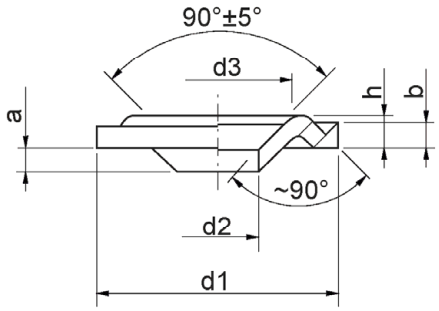
FUSA-fast / F+S PRO
CPS Chipboard Screws and WBS Woodbuilding Screws

FUSA-fast / F+S PRO WBS TT (Top Thread Screws) ∅ 8.0 mm

Annex 4.7

Deutsches Institut für Bautechnik DIBt

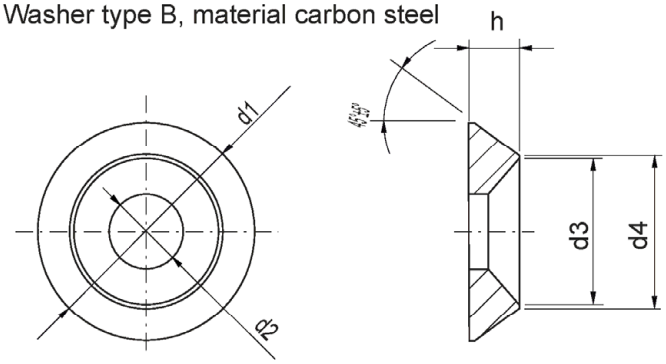
FUSA-fast / F+S PRO Washer type A, material carbon steel



	d1 ±0,5	d2 +0,5	d3 ±1	a ±0,8	b ±0,5	h ±0,5
6	22	6,5	13	2,4	2,5	3,0
8	28	8,5	16	3,3	3,0	3,5
10	33	10,5	19,5	3,4	3,0	4,3
12	42	12,5	23	3,0	4,0	5,0

All sizes in mm

FUSA-fast / F+S PRO Washer type B, material carbon steel



H-H

	d1 ±0,3	d2 ±0,3	d3 ±0,3	d4 ±0,3	h ±0,3
6	19,5	8,0	8,5	9,5	4,8
8	25	8,5	16,5	17,5	5,0
10	32	11	21,5	22,5	6,0

All sizes in mm

FUSA-fast / F+S PRO CPS Chipboard Screws and WBS Woodbuilding Screws	Annex 4.8
FUSA-fast / F+S PRO Washers	