

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-12/0276**  
**of 16 February 2017**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

WBS - Wood Building Screws und CPS - Chipboard  
Screws

Product family  
to which the construction product belongs

WBS - Wood Building Screws und CPS - Chipboard  
Screws for use in timber constructions

Manufacturer

Din Ling GmbH  
Puntigamer Straße 127  
8055 GRAZ  
ÖSTERREICH

Manufacturing plant

Werk 1, Werk 2, Werk 3, Werk 4, Werk 5

This European Technical Assessment  
contains

25 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

European Assessment Document (EAD)  
130118-00-0603

**European Technical Assessment**

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## Specific Part

### 1 Technical description of the product

CPS and WBS screws are self-tapping screws made from special carbon steel. The screws are hardened and they have a corrosion protection according to 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.

### 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.

Durability is only ensured if the specifications of intended use according to Annex 1 and 2 are taken into account.

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
Characteristic withdrawal parameter	See Annex 2
Characteristic head pull-through parameter	See Annex 2
Characteristic tensile strength	See Annex 2
Characteristic yield strength	No performance determined
Characteristic torsional strength	See Annex 2
Insertion moment	See Annex 2
Spacing, end and edge distances of the screws and minimum thickness of the wood based material	See Annex 2
Slip modulus for mainly axially loaded screws	See Annex 2

### 3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	The screws are made of steel classified as Euroclass A1 in accordance with EC decision 96/603/EC, as amended by EC decision 2000/605/EC.

### 3.3 Hygiene, health and the environment (BWR 3)

Not applicable

### 3.4 Safety and accessibility in use (BWR 4)

Same as BWR 1

### 3.5 Protection against noise (BWR 5)

Not applicable

### 3.6 Energy economy and heat retention (BWR 6)

Not applicable

### 3.7 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was investigated for this product.

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

In accordance with EAD No. 130118-00-0603 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 16 February 2017 by Deutsches Institut für Bautechnik

Uwe Bender  
Head of Department

*beglaubigt:*  
Dewitt

## Annex 1 Specifications of intended use

### A.1.1 Use of the CPS and WBS screws only for:

- Static and quasi-static loads

### A.1.2 Base materials

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

- Solid timber (softwood) according to EN 14081-1<sup>1</sup>,
- Glued laminated timber (softwood) according to EN 14080<sup>2</sup>,
- Laminated veneer lumber LVL of softwood according to EN 14374<sup>3</sup>, 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.

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

- Plywood according to EN 636<sup>4</sup> and EN 13986<sup>5</sup>,
- Oriented Strand Board, OSB according to EN 300<sup>6</sup> and EN 13986,
- Particleboard according to EN 312<sup>7</sup> and EN 13986,
- Fibreboards according to EN 622-2<sup>8</sup>, EN 622-3<sup>9</sup> and EN 13986,
- Cement-bonded particle boards according to EN 634-2<sup>10</sup> and EN 13986,
- Solid-wood panels according to EN 13353<sup>11</sup> and EN 13986.

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

CPS and WBS 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.

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 636:2012+A1:2015	Plywood - Specifications
5	EN 13986:2004+A1:2015	Wood-based panels for use in construction - Characteristics, evaluation of conformity and marking
6	EN 300:2006	Oriented strand boards (OSB) – Definition, classification and specifications
7	EN 312:2010	Particleboards - Specifications
8	EN 622-2:2004	Fibreboards – Specifications – Part 2: Requirements for hardboards
9	EN 622-3:2004	Fibreboards - Specifications - Part 3: Requirements for medium boards
10	EN 634-2:2007	Cement-bonded particleboards – Specifications – Part 2: Requirements for OPC bonded particleboards for use in dry, humid and external conditions
11	EN 13353:2008+A1:2011	Solid wood panels (SWP) – Requirements

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Specifications of intended use	

### A.1.3 Use Conditions (environmental conditions)

The corrosion protection of the CPS and WBS screws is specified in Annex A.2.6. With regards to the use and the environmental conditions, the national provisions of the place of installation apply.

### A.1.4 Installation provisions

EN 1995-1-1<sup>12</sup> in conjunction with the respective national annex applies for the installation.

A minimum of two screws shall be used for connections in load bearing timber structures. This does not apply for special situations specified in National Annexes to EN 1995-1-1.

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 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 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.

<sup>12</sup> 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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Installation provisions	

## ANNEX 2 – Characteristic values of the load-carrying capacities

Table A.2.1 Characteristic load-carrying capacities of CPS and WBS 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

The penetration length of the threaded part of the screw in the wood-based members  $l_{ef}$  shall be

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

where

- $\alpha$  angle between screw axis and grain direction  
 $d$  outer thread diameter of the screw.

The outer thread diameter of screws inserted in cross-laminated timber shall be at least 6 mm. The inner thread diameter  $d_1$  of the screws shall be 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 according to 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 or from national provisions that apply at the installation site unless otherwise specified in the following.

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 2
Characteristic values of the load-carrying capacities	

#### A.2.2.2 Cross laminated timber

The embedding strength for screws arranged parallel to the plane of cross laminated timber may be assumed according to equation (2.2) independent of the angle between screw axis and grain direction,  $0^\circ \leq \alpha \leq 90^\circ$ :

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

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 Approval/ Assessment or national approval of the cross laminated timber apply.

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. Where applicable, the angle between force and grain direction of the outer layer shall 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.

#### A.2.3 Axially loaded screws

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

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

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.2.3.1 Axial withdrawal capacity

The characteristic withdrawal parameter at an angle  $\alpha = 90^\circ$  to the grain based on a characteristic density of the wood-based member of  $350 \text{ kg/m}^3$  is

$f_{ax,k} = 12.0 \text{ N/mm}^2$  for screws with  $3.0 \text{ mm} \leq d \leq 5.0 \text{ mm}$ ,

$f_{ax,k} = 11.0 \text{ N/mm}^2$  for screws with  $6.0 \text{ mm} \leq d \leq 8.0 \text{ mm}$ ,

$f_{ax,k} = 10.0 \text{ N/mm}^2$  for screws with  $d \geq 10.0 \text{ mm}$ .

For LVL a maximum characteristic density of  $500 \text{ kg/m}^3$  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 lateral surfaces of the cross laminated timber the screws shall be 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,  $0^\circ \leq \alpha \leq 90^\circ$ , may be calculated from:

$$F_{ax,Rk} = 20 \cdot d^{0,8} \cdot l_{ef}^{0,9} \quad (2.4)$$

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].

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

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 2
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### A.2.3.2 Head pull-through capacity

The characteristic value of the head pull-through parameter for CPS and WBS screws for a characteristic density of 350 kg/m<sup>3</sup> of the timber and for wood-based panels like

- 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

with a thickness of more than 20 mm is

$$f_{\text{head,k}} = 9.4 \text{ N/mm}^2.$$

For wood-based panels a maximum characteristic density of 380 kg/m<sup>3</sup> and for LVL a maximum characteristic density of 500 kg/m<sup>3</sup> 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 for all wood-based materials:  $F_{\text{ax},\alpha,\text{RK}} = 0$ .

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

$$f_{\text{head,k}} = 8 \text{ N/mm}^2$$

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 N/mm<sup>2</sup>, and limited to 400 N complying with the minimum thickness of the wood based panels of  $1.2 \cdot d$ , with  $d$  as outer thread diameter and the values in Table A.2.2.

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 particle board	8
Solid wood Panels	12

Outer diameter of washer  $d_k > 32 \text{ mm}$  shall not be considered.

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

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 2
Characteristic values of the load-carrying capacities	

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

Minimum thickness for structural members made from solid timber, glued laminated timber, glued solid timber, laminated veneer lumber and cross laminated timber is  $t = 24$  mm for screws with  $d < 8$  mm,  $t = 30$  mm for screws with  $d = 8$  mm,  $t = 40$  mm for screws with  $d = 10$  mm and  $t = 80$  mm for screws with  $d = 12$  mm.

##### A.2.4.1 Laterally and/or axially loaded screws

Screws in non pre-drilled holes

For CPS and WBS screws minimum spacing and distances are given in EN 1995-1-1: 2004+AC:2006+A1: 2008+A2:2014, 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 spacing and distances parallel to the grain shall be increased by 50%.

Minimum distances from loaded or unloaded ends shall be at least  $15 \cdot d$  for screws with outer thread diameter  $d \geq 8$  mm and timber thickness  $t < 5 \cdot d$ .

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

Screws in pre-drilled holes

For CPS and WBS screws in pre-drilled holes the minimum spacings, end and edge distances are given in EN 1995-1-1:2004+A1: 2008, 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.

##### A.2.4.2 Only axially loaded screws

For CPS and WBS screws the minimum spacings, end and edge distances are given in EN 1995-1-1: 2004+AC:2006+A1:2008+A2:2014, clause 8.3.1.2 and Table 8.2 as for nails in non-predrilled holes and clause 8.7.2, Table 8.6.

##### A.2.4.3 Cross laminated timber

The minimum requirements for spacing, end and edge distances of screws in the plane or edge surfaces of cross laminated timber are summarised in Table A.2.3. The definition of spacing, end and edge distance is shown in Figure A.2.1 and Figure A.2.2. The minimum spacing, end and edge distances in the edge surfaces are independent of the angle between screw axis and grain direction. They may be used based on the following conditions:

- Minimum thickness of cross laminated timber:  $10 \cdot d$
- Minimum penetration depth in the edge surface:  $10 \cdot d$

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

Table A.2.3: Minimum spacing, end and edge distances of screws in the plane or edge surfaces of cross laminated timber

	$a_1$	$a_{1,t}$	$a_{1,c}$	$a_2$	$a_{2,t}$	$a_{2,c}$
Plane surface (see Figure A.2.1)	$4 \cdot d$	$6 \cdot d$	$6 \cdot d$	$2,5 \cdot d$	$6 \cdot d$	$2,5 \cdot d$
Edge surface (see Figure A.2.2)	$10 \cdot d$	$12 \cdot d$	$7 \cdot d$	$4 \cdot d$	$6 \cdot d$	$3 \cdot d$

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Spacing, end and edge distances	

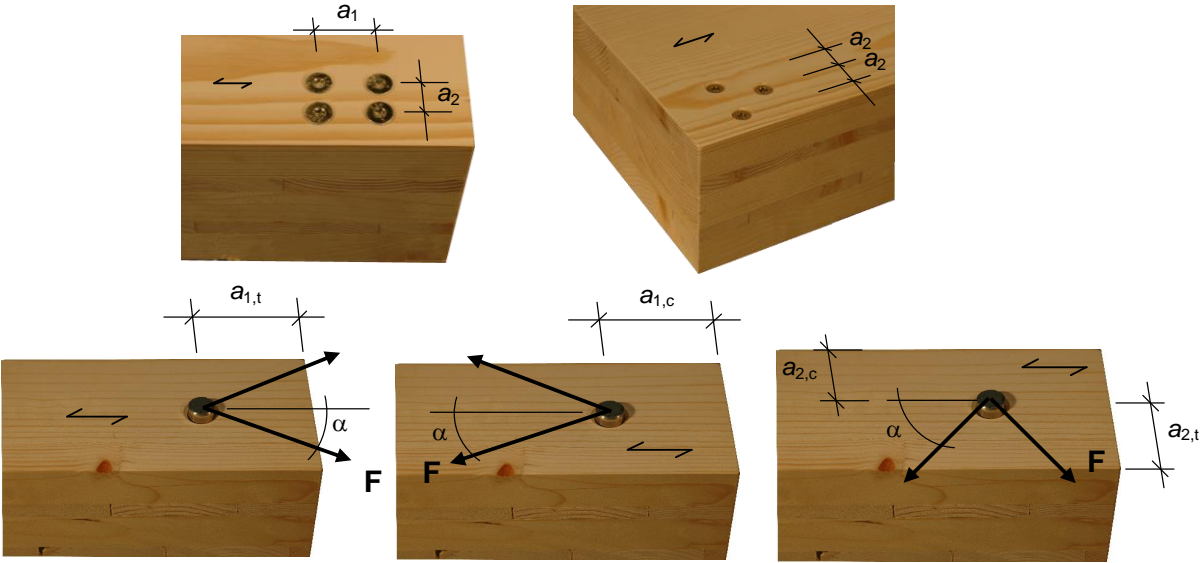


Figure A.2.1: Definition of spacing, end and edge distances in the plane surface

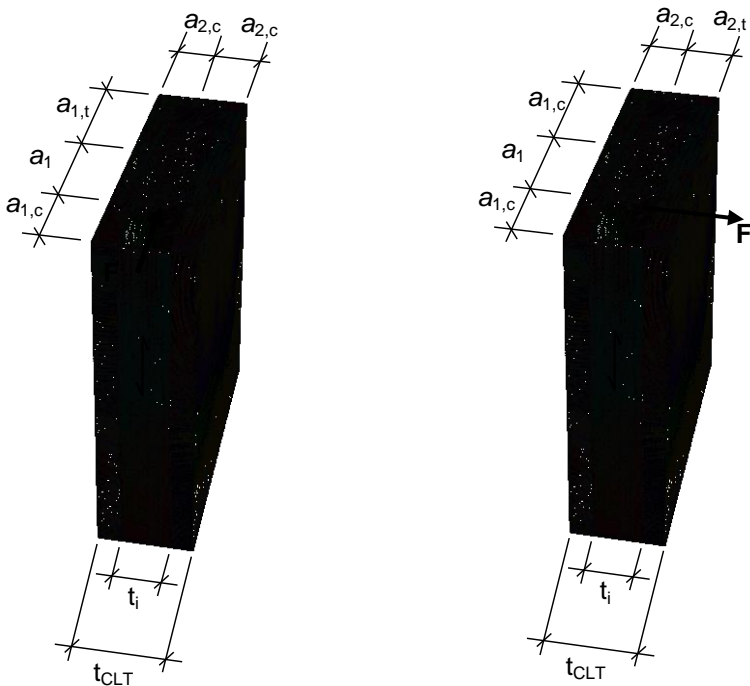


Figure A.2.2: Definition of spacing, end and edge distances in the edge surface

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 2
Spacing, end and edge distances	

### A.2.5 Insertion moment

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

### A.2.6 Durability against corrosion

Screws and washers made from carbon steel may have the coatings according to Table A.2.4

Table A.2.4 Coatings of the CPS and WBS screws

Coating		Mean thickness of the coating [ $\mu\text{m}$ ]
electrolytically galvanised	blue chromated	5
	yellow chromated	
zinc-nickel coating		4
brass-plated		5
browned		5
nickel-plated		5

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Insertion moment and durability against corrosion	

## ANNEX 3 - Fastening of thermal insulation material on top of rafters

### A.3.1 General

CPS and WBS 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 may be up to 300 mm. The thermal insulation material shall be applicable as insulation on top of rafters or for façades according to national provisions that apply at the installation site.

The battens have to be from solid timber according to EN 338/ EN 14081-1. The minimum thickness  $t$  and the minimum width  $b$  of the battens are given in table A.3.1:

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

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

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

The minimum width of the rafters shall be 60 mm.

The spacing between screws shall be not more than 1.75 m.

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

The anchorage of wind suction forces as well as the bending stresses of the battens shall be considered for design. Screws perpendicular to the grain of the rafter (angle  $\alpha = 90^\circ$ ) may be arranged where required considering the design of the 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 may 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 according to EN 826<sup>13</sup>, shall be  $\sigma_{(10\%)} = 0.05 \text{ N/mm}^2$ . The counter batten is loaded perpendicular to the axis by point loads  $F_b$  transferred by regularly spaced battens. 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 battens the following wood-based panels may be used to cover the thermal insulation material if they are suitable for that use:

- 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.

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

The word batten includes the meaning of wood-based panels in the following.

<sup>13</sup> EN 826:2013 Thermal insulating products for building applications - Determination of compression behaviour

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 3
Fastening of thermal insulation material on top of rafters	

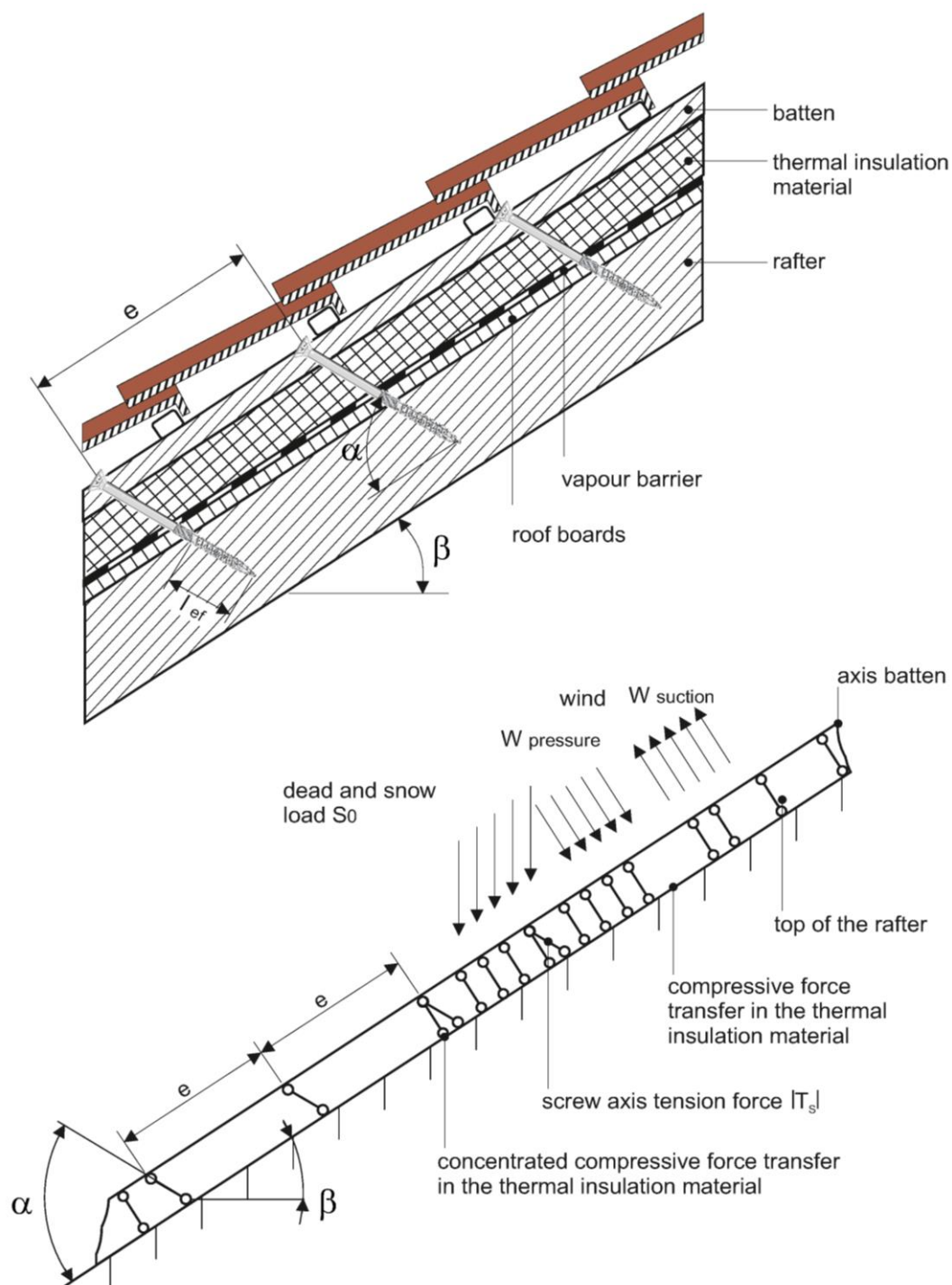


Figure A.3.1 Fastening of the thermal insulation material on top of rafters - structural system

WBS - Wood Building Screws und CPS - Chipboard Screws

Fastening of thermal insulation material on top of rafters

Annex 3

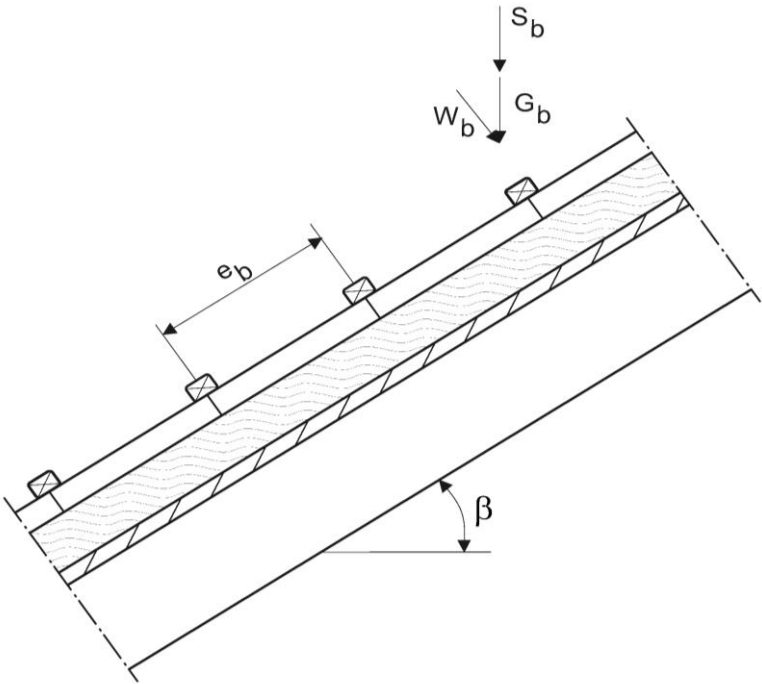


Figure A.3.2 Point loads  $F_b$  perpendicular to the battens

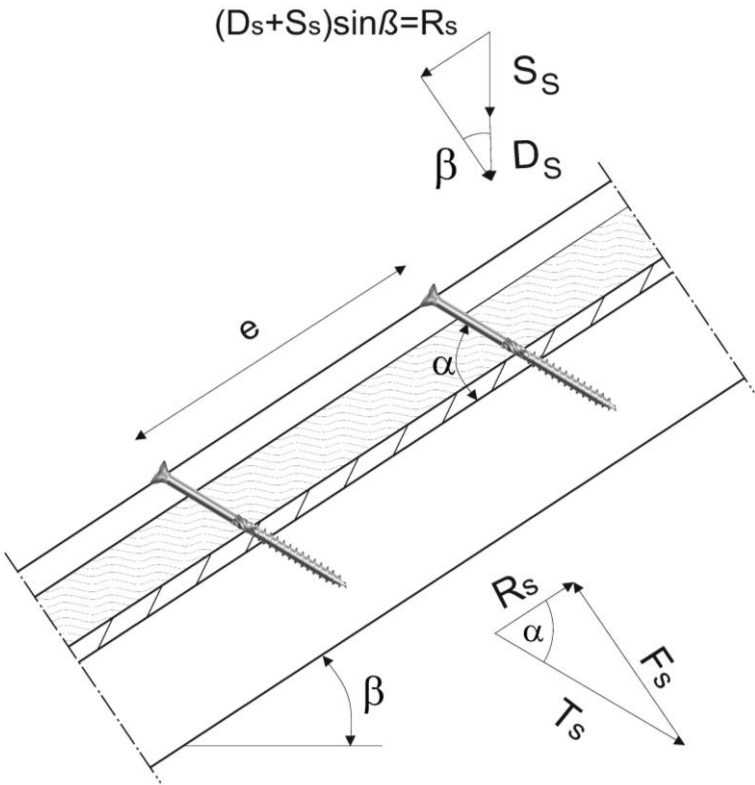


Figure A.3.3 Point loads  $F_s$  perpendicular to the battens, load application in the area of the screw heads

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 3
Fastening of thermal insulation material on top of rafters	



### A.3.2.2 Design of the battens

It's assumed that the spacing between the counter battens exceeds the characteristic length  $l_{\text{char}}$ .

The characteristic values of the bending stresses are calculated as:

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

where

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

$EI$  = bending stiffness of the batten

$K$  = coefficient of subgrade

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

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

$F_{s,k}$  = 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 material if the effective width  $w_{\text{ef}}$  of the thermal insulation material under compression is known. Due to the load extension in the thermal insulation material 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 material may be determined according to:

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

where

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

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

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

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 according to:

$$V_k = \frac{(F_b + F_s)}{2} \quad (3.6)$$

The following condition need to 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.

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 3
Fastening of thermal insulation material on top of rafters	



### A.3.2.3 Design of the thermal insulation material

The characteristic value of the compressive stresses in the thermal insulation material shall be calculated according to:

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

The design value of the compressive stress shall not be greater than 110 % of the compressive strength at 10 % deformation calculated according to 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  $R_s$ :

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

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

$$F_{ax,\alpha,Rd} = \min \left\{ \frac{f_{ax,d} \cdot d \cdot l_{ef,r} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left( \frac{\rho_k}{350} \right)^{0.8}; f_{head,d} \cdot d_h^2 \cdot \left( \frac{\rho_k}{350} \right)^{0.8}; \frac{f_{tens,k}}{\gamma_{M2}} \right\} \quad \text{for CPS and WBS screws} \quad (3.10)$$

$$F_{ax,\alpha,Rd} = \min \left\{ \frac{f_{ax,d} \cdot d \cdot l_{ef,r} \cdot k_1 \cdot k_2}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left( \frac{\rho_k}{350} \right)^{0.8}; \max \left\{ f_{head,d} \cdot d_h^2 \cdot \left( \frac{\rho_k}{350} \right)^{0.8}; \frac{f_{ax,d} \cdot d \cdot l_{ef,b}}{1.2 \cdot \cos^2 \alpha + \sin^2 \alpha} \cdot \left( \frac{\rho_k}{350} \right)^{0.8} \right\}; \frac{f_{tens,k}}{\gamma_{M2}} \right\} \quad \text{for WBS TT screws} \quad (3.11)$$

where:

- $f_{ax,d}$  design value of the axial withdrawal capacity of the threaded part of the screw in the rafter or in the batten according to Annex A.2.3.1,  $f_{ax,d}$  does not apply for wood-based panels [N/mm<sup>2</sup>]
- $d$  outer thread diameter of the screw [mm]
- $l_{ef,r}$  penetration length of the threaded part of the screw in the rafter,  $l_{ef} \geq 40$  mm
- $l_{ef,b}$  penetration length of the threaded part of the screw in the batten [mm]
- $\rho_k$  characteristic density of the wood-based member [kg/m<sup>3</sup>], for LVL the assumed characteristic density shall not exceed 500 kg/m<sup>3</sup>, for wood-based panels  $\rho_k = 350$  kg/m<sup>3</sup>
- $\alpha$  angle  $\alpha$  between screw axis and grain direction,  $30^\circ \leq \alpha \leq 90^\circ$
- $f_{head,d}$  design value of the head pull-through capacity of the screw [N/mm<sup>2</sup>]
- $d_h$  head diameter of the screw [mm]

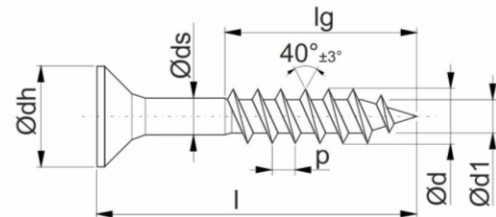
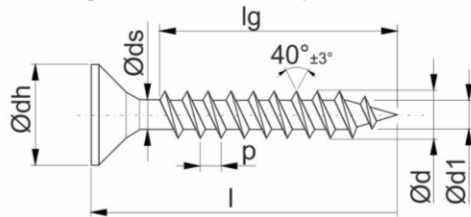
WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 3
Fastening of thermal insulation material on top of rafters	

$f_{\text{tens,k}}$	characteristic tensile capacity of the screw according to Annex 2 [N]
$\gamma_{M2}$	partial factor according to EN 1993-1-1 in conjunction with the particular national annex
$k_1$	$\min \{1; 220/t_{HI}\}$
$k_2$	$\min \{1; \sigma_{10\%}/0,12\}$
$t_{HI}$	thickness of the thermal insulation material [mm]
$\sigma_{10\%}$	compressive stress of the thermal insulation material under 10 % deformation [N/mm <sup>2</sup> ]

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

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 3
Fastening of thermal insulation material on top of rafters	

CPS - Self-drilling screw with full or part thread, material carbon steel



Head shapes and types of thread for Ø3 mm

All sizes in mm

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

Lengths for Ø3 mm: l=16 bis 50 ± 2,0 lg=12 bis 46 ± 2,0 Thread length between lg min and lg max possible

Head shapes and types of thread for Ø3,5 mm

All sizes in mm

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

Lengths for Ø3,5 mm: l=18 bis 50 ± 2,0 lg=14 bis 44 ± 2,0 Thread length between lg min and lg max possible

Head shapes and types of thread for Ø4 mm

all sizes in mm

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

Lengths for Ø4 mm: l=20 bis 70 ± 2,0 lg=16 bis 64 ± 2,0 Thread length between lg min and lg max possible

Types of cone point



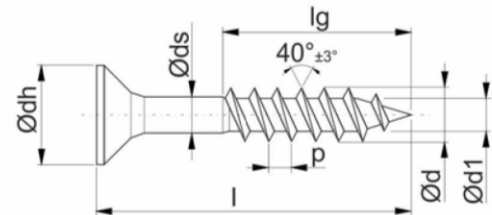
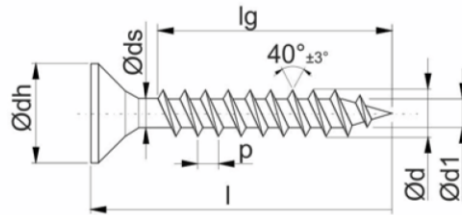
Type A1 cut to end of cone point or shifted  
Type B saw thread  $x=1/3$  lg  
Type B1 saw thread  $x=1/3$  lg with cut

WBS - Wood Building Screws und CPS - Chipboard Screws

CPS – Chipboard screws fully or partly threaded

Annex 4.1

CPS - Self-drilling screw with full or part thread, material carbon steel



Head shapes and types of thread for Ø4,5 mm

All sizes in mm

			[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	

Countersunk head with or without ribs under head

Raised countersunk with or without ribs under head

Pan Head

Details of thread geometry

Lengths for Ø4,5 mm: l=25 to 80 ± 1,0  
lg=18 to 74 ± 1,0

Thread length between lg min and lg max possible

Head shapes and types of thread for Ø5 mm

All sizes in mm

			[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	

Countersunk head with or without ribs under head

Raised countersunk with or without ribs under head

Pan Head

Details of thread geometry

Lengths for Ø5 mm: l=25 to 120 ± 1,0  
lg=20 to 75 ± 1,0

Thread length between lg min and lg max possible

Head shapes and types of thread for Ø6 mm

All sizes in mm

			[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	

Countersunk head with or without ribs under head

Raised countersunk with or without ribs under head

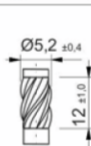
Pan Head

Details of thread geometry

Lengths for Ø6 mm: l=30 to 300 ± 1,0  
lg=24 to 75 ± 1,0

Thread length between lg min and lg max possible

with shank ribs:  
l=220 to 300 ± 1,0



Types of cone point

A

B

A1

B1

Type A1 cut to end of cone point or shifted

Type B saw thread x=1/3 lg

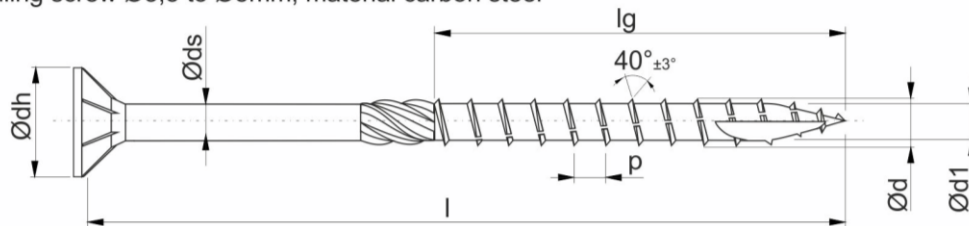
Type B1 saw thread x=1/3 lg with cut

WBS - Wood Building Screws und CPS - Chipboard Screws

CPS – Chipboard screws fully or partly threaded

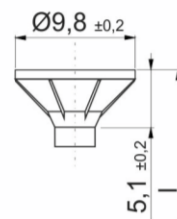
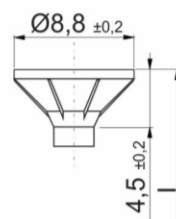
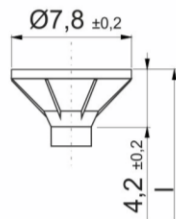
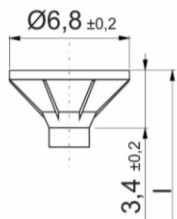
Annex 4.2

"WBS" Self-drilling screw Ø3,5 to Ø5mm, material carbon steel



All sizes in mm

Head shape for "WBS" Self-drilling screw Ø3,5 to Ø5mm



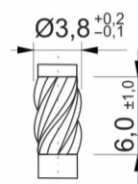
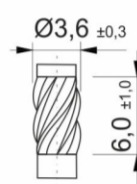
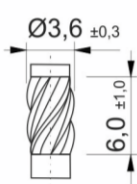
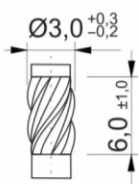
Countersunk head Ø3,5mm

Countersunk head Ø4mm

Countersunk head Ø4,5mm

Countersunk head Ø5mm

Shank ribs for WBS Ø3,5mm to Ø5mm, for all lengths selectable



Geometry shank ribs Ø3,5mm

Geometry shank ribs Ø4mm

Geometry shank ribs Ø4,5mm

Geometry shank ribs Ø5mm

[mm]	Min.	Max.	[mm]	Min.	Max.	[mm]	Min.	Max.	[mm]	Min.	Max.
d	3,20	3,50	d	3,70	4,00	d	4,20	4,50	d	4,70	5,00
d1	1,90	2,10	d1	2,05	2,50	d1	2,40	2,90	d1	2,80	3,30
ds	2,50		ds	2,80		ds	3,16		ds	3,47	
p	2,70 ±10%		p	2,80 ±10%		p	3,10 ±10%		p	3,20 ±10%	
Tx	10 or 15		Tx	15 or 20		Tx	20 or 25		Tx	25	

Thread geometry Ø3,5mm

Thread geometry Ø4mm

Thread geometry Ø4,5mm

Thread geometry Ø5mm

Lengths for WBS Ø3,5mm to Ø5mm, thread length between lg min and lg max possible

Lengths for Ø3,5mm:	l=20 bis 70 ± 1,0 2,0	lg=14 bis 42 ± 1,0 3,0
Lengths for Ø4mm:	l=20 bis 80 ± 1,0 2,0	lg=16 bis 49 ± 1,0 3,0
Lengths for Ø4,5mm:	l=20 bis 80 ± 1,0 2,0	lg=18 bis 49 ± 1,0 3,0
Lengths for Ø5mm:	l=25 bis 120 ± 1,0 2,0	lg=20 bis 74 ± 1,0 3,0

Types of cone point

Type A1 cut to end of cone point or shifted

Type B saw thread x=1/3 lg

Type B1 saw thread x=1/3 lg with cut



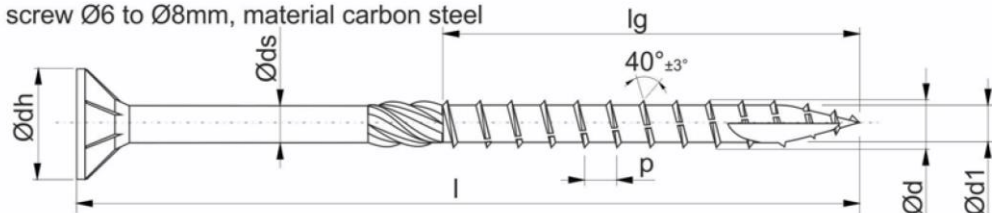
WBS - Wood Building Screws und CPS - Chipboard Screws

WBS – Wood Building screws

Annex 4.3

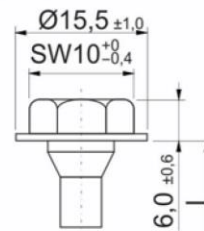
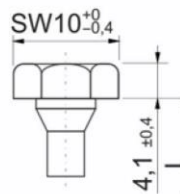
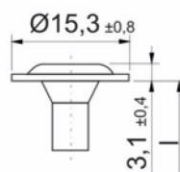
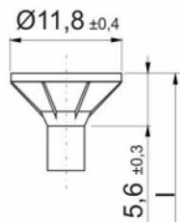


"WBS" Self-drilling screw Ø6 to Ø8mm, material carbon steel



Head shapes for Ø6 mm

All sizes in mm

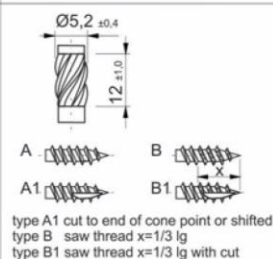
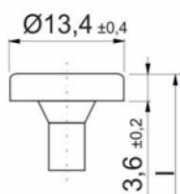


Countersunk head

Wafer head

Hex head

Hex wafer head



[mm]	Min.	Max.	[mm]	Min.	Max.
d	5,80	6,20	l	40 ±2,0	300 ±2,0
d1	3,65	4,00	lg	24 ±1,5	75 ±1,5
ds	4,15	4,35	I < 60 without shank ribs Thread length between lg min and lg max possible		
p	4,50 ±10%				
Tx	25 or 30				

Pan head

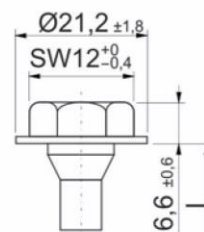
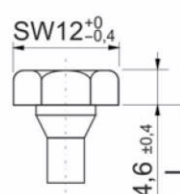
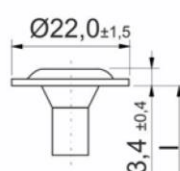
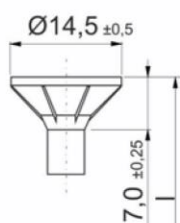
Geometry of shank ribs and types of cone point

Thread geometry Ø6mm

Lengths for Ø6mm

Head shapes for Ø8 mm

All sizes in mm

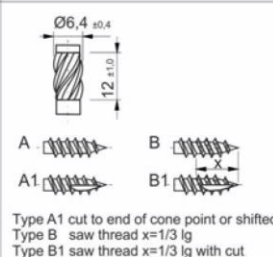
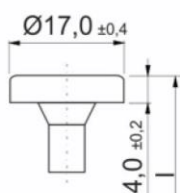


Countersunk head

Wafer head

Hex head

Hex wafer head



[mm]	Min.	Max.	[mm]	Min.	Max.
d	7,60	8,25	l	40 ±2,0	600 ±2,0
d1	5,05	5,50	lg	32 ±1,5	150 ±1,5
ds	5,70	5,90	I < 60 without shank ribs Thread length between lg min and lg max possible		
p	5,20 ±10%				
Tx	40				

Pan head

Geometry of shank ribs and types of cone point

Thread geometry Ø8mm

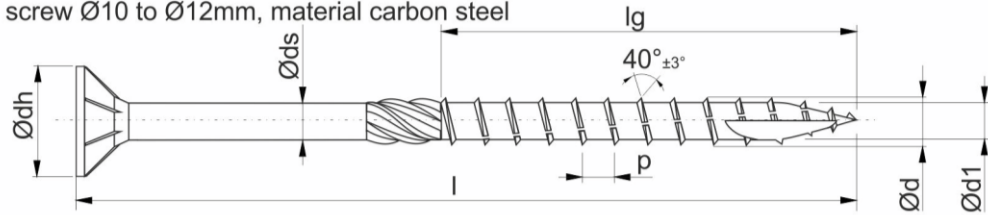
Lengths for Ø8mm

WBS - Wood Building Screws und CPS - Chipboard Screws

WBS – Wood Building screws

Annex 4.4

"WBS" Self-drilling screw Ø10 to Ø12mm, material carbon steel



Head shapes for Ø10mm

All sizes in mm

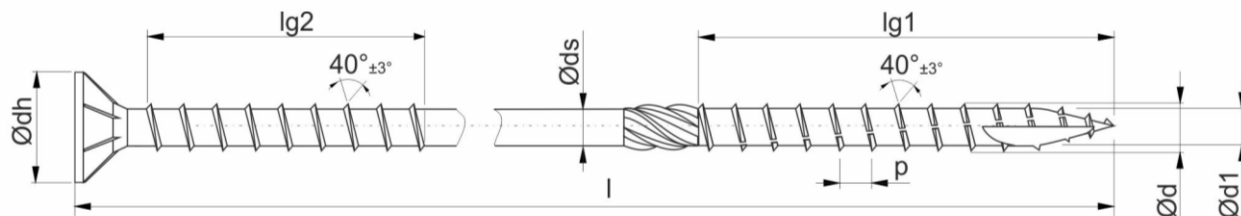
Countersunk head	Wafer head	Hex head	Hex wafer head																											
	<p>type A1 cut to end of cone point or shifted type B saw thread x=1/3 lg type B1 saw thread x=1/3 lg with cut</p>	<table><tr><td>[mm]</td><td>Min.</td><td>Max.</td></tr><tr><td>d</td><td>9,60</td><td>10,25</td></tr><tr><td>d1</td><td>6,20</td><td>6,70</td></tr><tr><td>ds</td><td>6,80</td><td>7,30</td></tr><tr><td>p</td><td>5,60 ±10%</td><td></td></tr><tr><td>Tx</td><td>40</td><td></td></tr></table>	[mm]	Min.	Max.	d	9,60	10,25	d1	6,20	6,70	ds	6,80	7,30	p	5,60 ±10%		Tx	40		<table><tr><td>[mm]</td><td>Min.</td><td>Max.</td></tr><tr><td>l</td><td>80 ±2,0</td><td>600 ±2,0</td></tr><tr><td>lg</td><td>40 ±1,5</td><td>150 ±1,5</td></tr></table> <p>Thread length between lg min and lg max possible</p>	[mm]	Min.	Max.	l	80 ±2,0	600 ±2,0	lg	40 ±1,5	150 ±1,5
[mm]	Min.	Max.																												
d	9,60	10,25																												
d1	6,20	6,70																												
ds	6,80	7,30																												
p	5,60 ±10%																													
Tx	40																													
[mm]	Min.	Max.																												
l	80 ±2,0	600 ±2,0																												
lg	40 ±1,5	150 ±1,5																												
Pan head	Geometry of shank ribs and types of cone point	Thread geometry Ø10mm	Lengths for Ø10mm																											
Head shapes for Ø12mm																														
All sizes in mm																														
Countersunk head	Wafer head	Hex head	Hex wafer head																											
	<p>Type A1 cut to end of cone point or shifted Type B saw thread x=1/3 lg Type B1 saw thread x=1/3 lg with cut</p>	<table><tr><td>[mm]</td><td>Min.</td><td>Max.</td></tr><tr><td>d</td><td>11,60</td><td>12,30</td></tr><tr><td>d1</td><td>7,00</td><td>7,50</td></tr><tr><td>ds</td><td>7,90</td><td>8,40</td></tr><tr><td>p</td><td>6,00 ±10%</td><td></td></tr><tr><td>Tx</td><td>40 or 50</td><td></td></tr></table>	[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		<table><tr><td>[mm]</td><td>Min.</td><td>Max.</td></tr><tr><td>l</td><td>80 ±2,0</td><td>600 ±2,0</td></tr><tr><td>lg</td><td>50 ±1,5</td><td>150 ±1,5</td></tr></table> <p>Thread length between lg min and lg max possible</p>	[mm]	Min.	Max.	l	80 ±2,0	600 ±2,0	lg	50 ±1,5	150 ±1,5
[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																													
[mm]	Min.	Max.																												
l	80 ±2,0	600 ±2,0																												
lg	50 ±1,5	150 ±1,5																												
Geometry of shank ribs	Types of cone point	Thread geometry Ø12mm	Lengths for Ø12mm																											

WBS - Wood Building Screws und CPS - Chipboard Screws

WBS – Wood Building screws

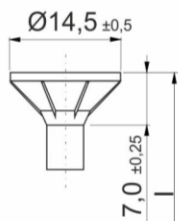
Annex 4.5

"WBS TT" Self-drilling screw Ø8mm, material carbon steel

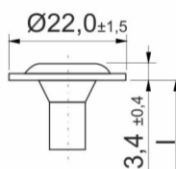


Head shapes for Ø8mm

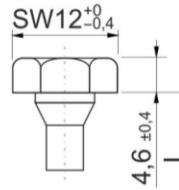
All sizes in mm



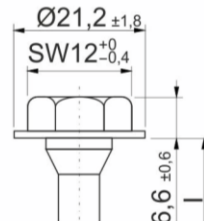
Countersunk head



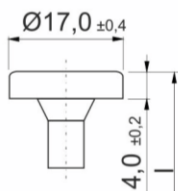
Wafer head



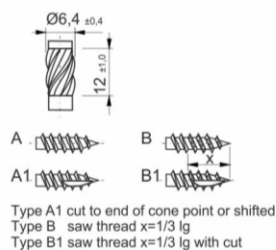
Hex head



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	

Thread geometry Ø8mm

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

Lengths for Ø 8mm

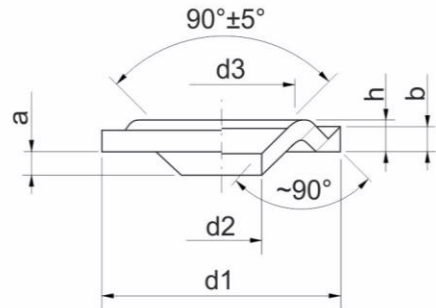
WBS - Wood Building Screws und CPS - Chipboard Screws

WBS TT Screw

Annex 4.6



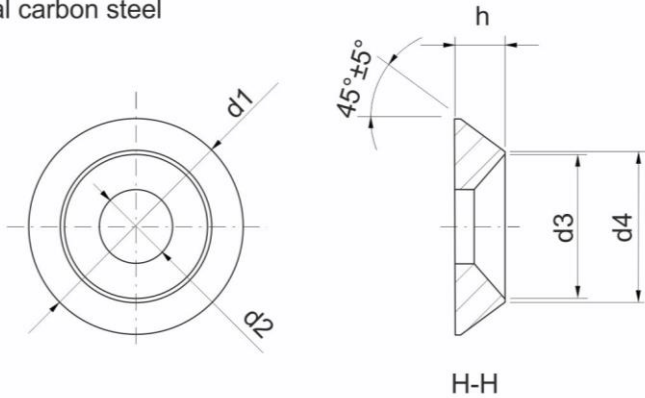
Washer type A, material carbon steel



All sizes in mm

	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

Washer type B, material carbon steel



All sizes in mm

	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

WBS - Wood Building Screws und CPS - Chipboard Screws	Annex 4.7
Washers	