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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-19/0175 of 2025/09/22

I GENERAL PART

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	fischer PowerFast II screws fischer PowerFast II – Chipboard screws fischer PowerFast II – Wood Construction screws
Product family to which the construction product belongs:	Screws for use in timber constructions
Manufacturer:	fischerwerke GmbH & Co. KG Klaus-Fischer-Straße 1 DE-72178 Waldachtal Phone: +49 7443 120 www.fischer.de
Manufacturing plant:	fischerwerke
This European Technical Assessment contains:	79 pages including 8 Annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	European Assessment Document (EAD) EAD 130118-01-0603 “Screws and threaded rods for use in timber constructions”
This version replaces:	The ETA with the same number issued on 2023-09-19

CONTENT

CONTENT

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The document refers to the following standards and regulations:

EAD 130118-01-0603	Screws and threaded rods for use in timber constructions, EOTA 2019
EN 300:2006	Oriented Strand boards (OSB) – Definitions, classifications and specifications
EN 312:2010	Particleboards – Specifications
EN 314-2:1997	Plywood - Bonding Quality – Requirements
EN 338:2016	Structural timber – Strength classes
EN 520:2010	Gypsum plasterboards – Definitions, requirements and test methods
EN 622-2:2006	Fibreboards – Specifications – Part 2: Requirements for hardboards
EN 622-3:2006	Fibreboards – Specifications – Part 3: Requirements for medium boards
EN 634-2:2007	Cement-bonded particleboards
EN 636:2016	Plywood – Specifications
EN 826:2013	Thermal insulating products for building applications – Determination of compression behaviour
EN 13501-1:2020	Fire classification of construction products and building elements – Part 1
EN 1912:2013	Structural Timber – Strength classes – Assignment of visual grades and species
EN 1990:2013	Eurocode – Basis of structural design
EN 1993-1-1:2014	Eurocode 3: Design of steel structures – Part 1-1: General rules and rules for buildings
EN 1993-1-8:2012	Eurocode 3: Design of steel structures – Part 1-8: Design of joints
EN 1995-1-1:2014	Eurocode 5: Design of timber structures – Part 1-1: General – Common rules
EN 1999-1-1:2014	Eurocode 9: Design of aluminium structures – Part1-1: General structural rules
EN 10088-1:2024	Stainless steel – Part 1: List of stainless steels
EN 13353:2011	Solid wood panels (SWP) - Requirements
EN 13986:2015	Wood-based panels for use in construction – Characteristics, evaluation of conformity
EN 14080:2013	Timber structures – Glued laminated timber and glued Solid Timber – Requirements
EN 14081-1:2019	Timber structures – Strength graded structural timber with rectangular cross section – Part 1: General requirements
EN 14374:2016	Timber structures – Laminated Veneer Lumber (LVL) – Requirements
EN 14592:2012	Timber Structures – Dowel-type fasteners - Requirements
EN 15283-2:2009	Gypsum boards with fibrous reinforcements – Definitions, requirements and test methods – Part 2: Gypsum fibre boards
EN 15497:2014	Structural finger jointed Solid Timber – Performance requirements and minimum production requirements
EN ISO 7094:2000	Plain washers - Extra large series, product grade C
ETA-14/0354:2018	Pollmeier Furnierwerkstoffe GmbH
ETA-05/0090:2018-09	DURISOL - Schalungssteine aus Holzspanbeton, Leier Baustoffe GmbH & Co KG (German Title)
ETA-13/0609:2018-11	FERMACELL Powerpanel HD
ETA-05/0261:2018-09	ISO SPAN - Schalungs-/Mantelsteine aus Holzspanbeton; ISO SPAN Baustoffwerk GmbH
Z-9.1-865:2023	Accoya Schnittholz" und "Accoya Color Grey" als tragende Bauteile im Holzbau

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of the product

»fischer PowerFast II – Chipboard screws and Wood Construction screws« are self-tapping screws to be used in timber structures. They shall be threaded over a part of the length or over the whole length. The screws are produced from a carbon or stainless steel wire. fischer »PowerFast II – Chipboard screws« have an outer thread diameter *d* (nominal diameter) between 3,0 mm and 6,0 mm. »fischer PowerFast II – Wood Construction screws« have a nominal diameter between 8,0 mm to 12,0 mm. Where corrosion protection is required, the material or coating shall be declared in accordance with the relevant specification given in Annex A of EN 14592. They are zinc-plated (e.g. yellow-zinced or blue-zinced), bonus-zinc-coated, burnished, nickel-plated, brass-plated or black coated. The thickness of the zinc-plated screws is min. 5 μm.

The stainless steel screws are made from stainless steel no 1.4301, 1.4567, 1.4401 and 1.4578 and their equivalents according to EN 10088-1.

The FAFS-Clip is made of zinc die-cast for »fischer PowerFast II – Chipboard screws« with countersunk head and a diameter of 5,0 mm (see Annex A18).

Product and product description are given in Annex A.

The characteristic material values, dimensions and tolerances of the »fischer PowerFast II« screws not indicated in the Annexes shall correspond to the respective values laid down in the Technical Documentation of this European Technical Assessment (ETA).

Specifications of the product itself are given in Annex C. The screws are intended to be used with a minimum embedment depth (penetration length) given in Annex D. It is possible to consider the influences of the tip of the screws on the load-carrying capacities. The intended use and exemplary applications are also detailed in the Annex E to Annex H.

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

The performances given in Section 3 are only valid if the »fischer PowerFast II« screws are used in compliance with the specifications and conditions provided in Annex C.

The intended use of the screws is in timber connections for which all requirements of mechanical resistance, stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation 305/2011 (EU) shall be fulfilled.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the screws of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the products.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR1)	
Dimensions	See Annex A
Characteristic yield moment	See Annex C
Bending angle	See Annex C
Characteristic withdrawal parameter	See Annex D
Characteristic head-pull through parameter of screws	See Annex D
Characteristic tensile strength	See Annex C
Characteristic torsional strength	See Annex C
Insertion moment	See Annex C
Spacing, end and edge distances of the screws and minimum thickness of the timber material	See Annex B
Slip modulus for laterally and axially loaded screws	See Annex D
Durability against corrosion	See Chapter 3.4
3.2 Safety in case of fire (BWR2)	
Reaction to fire	The screws are considered to satisfy **Euroclass A1** in accordance with EN 13501-1 and Delegated Regulation 2016/364, according to EC Decision 96/603/EC.
3.3 Safety and accessibility in use (BWR4)	
Same as BWR 1	See aspects covered by BWR1

The intended use and exemplary applications are also detailed in the Annex E to Annex H

See additional information in section 3.4 and 3.5

3.4 Methods of verification

The assessment of the performance »fischer PowerFast II« screws in relation to the applicable BWR's has been made in accordance with the European Assessment Document (EAD) No. EAD 130118-01-0603 »Screws and threaded rods for use in timber constructions«.

Durability and serviceability

The screws have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in EN 1995-1-1 and subjected to the conditions defined by service classes 1 and 2 for carbon steel zinc-plated (e.g. yellow-zinced or blue-zinced), bonus-zinc-coated, burnished, nickel-plated, brass-plated or black coated. The thickness of the zinc-plated screws is minimum 5 µm and up to service class 3 for screws produced from stainless steel no 1.4301, 1.4567, 1.4401 and 1.4578 and their equivalents according to EN 10088-1.

3.5 General aspects related to the performance of the product

The European Technical Assessment is issued for the screws based on agreed data/information, deposited with ETA-Danmark, which identifies the product that has been assessed. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to ETA-Danmark before the changes are introduced. ETA-Danmark will decide if such changes affect the ETA and consequently the validity of the CE marking based on the ETA, and if so, whether further assessment or alterations to the ETA shall be necessary.

The screws are manufactured in accordance with the provisions of the European Technical Assessment using the automated manufacturing process as identified during the inspection of the plant by the assessment body issuing the ETA and the notified body and laid down in the technical documentation. The installation shall be carried out following EN 1995-1-1 (Eurocode 5) or an appropriate national code unless otherwise defined in this document.

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

4.1 AVCP system

According to the European Commission's decision 97/176/EC, as amended, the system(s) for assessing and verifying constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 3.

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

The control plan deposited at ETA-Danmark prior to CE marking contains technical details necessary for implementing the AVCP system.

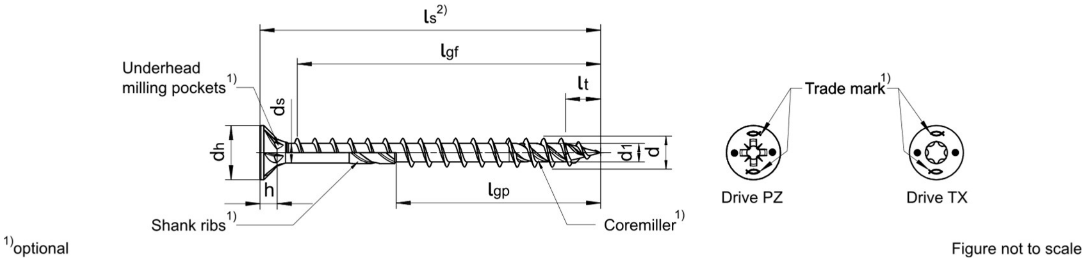
Issued in Copenhagen on 2025-09-22 by

Thomas Bruun
Managing Director, ETA-Danmark

PowerFast II – Chipboard screw - Countersunk head with full- or partial thread Carbon steel

Table A1.1: Screw Dimensions and Materials for carbon steel

Drawing



Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		3,0	3,5	4,0	4,5	5,0	6,0
d	Outer thread diameter	3,00	3,50	4,00	4,50	5,10	6,00
	Allowed deviation	± 0,25	± 0,25	± 0,30	± 0,30	± 0,30	± 0,30
***d*₁**	Inner thread diameter	1,95	2,20	2,50	2,75	3,25	4,00
	Allowed deviation	± 0,18	± 0,18	± 0,20	± 0,20	± 0,20	± 0,30
***d*ₕ**	Head diameter	6,00	7,00	8,00	8,80	9,80	11,80
	Allowed deviation	± 0,50	± 0,50	± 0,60	± 0,60	± 0,60	± 0,60
***d*ₛ**	Shank diameter	2,25	2,60	2,90	3,20	3,70	4,30
	Allowed deviation	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15
h	Head height	1,80	2,30	2,40	2,70	3,00	3,60
***l*ₜ**	Length of the screw tip	-	-	-	-	-	7,30
	Drive TX	10	10 / 20	20	20	20 / 25	30
	Drive PZ	1	2	2	2	2	3

Nominal length		Standard thread length | l_{gf} = Full thread | l_{gp} = Partial thread | Tolerance: ± 2,0[3]											
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ±1,05	16		16									
25	l_s ±1,25	21	18	21	18	20	18	20					
30	l_s ±1,25	26	18	26	18	25	18	25	18	24			
35	l_s ±1,50	31	24	31	24	30	24	30	24	29	24	28	
40	l_s ±1,50	36	28	36	28	35	28	35	28	34	28	33	28
45	l_s ±1,50	41	30	41	30	40	30	40	30	39	30	38	30
50	l_s ±1,50			46	30	45	30	45	30	44	30	43	30
55	l_s ±1,75					50	36	50	36	49	36	48	36
in steps of 10 mm													
60	l_s ±1,75					55	36	55	36	54	36	53	36
70	l_s ±1,75						42	60	42	64	42	63	42
80	l_s ±1,75						45	75	45	74	45	73	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130 - 300	l_s ± 3,00												70

All sizes in [mm]

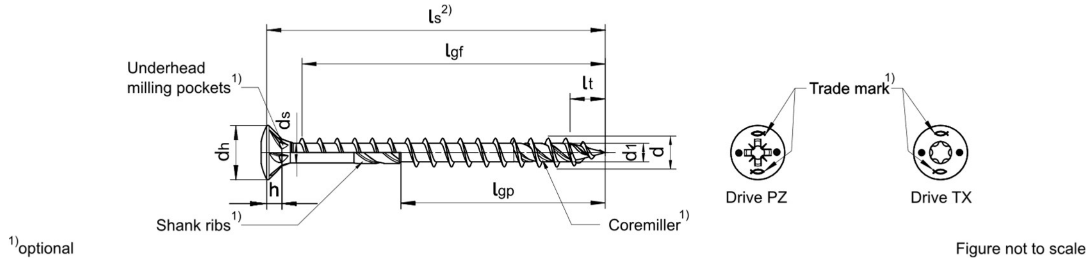
[2] Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

[3] For 10 mm ≤ l_{gf} resp., l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw – Raised countersunk head with full- or partial thread
Carbon steel

Table A2.1: Screw Dimensions and Materials

Drawing



Materials and coatings
- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**
d	Outer thread diameter	3,00	3,50	4,00	4,50	5,10	6,00
	Allowed deviation	± 0,25	± 0,25	± 0,30	± 0,30	± 0,30	± 0,30
d_1	Inner thread diameter	1,95	2,20	2,50	2,75	3,25	4,00
	Allowed deviation	± 0,18	± 0,18	± 0,20	± 0,20	± 0,20	± 0,30
d_h	Head diameter	6,00	7,00	8,00	8,80	9,80	11,80
	Allowed deviation	± 0,50	± 0,50	± 0,60	± 0,60	± 0,60	± 0,60
d_s	Shank diameter	2,25	2,60	2,90	3,20	3,70	4,30
	Allowed deviation	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15
h	Head height	1,80	2,30	2,40	2,70	3,00	3,60
l_t	Length of the screw tip	-	-	-	-	-	7,30
	Drive TX	10	10, 20	20	20	20, 25	30
	Drive PZ	1	2	2	2	2	3

Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} = Partial thread | Tolerance: ± 2,0 3)**											
l_s		Allowed Deviations											
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ± 1,05	16		16									
25	l_s ±1,25	21	18	21	18	20	18	20					
30	l_s ±1,25	26	18	26	18	25	18	25	18	24			
35	l_s ±1,50	31	24	31	24	30	24	30	24	29	24	28	
40	l_s ±1,50	36	28	36	28	35	28	35	28	34	28	33	28
45	l_s ±1,50	41	30	41	30	40	30	40	30	39	30	38	30
50	l_s ±1,50			46	30	45	30	45	30	44	30	43	30
55	l_s ±1,75					50	36	50	36	49	36	48	36
in steps of 10 mm													
60	l_s ±1,75					55	36	55	36	54	36	53	36
70	l_s ±1,75						42	60	42	64	42	63	42
80	l_s ±1,75						45	75	45	74	45	73	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130-300	l_s ± 3,00												70

All sizes in [mm]

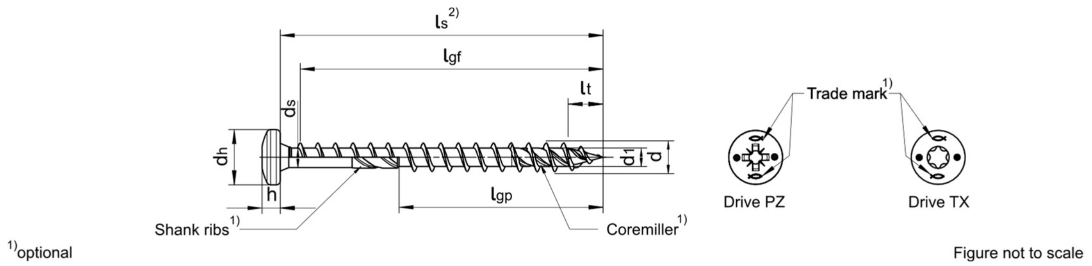
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp., l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw – Pan head with full- or partial thread
Carbon steel

Table A3.1: Screw Dimensions and Materials

Drawing



Materials and coatings
- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		3,0	3,5	4,0	4,5	5,0	6,0
d	Outer thread diameter	3,00	3,50	4,00	4,50	5,10	6,00
	Allowed deviation	± 0,25	± 0,25	± 0,30	± 0,30	± 0,30	± 0,30
***d*₁**	Inner thread diameter	1,95	2,20	2,50	2,75	3,25	4,00
	Allowed deviation	± 0,18	± 0,18	± 0,20	± 0,20	± 0,20	± 0,30
***d*ₕ**	Head diameter	6,00	7,00	8,00	9,00	10,00	12,00
	Allowed deviation	± 0,50	± 0,50	± 0,60	± 0,60	± 0,60	± 0,60
***d*ₛ**	Shank diameter	2,25	2,60	2,90	3,20	3,70	4,30
	Allowed deviation	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15
h	Head height	2,30	2,50	2,80	2,80	3,40	3,40
***l*ₜ**	Length of the screw tip	-	-	-	-	-	7,30
	Drive TX	10	10 | 20	20	20	20 | 25	30
	Drive PZ	1	2	2	2	2	3

Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} = Partial thread | Tolerance: ± 2,0 3)**											
l_s	Allowed Deviations												
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ± 1,05	16		16									
25	l_s ±1,25	21	18	21	18	21	18	21					
30	l_s ±1,25	26	18	26	18	26	18	26	18	26			
35	l_s ±1,50	31	24	31	24	31	24	31	24	31	24	30	
40	l_s ±1,50	36	28	36	28	36	28	36	28	36	28	35	28
45	l_s ±1,50	41	30	41	30	41	30	41	30	41	30	40	30
50	l_s ±1,50			46	30	46	30	46	30	46	30	45	30
55	l_s ±1,75					51	36	51	36	51	36	50	36
in steps of 10 mm													
60	l_s ±1,75					56	36	56	36	56	36	55	36
70	l_s ±1,75						42	66	42	66	42	65	42
80	l_s ±1,75						45	76	45	76	45	75	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130-300	l_s ± 3,00												70

All sizes in [mm]

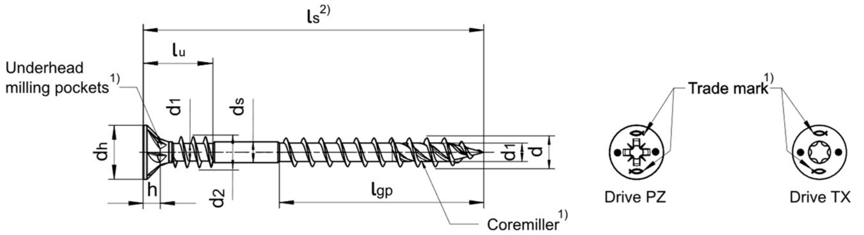
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp., l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw with clamping effect
Carbon steel

Table A4.1: Screw Dimensions and Materials

Drawing



1)optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		**3,5**		**4,0**	**4,5**
d	Outer thread diameter	3,50		4,00	4,50
	Allowed deviation	± 0,25		± 0,30	± 0,30
d_1	Inner thread diameter	2,20		2,50	2,75
	Allowed deviation	± 0,18		± 0,20	± 0,20
d_2	Outer thread diameter	4,00		4,50	5,00
	Allowed deviation	± 0,30		± 0,30	± 0,30
d_h	Head diameter	7,00		8,00	8,80
	Allowed deviation	± 0,50		± 0,60	± 0,60
d_s	Shank diameter	2,60		2,90	3,20
	Allowed deviation	± 0,15		± 0,15	± 0,15
h	Head height	2,30		2,40	2,70
l_t	Length of the screw tip	-		-	-
	Drive TX	10	20	20	20
	Drive PZ	2		2	2

Nominal length	**Standard thread length | l_u = Underhead thread | l_{gp} =Partial thread | Tol.: ± 2,0[3]**						
l_s	Allowed Deviations						
	$l_{s,min/max}$	l_u	l_{gp}	l_u	l_{gp}	l_u	l_{gp}
30	l_s ±1,25	10	16	10,5	16		
35	l_s ±1,50	10	16	10,5	16		
40	l_s ±1,50	10	24	10,5	24		
45	l_s ±1,50	10	24	10,5	24		
50	l_s ±1,50	10	24	10,5	24	12	24
55	l_s ±1,75	10	30	10,5	30	12	30
in steps of 10 mm							
60	l_s ±1,75	10	30	10,5	30	12	30
70	l_s ±1,75			10,5	30	12	30
80	l_s ±1,75						
130-300	l_s ± 3,00						

All sizes in [mm]

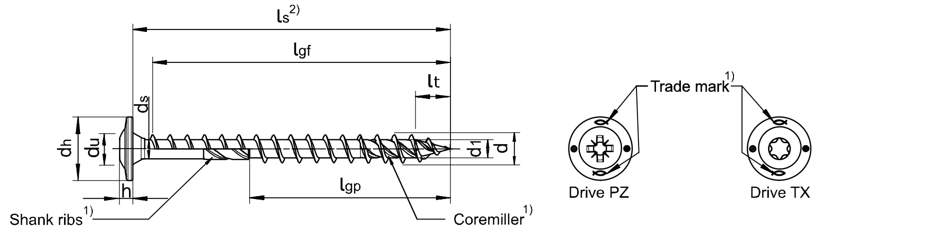
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp.,l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw - Flange head with full- or partial thread
Carbon steel

Table A5.1: Screw Dimensions and Materials

Drawing



1) optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		**5,0**		**6,0**	
d	Outer thread diameter	5,10		6,00	
	Allowed deviation	± 0,30		± 0,30	
d_1	Inner thread diameter	3,25		4,00	
	Allowed deviation	± 0,20		± 0,30	
d_h	Head diameter	11,00		13,50	
	Allowed deviation	± 1,00		± 1,00	
d_u	Underhead diameter	6,00		6,00	
d_s	Shank diameter	3,70		4,30	
	Allowed deviation	± 0,15		± 0,15	
h	Head height	3,00		3,10	
l_t	Length of the screw tip	-		7,30	
	Drive TX	20	25	30	
	Drive PZ	2		3	
Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0[3)]**			
l_s		Allowed Deviations			
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}
30	l_s ±1,25	26			
35	l_s ±1,50	31	24	30	
40	l_s ±1,50	36	28	35	28
45	l_s ±1,50	41	30	40	30
50	l_s ±1,50	46	30	45	30
55	l_s ±1,75	51	36	50	36
in steps of 10 mm					
60	l_s ±1,75	56	36	55	36
70	l_s ±1,75	66	42	65	42
80	l_s ±1,75	76	45	75	45
90	l_s ±2,00		54		54
100	l_s ±2,00		60		60
110	l_s ±2,00		70		70
120	l_s ±2,00		70		70
130-300	l_s ±3,00				70

All sizes in [mm]

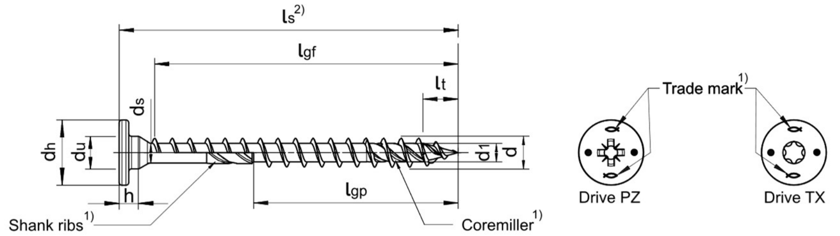
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp., l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw – Step countersunk head with full- or partial thread Carbon steel

Table A6.1: Screw Dimensions and Materials

Drawing



1) optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel plated, brass plated, black coated

Nominal diameter		**5,0**	**6,0**
d	Outer thread diameter	5,10	6,00
	Allowed deviation	± 0,30	± 0,30
d_1	Inner thread diameter	3,25	4,00
	Allowed deviation	± 0,20	± 0,30
d_h	Head diameter	11,00	13,50
	Allowed deviation	± 1,00	± 1,00
d_u	Underhead diameter	6,00	8,00
d_s	Shank diameter	3,70	4,30
	Allowed deviation	± 0,15	± 0,15
h	Head height	3,30	4,20
l_t	Length of the screw tip	-	7,30
	Drive TX	20 25	30
	Drive PZ	2	3

Nominal length	Standard thread length | l_{gf} = Full thread | l_{gp} = Partial thread | Tolerance: ± 2,0 3)				
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}
30	l_s ±1,25	22			
35	l_s ±1,50	27	24	25	
40	l_s ±1,50	32	28	30	28
45	l_s ±1,50	37	30	35	30
50	l_s ±1,50	42	30	40	30
55	l_s ±1,75	47	36	45	36
in steps of 10 mm					
60	l_s ±1,75	52	36	50	36
70	l_s ±1,75	62	42	60	42
80	l_s ±1,75	72	45	70	45
90	l_s ±2,00		54		54
100	l_s ±2,00		60		60
110	l_s ±2,00		70		70
120	l_s ±2,00		70		70
130-300	l_s ± 3,00				70

All sizes in [mm]

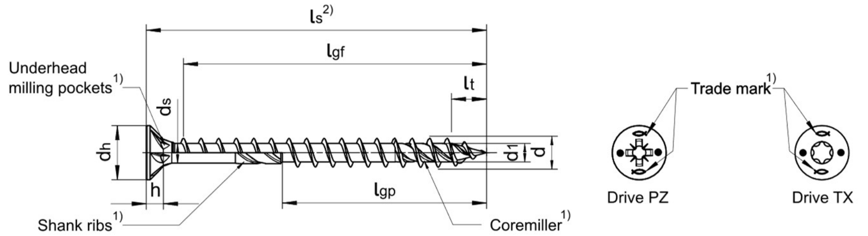
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp., l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II - Wood Construction screw – Countersunk head with full- or partial thread Carbon steel

Table A7.1: Screw Dimensions and Materials

Drawing



1) optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12 µm, bonus-zinc-coated, black coated

Nominal diameter		8,0	10,0	12,0
d	Outer thread diameter	8,0	10,0	12,0
	Allowed deviation	± 0,40	± 0,50	± 0,60
d_1	Inner thread diameter	5,40	6,40	7,40
	Allowed deviation	± 0,30	± 0,30	± 0,35
d_h	Head diameter	14,40	18,40	22,40
	Allowed deviation	± 0,70	± 0,90	± 1,10
d_s	Shank diameter	5,90	6,90	8,20
	Allowed deviation	± 0,30	± 0,35	± 0,35
h	Head height	4,60	5,40	6,70
l_t	Length of the screw tip	11,00	12,00	13,00
	Drive TX	40	40	50

Nominal length		Standard thread length | l_{gf} = Full thread | l_{gp} = Partial thread | Tolerance: ± 2,0					
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
80	l_s ±2,30	68	60		60		
90	l_s ±2,70	78	60		60		
in steps of 20 mm							
100	l_s ±2,70	88	60		60		60
120	l_s ±2,70	108	80		80		80
140	l_s ±3,20		80		80		80
160	l_s ±3,20		80		80		80
180	l_s ±3,20		100		100		100
200	l_s ±3,60		100		100		100
220	l_s ±3,60		100		100		100
240	l_s ±3,60		100		100		120
260	l_s ±4,10		100		100		120
280	l_s ±4,10		100		115		120
300	l_s ±4,10		100		115		120
320-400	l_s ±4,50		100		115		120
420-500	l_s ± 4,90		100		115		120
520-600	l_s ± 5,50		100		115		120

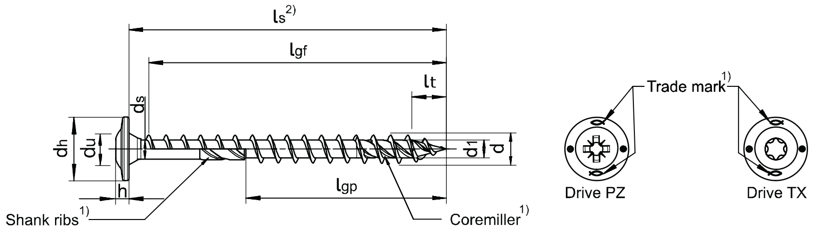
All sizes in [mm]

2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

PowerFast II - Wood Construction screw – Flange head with full- or partial thread
Carbon steel

Table A8.1: Screw Dimensions and Materials

Drawing



[1)]optional

Figure not to scale

Materials and coatings
- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12 µm, bonus-zinc-coated, black coated

Nominal diameter		**8,0**	**10,0**	**12,0**
d	Outer thread diameter	8,0	10,0	12,0
	Allowed deviation	± 0,40	± 0,50	± 0,60
d_1	Inner thread diameter	5,40	6,40	7,40
	Allowed deviation	± 0,30	± 0,30	± 0,35
d_h	Head diameter	21,00	25,50	30,50
	Allowed deviation	±1,00	±1,50	±2,50
d_u	Underhead diameter	8,00	10,00	12,00
d_s	Shank diameter	5,90	6,90	8,20
	Allowed deviation	± 0,30	± 0,35	± 0,35
h	Head height	3,50	4,70	5,70
l_t	Length of the screw tip	11,00	12,00	13,00
	Drive TX	40	40	50

Nominal length — **Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0**

l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
40	l_s ±2,00	36					
50	l_s ±2,00	46					
60	l_s ±2,30	56					
70	l_s ±2,30	65	60				
80	l_s ±2,30	75	60		60		
90	l_s ±2,70	82	60		60		
in steps of 20 mm							
100	l_s ±2,70	92	60		60		60
120	l_s ±2,70	112	80		80		80
140	l_s ±3,20		80		80		80
160	l_s ±3,20		80		80		80
180	l_s ±3,20		100		100		100
200	l_s ±3,60		100		100		100
220	l_s ±3,60		100		100		100
240	l_s ±3,60		100		100		120
260	l_s ±4,10		100		100		120
280	l_s ±4,10		100		115		120
300	l_s ±4,10		100		115		120
320-400	l_s ±4,50		100		115		120
420-500	l_s ± 4,90		100		115		120
520-600	l_s ± 5,50		100		115		120

All sizes in [mm]

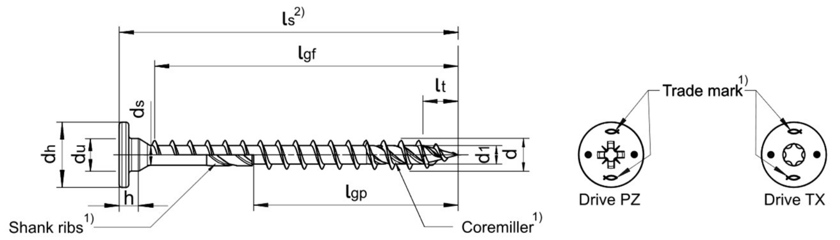
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

fischer PowerFast II – Wood Construction screw – Carbon steel	**Annex A8**
Dimensions and Materials – Flange head with full- or partial thread	

PowerFast II - Wood Construction screw – Step Countersunk head with full- or partial thread Carbon steel

Table A9.1: Screw Dimensions and Materials

Drawing



1) optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12 µm, bonus-zinc-coated, black coated

Nominal diameter		**8,0**	**10,0**
d	Outer thread diameter	8,0	10,0
	Allowed deviation	± 0,40	± 0,50
d_1	Inner thread diameter	5,40	6,40
	Allowed deviation	± 0,30	± 0,30
d_h	Head diameter	21,00	25,50
	Allowed deviation	±1,00	±1,50
d_u	Underhead diameter	9,00	12,00
d_s	Shank diameter	5,90	6,90
	Allowed deviation	± 0,30	± 0,35
h	Head height	5,50	6,70
l_t	Length of the screw tip	11,00	12,00
	Drive TX	40	40

Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0**			
l_s	Allowed Deviations				
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}
40	l_s ±2,00	36			
50	l_s ±2,00	46			
60	l_s ±2,30	56			
70	l_s ±2,30	65	60		
80	l_s ±2,30	75	60		60
90	l_s ±2,70	82	60		60
in steps of 20 mm					
100	l_s ±2,70	88	60		60
120	l_s ±2,70	108	80		80
140	l_s ±3,20		80		80
160	l_s ±3,20		80		80
180	l_s ±3,20		100		100
200	l_s ±3,60		100		100
220	l_s ±3,60		100		100
240	l_s ±3,60		100		100
260	l_s ±4,10		100		100
280	l_s ±4,10		100		115
300	l_s ±4,10		100		115
320-400	l_s ±4,50		100		115
420-500	l_s ± 4,90		100		115
520-600	l_s ± 5,50		100		115

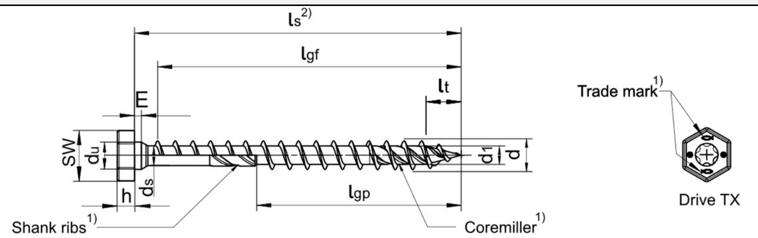
All sizes in [mm]

2) Other screw lengths with l_{s} min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

PowerFast II - Wood Construction screw – Hexagon head with full- or partial thread Carbon steel

Table A10.1: Screw Dimensions and Materials

Drawing



[1)]optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12 µm, bonus-zinc-coated, black coated

Nominal diameter		**8,0**	**10,0**	**12,0**
d	Outer thread diameter	8,0	10,0	12,0
	Allowed deviation	± 0,40	± 0,50	± 0,60
d_1	Inner thread diameter	5,40	6,40	7,40
	Allowed deviation	± 0,30	± 0,30	± 0,35
d_u	Underhead diameter	8,00	10,00	12,00
SW	Wrench size	12,90	14,90	16,90
	Allowed deviation	± 0,50	± 0,50	± 0,50
E	Height	2,10	2,30	3,30
	Allowed deviation	± 0,60	± 0,60	± 0,60
d_s	Shank diameter	5,90	6,90	8,20
	Allowed deviation	± 0,30	± 0,35	± 0,35
h	Head height	5,50	6,00	6,80
l_t	Length of the screw tip	11,00	12,00	13,00
	Drive TX	40	40	50

Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0**					
l_s	Allowed Deviations						
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
80	l_s ±2,30	75	75		75		
90	l_s ±2,70	82	75		75		
in steps of 20 mm							
100	l_s ±2,70	92	75		75		80
120	l_s ±2,70	112	100		115		100
140	l_s ±3,20		100		115		120
160	l_s ±3,20		100		115		120
180	l_s ±3,20		100		115		145
200-240	l_s ±3,60		100		115		145
260-300	l_s ±4,10		100		115		145
320-400	l_s ±4,50		100		115		145
420-500	l_s ±4,90		100		115		145
520-600	l_s ± 5,50		100		115		145

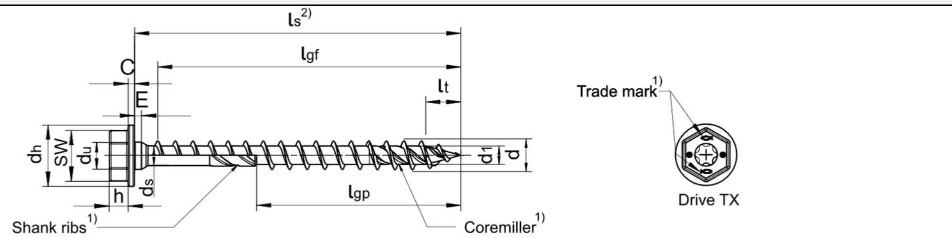
All sizes in [mm]

[2)] Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

PowerFast II - Wood Construction screw – Hexagon head with washer and full- or partial thread
Carbon steel

Table A11.1: Screw Dimensions and Materials

Drawing



[1)]optional

Figure not to scale

Materials and coatings

- Carbon Steel
- yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12 µm, bonus-zinc-coated, black coated

Nominal diameter		**8,0**	**10,0**	**12,0**
d	Outer thread diameter	8,0	10,0	12,0
	Allowed deviation	± 0,40	± 0,50	± 0,60
d_1	Inner thread diameter	5,40	6,40	7,40
	Allowed deviation	± 0,30	± 0,30	± 0,35
d_h	Head diameter	18,00	21,30	23,40
	Allowed deviation	± 1,00	± 1,10	±1,20
d_u	Underhead diameter	8,00	10,00	12,00
SW	Wrench size	12,90	14,90	16,90
	Allowed deviation	± 0,50	± 0,50	± 0,50
C	Washer height	2,00	2,20	2,50
E	Height	2,10	2,30	3,30
	Allowed deviation	± 0,60	± 0,60	± 0,60
d_s	Shank diameter	5,90	6,90	8,20
	Allowed deviation	± 0,30	± 0,35	± 0,35
h	Head height	5,50	6,00	6,80
l_t	Length of the screw tip	11,00	12,00	13,00
	Drive TX	40	40	50

Nominal length		**Standard thread length | l_{gf} =Full thread | l_{gp}=Partial thread | Tolerance: ± 2,0**					
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf} (8,0)	l_{gp} (8,0)	l_{gf} (10,0)	l_{gp} (10,0)	l_{gf} (12,0)	l_{gp} (12,0)
80	l_s ±2,30	75	75		75		
90	l_s ±2,70	82	75		75		
in steps of 20 mm							
100	l_s ±2,70	92	75		75		80
120	l_s ±2,70	112	100		115		100
140	l_s ±3,20		100		115		120
160	l_s ±3,20		100		115		120
180	l_s ±3,20		100		115		145
200-240	l_s ±3,60		100		115		145
260-300	l_s ±4,10		100		115		145
320-400	l_s ±4,50		100		115		145
420-500	l_s ±4,90		100		115		145
520-600	l_s ± 5,50		100		115		145

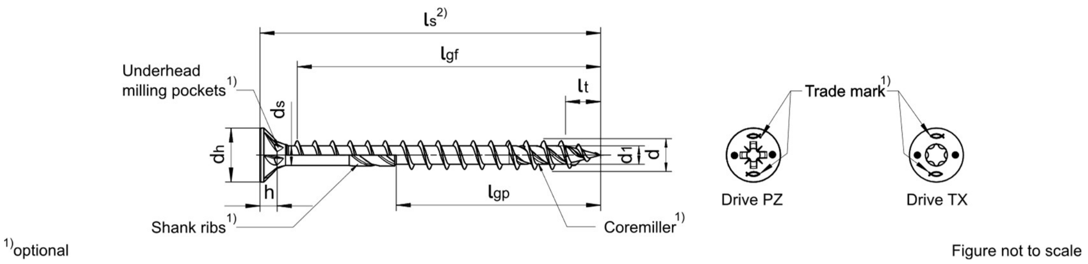
All sizes in [mm]

[2)] Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max. standard thread lengths are allowed

PowerFast II – Chipboard screw - Countersunk head with full- or partial thread Stainless steel

Table A12.1: Screw Dimensions and Materials

Drawing



Stainless steel

Nominal diameter		3,0	3,5	4,0	4,5	5,0	6,0
d	Outer thread diameter	3,00	3,50	4,00	4,50	5,10	6,00
	Allowed deviation	± 0,25	± 0,25	± 0,30	± 0,30	± 0,30	± 0,30
***d*1**	Inner thread diameter	1,95	2,20	2,50	2,75	3,25	4,00
	Allowed deviation	± 0,18	± 0,18	± 0,20	± 0,20	± 0,20	± 0,30
***d*h**	Head diameter	6,00	7,00	8,00	8,80	9,80	11,80
	Allowed deviation	± 0,50	± 0,50	± 0,60	± 0,60	± 0,60	± 0,60
***d*s**	Shank diameter	2,25	2,60	2,90	3,20	3,70	4,30
	Allowed deviation	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15
h	Head height	1,80	2,30	2,40	2,70	3,00	3,60
***l*t**	Length of the screw tip	-	-	-	-	-	7,30
	Drive TX	10	10 / 20	20	20	20 / 25	30
	Drive PZ	1	2	2	2	2	3

Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0[3)]**											
l_s	Allowed Deviations												
	$l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ±1,05	16		16									
25	l_s ±1,25	21	18	21	18	20	18	20					
30	l_s ±1,25	26	18	26	18	25	18	25	18	24			
35	l_s ±1,50	31	24	31	24	30	24	30	24	29	24	28	
40	l_s ±1,50	36	28	36	28	35	28	35	28	34	28	33	28
45	l_s ±1,50	41	30	41	30	40	30	40	30	39	30	38	30
50	l_s ±1,50			46	30	45	30	45	30	44	30	43	30
55	l_s ±1,75					50	36	50	36	49	36	48	36
in steps of 10 mm													
60	l_s ±1,75					55	36	55	36	54	36	53	36
70	l_s ±1,75						42	60	42	64	42	63	42
80	l_s ±1,75						45	75	45	74	45	73	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130 - 300	l_s ± 3,00												70

All sizes in [mm]

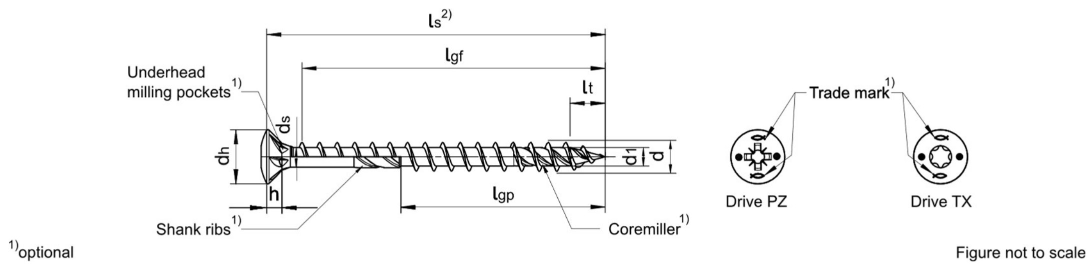
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp.,l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw – Raised countersunk head with full- or partial thread
Stainless steel

Table A13.1: Screw Dimensions and Materials

Drawing



Stainless steel

Nominal diameter		3,0	3,5	4,0	4,5	5,0	6,0
d	Outer thread diameter	3,00	3,50	4,00	4,50	5,10	6,00
	Allowed deviation	± 0,25	± 0,25	± 0,30	± 0,30	± 0,30	± 0,30
d_1	Inner thread diameter	1,95	2,20	2,50	2,75	3,25	4,00
	Allowed deviation	± 0,18	± 0,18	± 0,20	± 0,20	± 0,20	± 0,30
d_h	Head diameter	6,00	7,00	8,00	8,80	9,80	11,80
	Allowed deviation	± 0,50	± 0,50	± 0,60	± 0,60	± 0,60	± 0,60
d_s	Shank diameter	2,25	2,60	2,90	3,20	3,70	4,30
	Allowed deviation	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15	± 0,15
h	Head height	1,80	2,30	2,40	2,70	3,00	3,60
l_t	Length of the screw tip	-	-	-	-	-	7,30
	Drive TX	10	10 / 20	20	20	20 / 25	30
	Drive PZ	1	2	2	2	2	3

Nominal length — **Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0 3)**

l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ± 1,05	16		16									
25	l_s ±1,25	21	18	21	18	20	18	20					
30	l_s ±1,25	26	18	26	18	25	18	25	18	24			
35	l_s ±1,50	31	24	31	24	30	24	30	24	29	24	28	
40	l_s ±1,50	36	28	36	28	35	28	35	28	34	28	33	28
45	l_s ±1,50	41	30	41	30	40	30	40	30	39	30	38	30
50	l_s ±1,50			46	30	45	30	45	30	44	30	43	30
55	l_s ±1,75					50	36	50	36	49	36	48	36
in steps of 10 mm													
60	l_s ±1,75					55	36	55	36	54	36	53	36
70	l_s ±1,75						42	60	42	64	42	63	42
80	l_s ±1,75						45	75	45	74	45	73	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130-300	l_s ± 3,00												70

All sizes in [mm]

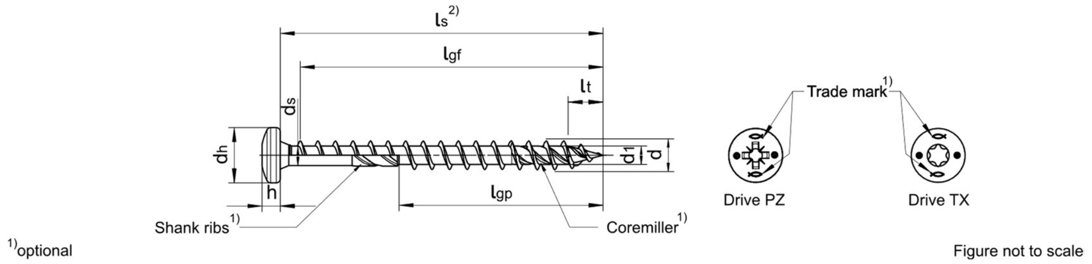
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp.,l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw – Pan head with full- or partial thread
Stainless steel

Table A14.1: Screw Dimensions and Materials

Drawing



Stainless steel

Nominal diameter		3,0		3,5		4,0		4,5		5,0		6,0	
d	Outer thread diameter	3,00		3,50		4,00		4,50		5,10		6,00	
	Allowed deviation	± 0,25		± 0,25		± 0,30		± 0,30		± 0,30		± 0,30	
d_1	Inner thread diameter	1,95		2,20		2,50		2,75		3,25		4,00	
	Allowed deviation	± 0,18		± 0,18		± 0,20		± 0,20		± 0,20		± 0,30	
d_h	Head diameter	6,00		7,00		8,00		9,00		10,00		12,00	
	Allowed deviation	± 0,50		± 0,50		± 0,60		± 0,60		± 0,60		± 0,60	
d_s	Shank diameter	2,25		2,60		2,90		3,20		3,70		4,30	
	Allowed deviation	± 0,15		± 0,15		± 0,15		± 0,15		± 0,15		± 0,15	
h	Head height	2,30		2,50		2,80		2,80		3,40		3,40	
l_t	Length of the screw tip	-		-		-		-		-		7,30	
	Drive TX	10		10	20	20		20		20	25	30	
	Drive PZ	1		2		2		2		2		3	
Nominal length		**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0 3)**											
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}	l_{gf}	l_{gp}
20	l_s ± 1,05	16		16									
25	l_s ±1,25	21	18	21	18	21	18	21					
30	l_s ±1,25	26	18	26	18	26	18	26	18	26			
35	l_s ±1,50	31	24	31	24	31	24	31	24	31	24	30	
40	l_s ±1,50	36	28	36	28	36	28	36	28	36	28	35	28
45	l_s ±1,50	41	30	41	30	41	30	41	30	41	30	40	30
50	l_s ±1,50			46	30	46	30	46	30	46	30	45	30
55	l_s ±1,75					51	36	51	36	51	36	50	36
in steps of 10 mm													
60	l_s ±1,75					56	36	56	36	56	36	55	36
70	l_s ±1,75						42	66	42	66	42	65	42
80	l_s ±1,75						45	76	45	76	45	75	45
90	l_s ±2,00										54		54
100	l_s ±2,00										60		60
110	l_s ±2,00										70		70
120	l_s ±2,00										70		70
130-300	l_s ± 3,00												70

All sizes in [mm]

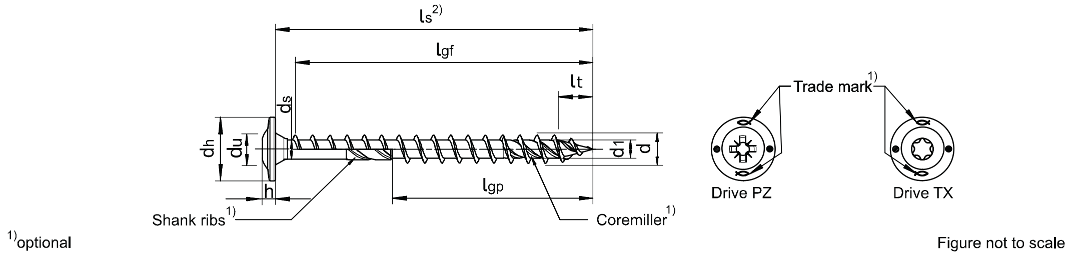
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp.,l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II – Chipboard screw - Flange head with full- or partial thread
Stainless steel

Table A15.1: Screw Dimensions and Materials

Drawing



Stainless steel

Nominal diameter		**5,0**		**6,0**	
d	Outer thread diameter	5,10		6,00	
	Allowed deviation	± 0,30		± 0,30	
***d*₁**	Inner thread diameter	3,25		4,00	
	Allowed deviation	± 0,20		± 0,30	
***d*ₕ**	Head diameter	11,00		13,50	
	Allowed deviation	± 1,00		± 1,00	
***d*ᵤ**	Underhead diameter	6,00		6,00	
***d*ₛ**	Shank diameter	3,70		4,30	
	Allowed deviation	± 0,15		± 0,15	
h	Head height	3,00		3,10	
***l*ₜ**	Length of the screw tip	-		7,30	
	Drive TX	20	25	30	
	Drive PZ	2		3	
Nominal length	**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0[3]**				
l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}	l_{gf}	l_{gp}
30	l_s ±1,25	26			
35	l_s ±1,50	31	24	30	
40	l_s ±1,50	36	28	35	28
45	l_s ±1,50	41	30	40	30
50	l_s ±1,50	46	30	45	30
55	l_s ±1,75	51	36	50	36
in steps of 10 mm					
60	l_s ±1,75	56	36	55	36
70	l_s ±1,75	66	42	65	42
80	l_s ±1,75	76	45	75	45
90	l_s ±2,00		54		54
100	l_s ±2,00		60		60
110	l_s ±2,00		70		70
120	l_s ±2,00		70		70
130-300	l_s ±3,00				70

All sizes in [mm]

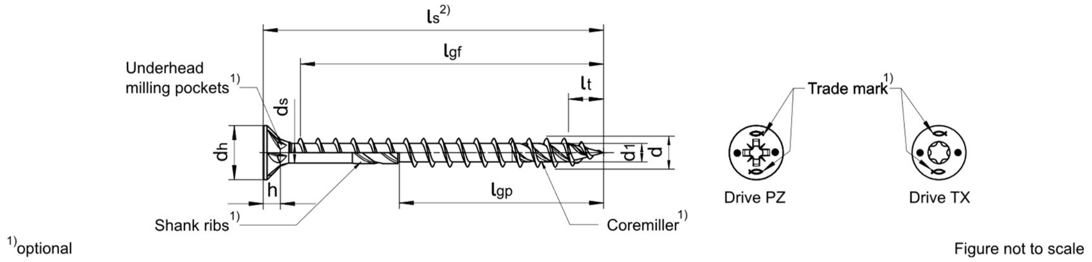
2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

3) For 10 mm ≤ l_{gf} resp.,l_{gp} ≤ 18 mm → tolerance ±1,5 mm and for 18 mm < l_{gf} resp. l_{gp} ≤ 30 mm → tolerance ±1,7 mm

PowerFast II - Wood Construction screw – Countersunk head with full- or partial thread Stainless steel

Table A16.1: Screw Dimensions and Materials

Drawing



Stainless steel

Nominal diameter		**8,0**
d	Outer thread diameter	8,0
	Allowed deviation	± 0,40
***d*₁**	Inner thread diameter	5,40
	Allowed deviation	± 0,30
***d*ₕ**	Head diameter	14,40
	Allowed deviation	± 0,70
***d*ₛ**	Shank diameter	5,90
	Allowed deviation	± 0,30
h	Head height	4,60
***l*ₜ**	Length of the screw tip	11,00
	Drive TX	40

Nominal length — **Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0**

l_s	Allowed Deviations $l_{s,min/max}$	l_{gf}	l_{gp}
80	l_s ±2,30	75	60
90	l_s ±2,70	82	60
in steps of 20 mm			
100	l_s ±2,70	88	60
120	l_s ±2,70	108	80
140	l_s ±3,20		80
160	l_s ±3,20		80
180	l_s ±3,20		100
200	l_s ±3,60		100
220	l_s ±3,60		100
240	l_s ±3,60		100
260	l_s ±4,10		100
280	l_s ±4,10		100
300	l_s ±4,10		100
320-400	l_s ±4,50		100
420-500	l_s ± 4,90		100
520-600	l_s ± 5,50		100

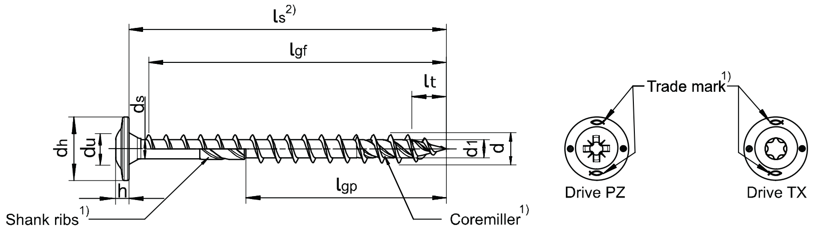
All sizes in [mm]

2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

PowerFast II - Wood Construction screw – Flange head with full- or partial thread Stainless steel

Table A17.1: Screw Dimensions and Materials

Drawing



1) optional

Figure not to scale

Stainless steel

Nominal diameter		**8,0**
d	Outer thread diameter	8,0
	Allowed deviation	± 0,40
d_1	Inner thread diameter	5,40
	Allowed deviation	± 0,30
d_h	Head diameter	21,00
	Allowed deviation	±1,00
d_u	Underhead diameter	8,00
d_s	Shank diameter	5,90
	Allowed deviation	± 0,30
h	Head height	3,50
l_t	Length of the screw tip	11,00
	Drive TX	40

Nominal length	**Standard thread length | l_{gf} = Full thread | l_{gp} =Partial thread | Tolerance: ± 2,0**		
l_s	Allowed Deviations		
	$l_{s,min/max}$	l_{gf}	l_{gp}
40	l_s ±2,00	36	
50	l_s ±2,00	46	
60	l_s ±2,30	56	
70	l_s ±2,30	65	60
80	l_s ±2,30	75	60
90	l_s ±2,70	82	60
in steps of 20 mm			
100	l_s ±2,70	92	60
120	l_s ±2,70	112	80
140	l_s ±3,20		80
160	l_s ±3,20		80
180	l_s ±3,20		100
200	l_s ±3,60		100
220	l_s ±3,60		100
240	l_s ±3,60		100
260	l_s ±4,10		100
280	l_s ±4,10		100
300	l_s ±4,10		100
320-400	l_s ±4,50		100
420-500	l_s ± 4,90		100
520-600	l_s ± 5,50		100

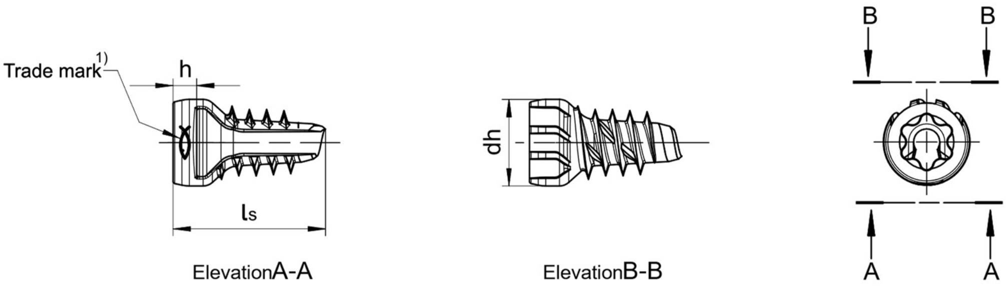
All sizes in [mm]

2) Other screw lengths with l_s min ≤ l_s ≤ l_s max and other thread lengths l_{gf} resp. l_{gp} ≥ 4·d up to max, standard thread lengths are allowed

FAFS-Clip of adjustable frame screw

Table A18.1: FAFS-Clip Dimensions and Materials

Drawing



[1)]optional

Figure not to scale

Materials and coatings

- Zinc die-cast

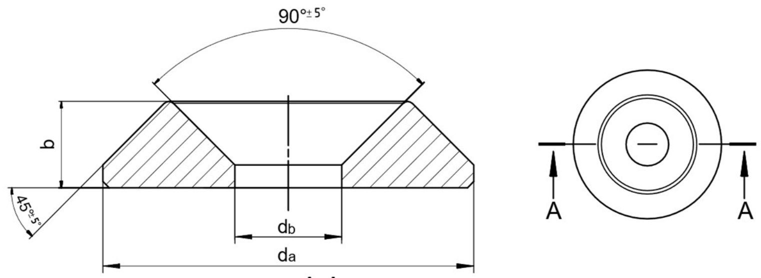
Nominal diameter		5,0
l_s	Nominal length	22,0
	Allow. deviation	± 1,50
d_h	Head diameter	12,5
	Allow. deviation	± 0,62
h	Head height	4,30
	Allow. deviation	± 0,20
	Drive TX	non-standard

All sizes in [mm]

PowerFast II - Washers

Table A19.1: Washer Dimensions and Materials

Drawing



[1)]optional

Section A-A

Figure not to scale

Materials and coatings
- Carbon Steel
- Yellow zinc-plated, blue zinc-plated, blue zinc-plated ≥12µm, bonus-zinc-coated, burnished, nickel-plated, brass-plated
- Stainless steel

Nominal diameter		6,0	8,0		10,0		12,0
d_a	Outer diameter	21,00	25,50	30,00	30,50	35,00	37,40
	Allowed deviation	± 2,0	± 2,0		± 2,0		± 2,0
d_b	Inner diameter	6,70	8,80		11,60		14,00
	Allowed deviation	+ 0,7	± 0,5		± 0,8		± 0,8
b	Washer height	4,70	5,50		6,30		8,50
	Allowed deviation	± 0,4	± 0,4		± 0,5		± 0,5

All sizes in [mm]

Specifications of the intended use

Base Materials:
The screws are used for connections in load-bearing timber structures between members of softwood and hardwood (e.g. ash, beech, birch, oak), acetylated wood (e.g. Accoya) shown in the Table B1.1 and in combination with steel plates and wood chip concrete (e.g. DURISOL, ISO SPAN).
»fischer PowerFast II« screws can also be used for fixing of thermal insulation on rafters and on vertical facades and ceilings (Annex E, F and Annex G).

»fischer PowerFast II« screws with a thread over the full length can also be used as tensile or compressive reinforcement perpendicular to the grain or as shear reinforcement. Furthermore »fischer PowerFast II« screws with a diameter ≥ 6 mm may also be used for fixing of thermal insulation on rafters and on vertical facades, see also Annex E and Annex G. Steel plates and wood-based panels which are not covered with explicit characteristic values (e.g. Table D12.2) in that ETA, shall only be fixed on the side of the screw head. The penetration depth of the screw thread in wood-based panels, should be at least $6 \cdot d$, including the screw tip. If this is not achievable, »fischer PowerFast II« screws should be installed in such a manner, that the constant thread thickness extends over the entire panel thickness. The minimum thickness of wood-based panels should be at least $1,2 \cdot d$ - except for approved wood-based panels acc. to Annex D5 and D6.

Table B1.1: Materials for the intended use

<table>
<tr><th colspan="2">Groups and Subgroups</th><th>Product</th><th>Abbreviation</th><th>hEN, or ETA</th></tr>
<tr><td rowspan="10">Solid wood-based (SWB)</td><td rowspan="4">Structural timber (ST)</td><td>Strength-graded structural softwood timber</td><td>ST-c</td><td>EN 14081-1,
EN 1912</td></tr>
<tr><td>Strength-graded structural hardwood timber</td><td>ST-d</td><td>EN 14081-1,
EN 1912</td></tr>
<tr><td>Structural finger-jointed timber</td><td>FST</td><td>EN 15497</td></tr>
<tr><td>Glued structural timber</td><td>GST</td><td>EN 14080</td></tr>
<tr><td rowspan="4">Parallel laminated timber (PL)</td><td>Glued laminated timber made of softwoods</td><td>GLT-c</td><td>EN 14080</td></tr>
<tr><td>Block glued glulam</td><td>BGLT</td><td>EN 14080</td></tr>
<tr><td>Glued laminated timber made of hardwoods</td><td>GLT-d</td><td>various ETAs</td></tr>
<tr><td>Single-layered solid wood panel</td><td>SWP-P</td><td>EN 13353</td></tr>
<tr><td rowspan="2">Cross laminated timber (CL)</td><td>Cross-laminated timber</td><td>CLT</td><td>various ETAs,
EN 16351</td></tr>
<tr><td>Multi-layered solid wood panel</td><td>SWP-C</td><td>EN 13353</td></tr>
</table>

Table B2.1: Materials for the intended use (continuous of Table B1.1)

Groups and Subgroups			Product	Abbreviation	hEN or ETA
Veneer-based (VB)	Laminated Veneer Lumber (LVL)	LVL-P	Softwood LVL with parallel veneers	LVL-P-c	EN 14374
			Hardwood LVL with parallel veneers	LVL-P-d	various ETAs
			Hardwood Glued LVL with parallel veneers	GLVL-P-c	various ETAs
			Hardwood Glued LVL with parallel veneers	GLVL-P-d	various ETAs
		LVL-C	Softwood LVL with crossband veneers	LVL-C-c	EN 14374
			Hardwood LVL with crossband veneers	LVL-C-d	various ETAs
			Softwood Glued LVL with crossband veneers	GLVL-C-c	various ETAs
			Softwood Glued LVL with crossband veneers	GLVL-C-d	various ETAs
	PLY		Softwood Plywood	PLY-c	EN 13986 and EN 636
			Hardwood Plywood	PLY-d	EN 13986 and EN 636
Strand based (SB)			Oriented strand board	OSB	EN 13986 and EN 300
Wood -fibre-based (WFB)			Fibreboard, hard	HB	EN 622-2
			Fibreboard, medium	MB	EN 622-3
Wood-particle-based (WPB)			Resinoid-bonded particle board	RPB	EN 13986 and EN 312
Gypsum -based (GYB)			Gypsum plasterboards	GPB	EN 520
			Gypsum fibreboards	GFB	EN 15283-2
Timber concrete composites (TCC)			Wood chip concrete	WCC	various ETAs
			Cement-bonded particleboard	CBPB	EN 634-2

Specifications of the intended use

Design:
The design of the connections shall be based on the characteristic load-carrying capacities of the screws given in Annex C and Annex D.
The design capacities shall be derived from the characteristic capacities in accordance with the EN 1995-1-1 or an appropriate National Code. The screws are intended for the use of connections subjected to static or quasi-static loadings.
The zinc-coated screws are for the use in timber structures subjected to moisture defined by the service classes 1 and 2 according to EN 1995-1-1. The stainless steel screws are for the use in timber structures subjected to moisture defined by the service classes 1, 2 and 3 according to EN 1995-1-1.

- Instructions from *fischerwerke GmbH & Co. KG* should be considered for installation.
- A minimum of two screws should be used for connections in load bearing timber structures.
- The overall length l_s of the screws, shall not be less than 20 mm and shall not be greater than 600 mm. Dimensions see Annex A.
- The ratio of inner thread diameter to outer thread diameter d_1/d ranges from 0,50 to 0,80.
- The thread pitch p (distance between two adjacent thread flanks) ranges from $0{,}50 \cdot d$ to $0{,}85 \cdot d$.
- Earthquake design: No breaking is observed at a bending angle of $\alpha \leq (45/d^{0,7} + 20)°$.

Installation: The screws shall be driven into softwood and hardwood with a maximum characteristic density of 730 kg/m³ after pre-drilling or without pre-drilling (see Table B3.1 and Table B4.1) with a diameter not larger than the inner threaded diameter d_1 (Annex A).

Table B3.1: Recommended pre-drilling diameter for soft- and hardwood

Outer thread diameter *d* [mm]	Bore-hole diameter [mm] Softwood and Hardwood
3,0	2,0
3,5	2,0
4,0	2,5
4,5	2,5
5,0	3,0
6,0	4,0
8,0	5,0
10,0	6,0
12,0	7,0

Specifications of the intended use

Installation:
Recommended values without pre-drilling for the maximum penetration length of the threaded part of »fischer PowerFast II« made of carbon steel in wood-based members like ash, beech and oak or LVL according to ETA-14/0354 (e.g. BauBuche) are shown in Table B4.1 below. There is no limitation in softwood or wood-based members made of softwood.
»fischer PowerFast II« made of stainless steel for applications in softwood with a gross density up to 480 kg/m³ should be pre-drilled for screw-in lengths more than 25·*d*. For applications with screws made of stainless steel in hardwood, pre-drilling is required.

Table B4.1: Recommended penetration length
without pre-drilling in hardwood for screws made of Carbon steel

Outer thread diameter *d* [mm]	Maximum penetration length [mm]
3,0	40
3,5	45
4,0	50
4,5	60
5,0	70
6,0	70
8,0	70
10,0	Pre-drilled application is recommended
12,0	

When using screws with a countersunk or step countersunk the upper surface of the screw head must be flush with the surface of the timber part. Especially for timber parts with gross densities higher than 550 kg/m³ it is recommended to use adequate counter-sinker to avoid breaking of the screw heads. For non-pre-drilled applications countersinking deeper is not permitted and should be avoided, because of damaging the surface and reduce the durability of the construction. Countersunk head screws made of carbon or stainless steel according to Annex A1, A2, A7, A12, A13 and A16 can be used together with washers according to Annex A19. Washers according to EN ISO 7094 can be used together with washers according to Annex A19.

»fischer PowerFast II – Chipboard screws – Carbon steel« with a diameter between 4,5 mm and 6,0 mm and all diameters of »fischer PowerFast II – Wood Construction screws – Carbon steel« can be driven in with standard screw drillers and with torque impact screw drivers (e.g. fischer FSS 18V 600) too. In combination with steel plates, torque controlled tools e.g. torque wrenches have to be used. For the use of screws in wood-based panels, like particle- and fibreboards, the screws have to be tightened carefully to ensure the characteristic load bearing capacity.

If on the head side metal plates are mounted, it has to be ensured that the diameter of the borehole of the metal plate has to be ≤ d + 1 [mm]. Screws according to Annex A5, A6, A8, A9, A10, A11, A15 and A17 the borehole of the metal plate has to be ≤ d_u + 1 [mm], where d_u is the underhaed diameter of the screw. Effects of the borehole tolerances must be considered in the structural design (load-independent slippage).

In addition, care must be taken about the accuracy of fit between the screw head and the metal to avoid stress peaks, and thus also requires a maximum allowed deviation of the screw-in-direction of ± 5° (e. g. screw-in direction ε = 90° to the surface means 85° ≤ ε ≤ 95°). For the definition of the angle ε referred to the screw axis and the structural element see Figure D2.1.

Specifications of the intended use

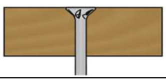
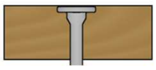
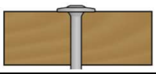
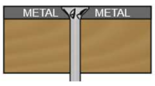
Minimum timber cross-section, end- and edge distances - Notations

For structural timber members, minimum spacings and distances for screws $d \leq 8$ mm in pre-drilled holes are given as for nails in pre-drilled holes in EN 1995-1-1 clause 8.3.1.2 and table 8.2 and for screws $d > 8$ mm in clause 8.5. Here, the outer thread diameter d must be considered. The minimum thickness requirements for the timber elements must be considered; see EN 1995-1-1 clause 8.3.1.2.

Spacing a_2 may be reduced from $5 \cdot d$ to $2{,}5 \cdot d$, if the condition $a_1 \cdot a_2 \geq 25 \cdot d^2$ is fulfilled. For Douglas-fir members without pre-drilling, minimum spacings and distances parallel to the end grain shall be increased by at least 50 %.

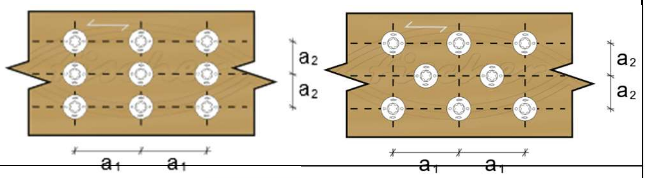
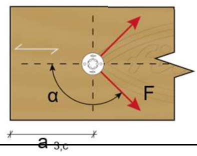
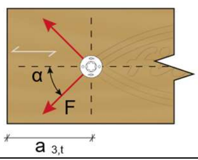
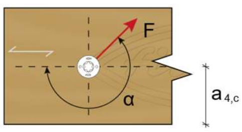
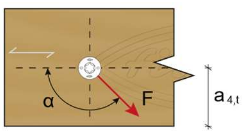
Minimum distances from the unloaded edge $a_{4,c}$ perpendicular to the grain may be reduced to $3 \cdot d$ also for timber thickness $t < 5 \cdot d$, if the spacing parallel to the grain and the end distance is at least $25 \cdot d$.

Table B5.1: Shapes of screw heads and applications with steel plates

Under-head shapes	Description
	Screws with countersunk, raised countersunk according to Annex A1, A2, A4, A7, A12, A13, A16
	Screws with step countersunk according to Annex A6, A9
	Screws with pan head and flange head and hexagon head according to Annex A3, A5, A8, A10, A11, A14, A15, A17
	Screws to fix steel plates on the head side according to Annex A1, A2, A3, A5, A6, A7, A8, A9, A10, A11, A12, A13, A14, A15, A16, A17

Figures not to scale

Table B5.2: Minimum distances and spacings for both sides, the screw tip and the screw head. Notations for Structural Timber (ST-c) and Glued Laminated Timber (GLT-c) made in softwoods

Notations		
a_1	Spacing a_1 parallel to the grain of Solid Timber	
a_2	Spacing a_2 perpendicular to the grain of Solid Timber	
$a_{3,c}$	Distance $a_{3,c}$ from the centre of the screw-part in timber to the unloaded end grain of Solid Timber, $90° \leq \alpha \leq 270°$	
$a_{3,t}$	Distance $a_{3,t}$ from the centre of the screw-part in timber to the loaded end grain of Solid Timber $-90° \leq \alpha \leq 90°$	
$a_{4,c}$	Distance $a_{4,c}$ from the centre of the screw-part in timber to the unloaded edge of Solid Timber $180° \leq \alpha \leq 360°$	
$a_{4,t}$	Distance $a_{4,t}$ from the centre of the screw-part in timber to the loaded edge of Solid Timber $0° < \alpha < 180°$	

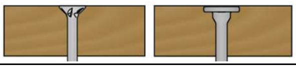
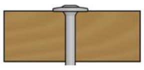
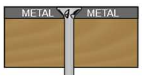
Figures not to scale

Specifications of the intended use

Minimum timber cross section, end- and edge distances
Materials: Solid Timber (ST, FST, and GST) and Glued Laminated Timber (GLT, BGLT) and Single-layered solid wood panels (SWP)

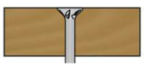
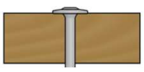
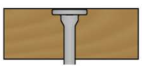
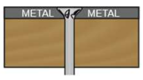
Laterally loaded Screws
Minimum distances and spacings for laterally loaded »fischer PowerFast II« screws in non-pre-drilled holes in members of solid wood-based or similar glued products with a minimum height $h = 12 \cdot d$ and a minimum width b of $8 \cdot d$ or 60 mm, whichever is greater up to a gross density of 480 kg/m³, are recommended to choose with the help of Table B6.1. All other applications (e.g. dimensions of the timber elements and gross densities higher than 480 kg/m³) have to be pre-drilled following the conditions of Table B6.2.

Table B6.1: **<u>Laterally loaded</u>** screws: Minimum end- and edge distances for Solid Timber and Glued Laminated Timber products, for both sides, the screw tip and the screw head for **<u>non-pre-drilled</u>** applications

Head shapes and applications (see Table B5.1)	gross-density [kg/m³]	min b [mm]	min h [mm]	Solid wood-based materials, see Table B1.1 (ST-c, FST, GST, GLT-c, BGLT, SWP-P) Minimum spacings and distances, **non-pre-drilled** [mm]					
				a_1	a_2	$a_{3,c}$	$a_{3,t}$	$a_{4,c}$	$a_{4,t}$
	≤ 480	$12 \cdot d$ (≥ 60 mm)	$8 \cdot d$ (≥ 60 mm)	$(5+\lvert\cos\alpha\rvert)\cdot d$	$5\cdot d$	$7\cdot d$	$(7+5\cdot\cos\alpha)\cdot d$	$5\cdot d$	$(5+2\cdot\sin\alpha)\cdot d$
				$(5+\lvert\cos\alpha\rvert)\cdot d$	$5\cdot d$	$7\cdot d$	$(5+5\cdot\cos\alpha)\cdot d$	$5\cdot d$	$(5+2\cdot\sin\alpha)\cdot d$
				$(3{,}5+\lvert\cos\alpha\rvert)\cdot d$	$3{,}5\cdot d$	$7\cdot d$	$(5+5\cdot\cos\alpha)\cdot d$	$5\cdot d$	$(5+2\cdot\sin\alpha)\cdot d$

Figures not to scale

Table B6.2: **<u>Laterally loaded</u>** screws: Minimum end- and edge distances for Solid Timber and Glued Laminated Timber products, for both sides, the screw tip and the screw head for **<u>pre-drilled</u>** applications

<table>
<tr><th rowspan="2">Head shapes and applications (see Table B5.1)</th><th rowspan="2">gross-density [kg/m³]</th><th rowspan="2">min b
[mm]</th><th rowspan="2">min h
[mm]</th><th colspan="6">Solid wood-based materials, see Table B1.1 (ST-c, ST-d, FST, GST, GLT-c, GLT-d, BGLT, SWP-P)
Minimum spacings and distances, pre-drilled for 3,0 ≤ d ≤ 8,0 mm</th></tr>
<tr><th>a_1</th><th>a_2</th><th>$a_{3,c}$</th><th>$a_{3,t}$</th><th>$a_{4,c}$</th><th>$a_{4,t}$</th></tr>
<tr><td rowspan="10">


</td><td rowspan="10">All</td><td rowspan="10" colspan="2">see EN 1995-1-1</td><td>$(4+\lvert\cos\alpha\rvert)\cdot d$</td><td>$(3+\lvert\sin\alpha\rvert)\cdot d$</td><td>$7\cdot d$</td><td>$(7+5\cdot\cos\alpha)\cdot d$</td><td>$3\cdot d$</td><td>$(3+2\cdot\sin\alpha)\cdot d$</td></tr>
<tr><td colspan="6">Solid wood-based materials, see Table B1.1
(ST-c, ST-d, FST, GST, GLT-c, GLT-d, BGLT, SWP-P)</td></tr>
<tr><td colspan="6">Minimum spacings and distances, pre-drilled for 10,0 ≤ d ≤ 12,0 mm</td></tr>
<tr><td>a_1</td><td>a_2</td><td>$a_{3,c}$</td><td>$a_{3,t}$</td><td>$a_{4,c}$</td><td>$a_{4,t}$</td></tr>
<tr><td rowspan="6">$(4+\lvert\cos\alpha\rvert)\cdot d$</td><td rowspan="6">$4\cdot d$</td><td>for: 90°≤ α < 150°</td><td rowspan="6">max{$7\cdot d$;80 mm}</td><td rowspan="6">$3\cdot d$</td><td rowspan="6">max{$(2+2\cdot\sin\alpha)\cdot d$;$3\cdot d$}</td></tr>
<tr><td>$(1+6\cdot\sin\alpha)\cdot d$</td></tr>
<tr><td>for: 150°≤ α < 210°</td></tr>
<tr><td>$4\cdot d$</td></tr>
<tr><td>for: 210°≤ α ≤ 270°</td></tr>
<tr><td>$(1+6\cdot\sin\alpha)\cdot d$</td></tr>
</table>

Figures not to scale

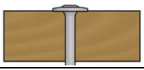
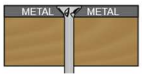
Specifications of the intended use

Minimum timber cross section, end- and edge distances
Materials: Solid Timber (ST, FST, and GST) and Glued Laminated Timber (GLT, BGLT)

Axially loaded screws

Minimum distances and spacings for exclusively axially loaded »fischer PowerFast II« screws, in non-pre-drilled holes in members of solid wood-based or similar glued products with a minimum thickness $t = 10 \cdot d$ and a minimum width of $8 \cdot d$ or 60 mm, whichever is the greater, may be taken as given in Table B7.1.

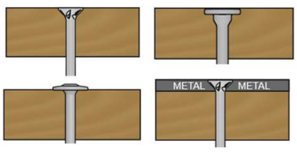
Table B7.1: **Axially loaded** screws: Minimum end- and edge distances for Solid Timber and Glued Laminated Timber products for both sides, the screw tip and the screw head for **non-pre-drilled** applications

Head shapes and applications (see Table B5.1)	gross-density [kg/m³]	min b [mm]	min h [mm]	Solid wood-based materials, see Table B1.1 (ST-c, FST, GST-c, GLT-c, BGLT, SWP-P) Minimum spacings and distances, **non-pre-drilled**			
				a_1	a_2	$a_{1,CG}$ [2)]	$a_{2,CG}$ [3)]
	≤ 480	$8 \cdot d$ (≥ 60 mm)	$10 \cdot d$ (≥ 60 mm)	$7 \cdot d$	$5 \cdot d$	$10 \cdot d$ *($5 \cdot d$[1)])*	$4 \cdot d$
							
							

[1)] The values in brackets may be applied if no lateral loading is present
[2)] $a_{1,CG}$ Minimum spacing parallel to the grain direction between the centroids of the screw axis
[3)] $a_{2,CG}$ Minimum spacing perpendicular to the grain direction between the centroids of the screw axis

Figures not to scale

Table B7.2: **Axially loaded** screws: Minimum end- and edge distances for Solid Timber and Glued Laminated Timber products for both sides, the screw tip and the screw head, for **pre-drilled** applications

Head shapes and applications (see Table B5.1)	gross-density [kg/m³]	min b [mm]	min h [mm]	Solid wood-based materials, see Table B1.1 (ST-c, ST-d, FST, GST, GLT-c, GLT-d, BGLT, SWP-P) Minimum spacings and distances, **pre-drilled**			
				a_1	a_2	$a_{1,CG}$ [2)]	$a_{2,CG}$ [3)]
	All	see EN 1995-1-1		$5 \cdot d$	$2{,}5 \cdot d$	$10 \cdot d$ *($4 \cdot d$[1)])*	$2 \cdot d$

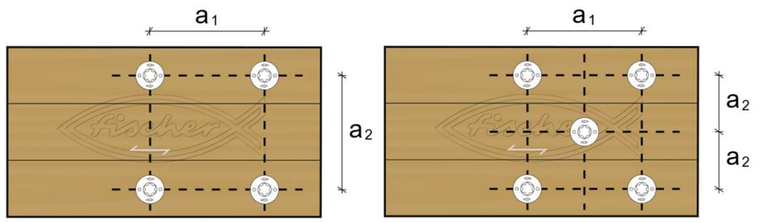
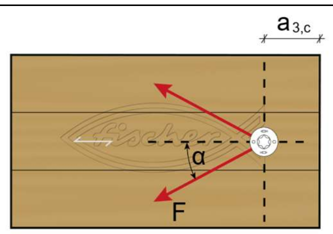
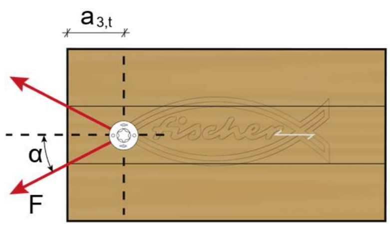
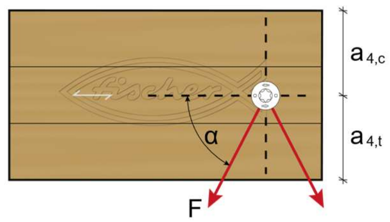
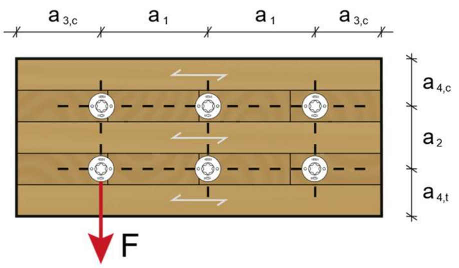
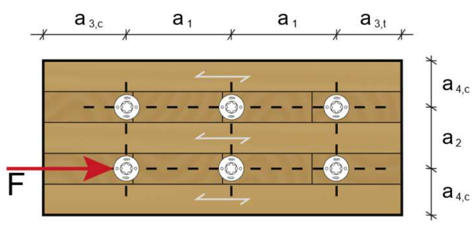
[1)] The values in brackets may be applied if no lateral loading is present
[2)] $a_{1,CG}$ Minimum spacing parallel to the grain direction between the centroids of the screw axis
[3)] $a_{2,CG}$ Minimum spacing perpendicular to the grain direction between the centroids of the screw axis

Figures not to scale

Specifications of the intended use

Minimum timber cross section, end- and edge distances
Material: Cross Laminated Timber (CLT)

Table B8.1: Minimum distances and spacings, notations for Cross Laminated Timber for both sides, the screw tip and the screw head

Notations for applications in the plane surface (see Figure D3.1)		
a_1	Spacing a_1 parallel to the plane direction of the CLT-panel	
a_2	Spacing a_2 perpendicular to the plane direction of the CLT-panel	
$a_{3,c}$	Distance $a_{3,c}$ from centre of the screw-part in timber to the unloaded edge in plane direction of the CLT-panel	
$a_{3,t}$	Distance $a_{3,t}$ from centre of the screw-part in timber to the loaded edge in plane direction of the CLT-panel	
$a_{4,c}$	Distance $a_{4,c}$ from centre of the screw-part in timber to the unloaded edge perpendicular to the plane direction of the CLT-panel	
$a_{4,t}$	Distance $a_{4,t}$ from centre of the screw-part in timber to the loaded edge perpendicular to the plane direction of the CLT-panel	
Notations for applications in the edge surface (see Figure D3.1)		
		

Figures not to scale

Specifications of the intended use

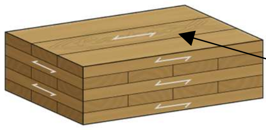
Minimum distances and spacings
Material: Cross Laminated Timber (CLT)

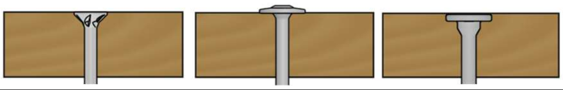
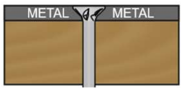
Laterally and axially loaded screws:

Unless specified otherwise in the technical specification (ETA or hEN) of Cross Laminated Timber, minimum distances and spacings for screws in the plane surface of Cross Laminated Timber members with a minimum thickness $t = 10 \cdot d$ may be taken as shown in Table B9.1 and Table B9.2.

Table B9.1: Minimum end- and edge distances for Cross Laminated Timber in the plane surface for both sides, the screw tip and the screw head

Cross Laminated Timber, Screws in the plane surface (CLT)



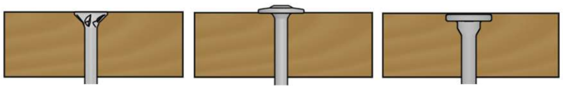
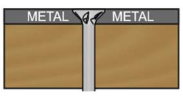
Head shapes and applications (see Table B5.1)	Minimum spacings and distances					
	a_1	a_2	$a_{3,c}$	$a_{3,t}$	$a_{4,c}$	$a_{4,t}$
	$4 \cdot d$	$2{,}5 \cdot d$	$6 \cdot d$	$6 \cdot d$	$2{,}5 \cdot d$	$6 \cdot d$
	$3 \cdot d$	$2{,}0 \cdot d$	$6 \cdot d$	$5 \cdot d$	$2{,}5 \cdot d$	$6 \cdot d$

Figures not to scale

Unless specified otherwise in the technical specification (ETA or hEN) of Cross Laminated Timber, minimum distances and spacing for screws in the edge surface of Cross Laminated Timber members with a minimum thickness $t = 10 \cdot d$ and a minimum penetration depth perpendicular to the edge surface of $10 \cdot d$ may be considered.

Table B9.2: Minimum end- and edge distances for Cross Laminated Timber in the edge surface for both sides, the screw tip and the screw head

Cross Laminated Timber, Screws in the edge surface

Head shapes and applications (see Table B5.1)	Minimum spacings and distances					
	a_1	a_2	$a_{3,c}$	$a_{3,t}$	$a_{4,c}$	$a_{4,t}$
	$10 \cdot d$	$3 \cdot d$	$7 \cdot d$	$12 \cdot d$	$5 \cdot d$	$5 \cdot d$
	$7 \cdot d$	$3 \cdot d$	$7 \cdot d$	$12 \cdot d$	$5 \cdot d$	$5 \cdot d$

Figures not to scale

fischer PowerFast II screws for the structural use in timber constructions

General Notes for Secondary Structural Elements, not pre-drilled applications:
For secondary structural members (e.g. battens, counter-battens, wind bracings, etc.), the minimum dimensions made of softwood for both sides, the screw tip and the screw head, following the requirements of EN 338 may be less than those specified in Annex B5 to B7, as follows.

The minimum thickness of the battens is 80 mm and the minimum width is 100 mm for screws with an outer thread diameter of d = 12 mm.

The minimum thickness of the battens is 40 mm and the minimum width is 60 mm for screws with an outer thread diameter of d = 10 mm.

For screws with an outer thread diameter of $6 \leq d \leq 8$ mm, the minimum thickness of the battens is 30 mm and the minimum width is 50 mm.

For formwork, shuttering and boardings, the minimum thickness is 24 mm and the minimum width is 48 mm for screws with an outer thread diameter of less than 6 mm.

Additional information for screws smaller than 6,0 mm see also EN 1995-1-1, chapter 8.3.

The distances of the screws from the end grain edges for both sides, the screw tip and the screw head must meet the specifications in Annex B6 and B7 depending on the chosen screw-in method, non-pre-drilled or predrilled. If the distances to the edges can not be fulfilled, the screws should be positioned along the centre line of the cross-sections. Furthermore, it should be noted, that if there is only one screw in the contact/shear plane, the load-bearing capacity of the screw should be reduced by 50 %.

FAFS-Clip
FAFS-Clips on the head side may only be used in solid softwood timber. For the FAFS-Clip, the minimum distances and minimum end-grain distances in softwood are:

- 60 mm for pre-drilled applications
- 120 mm for non-pre-drilled applications

The minimum cross-section for pre-drilled and non-pre-drilled applications in softwood must be at least 30 x 50 mm², with a minimum width of 50 mm and $a_{4,t} \geq 25$ mm.

Pre-drilling is permitted with a diameter of 5 mm.

A combination of pre-drilled and non-pre-drilled holes for the screws with the FAFS-Clip is allowed, e.g., if only the hole for the screw with the FAFS-Clip positioned close to the end grain is pre-drilled in the batten, and a distance of 60 mm to the end grain is maintained. The subsequent screws in the batten do not need to be pre-drilled, but a distance of 120 mm between the screws with the FAFS-Clip must then be maintained.

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

Performance of the PowerFast II screws itself (single product)

Table C1.1: Characteristic values of the load-carrying capacities of fischer PowerFast II - Chipboard screws – Carbon steel

Outer thread diameter	***d***	**[mm]**	**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**
Characteristic strength parameters								
Tensile strength	$f_{tens,k}$	[kN]	3,2	4,1	5,2	6,3	8,9	13,1
Torsional strength	$f_{tor,k}$	[Nm]	1,5	2,0	3,0	4,2	6,0	10,0
Yield moment	$M_{y,Rk}$	[Nmm]	1.654	2.489	3.546	4.844	6.405	10.384
Yield strength	$f_{y,k}$	[N/mm²]	1.050					
Characteristic stiffness parameters								
Modulus of elasticity	E_s	[N/mm²]	210.000					
Assessed performances								
Bending angle		[°]	No breaking has been observed at a bending angle of $\alpha \leq 45°/d^{0,7}+20°$					
Safety factor insertion moment		[-]	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$ *Note: Reference density of the timber 480 kg/m³*					

Table C1.2: Characteristic values of the load-carrying capacities of fischer PowerFast II – Wood Construction screws – Carbon steel

Outer thread diameter	***d***	**[mm]**	**8,0**	**10,0**	**12,0**	
Characteristic strength parameters						
Tensile strength	$f_{tens,k}$	[kN]	23,0	31,0	42,0	
Torsional strength	$f_{tor,k}$	[Nm]	28,0	42,0	64,0	
Yield moment	$M_{y,Rk}$	[Nmm]	22.200	37.400	59.900	
Yield strength	$f_{y,k}$	[N/mm²]	975			
Characteristic stiffness parameters						
Modulus of elasticity	E_s	[N/mm²]	210.000			
Assessed performances						
Bending angle		[°]	No breaking has been observed at a bending angle of $\alpha \leq 45°/d^{0,7}+20°$			
Safety factor insertion moment		[-]	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$ *Note: Reference density of the timber 480 kg/m³*			

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

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

Performance of the PowerFast II screws itself (single product)

Table C2.1: Characteristic values of the load-carrying capacities of fischer PowerFast II - Chipboard screws – Stainless steel

Outer thread diameter	d	**[mm]**	**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**
Characteristic strength parameters								
Tensile strength	$f_{tens,k}$	[kN]	2,4	3,0	3,7	4,6	5,4	7,1
Torsional strength	$f_{tor,k}$	[Nm]	1,1	1,5	2,2	2,7	4,2	6,8
Yield moment	$M_{y,Rk}$	[Nmm]	1.379	2.074	2.955	4.037	5.337	8.653
Yield strength	$f_{y,k}$	[N/mm²]	500					
Characteristic stiffness parameters								
Modulus of elasticity	E_s	[N/mm²]	195.000					
Assessed performances								
Bending angle		[°]	No breaking has been observed at a bending angle of $\alpha \leq 45°/d^{0,7}+20°$					
Safety factor insertion moment		[-]	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$ *Note: Reference density of the timber 480 kg/m³*					

Table C2.2: Characteristic values of the load-carrying capacities of fischer PowerFast II – Wood Construction screws – Stainless steel

Outer thread diameter	d	**[mm]**	**8,0**	
Characteristic strength parameters				
Tensile strength	$f_{tens,k}$	[kN]	13,2	
Torsional strength	$f_{tor,k}$	[Nm]	16,8	
Yield moment	$M_{y,Rk}$	[Nmm]	18.546	
Yield strength	$f_{y,k}$	[N/mm²]	500	
Characteristic stiffness parameters				
Modulus of elasticity	E_s	[N/mm²]	195.000	
Assessed performances				
Bending angle		[°]	No breaking has been observed at a bending angle of $\alpha \leq 45°/d^{0,7}+20°$	
Safety factor insertion moment		[-]	Ratio of the characteristic torsional strength to the mean insertion moment: $f_{tor,k} / R_{tor,mean} \geq 1,5$ *Note: Reference density of the timber 480 kg/m³*	

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

fischer PowerFast II screws for the structural use in timber constructions

1 Mechanical Resistance and Stability

The load-carrying capacities for the »fischer PowerFast II« screws are applicable to the wood-based materials mentioned in Annex B, even though the term *»timber«* has been used in the following. European Technical Assessments for structural members or wood-based panels must be considered if applicable.

The characteristic lateral load-carrying capacities and the characteristic axial withdrawal capacities of »fischer PowerFast II« screws should be used for designs in accordance with EN 1995-1-1 or an appropriate valid national code.

ETA's for structural members or wood-based panels must be considered where applicable.

For screws arranged under an angle between screw axis and grain-direction $\varepsilon \leq 15°$ (see Figure D2.1), the threaded penetration length (including the tip of the screw) has to fulfill equation (1).

$$l_{ef} = \min \begin{cases} \dfrac{4 \cdot d}{\sin \varepsilon} \\ 20 \cdot d \end{cases} \quad (1)$$

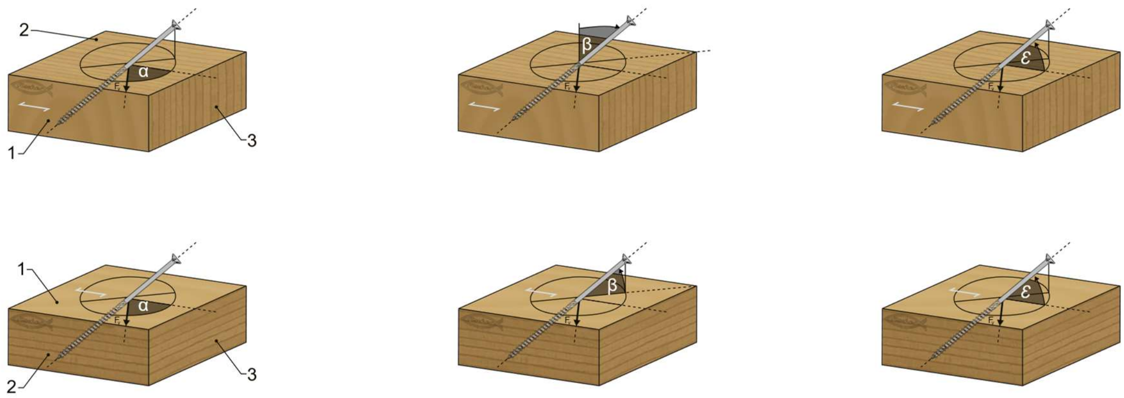
For screws arranged under an angle between screw and grain-direction $15° < \varepsilon \leq 90°$ the minimum threaded penetration length must be $l_{ef} \geq 4 \cdot d$ (see also Figure D2.1). For the fixing of rafters or similar building parts, the point side penetration length must be at least 40 mm (i.e. $l_{ef} \geq 40$ mm).

Reductions in the cross-sectional area caused by »fischer PowerFast II« screws shall be considered in accordance to the EN 1995-1-1, section 5.2.

fischer PowerFast II screws for the structural use in timber constructions

1.1 Lateral load-carrying capacity $F_{v,Rk}$

The characteristic lateral load-carrying capacity of »fischer PowerFast II« screws shall be calculated according to EN 1995-1-1. The contribution of the rope effect may be considered, if only lateral loads (no axial loads) are acting on the screws. For the calculation of the load-carrying capacity, the following parameters should be taken into account. Figure D2.1 shows the definition of the necessary angles which consider the angle between load and grain-direction α, the angle between the surface of wide face of the structural element and the screw axis β and the angle between the screw axis and the grain-direction ε.



(1)	Wide face	α	Angle between grain-direction and acting load [°]
(2)	Edge face	β	Angle between screw axis and the surface of the wide face [°]
(3)	End grain	ε	Angle between screw axis and grain-direction [°]
		F_v	Lateral force in the wide or edge face plane

Figure D2.1: Notations for angles in SWB, LVL, SB and WFB (figures not to scale)

1.1.1 Embedment strength $f_{h,\varepsilon,k}$ for the use in Structural Timber (ST-c/d, FST-c/d and GST-c/d, BGLT) and Parallel Laminated Timber (GLT-c)

The embedment strength for »fischer PowerFast II« screws in non-pre-drilled holes arranged at an angle between screw axis and grain-direction, $0° \leq \varepsilon \leq 90°$ for structural timber elements with $\rho_k \leq 730$ kg/m³ can be calculated with the help of equation (2) and for pre-drilled applications with the help of equation (3)

$$f_{h,\varepsilon,k} = \frac{0{,}019 \cdot \rho_k^{1{,}24} \cdot d^{-0{,}3}}{2{,}5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon} \quad (2)$$

$$f_{h,\varepsilon,k} = \frac{0{,}082 \cdot \rho_k \cdot (1 - 0{,}01 \cdot d)}{2{,}5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon} \quad (3)$$

Note: Screws parallel to the end-grain-direction stressed perpendicular to the screw axis (ε = 0°) are only allowed for short-time loads.

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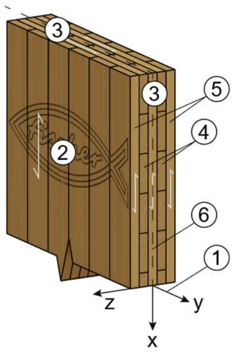
1.1.2 Embedment strength $f_{h,k}$ for the use in Cross Laminated Timber (CLT-c)

If there are no other technical specification (ETA) for Cross Laminated Timber (CLT-c), the embedment strength for screws can be calculated as stated below. The following specifications are only applicable for screws with a diameter *d* of at least 6 mm, possible influences of gaps between the single lamellas have to be considered.



(1) Element plane
(2) Plane surface
(3) Edge surface (Narrow side)
(4) Inner layer (Inner lamellas)
(5) Outer layer (Outer lamellas)
(6) Middle layer (Middle lamella)

Figure D3.1: Notations CLT-elements (figure not to scale)

Screws in the plane surface

The embedment strength for screws in the plane surface of CLT-elements should be assumed as for Solid Timber according to equation (2), based on the characteristic density of the outer layer.

Screws in the edge (narrow) side

The embedment strength for screws in the narrow side of CLT-elements should be assumed according to equation (4).

$$f_{h,k} = 20 \cdot d^{-0,5} \qquad (4)$$

1.1.3 Embedment strength $f_{h,\beta,\varepsilon,k}$ for the use in Laminated Veneer Lumber in softwood (LVL-c)

The embedment strength for »fischer PowerFast II« screws arranged at an angle between screw axis and grain-direction ε and an angle between screw axis of wide surface of the LVL β for $d \leq 12$ mm can be calculated with equation (5) for non-pre-drilled holes

$$f_{h,\beta,\varepsilon,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,3}}{(\sin^2\beta + k_2 \cdot \cos^2\beta) \cdot (\sin^2\varepsilon + 2,5 \cdot \cos^2\varepsilon)} \qquad (5)$$

and for pre-drilled holes

$$f_{h,\beta,\varepsilon,k} = \frac{0,082 \cdot \rho_k \cdot (1 - 0,01 \cdot d)}{(\sin^2\beta + k_2 \cdot \cos^2\beta) \cdot (\sin^2\varepsilon + 2,5 \cdot \cos^2\varepsilon)} \qquad (6)$$

with

$$k_2 = \begin{cases} 1 & \text{for LVL-P} \\ \min\begin{cases} d/(d-2) \\ 3 \end{cases} & \text{for LVL-C} \end{cases} \qquad (7)$$

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1.1.4 Embedment strength $f_{h,\alpha,\beta,k}$ for use in Laminated Veneer Lumber in hardwood LVL-d

The embedment strength for »fischer PowerFast II« screws arranged at an angle between load and grain-direction, 0° ≤ α ≤ 90° can be calculated with the help of equation (8). Screws with d > 8 mm should be pre-drilled.

$$f_{h,\alpha,\beta,k} = \frac{f_{h,k}}{(k_{90} \cdot \sin^2 \alpha + \cos^2 \alpha) \cdot (\sin^2 \beta + k_1 \cdot \cos^2 \beta)} \tag{8}$$

with

$$k_{90} = 0,5 + 0,024 \cdot d$$
$$k_1 = \begin{cases} 1,2 & \text{for LVL-P in hardwood} \\ \min\begin{cases} d/(d-2) \\ 3 \end{cases} & \text{for LVL-C in hardwood} \end{cases} \tag{9}$$

Where

d	Outer diameter of the screw [mm]
$f_{h,\alpha,\beta,k}$	Characteristic embedment strength for screws d ≤ 12 mm in LVL-d [N/mm²]
$f_{h,\beta,\varepsilon,k}$	Characteristic embedment strength for screws d ≤ 12 mm in LVL-c [N/mm²]
$f_{h,\varepsilon,k}$	Characteristic embedment strength for screws d ≤ 12 mm in ST-c, FST, GLT, BGLT [N/mm²]
$f_{h,k}$	Characteristic value of the embedment strength according to Table D5.1 [N/mm²]
k_{90}	Factor to consider influences of the diameter [-]
k_1, k_2, k_3	Factors to consider influences of the diameter and material [-]
α	Angle between grain-direction and acting load [°]
β	Angle between screw axis and surface [°]
ε	Angle between screw axis and grain-direction [°]
ρ_k	Characteristic gross density of the wood-based element [kg/m³]

For BauBuche, according to ETA-14/0354, the embedment strength pre-drilled and non-pre-drilled should be calculated with the equation below.

$$f_{h,k} = \frac{0,082 \cdot \rho_k \cdot d^{-0,15}}{(k_{90} \cdot \sin^2 \alpha + \cos^2 \alpha) \cdot (1,2 \cdot \cos^2 \beta + \sin^2 \beta) \cdot (2,5 \cdot \cos^2 \varepsilon + \sin^2 \varepsilon)} \tag{10}$$

with

ρ_k Characteristic gross density BauBuche with ρ_k = 730 [kg/m³]

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1.1.5 Embedment strength $f_{h,k}$ for the use in Oriented Strand Boards (OSB), Plywood (PLY), Fibreboards (HB, MB, SB), Particleboards (RPB) in the plane surface

The embedment strength for »fischer PowerFast II« screws in non-pre-drilled holes if no other regulations are given, arranged at an angle β = 90° to the plane surface can be calculated with the help of Table D5.1.

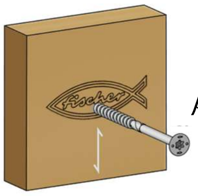

Figure D5.1: Screw arrangement in the plane surface of WBP (figure not to scale)

Table D5.1: Characteristic values of the embedment strength in the plane surface of OSB, HB, MB, SB, PLY and RPB

Outer thread diameter [mm]	***d***	**3,5 mm – 6,0 mm**
Material	**Embedment parameters in the plane surface [N/mm²]**	
OSB, general without pre-drilling, t > 5 mm (EN 300)	$f_{h,k}$=	$48 \cdot d^{-0,7} \cdot t^{0,1}$
OSB 4, general pre-drilled, t > 10 mm, (EN 13986)	$f_{h,k}$=	$50 \cdot d^{-0,6} t^{0,2}$
OSB 4, general without pre-drilling, t > 10 mm, (EN 13986)	$f_{h,k}$=	$65 \cdot d^{-0,7} \cdot t^{0,1}$
Plywood PLY t > 4 mm (EN 314-2)	$f_{h,k}$=	$65 \cdot d^{-0,7} \cdot t^{0,1}$
Fibreboard hard (HB) t > 3 mm (EN 622-2)	$f_{h,k}$=	$30 \cdot d^{-0,3} \cdot t^{0,6}$
Fibreboard medium (MB) t > 3 mm (EN 622-3)	$f_{h,k}$=	$28 \cdot d^{-0,6} \cdot t^{0,6}$
Fibreboard soft (SB) 150 ≤ ρ_k ≤ 300 kg/m³ 18 mm ≤ t ≤ 60 mm	$f_{h,k}$=	$4 \cdot 10^{-4} \cdot t \cdot \rho_k^{1,2}$
Fibreboard soft (SB) ρ_k < 150 kg/m³	$f_{h,k}$=	$15 \cdot 10^{-5} \cdot d^{-075} \cdot \rho_k^{2}$
Particleboards (RPB) t > 5 mm (EN 312)	$f_{h,k}$=	$50 \cdot d^{-0,6} \cdot t^{0,2}$
Gypsum plasterboard t ≥ 9 mm (EN 520)	$f_{h,k}$=	$3,9 \cdot d^{-0,6} \cdot t^{0,7}$
Gypsum board with fibrous reinforcement t ≥ 9 mm (EN 15283-2)	$f_{h,k}$=	$7,8 \cdot d^{-0,2} \cdot t^{0,7}$
Cement-bonded particleboard (EN 634-2)	$f_{h,k}$=	$(75+1,9 \cdot d) \cdot d^{-0,5} + d/10$
Fermacell Powerpanel HD ETA-13/0609	$f_{h,k}$=	$37 \cdot d^{-0,5}$

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1.1.6 Embedment strength $f_{h,k}$ for the use in Oriented Strand Boards (OSB) in the edge surface

The embedment strength for »fischer PowerFast II« screws, if no other regulations are given, arranged at an angle β = 0° to the plane surface can be calculated with the help of Table D6.1.

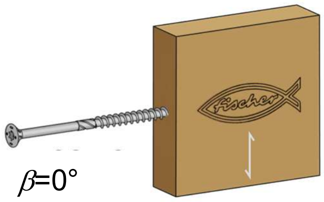

Figure D6.1: Screw arrangement in the narrow surface of OSB (figure not to scale)

Table D6.1: Characteristic values of the embedment strength in the edge surface of OSB

Outer thread diameter [mm]	***d***	**≤ 5,0 mm**
Material	**Embedment parameters in the edge surface [N/mm²]**	
EGGER OSB 4 TOP, pre-drilled t >10 mm Load parallel to plane (EN 13986)	$f_{h,k}$=	$50 \cdot d^{-0,6} t^{\,0,2}$
EGGER OSB 4 TOP, without pre-drilling t >10 mm Load parallel to plane (EN 13986)	$f_{h,k}$=	$65 \cdot d^{-0,7} \cdot t^{\,0,1}$
EGGER OSB 4 TOP, pre-drilled t >10 mm Load normal to plane (EN 13986)	$f_{h,k}$=	$65 \cdot d^{-0,7} \cdot t^{\,0,1}$
EGGER OSB 4 TOP, without pre-drilling t >10 mm Load normal to plane (EN 13986)	$f_{h,k}$=	$30 \cdot d^{-0,3} \cdot t^{\,0,6}$

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1.1.7 Embedment strength $f_{h,k}$ for the use in combination with pre-drilled steel plates

The characteristic embedment strength of »fischer PowerFast II« screws in steel plates can be taken like following into account.

$$f_{h,k} = k_{pl} \cdot 600 \text{ [N/mm}^2\text{]} \tag{11}$$

with

k_{pl}=1,0 for inner steel plates
k_{pl}=0,5 for the ratio $t / d \leq 0,5$ for outer steel plates
k_{pl}=1,0 for the ratio $t / d > 1,0$ for outer steel plates
Note: Intermediate values should be linearly interpolated

Note: The 600 N/mm² should be used for any steel and may be different for other materials. The metal plate should be verified in accordance to the corresponding Eurocode (e. g. EN 1993-1-1, EN 1993-1-8, EN 1999-1-1).

1.1.8 Effective number of screws each row n_{ef}

Splitting along the grain of a row of PowerFast II screws, should be considered by the effective number of fasteners n_{ef}.
For laterally loaded screws with d < 12 mm, the following rules for multiple fastener connections should be applied.

$$n_{ef} = n^{k_{ef}} \tag{12}$$

Table D7.1: Values for k_{ef} for SL, PL, CL and in the plane surface of LVL and GLVL

Distance	Materials	k_{ef} not pre-drilled	k_{ef} pre-drilled
$a_1 \geq 14 \cdot d$	SL, PL, CL and in the plane surface of LVL and GLVL	1,0	1,0
$a_1 \geq 10 \cdot d$		0,85	0,85
$a_1 \geq 7 \cdot d$		0,7	0,7
$a_1 \geq 4 \cdot d$		-	0,5
For intermediate spacings, linear interpolation of k_{ef} may be applied			
-	in the narrow surface of LVL and GLVL	$k_{ef} = \min\begin{cases} 1 - 0,03 \cdot \left(20 - \frac{a_1}{d}\right) \\ 1 \end{cases}$	
For intermediate spacings, linear interpolation of k_{ef} may be applied			

For fischer PowerFast II screws with $d \leq 8$ mm staggered at least by $1 \cdot d$ without pre-drilling the spacing a_1 may be doubled for the determination of n_{ef}.

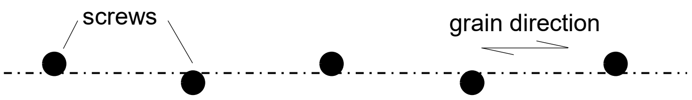

Figure D7.1: Staggered arrangement of the screws parallel to the grain direction (figure not to scale)

The effective number of fasteners loaded perpendicular to grain should be taken as $n_{ef} = n_{90}$.

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For laterally loaded screws with $d \geq 12$ mm, the following rules for multiple fastener connections should be applied.

$$n_{ef} = \min \begin{cases} n \\ n^{0,9} \cdot \sqrt[4]{\dfrac{a_1}{13 \cdot d}} \end{cases} \quad \text{in SL, PL and CL} \qquad (13)$$

$$n_{ef} = \min \begin{cases} n \\ n^{0,9} \cdot \sqrt[4]{\dfrac{t \cdot a}{50 \cdot d^2}} \end{cases} \quad \text{in LVL and GLVL} \qquad (14)$$

with

$$a = \begin{cases} a_3 & \text{when n=1} \\ \min \begin{cases} a_1 \\ a_{3,t} \end{cases} & \text{when n} \geq 2 \end{cases} \qquad (15)$$

$$t = \begin{cases} \min \begin{cases} t_1 \\ t_2 \end{cases} & \text{for single shear connection} \\ \min \begin{cases} 2 \cdot t_1 \\ 2 \cdot t_2 \\ t_{ms} \end{cases} & \text{for double shear connection} \end{cases} \qquad (16)$$

Where

n_0	Number of fasteners parallel to grain direction [-]
n_{90}	Number of fasteners perpendicular to the grain direction [-]
a_1	Spacing parallel to grain [mm]
$a_{3,t}$	Loaded end distance parallel to grain [mm]
d	Nominal Diamter of fischer PowerFast II screws [mm]
t_1 and t_2	thicknesses of the outer timber members [mm]
t_{ms}	thickness of the inner member of double shear connections or the smallest thickness of the inner member of multiple shear plane connections [mm]

1.2 Axial resistance of the screw under tension $F_{ax,t,Rd}$

The design axial tensile resistance $F_{ax,t,Rd}$ for a group of axially loaded screws is limited by the head pull-through parameter, the withdrawal capacity and the tensile capacity of the screw itself and should be considered as following.

$$F_{ax,t,Rd} = \min \begin{cases} n_{ef} \cdot F_{ax,t,Rd,1} \\ n \cdot F_{ax,t,Rd,2} \end{cases} \quad (17)$$

with

$$F_{ax,t,Rd,1} = \frac{k_{mod}}{\gamma_M} \cdot \min \begin{cases} \text{Headside: } \max\left\{F_{head,Rk}; F_{ax,\alpha,Rk}\right\} \\ \text{Tipside: } F_{ax,\alpha,Rk} \end{cases} \quad (18)$$

and

$$F_{ax,t,Rd,2} = \frac{f_{tens,k}}{\gamma_{M,2}} \quad (19)$$

Where

k_{mod}	Modification factor see also EN 1995-1-1 [-]
n	Number of screws in a connection [-]
n_{ef}	Effective number of screws in a connection [-]
γ_M	Partial factor for the screw, see EN 1995-1-1; *Note: Recommended value γ_M=1,30*
$F_{head,Rk}$	Characteristic head pull-through resistance in according to see Annex D16 [N]
$F_{ax,\alpha,Rk}$	Characteristic withdrawal resistance according to Annexes D9 to D14 [N]
$F_{ax,t,Rd}$	Design withdrawal resistance [N]
$F_{ax,t,Rd,1}$	Design withdrawal resistance on the timber side [N]
$F_{ax,t,Rd,2}$	Design tension strength of the screw itself [N]
$f_{tens,k}$	Characteristic tensile strength of the »fischer PowerFast II« screws, see Table C1.1 and C1.2 [N], *Note: Values in Table C1.1 and C1.2 are given in [kN]*
$\gamma_{M,2}$	Partial factor for resistance of cross-sections of a metal fastener in tension to fracture, see EN 1993-1-8; *Note: Recommended value $\gamma_{M,2}$=1,25*

1.2.1 Withdrawal capacity $F_{ax,\alpha,Rk}$ for use in Structural Timber (ST-c, FST and GST) and Parallel Laminated Timber (GLT-c)

In Structural Timber (ST-c) and Glued Laminated Timber of softwood (GLT-c), the characteristic withdrawal capacities of »fischer PowerFast II« screws, with an angle of 0° ≤ ε ≤ 90° for self-tapping screws shall be calculated according to equation (20) or (21).

$$F_{ax,\alpha,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \quad (20)$$

$$F_{ax,\alpha,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_g \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \quad (21)$$

with

$$k_{ax} = \min \begin{cases} 0,3 + (0,7 \cdot \varepsilon) / 45° \\ 1,00 \end{cases} \quad (22)$$

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For screws arranged under an angle between screw axis and grain-direction $\varepsilon \leq 15°$ (see Figure D2.1), the threaded penetration length (inclusive the tip of the screw) has to fulfil equation (23).

$$l_{ef} = \min \begin{cases} \dfrac{4 \cdot d}{\sin \varepsilon} \\ 20 \cdot d \end{cases} \qquad (23)$$

For screws arranged under an angle between screw and grain-direction $15° < \varepsilon \leq 90°$ the minimum threaded penetration length must be $l_{ef} \geq 4 \cdot d$. For the fixing of rafters or similar building parts, the point side penetration length must be at least 40 mm (i.e. $l_{ef} \geq 40$ mm).

1.2.2 Withdrawal capacity $F_{ax,\alpha,Rk}$ for use in Structural Timber (ST-d, GLT-d) and Laminated Veneer Lumber (LVL-d) according to ETA-14/0354

The characteristic withdrawal capacity of »fischer PowerFast II« screws in Structural Timber (ST-d, GLT-d) and Laminated Veneer Lumber in hardwood (LVL-d) according to ETA-14/0354 with an angle of $0° \leq \varepsilon \leq 90°$ shall be calculated according to equation (24) or (25).

$$F_{ax,\alpha,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_{ef} \cdot \left(\frac{\rho_k}{730} \right)^{0,8} \qquad (24)$$

$$F_{ax,\alpha,Rk} = k_{ax} \cdot f_{ax,k} \cdot d \cdot l_g \cdot \left(\frac{\rho_k}{730} \right)^{0,8} \qquad (25)$$

with

$$k_{ax} = \min \begin{cases} 0,3 + (0,7 \cdot \varepsilon) / 45° \\ 1,00 \end{cases} \qquad (26)$$

The penetration length in hardwood has to be at least $l_{ef} \geq 4 \cdot d$.

Where

d	Outer thread diameter of the screw [mm]
$f_{ax,k}$	Characteristic withdrawal strength parameter, see Table D11.1 and D11.2 [N/mm²]
k_{ax}	Factor to consider the influence between the angle of the screw axis and the grain-direction [-]
l_{ef}	Penetration length of the threaded part of the screw, including the screw head and/or screw tip [mm]
l_g	$l_g = l_{gp} - l_t$ [mm] Penetration length of the threaded part of the screw with d = const. Values for l_t see Annex A; l_t …length of the screw tip [mm]
n_{ef}	Effective number of screws, see Annex D15 [-]
$F_{ax,\alpha,Rk}$	Characteristic withdrawal capacity of the screw with an angle α to the grain-direction [N]
ε	Angle between grain-direction and the screw axis [°], see Figure D2.1
ρ_k	Characteristic gross density of the timber/wood based member [kg/m³]

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Table D11.1: Characteristic values of »fischer PowerFast II – Chipboard screws« of the withdrawal strength parameter in Structural Timber in softwood and hardwood, Laminated Veneer Lumber according to ETA-14/0354 and wood chip concrete (e.g. DURISOL, ISO SPAN) referred to l_{ef}

Outer thread diameter *d* [mm] Values referred to the effective length l_{ef}, see equations (20) and (24)			**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**
Product	**Abbreviation, Note**	**Parameter**	**Withdrawal capacity [N/mm²]**					
Structural Timber Parallel Laminated Timber	*ST-c, FST, GST, GLT-c, BGLT, SWP-P, CLT*	$f_{ax,k}$	15,5	14,9	14,5	14,1	13,8	12,9
	ST-d, GLT-d	$f_{ax,k}$	32,9	30,8	29,2	27,8	26,6	24,7
Accoya according to Z-9.1-865	*Sorting class A1*	$f_{ax,k}$	-	-	-	-	11,0	10,5
ISO SPAN, ETA-05/0261 DURISOL, ETA-05/0090	*WCC*	$f_{ax,k}$	-	-	-	-	-	1,40
LVL according to ETA-14/0354 (see Figure D11.1)	*LVL*	$f_{ax,90\|90,k}$	-	-	-	-	40,0	32,0
		$f_{ax,90\|00,k}$	-	-	-	-	32,0	24,0
		$f_{ax,00\|00,k}$	-	-	-	-	32,0	24,0
Giant Bamboo		$f_{ax,k}$	-	-	-	-	-	30,0

Table D11.2: Characteristic values of »fischer PowerFast II – Wood Construction screws« of the withdrawal strength parameter in Structural Timber in softwood and Laminated Veneer Lumber according to ETA-14/0354, referred to l_{ef}

Outer thread diameter *d* [mm] Values referred to the effective length l_{ef}, see equations (20) and (24)			**8,0**	**10,0**	**12,0**	
Product	**Abbreviation, Note**	**Parameter**	**Withdrawal capacity [N/mm²]**			
Structural Timber Parallel Laminated Timber	*ST-c, ST-d, FST, GST, GLT-c, BGLT, SWP-P*	$f_{ax,k}$	12,0	11,5	10,3	
	ST-d, GLT-d	$f_{ax,k}$	22,0	20,1	18,6	
Cross Laminated Timber in the plane surface	*CLT*	$f_{ax,k}$	12,0	11,5	10,3	
Accoya according to Z-9.1-865	*Sorting class A1*	$f_{ax,k}$	9,5	-	-	
ISO SPAN, ETA-05/0261 DURISOL, ETA-05/0090	*WCC*	$f_{ax,k}$	1,1	-	-	
LVL according to ETA-14/0354 (see Figure D11.1)	*LVL*	$f_{ax,90\|90,k}$	30,0	28,0	-	
		$f_{ax,90\|00,k}$	22,0	20,0	-	
		$f_{ax,00\|00,k}$	22,0	20,0	-	

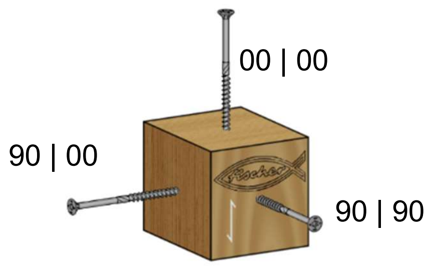

Figure D11.1: fischer PowerFast II in LVL-d (figure not to scale)

fischer PowerFast II screws for the structural use in timber constructions

Table D12.1: Characteristic values of »fischer PowerFast II – Chipboard screws« and »fischer PowerFast II - Wood Construction screws« of the withdrawal strength parameter in Structural Timber in softwood and Laminated Veneer Lumber according to ETA-14/0354, referred to l_g

Outer thread diameter *d* [mm] Values referred to the threaded length with constant diameter l_g, see equation (21) and (25)			**6,0**	**8,0**	**10,0**	**12,0**	
Product	**Abbreviation**	**Parameter**	**Withdrawal capacity [N/mm²]**				
Structural Timber Parallel Laminated Timber	*ST-c, FST, GST, GLT-c, GLT-d, BGLT, SWP-P, CLT*	$f_{ax,k}$	20,0	15,0	13,5	-	
LVL according to ETA-14/0354	*LVL*	$f_{ax,90\|90,k}$	48,0	-	-	-	
		$f_{ax,90\|00,k}$	44,6	-	-	-	
		$f_{ax,00\|00,k}$	31,6	-	-	-	

The characteristic axial withdrawal capacity of »fischer PowerFast II« screws with an angle of α = 90 | 90 in wood-based panels with a minimum thickness and/or a penetration depth of the threaded part of at least $4 \cdot d$ can be calculated according to equation (27) for applications in the plane surface.

$$F_{ax,\alpha,Rk} = n_{ef} \cdot f_{ax,90|90,k} \cdot d \cdot l_{ef} \quad (27)$$

Where

d	Outer thread diameter of the screw [mm]
$f_{ax,90\|90,k}$	Characteristic withdrawal parameter in the plane surface [N/mm²]
n_{ef}	Effective number of screws, see Annex D15 [-]
l_{ef}	Penetration length of the threaded part of the screw, including the screw head and/or screw tip [mm]

Table D12.2: Characteristic values of »fischer PowerFast II – Chipboard screws« of the withdrawal strength parameter in the plane surface of derived wood panels, referred to l_{ef}

Outer thread diameter *d* [mm] Values referred to the effective length l_{ef}, see equations (20) and (24)			**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**
Product	**Abbreviation**	**Parameter**	**Withdrawal capacity [N/mm²]**					
Oriented strand board (EN 300)	*OSB*	$f_{ax,k}$	9,3	9,0	8,6	8,3	8,0	7,1
Particleboard (EN 312)	*RPB*	$f_{ax,k}$	11,9	11,1	10,3	9,5	8,7	7,1
Fibreboards (EN 622-2)	*HB*	$f_{ax,k}$	13,2	12,4	11,6	10,8	10,0	8,5
Laminated veneer lumber (EN 14374)	*LVL-C*	$f_{ax,k}$	16,0	15,4	14,7	14,0	13,3	12,0

Note: The withdrawal resistance in Table D12.2 may be applied if the penetration depth of the screw thread in wood-based panels should be at least $6 \cdot d$ including the screw tip. If this is not achievable, »fischer PowerFast II« screws should be installed in such a manner that the constant thread thickness extends over the entire panel thickness.

fischer PowerFast II screws for the structural use in timber constructions

The characteristic axial withdrawal capacity of »fischer PowerFast II« screws for pre-drilled applications in the edge surface with an angle α = 90 | 00 (see Figure D11.1) in wood-based panels with a thickness of at least $5 \cdot d$ arranged in the center of the thickness of the panel with a penetration depth of the threaded part of the screws of at least $6 \cdot d$ can be calculated according to equation (28).

$$F_{ax,\alpha,Rk} = n_{ef} \cdot f_{ax,90|00,k} \cdot d \cdot l_{ef} \tag{28}$$

Where

- d Outer thread diameter of the screw [mm]
- $f_{ax,90|00,k}$ Characteristic withdrawal parameter in the edge surface [N/mm²]
- n_{ef} Effective number of screws, see Annex D15 [-]
- l_{ef} Penetration length of the threaded part of the screw, including the screw head and/or screw tip [mm]

Table D13.1: Characteristic values of »fischer PowerFast II – Chipboard screws« of the withdrawal strength parameter in the edge surface of derived wood panels, referred to l_{ef}

Outer thread diameter *d* [mm] Values referred to the effective length l_{ef}, see equations (20) and (25)			**4,0**	**4,5**	**5,0**	**6,0**
Product	**Abbreviation**	**Parameter**	**Withdrawal capacity [N/mm²]**			
Oriented strand board (EN 300)	*OSB*	$f_{ax,k}$	6,0	5,8	5,6	5,1
Particleboard (EN 312)	*RPB*	$f_{ax,k}$	5,6	5,4	5,2	4,7
Fibreboards (EN 622-2)	*HB*	$f_{ax,k}$	7,0	6,5	6,0	5,1
Laminated veneer lumber (EN 14374)	*LVL-C*	$f_{ax,k}$	9,2	8,8	8,4	7,5

fischer PowerFast II screws for the structural use in timber constructions

1.2.3 Withdrawal capacity $F_{ax,Rk}$ for use in Cross Laminated Timber (CLT)

If there are no other technical specification (ETA or hEN) for Cross Laminated Timber (CLT), the withdrawal capacity for screws can be calculated as following.

Screws in the plane surface

The withdrawal capacity for screws with $d \geq 6$ mm in the plane surface of CLT-c elements should be assumed as for Structural Timber according to equation (20) based on a characteristic density in accordance to equation (29), if there are no other specifications given. If necessary, gaps between the single lamellas have to be considered.

$$\rho_k = 1{,}1 \cdot \rho_{lay,k} \tag{29}$$

Where

ρ_k	Characteristic density for the calculation in equation (20) [kg/m³]
$\rho_{lay,k}$	Lowest characteristic density of the lamellas in a layer of the CLT-c element [kg/m³]

Screws in the narrow side

The withdrawal capacity for screws in the narrow side of CLT-elements should be assumed according to equation (30).

$$F_{ax,Rk} = 20 \cdot d^{0,8} \cdot l_{ef}^{\ 0,9} \tag{30}$$

If possible, the screws in the narrow side should be driven perpendicular into the grain-direction of the lamella. To avoid unwanted effects by screwing in only parallel to the grain direction, and gaps between lamellas in the narrow side of CLT panels, the considered penetration length l_{ef} in equation (30) should be decreased by $3 \cdot d$ (for calculation only).

If it is guaranteed that the angle between the grain-direction of the lamellas and the screw axis is ≥ 30°, the characteristic withdrawal capacity from equation (30) can be increased of about 25 %.

For screws penetrating more than one layer of Cross Laminated Timber, the different layers may be considered proportionally.

1.2.4 Withdrawal capacity $F_{ax,Rk}$ for use in Wood chip concrete members (WCC)

If there are no other technical specifications (ETA or hEN) for the use of screws in WCC, the withdrawal capacity for screws can be calculated as following. The screw should penetrate the WCC element if possible over the total thickness t_{WCC}, but at least 30 mm including the screw tip.

$$F_{ax,Rk} = n_{ef} \cdot f_{ax,k} \cdot d \cdot l_{ef}^{\ 0,9} \tag{31}$$

Where

d	Outer thread diameter of the screw [mm]
$f_{ax,k}$	Characteristic withdrawal capacity, see Table D11.1 and D11.2 [N/mm²]
l_{ef}	Penetration length of the screws into WCC with $l_{ef}=t_{WCC}$ [mm]
n_{ef}	Effective number of screws, see Annex D15 [-]

fischer PowerFast II screws for the structural use in timber constructions

1.2.5 Effective number of screws n_{ef}

For axially loaded screws in tension, where the external force is parallel to the screw axis, the following rules should be applied.

$$n_{ef} = \max \begin{cases} n^{0,9} & \text{in general without torque controlled insertion drivers} \\ 0{,}9 \cdot n & \text{for screws } 30° \le \varepsilon \le 90° \text{ and torque controlled insertion drivers} \\ 0{,}9 \cdot n & \text{for a group with more than 10 screws in a timber-to-timber connection} \\ & \text{(e.g. ST, PL, CL, LVL, PLY, OSB)} \\ n & \text{for a group up to 10 screws in a timber-to-timber connection} \\ & \text{(e.g. ST, PL, CL, LVL, PLY, OSB)} \end{cases} \quad (32)$$

Where

n Number of screws acting together in a joint [-]

ε Angle between screw axis and grain-direction, see Figure D2.1 [°]

For axially loaded screws in compression, where the external force is parallel to the screw axis, n_{ef} = n unless otherwise stated.

fischer PowerFast II screws for the structural use in timber constructions

1.3 Head pull-through capacity $F_{head,Rk}$

1.3.1 Head pull-through capacity $f_{head,k}$ for use in Solid Timber (ST-c, ST-d, FST, GST, BGLT) Glued Laminated Timber (GLT-c, GLT-d), Cross Laminated Timber (CLT) and Wood-based panels (WFB, WPB)

The characteristic head pull-through capacity of »fischer PowerFast II« screws in Solid Timber can be calculate as following.

$$F_{head,Rk} = n_{ef} \cdot f_{head,k} \cdot d_h^{\,2} \cdot \left(\frac{\rho_k}{350}\right)^{0,8} \tag{33}$$

Where

d_h Diameter of the screw head [mm]
n_{ef} Effective number of screws according to Annex D7 and D15
ρ_k Characteristic density of the timber element [kg/m³]
$f_{head,k}$ Characteristic head pull-through parameter for »fischer PowerFast II« given below [N/mm²]

For timber elements with a thickness of at least 20 mm, the characteristic value of the head pull-through parameter $f_{head,k}$ can be taken into account as follows.

Table D16.1: Characteristic values of the head pull-through parameter

Outer thread diameter *d*			**3,0**	**3,5**	**4,0**	**4,5**	**5,0**	**6,0**	**8,0**	**10,0**	**12,0**
Head type	**Material (Annex B)**	**Parameter**	**Head pull-through parameter [N/mm²]**								
Countersunk, Raised countersunk and Pan head (Annex A1, A2, A3, A7)	*ST-c, ST-d, FST, GST, GLT-c, GLT-d, BGLT, SWP-P, CLT, WFB, WPB*	$f_{head,k}$	19,0	16,3	15,0	14,2	13,4	13,0	12,5	12,0	11,6
Washer head and Screw with clamping effect (Annex A4, A5, A8)			-	-	-	-	20,0	15,5	14,3	12,6	11,2
Step countersunk (Annex A6, A9)			-	-	-	-	19,5	15,0	13,5	11,5	-
Hexagon head (Annex A10, A11)			-	-	-	-	-	-	10,0	10,0	10,0

For steel-to-timber connections, the head pull-through capacity may be disregarded.

Notes: An accurate fit is important to avoid any kind of notch stresses, see also Annex B4
The tear-off capacity of the screw head is greater than the tensile capacity of the screw.

For the wood-based panels with a thickness of more than 20 mm, the characteristic value of the head pull-through parameter can be calculated with

$$f_{head,k} = 10 \text{ N/mm}^2 \tag{34}$$

For wood-based panels with a thickness between 12 mm and 20 mm, the characteristic value of the head pull-through parameter can be calculated with

$$f_{head,k} = 8 \text{ N/mm}^2 \tag{35}$$

fischer PowerFast II screws for the structural use in timber constructions

For wood-based panels with a thickness of less than 12 mm, the characteristic head pull-through capacity can be calculated with $f_{head,k}$ = 8 N/mm², with a limit of 400 N, complying with a minimum thickness of the wood-based panels of 1,2·d. In addition, the minimum thickness of Table D17.1 applies.

Table D17.1: Minimum thickness of Wood-Based Panels be fixed on the side of the screw head

Wood-based panel	Min. thickness [mm]
Plywood	6
Oriented strand board	8
Solid wood panels	12
Particleboards	8
Cement-bonded particle boards	8
Fibreboards (hard boards and medium boards)	6
Gypsum fibre and Plasterboards	12

The characteristic head pull-through parameter $f_{head,k}$ capacity in softwood, referred to C24 with ρ_k=350 kg/m³, in combination with washers shown with Annex A19 may be considered in accordance with Table D17.2. The effective head pull-through capacity should be calculated in accordance with equation (33). For other strength classes the actual gross-density of the wooden member may be considered for ρ_k in equation (33).

Table D17.2: Head pull-through capacity $f_{head,k}$ of washers according to Annex A19

Nominal diameter of the screw	6,0	8,0		10,0		12
Outer diameter washer, Table A19.1	21,00	25,50	30,00	30,50	35,00	37,40
Minimum thickness of the timber member [mm][1)]	24	32		40		48
Head pull-through capacity $f_{head,k}$ [N/mm²]	15	15	15	15	15	15

[1)] For timber members with a thickness t > 4·d and other wood-based panels see FprEN 1995-1-1

The characteristic head pull-through capacity in softwood of the FAFS–Clip of adjustable frame screw can be calculated for tension and/or compression (push-through capacity) loads of the screws with the characteristic values given in Table D17.3.

Table D17.3: Characteristic values of the head pull-through capacities of Screws with Clamping effect and FAFS-Clip referred to C24 (see Annex A4 and A18). For other strength classes, the influence of the gross density can be considered with $(\rho / \rho_k)^{0,8}$

Outer thread diameter d [mm]			3,5	4,0	4,5	5,0
Head type	Product Abbreviation	Parameter	Headside pull-through capacity [N]			
Screw with clamping effect	*ST-c, FST-c, GST-c, GLT-c, BGLT-c, SWP-P*	$F_{headside,Rk}$	1.220	1.485	1.750	-
FAFS-Clip		$F_{FAFS,t,Rk}$ (tension)	-	-	-	2.200
		$F_{FAFS,c,Rk}$ (compression)	-	-	-	1.290

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1.4 Compression capacity in Solid Timber (ST, FST, GST) and Glued Laminated Timber (GLT-c, BGLT) and Laminated Veneer Lumber (LVL-c)

The design compressive capacity $F_{ax,Rd}$ of »fischer PowerFast II« screws with the thread completely embedded in timber and a free screw length protruding from the timber member, including the screw head, and additional head supporting thick metal plates according to Annex H, shall be calculated as following.

$$F_{ax,\alpha,Rd} = \min \begin{cases} F_{ax,\alpha,Rd} \\ F_{b,Rd} \end{cases} \quad (36)$$

Where

$F_{ax,\alpha,Rd}$ Withdrawal capacity see Annex D9 to D15 [N]

$F_{b,Rd}$ Buckling strength [N]

$$F_{b,Rd} = 1{,}10 \cdot \kappa_c \cdot N_{pl,Rd} \quad (37)$$

With

$$\kappa_c = 1 \qquad \text{for } \bar{\lambda} \le 0{,}2$$
$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \bar{\lambda}^2}} \qquad \text{for } \bar{\lambda} > 0{,}2 \quad (38)$$

and

$$k = 0{,}5 \cdot \left[1 + 0{,}49 \cdot \left(\bar{\lambda} - 0{,}2\right) + \bar{\lambda}^2\right] \quad (39)$$

The relative slenderness ratio shall be calculated with

$$\bar{\lambda} = \sqrt{\frac{N_{pl,k}}{N_{b,k}}} \quad (40)$$

With the characteristic value for the axial capacity in the case of plastic analysis

$$N_{pl,k} = \frac{d_s^{\,2} \cdot \pi}{4} \cdot f_{y,k} \quad (41)$$

With

d_s Outer shank diameter of the screw [mm]

$f_{y,k}$ Yield strength, see Annex C1 and Annex C2 [N/mm²]

$N_{pl,k}$ Characteristic value of the plastic axial capacity [N]

fischer PowerFast II screws for the structural use in timber constructions

With the characteristic value for buckling strength

$$N_{b,k} = \frac{\pi^2 \cdot E_s I_s}{l_{ef}^{\,2}} \qquad (42)$$

With the

Modulus of elasticity

- fischer PowerFast II made of Carbon Steel:

$$E_s = 210.000 \ \mathrm{N/mm^2} \qquad (43)$$

- fischer PowerFast II made of Stainless Steel:

$$E_s = 195.000 \ \mathrm{N/mm^2} \qquad (44)$$

and the second moment of area

$$I_s = \frac{\pi \cdot d_s^{\,4}}{64} \qquad (45)$$

Where

d_s	Outer shank diameter d_s [mm]
l_{ef}	Buckling length [mm] *with* $l_{ef}=0{,}7\cdot l$
l	Free screw length protruding of the timber member including the screw head [mm]

Note: The compressive capacity must be modified for $F_{ax,\alpha,Rd}$ with the factors k_{mod} and γ_M for timber connections according to EN 1995-1-1, while $N_{pl,Rd}$ the partial-factor $\gamma_{M,1}$ for steel buckling according to EN 1993-1-1 and/or national standards respectively have to be considered.
For γ_M, $\gamma_{M,1}$ the values γ_M =1,3 and $\gamma_{M,1}$ =1,1 are recommended.

Screws loaded in compression with additional head supporting thick metal plates where distortion and displacement of the screw head perpendicular to the buckling loads are not possible, should be considered in accordance to Table H.1 (see Annex H1).

fischer PowerFast II screws for the structural use in timber constructions

1.5 Combined laterally and axially loaded screws

For connections subjected to a combination of axial and lateral loads, the following equation has to be considered.

$$\left(\frac{F_{ax,Ed}}{F_{ax,Rd}}\right)^2 + \left(\frac{F_{v,Ed}}{F_{v,Rd}}\right)^2 \leq 1 \qquad (46)$$

Where

$F_{ax,Ed}$	Axial design action [N]
$F_{v,Ed}$	Lateral design action [N]
$F_{ax,Rd}$	Design load-carrying capacity of axially loaded screws [N]
$F_{v,Rd}$	Design load-carrying capacity of laterally loaded screws [N]

fischer PowerFast II screws for the structural use in timber constructions

1.6 Slip modulus in the Serviceability Limit State

1.6.1 Laterally loaded screws

For laterally loaded »fischer PowerFast II« screws, the slip modulus, pre-drilled or non-pre-drilled, for the serviceability limit state (SLS) should be calculated according to EN 1995-1-1 independent of the load grain-direction angle α with equation (47).

$$K_{v,ser} = k_{st} \cdot k_{sp} \cdot C_{v,ser} \tag{47}$$

With

k_{st} $$k_{st} = \begin{cases} 1 & \text{for timber-timber connections} \\ 2 & \text{for steel-timber connections} \end{cases}$$

k_{sp} Number of shear planes

$C_{v,ser}$ Slip modulus in the Serviceability limit state (SLS), each shear plane, Table D21.1 [N/mm]

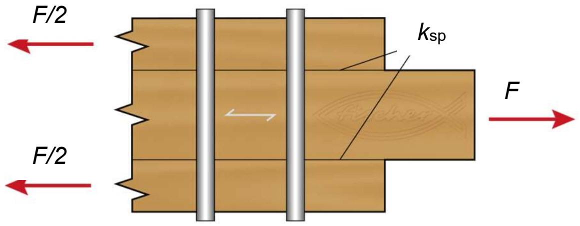


Figure D21.1: Definition of the shear plane k_{sp} (figure not to scale)

1.6.2 Axially loaded screws

For axially loaded screws the slip modulus for the serviceability limit state (SLS) can be calculated according to equation (48).

$$K_{ax,ser} = C_{ax,ser} \tag{48}$$

With

d Outer thread diameter [mm]

l_{ef} Penetration length of the threaded part , including the tip in [mm]

$C_{ax,ser}$ Slip modulus in the serviceability limit state (SLS), Table D21.1 [N/mm]

fischer PowerFast II screws for the structural use in timber constructions

1.7 Slip modulus in the ultimate limit state

To consider the slip modulus K_u in the ultimate limit state (ULS) K_{ser} has to be reduced for both directions (laterally and axially) according to EN 1995-1-1 with

$$K_u = 2/3 \cdot K_{ser} \tag{49}$$

1.7.1 Laterally loaded screws

For laterally loaded »fischer PowerFast II« screws, the slip modulus, pre-drilled or non-pre-drilled, for the ultimate limit state (ULS) should be calculated according to EN 1995-1-1 independent of the load grain-direction angle α with equation (49).

Table D22.1: Mean values of the lateral slip-modules in Serviceability Limit State (SLS) in the plane surface of timber elements and wood-based panels

Outer thread diameter ***d*** **[mm]**	**3,0 – 12,0 mm**
Material	**Lateral Slip-Modulus $C_{v,ser}$ [N/mm]**
Solid Timber Glued-Laminated Timber Softwood and Hardwood (EN 338, EN 15497, EN 14080)	$\frac{\rho_m^{1,5} \cdot d}{23}$
OSB t > 5 mm (EN 300)	$6,8 \cdot \rho_m \cdot d^{-0,4}$
Plywood t > 4 mm (EN 314-2)	*740*
Fibreboards t > 3 mm (EN 622-2, EN 622-3)	$9 \cdot \rho_m \cdot d^{-0,9}$
Particleboards t > 5 mm (EN 312)	$3 \cdot \rho_m \cdot d^{-0,4}$
Gypsum plasterboards t ≥ 9 mm (EN 520)	$6700 \cdot d^{-087}$
Gypsum boards with fibrous reinforcement t ≥ 9 mm (EN 15283-2)	$1,4 \cdot \rho_m \cdot d^{-0,7}$
LVL Soft- and Hardwood (EN 14374)	$\frac{\rho_m^{1,5} \cdot d}{20}$

fischer PowerFast II screws for the structural use in timber constructions

1.7.2 Axially loaded screws

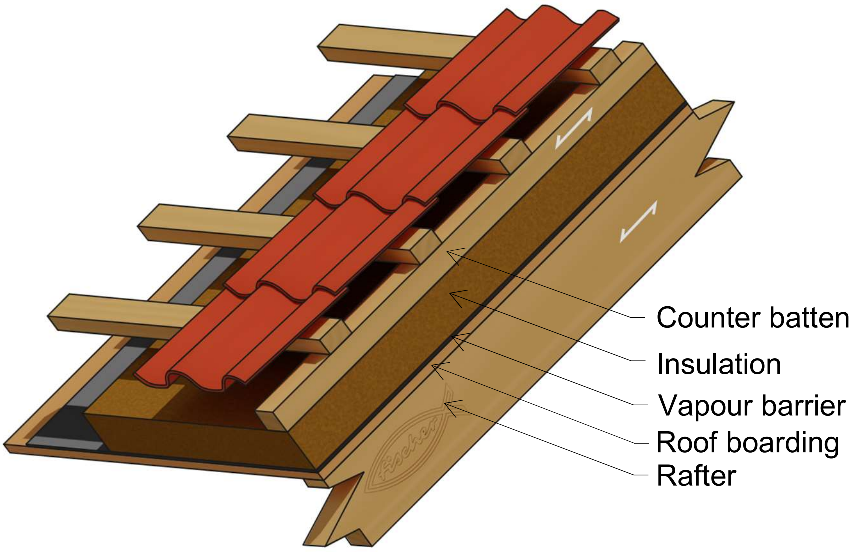
For axially loaded »fischer PowerFast II« screws, the slip modulus, pre-drilled or non-pre-drilled, for the ultimate limit state (ULS) should be calculated according to EN 1995-1-1 independent of the load grain-direction angle α with equation (49).

Table D23.1: Mean values of the axial slip-modules in Serviceability Limit State (SLS) in the plane surface of timber elements and wood-based panels

Outer thread diameter ***d*** **[mm]**	**3,0 – 12,0 mm**
Material	**Axial Slip-Modulus $C_{ax,ser}$ [N/mm]**
Softwood $\rho_k \geq 350$ kg/m³	$32 \cdot d \cdot l_{ef}$
Hardwood $\rho_k \geq 510$ kg/m³	$38 \cdot d \cdot l_{ef}$
OSB t > 5 mm (EN 300)	$10 \cdot d \cdot l_{ef}$
Fibreboards t > 3 mm (EN 622-2, EN 622-3)	$15 \cdot d \cdot l_{ef}$
Particleboards t > 5 mm (EN 312)	$10 \cdot d \cdot l_{ef}$
LVL (EN 14374) Soft- and Hardwood $\rho_k \geq 480$ kg/m³ 90|90, see figure D11.1	$28 \cdot d \cdot l_{ef}$

Applications of PowerFast II screws for the structural use in timber constructions

Fixations of on-roof insulation systems for sufficiently compression-resistant insulations



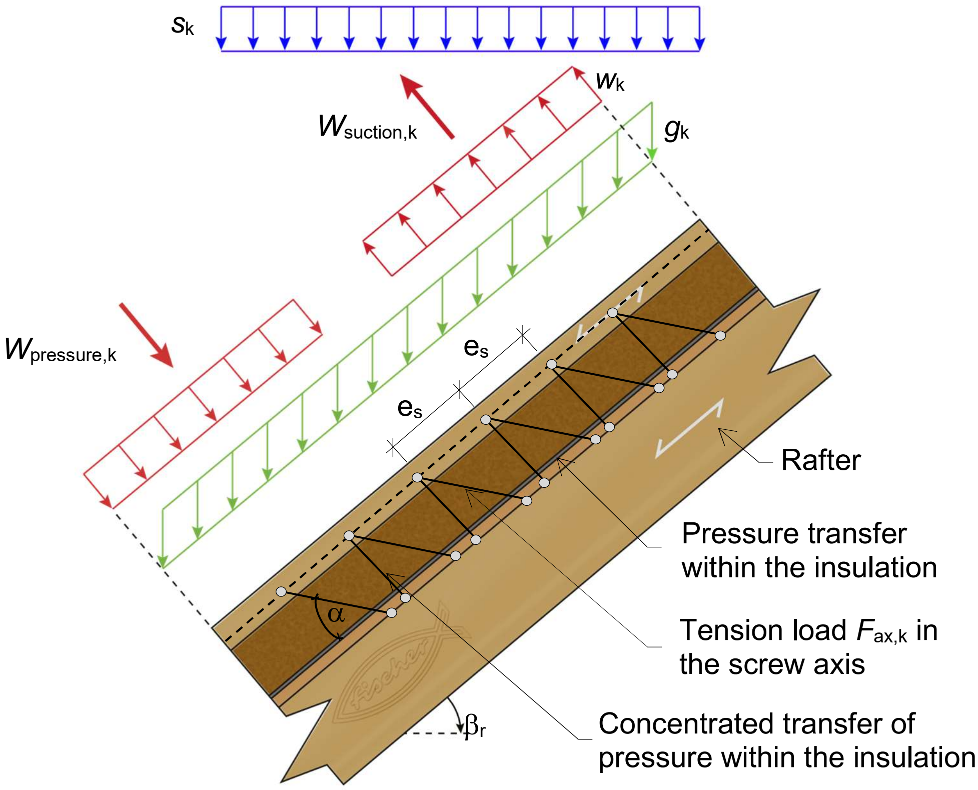


Figure E1.1: Counter batten on rafters with insulation (figures not to scale)

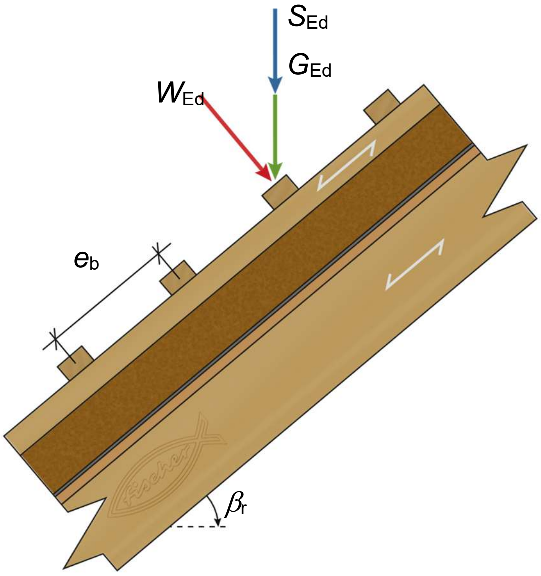
Where

β_r	Roof inclination	α	Angle between the screw axis and the grain-direction of the rafter
e_s	Spacing of screws	l_{ef}	Point side penetration length of the threaded part in the rafter

fischer PowerFast II	**Annex E1**
Fixations of on-roof insulations	

fischer PowerFast II screws for the structural use in timber constructions

Point loads F_{Ed} perpendicular to the battens for sufficiently compression resistant insulations



$$\begin{aligned} G_{Ed} &= \gamma_G \cdot g_k \cdot e_b \cdot e_r \\ S_{Ed} &= \gamma_Q \cdot s_k' \cdot e_b \cdot e_r \cdot \cos\beta_r \\ W_{Ed} &= \gamma_Q \cdot w_{pressure,k} \cdot e_b \cdot e_r \\ F_{Ed} &= W_{Ed} + (G_{Ed} + S_{Ed}) \cdot \cos\beta_r \end{aligned} \qquad (50)$$

Figure E2.1: Counter batten on rafters with insulation – Calculation model action loads (figure not to scale)

Where

F_{Ed}	Point load perpendicular to the battens [N]
G_{Ed}	Point load by dead weight [N]
S_{Ed}	Point load by snow load [N]
W_{Ed}	Point load by wind pressure [N]
e_b	Distance of the battens [mm]
e_r	Distance of the rafters [mm]
g_k	Characteristic dead load per m² roof area [N/m²]
s_k'	Characteristic snow load per m² roof area [N/m²]
$w_{pressure,k}$	Characteristic wind pressure per m² roof area [N/m²]
β_r	Roof inclination [°]
γ_G	Partial factor for permanent action acc. to EN 1990
γ_Q	Partial factor for variable action acc. to EN 1990

Note: For the calculation design values must be used

Design of PowerFast II screws for the structural use in timber constructions

Point loads F_{Ed} perpendicular to the battens by the screws

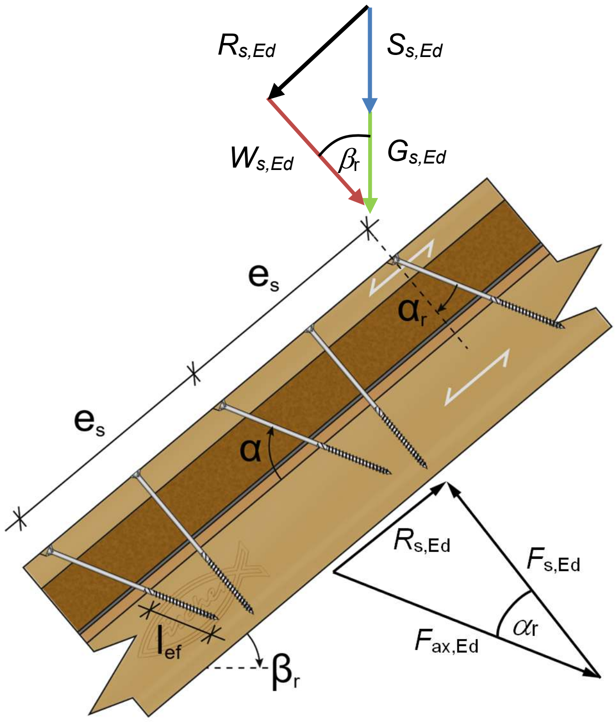


Figure E3.1: Counter batten on rafters with insulation – Design loads (figure not to scale)

$$
\begin{aligned}
G_{s,Ed} &= \gamma_G \cdot g_k \cdot e_s \cdot e_r \\
S_{s,Ed} &= \gamma_Q \cdot s_k{}' \cdot e_s \cdot e_r \cdot \cos\beta_r \\
R_{s,Ed} &= \left(G_{s,Ed} + S_{s,Ed}\right) \cdot \sin\beta_r \\
F_{s,Ed} &= R_{s,Ed} / \tan\alpha_r
\end{aligned}
\quad (51)
$$

Where

$F_{ax,Ed}$	Axial load of the screws [N]
$F_{s,Ed}$	Point loads perpendicular to the battens by screws [N]
$G_{s,Ed}$	Point load by dead weight [N]
$R_{s,Ed}$	Shear load due to dead weight and snow load [N]
$S_{s,Ed}$	Point load by snow load [N]
$W_{S,Ed}$	Point load by wind pressure [N]
e_s	Distance of the screws [mm]
e_r	Distance of the rafters [mm]
g_k	Characteristic dead load on the roof [N/m²]
s_k’	Characteristic snow load on the roof [N/m²]
α_r	Inclination of the screw axis (see Figure L3.1) [°]
β_r	Roof inclination [°]
γ_G	Partial factor for permanent action acc. to EN 1990 [-]
γ_Q	Partial factor for variable action acc. to EN 1990 [-]

Note: For the calculation design values must be used

Design of PowerFast II screws for the structural use in timber constructions

The bending stresses of the battens are calculated with

$$M_{Ed} = \frac{\left(F_{Ed} + F_{s,Ed}\right) \cdot l_{char}}{4} \quad (52)$$

Where

F_{Ed} Point loads perpendicular to the battens [N]
$F_{s,Ed}$ Point loads perpendicular to the battens in the area of the screw heads [N]
M_{Ed} Design bending moment of the batten [Nmm]
l_{char} Characteristic length of the batten [mm]

with $l_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}}$, where

- EI Bending stiffness of the batten [Nmm²]
- w_{ef} Effective width of the thermal insulation [mm]
  with $w_{ef} = w + t_{ti} / 2$, where
  - w Minimum width of the batten or rafter [mm]
  - t_{ti} Thickness of the thermal insulation [mm]
- K Bedding modulus [N/mm³]
  The coefficient K may be calculated from the modulus of elasticity E_{ti} and the thickness t_{ti} of the thermal insulation if the effective width w_{ef} of the thermal insulation under compression is known. Due to the load extension in the insulation the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the thermal insulation may be determined with $K = \frac{E_{ti}}{t_{ti}}$, where
  - E_{ti} Modulus of elasticity of the thermal insulation [N/mm²]
  - t_{ti} Thickness of the thermal insulation [mm]

The following conditions shall be satisfied:

$$\frac{\sigma_{m,Ed}}{f_{m,d}} \leq 1 \quad (53)$$

Where

$\sigma_{m,Ed}$ Design value of the bending stress of the batten [N/mm²]
$f_{m,d}$ Design value of the bending strength [N/mm²]

$$\frac{\tau_{Ed}}{f_{v,d}} = \frac{3 \cdot V_{Ed}}{2 \cdot A_{ef} \cdot f_{v,d}} \leq 1 \quad (54)$$

Where
$f_{v,d}$ Design value of the shear strength of the batten [N/mm²]
A_{ef} Net cross section of the batten [mm²]
V_{Ed} Design shear load onto the batten [N]

with $V_{Ed} = \frac{F_{Ed} + F_{s,Ed}}{2}$

τ_{Ed} Design value of the shear stress of the batten [N/mm²]

Design of PowerFast II screws for the structural use in timber constructions

If the compressive stresses are transferred over the thermal insulation and not the screws, the following equation has to be considered.

$$\sigma_{c,Ed} = \frac{1{,}5 \cdot F_{Ed} + F_{s,Ed}}{2 \cdot l_{char} \cdot w_{ef}} \quad (55)$$

Where

$\sigma_{c,Ed}$ Design value of the compression stresses of the thermal insulation
F_{Ed} Point loads perpendicular to the battens [N]
$F_{s,Ed}$ Point loads perpendicular to the battens in the area of the screw heads [N]
l_{char} Characteristic length of the batten [mm]

with $l_{char} = \sqrt[4]{\frac{4 \cdot EI}{w_{ef} \cdot K}}$, where

EI Bending stiffness of the batten [Nmm²]
w_{ef} Effective width of the thermal insulation [mm]

with $w_{ef} = w + t_{ti} / 2$,

Where
w Minimum width of the batten or rafter [mm]
t_{ti} Thickness of the thermal insulation [mm]

K Bedding modulus [N/mm³]
The coefficient K may be calculated from the modulus of elasticity E_{ti} and the thickness t_{ti} of the thermal insulation if the effective width w_{ef} of the thermal insulation under compression is known. Due to the load extension in the insulation the effective width w_{ef} is greater than the width of the batten or rafter, respectively. For further calculations, the effective width w_{ef} of the thermal insulation may be determined with $K = \frac{E_{ti}}{t_{ti}}$, where

E_{ti} Modulus of elasticity of the thermal insulation [N/mm²]
t_{ti} Thickness of the thermal insulation [mm]

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

Design of PowerFast II screws for the structural use in timber constructions

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

$$F_{ax,Ed} = \frac{R_{s,Ed}}{\cos \alpha_r} \leq F_{ax,\alpha,Rd} \tag{56}$$

Where

$F_{ax,Ed}$	Design value of the axial tension forces onto the screw [N]
$F_{ax,\alpha,Rd}$	Design value of the withdrawal capacity of the screw [N]
$R_{s,Ed}$	Shear loads onto the screw [N]
α_r	Angle inclined screw (see Figure L3.1) [°]

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

The design axial capacity of fischer PowerFast II screws for rafter or façade installation should be calculated with equation (57). 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.

$$F_{ax,\alpha,Rd} = \min\left\{ k_{ax} \cdot f_{ax,d} \cdot d \cdot l_{ef,r} \cdot k_1 \cdot k_2 \cdot \left(\frac{\rho_{k,r}}{350}\right)^{0,8} ;\ \max\left\{ \begin{matrix} f_{head,d} \cdot d_h^{\,2} \\ k_{ax} \cdot f_{ax,d} \cdot d \cdot l_{ef,b} \end{matrix} \right\} \cdot \left(\frac{\rho_{k,b}}{350}\right)^{0,8} ; f_{tens,d} \right\} \tag{57}$$

Where

$F_{ax,\alpha,Rd}$	Design value of the withdrawal capacity of the screw [N]
d	Diameter of the screw [mm]
d_h	Head diameter of the screw [mm]
$f_{ax,d}$	Design value of the withdrawal parameter of the threaded part of the screw [N/mm²]
$f_{head,d}$	Design value of the head pull-through capacity of the screw [N/mm²]
$f_{tens,d}$	Design value of the tensile capacity of the screw [N]
k_{ax}	Coefficient according to equation (22)
k_1	min {1; 200 / t_{ti}} [-]
k_2	min {1; $\sigma_{10\%,Ed}$ / 0,12} [-], where $\sigma_{10\%,Ed}$ Compressive stress of the heat insulation at 10 % deformation [N/mm²] t_{ti} Thickness of the thermal insulation [mm]
$l_{ef,r}$	Point side penetration length of the threaded part in the rafter with $l_{ef} \geq 40$ mm
$l_{ef,b}$	Penetration length of the threaded part in the batten
α	Angle between grain and screw axis ($\alpha \geq 30°$) [°]
ρ_k	Characteristic density of the timber element [kg/m³]

Note: If the factors k_1 and k_2 are considered in the equation for $F_{ax,Rd}$, the deflection of the battens is not be taken into account. Alternatively to the battens, panels with a minimum thickness of 20 mm from plywood according to EN 636, national provisions or with an ETA that apply at the installation site, particle board according to EN 312, national provisions or with an ETA that apply at the installation site, oriented strand board according to EN 300, national provisions or with an ETA that apply at the installation site and solid wood panels according to EN 13353, national provisions or with an ETA that apply at the installation site or Cross- laminated Timber according to an ETA may be used.

Design of PowerFast II screws for the structural use in timber constructions

Thermal insulation material on rafters with parallel screws perpendicular to the roof plane

Alternative to the battens, panels with a minimum thickness of 20 mm from plywood according to EN 636, particleboard according to EN 312, oriented strand board OSB/3 and OSB/4 according to EN 300 or European Technical Assessment and solid wood panels according to EN 13353 may be used.
The insulation must have a minimum compressive strength of $\sigma_{10\%}$=0,05 N/mm² at 10 % deformation according to EN 826.
The battens or wood-based panels, respectively, must have sufficient strength and stiffness. The maximum design value of the compressive stress between the battens or boards, respectively, and the insulation shall not exceed 1,1 $\sigma_{10\%}$.

Characteristic load-carrying capacity of a screw loaded in shear may be calculated with

$$F_{v,Rk} = \min \begin{cases} f_{h,b,k} \cdot d \cdot t_b \\ f_{h,r,k} \cdot d \cdot t_r \\ \dfrac{f_{h,b,k} \cdot d \cdot \beta}{1+\beta} \cdot \left(\sqrt{4t_{ti}^2 + (2+\dfrac{1}{\beta})t_b^2 + (2+\beta)t_r^2 + 4t_{ti}\left(t_b + t_r\right) + 2t_b t_r} - 2t_{ti} - t_b - t_r \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}05 \cdot \dfrac{f_{h,b,k} \cdot d \cdot \beta}{\dfrac{1}{2}+\beta} \left(\sqrt{t_{ti}^2 + t_{ti}t_b + \dfrac{t_b^2}{2}\left(1+\dfrac{1}{\beta}\right) + \dfrac{M_{y,k}}{f_{h,b,k} \cdot d}\left(1+\dfrac{2}{\beta}\right)} - t_{ti} - \dfrac{t_b}{2} \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}05 \cdot \dfrac{f_{h,b,k} \cdot d \cdot \beta}{\dfrac{1}{2}+\beta} \left(\sqrt{t_{ti}^2 + t_{ti}t_r + \dfrac{t_r^2}{2}\left(1+\beta\right) + \dfrac{M_{y,k}}{f_{h,b,k} \cdot d}\left(2+\dfrac{1}{\beta}\right)} - t_{ti} - \dfrac{t_r}{2} \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}15 \cdot \dfrac{f_{h,b,k} \cdot d}{1+\beta} \left(\sqrt{\beta^2 t_{ti}^2 + 4 \cdot \beta\left(\beta+1\right) \cdot \dfrac{M_{y,k}}{f_{h,b,k} \cdot d}} - \beta \cdot t_{ti} \right) + \dfrac{F_{ax,Rk}}{4} \end{cases} \tag{58}$$

Where

$F_{v,RK}$	Characteristic load-carrying capacity of a screw loaded in shear [N]
$M_{y,k}$	Characteristic yield moment of the screw [Nmm]
$F_{ax,Rk}$	The minimum characteristic load-carrying capacity of the axially loaded screws acc. to Annex D [N]
$f_{h,b,k}$	Characteristic embedment strength of the batten [N/mm²]
$f_{h,r,k}$	Characteristic embedment strength of the rafter [N/mm²]
d	Outer thread diameter [mm]
t_b	Batten thickness [mm]
t_r	The lower value of rafter thickness or screw penetration length [mm]
t_{ti}	Thickness of the thermal insulation [mm]
β	Coefficient of the embedment strength of the rafter to the batten [-] with $\beta = f_{h,r,k} / f_{h,b,k}$

Applications of PowerFast II screws for the structural use in timber constructions

FAFS-Clip of adjustable frame screw: Installations of ceilings or technical shells

The FAFS-Clip has to be used in combination with fischer PowerFast II – Chipboard screws with *d*=5 mm and countersunk head geometry (see Annex A1). It should be considered that the screw-in direction referred to the load direction (see Figure F1.1) is 0 ± 5°. Horizontal loads which also effects bending moments of the screws should be avoided or otherwise transferred with additional slanted screws. Minimum spacings and distances to the end grain see Annex B10.

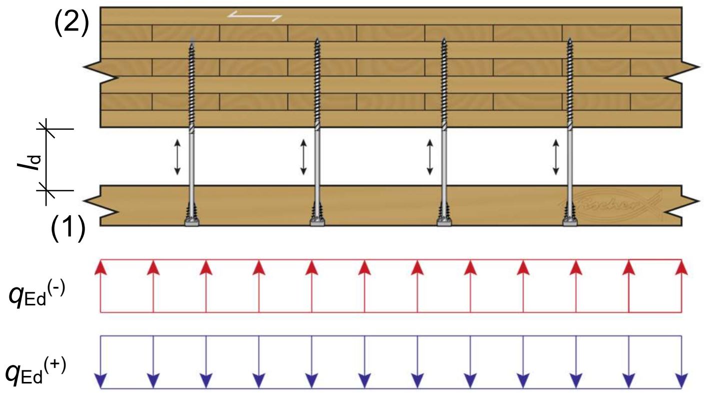


Figure F1.1: Installation of a ceiling or technical shell with the FAFS-Clip (figure not to scale)

The load-carrying capacity for acting loads $q_{Ed}^{(+)}$ can be calculated like following:

$$q_{Ed}^{(+)} \cdot e \leq \min \begin{cases} F_{ax,Rd} \\ F_{FAFS,t,Rd} \end{cases} \qquad (59)$$

With

$F_{ax,Rd}$	According to Annex D9 for screws in Annex A1 with *d* = 5,0 mm
$F_{FAFS,t,Rd}$	According to Annex D17 for FAFS-Clip in Annex A18

The load carrying capacity for acting loads $q_{Ed}^{(-)}$ should be calculated like shown below, for vertical applications with lateral loads on the FAFS-Clip screw system see Annex F3.

$$q_{Ed}^{(-)} \cdot e \leq \min \begin{cases} F_{ax,Rd} \\ F_{ki,Rd} \\ F_{FAFS,c,Rd} \end{cases} \qquad (60)$$

With

$F_{ax,Rd}$	According to Annex D9 for screws in Annex A1 with *d* = *5,0* mm
$F_{FAFS,c,Rd}$	According to Annex D17 for FAFS-Clip in Annex A18

and

$$F_{ki,Rd} = \kappa_c \cdot N_{pl,d} \qquad (61)$$

where

$$\kappa_c = 1 \qquad \text{for } \bar{\lambda} \leq 0,2$$
$$\kappa_c = \frac{1}{k + \sqrt{k^2 - \bar{\lambda}^2}} \qquad \text{for } \bar{\lambda} > 0,2 \qquad (62)$$

Applications of PowerFast II screws for the structural use in timber constructions

FAFS-Clip of adjustable frame screw: Installations of ceilings or technical shells

with

$$k = 0,5 \cdot \left[1 + 0,49 \cdot \left(\overline{\lambda} - 0,2\right) + \overline{\lambda}^2\right] \quad (63)$$

The relative slenderness ratio shall be calculated with

$$\overline{\lambda} = \frac{4 \cdot L_{cr}}{\pi \cdot (0,7 \cdot d)} \cdot \sqrt{\frac{f_{y,k}}{E_s}} \quad (64)$$

With the characteristic value for the axial capacity in case of plastic analysis referred to the diameter

$$N_{pl,k} = \frac{(0,7 \cdot d)^2 \cdot \pi}{4} \cdot f_{y,k} \quad (65)$$

For screws with a diameter of 5 mm, according to Annex A1

$$N_{pl,k} = 8710 \text{ N} \quad (66)$$

And the buckling length L_{cr} *on the side of the screw tip* with a minimum penetration depth of $8 \cdot d$

$$L_{cr} = 0,7 \cdot l_d \quad (67)$$

Where

d	Nominal diameter of the screw [mm]
e	Effective distance (supporting points) between parallel arranged screws [m]
E_s	Modulus of elasticity of the screw [N/mm²], see Annex C
$F_{ax,Rd}$	Design withdrawal capacity of the screw in the structural timber element (2) [N], see Annex D10
$F_{FAFS,t,Rd}$	Design head pull-through capacity of the FAFS-Clip in timber part (1) for tension forces [N], see Annex D17
$F_{FAFS,c,Rd}$	Design head push-through capacity of the FAFS-Clip in timber part (1) for compression forces [N], see Annex D17
L_{cr}	Buckling length of the screw [mm]
l_d	Distance between (1) and (2) [mm]
$N_{pl,k}$	Characteristic axial capacity in case of plastic analysis [N]
$q_{Ed}^{(+)}$	Design load effecting tension loads on the installation element (1) [N/m]
$q_{Ed}^{(-)}$	Design load effecting compression loads on the installation element (1) [N/m]

Note: The compressive capacity must be modified for $f_{ax,d}$ with the factors k_{mod} and γ_M for timber according to EN 1995-1-1, while $N_{pl,d}$ the partial-factor $\gamma_{M,1}$ for steel buckling according to EN 1993-1-1 and/or national standards must be considered.

Applications of PowerFast II screws for the structural use in timber constructions

Installation of vertical shells, structural design

Structural design

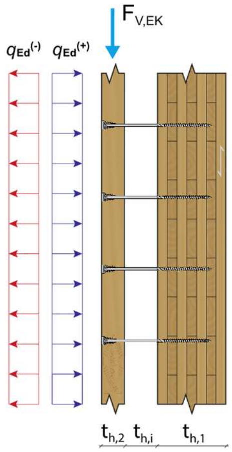


Figure F3.1: Vertical application of FAFS-Clips – principal of the structural-design (figure not to scale)

$$F_{v,Rk} = \min \begin{cases} f_{h,2,k} \cdot d \cdot t_{h,2} \\ f_{h,1,k} \cdot d \cdot \ell_{ef} \\ \dfrac{f_{h,2,k} \cdot d \cdot \beta}{1+\beta} \cdot \left(\sqrt{4t_{h,i}^2 + (2+\dfrac{1}{\beta})t_2^2 + (2+\beta)\ell_{ef}^{\ 2} + 4l_{ef}\left(t_2 + \ell_{ef}\right) + 2t_2\ell_{ef}} - 2t_{h,i} - t_{h,2} - \ell_{ef} \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}05 \cdot \dfrac{f_{h,2,k} \cdot d \cdot \beta}{\dfrac{1}{2}+\beta} \left(\sqrt{t_{h,i}^2 + t_{h,i} \cdot t_{h,2} + \dfrac{t_2^2}{2}\left(1+\dfrac{1}{\beta}\right) + \dfrac{M_{y,k}}{f_{h,2,k} \cdot d}\left(1+\dfrac{2}{\beta}\right)} - t_{h,i} - \dfrac{t_2}{2} \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}05 \cdot \dfrac{f_{h,2,k} \cdot d \cdot \beta}{\dfrac{1}{2}+\beta} \left(\sqrt{t_{h,i}^2 + t_{h,i}\ell_{ef} + \dfrac{\ell_{ef}^{\ 2}}{2}\left(1+\beta\right) + \dfrac{M_{y,k}}{f_{h,2,k} \cdot d}\left(2+\dfrac{1}{\beta}\right)} - t_{h,i} - \dfrac{\ell_{ef}}{2} \right) + \dfrac{F_{ax,Rk}}{4} \\ 1{,}15 \cdot \dfrac{f_{h,2,k} \cdot d}{1+\beta} \left(\sqrt{\beta^2 t_{h,i}^2 + 4 \cdot \beta\left(\beta+1\right) \cdot \dfrac{M_{y,k}}{f_{h,2,k} \cdot d}} - \beta \cdot t_{h,i} \right) + \dfrac{F_{ax,Rk}}{4} \end{cases} \quad (68)$$

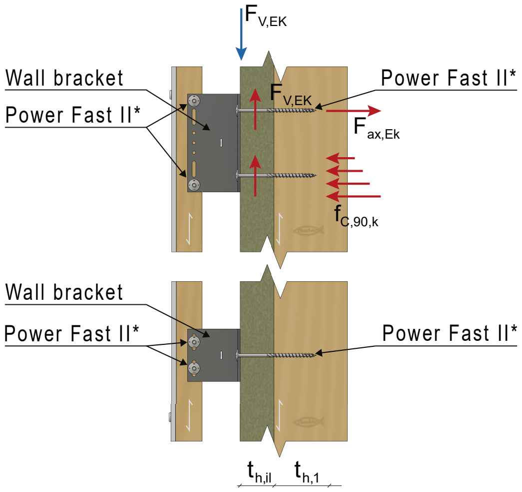
Where

$F_{v,RK}$	Characteristic value of the load-carrying capacity of a screw in shear [N]
$M_{y,k}$	Characteristic value of the yield moment of the screw, see Table C1.1 [Nmm]
$F_{ax,Rk}$	Characteristic value of the withdrawal capacity of fischer PowerFast II screws [N]
$f_{h,1,k}$	Characteristic value of the embedment strength in the timber member 1 [N/mm²]
$f_{h,2,k}$	Characteristic value of the embedment strength in timber member 2 [N/mm²]
d	Outer thread diameter of the screw [mm]
$t_{h,1}$	Thickness of timber member 1 [mm]
$t_{h,2}$	Thickness of timber member 2 [mm]
l_{ef}	Penetration length of the screw in the timber member 1 [mm]
$t_{h,i}$	Thickness of the movable intermediate elastic layer [mm]
β	Ratio of the embedment strengths of both timber members with $\beta = f_{h,1,k} / f_{h,2,k}$ [-]

Design of PowerFast II screws for the structural use in timber constructions

Calculation models for structural systems with movable interlayers and thin metal plates

For the installation of secondary structural members with thin metal plates ($t \leq 0{,}5 \cdot d$) fixed on movable compression-resistant intermediate layers the load-carrying capacity of the screws in lateral direction should be calculated with equation (69).



*) Type of PowerFast II screw has to be selected based on load, base material an geometric boundaries

Figure F4.1: Applications of fischer PowerFast II screws for Systems with movable interlayers (figures not to scale)

$$F_{v,d} = \frac{1}{\gamma_M} \cdot \min \begin{cases} f_{h,1,k} \cdot k_{mod,1} \cdot d \cdot \left[\sqrt{\delta \cdot t_{h,il}^2 + 4 \cdot t_{h,il}^2 + 4 \cdot t_{h,1} \cdot t_{h,il} + 2 \cdot t_{h,1}^2} - \left(2 \cdot t_{h,il} + t_{h,1} \right) \right] \\ f_{h,1,k} \cdot k_{mod,1} \cdot d \cdot \left[\sqrt{\frac{\delta \cdot t_{h,il}^2}{2} + 2 \cdot t_{h,il}^2 + \frac{2 \cdot M_{y,Rk}}{f_{h,1,k} \cdot k_{mod,1} \cdot d}} + t_{h,il}{}^2 - t_{h,il} \right] \end{cases} \qquad (69)$$

with

$$\delta = \frac{k_{mod,il} \cdot f_{h,il,k}}{k_{mod,1} \cdot f_{h,1,k}} \qquad (70)$$

Where

$f_{h,1,k}$	Characteristic embedment strength in timber member [N/mm²]
$f_{h,il,k}$	Characteristic embedment strength in the interlayer [N/mm²]
$t_{h,1}$	Embedment depth in the timber member, note: $t_{h,1}=l_{ef}$ [mm]
$t_{h,il}$	Thickness of the intermediate layer [mm]
d	Outer thread diameter of the fischer PowerFast II screws [mm]
$k_{mod,1}$	Modification factor for timber members [-]
$k_{mod,il}$	Modification factor interlayer [-]
$M_{y,Rk}$	Characteristic yield moment [Nmm]
γ_M	Partial factor for the screws, recommended γ_M=1,30

Note: In addition to the lateral impacts on »fischer PowerFast II« screws, depending on the structural system also axial loads on the screws must be considered due to the couple of forces. Pull-through resistance of the screw heads shall be verified separately in accordance with the applicable design standards and the specific components used, as the tear-off capacity of the screw head exceeds the tensile strength of the screw itself.
PowerFast II screws – Stainless steel should only be used in combination with timber supports.

Design of PowerFast II screws for the structural use in timber constructions

Calculation models for structural models with unmovable interlayers and thin metal plates

For the installation of secondary structural members with thin metal plates ($t \leq 0{,}5 \cdot d$) fixed on unmovable compression-resistant intermediate layers the load-carrying capacity of the screws in lateral direction should be calculated with equation (71).

$$F_{v,Rd} = \frac{1}{\gamma_M} \cdot \min \begin{cases} k_{mod,1} \cdot f_{h,1,k} \cdot t_1 \cdot d + k_{mod,il} \cdot f_{h,il,k} \cdot t_{h,il} \cdot d \\ 2 \cdot f_{h,1,k} \cdot k_{mod,1} \cdot d \cdot \left(\sqrt{-\frac{\delta \cdot t_{h,il}^2}{2} + \frac{t_{h,1}^2}{2} + \frac{M_{y,Rk}}{f_{h,1,k} \cdot k_{mod,1} \cdot d} + t_{h,il}^2 + t_{h,1} \cdot t_{h,il}} - t_{h,il} \right) + \left(f_{h,il,k} \cdot k_{mod,il} \cdot t_{h,il} - f_{h,1,k} \cdot k_{mod,1} \cdot t_{h,1} \right) \cdot d \\ f_{h,1,k} \cdot k_{mod,1} \cdot d \cdot \left(\sqrt{\frac{4 \cdot M_{y,Rk}}{f_{h,1,k} \cdot k_{mod,1} \cdot d} + \left(t_{h,il}^2 - \delta \cdot t_{h,il}^2 \right)} - t_{h,il} \right) + f_{h,il,k} \cdot k_{mod,il} \cdot t_{h,il} \cdot d \end{cases} \quad (71)$$

with

$$\delta = \frac{k_{mod,il} \cdot f_{h,il,k}}{k_{mod,1} \cdot f_{h,1,k}} \quad (72)$$

Where

$f_{h,1,k}$	Characteristic embedment strength in timber member [N/mm²]
$f_{h,il,k}$	Characteristic embedment strength in the interlayer [N/mm²]
$t_{h,1}$	Embedment depth in the timber member [mm]
$t_{h,il}$	Thickness of the intermediate layer [mm]
d	Outer thread diameter of the fischer PowerFast II screws [mm]
$k_{mod,1}$	Modification factor for timber members [-]
$k_{mod,il}$	Modification factor interlayer [-]
$M_{y,Rk}$	Characteristic yield moment [Nmm]
γ_M	Partial factor for the screws, recommended γ_M=1,30

Note: In addition to the lateral impacts on »fischer PowerFast II« screws, depending on the structural system also axial loads on the screws must be considered due to the couple of forces.
Pull-through resistance of the screw heads shall be verified separately in accordance with the applicable design standards and the specific components used, as the tear-off capacity of the screw head exceeds the tensile strength of the screw itself.
PowerFast II screws – Stainless steel should only be used in combination with timber supports.

Design of PowerFast II screws for the structural use in timber constructions

Inclined screws with an angle of 45° for the use in single shear plane timber-to-steel connections

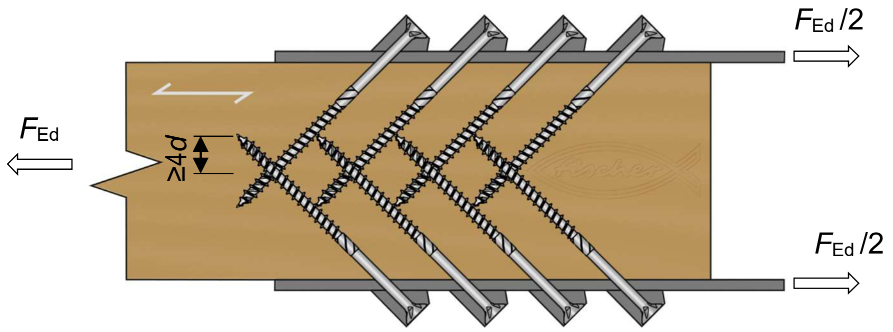


Figure G1.1: Shear connection with inclined screws steel-to-timber connection (figure not to scale)

$$F_{v,Rk} = F_{ax,\alpha,Rk} \cdot (\mu \cdot \sin\alpha + \cos\alpha) + \sqrt{2 \cdot (1+\zeta)} \cdot \sqrt{M_{y,Rk} \cdot f_{h,\alpha,k} \cdot (0,7 \cdot d) \cdot \sin^2\alpha} \cdot (1 - \mu \cdot \cot\alpha) \quad (73)$$

With

Where

$F_{v,Rk}$	Characteristic load-carrying capacity of a screw each shear plane [N]
$F_{ax,\alpha,Rk}$	Characteristic withdrawal capacity of the screw [N], see Annex D
α	Angle between screw axis and grain-direction [°], α = 45°
ζ	Factor to consider partial restraint of the screw head in the steel plate [0≤ ζ ≤1] ζ=0 For thin steel plates t < 1,5·d ζ=1 For thick steel plates t ≥ 1,5·d *and tolerances of the diameter less than* 0,1·d In between a linear interpolation is allowed
$M_{y,Rk}$	Yield moment of the screw see Annex C [Nmm],
$f_{h,\alpha',k}$	Characteristic embedment strength of the screw with an angle α' = 45 [°]
μ	Coefficient of friction, if permanent compression forces between the steel/aluminium and timber elements can be ensured For steel and aluminium μ = 0,25

Note: For the use of inclined screws from opposite sides, the screws must overlap in the area of the screw tips to avoid a damage due to tension stress perpendicular to the grain-direction (Recommended value ≥ 4·d)

Design of PowerFast II screws for the structural use in timber constructions

Inclined screws for the use in single shear plane timber-to-timber connections

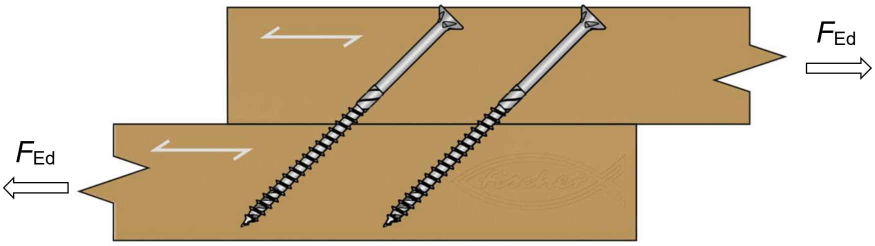


Figure G2.1: Shear connection with inclined screws timber-to-timber connection (figure not to scale)

The load-carrying capacity

$$F_{v,Rk} = \frac{1}{\sqrt{\left(\frac{\cos\alpha}{F_{v,Rk}}\right)^2 + \left(\frac{\sin\alpha}{F_{ax,Rk}}\right)^2}} \qquad (74)$$

The slip modulus, see also Annex D21 to D23

$$K_{ser} = K_{v,ser} \cdot \cos\alpha \cdot (\cos\alpha - \mu \cdot \sin\alpha) + K_{ax,ser} \cdot \sin\alpha \cdot (\sin\alpha + \mu \cdot \cos\alpha) \qquad (75)$$

For cross coupled screws the friction should not be considered, which leads to

$$K_{ser} = K_{v,ser} \cdot \cos^2\alpha + K_{ax,ser} \cdot \sin^2\alpha \qquad (76)$$

Considering the deformations in both parts leads to the total slip modulus

$$K_{v,tot,ser} = \frac{1}{\frac{1}{K_{ax,ser,1}} + \frac{1}{K_{ax,ser,2}}} \qquad (77)$$

Where

d	Outer thread diameter of the screw [mm]
$F_{v,Rk}$	Characteristic load-carrying capacity of a screw each shear plane [N]
$F_{ax,Rk}$	Withdrawal capacity of the screw [N], see Annex D
$K_{ax,ser}$	Slip modulus parallel to the screw axis in the serviceability limit state [N/mm]
$K_{v,ser}$	Slip modulus perpendicular to the screw axis in the serviceability limit state [N/mm]
α	Angle between screw axis and grain-direction [°]
μ	Coefficient of friction, if permanent compression forces between the timber elements can be ensured μ = 0,25

Applications of PowerFast II screws for the structural use in timber constructions

Axial resistance of protruding screws in timber elements
Based on the design models shown in Annex D18, Figure H1.1 shows an example how to clamp screws and introduce compressive forces into the screw's head.

For screws loaded in compression which are not completely embedded in timber, values based on Euler's theory from Table H1.1 can be used for the critical buckling load in combination with screw head supporting plates shown in Figure H1.1.

Table H1.1: Design buckling capacities in [kN] for screws with a free screw length protruding from the timber member including the screw head and the screw fixed between two metal plates where distortion and displacement of the screw head perpendicular to the buckling loads of the screw head are not possible, referred to a minimum gross density of the timber member of 350 kg/m³ and a partial factor of $\gamma_{M,1}$=1,1.

Free screw length protruding from the timber member including the screw head [mm]	Carbon steel		Stainless steel
	8,0	10,0	8,0
≤ 120[1)]	11,12	18,52	8,05
140	8,91	15,26	6,83
160	7,23	12,62	5,78
180	5,96	10,53	4,89
200	4,98	8,87	4,17
220	4,21	7,56	3,58
240	3,61	6,51	3,10
260	3,12	5,65	2,71
280	2,73	4,96	2,38
300	2,40	4,38	2,11

[1)] For free screw lengths ≤ 120 mm, buckling is not decisive

Example of a supporting plate to restrain screw heads
Metric screws with hexagon head, countersunk head or cylindric head or threaded rods with nut and washer – each according to the structural requirements – at least 2 x M8 (≥ 4.6 respectively A2-50) for the connection of the two plates made of aluminium (mechanical properties at least like e.g. EN AW 6082, EN AW 5083, EN AW 6060 or EN AC-44100); made of carbon steel or made of stainless steel (each at least S235).

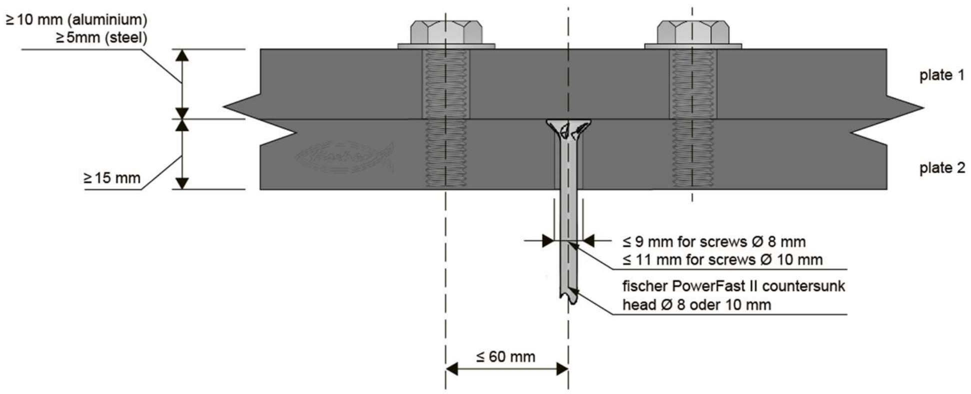


Figure H1.1: Screw head supporting plate for fischer PowerFast II screws (figure not to scale)