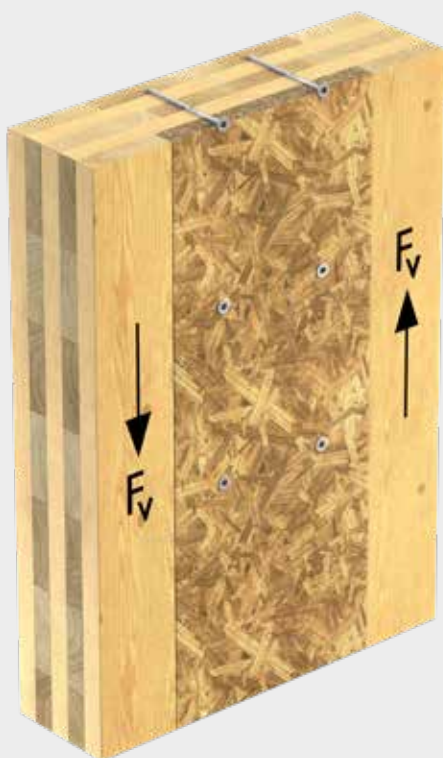


CROSS-LAMINATED TIMBER CONNECTIONS

Wall and floor assemblies



CONTENTS

1. Application	3
2. Panel-to-panel connections	4
2.1 Single surface spline	4
2.2 Half-lapped joint	6
2.3 Internal spline	8
3. Products	10
4. Accessories	11
5. General situation	12

Note:

Relevant parameters of ETA and/or other standards may be quoted in part and summarized in this brochure. Please observe the full text of the respective regulations and standards. Plausibility and conformity with currently applicable standards shall be checked and approved by the responsible structural engineer.

ASSY screws have approval in accordance with ETA-11/0190, are subject to voluntary third-party inspection according to the 2+ system and are CE marked in accordance with the Construction Products Regulation. For specific instructions for use please refer to ETA-11/0190.

1. Application

Creating panel-to-panel assemblies between two CLT (cross-laminated timber) wall elements or two CLT floor elements.

The dimensions of CLT elements depend on the manufacturing, transport and installation conditions as well as on structural and physical requirements. Due to their dimensions, several CLT members are connected together to form wall and floor assemblies, which are a prerequisite for bracing buildings. Various connection systems may be used to transfer shear loads into the joints on the narrow side of the panel.

The following pages show the connection systems most widely used to create a continuous assembly. The tables list the characteristic load-bearing values of the selected fastener subject to the required edge distance if spacing distances vary.

The selection of suitable connection systems taking into account a variation of fasteners allows for the greatest possible flexibility when pre-designing wall and floor assemblies for your CLT project.

Using full-thread screws, for instance, to fasten the individual members at their beginning and end automatically creates a force-closed connection for a rigid floor assembly.

Three connection techniques



2. Panel-to-panel connections

2.1 Single surface spline

Dimensions

CLT elements

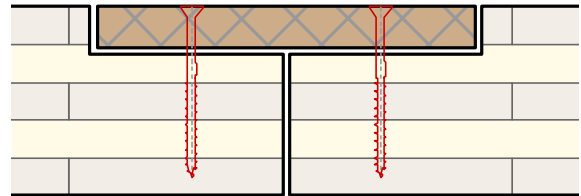
$t_{CLT} \geq 100$ mm

Spline material

OSB: $t_{EWP} = 22$ mm; $b = 120$ mm

LVL⁶⁾: $t_{EWP} = 27$ mm; $b = 140$ mm

Solid wood panel⁶⁾: $t_{EWP} = 22$ mm; $b = 120$ mm



Characteristic load capacity

Material	No.	$F_{v,Rk}$ [kN] per fastener	$f_{v,Rk}$ [kN/lfm]									Fasteners
			a_1 [mm]									
			50	75	100	125	150	175	200	225	250	
OSB ¹⁾	1.1.1	0.814	17.1	11.7	9.0	7.3	6.2	5.5	4.9	-	-	Smooth-shank nails 2.8 x 65
	1.1.2	1.97	-	28.2	21.7	17.7	15.1	13.2	11.8	10.7	9.9	ASSY 4 CSMP (TG) 6 x 70/42
	1.1.3	1.74	-	24.9	19.1	15.7	13.3	11.7	10.4	9.5	8.7	ASSY 4 WH (TG) 5 x 70/42
	1.1.4	0.840	17.6	12.0	9.2	7.6	-	-	-	-	-	⁵⁾ Resin-coated ETA-Q staples; $d = 1.8$ mm
LVL ²⁾³⁾⁶⁾	1.2.1	0.752	15.8	10.8	8.3	6.8	5.8	5.0	4.5	-	-	Smooth-shank nails 2.8 x 65
	1.2.2	2.17	-	31.1	23.9	19.5	16.6	14.6	13.0	11.8	10.9	ASSY 4 CSMP (TG) 6 x 70/42
	1.2.3	1.64	-	23.5	18.0	14.8	12.6	11.0	9.8	8.9	8.2	ASSY 4 CSMP (TG) 5 x 70/42
	1.2.4	1.34	28.1	19.2	14.7	12.1	10.3	9.0	8.0	7.3	6.7	ASSY 4 P CSMP 4.5 x 60/28
	1.2.5	0.760	16.0	10.9	8.4	6.8	-	-	-	-	-	⁵⁾ Resin-coated ETA-Q staples; $d = 1.8$ mm
Solid wood panel ⁴⁾⁶⁾	1.3.1	0.645	13.5	9.2	7.1	5.8	4.9	4.3	3.9	-	-	Smooth-shank nails 2.8 x 65
	1.3.2	1.66	-	23.8	18.3	14.9	12.7	11.1	10.0	9.0	8.3	ASSY 4 CSMP (TG) 6 x 70/42
	1.3.3	1.23	-	17.6	13.5	11.1	9.4	8.3	7.4	6.7	6.2	ASSY 4 CSMP (TG) 5 x 70/42
	1.3.4	1.18	24.8	16.9	13.0	10.6	9.0	7.9	7.1	6.4	5.9	ASSY 4 P CSMP 4.5 x 60/28
	1.3.5	0.708	14.9	10.1	7.8	6.4	-	-	-	-	-	⁵⁾ Resin-coated ETA-Q staples; $d = 1.8$ mm

¹⁾ OSB/2 or higher (OSB/3, OSB/4) according to DIN EN 13896, DIN EN 300 and DIN 20000-1.

²⁾ Steico X is used in accordance with the specifications of general construction permit Z-9.1-842 - including declaration of performance according to DIN EN 14374.

³⁾ Kerto Q is used in accordance with the specifications of general construction permit Z-9.1-847 - including declaration of performance according to DIN EN 14374.

⁴⁾ Solid wood panel (SWP; e.g. "3-ply panel") according to DIN EN 13896, DIN EN 13353 and DIN 20000-1.

⁵⁾ Resin-coated WÜRTH ETA-Q staple; $d = 1.8$ mm; $L_n = 56$ mm or $L_n = 63$ mm; $R_b = 11.0$ mm; zinc-plated (A4K); according to ETA-17/0631

⁶⁾ The grain of the face veneer must be aligned in parallel to the elements' butt joint.

Remarks: Design calculations must be made per building component (e.g. shear load calculations).

Fasteners arranged in one line with the grain **MUST** be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

Fasteners arranged in one line with the grain do **NOT** have to be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

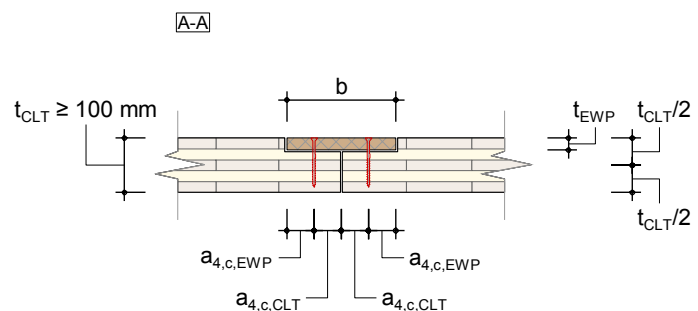
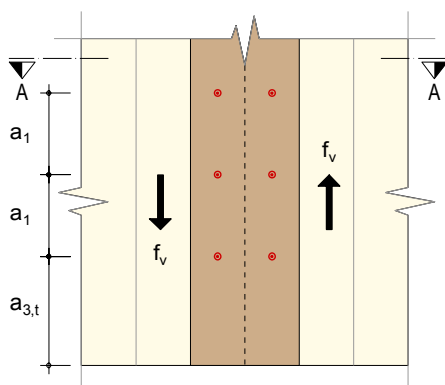
Fasteners arranged in one line with the grain do **NOT** have to be staggered by d at a right angle to the grain. Engineered wood connections that are only used for bracing, cf. DIN EN 1995-1-1, 8.3.1.3 /NA. 12).

The following table lists the minimum distances required per fastener. The resulting dimensions and load-bearing capacities of the components may be more economical than listed in the load-bearing capacity table, among others. The previously listed recommendations for component dimensions and load-bearing capacity have been based on practical construction considerations such as imprecise execution and tolerances.

Fastener spacing when using a single surface spline

No.	Fasteners	Minimum distance [mm]				Minimum distance in relation to diameter				Material
		a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$	a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$	
1.1.1	Smooth-shank nails 2.8 x 65	24	28	8	8	$0.85 \cdot 10 d$	$10 d$	$3 d$	$3 d$	OSB
1.1.2	ASSY 4 CSMP (TG) 6 x 70/42	61	42	18	18	$0.85 \cdot 12 d$	$7 d$	$3 d$	$3 d$	
1.1.3	ASSY 4 WH (TG) 5 x 70/42	51	35	15	15	$0.85 \cdot 12 d$	$7 d$	$3 d$	$3 d$	
1.1.4	Resin-coated ETA-Q staples; $d = 1.8 \text{ mm}$	27	36	18	18	$15 d$	$20 d$	$10 d$	$10 d$	
1.2.1	Smooth-shank nails 2.8 x 65	28	42	8	14	$10 d$	$15 d$	$3 d$	$5 d$	LVL
1.2.2	ASSY 4 CSMP (TG) 6 x 70/42	72	90	18	30	$12 d$	$15 d$	$3 d$	$5 d$	
1.2.3	ASSY 4 CSMP (TG) 5 x 70/42	60	75	15	25	$12 d$	$15 d$	$3 d$	$5 d$	
1.2.4	ASSY 4 P CSMP 4.5 x 60/28	45	68	14	23	$10 d$	$15 d$	$3 d$	$5 d$	
1.2.5	Resin-coated ETA-Q staples; $d = 1.8 \text{ mm}$	27	36	18	18	$15 d$	$20 d$	$10 d$	$10 d$	
1.3.1	Smooth-shank nails 2.8 x 65	24	28	8	8	$0.85 \cdot 10 d$	$10 d$	$3 d$	$3 d$	Solid wood panel
1.3.2	ASSY 4 CSMP (TG) 6 x 70/42	61	42	18	18	$0.85 \cdot 12 d$	$7 d$	$3 d$	$3 d$	
1.3.3	ASSY 4 CSMP (TG) 5 x 70/42	51	35	15	15	$0.85 \cdot 12 d$	$7 d$	$3 d$	$3 d$	
1.3.4	ASSY 4 P CSMP 4.5 x 60/28	38	32	14	14	$0.85 \cdot 10 d$	$7 d$	$3 d$	$3 d$	
1.3.5	Resin-coated ETA-Q staples; $d = 1.8 \text{ mm}$	27	36	18	18	$15 d$	$20 d$	$10 d$	$10 d$	

Single surface spline connection geometry



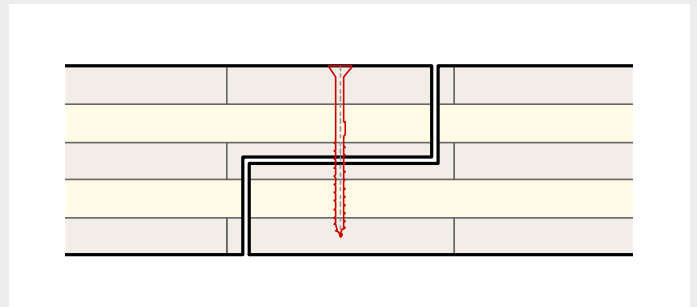
2.2 Half-lapped joint

Dimensions

CLT elements

$t_{CLT} \geq 100 \text{ mm}$

$b = 80 \text{ mm}$



Characteristic load capacity

No.	$F_{v,Rk}$ [kN] per fastener	$f_{v,Rk}$ [kN/lfm]									Fasteners
		a_1 [mm]									
		50	75	100	125	150	175	200	225	250	
2.1	3.28	-	47.0	36.1	29.5	25.1	22.0	19.7	17.9	16.4	ASSY 4 CSMP (TG) 8 x 100/60
2.2	2.10	44.1	30.1	23.1	18.9	16.1	14.1	12.6	11.4	10.5	ASSY 4 CSMP (TG) 6 x 90/50
2.3	4.06	-	58.2	44.7	36.5	31.1	27.3	24.4	22.1	20.3	ASSYplus VG 4 8 x 120 NOTE: only for $t_{CLT} \geq 120 \text{ mm}$!
2.4	2.49	52.3	35.7	27.4	22.4	19.1	16.7	14.9	13.6	12.5	ASSYplus VG 4 6 x 100

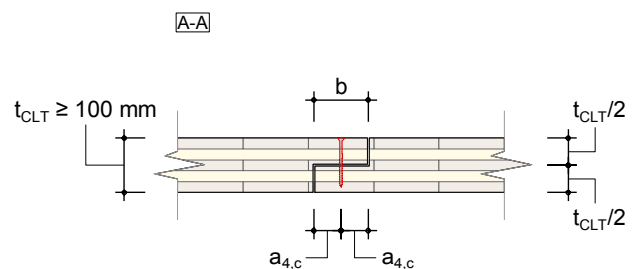
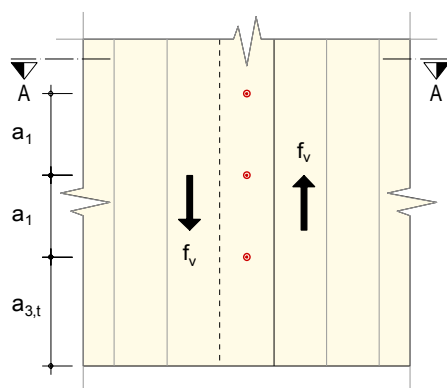
Fasteners arranged in one line with the grain **MUST** be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

Fasteners arranged in one line with the grain do **NOT** have to be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

The following table lists the minimum distances required per fastener. The resulting dimensions and load-bearing capacities of the components may be more economical than listed in the load-bearing capacity table, among others. The previously listed recommendations for component dimensions and load-bearing capacity have been based on practical construction considerations such as imprecise execution and tolerances.

Fastener spacing when using a half-lapped joint to create floor-floor/wall-wall assemblies

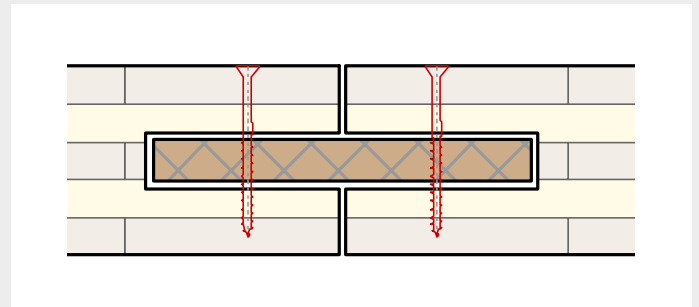
No.	Fasteners	Minimum distance [mm]				Minimum distance in relation to diameter			
		a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$	a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$
2.1	ASSY 4 CSMP (TG) 8 x 100/60	32	48	24	24	4 d	6 d	3 d	3 d
2.2	ASSY 4 CSMP (TG) 6 x 90/50	24	36	18	18	4 d	6 d	3 d	3 d
2.3	ASSYplus VG 4 8 x 120 NOTE: only for $t_{CLT} \geq 120$ mm!	32	48	24	24	4 d	6 d	3 d	3 d
2.4	ASSYplus VG 4 6 x 100	24	36	18	18	4 d	6 d	3 d	3 d



2.3 Internal spline

Dimensions

CLT components	Internal spline material
$t_{CLT} \geq 100$ mm	OSB: $t_{EWP} = 22$ mm; $b = 120$ mm
	LVL: $t_{EWP} = 27$ mm; $b = 140$ mm
	Solid wood panel: $t_{EWP} = 22$ mm; $b = 120$ mm



Characteristic load capacity

Material	No.	$F_{v,Rk}$ [kN] per fastener	$f_{v,Rk}$ [kN/lfm]									Fasteners
			a_1 [mm]									
			50	75	100	125	150	175	200	225	250	
OSB ¹⁾	3.1.1	3.34	-	47.9	36.7	30.1	25.6	22.4	20.0	18.2	16.7	1. ASSY 4 CSMP (TG) 6 x 90/50
	3.1.2	2.96	-	42.4	32.6	26.6	22.7	19.9	17.8	16.1	14.8	2. ASSY 4 CSMP (TG) 5 x 90/47
	3.1.3	3.34	-	47.9	36.7	30.1	25.6	22.4	20.0	18.2	16.7	3. ASSYplus VG 4 6 x 100
LVL ²⁾³⁾⁵⁾	3.2.1	3.62	-	51.9	39.8	32.6	27.8	24.3	21.7	19.7	18.1	1. ASSY 4 CSMP (TG) 6 x 90/50
	3.2.2	2.76	-	39.6	30.4	24.8	21.2	18.5	16.6	15.0	13.8	2. ASSY 4 CSMP (TG) 5 x 90/47
	3.2.3	3.72	-	53.3	40.9	33.5	28.5	25.0	22.3	20.3	18.6	3. ASSYplus VG 4 6 x 100
Solid wood panel ⁴⁾⁵⁾	3.3.1	2.22	-	31.8	24.4	20.0	17.0	14.9	13.3	12.1	11.1	1. ASSY 4 CSMP (TG) 6 x 90/50
	3.3.2	1.94	-	27.8	21.3	17.5	14.9	13.0	11.6	10.6	9.7	2. ASSY 4 CSMP (TG) 5 x 90/47
	3.3.3	2.22	-	31.8	24.4	20.0	17.0	14.9	13.3	12.1	11.1	3. ASSYplus VG 4 6 x 100

¹⁾ OSB/2 or higher (OSB/3, OSB/4) according to DIN EN 13896, DIN EN 300 and DIN 20000-1.

²⁾ Steico X is used in accordance with the specifications of general construction permit Z-9.1-842 - including declaration of performance according to DIN EN 14374.

³⁾ Kerto Q is used in accordance with the specifications of general construction permit Z-9.1-847 - including declaration of performance according to DIN EN 14374.

⁴⁾ Solid wood panel (SWP; e.g. "3-ply panel") according to DIN EN 13896, DIN EN 13353 and DIN 20000-1.

⁵⁾ The grain of the face veneer must be aligned in parallel to the elements' butt joint.

Remarks:

Design calculations must be made per building component (e.g. shear load calculations).

Fasteners arranged in one line with the grain **MUST** be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

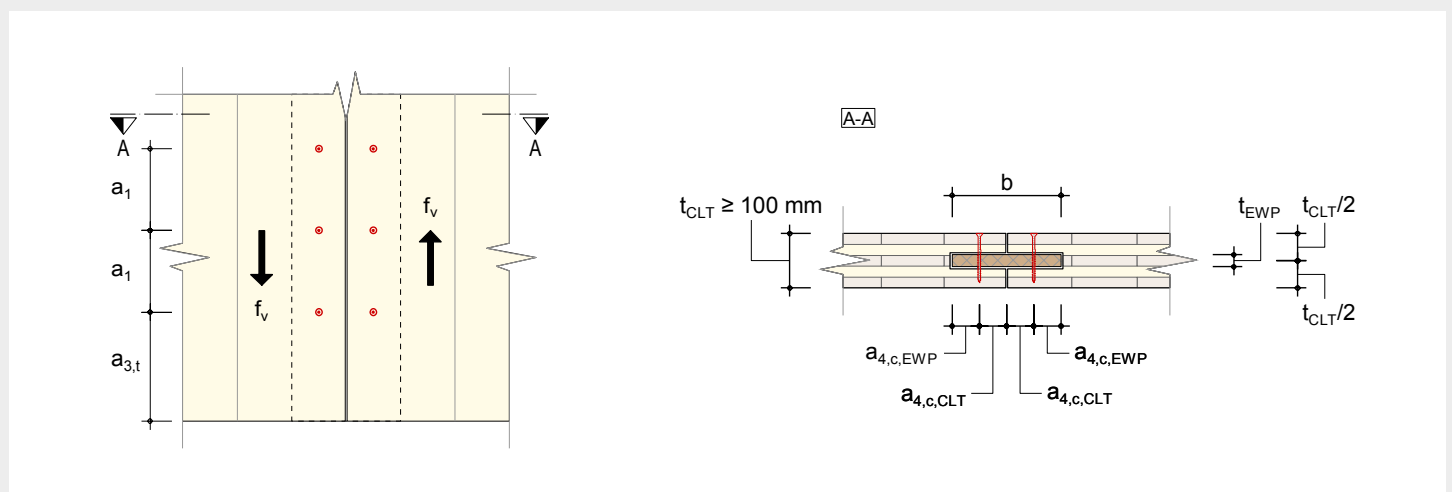
Fasteners arranged in one line with the grain do **NOT** have to be staggered by d at a right angle to the grain, cf. DIN EN 1995-1-1, 8.3.1.1 (8). Therefore, the following applies: $n = n_{ef}$

Fasteners arranged in one line with the grain do NOT have to be staggered by d at a right angle to the grain. Engineered wood connections that are only used for bracing, cf. DIN EN 1995-1-1, 8.3.1.3 /NA. 12).

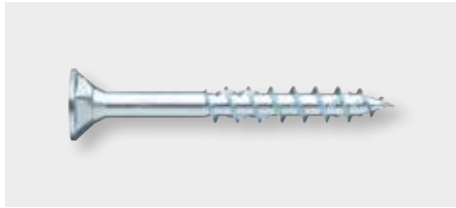
The following table lists the minimum distances required per fastener. The resulting dimensions and load-bearing capacities of the components may be more economical than listed in the load-bearing capacity table, among others. The previously listed recommendations for component dimensions and load-bearing capacity have been based on practical construction considerations such as imprecise execution and tolerances.

Fastener spacing when using an internal spline to create wall-wall assemblies

No.	Fasteners	Minimum distance [mm]				Minimum distance in relation to diameter				Material
		a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$	a_1	$a_{3,t}$	$a_{4,c,CLT}$	$a_{4,c,EWP}$	
3.1.1	1. ASSY 4 CSMP (TG) 6 x 90/50	61	42	18	18	$0.85 \cdot 12 d$	7 d	3 d	3 d	OSB
3.1.2	2. ASSY 4 CSMP (TG) 5 x 90/47	51	35	15	15	$0.85 \cdot 12 d$	7 d	3 d	3 d	
3.1.3	3. ASSYplus VG 4 6 x 100	61	42	18	18	$0.85 \cdot 12 d$	7 d	3 d	3 d	
3.2.1	1. ASSY 4 CSMP (TG) 6 x 90/50	72	90	18	30	12 d	15 d	3 d	5 d	LVL
3.2.2	2. ASSY 4 CSMP (TG) 5 x 90/47	60	75	15	25	12 d	15 d	3 d	5 d	
3.2.3	3. ASSYplus VG 4 6 x 100	72	90	18	30	12 d	15 d	3 d	5 d	
3.3.1	1. ASSY 4 CSMP (TG) 6 x 90/50	61	42	18	18	$0.85 \cdot 12 d$	7 d	3 d	3 d	Solid wood panel
3.3.2	2. ASSY 4 CSMP (TG) 5 x 90/47	51	35	15	15	$0.85 \cdot 12 d$	7 d	3 d	3 d	
3.3.3	3. ASSYplus VG 4 6 x 100	61	42	18	18	$0.85 \cdot 12 d$	7 d	3 d	3 d	



3. Products

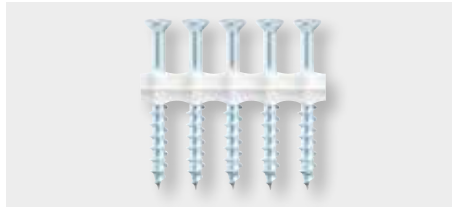


ASSY® 4 CSMP universal screw
Steel zinc plated partial thread counter-sunk milling pocket head

Universal partial-thread screw for fast, gap-free fastening of wood-wood connections in furniture construction, interior fitting or wood construction in indoor dry or wet areas

ASSY 4 CSMP (TG)

- Art. no. 0190 150 90** 5 x 90
- Art. no. 0190 160 70** 6 x 70
- Art. no. 0190 160 90** 6 x 90
- Art. no. 0190 180 100** 8 x 100

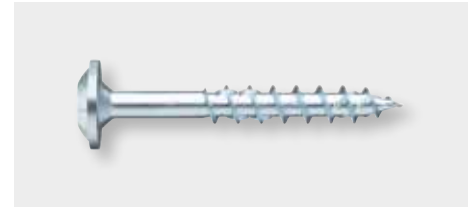


ASSY® 4 CSMP universal screw collated
Steel zinc plated partial thread counter-sunk milling pocket head

Universal collated partial-thread screw for gap-free fastening, without pre-drilling, of wood-wood connections in interior construction, window installation or wood construction in indoor dry or wet areas

ASSY 4 WH (TG)

Art. no. 0163 115 070



ASSY® 4 WH washer head screw
Steel zinc plated partial thread washer head

Partial-thread screw with large washer head or washer head for wood-wood fastening in a structural wood construction which must be pulled together in indoor dry or wet areas

ASSY 4 WH (TG)

Art. no. 0177 350 70 5 x 70

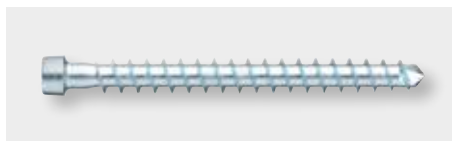


ASSY® 4 P CSMP universal screw
Steel zinc-plated partial thread with under-head thread milling pocket head

Universal partial-thread screw with underhead thread with high tightening effect for fast, gap-free fastening of wood-wood connections in furniture construction, interior construction or wood construction in indoor dry or wet areas

ASSY 4 P CSMP

Art. no. 0190 404 560

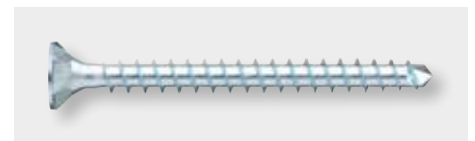


ASSY®plus FT 4 CH construction screw
Steel zinc plated full thread cylinder head

Special full-thread screw with small cylinder head for high-load-bearing wood-wood connections or reinforcements in structural wood construction, which also require small edge and screw clearances, in indoor dry or wet areas

ASSYplus VG 4

- Art. no. 0150 008 120** 8 x 120
- Art. no. 0150 006 100** 6 x 100



ASSY®plus FT 4 CSMP construction screw
Steel zinc plated full thread countersunk milling pocket head

Special full-thread screw with countersunk head with milling pockets for universal use for high-load-bearing wood/wood, wood/metal connections or reinforcements in structural wood construction, which also require small edge and screw clearances, in indoor dry or wet areas

ASSY®plus FT 4 CSMP

- Art. no. 0150 108 120** 8 x 120
- Art. no. 0150 106 100** 6 x 100



Half-head strip nail 34°

With ring shank. Steel, hot-dip galvanised (TZN)
 Suitable for DSN 5090 34°, art. no. 0703 543 0

Nails in accordance with DIN EN 14592 and A1 (Eurocode 5)

Art. no. 0482 800 63

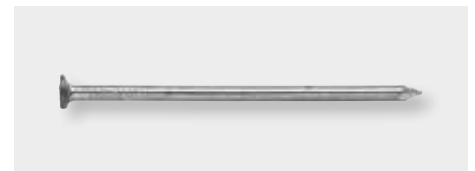


Type ETA-Q staple

Suitable for short, medium, long-term and permanent pull-out and shear stress in accordance with ETA-17/0631

Suitable for DKN 3065 Combi, art. no. 0703 556 0
 Approved by European Technical Assessment ETA-17/0631 as a dowel-type wood fastener in all European member states

Art. no. 5089 650 003



Wire nail

DIN 1151 plain steel

Art. no. 0478 528 65

4. Accessories



Pneumatic nailer DSN 5090 34°

Powerful, light-weight pneumatic nailer for processing half-head strip nails with a 30-34° angle

Art. no. 0703 543 0



Cordless drill driver ABS 18 POWER M-CUBE®

Very powerful, handy cordless drill driver designed specifically for tough construction site conditions with a torque of 140 Nm. Developed by Würth to meet the requirements of craftspeople.

Art. no. 5701 404 ...



Pneumatic stapler/nail gun DKN 3065 Combi

Pneumatic stapler/nail gun DKN 3065 Combi

Art. no. 0703 556 0



DIGA® WO-1/34 high-performance gas-powered device

High-performance gas device for wood connections with 34° magazine

Art. no. 0864 93



Gas cartridge

For DIGA® WO-1/21, WO-1/34 and Paslode Impulse IM 350

Art. no. 0864 900 2..



Safety shoes S3 SRC Stretch X grey

M418 099 ...



Electra safety goggles

Art. no. 0899 102 340



Roofer's hammer

Art. no. 0714 733 030



Corded ear plugs

Art. no. 0899 300 338



Mechanic's glove

Art. no. 0624 400 528



1/4 inch bit box

Art. no. 0614 250 102

5. General conditions

Installation conditions

Cross-laminated timber	CLT element (t = 10 cm)
Material used for connection	OSB/2 LVL (various manufacturers) C24-grade solid wood panel (3-ply)
Recommended dimensions	OSB d = 22 mm; b = 120 mm LVL d = 27; b = 140 mm Solid wood panel d = 22 mm; b = 120 mm

Calculation basis

DIN EN 1995-1-1:2010-12	Design of timber structures – Part 1-1: General – Common rules and rules for buildings
DIN EN 14592:2012-07	Timber structures – Dowel-type fasteners – Requirements
DIN 20000-6	Application of construction products in structures – Part 6: Dowel-type fasteners and connectors
DIN EN 300	OSB2
DIN EN 13896	Solid wood panel; OSB2
DIN EN 13353	Solid wood panel
DIN 20000-1	Solid wood panel; OSB2
ETA-11/0190	Self-tapping screws for use in timber constructions
ETA-17/0631	ETA-Q type fasteners
Z-9.1-842	Steico (incl. DoP acc. to DIN EN 14374)
Z-9.1-847	Kerto (incl. DoP acc. to DIN EN 14374)

CROSS-LAMINATED TIMBER CONNECTIONS

Wall and floor assemblies

Adolf Würth GmbH & Co. KG
74650 Künzelsau, Germany
T +49 7940 15-0
F +49 7940 15-1000
info@wuerth.com
www.wuerth.de

© by Adolf Würth GmbH & Co. KG
Printed in Germany
All rights reserved
Responsible for content:
Dept. IDC/Nils Horn
© SWG Engineering

Reprint only with prior permission.
IDC-SF-06/21

We reserve the right to make product alterations that, in our view, improve quality at any time without prior notice or dissemination.
Illustrations may be published for example purposes only and the appearance of supplied goods may vary. Errors excepted. We do not assume liability for printing errors.
Our General Terms and Conditions of Business apply.