TBS

FLANGE HEAD SCREW

UKCA UKTA-0836 22/6195 | ICC ES AC233 ESR-4645 | CE ETA-11/0030

INTEGRATED WASHER
The flange head serves as washer and ensures high head strength and pull-through. Ideal in the presence of wind or variations in timber dimensions.

3 THORNS TIP
Thanks to the 3 THORNS tip, minimum installation distances are reduced. More screws can be used in less space and larger screws in smaller elements.
Costs and time for project implementation are reduced.

NEW-GENERATION WOODS
Tested and certified for use on a wide variety of engineered timbers such as CLT, GL, LVL, OSB and Beech LVL.
Extremely versatile, the TBS screw guarantees the use of new-generation woods for the creation of increasingly innovative and sustainable structures.

FAST
With the 3 THORNS tip, screw grip becomes more reliable and faster, while maintaining the usual mechanical performance.
More speed, less effort.

MY PROJECT SOFTWARE

BIT INCLUDED

DIAMETER [mm]	6 (6 – 12) 16
LENGTH [mm]	40 (40 – 1000) 1000
SERVICE CLASS	SC1 SC2
ATMOSPHERIC CORROSIVITY	C1 C2
WOOD CORROSIVITY	T1 T2
MATERIAL	Zn ELECTRO PLATED electrogalvanized carbon steel

FIELDS OF USE

- timber based panels
- fibreboard and MDF panels
- solid timber and glulam
- CLT and LVL
- high density woods

SECONDARY BEAMS

Ideal for fastening joists to sill beams to achieve high wind uplift resistance. The flange head guarantees excellent tensile strength which means the use of additional lateral fastening systems can be avoided.

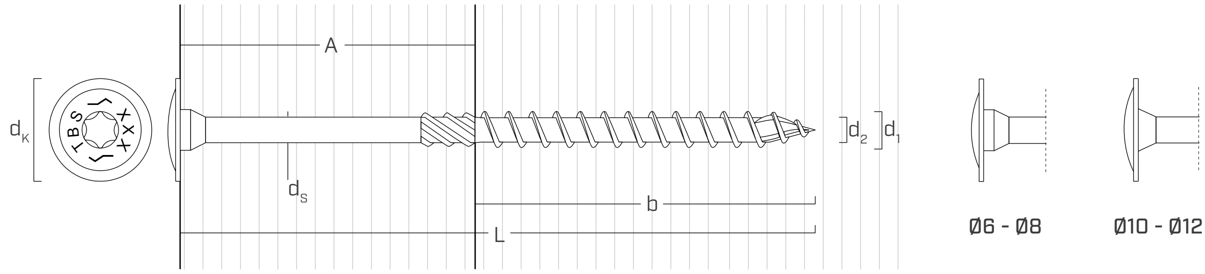
I-JOIST

Values also tested, certified and calculated for CLT and high density woods such as Microllam® LVL.

Fastening SIP panels with 8 mm diameter TBS screws.

Fastening CLT walls with TBS screws.

GEOMETRY AND MECHANICAL CHARACTERISTICS



GEOMETRY

Nominal diameter	d_1	**[mm]**	**6**	**8**	**10**	**12**
Head diameter	d_K	[mm]	15,50	19,00	25,00	29,00
Thread diameter	d_2	[mm]	3,95	5,40	6,40	6,80
Shank diameter	d_S	[mm]	4,30	5,80	7,00	8,00
Pre-drilling hole diameter(1)	$d_{V,S}$	[mm]	4,0	5,0	6,0	7,0
Pre-drilling hole diameter(2)	$d_{V,H}$	[mm]	4,0	6,0	7,0	8,0

(1) Pre-drilling valid for softwood.
(2) Pre-drilling valid for hardwood and beech LVL.

CHARACTERISTIC MECHANICAL PARAMETERS

Nominal diameter	d_1	**[mm]**	**6**	**8**	**10**	**12**
Tensile strength	$f_{tens,k}$	[kN]	11,3	20,1	31,4	33,9
Yield moment	$M_{y,k}$	[Nm]	9,5	20,1	35,8	48,0

			softwood *(softwood)*	**LVL softwood** *(LVL softwood)*	**pre-drilled beech LVL** *(beech LVL predrilled)*
Withdrawal resistance parameter	$f_{ax,k}$	[N/mm²]	11,7	15,0	29,0
Head-pull-through parameter	$f_{head,k}$	[N/mm²]	10,5	20,0	-
Associated density	ρ_a	[kg/m³]	350	500	730
Calculation density	ρ_k	*[kg/m³]*	*≤ 440*	*410 ÷ 550*	*590 ÷ 750*

For applications with different materials please see ETA-11/0030.

CODES AND DIMENSIONS

d1 [mm]	dK [mm]	CODE	L [mm]	b [mm]	A [mm]	pcs
6 TX 30	15,5	**TBS660**	60	40	20	100
		TBS670	70	40	30	100
		TBS680	80	50	30	100
		TBS690	90	50	40	100
		TBS6100	100	60	40	100
		TBS6120	120	75	45	100
		TBS6140	140	75	65	100
		TBS6160	160	75	85	100
		TBS6180	180	75	105	100
		TBS6200	200	75	125	100
		TBS6220	220	100	120	100
		TBS6240	240	100	140	100
		TBS6260	260	100	160	100
		TBS6280	280	100	180	100
		TBS6300	300	100	200	100
		TBS6320	320	100	220	100
		TBS6360	360	100	260	100
		TBS6400	400	100	300	100
8 TX 40	19,0	**TBS840**	40	32	8	100
		TBS860	60	52	8	100
		TBS880	80	52	28	50
		TBS8100	100	52	48	50
		TBS8120	120	80	40	50
		TBS8140	140	80	60	50
		TBS8160	160	100	60	50
		TBS8180	180	100	80	50
		TBS8200	200	100	100	50
		TBS8220	220	100	120	50
		TBS8240	240	100	140	50
		TBS8260	260	100	160	50
		TBS8280	280	100	180	50
		TBS8300	300	100	200	50
		TBS8320	320	100	220	50
		TBS8340	340	100	240	50
		TBS8360	360	100	260	50
		TBS8380	380	100	280	50
		TBS8400	400	100	300	50
		TBS8440	440	100	340	50
		TBS8480	480	100	380	50
		TBS8520	520	100	420	50
		TBS8560	560	100	460	50
		TBS8580	580	100	480	50
		TBS8600	600	100	500	50

d1 [mm]	dK [mm]	CODE	L [mm]	b [mm]	A [mm]	pcs
10 TX 50	25,0	**TBS10100**	100	52	48	50
		TBS10120	120	60	60	50
		TBS10140	140	60	80	50
		TBS10160	160	80	80	50
		TBS10180	180	80	100	50
		TBS10200	200	100	100	50
		TBS10220	220	100	120	50
		TBS10240	240	100	140	50
		TBS10260	260	100	160	50
		TBS10280	280	100	180	50
		TBS10300	300	100	200	50
		TBS10320	320	120	200	50
		TBS10340	340	120	220	50
		TBS10360	360	120	240	50
		TBS10380	380	120	260	50
		TBS10400	400	120	280	50
		TBS10440	440	120	320	50
		TBS10480	480	120	360	50
		TBS10520	520	120	400	50
		TBS10560	560	120	440	50
		TBS10600	600	120	480	50
12 TX 50	29,0	**TBS12200**	200	120	80	25
		TBS12240	240	120	120	25
		TBS12280	280	120	160	25
		TBS12320	320	120	200	25
		TBS12360	360	120	240	25
		TBS12400	400	140	260	25
		TBS12440	440	140	300	25
		TBS12480	480	140	340	25
		TBS12520	520	140	380	25
		TBS12560	560	140	420	25
		TBS12600	600	140	460	25
		TBS12800	800	160	640	25
		TBS121000	1000	160	840	25

RELATED PRODUCTS

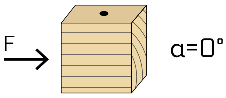
TBS MAX
page 92

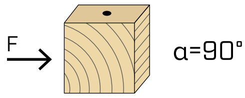
XYLOFON WASHER
page 73

TORQUE LIMITER
page 408

MINIMUM DISTANCES FOR SHEAR LOADS | TIMBER

screws inserted **WITHOUT pre-drilled hole** — $\rho_k \leq 420\ kg/m^3$

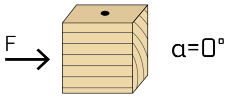


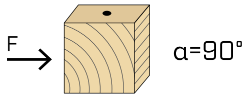


d_1	[mm]		6	8	10	12
a_1	[mm]	10·d	60	80	100	120
a_2	[mm]	5·d	30	40	50	60
$a_{3,t}$	[mm]	15·d	90	120	150	180
$a_{3,c}$	[mm]	10·d	60	80	100	120
$a_{4,t}$	[mm]	5·d	30	40	50	60
$a_{4,c}$	[mm]	5·d	30	40	50	60

d_1	[mm]		6	8	10	12
a_1	[mm]	5·d	30	40	50	60
a_2	[mm]	5·d	30	40	50	60
$a_{3,t}$	[mm]	10·d	60	80	100	120
$a_{3,c}$	[mm]	10·d	60	80	100	120
$a_{4,t}$	[mm]	10·d	60	80	100	120
$a_{4,c}$	[mm]	5·d	30	40	50	60

screws inserted **WITH pre-drilled hole**

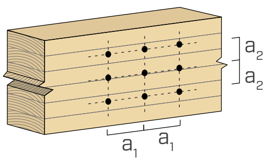




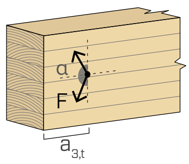
d_1	[mm]		6	8	10	12
a_1	[mm]	5·d	30	40	50	60
a_2	[mm]	3·d	18	24	30	36
$a_{3,t}$	[mm]	12·d	72	96	120	144
$a_{3,c}$	[mm]	7·d	42	56	70	84
$a_{4,t}$	[mm]	3·d	18	24	30	36
$a_{4,c}$	[mm]	3·d	18	24	30	36

d_1	[mm]		6	8	10	12
a_1	[mm]	4·d	24	32	40	48
a_2	[mm]	4·d	24	32	40	48
$a_{3,t}$	[mm]	7·d	42	56	70	84
$a_{3,c}$	[mm]	7·d	42	56	70	84
$a_{4,t}$	[mm]	7·d	42	56	70	84
$a_{4,c}$	[mm]	3·d	18	24	30	36

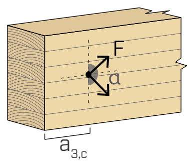
α = load-to-grain angle
d = d_1 = nominal screw diameter



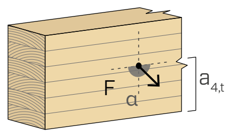
stressed end
-90° < α < 90°



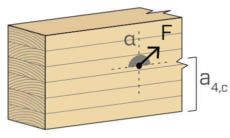
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



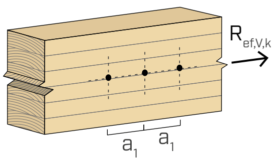
unload edge
180° < α < 360°



NOTE on page 87.

EFFECTIVE NUMBER FOR SHEAR LOADS

The load-bearing capacity of a connection made with several screws, all of the same type and size, may be lower than the sum of the load-bearing capacities of the individual connection system.
For a row of n screws arranged parallel to the direction of the grain at a distance a_1, the characteristic effective load-bearing capacity is equal to:



$$R_{ef,V,k} = n_{ef} \cdot R_{V,k}$$

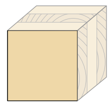
The n_{ef} value is given in the table below as a function of n and a_1.

		a_1(*)										
		4·d	5·d	6·d	7·d	8·d	9·d	10·d	11·d	12·d	13·d	≥ 14·d
n	2	1,41	1,48	1,55	1,62	1,68	1,74	1,80	1,85	1,90	1,95	2,00
	3	1,73	1,86	2,01	2,16	2,28	2,41	2,54	2,65	2,76	2,88	3,00
	4	2,00	2,19	2,41	2,64	2,83	3,03	3,25	3,42	3,61	3,80	4,00
	5	2,24	2,49	2,77	3,09	3,34	3,62	3,93	4,17	4,43	4,71	5,00

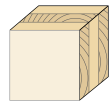
(*)For intermediate a_1 values a linear interpolation is possible.

MINIMUM DISTANCES FOR SHEAR AND AXIAL LOADS | CLT

screws inserted **WITHOUT pre-drilled hole**



lateral face

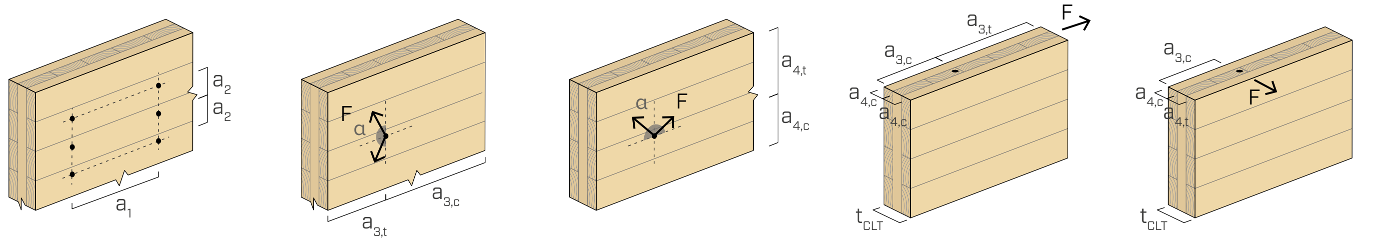


narrow face

d_1	[mm]		6	8	10	12
a_1	[mm]	**4·d**	24	32	40	48
a_2	[mm]	**2,5·d**	15	20	25	30
$a_{3,t}$	[mm]	**6·d**	36	48	60	72
$a_{3,c}$	[mm]	**6·d**	36	48	60	72
$a_{4,t}$	[mm]	**6·d**	36	48	60	72
$a_{4,c}$	[mm]	**2,5·d**	15	20	25	30

d_1	[mm]		6	8	10	12
a_1	[mm]	**10·d**	60	80	100	120
a_2	[mm]	**4·d**	24	32	40	48
$a_{3,t}$	[mm]	**12·d**	72	96	120	144
$a_{3,c}$	[mm]	**7·d**	42	56	70	84
$a_{4,t}$	[mm]	**6·d**	36	48	60	72
$a_{4,c}$	[mm]	**3·d**	18	24	30	36

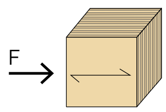
d = d_1 = nominal screw diameter



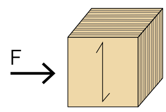
NOTE on page 87.

MINIMUM DISTANCES FOR SHEAR LOADS | LVL

screws inserted **WITHOUT pre-drilled hole**



α=0°

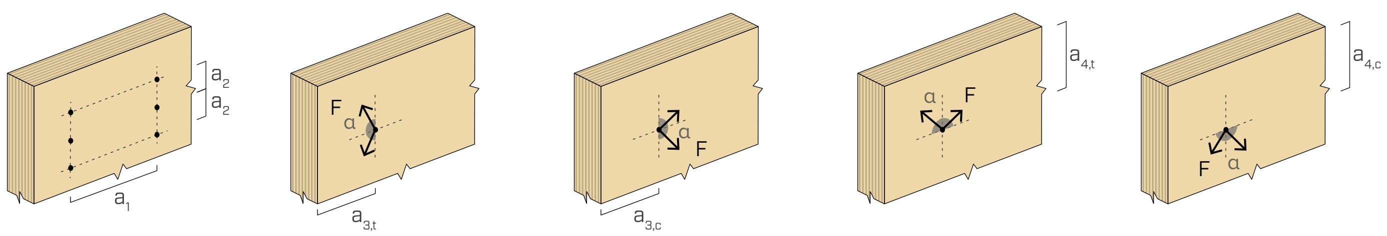


α=90°

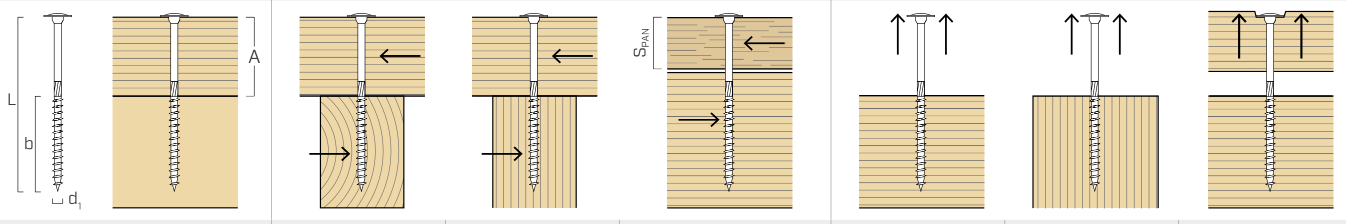
d_1	[mm]		6	8	10
a_1	[mm]	**12·d**	72	96	120
a_2	[mm]	**5·d**	30	40	50
$a_{3,t}$	[mm]	**15·d**	90	120	150
$a_{3,c}$	[mm]	**10·d**	60	80	100
$a_{4,t}$	[mm]	**5·d**	30	40	50
$a_{4,c}$	[mm]	**5·d**	30	40	50

d_1	[mm]		6	8	10
a_1	[mm]	**5d**	30	40	50
a_2	[mm]	**5d**	30	40	50
$a_{3,t}$	[mm]	**10d**	60	80	100
$a_{3,c}$	[mm]	**10d**	60	80	100
$a_{4,t}$	[mm]	**10d**	60	80	100
$a_{4,c}$	[mm]	**5d**	30	40	50

α = load-to-grain angle
d = d_1 = nominal screw diameter



NOTE on page 87.



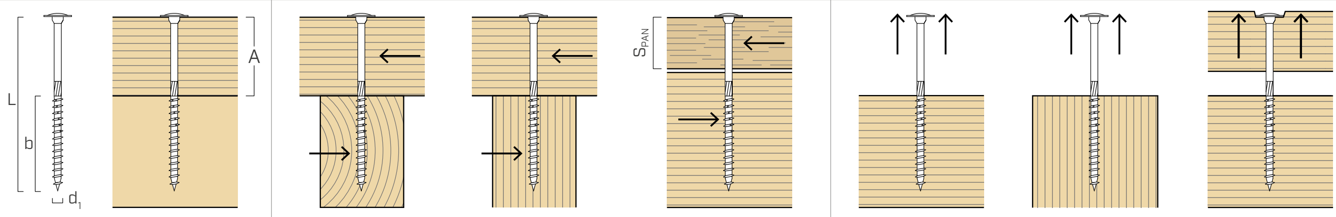
				SHEAR				TENSION		
geometry				timber-to-timber ε=90°	timber-to-timber ε=0°	panel-to-timber		thread withdrawal ε=90°	thread withdrawal ε=0°	head pull-through
d_1 [mm]	L [mm]	b [mm]	A [mm]	$R_{V,90,k}$ [kN]	$R_{V,0,k}$ [kN]	S_{PAN} [mm]	$R_{V,k}$ [kN]	$R_{ax,90,k}$ [kN]	$R_{ax,0,k}$ [kN]	$R_{head,k}$ [kN]
6	60	40	20	1,89	1,02	50	-	3,03	0,91	2,72
	70	40	30	2,15	1,20		-	3,03	0,91	2,72
	80	50	30	2,15	1,37		2,14	3,79	1,14	2,72
	90	50	40	2,35	1,38		2,50	3,79	1,14	2,72
	100	60	40	2,35	1,58		2,50	4,55	1,36	2,72
	120	75	45	2,35	1,69		2,50	5,68	1,70	2,72
	140	75	65	2,35	1,69		2,50	5,68	1,70	2,72
	160	75	85	2,35	1,69		2,50	5,68	1,70	2,72
	180	75	105	2,35	1,69		2,50	5,68	1,70	2,72
	200	75	125	2,35	1,69		2,50	5,68	1,70	2,72
	220	100	120	2,35	1,83		2,50	7,58	2,27	2,72
	240	100	140	2,35	1,83		2,50	7,58	2,27	2,72
	260	100	160	2,35	1,83		2,50	7,58	2,27	2,72
	280	100	180	2,35	1,83		2,50	7,58	2,27	2,72
	300	100	200	2,35	1,83		2,50	7,58	2,27	2,72
	320	100	220	2,35	1,83		2,50	7,58	2,27	2,72
	360	100	260	2,35	1,83		2,50	7,58	2,27	2,72
	400	100	300	2,35	1,83		2,50	7,58	2,27	2,72
8	40	32	8	1,08	0,90	65	-	3,23	0,97	4,09
	60	52	8	1,08	1,08		-	5,25	1,58	4,09
	80	52	28	3,02	1,70		-	5,25	1,58	4,09
	100	52	48	3,71	1,95		3,22	5,25	1,58	4,09
	120	80	40	3,41	2,54		3,89	8,08	2,42	4,09
	140	80	60	3,71	2,61		3,89	8,08	2,42	4,09
	160	100	60	3,71	2,79		3,89	10,10	3,03	4,09
	180	100	80	3,71	2,79		3,89	10,10	3,03	4,09
	200	100	100	3,71	2,79		3,89	10,10	3,03	4,09
	220	100	120	3,71	2,79		3,89	10,10	3,03	4,09
	240	100	140	3,71	2,79		3,89	10,10	3,03	4,09
	260	100	160	3,71	2,79		3,89	10,10	3,03	4,09
	280	100	180	3,71	2,79		3,89	10,10	3,03	4,09
	300	100	200	3,71	2,79		3,89	10,10	3,03	4,09
	320	100	220	3,71	2,79		3,89	10,10	3,03	4,09
	340	100	240	3,71	2,79		3,89	10,10	3,03	4,09
	360	100	260	3,71	2,79		3,89	10,10	3,03	4,09
	380	100	280	3,71	2,79		3,89	10,10	3,03	4,09
	400	100	300	3,71	2,79		3,89	10,10	3,03	4,09
	440	100	340	3,71	2,79		3,89	10,10	3,03	4,09
	480	100	380	3,71	2,79		3,89	10,10	3,03	4,09
	520	100	420	3,71	2,79		3,89	10,10	3,03	4,09
	560	100	460	3,71	2,79		3,89	10,10	3,03	4,09
	580	100	480	3,71	2,79		3,89	10,10	3,03	4,09
	600	100	500	3,71	2,79		3,89	10,10	3,03	4,09

ε = screw-to-grain angle

NOTES and GENERAL PRINCIPLES on page 87.

STRUCTURAL VALUES | TIMBER

CHARACTERISTIC VALUES
EN 1995:2014



				SHEAR				TENSION		
geometry				timber-to-timber ε=90°	timber-to-timber ε=0°	panel-to-timber		thread withdrawal ε=90°	thread withdrawal ε=0°	head pull-through
d_1	L	b	A	$R_{V,90,k}$	$R_{V,0,k}$	S_{PAN}	$R_{V,k}$	$R_{ax,90,k}$	$R_{ax,0,k}$	$R_{head,k}$
[mm]	[mm]	[mm]	[mm]	[kN]	[kN]	[mm]	[kN]	[kN]	[kN]	[kN]
	100	52	48	4,92	2,56		-	6,57	1,97	7,08
	120	60	60	5,64	2,75		-	7,58	2,27	7,08
	140	60	80	5,64	2,75		5,84	7,58	2,27	7,08
	160	80	80	5,64	3,28		5,85	10,10	3,03	7,08
	180	80	100	5,64	3,28		5,85	10,10	3,03	7,08
	200	100	100	5,64	3,87		5,85	12,63	3,79	7,08
	220	100	120	5,64	3,87		5,85	12,63	3,79	7,08
	240	100	140	5,64	3,87		5,85	12,63	3,79	7,08
	260	100	160	5,64	3,87		5,85	12,63	3,79	7,08
	280	100	180	5,64	3,87		5,85	12,63	3,79	7,08
10	300	100	200	5,64	3,87	80	5,85	12,63	3,79	7,08
	320	120	200	5,64	4,06		5,85	15,15	4,55	7,08
	340	120	220	5,64	4,06		5,85	15,15	4,55	7,08
	360	120	240	5,64	4,06		5,85	15,15	4,55	7,08
	380	120	260	5,64	4,06		5,85	15,15	4,55	7,08
	400	120	280	5,64	4,06		5,85	15,15	4,55	7,08
	440	120	320	5,64	4,06		5,85	15,15	4,55	7,08
	480	120	360	5,64	4,06		5,85	15,15	4,55	7,08
	520	120	400	5,64	4,06		5,85	15,15	4,55	7,08
	560	120	440	5,64	4,06		5,85	15,15	4,55	7,08
	600	120	480	5,64	4,06		5,85	15,15	4,55	7,08
	200	120	80	7,16	4,98		7,35	18,18	5,45	9,53
	240	120	120	7,16	4,98		7,35	18,18	5,45	9,53
	280	120	160	7,16	4,98		7,35	18,18	5,45	9,53
	320	120	200	7,16	4,98		7,35	18,18	5,45	9,53
	360	120	240	7,16	4,98		7,35	18,18	5,45	9,53
	400	140	260	7,16	5,20		7,35	21,21	6,36	9,53
12	440	140	300	7,16	5,20	95	7,35	21,21	6,36	9,53
	480	140	340	7,16	5,20		7,35	21,21	6,36	9,53
	520	140	380	7,16	5,20		7,35	21,21	6,36	9,53
	560	140	420	7,16	5,20		7,35	21,21	6,36	9,53
	600	140	460	7,16	5,20		7,35	21,21	6,36	9,53
	800	160	640	7,16	5,43		7,35	24,24	7,27	9,53
	1000	160	840	7,16	5,43		7,35	24,24	7,27	9,53

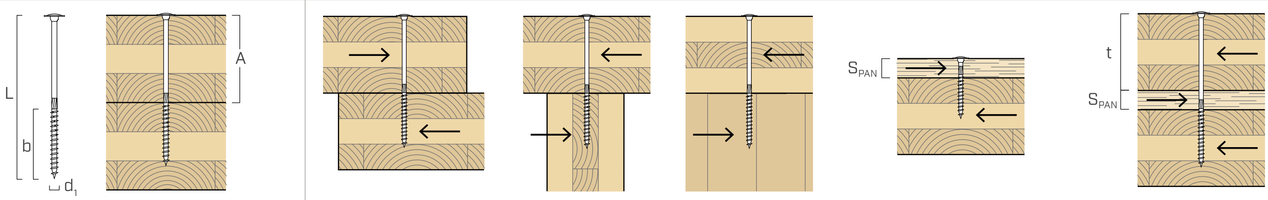
ε = screw-to-grain angle

NOTES and **GENERAL PRINCIPLES** on page 87.

STRUCTURAL VALUES | CLT

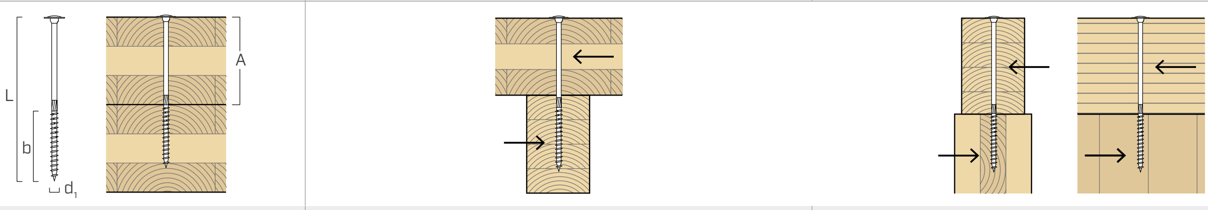
CHARACTERISTIC VALUES
EN 1995:2014

SHEAR



geometry				CLT-CLT lateral face	CLT-CLT lateral face-narrow face	panel-CLT lateral face		CLT-panel-CLT lateral face		
d_1	L	b	A	$R_{V,k}$	$R_{V,k}$	S_{PAN}	$R_{V,k}$	S_{PAN}	t	$R_{V,k}$
[mm]	[mm]	[mm]	[mm]	[kN]	[kN]	[mm]	[kN]	[mm]	[mm]	[kN]
6	60÷70	40	≥ 20	1,77	-	18	1,82	18	≥ 20	2,67
	80÷90	50	≥ 30	2,00	-		1,82		≥ 30	2,67
	100	60	40	2,22	-		1,82		≥ 40	2,67
	120÷200	75	≥ 45	2,22	-		1,82		≥ 50	2,67
	220÷400	100	≥ 120	2,22	-		1,82		≥ 100	2,67
8	40	32	8	0,98	0,98	22	1,65	22	≥ 5	1,23
	60÷100	52	≥ 30	2,23	1,70		2,66		≥ 15	3,64
	120÷140	80	≥ 40	3,16	2,80		2,98		≥ 45	3,64
	160÷600	100	≥ 60	3,51	2,98		2,98		≥ 65	3,64
10	100	52	48	4,50	3,14	25	4,20	25	≥ 35	4,47
	120÷140	60	≥ 60	5,22	3,41		4,44		≥ 45	4,47
	160÷180	80	≥ 80	5,33	4,12		4,44		≥ 65	4,47
	200÷300	100	≥ 100	5,33	4,52		4,44		≥ 85	4,47
	320÷600	120	≥ 200	5,33	4,52		4,44		≥ 145	4,47
12	200÷360	120	≥ 80	6,76	5,72	25	4,72	25	≥ 85	4,72
	400÷600	140	≥ 260	6,76	5,72		4,72		≥ 185	4,72
	800÷1000	160	≥ 640	6,76	5,72		4,72		≥ 385	4,72

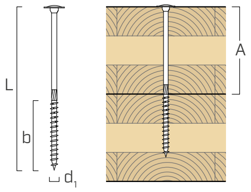
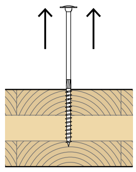
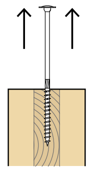
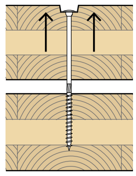
SHEAR



geometry				CLT-timber lateral face	timber-CLT narrow face
d_1	L	b	A	$R_{V,k}$	$R_{V,k}$
[mm]	[mm]	[mm]	[mm]	[kN]	[kN]
6	60-70	40	≥ 20	1,79	-
	80-90	50	≥ 30	2,02	-
	100	60	40	2,26	-
	120-200	75	≥ 45	2,26	-
	220-400	100	≥ 120	2,26	-
8	40	32	8	0,98	1,08
	60-100	52	≥ 30	2,36	1,70
	120-140	80	≥ 40	3,20	2,90
	160-600	100	≥ 60	3,57	3,01
10	100	52	48	4,78	3,17
	120-140	60	≥ 60	5,32	3,43
	160-180	80	≥ 80	5,42	4,15
	200-300	100	≥ 100	5,42	4,56
	320-600	120	≥ 200	5,42	4,57
12	200-360	120	≥ 80	6,87	5,77
	400-600	140	≥ 260	6,87	5,77
	800-1000	160	≥ 640	6,87	5,77

STRUCTURAL VALUES | CLT

CHARACTERISTIC VALUES
EN 1995:2014

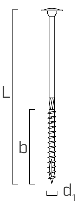
geometry			TENSION		
geometry			thread withdrawal narrow face	thread withdrawal narrow face	head pull-through
					
d_1 [mm]	L [mm]	b [mm]	$R_{ax,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{head,k}$ [kN]
6	60÷70	40	2,81	-	2,52
	80÷90	50	3,51	-	2,52
	100	60	4,21	-	2,52
	120÷200	75	5,27	-	2,52
	220÷400	100	7,02	-	2,52
8	40	32	3,00	2,39	3,79
	60÷100	52	4,87	3,70	3,79
	120÷140	80	7,49	5,45	3,79
	160÷600	100	9,36	6,66	3,79
10	100	52	6,08	4,42	6,56
	120÷140	60	7,02	5,03	6,56
	160÷180	80	9,36	6,51	6,56
	200÷300	100	11,70	7,96	6,56
	320÷600	120	14,04	9,38	6,56
12	200÷360	120	16,85	10,86	8,83
	400÷600	140	19,66	12,47	8,83
	800÷1000	160	22,46	14,06	8,83

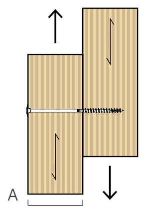
NOTES and GENERAL PRINCIPLES on page 87.

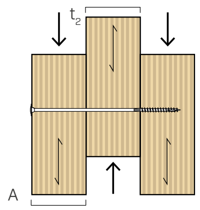
STRUCTURAL VALUES | LVL

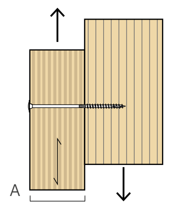
CHARACTERISTIC VALUES
EN 1995:2014

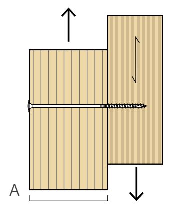
SHEAR





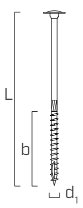


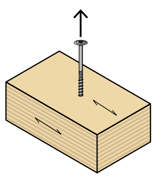
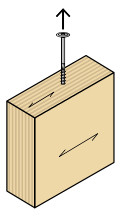
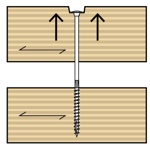




geometry			LVL-LVL		LVL-LVL- LVL			LVL-timber		timber-LVL	
d_1 [mm]	L [mm]	b [mm]	A [mm]	$R_{V,k}$ [kN]	A [mm]	t_2 [mm]	$R_{V,k}$ [kN]	A [mm]	$R_{V,k}$ [kN]	A [mm]	$R_{V,k}$ [kN]
6	80÷90	50	-	-	-	-	-	-	-	≥ 30	2,21
	100	60	45	3,02	-	-	-	45	2,80	40	2,44
	120÷200	75	≥ 45	3,02	≥ 45	≥ 75	5,47	≥ 45	2,92	≥ 45	2,44
	220÷400	100	≥ 120	3,02	≥ 70	≥ 85	6,05	≥ 120	2,92	≥ 120	2,44
8	120÷140	80	≥ 60	4,74	-	-	-	≥ 60	4,34	≥ 40	3,51
	160÷180	100	≥ 60	4,74	-	-	-	≥ 60	4,57	≥ 60	3,85
	200÷600	100	≥ 60	4,74	≥ 60	≥ 75	9,48	≥ 60	4,57	≥ 60	3,85
10	120÷140	60	-	-	-	-	-	-	-	≥ 60	5,84
	160÷180	80	≥ 75	7,23	-	-	-	≥ 75	6,60	≥ 80	5,85
	200	100	100	7,35	-	-	-	100	7,10	100	5,85
	220÷300	100	≥ 120	7,35	≥ 75	≥ 75	13,73	≥ 100	7,10	≥ 100	5,85
	320÷600	120	≥ 200	7,35	≥ 100	≥ 125	14,69	≥ 200	7,10	≥ 200	5,85

TENSION



geometry			thread withdrawal flat	thread withdrawal edge	head pull-through flat
d_1 [mm]	L [mm]	b [mm]	$R_{ax,k}$ [kN]	$R_{ax,k}$ [kN]	$R_{head,k}$ [kN]
6	60÷70	40	3,48	2,32	4,65
	80÷90	50	4,36	2,90	4,65
	100	60	5,23	3,48	4,65
	120÷200	75	6,53	4,36	4,65
	220÷400	100	8,71	5,81	4,65
8	40	32	3,72	2,48	6,99
	60÷100	52	6,04	4,03	6,99
	120÷140	80	9,29	6,19	6,99
	160÷180	100	11,61	7,74	6,99
	200÷600	100	11,61	7,74	6,99
10	100	52	7,55	5,03	12,10
	120÷140	60	8,71	5,81	12,10
	160÷180	80	11,61	7,74	12,10
	200÷300	100	14,52	9,68	12,10
	320÷600	120	17,42	11,61	12,10

NOTES and GENERAL PRINCIPLES on page 87.

STRUCTURAL VALUES

GENERAL PRINCIPLES

- Characteristic values consistent with EN 1995:2014 and in accordance with ETA-11/0030.
- Design values can be obtained from characteristic values as follows:

$$R_d = \frac{R_k \cdot k_{mod}}{\gamma_M}$$

  The coefficients γ_M and k_{mod} should be taken according to the current regulations used for the calculation.
- For the mechanical resistance values and the geometry of the screws, reference was made to ETA-11/0030.
- Sizing and verification of the timber elements and panels must be done separately.
- The screws must be positioned in accordance with the minimum distances.
- The characteristic shear resistances are calculated for screws inserted without pre-drilling hole. In the case of screws inserted with pre-drilling hole, greater resistance values can be obtained.
- Shear strengths were calculated considering the threaded part fully inserted in the second element.
- The characteristic panel-timber shear strength are calculated considering an OSB panel or particle board with a S_{PAN} thickness and density ρ_k = 500 kg/m^3.
- The thread withdrawal characteristic strength has been evaluated considering a fixing length equal to b.
- The head pull-through characteristic strength was calculated using timber elements.
- For different calculation configurations, the MyProject software is available (www.rothoblaas.com).

NOTES | TIMBER

- The characteristic timber-to-timber shear strengths were evaluated considering both an ε angle of 90° ($R_{V,90,k}$) and 0° ($R_{V,0,k}$) between the grains of the second element and the connector.
- The characteristic panel-timber shear strengths were evaluated considering an angle ε of 90° between the grains of the timber element and the connector.
- The characteristic thread withdrawal resistances were evaluated considering both an ε angle of 90° ($R_{ax,90,k}$) and of 0° ($R_{ax,0,k}$) between the grains of the timber element and the connector.
- For the calculation process a timber characteristic density ρ_k = 385 kg/m^3 has been considered.
  For different ρ_k values, the strength on the table (timber-to-timber shear and tensile) can be converted by the k_{dens} coefficient.

$$R'_{V,k} = k_{dens,v} \cdot R_{V,k}$$
$$R'_{ax,k} = k_{dens,ax} \cdot R_{ax,k}$$
$$R'_{head,k} = k_{dens,ax} \cdot R_{head,k}$$

ρ_k [kg/m^3]	350	380	**385**	405	425	430	440
C-GL	C24	C30	GL24h	GL26h	GL28h	GL30h	GL32h
$k_{dens,v}$	0,90	0,98	1,00	1,02	1,05	1,05	1,07
$k_{dens,ax}$	0,92	0,98	1,00	1,04	1,08	1,09	1,11

Strength values thus determined may differ, for higher safety standards, from those resulting from an exact calculation.

NOTES | CLT

- The characteristic values are according to the national specifications ÖNORM EN 1995 - Annex K.
- For the calculation process, a mass density of ρ_k = 350 kg/m^3 has been considered for CLT elements and a mass density of ρ_k = 385 kg/m^3 has been considered for timber elements.
- The characteristics shear resistance are calculated considering a minimum fixing length of 4 d_1.
- The characteristic shear strength is independent from the direction of the grain of the CLT panels outer layer.
- The axial thread withdrawal resistance in the narrow face is valid for minimum CLT thickness $t_{CLT,min}$ = 10·d_1 and minimum screw pull-through depth t_{pen} = 10·d_1.

NOTES | LVL

- For the calculation process, a mass density of ρ_k = 480 kg/m^3 has been considered for the softwood LVL elements and a mass density of ρ_k = 385 kg/m^3 has been considered for timber elements.
- The characteristic shear strengths are evaluated for connectors inserted on the side face (wide face) considering, for individual timber elements, a 90° angle between the connector and the grain, a 90° angle between the connector and the side face of the LVL element and a 0° angle between the force and the grain.
- The axial thread-withdrawal resistance was calculated considering a 90° angle between the grains and the connector.
- Screws shorter than the minimum in the table are not compatible with the calculation assumptions and are therefore not reported.

MINIMUM DISTANCES

NOTES | TIMBER

- The minimum distances comply with the EN 1995:2014 standard in accordance with ETA-11/0030.
- The minimum spacing for all panel-to-timber connections (a_1, a_2) can be multiplied by a coefficient of 0,85.
- In the case of joints with elements in Douglas fir (Pseudotsuga menziesii), the minimum spacing and distances parallel to the grain must be multiplied by a coefficient of 1.5.
- The spacing a_1 in the table for screws with 3 THORNS tip inserted without pre-drilling hole in timber elements with density $\rho_k \leq$ 420 kg/m^3 and load-to-grain angle α=0° was assumed to be 10·d based on experimental tests; alternatively, adopt 12·d in accordance with EN 1995:2014.

NOTES | CLT

- The minimum distances are compliant with ETA-11/0030 and are to be considered valid unless otherwise specified in the technical documents for the CLT panels.
- Minimum distances are valid for minimum CLT thickness $t_{CLT,min}$ =10·d_1.
- The minimum distances referred to "narrow face" are valid for minimum screw pull-through depth t_{pen} = 10·d_1.

NOTES | LVL

- The minimum distances are compliant with ETA-11/0030 and are to be considered valid unless otherwise specified in the technical documents for the LVL panels.
- The minimum distances are applicable when using both parallel and cross grain softwood LVL.
- The minimum distances without pre-drilling hole are valid for minimum thickness of LVL elements t_{min}:

$$t_1 \geq 8{,}4 \cdot d - 9$$
$$t_2 \geq \begin{cases} 11{,}4 \cdot d \\ 75 \end{cases}$$

  where:
  - t_1 is the thickness in mm of the LVL element in a connection with 2 wooden elements. For connections with 3 or more elements, t_1 represents the thickness of the most external LVL;
  - t_2 is the thickness in mm of the central element in a connection with 3 or more elements.