TENSILE SHEAR STRENGTHS OF ASSY® SCREWS

SOFTWOOD $\rho_K \geq 350 \text{kg/m}^3$
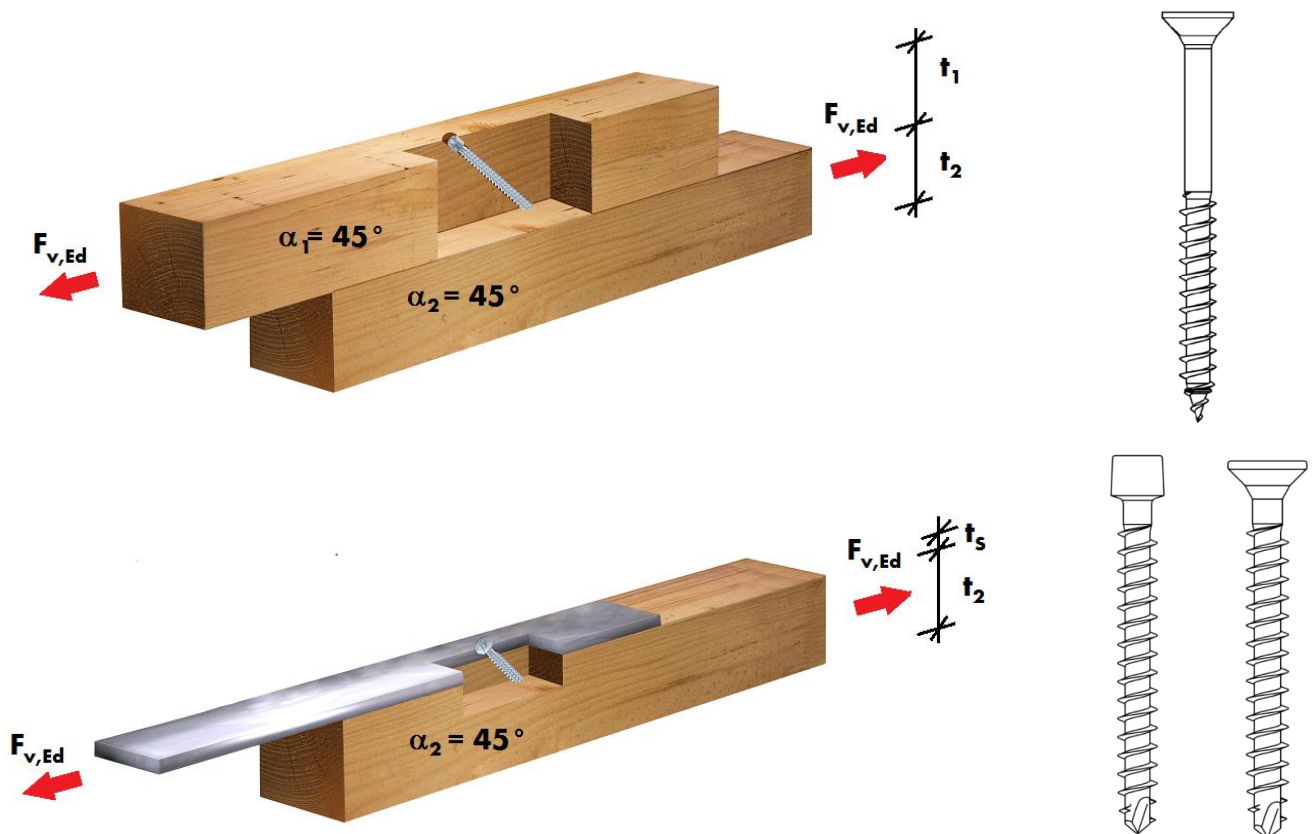
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General

Tables

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

DETERMINING THE TENSILE SHEAR TABLE VALUES FOR SOFTWOOD

Boundary conditions

The example calculation is based on ETA-11/0190 and DIN EN 1995-1-1. This example assumes a connection between C24 wood and C24 wood. The analyzed fastener is a Würth ASSY plus VG 8x180mm.

Component 1	$h =$	40 mm	**Component 2**	$h =$	120 mm
Wood	$b =$	200 mm	**Wood**	$b =$	200 mm
	$\rho_{k,1} =$	350 kg/m³		$\rho_{k,2} =$	350 kg/m³
	$l_{g,1} =$	56.56 mm		$l_{g,2} =$	123.4 mm

Würth ASSY plus VG Ø8x180mm

$d =$	8 mm	"Screw diameter"
$l_{g,1} =$	56.6 mm	"Mathematical threaded length"
$d_h =$	22 mm	"Head diameter"
$M_{y,Rk} =$	20000 Nmm	"Characteristic yield moment [Annex 1 Table 1.1]"
$f_{ax,k} =$	11 N/mm²	"Characteristic pull-out parameter [A.1.3.1]"

Data according to ETA-11/0190 and corresponding product details

Pullout strength

$\alpha =$	90°	"Angle between screw axis and direction of grain"
$k_{ax} =$	1,00	"Factor [ETA 11/0190 A.1.3.1]2"
$f_{head,k} =$	10 N/mm²	"Head pull-through parameter [ETA 11/0190 A.1.3.2]"
$f_{tens,k} =$	20000 N	"Characteristic tensile strength [ETA 11/0190 Annex 1 Table 1.1]"
$l_{ef} =$	56.6mm	"Effective thread length in wood (t_2)"

$$\mathbf{F_{ax,\alpha,Rk,1}} = \mathbf{4977} \qquad = k_{ax} \times f_{ax,k} \times d \times l_{ef} \times \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,\alpha,Rk,2} = 2930 \qquad = F_{ax,\alpha,Rk,2} = f_{head,k} \times d_h{}^2 \times \left(\frac{\rho_k}{350}\right)^{0,8}$$

$$F_{ax,\alpha,Rk,3} = 20000\ N \qquad \text{"Characteristic tensile strength [Annex 1 Table 1.1]"}$$

$$\mathbf{F_{ax,\alpha,Rk}} = \mathbf{4977} \qquad \text{"Minimum pullout strength"}$$

"The head pull-through for full thread screws may be neglected"
Data according to ETA-11/0190 and corresponding product details

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

DETERMINING THE TENSILE SHEAR TABLE VALUES FOR SOFTWOOD

Load-bearing capacity in the shear joint

Utilization class =	1		"Utilization class DIN EN 1995-1-1:2010-12 [2.3.1.3]"
KLED =	medium		"Load duration class DIN EN 1995-1-1:2010-12 [Table 2.2]"
k_{mod} =	0,8		"Modification factor DIN EN 1995-1-1:2010-12 [Table 3.1]"
γ_M =	1,3		"Part safety coefficient DIN EN 1995-1-1:2010-12 [Table 2.3]"
$F_{ax,Rd}$ =	**3063N**	**= 3.06 kN**	$= \dfrac{F_{ax,Rk} \times k_{mod}}{\gamma_M}$
$F_{v,Rd}$ =	**2165 N**	**= 2.17 kN**	$= F_{ax,Rd} \times \cos 45°$

Owing to the inclined screw, the tensile force it carries exerts a pressure force in the joint. Accordingly, an effective friction force may also be assumed.
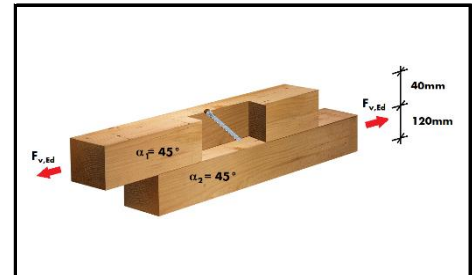
$F_{v,Rd}$ =	**2707**	**= 2.71 kN**	$= F_{ax,Rd} \times (\cos 45° + 0{,}25 \times \sin 45°)$

This value is not listed in the tables.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

USING THE TABLE VALUES

Example calculation

System:	Tensile splice
Side tab t_1:	h/w = 40 mm / 200 mm, softwood, strength class C24 according to EN 338 (ρ_k = 350 kg/m³)
Beam t_2:	h/w = 120 mm / 200 mm, softwood, strength class C24 according to EN 338 (ρ_k = 350 kg/m³)
Basic for calculation:	Dimensioning: EC5 or DIN EN 1995-1-1:2010-12 and national German application document DIN 20000-6:2012-06; ETA 11/0190 ASSY wood screws.
Design force:	$F_{v,Ed}$ = 5,5 kN (utilization class = 1, KLED = "medium")
Connection / design load:	According to the table, each screw ASSY plus VG 8.0x180mm in a side tab thickness t_1 = 40 mm and with the assumption (k_{mod} = 0.8 and γ_M =1.3) exhibits a load-bearing capacity of $F_{v,Rd}$ = 2.17 kN.

ASSY plus VG ∅ 6, 8, 10, 12mm – tensile shear strength $F_{v,Rk}$ and $F_{v,Rd}$ (k_{mod} = 0.8 and γ_M =1.3) with requisite minimum screw length l_{min}

t_1 mm	∅ 6mm $F_{v,R}$ kN	l_{min} mm	∅ 8mm $F_{v,R}$ kN	l_{min} mm	∅ 10mm $F_{v,R}$ kN	l_{min} mm	∅ 12mm $F_{v,R}$ kN	l_{min} mm
30	2,07	100	2,64	120				
	1,27	100	1,62	120				
40	2,76	120	3,52	120	4,00	120		
	1,70	120	2,17	120	2,46	120		
50	3,45	160	4,40	160	5,00	160		
	2,12	160	2,71	160	3,08	160		
60	4,14	180	5,28	180	6,00	180		
	2,55	180	3,25	180	3,69	180		
80	5,52	240	7,04	240	8,00	240	9,60	240
	3,40	240	4,33	240	4,92	240	5,91	240

General Information
Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq$ 350 kg/m³.

Consideration to the group effect yields the following effective number for 3 screws:

$$n_{ef} = 3 \times 0.9 = 2.69 \text{ pcs.}$$

The connection therefore has a load-bearing capacity of $F_{v,Rd}$ = 5.86 kN.

$$2.7 \times 2\text{-}17 \text{ kN} = 5.86 \text{ kN}$$

$$F_{v,Rd} = 5.86 \text{ kN} \quad > \quad F_{v,Ed} = 5.5 \text{ kN}$$

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

LEGEND FOR TENSILE SHEAR TABLES FOR SOFTWOOD-SOFTWOOD OR STEEL-SOFTWOOD

Legend

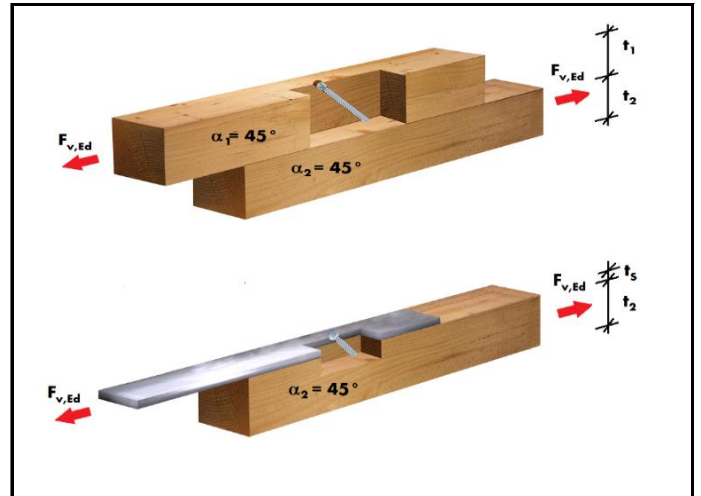|	
$F_{v,Rk}$	Characteristic tensile shear strength in [kN] of a screw for an angle of 45° between direction of grain and screw axis.
$F_{v,Rd}$	Design tensile shear strength in [kN] of a screw for an angle of 45° between direction of grain and screw axis with $k_{mod} = 0.8$ and $\gamma_M = 1.3$.
α_i	Angle between screw axis and component's direction of grain.
ℓ	Screw length in [mm]
ℓ_{min}	Minimum screw length in [mm] for obtaining the specified load-bearing capacity.
ℓ_{ef}	Effective anchorage length of thread in cm; pullout strength ASSY plus VG
d	Nominal diameter / outer thread diameter of screw in [mm]
t_S	Thickness of the steel component (minimum and maximum)
t_1	Side wood thickness on screw head side or thickness of the steel component in [mm]. The minimum thickness of wood components is 24mm (see ETA 11/0190 A1.4).
t_2	Side wood thickness on screw tip side component 2 (tensile shear application) $\alpha = 45°$ in [mm]; component 2: $t_2 \geq l_{min} / 1.414 - t_1$

Table explained

$\varnothing$ **6mm**		
$t_{S,min}$ = **3mm**		
$t_{S, max}$ = **6mm**		
$F_{v,R}$ in kN	l_{min} mm	
Characteristic value $F_{v,Rk}$ 7,78	140	l_{min} for $F_{v,Rk}$
Design value (k_{mod} = 0.8) $F_{v,Rd}$ 5,98	160	l_{min} for $F_{v,Rd}$

Remark on the use of angle washers:

The load-bearing capacities and minimum screw lengths apply to the maximum sheet thickness. A smaller sheet thickness may require a larger wood thickness.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

LEGEND FOR TENSILE SHEAR TABLES FOR SOFTWOOD-SOFTWOOD OR STEEL-SOFTWOOD

General Information

- Single-shear wood-wood or steel-wood connections with screws. All screws must be driven in flush to the surface.

- Screws of carbon steel may be used in utilization classes 1 and 2 only. (Exception: hot-galvanized ASSY plus VG ⌀14)

- Load-bearing capacities for one screw each in a characteristic bulk density $\rho k \geq 350$ kg/m³. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A.1.3.1.

- Load-bearing connections must consist of at least two screws. There may be deviations according to DIN EN 1995-1-1/NA:2010-12, NCI for 8.3.1.2 (NA.10), and ETA-11/0190, 4.2.

- The shear strength value Fv can be multiplied with 1.25 when the friction between the two components is considered.

- Load-bearing capacities and minimum screw lengths apply to the maximum sheet thickness; a smaller sheet thickness may require a larger wood thickness.
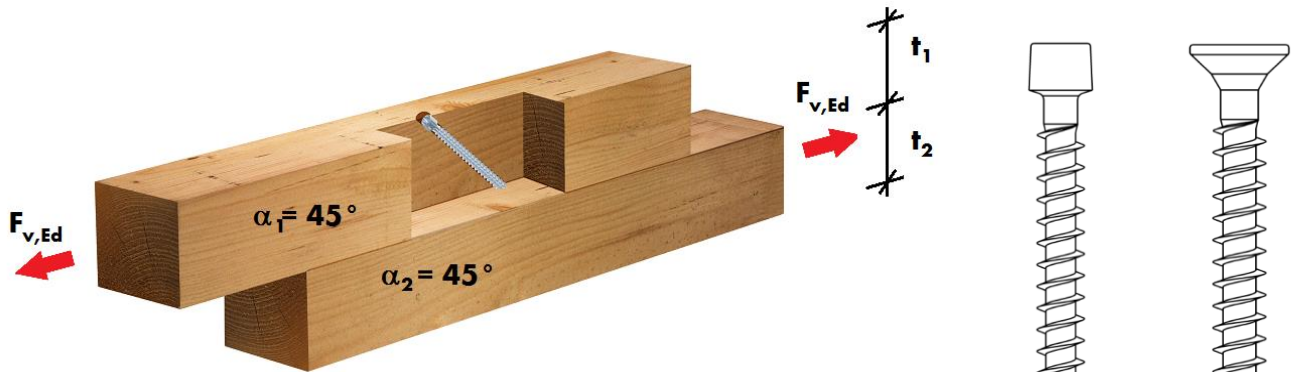
Bases for calculation

DIN EN 1/1/1995:2010-12	Design of timber structures – Common rules and rules for buildings
DIN EN 1995-1-1/NA:2013-08	National Annex – Nationally determined parameters
DIN 20000-6	Application of construction products in structures – Part 6: Dowel-type fasteners and connectors
ETA-11/0190	Würth self-tapping screws for use in timber constructions

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

TENSILE SHEAR TABLE SOFTWOOD-SOFTWOOD $\alpha_1 = 45°$, $\alpha_2 = 45°$
ASSY PLUS VG

ASSY plus VG $\varnothing$ 6, 8, 10, 12mm – tensile shear strength $F_{v,Rk}$ and $F_{v,Rd}$

($k_{mod} = 0.8$ and $\gamma_M = 1.3$) with requisite minimum screw length l_{min}

t_1	$\varnothing$ 6mm		$\varnothing$ 8mm		$\varnothing$ 10mm		$\varnothing$ 12mm	
mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm
30	2,07	100	2,64	120				
	1,27	100	1,62	120				
40	2,76	120	3,52	120	4,00	120		
	1,70	120	2,17	120	2,46	120		
50	3,45	160	4,40	160	5,00	160		
	2,12	160	2,71	160	3,08	160		
60	4,14	180	5,28	180	6,00	180		
	2,55	180	3,25	180	3,69	180		
80	5,52	240	7,04	240	8,00	240	9,60	240
	3,40	240	4,33	240	4,92	240	5,91	240
100	5,79	260	8,80	300	10,0	300	12,0	300
	3,56	260	5,42	300	6,15	300	7,38	300
120	4,41	260	10,6	380	12,0	340	14,4	380
	2,71	260	6,50	380	7,38	340	8,86	380
140	3,03	260	12,3	430	14,0	400	16,8	480
	1,86	260	7,58	430	8,62	400	10,3	480
160	1,65	260	14,1	480	16,0	480	19,2	480
	1,01	260	8,66	480	9,85	480	11,8	480
180			14,1	530	18,0	530	21,6	600
			9,75	530	11,1	530	13,3	600
200			14,1	530	20,0	580	24,0	600
			10,8	580	12,3	580	14,8	600
220			14,1	580	22,0	650	24,5	600
			10,3	580	13,5	650	15,1	600
240			14,1	580	22,6	700	22,1	600
			9,21	580	14,8	700	13,6	600
260			13,2	580	22,6	700	19,7	600
			8,13	580	16,0	750	12,1	600
280			11,5	580	22,6	750	17,3	600
			7,05	580	17,2	800	10,7	600
300			9,69	580	22,6	750	14,9	600
			5,96	580	16,3	800	9,18	600

$F_{v,R}$ in kN	l_{min} mm
$F_{v,Rk}$	
$F_{v,Rd}$	

General Information

Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq 350$ kg/m³.

Basis for calculation
- ETA-11/0190
- EN 1995-1-1:2010-12

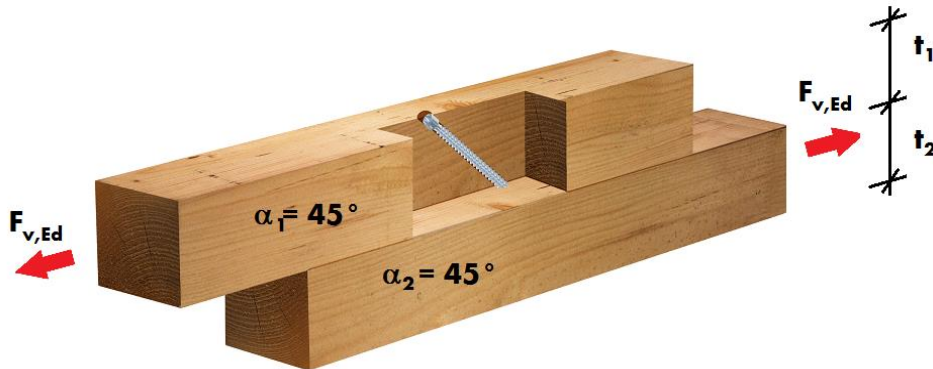The assumptions in the Legend section must be considered.

NOTE: The shear strength value F_v can be multiplied with 1.25 when the friction between the two components is to be considered. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A1.3.1.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

TENSILE SHEAR TABLE SOFTWOOD-SOFTWOOD $\alpha_1 = 45°$, $\alpha_2 = 45°$
ASSY PLUS VG $\varnothing$14MM

ASSY plus VG $\varnothing$14mm – tensile shear strength $F_{v,R}$ and $F_{v,Rd}$ (k_{mod} = 0.8 and γ_M =1.3) with requisite minimum screw length l_{min}

t_1	$\varnothing$ 14mm	
mm	$F_{v,R}$ in kN	l_{min} mm
200	28,0	800
	17,2	800
240	33,6	800
	20,7	800
280	39,2	800
	24,1	800
320	43,8	900
	27,6	950
360	43,8	1000
	31,0	1050
400	43,8	1050
	33,7	1200
440	43,8	1100
	33,7	1200
480	43,8	1200
	33,7	1300
520	43,8	1200
	33,7	1300
560	43,8	1300
	33,7	1400
600	43,8	1300
	33,7	1500
640	43,8	1400
	33,7	1500
680	43,8	1500
	32,8	1500
720	43,8	1500
	29,3	1500
760	42,1	1500
	25,9	1500
800	36,5	1500
	22,5	1500

$F_{v,R}$ in kN	l_{min} mm
$F_{v,Rk}$	
$F_{v,Rd}$	

General Information

Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq 350$ kg/m³.

Basis for calculation
- ETA-11/0190
- EN 1995-1-1:2010-12

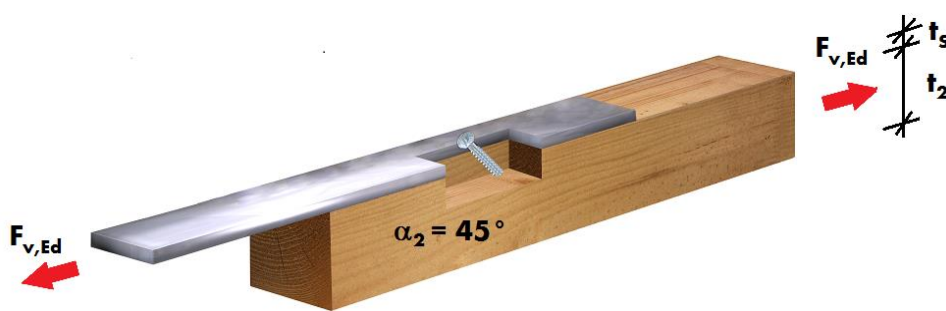The assumptions in the Legend section must be considered.

NOTE: The shear strength value F_v can be multiplied with 1.25 when the friction between the two components is to be considered. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A1.3.1.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

TENSILE SHEAR TABLE STEEL-SOFTWOOD $\alpha_2 = 45°$
ASSY PLUS VG COUNTERSUNK HEAD

ASSY plus VG countersunk head $\varnothing$ 6, 8, 10, 12mm – tensile shear strength $F_{v,Rk}$ and $F_{v,Rd}$ ($k_{mod} = 0.8$ and $\gamma_M = 1.3$) with requisite minimum screw length l_{min}

t_2	$\varnothing$ 6mm		$\varnothing$ 8mm		$\varnothing$ 10mm		$\varnothing$ 12mm	
	t_S = 12mm		t_S = 14mm		t_S = 18mm		t_S = 20mm	
	$F_{v,R}$	l_{min}	$F_{v,R}$	l_{min}	$F_{v,R}$	l_{min}	$F_{v,R}$	l_{min}
mm	in kN	mm	in kN	mm	in kN	mm	in kN	mm
60	3,37	80						
	2,07	80						
80	5,32	120	6,70	120	7,39	120	8,74	120
	3,27	120	4,12	120	4,55	120	5,38	120
100	6,30	140	7,95	140	8,81	140	10,4	140
	3,87	140	4,89	140	5,42	140	6,42	140
120	7,78	180	10,4	180	11,6	180	13,8	180
	5,08	180	6,42	180	7,16	180	8,51	180
140	7,78	180	11,7	200	13,0	200	15,5	200
	5,68	200	7,19	200	8,03	200	9,55	200
160	7,78	180	12,9	220	15,9	240	18,9	240
	5,98	220	7,95	220	9,77	240	11,6	240
180	7,78	180	14,1	240	17,3	260	20,6	260
	5,98	220	9,49	260	10,6	260	12,7	260
200	7,78	180	14,1	240	18,7	280	22,3	280
	5,98	220	10,3	280	11,5	280	13,7	280
220	7,78	180	14,1	240	21,5	320	24,0	300
	5,98	220	10,9	300	13,3	320	14,8	300
240	7,78	180	14,1	240	22,6	340	24,0	300
	5,98	220	10,9	300	14,1	340	14,8	300
260	7,78	180	14,1	240	22,6	340	30,8	380
	5,98	220	10,9	300	15,9	380	19,0	380
280	7,78	180	14,1	240	22,6	340	30,8	380
	5,98	220	10,9	300	16,7	400	19,0	380
300	7,78	180	14,1	240	22,6	340	30,8	380
	5,98	220	10,9	300	17,4	430	19,0	380
320	7,78	180	14,1	240	22,6	340	30,8	380
	5,98	220	10,9	300	17,4	430	19,0	380
340	7,78	180	14,1	240	22,6	340	31,8	480
	5,98	220	10,9	300	17,4	430	24,2	480
360	7,78	180	14,1	240	22,6	340	31,8	480
	5,98	220	10,9	300	17,4	430	24,2	480

$F_{v,R}$ in kN	l_{min} mm
$F_{v,Rk}$	
$F_{v,Rd}$	

General Information

Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq 350$ kg/m³.

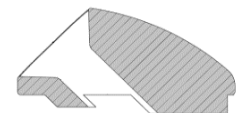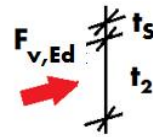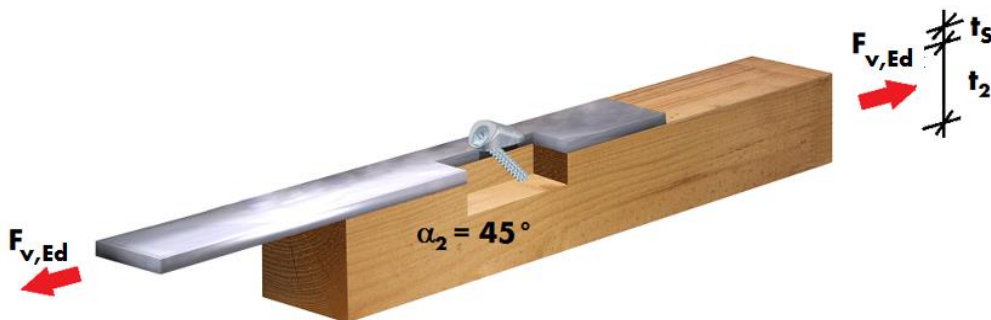### Basis for calculation
- ETA-11/0190
- EN 1995-1-1:2010-12

NOTE: The shear strength value F_v can be multiplied with 1.25 when the friction between the two components is to be considered. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A1.3.1.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

The assumptions in the Legend section must be considered.

TENSILE SHEAR TABLE STEEL-SOFTWOOD $\alpha_2 = 45°$
ASSY PLUS VG COUNTERSUNK HEAD + ANGLE WASHER

ASSY plus VG countersunk head $\varnothing$ 6, 8, 10, 12 mm – tensile shear strength $F_{v,Rk}$ and $F_{v,Rd}$ ($k_{mod} = 0.8$ and $\gamma_M = 1.3$) with requisite minimum screw length l_{min}

t_2	$\varnothing$ 6mm $t_{S,min}$ = 3mm $t_{S,max}$ = 6mm		$\varnothing$ 8mm $t_{S,min}$ = 4mm $t_{S,max}$ = 15mm		$\varnothing$ 10mm $t_{S,min}$ = 5mm $t_{S,max}$ = 21mm		$\varnothing$ 12mm $t_{S,min}$ = 6mm $t_{S,max}$ = 25mm	
mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm
60	2,75	80						
	1,69	80						
80	4,70	120	5,36	120	5,18	120	5,50	120
	2,89	120	3,30	120	3,19	120	3,39	120
100	5,68	140	6,60	140	6,60	140	8,90	160
	3,49	140	4,06	140	4,06	140	5,47	160
120	6,65	160	9,09	180	9,43	180	10,6	180
	4,09	160	5,59	180	5,80	180	6,52	180
140	7,78	200	10,3	200	10,8	200	12,3	200
	5,30	200	6,36	200	6,67	200	7,56	200
160	7,78	200	11,6	220	13,7	240	15,7	240
	5,90	220	7,13	220	8,41	240	9,65	240
180	7,78	200	14,1	260	15,1	260	17,4	260
	5,98	240	8,66	260	9,28	260	10,7	260
200	7,78	200	14,1	280	17,9	300	20,8	300
	5,98	240	9,42	280	11,0	300	12,8	300
220	7,78	200	14,1	280	19,3	320	20,8	300
	5,98	240	10,2	300	11,9	320	12,8	300
240	7,78	200	14,1	280	20,7	340	20,8	300
	5,98	240	10,9	330	12,8	340	12,8	300
260	7,78	200	14,1	280	22,6	380	27,6	380
	5,98	240	10,9	330	14,5	380	17,0	380
280	7,78	200	14,1	280	22,6	380	27,6	380
	5,98	240	10,9	330	15,4	400	17,0	380
300	7,78	200	14,1	280	22,6	380	27,6	380
	5,98	240	10,9	330	16,7	430	17,0	380
320	7,78	200	14,1	280	22,6	380	27,6	380
	5,98	240	10,9	330	16,7	430	17,0	380
340	7,78	200	14,1	280	22,6	380	31,8	480
	5,98	240	10,9	330	17,4	480	22,2	480
360	7,78	200	14,1	280	22,6	380	31,8	480
	5,98	240	10,9	330	17,4	480	22,2	480

$F_{v,R}$ in kN	l_{min} mm
$F_{v,Rk}$	
$F_{v,Rd}$	

General Information

Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq 350$ kg/m³.
The load-bearing capacities and minimum screw lengths apply to the maximum sheet thickness. A smaller sheet thickness may require a larger wood thickness.

Basis for calculation
- ETA-11/0190
- EN 1995-1-1:2010-12

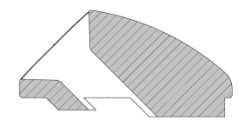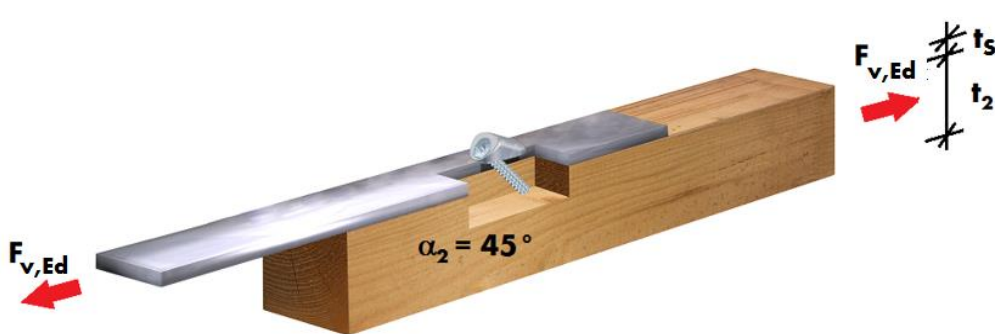The assumptions in the Legend section must be considered.

NOTE: The shear strength value F_v can be multiplied with 1.25 when the friction between the two components is to be considered. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A1.3.1.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

ASSY 3.0 A2 countersunk head $\varnothing$ 6, 8 mm – tensile shear strength $F_{v,Rk}$ and $F_{v,Rd}$

($k_{mod} = 0.8$ and $\gamma_M = 1.3$) with requisite minimum screw length l_{min}

t_2	$\varnothing$ 6mm		$\varnothing$ 8mm	
	$t_{S,min} = 3mm$		$t_{S,min} = 4mm$	
	$t_{S,max} = 6mm$		$t_{S,max} = 15mm$	
mm	$F_{v,R}$ in kN	l_{min} mm	$F_{v,R}$ in kN	l_{min} mm
60	2,44	80	3,11	80
	1,50	80	1,91	80
80	3,42	120	4,98	120
	2,10	120	3,06	120
100	3,42	140	4,98	140
	2,10	140	3,06	140
120	3,42	160	4,98	180
	2,10	160	3,06	180
140	3,42	200	4,98	200
	2,10	200	3,06	200
160	3,42	200	6,22	220
	2,10	200	3,83	220
180	3,42	200	6,22	260
	2,10	200	3,83	260
200	3,42	200	6,22	280
	2,10	200	3,83	280
220	3,42	200	6,22	280
	2,10	200	3,83	300
240	3,42	200	6,22	300
	2,10	200	3,83	300

$F_{v,R}$ in kN	l_{min} mm
$F_{v,Rk}$	
$F_{v,Rd}$	

General Information

Load-bearing capacities for one screw each in a characteristic bulk density $\rho_k \geq 350$ kg/m³.

The load-bearing capacities and minimum screw lengths apply to the maximum sheet thickness. A smaller sheet thickness may require a larger wood thickness.

Basis for calculation

• ETA-11/0190
• EN 1995-1-1:2010-12

NOTE: The shear strength value F_v can be multiplied with 1.25 when the friction between the two components is to be considered. Connections with more than one screw must consider the effective number of screws n_{ef} as defined under DIN EN 1995-1-1 (8.17) or ETA-11/0190 A1.3.1.

The assumptions in the Legend section must be considered.

NOTE: These are planning aids. These values must be measured by authorized persons for each project.

WÜRTH

ASSY® - THE SCREW FOR

TENSILE SHEAR APPLICATIONS

IN TIMBER STRUCTURES