VGS

AC233
ESR-4645

BIT INCLUDED

SOFTWARE

ETA-11/0030

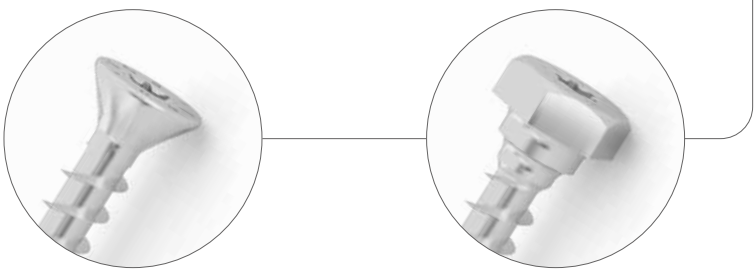
FULLY THREADED SCREW WITH COUNTERSUNK OR HEXAGONAL HEAD

SUPERIOR STRENGTH
Steel with superb bending yield strength (minimum of F_{yb} = 1110 N/mm² | **161,000 psi**). Very high torsional strength $f_{tor,k}$ for safer screwing.

STRUCTURAL APPLICATIONS
Evaluated by ICC-ES according to Acceptance Criteria AC 233. Withdrawal values for any angle between the screw axis and the grain (including end-grain).

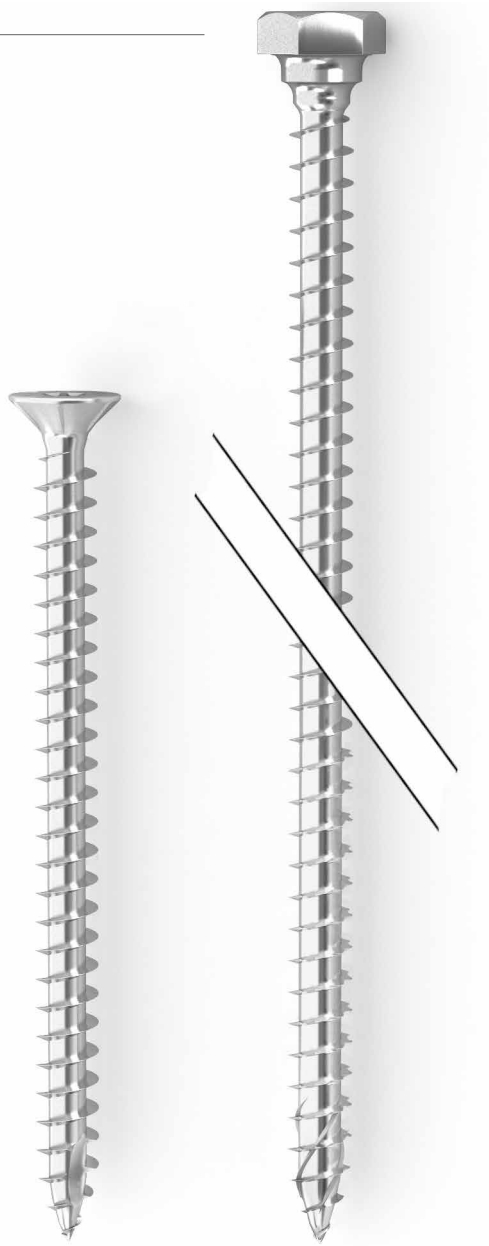
COUNTERSUNK OR HEXAGONAL HEAD
Countersunk head up to L = 600 mm | **23 5/8 inches**, ideal for use on plates or for concealed reinforcements. Hexagonal head L > 600 mm | **23 5/8 inches** to facilitate gripping with screwdriver.

CHROMIUM (VI) FREE
Total absence of hexavalent chromium. Compliance with the strictest regulations governing chemical substances (SVHC).
REACH information available.



9,0 | 11,0 | 13,0 mm - L ≤ 600 mm
0.36 | 0.44 | 0.52 inches - L ≤ 23 5/8 inches

11,0 | 13,0 mm - L > 600 mm
0.44 | 0.52 inches - L > 23 5/8 inches



CHARACTERISTICS

FOCUS	45° connections, reinforcements and couplings	
HEAD	countersunk with ribs for L ≤ 600 mm | **23 5/8 inches** hexagonal for L > 600 mm | **23 5/8 inches**	
DIAMETER	9,0 | 11,0 | 13,0 mm	**0.36 | 0.44 | 0.52 inches**
LENGTH	from 100 to 1200 mm	**4 to 47 1/4 inches**

MATERIAL
Bright zinc plated carbon steel.

FIELDS OF USE
- sawn lumber and timber
- Glued Laminated Timber
- CLT
- high density woods

Dry in-service conditions.

TENSILE STRENGTH

Ideal for joints requiring high tensile or sliding strength. Can be used on steel plates in combination with the VGU washer.

TITAN V

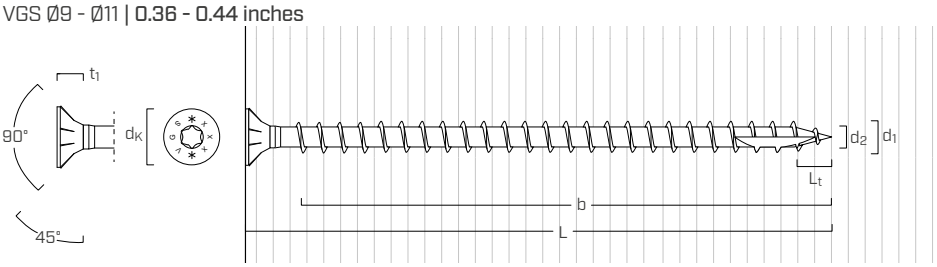
Values also tested, certified and calculated for fastening standard Rothoblaas plates.

Reinforcement perpendicular to the grain of a large glulam beam.

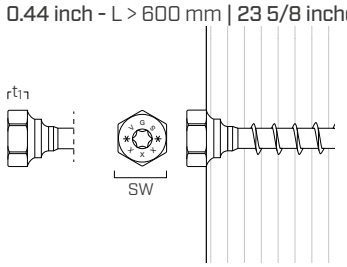
System for lifting and transport using WASP hook and VGS screw.

GEOMETRY AND MECHANICAL CHARACTERISTICS

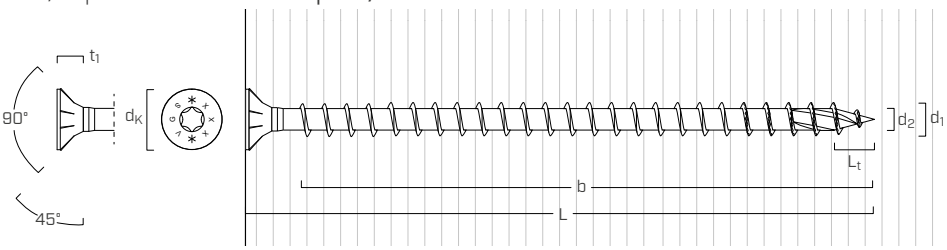
VGS Ø9 - Ø11 | **0.36 - 0.44 inches**



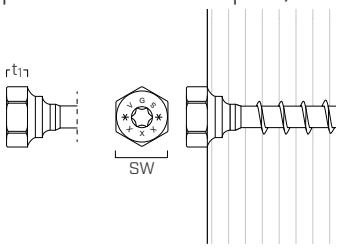
VGS Ø11 | **0.44 inch - L > 600 mm | 23 5/8 inches**



VGS Ø13 | **0.52 inch - L ≤ 600 mm | 23 5/8 inches**



VGS Ø13 | **0.52 inch - L > 600 mm | 23 5/8 inches**



Nominal diameter	d_1	[in](1)	0.36	0.44	0.44	0.52	0.52
Outer thread diameter	**d_1**	[mm]	9	11	11	13	13
		[in]	0.354	0.433	0.433	0.512	0.512
		[in]	-	L ≤ 23 5/8	L > 23 5/8	L ≤ 23 5/8	L > 23 5/8
Head diameter	d_K	[in]	0.630	0.760	-	0.866	-
Wrench size	SW	-	-	-	SW17	-	SW19
Root diameter	d_2	[in]	0.232	0.260	0.260	0.315	0.315
Head thickness	t_1	[in]	0.256	0.323	0.252	0.370	0.295
Tip length	L_t	[in]	0.354	0.433	0.433	0.512	0.512
Pre-drilling hole diameter(2)	d_V	[in]	0.20	0.24	0.24	0.31	0.31
Bending yield strength(3)	$F_{y,b}$	[psi]	180,000	170,000	170,000	161,000	161,000
Tensile strength	f_{tens}	[lbf]	2450	3200	3200	4400	4400

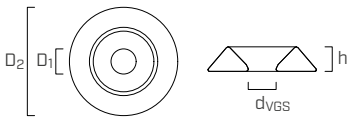
(1) The nominal diameter of the screw is converted into imperial units and rounded up to the nearest decimal point.
(2) Pre-drilling applies to softwood timber.
(3) Bending yield strengths are determined in accordance with ASTM F1575 using the root diameter d_2.

CODES AND DIMENSIONS

d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	pcs [mm]
9 **0.36 TX 40**	**VGS9100**	100	4	90	3 1/2	25
	VGS9120	120	4 3/4	110	4 3/8	25
	VGS9140	140	5 1/2	130	5 1/8	25
	VGS9160	160	6 1/4	150	6	25
	VGS9180	180	7 1/8	170	6 3/4	25
	VGS9200	200	8	190	7 1/2	25
	VGS9220	220	8 5/8	210	8 1/4	25
	VGS9240	240	9 1/2	230	9 1/16	25
	VGS9260	260	10 1/4	250	10	25
	VGS9280	280	11	270	10 5/8	25
	VGS9300	300	11 3/4	290	11 7/16	25
	VGS9320	320	12 5/8	310	12 3/16	25
	VGS9340	340	13 3/8	330	13	25
	VGS9360	360	14 1/4	350	13 3/4	25
	VGS9380	380	15	370	14 9/16	25
	VGS9400	400	15 3/4	390	15 3/8	25
	VGS9440	440	17 1/4	430	16 15/16	25
	VGS9480	480	19	470	18 1/2	25
	VGS9520	520	20 1/2	510	20 1/16	25
11 **0.44 TX 50**	**VGS11100**	100	4	90	3 1/2	25
	VGS11125	125	4 15/16	115	4 1/2	25
	VGS11150	150	6	140	5 1/2	25
	VGS11175	175	6 7/8	165	6 1/2	25
	VGS11200	200	8	190	7 1/2	25
	VGS11225	225	8 7/8	215	8 7/16	25
	VGS11250	250	10	240	9 1/2	25
	VGS11275	275	10 7/8	265	10 7/16	25
	VGS11300	300	11 3/4	290	11 7/16	25
	VGS11325	325	12 3/4	315	12 3/8	25
	VGS11350	350	13 3/4	340	13 3/8	25
	VGS11375	375	14 3/4	365	14 3/8	25
	VGS11400	400	15 3/4	390	15 3/8	25
	VGS11450	450	17 3/4	440	17 1/4	25
	VGS11500	500	19 3/4	490	19 5/16	25
	VGS11550	550	21 5/8	540	21 1/4	25
	VGS11600	600	23 5/8	590	23 1/4	25
11 **0.44 SW17 TX 50**	**VGS11700**	700	27 1/2	680	26 3/4	25
	VGS11800	800	31 1/2	780	30 11/16	25

d_1 [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	pcs [mm]
13 **0.52 TX 50**	**VGS13100**	100	4	90	3 1/2	25
	VGS13150	150	6	140	5 1/2	25
	VGS13200	200	8	190	7 1/2	25
	VGS13250(*)	250	10	240	9 1/2	25
	VGS13300	300	11 3/4	280	11	25
	VGS13350(*)	350	13 3/4	330	13	25
	VGS13400	400	15 3/4	380	15	25
	VGS13450(*)	450	17 3/4	430	16 15/16	25
	VGS13500	500	19 3/4	480	19	25
	VGS13600	600	23 5/8	580	22 13/16	25
13 **0.52 SW 19 TX 50**	**VGS13700**	700	27 1/2	680	26 3/4	25
	VGS13800	800	31 1/2	780	30 11/16	25
	VGS13900	900	35 1/2	880	34 5/8	25
	VGS131000	1000	39 3/8	980	38 9/16	25
	VGS131100	1100	43 5/16	1080	42 1/2	25
	VGS131200	1200	47 1/4	1180	46 7/16	25

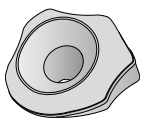
HUS COUNTERSUNK WASHER



d_{VGS} [mm] [in]	CODE	D_1 [in]	D_2 [in]	h [in]	pcs
9 **0.36**	**HUS8**	0.335	0.984	0.217	50
11 **0.44**	**HUS10**	0.425	1.181	0.256	50
13 **0.52**	**HUS12**	0.551	1.457	0.335	25

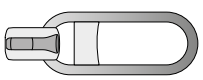
Further information can be found in the Technical data sheets HBS on the website www.rothoblaas.com.

VGU WASHER



CODE	screw VGS [mm]	screw VGS [in]	pcs
VGU945	Ø9	0.36	25
VGU1145	Ø11	0.44	25
VGU1345	Ø13	0.52	25

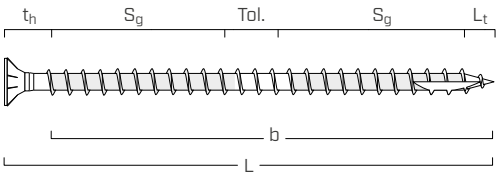
WASP HOOK(*)



CODE	screw VGS [mm]	screw VGS [in]	max. capacity [kg]	max. capacity [lb]	pcs
WASP	Ø11	0.44	1300	2866	2
WASPL	Ø13	0.52	5000	11023	2

(*) Not evaluated in ESR-4645.

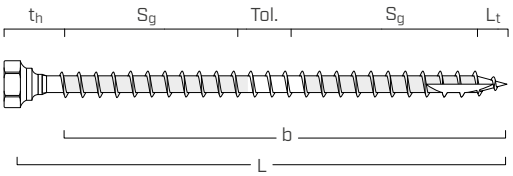
EFFECTIVE THREAD USED IN CALCULATION



b = L - t_h — represents the entire length of the threaded part

S_g = (b - L_t - Tol.) / 2 — represents the partial length of the threaded part net of a laying tolerance (Tol.) of 3/8 inch

The timber to timber withdrawal, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.



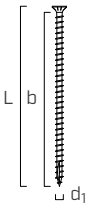
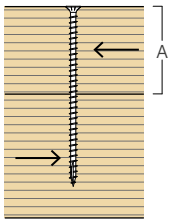
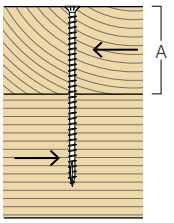
b = L - t_h — represents the entire length of the threaded part

S_g = (b - L_t - Tol.) / 2 — represents the partial length of the threaded part net of a laying tolerance (Tol.) of 3/8 inch

The timber to timber withdrawal, shear and sliding values were calculated considering the centre of gravity of the connector placed in correspondence with the shear plane.

STRUCTURAL VALUES | REFERENCE LATERAL DESIGN VALUES (Z) | WOOD-TO-WOOD

VGS Ø9 | 0.36 inch

geometry					$Z_{\parallel}$ (1)				$Z_{\perp/\parallel}$ (2)				$Z_{\perp}$ (3)			
																
d_1	L		b	A	G=0.35	G=0.42	G=0.49	G=0.55	G=0.35	G=0.42	G=0.49	G=0.55	G=0.35	G=0.42	G=0.49	G=0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
	100	4	3 1/2	1 1/2	159	216	264	309	128	173	211	247	128	173	211	247
	120	4 3/4	4 3/8	2 1/4	186	261	313	348	149	209	250	278	149	209	250	278
	140	5 1/2	5 1/8	2 3/4	219	272	313	348	175	217	250	278	175	217	250	278
	160	6 1/4	6	3	230	272	313	348	184	217	250	278	184	217	250	278
	180	7 1/8	6 3/4	3 1/2	230	272	313	348	184	217	250	278	184	217	250	278
	200	8	7 1/2	4	230	272	313	348	184	217	250	278	184	217	250	278
	220	8 5/8	8 1/4	4 1/4	230	272	313	348	184	217	250	278	184	217	250	278
	240	9 1/2	9 1/16	4 3/4	230	272	313	348	184	217	250	278	184	217	250	278
9	260	10 1/4	10	5	230	272	313	348	184	217	250	278	184	217	250	278
0.36	280	11	10 5/8	5 1/2	230	272	313	348	184	217	250	278	184	217	250	278
TX 40	300	11 3/4	11 7/16	6	230	272	313	348	184	217	250	278	184	217	250	278
	320	12 5/8	12 3/16	6 1/4	230	272	313	348	184	217	250	278	184	217	250	278
	340	13 3/8	13	6 3/4	230	272	313	348	184	217	250	278	184	217	250	278
	360	14 1/4	13 3/4	7	230	272	313	348	184	217	250	278	184	217	250	278
	380	15	14 9/16	7 1/4	230	272	313	348	184	217	250	278	184	217	250	278
	400	15 3/4	15 3/8	7 3/4	230	272	313	348	184	217	250	278	184	217	250	278
	440	17 1/4	16 15/16	8 1/2	230	272	313	348	184	217	250	278	184	217	250	278
	480	19	18 1/2	9 1/2	230	272	313	348	184	217	250	278	184	217	250	278
	520	20 1/2	20 1/16	10 1/4	230	272	313	348	184	217	250	278	184	217	250	278

NOTES:

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

(1) $Z_{\parallel}$ both side and main members loaded parallel to the grain.

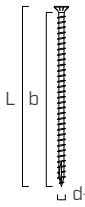
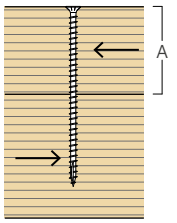
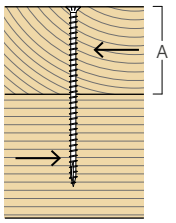
(2) $Z_{\perp/\parallel}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.

(3) $Z_{\perp}$ both side and main members loaded perpendicular to the grain.

Refer to page 15 for the general calculation principles.

STRUCTURAL VALUES | REFERENCE LATERAL DESIGN VALUES (Z) | WOOD-TO-WOOD

VGS Ø11 | 0.44 inch - VGS Ø13 | 0.52 inch

geometry					$Z_{\parallel}$ (1)				$Z_{\perp/\parallel}$ (2)				$Z_{\perp}$ (3)			
																
d_1	L		b	A	G=0.35	G=0.42	G=0.49	G=0.55	G=0.35	G=0.42	G=0.49	G=0.55	G=0.35	G=0.42	G=0.49	G=0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
	100	4	3 1/2	1	227	252	276	297	136	177	201	219	136	168	190	210
	125	4 15/16	4 1/2	2	281	327	370	394	181	216	253	286	150	195	242	276
	150	6	5 1/2	3	314	344	372	394	217	252	278	299	178	232	262	285
	175	6 7/8	6 1/2	3 1/2	314	344	372	394	225	252	278	299	205	234	262	285
	200	8	7 1/2	4	314	344	372	394	225	252	278	299	205	234	262	285
	225	8 7/8	8 7/16	4 1/2	314	344	372	394	225	252	278	299	205	234	262	285
	250	10	9 1/2	5	314	344	372	394	225	252	278	299	205	234	262	285
	275	10 7/8	10 7/16	5 1/2	314	344	372	394	225	252	278	299	205	234	262	285
11	300	11 3/4	11 7/16	6	314	344	372	394	225	252	278	299	205	234	262	285
0.44	325	12 3/4	12 3/8	6 1/4	314	344	372	394	225	252	278	299	205	234	262	285
TX 50	350	13 3/4	13 3/8	6 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	375	14 3/4	14 3/8	7 1/4	314	344	372	394	225	252	278	299	205	234	262	285
	400	15 3/4	15 3/8	7 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	450	17 3/4	17 1/4	8 1/2	314	344	372	394	225	252	278	299	205	234	262	285
	500	19 3/4	19 5/16	9 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	550	21 5/8	21 1/4	10 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	600	23 5/8	23 1/4	11 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	700	27 1/2	26 3/4	13 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	800	31 1/2	30 11/16	15 3/4	314	344	372	394	225	252	278	299	205	234	262	285
	100	4	3 1/2	1/2	154	185	216	243	75	97	122	144	75	97	122	144
	150	6	5 1/2	2 1/2	406	484	532	564	251	300	352	398	196	256	320	378
	200	8	7 1/2	4	450	493	532	564	312	351	387	416	262	319	357	388
	250(*)	10	9 1/2	5	450	493	532	564	312	351	387	416	280	319	357	388
	300	11 3/4	11	6	450	493	532	564	312	351	387	416	280	319	357	388
	350(*)	13 3/4	13	6 7/8	450	493	532	564	312	351	387	416	280	319	357	388
	400	15 3/4	15	7 3/4	450	493	532	564	312	351	387	416	280	319	357	388
13	450(*)	17 3/4	16 15/16	8 7/8	450	493	532	564	312	351	387	416	280	319	357	388
0.52	500	19 3/4	19	9 3/4	450	493	532	564	312	351	387	416	280	319	357	388
TX 50	600	23 5/8	22 13/16	11 3/4	450	493	532	564	312	351	387	416	280	319	357	388
	700	27 1/2	26 3/4	13 3/4	450	493	532	564	312	351	387	416	280	319	357	388
	800	31 1/2	30 11/16	15 3/4	450	493	532	564	312	351	387	416	280	319	357	388
	900	35 1/2	34 5/8	17 3/4	450	493	532	564	312	351	387	416	280	319	357	388
	1000	39 3/8	38 9/16	19 3/4	450	493	532	564	312	351	387	416	280	319	357	388
	1100	43 5/16	42 1/2	21 1/2	450	493	532	564	312	351	387	416	280	319	357	388
	1200	47 1/4	46 7/16	23 1/2	450	493	532	564	312	351	387	416	280	319	357	388

NOTES:

(*) The screws are not evaluated in ESR-4645.

Tabulated reference lateral design values (Z) are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

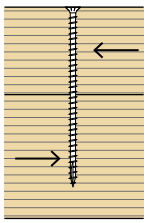
(1) $Z_{\parallel}$ both side and main members loaded parallel to the grain.

(2) $Z_{\perp/\parallel}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.

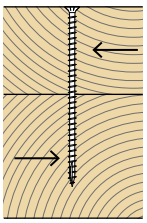
(3) $Z_{\perp}$ both side and main members loaded perpendicular to the grain.

Refer to page 15 for the general calculation principles.

MINIMUM DISTANCES FOR LATERAL LOADING



Load-to-grain angle α = 0°

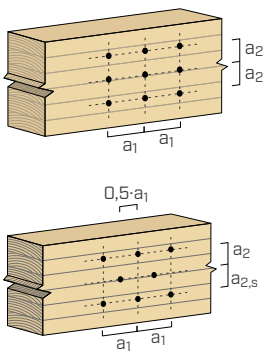


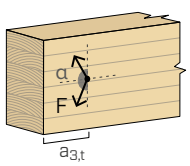
Load-to-grain angle α = 90°

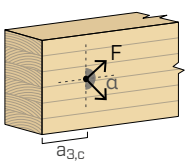
		Screws inserted without pre-drilling hole **G < 0.50**					Screws inserted without pre-drilling hole **G < 0.50**				
d_1	*[mm]*		*9*		*11*	*13*		*9*		*11*	*13*
	[in]		**0.36**		**0.44**	**0.52**		**0.36**		**0.44**	**0.52**
a_1	[in]	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16	**12·d**	4 1/4	**12·d**	5 3/16	6 1/8
a_2	[in]	**5·d**	1 3/4	**5·d**	2 3/16	2 9/16	**5·d**	1 3/4	**5·d**	2 3/16	2 9/16
$a_{2,s}$	[in]	**2.5·d**	7/8	**5·d**	2 3/16	2 9/16	**2.5·d**	7/8	**5·d**	2 3/16	2 9/16
$a_{3,t}$	[in]	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16	**10·d**	3 1/2	**10·d**	4 3/8	5 1/8
$a_{3,c}$	[in]	**10·d**	3 1/2	**10·d**	4 3/8	5 1/8	**10·d**	3 1/2	**10·d**	4 3/8	5 1/8
$a_{4,t}$	[in]	**5·d**	1 3/4	**5·d**	2 3/16	2 9/16	**10·d**	3 1/2	**10·d**	4 3/8	5 1/8
$a_{4,c}$	[in]	**5·d**	1 3/4	**5·d**	2 3/16	2 9/16	**5·d**	1 3/4	**5·d**	2 3/16	2 9/16

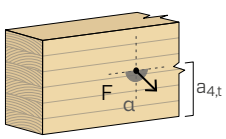
		Screws inserted without pre-drilling hole **G ≥ 0.50**					Screws inserted without pre-drilling hole **G ≥ 0.50**				
d_1	*[mm]*		*9*		*11*	*13*		*9*		*11*	*13*
	[in]		**0.36**		**0.44**	**0.52**		**0.36**		**0.44**	**0.52**
a_1	[in]	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16
a_2	[in]	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16
$a_{2,s}$	[in]	**3·d**	1 1/16	**5·d**	2 3/16	2 9/16	**3·d**	1 1/16	**5·d**	2 3/16	2 9/16
$a_{3,t}$	[in]	**20·d**	7 1/8	**20·d**	8 5/8	10 1/4	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16
$a_{3,c}$	[in]	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16	**15·d**	5 5/16	**15·d**	6 1/2	7 11/16
$a_{4,t}$	[in]	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16	**12·d**	4 1/4	**12·d**	5 3/16	6 1/8
$a_{4,c}$	[in]	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16

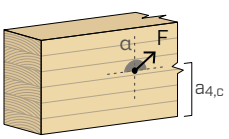
d = nominal screw diameter







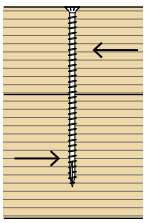




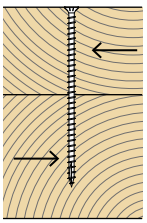
NOTES:

- The minimum spacing and distances comply with Table 9 of ESR-4645, where d refers to the nominal diameter of the screw.
- Values for spacing between staggered rows $a_{2,s}$ apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row ($0.5 \cdot a_1$).
- Wood member stresses must be checked in accordance with Section 11.1.2 and Appendix E of the NDS, and end distances, edge distances and fastener spacing may need to be increased accordingly.

MINIMUM DISTANCES FOR LATERAL LOADING



Load-to-grain angle α = 0°



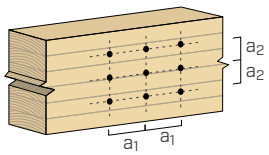
Load-to-grain angle α = 90°

		Screws inserted without pre-drilling hole **G ≤ 0.47**				Screws inserted without pre-drilling hole **G ≤ 0.47**			
d_1	*[mm]*		*9*	*11*	*13*		*9*	*11*	*13*
	[in]		**0.36**	**0.44**	**0.52**		**0.36**	**0.44**	**0.52**
a_1	[in]	**12·d**	4 1/4	5 3/16	6 1/8	**5·d**	1 3/4	2 3/16	2 9/16
a_2	[in]	**5·d**	1 3/4	2 3/16	2 9/16	**5·d**	1 3/4	2 3/16	2 9/16
$a_{3,t}$	[in]	**15·d**	5 5/16	6 1/2	7 11/16	**10·d**	3 1/2	4 3/8	5 1/8
$a_{3,c}$	[in]	**10·d**	3 1/2	4 3/8	5 1/8	**10·d**	3 1/2	4 3/8	5 1/8
$a_{4,t}$	[in]	**5·d**	1 3/4	2 3/16	2 9/16	**10·d**	3 1/2	4 3/8	5 1/8
$a_{4,c}$	[in]	**5·d**	1 3/4	2 3/16	2 9/16	**5·d**	1 3/4	2 3/16	2 9/16

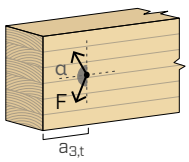
		Screws inserted without pre-drilling hole **G > 0.47**				Screws inserted without pre-drilling hole **G > 0.47**			
d_1	*[mm]*		*9*	*11*	*13*		*9*	*11*	*13*
	[in]		**0.36**	**0.44**	**0.52**		**0.36**	**0.44**	**0.52**
a_1	[in]	**15·d**	5 5/16	6 1/2	7 11/16	**7·d**	2 1/2	3 1/16	3 9/16
a_2	[in]	**7·d**	2 1/2	3 1/16	3 9/16	**7·d**	2 1/2	3 1/16	3 9/16
$a_{3,t}$	[in]	**20·d**	7 1/8	8 5/8	10 1/4	**15·d**	5 5/16	6 1/2	7 11/16
$a_{3,c}$	[in]	**15·d**	5 5/16	6 1/2	7 11/16	**15·d**	5 5/16	6 1/2	7 11/16
$a_{4,t}$	[in]	**7·d**	2 1/2	3 1/16	3 9/16	**12·d**	4 1/4	5 3/16	6 1/8
$a_{4,c}$	[in]	**7·d**	2 1/2	3 1/16	3 9/16	**7·d**	2 1/2	3 1/16	3 9/16

		Screws inserted **with** pre-drilling hole				Screws inserted **with** pre-drilling hole			
d_1	*[mm]*		*9*	*11*	*13*		*9*	*11*	*13*
	[in]		**0.36**	**0.44**	**0.52**		**0.36**	**0.44**	**0.52**
a_1	[in]	**5·d**	1 3/4	2 3/16	2 9/16	**4·d**	1 7/16	1 3/4	2 1/16
a_2	[in]	**3·d**	1 1/16	1 5/16	1 9/16	**4·d**	1 7/16	1 3/4	2 1/16
$a_{3,t}$	[in]	**12·d**	4 1/4	5 3/16	6 1/8	**7·d**	2 1/2	3 1/16	3 9/16
$a_{3,c}$	[in]	**7·d**	2 1/2	3 1/16	3 9/16	**7·d**	2 1/2	3 1/16	3 9/16
$a_{4,t}$	[in]	**3·d**	1 1/16	1 5/16	1 9/16	**7·d**	2 1/2	3 1/16	3 9/16
$a_{4,c}$	[in]	**3·d**	1 1/16	1 5/16	1 9/16	**3·d**	1 1/16	1 5/16	1 9/16

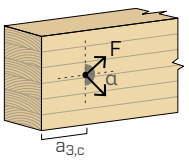
d = nominal screw diameter



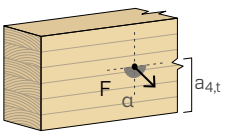
stressed end
-90° < α < 90°



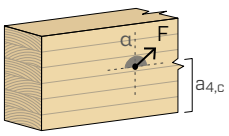
unloaded end
90° < α < 270°



stressed edge
0° < α < 180°



unload edge
180° < α < 360°

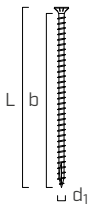
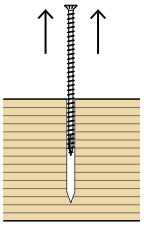
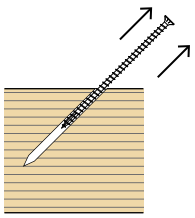


NOTES:

- The tabulated values for the minimum spacing and distances are according to the European Technical Assessment ETA-11/0030. The values from ETA-11/0030 are based on extensive research studies carried out in Europe and are according to the well-established provisions from EN 1995:2014 (Eurocode 5). Designers may adopt, under their responsibility, the minimum spacing and distances from ETA-11/0030.
- Specific gravity of G = 0.47 is equivalent to a characteristic density of ρ_k = 420 kg/m^3.
- The minimum spacing for all steel-to-timber connections (a_1 and a_2) can be multiplied by a coefficient of 0.7.

STRUCTURAL VALUES | THREAD WITHDRAWAL (W) | WOOD

VGS Ø9 | 0.36 inch - VGS Ø11 | 0.44 inch

geometry				W(1) α = 90°				W(1) α = 45°				W(1) α = 0°			
															
d_1 [mm] [in]	L [mm]	L [in]	b [in]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]
	100	4	3 1/2	411	475	552	603	374	432	502	548	123	143	166	181
	120	4 3/4	4 3/8	513	592	688	752	467	539	626	684	154	178	206	225
	140	5 1/2	5 1/8	615	710	824	900	559	646	750	819	184	213	247	270
	160	6 1/4	6	716	827	960	1049	652	753	874	955	215	248	288	315
	180	7 1/8	6 3/4	818	944	1097	1198	744	859	998	1090	245	283	329	359
	200	8	7 1/2	919	1062	1233	1347	837	966	1122	1226	276	319	370	404
	220	8 5/8	8 1/4	1021	1179	1369	1496	929	1073	1246	1361	306	354	411	449
	240	9 1/2	9 1/16	1122	1296	1505	1644	1021	1180	1370	1496	337	389	452	493
9	260	10 1/4	10	1224	1414	1641	1793	1114	1287	1494	1632	367	424	492	538
0.36	280	11	10 5/8	1326	1531	1778	1942	1206	1393	1618	1767	398	459	533	583
TX 40	300	11 3/4	11 7/16	1427	1648	1914	2091	1299	1500	1742	1903	428	495	574	627
	320	12 5/8	12 3/16	1529	1766	2050	2240	1391	1607	1866	2038	459	530	615	672
	340	13 3/8	13	1630	1883	2186	2389	1484	1714	1990	2174	489	565	656	717
	360	14 1/4	13 3/4	1732	2000	2323	2537	1576	1820	2114	2309	520	600	697	761
	380	15	14 9/16	1833	2118	2459	2686	1668	1927	2237	2444	550	635	738	806
	400	15 3/4	15 3/8	1935	2235	2595	2835	1761	2034	2361	2580	581	671	779	851
	440	17 1/4	16 15/16	2138	2470	2867	3133	1946	2247	2609	2851	641	741	860	940
	480	19	18 1/2	2341	2704	3140	3430	2131	2461	2857	3122	702	811	942	1029
	520	20 1/2	20 1/16	2544	2939	3412	3728	2315	2674	3105	3392	763	882	1024	1118
	100(2)	4	3 1/2	460	532	597	653	419	484	543	594	138	160	179	196
	125	4 15/16	4 1/2	606	700	786	860	551	637	715	782	182	210	236	258
	150	6	5 1/2	752	868	975	1067	684	790	887	971	225	261	293	320
	175	6 7/8	6 1/2	897	1037	1164	1273	817	943	1059	1159	269	311	349	382
	200	8	7 1/2	1043	1205	1353	1480	949	1097	1231	1347	313	362	406	444
	225	8 7/8	8 7/16	1189	1373	1542	1687	1082	1250	1403	1535	357	412	463	506
	250	10	9 1/2	1334	1542	1731	1893	1214	1403	1575	1723	400	463	519	568
	275	10 7/8	10 7/16	1480	1710	1920	2100	1347	1556	1747	1911	444	513	576	630
11	300	11 3/4	11 7/16	1626	1878	2109	2307	1479	1709	1919	2099	488	563	633	692
0.44	325	12 3/4	12 3/8	1771	2047	2298	2513	1612	1862	2091	2287	531	614	689	754
TX 50	350	13 3/4	13 3/8	1917	2215	2487	2720	1744	2016	2263	2475	575	664	746	816
	375	14 3/4	14 3/8	2063	2383	2676	2927	1877	2169	2435	2663	619	715	803	878
	400	15 3/4	15 3/8	2208	2552	2865	3133	2010	2322	2607	2851	663	765	859	940
	450	17 3/4	17 1/4	2500	2888	3243	3547	2275	2628	2951	3228	750	866	973	1064
	500	19 3/4	19 5/16	2791	3225	3621	3960	2540	2935	3295	3604	837	967	1086	1188
	550	21 5/8	21 1/4	3082	3561	3999	4374	2805	3241	3639	3980	925	1068	1200	1312
	600	23 5/8	23 1/4	3374	3898	4377	4787	3070	3547	3983	4356	1012	1169	1313	1436
	700	27 1/2	26 3/4	3898	4504	5057	5531	3547	4099	4602	5033	1169	1351	1517	1659
	800	31 1/2	30 11/16	4481	5177	5813	6358	4078	4711	5290	5786	1344	1553	1744	1907

NOTES:

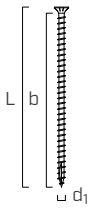
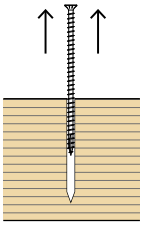
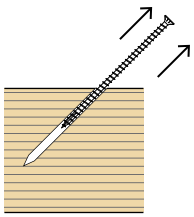
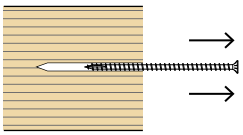
(1) The tabulated values refer to the effective thread penetration length of the screw in the wood member (b - L_t).

(2) The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle $0° \leq \alpha < 90°$ to the grain).

Refer to page 15 for the general calculation principles.

STRUCTURAL VALUES | THREAD WITHDRAWAL (W) | WOOD

VGS Ø13 | 0.52 inch

geometry				W(1) α = 90°				W(1) α = 45°				W(1) α = 0°			
															
d_1 [mm] [in]	L [mm]	L [in]	b [in]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]	G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]
13 **0.52 TX 50**	100(2)	4	3 1/2	631	725	819	891	574	659	745	811	189	217	246	267
	150	6	5 1/2	1040	1195	1350	1470	946	1087	1229	1338	312	359	405	441
	200	8	7 1/2	1449	1665	1881	2049	1319	1516	1712	1864	435	500	564	615
	250(*)	10	9 1/2	1859	2136	2413	2627	1692	1944	2196	2391	558	641	724	788
	300	11 3/4	11	2186	2512	2838	3090	1990	2286	2583	2812	656	754	851	927
	350(*)	13 3/4	13	2596	2983	3370	3669	2362	2714	3066	3339	779	895	1011	1101
	400	15 3/4	15	3005	3453	3901	4248	2735	3142	3550	3866	902	1036	1170	1274
	450(*)	17 3/4	16 15/16	3415	3924	4433	4827	3107	3571	4034	4392	1024	1177	1330	1448
	500	19 3/4	19	3824	4394	4964	5405	3480	3999	4517	4919	1147	1318	1489	1622
	600	23 5/8	22 13/16	4643	5335	6027	6563	4225	4855	5485	5972	1393	1601	1808	1969
	700	27 1/2	26 3/4	5462	6276	7090	7720	4970	5711	6452	7026	1639	1883	2127	2316
	800	31 1/2	30 11/16	6281	7217	8153	8878	5716	6568	7419	8079	1884	2165	2446	2663
	900	35 1/2	34 5/8	7100	8158	9216	10035	6461	7424	8387	9132	2130	2447	2765	3011
	1000	39 3/8	38 9/16	7919	9099	10279	11193	7206	8280	9354	10185	2376	2730	3084	3358
	1100	43 5/16	42 1/2	8738	10040	11342	12350	7951	9136	10321	11239	2621	3012	3403	3705
	1200	47 1/4	46 7/16	9557	10981	12405	13508	8696	9993	11289	12292	2867	3294	3722	4052

NOTES:

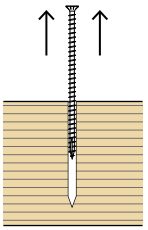
(*) The screws are not evaluated in ESR-4645.

(1) The tabulated values refer to the effective thread penetration length of the screw in the wood member (b - L_t).

(2) The embedded thread length does not comply with the minimum requirement of ESR-4645 (6 times the outer thread diameter for screws installed at 90° to the grain and 8 times the outer thread diameter for screws installed at an angle 0° ≤ α < 90° to the grain).

Refer to page 15 for the general calculation principles.

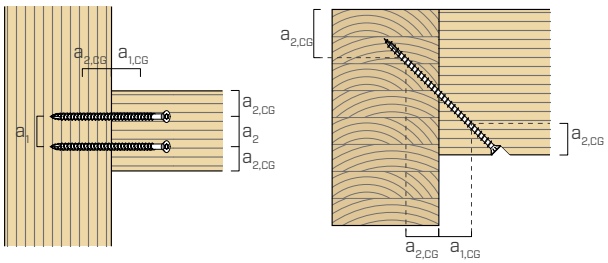
MINIMUM DISTANCES FOR AXIAL STRESSES



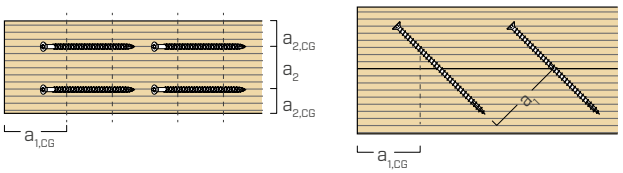
		Screws inserted with and without pre-drilling hole **G ≤ 0.55**				
d_1	*[mm]*		*9*		*11*	*13*
	[in]		**0.36**		**0.44**	**0.52**
a_1	[in]	**7·d**	2 1/2	**7·d**	3 1/16	3 9/16
a_2	[in]	**4·d**	1 7/16	**5·d**	2 3/16	2 1/16
$a_{1,CG}$	[in]	**10·d**	3 1/2	**10·d**	4 3/8	5 1/8
$a_{2,CG}$	[in]	**4·d**	1 7/16	**4·d**	1 3/4	2 9/16
$a_{2,CROSS}$	[in]	**1.5·d**	9/16	**1.5·d**	11/16	13/16

d = nominal screw diameter

SCREWS UNDER TENSION INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN

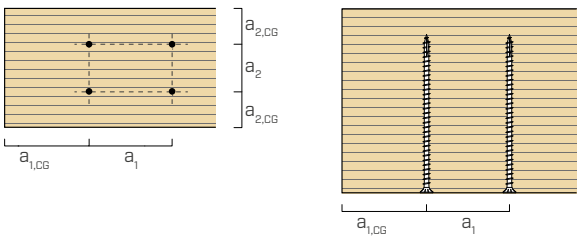


plan front



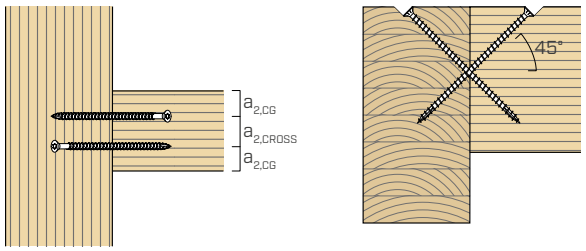
plan front

SCREWS INSERTED WITH α = 90° ANGLE WITH RESPECT TO THE GRAIN



plan front

CROSS SCREWS INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN

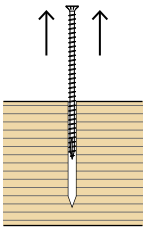


plan front

NOTES:

- The minimum spacing and distances comply with Table 9 of ESR-4645, where d refers to the nominal diameter of the screw.
- Wood member stresses must be checked in accordance with Section 11.1.2 and Appendix E of the NDS, and end distances, edge distances and fastener spacing may need to be increased accordingly.

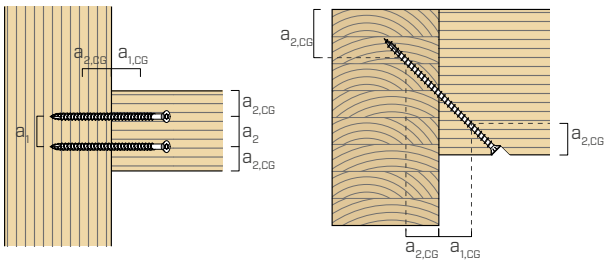
MINIMUM DISTANCES FOR AXIAL STRESSES



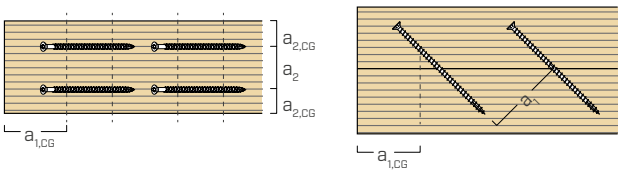
			Screws inserted with and without pre-drilling hole **G ≤ 0.55**		
d_1	*[mm]*		*9*	*11*	*13*
	[in]		**0.36**	**0.44**	**0.52**
a_1	[in]	**5·d**	1 3/4	2 3/16	2 9/16
a_2	[in]	**5·d**	1 3/4	2 3/16	2 9/16
$a_{2,LIM}$ (1)	[in]	**2.5·d**	*7/8*	*1 1/8*	*1 5/16*
$a_{1,CG}$	[in]	**10·d**	3 1/2	4 3/8	5 1/8
$a_{2,CG}$	[in]	**4·d**	1 7/16	1 3/4	2 1/16
a_{CROSS}	[in]	**1.5·d**	9/16	11/16	13/16

d = nominal screw diameter

SCREWS UNDER TENSION INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN

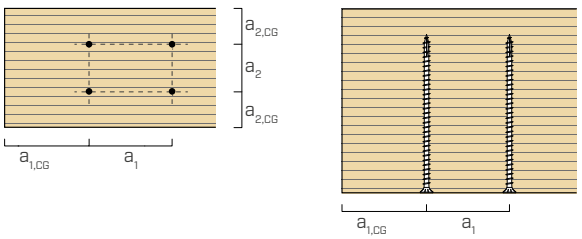


plan front



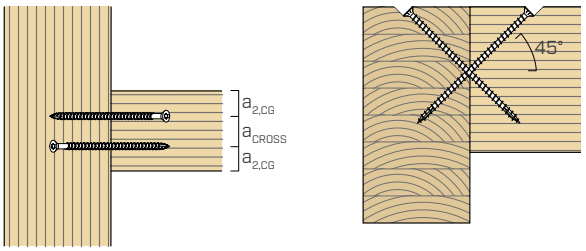
plan front

SCREWS INSERTED WITH α = 90° ANGLE WITH RESPECT TO THE GRAIN



plan front

CROSS SCREWS INSERTED WITH AN ANGLE α WITH RESPECT TO THE GRAIN



plan front

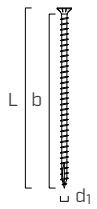
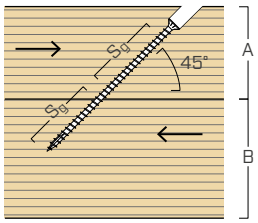
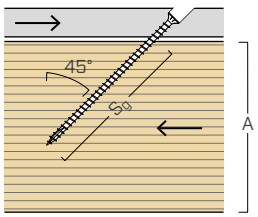
NOTES:

- The tabulated values for the minimum spacing and distances are according to the European Technical Assessment ETA-11/0030. The values from ETA-11/0030 are based on extensive research studies carried out in Europe and are according to the well-established provisions from EN 1995:2014 (Eurocode 5). Designers may adopt, under their responsibility, the minimum spacing and distances from ETA-11/0030.

(1) The axial distance a_2 can be reduced down to 2,5 d_1 if for each connector a "joint surface" $a_1 \cdot a_2 = 25 \cdot d_1^2$ is maintained.

STRUCTURAL VALUES | SLIDING RESISTANCE (R_V)

VGS Ø9 | 0.36 inch - VGS Ø11 | 0.44 inch

geometry			R_v							R_v					
															
d_1	L		S_g	A_{min}	B_{min}	G=0.35	G=0.42	G=0.49	G=0.55	S_g	A_{min}	G=0.35	G=0.42	G=0.49	G=0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
	100[1]	4	1 3/8	1 9/16	2 3/16	116	134	156	170	3 3/16	2 15/16	265	306	355	388
	120[1]	4 3/4	1 3/4	1 15/16	2 3/8	149	172	199	218	4	3 1/2	330	381	443	484
	140[1]	5 1/2	2 3/16	2 3/16	2 3/4	181	209	243	266	4 3/4	4 1/8	395	457	530	579
	160[1]	6 1/4	2 9/16	2 3/8	2 15/16	214	247	287	314	5 9/16	4 3/4	461	532	618	675
	180	7 1/8	2 15/16	2 3/4	3 3/8	247	285	331	361	6 5/16	5 5/16	526	608	706	771
	200	8	3 3/8	2 15/16	3 1/2	279	323	375	409	7 1/8	6	592	683	793	867
	220	8 5/8	3 3/4	3 3/8	4	312	360	419	457	8	6 1/4	657	759	881	962
	240	9 1/2	4 1/8	3 1/2	4 1/8	345	398	462	505	8 5/8	6 7/8	722	834	969	1058
9	260	10 1/4	4 1/2	4	4 3/8	377	436	506	553	9 1/2	7 1/2	788	910	1056	1154
0.36	280	11	4 15/16	4 1/8	4 3/4	410	474	550	601	10 1/4	8 1/16	853	985	1144	1250
TX 40	300	11 3/4	5 5/16	4 3/8	4 15/16	443	511	594	649	11	8 5/8	918	1061	1232	1345
	320	12 5/8	5 11/16	4 3/4	5 5/16	475	549	638	697	11 3/4	9 1/4	984	1136	1319	1441
	340	13 3/8	6 1/8	4 15/16	5 1/2	508	587	682	745	12 5/8	9 5/8	1049	1212	1407	1537
	360	14 1/4	6 1/2	5 5/16	5 11/16	541	625	725	792	13 3/8	10 1/4	1114	1287	1494	1633
	380	15	6 7/8	5 1/2	6 1/8	574	662	769	840	14 1/4	10 7/8	1180	1363	1582	1728
	400	15 3/4	7 1/4	5 11/16	6 1/4	606	700	813	888	15	11 7/16	1245	1438	1670	1824
	440	17 1/4	8 1/16	6 1/4	6 7/8	672	776	901	984	16 9/16	12 5/8	1376	1589	1845	2016
	480	19	8 7/8	6 7/8	7 1/2	737	851	988	1080	18 1/8	13 9/16	1507	1740	2020	2207
	520	20 1/2	9 5/8	7 1/2	8 1/16	802	927	1076	1175	19 3/4	14 3/4	1637	1891	2196	2399
	100[1]	4	1 5/16	1 9/16	2 3/16	129	149	168	184	3 1/8	2 15/16	296	342	384	420
	125	4 15/16	1 7/8	1 15/16	2 9/16	176	204	229	250	4 1/8	3 3/4	390	451	506	553
	150	6	2 5/16	2 3/8	2 15/16	223	258	289	317	5 1/16	4 3/8	484	559	627	686
	175	6 7/8	2 13/16	2 3/4	3 1/8	270	312	350	383	6 1/16	5 1/8	577	667	749	819
	200	8	3 5/16	3 1/8	3 1/2	317	366	411	450	7 1/16	5 11/16	671	775	871	952
	225	8 7/8	3 13/16	3 3/8	4	364	420	472	516	8 1/16	6 1/2	765	884	992	1085
	250	10	4 5/16	3 3/4	4 3/8	411	474	533	583	9 1/16	7 1/8	859	992	1114	1218
	275	10 7/8	4 13/16	4 1/8	4 1/2	457	529	593	649	10 1/16	8	952	1100	1235	1351
11	300	11 3/4	5 1/4	4 1/2	4 15/16	504	583	654	716	11	8 7/16	1046	1209	1357	1484
0.44	325	12 3/4	5 13/16	4 3/4	5 5/16	551	637	715	782	12	9 1/4	1140	1317	1479	1617
TX 50	350	13 3/4	6 1/4	5 1/8	5 11/16	598	691	776	849	13	10 1/16	1234	1425	1600	1750
	375	14 3/4	6 3/4	5 1/2	6 1/8	645	745	837	915	14	10 5/8	1327	1534	1722	1883
	400	15 3/4	7 1/4	6	6 1/4	692	799	897	982	15	11 7/16	1421	1642	1843	2016
	450	17 3/4	8 1/16	6 1/2	7 1/8	785	908	1019	1115	16 15/16	12 3/4	1608	1858	2087	2282
	500	19 3/4	9 1/16	7 1/4	7 11/16	879	1016	1141	1248	19	14 1/4	1796	2075	2330	2548
	550	21 5/8	10 1/16	8	8 7/16	973	1124	1262	1381	20 7/8	15 9/16	1983	2292	2573	2814
	600	23 5/8	11	8 5/8	9 1/16	1067	1232	1384	1514	22 13/16	16 15/16	2171	2508	2816	3080
	700	27 1/2	12 3/4	10 1/16	10 7/16	1254	1449	1627	1780	-	-	-	-	-	-
	800	31 1/2	14 3/4	11 7/16	12	1442	1666	1870	2046	-	-	-	-	-	-

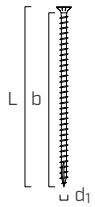
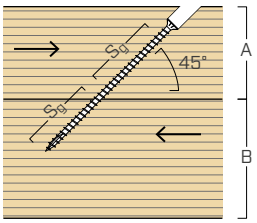
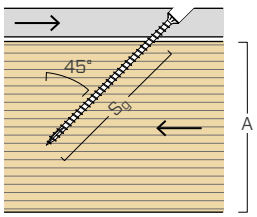
NOTES:

[1] The embedded thread length in the main and side member for timber-to-timber connection and in the main member for steel-to-timber connection does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle α = 45° to the grain).

Refer to page 15 for the general calculation principles.

STRUCTURAL VALUES | SLIDING RESISTANCE (R_V)

VGS Ø13 | 0.52 inch

geometry			R_V							R_V					
															
d_1	L		S_g	A_{min}	B_{min}	G=0.35	G=0.42	G=0.49	G=0.55	S_g	A_{min}	G=0.35	G=0.42	G=0.49	G=0.55
[mm] [in]	[mm]	[in]	[in]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]	[in]	[in]	[lbf]	[lbf]	[lbf]	[lbf]
13 **0.52 TX 50**	100(1)	4	1 5/16	1 3/4	2 3/16	177	203	229	250	3 1/16	2 15/16	393	466	527	573
	150	6	2 5/16	2 3/8	2 15/16	308	354	400	436	5	4 3/8	586	769	869	946
	200	8	3 1/4	3 1/8	3 1/2	440	506	571	622	6 15/16	5 11/16	761	1072	1211	1318
	250(*)	10	4 1/4	3 3/4	4 1/8	572	657	742	808	8 15/16	7 1/8	954	1374	1553	1691
	300	11 3/4	5 1/16	4 1/2	4 15/16	703	808	913	994	10 7/16	8 1/4	1104	1617	1826	1989
	350(*)	13 3/4	6	5 1/8	5 1/2	835	960	1084	1181	12 3/8	9 5/8	1288	1919	2168	2361
	400	15 3/4	7	6	6 1/4	967	1111	1255	1367	14 9/16	11	1472	2222	2510	2733
	450(*)	17 3/4	8	6 1/2	6 7/8	1099	1262	1426	1553	16 9/16	12 3/8	1656	2525	2852	3106
	500	19 3/4	8 7/8	7 1/4	7 11/16	1230	1414	1597	1739	18 15/16	13 3/4	1840	2828	3194	3478
	600	23 5/8	10 7/8	8 5/8	9 1/16	1494	1716	1939	2112	22 5/16	16 9/16	2217	3433	3878	4223
	700	27 1/2	12 3/4	10 1/16	10 7/16	1757	2019	2281	2484	-	-	-	-	-	-
	800	31 1/2	14 3/4	11 7/16	12	2021	2322	2623	2856	-	-	-	-	-	-
	900	35 1/2	16 3/4	12 3/4	13 3/8	2284	2625	2965	3229	-	-	-	-	-	-
	1000	39 3/8	18 11/16	14 1/4	14 3/4	2548	2927	3307	3601	-	-	-	-	-	-
	1100	43 5/16	20 11/16	15 9/16	16 1/8	2811	3230	3649	3974	-	-	-	-	-	-
	1200	47 1/4	22 5/8	16 15/16	17 1/2	3075	3533	3991	4346	-	-	-	-	-	-

NOTES:

(*) The screws are not evaluated in ESR-4645.

(1) The embedded thread length in the main and side member for timber-to-timber connection and in the main member for steel-to-timber connection does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle α = 45° to the grain).

Refer to page 15 for the general calculation principles.

GENERAL PRINCIPLES:

- Tabulated values must be multiplied by all adjustment factors included in the NDS for dowel-type fasteners to determine allowable loads for use with ASD, design loads for use with LRFD or both.
- As part of the connection design, the structural wood members must be checked for load-carrying capacity in accordance with Section 11.1.2 of the NDS and local stresses within multiple-fastener connections must be checked against Appendix E of the NDS to ensure the capacity of the connection and fastener group.
- The design of connection with steel side plate must comply with Section 11.2.3 of the NDS.
- Connections with multiple screws must be designed in accordance with Sections 11.2.2 and 12.6 of the NDS and the requirements in Section 4.1.7.3.1 of ESR-4645.
- VGS screws must be installed and used in dry in-service conditions in accordance with the NDS (wet service factor for connection C_M is 1.0).
- Sizing and verification of the timber elements and steel plates must be done separately by the designer.
- 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.

REFERENCE LATERAL DESIGN VALUES:

- Tabulated values are determined from the yield model equations in Section 12.3 and Table 12.3.1A of the NDS.
- The screw penetration into the main member is minimum 6 times the outer thread diameter unless otherwise noted.
- The reference lateral design values may be determined for other connection configurations in accordance with the NDS and Section 4.1.6.2 of ESR-4645.
- The reference lateral design values 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.

WOOD-TO-WOOD

- The wood main member thickness must be greater than the screw length less the thickness of the wood side member.
- The tabulated lateral design values are based on both wood members having the same specific gravity G.

STEEL-TO-WOOD

- The steel side member must have a minimum tensile strength equal to 58 ksi (400 MPa) and comply with the minimum requirements of ASTM A36.
- The wood main member thickness must be greater than the screw length less the thickness of the steel side member.

REFERENCE WITHDRAWAL DESIGN VALUES:

The reference withdrawal design values (W_{ref}) expressed in pounds-force per inch of thread penetration into the main member for screws installed at an angle of 90° to the grain can be found in Table 7 of ESR-4645 and are reported below.

d_1	Reference withdrawal design values W_{ref}			
	G=0.35	G=0.42	G=0.49	G=0.55
[mm] [in]	[lbf/in]	[lbf/in]	[lbf/in]	[lbf/in]
9 **036**	129	149	173	189
11 **0.44**	148	171	192	210
13 **0.52**	208	239	270	294

- The values for screws installed at an angle α to the grain are determined by multiplying the reference withdrawal design values with the effective thread penetration L_{eff} of the screw in the wood member and with the factor k_α:

$$W_\alpha = W_{ref} \cdot k_\alpha \cdot L_{eff}$$

Where:

- W_{ref} is the reference withdrawal design value for screws installed at an angle of 90° to the grain, as shown in the table on the left;
- k_α factor is calculated as:

$$k_\alpha = \begin{cases} 35^\circ < \alpha \leq 90^\circ & \dfrac{1}{1.2 \cdot \cos^2(\alpha) + \sin^2(\alpha)} \\ 0^\circ \leq \alpha \leq 35^\circ & 0.3 + 0.7 \cdot \dfrac{\alpha}{45} \end{cases}$$

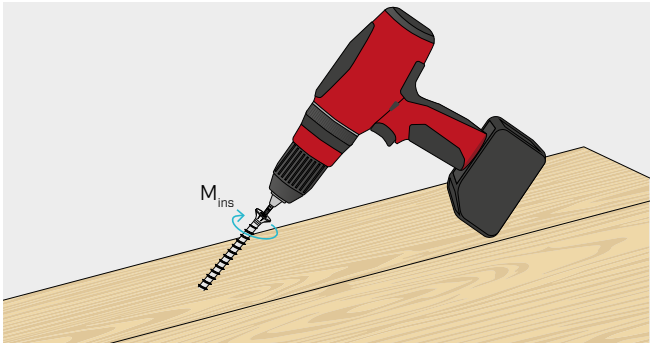
- α is the angle between the grain direction and screw axis.

- The minimum embedded thread length is 6 times the outer thread diameter for screws installed at 90° to the grain, unless otherwise noted.
- The minimum embedded thread length for screws installed at an angle $0° \leq \alpha < 90°$ to the grain is 8 times the outer thread diameter, unless otherwise noted.
- At least four screws must be used in a connection with screws installed in the wood member with an angle between the grain direction and screw axis $\alpha \leq 15°$.
- The reference withdrawal design values must be less than f_{tens} of the screw.

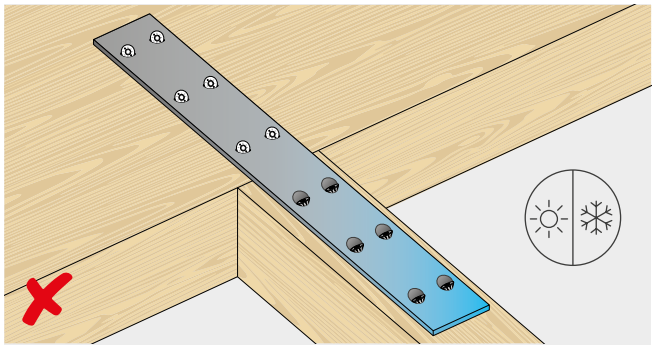
TIMBER-TO-TIMBER APPLICATION

RECOMMENDED INSERTION MOMENT: M_{ins}

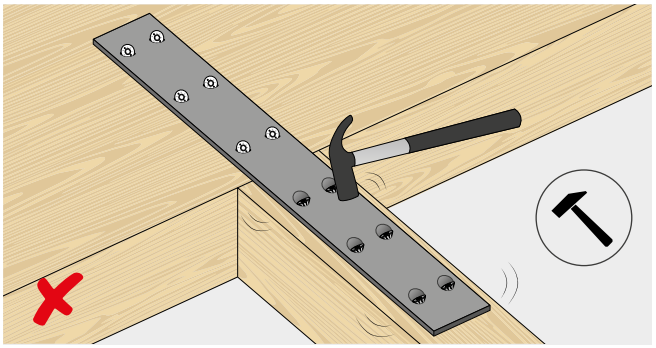
VGS Ø9 mm **VGS 0.36 inch**	M_{ins} = 20 Nm **M_{ins} = 14.75 lbf-ft**
VGS Ø11 mm L < 400 mm **VGS 0.44 inch L < 15 3/4 inch**	M_{ins} = 30 Nm **M_{ins} = 22.13 lbf-ft**
VGS Ø11 mm L ≥ 400 mm **VGS 0.44 inch L ≥ 15 3/4 inch**	M_{ins} = 30 Nm **M_{ins} = 22.13 lbf-ft**
VGS Ø13 mm **VGS 0.52 inch**	M_{ins} = 50 Nm **M_{ins} = 36.88 lbf-ft**



STEEL-TO-TIMBER APPLICATION

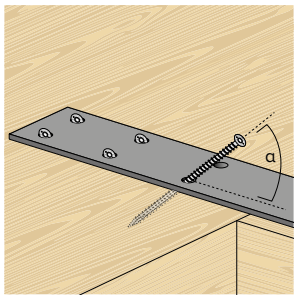


Avoid dimensional changes to the metal.

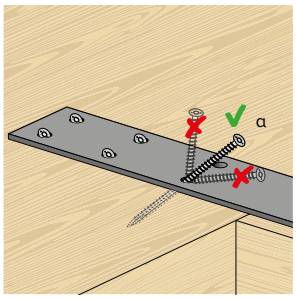


Avoid accidental stress during installation.

A. SHAPED PLATE WITH COUNTERSUNK HOLES

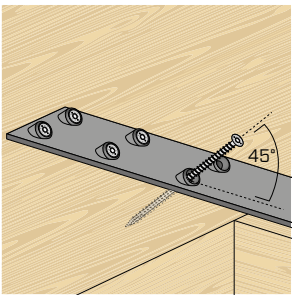


Respect the insertion angle (e.g. adopting a template).

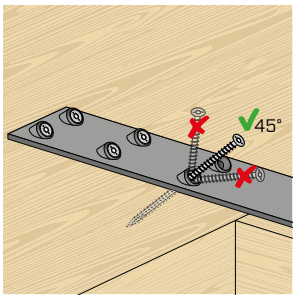


Avoid bending.

B. VGU WASHER

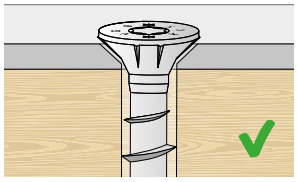


Respect the 45° insertion angle.

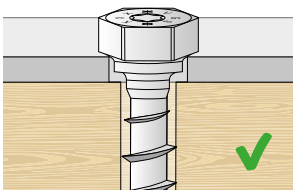


Avoid bending.

A. SHAPED PLATE

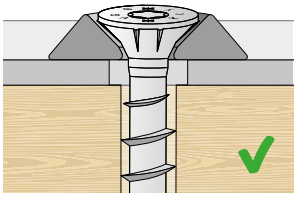


Countersunk hole.

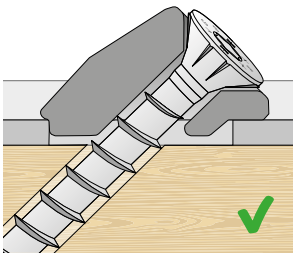


Cylindrical hole.

B. WASHERS

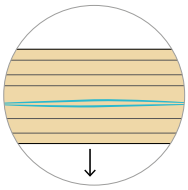


Flared washer.

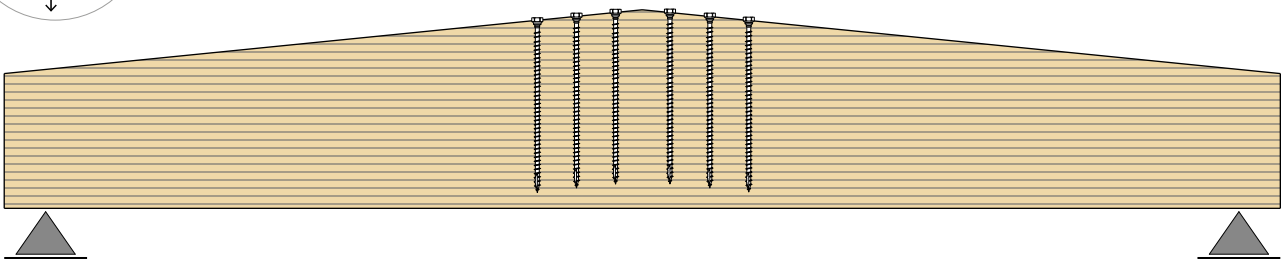


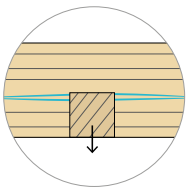
VGU washer.

APPLICATION EXAMPLES

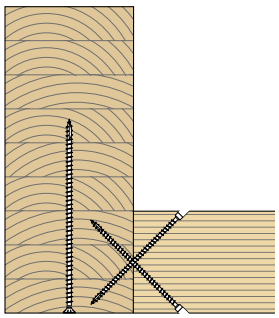


TAPERED BEAMS
apex tension reinforcement perpendicular to grain

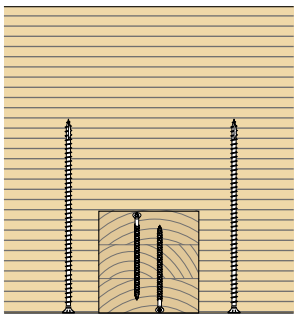




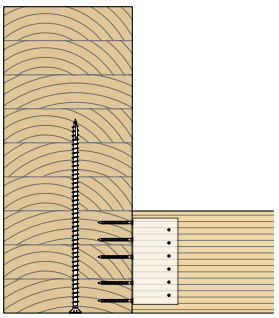
HANGING LOAD
tension reinforcement perpendicular to grain



section



front



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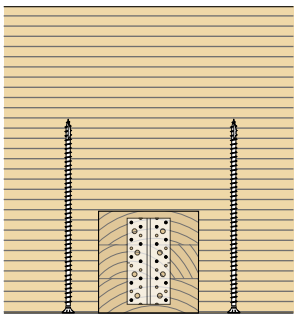
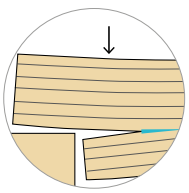
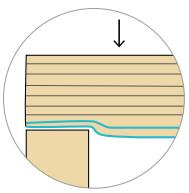


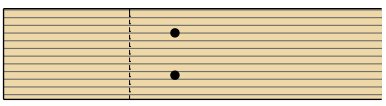
front



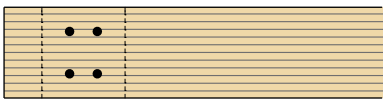
NOTCH
tension reinforcement
perpendicular to grain



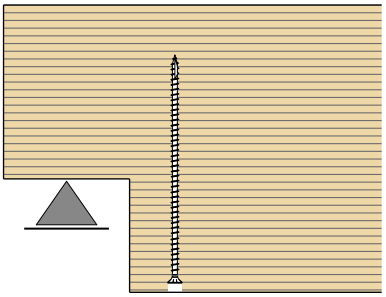
SUPPORT
compression reinforcement
perpendicular to grain



plan



plan



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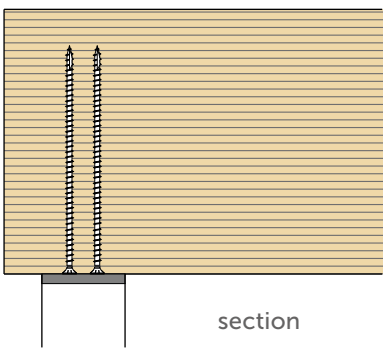

section