

C4 EVO COATING

C4 EVO 20 µm multilayer coating with a surface treatment of epoxy resin and aluminum flakes. No rust after 1440 hours of salt spray exposure, as per ISO 9227. Tested for use in outdoor applications under C4 atmospheric corrosion class conditions (ISO 12944-2).

PRESSURE - TREATED LUMBER

Ideal for applications with timber containing tannin or treatment agents. EVO Coating has been evaluated by ICC-ES according to Acceptance Criteria AC 257 for use with ACQ treated lumber for durable structures in challenging conditions.

SUPERIOR STRENGTH

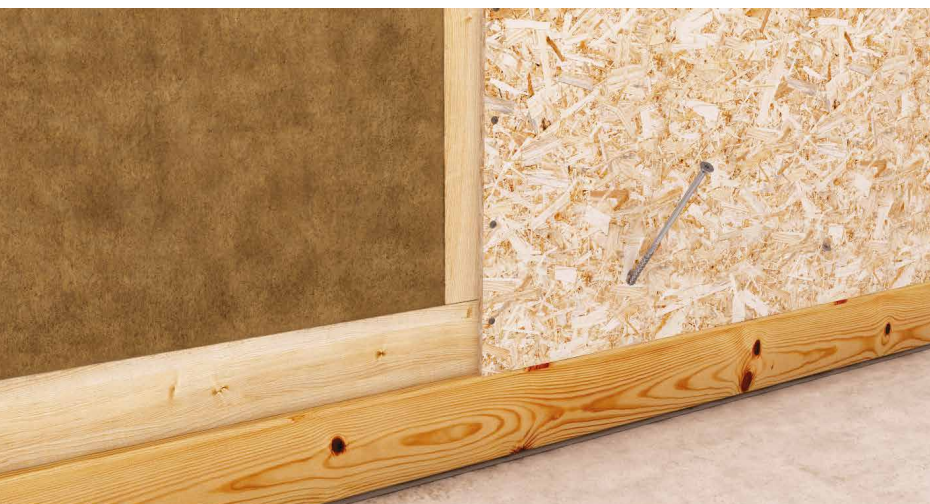
Steel with superb bending yield strength (minimum of $F_{yb} = 1241 \text{ N/mm}^2$ | 180,000 psi according to ESR-4645). Very high torsional strength $f_{tor,k}$ for safer screwing.

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). Asymmetric "umbrella" shape thread for improved penetration capacity into the wood member.

CHARACTERISTICS

FOCUS	corrosiveness class C4	
HEAD	countersunk with under-head ribs	
DIAMETER	from 5,0 to 8,0 mm	0.20 to 0.32 inches
LENGTH	from 80 to 320 mm	3 1/8 to 12 5/8 inches



MATERIAL

Carbon steel, with a 20 µm coating, highly resistant to corrosion.

FIELDS OF USE

- sawn lumber and timber
 - Glued Laminated Timber
 - CLT
 - high density woods
 - Pressure - treated lumber (ACQ)
- Dry in-service conditions.

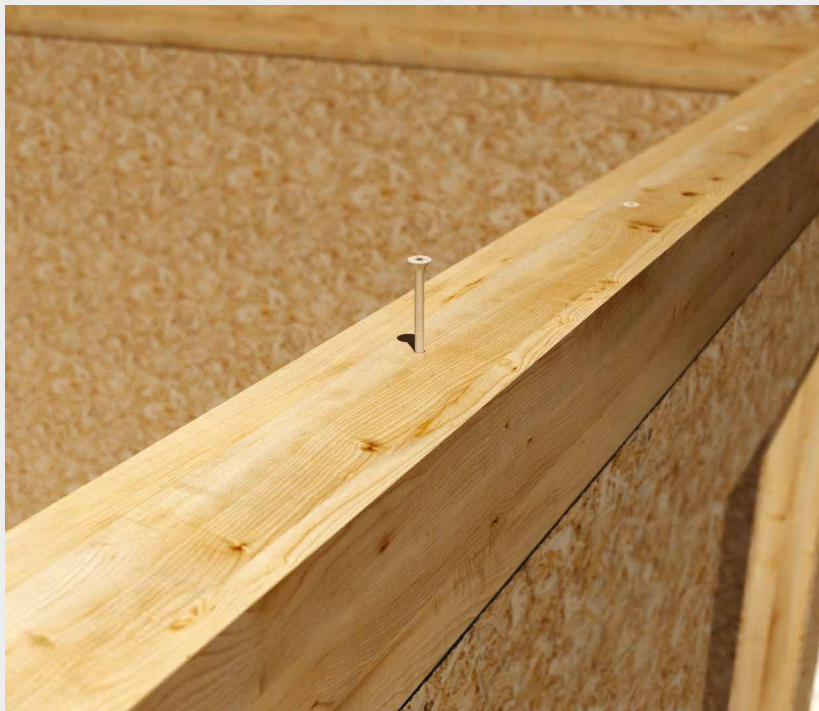


EXPOSURE CONDITIONS 3

Approved for use in exposure condition 3 outdoor applications according to Acceptance Criteria AC 257, and tested for use under class C4 atmospheric corrosion conditions.

OUTDOOR STRUCTURAL PERFORMANCE

Ideal for fastening timber-framed panels and lattice beams (Rafter, Truss). Values were also tested, certified, and calculated for high-density woods.

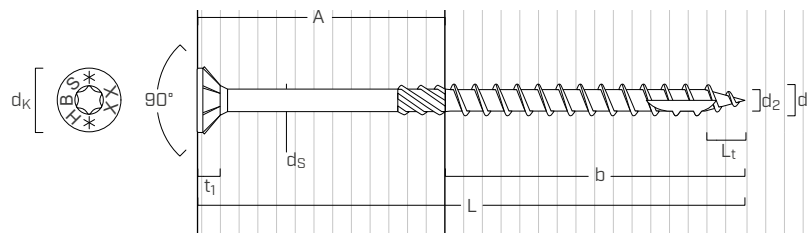


Fastening sill beams in frame structures.



Fastening outdoor fencing. ➤

■ GEOMETRY AND MECHANICAL CHARACTERISTICS



Nominal diameter	d_1	[in]⁽¹⁾	0.20^(*)	0.24	0.32
Outer thread diameter	d_1	[mm]	5	6	8
		[in]	0.197	0.236	0.315
Head diameter	d_k	[in]	0.394	0.472	0.571
Root diameter	d_2	[in]	0.134	0.156	0.213
Shank diameter	d_s	[in]	0.144	0.169	0.228
Head thickness	t_1	[in]	0.122	0.177	0.177
Tip length	L_t	[in]	0.197	0.236	0.315
Pre-drilling hole diameter ⁽²⁾	d_v	[in]	0.12	0.16	0.20
Bending yield strength ⁽³⁾	$F_{y,b}$	[psi]	145,000	200,000	180,000
Tensile strength	f_{tens}	[lbf]	680	1180	2040

(*) Not evaluated in ESR-4645.

(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 for HBS screws with nominal diameters of 0.24 and 0.32 inches are determined in accordance with ASTM F1575 using the root diameter d_2 . Bending yield strengths for HBS screws with nominal diameter of 0.20 inches are based on experimental tests according to ETA-11/0030.

CODES AND DIMENSIONS

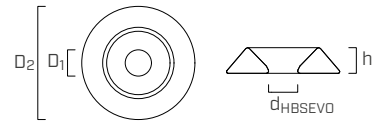
d ₁ [mm] [in]	CODE	L [mm] [in]	b [in]	A [mm] [in]	pcs
5 0.20 TX 25	HBSEVO580 ^(*)	80 3 1/8	1 9/16	38 1 1/2	100
	HBSEVO590 ^(*)	90 3 1/2	1 3/4	44 1 3/4	100
	HBSEVO5100 ^(*)	100 4	1 15/16	44 1 3/4	100
6 0.24 TX 30	HBSEVO680	80 3 1/8	1 9/16	38 1 1/2	100
	HBSEVO6100	100 4	1 15/16	44 1 3/4	100
	HBSEVO6120	120 4 3/4	2 3/8	51 2	100
	HBSEVO6140	140 5 1/2	2 15/16	64 2 1/2	100
	HBSEVO6160	160 6 1/4	2 15/16	83 3 1/4	100
	HBSEVO6180	180 7 1/8	2 15/16	102 4	100
	HBSEVO6200	200 8	2 15/16	121 4 3/4	100

(*) Not evaluated in ESR-4645.

d ₁ [mm] [in]	CODE	L [mm] [in]	b [in]	A [mm] [in]	pcs
8 0.32 TX 40	HBSEVO8100	100 4	2 1/16	44 1 3/4	100
	HBSEVO8120	120 4 3/4	2 3/8	57 2 1/4	100
	HBSEVO8140	140 5 1/2	2 3/8	76 3	100
	HBSEVO8160	160 6 1/4	3 1/8	76 3	100
	HBSEVO8180	180 7 1/8	3 1/8	95 3 3/4	100
	HBSEVO8200	200 8	3 1/8	114 4 1/2	100
	HBSEVO8220	220 8 5/8	3 1/8	140 5 1/2	100
	HBSEVO8240	240 9 1/2	3 1/8	159 6 1/4	100
	HBSEVO8280	280 11	3 1/8	197 7 3/4	100
	HBSEVO8320	320 13	4	216 8 1/2	100

HUS EVO COUNTERSUNK WASHER WITH C4 EVO COATING^(*)

d _{HBSEVO} [mm] [in]	CODE	D ₁ [in]	D ₂ [in]	h [in]	pcs
6 0.24	HUSEVO6	0.295	0.787	0.181	100
8 0.32	HUSEVO8	0.335	0.984	0.213	50



(*) Not evaluated in ESR-4645.

STRUCTURAL VALUES | HEAD PULL - THROUGH (W_H)

HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

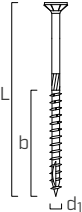
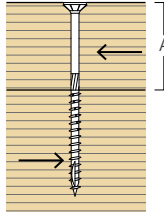
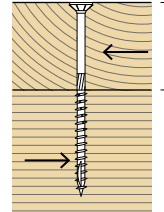
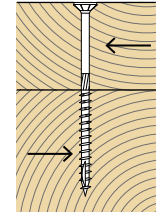
geometry						head pull-through			
d ₁ [mm] [in]	L [mm] [in]	countersunk washer	washer outer diameter D ₂ [in]	minimum side member thickness [in]		G=0.35 [lbf]	G=0.42 [lbf]	G=0.49 [lbf]	G=0.55 [lbf]
6 0.24	from 80 to 200 from 3 1/8 to 8	HUSEVO6	0.787	1 1/2		166	239	270	294
8 0.32	from 100 to 320 from 4 to 13	HUSEVO8	0.984	1 1/2		166	239	325	410

NOTES:

Refer to page 10 for the general calculation principles.

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

HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

geometry					$Z_{ }^{(1)}$				$Z_{\perp/ }^{(2)}$				$Z_{\perp}^{(3)}$			
																
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]	[in] [in]	[in] [in]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]	[lbf] [lbf]
5 0.20 ^(*)	80	3 1/8	1 9/16	1 1/2	88	104	120	133	88	104	120	133	88	104	120	133
	90	3 1/2	1 3/4	1 3/4	88	104	120	133	88	104	120	133	88	104	120	133
	100	4	1 15/16	1 3/4	88	104	120	133	88	104	120	133	88	104	120	133
6 0.24	80	3 1/8	1 9/16	1 1/2	107	149	190	211	107	149	190	211	107	149	190	211
	100	4	1 15/16	1 3/4	129	165	190	211	129	165	190	211	129	165	190	211
	120	4 3/4	2 3/8	2	139	165	190	211	139	165	190	211	139	165	190	211
	140	5 1/2	2 15/16	2 1/2	139	165	190	211	139	165	190	211	139	165	190	211
	160	6 1/4	2 15/16	3 1/4	139	165	190	211	139	165	190	211	139	165	190	211
	180	7 1/8	2 15/16	4	139	165	190	211	139	165	190	211	139	165	190	211
	200	8	2 15/16	4 3/4	139	165	190	211	139	165	190	211	139	165	190	211
8 0.32	100	4	2 1/16	1 3/4	153	214	270	313	123	171	216	251	123	171	216	251
	120	4 3/4	2 3/8	2 1/4	184	245	282	313	147	196	225	251	147	196	225	251
	140	5 1/2	2 3/8	3	196	245	282	313	157	196	225	251	157	196	225	251
	160	6 1/4	3 1/8	3	207	245	282	313	165	196	225	251	165	196	225	251
	180	7 1/8	3 1/8	3 3/4	207	245	282	313	165	196	225	251	165	196	225	251
	200	8	3 1/8	4 1/2	207	245	282	313	165	196	225	251	165	196	225	251
	220	8 5/8	3 1/8	5 1/2	207	245	282	313	165	196	225	251	165	196	225	251
	240	9 1/2	3 1/8	6 1/4	207	245	282	313	165	196	225	251	165	196	225	251
	280	11	3 1/8	7 3/4	207	245	282	313	165	196	225	251	165	196	225	251
	320	12 5/8	4	8 1/2	207	245	282	313	165	196	225	251	165	196	225	251

NOTES:

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

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

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

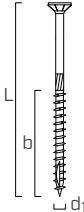
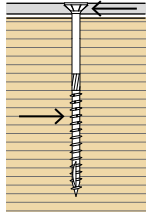
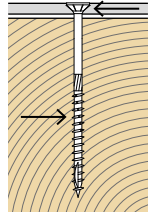
⁽²⁾ $Z_{\perp/||}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.

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

Refer to page 10 for the general calculation principles.

STRUCTURAL VALUES | REFERENCE LATERAL DESIGN VALUES (Z) | STEEL-TO-WOOD^[*]

HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

geometry				$Z_{\perp}^{(1)}$					$Z_{\perp}^{(2)}$				
													
d_1	L		b	steel plate thickness	G=0.35	G=0.42	G=0.49	G=0.55	steel plate thickness	G=0.35	G=0.42	G=0.49	G=0.55
$[mm]$	$[mm]$	$[in]$	$[in]$	$[in]$	$[lbf]$	$[lbf]$	$[lbf]$	$[lbf]$	$[in]$	$[lbf]$	$[lbf]$	$[lbf]$	$[lbf]$
5 0.20 ^(*)	80	3 1/8	1 9/16	$S_{PLATE} = 1/16"$	91	106	121	133	$S_{PLATE} = 1/16"$	91	106	121	133
	90	3 1/2	1 3/4		91	106	121	133		91	106	121	133
	100	4	1 15/16		91	106	121	133		91	106	121	133
6 0.24	80	3 1/8	1 9/16	$S_{PLATE} = 1/8"$	155	180	205	225	$S_{PLATE} = 1/8"$	155	180	205	225
	100	4	1 15/16		155	180	205	225		155	180	205	225
	120	4 3/4	2 3/8		155	180	205	225		155	180	205	225
	140	5 1/2	2 15/16		155	180	205	225		155	180	205	225
	160	6 1/4	2 15/16		155	180	205	225		155	180	205	225
	180	7 1/8	2 15/16		155	180	205	225		155	180	205	225
	200	8	2 15/16		155	180	205	225		155	180	205	225
8 0.32	100	4	2 1/16	$S_{PLATE} = 1/8"$	218	255	290	319	$S_{PLATE} = 1/8"$	174	204	232	255
	120	4 3/4	2 3/8		218	255	290	319		174	204	232	255
	140	5 1/2	2 3/8		218	255	290	319		174	204	232	255
	160	6 1/4	3 1/8		218	255	290	319		174	204	232	255
	180	7 1/8	3 1/8		218	255	290	319		174	204	232	255
	200	8	3 1/8		218	255	290	319		174	204	232	255
	220	8 5/8	3 1/8		218	255	290	319		174	204	232	255
	240	9 1/2	3 1/8		218	255	290	319		174	204	232	255
	280	11	3 1/8		218	255	290	319		174	204	232	255
	320	12 5/8	4		218	255	290	319		174	204	232	255

NOTES:

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

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

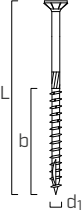
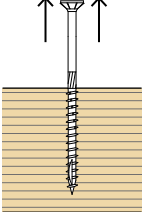
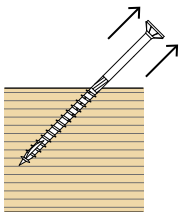
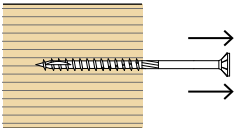
(1) $Z_{\perp}$ both side and main members loaded parallel to the grain.

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

Refer to page 10 for the general calculation principles.

■ STATIC VALUES | THREAD WITHDRAWAL W

HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

geometry				thread withdrawal $\alpha = 90^\circ$				thread withdrawal $\alpha = 45^\circ$				thread withdrawal $\alpha = 0^\circ$			
															
d_1	L		b	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]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]	[lbf]
5 0.20(*)	80 ⁽¹⁾	3 1/8	1 9/16	88	102	150	164	80	93	137	149	26	31	45	49
	90	3 1/2	1 3/4	101	117	172	187	92	106	156	171	30	35	51	56
	100	4	1 15/16	113	131	193	211	103	119	176	192	34	39	58	63
6 0.24	80 ⁽²⁾	3 1/8	1 9/16	103	119	175	191	94	108	160	174	31	36	53	57
	100 ⁽³⁾	4	1 15/16	133	154	227	248	121	140	207	225	40	46	68	74
	120	4 3/4	2 3/8	164	189	279	304	149	172	253	277	49	57	84	91
	140	5 1/2	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
	160	6 1/4	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
	180	7 1/8	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
	200	8	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
8 0.32	100 ⁽¹⁾	4	2 1/16	189	217	285	301	172	197	259	274	57	65	85	90
	120 ⁽²⁾	4 3/4	2 3/8	223	256	328	356	203	233	298	324	67	77	98	107
	140 ⁽²⁾	5 1/2	2 3/8	223	256	328	356	203	233	298	324	67	77	98	107
	160	6 1/4	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	180	7 1/8	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	200	8	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	220	8 5/8	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	240	9 1/2	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	280	11	3 1/8	309	354	431	493	281	322	392	449	93	106	129	148
	320	12 5/8	4	395	453	552	630	359	412	502	574	118	136	166	189

NOTES:

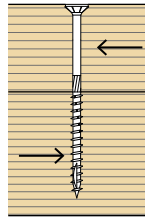
(*)The screws are not evaluated in ESR-4645.

(1) The embedded thread length is lower than 8 times the outer thread diameter.

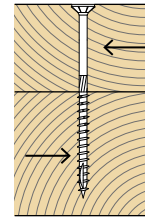
(2) The embedded thread length does not comply with the minimum requirement of ESR-4645 (6 times the outer thread diameter for screws installed at 90° to the grain and 8 times the outer thread diameter for screws installed at an angle $0^\circ \leq \alpha < 90^\circ$ to the grain).

(3) 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 $0^\circ \leq \alpha < 90^\circ$ to the grain).

Refer to page 10 for the general calculation principles.



Load-to-grain angle $\alpha = 0^\circ$

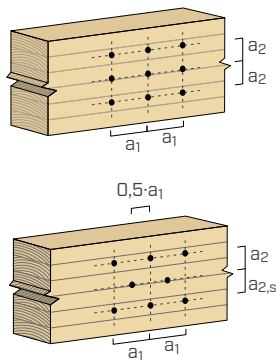


Load-to-grain angle $\alpha = 90^\circ$

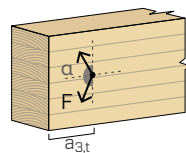
Screws inserted without pre-drilling hole $G < 0.50$					Screws inserted without pre-drilling hole $G < 0.50$				
d_1	[mm]	5(*)	6	8	d_1	[mm]	5(*)	6	8
	[in]	0.20	0.24	0.32		[in]	0.20	0.24	0.32
a_1	[in]	15·d	2 15/16	3 1/2	4 3/4	12·d	2 3/8	2 13/16	3 3/4
a_2	[in]	5·d	1	1 3/16	1 9/16	5·d	1	1 3/16	1 9/16
$a_{2,s}$	[in]	2.5·d	1/2	9/16	13/16	2.5·d	1/2	9/16	13/16
$a_{3,t}$	[in]	15·d	2 15/16	3 1/2	4 3/4	10·d	1 15/16	2 3/8	3 1/8
$a_{3,c}$	[in]	10·d	1 15/16	2 3/8	3 1/8	10·d	1 15/16	2 3/8	3 1/8
$a_{4,t}$	[in]	5·d	1	1 3/16	1 9/16	10·d	1 15/16	2 3/8	3 1/8
$a_{4,c}$	[in]	5·d	1	1 3/16	1 9/16	5·d	1	1 3/16	1 9/16

Screws inserted without pre-drilling hole $G \geq 0.50$					Screws inserted without pre-drilling hole $G \geq 0.50$				
d_1	[mm]	5(*)	6	8	d_1	[mm]	5(*)	6	8
	[in]	0.20	0.24	0.32		[in]	0.20	0.24	0.32
a_1	[in]	15·d	2 15/16	3 1/2	4 3/4	15·d	2 15/16	3 1/2	4 3/4
a_2	[in]	7·d	1 3/8	1 5/8	2 3/16	7·d	1 3/8	1 5/8	2 3/16
$a_{2,s}$	[in]	3·d	9/16	11/16	15/16	3·d	9/16	11/16	15/16
$a_{3,t}$	[in]	20·d	4	4 3/4	6 1/4	15·d	2 15/16	3 1/2	4 3/4
$a_{3,c}$	[in]	15·d	2 15/16	3 1/2	4 3/4	15·d	2 15/16	3 1/2	4 3/4
$a_{4,t}$	[in]	7·d	1 3/8	1 5/8	2 3/16	12·d	2 3/8	2 13/16	3 3/4
$a_{4,c}$	[in]	7·d	1 3/8	1 5/8	2 3/16	7·d	1 3/8	1 5/8	2 3/16

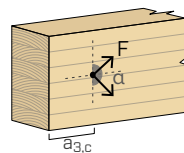
d = nominal screw diameter



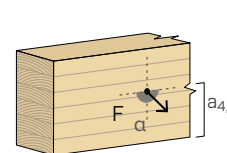
stressed end
 $-90^\circ < \alpha < 90^\circ$



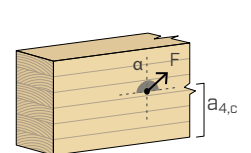
unloaded end
 $90^\circ < \alpha < 270^\circ$



stressed edge
 $0^\circ < \alpha < 180^\circ$



unload edge
 $180^\circ < \alpha < 360^\circ$

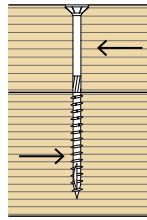


NOTES:

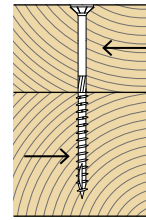
(*) Not evaluated in ESR-4645.

- 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.



Load-to-grain angle $\alpha = 0^\circ$



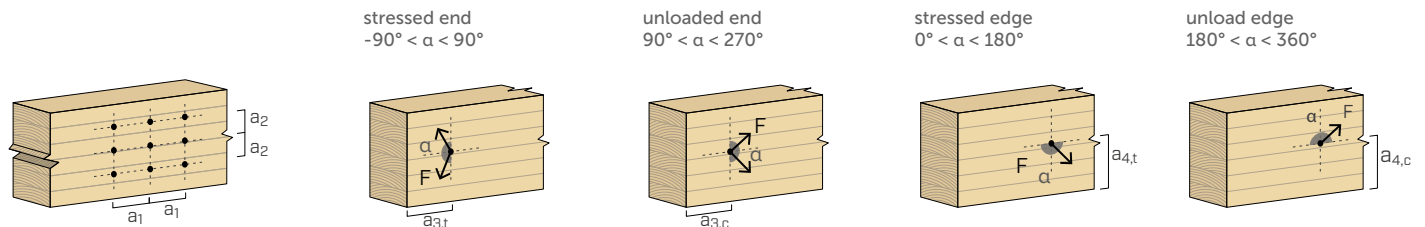
Load-to-grain angle $\alpha = 90^\circ$

Screws inserted without pre-drilling hole $G \leq 0.47$					Screws inserted without pre-drilling hole $G \leq 0.47$				
d_1 [mm]		5	6	8		5	6	8	
d_1 [in]		0.20	0.24	0.32		0.20	0.24	0.32	
a_1 [in]	12·d	2 3/8	2 13/16	3 3/4	5·d	1	1 3/16	1 9/16	
a_2 [in]	5·d	1	1 3/16	1 9/16	5·d	1	1 3/16	1 9/16	
$a_{3,t}$ [in]	15·d	2 15/16	3 1/2	4 3/4	10·d	1 15/16	2 3/8	3 1/8	
$a_{3,c}$ [in]	10·d	1 15/16	2 3/8	3 1/8	10·d	1 15/16	2 3/8	3 1/8	
$a_{4,t}$ [in]	5·d	1	1 3/16	1 9/16	10·d	1 15/16	2 3/8	3 1/8	
$a_{4,c}$ [in]	5·d	1	1 3/16	1 9/16	5·d	1	1 3/16	1 9/16	

Screws inserted without pre-drilling hole $G > 0.47$					Screws inserted without pre-drilling hole $G > 0.47$				
d_1 [mm]		5	6	8		5	6	8	
d_1 [in]		0.20	0.24	0.32		0.20	0.24	0.32	
a_1 [in]	15·d	2 15/16	3 1/2	4 3/4	7·d	1 3/8	1 5/8	2 3/16	
a_2 [in]	7·d	1 3/8	1 5/8	2 3/16	7·d	1 3/8	1 5/8	2 3/16	
$a_{3,t}$ [in]	20·d	4	4 3/4	6 1/4	15·d	2 15/16	3 1/2	4 3/4	
$a_{3,c}$ [in]	15·d	2 15/16	3 1/2	4 3/4	15·d	2 15/16	3 1/2	4 3/4	
$a_{4,t}$ [in]	7·d	1 3/8	1 5/8	2 3/16	12·d	2 3/8	2 13/16	3 3/4	
$a_{4,c}$ [in]	7·d	1 3/8	1 5/8	2 3/16	7·d	1 3/8	1 5/8	2 3/16	

Screws inserted with pre-drilling hole					Screws inserted with pre-drilling hole				
d_1 [mm]		5	6	8		5	6	8	
d_1 [in]		0.20	0.24	0.32		0.20	0.24	0.32	
a_1 [in]	5·d	1	1 3/16	1 9/16	4·d	13/16	15/16	1 1/4	
a_2 [in]	3·d	9/16	11/16	15/16	4·d	13/16	15/16	1 1/4	
$a_{3,t}$ [in]	12·d	2 3/8	2 13/16	3 3/4	7·d	1 3/8	1 5/8	2 3/16	
$a_{3,c}$ [in]	7·d	1 3/8	1 5/8	2 3/16	7·d	1 3/8	1 5/8	2 3/16	
$a_{4,t}$ [in]	3·d	9/16	11/16	15/16	7·d	1 3/8	1 5/8	2 3/16	
$a_{4,c}$ [in]	3·d	9/16	11/16	15/16	3·d	9/16	11/16	15/16	

d = nominal screw diameter



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 $\rho_k = 420 \text{ kg/m}^3$.
- The minimum spacing for all steel-to-timber connections (a_1 and a_2) can be multiplied by a coefficient of 0.7.

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.
- HBS EVO 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.

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 [mm] [in]	Reference withdrawal design values W_{ref}			
	$G=0.35$	$G=0.42$	$G=0.49$	$G=0.55$
	[lbf/in]	[lbf/in]	[lbf/in]	[lbf/in]
5 0.20(*)	64	74	109	119
6 0.24	77	89	131	143
8 0.32	109	125	138	174

(*) Not evaluated in ESR-4645.

- 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_a :

$$W_a = W_{ref} \cdot k_a \cdot L_{eff}$$

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_a factor is calculated as:

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

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

Tabulated values at page 7 are valid for L_{eff} equal to the screw thread length b minus the tip length L_t and $k_a = 1$ for $\alpha = 90^\circ$, $k_a = 0.91$ for $\alpha = 45^\circ$, $k_a = 0.3$ for $\alpha = 0^\circ$.

- 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 $0^\circ \leq \alpha < 90^\circ$ 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 $\alpha \leq 15^\circ$.
- The reference withdrawal design values must be less than f_{tens} of the screw.

REFERENCE HEAD-PULL THROUGH DESIGN VALUES:

- Tabulated values are valid for HBS EVO screws in combination with HUS EVO countersunk washers installed perpendicular to the faces of the wood members.
- The reference head pull-through values must be less than f_{tens} of the screw.
- The head pull-through design values for HBS EVO screws with diameter 5 mm | 0.20 inch screw can be determined according to the NDS.
- The head pull-through design values for HBS EVO screws with diameter 6 mm | 0.24 inch and 8 mm | 0.32 inch screws can be found in Table 8 of ESR-4645.