TBS

LARGE WASHER HEAD SCREW

AC233
ESR-4645

BIT INCLUDED

SOFTWARE

ETA-11/0030

INTEGRATED WASHER

The large head serves as washer and ensures high tensile strength. Ideal in the presence of wind or variations in timber dimensions.

SUPERIOR STRENGTH

Steel with superb bending yield strength (minimum of F_{yb} = 1240 N/mm² | **180,000 psi**). Very high torsional strength $f_{tor,k}$ for safer screwing.

STRUCTURAL APPLICATIONS

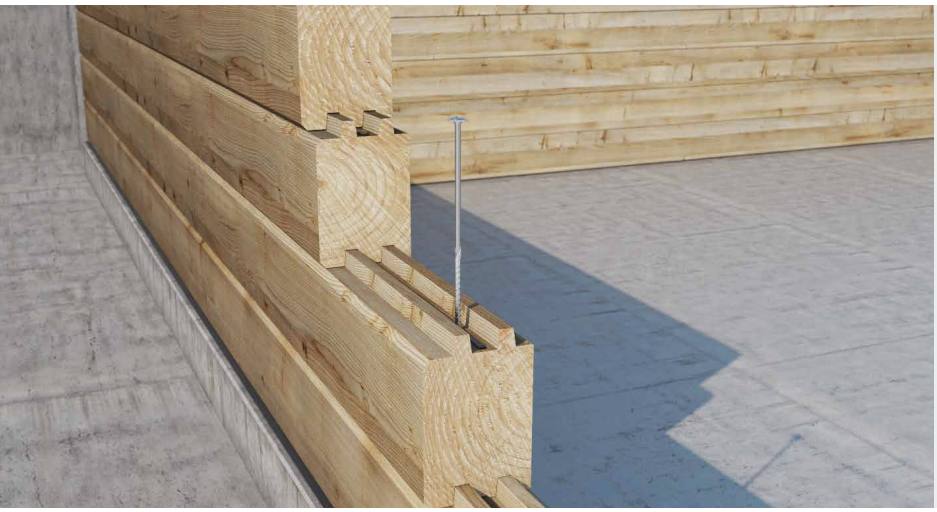
Evaluated by ICC-ES according to Acceptance Criteria AC 233. Withdrawal values for any angle between the screw axis and the grain (including end-grain). Asymmetric "umbrella" shape thread for improved penetration capacity into the wood member.

DUCTILITY

The bending angle is 20° greater than the minimum required by the standard, and certified according to ETA-11/0030. Cyclical SEISMIC-REV tests according to EN 12512. Seismic performance tested according to EN 14592.

CHARACTERISTICS

FOCUS	screw with built-in washer	
HEAD	large washer head	
DIAMETER	from 6,0 to 10,0 mm	0.24 to 0.40 inches
LENGTH	from 40 to 520 mm	1 9/16 to 20 1/2 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

SECONDARY BEAMS

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

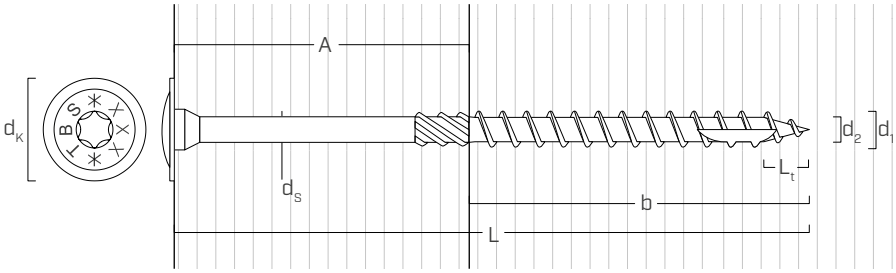
I-JOIST

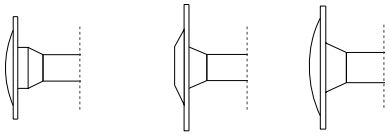
ESR-4645 values applicable to connections with the flanges, made of sawn lumber, of I-Joists.

Fastening SIP panels with 8 mm | **0.32 inch** diameter TBS screws.

Fastening CLT walls
with 8 mm | **0.32 inch** diameter TBS screws.

GEOMETRY AND MECHANICAL CHARACTERISTICS





Nominal diameter	d_1	[in](1)	0.24	0.32	0.32 MAX	0.40
Outer thread diameter	**d_1**	[mm]	6	8	8 MAX	10
		[in]	0.236	0.315	0.315	0.394
Head diameter	d_K	[in]	0.610	0.748	0.965	0.984
Root diameter	d_2	[in]	0.156	0.213	0.213	0.252
Shank diameter	d_S	[in]	0.169	0.228	0.228	0.276
Tip length	L_t	[in]	0.236	0.315	0.315	0.394
Pre-drilling hole diameter(2)	d_V	[in]	0.16	0.20	0.20	0.24
Bending yield strength(3)	$F_{y,b}$	[psi]	200,000	180,000	180,000	185,000
Tensile strength	f_{tens}	[lbf]	1180	2040	2040	2700

(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]	d_K [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [mm]	A [in]	pcs
6 **0.24 TX 30**	15.5 **0.61**	**TBS660**	60	2 3/8	40	1 9/16	13	1/2	100
		TBS670	70	2 3/4	40	1 9/16	25	1	100
		TBS680	80	3 1/8	50	1 15/16	25	1	100
		TBS690	90	3 1/2	50	1 15/16	32	1 1/4	100
		TBS6100	100	4	60	2 3/8	32	1 1/4	100
		TBS6120	120	4 3/4	75	2 15/16	38	1 1/2	100
		TBS6140	140	5 1/2	75	2 15/16	57	2 1/4	100
		TBS6160	160	6 1/4	75	2 15/16	83	3 1/4	100
		TBS6180	180	7 1/8	75	2 15/16	102	4	100
		TBS6200	200	8	75	2 15/16	121	4 3/4	100
		TBS6220	220	8 5/8	100	4	114	4 1/2	100
		TBS6240	240	9 1/2	100	4	133	5 1/4	100
		TBS6260	260	10 1/4	100	4	152	6	100
		TBS6280	280	11	100	4	178	7	100
		TBS6300	300	11 3/4	100	4	197	7 3/4	100
8 **0.32 TX 40**	19 **0.75**	**TBS840**	40	1 9/16	32	1 1/4	3	1/8	100
		TBS860	60	2 3/8	32	1 1/4	3	1/8	100
		TBS880	80	3 1/8	52	2 1/16	25	1	50
		TBS8100	100	4	52	2 1/16	44	1 3/4	50
		TBS8120	120	4 3/4	80	3 1/8	32	1 1/4	50
		TBS8140	140	5 1/2	80	3 1/8	57	2 1/4	50
		TBS8160	160	6 1/4	100	4	57	2 1/4	50
		TBS8180	180	7 1/8	100	4	76	3	50
		TBS8200	200	8	100	4	95	3 3/4	50
		TBS8220	220	8 5/8	100	4	114	4 1/2	50
		TBS8240	240	9 1/2	100	4	133	5 1/4	50
		TBS8260	260	10 1/4	100	4	152	6	50
		TBS8280	280	11	100	4	175	6 7/8	50
		TBS8300	300	11 3/4	100	4	197	7 3/4	50
		TBS8320	320	12 5/8	100	4	216	8 1/2	50
		TBS8340	340	13 3/8	100	4	235	9 1/4	50
		TBS8360	360	14 1/4	100	4	257	10 1/8	50
		TBS8380	380	15	100	4	276	10 7/8	50
		TBS8400	400	15 3/4	100	4	292	11 1/2	50
		TBS8440	440	17 1/4	100	4	337	13 1/4	50
		TBS8480	480	19	100	4	375	14 3/4	50
		TBS8520	520	20 1/2	100	4	413	16 1/4	50

d_1 [mm] [in]	d_K [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [mm]	A [in]	pcs
10 **0.40 TX 40**	25 **0.98**	**TBS10100**	100	4	52	2 1/16	32	1 1/4	50
		TBS10120	120	4 3/4	60	2 3/8	51	2	50
		TBS10140	140	5 1/2	60	2 3/8	70	2 3/4	50
		TBS10160	160	6 1/4	80	3 1/8	76	3	50
		TBS10180	180	7 1/8	80	3 1/8	95	3 3/4	50
		TBS10200	200	8	100	4	95	3 3/4	50
		TBS10220	220	8 5/8	100	4	114	4 1/2	50
		TBS10240	240	9 1/2	100	4	133	5 1/4	50
		TBS10260	260	10 1/4	100	4	152	6	50
		TBS10280	280	11	100	4	175	6 7/8	50
		TBS10300	300	11 3/4	100	4	197	7 3/4	50
		TBS10320	320	12 5/8	120	4 3/4	197	7 3/4	50
		TBS10340	340	13 3/8	120	4 3/4	216	8 1/2	50
		TBS10360	360	14 1/4	120	4 3/4	235	9 1/4	50
		TBS10380	380	15	120	4 3/4	254	10	50
		TBS10400	400	15 3/4	120	4 3/4	276	10 7/8	50
		TBS10440	440	17 1/4	120	4 3/4	311	12 1/4	50
		TBS10480	480	19	120	4 3/4	356	14	50
		TBS10520	520	20 1/2	120	4 3/4	394	15 1/2	50

TBS MAX

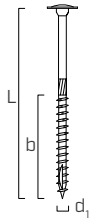
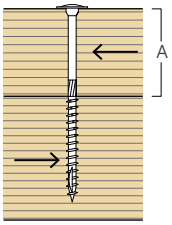
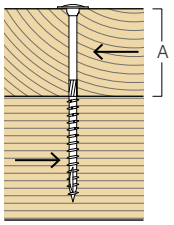
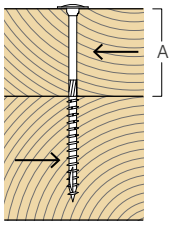
d_1 [mm] [in]	d_K [mm] [in]	CODE	L [mm]	L [in]	b [mm]	b [in]	A [mm]	A [in]	pcs
8 **0.32 TX 40**	24.5 **0.96**	**TBSMAX8200**	200	8	120	4 3/4	76	3	50
		TBSMAX8220	220	8 5/8	120	4 3/4	95	3 3/4	50
		TBSMAX8240	240	9 1/2	120	4 3/4	114	4 1/2	50

TBS MAX FOR RIB TIMBER

With its increased thread (120 mm | **4 3/4 inch**) and enlarged head (24,5 mm | **0.96 inch**), the TBS MAX guarantees excellent grip and superb joint closure. Ideal for the production of ribbed floors (Rippendecke), optimising the number of fastenings. The enlarged head guarantees excellent joint tightening, making the use of presses unnecessary when gluing wooden elements together.

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

TBS Ø6 | 0.24 inch - TBS Ø8 | 0.32 inch - TBS MAX Ø8 | 0.32 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]
6 0.24	60	2 3/8	1 9/16	1/2	85	116	135	151	85	116	135	151	85	116	135	151
	70	2 3/4	1 9/16	1	99	129	156	182	99	129	156	182	99	129	156	182
	80	3 1/8	1 15/16	1	104	129	156	182	104	129	156	182	104	129	156	182
	90	3 1/2	1 15/16	1 1/4	111	140	174	206	111	140	174	206	111	140	174	206
	100	4	2 3/8	1 1/4	111	140	174	206	111	140	174	206	111	140	174	206
	120	4 3/4	2 15/16	1 1/2	120	154	190	211	120	154	190	211	120	154	190	211
	140	5 1/2	2 15/16	2 1/4	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
	220	8 5/8	4	4 1/2	139	165	190	211	139	165	190	211	139	165	190	211
	240	9 1/2	4	5 1/4	139	165	190	211	139	165	190	211	139	165	190	211
	260	10 1/4	4	6	139	165	190	211	139	165	190	211	139	165	190	211
	280	11	4	7	139	165	190	211	139	165	190	211	139	165	190	211
	300	11 3/4	4	7 3/4	139	165	190	211	139	165	190	211	139	165	190	211
8 0.32	40[4]	1 9/16	1 1/4	1/8	24	34	45	56	19	27	36	45	19	27	36	45
	60	2 3/8	1 1/4	1/8	24	34	45	56	19	27	36	45	19	27	36	45
	80	3 1/8	2 1/16	1	135	179	213	244	108	143	170	195	108	143	170	195
	100	4	2 1/16	1 3/4	155	216	270	313	124	173	216	251	124	173	216	251
	120	4 3/4	3 1/8	1 1/4	153	189	228	266	122	151	183	213	122	151	183	213
	140	5 1/2	3 1/8	2 1/4	191	245	282	313	153	196	225	251	153	196	225	251
	160	6 1/4	4	2 1/4	191	245	282	313	153	196	225	251	153	196	225	251
	180	7 1/8	4	3	207	245	282	313	165	196	225	251	165	196	225	251
	200	8	4	3 3/4	207	245	282	313	165	196	225	251	165	196	225	251
	220	8 5/8	4	4 1/2	207	245	282	313	165	196	225	251	165	196	225	251
	240	9 1/2	4	5 1/4	207	245	282	313	165	196	225	251	165	196	225	251
	260	10 1/4	4	6	207	245	282	313	165	196	225	251	165	196	225	251
	280	11	4	6 7/8	207	245	282	313	165	196	225	251	165	196	225	251
	300	11 3/4	4	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
	340	13 3/8	4	9 1/4	207	245	282	313	165	196	225	251	165	196	225	251
	360	14 1/4	4	10 1/8	207	245	282	313	165	196	225	251	165	196	225	251
	380	15	4	10 7/8	207	245	282	313	165	196	225	251	165	196	225	251
	400	15 3/4	4	11 1/2	207	245	282	313	165	196	225	251	165	196	225	251
	440	17 1/4	4	13 1/4	207	245	282	313	165	196	225	251	165	196	225	251
	480	19	4	14 3/4	207	245	282	313	165	196	225	251	165	196	225	251
	520	20 1/2	4	16 1/4	207	245	282	313	165	196	225	251	165	196	225	251
8 MAX 0.32 MAX	200	8	4 3/4	3	207	245	282	313	165	196	225	251	165	196	225	251
	220	8 5/8	4 3/4	3 3/4	207	245	282	313	165	196	225	251	165	196	225	251
	240	9 1/2	4 3/4	4 1/2	207	245	282	313	165	196	225	251	165	196	225	251

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.

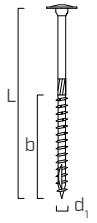
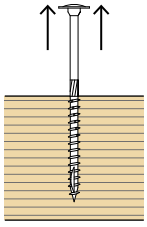
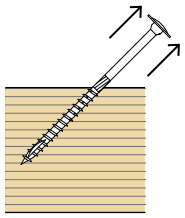
[3] $Z_{\perp}$ both side and main members loaded perpendicular to the grain.

[4] The screw penetration in the main member is lower than 6 times the outer thread diameter as specified in ESR-4645.

Refer to page 12 for the general calculation principles.

STRUCTURAL VALUES | THREAD WITHDRAWAL (W)

TBS Ø6 | 0.24 inch - TBS Ø8 | 0.32 inch - TBS MAX Ø8 | 0.32 inch

geometry				thread withdrawal α = 90°				thread withdrawal α = 45°				thread withdrawal α = 0°(3)			
															
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]
	60(1)	2 3/8	1 9/16	103	119	175	191	94	108	160	174	31	36	53	57
	70(1)	2 3/4	1 9/16	103	119	175	191	94	108	160	174	31	36	53	57
	80(2)	3 1/8	1 15/16	133	154	227	248	121	140	207	225	40	46	68	74
	90(2)	3 1/2	1 15/16	133	154	227	248	121	140	207	225	40	46	68	74
	100	4	2 3/8	164	189	279	304	149	172	253	277	49	57	84	91
	120	4 3/4	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
	140	5 1/2	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
6	*160*	6 1/4	2 15/16	209	242	356	388	190	220	324	354	63	73	107	117
0.24	*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
	220	8 5/8	4	285	329	485	529	259	300	441	482	85	99	145	159
	240	9 1/2	4	285	329	485	529	259	300	441	482	85	99	145	159
	260	10 1/4	4	285	329	485	529	259	300	441	482	85	99	145	159
	280	11	4	285	329	485	529	259	300	441	482	85	99	145	159
	300	11 3/4	4	285	329	485	529	259	300	441	482	85	99	145	159
	40(1)	1 9/16	1 1/4	103	118	130	164	94	107	119	150	31	35	39	49
	60(1)	2 3/8	1 1/4	103	118	130	164	94	107	119	150	31	35	39	49
	80(1)	3 1/8	2 1/16	189	217	239	301	172	197	218	274	57	65	72	90
	100(1)	4	2 1/16	189	217	239	301	172	197	218	274	57	65	72	90
	120	4 3/4	3 1/8	309	354	391	493	281	322	356	449	93	106	117	148
	140	5 1/2	3 1/8	309	354	391	493	281	322	356	449	93	106	117	148
	160	6 1/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	180	7 1/8	4	395	453	500	630	359	412	455	574	118	136	150	189
	200	8	4	395	453	500	630	359	412	455	574	118	136	150	189
	220	8 5/8	4	395	453	500	630	359	412	455	574	118	136	150	189
8	*240*	9 1/2	4	395	453	500	630	359	412	455	574	118	136	150	189
0.32	*260*	10 1/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	280	11	4	395	453	500	630	359	412	455	574	118	136	150	189
	300	11 3/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	320	12 5/8	4	395	453	500	630	359	412	455	574	118	136	150	189
	340	13 3/8	4	395	453	500	630	359	412	455	574	118	136	150	189
	360	14 1/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	380	15	4	395	453	500	630	359	412	455	574	118	136	150	189
	400	15 3/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	440	17 1/4	4	395	453	500	630	359	412	455	574	118	136	150	189
	480	19	4	395	453	500	630	359	412	455	574	118	136	150	189
	520	20 1/2	4	395	453	500	630	359	412	455	574	118	136	150	189
8 MAX	*200*	8	4 3/4	481	551	609	767	437	502	554	698	144	165	183	230
0.32 MAX	*220*	8 5/8	4 3/4	481	551	609	767	437	502	554	698	144	165	183	230
	240	9 1/2	4 3/4	481	551	609	767	437	502	554	698	144	165	183	230

NOTES:

(1) 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).

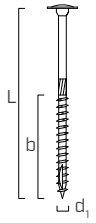
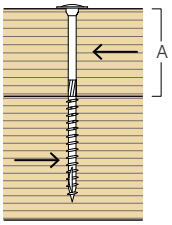
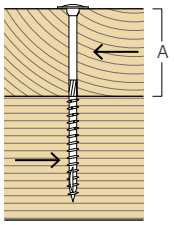
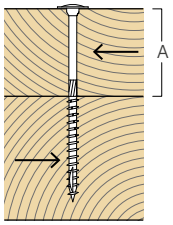
(2) The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle 0°≤α<90° to the grain).

(3) 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 α ≤ 15°.

Refer to page 12 for the general calculation principles and for the calculation of the reference withdrawal design values for screws installed at an angle to the grain.

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

TBS Ø10 | 0.40 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	2 1/16	1 1/4	231	260	287	311	159	182	206	227	128	167	197	219
	120	4 3/4	2 3/8	2	264	317	361	387	178	213	249	281	143	186	233	272
	140	5 1/2	2 3/8	2 3/4	306	338	365	387	202	249	274	295	165	215	259	282
	160	6 1/4	3 1/8	3	308	338	365	387	220	249	274	295	190	232	259	282
	180	7 1/8	3 1/8	3 3/4	308	338	365	387	222	249	274	295	203	232	259	282
	200	8	4	3 3/4	308	338	365	387	222	249	274	295	203	232	259	282
	220	8 5/8	4	4 1/2	308	338	365	387	222	249	274	295	203	232	259	282
	240	9 1/2	4	5 1/4	308	338	365	387	222	249	274	295	203	232	259	282
	260	10 1/4	4	6	308	338	365	387	222	249	274	295	203	232	259	282
10 **0.40**	*280*	11	4	6 7/8	308	338	365	387	222	249	274	295	203	232	259	282
	300	11 3/4	4	7 3/4	308	338	365	387	222	249	274	295	203	232	259	282
	320	12 5/8	4 3/4	7 3/4	308	338	365	387	222	249	274	295	203	232	259	282
	340	13 3/8	4 3/4	8 1/2	308	338	365	387	222	249	274	295	203	232	259	282
	360	14 1/4	4 3/4	9 1/4	308	338	365	387	222	249	274	295	203	232	259	282
	380	15	4 3/4	10	308	338	365	387	222	249	274	295	203	232	259	282
	400	15 3/4	4 3/4	10 7/8	308	338	365	387	222	249	274	295	203	232	259	282
	440	17 1/4	4 3/4	12 1/4	308	338	365	387	222	249	274	295	203	232	259	282
	480	19	4 3/4	14	308	338	365	387	222	249	274	295	203	232	259	282
	520	20 1/2	4 3/4	15 1/2	308	338	365	387	222	249	274	295	203	232	259	282

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.

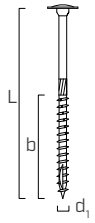
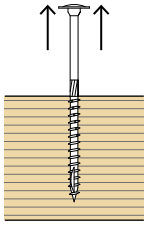
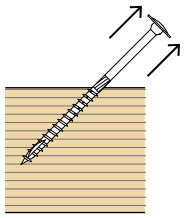
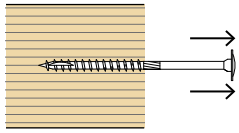
(2) $Z_{\perp/\parallel}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.

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

Refer to page 12 for the general calculation principles.

STRUCTURAL VALUES | THREAD WITHDRAWAL (W)

TBS Ø10 | 0.40 inch

geometry				thread withdrawal α = 90°				thread withdrawal α = 45°				thread withdrawal α = 0°(3)			
															
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]
	100(1)	4	2 1/16	231	266	311	339	211	242	283	308	69	80	93	102
	120(1)	4 3/4	2 3/8	276	317	370	404	251	288	337	367	83	95	111	121
	140(1)	5 1/2	2 3/8	276	317	370	404	251	288	337	367	83	95	111	121
	160(1)	6 1/4	3 1/8	386	444	518	565	351	404	471	514	116	133	155	169
	180(1)	7 1/8	3 1/8	386	444	518	565	351	404	471	514	116	133	155	169
	200	8	4	496	570	666	726	451	519	606	661	149	171	200	218
	220	8 5/8	4	496	570	666	726	451	519	606	661	149	171	200	218
	240	9 1/2	4	496	570	666	726	451	519	606	661	149	171	200	218
	260	10 1/4	4	496	570	666	726	451	519	606	661	149	171	200	218
10 **0.40**	*280*	11	4	496	570	666	726	451	519	606	661	149	171	200	218
	300	11 3/4	4	496	570	666	726	451	519	606	661	149	171	200	218
	320	12 5/8	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	340	13 3/8	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	360	14 1/4	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	380	15	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	400	15 3/4	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	440	17 1/4	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	480	19	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266
	520	20 1/2	4 3/4	606	697	814	888	552	634	741	808	182	209	244	266

NOTES:

(1) The minimum embedded thread length is 4 times the outer thread diameter, rather than 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 $0 \leq \alpha < 90°$ to the grain, as specified in ESR-4645.

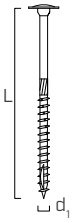
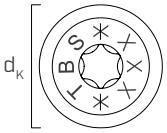
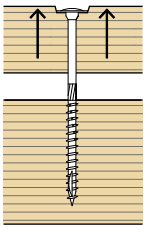
(2) The minimum embedded thread length is 6 times the outer thread diameter for screws installed at α=45° and α=0° to the grain, rather than 8 times the outer thread diameter as specified in ESR-4645.

(3) 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 $\alpha \leq 15°$.

Refer to page 12 for the general calculation principles and for the calculation of the reference withdrawal design values for screws installed at an angle to the grain.

STRUCTURAL VALUES | HEAD PULL-THROUGH (W_H)

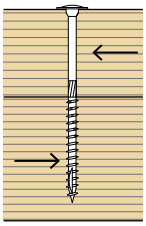
TBS Ø6 | 0.24 inch - TBS Ø8 | 0.32 inch - TBS MAX Ø8 | 0.32 inch - TBS Ø10 | 0.40 inch

geometry					head pull-through			
								
d_1 *[mm]* [in]	d_K *[mm]* [in]	L *[mm]*	L [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**	*15,5* **0.61**	*from 60 to 300*	from 2 3/8 to 11 3/4	1 1/2	125	144	162	177
8 **0.32**	*19,0* **0.75**	*from 40 to 520*	from 1 9/16 to 20 1/2	1 1/2	166	216	243	265
8 MAX **0.32 MAX**	*24,5* **0.96**	*from 200 to 240*	from 8 to 9 1/2	1	421	484	545	594
10 **0.40**	*25,0* **0.98**	*from 100 to 520*	from 4 to 20 1/2	1 1/2	166	239	325	410

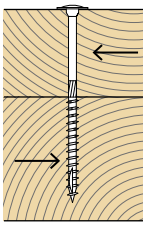
NOTES:

Refer to page 12 for the general calculation principles.

MINIMUM DISTANCES FOR LATERAL LOADING



Load-to-grain angle α = 0°

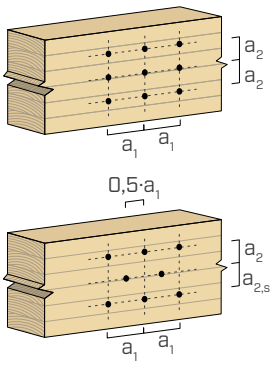


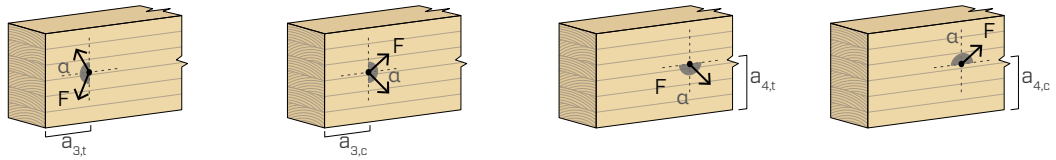
Load-to-grain angle α = 90°

		Screws inserted without pre-drilling hole **G < 0.50**						Screws inserted without pre-drilling hole **G < 0.50**					
d_1	*[mm]*		*6*	*8*	*8 MAX*		*10*		*6*	*8*	*8 MAX*		*10*
	[in]		**0.24**	**0.32**	**0.32 MAX**		**0.40**		**0.24**	**0.32**	**0.32 MAX**		**0.40**
a_1	[in]	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6	**12·d**	2 13/16	3 3/4	3 3/4	**12·d**	4 3/4
a_2	[in]	**5·d**	1 3/16	1 9/16	1 9/16	**5·d**	1 15/16	**5·d**	1 3/16	1 9/16	1 9/16	**5·d**	1 15/16
$a_{2,s}$	[in]	**2,5·d**	9/16	13/16	13/16	**5·d**	1 15/16	**2,5·d**	9/16	13/16	13/16	**5·d**	1 15/16
$a_{3,t}$	[in]	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6	**10·d**	2 3/8	3 1/8	3 1/8	**10·d**	4
$a_{3,c}$	[in]	**10·d**	2 3/8	3 1/8	3 1/8	**10·d**	4	**10·d**	2 3/8	3 1/8	3 1/8	**10·d**	4
$a_{4,t}$	[in]	**5·d**	1 3/16	1 9/16	1 9/16	**5·d**	1 15/16	**10·d**	2 3/8	3 1/8	3 1/8	**10·d**	4
$a_{4,c}$	[in]	**5·d**	1 3/16	1 9/16	1 9/16	**5·d**	1 15/16	**5·d**	1 3/16	1 9/16	1 9/16	**5·d**	1 15/16

		Screws inserted without pre-drilling hole **G ≥ 0.50**						Screws inserted without pre-drilling hole **G ≥ 0.50**					
d_1	*[mm]*		*6*	*8*	*8 MAX*		*10*		*6*	*8*	*8 MAX*		*10*
	[in]		**0.24**	**0.32**	**0.32 MAX**		**0.40**		**0.24**	**0.32**	**0.32 MAX**		**0.40**
a_1	[in]	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6
a_2	[in]	**7·d**	1 5/8	2 3/16	2 3/16	**7·d**	2 3/4	**7·d**	1 5/8	2 3/16	2 3/16	**7·d**	2 3/4
$a_{2,s}$	[in]	**3·d**	11/16	15/16	15/16	**5·d**	1 15/16	**3·d**	11/16	15/16	15/16	**5·d**	1 15/16
$a_{3,t}$	[in]	**20·d**	4 3/4	6 1/4	6 1/4	**20·d**	8	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6
$a_{3,c}$	[in]	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6	**15·d**	3 1/2	4 3/4	4 3/4	**15·d**	6
$a_{4,t}$	[in]	**7·d**	1 5/8	2 3/16	2 3/16	**7·d**	2 3/4	**12·d**	2 13/16	3 3/4	3 3/4	**12·d**	4 3/4
$a_{4,c}$	[in]	**7·d**	1 5/8	2 3/16	2 3/16	**7·d**	2 3/4	**7·d**	1 5/8	2 3/16	2 3/16	**7·d**	2 3/4

d = nominal screw diameter

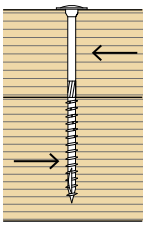




NOTES:

- 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



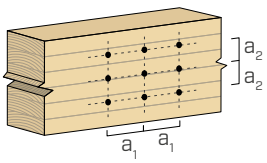
Load-to-grain angle α = 0°

			Screws inserted without pre-drilling hole **G ≤ 0.47**					Screws inserted without pre-drilling hole **G ≤ 0.47**			
d_1	*[mm]*		*6*	*8*	*8 MAX*	*10*		*6*	*8*	*8 MAX*	*10*
	[in]		**0.24**	**0.32**	**0.32 MAX**	**0.40**		**0.24**	**0.32**	**0.32 MAX**	**0.40**
a_1	[in]	**12·d**	2 13/16	3 3/4	3 3/4	4 3/4	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16
a_2	[in]	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16
$a_{3,t}$	[in]	**15·d**	3 1/2	4 3/4	4 3/4	6	**10·d**	2 3/8	3 1/8	3 1/8	4
$a_{3,c}$	[in]	**10·d**	2 3/8	3 1/8	3 1/8	4	**10·d**	2 3/8	3 1/8	3 1/8	4
$a_{4,t}$	[in]	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16	**10·d**	2 3/8	3 1/8	3 1/8	4
$a_{4,c}$	[in]	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16	**5·d**	1 3/16	1 9/16	1 9/16	1 15/16

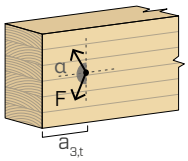
			Screws inserted without pre-drilling hole **G > 0.47**					Screws inserted without pre-drilling hole **G > 0.47**			
d_1	*[mm]*		*6*	*8*	*8 MAX*	*10*		*6*	*8*	*8 MAX*	*10*
	[in]		**0.24**	**0.32**	**0.32 MAX**	**0.40**		**0.24**	**0.32**	**0.32 MAX**	**0.40**
a_1	[in]	**15·d**	3 1/2	4 3/4	4 3/4	6	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4
a_2	[in]	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4
$a_{3,t}$	[in]	**20·d**	4 3/4	6 1/4	6 1/4	8	**15·d**	3 1/2	4 3/4	4 3/4	6
$a_{3,c}$	[in]	**15·d**	3 1/2	4 3/4	4 3/4	6	**15·d**	3 1/2	4 3/4	4 3/4	6
$a_{4,t}$	[in]	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4	**12·d**	2 13/16	3 3/4	3 3/4	4 3/4
$a_{4,c}$	[in]	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4	**7·d**	1 5/8	2 3/16	2 3/16	2 3/4

			Screws inserted **with** pre-drilling hole					Screws inserted **with** pre-drilling hole			
d_1	*[mm]*		*6*	*8*	*8 MAX*	*10*		*6*	*8*	*8 MAX*	*10*
	[in]		**0.24**	**0.32**	**0.32 MAX**	**0.40**		**0.24**	**0.32**	**0.32 MAX**	**0.40**
a_1	[in]	**5·d**	1 3/16	1 9/16	1 9/16	2 3/8	**4·d**	15/16	1 1/4	1 1/4	1 7/8
a_2	[in]	**3·d**	11/16	15/16	15/16	1 7/16	**4·d**	15/16	1 1/4	1 1/4	1 7/8
$a_{3,t}$	[in]	**12·d**	2 13/16	3 3/4	3 3/4	5 11/16	**7·d**	1 5/8	2 3/16	2 3/16	3 5/16
$a_{3,c}$	[in]	**7·d**	1 5/8	2 3/16	2 3/16	3 5/16	**7·d**	1 5/8	2 3/16	2 3/16	3 5/16
$a_{4,t}$	[in]	**3·d**	11/16	15/16	15/16	1 7/16	**7·d**	1 5/8	2 3/16	2 3/16	3 5/16
$a_{4,c}$	[in]	**3·d**	11/16	15/16	15/16	1 7/16	**3·d**	11/16	15/16	15/16	1 7/16

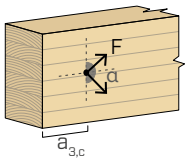
d = nominal screw diameter



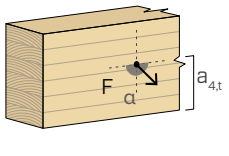
stressed end
-90° < α < 90°



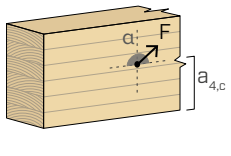
unloaded end
90° < α < 270°



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.

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.
- 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.
- TBS screws must be installed and used in dry in-service conditions in accordance with the NDS (wet service factor for connection CM 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.

WOOD-TO-WOOD

- The wood main member thickness must be greater than the screw length less the thickness of the wood side member.
- Values are calculated considering the threaded part as being completely inserted in the main member.
- The tabulated lateral design values are based on both wood members having the same specific gravity G.

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]
6 **0.24**	77	89	131	143
8 **0.32**	109	125	138	174
8 MAX **0.32 MAX**	109	125	138	174
10 **0.40**	140	161	188	205

- 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.

Tabulated values at page 6 and 8 are valid for L_{eff} equal to the screw thread length b minus the tip length L_t and k_α = 1 for α=90°, k_α = 0.91 for α = 45°, k_α = 0.3 for α = 0°.

- 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.

REFERENCE HEAD-PULL THROUGH DESIGN VALUES:

- Tabulated values are valid for TBS screws installed perpendicular to the faces of the wood members.
- The reference head pull-through values must be less than the allowable tensile strength of the screw.