# HBS EVO

## COUNTERSUNK SCREW

AC233 | AC257
ESR-4645

BIT INCLUDED

SOFTWARE

COATING

ETA-11/0030

### 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 Fyb = 1241 N/mm² | **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 4,5 to 8,0 mm | 0.18 to 0.32 inches |
| **LENGTH** | from 45 to 320 mm | 1 3/4 to 12 5/8 inches |

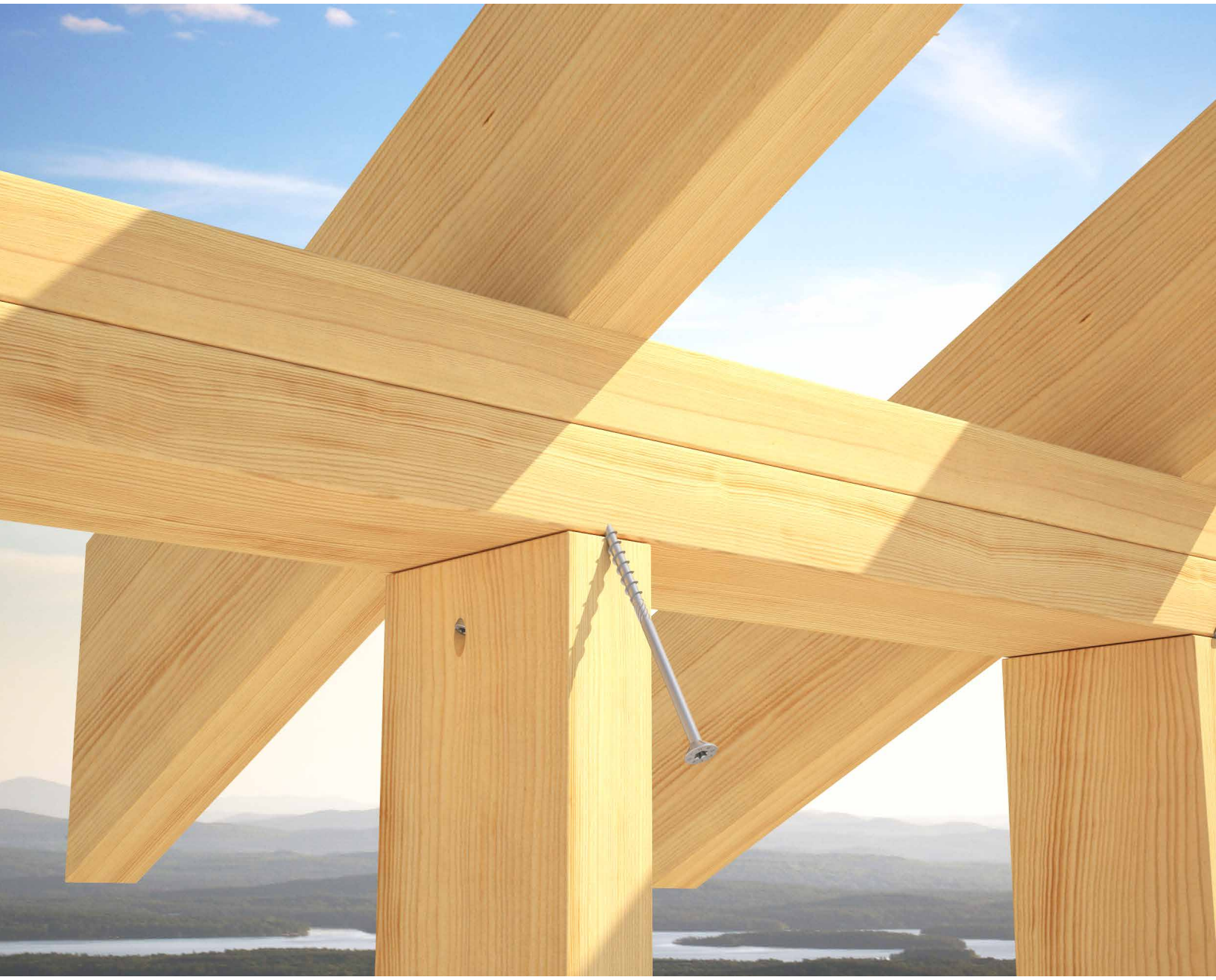
### MATERIAL

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.

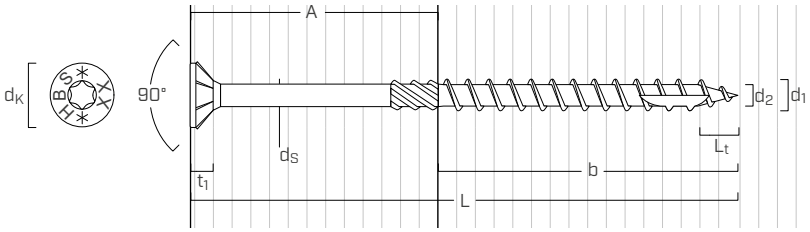
## OUTDOOR STRUCTURAL PERFORMANCE

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) | 0.18(*) | 0.20(*) | 0.24 | 0.32 |
| **Outer thread diameter** | **$d_1$** | [mm] | 4,5 | 5 | 6 | 8 |
| | | [in] | 0.177 | 0.197 | 0.236 | 0.315 |
| Head diameter | $d_K$ | [in] | 0.354 | 0.394 | 0.472 | 0.571 |
| Root diameter | $d_2$ | [in] | 0.110 | 0.134 | 0.156 | 0.213 |
| Shank diameter | $d_S$ | [in] | 0.124 | 0.144 | 0.169 | 0.228 |
| Head thickness | $t_1$ | [in] | 0.110 | 0.122 | 0.177 | 0.177 |
| Tip length | $L_t$ | [in] | 0.177 | 0.197 | 0.236 | 0.315 |
| Pre-drilling hole diameter(2) | $d_V$ | [in] | 0.10 | 0.12 | 0.16 | 0.20 |
| Bending yield strength(3) | $F_{y,b}$ | [psi] | 145,000 | 145,000 | 200,000 | 180,000 |
| Tensile strength | $f_{tens}$ | [lbf] | 540 | 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 EVO screws with nominal diameters of 0.18 and 0.20 inches aare based on experimental tests according to ETA-11/0030. Bending yield strengths for HBS EVO screws with nominal diameter of 0.24 and 0.32 inches 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 [in] | A [mm] | A [in] | pcs |
|---|---|---|---|---|---|---|---|
| 4,5 **0.18** **TX 25** | **HBSEVO4545**(*) NEW | 45 | 1 3/4 | 30 | 13 | 1/2 | 400 |
| | **HBSEVO4550**(*) NEW | 50 | 1 15/16 | 30 | 19 | 3/4 | 200 |
| | **HBSEVO4560**(*) NEW | 60 | 2 3/8 | 35 | 19 | 3/4 | 200 |
| | **HBSEVO4570**(*) NEW | 70 | 2 3/4 | 40 | 25 | 1 | 200 |
| 5 **0.20** **TX 25** | **HBSEVO550**(*) NEW | 50 | 1 15/16 | 24 | 13 | 1/2 | 200 |
| | **HBSEVO560**(*) NEW | 60 | 2 3/8 | 30 | 25 | 1 | 200 |
| | **HBSEVO570**(*) NEW | 70 | 2 3/4 | 35 | 32 | 1 1/4 | 100 |
| | **HBSEVO580**(*) | 80 | 3 1/8 | 40 | 38 | 1 1/2 | 100 |
| | **HBSEVO590**(*) | 90 | 3 1/2 | 45 | 44 | 1 3/4 | 100 |
| | **HBSEVO5100**(*) | 100 | 4 | 50 | 44 | 1 3/4 | 100 |
| 6 **0.24** **TX 30** | **HBSEVO660** NEW | 60 | 2 3/8 | 30 | 19 | 3/4 | 100 |
| | **HBSEVO670** NEW | 70 | 2 3/4 | 40 | 25 | 1 | 100 |
| | **HBSEVO680** | 80 | 3 1/8 | 40 | 38 | 1 1/2 | 100 |
| | **HBSEVO6100** | 100 | 4 | 50 | 44 | 1 3/4 | 100 |
| | **HBSEVO6120** | 120 | 4 3/4 | 60 | 51 | 2 | 100 |
| | **HBSEVO6140** | 140 | 5 1/2 | 75 | 64 | 2 1/2 | 100 |
| | **HBSEVO6160** | 160 | 6 1/4 | 75 | 83 | 3 1/4 | 100 |
| | **HBSEVO6180** | 180 | 7 1/8 | 75 | 102 | 4 | 100 |
| | **HBSEVO6200** | 200 | 8 | 75 | 121 | 4 3/4 | 100 |

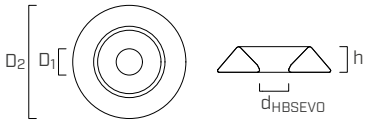
| $d_1$ [mm] [in] | CODE | L [mm] | L [in] | b [in] | A [mm] | A [in] | pcs |
|---|---|---|---|---|---|---|---|
| 8 **0.32** **TX 40** | **HBSEVO8100** | 100 | 4 | 52 | 44 | 1 3/4 | 100 |
| | **HBSEVO8120** | 120 | 4 3/4 | 60 | 57 | 2 1/4 | 100 |
| | **HBSEVO8140** | 140 | 5 1/2 | 60 | 76 | 3 | 100 |
| | **HBSEVO8160** | 160 | 6 1/4 | 80 | 76 | 3 | 100 |
| | **HBSEVO8180** | 180 | 7 1/8 | 80 | 95 | 3 3/4 | 100 |
| | **HBSEVO8200** | 200 | 8 | 80 | 114 | 4 1/2 | 100 |
| | **HBSEVO8220** | 220 | 8 5/8 | 80 | 140 | 5 1/2 | 100 |
| | **HBSEVO8240** | 240 | 9 1/2 | 80 | 159 | 6 1/4 | 100 |
| | **HBSEVO8260** NEW | 260 | 10 1/4 | 80 | 178 | 7 | 100 |
| | **HBSEVO8280** | 280 | 11 | 80 | 197 | 7 3/4 | 100 |
| | **HBSEVO8300** NEW | 300 | 11 3/4 | 100 | 197 | 7 3/4 | 100 |
| | **HBSEVO8320** | 320 | 12 5/8 | 100 | 216 | 8 1/2 | 100 |

(*) Not evaluated in ESR-4645.

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

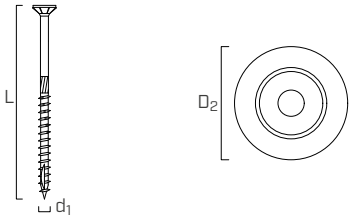
| $d_{HBSEVO}$ [mm] [in] | CODE | $D_1$ [in] | $D_2$ [in] | h [in] | pcs |
|---|---|---|---|---|---|
| 6 **0.24** | **HUSEVO6** | 0.295 | 0.787 | 0.181 | 100 |
| 8 **0.32** | **HUSEVO8** | 0.335 | 0.984 | 0.213 | 50 |

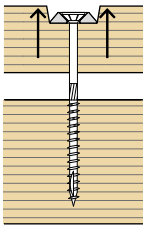
(*) Not evaluated in ESR-4645.




## STRUCTURAL VALUES | HEAD PULL - THROUGH ($W_H$)

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



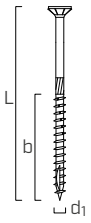
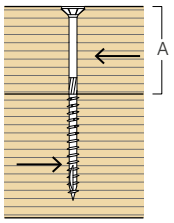
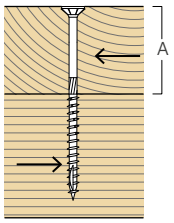
| $d_1$ [mm] [in] | L [mm] | L [in] | countersunk washer | washer outer diameter $D_2$ [in] | minimum side member thickness [in] | G=0.35 [lbf] | G=0.42 [lbf] | G=0.49 [lbf] | G=0.55 [lbf] |
|---|---|---|---|---|---|---|---|---|---|
| 6 **0.24** | from 80 to 200 | from 3 1/8 to 8 | **HUSEVO6** | 0.787 | 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 Ø4,5 | 0.18 inch - HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO 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] |
| | 45 | 1 3/4 | 1 3/16 | 1/2 | 43 | 52 | 62 | 72 | 43 | 52 | 62 | 72 | 43 | 52 | 62 | 72 |
| 4,5 **0.18**(*) | 50 | 1 15/16 | 1 3/16 | 3/4 | 47 | 60 | 74 | 88 | 47 | 60 | 74 | 88 | 47 | 60 | 74 | 88 |
| | 60 | 2 3/8 | 1 3/8 | 3/4 | 47 | 60 | 74 | 88 | 47 | 60 | 74 | 88 | 47 | 60 | 74 | 88 |
| | 70 | 2 3/4 | 1 9/16 | 1 | 54 | 70 | 81 | 90 | 54 | 70 | 81 | 90 | 54 | 70 | 81 | 90 |
| | 50 | 1 15/16 | 15/16 | 1/2 | 62 | 75 | 88 | 100 | 62 | 75 | 88 | 100 | 62 | 75 | 88 | 100 |
| | 60 | 2 3/8 | 1 3/16 | 1 | 69 | 92 | 115 | 133 | 69 | 92 | 115 | 133 | 69 | 92 | 115 | 133 |
| 5 **0.20**(*) | 70 | 2 3/4 | 1 3/8 | 1 1/4 | 80 | 104 | 120 | 133 | 80 | 104 | 120 | 133 | 80 | 104 | 120 | 133 |
| | 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 |
| | 60 | 2 3/8 | 1 3/16 | 3/4 | 86 | 120 | 142 | 163 | 86 | 120 | 142 | 163 | 86 | 120 | 142 | 163 |
| | 70 | 2 3/4 | 1 9/16 | 1 | 97 | 129 | 156 | 182 | 97 | 129 | 156 | 182 | 97 | 129 | 156 | 182 |
| | 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 |
| 6 **0.24** | 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 |
| | 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 |
| 8 **0.32** | 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 |
| | 260 | 10 1/4 | 3 1/8 | 7 | 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 |
| | 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 |

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

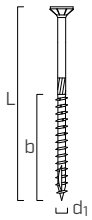
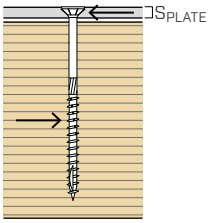
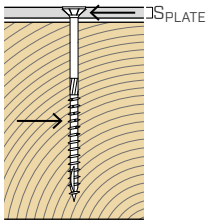
(2) $Z_{\perp/\parallel}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.

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

Refer to page 10 for the general calculation principles.

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

HBS EVO Ø4,5 | 0.18 inch - HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

| geometry | | | | $Z_{\parallel}$ (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] [in] | [mm] | [in] | [in] | [in] | [lbf] | [lbf] | [lbf] | [lbf] | [in] | [lbf] | [lbf] | [lbf] | [lbf] |
| 4.5 **0.18**(*) | 45 | 1 3/4 | 1 3/16 | $S_{PLATE}$ = 1/16" | 64 | 74 | 84 | 93 | $S_{PLATE}$ = 1/16" | 64 | 74 | 84 | 93 |
| | 50 | 1 15/16 | 1 3/16 | | 64 | 74 | 84 | 93 | | 64 | 74 | 84 | 93 |
| | 60 | 2 3/8 | 1 3/8 | | 64 | 74 | 84 | 93 | | 64 | 74 | 84 | 93 |
| | 70 | 2 3/4 | 1 9/16 | | 64 | 74 | 84 | 93 | | 64 | 74 | 84 | 93 |
| 5 **0.20**(*) | 50 | 1 15/16 | 15/16 | $S_{PLATE}$ = 1/16" | 91 | 106 | 121 | 133 | $S_{PLATE}$ = 1/16" | 91 | 106 | 121 | 133 |
| | 60 | 2 3/8 | 1 3/16 | | 91 | 106 | 121 | 133 | | 91 | 106 | 121 | 133 |
| | 70 | 2 3/4 | 1 3/8 | | 91 | 106 | 121 | 133 | | 91 | 106 | 121 | 133 |
| | 80 | 3 1/8 | 1 9/16 | | 91 | 106 | 121 | 133 | | 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** | 60 | 2 3/8 | 1 3/16 | $S_{PLATE}$ = 1/8" | 155 | 180 | 205 | 225 | $S_{PLATE}$ = 1/8" | 155 | 180 | 205 | 225 |
| | 70 | 2 3/4 | 1 9/16 | | 155 | 180 | 205 | 225 | | 155 | 180 | 205 | 225 |
| | 80 | 3 1/8 | 1 9/16 | | 155 | 180 | 205 | 225 | | 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 |
| | 260 | 10 1/4 | 3 1/8 | | 218 | 255 | 290 | 319 | | 174 | 204 | 232 | 255 |
| | 280 | 11 | 3 1/8 | | 218 | 255 | 290 | 319 | | 174 | 204 | 232 | 255 |
| | 300 | 11 3/4 | 4 | | 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:

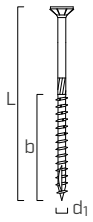
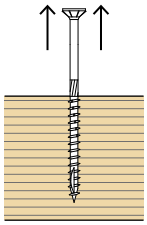
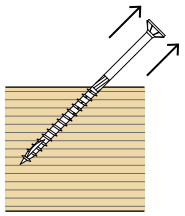
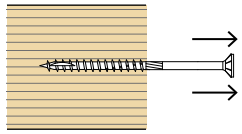
(1) $Z_{\parallel}$ both side and main members loaded parallel to the grain.

(2) $Z_{\perp}$ 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 Ø4,5 | 0.18 inch - HBS EVO Ø5 | 0.20 inch - HBS EVO Ø6 | 0.24 inch - HBS EVO Ø8 | 0.32 inch

| geometry | | | | thread withdrawal α = 90° | | | | thread withdrawal α = 45° | | | | thread withdrawal α = 0° | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | | | |  | | | |  | | | |  | | | |
| $d_1$ | 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] |
| 4,5 **0.18(*)** | 45(1) | 1 3/4 | 1 3/16 | 58 | 67 | 98 | 107 | 53 | 61 | 90 | 98 | 17 | 20 | 30 | 32 |
| | 50(1) | 1 15/16 | 1 3/16 | 58 | 67 | 98 | 107 | 53 | 61 | 90 | 98 | 17 | 20 | 30 | 32 |
| | 60(2) | 2 3/8 | 1 3/8 | 70 | 80 | 118 | 128 | 63 | 73 | 107 | 117 | 21 | 24 | 35 | 39 |
| | 70(2) | 2 3/4 | 1 9/16 | 81 | 94 | 137 | 150 | 74 | 85 | 125 | 136 | 24 | 28 | 41 | 45 |
| 5 **0.20(*)** | 50(1) | 1 15/16 | 15/16 | 48 | 55 | 82 | 89 | 44 | 50 | 74 | 81 | 14 | 17 | 24 | 27 |
| | 60(1) | 2 3/8 | 1 3/16 | 63 | 73 | 107 | 117 | 57 | 66 | 98 | 107 | 19 | 22 | 32 | 35 |
| | 70(2) | 2 3/4 | 1 3/8 | 76 | 87 | 129 | 141 | 69 | 80 | 117 | 128 | 23 | 26 | 39 | 42 |
| | 80(2) | 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** | 60(1) | 2 3/8 | 1 3/16 | 73 | 84 | 124 | 135 | 66 | 77 | 113 | 123 | 22 | 25 | 37 | 41 |
| | 70(1) | 2 3/4 | 1 9/16 | 103 | 119 | 175 | 191 | 94 | 108 | 160 | 174 | 31 | 36 | 53 | 57 |
| | 80(1) | 3 1/8 | 1 9/16 | 103 | 119 | 175 | 191 | 94 | 108 | 160 | 174 | 31 | 36 | 53 | 57 |
| | 100(2) | 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 |
| | 260 | 10 1/4 | 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 |
| | 300 | 11 3/4 | 4 | 395 | 453 | 552 | 630 | 359 | 412 | 502 | 574 | 118 | 136 | 166 | 189 |
| | 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.

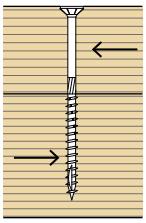
(1) The embedded thread length is lower than 8 times the outer thread diameter.

(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°≤ α <90° to the grain).

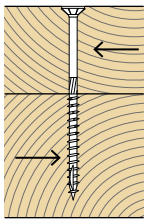
(3) The embedded thread length does not comply with the minimum requirement of ESR-4645 (8 times the outer thread diameter for screws installed at an angle 0°≤ α <90° to the grain).

Refer to page 10 for the general calculation principles.

# MINIMUM DISTANCES FOR LATERAL LOADING



Load-to-grain angle α = 0°

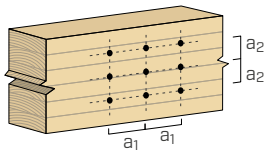


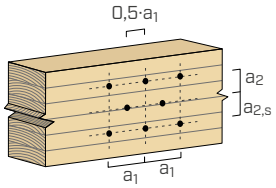
Load-to-grain angle α = 90°

| | | Screws inserted without pre-drilling hole **G < 0.50** | | | | | Screws inserted without pre-drilling hole **G < 0.50** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | *[mm]* | | *4,5(*)* | *5(*)* | *6* | *8* | | *4,5(*)* | *5(*)* | *6* | *8* |
| | **[in]** | | **0.18** | **0.20** | **0.24** | **0.32** | | **0.18** | **0.20** | **0.24** | **0.32** |
| $a_1$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_2$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 |
| $a_{2,s}$ | [in] | **2.5·d** | 1/2 | 1/2 | 9/16 | 13/16 | **2.5·d** | 1/2 | 1/2 | 9/16 | 13/16 |
| $a_{3,t}$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{3,c}$ | [in] | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{4,t}$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{4,c}$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 |

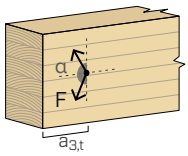
| | | Screws inserted without pre-drilling hole **G ≥ 0.50** | | | | | Screws inserted without pre-drilling hole **G ≥ 0.50** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | *[mm]* | | *4,5(*)* | *5(*)* | *6* | *8* | | *4,5(*)* | *5(*)* | *6* | *8* |
| | **[in]** | | **0.18** | **0.20** | **0.24** | **0.32** | | **0.18** | **0.20** | **0.24** | **0.32** |
| $a_1$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_2$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_{2,s}$ | [in] | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 |
| $a_{3,t}$ | [in] | **20·d** | 3 1/2 | 4 | 4 3/4 | 6 1/4 | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 |
| $a_{3,c}$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 |
| $a_{4,t}$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **12·d** | 2 1/8 | 2 3/8 | 2 13/16 | 3 3/4 |
| $a_{4,c}$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |

**d = nominal screw diameter**

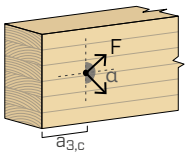


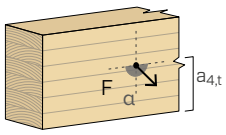

stressed end
-90° < α < 90°



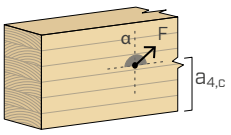

unloaded end
90° < α < 270°




stressed edge
0° < α < 180°




unload edge
180° < α < 360°

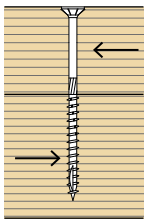



NOTES:

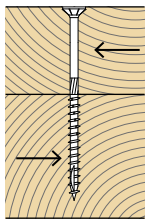
(*) Not evaluated in ESR-4645.

- 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.

# MINIMUM DISTANCES FOR LATERAL LOADING



Load-to-grain angle α = 0°



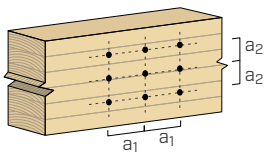
Load-to-grain angle α = 90°

| | | Screws inserted without pre-drilling hole **G ≤ 0.47** | | | | | Screws inserted without pre-drilling hole **G ≤ 0.47** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | *[mm]* | | *4,5* | *5* | *6* | *8* | | *4,5* | *5* | *6* | *8* |
| | **[in]** | | **0.18** | **0.20** | **0.24** | **0.32** | | **0.18** | **0.20** | **0.24** | **0.32** |
| $a_1$ | [in] | **12·d** | 1 3/4 | 2 3/8 | 2 13/16 | 3 3/4 | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 |
| $a_2$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 |
| $a_{3,t}$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{3,c}$ | [in] | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 | **10·d** | 1 3/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{4,t}$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **10·d** | 1 1/4 | 1 15/16 | 2 3/8 | 3 1/8 |
| $a_{4,c}$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 |

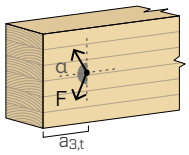
| | | Screws inserted without pre-drilling hole **G > 0.47** | | | | | Screws inserted without pre-drilling hole **G > 0.47** | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | *[mm]* | | *4,5* | *5* | *6* | *8* | | *4,5* | *5* | *6* | *8* |
| | **[in]** | | **0.18** | **0.20** | **0.24** | **0.32** | | **0.18** | **0.20** | **0.24** | **0.32** |
| $a_1$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_2$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_{3,t}$ | [in] | **20·d** | 3 1/2 | 4 | 4 3/4 | 6 1/4 | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 |
| $a_{3,c}$ | [in] | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 | **15·d** | 2 11/16 | 2 15/16 | 3 1/2 | 4 3/4 |
| $a_{4,t}$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **12·d** | 1 5/8 | 2 3/8 | 2 13/16 | 3 3/4 |
| $a_{4,c}$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |

| | | Screws inserted **with** pre-drilling hole | | | | | Screws inserted **with** pre-drilling hole | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $d_1$ | *[mm]* | | *4,5* | *5* | *6* | *8* | | *4,5* | *5* | *6* | *8* |
| | **[in]** | | **0.18** | **0.20** | **0.24** | **0.32** | | **0.18** | **0.20** | **0.24** | **0.32** |
| $a_1$ | [in] | **5·d** | 7/8 | 1 | 1 3/16 | 1 9/16 | **4·d** | 11/16 | 13/16 | 15/16 | 1 1/4 |
| $a_2$ | [in] | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 | **4·d** | 11/16 | 13/16 | 15/16 | 1 1/4 |
| $a_{3,t}$ | [in] | **12·d** | 2 1/8 | 2 3/8 | 2 13/16 | 3 3/4 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_{3,c}$ | [in] | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 | **7·d** | 1 1/4 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_{4,t}$ | [in] | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 | **7·d** | 7/8 | 1 3/8 | 1 5/8 | 2 3/16 |
| $a_{4,c}$ | [in] | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 | **3·d** | 9/16 | 9/16 | 11/16 | 15/16 |

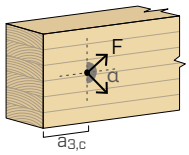
d = nominal screw diameter



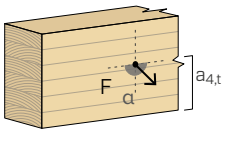

stressed end
-90° < α < 90°



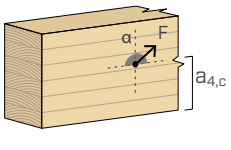

unloaded end
90° < α < 270°




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 $\rho_k$ = 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.
- 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.

| $d_1$ | 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] |
| *4,5* **0.18(*)** | 58 | 67 | 98 | 107 |
| *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 $k_\alpha$:

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

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;
- $k_\alpha$ 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 7 are valid for $L_{eff}$ equal to the screw thread length b minus the tip length $L_t$ and $k_\alpha$ = 1 for α=90°, $k_\alpha$ = 0.91 for α = 45°, $k_\alpha$ = 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 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 4,5 mm | **0.18 inch** and 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.