

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES

Section: 06 05 23—Wood, Plastic, and Composite Fastenings

REPORT HOLDER:

ROTHO BLAAS S.R.L.

EVALUATION SUBJECT:

ROTHO BLAAS SELF-TAPPING WOOD SCREWS

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)

Properties evaluated:

- Structural
- Corrosion resistance

2.0 USES

Rotho Blaas self-tapping screws are used for wood-to-wood and steel-to-wood connections that are designed in accordance with the IBC. For structures regulated under the IRC, the screws may be used where an engineered design is submitted in accordance with IRC Section R301.1.3. Rotho Blaas screws with EVO coating may be used where fasteners are required to exhibit corrosion resistance when exposed to adverse environmental conditions, in chemically treated wood (subject to the limitations of Sections 4.2, 5.4 and Table 10) or both; and are alternates to hot-dip zinc galvanized fasteners with a coating weight in compliance with ASTM A153, Class D. Rotho Blaas screws with EVO coating have been evaluated for use with wood chemically treated with waterborne alkaline copper quaternary (ACQ). The EVO coated screws are intended for use in the Exposure Conditions 1 and 3, as shown in Table 10.

3.0 DESCRIPTION

3.1 Screws:

The screws are dowel-type threaded fasteners designed to be installed in wood without drilling a lead hole due to their self-drilling point. The screws are manufactured from carbon steel wire according to the manufacturer's specifications. Following the head forming and the thread rolling process, the screws are heat-treated and coated. Screws are zinc plated or coated with EVO coating. EVO coating is a multilayer corrosion resistance coating. The screws

dimensions and strengths are provided in Tables 1 through 3 of this report.

3.1.1 HBS and HBS EVO screws: HBS and HBS EVO screws are partially threaded and available in various diameters and lengths as shown in Table 1 and Figure 1. The screws have a countersunk head with milling ribs under the head. HBS screws are available with nominal diameters of 0.24, 0.32, 0.40 and 0.48 inches and zinc plated, HBS EVO screws are available with nominal diameters of 0.24 and 0.32 inches with EVO coating. HBS screws may be used in combination with HUS countersunk washers as shown in Figure 4.

3.1.2 TBS, TBS MAX and TBS EVO screws: TBS, TBS MAX and TBS EVO screws are partially threaded and available in various diameters and lengths as shown in Table 1 and Figure 1. The screws have a large washer head with head diameters of 0.610, 0.748, 0.965 and 0.984 inches. TBS screws are available with nominal diameters of 0.24, 0.32 and 0.40 inches and zinc plated, TBS MAX screws are available with nominal diameters of 0.32 inches and zinc plated, TBS EVO screws are available with nominal diameters of 0.24 and 0.32 inches with EVO coating.

3.1.3 VGZ and VGZ EVO screws: VGZ and VGZ EVO screws are fully threaded and available in various diameters and lengths as shown in Table 2 and Figure 2. The screws have a cylindrical head. VGZ screws are available with nominal diameters of 0.21, 0.23, 0.28, 0.36 and 0.44 inches and zinc plated, VGZ EVO screws are available with nominal diameters of 0.21, 0.23, 0.28 and 0.36 inches with EVO coating.

3.1.4 VGS screws: VGS screws are fully threaded and available in various diameters and lengths as shown in Table 2 and Figure 2. The screws have either a countersunk or hexagonal star drive head. VGS screws are available with nominal diameters of 0.36, 0.44 and 0.52 inches and zinc plated. VGS screws may be used in combination with VGU 45° countersunk washers in steel-to-wood connections as shown in Figure 5.

3.1.5 LBS screws: LBS screws are fully threaded and available in various diameters and lengths as shown in Table 2 and Figure 2. The screws have round head with a cylindrical underhead. LBS screws are available with nominal diameters of 0.20 and 0.28 inches and zinc plated.

3.1.6 DGZ screws: DGZ screws are double threaded and available in various diameters and lengths as shown in Table 3 and Figure 3. The screws have a cylindrical head. DGZ screws are available with nominal diameters of 0.28 and 0.36 inches and are zinc plated.

3.2 Wood Members:

For purposes of connection design, sawn lumber and timber members must have an assigned specific gravity as

indicated in the tables in this report. Assigned specific gravity for sawn lumber and timber must be determined in accordance with Table 12.3.3A of the ANSI/AWC National Design Specification for Wood Construction® (NDS) (Table 11.3.3A of the NDS for the 2012 IBC, Table 11.3.2 of the NDS for the 2009 IBC). Unless otherwise noted, sawn lumber and timber members must have a moisture content of 19 percent or less.

For the purposes of connection design, structural glued laminated timber (GL) must have a Specific Gravity for Fastener Design (addressed in Tables 5A through 5D of the NDS Supplement), as indicated in the tables in this report. Unless otherwise noted, GL must have a moisture content of less than 16 percent.

When designing connections with screws installed into the face of cross-laminated timber (CLT) panels fabricated with sawn lumber laminations, all of the laminations must have a minimum assigned specific gravity in accordance with the NDS as indicated in the tables in this report. Moisture content must be less than 16 percent.

Use of the screws in engineered wood products (EWP) other than those addressed above is outside the scope of this report.

For wood-to-wood connections, the tabulated side member thickness t_s is an absolute value (not a minimum or maximum value). The thickness of the wood main member t_m must be equal to or greater than the screw length less the thickness of the side member.

3.3 Steel Members:

Steel side members must have a minimum tensile strength, F_u , equal to 58 ksi (400 MPa). The hole in the steel side member for the screws must be predrilled or prepunched. For application with VGU 45° countersunk washer, the geometry requirements of the slotted holes and the steel plate thickness are shown in Figure 5.

3.4 Steel washers:

HUS countersunk washers are available for use with HBS screws in wood-to-wood and steel-to-wood connections. For VGS screws oriented at 45° angle to the face of the member through steel side plates in steel-to-wood connections, VGU 45° countersunk washers must be used.

4.0 DESIGN AND INSTALLATION

4.1 Design:

The design values in this report are intended to aid the registered design professional in meeting the requirements of IBC Section 1604.2. For connections not completely described in this report, determination of the suitability of the screws for the specific application is the responsibility of the registered design professional and is outside the scope of this report. The registered design professional is responsible for determining the available strengths for the connection, considering all applicable limit states, and for considering serviceability issues.

4.1.1 Screw Strength: Allowable screw tension strengths (ASD) and minimum specified bending yield strength for the screws are shown in Tables 1 through 3.

4.1.2 Adjustments to Reference Design Values: The reference design values must be adjusted in accordance with the requirements for dowel-type fasteners in Section 11.3 of the NDS (Section 10.3 of the NDS for the 2012 and 2009 IBC), including the wet service factor, C_M , to determine allowable loads for use with ASD, design loads for use with LRFD, or both. The reference design values must also be adjusted in accordance with Section 12.5 of the NDS

(Section 11.5 of the NDS for the 2012 and 2009 IBC), as applicable. When the capacity of a connection is controlled by the fastener strength, the allowable connection strength must not be increased by the adjustment factors specified in the NDS.

4.1.3 Design of Steel Parts: Design of connections using steel side plates must comply with Section 11.2.3 of the NDS (Section 10.2.3 of NDS-12 and NDS-05 for the 2012 and 2009 IBC).

4.1.4 Capacity Requirements for Wood Members: When designing a connection, the structural members must be checked for load-carrying capacity in accordance with Section 11.1.2 of the NDS (Section 10.1.2 of the NDS for the 2012 and 2009 IBC), 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.

4.1.5 Connections with Multiple Screws: Connections made with multiple screws must be designed in accordance with Sections 11.2.2 and 12.6 of the NDS (Sections 10.2.2 and 11.6 of the NDS for the 2012 and 2009 IBC) and the requirements in Section 4.1.7.3.1 of this report.

4.1.6 Design of connections with screws installed perpendicular to the grain:

4.1.6.1 Reference Withdrawal and Pull-through Design Values: Reference withdrawal design values (W) in pounds per inch of the effective thread penetration l for screws installed perpendicular to the face of the wood member are shown in Table 7. The reference design load values must be calculated using Equation (1) and must be less than the allowable tensile strength of the screw.

$$W_{load} = Wl \text{ [lbs]} \quad (1)$$

Reference head pull-through values (W_H) are shown in Table 8. For fully threaded screws pull-through design load values ($W_{load,H,t}$) for a single fastener must be calculated using the reference withdrawal design value W multiplied with the effective thread length L_{eff} in the side member thickness t_s as shown in Equation (2). The minimum side panel thickness must be greater than NDS requirements and the reference design values pull-through must be less than the allowable tensile strength of the screw.

Pull-through load (fully threaded)

$$W_{load,H,t} = W L_{eff} \text{ [lbs]} \quad (2)$$

4.1.6.2 Lateral Connections in Accordance with the NDS: The reference lateral design strength for selected wood-to-wood and steel-to-wood connections are shown in Tables 4 and 5. For other connection configurations, the reference lateral design strength may be determined in accordance with the NDS, subject to the following conditions:

1. The applicable specified bending yield strength from Tables 1 through 3 must be used for design.
2. The minor thread diameter, D_r , must be used to determine R_d and K_D in accordance with Table 12.3.1B of the NDS, the dowel bearing strength in accordance with Table 12.3.3 of the NDS and the reference lateral design value based on Table 12.3.1A of the NDS (Tables 11.3.1B, 11.3.3 and 11.3.1 A of the 2012 NDS for the 2015 IBC; Tables 11.3.1B, 11.3.2 and 11.3.1A of the 2005 NDS for the 2009 IBC).
3. The screw penetration into the main member must be a minimum of 6 times the major thread diameter.

4. Spacing, edge and end distance must be in accordance with Table 9, and as needed to prevent splitting of the wood.

4.1.6.3 Governing Design Values: The allowable load for a two-member, single-screw connection in which the screw is subject to tension is the least of: (a) the reference withdrawal design load value given in Table 7, multiplied by the embedded thread length, and adjusted by all applicable adjustment factors; (b) the reference head pull-through design value given in Table 8 or calculated according to Equation (2), adjusted by all applicable factors; and (c) the allowable screw tension strength given in the applicable table in this report.

4.1.6.4 Combined Loading: Where the screws are subjected to combined lateral and withdrawal loads, connections must be designed in accordance with Section 12.4.1 of the NDS (Section 11.4.1 of the NDS for the 2012 and 2009 IBC).

4.1.7 Design of connections with screws installed at an angle to the grain:

General: Connections used to transfer lateral loads between side members and a main member using groups of Rotho Blaas screws installed at an angle between 0° and 90° to the wood grain must be designed in accordance with this section.

4.1.7.1 Reference withdrawal values for screws installed at an angle to the grain between 90° and 0°:

Reference withdrawal design values (W_α) in pounds per inch of thread penetration for screws installed at an angle α (in degrees) to the grain of the wood member must be determined in accordance with Equations (3), (4) and (5) as follows:

$$W_\alpha = W \times k_\alpha \quad (3)$$

α	k_α	α	k_α
90	1.00	35	0.84
85	1.00	30	0.77
80	0.99	25	0.69
75	0.99	20	0.61
70	0.98	15	0.53
65	0.97	α	k_α
60	0.95	(at least four screws required)	
55	0.94	14	0.52
50	0.92	10	0.46
45	0.91	5	0.38
40	0.89	0	0.30

Where:

- W is the reference withdrawal design value for the screw as shown in Table 7.
- Calculation of k_α :

$$35^\circ < \alpha \leq 90^\circ \quad k_\alpha = \frac{1}{1.2 \times \cos^2(\alpha) + \sin^2(\alpha)} \quad (4)$$

$$0^\circ \leq \alpha \leq 35^\circ \quad k_\alpha = 0.3 + 0.7 \times \frac{\alpha}{45} \quad (5)$$

4.1.7.2 The expected axial slip modulus (K_{axial}) between the side member and the main member at the allowable load level must be determined in accordance with Equation (6) as follows:

$$K_{axial} = 92000 \times d \times l_{ef} \quad [\text{lbs/inch}] \quad (6)$$

d : outer thread diameter [inch]

l_{ef} : minimum of the thread penetration in the wood main and side members for wood-to-wood connections. Thread

penetration in the wood main member for steel-to-wood connections [inch]

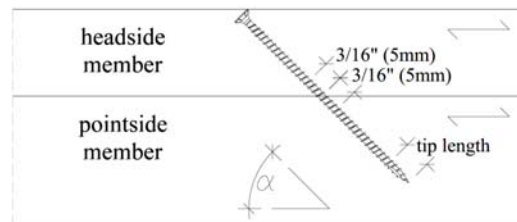
4.1.7.3 Design method: The design method applies to wood-to-wood and steel-to-wood connections where the lateral load between side and main member is transferred through the axial capacity of the screw installed at an angle $0^\circ \leq \alpha < 90^\circ$ to the wood grain. The following conditions apply:

- The connection consists of one or two side members, either wood or steel, and a wood main member.
- The conditions reported in Section 3.2 on the members made of sawn lumber, GL and CLT apply.
- For steel-to-wood connections with VGU 45° countersunk washer, VGS screws must be used and installed at 45° angle to the grain as shown in Figure 5.
- The minimum screw penetration in both the wood main and side member must be $8d_1$, measured along the axis of the screw.
- A minimum of two screws must be used in each connection.
- The minimum spacing, edge and end distance must comply with the connection geometry requirements of Table 8 and Figure 6.
- The steel thickness of the side plate used in combination with VGU 45° countersunk washer must comply with Figure 5.
- A minimum of four screws must be used in connections with screws installed at an angle less than 15 degrees between the grain direction and the screw axis.

4.1.7.4 Wood-to-wood connections:

4.1.7.4.1 Two-member connections: The allowable lateral load for a two-member connection with a wood side member and a wood main member must be determined as follows:

- Determine the length of the thread part of the screw in the side and main member.
 - o The effective length of the thread part of the screw in the headside member must consider an installation tolerance of 3/16 inch (5 mm).
 - o The effective length of the thread part of the screw in the pointside member must consider an installation tolerance of 3/16 inch (5 mm) and the screw tip, as shown in Tables 1 through 3.



- Determine the reference withdrawal design value (W_α) in the side and main member for the screw installed at angle α to the grain, where α is the angle between the grain direction and screw axis, as shown in Table 7 and according to Section 4.1.8 of this report.
- Determine the allowable withdrawal strength in the side and main member by multiplying the reference withdrawal design value (W_α) by the effective length

of the screw and using all applicable adjustment factors according to the NDS.

- The allowable axial capacity of the screw is the minimum of the allowable withdrawal strength in either the side or main member and the allowable fastener tension strength, as shown in Tables 1 through 3.
- The allowable lateral design load of the wood-to-wood connection is the minimum of the allowable axial capacity of the screw, projected along the load vector.
- For a group of axially loaded screws the allowable lateral design strength must be multiplied for the effective number of screws as follows:

$$n_{ef} = \max \{n^{0.9}; 0.9 \times n\}$$

where n is the number of screws, or the number of crossed pairs of screws.

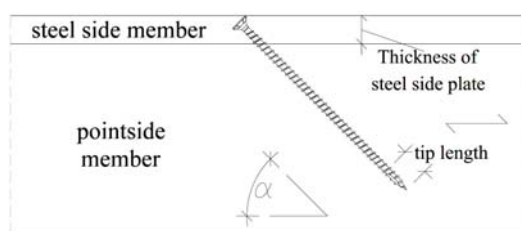
- The structural members must be checked for load-carrying capacity in accordance with Section 4.1.4.

4.1.7.4.2 Three-member connections: The allowable lateral load for a symmetrical three-member connection consisting of two identical wood side members and a wood main member is double the allowable lateral load for a two-member connection consisting of a wood side member and wood main member, determined in accordance with Section 4.1.7.3.1.

4.1.7.5 Steel-to-wood connections:

4.1.7.5.1 Two-member connections: The allowable lateral load for a two-member connection with a steel side member and a wood main member must be determined as follows:

- Determine the length of the thread part of the screw in the main member.
 - o The effective length of the thread part of the screw in the pointside member must take into account the screw tip, as shown in Tables 1 through 3, and the thickness of the steel side plate.



- o For connections with VGU 45° countersunk washer the effective length of the thread part of the VGS screw must take into account the thickness of the VGU washer, as shown in Figure 5, and the thickness of the steel side plate.
- Determine the reference withdrawal design value (W_a) in the side and main member for the screw installed at angle α to the grain, where α is the angle between the grain direction and screw axis, as shown in Table 7 and according to Section 4.1.8 of this report.
- Determine the allowable withdrawal strength in the main member by multiplying the reference withdrawal design value (W_a) by the effective length of the screw and using all applicable adjustment factors according to the NDS.

- The allowable axial capacity of the screw is the minimum of the allowable withdrawal strength in the main member and the allowable fastener tension strength, as shown in Tables 1 through 3.
- The allowable lateral design load of the steel-to-wood connection is the minimum of the allowable axial capacity of the screw, projected along the load vector.
- For a group of axially loaded screws the allowable lateral design strength must be multiplied for the effective number of screws as follows:

$$n_{ef} = \max \{n^{0.9}; 0.9 \times n\}$$

where n is the number of screws, or the number of crossed pairs of screws.

- The structural members must be checked for load-carrying capacity in accordance with Sections 4.1.3 and 4.1.4.

4.1.7.5.2 Three-member connections: The allowable lateral load for a symmetrical three-member connection consisting of two identical steel side members and a wood main member is double the allowable lateral load for a two-member connection consisting of a steel side member and wood main member, determined in accordance with Section 4.1.7.4.1 of this report.

4.2 Corrosion Resistance:

The EVO coated screws must be used in wood treated with ACQ preservative with a maximum retention of 0.40 pcf (6.4 kg/m³) and in other treated wood products that have been demonstrated to have a lower level of corrosivity. EVO coated screws can be considered as a equivalent alternative to hot-dip galvanized fasteners respecting ASTM A153 Class D. Evo coated fasteners must be limited to use in the Exposure Conditions shown in Table 10.

4.3 Installation:

Rotho Blaas self-tapping screws must be installed in accordance with the report holder's installation instructions and this report. The screws must be installed perpendicular to the face of the wood member, at angle to the grain or in the end grain, as specified in this report. Screws must be installed with the minimum spacing, end distances, and edge distances needed to prevent splitting of the wood or as noted in Table 9, whichever is more restrictive.

For TBS, TBS MAX, TBS EVO the underside of the flat screw head must bear against the surface of the wood side member. For LBS screws the underside of the flat screw head must bear against the surface of the steel plate. For HBS screws installed in combination with HUS countersunk washer, the underside of the countersunk washer must bear against the wood or steel side member with the underside of the screw head seated in the washer.

For HBS, HBS EVO, VGZ, VGZ EVO and DGZ screws, the top of the screw head must either be flush with the surface of the wood side member or recessed in the wood side member.

For wood-to-wood and steel-to-wood connections with screws installed at 45° angle to the grain, a 45° angle assembly jig is provided and recommended by the manufacturer to facilitate the installation.

Screws used in steel-to-wood connections, including VGS screws installed in combination with VGU 45° countersunk washers, must be installed in accordance with the report holder's published installation instructions.

Screws must not be overdriven. The screws must be driven into the wood members without pre-drilling or after pre-drilling. The screws must be installed by turning with a power

driver, not by driving with a hammer, using the bit provided by the report holder.

5.0 CONDITIONS OF USE

The screws described in this report comply with, or are suitable alternatives to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

- 5.1 The screws must be installed in accordance with the report holder's installation instructions and this report. In the case of a conflict between this report and the report holder's instructions, this report governs.
- 5.2 Design loads for the screws must not exceed the available strengths described in Section 4.1.
- 5.3 Calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.4 Use of fasteners in locations exposed to saltwater or saltwater spray is outside the scope of this evaluation report.
- 5.5 Use of the EVO coated screws in contact with fire-retardant-treated wood is outside the scope of this report.
- 5.6 The screws are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Dowel-type Threaded Fasteners Used in Wood (AC233), dated October 2020.
- 6.2 Data in accordance with the ICC-ES Acceptance Criteria for Corrosion-resistant Fasteners and Evaluation of Corrosion Effects of Wood Treatments (AC257), dated October 2009 (editorially revised March 2018).

7.0 IDENTIFICATION

- 7.1 The packaging for the self-tapping wood screws is labeled with the report holder name (Rotho Blaas srl), the fastener type (HBS, HBS EVO, TBS, TBS MAX, TBS EVO, VGZ, VGZ EVO, VGS, LBS and DGZ), the fastener size and length (in both inches and millimeters), the fastener thread length, head type and drive size, and the ICC-ES evaluation report number (ESR-4645). The screw head is marked with the product family type and the fastener length, apart from LBS, VGZ and DGZ screws. The packaging for the countersunk washers HUS and VGU is labeled with the report holder name (Rotho Blaas srl), the product type and the ICC-ES evaluation report number (ESR-4645). "EVO coating" is either reported on the label or in the leaflet inside the container of the self-tapping wood screws with EVO coating.

- 7.2 The report holder's contact information is the following:

ROTHO BLAAS S.R.L.
VIA DELL'ADIGE 2/1
39040 CORTACCIA (BZ)
ITALY
TEL. +39 0471 818400
www.rothoblaas.com

TABLE 1—PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS^{1,2,3}

DESIGNATION	NOMINAL DIAMETER (inch - mm)	OVERALL LENGTH ¹ , L (inches)	THREAD LENGTH ² , L _G (inches)	HEAD TYPE	HEAD DIAMETER, d _K (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER, d _S (inch)	ROOT DIAMETER, d ₂ (inch)	OUTSIDE THREAD DIAMETER, d ₁ (inch)	TIP LENGTH (inch)	SPECIFIED BENDING YIELD STRENGTH ³ F _{yb} (psi)	ALLOWABLE FASTENER TENSION STRENGTH (lbf)
HBS640	0.24 (6mm)	1 9/16	1 3/8	Countersunk CS	0.472	TX 30	0.169	0.156	0.236	0.236	200,000	1180
HBS650		1 15/16	1 3/8									
HBS660		2 3/8	1 3/16									
HBS670		2 3/4	1 9/16									
HBS680 HBSEVO680		3 1/8	1 9/16									
HBS690		3 1/2	1 15/16									
HBS6100 HBSEVO6100		4	1 15/16									
HBS6110		4 3/8	2 3/8									
HBS6120 HBSEVO6120		4 3/4	2 3/8									
HBS6130		5 1/8	2 3/8									
HBS6140 HBSEVO6140		5 1/2	2 15/16									
HBS6150		6	2 15/16									
HBS6160 HBSEVO6160		6 1/4	2 15/16									
HBS6180 HBSEVO6180		7 1/8	2 15/16									
HBS6200 HBSEVO6200		8	2 15/16									
HBS6220		8 5/8	2 15/16									
HBS6240		9 1/2	2 15/16									
HBS6260		10 1/4	2 15/16									
HBS6280		11	2 15/16									
HBS6300		11 3/4	2 15/16									
HBS880	0.32 (8mm)	3 1/8	2 1/16	Countersunk CS	0.571	TX 40	0.228	0.213	0.315	0.315	180,000	2040
HBS8100 HBSEVO8100		4	2 1/16									
HBS8120 HBSEVO8120		4 3/4	2 3/8									
HBS8140 HBSEVO8140		5 1/2	2 3/8									
HBS8160 HBSEVO8160		6 1/4	3 1/8									

TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS^{1,2,3}(Continued)

HBS8180 HBSEVO8180	0.32 (8mm)	7 1/8	3 1/8	Countersunk CS	0.571	TX 40	0.228	0.213	0.315	0.315	180,000	2040
HBS8200 HBSEVO8200		8	3 1/8									
HBS8220 HBSEVO8220		8 5/8	3 1/8									
HBS8240 HBSEVO8240		9 1/2	3 1/8									
HBS8260		10 1/4	3 1/8									
HBS8280 HBSEVO8280		11	3 1/8									
HBS8300		11 3/4	4									
HBS8320 HBSEVO8320		12 5/8	4									
HBS8340		13 3/8	4									
HBS8360		14 1/4	4									
HBS8380		15	4									
HBS8400		15 3/4	4									
HBS8440		17 1/4	4									
HBS8480		19	4									
HBS8520		20 1/2	4									
HBS1080		0.40 (10mm)	3 1/8									
HBS10100	4		2 1/16									
HBS10120	4 3/4		2 3/8									
HBS10140	5 1/2		2 3/8									
HBS10160	6 1/4		3 1/8									
HBS10180	7 1/8		3 1/8									
HBS10200	8		3 1/8									
HBS10220	8 5/8		3 1/8									
HBS10240	9 1/2		3 1/8									
HBS10260	10 1/4		3 1/8									
HBS10280	11		3 1/8									
HBS10300	11 3/4		4									
HBS10320	12 5/8		4									
HBS10340	0.40 (10mm)		13 3/8	4	Countersunk CS	0.719	TX40	0.276	0.252	0.394	0.394	185,000
HBS10360		14 1/4	4									

TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS^{1,2,3}(Continued)

HBS10380		15	4									
HBS10400		15 3/4	4									
HBS12120	0.48 (12mm)	4 3/4	3 1/8	Countersunk CS	0.817	TX 50	0.315	0.268	0.472	0.472	190,000	3060
HBS12160		6 1/4	3 1/8									
HBS12200		8	3 1/8									
HBS12240		9 1/2	3 1/8									
HBS12280		11	3 1/8									
HBS12320		12 5/8	4 3/4									
HBS12360		14 1/4	4 3/4									
HBS12400		15 3/4	4 3/4									
HBS12440		17 1/4	4 3/4									
HBS12480		19	4 3/4									
HBS12520		20 1/2	4 3/4									
HBS12560		22	4 3/4									
HBS12600		23 5/8	4 3/4									
TBS660 TBSEVO660		0.24 (6mm)	2 3/8									
TBS670	2 3/4		1 9/16									
TBS680 TBSEVO680	3 1/8		1 15/16									
TBS690	3 1/2		1 15/16									
TBS6100 TBSEVO6100	4		2 3/8									
TBS6120 TBSEVO6120	4 3/4		2 15/16									
TBS6140 TBSEVO6140	5 1/2		2 15/16									
TBS6160 TBSEVO6160	6 1/4		2 15/16									
TBS6180 TBSEVO6180	7 1/8		2 15/16									
TBS6200 TBSEVO6200	8		2 15/16									
TBS6220	0.24 (6mm)	8 5/8	4	Large washer head LW	0.610	TX 30	0.169	0.156	0.236	0.236	200,000	1180
TBS6240		9 1/2	4									
TBS6260		10 1/4	4									
TBS6280		11	4									

TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS^{1,2,3}(Continued)

TBS6300		11 3/4	4									
TBS840	0.32 (8mm)	1 9/16	1 1/4	Large washer head LW	0.748	TX 40	0.228	0.213	0.315	0.315	180,000	2040
TBS860		2 3/8	2 1/16									
TBS880		3 1/8	2 1/16									
TBS8100 TBSEVO8100		4	2 1/16									
TBS8120 TBSEVO8120		4 3/4	3 1/8									
TBS8140 TBSEVO8140		5 1/2	3 1/8									
TBS8160 TBSEVO8160		6 1/4	4									
TBS8180 TBSEVO8180		7 1/8	4									
TBS8200 TBSEVO8200		8	4									
TBS8220 TBSEVO8220		8 5/8	4									
TBS8240 TBSEVO8240		9 1/2	4									
TBS8260		10 1/4	4									
TBS8280		11	4									
TBS8300		11 3/4	4									
TBS8320		12 5/8	4									
TBS8340		13 3/8	4									
TBS8360		14 1/4	4									
TBS8380		15	4									
TBS8400		15 3/4	4									
TBS8440		17 1/4	4									
TBS8480		19	4									
TBS8520		20 1/2	4									
TBSMAX8200	0.32 (8mm)	8	4 3/4	Large washer head LW	0.965	TX 40	0.228	0.213	0.315	0.315	180,000	2040
TBSMAX8220		8 5/8	4 3/4									
TBSMAX8240		9 1/2	4 3/4									
TBS10100	0.40 (10mm)	4	2 1/16	Large washer head LW	0.984	TX 50	0.276	0.252	0.394	0.394	185,000	2700
TBS10120		4 3/4	2 3/8									
TBS10140		5 1/2	2 3/8									

TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS^{1,2,3}(Continued)

TBS10160		6 1/4	3 1/8									
TBS10180		7 1/8	3 1/8									
TBS10200		8	4									
TBS10220		8 5/8	4									
TBS10240		9 1/2	4									
TBS10260		10 1/4	4									
TBS10280		11	4									
TBS10300		11 3/4	4									
TBS10320		12 5/8	4 3/4									
TBS10340		13 3/8	4 3/4									
TBS10360		14 1/4	4 3/4									
TBS10380		15	4 3/4									
TBS10400		15 3/4	4 3/4									
TBS10440		17 1/4	4 3/4									
TBS10480		19	4 3/4									
TBS10520		20 1/2	4 3/4									

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

¹For TBS, TBS MAX and TBS EVO screws the overall length is measured from the underside of the large washer head to the screw tip. For HBS and HBS EVO screws the overall length is measured from the top of the head to the screw tip.

²Length of thread includes tip.

³Bending yield strength determined in accordance with ASTM F1575 using the root diameter, d₂.

TABLE 2— FULLY THREADED FASTENERS DIMENSIONS AND STRENGTH

DESIGNATION	NOMINAL DIAMETER (inch - mm)	OVERALL LENGTH ¹ , L (inches)	THREAD LENGTH ² , L ₆ (inches)	HEAD TYPE	HEAD DIAMETER, d _k (inch)	DRIVE TYPE AND SIZE	ROOT DIAMETER, d ₂ (inch)	OUTSIDE THREAD DIAMETER, d ₁ (inch)	TIP LENGTH (inch)	SPECIFIED BENDING YIELD STRENGTH ³ F _y b (psi)	ALLOWABLE FASTENER TENSION STRENGTH (lbf)
LBS525	0.20 (5mm)	1	13/16	Round head with cylindrical underhead RU	0.307	TX 20	0.118	0.197	0.197	180,000	740
LBS540		1 9/16	1 7/16								
LBS550		1 15/16	1 13/16								
LBS560		2 3/8	2 3/16								
LBS570		2 3/4	2 5/8								
LBS760	0.28 (7mm)	2 3/8	2 3/16	Round head with cylindrical underhead RU	0.433	TX 30	0.173	0.276	0.276	192,000	1600
LBS780		3 1/8	2 15/16								
LBS7100		4	3 3/4								
VGZ580 VGZEVO580	0.21 (5.3mm)	3 1/8	2 3/4	Cylindrical head CY	0.315	TX25	0.142	0.209	0.209	168,000	1000
VGZ5100 VGZEVO5100		4	3 1/2								
VGZ5120 VGZEVO5120		4 3/4	4 3/8								
VGZ5140 VGZEVO5140	0.23 (5.6mm)	5 1/2	5 1/8	Cylindrical head CY	0.315	TX25	0.150	0.220	0.220	168,000	1100
VGZ5160 VGZEVO5160		6 1/4	6								
VGZ780		3 1/8	2 3/4								
VGZ7100	0.28 (7mm)	4	3 1/2	Cylindrical head CY	0.374	TX30	0.181	0.276	0.276	195,000	1450
VGZ7120		4 3/4	4 3/8								
VGZ7140 VGZEVO7140		5 1/2	5 1/8								
VGZ7160		6 1/4	6								
VGZ7180 VGZEVO7180		7 1/8	6 3/4								
VGZ7200		8	7 1/2								
VGZ7220 VGZEVO7220		8 5/8	8 1/4								
VGZ7240		9 1/2	9 1/16								
VGZ7260 VGZEVO7260		10 1/4	10								
VGZ7280		11	10 5/8								

TABLE 2— FULLY THREADED FASTENERS DIMENSIONS AND STRENGTH (Continued)

VGZ7300 VGZEVO7300	0.28 (7mm)	11 3/4	11 7/16	Cylindrical head CY	0.374	TX30	0.181	0.276	0.276	195,000	1450
VGZ7340		13 3/8	13								
VGZ7380		15	14 9/16								
VGZ9160	0.36 (9mm)	6 1/4	6	Cylindrical head CY	0.453	TX40	0.232	0.354	0.354	180,000	2450
VGZ9180		7 1/8	6 3/4								
VGZ9200 VGZEVO9200		8	7 1/2								
VGZ9220		8 5/8	8 1/4								
VGZ9240 VGZEVO9240		9 1/2	9 1/16								
VGZ9260		10 1/4	10								
VGZ9280 VGZEVO9280		11	10 5/8								
VGZ9300		11 3/4	11 7/16								
VGZ9320 VGZEVO9320		12 5/8	12 3/16								
VGZ9340		13 3/8	13								
VGZ9360 VGZEVO9360		14 1/4	13 3/4								
VGZ9380		15	14 9/16								
VGZ9400		15 3/4	15 3/8								
VGZ9440		17 1/4	16 15/16								
VGZ9480		19	18 1/2								
VGZ9520		20 1/2	20 1/16								
VGZ11250	0.44 (11mm)	10	9 1/2	Cylindrical head CY	0.531	TX50	0.260	0.433	0.433	170,000	3200
VGZ11300		11 3/4	11 7/16								
VGZ11350		13 3/4	13 3/8								
VGZ11400		15 3/4	15 3/8								
VGZ11450		17 3/4	17 1/4								
VGZ11500		19 3/4	19 5/16								
VGZ11550		21 5/8	21 1/4								
VGZ11600		23 5/8	23 1/4								
VGS9100	0.36 (9mm)	4	3 1/2	Countersunk head CS	0.630	TX40	0.232	0.354	0.354	180,000	2450
VGS9120		4 3/4	4 3/8								

TABLE 2— FULLY THREADED FASTENERS DIMENSIONS AND STRENGTH (Continued)

VGS9140	0.36 (9mm)	5 1/2	5 1/8	Countersunk head CS	0.630	TX40	0.232	0.354	0.354	180,000	2450
VGS9160		6 1/4	6								
VGS9180		7 1/8	6 3/4								
VGS9200		8	7 1/2								
VGS9220		8 5/8	8 1/4								
VGS9240		9 1/2	9 1/16								
VGS9260		10 1/4	10								
VGS9280		11	10 5/8								
VGS9300		11 3/4	11 7/16								
VGS9320		12 5/8	12 3/16								
VGS9340		13 3/8	13								
VGS9360		14 1/4	13 3/4								
VGS9380		15	14 9/16								
VGS9400		15 3/4	15 3/8								
VGS9440		17 1/4	16 15/16								
VGS9480		19	18 1/2								
VGS9520		20 1/2	20 1/16								
VGS11100		0.44 (11mm)	4								
VGS11125	4 15/16		4 1/2								
VGS11150	6		5 1/2								
VGS11175	6 7/8		6 1/2								
VGS11200	8		7 1/2								
VGS11225	8 7/8		8 7/16								
VGS11250	10		9 1/2								
VGS11275	10 7/8		10 7/16								
VGS11300	11 3/4		11 7/16								
VGS11325	12 3/4		12 3/8								
VGS11350	13 3/4		13 3/8								
VGS11375	14 3/4		14 3/8								
VGS11400	15 3/4		15 3/8								

TABLE 2— FULLY THREADED FASTENERS DIMENSIONS AND STRENGTH (Continued)

VGS11450		17 3/4	17 1/4								
VGS11500	0.44 (11mm)	19 3/4	19 5/16	Countersunk head CS	0.760	TX50	0.260	0.433	0.433	170,000	3200
VGS11550		21 5/8	21 1/4								
VGS11600		23 5/8	23 1/4								
VGS11700		27 1/2	27 3/16	Hexagonal star drive head EXA							
VGS11800		31 1/2	31 1/8								
VGS13100	0.52 (13mm)	4	3 1/2	Countersunk head CS	0.866	TX50	0.315	0.512	0.512	161,000	4400
VGS13150		6	5 1/2								
VGS13200		8	7 1/2								
VGS13300		11 3/4	11								
VGS13400		15 3/4	15								
VGS13500		19 3/4	19								
VGS13600		23 5/8	22 13/16	Hexagonal star drive head EXA							
VGS13700		27 1/2	26 3/4								
VGS13800		31 1/2	30 11/16								
VGS13900		35 1/2	34 5/8								
VGS131000		39 3/8	38 9/16								
VGS131100		43 5/16	42 1/2								
VGS131200		47 1/4	46 7/16								

For **SI**: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

¹For LBS screws, VGZ and VGS screws with hexagonal star drive head the overall length is measured from the underside of the head to the screw tip. For VGZ screws with cylindrical head, VGZ EVO screws and VGS screws with countersunk head the overall length is measured from the top of the head to the screw tip.

²Length of thread L_{G1} includes tip.

³Bending yield strength determined in accordance with ASTM F1575 using the root diameter, d_2 .

TABLE 3— DOUBLE THREADED FASTENERS DIMENSIONS AND STRENGTH

DESIGNATION	NOMINAL DIAMETER (inch - mm)	OVERALL LENGTH ¹ , L (inches)	THREAD LENGTH ² , L _{G1} - L _{G2} (inches)	HEAD TYPE	HEAD DIAMETER d _K (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER d _S (inch)	ROOT DIAMETER d ₂ (inch)	OUTSIDE THREAD DIAMETER, d ₁ (inch)	TIP LENGTH (inch)	SPECIFIED BENDING YIELD STRENGTH ³ F _{yb} (psi)	ALLOWABLE FASTENER TENSION STRENGTH (lbf)
DGZ7220	0.28 (7mm)	8 5/8	4 – 2 3/8	Cylindrical head CY	0.374	TX30	0.197	0.181	0.276	0.276	195,000	1750
DGZ7260		10 1/4	4 – 2 3/8									
DGZ7300		11 3/4	4 – 2 3/8									
DGZ7340		13 3/8	4 – 2 3/8									
DGZ7380		15	4 – 2 3/8									
DGZ9240	0.36 (9mm)	9 1/2	4 – 2 3/8	Cylindrical head CY	0.453	TX40	0.256	0.232	0.354	0.354	180,000	2900
DGZ9280		11	4 – 2 3/8									
DGZ9320		12 5/8	4 – 2 3/8									
DGZ9360		14 1/4	4 – 2 3/8									
DGZ9400		15 3/4	4 – 2 3/8									
DGZ9440		17 1/4	4 – 2 3/8									
DGZ9480		19	4 – 2 3/8									
DGZ9520		20 1/2	4 – 2 3/8									

For SI: 1 inch = 25.4 mm, 1 psi = 6.89 kPa, 1 lbf = 4.45 N.

¹The overall length is measured from the top of the head to the screw tip.
²Length of thread L_{G1} includes tip. Length of thread L_{G2} is located towards the fastener head as shown in Figure 3.
³Bending yield strength determined in accordance with ASTM F1575 using the root diameter, d₂.

TABLE 4—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED FASTENERS^{1,2,3,4}

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS t_s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			$Z_{ }$	$Z_{L }$	$Z_{\perp}$	$Z_{ }$	$Z_{L }$	$Z_{\perp}$	$Z_{ }$	$Z_{L }$	$Z_{\perp}$	$Z_{ }$	$Z_{L }$	$Z_{\perp}$
HBS650	1 15/16	3/8	64	64	64	89	89	89	118	118	118	146	146	146
HBS660	2 3/8	3/4	86	86	86	120	120	120	142	142	142	163	163	163
HBS670	2 3/4	1	97	97	97	129	129	129	156	156	156	182	182	182
HBS680 HBSEVO680	3 1/8	1 1/2	107	107	107	149	149	149	190	190	190	211	211	211
HBS690	3 1/2	1 1/2	120	120	120	154	154	154	190	190	190	211	211	211
HBS6100 HBSEVO6100	4	1 3/4	129	129	129	165	165	165	190	190	190	211	211	211
HBS6110	4 3/8	1 3/4	129	129	129	165	165	165	190	190	190	211	211	211
HBS6120 HBSEVO6120	4 3/4	2	139	139	139	165	165	165	190	190	190	211	211	211
HBS6130	5 1/8	2 1/2	139	139	139	165	165	165	190	190	190	211	211	211
HBS6140 HBSEVO6140	5 1/2	2 1/2	139	139	139	165	165	165	190	190	190	211	211	211
HBS6150	6	2 3/4	139	139	139	165	165	165	190	190	190	211	211	211
HBS6160 HBSEVO6160	6 1/4	3 1/4	139	139	139	165	165	165	190	190	190	211	211	211
HBS6180 HBSEVO6180	7 1/8	4	139	139	139	165	165	165	190	190	190	211	211	211
HBS6200 HBSEVO6200	8	4 3/4	139	139	139	165	165	165	190	190	190	211	211	211
HBS6220	8 5/8	5 1/2	139	139	139	165	165	165	190	190	190	211	211	211
HBS6240	9 1/2	6 1/4	139	139	139	165	165	165	190	190	190	211	211	211
HBS6260	10 1/4	7	139	139	139	165	165	165	190	190	190	211	211	211
HBS6280	11	8	139	139	139	165	165	165	190	190	190	211	211	211
HBS6300	11 3/4	8 3/4	139	139	139	165	165	165	190	190	190	211	211	211
HBS880	3 1/8	1	132	105	105	179	143	143	213	170	170	244	195	195
HBS8100 HBSEVO8100	4	1 3/4	153	123	123	214	171	171	270	216	216	313	251	251
HBS8120 HBSEVO8120	4 3/4	2 1/4	184	147	147	245	196	196	282	225	225	313	251	251
HBS8140 HBSEVO8140	5 1/2	3	196	157	157	245	196	196	282	225	225	313	251	251
HBS8160 HBSEVO8160	6 1/4	3	207	165	165	245	196	196	282	225	225	313	251	251
HBS8180 HBSEVO8180	7 1/8	3 3/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8200 HBSEVO8200	8	4 1/2	207	165	165	245	196	196	282	225	225	313	251	251
HBS8220 HBSEVO8220	8 5/8	5 1/2	207	165	165	245	196	196	282	225	225	313	251	251
HBS8240 HBSEVO8240	9 1/2	6 1/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8260	10 1/4	7	207	165	165	245	196	196	282	225	225	313	251	251
HBS8280 HBSEVO8280	11	7 3/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8300	11 3/4	7 3/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8320 HBSEVO8320	12 5/8	8 1/2	207	165	165	245	196	196	282	225	225	313	251	251
HBS8340	13 3/8	9 1/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8360	14 1/4	10	207	165	165	245	196	196	282	225	225	313	251	251
HBS8380	15	11	207	165	165	245	196	196	282	225	225	313	251	251

TABLE 4—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			Z	Z _{L/}	Z _⊥	Z	Z _{L/}	Z _⊥	Z	Z _{L/}	Z _⊥	Z	Z _{L/}	Z _⊥
BS8400	15 3/4	11 1/2	207	165	165	245	196	196	282	225	225	313	251	251
HBS8440	17 1/4	13 1/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8480	19	14 3/4	207	165	165	245	196	196	282	225	225	313	251	251
HBS8520	20 1/2	16 1/2	207	165	165	245	196	196	282	225	225	313	251	251
HBS1080	3 1/8	1/2	123	67	67	148	87	87	173	109	109	194	129	129
HBS10100	4	1	222	134	134	247	174	166	270	198	188	290	216	207
HBS10120	4 3/4	2 1/8	258	176	140	310	218	182	361	258	228	387	292	269
HBS10140	5 1/2	2 3/4	302	199	164	338	249	213	365	274	259	387	295	282
HBS10160	6 1/4	3	308	220	188	338	249	232	365	274	259	387	295	282
HBS10180	7 1/8	3 3/4	308	222	203	338	249	232	365	274	259	387	295	282
HBS10200	8	4 1/2	308	222	203	338	249	232	365	274	259	387	295	282
HBS10220	8 5/8	5 1/2	308	222	203	338	249	232	365	274	259	387	295	282
HBS10240	9 1/2	6 1/4	308	222	203	338	249	232	365	274	259	387	295	282
HBS10260	10 1/4	7	308	222	203	338	249	232	365	274	259	387	295	282
HBS10280	11	7 3/4	308	222	203	338	249	232	365	274	259	387	295	282
HBS10300	11 3/4	7 3/4	308	222	203	338	249	232	365	274	259	387	295	282
HBS10320	12 5/8	8 1/2	308	222	203	338	249	232	365	274	259	387	295	282
HBS10340	13 3/8	9 1/4	308	222	203	338	249	232	365	274	259	387	295	282
HBS10360	14 1/4	10	308	222	203	338	249	232	365	274	259	387	295	282
HBS10380	15	11	308	222	203	338	249	232	365	274	259	387	295	282
HBS10400	15 3/4	11 1/2	308	222	203	338	249	232	365	274	259	387	295	282
HBS12120	4 3/4	1 1/2	273	183	155	308	211	197	342	240	228	372	266	255
HBS12160	6 1/4	3	353	235	192	387	282	250	418	311	292	442	334	317
HBS12200	8	4 1/2	353	251	226	387	282	261	418	311	292	442	334	317
HBS12240	9 1/2	6 1/4	353	251	218	387	282	261	418	311	292	442	334	317
HBS12280	11	7 3/4	353	251	221	387	282	261	418	311	292	442	334	317
HBS12320	12 5/8	7 3/4	353	251	229	387	282	261	418	311	292	442	334	317
HBS12360	14 1/4	9 1/4	353	251	229	387	282	261	418	311	292	442	334	317
HBS12400	15 3/4	11	353	251	229	387	282	261	418	311	292	442	334	317
HBS12440	17 1/4	12 1/2	353	251	229	387	282	261	418	311	292	442	334	317
HBS12480	19	14	353	251	229	387	282	261	418	311	292	442	334	317
HBS12520	20 1/2	15 1/2	353	251	229	387	282	261	418	311	292	442	334	317
HBS12560	22	17	353	251	229	387	282	261	418	311	292	442	334	317
HBS12600	23 5/8	18 1/2	353	251	229	387	282	261	418	311	292	442	334	317
TBS660 TBSEVO660	2 3/8	1/2	85	85	85	116	116	116	135	135	135	151	151	151
TBS670	2 3/4	1	99	99	99	129	129	129	156	156	156	182	182	182
TBS680 TBSEVO680	3 1/8	1	104	104	104	129	129	129	156	156	156	182	182	182
TBS690	3 1/2	1 1/4	111	111	111	140	140	140	174	174	174	206	206	206
TBS6100 TBSEVO6100	4	1 1/4	111	111	111	140	140	140	174	174	174	206	206	206

TABLE 4—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥
TBS6120 TBSEVO6120	4 3/4	1 1/2	120	120	120	154	154	154	190	190	190	211	211	211
TBS6140 TBSEVO6140	5 1/2	2 1/4	139	139	139	165	165	165	190	190	190	211	211	211
TBS6160 TBSEVO6160	6 1/4	3 1/4	139	139	139	165	165	165	190	190	190	211	211	211
TBS6180 TBSEVO6180	7 1/8	4	139	139	139	165	165	165	190	190	190	211	211	211
TBS6200 TBSEVO6200	8	4 3/4	139	139	139	165	165	165	190	190	190	211	211	211
TBS6220	8 5/8	4 1/2	139	139	139	165	165	165	190	190	190	211	211	211
TBS6240	9 1/2	5 1/4	139	139	139	165	165	165	190	190	190	211	211	211
TBS6260	10 1/4	6	139	139	139	165	165	165	190	190	190	211	211	211
TBS6280	11	7	139	139	139	165	165	165	190	190	190	211	211	211
TBS6300	11 3/4	7 3/4	139	139	139	165	165	165	190	190	190	211	211	211
TBS860	2 3/8	1/8	24	19	19	34	27	27	45	36	36	56	45	45
TBS880	3 1/8	1	135	108	108	179	143	143	213	170	170	244	195	195
TBS8100 TBSEVO8100	4	1 3/4	155	124	124	216	173	173	270	216	216	313	251	251
TBS8120 TBSEVO8120	4 3/4	1 1/4	153	122	122	189	151	151	228	183	183	266	213	213
TBS8140 TBSEVO8140	5 1/2	2 1/4	191	153	153	245	196	196	282	225	225	313	251	251
TBS8160 TBSEVO8160	6 1/4	2 1/4	191	153	153	245	196	196	282	225	225	313	251	251
TBS8180 TBSEVO8180	7 1/8	3	207	165	165	245	196	196	282	225	225	313	251	251
TBS8200 TBSEVO8200	8	3 3/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8220 TBSEVO8220	8 5/8	4 1/2	207	165	165	245	196	196	282	225	225	313	251	251
TBS8240 TBSEVO8240	9 1/2	5 1/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8260	10 1/4	6	207	165	165	245	196	196	282	225	225	313	251	251
TBS8280	11	6 7/8	207	165	165	245	196	196	282	225	225	313	251	251
TBS8300	11 3/4	7 3/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8320	12 5/8	8 1/2	207	165	165	245	196	196	282	225	225	313	251	251
TBS8340	13 3/8	9 1/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8360	14 1/4	10 1/8	207	165	165	245	196	196	282	225	225	313	251	251
TBS8380	15	10 7/8	207	165	165	245	196	196	282	225	225	313	251	251
TBS8400	15 3/4	11 1/2	207	165	165	245	196	196	282	225	225	313	251	251
TBS8440	17 1/4	13 1/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8480	19	14 3/4	207	165	165	245	196	196	282	225	225	313	251	251
TBS8520	20 1/2	16 1/4	207	165	165	245	196	196	282	225	225	313	251	251
TBSMAX8200	8	3	207	165	165	245	196	196	282	225	225	313	251	251
TBSMAX8220	8 5/8	3 3/4	207	165	165	245	196	196	282	225	225	313	251	251
TBSMAX8240	9 1/2	4 1/2	207	165	165	245	196	196	282	225	225	313	251	251
TBS10100	4	1 1/4	231	159	128	260	182	167	287	206	197	311	227	219
TBS10120	4 3/4	2	264	178	143	317	213	186	361	249	233	387	281	272
TBS10140	5 1/2	2 3/4	306	202	165	338	249	215	365	274	259	387	295	282

TABLE 4—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t_s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$
TBS10160	6 1/4	3	308	220	190	338	249	232	365	274	259	387	295	282
TBS10180	7 1/8	3 3/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10200	8	3 3/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10220	8 5/8	4 1/2	308	222	203	338	249	232	365	274	259	387	295	282
TBS10240	9 1/2	5 1/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10260	10 1/4	6	308	222	203	338	249	232	365	274	259	387	295	282
TBS10280	11	6 7/8	308	222	203	338	249	232	365	274	259	387	295	282
TBS10300	11 3/4	7 3/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10320	12 5/8	7 3/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10340	13 3/8	8 1/2	308	222	203	338	249	232	365	274	259	387	295	282
TBS10360	14 1/4	9 1/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10380	15	10	308	222	203	338	249	232	365	274	259	387	295	282
TBS10400	15 3/4	10 7/8	308	222	203	338	249	232	365	274	259	387	295	282
TBS10440	17 1/4	12 1/4	308	222	203	338	249	232	365	274	259	387	295	282
TBS10480	19	14	308	222	203	338	249	232	365	274	259	387	295	282
TBS10520	20 1/2	15 1/2	308	222	203	338	249	232	365	274	259	387	295	282

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.45 N.

¹ 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.

² Tabulated reference lateral design values are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

- $Z_{||}$ both side and main members loaded parallel to the grain.
- $Z_{\perp||}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.
- $Z_{\perp}$ both side and main members loaded perpendicular to the grain.

³ The wood main member thickness must be equal to or greater than the screw length less the thickness of the wood side member.

⁴ The tabulated lateral design values are based on both wood members having the same specific gravity.

TABLE 5—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH FULLY THREADED FASTENERS^{1,2,3,4}

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t_s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$
VGZ580 VGZEVO580	3 1/8	1 1/2	98	98	98	125	125	125	144	144	144	161	161	161
VGZ5100 VGZEVO5100	4	2	106	106	106	125	125	125	144	144	144	161	161	161
VGZ5120 VGZEVO5120	4 3/4	2 1/4	106	106	106	125	125	125	144	144	144	161	161	161
VGZ5140 VGZEVO5140	5 1/2	2 3/4	118	118	118	140	140	140	161	161	161	179	179	179
VGZ5160 VGZEVO5160	6 1/4	3	118	118	118	140	140	140	161	161	161	179	179	179
VGZ780	3 1/8	1 1/4	120	96	96	168	135	135	206	165	165	242	194	194
VGZ7100	4	2	149	119	119	202	161	161	242	193	193	269	215	215
VGZ7120	4 3/4	2 1/4	176	141	141	210	168	168	242	193	193	269	215	215
VGZ7140 VGZEVO7140	5 1/2	2 3/4	177	142	142	210	168	168	242	193	193	269	215	215

TABLE 5—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH FULLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥
VGZ7160	6 1/4	3	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7180 VGZEVO7180	7 1/8	3 1/2	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7200	8	4	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7220 VGZEVO7220	8 5/8	4 1/4	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7240	9 1/2	4 3/4	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7260 VGZEVO7260	10 1/4	5	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7280	11	5 1/2	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7300 VGZEVO7300	11 3/4	6	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7340	13 3/8	6 3/4	177	142	142	210	168	168	242	193	193	269	215	215
VGZ7380	15	7 1/4	177	142	142	210	168	168	242	193	193	269	215	215
VGZ9160	6 1/4	3	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9180	7 1/8	3 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9200 VGZEVO9200	8	4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9220	8 5/8	4 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9240 VGZEVO9240	9 1/2	4 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9260	10 1/4	5	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9280 VGZEVO9280	11	5 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9300	11 3/4	6	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9320 VGZEVO9320	12 5/8	6 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9340	13 3/8	6 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9360 VGZEVO9360	14 1/4	7	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9380	15	7 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9400	15 3/4	7 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9440	17 1/4	8 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9480	19	9 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGZ9520	20 1/2	10 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGZ11250	10	5	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11300	11 3/4	6	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11350	13 3/4	6 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11400	15 3/4	7 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11450	17 3/4	8 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11500	19 3/4	9 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11550	21 5/8	10 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGZ11600	23 5/8	11 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS9100	4	1 1/2	159	128	128	216	173	173	264	211	211	309	247	247
VGS9120	4 3/4	2 1/4	186	149	149	261	209	209	313	250	250	348	278	278
VGS9140	5 1/2	2 3/4	219	175	175	272	217	217	313	250	250	348	278	278
VGS9160	6 1/4	3	230	184	184	272	217	217	313	250	250	348	278	278

TABLE 5—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH FULLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t _s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥	Z	Z _L	Z _⊥
VGS9180	7 1/8	3 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGS9200	8	4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9220	8 5/8	4 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9240	9 1/2	4 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9260	10 1/4	5	230	184	184	272	217	217	313	250	250	348	278	278
VGS9280	11	5 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGS9300	11 3/4	6	230	184	184	272	217	217	313	250	250	348	278	278
VGS9320	12 5/8	6 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9340	13 3/8	6 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9360	14 1/4	7	230	184	184	272	217	217	313	250	250	348	278	278
VGS9380	15	7 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9400	15 3/4	7 3/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS9440	17 1/4	8 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGS9480	19	9 1/2	230	184	184	272	217	217	313	250	250	348	278	278
VGS9520	20 1/2	10 1/4	230	184	184	272	217	217	313	250	250	348	278	278
VGS11100	4	1	227	136	136	252	177	168	276	201	190	297	219	210
VGS11125	4 15/16	2	281	181	150	327	216	195	370	253	242	394	286	276
VGS11150	6	3	314	217	178	344	252	232	372	278	262	394	299	285
VGS11175	6 7/8	3 1/2	314	225	205	344	252	234	372	278	262	394	299	285
VGS11200	8	4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11225	8 7/8	4 1/2	314	225	205	344	252	234	372	278	262	394	299	285
VGS11250	10	5	314	225	205	344	252	234	372	278	262	394	299	285
VGS11275	10 7/8	5 1/2	314	225	205	344	252	234	372	278	262	394	299	285
VGS11300	11 3/4	6	314	225	205	344	252	234	372	278	262	394	299	285
VGS11325	12 3/4	6 1/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11350	13 3/4	6 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11375	14 3/4	7 1/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11400	15 3/4	7 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11450	17 3/4	8 1/2	314	225	205	344	252	234	372	278	262	394	299	285
VGS11500	19 3/4	9 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11550	21 5/8	10 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11600	23 5/8	11 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11700	27 1/2	13 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS11800	31 1/2	15 3/4	314	225	205	344	252	234	372	278	262	394	299	285
VGS13100	4	1/2	154	75	75	185	97	97	216	122	122	243	144	144
VGS13150	6	2 1/2	406	251	196	484	300	256	532	352	320	564	398	378
VGS13200	8	4	450	312	262	493	351	319	532	387	357	564	416	388
VGS13300	11 3/4	6	450	312	280	493	351	319	532	387	357	564	416	388
VGS13400	15 3/4	7 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS13500	19 3/4	9 3/4	450	312	280	493	351	319	532	387	357	564	416	388

TABLE 5—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH FULLY THREADED FASTENERS^{1,2,3,4} (Continued)

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS, t_s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:											
			0.35			0.42			0.49			0.55		
			$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp }$	$Z_{\perp}$
VGS13600	23 5/8	11 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS13700	27 1/2	13 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS13800	31 1/2	15 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS13900	35 1/2	17 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS131000	39 3/8	19 3/4	450	312	280	493	351	319	532	387	357	564	416	388
VGS131100	43 5/16	21 1/2	450	312	280	493	351	319	532	387	357	564	416	388
VGS131200	47 1/4	23 1/2	450	312	280	493	351	319	532	387	357	564	416	388

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.45 N.

¹ 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.

² Tabulated reference lateral design values are applicable to screws installed perpendicular to the faces of the wood members and loaded as follows:

- $Z_{||}$ both side and main members loaded parallel to the grain.
- $Z_{\perp||}$ side member loaded perpendicular to the grain; main member loaded parallel to the grain.
- $Z_{\perp}$ both side and main members loaded perpendicular to the grain.

³ The wood main member thickness must be equal to or greater than the screw length less the thickness of the wood side member.

⁴ The tabulated lateral design values are based on both wood members having the same specific gravity.

TABLE 6—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER STEEL-TO-WOOD CONNECTIONS^{1,2,3,4}

FASTENER DESIGNATION	OVERALL SCREW LENGTH, L (inches)	STEEL SIDE MEMBER THICKNESS, t_s (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (G) OF:							
			0.35		0.42		0.49		0.55	
			$Z_{ }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp}$	$Z_{ }$	$Z_{\perp}$
LBS540	1 9/16	1/8	85	85	110	110	124	124	136	136
LBS550	1 15/16	1/8	94	94	110	110	124	124	136	136
LBS560	2 3/8	1/8	94	94	110	110	124	124	136	136
LBS570	2 3/4	1/8	94	94	110	110	124	124	136	136
LBS760	2 3/8	1/8	172	138	212	170	241	193	265	212
LBS780	3 1/8	1/8	182	145	212	170	241	193	265	212
LBS7100	4	1/8	182	145	212	170	241	193	265	212
LBS540	1 9/16	1/4	89	89	115	115	143	143	158	158
LBS550	1 15/16	1/4	105	105	125	125	143	143	158	158
LBS560	2 3/8	1/4	106	106	125	125	143	143	158	158
LBS570	2 3/4	1/4	106	106	125	125	143	143	158	158
LBS760	2 3/8	1/4	202	161	262	209	309	247	338	271
LBS780	3 1/8	1/4	233	186	273	219	309	247	338	271
LBS7100	4	1/4	233	186	273	219	309	247	338	271

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.45 N.

¹ The steel side member must meet the requirements of Section 3.3 of this report.

² 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.

³ Tabulated reference lateral design values are applicable to screws installed perpendicular to the face of the wood members and loaded as follows:

- $Z_{||}$ main member loaded parallel to the grain.
- $Z_{\perp}$ main member loaded perpendicular to the grain.

³ The wood main member thickness must be equal to or greater than the screw length less the thickness of the steel side member.

⁴ The tabulated lateral design values are based on both wood members having the same specific gravity.

TABLE 7—REFERENCE WITHDRAWAL DESIGN VALUES (W) FOR INSTALLATION INTO THE FACE OF THE WOOD MEMBER^{1,2,3,4}

FASTENER DESIGNATION	NOMINAL DIAMETER (inch - mm)	REFERENCE WITHDRAWAL DESIGN VALUE, W (lbf/in) FOR SPECIFIC GRAVITY (G) OF:			
		0.35	0.42	0.49	0.55
HBS / HBS EVO / TBS	0.24 (6mm)	77	89	131	143
HBS / HBS EVO / TBS / TBS EVO / TBS MAX	0.32 (8mm)	109	125	138	174
HBS / TBS	0.40 (10mm)	140	161	188	205
HBS / TBS	0.48 (12mm)	206	236	266	290
VGZ / VGZ EVO	0.21 (5.3mm)	102	118	132	145
VGZ / VGZ EVO	0.23 (5.6mm)	107	123	139	152
VGZ / VGZ EVO / DGZ	0.28 (7mm)	129	148	166	182
VGZ / VGZ EVO / VGS / DGZ	0.36 (9mm)	129	149	173	189
VGZ / VGS	0.44 (11mm)	148	171	192	210
VGS	0.52 (13mm)	208	239	270	294
LBS	0.20 (5mm)	99	114	128	140
LBS	0.28 (7mm)	115	132	149	162

For **SI**: 1 inch = 25.4 mm, 1 lbf/in = 175N/m; 1 lbf = 4.45 N.

¹ 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.

² Tabulated values are applicable to screws installed at an angle of 90° to the grain. The calculation of the reference withdrawal design values (W_{α}) for screws installed at an angle to the grain between 0 and 90° can be found in Section 4.1.8 of this report.

³ The tabulated reference withdrawal design value is in pounds-force per inch of thread embedment into the main member.

⁴ Embedded thread length is that portion of the screw held in the main member including the screw tip. The minimum embedded thread length is $6d_1$, where d_1 is the outside thread diameter.

TABLE 8—REFERENCE PULL THROUGH DESIGN VALUES (W_H)^{1,2,3,4}

FASTENER DESIGNATION	NOMINAL DIAMETER (inch - mm)	HEAD DIAMETER (inch)	MINIMUM SIDE MEMBER THICKNESS (inches)	REFERENCE PULL-THROUGH DESIGN VALUE, W_H (lbf) FOR SPECIFIC GRAVITY (G) OF:			
				0.35	0.42	0.49	0.55
TBS - TBS EVO	0.24 (6mm)	0.610	1 1/2	125	144	162	177
TBS - TBS EVO	0.32 (8mm)	0.748	1 1/2	166	216	243	265
TBS	0.40 (10mm)	0.984	1 1/2	166	239	325	410
TBSMAX	0.32 (8mm)	0.965	1	421	484	545	594
HBS + HUS6	0.24 (6mm)	0.787	1 1/2	166	239	270	294
HBS + HUS8	0.32 (8mm)	0.984	1 1/2	166	239	325	410
HBS + HUS10	0.40 (10mm)	1.181	1 1/2	166	239	325	410
HBS + HUS12	0.48 (12mm)	1.457	1 1/2	166	239	325	410
DGZ	0.28 (7mm)	0.374	1	191	220	248	270
DGZ	0.36 (9mm)	0.453	1	196	225	253	277

For **SI**: 1 inch = 25.4 mm, 1 lbf = 4.45 N.

¹ 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.

² Tabulated values for TBS, TBS EVO, HBS in combination with HUS countersunk washer and TBS MAX are applicable to screws installed perpendicular to the faces of the wood members. Tabulated values for DGZ screws are applicable to screws installed at 60° angle to the grain.

³ Screws must be installed and used in dry in-service conditions, so that the wet service factor for connections C_M is 1.0, in accordance with the NDS.

⁴ TBS, TBS EVO, and HBS screws with HUS countersunk washers are for 1/2 inch diameter head to conform with the NDS.

TABLE 9—CONNECTION GEOMETRY REQUIREMENTS^{1,2,3}

CONDITION			REQUIRED DIMENSION	
			G < 0.50	0.50 ≤ G
End distance	Tension loading parallel to grain (fastener bearing toward end)		15D	20D
	Compression loading parallel to grain (fastener bearing away from end)		10D	15D
	Loading perpendicular to grain		10D	15D
	Axial loading $a_{1,CG}$ ⁶ (fastener withdrawal or pull-through)		10D	10D
Edge distance	Loading parallel to grain		5D	7D
	Loading perpendicular to grain	Load toward edge	10D	12D
		Load away from edge	5D	7D
	Axial Loading $a_{2,CG}$ ⁶		4D	4D
Spacing between fasteners in a row (parallel to grain of main member)	Loading parallel to grain		15D	15D
	Loading perpendicular to grain		12D	15D
	Axial loading a_1 ⁶		7D	7D
Spacing between rows (perpendicular to grain of main member)	Lateral loading	In-line rows	5D	7D
		Staggered rows ^{4,5}	2.5D	3D
	Axial loading a_2 ^{5,6}		4D	4D
	Axial loading for crossed screws $a_{2,cross}$ ⁷		1.5D	1.5D

For SI: 1 inch = 25.4 mm.

¹End distances, edge distances and fastener spacing must be sufficient to prevent splitting of the wood, or as required by this table, whichever is the more restrictive.

²Wood 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.

³D refers to the outside thread diameter.

⁴Values for spacing between staggered rows apply where fasteners in adjacent rows are offset by half of the spacing between fasteners in a row.

⁵For screws with a shank diameter d_s greater than ¼ inch the spacing between rows (perpendicular to grain of member) for staggered rows and axial loading must be increased to 5D (for G < 0.50 and 0.50 ≤ G).

⁶End and edge distances ($a_{1,CG}$ and $a_{2,CG}$) for screws under axial loading are referred to the center of gravity of the threaded portion of the screw in either the side or main member, as shown in Figure 9 and 10.

⁷Spacing between rows for pairs of crossed screws is shown in Figure 10 and 11.

TABLE 10—APPLICABLE EXPOSURE CONDITIONS

EXPOSURE CONDITION	TYPICAL APPLICATIONS	RECOGNITION LIMITATIONS
1	Treated wood in dry use applications	Limited to use where equilibrium moisture content of the chemically treated wood meets the dry service conditions as described in the NDS.
3	General construction	Limited to freshwater and chemically treated wood exposure, i.e., no saltwater exposure.

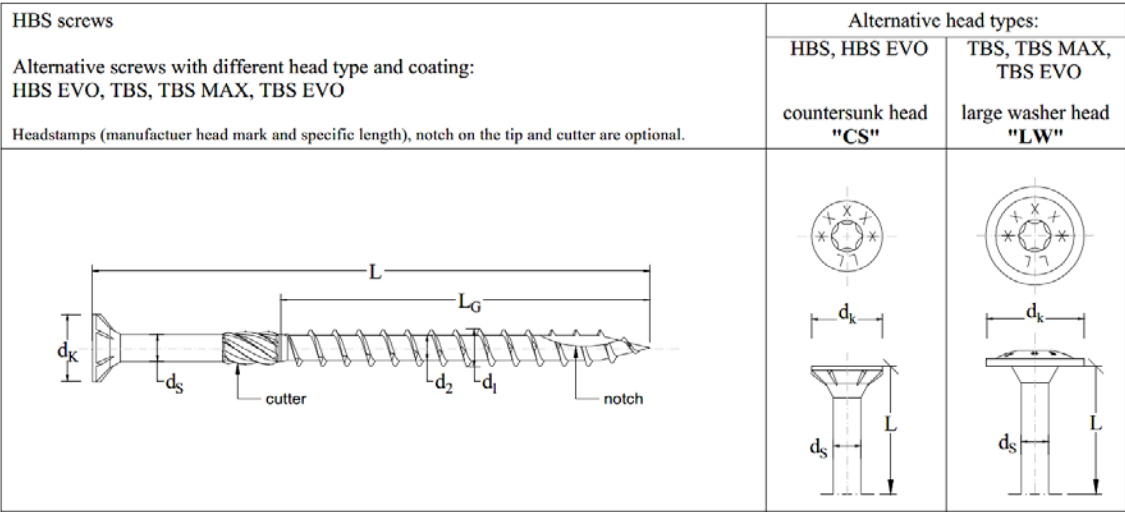


FIGURE 1—PARTIALLY THREADED SCREWS

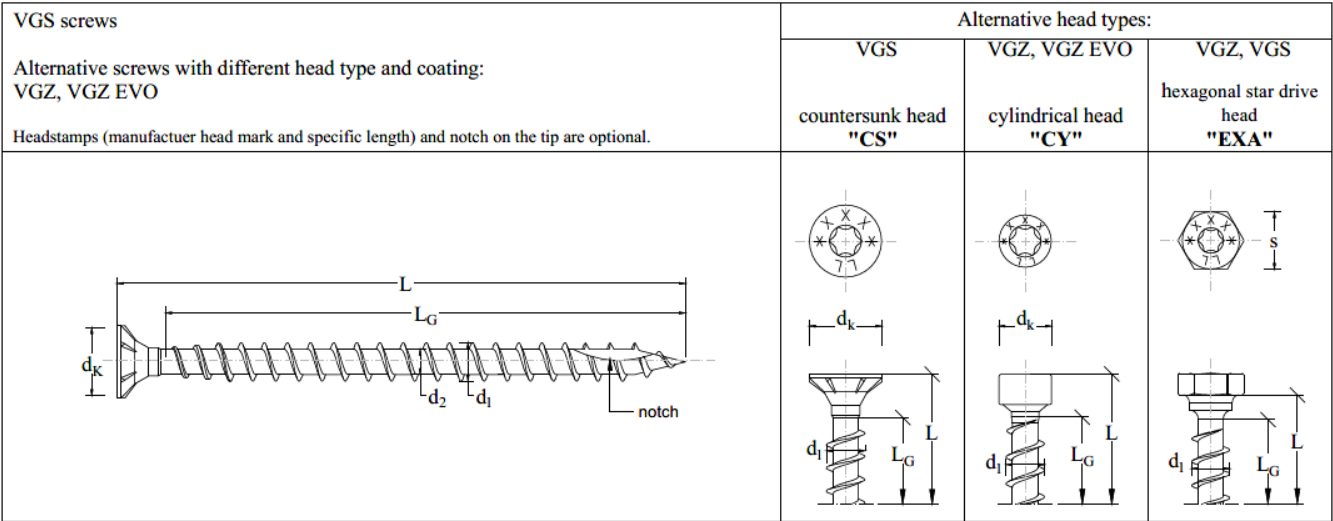
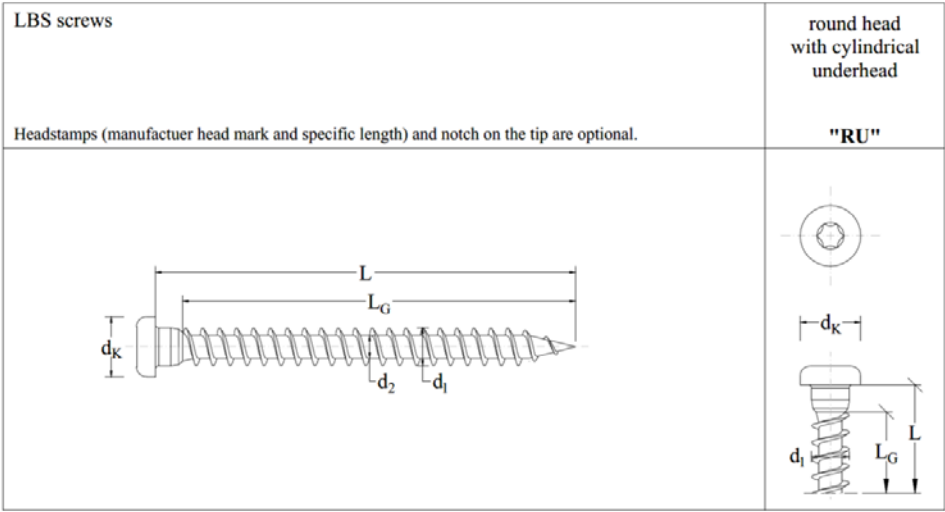


FIGURE 2—FULLY THREADED SCREWS

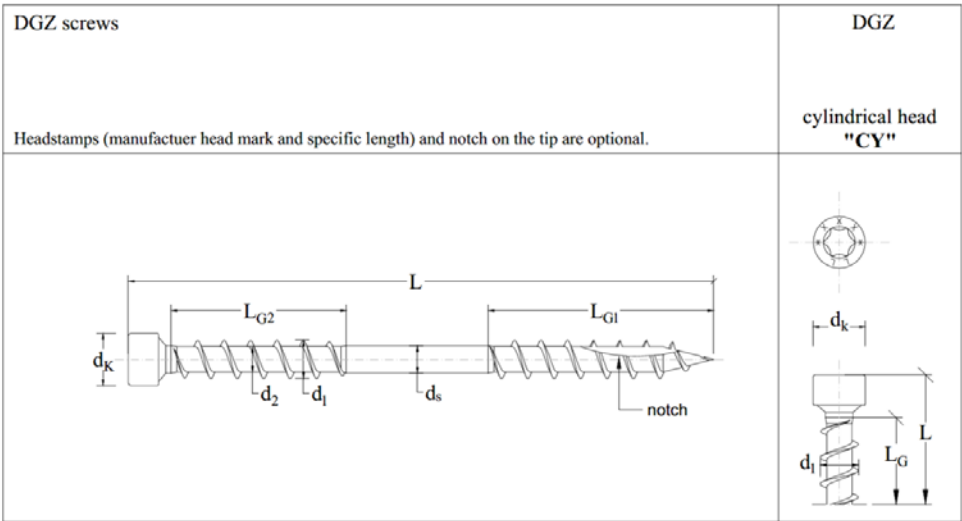
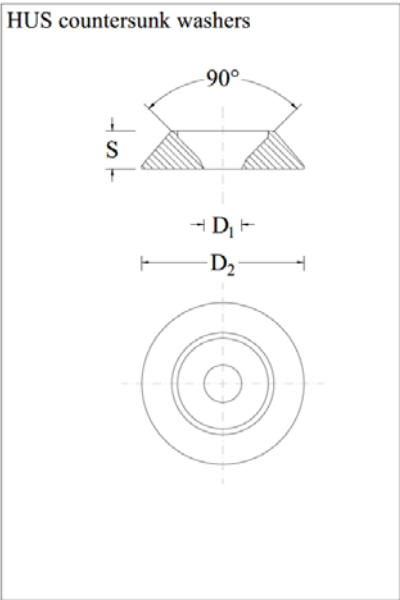


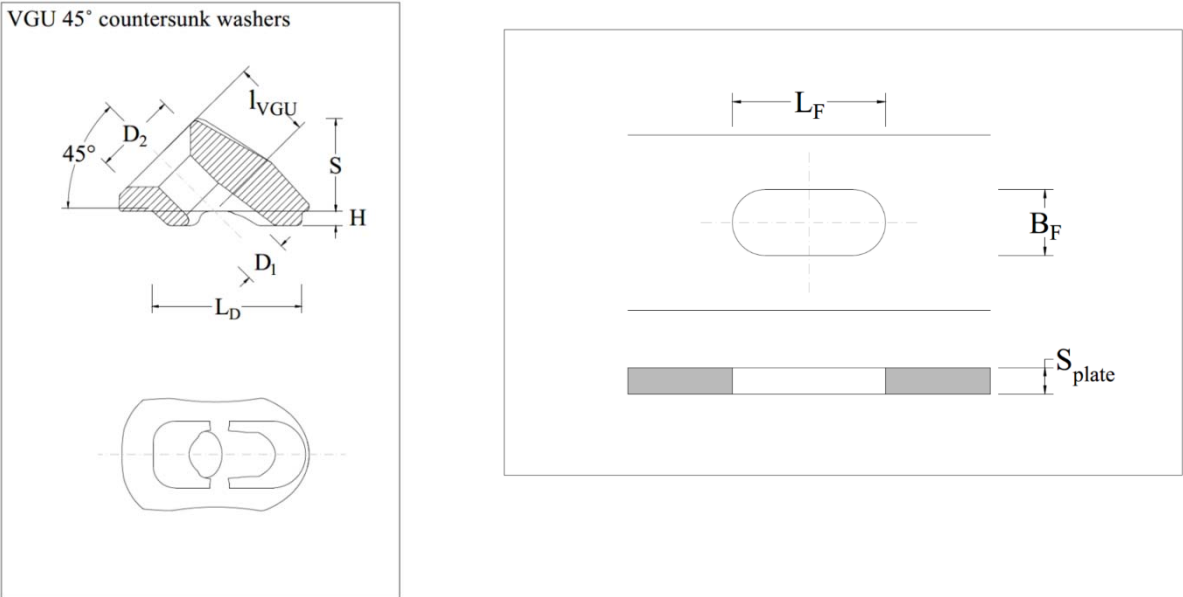
FIGURE 3—DOUBLE THREADED SCREWS



DESIGNATION	SCREW TYPE	D ₁ (inch)	D ₂ (inch)	S (inch)
HUS6	HBS6	0.295	0.787	0.181
HUS8	HBS8	0.335	0.984	0.213
HUS10	HBS10	0.425	1.181	0.252
HUS12	HBS12	0.551	1.457	0.335

For **SI**: 1 inch = 25.4 mm.
¹HUS countersunk washers to be used in combination with HBS screws.

FIGURE 4—HUS COUNTERSUNK WASHER



DESIGNATION	SCREW TYPE	D ₁ (inch)	D ₂ (inch)	S (inch)	H (inch)	L _D (inch)	L _{VGU} (inch)	Slotted hole length L _F (inch)	Slotted hole width B _F (inch)	Steel plate thickness S _{plate} (inch) ¹
VGU945	VGS9	0.382	0.748	0.787	0.118	1.252	0.740	min. 1.299 max. 1.339	min. 0.551 max. 0.591	min. 0.118 max. 0.472
VGU1145	VGS11	0.465	0.906	0.961	0.142	1.528	0.906	min. 1.614 max. 1.654	min. 0.669 max. 0.709	min. 0.157 max. 0.591
VGU1345	VGS13	0.551	1.079	1.130	0.169	1.803	1.059	min. 1.929 max. 1.969	min. 0.787 max. 0.827	min. 0.197 max. 0.591

For SI: 1 inch = 25.4 mm.

¹A countersink hole in the lower part of the steel plate is required if the thickness of the steel plate is greater than maximum value shown.
²VGU 45° countersunk washers to be used in combination with VGS screws.

FIGURE 5—VGU 45° COUNTERSUNK WASHER

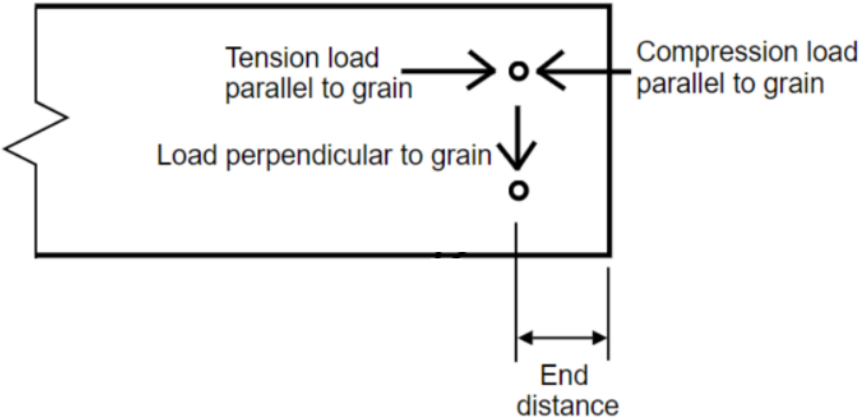


FIGURE 6—END DISTANCE FOR SCREWS INSTALLED PERPENDICULAR TO THE GRAIN

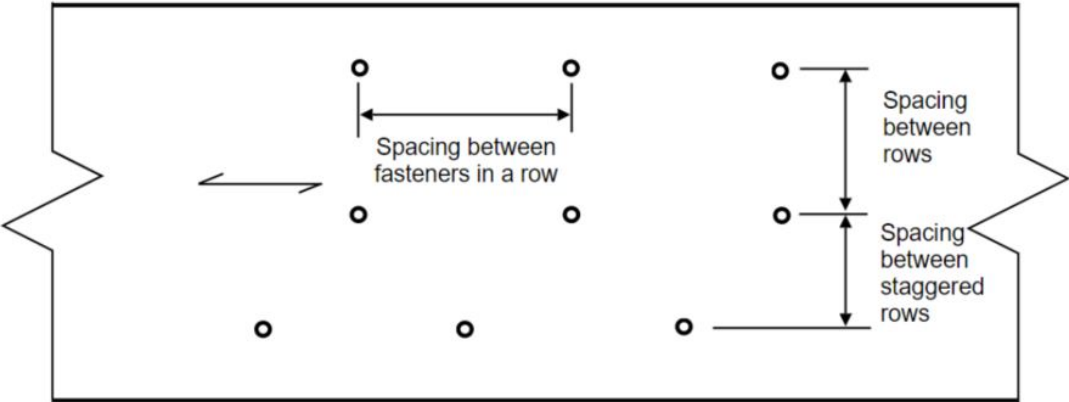


FIGURE 7— EDGE DISTANCE FOR SCREWS INSTALLED PERPENDICULAR TO THE GRAIN

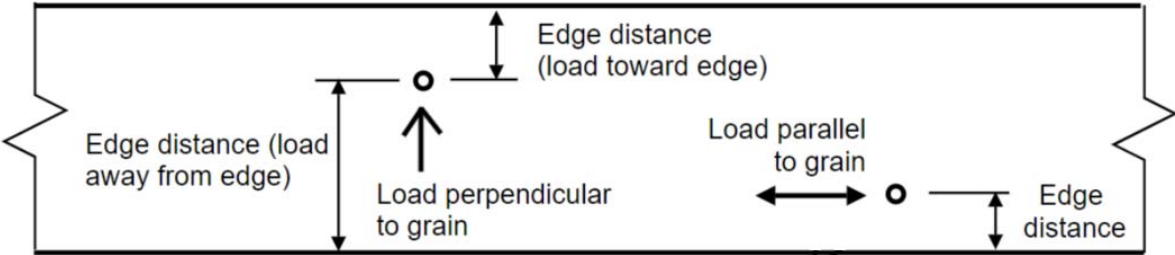


FIGURE 8— SPACING FOR SCREWS INSTALLED PERPENDICULAR TO THE GRAIN

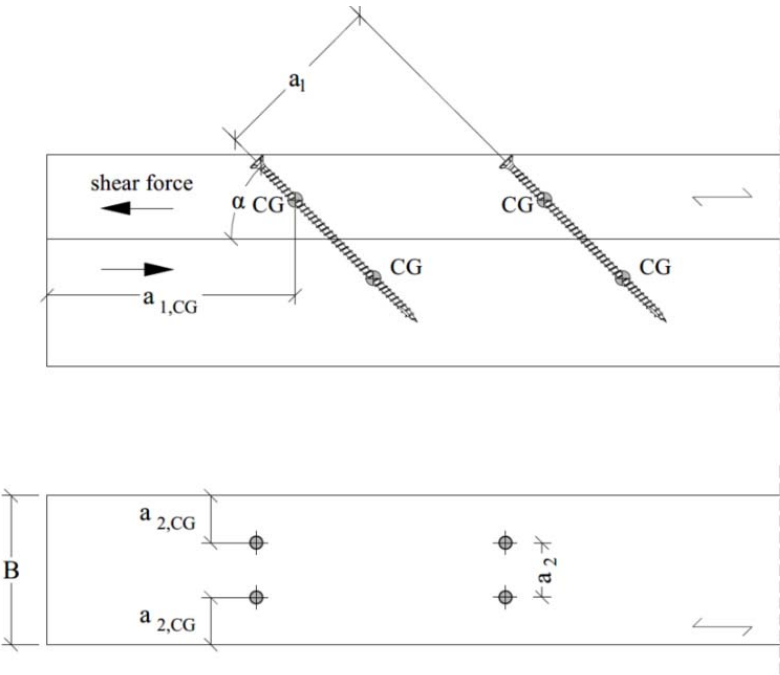


FIGURE 9—END AND EDGE DISTANCE AND SPACING FOR AXIALLY LOADED SCREWS AT AN ANGLE TO THE GRAIN – SINGLE CONFIGURATION

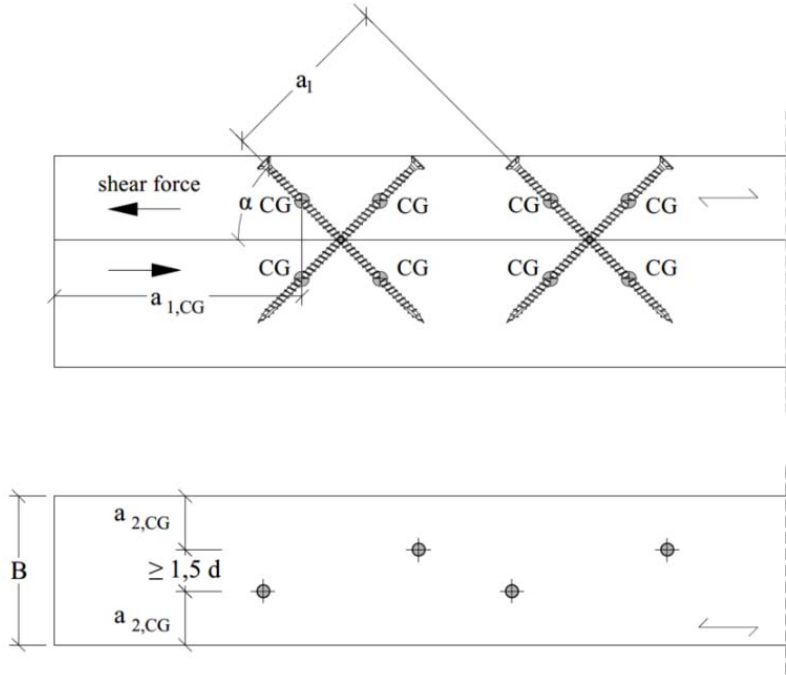


FIGURE 10—END AND EDGE DISTANCE AND SPACING FOR AXIALLY LOADED SCREWS AT AN ANGLE TO THE GRAIN – PAIR OF CROSSED SCREWS

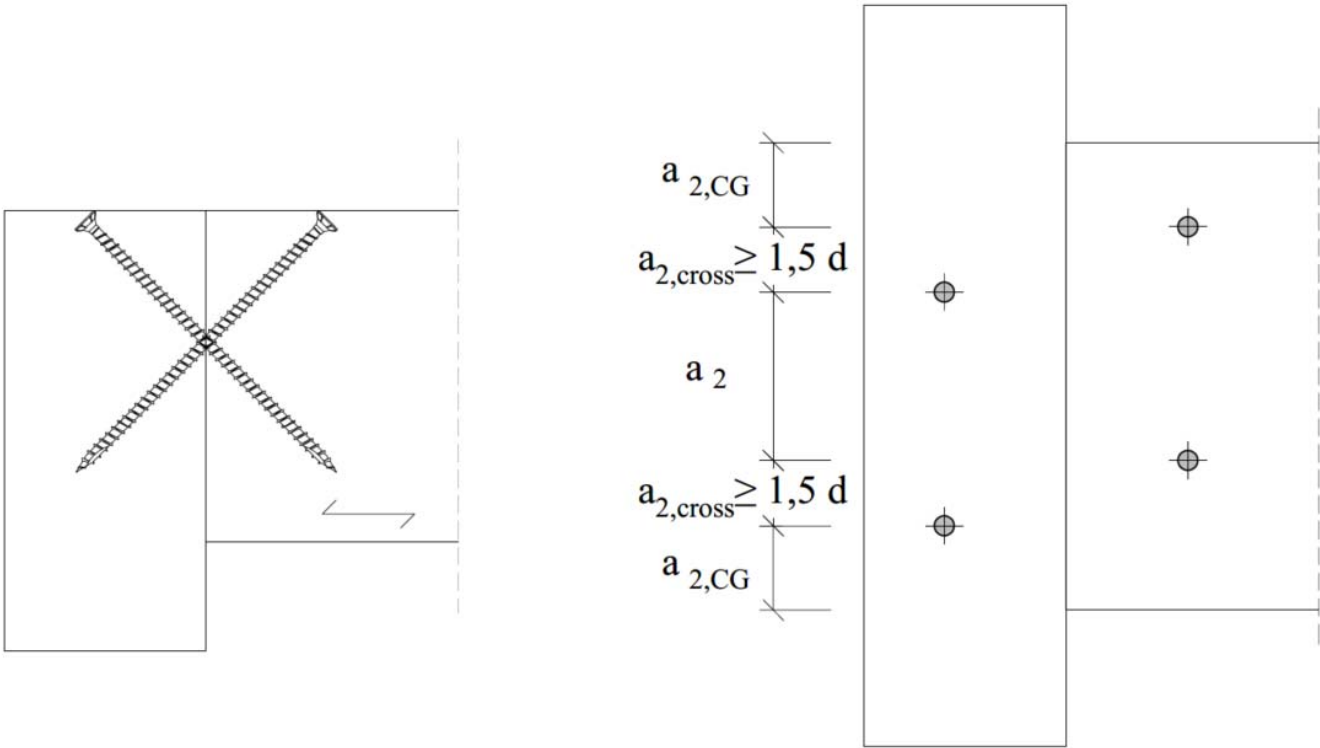


FIGURE 11—EDGE DISTANCE AND SPACING BETWEEN ROWS OF PAIRS OF CROSSED SCREWS