



### 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)

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

**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 ( $W_\alpha$ ) in pounds per inch of thread penetration for screws installed at an angle  $\alpha$  (in degrees) to the grain of the wood member must be determined in accordance with Equations (3), (4) and (5) as follows:

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

| $\alpha$ | $k_\alpha$ | $\alpha$                        | $k_\alpha$ |
|----------|------------|---------------------------------|------------|
| 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       | $\alpha$                        | $k_\alpha$ |
| 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  $k_\alpha$ :

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

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

**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]

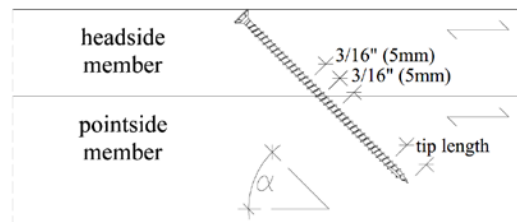
**4.1.7.3 Design method:** The design method applies to wood-to-wood and steel-to-wood connections where the lateral load between side and main member is transferred through the axial capacity of the screw installed at an angle  $0^\circ \leq \alpha < 90^\circ$  to the wood grain. The following conditions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

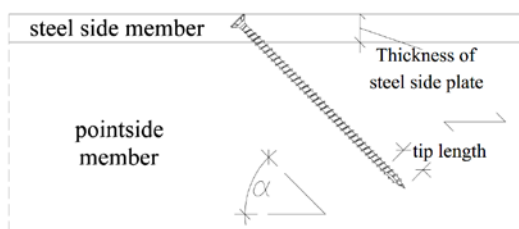
- The structural members must be checked for load-carrying capacity in accordance with Section 4.1.4.

**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 ( $W_d$ ) in the side and main member for the screw installed at angle  $\alpha$  to the grain, where  $\alpha$  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 ( $W_d$ ) 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**  
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**TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS<sup>1,2,3</sup>**

| DESIGNATION           | NOMINAL DIAMETER (inch - mm) | OVERALL LENGTH <sup>1</sup> , L (inches) | THREAD LENGTH <sup>2</sup> , L <sub>G</sub> (inches) | HEAD TYPE      | HEAD DIAMETER, d <sub>K</sub> (inch) | DRIVE TYPE AND SIZE | UNTHREADED SHANK DIAMETER, d <sub>S</sub> (inch) | ROOT DIAMETER, d <sub>2</sub> (inch) | OUTSIDE THREAD DIAMETER, d <sub>1</sub> (inch) | TIP LENGTH (inch) | SPECIFIED BENDING YIELD STRENGTH <sup>3</sup> F <sub>yb</sub> (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<br>HBSEVO680   |                              | 3 1/8                                    | 1 9/16                                               |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS690                |                              | 3 1/2                                    | 1 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6100<br>HBSEVO6100 |                              | 4                                        | 1 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6110               |                              | 4 3/8                                    | 2 3/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6120<br>HBSEVO6120 |                              | 4 3/4                                    | 2 3/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6130               |                              | 5 1/8                                    | 2 3/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6140<br>HBSEVO6140 |                              | 5 1/2                                    | 2 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6150               |                              | 6                                        | 2 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6160<br>HBSEVO6160 |                              | 6 1/4                                    | 2 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6180<br>HBSEVO6180 |                              | 7 1/8                                    | 2 15/16                                              |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS6200<br>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<br>HBSEVO8100 |                              | 4                                        | 2 1/16                                               |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS8120<br>HBSEVO8120 |                              | 4 3/4                                    | 2 3/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS8140<br>HBSEVO8140 |                              | 5 1/2                                    | 2 3/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |
| HBS8160<br>HBSEVO8160 |                              | 6 1/4                                    | 3 1/8                                                |                |                                      |                     |                                                  |                                      |                                                |                   |                                                                     |                                           |

**TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS<sup>1,2,3</sup>(Continued)**

|                       |                |                |        |                   |       |       |       |       |       |       |         |      |
|-----------------------|----------------|----------------|--------|-------------------|-------|-------|-------|-------|-------|-------|---------|------|
| HBS8180<br>HBSEVO8180 | 0.32<br>(8mm)  | 7 1/8          | 3 1/8  | Countersunk<br>CS | 0.571 | TX 40 | 0.228 | 0.213 | 0.315 | 0.315 | 180,000 | 2040 |
| HBS8200<br>HBSEVO8200 |                | 8              | 3 1/8  |                   |       |       |       |       |       |       |         |      |
| HBS8220<br>HBSEVO8220 |                | 8 5/8          | 3 1/8  |                   |       |       |       |       |       |       |         |      |
| HBS8240<br>HBSEVO8240 |                | 9 1/2          | 3 1/8  |                   |       |       |       |       |       |       |         |      |
| HBS8260               |                | 10 1/4         | 3 1/8  |                   |       |       |       |       |       |       |         |      |
| HBS8280<br>HBSEVO8280 |                | 11             | 3 1/8  |                   |       |       |       |       |       |       |         |      |
| HBS8300               |                | 11 3/4         | 4      |                   |       |       |       |       |       |       |         |      |
| HBS8320<br>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<br>(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<br>(10mm) | 13 3/8         | 4      | Countersunk<br>CS | 0.719 | TX40  | 0.276 | 0.252 | 0.394 | 0.394 | 185,000 | 2700 |
| HBS10360              |                | 14 1/4         | 4      |                   |       |       |       |       |       |       |         |      |

**TABLE 1— PARTIALLY THREADED FASTENERS DIMENSIONS AND STRENGTHS<sup>1,2,3</sup>(Continued)**

|                       |                |               |         |                            |       |       |       |       |       |       |         |      |
|-----------------------|----------------|---------------|---------|----------------------------|-------|-------|-------|-------|-------|-------|---------|------|
| HBS10380              |                | 15            | 4       |                            |       |       |       |       |       |       |         |      |
| HBS10400              |                | 15 3/4        | 4       |                            |       |       |       |       |       |       |         |      |
| HBS12120              | 0.48<br>(12mm) | 4 3/4         | 3 1/8   | Countersunk<br>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<br>TBSEVO660   |                | 0.24<br>(6mm) | 2 3/8   |                            |       |       |       |       |       |       |         |      |
| TBS670                | 2 3/4          |               | 1 9/16  |                            |       |       |       |       |       |       |         |      |
| TBS680<br>TBSEVO680   | 3 1/8          |               | 1 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS690                | 3 1/2          |               | 1 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6100<br>TBSEVO6100 | 4              |               | 2 3/8   |                            |       |       |       |       |       |       |         |      |
| TBS6120<br>TBSEVO6120 | 4 3/4          |               | 2 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6140<br>TBSEVO6140 | 5 1/2          |               | 2 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6160<br>TBSEVO6160 | 6 1/4          |               | 2 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6180<br>TBSEVO6180 | 7 1/8          |               | 2 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6200<br>TBSEVO6200 | 8              |               | 2 15/16 |                            |       |       |       |       |       |       |         |      |
| TBS6220               | 0.24<br>(6mm)  | 8 5/8         | 4       | Large washer<br>head<br>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<sup>1,2,3</sup>(Continued)**

|                       |                |               |        |                            |       |       |       |       |       |       |         |      |
|-----------------------|----------------|---------------|--------|----------------------------|-------|-------|-------|-------|-------|-------|---------|------|
| TBS6300               |                | 11 3/4        | 4      |                            |       |       |       |       |       |       |         |      |
| TBS840                | 0.32<br>(8mm)  | 1 9/16        | 1 1/4  | Large washer<br>head<br>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<br>TBSEVO8100 |                | 4             | 2 1/16 |                            |       |       |       |       |       |       |         |      |
| TBS8120<br>TBSEVO8120 |                | 4 3/4         | 3 1/8  |                            |       |       |       |       |       |       |         |      |
| TBS8140<br>TBSEVO8140 |                | 5 1/2         | 3 1/8  |                            |       |       |       |       |       |       |         |      |
| TBS8160<br>TBSEVO8160 |                | 6 1/4         | 4      |                            |       |       |       |       |       |       |         |      |
| TBS8180<br>TBSEVO8180 |                | 7 1/8         | 4      |                            |       |       |       |       |       |       |         |      |
| TBS8200<br>TBSEVO8200 |                | 8             | 4      |                            |       |       |       |       |       |       |         |      |
| TBS8220<br>TBSEVO8220 |                | 8 5/8         | 4      |                            |       |       |       |       |       |       |         |      |
| TBS8240<br>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<br>(8mm) | 8      |                            |       |       |       |       |       |       |         |      |
| TBSMAX8220            | 8 5/8          |               | 4 3/4  |                            |       |       |       |       |       |       |         |      |
| TBSMAX8240            | 9 1/2          |               | 4 3/4  |                            |       |       |       |       |       |       |         |      |
| TBS10100              | 0.40<br>(10mm) | 4             | 2 1/16 | Large washer<br>head<br>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<sup>1,2,3</sup>(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.

<sup>1</sup>For 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.

<sup>2</sup>Length of thread includes tip.

<sup>3</sup>Bending yield strength determined in accordance with ASTM F1575 using the root diameter, d<sub>2</sub>.

**TABLE 2— FULLY THREADED FASTENERS DIMENSIONS AND STRENGTH**

| DESIGNATION           | NOMINAL DIAMETER<br>(inch - mm) | OVERALL LENGTH <sup>1</sup> , L<br>(inches) | THREAD LENGTH <sup>2</sup> , L <sub>G</sub><br>(inches) | HEAD TYPE                                         | HEAD DIAMETER, d <sub>K</sub><br>(inch) | DRIVE TYPE AND SIZE | ROOT DIAMETER, d <sub>2</sub><br>(inch) | OUTSIDE THREAD DIAMETER, d <sub>1</sub><br>(inch) | TIP LENGTH<br>(inch) | SPECIFIED BENDING YIELD STRENGTH <sup>3</sup><br>F <sub>yb</sub> (psi) | ALLOWABLE FASTENER TENSION STRENGTH<br>(lbf) |
|-----------------------|---------------------------------|---------------------------------------------|---------------------------------------------------------|---------------------------------------------------|-----------------------------------------|---------------------|-----------------------------------------|---------------------------------------------------|----------------------|------------------------------------------------------------------------|----------------------------------------------|
| LBS525                | 0.20<br>(5mm)                   | 1                                           | 13/16                                                   | Round head<br>with cylindrical<br>underhead<br>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<br>(7mm)                   | 2 3/8                                       | 2 3/16                                                  | Round head<br>with cylindrical<br>underhead<br>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<br>VGZEVO580   | 0.21<br>(5.3mm)                 | 3 1/8                                       | 2 3/4                                                   | Cylindrical<br>head<br>CY                         | 0.315                                   | TX25                | 0.142                                   | 0.209                                             | 0.209                | 168,000                                                                | 1000                                         |
| VGZ5100<br>VGZEVO5100 |                                 | 4                                           | 3 1/2                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ5120<br>VGZEVO5120 |                                 | 4 3/4                                       | 4 3/8                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ5140<br>VGZEVO5140 | 0.23<br>(5.6mm)                 | 5 1/2                                       | 5 1/8                                                   | Cylindrical<br>head<br>CY                         | 0.315                                   | TX25                | 0.150                                   | 0.220                                             | 0.220                | 168,000                                                                | 1100                                         |
| VGZ5160<br>VGZEVO5160 |                                 | 6 1/4                                       | 6                                                       |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ780                |                                 | 3 1/8                                       | 2 3/4                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7100               | 0.28<br>(7mm)                   | 4                                           | 3 1/2                                                   | Cylindrical<br>head<br>CY                         | 0.374                                   | TX30                | 0.181                                   | 0.276                                             | 0.276                | 195,000                                                                | 1450                                         |
| VGZ7120               |                                 | 4 3/4                                       | 4 3/8                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7140<br>VGZEVO7140 |                                 | 5 1/2                                       | 5 1/8                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7160               |                                 | 6 1/4                                       | 6                                                       |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7180<br>VGZEVO7180 |                                 | 7 1/8                                       | 6 3/4                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7200               |                                 | 8                                           | 7 1/2                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7220<br>VGZEVO7220 |                                 | 8 5/8                                       | 8 1/4                                                   |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7240               |                                 | 9 1/2                                       | 9 1/16                                                  |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7260<br>VGZEVO7260 |                                 | 10 1/4                                      | 10                                                      |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |
| VGZ7280               |                                 | 11                                          | 10 5/8                                                  |                                                   |                                         |                     |                                         |                                                   |                      |                                                                        |                                              |

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

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

|          |                |         |          |                           |       |      |       |       |       |         |      |
|----------|----------------|---------|----------|---------------------------|-------|------|-------|-------|-------|---------|------|
| VGS9140  | 0.36<br>(9mm)  | 5 1/2   | 5 1/8    | Countersunk<br>head<br>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<br>(11mm) | 4       | 3 1/2    | Countersunk<br>head<br>CS | 0.760 | TX50 | 0.260 | 0.433 | 0.433 | 170,000 | 3200 |
| 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<br>(11mm) | 19 3/4  | 19 5/16  | Countersunk<br>head<br>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<br>drive head<br>EXA |       | SW17 |       |       |       |         |      |
| VGS11800  |                | 31 1/2  | 31 1/8   |                                     |       |      |       |       |       |         |      |
| VGS13100  |                | 4       | 3 1/2    |                                     |       |      |       |       |       |         |      |
| VGS13150  | 0.52<br>(13mm) | 6       | 5 1/2    | Countersunk<br>head CS              | 0.866 | TX50 | 0.315 | 0.512 | 0.512 | 161,000 | 4400 |
| 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 |                                     |       |      |       |       |       |         |      |
| VGS13700  |                | 27 1/2  | 26 3/4   | Hexagonal star<br>drive head<br>EXA |       | SW19 |       |       |       |         |      |
| 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.

<sup>1</sup>For 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.

<sup>2</sup>Length of thread  $L_{G1}$  includes tip.

<sup>3</sup>Bending 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 <sup>1</sup> , L (inches) | THREAD LENGTH <sup>2</sup> , L <sub>G1</sub> - L <sub>G2</sub> (inches) | HEAD TYPE           | HEAD DIAMETER d <sub>K</sub> (inch) | DRIVE TYPE AND SIZE | UNTHREADED SHANK DIAMETER d <sub>S</sub> (inch) | ROOT DIAMETER d <sub>2</sub> (inch) | OUTSIDE THREAD DIAMETER, d <sub>1</sub> (inch) | TIP LENGTH (inch) | SPECIFIED BENDING YIELD STRENGTH <sup>3</sup> F <sub>yb</sub> (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.

<sup>1</sup>The overall length is measured from the top of the head to the screw tip.  
<sup>2</sup>Length of thread L<sub>G1</sub> includes tip. Length of thread L<sub>G2</sub> is located towards the fastener head as shown in Figure 3.  
<sup>3</sup>Bending yield strength determined in accordance with ASTM F1575 using the root diameter, d<sub>2</sub>.

TABLE 4—REFERENCE LATERAL DESIGN VALUES (Z) FOR TWO MEMBER WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED FASTENERS<sup>1,2,3,4</sup>

| 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     |               |             |
|                       |                                  |                                      | $Z_{  }$                               | $Z_{\perp  }$ | $Z_{\perp}$ | $Z_{  }$ | $Z_{\perp  }$ | $Z_{\perp}$ | $Z_{  }$ | $Z_{\perp  }$ | $Z_{\perp}$ | $Z_{  }$ | $Z_{\perp  }$ | $Z_{\perp}$ |
| 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<br>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<br>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<br>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<br>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<br>HBSEVO6160 | 6 1/4                            | 3 1/4                                | 139                                    | 139           | 139         | 165      | 165           | 165         | 190      | 190           | 190         | 211      | 211           | 211         |
| HBS6180<br>HBSEVO6180 | 7 1/8                            | 4                                    | 139                                    | 139           | 139         | 165      | 165           | 165         | 190      | 190           | 190         | 211      | 211           | 211         |
| HBS6200<br>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<br>HBSEVO8100 | 4                                | 1 3/4                                | 153                                    | 123           | 123         | 214      | 171           | 171         | 270      | 216           | 216         | 313      | 251           | 251         |
| HBS8120<br>HBSEVO8120 | 4 3/4                            | 2 1/4                                | 184                                    | 147           | 147         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8140<br>HBSEVO8140 | 5 1/2                            | 3                                    | 196                                    | 157           | 157         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8160<br>HBSEVO8160 | 6 1/4                            | 3                                    | 207                                    | 165           | 165         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8180<br>HBSEVO8180 | 7 1/8                            | 3 3/4                                | 207                                    | 165           | 165         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8200<br>HBSEVO8200 | 8                                | 4 1/2                                | 207                                    | 165           | 165         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8220<br>HBSEVO8220 | 8 5/8                            | 5 1/2                                | 207                                    | 165           | 165         | 245      | 196           | 196         | 282      | 225           | 225         | 313      | 251           | 251         |
| HBS8240<br>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<br>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<br>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<sup>1,2,3,4</sup> (Continued)**

| FASTENER DESIGNATION  | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|-----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                       |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                       |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| 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<br>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<br>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<br>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<sup>1,2,3,4</sup> (Continued)**

| FASTENER DESIGNATION  | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|-----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                       |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                       |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| TBS6120<br>TBSEVO6120 | 4 3/4                            | 1 1/2                                          | 120                                    | 120              | 120            | 154             | 154              | 154            | 190             | 190              | 190            | 211             | 211              | 211            |
| TBS6140<br>TBSEVO6140 | 5 1/2                            | 2 1/4                                          | 139                                    | 139              | 139            | 165             | 165              | 165            | 190             | 190              | 190            | 211             | 211              | 211            |
| TBS6160<br>TBSEVO6160 | 6 1/4                            | 3 1/4                                          | 139                                    | 139              | 139            | 165             | 165              | 165            | 190             | 190              | 190            | 211             | 211              | 211            |
| TBS6180<br>TBSEVO6180 | 7 1/8                            | 4                                              | 139                                    | 139              | 139            | 165             | 165              | 165            | 190             | 190              | 190            | 211             | 211              | 211            |
| TBS6200<br>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<br>TBSEVO8100 | 4                                | 1 3/4                                          | 155                                    | 124              | 124            | 216             | 173              | 173            | 270             | 216              | 216            | 313             | 251              | 251            |
| TBS8120<br>TBSEVO8120 | 4 3/4                            | 1 1/4                                          | 153                                    | 122              | 122            | 189             | 151              | 151            | 228             | 183              | 183            | 266             | 213              | 213            |
| TBS8140<br>TBSEVO8140 | 5 1/2                            | 2 1/4                                          | 191                                    | 153              | 153            | 245             | 196              | 196            | 282             | 225              | 225            | 313             | 251              | 251            |
| TBS8160<br>TBSEVO8160 | 6 1/4                            | 2 1/4                                          | 191                                    | 153              | 153            | 245             | 196              | 196            | 282             | 225              | 225            | 313             | 251              | 251            |
| TBS8180<br>TBSEVO8180 | 7 1/8                            | 3                                              | 207                                    | 165              | 165            | 245             | 196              | 196            | 282             | 225              | 225            | 313             | 251              | 251            |
| TBS8200<br>TBSEVO8200 | 8                                | 3 3/4                                          | 207                                    | 165              | 165            | 245             | 196              | 196            | 282             | 225              | 225            | 313             | 251              | 251            |
| TBS8220<br>TBSEVO8220 | 8 5/8                            | 4 1/2                                          | 207                                    | 165              | 165            | 245             | 196              | 196            | 282             | 225              | 225            | 313             | 251              | 251            |
| TBS8240<br>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<sup>1,2,3,4</sup> (Continued)**

| FASTENER DESIGNATION | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                      |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                      |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| 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.

<sup>1</sup> 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.

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

- Z<sub>||</sub> both side and main members loaded parallel to the grain.
- Z<sub>L||</sub> side member loaded perpendicular to the grain; main member loaded parallel to the grain.
- Z<sub>⊥</sub> both side and main members loaded perpendicular to the grain.

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

<sup>4</sup> 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<sup>1,2,3,4</sup>**

| FASTENER DESIGNATION  | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|-----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                       |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                       |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| VGZ580<br>VGZEVO580   | 3 1/8                            | 1 1/2                                          | 98                                     | 98               | 98             | 125             | 125              | 125            | 144             | 144              | 144            | 161             | 161              | 161            |
| VGZ5100<br>VGZEVO5100 | 4                                | 2                                              | 106                                    | 106              | 106            | 125             | 125              | 125            | 144             | 144              | 144            | 161             | 161              | 161            |
| VGZ5120<br>VGZEVO5120 | 4 3/4                            | 2 1/4                                          | 106                                    | 106              | 106            | 125             | 125              | 125            | 144             | 144              | 144            | 161             | 161              | 161            |
| VGZ5140<br>VGZEVO5140 | 5 1/2                            | 2 3/4                                          | 118                                    | 118              | 118            | 140             | 140              | 140            | 161             | 161              | 161            | 179             | 179              | 179            |
| VGZ5160<br>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<br>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<sup>1,2,3,4</sup> (Continued)

| FASTENER DESIGNATION  | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|-----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                       |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                       |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| VGZ7160               | 6 1/4                            | 3                                              | 177                                    | 142              | 142            | 210             | 168              | 168            | 242             | 193              | 193            | 269             | 215              | 215            |
| VGZ7180<br>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<br>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<br>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<br>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<br>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<br>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<br>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<br>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<br>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<sup>1,2,3,4</sup> (Continued)

| FASTENER DESIGNATION | OVERALL SCREW LENGTH, L (inches) | SIDE MEMBER THICKNESS, t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                  |                |                 |                  |                |                 |                  |                |                 |                  |                |
|----------------------|----------------------------------|------------------------------------------------|----------------------------------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|-----------------|------------------|----------------|
|                      |                                  |                                                | 0.35                                   |                  |                | 0.42            |                  |                | 0.49            |                  |                | 0.55            |                  |                |
|                      |                                  |                                                | Z <sub>  </sub>                        | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L  </sub> | Z <sub>⊥</sub> |
| 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<sup>1,2,3,4</sup> (Continued)**

| FASTENER<br>DESIGNATION | OVERALL<br>SCREW<br>LENGTH,<br>L (inches) | SIDE<br>MEMBER<br>THICKNESS<br>t <sub>s</sub> (inches) | Z (lbf) FOR SPECIFIC GRAVITIES (G) OF: |                   |                |                 |                   |                |                 |                   |                |                 |                   |                |
|-------------------------|-------------------------------------------|--------------------------------------------------------|----------------------------------------|-------------------|----------------|-----------------|-------------------|----------------|-----------------|-------------------|----------------|-----------------|-------------------|----------------|
|                         |                                           |                                                        | 0.35                                   |                   |                | 0.42            |                   |                | 0.49            |                   |                | 0.55            |                   |                |
|                         |                                           |                                                        | Z <sub>  </sub>                        | Z <sub>L/  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L/  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L/  </sub> | Z <sub>⊥</sub> | Z <sub>  </sub> | Z <sub>L/  </sub> | Z <sub>⊥</sub> |
| 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.

<sup>1</sup> 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.

<sup>2</sup> 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.

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

<sup>4</sup> 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<sup>1,2,3,4</sup>**

| 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.

<sup>1</sup> The steel side member must meet the requirements of Section 3.3 of this report.

<sup>2</sup> 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.

<sup>3</sup> 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.

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

<sup>4</sup> 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<sup>1,2,3,4</sup>

| 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.

<sup>1</sup> 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.

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

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

<sup>4</sup> 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 ( $W_H$ )<sup>1,2,3,4</sup>

| 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.

<sup>1</sup> 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.

<sup>2</sup> 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.

<sup>3</sup> 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.

<sup>4</sup> 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<sup>1,2,3</sup>

| 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 $a_{1,CG}$ <sup>6</sup> (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 $a_{2,CG}$ <sup>6</sup>                                       |                               | 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 $a_1$ <sup>6</sup>                                            |                               | 7D                 | 7D       |
| Spacing between rows (perpendicular to grain of main member)          | Lateral loading                                                             | In-line rows                  | 5D                 | 7D       |
|                                                                       |                                                                             | Staggered rows <sup>4,5</sup> | 2.5D               | 3D       |
|                                                                       | Axial loading $a_2$ <sup>5,6</sup>                                          |                               | 4D                 | 4D       |
|                                                                       | Axial loading for crossed screws $a_{2,cross}$ <sup>7</sup>                 |                               | 1.5D               | 1.5D     |

For SI: 1 inch = 25.4 mm.

<sup>1</sup>End 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.

<sup>2</sup>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.

<sup>3</sup>D refers to the outside thread diameter.

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

<sup>5</sup>For screws with a shank diameter  $d_s$  greater than  $\frac{1}{4}$  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  $0.50 \leq G$ ).

<sup>6</sup>End 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.

<sup>7</sup>Spacing 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.                                                   |

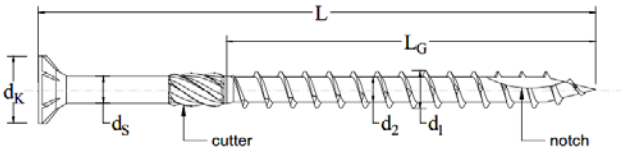
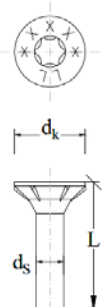
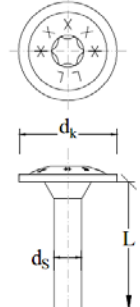
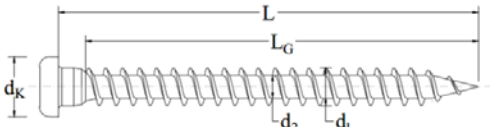
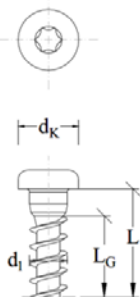
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| HBS screws<br><br>Alternative screws with different head type and coating:<br>HBS EVO, TBS, TBS MAX, TBS EVO<br><br>Headstamps (manufactuer head mark and specific length), notch on the tip and cutter are optional. | Alternative head types:                                                             |                                                                                     |
|                                                                                                                                                                                                                       | HBS, HBS EVO<br><br>countersunk head<br>"CS"                                        | TBS, TBS MAX,<br>TBS EVO<br><br>large washer head<br>"LW"                           |
|                                                                                                                                      |  |  |

FIGURE 1—PARTIALLY THREADED SCREWS

|                                                                                                             |                                                                                      |
|-------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| LBS screws<br><br>Headstamps (manufactuer head mark and specific length) and notch on the tip are optional. | round head<br>with cylindrical<br>underhead<br><br>"RU"                              |
|                          |  |

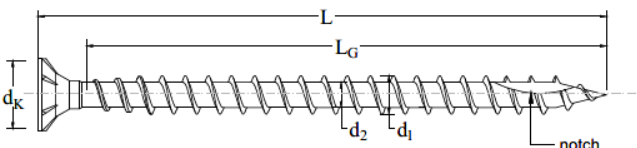
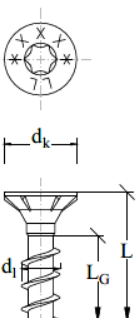
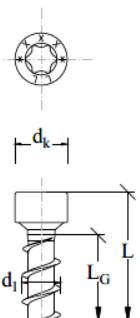
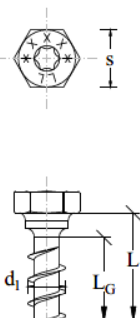
|                                                                                                                                                                                             |                                                                                      |                                                                                       |                                                                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| VGS screws<br><br>Alternative screws with different head type and coating:<br>VGZ, VGZ EVO<br><br>Headstamps (manufactuer head mark and specific length) and notch on the tip are optional. | Alternative head types:                                                              |                                                                                       |                                                                                       |
|                                                                                                                                                                                             | VGS<br><br>countersunk head<br>"CS"                                                  | VGZ, VGZ EVO<br><br>cylindrical head<br>"CY"                                          | VGZ, VGS<br><br>hexagonal star drive<br>head<br>"EXA"                                 |
|                                                                                                          |  |  |  |

FIGURE 2—FULLY THREADED SCREWS

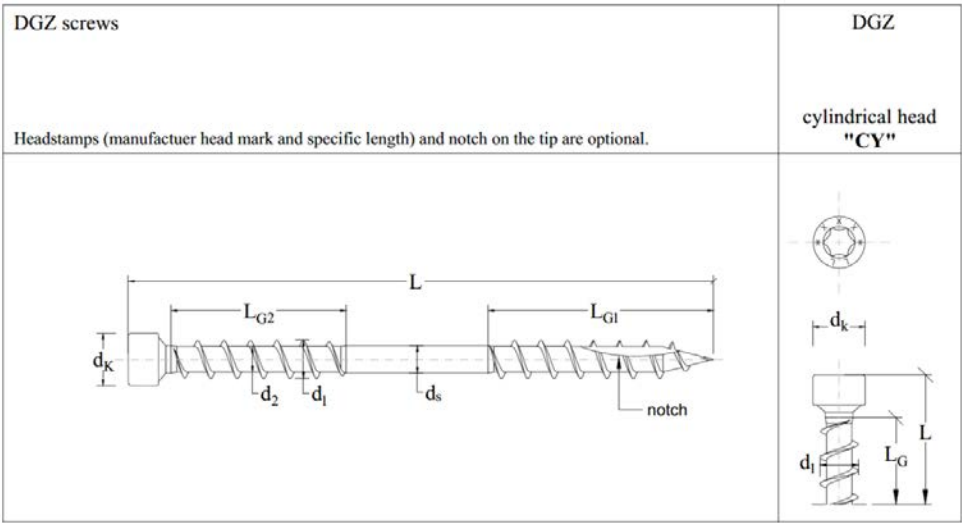
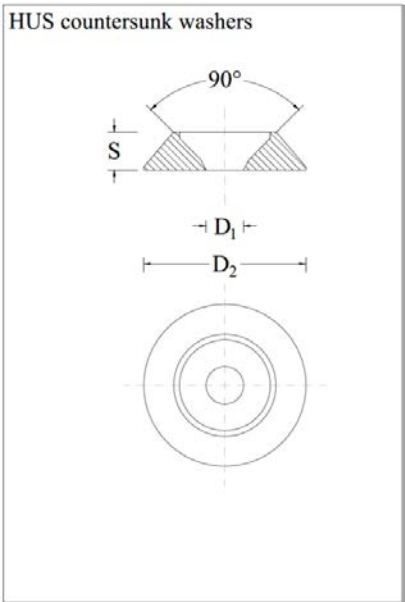


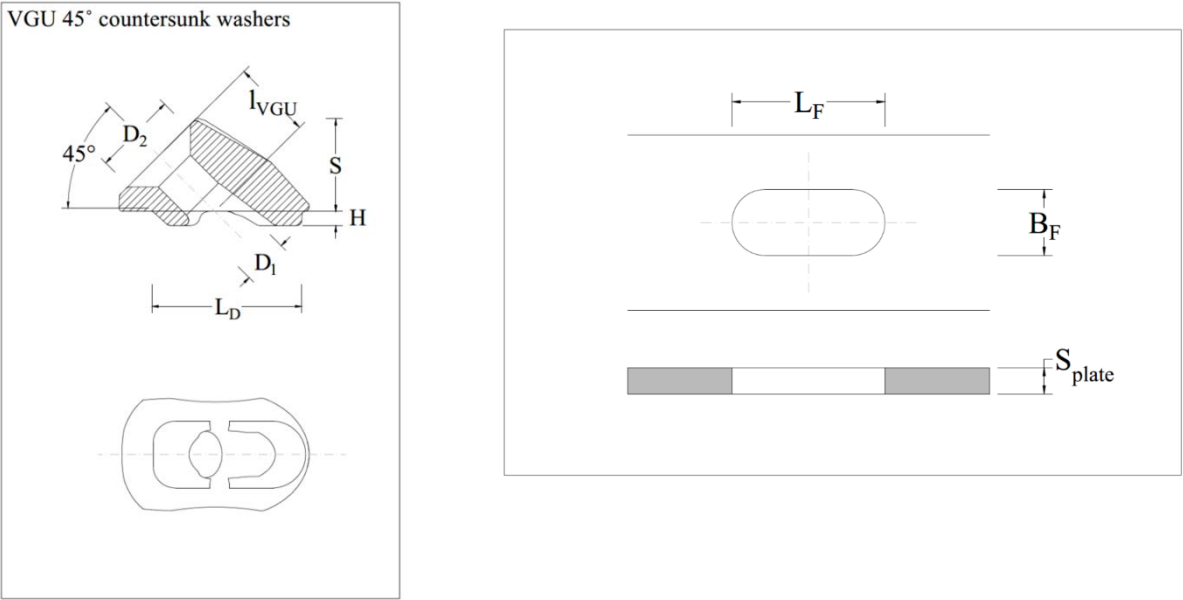
FIGURE 3—DOUBLE THREADED SCREWS



| DESIGNATION | SCREW TYPE | D <sub>1</sub><br>(inch) | D <sub>2</sub><br>(inch) | S<br>(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.  
<sup>1</sup>HUS countersunk washers to be used in combination with HBS screws.

FIGURE 4—HUS COUNTERSUNK WASHER



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

For SI: 1 inch = 25.4 mm.

<sup>1</sup>A 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.  
<sup>2</sup>VGU 45° countersunk washers to be used in combination with VGS screws.

FIGURE 5—VGU 45° COUNTERSUNK WASHER

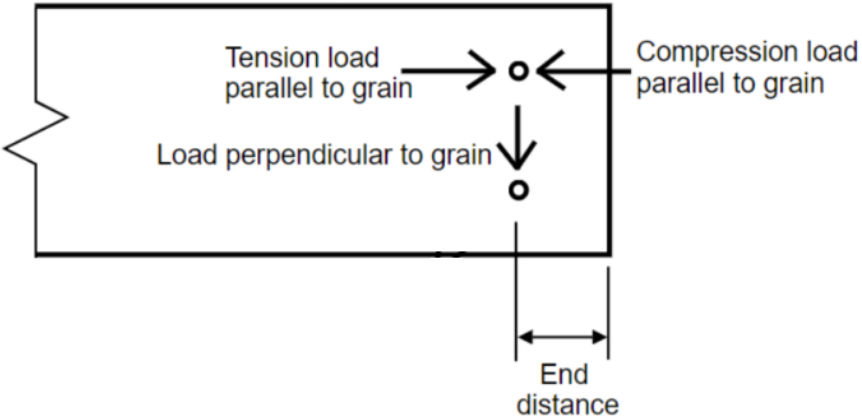
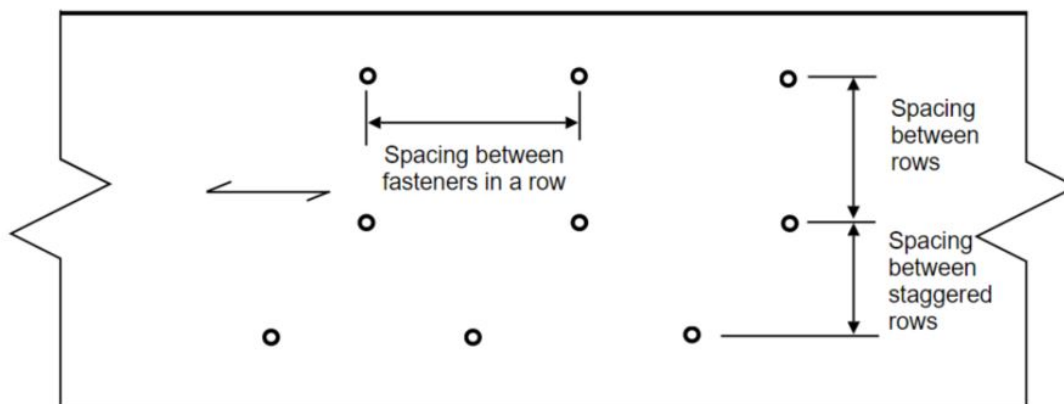
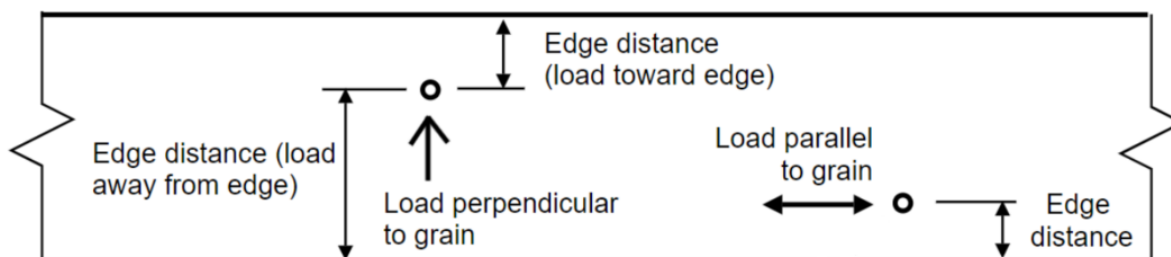


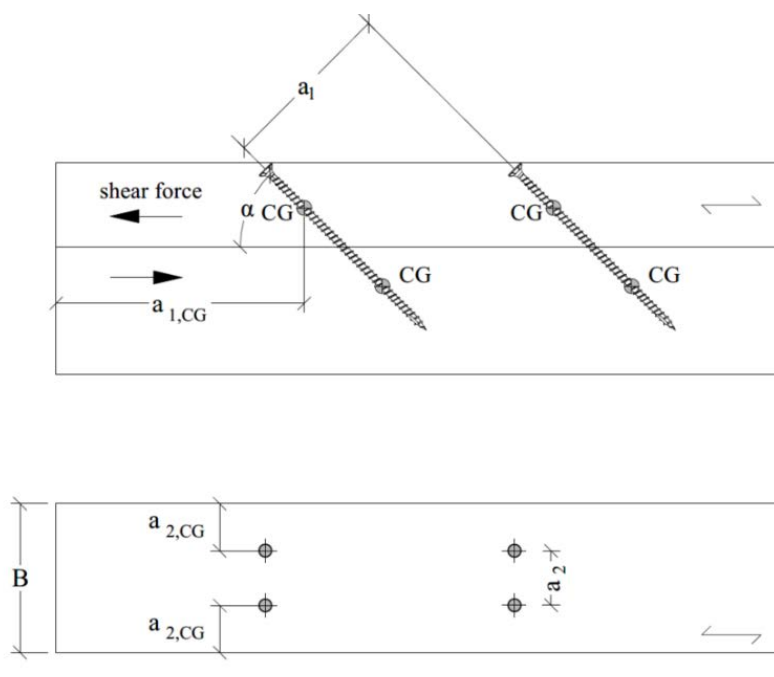
FIGURE 6— END DISTANCE FOR SCREWS INSTALLED PERPENDICULAR TO THE GRAIN



**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**

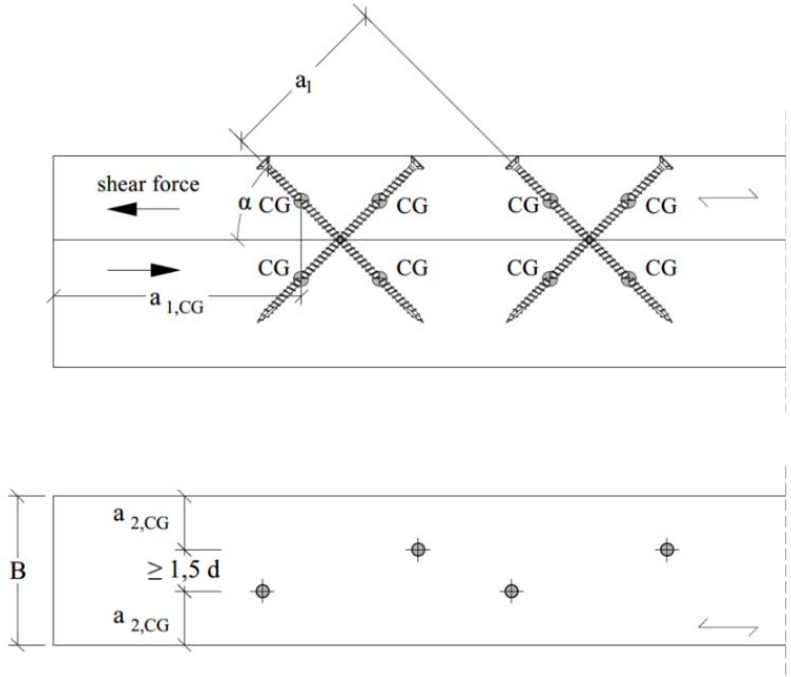


FIGURE 10—END AND EDGE DISTANCE AND SPACING FOR AXIALLY LOADED SCREWS AT AN ANGLE TO THE GRAIN – PAIR OF CROSSED SCREWS

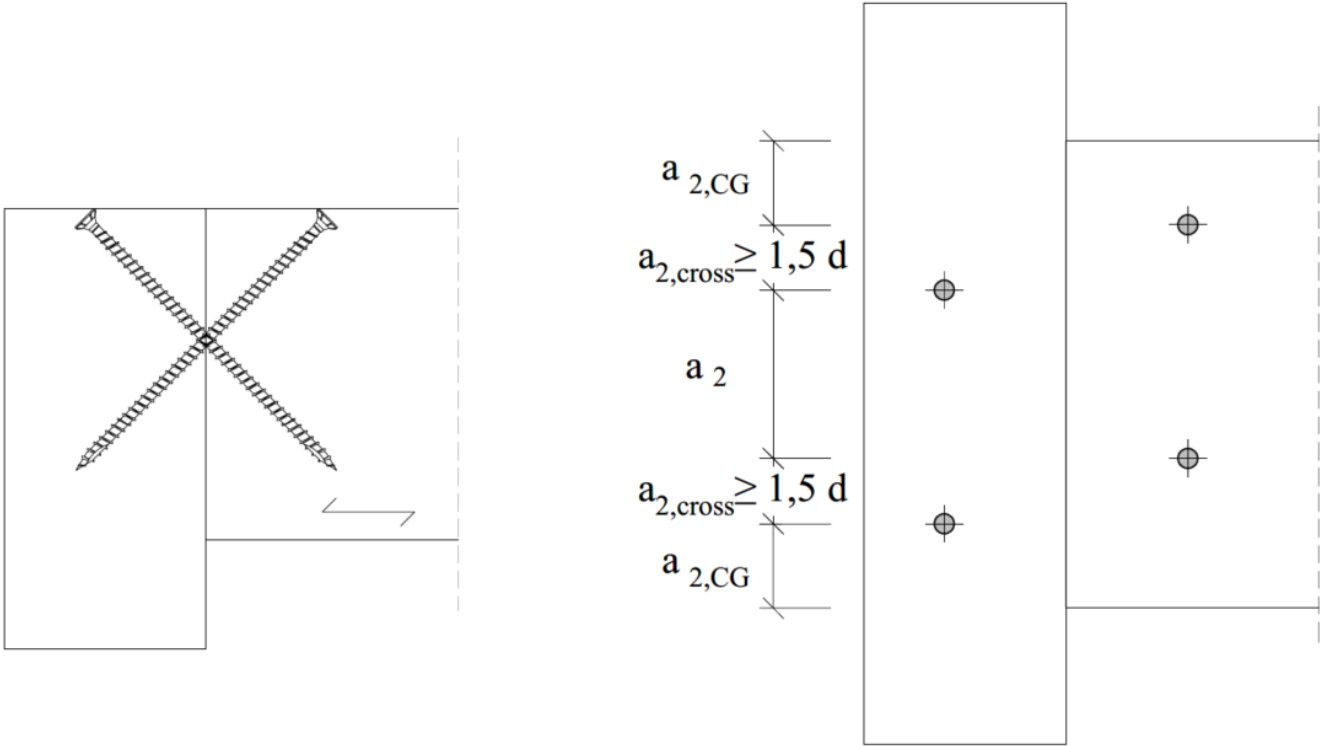


FIGURE 11—EDGE DISTANCE AND SPACING BETWEEN ROWS OF PAIRS OF CROSSED SCREWS