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ICC-ES Evaluation Report
ESR-4645

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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:

- 2021, 2018, 2015, 2012 and 2009 *International Building Code*® (IBC)
- 2021, 2018, 2015, 2012 and 2009 *International Residential Code*® (IRC)

Properties evaluated:

- Structural
- Corrosion resistance

2.0 USES

Rotho Blaas self-tapping wood screws are used for wood-to-wood and metal-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 and washers with EVO coating are intended for use in the Exposure Conditions shown in Table 13.

3.0 DESCRIPTION

3.1 Notation and Symbols:

a_{xx} : Screw spacings and distances
C_M : Wet-service factor
D_{nom} : Nominal screw diameter
D : Outside thread diameter
D_r : Minor thread (root) diameter
D_H : Head diameter
D_S : Unthreaded shank diameter
E : Tip length
F_{yb} : Bending yield strength determined in accordance with ASTM F1575 using root diameter D_r
k_α : Withdrawal load reduction factor for inclined screws
L : Screw length
L_{tip} : Tip length
$l_{eff,s}$: Effective embedded thread length in the wood side member
$l_{eff,m}$: Effective embedded thread length in the wood main member
N_a : Allowable tension strength of the screw for use in ASD
N_u : Design tension strength of the screw for use in LRFD
SG_{NDS} : Assigned specific gravity determined in accordance with the NDS
T : Threaded length including tip
t_m : Thickness of wood main member
$t_{s,w}$: Thickness of wood side member
$t_{s,s}$: Thickness of metal side member
W_{90} : Reference unit withdrawal design value for screws installed perpendicular to grain of the wood
W_α : Reference unit withdrawal design value for screws installed at an angle α to the grain of the wood
W_L : Total reference withdrawal design load
W_H : Reference head pull-through design value for partially threaded screws
$Z_\parallel$: Reference lateral design values, loaded parallel to the grain
$Z_\perp$: Reference lateral design values, loaded perpendicular to the grain
$Z_{\perp/\parallel}$: Reference lateral design values, loaded perpendicular to the grain (side member) and parallel (main member)

Z_{end} : Reference lateral design value for screws installed in end-grain of wood

α : Angle between the axis of the fastener and the grain of the applicable wood member

3.2 Rotho Blaas Screws:

The Rotho Blaas self-tapping wood 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 or stainless-steel wire complying with the manufacturer's specifications. Following the head forming and thread rolling processes, the carbon steel screws are heat-treated. The carbon steel screws are zinc plated or coated with EVO coating. EVO coating is a proprietary multi-layer corrosion-resistant coating.

The screw dimensions and strengths are provided in Tables 1 through 4. Screws with intermediate lengths are also available upon request.

3.2.1 Partially-threaded Carbon Steel Screws:

3.2.1.1 HBS and HBS EVO Screws: HBS and HBS EVO screws are available in various diameters and lengths as shown in Table 1A and Figure 1. The screws have a countersunk head with milling ribs under the head. HBS and HBS EVO screws have zinc plating and EVO coating, respectively. HBS and HBS EVO screws are compatible with HUS and HUS EVO countersunk washers described in Section 3.5.1.

3.2.1.2 HBS PLATE and HBS PLATE EVO Screws: HBS PLATE and HBS PLATE EVO screws are available in various diameters and lengths as shown in Table 1B and Figure 1. The screws have a washer head combined with a cylindrical feature under the head. HBS PLATE and HBS PLATE EVO screws have zinc plating and EVO coating, respectively.

3.2.1.3 TBS, TBS MAX and TBS EVO screws: TBS, TBS MAX and TBS EVO screws are available in various diameters and lengths as shown in Table 1C and Figure 1. TBS and TBS EVO screws have zinc plating and EVO coating, respectively. TBS MAX screws are zinc plated.

3.2.2 Fully-threaded Carbon Steel Screws:

3.2.2.1 LBS and LBS EVO Screws: LBS and LBS EVO screws are available in various diameters and lengths as shown in Table 2A and Figure 2. The screws have a round head combined with a cylindrical feature under the head. LBS and LBS EVO screws have zinc plating and EVO coating, respectively.

3.2.2.2 VGZ and VGZ EVO Screws: VGZ and VGZ EVO screws are available in various diameters and lengths as shown in Table 2B and Figure 3. The screws have a cylindrical head. VGZ and VGZ EVO screws have a zinc plating and EVO coating, respectively.

3.2.2.3 VGS and VGS EVO Screws: VGS and VGS EVO screws are available in various diameters and lengths as shown in Table 2C and Figure 3. The screws have either a countersunk or hexagonal star drive head. VGS and VGS EVO screws have zinc plating and EVO coating, respectively. VGS and VGS EVO screws with a countersunk head are compatible with the Rotho Blaas washers described in Section 3.5.

3.2.3 Double-thread Carbon Steel Screws - DGZ, DGZ EVO and CTC Screws: DGZ, DGZ EVO and CTC screws are double threaded and available in various diameters and lengths as shown in Table 3 and Figures 4 and 5. The screws have a cylindrical head. The outside thread diameter and root diameter are the same for both threaded portions of the screw. For the DGZ and DGZ EVO screws, both threads are oriented in the same direction. For the CTC screws, the threads at the head end of the screw are reversed. DGZ and DGZ EVO screws have zinc plating and EVO coating, respectively. CTC screws are zinc plated.

3.2.4 Partially-threaded Stainless Steel Screws:

3.2.4.1 KKF Screws: KKF screws are available in various diameters and lengths as shown in Table 4A and Figure 6. The screws have a washer head combined with a cylindrical feature under the head. The screws are made of martensitic stainless steel Type 410.

3.2.4.2 SHS AS Screws: SHS AS screws are available in various diameters and lengths as shown in Table 4B and Figure 6. The screws have a countersunk head combined with milling ribs under the head. The screws are made of martensitic stainless steel Type 410.

3.2.5 Alternative Product Names: Some of the products addressed in this report are available with alternative product names, as shown in the table below:

PRIMARY PRODUCT DESIGNATION	ALTERNATIVE PRODUCT DESIGNATION
HBS HBS EVO	SNK SNK EVO
HBS PLATE (HBSP) HBS PLATE EVO (HBSP EVO)	KGL KGL EVO
TBS TBS EVO	TLL TLL EVO
LBS	SBL
DGZ	DWZ
KKF	KGA

3.3 Wood Members:

For purposes of connection design, sawn lumber members must have an assigned specific gravity, SG_{NDS}, 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 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 or edge of cross-laminated timber (CLT) panels fabricated with sawn lumber laminations, all 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, $t_{s,w}$, is an absolute value (not a minimum or maximum value). The thickness of the wood main member, t_m, must be adequate to fully encapsulate the screw in the wood.

3.4 Metal Members:

Steel and aluminum side members must have a minimum tensile strength, F_u, equal to 58 ksi (400 MPa) for steel and 38 ksi (262 MPa) for aluminum. The holes in the metal side member for the screws must be predrilled or prepunched, with hole shape and dimension as indicated in this report. For application with VGU 45˚ countersunk washer, the geometry requirements of the slotted holes and the metal plate thickness are shown in Figure 8.

3.5 Rotho Blaas Steel Washers:

3.5.1 HUS and HUS EVO Countersunk Washers: HUS and HUS EVO countersunk washers are available for use with countersunk screws used in wood-to-wood and metal-to-wood connections. The HUS and HUS EVO washers are formed from carbon steel and have zinc plating and EVO coating, respectively. See Figure 7 for washer dimensions and a depiction of the washer.

3.5.2 VGU 45˚ and VGU EVO 45° Countersunk Washers: VGU 45˚ and VGU EVO 45° countersunk washers are available for use with VGS and VGS EVO screws with countersunk heads used in metal-to-wood connections with the screws oriented at 45˚ angle to the face of the members. VGU 45˚ and VGU EVO 45° countersunk washers are formed from carbon steel and have zinc plating and EVO coating, respectively. See Figure 8 for washer dimensions and a depiction of the washer.

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.

Tabulated design and connection geometry information for zinc plated, carbon steel screws also applies to EVO coated screws.

4.1.1 Screw Strength: Allowable screw tensile strength (N_a), design screw tensile strength (N_u) and minimum bending yield strength (F_{yb}) for the screws are shown in Tables 1 through 4.

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 or metal side member, the allowable connection strength must not be increased by the adjustment factors specified in the NDS.

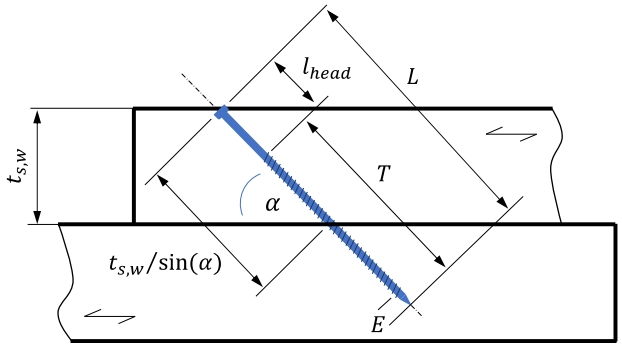
4.1.3 Design of Metal Parts: Design of connections using metal side plates must comply with Section 11.2.3 of the NDS (Section 10.2.3 of NDS-12 and NDS-05 for the 2012 and 2009 IBC).

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).

4.1.6 Effective Embedded Thread Length: The effective embedded thread penetration of inclined screws is the portion of the thread in the applicable wood member, considering the tip length, head recess, washer thickness, etc. as applicable and an installation tolerance l_{tol} according to the report holder recommendations.

For example, for screws installed flush to the surface of a wood side member the determination is depicted below:



$$l_{eff,s} = (t_{s,w}/\sin(\alpha)) - l_{head} - l_{tol} \le T - E \quad \text{(Eq. 1)}$$

$$l_{eff,m} = (L - (t_{s,w}/\sin(\alpha))) - E - l_{tol} \le T - E \quad \text{(Eq. 2)}$$

Where:

l_{head} : the sum of the length of the fastener head and the unthreaded shank ($L - T$).

l_{tol} : 3/16 inch (5 mm)

4.1.7 Reference Design Values for Limit States of Withdrawal and Head Pull-Through: Fasteners are typically installed perpendicular to the grain for tensile (axial) and lateral loading.

4.1.7.1 Reference Withdrawal Design Values: Reference withdrawal design values, W_{90}, in pounds per inch of effective embedded thread, l_{eff}, for screws installed perpendicular ($\alpha = 90°$) to the face of the wood member are shown in Table 5. The total reference withdrawal design load value, W_L, for a given angle α, must be calculated using Equation 3.

$$W_L = W_{90} \cdot k_\alpha \cdot l_{eff} = W_\alpha \cdot l_{eff} \le N_a \quad \text{[lbf]} \quad \text{(Eq. 3)}$$

with $l_{eff} \ge 6D$

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

(continued)

Calculation of the adjustment factor k_α:

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

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

4.1.7.2 Reference Head Pull-through Design Values: Reference head pull-through values, W_H, for partially threaded carbon steel screws are shown in Table 6 for $90° \geq \alpha \geq 30°$. Angles $30° > \alpha \geq 0°$ are outside the scope of this evaluation. No reduction factor is applied for inclined fasteners. For DGZ and DGZ EVO screws, reference head pull-through values for screws installed at an angle to grain of 60° are shown in Table 7. For fully threaded screws, the reference head pull-through value is the reference withdrawal design value, W_L, for $l_{eff,s}$, determined in accordance with Section 4.1.7.1.

4.1.8 Lateral Connections Designed in Accordance with the NDS: Reference lateral design values for screws addressed in this report may be determined in accordance with the NDS, subject to the following conditions:

1. The applicable bending yield strength, F_{yb}, from Tables 1 through 4 must be used for design.
2. The minor thread diameter, D_r, must be used where '*D*' is referenced in Tables 12.3.1A, 12.3.1B and 12.3.3 of the NDS (Tables 11.3.1A, 11.3.1B and 11.3.3 of the 2012 NDS for the 2015 and 2012 IBC; Tables 11.3.1A, 11.3.1B and 11.3.2 of the 2005 NDS for the 2009 IBC).
3. SG_{NDS} must be 0.55 or less.
4. The wood side member thickness, $t_{s,w}$, must be in accordance with the report holder's recommendations.
5. The metal side member thickness, $t_{s,s}$, must be in accordance with the report holder's recommendations and must have properties complying with Section 3.4.
6. The minimum screw penetration into the main member must be $6D$, including the tip length.
7. For installation in end grain, the minimum screw penetration must be 6D.
8. The dowel bearing length L_m must be taken as the screw penetration less $L_{tip}/2$.
9. Spacing, edge and end distance must be in accordance with Table 8 or 12, as applicable, and as needed to prevent splitting of the wood.

4.1.9 Combined Lateral and Withdrawal 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).

4.1.10 Design of Lateral Connections with Screws Installed at an Angle to the Grain: Connections used to transfer lateral load between side members and a main member using groups of Rotho Blaas screws installed at an angle between 90° and 0° to the wood grain must be designed in accordance with this section.

4.1.10.1 Design Method - General: The design method applies to wood-to-wood and metal-to-wood connections where the lateral load is transferred between the side and main member through the axial capacity of the screw installed at an angle $90° > \alpha \geq 0°$ to the wood grain. The following conditions apply:

- The connection consists of one or two side members, which can be either wood or metal, and a wood main member.
- Sawn lumber, GL and CLT must comply with Section 3.3.
- For metal-to-wood connections with a VGU 45° countersunk washer, VGS and VGS EVO screws must be used and installed at 45° angle to the metal side member as shown in Figure 8.
- The minimum screw penetration in both the wood main and side member must be $8D$, 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.
- The minimum thickness of the wood main and side member must be in accordance with the report holder's published design manual for the respective application.
- The metal thickness ($t_{s,s}$) of the side plate used in combination with VGU 45° countersunk washer must comply with Figure 8.
- 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.
- For the effective number of screws loaded axially refer to the report holder's published recommendation.

4.1.10.2 Wood-to-wood Connections: The allowable lateral load for a wood-to-wood connection must be determined as follows:

- Determine the minimum effective embedded thread length of all screws in the connection in accordance with Section 4.1.6.
- Determine the reference withdrawal design value, W_L, in accordance with Section 4.1.7.1 for the main member and apply adjustment factors in accordance with the NDS to determine allowable withdrawal strength.
- Determine the reference head pull-through design value in accordance with Section 4.1.7.2 for the side member, as applicable, and apply adjustment factors in accordance with the NDS to determine allowable head pull-through strength or withdrawal strength, as applicable.
- The allowable axial capacity of the screw is the minimum of the allowable withdrawal strength in the main member, the allowable head pull-through or withdrawal strength in the side member and the allowable screw tension strength.
- The allowable lateral design load for one screw in a wood-to-wood connection is the allowable axial capacity of the screw, projected along the load vector.
- The structural wood members must be checked for load-carrying capacity in accordance with Section 4.1.4.
- Group effects must be considered when using multiple screws in one connection.

4.1.10.3 Metal-to-wood Connections: The allowable lateral load for a metal-to-wood connection with a metal side member and a wood main member must be determined as follows:

- Determine the minimum effective embedded thread length of all screws in the connection in accordance with Section 4.1.6.
- Determine the reference withdrawal design value in the wood member, W_L, in accordance with Section 4.1.7.1, and apply adjustment factors in accordance with the NDS to determine allowable withdrawal strength.
- The allowable axial capacity of the screw is the lesser of the allowable withdrawal strength, the metal pull-over strength (outside the scope of this report) and the allowable screw tension strength.
- The allowable lateral design load for one screw in a metal-to-wood connection is the allowable axial capacity of the screw, projected along the load vector.
- For applications with a VGU 45° countersunk washer and VGS and VGS EVO screws, the failure mode of metal washer pull-over does not govern.
- The metal member must be checked for load-carrying capacity in accordance with Section 4.1.3 and the wood member must be checked for load-carrying capacity in accordance with Section 4.1.4.
- Group effects must be considered when using multiple screws in one connection.

4.1.10.4 Stiffness: The expected axial slip modulus (K_{axial}) along the screw axis at the allowable load level of the threaded part of the screw must be determined in accordance with Equation 7 as follows:

$$K_{axial} = 92000 \times D \times l_{eff,min} \quad \text{[lbf/inch]} \quad \text{(Eq. 6)}$$

$l_{eff,min}$: minimum of $l_{eff,m}$ and $l_{eff,s}$ for wood-to-wood connections. $l_{eff,m}$ for metal-to-wood connections [inch]

4.1.11 Reference Lateral Design Values Based on Testing:

4.1.11.1 Wood-to-wood Side-grain Connections: Reference lateral design values for tested wood-to-wood connections for screws installed perpendicular to the faces of the wood members are shown in Table 9.

4.1.11.2 Metal-to-wood End-Grain Connections: For metal-to-wood connections with LBS/LBS EVO or HBS PLATE/HBS PLATE EVO screws installed in the end-grain, reference lateral design values determined from testing are given in Table 11. The metal side member must have a minimum tensile strength, F_u, equal to 38 ksi (262 MPa) and minimum thickness of 0.197 inches. The hole in the metal side member must be pre-drilled or prepunched and must be no greater than 0.244 inch (6.2 mm) for LBS and HBS PLATE screws with D_{nom} = 0.20 inches, 0.303 inch (7.7 mm) for LBS screws with D_{nom} = 0.28 inches and 0.591 inches (15.0 mm) for HBS PLATE screws with D_{nom} = 0.48 inches. Minimum fastener spacing and edge distance must be in accordance with Table 12 and Figure 9.

4.2 Corrosion Resistance:

The EVO coated screws and washers may 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 and washers can be considered as an equivalent alternative to hot-dip galvanized fasteners complying with ASTM A153 Class D. EVO coated fasteners must be limited to use in the Exposure Conditions 1 and 3, as shown in Table 13.

4.3 Installation:

Rotho Blaas self-tapping screws must be installed in accordance with the report holder's published installation instructions and 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 Tables 8, 10 and 12, as applicable, whichever is more restrictive.

For TBS, TBS MAX and TBS EVO screws the underside of the flat screw head must bear against the surface of the wood side member. For LBS, LBS EVO, HBS PLATE, HBS PLATE EVO and KKF screws, and VGS and VGS EVO screws with a hexagonal head, the underside of the flat portion of the screw head must bear against the surface of the metal plate.

For HBS, HBS EVO, VGZ, VGZ EVO, DGZ, DGZ EVO, CTC and SHS AS screws, and VGS and VGS EVO screws with a countersunk head, the top of the screw head must either be flush with the surface of the wood side member or recessed into the wood side member, if a pre-drilled hole of the size of the screw head is made. Side member thickness requirements given in this report apply to the wood dimension below the top of the screw head.

For screws with countersunk heads (HBS, HBS EVO, VGS, VGS EVO) installed in combination with HUS and HUS EVO countersunk washer, the underside of the countersunk washer must bear against the wood or metal side member with the underside of the screw head seated in the washer.

For wood-to-wood and metal-to-wood connections with screws installed at 45˚ angle to the grain, a 45˚ angle assembly jig is offered and recommended by the report holder to facilitate the installation.

Predrilling is required for $SG_{NDS} > 0.55$. For $SG_{NDS} \leq 0.55$ predrilling is optional. The respective drill hole diameter requirements are given below.

Nominal Diameter D_{nom} (inch)	Drill Hole Diameter for $SG_{NDS} \leq 0.55$ (inch)	Drill Hole Diameter for $SG_{NDS} > 0.55$ (inch)
0.20	1/8	9/64
0.21	9/64	5/32
0.23	9/64	5/32
0.24	5/32	5/32
0.28	5/32	13/64
0.32	13/64	15/64
0.36	13/64	15/64
0.40	15/64	9/32
0.44	15/64	9/32
0.48	9/32	5/16
0.52	5/16	23/64

Screws must not be overdriven. The screws must be installed by turning with a power driver, not by driving with a hammer, using the bit size 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 February 2022.

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 ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-4645) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, the packaging for the self-tapping wood screws is labeled with the product designation (or alternative product designation shown in Section 3.2.5), the screw size (D_{nom}) and length (in both inches and millimeters), the thread length and the head type and drive size.

7.3 The packaging for the Rotho Blaas washers is labeled with the product type.

7.4 "EVO coating" is either reported on the label or in the leaflet inside the container of the self-tapping wood screws and washers with EVO coating.

7.5 The screw head is marked with the product family type according to Figures 1 through 6.

7.6 The report holder's contact information is the following:

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TABLE 1A—HBS AND HBS EVO SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.14 (3.5mm)	1 9/16	11/16	0.276	TX 15	0.096	0.089	0.138	0.138	257,000	320	490
	1 3/4 to 1 15/16	15/16									
0.16 (4mm)	1 3/16 to 1 3/8	11/16	0.315	TX 20	0.108	0.100	0.157	0.157	248,000	430	640
	1 9/16	15/16									
	1 3/4 to 1 15/16	1 3/16									
	2 3/8	1 3/8									
	2 3/4 to 3 1/8	1 9/16									
0.18 (4.5mm)	1 9/16	15/16	0.354	TX 20	0.124	0.110	0.177	0.177	253,500	540	810
	1 3/4 to 1 15/16	1 3/16									
	2 3/8	1 3/8									
	2 3/4 to 3 1/8	1 9/16									
0.20 (5mm)	1 9/16 to 1 15/16	15/16	0.394	TX 25	0.144	0.134	0.197	0.197	220,000	690	1030
	2 3/8	1 3/16									
	2 3/4	1 3/8									
	3 1/8	1 9/16									
	3 1/2	1 3/4									
	4	1 15/16									
	4 3/4	2 3/8									
0.24 (6mm)	1 9/16 to 1 15/16	1 3/8	0.472	TX 30	0.169	0.156	0.236	0.236	200,000	1180	1780
	2 3/8	1 3/16									
	2 3/4 to 3 1/8	1 9/16									
	3 1/2 to 4	1 15/16									
	4 3/8 to 5 1/8	2 3/8									
	5 1/2 to 15 3/4	2 15/16									
0.32 (8mm)	3 1/8 to 4	2 1/16	0.571	TX 40	0.228	0.213	0.315	0.315	180,000	2040	3060
	4 3/4 to 5 1/2	2 3/8									
	6 1/4 to 11	3 1/8									
	11 3/4 to 23 5/8	4									
0.40 (10mm)	3 1/8 to 4	2 1/16	0.719	TX 40	0.276	0.252	0.394	0.394	185,000	2700	4060
	4 3/4 to 5 1/2	2 3/8									
	6 1/4 to 11	3 1/8									
	11 3/4 to 23 5/8	4									
0.48 (12mm)	4 3/4 to 11	3 1/8	0.817	TX 50	0.315	0.268	0.472	0.472	190,000	3060	4600
	12 5/8 to 39 3/8	4 3/4									

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

[1]The overall length is measured from the top of the head to the screw tip, as shown in Figure 1.

TABLE 1B—HBS PLATE (HBSP) AND HBS PLATE EVO (HBSP EVO) SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.20 (5mm)	1 15/16	1 3/16	0.380	TX 25	0.144	0.134	0.197	0.197	220,000	690	1030
	2 3/8	1 3/8									
	2 3/4	1 9/16									
	3 1/8	1 15/16									
0.24 (6mm)	3 1/8	1 15/16	0.472	TX 30	0.169	0.156	0.236	0.236	200,000	1180	1780
	3 1/2	2 3/16									
0.32 (8mm)	1 9/16	1 1/4	0.571	TX 40	0.228	0.213	0.315	0.315	180,000	2040	3060
	2 3/8	2 1/16									
	3 1/8	2 3/16									
	4	2 15/16									
	4 3/4	3 3/4									
	5 1/2	4 3/8									
	6 1/4	5 1/8									
0.40 (10mm)	2 3/8	2 1/16	0.719	TX 40	0.276	0.252	0.394	0.394	185,000	2700	4060
	3 1/8	2 3/8									
	4	2 15/16									
	4 3/4	3 3/4									
	5 1/2	4 3/8									
	6 1/4	5 1/8									
	7 1/8	6									
0.48 (12mm)	4	2 15/16	0.817	TX 50	0.315	0.268	0.472	0.472	190,000	3060	4600
	4 3/4	3 1/2									
	5 1/2	4 3/8									
	6 1/4	4 3/4									
	7 1/8	5 1/2									
	8	6 1/4									

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

[1]The overall length is measured from the underside of the washer head to the screw tip, as shown in Figure 1.

TABLE 1C—TBS, TBS EVO AND TBS MAX SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
TBS and TBS EVO											
0.24 (6mm)	2 3/8 to 2 3/4	1 9/16	0.610	TX 30	0.169	0.156	0.236	0.236	200,000	1180	1780
	3 1/8 to 3 1/2	1 15/16									
	4	2 3/8									
	4 3/4 to 8	2 15/16									
	8 5/8 to 15 3/4	4									
0.32 (8mm)	1 9/16	1 1/4	0.748	TX 40	0.228	0.213	0.315	0.315	180,000	2040	3060
	2 7/8 to 6 7/8	1 5/16									
	2 3/8 to 4	2 1/16									
	4 3/4 to 5 1/2	3 1/8									
	6 1/4 to 23 5/8	4									
0.40 (10mm)	4	2 1/16	0.984	TX 50	0.276	0.252	0.394	0.394	185,000	2700	4060
	4 3/4 to 5 1/2	2 3/8									
	6 1/4 to 7 1/8	3 1/8									
	8 to 113/4	4									
	12 5/8 to 23 5/8	4 3/4									
0.48 (12mm)	8 to 14 1/4	4 3/4	1.142	TX 50	0.315	0.268	0.472	0.472	190,000	3060	4600
	15 3/4 to 23 5/8	5 1/2									
	31 1/2 to 39 3/8	6 1/4									
TBS MAX											
0.32 (8mm)	4 3/4	4	0.965	TX 40	0.228	0.213	0.315	0.315	180,000	2040	3060
	6 1/4 to 15 3/4	4 3/4									

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

[1]The overall length is measured from the underside of the large washer head to the screw tip, as shown in Figure 1.

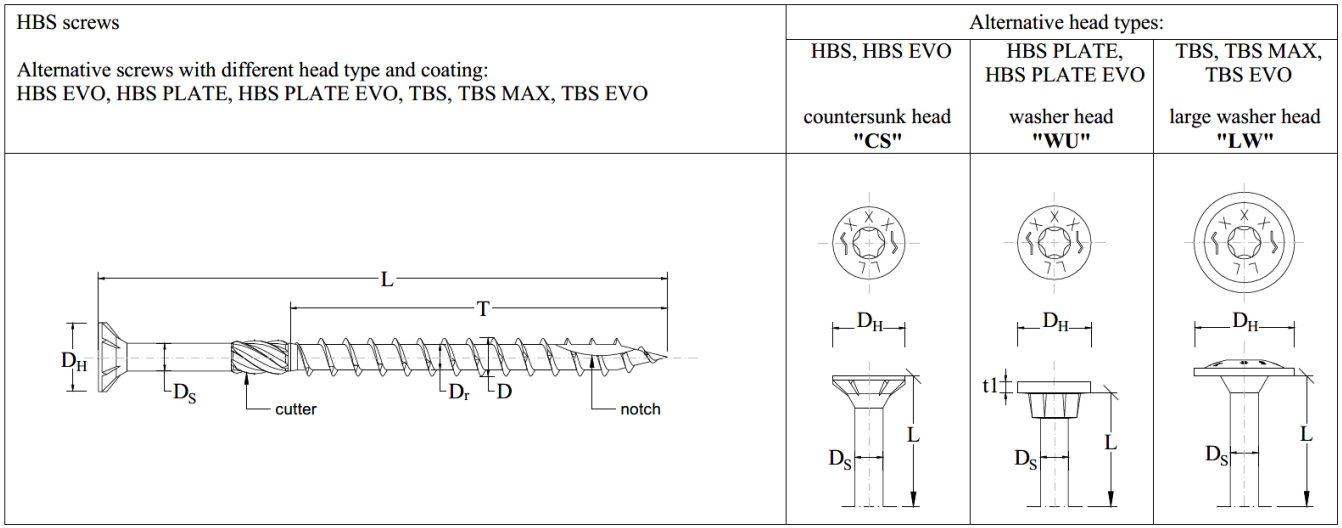


FIGURE 1—TYPICAL PARTIALLY-THREADED CARBON STEEL SCREWS

Note: The presence or absence of the reamer knurl (cutter) and notch depends on screw size and length.

TABLE 2A—LBS AND LBS EVO SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.20 (5mm)	1 to $2^3/_4$	L – 0.157	0.307	TX 20	0.118	0.197	0.197	180,000	740	1110
0.28 (7mm)	$2^3/_8$ to 4	L – 0.197	0.433	TX 30	0.173	0.276	0.276	192,000	1600	2410

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

[1]The overall length is measured from the underside of the head to the screw tip, as shown in Figure 2.

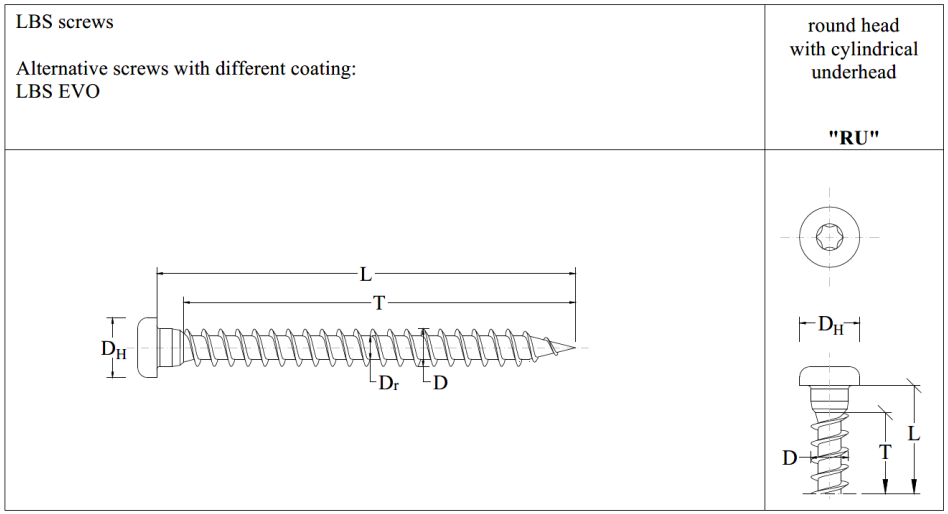


FIGURE 2—LBS AND LBS EVO FULLY THREADED SCREWS

TABLE 2B—VGZ AND VGZ EVO SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.21 (5.3mm)	$3^1/_8$ to $4^3/_4$	L – 0.394	0.315	TX 25	0.142	0.209	0.209	168,000	1000	1550
0.23 (5.6mm)	$5^1/_2$ to $6^1/_4$	L – 0.394	0.315	TX 25	0.150	0.220	0.220	168,000	1100	1680
0.28 (7mm)	$3^1/_8$ to $15^3/_4$	L – 0.394	0.374	TX 30	0.181	0.276	0.276	195,000	1450	2210
0.36 (9mm)	$6^1/_4$ to $23^5/_8$	L – 0.394	0.453	TX 40	0.232	0.354	0.354	180,000	2450	3710
0.44 (11mm)	6 to $39^3/_8$	L – 0.394	0.531	TX 50	0.260	0.433	0.433	170,000	3200	4820

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

[1]The overall length is measured from the top of the head to the screw tip, as shown in Figure 3.

TABLE 2C—VGS AND VGS EVO SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	HEAD STYLE	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.36 (9mm)	Countersunk (CS)	4 to $23^5/_8$	L – 0.394	0.630	TX 40	0.232	0.354	0.354	180,000	2450	3710
0.44 (11mm)	Countersunk (CS)	$3^1/_8$ to $23^5/_8$	L – 0.394	0.760	TX 50	0.260	0.433	0.433	170,000	3200	4820
	Hexagonal (EXA)	$25^9/_{16}$ to $39^3/_8$	L – 0.787	0.669	SW 17						
0.52 (13mm)	Countersunk (CS)	$3^1/_8$ to 10	L – 0.394	0.866	TX 50	0.315	0.512	0.512	161,000	4400	6650
		$11^3/_4$ to $23^5/_8$	L – 0.787	0.866	TX 50						
	Hexagonal (EXA)	$25^9/_{16}$ to $59^1/_{16}$	L – 0.787	0.748	SW 19						

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

[1]The overall length is measured from the underside of the head to the screw tip, as shown in Figure 3.

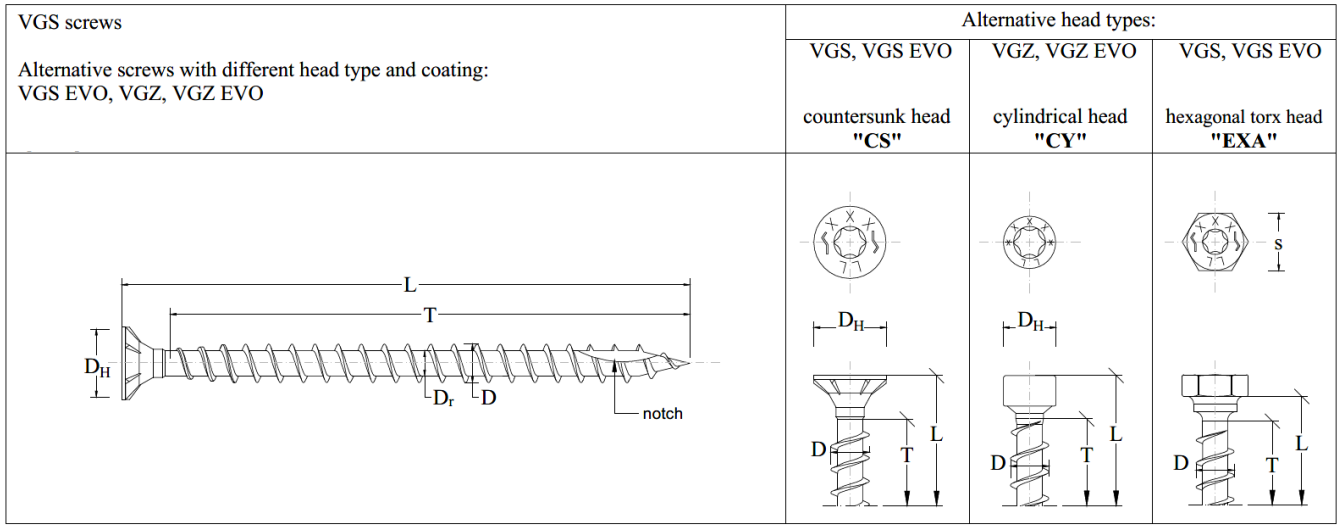


FIGURE 3—TYPICAL VGS, VGS EVO, VGZ AND VGZ EVO FULLY THREADED SCREWS
Note: The presence or absence of the milling ribs and notch depends on screw size and length.

TABLE 3—DGZ, DGZ EVO AND CTC SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	DESIGNATION	OVERALL LENGTH[1] L (inches)	THREAD LENGTH[2] $T_1 - T_2$ (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.28 (7mm)	DGZ DGZ EVO	$8^5/_8$ to 15	$4 - 2^3/_8$	0.374	TX 30	0.197	0.181	0.276	0.276	195,000	1750	2640
	CTC	$6^1/_4$	$4^3/_8 - 1^9/_{16}$	0.374	TX 30	0.197	0.181	0.276	0.276	195,000	1750	2640
		$9^1/_2$	$7^1/_2 - 1^9/_{16}$									
0.36 (9mm)	DGZ DGZ EVO	$9^1/_2$ to $20^1/_2$	$4 - 2^3/_8$	0.453	TX 40	0.256	0.232	0.354	0.354	180,000	2900	4360
	CTC	$6^1/_4$	$4^3/_8 - 1^9/_{16}$	0.453	TX 40	0.256	0.232	0.354	0.354	180,000	2900	4360
		$9^1/_2$	$7^1/_2 - 1^9/_{16}$									

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

[1]The overall length is measured from the top of the head to the screw tip.

[2]Length of thread T_1 includes tip. Length of thread T_2 is located towards the screw head, as shown in Figures 4 and 5.

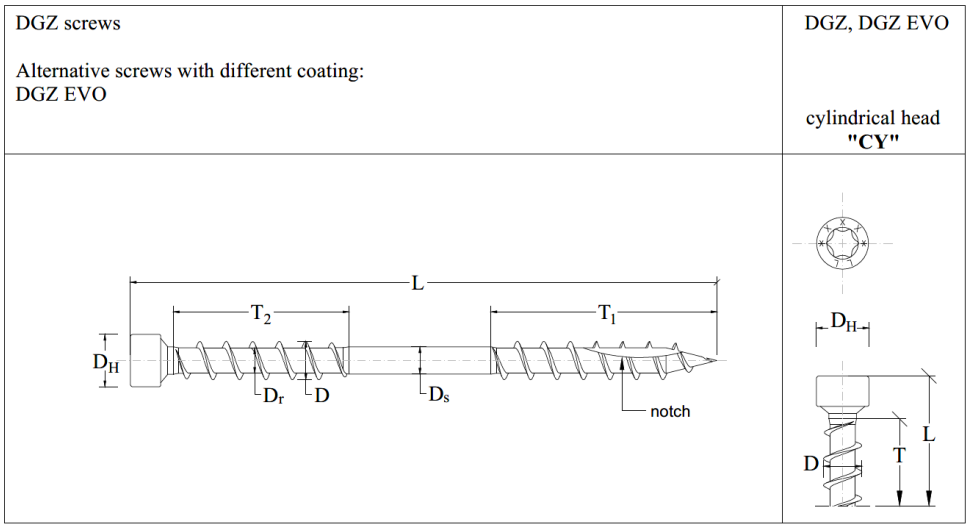


FIGURE 4—DGZ AND DGZ EVO DOUBLE THREADED SCREWS

Note: The presence or absence of the notch depends on screw size and length.

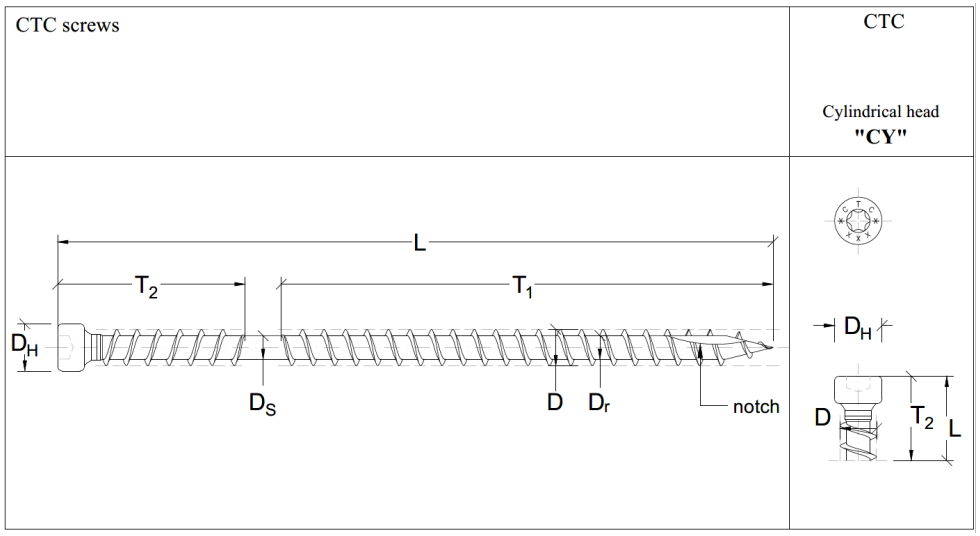


FIGURE 5—CTC DOUBLE THREADED SCREWS

Note: The presence or absence of the notch depends on screw size and length.

TABLE 4A—KKF SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.16 (4mm)	$1^3/_{16}$	$^{11}/_{16}$	0.303	TX 20	0.114	0.102	0.157	0.157	179,000	480	720
	$1^3/_8$	$^{13}/_{16}$									
	$1^9/_{16}$	$^{15}/_{16}$									
	$1^3/_4$ to $1^{15}/_{16}$	$1^3/_{16}$									
0.18 (4.5mm)	$^{13}/_{16}$	$^9/_{16}$	0.343	TX 20	0.132	0.120	0.177	0.177	185,000	740	1120
	$1^9/_{16}$	$^{15}/_{16}$									
	$1^3/_4$ to $1^{15}/_{16}$	$1^3/_{16}$									
	$2^3/_8$	$1^3/_8$									
	$2^3/_4$	$1^9/_{16}$									
0.20 (5mm)	$1^9/_{16}$	$^{15}/_{16}$	0.380	TX 25	0.142	0.128	0.197	0.197	164,000	810	1220
	$1^{15}/_{16}$	$1^3/_{16}$									
	$2^3/_8$	$1^3/_8$									
	$2^3/_4$	$1^9/_{16}$									
	$3^1/_8$	$1^{15}/_{16}$									
	$3^1/_2$	$2^3/_{16}$									
	4	$2^3/_8$									
0.24 (6mm)	$3^1/_8$	$1^{15}/_{16}$	0.459	TX 30	0.169	0.159	0.236	0.236	150,000	1170	1760
	4	$2^3/_8$									
	$4^3/_4$	$2^{15}/_{16}$									

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

[1]The overall length is measured from the underside of the washer head to the screw tip, as shown in Figure 6.

TABLE 4B—SHS AS SCREW DIMENSIONS AND STRENGTHS

NOMINAL DIAMETER D_{nom} [inch (mm)]	OVERALL LENGTH[1] L (inches)	THREAD LENGTH T (inches)	HEAD DIAMETER D_H (inch)	DRIVE TYPE AND SIZE	UNTHREADED SHANK DIAMETER D_S (inch)	ROOT DIAMETER D_r (inch)	OUTSIDE THREAD DIAMETER D (inch)	TIP LENGTH L_{tip} (inch)	SPECIFIED BENDING YIELD STRENGTH $F_{yb,spec}$ (psi)	ALLOWABLE SCREW TENSION STRENGTH (ASD) N_a (lbf)	DESIGN SCREW TENSION STRENGTH (LRFD) N_u (lbf)
0.18 (4.5mm)	$11^5/_{16}$	$1^3/_{16}$	0.295	TX 20	0.132	0.120	0.177	0.177	185,000	740	1120
	$2^3/_8$	$1^3/_8$									
	$2^3/_4$	$1^9/_{16}$									
0.20 (5mm)	$1^{15}/_{16}$	$^{15}/_{16}$	0.335	TX 25	0.142	0.128	0.197	0.197	164,000	810	1220
	$2^3/_8$	$1^3/_{16}$									
	$2^3/_4$	$1^3/_8$									
	$3^1/_8$	$1^9/_{16}$									
	4	$1^{15}/_{16}$									
0.24 (6mm)	$3^1/_8$	$1^9/_{16}$	0.433	TX 30	0.169	0.159	0.236	0.236	150,000	1170	1760
	4	$1^{15}/_{16}$									
	$4^3/_4$	$2^3/_8$									
	$5^1/_2$ to 8	$2^{15}/_{16}$									
0.32 (8mm)	$4^3/_4$ to $5^1/_2$	$2^3/_8$	0.512	TX 40	0.228	0.213	0.315	0.315	180,000	2180	3280
	$6^1/_4$ to 11	$3^1/_8$									

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

[1]The overall length is measured from the top of the head to the screw tip, as shown in Figure 6.

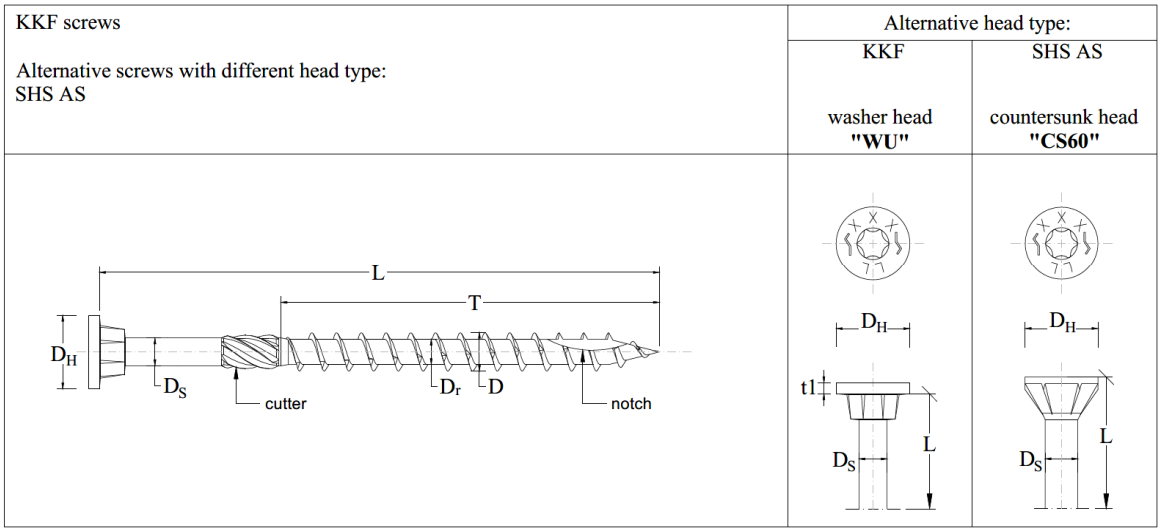
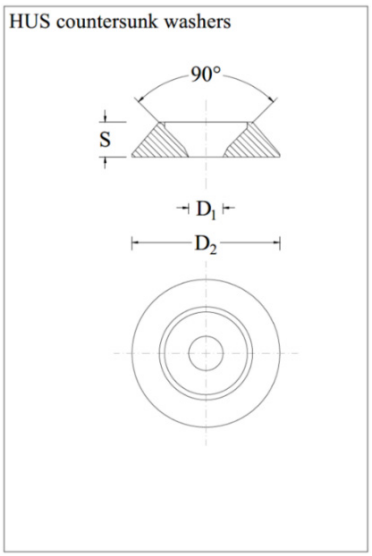


FIGURE 6—KKF AND SHS AS PARTIALLY THREADED STAINLESS-STEEL SCREWS

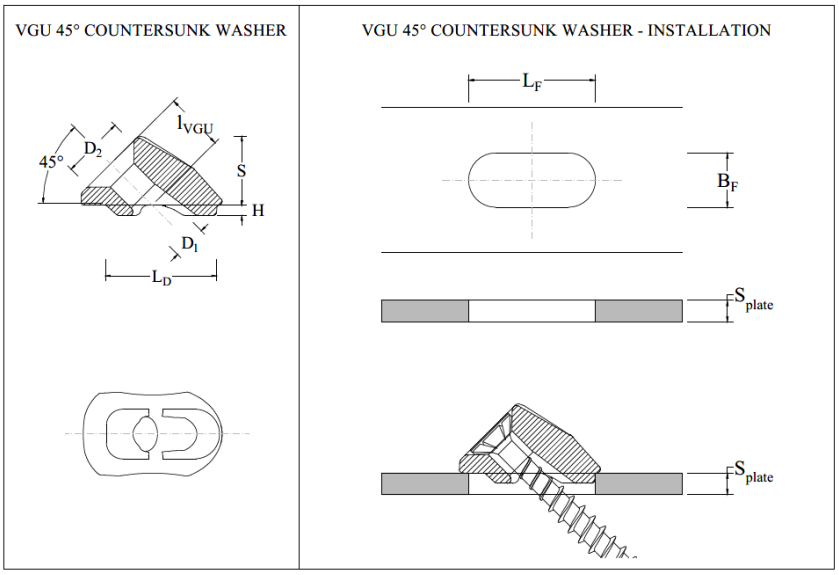
Note: The presence or absence of the reamer knurl (cutter) and notch depends on screw size and length.



DESIGNATION	APPLICABLE SCREW TYPE	D_1 (inch)	D_2 (inch)	S (inch)
HUS6, HUSEVO6	HBS6, HBSEVO6	0.295	0.787	0.177
HUS8, HUSEVO8	HBS8, HBSEVO8, VGS9, VGSEVO9	0.335	0.984	0.217
HUS10, HUSEVO10	HBS10, HBSEVO10, VGS11, VGSEVO11	0.425	1.181	0.256
HUS12, HUSEVO12	HBS12, HBSEVO12 VGS13, VGSEVO13	0.551	1.457	0.335

For **SI:** 1 inch = 25.4 mm.

FIGURE 7—HUS AND HUS EVO COUNTERSUNK WASHER



DESIGNATION	APPLICABLE SCREW TYPE	D_1 (inch)	D_2 (inch)	S (inch)	H (inch)	L_D (inch)	l_{VGU} (inch)	Slotted hole length L_F (inch)	Slotted hole width B_F (inch)	Metal plate thickness S_{plate} (inch)[1]
VGU945	VGS9, VGSEVO9	0.382	0.748	0.787	0.118	1.252	0.740	min. 1.299 max. 1.339	min. 0.551 max. 0.591	min. 0.118 max. 0.472
VGU1145	VGS11, VGSEVO11	0.465	0.906	0.961	0.142	1.528	0.906	min. 1.614 max. 1.654	min. 0.669 max. 0.709	min. 0.157 max. 0.591
VGU1345	VGS13, VGSEVO13	0.551	1.079	1.130	0.169	1.803	1.059	min. 1.929 max. 1.969	min. 0.787 max. 0.827	min. 0.197 max. 0.591

For **SI:** 1 inch = 25.4 mm.

[1]For metal plates with thickness greater than the tabulated maximum, the bottom of the hole must be flared to prevent contact between the screw thread and the metal plate.

FIGURE 8—VGU 45˚ AND VGU 45˚ EVO COUNTERSUNK WASHER

TABLE 5—REFERENCE WITHDRAWAL DESIGN VALUES (W_{90}) FOR INSTALLATION INTO THE FACE OF THE WOOD MEMBER[1]

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	MINIMUM EMBEDDED THREAD LENGTH[2] (inches)	REFERENCE WITHDRAWAL DESIGN VALUE, W_{90} (lbf/in) FOR SELECTED SG_{NDS} VALUES:			
			0.35	0.42	0.49	0.55
HBS	0.14 (3.5mm)	$^{13}/_{16}$	86	99	111	121
HBS / KKF	0.16 (4mm)	$^{15}/_{16}$	86	99	111	121
HBS / KKF / SHS AS	0.18 (4.5mm)	$1^{1}/_{16}$	86	99	111	121
HBS / KKF / SHS AS	0.20 (5mm)	$1^{3}/_{16}$	103	119	133	146
HBS / TBS / HBS PLATE / KKF / SHS AS	0.24 (6mm)	$1^{7}/_{16}$	131	151	171	188
HBS / TBS / TBS MAX / HBS PLATE / KKF / SHS AS	0.32 (8mm)	$1^{7}/_{8}$	172	199	225	247
HBS / TBS / HBS PLATE	0.40 (10mm)	$2^{3}/_{8}$	206	239	270	296
HBS / TBS / HBS PLATE	0.48 (12mm)	$2^{13}/_{16}$	220	255	288	316
VGZ	0.21 (5.3mm)	$1^{1}/_{4}$	102	118	132	145
VGZ	0.23 (5.6mm)	$1^{5}/_{16}$	107	123	139	152
VGZ / DGZ / CTC	0.28 (7mm)	$1^{5}/_{8}$	141	164	185	203
VGZ / VGS / DGZ / CTC	0.36 (9mm)	$2^{1}/_{8}$	192	220	255	280
VGZ / VGS	0.44 (11mm)	$2^{5}/_{8}$	207	240	272	298
VGS	0.52 (13mm)	$3^{1}/_{16}$	235	272	308	338
LBS	0.20 (5mm)	$1^{3}/_{16}$	99	114	128	140
LBS	0.28 (7mm)	$1^{5}/_{8}$	115	132	149	162

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

[1] The determination of the reference withdrawal design values (W_{α}) for screws installed at an angle to the grain between 0° and 90° is addressed in Section 4.1.7.1.

[2]Includes tip length.

TABLE 6—REFERENCE HEAD PULL-THROUGH DESIGN VALUES FOR HBS, TBS AND TBS MAX SCREWS (W_H)

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	HEAD DIAMETER D_H (inch)	MINIMUM SIDE MEMBER THICKNESS $t_{s,w}$ (inches)	REFERENCE HEAD PULL-THROUGH DESIGN VALUE, W_H (lbf) FOR SELECTED SG_{NDS} VALUES:			
				0.35	0.42	0.49	0.55
HBS	0.14 (3.5mm)	0.276	1	51	59	67	73
HBS	0.16 (4mm)	0.315	$1^1/_2$	75	87	98	108
HBS	0.18 (4.5mm)	0.354	$1^1/_2$	95	110	124	136
HBS	0.20 (5mm)	0.394	$1^1/_2$	117	136	153	168
HBS	0.24 (6mm)	0.472	$1^1/_2$	142	165	186	204
HBS	0.32 (8mm)	0.571	$1^1/_2$	220	264	298	327
HBS	0.40 (10mm)	0.719	$1^1/_2$	273	316	357	392
HBS	0.48 (12mm)	0.817	$1^1/_2$	392	453	513	562
TBS	0.24 (6mm)	0.610	$1^1/_2$	182	263	357	450
TBS	0.32 (8mm)	0.748	$1^1/_2$	223	322	438	552
TBS	0.40 (10mm)	0.984	$1^1/_2$	314	452	615	774
TBS MAX	0.32 (8mm)	0.965	1	421	484	545	594

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

TABLE 7—REFERENCE HEAD PULL-THROUGH DESIGN VALUES FOR DGZ AND DGZ EVO SCREWS (W_H)[1]

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	HEAD DIAMETER D_H (inch)	MINIMUM SIDE MEMBER THICKNESS $t_{s,w}$ (inches)	REFERENCE HEAD PULL-THROUGH DESIGN VALUE, W_H (lbf) FORSELECTED SG_{NDS} VALUES:			
				0.35	0.42	0.49	0.55
DGZ	0.28 (7mm)	0.374	$1^1/_2$	191	220	248	270
DGZ	0.36 (9mm)	0.453	$1^1/_2$	196	225	253	277

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

[1] Tabulated values for DGZ screws are applicable to screws installed at 60˚ angle to the grain.

TABLE 8—CONNECTION GEOMETRY REQUIREMENTS FOR FASTENERS INSTALLED PERPENDICULAR TO THE FACE OF WOOD MEMBERS AND INCLINED FASTENERS BASED ON D[1,2,3]

CONDITION		MINIMUM DISTANCE OR SPACING		
		Self-drilled		Predrilled Hole
		$SG_{NDS} < 0.50$	$SG_{NDS} \geq 0.50$	
For screws with D_s of less than $^1/_4$ inch, installed into sawn lumber, structural glued laminated timber (GL) and cross laminated timber (CLT) panels				
End distance (Figure A)	Tension loading parallel to grain (fastener bearing toward end), $a_{3,t}$	15D	20D	12D
	Compression loading parallel to grain (fastener bearing away from end), $a_{3,c}$	10D	15D	7D
	Loading perpendicular to grain, $a_{3,c}$	10D	15D	7D
	Axial loading (fastener withdrawal or head pull-through), $a_{3,a}$ Inclined fastener $a_{1,CG}$ (Figure C)	10D	10D	7D
Edge distance (Figure A)	Loading parallel to grain, $a_{4,c}$	5D	7D	3D
	Loading toward edge, $a_{4,t}$	10D	12D	7D
	Loading away from edge, $a_{4,c}$	5D	7D	3D
	Axial Loading, $a_{4,a}$ Inclined fastener $a_{2,CG}$ (Figure C)	4D	4D	3D
Spacing between fasteners, parallel to grain, a_1 (Figures B and C)	Loading parallel to grain	15D	15D	10D
	Loading perpendicular to grain	10D	10D	5D
	Axial loading	7D	7D	7D
Spacing between fasteners, perpendicular to grain, a_2 (Figures B and C)	Lateral loading	5D	7D	4D
	Axial loading	4D	4D	3D
	Axial loading for crossed screws $a_{2,cross}$ (Figure C)	1.5D	1.5D	1.5D
For screws with D_s equal to or greater than $^1/_4$ inch, installed into sawn lumber, structural glued laminated timber (GL) and cross laminated timber (CLT) panels				
End distance (Figure A)	Tension loading parallel to grain (fastener bearing toward end), $a_{3,t}$	15D	20D	7D
	Compression loading parallel to grain (fastener bearing away from end), $a_{3,c}$	10D	15D	4D
	Loading perpendicular to grain, $a_{3,c}$	10D	15D	4D
	Axial loading (fastener withdrawal or head pull-through), $a_{3,a}$ Inclined fastener $a_{1,CG}$ (Figure C)	10D	10D	4D
Edge distance (Figure A)	Loading parallel to grain, $a_{4,c}$	5D	7D	3D
	Loading toward edge, $a_{4,t}$	10D	12D	4D
	Loading away from edge, $a_{4,c}$	5D	7D	3D
	Axial Loading, $a_{4,a}$ Inclined fastener $a_{2,CG}$ (Figure C)	4D	4D	3D
Spacing between fasteners, parallel to grain, a_1 [4] (Figures B and C)	Loading parallel to grain	15D	15D	5D
	Loading perpendicular to grain	10D	10D	5D
	Axial loading	7D	7D	5D
Spacing between fasteners, perpendicular to grain, a_2 (Figures B and C)	Lateral loading	5D	7D	5D
	Axial loading	5D	5D	5D
	Axial loading for crossed screws $a_{2,cross}$ (Figure C)	1.5D	1.5D	1.5D

For **SI:** 1 inch = 25.4 mm.

[1]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.

[2]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.

[3]Values in Table 8 are applicable for wood-to-wood and steel-to-wood connections.

[4]Spacing, edge and end distance may be reduced in accordance with Table 10, when applicable.

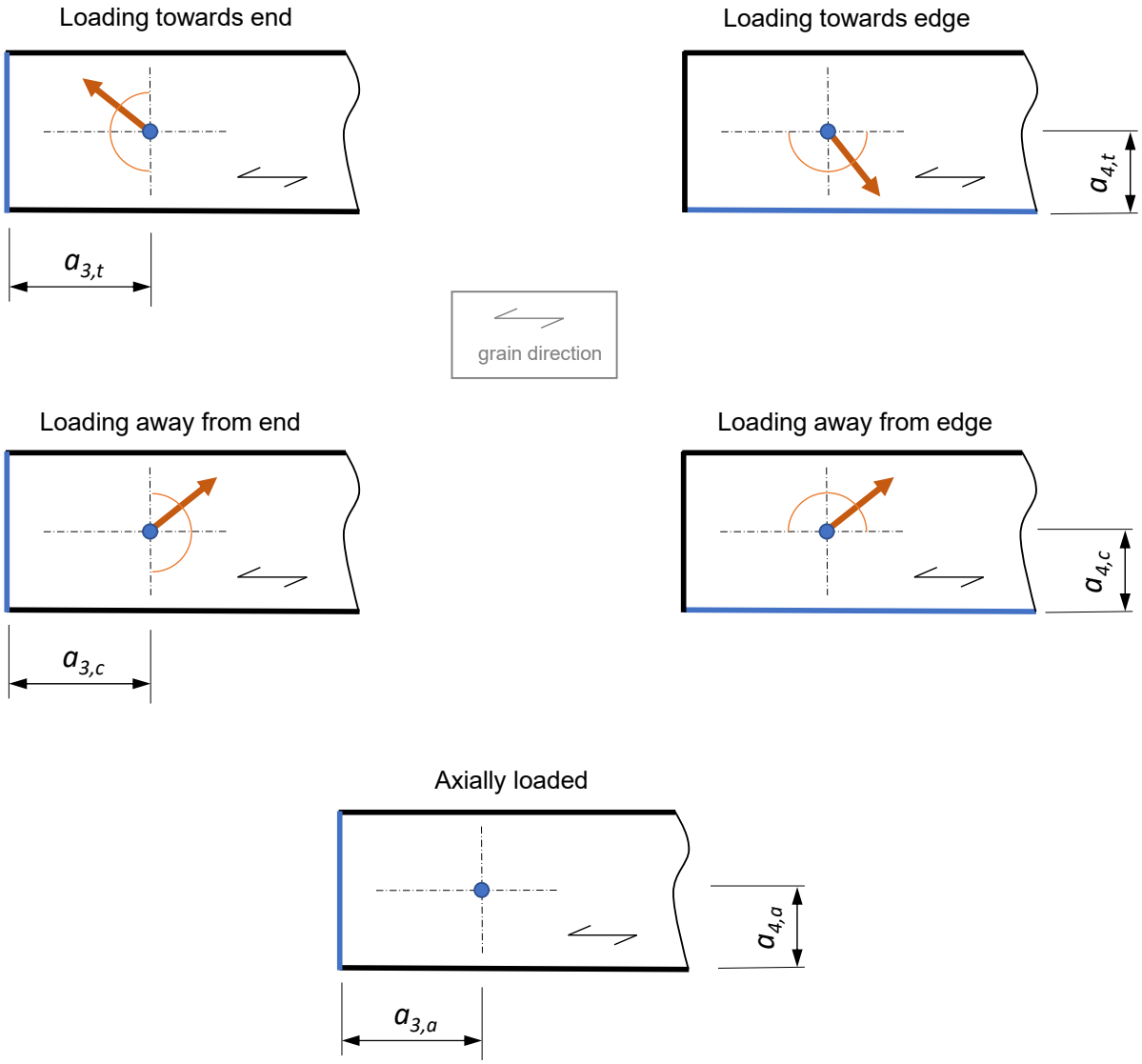


FIGURE A—END AND EDGE DISTANCE DEFINITIONS FOR SCREWS INSTALLED PERPENDICULAR TO GRAIN

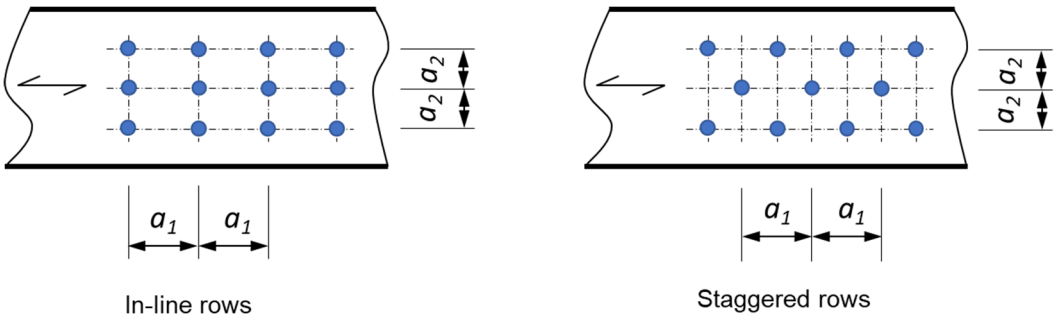


FIGURE B—SPACING DEFINITIONS FOR SCREWS INSTALLED PERPENDICULAR TO GRAIN

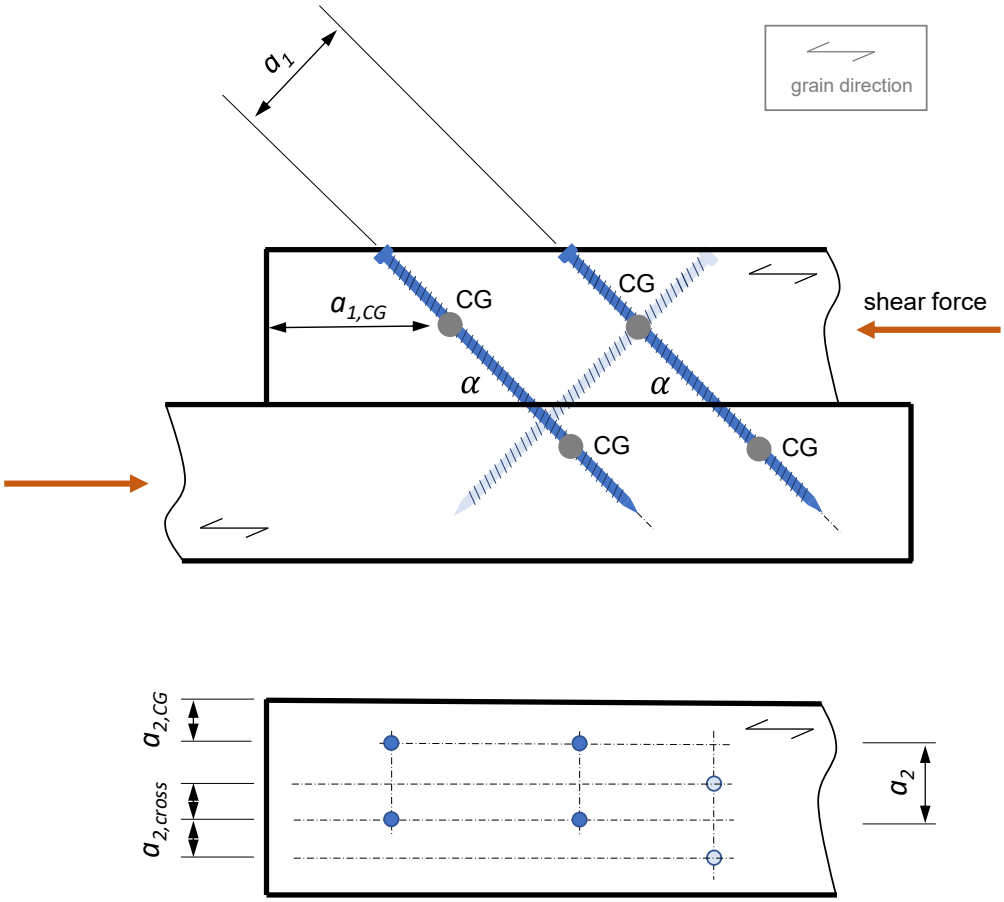


FIGURE C—SPACING DEFINITIONS FOR INCLINED AND CROSSED SCREWS

TABLE 9—REFERENCE LATERAL DESIGN VALUES (Z) FOR TESTED WOOD-TO-WOOD CONNECTIONS WITH PARTIALLY THREADED SCREWS[1]

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	MINIMUM SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS $t_{s,w}$ (inches)	Z (lbf) FOR SELECTED SG_{NDS} VALUES:											
				0.35			0.42			0.49			0.51		
				$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$
HBS / TBS	0.32 (8mm)	$6^1/_4$	$2^1/_4$	207	207	207	245	245	245	282	282	282	292	292	292
	0.40 (10mm)	$6^1/_4$	$2^7/_8$	308	308	308	338	338	338	365	365	365	372	372	372
	0.48 (12mm)	$6^1/_4$	$3^1/_2$	353	353	353	387	387	387	418	418	418	426	426	426

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

[1]See Table 10 for applicable connection geometry requirements.

TABLE 10—REDUCED CONNECTION GEOMETRY REQUIREMENTS BASED ON TESTING OF WOOD-TO-WOOD CONNECTIONS WITH HBS, TBS AND HBS PLATE SCREWS[1,2,3,4]

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	MINIMUM SIDE MEMBER THICKNESS $t_{s,w}$ (inches)	CONDITION		MINIMUM REQUIREMENT	
					$SG_{NDS} < 0.48$	$0.48 \le SG_{NDS} \le 0.51$
HBS / TBS / HBS PLATE	0.32 (8mm)	$2^1/_4$	Spacing between screws, parallel to grain, a_1 (Figure B)	Loading parallel to grain	10D	See Table 8
	0.40 (10mm)	$2^7/_8$			10D	See Table 8
	0.48 (12mm)	$3^1/_2$			10D	See Table 8
	0.32 (8mm)	$2^1/_4$		Loading perpendicular to grain	5D	7D
	0.40 (10mm)	$2^7/_8$			5D	7D
	0.48 (12mm)	$3^1/_2$			5D	7D

For **SI:** 1 inch = 25.4 mm.

[1]Screw spacing must be sufficient to prevent splitting of the wood, or as required by this table, whichever is the more restrictive.
[2]Wood member stresses must be checked in accordance with Section 11.1.2 and Appendix E of the NDS, and screw spacing may need to be increased accordingly.
[3]Tabulated values are applicable for connections with self-drilled screws.
[4]For conditions not addressed above, refer to Table 8 for connection geometry requirements.

TABLE 11—REFERENCE LATERAL DESIGN VALUES (Z) FOR TESTED METAL-TO-WOOD CONNECTIONS WITH PARTIALLY AND FULLY THREADED SCREWS[1]

SCREW DESIGNATION	NOMINAL DIAMETER D_{nom} [inch (mm)]	MINIMUM SCREW LENGTH, L (inches)	SIDE MEMBER THICKNESS[3] $t_{s,w}$ (inches)	Z_{end} (lbf) FOR SELECTED SG_{NDS} VALUES:			
				0.35	0.42	0.49	0.51
LBS	0.20 (5mm)	$2^3/_4$	0.236	95	112	128	132
	0.28 (7mm)	$3^1/_8$	0.236	195	226	255	263
HBS PLATE	0.20 (5mm)	$1^{15}/_{16}$	0.236	84	108	125	129
	0.48 (12mm)[2,4]	$4^3/_4$	0.250	179	201	223	228

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

[1]See Table 12 for applicable connection geometry requirements.
[2]Rereference lateral design values have been limited to values determined in accordance with the NDS.
[3]Unless otherwise noted, the metal side member must have a minimum tensile strength, F_u, equal to 38 ksi (262 MPa) and minimum thickness of 0.197 inches.
[4]The side member must be steel and have a minimum tensile strength, F_u, equal to 58 ksi (400 MPa) and minimum thickness of 0.25 inches.

TABLE 12— END GRAIN SPACING AND DISTANCES FOR METAL TO WOOD CONNECTIONS BASED ON TESTING

CONDITION	LBS SCREWS		HBS PLATE SCREWS		
	D_{nom} = 0.20 inch (5mm)	D_{nom} = 0.28 inch (7mm)	D_{nom} = 0.20 inch (5mm)	D_{nom} = 0.48 inch (12mm)	
	$SG_{NDS} \leq 0.51$		$SG_{NDS} \leq 0.51$	$SG_{NDS} < 0.48$	$0.48 \leq SG_{NDS} \leq 0.51$
Spacing between screws - horizontal, $a_{1,H}$	7D	10.7D	7D	5D	7D
Spacing between screws - vertical, $a_{1,V}$	7D	7.1D	7D	8D	12D
Edge distance - horizontal, loading away from edge, $a_{4,c,H}$	4D	3.4D	4D	5D	7D
Edge distance - vertical, loading away from edge, $a_{4,c,V}$	6.5D	5D	6.5D	10D	15D
Edge distance, loading towards edge, $a_{4,t}$	12.5D	10.7D	12.5D	15D	20D

[1]See Figure 9 for fastener layout.

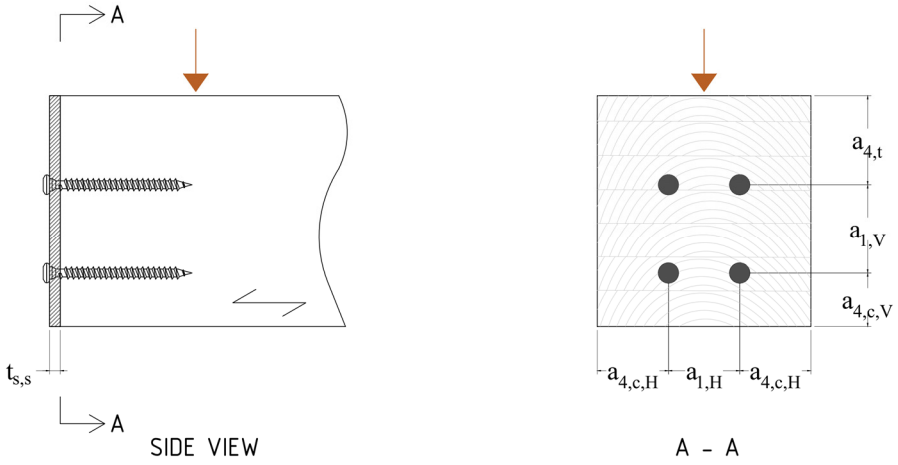


FIGURE 9— END GRAIN SPACING AND DISTANCES FOR LBS AND HBS PLATE SCREWS FOR METAL TO WOOD CONNECTIONS (BASED ON TESTING)

TABLE 13—APPLICABLE EXPOSURE CONDITIONS

EXPOSURE CONDITION	TYPICAL APPLICATIONS	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.

ICC-ES Evaluation Report

ESR-4645 FBC and FRC Supplement

Issued October 2023

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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 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Rotho Blaas self-tapping screws described in ICC-ES evaluation report ESR-4645 have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2023 *Florida Building Code—Building*
- 2023 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Rotho Blaas self-tapping screws and washers, described in ICC-ES evaluation report ESR-4645, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential.*, The design requirements must be determined in accordance with the *Florida Building Code—Building* or the *Florida Building Code—Residential,* as applicable. The installation requirements noted in ICC-ES evaluation report ESR-4645 for the 2021 *International Building Code*® meet the requirements of the *Florida Building Code—Building* and the *Florida Building Code—Residential,* as applicable.

Use of the Rotho Blaas self-tapping screws and washers has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code-Building* or the *Florida Building Code-Residential*.

For products falling under Florida Rule 61G20-3, verification that the report holder's quality assurance program is audited by a quality assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the evaluation report, reissued March 2023 and revised October 2023.