ICC-ES Evaluation Report

ESR-5931

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES **Section: 06 05 23—Wood, Plastic, and Composite Fastenings** **Section: 06 05 23.20—Screws**	**REPORT HOLDER:** **ADOLF WURTH GMBH & CO. KG**	**EVALUATION SUBJECT:** **WURTH SELF-TAPPING SCREWS**	

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2024, 2021 and 2018 *International Building Code®* (IBC)
- 2024, 2021 and 2018 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

Wurth self-tapping screws are alternate dowel-type threaded fasteners used in engineered wood-to-wood and steel-to-wood connections that are designed in accordance with the IBC. The fasteners may be used under the IRC when an engineered design is submitted in accordance with IRC Section R301.1.3.

3.0 DESCRIPTION

3.1 Notations and Symbols:

a	=	Connection geometry parameter (See Tables 8A and 8B.)
D	=	Outside thread diameter
D_H	=	Diameter of fastener head or integral washer
D_{nom}	=	Fastener size designation
D_r	=	Minor thread (root) diameter
D_s	=	Unthreaded shank diameter
F_u	=	Minimum specified tensile strength of steel material
$F_{yb,spec}$	=	Minimum specified bending yield strength, determined in accordance with ASTM F1575 using D_r.
K	=	Head thickness measured as shown in Figures 1 through 9.
L	=	Specified fastener length in mm (See Figures 1 through 9.)

$L_{eff,m}$ = Effective embedded thread length in the wood main member (See Section 4.1.3.)

$L_{eff,s}$ = Effective embedded thread length in the wood side member (See Section 4.1.3.)

$L_{emb,l}$ = Minimum required embedded fastener length in holding member, including tip, applicable to tabulated lateral design values

L_{nom} = Nominal fastener length in fractional inches (See Figures 1 through 9.)

L_{thread} = Length of thread including tip

L_{tip} = Length of tip

L_{un} = Length of unthreaded portion of the fastener, measured from the head of the fastener to the start of the threads (See Section 4.1.3)

N_a = Allowable tension strength of the fastener for use in ASD

N_u = Design tension strength of the fastener, for use in LRFD

R_α = Reduction factor for withdrawal resistance of inclined fasteners (See Section 4.1.4.)

SG_{eq} = Equivalent specific gravity for structural composite lumber, as reported by ICC-ES

SG_{NDS} = Assigned specific gravity (See Section 3.3.2.)

$t_{s,s}$ = Thickness of steel side member

$t_{s,w}$ = Thickness of wood side member

V_a = Allowable shear strength of the fastener for use in ASD

V_u = Design shear strength of the fastener, for use in LRFD

W = Reference unit withdrawal design value for fasteners installed perpendicular to face of the wood

W_H = Reference head pull-through design value

Z = Reference lateral design value

$Z_{\parallel}$ = Reference lateral design value for fasteners loaded parallel to the wood grain

$Z_{\perp}$ = Reference lateral design value for fasteners loaded perpendicular to the wood grain

α = Angle between the axis of the fastener and the grain of the applicable wood member, degrees

3.2 Screw Families:

3.2.1 ASSY 4 Screws: ASSY 4 screws are partially-threaded, self-tapping screws which have a sharp point. The screws typically have a cutting feature within the threaded portion of the screw. Various head styles are available, as shown in Figures 1 through 4. The heads have a recess intended to receive a proprietary RW bit or a TORX bit. The specified diameters and other dimensions are provided in Table 1.

3.2.2 ASSYplus VG 4 Wood-drilling Screws: ASSYplus VG 4 screws are fully-threaded, self-tapping screws which have a drilling point. Various head styles are available, as shown in Figures 5 through 9. The heads have a recess intended to receive a proprietary RW bit or a TORX bit, except for the screws with the reverse head style, which have no recess. The specified diameters and other dimensions are provided in Table 2.

3.3 Materials:

3.3.1 Screws: The screws are manufactured from carbon steel wire complying with the documented specifications. After the heads are formed and the threads are rolled, the screws are hardened, in accordance with the documented specifications. The screws have a zinc or zinc flake coating plus a lubricant. The zinc coating thickness is a minimum of 0.0002 inch (5 µm).

3.3.2 Wood Members: Wood members may be sawn lumber; structural glued laminated timber (glulam); cross-laminated timber (CLT) panels; parallel strand lumber (PSL) and laminated veneer lumber (LVL), as applicable. PSL and LVL are types of structural composite lumber (SCL). See Sections 4.1.4 through 4.1.7 for specific wood materials considered in the determination of design values. Use of the screws in engineered wood products other than those addressed above is outside the scope of this report.

For purposes of connection design, sawn lumber, glulam and CLT members must have SG_{NDS} as indicated in the tables in this report, and the moisture content must be less than or equal to 19 percent at the time of screw installation and while in service. SG_{NDS} for sawn lumber is the assigned specific gravity for the applicable grade mark, which must be determined in accordance with Table 12.3.3A of the ANSI/AWC National Design Specification for Wood Construction® (NDS) or the latest NDS Supplement. SG_{NDS} for glulam members is the Specific Gravity for Fastener Design addressed in Tables 5A through 5D of the NDS Supplement. When designing connections with screws installed into CLT panels, all of the laminations must have a minimum SG_{NDS} as indicated in the tables in this report.

For SCL, the moisture content at the time of installation and in service must be in accordance with the applicable ICC-ES evaluation report on the SCL. The SCL must have a minimum equivalent specific gravity, SG_{eq}, given in the applicable ICC-ES evaluation report, of 0.50.

The thickness of the wood main member, t_m, must be sufficient to ensure that the tip of the screw is embedded in the wood, with a minimum thickness of wood beyond the tip (cover) of $^3/_8$ inch (9.5 mm). Unless noted otherwise, the minimum thickness of both main and side members must also be as follows: $^{15}/_{16}$ inch (24 mm) for $^{15}/_{64}$-inch-diameter (6 mm) screws; $1^3/_{16}$ inches (30 mm) for $^5/_{16}$-inch-diameter (8 mm) screws; $1^9/_{16}$ inches (40 mm) for $^3/_8$-inch-diameter (10 mm) screws; $3^3/_{16}$ inches (80 mm) for $^1/_2$-inch-diameter (12 mm) screws; and $3^{15}/_{16}$ (100 mm) for $^9/_{16}$-inch-diameter (14 mm) screws.

3.3.3 Steel Side Plates: Steel side plates must be designed in accordance with AISI S100 or AISC 360, as applicable, and must comply with the minimum requirements of ASTM A36. For specific conditions addressed in the report, steel plate thickness and predrilled hole geometry must be as required by Section 4.1.11 or Table 7, as applicable. In general, screw holes in steel members must ensure that screw threads do not come into contact with the steel member during installation; a precise seating of the screw head in or on the steel member must be ensured, for example by providing an appropriate countersink when using countersunk screws.

3.3.4 Wedge Washers: Steel wedge washers are available from Wurth for use with inclined ASSYplus VG 4 screws with a countersunk head installed through steel side plates. See Figures 13 and 14.

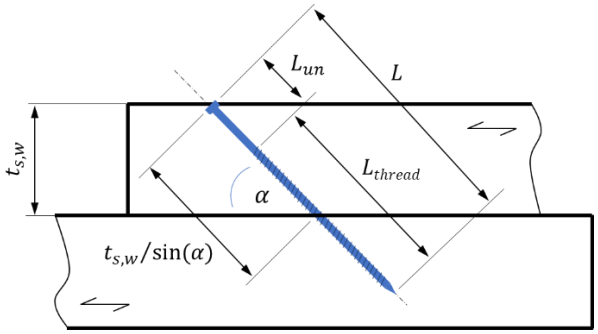
4.0 DESIGN AND INSTALLATION

4.1 Design:

4.1.1 General: The design values in this report are intended to aid the designer 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 designer and is outside the scope of this report. The designer is responsible for determining the available strengths for the connection, considering all applicable limit states, and for considering serviceability issues. The designer is responsible for determining the required spacing, edge distance and end distance for the screws, based on the characteristics of the connected building materials.

4.1.2 Screw Strengths: Allowable screw shear and tension strengths (ASD), design screw shear and tension strengths (LRFD) and minimum specified bending yield strength for the screws are shown in Table 3.

4.1.3 Effective Embedded Thread Length: The effective embedded thread length is the length of fastener thread in a wood member that is completely surrounded by the wood. For example, for a wood-to-wood connection the effective lengths in the side and main members are determined as follows:



$$L_{eff,s} = \left(\frac{t_{s,w}}{\sin(\alpha)}\right) - L_{un} \qquad \text{(Eq. 4.1.3-1)}$$

$$L_{eff,m} = \left(L - \left(\frac{t_{s,w}}{\sin(\alpha)}\right) - L_{tip}\right) \leq L_{thread} \quad \text{(Eq. 4.1.3-2)}$$

4.1.4 Reference Withdrawal Design Values: Reference withdrawal (*W*) design values in pounds per inch of effective embedded thread length, for screws installed perpendicular to the face of a sawn lumber, glulam, CLT or PSL member, with a minimum embedment depth of 8D are shown in Table 4. For inclined fastening, the applicable reduction factor from the following table must be applied:

α	R_α		α	R_α
90	1.00		55	0.94
85	1.00		50	0.92
80	0.99		45	0.91
75	0.99		40	0.89
70	0.98		35	0.84
65	0.97		30	0.77
60	0.95			

4.1.5 Reference Pull-through Design Values: Reference head pull-through values (W_H) for sawn lumber, glulam, CLT and PSL are shown in Table 5 for installation with 90° ≥ α ≥ 30°. Lesser angles (30° > α ≥ 0°) of installation are outside the scope of this report. Alternatively, for fully-threaded screws, the reference pull-through design value may be determined on the basis of the thread withdrawal from the side member, determined in accordance with Sections 4.1.3 and 4.1.4.

4.1.6 Lateral Connections Designed in Accordance with the NDS: Reference lateral design values for select wood-to-wood connection configurations with ASSYplus VG 4 screws are given in Table 6, based on calculations in accordance with the NDS. For other screw families and other connection configurations, reference lateral design values (*Z*) for connections of two or more wood members may be determined in accordance with the NDS, subject to the following conditions:

1. $F_{yb,spec}$ from Table 3 must be used for design.
2. D_r must be used where 'D' is referenced in Tables 12.3.1A, 12.3.1B and 12.3.3 of the NDS. For partially-threaded screws, when determining if Footnote 1 to Table 12.3.1B applies, D_s must be considered the nominal diameter.
3. Wood must have $SG_{NDS} \leq 0.55$.
4. For PSL or LVL, the specific gravity used for design must be the SG_{eq} for lateral loading given in the applicable ICC-ES evaluation report.
5. The wood side member thickness, $t_{s,w,}$ must be a minimum of $1^3/_4$ inches (45 mm).
6. Fastener penetration into the main member must be a minimum of 6*D*.
7. Dowel bearing length must be determined in accordance with Section 12.3.5.3 of the NDS, using L_{tip} given in Table 1 or 2, as applicable.
8. Spacing, edge and end distance must be in accordance with Table 8A or 8B, as applicable, and as needed to prevent splitting of the wood.

4.1.7 Reference Lateral Design Values Based on Testing: For ASSYplus VG 4 CSMP/CS screws, reference lateral design values for steel-to-wood connections based on testing are shown in Table 7.

4.1.8 Adjustments to Reference Design Values: Reference design values must be adjusted in accordance with the NDS provisions for dowel-type fasteners to determine the allowable strengths for use in ASD and the design strengths for use in LRFD. Use is limited to dry in-service conditions, such that the wet service factor, C_M, is 1.0 in accordance with the NDS.

4.1.9 Connections with Multiple Screws: See Sections 11.1.2, 11.2.2 and 12.6 of the NDS regarding multiple fastener connections and consideration of local stresses in the wood members.

4.1.10 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.

4.1.11 Lateral Connections with Multiple Inclined ASSYplus VG 4 Screws:

4.1.11.1 General: Connections used to transfer lateral loads between side members and a main member using groups of ASSYplus VG 4 screws installed at a 45-degree angle to the grain of the wood members must be designed in accordance with this section. Specific design procedures for steel-to-wood connections are addressed in Section 4.1.11.3. Specific design procedures for wood-to-wood connections are addressed in Section 4.1.11.4. The expected slip between the side member(s) and the main member at design load is less than $^1/_{16}$ inch (1.6 mm).

4.1.11.2 Applicable Parameters: The design methods presented in Section 4.1.11 apply under the following conditions:

1. The connections are two or three member connections with a wood main member and either wood or steel side member(s).
2. SG_{NDS} for sawn lumber and glulam, and SG_{eq} for PSL, must be within the ranges shown in Tables 4 and 5.
3. Screws used with steel side plates must be ASSYplus VG 4 screws with countersunk heads (CS or CSMP), installed using wedge washers in slotted holes.
4. The screws must be installed at a 45-degree angle to the wood grain, which is parallel to the direction of the force being transferred between the members.
5. The effective screw penetration in both the wood main member, $L_{eff,m}$, and the wood side member, $L_{eff,s}$, must be a minimum of 8D, measured along the axis of the screw.
6. A minimum of 2 screws through each side member must be used in each connection.
7. Spacing, edge distance and end distance must be in accordance with Section 4.2.2 and Table 9.
8. Wood side members must be of sufficient thickness to accommodate a minimum thread length of 8D plus L_{un}, shown in Table 2.
9. For connections of steel side plates to wood main members, the spacing between the outermost screws perpendicular to grain must not exceed 5 inches (127 mm).
10. Steel side plate thickness must be as shown in the following table, to accommodate the available wedge washers:

D_{nom}		MIN. PLATE THICKNESS (in.)	MAX. PLATE THICKNESS (in.)
mm	in.		
8	5/16	3/16	1/2
10	3/8	1/4	3/4
12	1/2	1/4	1

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

4.1.11.3 Steel-to-Wood Connections:

4.1.11.3.1 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:

1. Determine the length of the screw in the side member as follows:

$$L_s = L_w + t_{s,s}/\cos 45°$$

Where:

L_w = the length of the screw in the wedge washer. (See Figure 13)

$t_{s,s}$ = the thickness of the steel side member.

2. Determine the effective length of the screw in the main member as follows:

$$L_{eff,m} = L - L_s - L_{tip}$$

3. Determine the applicable reference withdrawal design value for the screw installed at 45° to the grain of the wood, in pounds-force per inch, in accordance with Section 4.1.4. Then determine the allowable withdrawal strength in the main member, W'_m, taking into account $L_{eff,m}$ and the applicable adjustment factors in the NDS.
4. If W'_m is less than N_a (shown in Table 3), the allowable lateral strength of the multiple fastener connection, P_a, must be determined as follows:

$$P_a = n \cdot W'_m \cdot \cos 45°$$

Where:

n = the number of screws acting together in the shear plane.

5. If W'_m exceeds N_a, the allowable lateral strength of the multiple fastener connection must be determined as follows:

$$P_a = n \cdot N_a \cdot \cos 45°$$

6. The structural members must be checked for load-carrying capacity along the entire load path in accordance with the code. This verification must include, but not be limited to, verifying the longitudinal shear capacity of the wood member; the cross tension capacity of the wood member; and the fastener group or individual fastener wood tear out capacities.

4.1.11.3.2 Three-member Connections: The allowable lateral load for a three-member connection with two steel side members and a wood main member is equal to two times the allowable lateral load for a two-member connection with a steel side member and a wood main member, determined in accordance with Section 4.1.11.3.1.

4.1.11.4 Wood-to-wood Connections:

4.1.11.4.1 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:

1. Determine $L_{eff,s}$ and $L_{eff,m}$ in accordance with Section 4.1.3.
2. Determine the applicable reference withdrawal design value for the screw installed at 45° to the grain of the wood, in pounds-force per inch, in accordance with Section 4.1.4. Then determine the allowable withdrawal strength in the side and main members, W'_s and W'_m, taking into account $L_{eff,s}$ and $L_{eff,m}$, respectively, along with the applicable adjustment factors in the NDS.
3. If either W'_s or W'_m (or both) is less than N_a, the allowable lateral strength of the multiple fastener connection must be determined as follows:

$$P_a = n \cdot min\begin{bmatrix} W'_s \\ W'_m \end{bmatrix} \cdot \cos 45°$$

4. If both W'_s and W'_m exceed N_a, the allowable lateral strength of the connection must be determined as follows:

$$P_a = n \cdot N_a \cdot \cos 45°$$

5. The structural members must be checked for load-carrying capacity in accordance with Section 4.1.11.3.1.

4.1.11.4.2 Three-member Connections: The allowable lateral load for a three-member connection with two wood side members and a wood main member is equal to 2 times the allowable lateral load for a two-member connection with a wood side member and a wood main member, determined in accordance with Section 4.1.11.4.1.

4.2 Installation:

4.2.1 General: The screws must be installed in accordance with the report holder's published installation instructions, the approved plans, and this report. In the event of a conflict between this report and the published installation instructions, the more severe requirements govern.

Screws must be installed using an RW or TORX drive bit, with a rotary drill, or a percussion drill set to rotary only mode. Unless noted otherwise in the construction documents, the top of the countersunk, flat washer and cylindrical heads must be flush with the surface of the side member, and the underside of hex heads and washer heads must bear on the surface of the side member, as shown in the approved plans. The screws must not be overdriven. Side member thickness requirements given in this report apply to the wood dimension below the top of the screw head.

4.2.2 Moisture Content: The screws must be installed in wooden members with a moisture content which is similar to the expected wood moisture content once the building is in use. Significant changes in moisture content of the wood members between the time of screw installation and the typical service condition after construction should be avoided.

4.2.3 End Distance, Edge Distance and Spacing: Unless otherwise noted, minimum wood member end distances, edge distances and spacing of the screws must be sufficient to prevent splitting of the wood, or as required by Table 8A, 8B or 9, as applicable, whichever is greater. When the screws are used in SCL, the minimum screw end and edge distances and spacing must be in accordance with Table 8A, 8B or 9, as applicable, or in accordance with the ICC-ES evaluation report on the SCL, whichever is more restrictive.

4.2.4 Pilot Holes and Predrilled Holes: Typical installation of the screws with $SG_{NDS} \leq 0.50$ does not require predrilled holes through the entire thickness of the wood member, but predrilled holes in wood members with $SG_{NDS} \leq 0.50$ may be used to reduce the likelihood of splitting and increase ease of installation. Installation of screws in wood members $SG_{NDS} > 0.5$ requires predrilled holes. See the table below for recommended sizes of predrilled holes.

D_{nom}		$D_{predrill}$ for $SG_{NDS} \leq 0.50$		$D_{predrill}$ for $SG_{NDS} > 0.50$	
mm	inch	mm	inch	mm	inch
6	15/64	4	5/32	4	5/32
8	5/16	5	3/16	6	15/64
10	3/8	6	15/64	7	9/32
12	1/2	7	9/32	8	5/16
14	9/16	8	5/16	9	11/32

4.2.5 Steel-to-Wood Connections: Steel-to-wood connections must be made with steel plates complying with Section 3.3.3. It is recommended to use a torque of 70 to 80 percent but not more than 90 percent of the characteristic torsional strength, $f_{tor,k}$, of the screw. See the table below. For steel-to-wood connections with multiple screws, each screw must be installed with the same torque to ensure homogeneous load distribution. After installation, all screw heads must be flush with, or bearing on, the steel member as intended.

D_{nom} (mm)	D_{nom} (inch)	Characteristic Torsional Strength $f_{tor,k}$			
		Nm		lbf·ft	
		ASSY 4	ASSYplus VG 4	ASSY 4	ASSYplus VG 4
6	15/64	10	10.5	7	8
8	5/16	23	25	17	18
10	3/8	45	47	33	35
12	1/2	65	76	48	56
14	9/16	-	115	-	85

5.0 CONDITIONS OF USE:

The Wurth self-tapping 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 manufactured and identified in accordance with this report.

5.2 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.

5.3 Except as described in Section 4.1.11, connection design for lateral loading applications using inclined fasteners is outside the scope of this report.

5.4 Connection geometry for inclined fastening must be justified to the satisfaction of the code official, including the minimum required wood thickness between crossing fasteners.

5.5 The screws have only been evaluated for use in dry service applications. Use in wet service conditions is outside the scope of this report.

5.6 Use of the screws in contact with preservative-treated or fire-retardant-treated wood is outside the scope of this report.

5.7 Use of the screws in locations exposed to saltwater or saltwater spray is outside the scope of this evaluation report.

5.8 The screws are manufactured under quality control programs with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Dowel-type Threaded Fasteners Used in Wood (AC233), dated June 2023 (editorially revised June 2024).

7.0 IDENTIFICATION

7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-5931) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

7.2 In addition, packages of screws are identified with the product name (ASSY 4 or ASSYplus VG 4); head type; and the screw diameter and length (in both inches and millimeters). In addition, where space allows, the screw heads are marked with the letters “ASSY”.

7.3 The report holder’s contact information is the following:

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TABLE 1—FASTENER SPECIFICATIONS – ASSY 4 PARTIAL THREAD SCREWS

D_{nom} (mm)	D_{nom} (inch)	HEAD STYLE	D (inch)	D_r (inch)	D_s (inch)	D_H (inch)	K (inch)	DRIVE TYPE AND SIZE	L^1 (mm)	$L_{nom}{}^1$ (inch)	L_{thread} (inch)	L_{tip} (inch)
6	15/64	Washer (WH) See Figure 2	0.236	0.154	0.175	0.551	0.118	RW 40	70	2 3/4	1 5/8	0.236
									80 to 90	3 1/8 to 3 1/2	2	
									100	4	2 3/8	
									110 to 300	4 3/8 to 11 7/8	2 3/4	
		Countersunk with milling pockets (CSMP) See Figure 3	0.236	0.154	0.173	0.472	0.173	RW 40	70	2 3/4	1 5/8	
									80 to 90	3 1/8 to 3 1/2	2	
									100	4	2 3/8	
									110 to 300	4 3/8 to 11 7/8	2 3/4	
8	5/16	Hex (Combi) See Figure 1	0.315	0.209	0.228	0.467 (across flats)	0.177	RW 40 or 12 mm hex socket	80 to 90	3 1/8 to 3 1/2	2	0.315
									100	4	2 3/8	
									120 to 200	4 3/4 to 7 7/8	3 1/8	
									220 to 800	8 5/8 to 31 1/2	3 7/8	
		Washer (WH) See Figure 2	0.315	0.209	0.228	0.866	0.150	RW 40	80 to 90	3 1/8 to 3 1/2	2	
									100	4	2 3/8	
									120 to 200	4 3/4 to 7 7/8	3 1/8	
									220 to 800	8 5/8 to 31 1/2	3 7/8	
		Countersunk with milling pockets (CSMP) See Figure 3	0.315	0.209	0.228	0.583	0.193	RW 40	80 to 90	3 1/8 to 3 1/2	2	
									100	4	2 3/8	
									120 to 200	4 3/4 to 7 7/8	3 1/8	
									220 to 800	8 5/8 to 31 1/2	3 7/8	
		Flat Washer (WH II) See Figure 4	0.315	0.209	0.228	0.719	0.098	RW40	45	1 3/4	1 1/4	
									50 to 55	2 to 2 3/16	1 9/16	
									60 to 90	2 3/8 to 3 1/2	2	
									100	4	2 3/8	
									120 to 200	4 3/4 to 7 7/8	3 1/8	
									220 to 800	8 5/8 to 31 1/2	3 7/8	
10	3/8	Hex (Combi) See Figure 1	0.394	0.256	0.283	0.581 (across flats)	0.197	RW 40 or 15 mm hex socket	100	4	2 3/8	0.394
									120 to 140	4 3/4 to 5 1/2	3 1/8	
									160 to 300	6 1/4 to 11 7/8	3 7/8	
									320 to 1000	12 5/8 to 39 3/8	4 3/4	
		Washer (WH) See Figure 2	0.394	0.256	0.283	0.984	0.181	RW 50	100	4	2 3/8	
									120 to 140	4 3/4 to 5 1/2	3 1/8	
									160 to 300	6 1/4 to 11 7/8	3 7/8	
									320 to 1000	12 5/8 to 39 3/8	4 3/4	
		Countersunk with milling pockets (CSMP) See Figure 3	0.394	0.256	0.283	0.713	0.228	RW 40	100	4	2 3/8	
									120 to 140	4 3/4 to 5 1/2	3 1/8	
									160 to 300	6 1/4 to 11 7/8	3 7/8	
									320 to 1000	12 5/8 to 39 3/8	4 3/4	

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

[1]For the Hex and Washer head styles, overall fastener length is measured from the underside of the head to bottom of tip. For the Countersunk and Flat Washer head styles, overall fastener length is measured from top of head to bottom of tip. Fastener lengths, L, in mm are specified dimensions. Nominal fastener lengths, L_{nom}, in inches are approximate conversions of the metric lengths. See Figures 1 through 4.
[2]Bending yield strength determined in accordance with ASTM F1575 using the root diameter.

TABLE 2—FASTENER SPECIFICATIONS AND STRENGTHS—ASSYplus VG 4 SCREWS

D_{nom} (mm)	D_{nom} (inch)	HEAD STYLE	D (inch)	D_r (inch)	D_H (inch)	K (inch)	DRIVE TYPE AND SIZE	L^1 (mm)	L^1 (inch)	L_{un} (inch)	L_{tip} (inch)
6	15/64	Cylindrical (CH) See Figure 5	0.236	0.150	0.317	0.185	RW 30	70 to 120	2 3/4 to 4 3/4	0.394	0.236
								140 to 260	5 1/2 to 10 1/4	0.472	
8	5/16	Cylindrical (CH) See Figure 5	0.315	0.197	0.390	0.295	RW 40	80 to 280	3 1/8 to 11	0.551	0.315
								300 to 450	11 7/8 to 17 5/8	0.590	
								480 to 600	18 7/8 to 23 5/8	0.787	
		Countersunk with milling pockets (CSMP) See Figure 7	0.315	0.197	0.583	0.185	RW 40	80 to 280	3 1/8 to 11	0.551	0.315
								300 to 450	11 7/8 to 17 5/8	0.590	
								480 to 600	18 7/8 to 23 5/8	0.787	
10	3/8	Cylindrical (CH) See Figure 5	0.394	0.244	0.528	0.315	RW 50	100 to 450	4 to 17 5/8	0.709	0.394
								480 to 800	18 7/8 to 31 1/2	0.905	
		Countersunk (CS) See Figure 6	0.394	0.244	0.774	0.256	RW 50	100 to 450	4 to 17 5/8	0.709	0.394
								480 to 800	18 7/8 to 31 1/2	0.905	
12	1/2	Countersunk with milling pockets (CSMP) See Figure 7	0.472	0.280	0.868	0.276	RW 50	120 to 240	4 3/4 to 9 1/2	0.827	0.472
								260 to 600	10 1/4 to 23 5/8	1.024	
14	9/16	Reverse (ETX) See Figure 8	0.551	0.335	0.709	0.394	TX E12	120 to 200	4 3/4 to 7 7/8	0.699	0.551
								210 to 1500	8 1/4 to 59 1/8	0.866	
		Hex Washer (Combi) See Figure 9	0.551	0.335	0.846 Across flats	0.354	RW 50	120 to 200	4 3/4 to 7 7/8	0.699	0.551
								210 to 1500	8 1/4 to 59 1/8	0.866	

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

[1]For countersunk and cylindrical head screws, the overall fastener length is measured from top of head to bottom of tip. For the reverse head and hex washer head screws, the overall fastener length is measured from the underside of the integral washer to the bottom of the tip. See Figures 5 through 9.

[2]Bending yield strength determined in accordance with ASTM F1575 using the root diameter.

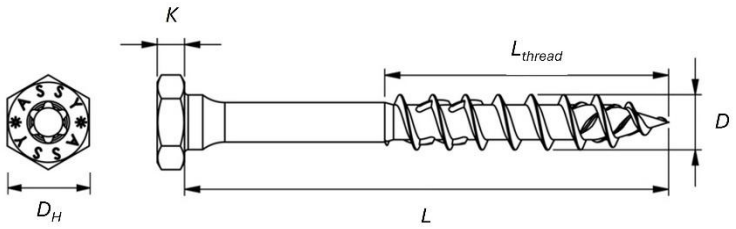


FIGURE 1—ASSY 4 SCREW WITH HEX HEAD (COMBI)

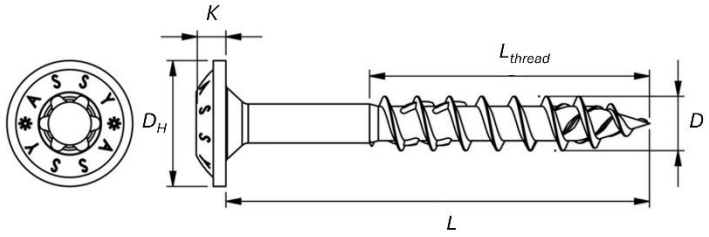


FIGURE 2—ASSY 4 SCREW WITH WASHER HEAD (WH)

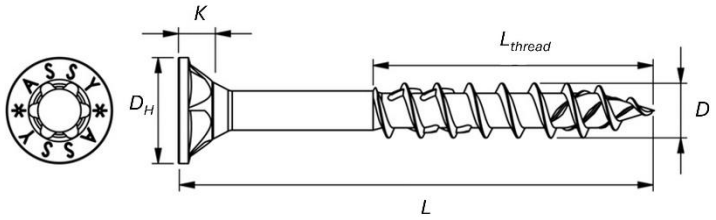


FIGURE 3—ASSY 4 SCREW WITH COUNTERSUNK HEAD WITH MILLING POCKETS (CSMP)

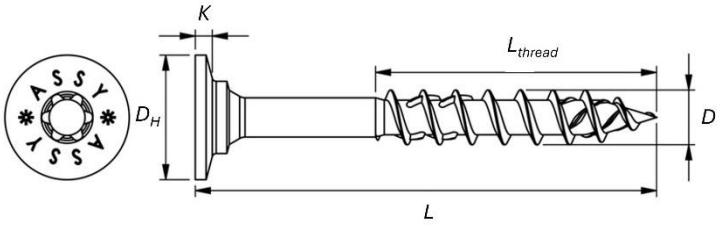


FIGURE 4—ASSY 4 SCREW WITH FLAT WASHER HEAD (WH II)

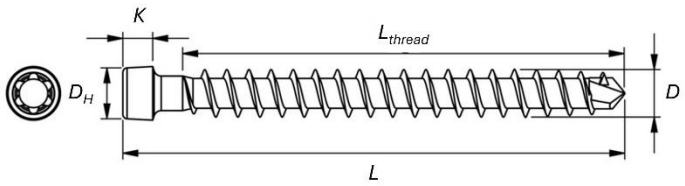


FIGURE 5—ASSYplus VG 4 SCREW WITH CYLINDRICAL HEAD (CH)

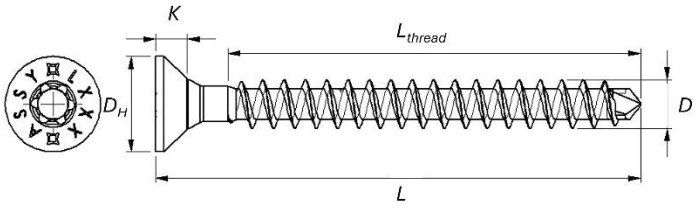


FIGURE 6—ASSYplus VG 4 SCREW WITH COUNTERSUNK HEAD (CS)

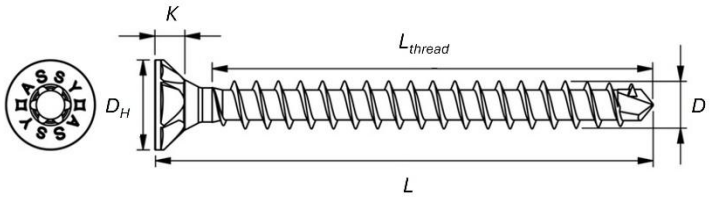


FIGURE 7—ASSYplus VG 4 SCREW WITH COUNTERSUNK HEAD WITH MILLING POCKETS (CSMP)

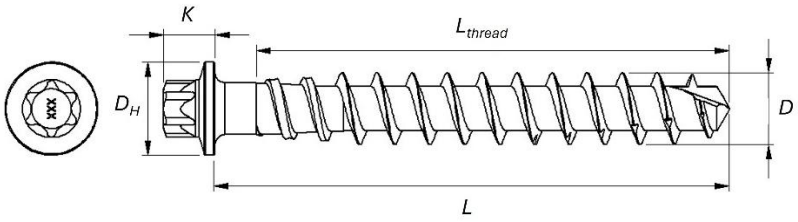


FIGURE 8—ASSYplus VG 4 SCREW WITH REVERSE HEAD (ETX)

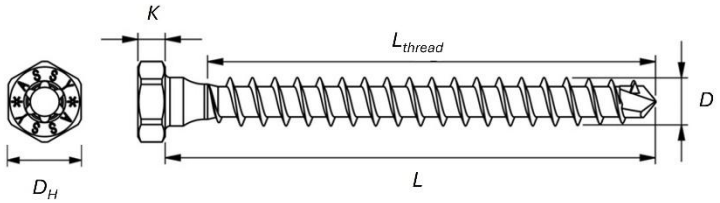


FIGURE 9—ASSYplus VG 4 SCREW WITH HEX WASHER HEAD (COMBI)

TABLE 3—SCREW STRENGTHS

D_{nom}		$F_{yb,spec}$[2] (psi)	ALLOWABLE STEEL STRENGTHS (ASD)		DESIGN STEEL STRENGTHS (LRFD)	
mm	In.		N_a (lbf)	V_a (lbf)	N_a (lbf)	V_a (lbf)
ASSY 4						
6	15/64	181,200	1,075	700	1,610	1,050
8	5/16	164,600	1,790	1,220	2,685	1,830
10	3/8	170,200	2,690	1,930	4,040	2,890
ASSYplus VG 4						
6	15/64	129,200	1165	590	1750	885
8	5/16	150,000	1775	1105	2665	1660
10	3/8	160,000	2550	1835	3825	2755
12	1/2	166,300	3470	2095	5205	3145
14	9/16	181,300	5135	3200	7700	4800

TABLE 4—REFERENCE WITHDRAWAL DESIGN VALUES (W) FOR ASSY 4 and ASSYplus VG 4 SCREWS[1,2]

D_{nom}		MIN. L_{eff} (inches)	REFERENCE WITHDRAWAL DESIGN VALUES, W (lbf/in.)				
			Installation into Face of Sawn Lumber, Glulam and CLT Panels				Installation in Face of PSL
mm	in.		SG_{NDS} = 0.55	SG_{NDS} = 0.49	SG_{NDS} = 0.42	SG_{NDS} = 0.35	SG_{eq} ≥ 0.50
6	15/64	2	230	202	169	137	156
8	5/16	2 1/2	279	248	212	176	179
10	3/8	3	317	280	237	190	211
12	1/2	4	334	297	254	211	223
14	9/16	4 1/2	430	347	300	–	–

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

[1]Tabulated reference withdrawal design values, W, apply to screws installed perpendicular to the faces of the wood members.
[2]Tabulated values are to be multiplied by L_{eff} to determine the total reference withdrawal design value.

TABLE 5—REFERENCE HEAD PULL-THROUGH DESIGN VALUES (W_H) FOR ASSY 4 AND ASSYPLUS VG 4 SCREWS[1] lbf

D_{nom}		HEAD TYPE	MIN. $t_{s,w}$ (inches)	REFERENCE HEAD PULL-THROUGH DESIGN VALUES, W_H (lbf)				
				Installation into Face of Sawn Lumber, Glulam and CLT Panels				Installation in Face of PSL
mm	in.			SG_{NDS} = 0.55	SG_{NDS} = 0.49	SG_{NDS} = 0.42	SG_{NDS} = 0.35	SG_{eq} ≥ 0.50
ASSY 4 Screws								
6	15/64	Washer	1 3/8	407	356	299	244	440
		Countersunk		221	194	163	133	262
8	5/16	Hex		275	233	188	146	326
		Washer		685	604	510	410	732
		Countersunk		318	277	232	187	327
		Flat Washer		--	480	406	--	--
10	3/8	Hex		369	327	278	225	420
		Washer		710	660	593	513	797
		Countersunk		445	385	319	246	509
12	1/2	Hex		390	351	305	257	474
		Washer		834	738	627	517	939
ASSYplus VG 4 Screws								
8	5/16	Countersunk, Countersunk Milling Pocket	1 3/8	414	350	281	216	398
10	3/8			474	408	334	266	491
12	1/2			474	408	334	266	491

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

[1]Tabulated head pull-through design values, W_H, are applicable to screws installed with 90° ≥ α ≥ 30°.

TABLE 6—REFERENCE LATERAL DESIGN VALUES (Z) FOR SINGLE SHEAR (TWO-MEMBER) WOOD-TO-WOOD CONNECTIONS WITH ASSYplus VG 4 SCREWS – DESIGNED IN ACCORDANCE WITH THE NDS[1,2,3,4,5,6]

D_{nom} x L_{nom}[1]		$t_{s,w}$ (in.)	$L_{emb,l}$ (in.)	REFERENCE LATERAL DESIGN VALUES, *Z* (lbf)								
				SG_{NDS} = 0.42			SG_{NDS} = 0.49			SG_{NDS} = 0.55		
mm	in.			$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$	$Z_{\parallel}$	$Z_{\perp/\parallel}$	$Z_{\perp}$
6 x 100	15/64" x 3 7/8"	2	1 3/4	123	123	123	142	142	142	158	158	158
6 x 140	15/64" x 5 1/2"	2 3/4	2 1/2	123	123	123	142	142	142	158	158	158
6 x 160	15/64" x 6 1/4"	3 1/2	2 1/2	123	123	123	142	142	142	158	158	158
8 x 120	5/16" x 4 3/4"	2	2 7/16	194	155	155	223	179	179	248	199	199
8 x 140	5/16" x 5 1/2"	2 3/4	2 7/16	194	155	155	223	179	179	248	199	199
8 x 160	5/16" x 6 1/4"	3 1/2	2 7/16	194	155	155	223	179	179	248	199	199
10 x 140	3/8" x 5 1/2"	2	3 1/8	239	191	191	289	231	231	321	257	257
10 x 140	3/8" x 5 1/2"	2 3/4	2 3/8	251	201	201	289	231	231	321	257	257
10 x 160	3/8" x 6 1/4"	2 3/4	3 1/8	251	201	201	289	231	231	321	257	257
12 x 180	1/2" x 7 1/8"	3 1/2	3 1/8	396	287	264	427	316	295	453	340	321
12 x 200	1/2" x 7 7/8"	3 1/2	3 7/8	396	287	264	427	316	295	453	340	321
12 x 200	1/2" x 7 7/8"	4	3 3/8	396	287	264	427	316	295	453	340	321

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

[1]Fastener length shown is a minimum. Tabulated values may be applied to longer fasteners, with greater penetration into the main and/or side member.

[2]Tabulated reference lateral design values, *Z*, apply to screws driven into the side grain of the main member or face of engineered wood products, such that the screws are oriented perpendicular to the grain and loaded as follows:

$Z_{\parallel}$: Both side and main members loaded parallel to grain.

$Z_{\perp/\parallel}$: Side member loaded perpendicular to grain; main member loaded parallel to grain

$Z_{\perp}$: Both side and main members loaded perpendicular to grain.

[3]Reference lateral design values must be multiplied by all adjustment factors applicable to wood screws, in accordance with the NDS.

[4]Tabulated values are for screws installed and used in dry in-service conditions, such that the wet service factor, C_M, is 1.0 in accordance with the NDS.

[5]The specific gravity used for design purposes must be the assigned specific gravity for sawn lumber or glulam, or the equivalent specific gravity given in the applicable ICC-ES evaluation report on the PSL or LVL product. See also Section 3.3.2.

[6]Connection configurations not addressed in the table may be designed in accordance with Section 4.1.6.

TABLE 7—REFERENCE LATERAL DESIGN VALUES (Z) FOR SINGLE SHEAR (TWO-MEMBER) STEEL-TO-WOOD CONNECTIONS WITH ASSYplus VG 4 SCREWS – DETERMINED FROM TESTING

SCREW TYPE	D_{nom}[1]		$t_{s,s}$ [2]	REFERENCE LATERAL DESIGN VALUES[3,4] (lbf)	
				SG_{NDS} = 0.50	
	mm	in.		$Z_{\perp}$	Z_{end}
ASSYplus VG 4 with CSMP head	8 x 80	5/16 x 3 1/8	0.200 inch (5 mm)	575	--
	8 x 160	5/16 x 6 1/4		575	555
	10 x 100	3/8 x 3 7/8		895	--
	10 x 200	3/8 x 7 7/8		895	895

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.45 N, 1 ksi =6.89 MPa.

[1]Fastener length shown is a minimum. Tabulated values may be applied to longer fasteners, with greater penetration into the main member.

[2]Steel plates must have a minimum specified yield strength of 37 ksi and a minimum tensile strength of 50 ksi. Holes in the steel side plates must be standard round holes with a diameter of 9 mm for the 5/16-inch screws and 11 mm for the 3/8-inch screws.

[3]Tabulated reference lateral design values, *Z*, apply as follows:

$Z_{\perp}$: Screws installed into the side grain of the wood member and loaded perpendicular to grain.

Z_{end} : Screws installed into end grain of the wood member and loaded laterally.

[4]Tabulated values apply to connections with at least two screws spaced a minimum of 5D.

TABLE 8A—CONNECTION GEOMETRY REQUIREMENTS FOR ASSY 4 SCREWS INSTALLED PERPENDICULAR TO THE FACE OF WOOD MEMBERS AND INCLINED FASTENERS [1,2,3,4]

CONDITION		MINIMUM DISTANCE OR SPACING		
		Self-drilled		Predrilled Hole[5]
		SG_{NDS} < 0.50	SG_{NDS} ≥ 0.50	
End distance (See Figures 10 and 12)	Loading toward end, $a_{end,1}$	15D	20D	12D
	Loading perpendicular to grain or away from end, $a_{end,2}$	10D	15D	7D
	Axial loading, $a_{end,2}$	10D	10D	7D
	Inclined fastener, $a_{end,CG}$			
Edge distance (See Figures 10 and 12)	Loading toward edge, $a_{edge,1}$	10D	12D	7D
	Loading parallel to grain or away from edge, $a_{edge,2}$	5D	7D	3D
	Axial Loading, $a_{edge,2}$	4D	4D	3D
	Inclined fastener, $a_{edge,CG}$			
Spacing between fasteners parallel to grain (See Figures 11 and 12)	Loading parallel to grain, a_1	15D	15D	10D
	Loading perpendicular to grain, a_1	10D	10D	5D
	Axial loading, a_1	7D	7D	7D
	Inclined fastener, a_1			
Spacing between fasteners, perpendicular to grain (see Figures 11 and 12)	Loading parallel to grain, a_2	5D	7D	5D
	Loading perpendicular to grain, a_2	5D	7D	5D
	Axial loading, a_2	5D	5D	5D
	Inclined fastener, a_2			
	Inclined fastener, crossed screws, $a_{2,cross}$	1.5D	1.5D	1.5D

See footnotes following Table 8B.

TABLE 8B—CONNECTION GEOMETRY REQUIREMENTS FOR ASSYplus VG 4 SCREWS INSTALLED PERPENDICULAR TO THE FACE OF WOOD MEMBERS AND INCLINED FASTENERS[1,2,3,4]

CONDITION		MINIMUM DISTANCE OR SPACING Self-drilled or Predrilled	
		$D_{nom} \le {}^3/_8$ inch (10 mm)	$D_{nom} > {}^3/_8$ inch (10 mm)
End distance (see Figures 10 and 12)	Loading toward end, $a_{end,1}$	12D	7D
	Loading perpendicular to grain or away from end, $a_{end,2}$	7D	4D
	Axial loading, $a_{end,2}$	7D	4D
	Inclined fastener, $a_{end,CG}$		
Edge distance (see Figures 10 and 12)	Loading toward edge, $a_{edge,1}$	7D	4D
	Loading parallel to grain or away from edge, $a_{edge,2}$	3D	3D
	Axial Loading, $a_{edge,2}$	3D	3D
	Inclined fastener, $a_{edge,CG}$		
Spacing between fasteners parallel to grain (see Figures 11 and 12)	Loading parallel to grain, a_1	10D	5D
	Loading perpendicular to grain, a_1	5D	4D
	Axial loading, a_1	7D	5D
	Inclined fastener, a_1		
Spacing between fasteners, perpendicular to grain (see Figures 11 and 12)	Loading parallel to grain, a_2	4D	5D
	Loading perpendicular to grain, a_2	4D	5D
	Axial loading, a_2	2.5D	5D
	Inclined fastener, a_2		
	Inclined fastener, crossed screws, $a_{2,cross}$	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]Tabulated values are applicable to wood-to-wood and steel-to-wood connections.
[4]For CLT products, parallel and perpendicular-to-grain descriptions apply to the grain orientation at the shear plane for lateral loading and to the face grain orientation for withdrawal loading.
[5]Tabulated geometry is applicable to ASSY 4 screws installed in predrilled holes that meet the following requirements:

- For installation in Douglas Fir and other species of similar or greater density, the hole must have a diameter between $0.60D_s$ and $0.75D_s$.
- For installation in SPF and other species of similar density, the hole must have a diameter between $0.40D_s$ and $0.70D_s$.
- The hole diameter must not exceed $0.9D_r$.

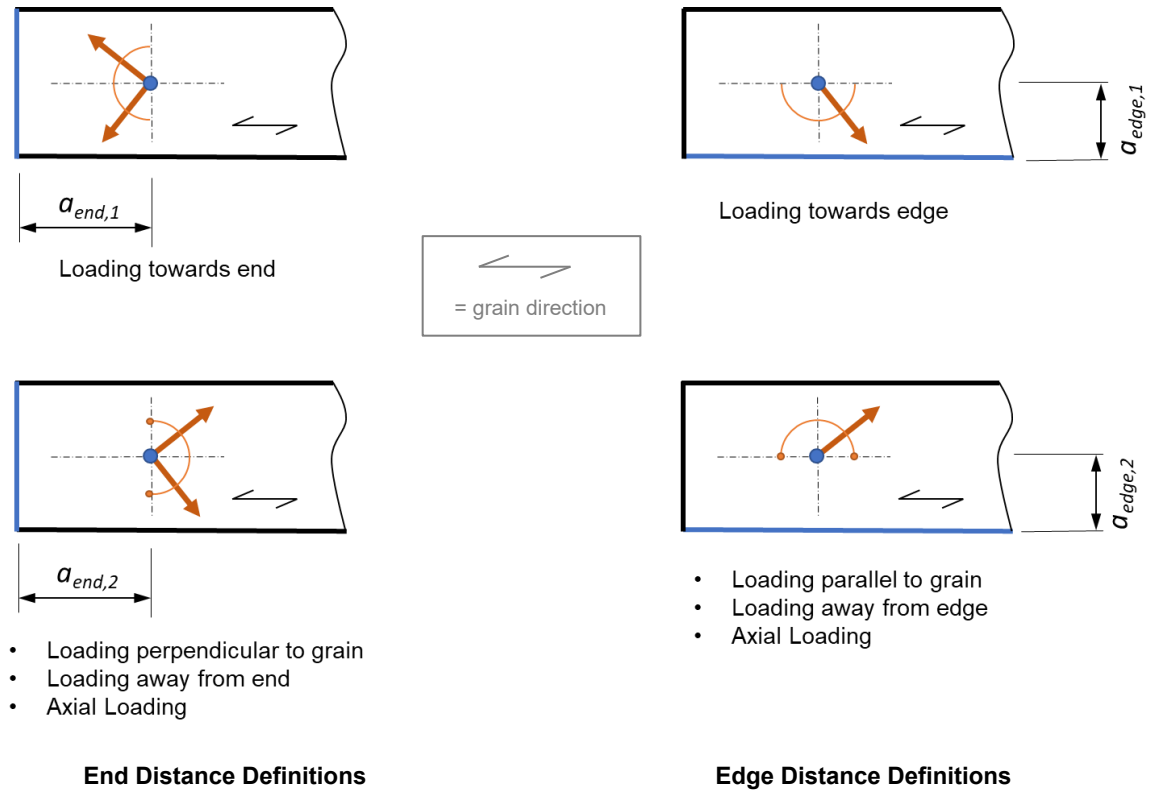


FIGURE 10—END AND EDGE DISTANCE DEFINITIONS FOR SCREWS INSTALLED PERPENDICULAR TO GRAIN

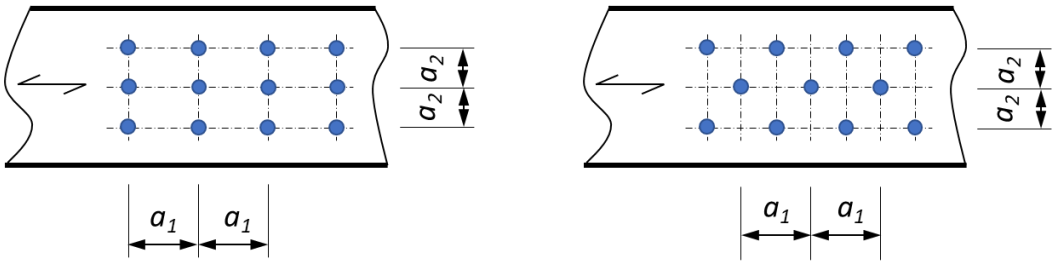


FIGURE 11—SPACING DEFINITIONS FOR SCREWS INSTALLED PERPENDICULAR TO GRAIN

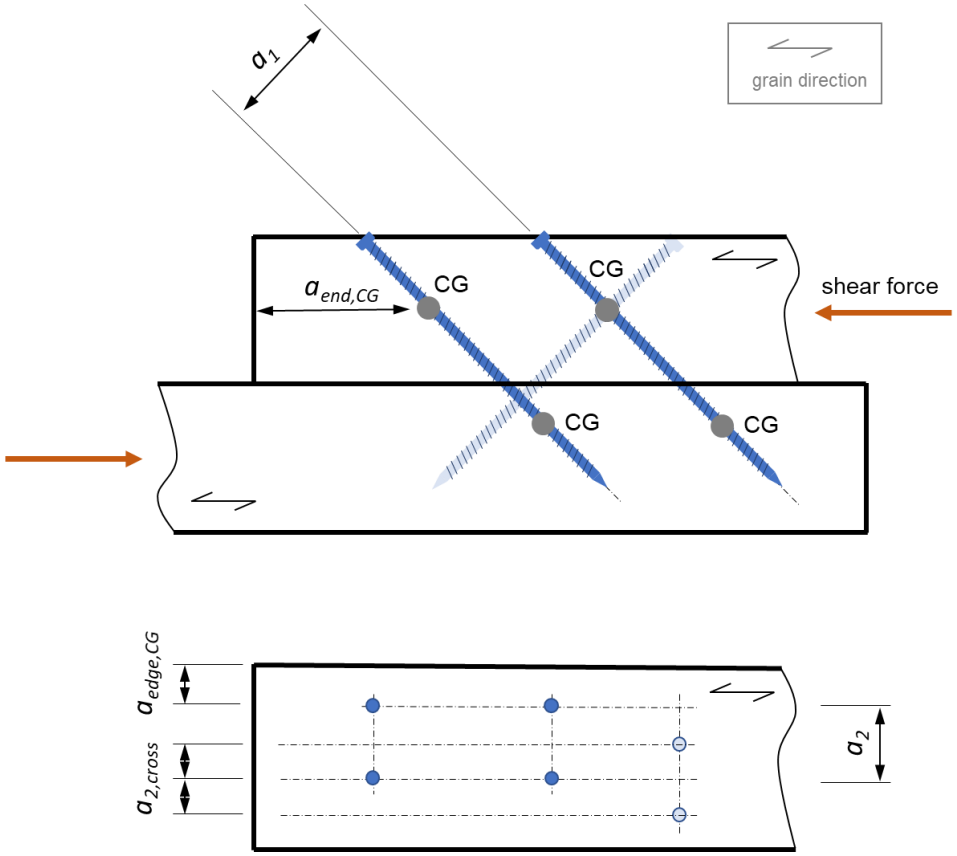
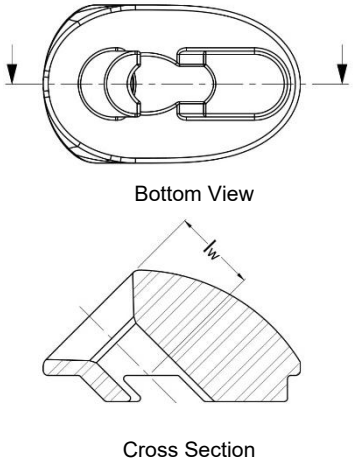
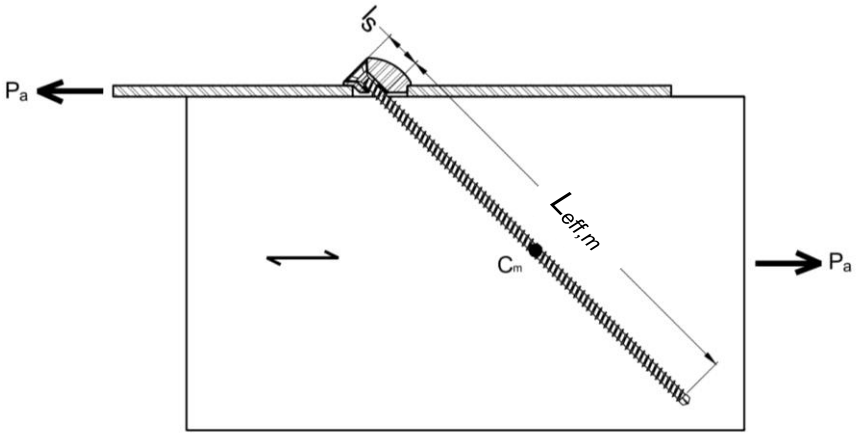


FIGURE 12—SPACING DEFINITIONS FOR INCLINED AND CROSSED SCREWS



NOMINAL SCREW DIAMETER (inch)	DIMENSION l_w (inch)
$^5/_{16}$	0.500
$^3/_8$	0.724
$^1/_2$	0.780

FIGURE 13—STEEL WEDGE WASHER



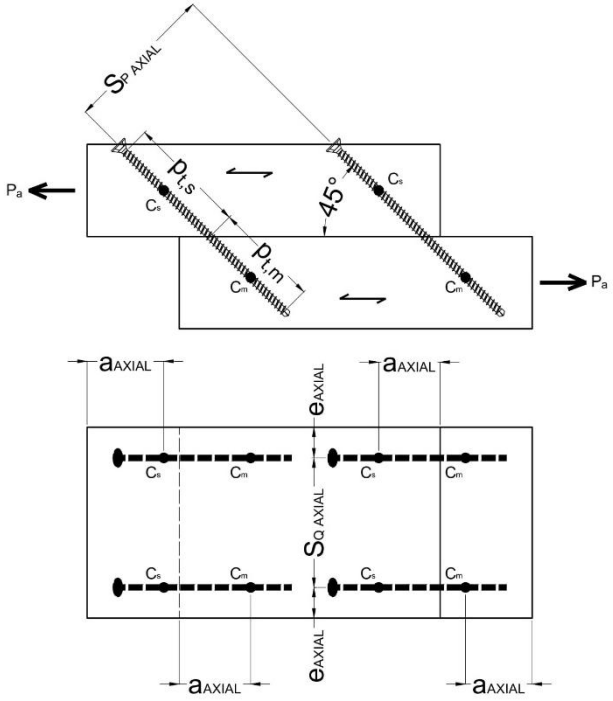
Note: Minimum dimensions for end distance, edge distance and spacing of the screws in the wood member are as shown in Figure 12.

FIGURE 14—CONNECTION GEOMETRY FOR INCLINED SCREWS USED IN STEEL-TO-WOOD CONNECTIONS WITH WEDGE WASHERS

TABLE 9—CONNECTION GEOMETRY REQUIREMENTS FOR CONNECTIONS WITH ASSYplus VG 4 SCREWS, DESCRIBED IN SECTION 4.1.11[1,2]

CONDITION	MINIMUM DIMENSION (in terms of nominal screw diameter, D)
End distance, a_{AXIAL} [3]	5D (7.5D in D-Fir)
Edge distance, e_{AXIAL}	3D
Spacing between fasteners in a row, $S_{P\ AXIAL}$	5D (7.5D in D-Fir)
Spacing between rows of fasteners, $S_{Q\ AXIAL}$	2.5D

[1] End distances, edge distances and screw spacing must be sufficient to prevent splitting of the wood, or as required by this table, whichever is the more restrictive.
[2] See Figures 15 and 16.
[3] End distance must also be sufficient to ensure that the screw is fully embedded in the wood member.



Note: C_m = Center of gravity of the threaded portion of the screw in the main member; C_s = Center of gravity of the threaded portion of the screw in the side member.

FIGURE 15—CONNECTION GEOMETRY PER TABLE 9 FOR TWO-MEMBER WOOD-TO-WOOD CONNECTION

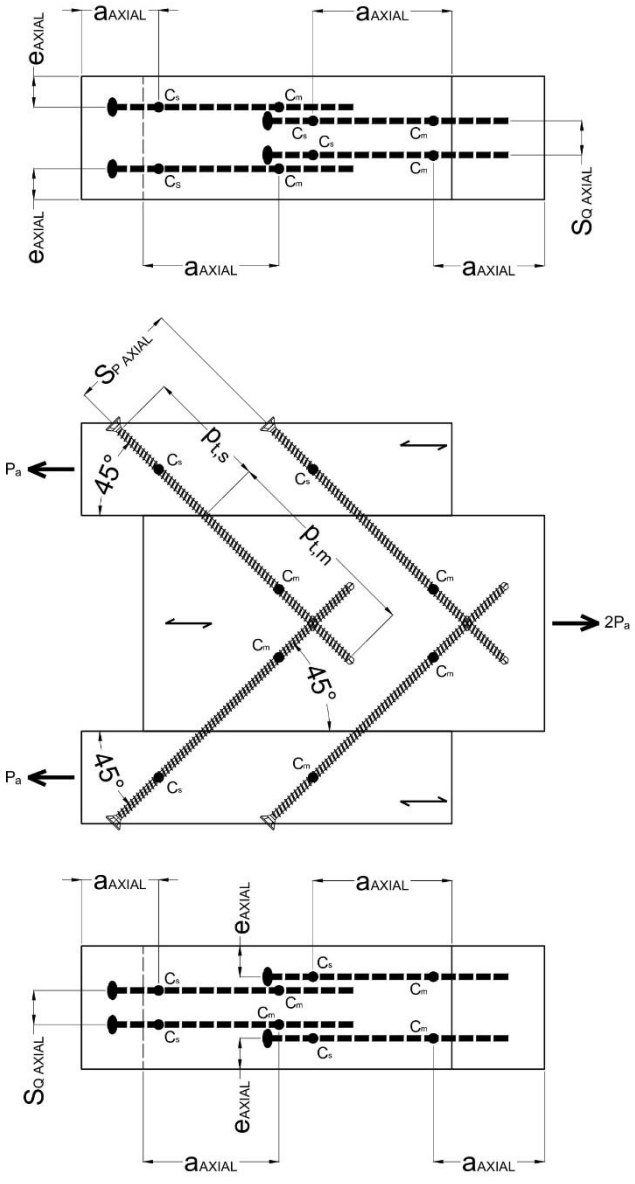


FIGURE 16—CONNECTION GEOMETRY PER TABLE 9 FOR THREE-MEMBER WOOD-TO-WOOD CONNECTION