

ICC-ES Evaluation Report

ESR-4558

Reissued August 2024


This report also contains:

- CBC Supplement

Subject to renewal August 2026

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<p>DIVISION: 06 00 00— WOOD, PLASTICS AND COMPOSITES</p> <p>Section: 06 05 23— Wood, Plastic and Composite Fastenings</p>	<p>REPORT HOLDER:</p> <p>RELIABLE FASTENERS, A DIVISION OF RICHELIEU HARDWARE LTD.</p>	<p>EVALUATION SUBJECT:</p> <p>PWR DRIVE SCREWS</p>	
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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2021, 2018, 2015 and 2012 [International Building Code® \(IBC\)](#)
- 2021, 2018, 2015 and 2012 [International Residential Code® \(IRC\)](#)

Properties evaluated:

- Structural
- Corrosion resistance

2.0 USES

PWR Drive screws are used in wood-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. The screws are intended for use in the Exposure Conditions shown in [Table 6](#).

3.0 DESCRIPTION

3.1 General:

3.1.1 PWR Drive screws are formed from carbon steel complying with the report holder’s specifications and are intended to be self-drilling. The screws have a proprietary coating designated as XHR-1000. See [Table 1](#) for screw dimensions. See [Figure 1](#) for depictions of the screws.

3.1.2 STR Screws: PWR Drive STR screws have a flat head with nibs under the head and a Type 17 point. The thread length of 1.6 inches (41 mm) is the same for all screw lengths. The threads closest to the tip are notched. The screws have a reamer knurl between the primary threads and the smooth shank. The coating on these screws is brown in color.

3.1.3 CST Screws: PWR Drive CST screws have a flat head with nibs and cutting serrations under the head and a Type 17 point. The screws have a thread length which varies with the length of the screw. The threads closest to the tip are notched. The screws have a reamer knurl between the primary threads and the smooth shank. The coating on these screws is gold in color.

3.1.4 LVL Screws: PWR Drive LVL screws have a flat head with nibs under the head and a Type 17 point. The thread length of 1.8 inches (46 mm) is the same for all screw lengths. The threads closest to the tip are notched. The screws have a reamer knurl between the primary threads and the smooth shank. The coating on these screws is orange in color.

3.1.5 LOG Screws: PWR Drive LOG screws have a flat head, with nibs under the head and a Type 17 point. The thread length of 2.5 inches (64 mm) is the same for all screw lengths. The threads closest to the tip are notched. The screws have a reamer knurl between the primary threads and the smooth shank. The coating on these screws is black in color.

3.2 Wood Members:

For the purposes of connection design, sawn lumber members must have an assigned specific gravity as indicated in the tables in this report. Assigned specific gravity for sawn lumber must be determined in accordance with Table 12.3.3A of the ANSI/AWC National Design Specification (NDS) for Wood Construction® (Table 11.3.3A of NDS-12 for the 2012 IBC). Unless otherwise noted, sawn lumber members must have a moisture content of 19 percent or less.

Wood structural panels must comply with DOC PS1 or PS2. For purposes of connection design, wood structural panels must have an assigned specific gravity of 0.42 or greater. Assigned specific gravity for wood structural panels must be determined in accordance with Table 12.3.3B of the NDS (Table 11.3.3B of the NDS for the 2012 IBC).

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

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

For the purposes of connection design, LVL must be addressed in an ICC-ES evaluation report and must have a minimum equivalent specific gravity of 0.50. Use of the LVL must be limited to covered, dry installation in accordance with the applicable ICC-ES evaluation report on the LVL.

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

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 PWR Drive 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.

4.1.2 Screw Strength: Allowable screw tension strengths (ASD) and design screw tension strengths (LRFD) and minimum specified bending yield strengths for the screws are shown in [Table 2](#).

4.1.3 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 IBC) to determine allowable loads for use with ASD and/or design loads for use with LRFD. 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 IBC), as applicable. When the capacity of a connection is controlled by the fastener strength, the allowable connection strength must not be increased by the adjustment factors specified in the NDS.

4.1.4 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 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 IBC).

4.1.6 Reference Withdrawal and Pull-through Design Values: Reference withdrawal (W) design values in pounds per inch of thread penetration and reference head pull-through values (W_H) for screws installed perpendicular to the face of the wood member are shown in [Table 3](#).

4.1.7 Lateral Connections in Accordance with the NDS: The reference lateral design strength for connections of two or more wood members using the PWR Drive screws may be designed in accordance with the NDS, subject to the following conditions:

1. Use of the NDS is applicable to lateral connections of wood with assigned specific gravity up to and including 0.55.
2. The applicable specified bending yield strength from [Table 2](#) must be used for design.
3. Side member thickness must be a minimum of 1.5 inches (38 mm).
4. The screw penetration into the main member must be a minimum of 6 times the major thread diameter.
5. Spacing, edge and end distance must be in accordance with [Table 5](#), and as needed to prevent splitting of the wood.
6. For the PWR Drive CST and LOG screws, the minor thread diameter, D_r , must be used to determine R_d and K_D in accordance with Table 12.3.1B of the NDS, the dowel bearing strength in accordance with Table 12.3.3 of the NDS and the reference lateral design value based on Table 12.3.1A of the NDS (Tables 11.3.1B, 11.3.3 and 11.3.1 A of the 2012 NDS for the 2015 and 2012 IBC).
7. For the PWR Drive STR and LVL screws, the shank diameter must be used to determine R_d and K_D in accordance with Table 12.3.1B of the NDS, the dowel bearing strength in accordance with Table 12.3.3 of the NDS and the reference lateral design value based on Table 12.3.1A of the NDS (Tables 11.3.1B, 11.3.3 and 11.3.1 A of the 2012 NDS for the 2015 and 2012 IBC). For the STR screws, the wood member into which the threads are embedded must be sawn lumber with a minimum thickness of 1.5 inches. For the LVL screws, the wood member into which the threads are embedded must be LVL with a minimum thickness of 1.75 inches.
8. For the purpose of calculations in accordance with the NDS, the dowel bearing length in the main member must be taken as the penetration length minus one-half of the tip length, E .

4.1.8 Two-member Wood-to-wood Connections Based on Testing: For select connection configurations, testing has been conducted to determine reference lateral design values which exceed those determined in accordance with the NDS. Reference lateral design values based on testing are shown in [Table 4](#).

4.1.9 Governing Design Values: The allowable load for a two-member, single-screw connection in which the screw is subject to tension is the least of: (a) the reference withdrawal design load value given in [Table 3](#), multiplied by the embedded thread length, and adjusted by all applicable adjustment factors; (b) the reference head pull-through design value given in [Table 3](#), adjusted by all applicable factors; and (c) the allowable screw tension strength given in the applicable table in this report.

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

4.2 Corrosion Resistance:

The PWR Drive screws have been evaluated for use in Douglas Fir treated with Micronized Copper Azole (MCA) preservatives with a maximum retention of 0.15 pcf (2.4 kg/m³), as alternates to hot-dip galvanized fasteners prescribed in IBC Section 2304.10.6 (2018 and 2015 IBC Section 2304.10.5; 2012 IBC Section 2304.9.5). The screws have been evaluated for the Exposure Conditions shown in [Table 6](#).

4.3 Installation:

PWR Drive screws must be installed in accordance with the report holder's published installation instructions and this report. The screws must be installed perpendicular to the face of the wood member. Screws must be installed with the minimum spacing, end distances, and edge distances needed to prevent splitting of the wood or as noted in [Table 5](#), whichever is more restrictive. The underside of the flat head must bear against the surface of the wood side member. Screws must not be overdriven. Installation must be performed without predrilling. The screws must be installed by turning with a power driver, not by driving with a hammer.

5.0 CONDITIONS OF USE:

The PWR Drive 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 this report and the report holder's published installation instructions. In the case of a conflict between the published installation instructions and this report, the more restrictive requirements govern.
- 5.2 Design loads for the screws must not exceed the available strengths given in Section 4.2.
- 5.3 Construction documents and calculations demonstrating that the design loads do not exceed the available strengths must be submitted to the code official. The calculations must be prepared by a registered design professional when required by statutes of the jurisdiction in which the project is to be constructed.
- 5.4 The screws have only been evaluated for use in dry service applications. Use in wet service conditions is outside the scope of this report.
- 5.5 Use of fasteners in treated wood in locations exposed to saltwater or saltwater spray is outside the scope of this evaluation report.
- 5.6 The screws are manufactured under a quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the [ICC-ES Acceptance Criteria for Dowel-type Threaded Fasteners Used in Wood \(AC233\)](#), dated October 2020 (editorially revised December 2020).
- 6.2 Data in accordance with the [ICC-ES Acceptance Criteria for Corrosion-resistant Fasteners and Evaluation of Corrosion Effects of Wood Treatments \(AC257\)](#), dated October 2009 (editorially revised January 2021).

7.0 IDENTIFICATION

- 7.1 The ICC-ES mark of conformity, electronic labeling, or the evaluation report number (ICC-ES ESR-4558) along with the name, registered trademark, or registered logo of the report holder must be included in the product label. [Electronic labeling is the ICC-ES web address (www.icc-es.org); specific URL related to the report; or the ICC-ES machine-readable code placed on the aforementioned items.]
- 7.2 In addition, packages of screws are identified with the brand name (PWR Drive), the product name (STR, CST, LVL or LOG), the model number and the nominal fastener size and length. Fastener heads are marked with "R-####", where #### represents the fastener shank diameter in decimal inches; and with the fastener length in decimal inches. See [Table 1](#) and [Figures 1](#).
- 7.3 The report holder's contact information is the following:

RELIABLE FASTENERS, A DIVISION OF RICHELIEU HARDWARE LTD.
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TABLE 1—PWR DRIVE SCREW DESCRIPTIONS

MODEL NO.	NOMINAL FASTENER DIAMETER (inch)	OVERALL LENGTH ¹ (inches)	HEAD MARKINGS	THREAD LENGTH ² (inches)	HEAD DIAMETER (inch) (DRIVE SIZE)	SHANK DIAMETER (inch)	MINOR THREAD (ROOT) DIAMETER, <i>D_r</i> (inch)	OUTSIDE THREAD DIAMETER, <i>D</i> (inch)	TIP LENGTH, <i>E</i> (inch)
STR									
FTC17BR5163	5/16	3	R-0.22 / 3	1.6	0.750 (T-40)	0.220	0.200	0.325	0.420
FTC17BR516412		4 1/2	R-0.22 / 4.5						
FTC17BR5166		6	R-0.22 / 6						
FTC17BR38612	3/8	6 1/2	R-0.24 / 6.5		0.750 (T-40)	0.240	0.218	0.360	0.455
FTC17BR38812		8 1/2	R-0.24 / 8.5						
CST									
FTC17GO5163	5/16	3	R-0.20 / 3	2	0.630 (T-40)	0.205	0.180	0.285	0.385
FTC17GO5164		4	R-0.20 / 4	2.6					
FTC17GO5165		5	R-0.20 / 5	3.3					
FTC17GO5166		6	R-0.20 / 6	3.9					
FTC17GO38412	3/8	4 1/2	R-0.23 / 4.5	3	0.700 (T-40)	0.230	0.206	0.320	0.435
FTC17GO386		6	R-0.23 / 6	3.9					
FTC17GO387		7	R-0.23 / 7	4.5					
FTC17GO38814		8 1/4	R-0.23 / 8.25	4.5					
FTC17GO3810		10	R-0.23 / 10	4.5					
FTC17GO3812		12	R-0.23 / 12	4.5					
LVL									
FTC17O38338	3/8	3 3/8	R-0.24 / 3.38	1.8	0.750 (T-40)	0.240	0.218	0.360	0.455
FTC17O38518		5 1/8	R-0.24 / 5.13						
FTC17O38678		6 7/8	R-0.24 / 6.8						
LOG									
FTC17BLK381012	3/8	10 1/2	R-0.24 / 10.5	2.5	0.750 (T-40)	0.240	0.218	0.360	0.455
FTC17BLK381312		13 1/2	R-0.24 / 13.5						
FTC17BLK3816		16	R-0.24 / 16						

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

¹Overall length of fastener is measured from the top of the head to the tip.

²Length of thread includes tip.

TABLE 2—PWR DRIVE SCREW STRENGTHS

NOMINAL SIZE	SPECIFIED BENDING YIELD STRENGTH ¹ <i>F_{yb}</i> (psi)	SCREW TENSION STRENGTH (lbf)	
		Allowable (ASD)	Design (LRFD)
STR			
5/16	223,500	1,785	2,675
3/8	232,000	2,075	3,115
CST			
5/16	183,500	1,800	2,705
3/8	220,000	2,175	3,260
LVL			
3/8	200,000	2,075	3,115
LOG			
3/8	200,000	2,075	3,115

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

¹Bending yield strength determined in accordance with ASTM F1575 using the root diameter.

TABLE 3—REFERENCE WITHDRAWAL (W) AND PULL-THROUGH (W_H) DESIGN VALUES FOR PWR DRIVE SCREWS INSTALLED INTO THE FACE OF THE WOOD MEMBER ^{1,2}

FASTENER SIZE	MINIMUM EMBEDDED THREAD LENGTH ³ (inches)	W (lbf/in.) FOR SPECIFIC GRAVITIES (SG) OF: ⁴			SIDE MEMBER THICKNESS (inches)	W_H (lbf) FOR SPECIFIC GRAVITIES (SG) OF:		
		SG ≥ 0.42	SG ≥ 0.55	ESG ≥ 0.50 ⁽⁵⁾		SG ≥ 0.42	SG ≥ 0.55	ESG ≥ 0.50 ⁽⁵⁾
STR								
⁵ / ₁₆	1.5	154	188	—	1.5	475	627	—
³ / ₈	1.5	154	223	—	1.5	475	647	—
CST								
⁵ / ₁₆	2	137	188	—	1.5	359	472	—
³ / ₈	2	137	188	—	1.5	404	541	—
	3.9	160	246	—				
LVL								
³ / ₈	1.8	—	—	171	1.75	—	—	642
LOG								
³ / ₈	1.5	154	223	—	1.5	475	647	—

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

¹Tabulated values must be multiplied by all adjustment factors in the NDS for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD.

²Tabulated values are applicable to screws installed perpendicular to the faces of the wood members.

³Embedded thread length is that portion of the screw held in the main member including the screw tip.

⁴Tabulated reference withdrawal design values are in pounds-force per inch of thread penetration into the main member.

⁵Required equivalent specific gravity described in the applicable ICC-ES evaluation report for LVL.

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

FASTENER SIZE	SIDE MEMBER THICKNESS (inch)	MINIMUM MAIN MEMBER PENETRATION (inches)	Z (lbf) FOR SPECIFIC GRAVITIES (SG) OF:					
			SG ≥ 0.42		SG ≥ 0.55		ESG ≥ 0.50 ⁽⁵⁾	
			Parallel to Grain, $Z_{ }$	Perpendicular to Grain, Z_{\perp}	Parallel to Grain, $Z_{ }$	Perpendicular to Grain, Z_{\perp}	Parallel to Grain, $Z_{ }$	Perpendicular to Grain, Z_{\perp}
STR								
⁵ / ₁₆	1 ¹ / ₂	1 ¹ / ₂	203	221	246	248	—	—
³ / ₈	5	1 ¹ / ₂	221	221	324	289	—	—
CST								
⁵ / ₁₆	¹ / ₂	2 ¹ / ₂	205 ⁽⁶⁾	230 ⁽⁶⁾	—	—	—	—
	1	2	220	292	310	398	—	—
	1 ¹ / ₂	3 ¹ / ₂	318	394	423	545	—	—
	2	4	329	460	466	605	—	—
³ / ₈	3 ³ / ₄	4 ¹ / ₂	418	403	386	454	—	—
LVL								
³ / ₈	1 ³ / ₄	1 ⁵ / ₈	—	—	—	—	332	418

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

¹Tabulated values must be multiplied by all adjustment factors included in the NDS for dowel-type fasteners to determine allowable loads for use with ASD and/or design loads for use with LRFD.

²Tabulated values are applicable to screws installed perpendicular to the faces of the wood members.

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

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

⁵Required equivalent specific gravity described in the applicable ICC-ES evaluation report for LVL.

⁶For rated plywood sheathing fastened to SPF CLT. Loading direction is based on grain direction of the surface ply of the CLT and the surface veneer of the plywood.

TABLE 5—CONNECTION GEOMETRY REQUIREMENTS FOR PWR DRIVE SCREWS INSTALLED PERPENDICULAR TO THE FACE OF WOOD MEMBERS^{1,2,3}

CONDITION		MINIMUM DISTANCE OR SPACING		
		G < 0.50	0.50 ≤ G	
End distance	Tension loading parallel to grain (fastener bearing toward end)	15D	20D	
	Compression loading parallel to grain (fastener bearing away from end)	10D	15D	
	Loading perpendicular to grain	10D	15D	
	Axial loading (fastener withdrawal or pull-through)	10D	10D	
Edge distance	Loading parallel to grain	5D	7D	
	Loading perpendicular to grain	Load toward edge	10D	12D
		Load away from edge	5D	7D
	Axial Loading	4D	4D	
Spacing between fasteners in a row (parallel to grain of main member)	Loading parallel to grain	15D	15D	
	Loading perpendicular to grain	10D	10D	
	Axial loading	7D	7D	
Spacing between rows (perpendicular to grain of main member)	Lateral loading	In-line rows	5D	7D
		Staggered rows ⁴	2.5D	3D
	Axial loading	4D	4D	

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 D refers to the outside thread diameter.

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

TABLE 6—APPLICABLE EXPOSURE CONDITIONS¹

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.

¹Treated wood refers to the specific wood treatment and retention level described in Section 4.2.

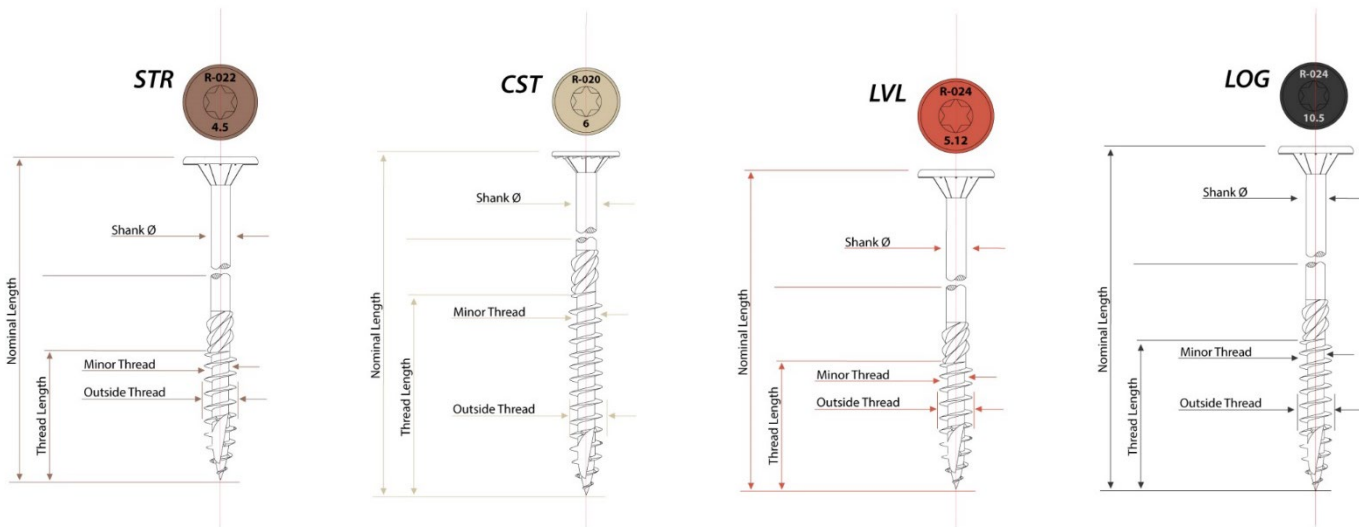


FIGURE 1—PWR DRIVE SCREWS

DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
Section: 06 05 23—Wood, Plastic and Composite Fastenings

REPORT HOLDER:

RELIABLE FASTENERS, A DIVISION OF RICHELIEU HARDWARE LTD.

EVALUATION SUBJECT:

PWR DRIVE SCREWS

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that PWR drive screws, described in ICC-ES evaluation report ESR-4558, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2022 California Building Code (CBC)

For evaluation of applicable Chapters adopted by the California Office of Statewide Health Planning and Development (OSHPD) AKA: California Department of Health Care Access and Information (HCAI) and the Division of State Architect (DSA), see Sections 2.1.1 and 2.1.2 below.

- 2022 California Residential Code (CRC)

2.0 CONCLUSIONS

2.1 CBC:

The PWR drive screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4558, comply with CBC Chapter 23, provided the design and installation are in accordance with the 2021 *International Building Code*® (IBC) provisions noted in the evaluation report and the additional requirements of CBC Chapters 16, 17 and 23, as applicable.

2.1.1 OSHPD:

The applicable OSHPD Sections and Chapters of the CBC are beyond the scope of this supplement.

2.1.2 DSA:

The applicable DSA Sections and Chapters of the CBC are beyond the scope of this supplement.

2.2 CRC:

The PWR drive screws, described in Sections 2.0 through 7.0 of the evaluation report ESR-4558, comply with CRC Chapter 3, provided the design and installation are in accordance with the 2021 *International Residential Code*® (IRC) provisions noted in the evaluation report and the additional requirements of CRC Chapter 3, as applicable.

This supplement expires concurrently with the evaluation report, reissued August 2024.