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ESR-3164

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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES
SECTION: 06 05 23—WOOD, PLASTIC AND COMPOSITE FASTENINGS

REPORT HOLDER:

DEWALT

**701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286**

EVALUATION SUBJECT:

WOODWORM™ SCREWS (DEWALT / POWERS)



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DIVISION: 06 00 00—WOOD, PLASTICS AND COMPOSITES

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

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EVALUATION SUBJECT:

WOODWORM™ SCREWS (DEWALT / POWERS)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012, 2009 and 2006 *International Building Code*® (IBC)
- 2015, 2012, 2009 and 2006 *International Residential Code*® (IRC)

Property evaluated:

Structural

2.0 USES

Woodworm screws are alternate dowel-type threaded fasteners used for wood-to-wood connections.

3.0 DESCRIPTION

3.1 General:

Woodworm screws are self-drilling, self-tapping screws comprised of a one-piece anchor body. The fastener body and thread designs differ from ANSI B18.2 and B18.6

standards, and the fasteners are not installed with lead (predrilled) holes. The four models of Woodworm screws recognized in this evaluation report are the Woodworm Ledger Screw, the Woodworm Truss Screw, the Woodworm Waferhead Screw (labeled as the Woodworm Lumber Screw), and the Woodworm Timber Screw. These four screw models are described in Sections 3.1.1 through 3.1.4, respectively. Corresponding product names for the report holder and the additional listee are presented in Table 1 of this report. Specified shank diameters, root thread diameters and outside thread diameters for the screws are given in Table 2.

3.1.1 Woodworm Ledger Screw: The Woodworm Ledger Screw is available in lengths of 3⁵/₈ inches and 5 inches (92 mm and 127 mm). It has a Type 17 gimlet point, 5¹/₁₆-inch (7.9 mm) hex head and integrated washer as shown in Figure 1A.

3.1.2 Woodworm Truss Screw: The Woodworm Truss Screw is available in lengths of 3⁵/₈ inches, 5 inches, and 6³/₄ inches (92 mm, 127 mm, and 171 mm). It has a gimlet point, 3³/₈-inch (9.5 mm) hex head and integrated washer as shown in Figure 1B.

3.1.3 Woodworm Waferhead (Lumber) Screw: The Woodworm Waferhead (Lumber) Screw is available in various lengths ranging from 2¹/₈ inches to 12 inches (73 mm to 305 mm). It has a Type 17 gimlet point and a proprietary Torx® T-30 waferhead head as shown in Figure 1C.

3.1.4 Woodworm Timber Screw: The Woodworm Timber Screw is available in various lengths ranging from 2¹/₂ inches to 12 inches (64 mm to 305 mm). It has a Type 17 gimlet point, 5¹/₁₆-inch (7.9 mm) hex head and integrated washer as shown in Figure 1D.

3.2 Materials:

3.2.1 Woodworm Screws: The fastener body and heads are manufactured from low-carbon steel wire conforming to ASTM A510, Grade 1022 or 10B21, and are case hardened to a Rockwell C hardness of 40 to 45 after forming. They are coated with a proprietary Perma-Seal® coating available in various colors.

3.2.2 Wood Members: Wood side and main members must have a moisture content less than or equal to 19 percent at the time of screw installation and in service. Wood members must be either solid-sawn lumber or boards having an assigned specific gravity as specified in Table 12.3.3A of the 2015 ANSI/AWC National Design Specification (NDS) for Wood Construction (Table 11.3.3A of the 2012 NDS, Table 11.3.2A of the 2005 NDS) or wood structural panels having an assigned specific gravity as specified in Table 12.3.3B of the 2015 NDS (Table 11.3.3B

of the 2012 NDS, Table 11.3.2B of the 2005 NDS) within the ranges given in Tables 3, 4 and 5 of this report. The thickness of the wood main member, t_m , must be equal to or greater than the screw length less the thickness of the side member. For the purposes of resisting lateral loads, the side member must have a minimum thickness, t_s , as specified in Table 3. For the purposes of resisting pull-through loads, the side member must have a minimum thickness, t_s , of 1.5 inches (38 mm).

4.0 DESIGN AND INSTALLATION

4.1 Design:

Reference lateral (Z), withdrawal (W), and head pull-through (P) design values for connections with Woodworm screws in wood members are given, respectively, in Tables 3, 4 and 5. Adjustment factors must be as specified for dowel-type fasteners and wood screws in the NDS. Allowable tensile and shear loads for the Woodworm screws, based on fastener strength, are given in Table 2.

The allowable lateral load for a single-screw connection is the lesser of: (a) the reference lateral design value given in Table 3, adjusted by all applicable adjustment factors; or (b) the allowable screw shear strength given in Table 2. The allowable load for a single-screw connection in which the screw is subject to tension is the least of: (a) the reference withdrawal design value given in Table 4, adjusted by all applicable adjustment factors; (b) the reference head pull-through design value given in Table 5, adjusted by all applicable adjustment factors; or (c) the allowable screw tension strength given in Table 2. When the *adjusted* lateral design value (Z') of a single-screw connection exceeds the allowable shear strength of the fastener itself, as specified in Table 2, the design lateral load of the connection must be limited to the shear value specified in Table 2, without any load duration adjustments. When the lesser of the adjusted withdrawal design value (W') and the *adjusted* pull-through design value (P') of a single-screw connection exceeds the allowable tensile strength of the fastener itself, as specified in Table 2, the design load of the connection must be limited to the tension value specified in Table 2, without any load duration adjustments.

Connections containing multiple Woodworm screws must be designed in accordance with Sections 11.2.2 and 12.6 of the 2015 NDS (Sections 10.2.2 and 11.6 of the 2012 and 2005 NDS). Where Woodworm screws are subjected to combined lateral and withdrawal loads, connections must be designed in accordance with Section 12.4.1 of the 2015 NDS (Section 11.4.1 of the 2012 and 2005 NDS). When designing a connection, the structural members must be checked for load-carrying capacity in accordance with Section 11.1.2 of the 2015 NDS (Section 10.1.2 of the 2012 and 2005 NDS), and local stresses within the connection must be checked against Appendix E of the NDS to ensure the capacity of the connection and fastener group. Minimum end distances, edge distances and spacing of the screws must be sufficient to prevent splitting of the wood, or as required by Table 6, whichever is greater.

4.2 Installation:

Woodworm screws must be installed in accordance with the report holder's published installation instructions and this report. Screws must be installed such that their main

axis is oriented perpendicular to the wood grain. An appropriate screw length must be used, such that the screw will have a minimum penetration into the main member as specified in Table 3. The side member must be in direct contact with the main member, such that no gap exists between the wood members. End distances, edge distances and spacing of the screws must be as specified in Section 4.1. The screw is driven into the wood members without predrilled pilot holes. The screw must be driven with a low RPM, high-torque electric drill, using the manufacturer-recommended driver bit. Upon installation, the underside of the screw head must be flush with the surface of the side member. The screws must not be overdriven.

5.0 CONDITIONS OF USE

The Woodworm 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 manufacturer's published installation instructions and this report. In case of a conflict between this report and the manufacturer's installation instructions, this report governs.
- 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 Woodworm screws must be installed and used in dry in-service conditions where the moisture content of the wood members does not exceed 19 percent.
- 5.4 Use of the screws in contact with fire-retardant-treated wood is outside the scope of this report. See [ESR-3213](#) for installations in which Woodworm screws are used in contact with treated wood.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Alternate Dowel-type Threaded Fasteners (AC233), dated April 2015.

7.0 IDENTIFICATION

Woodworm screws are identified in the field by dimensional characteristics and packaging. A manufacturer identification letter, "P", along with a length designation is stamped on each screw head, as shown in Figures 1A through 1D. Head markings corresponding to each fastener are indicated in Table 2. Packages are identified with the company name and product name (see Table 1); part number; head type; screw size and length; and the evaluation report number (ICC-ES ESR-3164).

TABLE 1—PRODUCT NAMES BY COMPANY

COMPANY NAME	PRODUCT NAME			
DEWALT	Woodworm Ledger Screw	Woodworm Truss Screw	Woodworm Waferhead (Lumber) Screw	Woodworm Timber Screw
Powers Fasteners	Woodworm Ledger Screw	Woodworm Truss Screw	Woodworm Waferhead (Lumber) Screw	Woodworm Timber Screw
The Hillman Group	Ledger Tite	Truss Tite	Lumber Tite	Timber Tite

TABLE 2—FASTENER SPECIFICATIONS AND STRENGTHS— WOODWORM SCREWS

FASTENER DESIGNATION	HEAD MARKING	OVERALL PART LENGTH ¹ (inches)	LENGTH OF THREAD ² (inches)	THREADS PER INCH	ROOT (MINOR) DIAMETER (inch)	SHANK DIAMETER (inch)	OUTSIDE THREAD (MAJOR) DIAMETER (inch)	BENDING YIELD STRENGTH ³ , F _{yb} (psi)	ALLOWABLE STEEL STRENGTH	
									Tension (lbf)	Shear (lbf)
Woodworm™ Ledger Screw	P3.6	3 ⁵ / ₈	2	7.5	0.202	0.229	0.305	190,000	2,175	1,300
	P5.0	5	3							
Woodworm™ Truss Screw	P3.3	3 ³ / ₈	1 ¹ / ₂	9.0	0.215	0.228	0.284	190,000	2,270	1,215
	P5.0	5	1 ¹ / ₂							
	P6.7	6 ³ / ₄	1 ¹ / ₂							
Woodworm™ Waferhead (Lumber) Screw	P2.9	2 ⁷ / ₈	1 ¹ / ₄	7.5	0.172	0.188	0.260	170,000	1,080	705
	P4.5	4 ¹ / ₂	2							
	P6.0	6	2							
	P7.0	7	2							
	P8.0	8	2							
	P9.0	9	2							
	P10.0	10	2							
P12.0	12	2								
Woodworm™ Timber Screw	P2.5	2 ¹ / ₂	1 ¹ / ₄	7.5	0.172	0.188	0.260	170,000	1,080	705
	P4.0	4	2							
	P6.0	6	2							
	P8.0	8	2							
	P10.0	10	2							
P12.0	12	2								

For SI: 1 inch = 25.4 mm; 1 lbf = 4.45 N; 1 psi = 6.9 kPa.

¹For purposes of measuring overall fastener length, fasteners are measured from underside of head to tip of point.

²Length of thread includes tip. See detailed illustrations in Figures 1A through 1D.

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

TABLE 3—REFERENCE LATERAL DESIGN VALUES, Z, FOR WOOD-TO-WOOD CONNECTIONS (lbf)^{1,2,3}

FASTENER DESIGNATION	HEAD MARKING	MINIMUM SIDE MEMBER THICKNESS ⁴ t _s (inches)	MINIMUM PENETRATION INTO MAIN MEMBER ⁵ p (inches)	REFERENCE LATERAL DESIGN VALUES, Z (lbf), FOR MINIMUM SPECIFIC GRAVITIES OF: ⁶							
				0.67	0.55	0.5	0.46	0.43	0.42	0.36	0.31
Ledger Screw	P3.6	1 ¹ / ₈	1 ¹ / ₂	323	246	206	177	155	148	113	84
	P5.0	1 ¹ / ₈									
Truss Screw	P3.6	1 ³ / ₈	2	376	285	241	208	182	174	132	99
	P5.0, P6.7	3									
Waferhead (Lumber) Screw	P2.9	7 ⁷ / ₈	2	248	191	170	154	141	137	117	99
	P4.5 – P12.0	2 ¹ / ₂									
Timber Screw	P2.5	1 ¹ / ₂	2	206	169	154	142	133	130	99	74
	P4.0	2									
	P6.0 – P12.0	2 ¹ / ₂									

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

¹Tabulated reference lateral design values, Z, apply to single shear (two-member) connections with wood main and side members having specific gravity as shown, in which the screw is oriented perpendicular to the grain and loaded laterally at any angle with respect to the grain. For connections in which the main and side members have different specific gravities, use the lower of the two for design. Gaps are not permitted between the main and side members.

²Values must be multiplied by all applicable adjustment factors, as applicable to dowel-type fasteners, in accordance with the NDS.

Woodworm screws must be installed and used in dry in-service conditions, such that the wet service factor, C_M, is 1.0 in accordance with the NDS.

⁴Side members with thicknesses greater than the tabulated minimum side member thickness may be used, provided the corresponding tabulated minimum main member penetration is still achieved for the given screw length.

⁵Minimum main member penetration is the minimum length of the screw (including threaded, unthreaded and tip length) that must be embedded within the main member.

⁶Specific gravity must be the assigned specific gravity for sawn lumber or wood structural panels per the NDS.

**TABLE 4—REFERENCE WITHDRAWAL DESIGN VALUES, *W* (lbf)^{1,2,3,4}
(Minimum Penetration into Main Member = 1.0 inch)**

FASTENER DESIGNATION	HEAD MARKING ⁵	<i>W</i> (lbf) FOR SPECIFIC GRAVITIES OF: ^{6,7}		
		S.G. ≥ 0.56	0.56 > S.G. ≥ 0.42	0.42 > S.G. ≥ 0.31
Ledger Screw	All	214	141	— ⁽⁶⁾
Truss Screw	All	193	149	— ⁽⁶⁾
Waferhead (Lumber) Screw	All	180	125	— ⁽⁶⁾
Timber Screw	All	180	125	— ⁽⁶⁾

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

¹Tabulated reference withdrawal design values, *W*, apply to screws driven into the side grain of the main member, such that the screws are oriented perpendicular to the grain and loaded in direct withdrawal.

²Values must be multiplied by all applicable adjustment factors, as applicable to wood screws, in accordance with the NDS, but must not be multiplied by thread penetration length (see footnote 4).

Woodworm screws must be installed and used in dry in-service conditions, such that the wet service factor, *C_M*, is 1.0 in accordance with the NDS.

⁴Reference withdrawal design values are absolute values, based on a minimum 1.0-inch thread penetration into the main member (including the tapered tip), and are not permitted to be multiplied by the length of thread penetration into the main member.

⁵Refer to Table 2 for head markings.

Woodworm screws have not been evaluated for withdrawal in wood members having specific gravities less than 0.42.

⁷Specific gravity must be the assigned specific gravity for sawn lumber or wood structural panels per the NDS.

TABLE 5—REFERENCE HEAD PULL-THROUGH DESIGN VALUES, *P* (lbf)^{1,2,3}

FASTENER DESIGNATION	HEAD MARKING	MINIMUM SIDE MEMBER THICKNESS <i>t_s</i> (inches)	<i>P</i> (lbf) FOR SPECIFIC GRAVITIES OF: ^{4,5}	
			S.G. ≥ 0.50	0.50 > S.G. ≥ 0.31
Ledger Screw	All	1½	430	— ⁽⁴⁾
Truss Screw	All	1½	280	— ⁽⁴⁾
Waferhead (Lumber) Screw	All	1½	430	— ⁽⁴⁾
Timber Screw	All	1½	280	— ⁽⁴⁾

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

¹Tabulated head pull-through design values, *P*, must be multiplied by all applicable adjustment factors, as applicable to wood screw withdrawal, in accordance with the NDS.

²Design values apply to connections with minimum side member thicknesses, *t_s*, as given above.

Woodworm screws must be installed and used in dry in-service conditions, such that the wet service factor, *C_M*, is 1.0 in accordance with the NDS.

Woodworm screws have not been evaluated for head pull-through resistance in wood members having specific gravities less than 0.50.

⁵Specific gravity must be the assigned specific gravity for sawn lumber or wood structural panels per the NDS.

TABLE 6—CONNECTION GEOMETRY REQUIREMENTS¹

CONDITION		MINIMUM DISTANCE OR SPACING (inches)	
		Ledger and Truss Screws	Waferhead (Lumber) and Timber Screws
End distance	Loading toward end	3½	2⅞
	Loading away from end	2⅞	1⅞
	Loading perpendicular to grain	2	2
Edge distance	Any load direction	1	1
Spacing between fasteners in a row	Loading parallel to grain	3½	2⅞
	Loading perpendicular to grain	2⅞	1⅞
Spacing between rows	In-line rows	1¼	1
	Staggered rows ²	⅝	1/2

For SI: 1 inch = 25.4 mm.

¹End 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.

²Values for spacing between staggered rows apply where screws in adjacent rows are offset by half of the spacing between screws in a row.

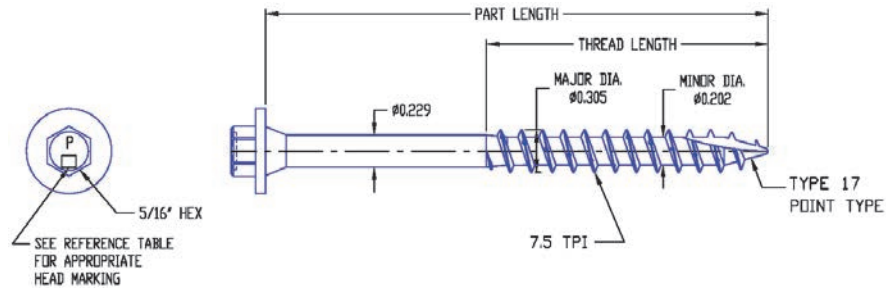


FIGURE 1A—FASTENER SPECIFICATIONS FOR WOODWORM LEDGER SCREW

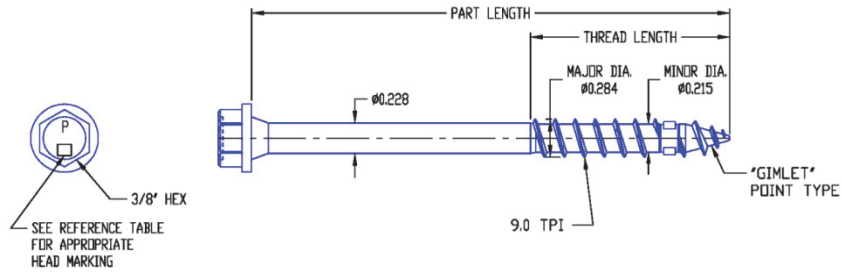


FIGURE 1B—FASTENER SPECIFICATIONS FOR WOODWORM TRUSS SCREW

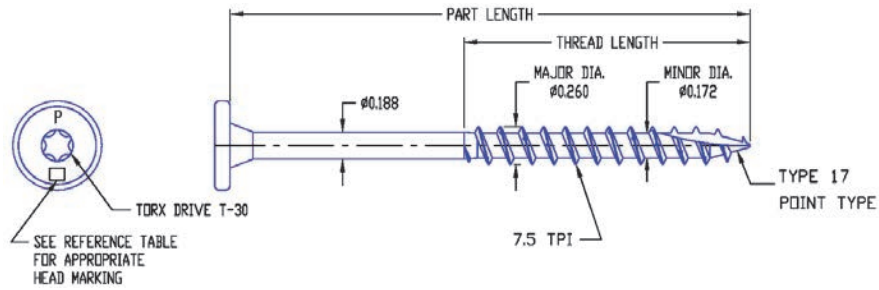


FIGURE 1C—FASTENER SPECIFICATIONS FOR WOODWORM WAFERHEAD (LUMBER) SCREW

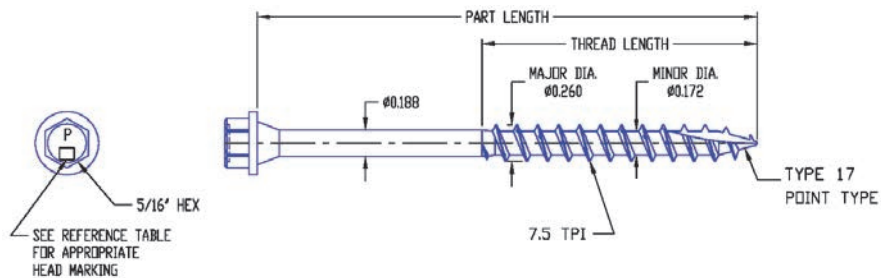


FIGURE 1D—FASTENER SPECIFICATIONS FOR WOODWORM TIMBER SCREW