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ESR-3042

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This report is subject to renewal 09/2018.

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

REPORT HOLDER:

DEWALT

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TOWSON, MARYLAND 21286

EVALUATION SUBJECT:

TAPPER®+ SCREW ANCHORS IN WOOD (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:

TAPPER®+ SCREW ANCHORS IN WOOD (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

Tapper+ screw anchors are alternate dowel-type threaded fasteners used in wood-to-wood connections.

3.0 DESCRIPTION

3.1 General:

Tapper+ screw anchors are self-drilling, self-tapping screws comprised of a one-piece anchor body with a hex head, slotted hex head or phillips flat head. The screw anchor body is formed with alternating high and low threads, and a gimlet point tip.

Product names for the report holder and the additional listees are presented in Table 1 of this report. The screw anchors are available with nominal diameters of $\frac{3}{16}$ inch and $\frac{1}{4}$ inch. The actual specified shank diameter, root thread diameter and outside thread diameter are given in Table 2B for each screw anchor. The nominally $\frac{3}{16}$ -inch screw anchor is available in lengths ranging from $1\frac{3}{4}$ inches to 4 inches (44.5 mm to 102 mm), and the nominally $\frac{1}{4}$ -inch screw anchor is available in lengths ranging from $1\frac{3}{4}$ inches to 6 inches (44.5 mm to 152 mm), as indicated in Table 2A.

3.2 Materials:

3.2.1 Tapper+ Screw Anchors: The screw anchors are manufactured from low-carbon steel wire, grade C1016 or C1022, and are case hardened 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 anchor installation and while in service. Wood members must be 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 panel 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 anchor 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 , of $\frac{3}{4}$ inch (19.0 mm). For the purposes of resisting pull-through and withdrawal loads, the side member must have a minimum thickness, t_s , of 1.0 inch (25.4 mm).

4.0 DESIGN AND INSTALLATION

4.1 Design:

Reference lateral (Z), withdrawal (W), and head pull-through (P) design values for Tapper+ screw anchor connections in wood members are given in Tables 3, 4 and 5, respectively. Adjustment factors must be as

specified for dowel-type fasteners and wood screws in the NDS. Allowable tensile and shear loads for the Tapper+ screw anchors, based on fastener strength, are given in Table 2B.

The allowable lateral load for a single-screw anchor 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 anchor shear strength given in Table 2B. The allowable load for a single-screw anchor connection in which the screw anchor 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 anchor tension strength given in Table 2B. Reference design values must be multiplied by all applicable adjustment factors, as specified for dowel-type fasteners and wood screws in the NDS. When the adjusted lateral design value (Z') of a single-screw anchor connection exceeds the allowable shear strength of the screw anchor itself, as specified in Table 2B, the design lateral load of the connection must be limited to the shear value specified in Table 2B, 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 anchor connection exceeds the allowable tensile strength of the screw anchor itself, as specified in Table 2B, the design load of the connection must be limited to the tension value specified in Table 2B, without any load duration adjustments.

Connections containing multiple Tapper+ screw anchors 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 Tapper+ screw anchors 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 screw anchors must be in accordance with Table 6 of this report.

4.2 Installation:

Tapper+ screw anchors must be installed in accordance with the manufacturer's published installation instructions and this report. Screw anchors must be installed such that their main axis is oriented perpendicular to the wood grain. An appropriate screw anchor length must be used, such that the screw anchor will penetrate a minimum of 1.0 inch (25.4 mm) into the main member. 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 screw anchors must be sufficient to prevent splitting of the wood, or as required by Table 6, whichever is greater. Installation may be performed without predrilling the wood members. The

screw anchor must be driven using the manufacturer-recommended socket tool (for hex head versions) or a phillips bit tip (for flat head versions), with a rotary drill or percussion drill set to rotary only mode. Upon installation, for hex head screw anchors, the underside of the screw anchor head must be flush with the surface of the side member; and for flat head screw anchors the head of the screw anchor must be flush with the surface of the side member. The screw anchors must not be overdriven.

5.0 CONDITIONS OF USE

The Tapper+ screw anchors 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 screw anchors 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 Tapper+ screw anchors 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 screw anchors in contact with preservative-treated or fire-retardant-treated wood is outside the scope of this report. See [ESR-3213](#) for installations in which Tapper+ screw anchors are used in contact with treated wood.
- 5.5 Lateral loading of $\frac{3}{16}$ -inch Tapper+ screw anchors is outside the scope of this evaluation report.
- 5.6 Tapper+ screw anchors have not been evaluated for withdrawal and head pull-through resistance in wood members having specific gravities of less than 0.50.
- 5.7 Tapper+ screw anchors are manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

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

7.0 IDENTIFICATION

The Tapper+ screw anchors are identified in the field by dimensional characteristics and packaging. A length letter code, as specified in Table 2A, is stamped on each screw anchor head along with a plus sign "+". Packages are identified with the product name; part number; head type; screw anchor size and length; the company name as set forth in Table 1 of this report; and the evaluation report number (ESR-3042).

TABLE 1—PRODUCT NAMES BY COMPANY

COMPANY NAME	PRODUCT NAME
DEWALT	Tapper+ Screw Anchors
Powers Fasteners	Tapper+ Screw Anchors
The Hillman Group	Hillman Tapper+ Screw Anchors
All Points Screw, Bolt & Specialty Co.	AP Tapper+ Screw Anchors

TABLE 2A—FASTENER SPECIFICATIONS – TAPPER+ SCREW ANCHORS

FASTENER DESIGNATION	HEAD MARKING ID	OVERALL PART LENGTH, L ¹ (inches)	LENGTH OF THREAD, E ² (inches)
3/16-inch and 1/4-inch Tapper+ Screw Anchor	A	1 3/4	1 5/8
	B	2 1/4	1 7/8
	C	2 3/4	2 1/4
	D	3 1/4	2 1/4
	E	3 3/4	2 1/4
	F	4	2 1/4
1/4-inch Tapper+ Screw Anchor	H	5	2 1/4
	J	6	2 1/4

For SI: 1 inch = 25.4 mm.

¹For purposes of measuring overall fastener length, fasteners with hex heads are measured from underside of head to tip of point and fasteners with flat heads are measured from the top of the head to the point.

²Length of thread includes tip. See detailed illustration in Figure 1.

TABLE 2B—FASTENER SPECIFICATIONS AND STRENGTHS – TAPPER+ SCREW ANCHORS

FASTENER DESIGNATION	ROOT DIAMETER ¹ (inch)	SHANK DIAMETER ¹ (inch)	OUTSIDE THREAD DIAMETER ¹ (inch)	BENDING YIELD STRENGTH ² , F _{yb} (psi)	ALLOWABLE STEEL STRENGTH	
					Tension (lbf)	Shear (lbf)
3/16-inch Tapper+ Screw Anchor	0.127	0.145	0.197	69,000	635	435
1/4-inch Tapper+ Screw Anchor	0.170	0.187	0.241	97,000	1050	785

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

¹Specified root, shank and outside thread diameters are shown in the table.

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

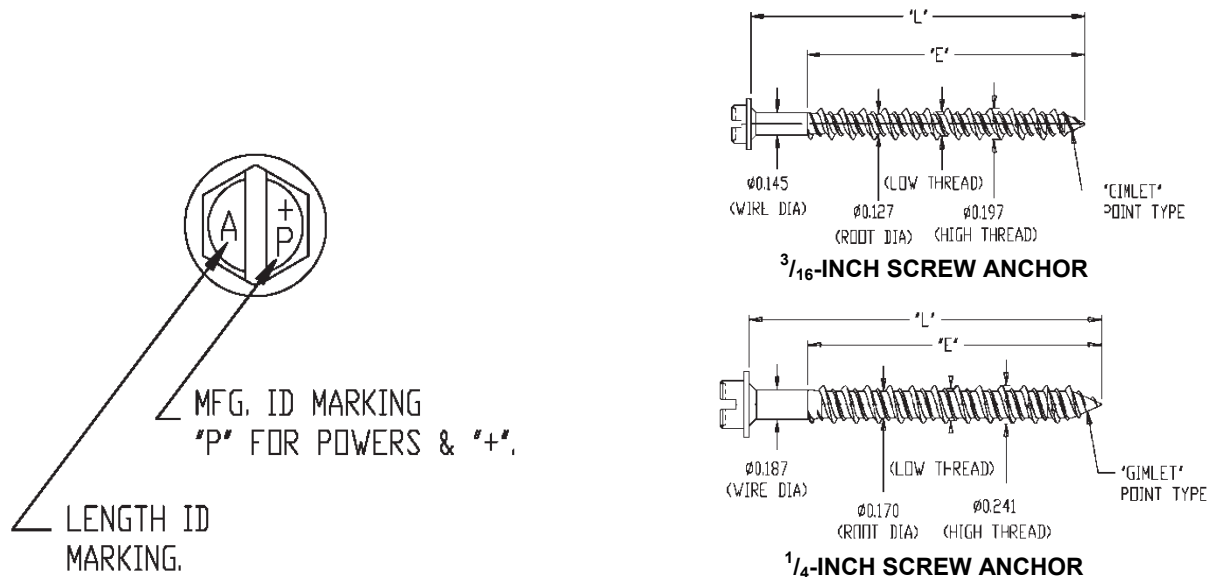


FIGURE 1—FASTENER SPECIFICATIONS FOR TAPPER+ SCREW ANCHOR (Slotted Hex Head Shown)

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

FASTENER DESIGNATION	HEAD MARKING	MIN. SIDE MEMBER THICKNESS ⁴ t _s (inches)	MIN. MAIN MEMBER PENETRATION ⁵ p (inches)	REFERENCE LATERAL DESIGN VALUES, Z (lbf) FOR MINIMUM SPECIFIC GRAVITIES OF: ⁶							
				0.67	0.55	0.50	0.46	0.43	0.42	0.36	0.31
³ / ₁₆ -inch Tapper+ Screw Anchor	A through F	(³ / ₁₆ -inch Tapper+ screw anchors have not been evaluated for lateral loading)									
¹ / ₄ -inch Tapper+ Screw Anchor	A	0.75	1.00	199	148	124	107	94	90	68	51
	B		1.50		152	134	120	110	107	90	71
	C through J		≥ 2.00								
	B	1.00	1.25	212	177	154	137	122	116	89	66
	C through J		≥ 1.75					124	120	98	81
	C	1.50	1.25	212	177	162	149	134	129	105	82
D through J	≥ 1.75		151				141	138	120	96	

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

Notes to Table 3:

- 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 anchor 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. 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.
- ³Tapper+ screw anchors 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 anchor length.
- ⁵Minimum main member penetration is the minimum length of the screw anchor (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)^{1,2,3,4}

FASTENER DESIGNATION	HEAD MARKING ⁵	THREAD LENGTH ⁵ (inches)	W (lbf/in) FOR SPECIFIC GRAVITIES OF: ^{6,7}		
			S.G. ≥ 0.56	0.56 > S.G. ≥ 0.50	0.50 > S.G. ≥ 0.31
³ / ₁₆ -inch Tapper+ Screw Anchor	A through F	1 ⁵ / ₈ through 2 ¹ / ₄	109	109	--
¹ / ₄ -inch Tapper+ Screw Anchor	A through J	1 ⁵ / ₈ through 2 ¹ / ₄	181	137	--

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

- ¹Tabulated reference withdrawal design values, W, apply to screw anchors driven into the side grain of the main member, such that the screw anchors 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.
- ³Tapper+ screw anchors 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 to be multiplied by the length of thread penetration into the main member, but must not exceed the head pull-through design values given in Table 5. Main member penetration must be ≥ 1 inch. Threaded length includes tapered tip.
- ⁵Refer to Table 2A for head markings and corresponding thread lengths.
- ⁶Tapper+ screw anchors have not been evaluated for withdrawal in wood members having specific gravities less than 0.50.
- 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)^{1,2,3}

FASTENER DESIGNATION	HEAD TYPE	HEAD MARKING	MINIMUM SIDE MEMBER THICKNESS t_s , (inch)	PULL-THROUGH DESIGN VALUES, P (lbf) FOR SPECIFIC GRAVITIES OF: ^{4,5}		
				S.G. ≥ 0.56	0.56 > S.G. ≥ 0.50	0.50 > S.G. ≥ 0.31
³ / ₁₆ -inch Tapper+ Screw Anchor	Hex Head / Slotted Hex Head	A through F	1.00	125	125	--
	Phillips Flat Head	A through F	1.00	125	125	--
¹ / ₄ -inch Tapper+ Screw Anchor	Hex Head / Slotted Hex Head	A through J	1.00	314	176	--
	Phillips Flat Head	A through F	1.00	176	176	--

For SI: 1 inch = 25.4 mm; 1 pound = 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.

³Tapper+ screw anchors 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.

⁴Tapper+ screw anchors 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)	
		³ / ₁₆ -inch Tapper+ Screw Anchor	¹ / ₄ -inch Tapper+ Screw Anchor
End distance	Loading toward end	2 ³ / ₄	2 ³ / ₄
	Loading away from end	1 ⁷ / ₈	1 ⁷ / ₈
	Loading perpendicular to grain	2	2
Edge distance	Any load direction	1	1
Spacing between fasteners in a row	Loading parallel to grain	2 ¹ / ₄	2 ³ / ₄
	Loading perpendicular to grain	1 ¹ / ₂	1 ⁷ / ₈
Spacing between rows	In-line rows	³ / ₄	1
	Staggered rows ²	³ / ₈	¹ / ₂

For SI: 1 inch = 25.4 mm.

¹End distances, edge distances and screw anchor 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 screw anchors in adjacent rows are offset by half of the spacing between screw anchors in a row.