

ICC-ES Evaluation Report

ESR-2966

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors
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EVALUATION SUBJECT:
**POWERS POWER-STUD+ SD1 EXPANSION ANCHORS
IN MASONRY**
ADDITIONAL LISTEES:
COOPER B-LINE
 509 WEST MONROE STREET
 HIGHLAND, ILLINOIS 62249

L.H. DOTTIE COMPANY
 6131 SOUTH GARFIELD AVENUE
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THE HILLMAN GROUP
 10590 HAMILTON AVENUE
 CINCINNATI, OHIO 45231

1.0 EVALUATION SCOPE
Compliance with the following codes:

- 2009, 2006, 2003 and 2000 *International Building Code*® (IBC)
- 2009, 2006, 2003 and 2000 *International Residential Code*® (IRC)
- 1997 *Uniform Building Code*™ (UBC)

Property evaluated:

Structural

2.0 USES

The Powers Power-Stud+ SD1 expansion anchors are used for anchoring building components and structural connections in predrilled holes to grout-filled uncracked concrete masonry units, to resist static, wind and seismic tension and shear loads. The anchors are alternatives to the cast-in-place anchors described in Section 2107 of the IBC (TMS 402) and Section 2107 of the UBC. The anchors

may also be used under the IRC where an engineered design is submitted in accordance with Section R301.1.3 (2009, 2006 and 2003 IRC) or Section R301.1.2 (2000 IRC).

3.0 DESCRIPTION
3.1 Power-Stud+ SD1:

Power-Stud+ SD1 anchors are torque-controlled, mechanical expansion anchors comprised of an anchor body, expansion wedge (clip), washer and hex nut. Product names for the report holder and for the additional listees are presented in Table 1 of this report. Available diameters recognized for use in masonry are $\frac{3}{8}$ inch, $\frac{1}{2}$ inch, and $\frac{5}{8}$ inch (9.5 mm, 12.7 mm and 15.9 mm). The anchor body and expansion clip are manufactured from medium carbon steel complying with requirements set forth in the approved quality documentation, and have minimum 0.0002-inch-thick (5 μ m) zinc plating in accordance with ASTM B 633, SC1, Type III. The washers comply with ASTM F 844. The hex nuts comply with ASTM A 563, Grade A. The Power-Stud+ SD1 expansion anchor is illustrated in Figure 1.

The anchor body is comprised of a high-strength threaded rod at one end and a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion clip that freely moves around the mandrel. The expansion clip movement is restrained by the mandrel taper and by a collar. The anchors are installed in a predrilled hole with a hammer. When torque is applied to the nut of the installed anchor on the threaded end of the anchor body, the mandrel at the other end of the anchor is drawn into the expansion clip, forcing it outward into the sides of the predrilled hole in the base material.

3.2 Grout-filled Concrete Masonry:

The compressive strength of masonry, f'_m , at 28 days must be a minimum of 1,500 psi (10.3 MPa). Grout-filled masonry must be constructed from the following materials:

3.2.1 Concrete Masonry Units: Grout-filled concrete masonry walls must be constructed from minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units (CMUs) conforming to ASTM C 90 (IBC) or UBC Standard 21-4. The minimum allowable nominal size of the CMU must be 6 inches (152 mm) wide by 8 inches (203 mm) high by 16 inches (406 mm) long (i.e. 6x8x16).

3.2.2 Grout: The masonry units must be fully grouted with grout complying with Section 2103.12 of the 2009 and 2006 IBC, or Section 2103.10 of the 2003 and 2000 IBC; Section R609.1.1 of the IRC; or Section 2103.4 of the UBC

and UBC Standard 21-19, and having a minimum compressive strength as indicated in these code sections at 28 days.

3.2.3 Mortar: Mortar must be Type N, S or M, prepared in accordance with Section 2103.8 of the 2009 and 2006 IBC, or Section 2103.7 of the 2003 and 2000 IBC, or Section R607 of the IRC, or Section 2103.3 of the UBC and UBC Standard 21-15, as applicable.

4.0 DESIGN AND INSTALLATION

4.1 Allowable Stress Design (ASD):

The allowable load values for anchors described in this report are based on allowable stress design under the IBC and the UBC. Allowable tension and shear loads for installation in uncracked grout-filled concrete masonry are noted in Table 4.

Allowable loads are given in Table 4 for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr} , between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to a minimum spacing distance, s_{min} , of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor of 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.

The allowable loads for anchors installed in grout-filled concrete masonry subjected to combined tension and shear forces must be determined by the following equation:

$$\left(\frac{P_s}{P_t}\right)^{\frac{5}{3}} + \left(\frac{V_s}{V_t}\right)^{\frac{5}{3}} \leq 1 \quad (\text{Eq-1})$$

where:

P_s = Applied service tension load.

P_t = Allowable service tension load.

V_s = Applied service shear load.

V_t = Allowable service shear load.

4.2 Installation:

The Power-Stud+ SD1 expansion anchors must be installed in accordance with the manufacturer's published installation instructions and this report. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation parameters are provided in Table 2 and Figure 2. Anchors must be installed in holes drilled into the concrete using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The dust and debris must be removed from the predrilled hole using a hand pump, compressed air or vacuum to remove loose particles left from drilling. The anchor must be hammered into the predrilled hole until the proper nominal embedment depth is achieved. The nut must be tightened against the washer until the torque values specified in Table 2 are achieved.

4.3 Special Inspection:

Special inspection is required in accordance with Section 1704.15 of the 2009 IBC or Section 1704.13 of the 2006, 2003, and 2000 IBC, or Section 1701.5.2 of the UBC, when design loads are based on special inspections being provided during installation, as set forth in Table 4. Special inspection in accordance with Section 1704 of the IBC must be provided under the IRC when special inspection is specified in Table 4. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, drill bit size, masonry

type, masonry thickness, mortar type, anchor location, anchor embedment and adherence to the manufacturer's printed installation instructions. Under the IBC, additional requirements as set forth in Sections 1705, 1706 and 1707 must be observed, where applicable.

5.0 CONDITIONS OF USE

The Powers Power-Stud+ SD1 expansion 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 anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of conflict, this report governs.
- 5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.
- 5.3 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.
- 5.4 Design of anchors installed in grout-filled uncracked concrete masonry to resist static, wind and seismic load applications must be in accordance with Section 4.1 of this report.
- 5.5 When using the basic load combinations in accordance with IBC Section 1605.3.1.1 or UBC Section 1612.3.1, allowable loads are not permitted to be increased for wind or seismic loading. When using the alternative basic load combinations in IBC Section 1605.3.2 or UBC Section 1612.3.2 that include wind or seismic loads, the allowable tension and shear loads for anchors are permitted to be increased by $33\frac{1}{3}$ percent unless otherwise noted in Table 4 of this report.
- 5.6 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors subjected to fatigue and shock loading is unavailable at this time, the use of these anchors under these conditions is beyond the scope of this report.
- 5.7 Where not otherwise prohibited by the code, anchors are permitted for installation in fire-resistance-rated construction provided at least one of the following conditions is fulfilled:
 - Anchors are used to resist wind or seismic forces only.
 - Anchors that support fire-resistance-rated construction or gravity load-bearing structural elements are within a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
 - Anchors are used to support nonstructural elements.
- 5.8 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of expansion anchors in cracked masonry is unavailable at this time, the use of anchors must be limited to installation in uncracked grout-filled concrete masonry. Cracking occurs when $f_t > f_r$ due to service loads or deformations.

- 5.9 Use of carbon steel anchors is limited to dry, interior locations.
- 5.10 Special inspection must be provided in accordance with Section 4.3 of this report, where applicable.
- 5.11 Anchors are manufactured under an approved quality control program with inspections by CEL Consulting (AA-639).

6.0 EVIDENCE SUBMITTED

- 6.1 Data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), dated December 2009, for use in grout-filled uncracked concrete masonry; including optional seismic tests in tension and shear.
- 6.2 Quality control documentation.

7.0 IDENTIFICATION

The Powers Power-Stud+ SD1 expansion anchors are identified by dimensional characteristics and packaging. A length letter code, visible after installation, is stamped on each anchor on the exposed threaded stud end along with the number “1”. Table 3 summarizes the length code identification system. A plus sign (+) is also marked with the number “1” on all anchors recognized in this report. Packages are identified with the product name, type and size, the company name as set forth in Table 1 of this report, the name of the inspection agency (CEL) and the evaluation report number (ICC-ES ESR-2966).

TABLE 1—CROSS REFERENCE OF COMPANY NAMES TO PRODUCT NAMES

COMPANY NAME	PRODUCT NAME
Powers Fasteners, Inc.	Power-Stud+ SD1
Cooper B-Line	B-Line Power-Stud+ SD1
L. H. Dottie Co.	Dottie Wedge SD1
The Hillman Group	Hillman Power-Stud+ SD1

TABLE 2—POWER-STUD+ SD1 ANCHOR INSTALLATION SPECIFICATIONS IN GROUT-FILLED CONCRETE MASONRY

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter		
			³ / ₈ inch	¹ / ₂ inch	⁵ / ₈ inch
Anchor diameter	<i>d_o</i>	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Minimum diameter of hole clearance in fixture	<i>d_h</i>	in. (mm)	⁷ / ₁₆ (11.1)	⁹ / ₁₆ (14.3)	¹¹ / ₁₆ (17.5)
Nominal drill bit diameter	<i>d_{bit}</i>	in.	³ / ₈ ANSI	¹ / ₂ ANSI	⁵ / ₈ ANSI
Installation torque	<i>T_{inst}</i>	ft.-lbf. (N-m)	20 (27)	40 (54)	50 (68)
Torque wrench/socket size	-	in.	⁹ / ₁₆	³ / ₄	¹⁵ / ₁₆
Nut height	-	In.	²¹ / ₆₄	⁷ / ₁₆	³⁵ / ₆₄

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

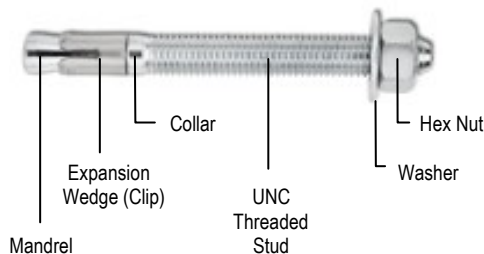


FIGURE 1—POWER-STUD+ SD1 ANCHOR ASSEMBLY

TABLE 3—POWER-STUD+ SD1 ANCHOR LENGTH CODE IDENTIFICATION SYSTEM

Length ID marking on threaded stud head		A	B	C	D	E	F	G	H	I
Overall anchor length, (inches)	From	1 ¹ / ₂	2	2 ¹ / ₂	3	3 ¹ / ₂	4	4 ¹ / ₂	5	5 ¹ / ₂
	Up to but not including	2	2 ¹ / ₂	3	3 ¹ / ₂	4	4 ¹ / ₂	5	5 ¹ / ₂	6
Length ID marking on threaded stud head (cont.)		J	K	L	M	N	O	P	Q	R
Overall anchor length, (inches)	From	6	6 ¹ / ₂	7	7 ¹ / ₂	8	8 ¹ / ₂	9	9 ¹ / ₂	10
	Up to but not including	6 ¹ / ₂	7	7 ¹ / ₂	8	8 ¹ / ₂	9	9 ¹ / ₂	10	11

TABLE 4—ALLOWABLE TENSION AND SHEAR LOAD CAPACITIES FOR POWER-STUD+ SD1 EXPANSION ANCHORS INSTALLED IN GROUT-FILLED CONCRETE MASONRY^{1,2,3,7}

ANCHOR INSTALLED INTO GROUTED MASONRY WALL FACES ⁴									
ANCHOR DIAMETER d_o (inch)	MIN. EMBED. h_{nom} (inches)	MIN. EDGE DISTANCE (inches)	MIN. END DIST. (inches)	TENSION LOAD (pounds)			Direction of Loading	SHEAR LOAD (pounds)	
				IBC / IRC	UBC			IBC / IRC	UBC
				With Special Inspection ⁵	With Special Inspection ⁶	Without Special Inspection		With Special Inspection ⁵	With or Without Special Inspection
$3/8$	$2^{3/8}$	4	4	445	555	275	Any	595	750 [32%]
$1/2$	$2^{1/2}$	4	4	530	660	330	Any	560	700 [32%]
		4	12	530	660	330	II to Edge	805 [14%]	920 [0%]
		12	4	530	660	330	II to End		
$5/8$	$3^{3/8}$	4	4	705	880	440	Any	685	855 [32%]
		4	12	705	880	440	II to Edge	1,065 [14%]	1225 [0%]
		12	4	705	880	440	II to End		

ANCHOR INSTALLED INTO TOPS OF GROUTED MASONRY WALLS ⁵									
ANCHOR DIAMETER d_o (inch)	MIN. EMBED. h_{nom} (inches)	MIN. EDGE DISTANCE (inches)	MIN. END DIST. (inches)	TENSION LOAD (pounds)			Direction of Loading	SHEAR LOAD (pounds)	
				IBC / IRC	UBC			IBC / IRC	UBC
				With Special Inspection ⁵	With Special Inspection ⁶	Without Special Inspection		With Special Inspection ⁵	With or Without Special Inspection
$3/8$	$2^{3/8}$	$1^{3/4}$	12	295	370 [24%]	185 [24%]	⊥ to Edge	230	285
							II to Edge	485	610 [31%]
$1/2$	$2^{1/2}$	$2^{1/4}$	12	445	555	275	Any	230	285
							⊥ to Edge	280	350
	5	$2^{1/4}$	12	685	855 [24%]	425 [24%]	II to Edge	565	705 [31%]
$5/8$	$3^{3/8}$	$2^{1/4}$	12	765	955 [24%]	475 [24%]	Any	230	285
							⊥ to Edge	340	430
	$6^{1/4}$	$2^{1/4}$	12	765	955 [24%]	475 [24%]	II to Edge	705	885 [31%]

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

¹Tabulated load values are for anchors installed in minimum 6-inch-wide (152 mm) grout-filled concrete masonry units described in Section 3.2 of this report. If the specified compressive strength of the masonry, f'_m , is minimum 2,000 psi (13.8 MPa) the tabulated values may be increased by 20 percent. See Figure 2 for permitted anchor locations.

²The embedment depth, h_{nom} , is measured from the outside surface of the concrete masonry unit to the embedded end of the anchor prior to tightening.

³The tabulated allowable loads are permitted to be increased for wind and seismic by $33\frac{1}{3}$ percent when using the alternative basic load combinations in accordance with Section 1605.3.2 of the IBC or Section 1612.3.2 of the UBC unless noted by a percentage in brackets [%] in the table. A percentage in brackets represents the maximum allowable increase for wind and seismic loading for the corresponding allowable load value. See Section 5.5 of this report.

⁴The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr} , between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to a minimum distance, s_{min} , of 8 times the anchor diameter but provided the allowable tension loads are multiplied by a reduction factor of 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.

⁵Anchor installations into tops of grouted masonry walls are limited to one per masonry cell.

⁶These allowable tension and shear load values are applicable only when the anchors are installed with special inspection as set forth in Section 4.3.

⁷Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than $1\frac{3}{8}$ inches from head joints. The minimum edge and end distances must also be maintained.

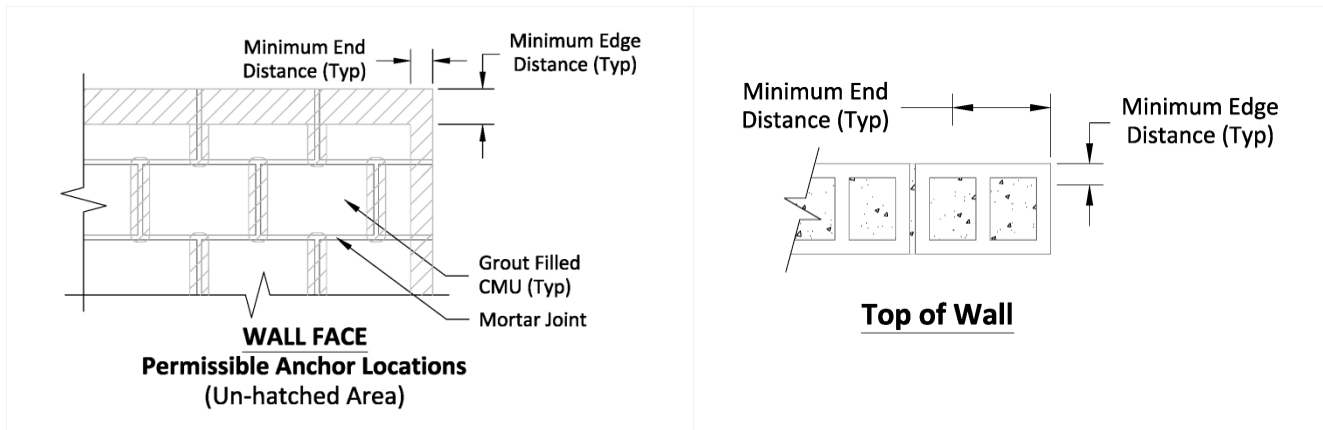


FIGURE 2—POWER-STUD+ SD1 EXPANSION ANCHORS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY