Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section	Page	Paragraph	Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® Power-Stud(R)+ SD1 -

The attached submittal package includes the product description, specifications, drawings, and performance data for use in the evaluation of the request.

SUBMITTED BY:

Name: Signature:

Company:

Address:

Date: Telephone: Fax:

FOR USE BY THE ARCHITECT AND/OR ENGINEER

☐ **Approved** ☐ **Approved as Noted** ☐ **Not Approved**

(If not approved, please briefly explain why the product was not accepted.)

By: Date:

Remarks:

Questions or inquiries? Contact us at engineering@powers.com, or call 1.800.524.3244

DEWALT® Power-Stud(R)+ SD1 Submittal Section:

Product Pages:

- Installation Instructions
- Design Tables
- Ordering Information

Code Reports & Agency Listings:

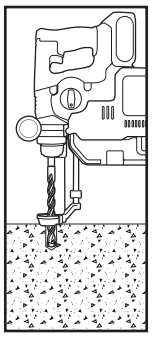
- ICC–ES Approval: ESR–2818 (Cracked & Uncracked Concrete)
- ICC–ES Approval: ESR–2966 (Concrete Masonry Units)

Other Items:

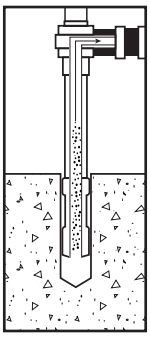
- Notes Page

INSTALLATION INSTRUCTIONS

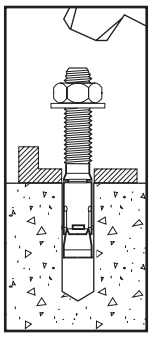
Installation Instructions for Power-Stud+ SD1



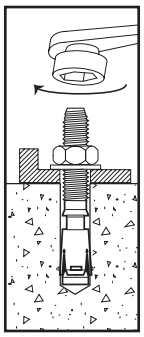
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove the dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.

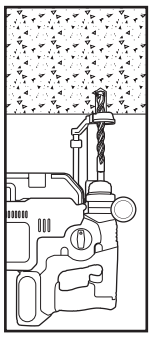


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.

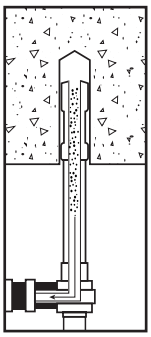


Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. Note: The threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

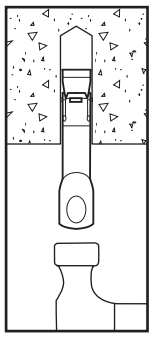
Installation Instructions for Power-Stud+ SD1 Tie Wire Version



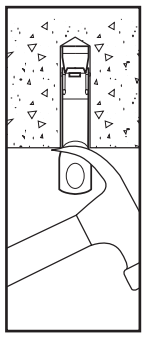
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove the dust and debris from the hole during drilling (e.g. dust extractor) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.

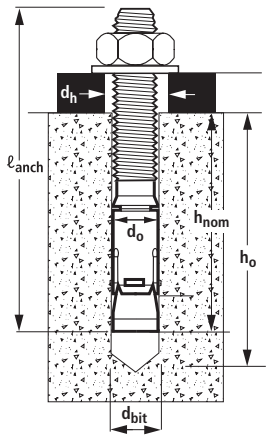


Step 3
Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

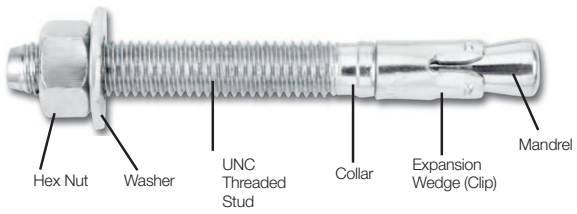


Step 4
Set the anchor with a prying action using a claw hammer.

Power-Stud+ SD1 Anchor Detail



Power-Stud+ SD1 Anchor Assembly



Head Marking

Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor (see ordering information)

Number Code 1 = Carbon Steel Body and Carbon Steel Expansion Clip (not on 1/4" diameter anchors)

Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
From	1-1/2"	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"	11"	12"
Up to but not including	2"	2-1/2"	3"	3-1/2"	4"	4-1/2"	5"	5-1/2"	6"	6-1/2"	7"	7-1/2"	8"	8-1/2"	9"	9-1/2"	10"	11"	12"	13"
Length identification mark indicates overall length of anchor.																				

REFERENCE DATA (ASD)

Installation Specifications for Power-Stud+ SD1 in Concrete[1,2]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter							
			1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Anchor diameter	d_o	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)	1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)
Nominal drill bit diameter	d_{bit}	in.	1/4" ANSI	3/8" ANSI	1/2" ANSI	5/8" ANSI	3/4" ANSI	7/8" ANSI	1" ANSI	1-1/4" ANSI
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-5/8 (41)	2-1/4 (57)	2-3/4 (70)	3-3/8 (86)	4-1/2 (114)	4-1/2 (114)	6-1/2 (165)
Minimum hole depth	h_o	in. (mm)	1-1/4 (48)	1-3/4 (44)	2-1/2 (64)	3-1/8 (79)	3-5/8 (92)	4-7/8 (122)	4-7/8 (122)	7-1/4 (184)
Installation torque	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)	40 (54)	80 (108)	110 (149)	175 (237)	225 (305)	375 (508)
Torque wrench/ socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8	1-5/16	1-1/2	1-7/8
Nut height	-	In.	7/32	21/64	7/16	35/64	41/64	3/4	55/64	1-1/16

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

1. The minimum base material thickness should be $1.5h_{nom}$ or 3", whichever is greater.
2. See Performance Data in Concrete for additional embedment depths.

Ultimate Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Embedment Depth in. (mm)	Minimum Concrete Compressive Strength							
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28)	1,320 (5.9)	1,160 (5.2)	1,435 (6.4)	1,255 (5.6)	1,660 (7.4)	1,255 (5.6)	-	-
	1-3/4 (44)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)
3/8	1-5/8 (41)	2,240 (10.9)	2,320 (10.3)	2,685 (12)	2,540 (11.3)	3,100 (13.8)	2,540 (11.3)	-	-
	2-3/8 (60)	3,485 (15.5)	2,540 (11.3)	3,815 (17)	2,540 (11.3)	4,410 (19.6)	2,540 (11.3)	5,400 (24)	2,540 (11.3)
1/2	2-1/4 (57)	3,800 (16.9)	3,840 (17.1)	4,155 (18.5)	4,195 (18.7)	4,800 (21.4)	4,195 (18.7)	-	-
	2-1/2 (64)	3,910 (17.4)	4,195 (18.7)	4,285 (19.1)	4,195 (18.7)	4,950 (22)	4,195 (18.7)	6,060 (27)	4,195 (18.7)
	3-3/4 (95)	7,955 (35.4)	4,195 (18.7)	8,715 (38.8)	4,195 (18.7)	10,065 (44.8)	4,195 (18.7)	12,325 (54.8)	4,195 (18.7)
5/8	2-3/4 (70)	4,960 (22.1)	6,220 (27.7)	5,440 (24.3)	6,815 (30.3)	6,285 (28)	6,815 (30.3)	-	-
	3-3/8 (86)	6,625 (29.5)	6,815 (30.3)	7,260 (32.3)	6,815 (30.3)	8,380 (37.3)	6,815 (30.3)	10,265 (45.7)	6,815 (30.3)
	4-5/8 (117)	11,260 (50.1)	6,815 (30.3)	12,335 (54.9)	6,815 (30.3)	14,245 (63.4)	6,815 (30.3)	14,465 (65.7)	6,815 (30.3)
3/4	3-3/8 (86)	7,180 (31.9)	11,480 (51.5)	7,860 (32.2)	12,580 (56.0)	9,075 (40.5)	12,580 (56.0)	-	-
	4 (102)	9,530 (42.4)	12,580 (56.0)	10,440 (46.5)	12,580 (56.0)	12,060 (53.6)	12,580 (56.0)	14,770 (65.7)	12,580 (56.0)
	5-5/8 (143)	17,670 (78.6)	12,580 (56.0)	19,355 (86.1)	12,580 (56.0)	22,350 (99.4)	12,580 (56.0)	25,065 (111.5)	12,580 (56.0)
7/8	3-7/8 (98)	9,120 (40.6)	10,680 (47.5)	10,005 (44.5)	11,690 (52.0)	11,555 (51.4)	11,690 (52.0)	-	-
	4-1/2 (114)	11,320 (50.4)	11,690 (52.0)	12,405 (55.2)	11,690 (52.0)	15,125 (67.3)	11,690 (52.0)	19,470 (86.6)	11,690 (52.0)
1	4-1/2 (114)	12,400 (55.2)	19,320 (85.9)	13,580 (60.4)	21,155 (94.1)	15,680 (69.7)	21,155 (94.1)	-	-
	5-1/2 (140)	16,535 (73.6)	21,155 (94.1)	18,115 (80.6)	21,155 (94.1)	20,915 (93)	21,155 (94.1)	25,615 (114)	21,155 (94.1)
	8 (203)	19,640 (87.4)	21,155 (94.1)	21,530 (95.8)	21,155 (94.1)	24,865 (110.6)	21,155 (94.1)	-	-
1-1/4	5-1/2 (140)	18,520 (82.5)	26,560 (118.1)	20,275 (90.9)	29,105 (129.4)	23,410 (105.0)	29,105 (129.4)	-	-
	6-1/2 (165)	22,485 (100.0)	29,105 (129.4)	24,630 (109.6)	29,105 (129.4)	28,440 (126.5)	29,105 (129.4)	37,360 (166.2)	29,105 (129.4)

1. Tabulated load values are for anchors installed in uncracked concrete with no edge or spacing considerations. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter (in.)	Minimum Embedment Depth in. (mm)	Minimum Concrete Compressive Strength							
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28)	330 (1.5)	290 (1.3)	360 (1.6)	315 (1.4)	415 (1.8)	315 (1.4)	-	-
	1-3/4 (44)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)
3/8	1-5/8 (41)	610 (2.7)	580 (2.6)	670 (3.0)	635 (2.8)	775 (3.4)	635 (2.8)	-	-
	2-3/8 (60)	870 (3.9)	635 (2.8)	955 (4.2)	635 (2.8)	1,105 (4.9)	635 (2.8)	1,350 (6.0)	635 (2.8)
1/2	2-1/4 (57)	950 (4.2)	960 (4.3)	1,040 (4.6)	1,050 (4.7)	1,200 (5.3)	1,050 (4.7)	-	-
	2-1/2 (64)	980 (4.4)	1,050 (4.7)	1,070 (4.8)	1,050 (4.7)	1,240 (5.5)	1,050 (4.7)	1,515 (6.7)	1,050 (4.7)
	3-3/4 (95)	1,990 (8.9)	1,050 (4.7)	2,180 (9.7)	1,050 (4.7)	2,515 (11.2)	1,050 (4.7)	3,080 (13.7)	1,050 (4.7)
5/8	2-3/4 (70)	1,240 (5.5)	1,555 (6.9)	1,360 (6.0)	1,705 (7.6)	1,570 (7.0)	1,705 (7.6)	-	-
	3-3/8 (86)	1,655 (7.4)	1,705 (7.6)	1,815 (8.1)	1,705 (7.6)	2,095 (9.3)	1,705 (7.6)	2,565 (11.4)	1,705 (7.6)
	4-5/8 (117)	2,815 (12.5)	1,705 (7.6)	3,085 (13.7)	1,705 (7.6)	3,560 (15.8)	1,705 (7.6)	3,615 (16.1)	1,705 (7.6)
3/4	3-3/8 (86)	1,795 (8.0)	2,870 (12.8)	1,965 (8.7)	3,145 (14.0)	2,270 (10.1)	3,145 (14.0)	-	-
	4 (102)	2,385 (10.6)	3,145 (14.0)	2,610 (11.6)	3,145 (14.0)	3,015 (13.4)	3,145 (14.0)	3,620 (16.1)	3,145 (14.0)
	5-5/8 (143)	4,420 (19.7)	3,145 (14.0)	4,840 (21.5)	3,145 (14.0)	5,590 (24.9)	3,145 (14.0)	6,265 (27.9)	3,145 (14.0)
7/8	3-7/8 (98)	2,280 (10.1)	2,670 (11.9)	2,500 (11.1)	2,925 (13.0)	2,890 (12.9)	2,925 (13.0)	-	-
	4-1/2 (114)	2,830 (12.6)	2,925 (13.0)	3,100 (13.8)	2,925 (13.0)	3,780 (16.8)	2,925 (13.0)	4,870 (21.7)	2,925 (13.0)
1	4-1/2 (114)	3,100 (13.8)	4,830 (21.5)	3,395 (15.1)	5,290 (23.5)	3,920 (17.4)	5,290 (23.5)	-	-
	5-1/2 (140)	4,135 (18.4)	5,290 (23.5)	4,530 (20.2)	5,290 (23.5)	5,230 (23.3)	5,290 (23.5)	6,405 (28.5)	5,290 (23.5)
	8 (203)	4,910 (21.8)	5,290 (23.5)	5,380 (23.9)	5,290 (23.5)	6,215 (27.6)	5,290 (23.5)	-	-
1-1/4	5-1/2 (140)	4,630 (20.6)	6,640 (29.5)	5,070 (22.6)	7,275 (32.4)	5,850 (26.0)	7,275 (32.4)	-	-
	6-1/2 (165)	5,620 (25.0)	7,275 (32.4)	6,160 (27.4)	7,275 (32.4)	7,110 (31.6)	7,275 (32.4)	9,340 (41.5)	7,275 (32.4)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.

Spacing Distance and Edge Distance Tension (F_{NS}, F_{NC}) Adjustment Factors for Normal-Weight Concrete

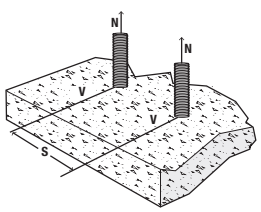
Dia. (in)		1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)		1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
s_{min} (in.)		2-1/4	3-1/2	4-1/2	5	6	4-1/4	6	6-1/2	6-1/2	8	8
Spacing Distance (inches)	2	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.78	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.80	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.83	-	-	-	-	-	-	-	-	-	-
	3	0.85	-	-	-	-	-	-	-	-	-	-
	3-1/2	0.90	0.84	-	-	-	-	-	-	-	-	-
	4	0.95	0.87	-	-	-	-	-	-	-	-	-
	4-1/4	0.98	0.89	-	-	-	0.72	-	-	-	-	-
	4-1/2	1.00	0.90	0.91	-	-	0.73	-	-	-	-	-
	5	1.00	0.94	0.94	0.79	-	0.75	-	-	-	-	-
	5-1/2	1.00	0.97	0.97	0.81	-	0.77	-	-	-	-	-
	6	1.00	1.00	1.00	0.83	0.88	0.79	0.87	-	-	-	-
	6-1/2	1.00	1.00	1.00	0.86	0.90	0.80	0.89	0.79	0.85	-	-
	7	1.00	1.00	1.00	0.88	0.93	0.82	0.91	0.81	0.87	-	-
	7-1/2	1.00	1.00	1.00	0.90	0.96	0.84	0.93	0.82	0.89	-	-
	8	1.00	1.00	1.00	0.92	0.99	0.86	0.95	0.83	0.91	0.84	0.82
	8-1/2	1.00	1.00	1.00	0.94	1.00	0.88	0.97	0.85	0.93	0.85	0.83
	9	1.00	1.00	1.00	0.97	1.00	0.89	0.99	0.86	0.94	0.87	0.84
	9-1/2	1.00	1.00	1.00	0.99	1.00	0.91	1.00	0.87	0.96	0.89	0.85
	10	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.89	0.98	0.90	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.90	1.00	0.92	0.87
	11	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.91	1.00	0.93	0.88
	11-1/2	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.93	1.00	0.95	0.90
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.96	0.91
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.98	0.92
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.93
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

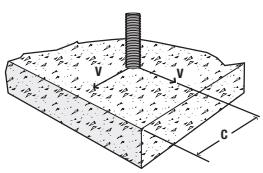
Dia. (in)		1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)		1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
c_{ac} (in.)		3-1/2	6-1/2	8	8	6	10	11	16	11-1/2	12	20
c_{min} (in.)		1-3/4	2-1/4	3-1/4	2-3/4	5-1/2	4-1/4	5	6	7	8	8
Edge Distance (inches)	1-3/4	0.50	-	-	-	-	-	-	-	-	-	-
	2	0.57	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.64	0.35	-	-	-	-	-	-	-	-	-
	2-1/2	0.71	0.38	-	-	-	-	-	-	-	-	-
	2-3/4	0.79	0.42	-	0.34	-	-	-	-	-	-	-
	3	0.86	0.46	-	0.38	-	-	-	-	-	-	-
	3-1/4	0.93	0.50	0.41	0.41	-	-	-	-	-	-	-
	3-1/2	1.00	0.54	0.44	0.44	-	-	-	-	-	-	-
	4	1.00	0.62	0.50	0.50	-	-	-	-	-	-	-
	4-1/4	1.00	0.65	0.53	0.53	-	0.43	-	-	-	-	-
	4-1/2	1.00	0.69	0.56	0.56	-	0.45	-	-	-	-	-
	5	1.00	0.77	0.63	0.63	-	0.50	0.45	-	-	-	-
	5-1/2	1.00	0.85	0.69	0.69	0.92	0.55	0.50	-	-	-	-
	6	1.00	0.92	0.75	0.75	1.00	0.60	0.55	0.38	-	-	-
	6-1/2	1.00	1.00	0.81	0.81	1.00	0.65	0.59	0.41	-	-	-
	7	1.00	1.00	0.88	0.88	1.00	0.70	0.64	0.44	0.61	-	-
	7-1/2	1.00	1.00	0.94	0.94	1.00	0.75	0.68	0.47	0.65	-	-
	8	1.00	1.00	1.00	1.00	1.00	0.80	0.73	0.50	0.70	0.67	0.40
	8-1/2	1.00	1.00	1.00	1.00	1.00	0.85	0.77	0.53	0.74	0.71	0.43
	9	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.56	0.78	0.75	0.45
	9-1/2	1.00	1.00	1.00	1.00	1.00	0.95	0.86	0.59	0.83	0.79	0.48
	10	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.63	0.87	0.83	0.50
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.66	0.91	0.88	0.53
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.96	0.92	0.55
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.96	0.58
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	0.60
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.63
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.65
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.68
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.70
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.73
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.75
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.78
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Distance and Edge Distance Shear (F_{VS}, F_{VC}) Adjustment Factors for Normal-Weight Concrete

	Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
	h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
	s_{min} (in.)	2-1/4	3-1/2	4-1/2	5	6	4-1/4	6	6-1/2	6-1/2	8	8
Spacing Distance (inches)	2-1/4	0.85	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.87	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.88	-	-	-	-	-	-	-	-	-	-
	3	0.90	-	-	-	-	-	-	-	-	-	-
	3-1/2	0.93	0.90	-	-	-	-	-	-	-	-	-
	4	0.97	0.92	-	-	-	-	-	-	-	-	-
	4-1/4	0.98	0.93	-	-	-	0.82	-	-	-	-	-
	4-1/2	1.00	0.94	0.95	-	-	0.82	-	-	-	-	-
	5	1.00	0.96	0.97	0.86	-	0.83	-	-	-	-	-
	5-1/2	1.00	0.98	0.98	0.87	-	0.85	-	-	-	-	-
	6	1.00	1.00	1.00	0.89	0.91	0.86	0.92	-	-	-	-
	6-1/2	1.00	1.00	1.00	0.90	0.93	0.87	0.93	0.88	0.91	-	-
	7	1.00	1.00	1.00	0.92	0.95	0.88	0.94	0.88	0.92	-	-
	7-1/2	1.00	1.00	1.00	0.93	0.97	0.89	0.96	0.89	0.93	-	-
	8	1.00	1.00	1.00	0.95	0.99	0.90	0.97	0.90	0.94	0.90	0.89
	8-1/2	1.00	1.00	1.00	0.96	1.00	0.92	0.98	0.91	0.96	0.91	0.90
	9	1.00	1.00	1.00	0.98	1.00	0.93	0.99	0.92	0.97	0.92	0.91
	9-1/2	1.00	1.00	1.00	0.99	1.00	0.94	1.00	0.92	0.98	0.93	0.91
	10	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.93	0.99	0.94	0.92
	10-1/2	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.94	1.00	0.95	0.93
	11	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.95	1.00	0.96	0.93
	11-1/2	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.96	1.00	0.97	0.94
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.98	0.95
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	0.99	0.95
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.96
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.97
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

	Dia. (in)	1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
	h_{nom} (in.)	1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
	c_{min} (in.)	1-3/4	2-1/4	3-1/4	2-3/4	5-1/2	4-1/4	5	6	7	8	8
Edge Distance (inches)	1-3/4	0.39	-	-	-	-	-	-	-	-	-	-
	2	0.44	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.50	0.38	-	-	-	-	-	-	-	-	-
	2-1/2	0.56	0.42	-	-	-	-	-	-	-	-	-
	2-3/4	0.61	0.46	-	0.28	-	-	-	-	-	-	-
	3	0.67	0.50	-	0.31	-	-	-	-	-	-	-
	3-1/4	0.72	0.54	0.54	0.33	-	-	-	-	-	-	-
	3-1/2	0.78	0.58	0.58	0.36	-	-	-	-	-	-	-
	4	0.89	0.67	0.67	0.41	-	-	-	-	-	-	-
	4-1/4	0.94	0.71	0.71	0.44	-	0.35	-	-	-	-	-
	4-1/2	1.00	0.75	0.75	0.46	-	0.38	-	-	-	-	-
	5	1.00	0.83	0.83	0.51	-	0.42	0.53	-	-	-	-
	5-1/2	1.00	0.92	0.92	0.56	0.67	0.46	0.59	-	-	-	-
	6	1.00	1.00	1.00	0.62	0.73	0.50	0.64	0.42	-	-	-
	6-1/2	1.00	1.00	1.00	0.67	0.79	0.54	0.69	0.46	-	-	-
	7	1.00	1.00	1.00	0.72	0.85	0.58	0.75	0.49	0.67	-	-
	7-1/2	1.00	1.00	1.00	0.77	0.91	0.63	0.80	0.53	0.71	-	-
	8	1.00	1.00	1.00	0.82	0.97	0.67	0.85	0.56	0.76	0.61	0.50
	8-1/2	1.00	1.00	1.00	0.87	1.00	0.71	0.91	0.60	0.81	0.65	0.53
	9	1.00	1.00	1.00	0.92	1.00	0.75	0.96	0.63	0.86	0.69	0.56
	9-1/2	1.00	1.00	1.00	0.97	1.00	0.79	1.00	0.67	0.90	0.72	0.59
	10	1.00	1.00	1.00	1.00	1.00	0.83	1.00	0.70	0.95	0.76	0.62
	10-1/2	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.74	1.00	0.80	0.65
	11	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.77	1.00	0.84	0.68
	11-1/2	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.81	1.00	0.88	0.71
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	0.91	0.74
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.95	0.78
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	0.99	0.81
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.84
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.87
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

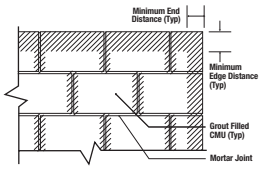




Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5,6]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	20 (27)	2,225 (10.0)	445 (2.0)	2,670 (12.0)	535 (2.4)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	4 (101.6)	40 (54)	2,650 (11.9)	530 (2.4)	3,180 (14.3)	635 (2.9)
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	50 (68)	3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
			20 (508.0)	20 (508.0)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)	80 (108)	7,580 (34.1)	1,515 (6.8)	8,755 (39.4)	1,750 (7.9)



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The 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 minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 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.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge distance and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5]

CODE LISTED
ICC-ES ESR-2966

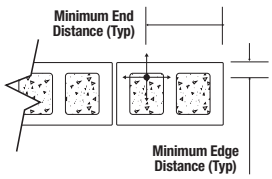
Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	20 (27)	2,975 (13.4)	595 (2.7)	3,570 (16.1)	715 (3.2)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	12 (304.8)	Perpendicular or parallel to wall edge or end	40 (54)	2,800 (12.6)	560 (2.5)	3,360 (15.1)	670 (3.0)
			12 (304.8)	4 (101.6)	Parallel to wall end		4,025 (18.1)	805 (3.6)	4,830 (21.7)	965 (4.3)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	50 (68)	3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
			12 (304.8)	4 (101.6)	Parallel to wall end		5,325 (24.0)	1,065 (4.8)	6,390 (28.8)	1,280 (5.8)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	Perpendicular or parallel to wall edge or end	80 (108)	8,850 (39.4)	1,770 (7.9)	9,375 (41.7)	1,875 (8.3)
			20 (508.0)	20 (508.0)			10,200 (45.4)	2,040 (9.1)	10,800 (48.0)	2,160 (9.6)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)			12,735 (56.7)	2,545 (11.3)	12,735 (56.7)	2,545 (11.3)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The 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 minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 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.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.

Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	20 (27)	1,475 (6.6)	295 (1.3)	1,770 (8.0)	355 (1.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)		40 (54)	2,225 (9.9)	445 (2.0)	2,575 (11.5)	515 (2.3)
		5 (127)				3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
5/8	5/8 ANSI	3-3/8 (85.7)			50 (68)	3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)



Top of Wall

1. Tabulated load values are for anchors installed in minimum 8-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	Perpendicular to wall toward minimum edge	20 (27)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
					Parallel to wall edge		2,425 (10.9)	485 (2.2)	2,910 (13.1)	580 (2.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)	12 (304.8)	Any	40 (54)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		5 (127)			Perpendicular to wall toward minimum edge		1,400 (6.3)	280 (1.3)	1,680 (7.6)	325 (1.5)
					Parallel to wall edge		2,825 12.7	565 (2.5)	3,390 (15.3)	680 (3.1)
5/8	5/8 ANSI	3-3/8 (85.7)	2-1/4 (57.1)	12 (304.8)	Any	50 (68)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		6-1/4 (158.8)			Perpendicular to wall toward minimum edge		1,700 (7.7)	340 (1.5)	2,040 (9.2)	410 (1.8)
					Parallel to wall edge		3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

STRENGTH DESIGN (SD)

Power-Stud+ SD1 Anchor Installation Specifications in Concrete[1]

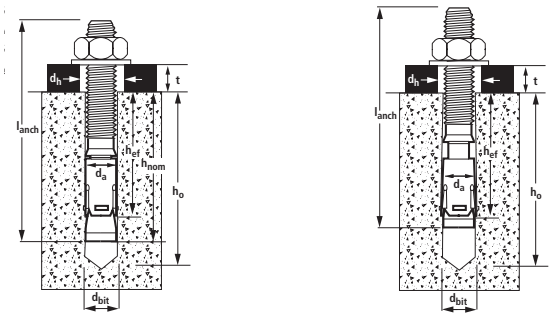
CODE LISTED ICC-ES ESR-2818

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter																					
			1/4 inch	3/8 inch			1/2 inch			5/8 inch			3/4 inch			7/8 inch	1 inch	1-1/4 inch					
Anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)			0.875 (22.2)	1.000 (25.4)	1.250 (31.8)					
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)			9/16 (14.3)			11/16 (17.5)			13/16 (20.6)			1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)					
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI			1/2 ANSI			5/8 ANSI			3/4 ANSI			7/8 ANSI	1 ANSI	1-1/4 ANSI					
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	2-3/8 (60)			2-1/2 (64)	3-3/4 (95)		3-3/8 (86)	4-5/8 (117)		4 (102)	5-5/8 (143)		4-1/2 (114)	5-1/2 (140)	6-1/2 (165)					
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)			2.00 (51)	3.25 (83)		2.75 (70)	4.00 (102)		3.125 (79)	4.75 (114)		3.50 (89)	4.375 (111)	5.375 (137)					
Minimum hole depth	h_{hole}	in. (mm)	1-7/8 (48)	2-1/2 (64)			2-3/4 (70)	4 (102)		3-3/4 (95)	5 (127)		4-1/4 (108)	5-7/8 (149)		4-7/8 (124)	5-7/8 (149)	7-1/4 (184)					
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	2-1/4 (57)	3 (76)			3-3/4 (95)	4-1/2 (114)		4-1/2 (114)	6 (152)		5-1/2 (140)	7 (178)		8 (203)	9 (229)	9 (229)					
Installation torque[6]	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)			40 (54)			80 (108)			110 (149)			175 (237)	225 (305)	375 (508)					
Torque wrench/socket size	-	in.	7/16	9/16			3/4			15/16			1-1/8			1-5/16	1-1/2	1-7/8					
Nut height	-	in.	7/32	21/64			7/16			35/64			41/64			3/4	55/64	1-1/16					
Anchors Installed in Concrete Construction																								
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-3/4 (95)		4 (102)	4 (102)		6 (152)		6 (152)	7 (178)	6 (152)	10 (254)		10 (254)	10 (254)	12 (305)						
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (45)	6 (152)	2-3/4 (70)	2-1/4 (57)	6 (152)	3-1/4 (95)	4 (102)	2-3/4 (70)	6 (152)	5-1/2 (140)	4-1/4 (108)	5 (127)	6 (152)	7 (178)	8 (203)	8 (203)						
Minimum spacing distance	s_{min}	in. (mm)	2-1/4 (57)	3-1/2 (89)	9 (229)	3-3/4 (95)	4-1/2 (114)	10 (254)	5 (127)	6 (152)	6 (152)	11 (270)	4-1/4 (108)	6 (152)	6-1/2 (165)	6-1/2 (165)	8 (203)	8 (203)						
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	3-1/2 (89)	6-1/2 (165)			8 (203)		8 (203)		6 (152)		10 (254)	11 (279)	16 (406)	11-1/2 (292)	12 (305)	20 (508)						
Anchors Installed in the Topside of Concrete-filled Steel Deck Assemblies[3,4]																								
Minimum member topping thickness	$h_{min,deck}$	in. (mm)	3-1/4 (83)	3-1/4 (83)			3-1/4 (83)		See note 3		See note 3			See note 3			See note 3		See note 3					
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1-3/4 (45)	2-3/4 (70)			4-1/2 (114)																	
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	2-1/4 (57)	4 (102)			6-1/2 (165)																	
Critical edge distance (uncracked concrete only)	$c_{ac,deck,top}$	in. (mm)	3-1/2 (89)	6-1/2 (165)			6 (152)																	
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete[5]																								
Minimum member topping thickness (see detail in Figure 2A)	$h_{min,deck}$	in. (mm)	Not Applicable	3-1/4 (95)			3-1/4 (95)			3-1/4 (95)			3-1/4 (95)			Not Applicable	Not Applicable	Not Applicable					
Minimum edge distance, lower flute (see detail in Figure 2A)	c_{min}	in. (mm)		1-1/4 (32)			1-1/4 (32)			1-1/4 (32)			1-1/4 (32)											
Minimum axial spacing distance along flute (see detail in Figure 2A)	s_{min}	in. (mm)		6-3/4 (171)			6-3/4 (171)	9-3/4 (248)		8-1/4 (210	12 (305)		9-3/8 (238)	14-1/4 (362)										
Minimum member topping thickness (see detail in Figure 2B)	$h_{min,deck}$	in. (mm)		2-1/4 (57)			2-1/4 (57)			Not Applicable			Not Applicable			Not Applicable	Not Applicable	Not Applicable					
Minimum edge distance, lower flute (see detail in Figure 2B)	c_{min}	in. (mm)		3/4 (19)			3/4 (19)																	
Minimum axial spacing distance along flute (see detail in Figure 2B)	s_{min}	in. (mm)		6 (152)			6 (152)	9-3/4 (248)																

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

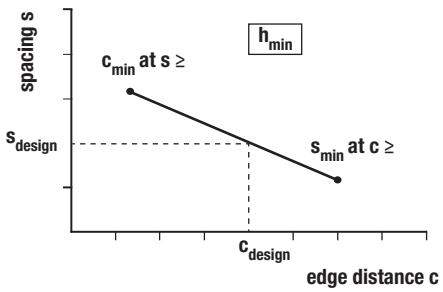
1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, nut height and washer thickness, and consideration of a possible fixture attachment.
3. The 1/4 -inch-diameter (6.4 mm) anchors may be installed in the topside of uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table. The 3/8 -inch (9.5 mm) through 1-1/4 -inch-diameter (31.8 mm) anchors may be installed in the topside of cracked and uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table under Anchors Installed in Concrete Construction.
4. For installations in the topside of concrete-filled steel deck assemblies, see the installation detail in Figure 1.
5. For installations through the soffit of steel deck assemblies into concrete, see the installation details in Figures 2A and 2B. In accordance with the figures, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
6. For installation of 5/8 -inch diameter anchors through the soffit of the steel deck into concrete, the installation torque is 50 ft.-lbf. For installation of 3/4-inch-diameter anchors through the soffit of the steel deck into concrete, installation torque is 80 ft.-lbf.

Power-Stud+ SD1 Anchor Detail



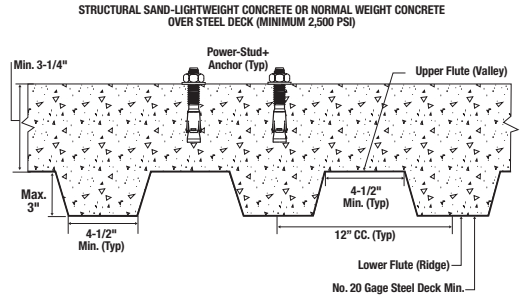
Application of Installation Torque

Interpolation of Minimum Edge Distance and Anchor Spacing



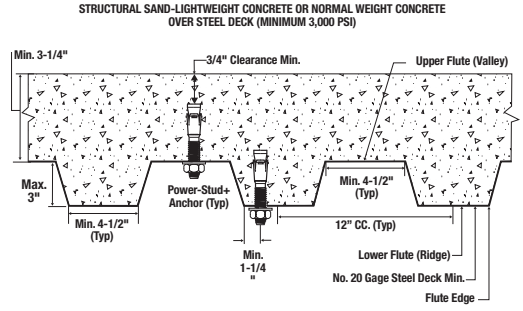
This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given in the SD Installation Specifications for Concrete table for a given anchor diameter under the same effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.

Figure 1 - Power-Stud+ SD1 Installation Detail for Anchors in the Topside Of Concrete Filled Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



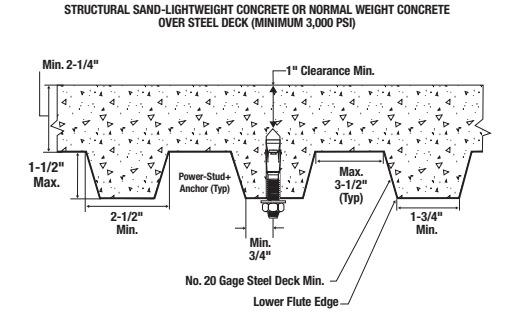
Anchors may be placed in the topside of steel deck profiles in accordance with Figure 1 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Installation Specifications.

Figure 2A - Power-Stud+ SD1 Installation Detail for Anchors in the Soffit Of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 2A provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 2A profiles may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

Figure 2B - Power-Stud+ SD1 Installation Detail for Anchors in the Soffit Of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)



Anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 2B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 2B profiles may be installed with a maximum 1/8-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width. Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 2B provided the concrete thickness above the upper flute is minimum 3-1/4-inch and a minimum hole clearance of 3/4-inch is satisfied.

Tension Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

CODE LISTED
ICC-ES ESR-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch	
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1	
STEEL STRENGTH IN TENSION[4]														
Minimum specified yield strength	f_{ya}	ksi (N/mm²)	88.0 (606)	88.0 (606)	80.0 (551)		80.0 (551)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)	
Minimum specified ultimate tensile strength (neck)	f_{uta}[12]	ksi (N/mm²)	110.0 (758)	110.0 (758)	100.0 (689)		100.0 (689)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)	
Effective tensile stress area (neck)	$A_{se,N}$	in² (mm²)	0.0220 (14.2)	0.0531 (34.3)	0.1018 (65.7)		0.1626 (104.9)		0.2376 (150.9)		0.327 (207.5)	0.430 (273.1)	0.762 (484)	
Steel strength in tension[4]	N_{sa}[12]	lb (kN)	2,255 (10.0)	5,455 (24.3)	9,080 (40.4)		14,465 (64.3)		19,000 (84.5)		24,500 (109.0)	32,250 (143.5)	56,200 (250)	
Reduction factor for steel strength[3]	ϕ	-	0.75											
CONCRETE BREAKOUT STRENGTH IN TENSION[8]														
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)	
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24		24		24	24	24	24	27	
Effectiveness factor for cracked concrete	k_{cr}	-	Not Applicable	17	17		17		21	17	21	24	24	
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$[12]	-	1.0	1.0	1.0		1.0		1.0		1.0	1.0	1.0	
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Installation Specifications											
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION (NON SEISMIC-APPLICATIONS)[8,9]														
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)	See note 7	2,865 (12.8)	3,220 (14.3)	5,530 (24.6)	See note 7	See note 7	See note 7		See note 7	See note 7	See note 7	
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8,9]														
Characteristic pullout strength, seismic (2,500 psi)[6,10]	$N_{p,eq}$[12]	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)	
Reduction factor for pullout strength, seismic[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK														
Characteristic pullout strength, uncracked concrete over steel deck(Figure 2A)[6,11]	$N_{p,deck,uncr}$	lb (kN)	Not Applicable	1,940 (8.6)	3,205 (14.2)		2,795 (12.4)		3,230 (14.4)		Not Applicable	Not Applicable	Not Applicable	
Characteristic pullout strength, cracked concrete over steel deck (Figure 2A)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)					
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2A)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)					
Characteristic pullout strength, uncracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,uncr}$	lb (kN)		1,665 (7.4)	1,900 (8.5)		Not Applicable		Not Applicable					
Characteristic pullout strength, cracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,180 (5.2)	1,420 (6.3)									
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2B)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,180 (5.2)	1,420 (6.3)									
Reduction factor for pullout strength, steel deck[3]	ϕ	-	0.65 (Condition B)											

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 -11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ apply to the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
5. For all design cases use $\Psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
6. For all design cases use $\Psi_{c,P} = 1.0$. For concrete compressive strength greater than 2,500 psi N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$. For concrete over steel deck the value of 2,500 must be replaced with the value of 3,000.
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
8. Anchors are permitted to be used in lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.
9. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
10. Tabulated values for characteristic pullout strength in tension are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.5.
11. Values for $N_{p,deck}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

Shear Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

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ICC-ES ESR-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1
STEEL STRENGTH IN SHEAR[4]													
Minimum specified yield strength (threads)	f_{ya}	ksi (N/mm²)	70.0 (482)	80.0 (552)	70.4 (485)		70.4 (485)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm²)	88.0 (606)	100.0 (689)	88.0 (607)		88.0 (607)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)
Effective tensile stress area (threads)	$A_{se,V}$	in² (mm²)	0.0318 (20.5)	0.0775 (50.0)	0.1419 (91.5)		0.2260 (145.8)		0.3345 (212.4)		0.462 (293.4)	0.6060 (384.8)	0.969 (615)
Steel strength in shear[5]	V_{sa}	lb (kN)	925 (4.1)	2,990 (13.3)	4,620 (20.6)		9,030 (40.2)		10,640 (47.3)	11,655 (54.8)	8,820 (39.2)	10,935 (48.6)	17,750 (79.0)
Reduction factor for steel strength[3]	ϕ	-	0.65										
CONCRETE BREAKOUT STRENGTH IN SHEAR[6,7]													
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.25 (31.8)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)										
PRYOUT STRENGTH IN SHEAR[6,7]													
Coefficient for pryout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS													
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	N/A	2,440 (10.9)	3,960 (17.6)		6,000 (26.7)		8,580 (38.2)	9,635 (42.9)	8,820 (39.2)	9,845 (43.8)	17,750 (79.0)
Reduction factor for steel strength in shear for seismic[3]	ϕ	-	0.65										
STEEL STRENGTH IN SHEAR FOR FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[9,10]													
Steel strength in shear, concrete over steel deck (Figure 2A)[9]	$V_{sa,deck}$	lb (kN)	Not Applicable	2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		5,505 (24.5)		Not Applicable	Not Applicable	Not Applicable
Steel strength in shear, concrete over steel deck, seismic (Figure 2A)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		4,570 (20.3)				
Steel strength in shear, concrete over steel deck (Figure 2B)[9]	$V_{sa,deck}$	lb (kN)		2,120 (9.4)	2,785 (12.4)		Not Applicable		Not Applicable				
Steel strength in shear, concrete over steel deck, seismic (Figure 2B)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,785 (12.4)								
Reduction factor for steel strength in shear, steel deck[3]	ϕ	-	0.65										

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm²; 1 lbf = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation D-20 in ACI 318-08.
6. Anchors are permitted to be used in lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.
7. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
8. Tabulated values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6.
9. Tabulated values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete (f'c, min = 3,000 psi); additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the deck soffit (flute).
10. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ϕN_n and ϕV_n
Calculated in accordance with ACI 318-14 Chapter 17
Compliant with the International Building Code

Tension and Shear Design Strengths for Power-Stud+ SD1 in Cracked Concrete[1-6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
1/4	1-3/4	-	-	-	-	-	-	-	-	-	-
3/8	2-3/8	1,325	1,685	1,450	1,845	1,675	1,945	2,050	1,945	2,365	1,945
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,005
	3-3/4	1,630	3,005	1,785	3,005	2,060	3,005	2,520	3,005	2,915	3,005
5/8	3-3/8	2,520	3,125	2,760	3,425	3,185	3,955	3,905	4,845	4,505	5,590
	4-5/8	2,895	5,870	3,170	5,870	3,660	5,870	4,480	5,870	5,175	5,870
3/4	4	3,770	6,210	4,130	6,800	4,770	6,915	5,840	6,915	6,735	6,915
	5-5/8	5,720	7,575	6,265	7,575	7,235	7,575	8,860	7,575	10,230	7,575
7/8	4-1/2	4,470	5,735	4,895	5,735	5,655	5,735	6,925	5,735	7,995	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	7,380	11,540	8,080	11,540	9,330	11,540	11,430	11,540	13,195	11,540

□ - Anchor Pullout/Pryout Strength Controls ■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths for Power-Stud+ SD1 in Uncracked Concrete[1-6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
1/4	1-3/4	1,435	600	1,570	600	1,690	600	1,690	600	1,690	600
3/8	2-3/8	1,860	1,945	2,040	1,945	2,335	1,945	2,885	1,945	3,330	1,945
1/2	2-1/2	2,095	2,375	2,295	2,605	2,645	3,005	3,240	3,005	3,745	3,005
	3-3/4	3,595	3,005	3,940	3,005	4,545	3,005	5,570	3,005	6,430	3,005
5/8	3-3/8	3,555	4,375	3,895	4,795	4,500	5,535	5,510	5,870	6,365	5,870
	4-5/8	6,240	5,870	6,835	5,870	7,895	5,870	9,665	5,870	10,850	5,870
3/4	4	4,310	6,915	4,720	6,915	5,450	6,915	6,675	6,915	7,710	6,915
	5-5/8	8,075	7,575	8,845	7,575	10,215	7,575	12,510	7,575	14,250	7,575
7/8	4-1/2	5,105	5,735	5,595	5,735	6,460	5,735	7,910	5,735	9,135	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	10,935	11,540	11,980	11,540	13,830	11,540	16,940	11,540	19,560	11,540

□ - Anchor Pullout/Pryout Strength Controls ■ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

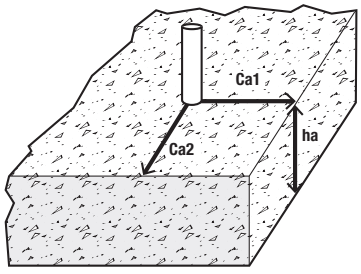
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 Chapter 17. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.



ORDERING INFORMATION

Power-Stud+ SD1 (Carbon Steel Body and Expansion Clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)	Suggested ANSI Carbide Drill Bit Cat. No.				
						Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7400SD1	1/4" x 1-3/4"	3/4"	100	600	3	DW5517	DW5416	-	-	-
7402SD1	1/4" x 2-1/4"	1-1/4"	100	600	4	DW5517	DW5417	-	-	-
7404SD1	1/4" x 3-1/4"	2-1/4"	100	600	5	DW5517	DW5417	-	-	-
7410SD1	3/8" x 2-1/4"	7/8"	50	300	8	DW5527	DW5427	-	-	-
7412SD1	3/8" x 2-3/4"	1-3/8"	50	300	9	DW5527	DW5427	-	-	-
7413SD1	3/8" x 3"	1-5/8"	50	300	10	DW5527	DW5427	-	-	-
7414SD1	3/8" x 3-1/2"	2-1/8"	50	300	12	DW5527	DW5427	-	-	-
7415SD1	3/8" x 3-3/4"	2-3/8"	50	300	13	DW5527	DW5427	-	-	-
7416SD1	3/8" x 5"	3-5/8"	50	300	15	DW55300	DW5429	-	-	-
7417SD1	3/8" x 7"	5-5/8"	50	300	21	DW55300	DW5429	-	-	-
7420SD1	1/2" x 2-3/4"	1"	50	200	19	DW5537	DW5437	DW5803	DWA54012	-
7422SD1	1/2" x 3-3/4"	2"	50	200	23	DW5537	DW5437	DW5803	DWA54012	-
7423SD1	1/2" x 4-1/2"	2-3/4"	50	200	27	DW5539	DW5438	DW5803	DWA54012	-
7424SD1	1/2" x 5-1/2"	3-3/4"	50	150	30	DW5539	DW5438	DW5803	DWA54012	-
7426SD1	1/2" x 7"	5-1/4"	25	100	38	DW5539	DW5438	DW5803	DWA54012	-
7427SD1	1/2" x 8-1/2"	6-3/4"	25	100	44	DW5539	DW5439	DW5804	DWA54012	-
7428SD1	1/2" x 10"	8-1/4"	25	100	53	DW5539	DW5439	DW5804	DWA54012	-
7430SD1	5/8" x 3-1/2"	1-1/2"	25	100	37	-	DW5446	DW5806	DWA54058	DWA54058
7432SD1	5/8" x 4-1/2"	2-1/2"	25	100	43	-	DW5446	DW5806	DWA54058	DWA54058
7433SD1	5/8" x 5"	3"	25	100	47	-	DW5446	DW5806	DWA54058	DWA54058
7434SD1	5/8" x 6"	4"	25	75	53	-	DW5446	DW5806	DWA54058	DWA54058
7436SD1	5/8" x 7"	5"	25	75	60	-	DW5447	DW5806	DWA54058	DWA54058
7438SD1	5/8" x 8-1/2"	6-1/2"	25	50	70	-	DW5447	DW5809	DWA54058	DWA54058
7439SD1	5/8" x 10"	8"	25	75	87	-	DW5447	DW5809	DWA54058	DWA54034
7440SD1	3/4" x 4-1/4"	1-3/4"	20	60	63	-	DW5453	DW5810	DWA54034	DWA54034
7441SD1	3/4" x 4-3/4"	2-1/4"	20	60	68	-	DW5453	DW5810	DWA54034	DWA54034
7442SD1	3/4" x 5-1/2"	3"	20	60	76	-	DW5453	DW5810	DWA54034	DWA54034
7444SD1	3/4" x 6-1/4"	3-3/4"	20	60	83	-	DW5455	DW5810	DWA54034	DWA54034
7446SD1	3/4" x 7"	4-1/2"	20	60	91	-	DW5455	DW5810	DWA54034	DWA54034
7448SD1	3/4" x 8-1/2"	6"	10	40	107	-	DW5455	DW5812	DWA54034	DWA54034
7449SD1	3/4" x 10"	7-1/2"	10	30	123	-	DW5455	DW5812	DWA54034	DWA54034
7451SD1	3/4" x 12"	9-1/2"	10	30	144	-	DW5456	DW5812	DWA54034	DWA54034
7450SD1	7/8" x 6"	2-3/4"	10	20	128	-	-	DW5815	-	DWA54078
7452SD1	7/8" x 8"	4-3/4"	10	40	161	-	-	DW5815	-	DWA54078
7454SD1	7/8" x 10"	6-3/4"	10	30	187	-	-	DW5816	-	DWA54078
7461SD1	1" x 6"	2-3/8"	10	30	168	-	-	DW5818	-	DWA58001
7463SD1	1" x 9"	5-3/8"	10	30	234	-	-	DW5819	-	DWA58001
7465SD1	1" x 12"	8-3/8"	5	15	307	-	-	DW5819	-	DWA58001
7473SD1	1-1/4" x 9"	4-3/4"	5	15	374	-	-	DW5820	-	-
7475SD1	1-1/4" x 12"	7-3/4"	5	15	476	-	-	DW5825	-	-

Tie Wire Power-Stud+ SD1 (Carbon Steel Body and Expansion clip)

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)
7409SD1	1/4" x 2"	N/A	100	500	3

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design.
The published size includes the diameter and the overall length of the anchor.
All anchors are packaged with nuts and washers (not including tie wire version).
See the DEWALT website or Buyers Guide for additional information on carbide drill bits.
A manual hand pump is available (Cat. No. 08280).
Hollow drill bits must be used with a dust extraction vacuum (Cat. No. DW012).

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ESR-2818

Reissued 12/2018
This report is subject to renewal 12/2019.

DIVISION: 03 00 00—CONCRETE
SECTION: 03 16 00—CONCRETE ANCHORS
DIVISION: 05 00 00—METALS
SECTION: 05 05 19—POST-INSTALLED CONCRETE ANCHORS

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS FOR CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

ICC-ES ICC-ES PMG ICC-ES LISTED

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ESR-2818

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

ADDITIONAL LISTEES:

POWERS FASTENERS

COOPER B-LINE

THE HILLMAN GROUP

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS FOR CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

For evaluation for compliance with the *National Building Code of Canada®* (NBCC), see listing report ELC-2818.

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-2818 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The Power-Stud+ SD1 expansion anchors are used as anchorage in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa) to resist static, wind and seismic tension and shear loads.

The $^3/_8$-inch- and $^1/_2$-inch-diameter (9.5 mm and 12.7 mm) anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The $^3/_8$-inch- to $^3/_4$-inch-diameter (9.5 mm to 19.1 mm) anchors may be installed in the soffit of cracked and uncracked [$^1/_4$-inch (6.4 mm) uncracked only] normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The anchors comply with Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC and Section 1912 of the 2009 and 2006 IBC. The anchors are alternatives to cast-in-place anchors described in Section 1908 of the 2012 IBC and Section 1911 of the 2009 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

Installation instructions and information are set forth in Section 4.3, Table 1 and Figures A,1 3, 4, 5A and 5B.

3.0 DESCRIPTION

3.1 Power-Stud+ SD1:

Power-Stud+ SD1 expansion anchors are torque-controlled, mechanical expansion anchors comprised of an anchor body, expansion wedge (clip), washer and hex nut. Product names corresponding to report holder and additional listees are presented in the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Power-Stud+ SD1
Powers Fasteners	Power-Stud+ SD1
Cooper B-Line	B-Line Power-Stud+ SD1
The Hillman Group	Hillman Power-Stud+ SD1

Available diameters are $^1/_4$ inch, $^3/_8$ inch, $^1/_2$ inch, $^5/_8$ inch, $^3/_4$ inch, $^7/_8$ inch, 1 inch, and $1^1/_4$ inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm, 19.1 mm, 22.0 mm, 25.4 mm and 31.8 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 µm) zinc plating in accordance with ASTM B633, SC1, Type III. The washers comply with ASTM F844. The hex nuts comply with ASTM A563, Grade A. The Power-Stud+ SD1 expansion anchor is illustrated in Figure 2.

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 opposite 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 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the IBC as applicable.

3.3 Steel Deck Panels:

Steel deck panels must comply with the configuration in Figure 4, Figure 5A and Figure 5B and have a minimum base steel thickness of 0.035 inch (0.889 mm) [No. 20 gage]. Steel must comply with ASTM A653/A653M SS Grade 33, and have a minimum yield strength of 33 ksi (228 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2015 IBC, as well as Section R301.3 of the 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC, as well as Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

Design strength of anchors complying with the 2009 IBC, as well as Section R301.1.3 of the 2009 IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

Design examples according to the 2015 IBC and 2012 IBC are given in Figure 6 of this report.

Design parameters provided in Tables 1, 2, and 3 and references to ACI 318 are based on the 2015 IBC (ACI 318-14) and on the 2012 IBC (ACI 318-11) unless noted otherwise in Sections 4.1.1 through 4.1.12 of this report. The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and noted in Tables 2 and 3 of this report, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC and ACI 318-14 Section 5.3 or ACI 318-11, Section 9.2, as applicable. Strength reduction factors, ϕ, described in ACI 318-11 D.4.4, must be used for load combinations calculated in accordance with ACI 318-11 Appendix C. Strength reduction factors, ϕ, corresponding to ductile steel elements are appropriate.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension, N_{sa}, calculated in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, is given in Table 2 of this report. Strength reduction factors, ϕ, corresponding to ductile steel elements may be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} and N_{cbg}, respectively must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The basic concrete breakout strength in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} and k_{cr} as given in Table 2 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with the value of k_{uncr} as given in Table 2 and with $\psi_{c,N}$ = 1.0.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Table 2. In lieu of ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, $\psi_{c,P}$ = 1.0 for all design cases. The nominal pullout strength in cracked concrete may be adjusted by calculations according to Eq-1:

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{2{,}500}\right)^{0.5} \quad \text{(lb, psi)} \quad \text{(Eq-1)}$$

$$N_{pn,f'_c} = N_{p,cr}\left(\frac{f'_c}{17.2}\right)^{0.5} \quad \text{(N,MPa)}$$

where f'_c is the specified concrete compressive strength.

In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, the nominal pullout strength in tension can be adjusted by calculations according to Eq-2:

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{2{,}500}\right)^{0.5} \quad \text{(lb, psi)} \quad \text{(Eq-2)}$$

$$N_{pn,f'_c} = N_{p,uncr}\left(\frac{f'_c}{17.2}\right)^{0.5} \quad \text{(N,MPa)}$$

where f'_c is the specified concrete compressive strength.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 2 of this report, the pullout strength in tension need not be evaluated.

The nominal pullout strength in tension for anchors installed in the soffit of sand-lightweight or normal weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, is provided in Table 2. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the nominal pullout strength in cracked concrete must be calculated according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, the nominal strength in uncracked concrete must be calculated according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Strength in Shear, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Table 3 of this report and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2b or ACI 318-11 Eq. D-29. The strength reduction factor, ϕ, corresponding to a ductile steel element must be used for all anchors, as described in Table 3 of this report.

The shear strength $V_{sa,deck}$ of anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, is given in Table 3 of this report in

lieu of the values derived by calculation from ACI 318-14 17.5.1.2b or ACI 318-11 Eq. D-29, as applicable.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, with modifications as described in this section. The basic concrete breakout strength in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the values of ℓ_e and d_a given in Table 3 of this report.

For anchors installed in the topside of concrete-filled steel deck assemblies, the nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.5.2.1 or ACI 318-11 D.6.2.1, as applicable, using the actual member topping thickness, $h_{min,deck}$, in the determination of A_{Vc}. Minimum member topping thickness for anchors in the topside of concrete-filled steel deck assemblies is given in Table 1 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, modified by using the value of k_{cp} provided in Table 3 and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic loads, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under Section 1905.1.8 of the 2015 IBC. For the 2012 IBC, Section 1905.1.9 must be omitted. Modifications to ACI 318-08, D.3.3 shall be applied under Section 1908.1.9 of the 2009 IBC.

The anchors comply with ACI 318-14 2.3 or ACI 318 (-11, -08) D.1, as applicable, as ductile steel elements and must be designed in accordance with ACI 318-14 17.2.3.4, 17.2.3.5, 17.2.3.6 or 17.2.3.7; ACI 318-11 D.3.3.4, D.3.3.5, D.3.3.6 or D.3.3.7; ACI 318-08 D.3.3.4, D.3.3.5 or D.3.3.6; as applicable. Strength reduction factors, ϕ, are given in Tables 2 and 3 of this report. The $^1/_4$-inch-diameter (6.4 mm) anchors must be limited to installation in structures assigned to IBC Seismic Design Categories A and B only. The $^3/_8$-inch-diameter (9.5 mm), $^1/_2$-inch-diameter (12.7 mm), $^5/_8$-inch-diameter (15.9 mm), $^3/_4$-inch-diameter (19.1 mm), $^7/_8$-inch-diameter (22.2 mm), 1-inch-diameter (25.4 mm) and $1^1/_4$-inch-diameter (31.8 mm) anchors may be installed in structures assigned to IBC Seismic Design Categories A to F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated in accordance with ACI 318-14 17.4.1 and 17.4.2 or ACI 318-11 D.5.1 and D.5.2, respectively, as applicable, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the appropriate value for pullout strength in tension for seismic loads, $N_{p,eq}$, described in Table 2 must be used in lieu of N_p. $N_{p,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, the nominal pullout strength in tension for seismic loads, $N_{p,deck,eq}$, is provided in Table 2 and must be used in lieu of $N_{p,cr}$. $N_{p,deck,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report where the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

Where values for $N_{p,eq}$ or $N_{p,deck,eq}$, are not provided in Table 2 of this report, the pullout strength in tension for seismic loads does not govern and need not be evaluated.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and concrete pryout strength for anchors in shear must be calculated according to ACI 318-14 17.5.2 and 17.5.3 or ACI 318-11 D.6.2 and D.6.3, respectively, as applicable, as described in Sections 4.1.6 and 4.1.7. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,eq}$, described in Table 3 must be used in lieu of V_{sa}.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figure 5A and Figure 5B, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,deck,eq}$, described in Table 3 must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: Anchors or groups of anchors that are subject to the effects of combined axial (tensile) and shear forces must be designed in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.10 Requirements for Critical Edge Distance: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-3:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \qquad \text{(Eq-3)}$$

where the factor $\psi_{cp,N}$ need not be taken as less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\psi_{cp,N} = 1.0$. In lieu of using ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} must comply with Table 1 of this report.

4.1.11 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318-14 17.7.1 and 17.7.3; or ACI 318-11 D.8.1 and D.8.3, respectively, as applicable, values of c_{min} and s_{min} must comply with Table 1. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thicknesses, h_{min} or $h_{min,deck}$, must comply with Table 1. Additional combinations of minimum member thickness, h_{min}, and spacing, s_{min}, may be derived by linear interpolation between the given boundary values.

For anchors installed in the topside of concrete-filled steel deck assemblies, the anchors must be installed in accordance with Table 1 and Figure 4 of this report.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figure 5A and Figure 5B and must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.12 Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f_c'}$ affecting N_n and V_n.

For ACI 318-14 (2015 IBC), ACI 318-11 (2012 IBC) and ACI 318-08 (2009 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in this report is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Where design values for use with allowable stress design (working stress design) load combinations in accordance with Section 1605.3 of the IBC are required these are calculated using Eq-4 and Eq-5 as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{(Eq-4)}$$

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad \text{(Eq-5)}$$

where:

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN)

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN)

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or N).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or N).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for nonductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, described in this report, must apply. An example of allowable stress design values for illustrative purposes is shown in Table 4 and Figures 7, 8 and 9.

4.2.2 Interaction of Tensile and Shear Forces: The interaction must be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11 and, -08) D.7 as follows:

For shear loads $V_{applied} \leq 0.2V_{allowable,ASD}$, the full allowable load in tension shall be permitted.

For tension loads $T_{applied} \leq 0.2T_{allowable,ASD}$, the full allowable load in shear shall be permitted.

For all other cases Eq-6 applies:

$$\frac{T_{applied}}{T_{allowable,ASD}} + \frac{V_{applied}}{V_{allowable,ASD}} \leq 1.2 \quad \text{(Eq-6)}$$

4.3 Installation:

Installation parameters are provided in Table 1 and Figures A,1, 3, 4, 5A and 5B of this report. Anchor locations must comply with this report and the plans and specifications approved by the code official. The Power-Stud+ SD1 expansion anchors must be installed in accordance with the manufacturer's published installation instructions and this report. 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 minimum drilled hole depth is given in Table 1, Figure 4, Figure 5A and Figure 5B. Prior to anchor installation, remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling (see Figures 3 and A) . 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 1 are achieved.

For installation in the topside of concrete-filled steel deck assemblies, installations must comply with Figure 4.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must be no more than $^1/_8$-inch (3.2 mm) larger than the diameter of the hole in the concrete. Member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies must comply with Figure 5A and Figure 5B.

4.4 Special Inspection:

Periodic special inspection is required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC and 2012 IBC, Section 1704.15 and Table 1704.4 of the 2009 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, drill bit type, hole dimensions, hole cleaning procedure, concrete member thickness, anchor embedment, anchor spacing, edge distances, tightening torque and adherence to the manufacturer's printed installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection".

5.0 CONDITIONS OF USE

The 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 The $^1/_4$-inch (6.4 mm) anchors must be installed in uncracked normal-weight or lightweight concrete; $^3/_8$-inch to $1^1/_4$-inch anchors (9.5 mm to 31.8 mm) must be installed in cracked or uncracked normal-weight or lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.4 The $^3/_8$-inch and $^1/_2$-inch (9.5 mm to 12.7 mm) anchors must be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.5 The $^3/_8$-inch to $^3/_4$-inch anchors (9.5 mm and 19.1 mm) must be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

5.6 The concrete shall have attained its minimum design strength prior to installation of the anchors.

5.7 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55.2 MPa).

5.8 Strength design values must be established in accordance with Section 4.1 of this report.

5.9 Allowable stress design values must be established in accordance with Section 4.2 of this report.

5.10 Anchor spacing(s) and edge distance(s), as well as minimum member thickness, must comply with Table 1, Figure 4, Figure 5A and Figure 5B of this report, unless otherwise noted.

5.11 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.

5.12 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.13 Anchors [except $^1/_4$-inch-diameter (6.4 mm)] may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.14 The $^1/_4$-inch-diameter (6.4 mm) anchors may be used to resist short-term loading due to wind forces, and for seismic load combinations limited to structures assigned to Seismic Design Categories A and B, under the IBC, subject to the conditions of this report. The $^3/_8$-inch- to $1^1/_4$-inch-diameter (9.5 mm to 31.8 mm) anchors may be used to resist short-term loading due to wind or seismic forces in structures assigned to Seismic Design Categories A through F, under the IBC, subject to the conditions of this report.

5.15 Where not otherwise prohibited in the code, Power-Stud+ SD1 expansion anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- The anchors are used to resist wind or seismic forces only.
- Anchors that support 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.

5.16 Use of carbon steel anchors is limited to dry, interior locations.

5.17 Special inspection must be provided in accordance with Section 4.4 of this report.

5.18 Anchors are manufactured under an approved quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2015, which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in cracked and uncracked concrete; including optional service-condition Test 18 and Test 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear; and quality control documentation.

7.0 IDENTIFICATION

7.1 The Power-Stud+ SD1 expansion anchors are identified by dimensional characteristics and packaging. A length letter code is stamped on each anchor on the exposed threaded stud end which is visible after installation. Table A summarizes the length code identification system. A plus sign "+" is also marked with the number "1" on all anchors with the exception of the $^1/_4$-inch-diameter (6.4 mm) anchors. Packages are identified with the product name, type and size, the company name as set forth in Section 3.1 of this report, and the evaluation report number (ESR-2818).

7.2 The report holder's contact information is the following:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.dewalt.com
anchors@dewalt.com

7.3 The additional listees' contact information is the following:

POWERS FASTENERS
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.powers.com
engineering@powers.com

COOPER B-LINE
509 WEST MONROE STREET
HIGHLAND, ILLINOIS 62249
blineus@cooperindustries.com

THE HILLMAN GROUP
10590 HAMILTON AVENUE
CINCINNATI, OHIO 45231
info@hillmangroup.com

TABLE 1—POWER-STUD+ SD1 ANCHOR INSTALLATION SPECIFICATIONS IN CONCRETE[1]

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter																	
			1/4 inch	3/8 inch		1/2 inch			5/8 inch		3/4 inch			7/8 inch	1 inch	1 1/4 inch				
Anchor diameter	d_a	in.	0.250	0.375		0.500			0.625		0.750			0.875	1.000	1.250				
		(mm)	(6.4)	(9.5)		(12.7)			(15.9)		(19.1)			(22.2)	(25.4)	(31.8)				
Minimum diameter of hole clearance in fixture	d_h	in.	5/16	7/16		9/16			11/16		13/16			1	1 1/8	1 3/8				
		(mm)	(7.5)	(11.1)		(14.3)			(17.5)		(20.6)			(25.4)	(28.6)	(34.9)				
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI		1/2 ANSI			5/8 ANSI		3/4 ANSI			7/8 ANSI	1 ANSI	1 1/4 ANSI				
Nominal embedment depth	h_{nom}	in.	1 3/4	2 3/8		2 1/2		3 3/4	3 3/8	4 5/8	4	5 5/8		4 1/2	5 1/2	6 1/2				
		(mm)	(44)	(60)		(64)		(95)	(86)	(117)	(102)	(143)		(114)	(140)	(165)				
Effective embedment depth	h_{ef}	in.	1.50	2.00		2.00		3.25	2.75	4.00	3.125	4.75		3.50	4.375	5.375				
		(mm)	(38)	(51)		(51)		(83)	(70)	(102)	(79)	(114)		(89)	(111)	(137)				
Minimum hole depth	h_{hole}	in.	1 7/8	2 1/2		2 3/4		4	3 3/4	5	4 1/4	5 7/8		4 7/8	5 7/8	7 1/4				
		mm	(48)	(64)		(70)		(102)	(95)	(127)	(108)	(149)		(124)	(149)	(184)				
Minimum overall anchor length[2]	ℓ_{anch}	in.	2 1/4	3		3 3/4		4 1/2	4 1/2	6	5 1/2	7		8	9	9				
		mm	(57)	(76)		(95)		(114)	(114)	(152)	(140)	(178)		(203)	(229)	(229)				
Installation torque[6]	T_{inst}	ft.-lbf.	4	20		40			80		110			175	225	375				
		(N-m)	(5)	(27)		(54)			(108)		(149)			(237)	(305)	(508)				
Torque wrench/socket size	-	in.	7/16	9/16		3/4			15/16		1 1/8			1 5/16	1 1/2	1 7/8				
Nut height	-	in.	7/32	21/64		7/16			35/64		41/64			3/4	55/64	1 1/16				
Anchors Installed in Concrete																				
Minimum member thickness	h_{min}	in.	3 1/4	3 3/4		4	4		6		6		7	6	10	10	10	12		
		(mm)	(83)	(95)		(102)	(102)		(152)		(152)		(178)	(152)	(254)	(254)	(254)	(305)		
Minimum edge distance	c_{min}	in.	1 3/4	6	2 3/4	2 1/4	6	3 1/4	4	2 3/4	6	5 1/2	4 1/4	5	6	7	8	8		
		(mm)	(44)	(152)	(70)	(57)	(152)	(95)	(102)	(70)	(152)	(140)	(108)	(127)	(152)	(178)	(203)	(203)		
Minimum spacing distance	s_{min}	in.	2 1/4	3 1/2	9	3 3/4	4 1/2	10	5	6	6	11	4 1/4	6	6 1/2	6 1/2	8	8		
		(mm)	(57)	(89)	(229)	(95)	(114)	(254)	(127)	(152)	(152)	(270)	(108)	(152)	(165)	(165)	(203)	(203)		
Critical edge distance (uncracked concrete only)	c_{ac}	in.	3 1/2	6 1/2		8			8		6		10	11	16	11 1/2	12	20		
		(mm)	(89)	(165)		(203)			(203)		(152)		(254)	(279)	(406)	(292)	(305)	(508)		
Anchors Installed in the Topside of Concrete-filled Steel Deck Assemblies[3,4]																				
Minimum member topping thickness	$h_{min,deck}$	in.	3 1/4	3 1/4		3 1/4		See Note 3	See Note 3		See Note 3			See Note 3	See Note 3	See Note 3				
		(mm)	(83)	(83)		(83)														
Minimum edge distance	$c_{min,deck,top}$	in.	1 3/4	2 3/4		4 1/2														
		(mm)	(44)	(70)		(114)														
Minimum spacing distance	$s_{min,deck,top}$	in.	2 1/4	4		6 1/2														
		(mm)	(57)	(102)		(165)														
Critical edge distance (uncracked concrete only)	$c_{ac,deck,top}$	in.	3 1/2	6 1/2		6														
		(mm)	(89)	(165)		(152)														
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete[5]																				
Minimum member topping thickness (see detail in Figure 5A)	$h_{min,deck}$	in.	Not Applicable	3 1/4		3 1/4			3 1/4		3 1/4			Not Applicable	Not Applicable	Not Applicable				
		(mm)		(83)		(83)			(83)		(83)									
Minimum edge distance, lower flute (see detail in Figure 5A)	c_{min}	in.		1 1/4		1 1/4			1 1/4		1 1/4									
		(mm)		(32)		(32)			(32)		(32)									
Minimum axial spacing distance along flute (see detail in Figure 5A)	s_{min}	in.		6 3/4		6 3/4		9 3/4	8 1/4	12	9 3/8	14 1/4								
		(mm)		(171)		(171)		(248)	(210)	(305)	(238)	(362)								
Minimum member topping thickness (see detail in Figure 5B)	$h_{min,deck}$	in.		2 1/4		2 1/4			Not Applicable		Not Applicable			Not Applicable	Not Applicable	Not Applicable				
		(mm)		(57)		(57)														
Minimum edge distance, lower flute (see detail in Figure 5B)	c_{min}	in.		3/4		3/4														
		(mm)		(19)		(19)														
Minimum axial spacing distance along flute (see detail in Figure 5B)	s_{min}	in.		6		6		9 3/4												
		(mm)		(152)		(152)		(248)												

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

[1]The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
[2]The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, nut height and washer thickness, and consideration of a possible fixture attachment.
[3]The 1/4-inch-diameter (6.4 mm) anchors may be installed in the topside of uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table. The 3/8 -inch (9.5 mm) through 1 1/4 -inch-diameter (31.8 mm) anchors may be installed in the topside of cracked and uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table under Anchors Installed in Concrete Construction.
[4]For installations in the topside of concrete-filled steel deck assemblies, see the installation detail in Figure 4.
[5]For installations through the soffit of steel deck assemblies into concrete, see the installation details in Figures 5A and 5B. In accordance with the figures, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
[6]For installation of 5/8-inch-diameter anchors through the soffit of the steel deck into concrete, the installation torque is 50 ft.-lbf. For installation of 3/4-inch-diameter anchors through the soffit of the steel deck into concrete, installation torque is 80 ft.-lbf.

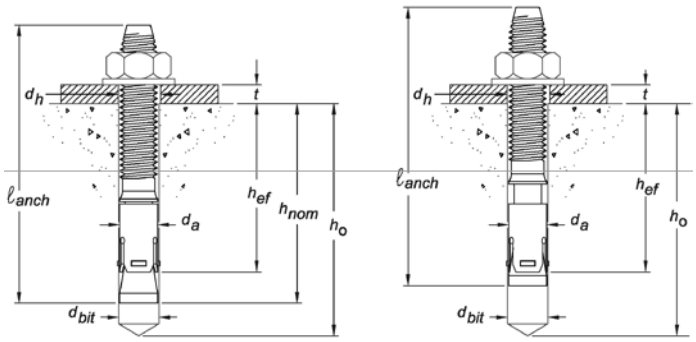


FIGURE 1—POWER-STUD+ SD1 ANCHOR DETAIL
Before (Left Picture) and After (Right Picture) Application of Installation Torque

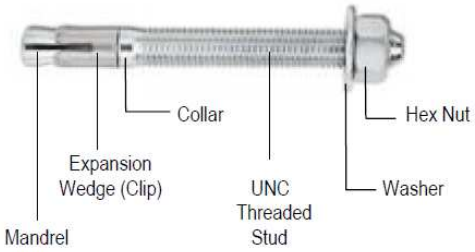
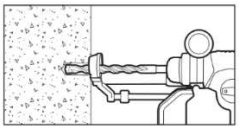
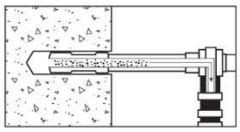


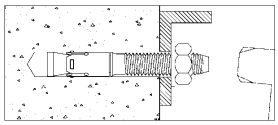
FIGURE 2—POWER-STUD+ SD1
ANCHOR ASSEMBLY



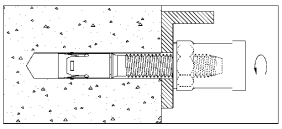
1.) *Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.*



2.) *Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.*



3.) *Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.*



4.) *Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. See Table1. Note: The threaded stud draws up during the tightening of the nut; the expansion clip (wedge) remains in original position.*

FIGURE 3—POWER-STUD+ SD1 INSTALLATION INSTRUCTIONS

The DEWALT drilling systems shown collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drills (see manufacturer's published installation instructions).

FIGURE A—EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

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

Length ID marking on threaded stud head		**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**	**R**	**S**	**T**
Overall anchor length, ℓ_{anch}, (inches)	From	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12
	Up to but not including	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13

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

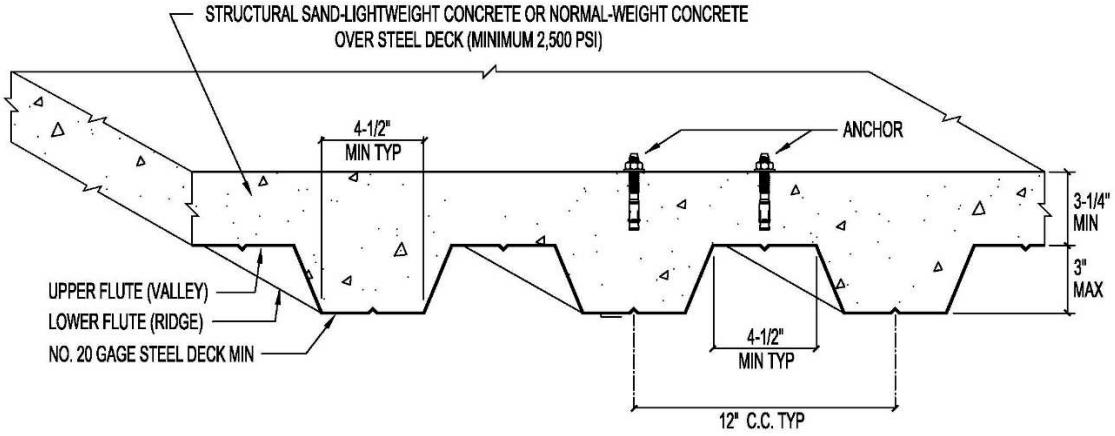


FIGURE 4—POWER-STUD+ SD1 INSTALLATION DETAIL FOR ANCHORS IN THE TOPSIDE OF CONCRETE-FILLED STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1]

[1]Anchors may be placed in the topside of steel deck profiles in accordance with Figure 4 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Table 1 of this report.

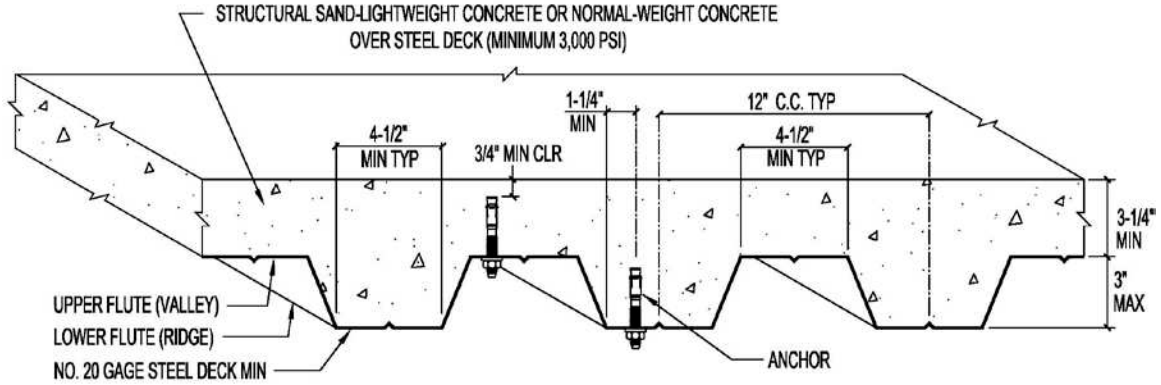


FIGURE 5A—POWER-STUD+ SD1 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1]

[1]Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5A provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 5A profiles may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

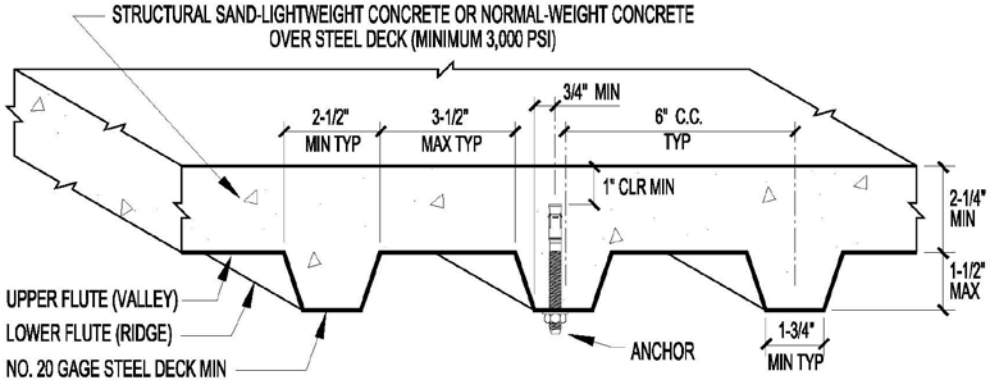


FIGURE 5B—POWER-STUD+ SD1 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

[1]Anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 5B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Figure 5B profiles may be installed with a maximum $^1/_8$-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied. In addition, the anchors must have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
[2]Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 5B provided the concrete thickness above the upper flute is minimum $3^1/_4$-inch and a minimum hole clearance of $^3/_4$-inch is satisfied.

TABLE 2—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD1 ANCHOR IN CONCRETE (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318 -11 Section 9.2)[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Diameter							
			1/4 inch	3/8 inch	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1 1/4 inch
Anchor category	1, 2 or 3	-	1	1	1	1	1	1	1	1
STEEL STRENGTH IN TENSION[4]										
Minimum specified yield strength (neck)	f_{ya}	ksi (N/mm^2)	88.0 (606)	88.0 (606)	80.0 (551)	80.0 (551)	64.0 (441)	58.0 (400)	58.0 (400)	58.0 (400)
Minimum specified ultimate tensile strength (neck)	f_{uta}[12]	ksi (N/mm^2)	110.0 (758)	110.0 (758)	100.0 (689)	100.0 (689)	80.0 (552)	75.0 (517)	75.0 (517)	75.0 (517)
Effective tensile stress area (neck)	$A_{se,N}$	in^2 (mm^2)	0.0220 (14.2)	0.0531 (34.3)	0.1018 (65.7)	0.1626 (104.9)	0.2376 (150.9)	0.327 (207.5)	0.4300 (273.1)	0.762 (484)
Steel strength in tension[4]	N_{sa}	lb (kN)	2,255 (10.0)	5,455 (24.3)	9,080 (40.4)	14,465 (64.3)	19,000 (84.5)	24,500 (109.0)	32,250 (143.5)	56,200 (250)
Reduction factor for steel strength[3]	ϕ	-	0.75							
CONCRETE BREAKOUT STRENGTH IN TENSION[8]										
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24		24		24	24	24	24	27
Effectiveness factor for cracked concrete	k_{cr}	-	Not Applicable	17	17		17		21	17	21	24	24
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0	1.0	1.0		1.0		1.0		1.0	1.0	1.0
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Table 1										
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION [8,9]										
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)	See note 7	2,865 (12.8)	3,220 (14.3)	5,530 (24.6)	See note 7	See note 7	See note 7	See note 7	See note 7	See note 7	See note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7	See note 7	See note 7	See note 7	11,350 (50.5)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8,9]										
Characteristic pullout strength, seismic (2,500 psi)[6,10]	$N_{p,eq}$	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.1)	See note 7	4,450 (19.8)	See note 7	See note 7	See note 7	See note 7	11,350 (50.5)
Reduction factor for pullout strength, seismic[3]	ϕ	-	0.65 (Condition B)										
PULLOUT STRENGTH IN TENSION FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK										
Characteristic pullout strength, uncracked concrete over steel deck(Figure 5A)[6,11]	$N_{p,deck,uncr}$	lb (kN)	Not Applicable	1,940 (8.6)	3,205 (14.2)	2,795 (12.4)	3,230 (14.4)	Not Applicable	Not Applicable	Not Applicable
Characteristic pullout strength, cracked concrete over steel deck(Figure 5A)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,375 (6.1)	2,390 (10.6)	1,980 (8.8)	2,825 (12.4)			
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 5A)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,375 (6.1)	2,390 (10.6)	1,980 (8.8)	2,825 (12.4)			
Characteristic pullout strength, uncracked concrete over steel deck (Figure 5B)[6,11]	$N_{p,deck,uncr}$	lb (kN)		1,665 (7.4)	1,900 (8.5)	Not Applicable	Not Applicable			
Characteristic pullout strength, cracked concrete over steel deck (Figure 5B)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,180 (5.2)	1,420 (6.3)					
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 5B)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,180 (5.2)	1,420 (6.3)					
Reduction factor for pullout strength, steel deck[3]	ϕ	-	0.65 (Condition B)							

For **SI:** 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm^2; 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 -11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
[2]Installation must comply with published instructions and details.
[3]All values of ϕ apply to the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
[4]The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
[5]For all design cases use $\Psi_{c,N}$ = 1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[6]For all design cases use $\Psi_{c,P}$ = 1.0. For the calculation of N_{pn}, see Section 4.1.4 of this report.
[7]Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
[8]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[9] For anchors in the topside of concrete-filled steel deck assemblies, see Figure 4.
[10]Tabulated values for characteristic pullout strength in tension are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.5.
[11]Values for $N_{p,deck}$ are for sand-lightweight concrete ($f'_{c,\,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

TABLE 3—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD1 ANCHOR IN CONCRETE (For use with load combinations taken from ACI 318-14 Section 5.3 or ACI 318-11, Section 9.2)[1,2]

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch	5/8 inch		3/4 inch		7/8 inch	1 inch	1 1/4 inch	
Anchor category	1, 2 or 3	-	1	1	1	1		1		1	1	1	
STEEL STRENGTH IN SHEAR[4]													
Minimum specified yield strength (threads)	f_{ya}	ksi (N/mm^2)	70.0 (482)	80.0 (552)	70.4 (485)	70.4 (485)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)	
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	88.0 (606)	100.0 (689)	88.0 (607)	88.0 (607)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)	
Effective tensile stress area (threads)	$A_{se,V}$	in^2 (mm^2)	0.0318 (20.5)	0.0775 (50.0)	0.1419 (91.5)	0.2260 (145.8)		0.3345 (212.4)		0.462 (293.4)	0.6060 (384.8)	0.969 (615)	
Steel strength in shear[5]	V_{sa}	lb (kN)	925 (4.1)	2,990 (13.3)	4,620 (20.6)	9,030 (40.2)		10,640 (47.3)	11,655 (54.8)	8,820 (39.2)	10,935 (48.6)	17,750 (79.0)	
Reduction factor for steel strength[3]	ϕ	-	0.65										
CONCRETE BREAKOUT STRENGTH IN SHEAR[6,7]													
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.25 (31.8)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)										
PRYOUT STRENGTH IN SHEAR[6,7]													
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS													
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	Not Applicable	2,440 (10.9)	3,960 (17.6)	6,000 (26.7)		8,580 (38.2)	9,635 (42.9)	8,820 (39.2)	9,845 (43.8)	17,750 (79.0)	
Reduction factor for steel strength in shear for seismic[3]	ϕ	-	0.65										
STEEL STRENGTH IN SHEAR FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[9,10]													
Steel strength in shear, concrete over steel deck (Figure 5A)[9]	$V_{sa,deck}$	lb (kN)	Not Applicable	2,120 (9.4)	2,290 (10.2)	3,710 (16.5)		5,505 (24.5)		Not Applicable	Not Applicable	Not Applicable	
Steel strength in shear, concrete over steel deck, seismic (Figure 5A)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,290 (10.2)	3,710 (16.5)		4,570 (20.3)					
Steel strength in shear, concrete over steel deck (Figure 5B)[9]	$V_{sa,deck}$	lb (kN)		2,120 (9.4)	2,785 (12.4)	Not Applicable		Not Applicable					
Steel strength in shear, concrete over steel deck, seismic (Figure 5B)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,785 (12.4)								
Reduction factor for steel strength in shear, steel deck[3]	ϕ	-	0.65										

For **SI:** 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm^2; 1 lbf = 0.0044 kN.

[1]The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
[2]Installation must comply with published instructions and details.
[3]All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
[4]The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
[5]Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation D-20 in ACI 318-08.
[6]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[7]For anchors in the topside of concrete-filled steel deck assemblies, see Figure 4.
[8]Tabulated values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6.
[9]Tabulated values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete ($f'_{c,\,min}$ = 3,000 psi); additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the deck soffit (flute).
[10]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

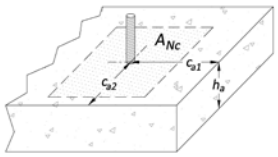
TABLE 4—EXAMPLE ALLOWABLE STRESS DESIGN VALUES FOR ILLUSTRATIVE PURPOSES[1,2,3,4,5,6,7,8,9]

Anchor Diameter (inches)	Nominal Embedment Depth (inches)	Effective Embedment (inches)	Allowable Tension Load (pounds)
1/4	1 3/4	1.50	970
3/8	2 3/8	2.00	1,260
1/2	2 1/2	2.00	1,415
	3 3/4	3.25	2,425
5/8	3 3/8	2.75	2,405
	4 5/8	4.00	4,215
3/4	4	3.125	2,910
	5 5/8	4.75	5,455
7/8	4 1/2	3.50	3,450
1	5 1/2	4.375	4,820
1 1/4	6 1/2	5.375	7,385

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

[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations are taken from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading).
[4]30% dead load and 70% live load, controlling load combination 1.2*D* + 1.6*L*.
[5]Calculation of weighted average for conversion factor α = 1.2(0.3) + 1.6(0.7) = 1.48.
[6] f'_c = 2,500 psi (normal weight concrete).
[7] $c_{a1} = c_{a2} \geq c_{ac}$.
[8] $h \geq h_{min}$.
[9]Values are for Condition B where supplementary reinforcement in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, is not provided.

Given: Calculate the factored resistance strength, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $T_{allowable,ASD}$, for a 3/8-inch-diameter Power-Stud+ SD1 anchor assuming the given conditions in Table 4.



Calculation in accordance with ACI 318-14, ACI 318-11 Appendix D and this report:	**318-14 Ref.**	**318-11 Ref.**	**Report Ref.**
Step 1. Calculate steel strength of a single anchor in tension: $\boldsymbol{\phi N_{sa}} = (0.75)(5{,}455) = 4{,}091\ lbs.$	17.4.1.2	D.5.1.2	Table 2
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ $N_b = k_c\, \lambda_\alpha \sqrt{f'_c} (h_{ef})^{1.5}$ $N_b = (24)(1.0)\sqrt{2{,}500}(2.0)^{1.5} = 3{,}394\ lbs.$ $\boldsymbol{\phi N_{cb}} = (0.65)\frac{(36.0)}{(36.0)}(1.0)(1.0)(1.0)(3{,}394) = 2{,}206\ lbs.$	17.4.2.1	D.5.2.1	Table 2
Step 3. Calculate pullout strength of a single anchor: $\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P} \left(\frac{f'_{c,act}}{2{,}500}\right)^n$ $\boldsymbol{\phi N_{pn}} = (0.65)(2{,}865)(1.0)(1.0)^{0.5} = 1{,}862\ lbs.$	17.4.3.2	D.5.3.2	Table 2
Step 4. Determine controlling factored resistance strength in tension: $\boldsymbol{\phi N_n} = \min\left\|\phi N_{sa}, \phi N_{cb}, \phi N_{pn}\right\| = \phi N_{pn} = 1{,}862\ lbs.$	17.3.1.1	D.4.1.1	-
Step 5. Calculate allowable stress design conversion factor for loading condition: Controlling load combination: 1.2*D* + 1.6*L* $\boldsymbol{\alpha}$ = 1.2(30%) + 1.6(70%) = 1.48	5.3	9.2	-
Step 6. Calculate the converted allowable stress design value: $\boldsymbol{T_{allowable,ASD}} = \frac{\boldsymbol{\phi N_n}}{\boldsymbol{\alpha}} = \frac{\mathbf{1{,}862}}{\mathbf{1.48}} = \mathbf{1{,}258\ lbs}.$	-	-	Section 4.2

FIGURE 6—EXAMPLE STRENGTH DESIGN CALCULATION INCLUDING ASD CONVERSION FOR ILLUSTRATIVE PURPOSES

ICC-ES Evaluation Report

ESR-2818 LABC and LARC Supplement

Reissued December 2018

This report is subject to renewal December 2019.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS FOR CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that Power-Stud+ SD1 Expansion Anchors for cracked and uncracked concrete, described in ICC-ES master evaluation report ESR-2818, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Power-Stud+ SD1 Expansion Anchors for cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2818, comply with the LABC Chapter 19, and the LARC, and are subject to the conditions of use described in this supplement.

3.0 CONDITIONS OF USE

The Power-Stud+ SD1 Expansion Anchors for cracked and uncracked concrete described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-2818.
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the master evaluation report ESR-2818.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the master evaluation report and tables are for the connection of the anchors to the concrete. The connection between the anchors and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the master report, reissued December 2018.

ICC-ES Evaluation Report

ESR-2818 FBC Supplement

Reissued December 2018

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS FOR CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Powers Power-Stud+ SD1 Expansion Anchors in uncracked concrete only [$^1/_4$ inch (6.4 mm)] and in cracked and uncracked concrete [$^3/_8$ inch to $1^1/_4$ inches (9.5 mm to 31.8 mm)], recognized in ICC-ES master evaluation report ESR-2818, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

- 2014 *Florida Building Code—Building*
- 2014 *Florida Building Code—Residential*

2.0 CONCLUSIONS

The Powers Power-Stud+ SD1 Expansion Anchors in uncracked concrete only [$^1/_4$ inch (6.4 mm)] and in cracked and uncracked concrete [$^3/_8$ inch to $1^1/_4$ inches (9.5 mm to 31.8 mm)], described in master evaluation report ESR-2818, comply with the 2014 *Florida Building Code—Building* and the 2014 *Florida Building Code—Residential*, when designed and installed in accordance with the 2012 *International Building Code®* provisions noted in the master report, and under the following conditions:

- Design wind loads must be based on Section 1609 of the 2014 *Florida Building Code—Building* or Section R301.2.1.1 of the 2014 *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2014 *Florida Building Code—Building*, as applicable.

Use of the Powers Power-Stud+ SD1 Expansion Anchors in uncracked concrete only [$^1/_4$ inch (6.4 mm)] and in cracked and uncracked concrete [$^3/_8$ inch to $1^1/_4$ inches (9.5 mm to 31.8 mm)], for compliance with the High-Velocity Hurricane Zone Provisions of the 2014 *Florida Building Code—Building* and the 2014 *Florida Building Code—Residential,* has not been evaluated, and is outside the scope of this supplement.

For products falling under Florida Rule 9N-3, verification that the report holder's quality assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, reissued December 2018.

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ESR-2966

Reissued 12/2018
This report is subject to renewal 12/2019.

DIVISION: 04 00 00—MASONRY

SECTION: 04 05 19.16—MASONRY ANCHORS

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS IN MASONRY (DEWALT / POWERS)

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ESR-2966

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS IN MASONRY (DEWALT / POWERS)

ADDITIONAL LISTEES:

POWERS FASTENERS

COOPER B-LINE

THE HILLMAN GROUP

1.0 EVALUATION SCOPE

Compliance with the following codes:

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

For evaluation for compliance with codes adopted by the Los Angeles Department of Building and Safety (LADBS), see ESR-2966 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The 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 8.1.3 (2013 edition) or Section 2.1.4 (2011 and 2008 editions) of TMS 402/ACI 530/ASCE 5 as referenced in Section 2107.1 of the IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the 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 the following table.

COMPANY NAME	PRODUCT NAME
DEWALT	Power-Stud+ SD1
Powers Fasteners	Power-Stud+ SD1
Cooper B-Line	B-Line Power-Stud+ SD1
The Hillman Group	Hillman Power-Stud+ SD1

Available diameters recognized for use in masonry are $^3/_8$ inch, $^1/_2$ inch, and $^5/_8$ 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 µm) zinc plating in accordance with ASTM B633, SC1, Type III. The washers comply with ASTM F844. The hex nuts comply with ASTM A563, Grade A. The Power-Stud+ SD1 expansion anchor is illustrated in Figure 2.

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 C90 (IBC). The minimum allowable nominal size of the CMU must be 6 inches wide by 8 inches high by 16 inches long (i.e. 6x8x16).

3.2.2 Grout: The masonry units must be fully grouted with grout complying with Section 2103.3 of the 2015 IBC; Section 2103.13 of the 2012 IBC; Section 2103.12 of the 2009 IBC; or Section R606 of the 2015 IRC; Section R609.1.1 of the 2012 and 2009 IRC 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 of the IBC; or Section

R606.2.11 of the 2015 IRC; Section R607.1 of the 2012 and 2009 IRC, 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. Allowable tension and shear loads for installation in uncracked grout-filled concrete masonry are noted in Table 3.

Allowable loads are given in Table 3 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:

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

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 1 and Figure 3. 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 1 are achieved.

4.3 Special Inspection:

Special inspection under the IBC and IRC must be provided in accordance with Sections 1704 and 1705 of the IBC. 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.

5.0 CONDITIONS OF USE

The 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 The grout and mortar shall have attained its minimum design strength prior to the installation of the anchors.

5.6 When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads are not permitted to be increased for wind or earthquake loading. When using the alternative basic load combinations in 2009 IBC Section 1605.3.2 that include wind or seismic loads, the allowable shear and tension loads for anchors are permitted to be increased by $33^1/_3$ percent (unless noted by a percentage in brackets [%] in Table 3). Alternatively, the basic load combinations may be reduced by a factor of 0.75 (unless noted by a fraction in brackets {0.xx} in Table 3) when using IBC Section 1605.3.2. For the 2015 and 2012 IBC, the allowable loads or load combinations may not be adjusted.

5.7 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.

5.8 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.

5.9 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.

5.10 Use of carbon steel anchors is limited to dry, interior locations.

5.11 Special inspection must be provided in accordance with Section 4.3 of this report, where applicable.

5.12 Anchors are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Expansion Anchors in Masonry Elements (AC01), dated November 2015, for use in grout-filled uncracked concrete masonry; including optional seismic tests in tension and shear.

7.0 IDENTIFICATION

7.1 The 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 2 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 Section 3.1 of this report, and the evaluation report number (ESR-2966).

7.2 The report holder's contact information is the following:

DEWALT
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.DEWALT.com
anchors@DEWALT.com

7.3 The Additional Listees' contact information is the following:

POWERS FASTENERS
701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286
(800) 524-3244
www.powers.com
engineering@powers.com

COOPER B-LINE
509 WEST MONROE STREET
HIGHLAND, ILLINOIS 62249

THE HILLMAN GROUP
10590 HAMILTON AVENUE
CINCINNATI, OHIO 45231

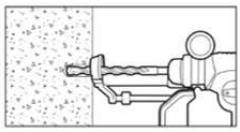
The DEWALT drilling systems shown above collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drills.
See manufacturer's printed installation instructions.

FIGURE A—EXAMPLES OF DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

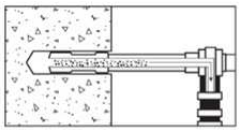
TABLE 1—POWER-STUD+ SD1 ANCHOR INSTALLATION SPECIFICATIONS IN GROUT-FILLED CONCRETE MASONRY

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter		
			$^3/_8$ inch	$^1/_2$ inch	$^5/_8$ inch
Anchor diameter	d_o	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	$^7/_{16}$ (11.1)	$^9/_{16}$ (14.3)	$^{11}/_{16}$ (17.5)
Nominal drill bit diameter	d_{bit}	in.	$^3/_8$ ANSI	$^1/_2$ ANSI	$^5/_8$ ANSI
Installation torque	T_{inst}	ft.-lbf. (N-m)	20 (27)	40 (54)	50 (68)
Torque wrench/socket size	-	in.	$^9/_{16}$	$^3/_4$	$^{15}/_{16}$
Nut height	-	In.	$^{21}/_{64}$	$^7/_{16}$	$^{35}/_{64}$

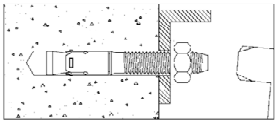
For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.



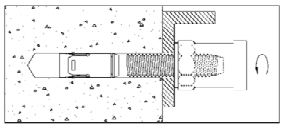
1.) *Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.*



2.) *Remove dust and debris from the hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created by drilling.*



3.) *Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.*



4.) *Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. See Table1. Note: The threaded stud draws up during the tightening of the nut; the expansion clip (wedge) remains in original position.*

FIGURE 1—POWER-STUD+ SD1 INSTALLATION INSTRUCTIONS

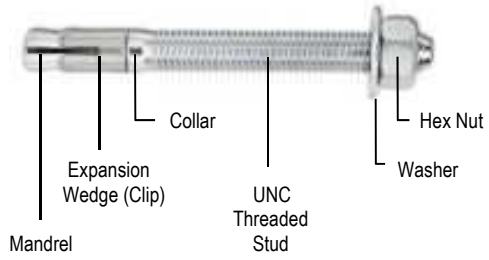


FIGURE 2—POWER-STUD+ SD1 ANCHOR ASSEMBLY

TABLE 2—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 3—ALLOWABLE TENSION AND SHEAR LOAD CAPACITIES FOR POWER-STUD+ SD1 EXPANSION ANCHORS INSTALLED IN GROUT-FILLED CONCRETE MASONRY[1,2,3,6]

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)	SHEAR LOAD (pounds)	
				IBC / IRC	Direction of Loading	*IBC / IRC*
$^3/_8$	$2^3/_8$	4	4	445	Any	595
$^1/_2$	$2^1/_2$	4	4	530	Any	560
		4	12	530	II to Edge	805 [14%] {0.88}
		12	4		II to End	
$^5/_8$	$3^3/_8$	4	4	705	Any	685
		4	12	705	II to Edge	1,065 [14%] {0.88}
		12	4		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)	SHEAR LOAD (pounds)	
				IBC / IRC	Direction of Loading	*IBC / IRC*
$^3/_8$	$2^3/_8$	$1^3/_4$	12	295	⊥ to Edge	230
					II to Edge	485
$^1/_2$	$2^1/_2$	$2^1/_4$	12	445	Any	230
	5	$2^1/_4$	12	685	⊥ to Edge	280
					II to Edge	565
$^5/_8$	$3^3/_8$	$2^1/_4$	12	765	Any	230
	$6^1/_4$	$2^1/_4$	12	765	⊥ to Edge	340
					II to Edge	705

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

[1]Tabulated 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 3 for permitted anchor locations.

[2]The 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.

[3]When using the basic load combinations in accordance with IBC Section 1605.3.1, allowable loads are not permitted to be increased for wind or earthquake loading. When using the alternative basic load combinations in 2009 IBC Section 1605.3.2 that include wind or seismic loads, the allowable shear and tension loads for anchors are permitted to be increased by $33^1/_3$ percent (unless noted by a percentage in brackets [%] in the table). Alternatively, the basic load combinations may be reduced by a factor of 0.75 (unless noted by a fraction in brackets {0.xx} in the table) when using IBC Section 1605.3.2. For the 2015 and 2012 IBC, the allowable loads or load combinations may not be adjusted.

[4]The 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.

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

[6]Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than $1^3/_8$ inches from head joints. The minimum edge and end distances must also be maintained.

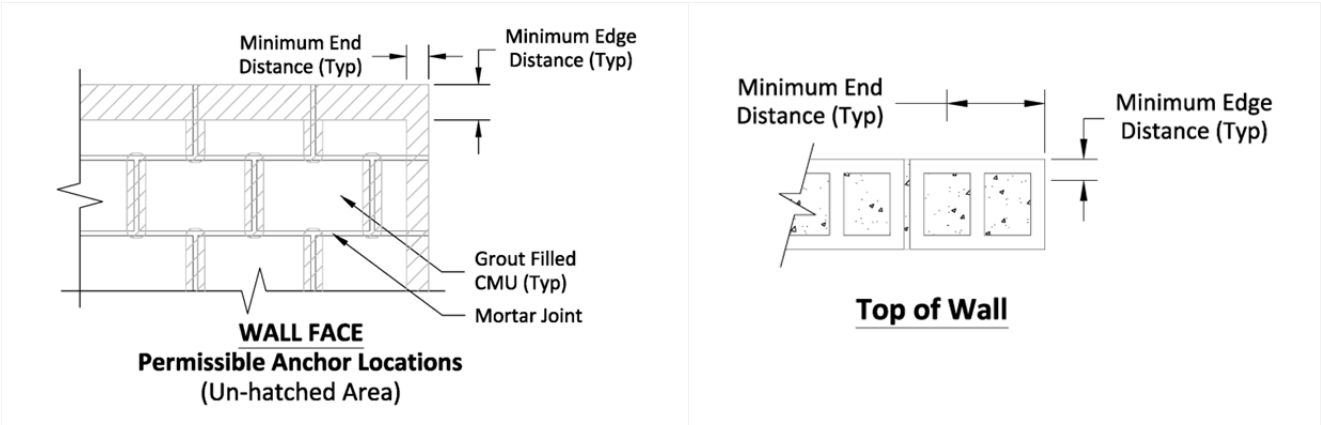


FIGURE 3—POWER-STUD+ SD1 EXPANSION ANCHORS INSTALLED INTO GROUT-FILLED CONCRETE MASONRY

ICC-ES Evaluation Report

ESR-2966 LABC and LARC Supplement

Reissued December 2018

This report is subject to renewal December 2019.

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DIVISION: 04 00 00—MASONRY
Section: 04 05 19.16—Masonry Anchors

REPORT HOLDER:

DEWALT

EVALUATION SUBJECT:

POWER-STUD®+ SD1 EXPANSION ANCHORS IN MASONRY (DEWALT / POWERS)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the Power-Stud+ SD1 Expansion Anchors in fully grouted concrete masonry, described in ICC-ES master evaluation report ESR-2966, have also been evaluated for compliance with the codes noted below as adopted by the Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The Power-Stud+ SD1 Expansion Anchors in fully grouted concrete masonry, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2966, comply with the LABC Chapter 21, and the LARC, and are subjected to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The Power-Stud+ SD1 Expansion Anchors described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-2966.
- The design, installation, conditions of use and identification of the anchors are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the master evaluation report ESR-2966.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable design values listed in the master evaluation report and tables are for the connection of the anchors to the masonry. The connection between the anchors and the connected members shall be checked for capacity (which may govern).
- Use of the anchors as out-of-plane wall anchorage for horizontal flexible diaphragm to resist tension loads is beyond the scope of this LABC and LARC Supplement.

This supplement expires concurrently with the master report, reissued December 2018.