DEWALT ENGINEERED BY Powers

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)+ SD4/SD6 -

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

Table of Contents

DEWALT® Power-Stud(R)+ SD4/SD6 Submittal Section:

GENERAL INFORMATION

POWER-STUD®+ SD4/SD6

Stainless Steel Wedge Expansion Anchors

PRODUCT DESCRIPTION

The Power-Stud+ SD4 and Power-Stud+ SD6 anchors are fully threaded, torque-controlled, stainless steel wedge expansion anchors which are designed for consistent performance in cracked and uncracked concrete. Suitable base materials are normal-weight, sand-lightweight concrete, and grouted concrete masonry (CMU). The anchor is manufactured with a stainless steel body and expansion clip. Nut and washer are included.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Safety-related and common attachments
- Interior and exterior applications
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers

FEATURES AND BENEFITS

+ Knurled mandrel design provides consistent performance in cracked concrete and helps prevent galling during service life.
+ Nominal drill bit size is the same as the anchor diameter
+ Anchor can be installed through standard clearance fixture holes
+ Length ID code and identifying marking stamped on head of each anchor
+ Anchor design allows for follow-up expansion after setting under tensile loading
+ Corrosion resistant stainless steel anchors
+ Domestically manufactured by request

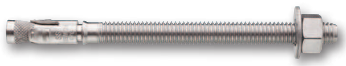
APPROVALS AND LISTINGS

- International Code Council Evaluation Service (ICC-ES), ESR-2502 for cracked and uncracked concrete
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2/ASTM E 488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00-Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD4 and Power-Stud+ SD6 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS



POWER-STUD+ STAINLESS STEEL ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Stainless steel body and expansion clip, nut and washer

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Grouted Concrete Masonry (CMU)

TENSION ZONE CRACKED CONCRETE

SEISMIC REGION QUALIFICATION

CODE LISTED
ICC-ES ESR-2502
CONCRETE

DDA DEWALT DESIGN ASSIST

DUST X+ ANCHOR INSTALLATION SYSTEM

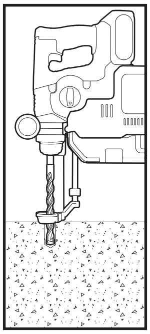
MATERIAL SPECIFICATIONS

Anchor component	Specification	
	SD4[1]	SD6[1]
Anchor body	Type 304 Stainless Steel	Type 316 Stainless Steel
Washer	300 Series Stainless Steel	Type 316 Stainless Steel
Hex Nut	Type 316 Stainless Steel	
Expansion wedge (clip)	Type 316 Stainless Steel	

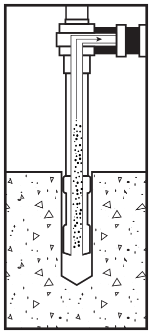
1. Domestically manufactured anchors are available upon request (made to order, see ordering information for details).

INSTALLATION INSTRUCTIONS

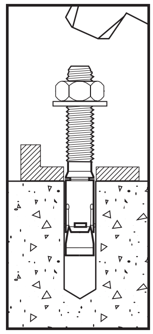
Installation Instructions for Power-Stud+ SD4 and Power-Stud+ SD6



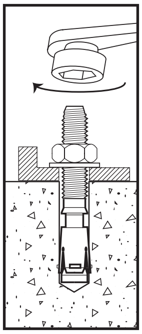
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove 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 supplied washer on the anchor and thread on the supplied 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.



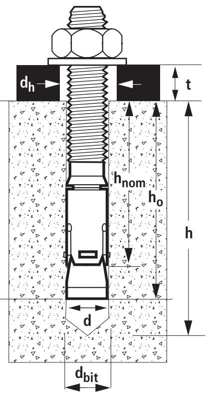
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
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"
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"

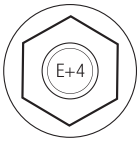
Length identification mark indicates overall length of anchor.

Anchor Detail



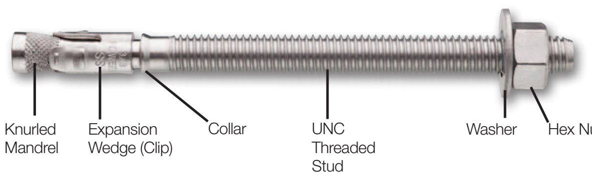
Nomenclature
- d = Diameter of anchor
- d_{bit} = Diameter of drill bit
- d_h = Diameter of fixture clearance hole
- h = Base material thickness. The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
- h_{nom} = Minimum embedment depth

Head Marking



Legend
- Letter Code = Length Identification Mark
- '+' Symbol = Strength Design Compliant Anchor (see ordering information, symbol not on 1/4" diameter anchors)
- Number Code = Stainless Steel Body Type (4 or 6)

Anchor Assembly



REFERENCE DATA (ASD)

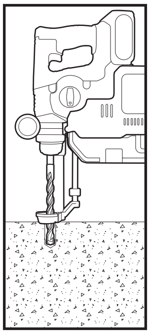
Installation Specifications Table for Power-Stud+ SD4 and Power-Stud+ SD6 in Concrete

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Thread Size (UNC)	-	in.	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)
Minimum embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-3/8 (41)	1-7/8 (48)	2-1/2 (64)	3-3/8 (86)
Minimum hole depth	h_o	in. (mm)	1-1/4 (32)	1-1/2 (38)	2 (51)	2-5/8 (67)	3-1/2 (89)
Installation torque	T_{inst}	ft.-lbf. (N-m)	6 (8)	25 (34)	40 (54)	60 (81)	110 (149)
Torque wrench/socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Nut height	-	in.	7/32	21/64	7/16	35/64	41/64

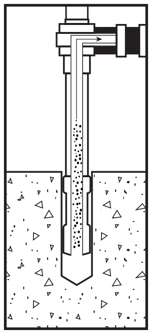
For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

INSTALLATION INSTRUCTIONS

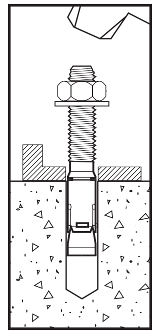
Installation Instructions for Power-Stud+ SD4 and Power-Stud+ SD6



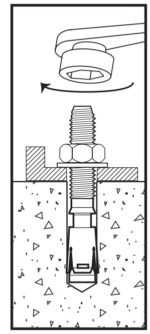
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove 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 supplied washer on the anchor and thread on the supplied 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.



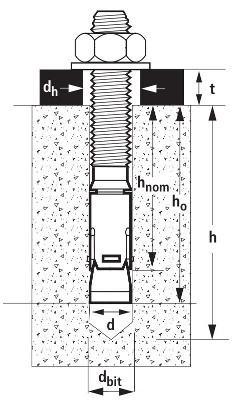
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

Length Identification

Mark	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
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"
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"

Length identification mark indicates overall length of anchor.

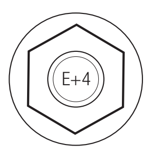
Anchor Detail



Nomenclature

d = Diameter of anchor
d_{bit} = Diameter of drill bit
d_h = Diameter of fixture clearance hole
h = Base material thickness. The minimum value of h should be $1.5h_{nom}$ or 3" whichever is greater
h_{nom} = Minimum embedment depth

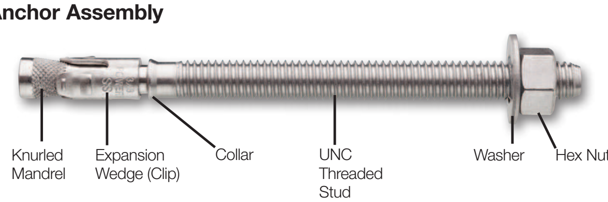
Head Marking



Legend

Letter Code = Length Identification Mark
'+' Symbol = Strength Design Compliant Anchor (see ordering information, symbol not on 1/4" diameter anchors)
Number Code = Stainless Steel Body Type (4 or 6)

Anchor Assembly



REFERENCE DATA (ASD)

Installation Specifications Table for Power-Stud+ SD4 and Power-Stud+ SD6 in Concrete

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Thread Size (UNC)	-	in.	1/4-20	3/8-16	1/2-13	5/8-11	3/4-10
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)
Minimum embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-3/8 (41)	1-7/8 (48)	2-1/2 (64)	3-3/8 (86)
Minimum hole depth	h_o	in. (mm)	1-1/4 (32)	1-1/2 (38)	2 (51)	2-5/8 (67)	3-1/2 (89)
Installation torque	T_{inst}	ft.-lbf. (N-m)	6 (8)	25 (34)	40 (54)	60 (81)	110 (149)
Torque wrench/socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Nut height	-	in.	7/32	21/64	7/16	35/64	41/64

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

Ultimate Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Embedment Depth h_{nom} 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)		f'c = 8,000 psi (55.2 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)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-1/8 (29)	1,095 (4.9)	2,135 (9.5)	1,200 (5.3)	2,135 (9.5)	1,390 (6.2)	2,135 (9.5)	1,455 (6.5)	2,135 (9.5)	1,680 (7.5)	2,135 (9.5)
	1-3/4 (44)	1,890 (8.4)	2,135 (9.5)	2,070 (9.2)	2,135 (9.5)	2,390 (10.6)	2,135 (9.5)	2,480 (11.0)	2,135 (9.5)	2,480 (11.0)	2,135 (9.5)
3/8	1-3/8 (41)	1,530 (6.8)	2,745 (12.2)	1,680 (7.5)	2,745 (12.2)	1,940 (8.6)	2,745 (12.2)	2,520 (11.2)	2,745 (12.2)	2,910 (12.9)	2,745 (12.2)
	1-7/8 (48)	2,790 (12.4)	2,745 (12.2)	3,060 (13.6)	2,745 (12.2)	3,530 (15.7)	2,745 (12.2)	4,195 (18.7)	2,745 (12.2)	4,840 (21.5)	2,745 (12.2)
	3 (76)	4,700 (20.9)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)	4,895 (21.8)	2,745 (12.2)
1/2	1-7/8 (48)	2,745 (12.2)	5,090 (22.6)	3,010 (13.4)	5,090 (22.6)	3,475 (15.5)	5,090 (22.6)	4,525 (20.1)	5,090 (22.6)	5,230 (23.3)	5,090 (22.6)
	2-3/8 (60)	5,370 (23.9)	5,090 (22.6)	5,880 (26.2)	5,090 (22.6)	6,790 (30.2)	5,090 (22.6)	6,790 (30.2)	5,090 (22.6)	7,845 (34.9)	5,090 (22.6)
	3-3/4 (95)	8,840 (39.3)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)	9,300 (41.4)	5,090 (22.6)
5/8	2-1/2 (64)	5,015 (22.3)	9,230 (41.1)	5,495 (24.4)	9,230 (41.1)	6,345 (28.2)	9,230 (41.1)	7,250 (32.2)	9,230 (41.1)	8,370 (37.2)	9,230 (41.1)
	3-1/4 (83)	6,760 (30.1)	9,230 (41.1)	7,405 (32.9)	9,230 (41.1)	8,560 (38.1)	9,230 (41.1)	9,615 (42.8)	9,230 (41.1)	11,105 (49.4)	9,230 (41.1)
	4-3/4 (121)	10,550 (46.9)	9,230 (41.1)	11,555 (51.4)	9,230 (41.1)	13,345 (59.4)	9,230 (41.1)	14,560 (64.8)	9,230 (41.1)	14,560 (64.8)	9,230 (41.1)
3/4	3-3/8 (86)	6,695 (29.8)	11,255 (50.1)	7,330 (32.6)	12,625 (56.2)	8,465 (37.7)	14,580 (64.9)	9,705 (43.2)	15,440 (68.7)	11,210 (49.9)	15,440 (68.7)
	4-1/2 (114)	10,800 (48.0)	15,440 (68.7)	11,830 (52.6)	15,440 (68.7)	13,575 (60.4)	15,440 (68.7)	17,110 (76.1)	15,440 (68.7)	19,760 (87.9)	15,440 (68.7)
	5-5/8 (143)	11,730 (52.2)	15,440 (68.7)	12,850 (57.2)	15,440 (68.7)	13,575 (60.4)	15,440 (68.7)	19,710 (87.7)	15,440 (68.7)	21,705 (96.5)	15,440 (68.7)

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+ SD4 and Power-Stud+ SD6 in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter in.	Minimum Embedment Depth h_{nom} 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)		f'c = 8,000 psi (55.2 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)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-1/8 (28)	275 (1.2)	535 (2.4)	300 (1.3)	535 (2.4)	350 (1.6)	535 (2.4)	365 (1.6)	535 (2.4)	420 (1.9)	535 (2.4)
	1-3/4 (44)	475 (2.1)	535 (2.4)	520 (2.3)	535 (2.4)	600 (2.7)	535 (2.4)	620 (2.8)	535 (2.4)	620 (2.8)	535 (2.4)
3/8	1-3/8 (41)	385 (1.7)	685 (3.0)	420 (1.9)	685 (3.0)	485 (2.2)	685 (3.0)	630 (2.8)	685 (3.0)	730 (3.2)	685 (3.0)
	1-7/8 (60)	700 (3.1)	685 (3.0)	765 (3.4)	685 (3.0)	885 (3.9)	685 (3.0)	1,050 (4.7)	685 (3.0)	1,210 (5.4)	685 (3.0)
	3 (60)	1,175 (5.2)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)	1,225 (5.4)	685 (3.0)
1/2	1-7/8 (57)	685 (3.0)	1,275 (5.7)	755 (3.4)	1,275 (5.7)	870 (3.9)	1,275 (5.7)	1,130 (5.0)	1,275 (5.7)	1,310 (5.8)	1,275 (5.7)
	2-3/8 (64)	1,345 (6.0)	1,275 (5.7)	1,470 (6.5)	1,275 (5.7)	1,700 (7.6)	1,275 (5.7)	1,700 (7.6)	1,275 (5.7)	1,960 (8.7)	1,275 (5.7)
	3-3/4 (95)	2,210 (9.8)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)	2,325 (10.3)	1,275 (5.7)
5/8	2-1/2 (70)	1,255 (5.6)	2,310 (10.3)	1,375 (6.1)	2,310 (10.3)	1,585 (7.1)	2,310 (10.3)	1,815 (8.1)	2,310 (10.3)	2,095 (9.3)	2,310 (10.3)
	3-1/4 (86)	1,690 (7.5)	2,310 (10.3)	1,850 (8.2)	2,310 (10.3)	2,140 (9.5)	2,310 (10.3)	2,405 (10.7)	2,310 (10.3)	2,775 (12.3)	2,310 (10.3)
	4-3/4 (117)	2,640 (11.7)	2,310 (10.3)	2,890 (12.9)	2,310 (10.3)	3,335 (14.8)	2,310 (10.3)	3,640 (16.2)	2,310 (10.3)	3,640 (16.2)	2,310 (10.3)
3/4	3-3/8 (86)	1,675 (7.5)	2,815 (12.5)	1,835 (8.2)	3,155 (14.0)	2,115 (9.4)	3,645 (16.2)	2,425 (10.8)	3,860 (17.2)	2,805 (12.5)	3,860 (17.2)
	4-1/2 (114)	2,700 (12.0)	3,860 (17.2)	2,960 (13.2)	3,860 (17.2)	3,395 (15.1)	3,860 (17.2)	4,280 (19.0)	3,860 (17.2)	4,940 (22.0)	3,860 (17.2)
	5-5/8 (143)	2,935 (13.1)	3,860 (17.2)	3,215 (14.3)	3,860 (17.2)	3,395 (15.1)	3,860 (17.2)	4,930 (21.9)	3,860 (17.2)	5,425 (24.1)	3,860 (17.2)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete 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 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 ADJUSTMENT FACTORS FOR NORMAL WEIGHT CONCRETE - TENSION (F_{NS}, F_{NC})

Spacing Reduction Factors - Tension (F_{NS})

	Diameter (in)	1/4	3/8	1/2	5/8	3/4
	Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
	Minimum Spacing, s_{min} (in)	2	3	3	5	5
Spacing Distance (inches)	1-3/4	-	-	-	-	-
	2	0.79	-	-	-	-
	2-1/4	0.81	-	-	-	-
	2-1/2	0.83	-	-	-	-
	2-3/4	0.85	-	-	-	-
	3	0.87	0.87	0.82	-	-
	3-1/2	0.91	0.91	0.85	-	-
	4	0.96	0.96	0.88	-	-
	4-1/2	1.00	1.00	0.91	-	-
	5	1.00	1.00	0.94	0.85	0.76
	5-1/2	1.00	1.00	0.97	0.87	0.78
	6	1.00	1.00	1.00	0.90	0.80
	6-1/2	1.00	1.00	1.00	0.92	0.82
	7	1.00	1.00	1.00	0.94	0.84
	7-1/2	1.00	1.00	1.00	0.97	0.86
	8	1.00	1.00	1.00	0.99	0.87
	8-1/4	1.00	1.00	1.00	1.00	0.88
	8-1/2	1.00	1.00	1.00	1.00	0.89
	9	1.00	1.00	1.00	1.00	0.91
	9-1/2	1.00	1.00	1.00	1.00	0.93
	10	1.00	1.00	1.00	1.00	0.95
	10-1/2	1.00	1.00	1.00	1.00	0.97
	11	1.00	1.00	1.00	1.00	0.99
	11-1/4	1.00	1.00	1.00	1.00	1.00

Edge Distance Reduction Factors- Tension (F_{NC})

	Diameter (in)	1/4	3/8	1/2	5/8	3/4
	Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
	Critical Edge Distance, c_{ac} (in)	5	5	7-1/2	9-1/2	9
	Min. Edge Distance, c_{min} (in)	1-3/4	3	3	4-1/2	5
Edge Distance (inches)	1-1/2	-	-	-	-	-
	1-3/4	0.35	-	-	-	-
	2	0.40	-	-	-	-
	2-1/4	0.45	-	-	-	-
	2-1/2	0.50	-	-	-	-
	2-3/4	0.55	-	-	-	-
	3	0.60	0.60	0.40	-	-
	3-1/2	0.70	0.70	0.47	-	-
	4	0.80	0.80	0.53	-	-
	4-1/2	0.90	0.90	0.60	0.47	-
	5	1.00	1.00	0.67	0.53	0.56
	5-1/2	1.00	1.00	0.73	0.58	0.61
	6	1.00	1.00	0.80	0.63	0.67
	6-1/2	1.00	1.00	0.87	0.68	0.72
	7	1.00	1.00	0.93	0.74	0.78
	7-1/2	1.00	1.00	1.00	0.79	0.83
	8	1.00	1.00	1.00	0.84	0.89
	8-1/2	1.00	1.00	1.00	0.89	0.94
	9	1.00	1.00	1.00	0.95	1.00
	9-1/2	1.00	1.00	1.00	1.00	1.00

SPACING DISTANCE AND EDGE DISTANCE ADJUSTMENT FACTORS FOR NORMAL WEIGHT CONCRETE - SHEAR (F_{VS}, F_{VC})

Spacing Reduction Factors - Shear (F_{VS})

	Diameter (in)	1/4	3/8	1/2	5/8	3/4
	Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
	Minimum Spacing, s_{min} (in)	2	3	3	5	5
Spacing Distance (inches)	1-3/4	-	-	-	-	-
	2	0.87	-	-	-	-
	2-1/4	0.88	-	-	-	-
	2-1/2	0.90	-	-	-	-
	2-3/4	0.91	-	-	-	-
	3	0.92	0.92	0.89	-	-
	3-1/2	0.95	0.95	0.91	-	-
	4	0.97	0.97	0.93	-	-
	4-1/2	1.00	1.00	0.95	-	-
	5	1.00	1.00	0.96	0.91	0.84
	5-1/2	1.00	1.00	0.98	0.93	0.85
	6	1.00	1.00	1.00	0.94	0.86
	6-1/2	1.00	1.00	1.00	0.95	0.88
	7	1.00	1.00	1.00	0.97	0.89
	7-1/2	1.00	1.00	1.00	0.98	0.90
	8	1.00	1.00	1.00	0.99	0.92
	8-1/4	1.00	1.00	1.00	1.00	0.92
	8-1/2	1.00	1.00	1.00	1.00	0.93
	9	1.00	1.00	1.00	1.00	0.94
	9-1/2	1.00	1.00	1.00	1.00	0.95
	10	1.00	1.00	1.00	1.00	0.97
	10-1/2	1.00	1.00	1.00	1.00	0.98
	11	1.00	1.00	1.00	1.00	0.99
	11-1/4	1.00	1.00	1.00	1.00	1.00

Edge Distance Reduction Factors - Shear (F_{VC})

	Diameter (in)	1/4	3/8	1/2	5/8	3/4
	Nominal Embed. h_{nom} (in)	1-3/4	1-7/8	2-1/2	3-1/4	4-1/2
	Min. Edge Distance, c_{min} (in)	1-3/4	3	3	4-1/2	5
Edge Distance (inches)	1-1/2	-	-	-	-	-
	1-3/4	0.39	-	-	-	-
	2	0.44	-	-	-	-
	2-1/4	0.50	-	-	-	-
	2-1/2	0.56	-	-	-	-
	2-3/4	0.61	-	-	-	-
	3	0.67	0.67	0.50	-	-
	3-1/2	0.78	0.78	0.58	-	-
	4	0.89	0.89	0.67	-	-
	4-1/2	1.00	1.00	0.75	0.55	-
	5	1.00	1.00	0.83	0.61	0.44
	5-1/2	1.00	1.00	0.92	0.67	0.49
	6	1.00	1.00	1.00	0.73	0.53
	6-1/2	1.00	1.00	1.00	0.79	0.58
	7	1.00	1.00	1.00	0.85	0.62
	7-1/2	1.00	1.00	1.00	0.91	0.67
	8	1.00	1.00	1.00	0.97	0.71
	8-1/4	1.00	1.00	1.00	1.00	0.73
	8-1/2	1.00	1.00	1.00	1.00	0.76
	9	1.00	1.00	1.00	1.00	0.80
	9-1/2	1.00	1.00	1.00	1.00	0.84
	10	1.00	1.00	1.00	1.00	0.89
	10-1/2	1.00	1.00	1.00	1.00	0.93
	11	1.00	1.00	1.00	1.00	0.98
	11-1/4	1.00	1.00	1.00	1.00	1.00

PERFORMANCE DATA

Ultimate Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 installed into the Face of Grout Filled Concrete Masonry[1,2]

Nominal Anchor Diameter in.	Minimum Embedment h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Ultimate Tension Load lb (kN)	Direction of Shear Loading	Ultimate Shear Load lb (kN)
1/2	2-3/8 (60)	3 (76.2)	3 (76.2)	1,695 (7.5)	Any	2,080 (9.3)
		12 (304.8)	12 (304.8)	2,425 (10.8)	Any	4,905 (21.8)
5/8	3-1/4 (83)	12 (304.8)	12 (304.8)	5,565 (24.8)	Any	7,944 (35.3)

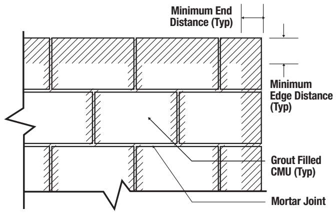
1. Tabulated load values are for anchors installed in minimum 8 inch wide, minimum Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 5.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD4 and Power-Stud+ SD6 installed into the Face of Grout Filled Concrete Masonry[1,2,3,4,5]

ALLOWABLE STRESS DESIGN ASD

Nominal Anchor Diameter in.	Minimum Embedment h_{nom} in. (mm)	Minimum Edge Distance in. (mm)	Minimum End Distance in. (mm)	Allowable Tension Load lb (kN)	Direction of Shear Loading	Allowable Shear Load lb (kN)
1/2	2-3/8 (60)	3 (76.2)	3 (76.2)	340 (1.5)	Any	415 (1.8)
		12 (304.8)	12 (304.8)	485 (2.2)	Any	980 (4.4)
5/8	3-1/4 (83)	12 (304.8)	12 (304.8)	1,115 (5.0)	Any	1,590 (7.1)

1. Tabulated load values are for anchors installed in minimum 8 inch wide, minimum Grade N, Type II, 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. The tabulated values are applicable for anchors installed in 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 provided the allowable tension loads are multiplied 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.
4. 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.
5. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

STRENGTH DESIGN (SD)

Strength Design Installation Table for Power-Stud+ SD4 and Power-Stud+ SD6[1,4]

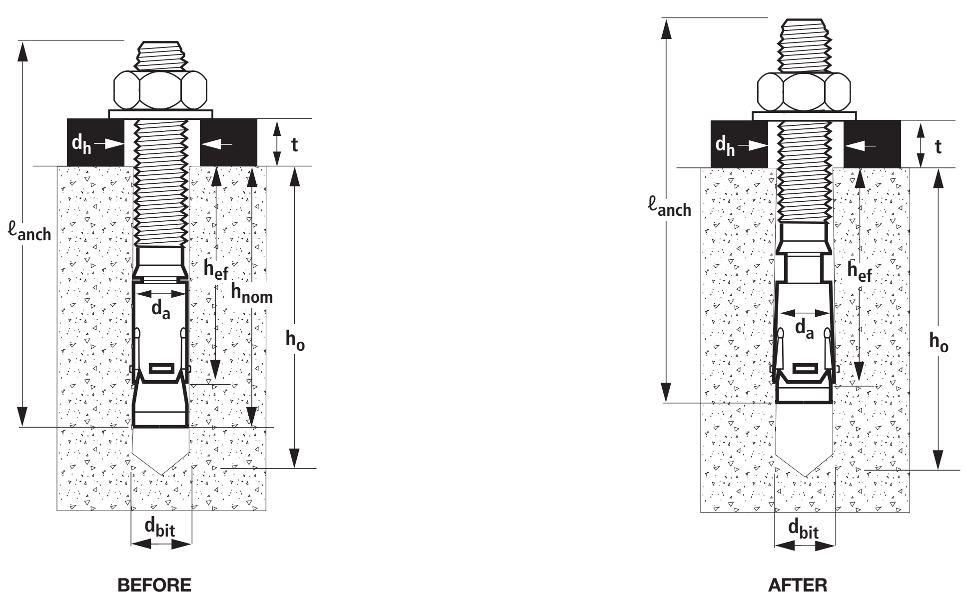
CODE LISTED
ICC-ES ESR-2502

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter								
			1/4	3/8		1/2		5/8		3/4	
Anchor outside 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)	
Thread Size (UNC)	-	in.	1/4-20	3/8-16		1/2-13		5/8-11		3/4-10	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI		1/2 ANSI		5/8 ANSI		3/4 ANSI	
Minimum nominal embedment depth[2]	h_{nom}	in. (mm)	1-3/4 (44)	1-7/8 (48)		2-1/2 (64)		3-1/4 (83)		4-1/2 (114)	
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)		2.00 (51)		2.75 (70)		3-3/4 (95)	
Minimum hole depth	h_o	in. (mm)	1-7/8 (48)	2 (51)		2-5/8 (67)		3-1/2 (89)		4-3/4 (121)	
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-1/4 (83)	4 (102)	4 (102)		5 (127)		6 (152)	
Minimum overall anchor length[3]	ℓ_{anch}	in. (mm)	2-1/4 (57)	2-3/4 (70)		3-3/4 (95)		4-1/2 (114)		5-1/2 (140)	
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (44)	3 (76)	3-1/2 (89)	6 (152)	3 (76)	4-1/2 (114)	8-1/2 (216)	5 (127)	9 (229)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	5-1/2 (140)	3 (76)	3 (76)	6 (152)	8-1/2 (216)	5 (127)	9 (229)	5 (127)
Critical edge distance	c_{ac}	in. (mm)	5 (127)	5 (127)		7-1/2 (191)		9-1/2 (241)		9 (229)	
Installation torque	T_{inst}	ft.-lbf. (N-m)	6 (8)	25 (34)		40 (54)		60 (81)		110 (149)	
Torque wrench/socket size	-	in.	7/16	9/16		3/4		15/16		1-1/8	
Nut height	-	in.	7/32	21/64		7/16		35/64		41/64	

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 embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
3. 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 and possible fixture attachment.
4. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with the following: the 1/4-inch diameter anchors must be installed in uncracked normal-weight or sand-lightweight concrete; 3/8-inch to 3/4-inch diameter anchors must be installed in cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'c, of 3,000 psi (20.7 MPa) provided the concrete thickness above the upper flute meets the minimum thickness specified in this table.

Power-Stud+ SD4 and Power-Stud+ SD6 Anchor Detail



Application of Installation Torque

Tension Design Information for Power-Stud+ SD4 and Power-Stud+ SD6 Anchors in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,8]

CODE LISTED ICC-ES ESR-2502

Design Characteristic		Notation	Units	Nominal Anchor Diameter				
				1/4	3/8	1/2	5/8	3/4
Anchor category		1,2 or 3	-	1	1	1	1	1
Nominal embedment depth		h_{nom}	in.	1-3/4	1-7/8	2-3/8	3-1/4	4-1/2
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)								
Minimum specified yield strength (neck		f_y	ksi (N/mm²)	60 (414)	60 (414)	60 (414)	60 (414)	60 (414)
Minimum specified ultimate tensile strength (neck)		f_{uta}	ksi (N/mm²)	90 (621)	90 (621)	90 (621)	90 (621)	90 (621)
Effective tensile stress area (neck)		$A_{se,N}$	in² (mm²)	0.0249 (16.1)	0.0530 (34.2)	0.1020 (65.8)	0.1630 (105.2)	0.2380 (151)
Steel strength in tension		N_{sa}	lb (kN)	2,240 (10.0)	4,780 (21.3)	9,160 (40.8)	14,635 (65.1)	21,380 (95.1)
Reduction factor for steel strength[2,3]		ϕ	-	0.75				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[8]								
Effective embedment		h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
Effectiveness factor for uncracked concrete		k_{uncr}	-	24	24	24	24	24
Effectiveness factor for cracked concrete		k_{cr}	-	Not Applicable	17	21	21	21
Modification factor for cracked and uncracked concrete		$\psi_{c,N}$	-	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5	1.0 See Note 5
Critical edge distance (uncracked concrete only)		c_{ac}	in. (mm)	5 (127)	5 (127)	7-1/2 (191)	9-1/2 (241)	9 (229)
Reduction factor for concrete breakout strength[4]		ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[8]								
Characteristic pullout strength, uncracked concrete (2,500 psi)[5]		$N_{p,uncr}$	lb (kN)	1,510 (6.7)	See Note 7	See Note 7	See Note 7	8,520 (37.8)
Characteristic pullout strength, cracked concrete (2,500 psi)[5]		$N_{p,cr}$	lb (kN)	Not Applicable	See Note 7	See Note 7	See Note 7	See Note 7
Reduction factor for pullout strength[3]		ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[8]								
Characteristic pullout strength, seismic (2,500 psi)[6,9]		$N_{p,eq}$	lb (kN)	Not Applicable	1,645 (7.3)	See Note 7	See Note 7	See Note 7
Reduction factor for pullout strength[4]		ϕ	-	0.65 (Condition B)				
Mean axial stiffnes values for service load range	Uncracked concrete	β	lbf/in (kN/mm)	171,400 (30,060)	490,000 (86,000)	459,000 (80,500)	234,000 (41,000)	395,000 (69,300)
	Cracked concrete	β	lbf/in (kN/mm)	Not Applicable	228,000 (40,000)	392,000 (68,800)	193,000 (33,800)	76,600 (13,400)

For SI: 1 inch = 25.4 mm; 1 ft-lbf = 1.356 N-m; 1 ksi = 6.894 N/mm²; 1 lb = 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, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
3. The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. The tabulated value of ϕ for concrete breakout strength and pullout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-11 D.4.4.
5. For all design cases $\psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
6. For all design cases $\psi_{c,P}$ =1.0. For concrete compressive strength greater than 2,500 psi, N_{pn} = (pullout strength value from table)*(specified concrete compressive strength/2,500)$^{0.5}$.
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. Tabulated values for characteristic pullout strength in tension are for seismic applications and are based on test results per ACI 355.2, Section 9.5.
10. Actual stiffness of the mean value varies depending on concrete strength, loading and geometry of application.

Shear Design Information for Power-Stud+ SD4 and Power-Stud+ SD6 Anchors in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,7]

CODE LISTED
ICC-ES ESR-2502

STRENGTH DESIGN TABLES

Design Characteristic	Notation	Units	Nominal Anchor Diameter				
			1/4	3/8	1/2	5/8	3/4
Anchor category	1, 2 or 3	-	1	1	1	1	1
Nominal embedment depth	h_{nom}	in.	1-3/4	1-7/8	2-3/8	3-1/4	4-1/2
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]							
Minimum specified yield strength (threads)	f_y	ksi (N/mm²)	60 (414)	60 (414)	60 (414)	60 (414)	60 (414)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm²)	90 (621)	90 (621)	90 (621)	90 (621)	90 (621)
Effective tensile stress area (threads)	$A_{se,V}$ [A_{se}][8]	in² (mm²)	0.0318 (20.5)	0.078 (50.3)	0.142 (91.6)	0.226 (145.8)	0.334 (212)
Steel strength in shear[6]	V_{sa}	lb (kN)	1,115 (5.0)	1,470 (6.6)	3,170 (14.3)	7,455 (33.6)	11,955 (53.2)
Reduction factor for steel strength[2,3]	ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)							
Load bearing length of anchor (h_{ef} or $8d_a$, whichever is less)	ℓ_e	in. (mm)	1.50 (38.1)	1.50 (38.1)	2.00 (50.8)	2.75 (69.9)	3.75 (95)
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)
Reduction factor for concrete breakout[4]	ϕ	-	0.70 (Condition B)				
CONCRETE PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.2.3.3 or ACI 318-11 D.6.3)							
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
Effective embedment	h_{ef}	in. (mm)	1.50 (38.1)	1.50 (38.1)	2.00 (50.8)	2.75 (69.9)	3.75 (95)
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)				
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)							
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	Not Applicable	1,305 (5.9)	2,765 (12.3)	5,240 (23.3)	7,745 (34.5)
Reduction factor for steel strength in shear for seismic[2]	ϕ	-	0.65				

For SI: 1 inch = 25.4 mm; 1 ft-lbf = 1.356 N-m; 1 ksi = 6.894 N/mm²; 1 lb = 0.0044 kN.

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 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, shall apply.
2. The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
3. The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
4. The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 14.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.
5. The tabulated value of for pryout strength applies if the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for pryout strength must be determined in accordance with ACI 318-11 D.4.4, Condition B.
6. Tabulated values for steel strength in shear must be used for design.
7. 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.
8. Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.

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 Installed 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_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)
1/4	-	-	-	-	-	-	-	-	-	-	-
3/8	1-7/8	1,015	955	1,110	955	1,285	955	1,570	955	1,815	955
1/2	2-1/2	1,930	2,060	2,115	2,060	2,440	2,060	2,990	2,060	3,455	2,060
5/8	3-1/4	3,110	4,520	3,410	4,845	3,935	4,845	4,820	4,845	5,570	4,845
3/4	4-1/2	4,955	5,270	5,430	5,770	6,270	6,665	7,680	7,770	8,865	7,770

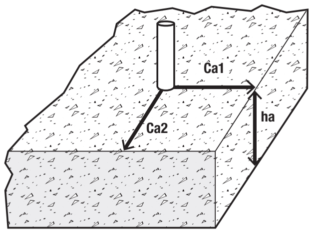
☐ - Anchor Pullout/Pryout Strength Controls ☐ - Concrete Breakout Strength Controls ■ - Steel Strength Controls

Tension and Shear Design Strengths Installed 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_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{sa}, ϕN_{cb} or ϕN_{cp} Tension (lbs.)	ϕV_{sa}, ϕV_{cb} or ϕV_{cp} Shear (lbs.)
1/4	1-3/4	980	725	1,075	725	1,240	725	1,520	725	1,680	725
3/8	1-7/8	1,435	955	1,570	955	1,815	955	2,220	955	2,565	955
1/2	2-1/2	2,205	2,060	2,415	2,060	2,790	2,060	3,420	2,060	3,945	2,060
5/8	3-1/4	3,555	4,845	3,895	4,845	4,500	4,845	5,510	4,845	6,365	4,845
3/4	4-1/2	5,540	7,375	6,065	7,770	7,005	7,770	8,580	7,770	9,905	7,770

☐ - 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+ SD4 (Type 304 Stainless Steel Body) and Power-Stud+ SD6 (Type 316 Stainless Steel Body)

Cat. No.		Anchor Size	Thread Length	Box Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit Cat. No.				
Type 304 SS	Type 316 SS					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7300SD4	7600SD6	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-	-	-
7302SD4	7602SD6	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-	-	-
7304SD4	7604SD6	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-	-	-
-	7610SD6	3/8" x 2-1/4"	7/8"	50	300	DW5527	DW5427	-	-	-
-	7612SD6	3/8" x 2-3/4"	1-3/8"	50	300	DW5527	DW5427	-	-	-
7313SD4	7613SD6	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-		
-	7614SD6	3/8" x 3-1/2"	2-1/8"	50	300	DW5527	DW5427	-	-	-
7315SD4	7615SD6	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-	-	-
7316SD4	7616SD6	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-	-	-
-	7617SD6	3/8" x 7"	5-5/8"	50	200	DW55300	DW5429	-	-	-
-	7620SD6	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7322SD4	7622SD6	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7323SD4	7623SD6	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7324SD4	7624SD6	1/2" x 5-1/2"	3-3/4"	50	100	DW5539	DW5438	DW5803	DWA54012	-
7326SD4	7626SD6	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803	DWA54012	-
-	7630SD6	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
-	7632SD6	5/8" x 4-1/2"	2-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7333SD4	7633SD6	5/8" x 5"	3"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7334SD4	7634SD6	5/8" x 6"	4"	25	75	-	DW5446	DW5806	DWA54058	DWA58058
-	7636SD6	5/8" x 7"	5"	25	75	-	DW5447	DW5806	DWA54058	DWA58058
7338SD4	7638SD6	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809	DWA54058	DWA58058
-	7640SD6	3/4" X 4-1/4"	1-7/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
-	7641SD6	3/4" X 4-3/4"	2-3/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
7342SD4	7642SD6	3/4" X 5-1/2"	3-1/8"	20	60	-	DW5453	DW5810	DWA54034	DWA58034
-	7644SD6	3/4" X 6-1/4"	3-7/8"	20	60	-	DW5455	DW5810	DWA54034	DWA58034
-	7646SD6	3/4" X 7"	4-5/8"	20	60	-	DW5455	DW5810	DWA54034	DWA58034
7348SD4	7648SD6	3/4" X 8-1/2"	6-1/8"	10	40	-	DW5455	DW5812	DWA54034	DWA58034
-	7649SD6	3/4" x 10"	7-5/8"	10	40	-	DW5455	DW5812	DWA54034	DWA58034

Power-Stud+ SD4 and Power-Stud+ SD6 anchors can be domestically manufactured (assembled in the USA with foreign and domestic components) and are made to order. Call for details.

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.

A manual hand pump is available (Cat. No. 08280).

Hollow drill bits must be used with a dust extraction vacuum (Cat. No. DW012).

ICC EVALUATION SERVICE

In Cooperation with Innovation RESEARCH LABS

Most Widely Accepted and Trusted

ICC-ES Evaluation Report

ICC-ES | (800) 423-6587 | (562) 699-0543 | www.icc-es.org

ESR-2502

Reissued 05/2018
This report is subject to renewal 05/2019.

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

REPORT HOLDER:

DEWALT

701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 STAINLESS STEEL ANCHORS AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT / POWERS)

"2014 Recipient of Prestigious Western States Seismic Policy Council (WSSPC) Award in Excellence"

A Subsidiary of INTERNATIONAL CODE COUNCIL

ICC-ES Evaluation Report

ESR-2502

Reissued May 2018
This report is subject to renewal May 2019.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

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

ADDITIONAL LISTEE:

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

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 STAINLESS STEEL ANCHORS AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN 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 codes adopted by Los Angeles Department of Building and Safety (LADBS), see ESR-2502 LABC and LARC Supplement.
- For evaluation for compliance with the *National Building Code of Canada®* (NBCC), see listing report ELC-2502.

Property evaluated:

Structural

2.0 USES

The Power-Stud+ SD2 carbon steel anchors and SD4 and SD6 stainless steel anchors are used to anchor building components to cracked and uncracked normal-weight 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) Power-Stud+ SD2 carbon steel anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete over steel deck having a minimum specified compressive strength, f'_c, of 2,500 psi (17.2 MPa).

The $^3/_8$-inch through $^3/_4$-inch diameter (9.5 mm through 19.1 mm) Power-Stud+ SD2 carbon steel anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete over 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 IBC. The anchors are an alternative 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.

3.0 DESCRIPTION

3.1 General:

The 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 the additional listee are presented in Table A of this report. The anchor body is comprised of a high-strength carbon or stainless steel rod threaded at one end and having a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion clip which freely moves around the mandrel. The expansion clip movement is restrained by the mandrel taper and by a collar. On the stainless steel anchors, the mandrel taper has a knurling with the exception of the $^1/_4$-inch-diameter (6.4 mm) anchors.

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. Installation instructions and related information are set forth in Section 4.3, Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.2 Power-Stud+ SD2 Carbon Steel Anchors:

The anchor body is manufactured from medium carbon steel and has minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633. The expansion clip is manufactured from AISI Type 316 stainless steel. The washer conforms to ASTM F844. The hex nuts conform to ASTM A563, Grade A. The Power-Stud+ SD2 anchor is illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Tables 1 and 2, and Figures A, 1, 3, 5A, 5B, 5C and 5D.

3.3 Power-Stud+ SD4 and Power-Stud+ SD6 Stainless Steel Anchors:

The Power-Stud+ SD4 anchor body is manufactured from Type 304 stainless steel and the Power-Stud+ SD6 is manufactured from Type 316 stainless steel. The expansion clips and hex nuts are manufactured from Type 316 stainless steel. Washers are manufactured from 300 series stainless steel for the Power-Stud+ SD4 and Type 316 stainless steel for the Power-Stud+ SD6. The Power-Stud+ SD4 and Power-Stud+ SD6 anchors are illustrated in Figure 2. Installation instructions and related information are set forth in Section 4.3, Table 6, and Figures A, 1 and 3.

3.4 Concrete:

Normal-weight and lightweight concrete must conform to Sections 1903 and 1905 of the IBC.

3.5 Steel Deck Panels (for SD2 anchors only):

Steel deck panels must comply with the configurations in Figure 5A and 5C of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gage]. Steel deck must comply with the requirements of ASTM A653/A653M SS Grade 33, and have a minimum yield strength of 33 ksi (228 MPa) for Figures 5A and 5C.

Steel deck panels must comply with the configurations in Figure 5B of this report and have a minimum base-metal thickness of 0.035 inch (0.899 mm) [20 gage].Steel deck must comply with requirements of ASTM A653/A653M SS Grade 50, and have a minimum yield strength of 50 ksi (345 MPa) for Figure 5B.

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 R301.1.3 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.

A design example in accordance with the 2015 and 2012 IBC is shown in Figure 6 of this report. Design parameters are based on the 2015 IBC (ACI 318-14) and the 2012 IBC (ACI318-11) 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 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 3, 4, 5, 7 and 8 of this report, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC and Section 5.3 of ACI 318-14 or Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4, must be used for load combinations calculated in accordance with Appendix C of ACI 318-11. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal steel strength of a single anchor in tension, N_{sa}, is given in Tables 3 and 7 of this report. The values of N_{sa} for single anchors given in Tables 3 and 7 must be used and not be derived by calculation. For installation in the soffit of steel deck, the steel strength in tension is not decisive and need not be calculated.

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 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 of a single anchor in tension, N_b, must be calculated according to 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 Tables 3 and 7 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 $\psi_{c,N}$ = 1.0 and using the value of k_{uncr} as given in Tables 3 and 7. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, 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 tension 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 Tables 3 and 7 of this report. 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. 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 adjusted by calculation according to Eq-1:

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

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

where f'_c is the specified concrete compressive strength and whereby the exponent n = $^1/_2$ for all anchor diameters with the exception of the $^3/_8$-inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size, where n = $^1/_3$.

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 must be adjusted by calculation according to Eq-2:

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

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

where f'_c is the specified concrete compressive strength and whereby the exponent $n = {}^1/_2$ for all anchors.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Tables 3 or 7, the pullout strength in tension need not be evaluated.

The nominal pullout strength in tension of the anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, is provided in Table 5. 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 values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 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 values of 3,000 psi or 20.7 MPa must substitute for 2,500 psi or 17.2 MPa in the denominator.

4.1.5 Requirements for Static Steel Shear Capacity, 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 a applicable, is given in Tables 4 and 8 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, as applicable. The shear strength $V_{sa,deck}$ of anchors installed in the soffit of sand-lightweight or normal weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, is given in Table 5.

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 of a single anchor 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 Tables 4 and 8. The value of f'_c must be limited to 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2 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 a group of anchors in shear, V_{cp} or V_{cpg}, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, using the value of k_{cp} provided in Tables 4 and 8 and the value of N_{cb} or N_{cbg} as calculated in accordance with Section 4.1.3 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete on steel deck floor and roof assemblies, as shown in Figures 5A, 5B and 5C, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3 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 shall 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 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; or ACI 318-05 D.3.3.4 or D.3.3.5, as applicable. Strength reduction factors, ϕ, are given in Tables 3, 4, 5, 7 and 8. The anchors, except for the ${}^1/_4$-inch-diameter (6.4 mm) stainless steel anchors, may be installed in regions designed as IBC Seismic Design Category A through F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to 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, $N_{p.eq}$ or $N_{p,deck,cr}$, described in Tables 3, 5 and 7 of this report, must be used in lieu of N_p. The values of $N_{p,eq}$ or $N_{p,deck,cr}$ can be adjusted for concrete strength as follows:

$$N_{eq,f'_c} = N_{eq}\left(\frac{f'_c}{2,500}\right)^n \text{ (lb, psi)} \qquad \text{(Eq-3)}$$

$$N_{eq,f'_c} = N_{eq}\left(\frac{f'_c}{17.2}\right)^n \text{ (N,MPa)}$$

where f'_c is the specified concrete compressive strength and whereby the exponent $n = {}^1/_2$ for all anchor diameters with the exception of the ${}^3/_8$-inch-diameter (9.5 mm) Power-Stud+ SD2 anchor size where $n = {}^1/_3$. In addition, for sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, the value of 3,000 psi or 20.7 MPa must be substituted for the value of 2,500 psi or 17.2 MPa in the denominator.

Where values of $N_{p,eq}$ are not provided in Tables 3 and 7 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 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 of this report. 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, $V_{sa,eq}$ or $V_{sa,deck,eq}$, described in Tables 4, 5 and 8 of this report must be used in lieu of V_{sa}.

4.1.9 Interaction of Tensile and Shear Forces: For anchors or groups of anchors that are subject to the effects of combined tension and shear forces, the design must be performed 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 the following equation:

$$\psi_{cp,N}=\frac{c}{c_{ac}} \quad \text{(Eq-4)}$$

whereby 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 ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} provided in Tables 1, 2 and 6 of this report must be used.

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} as given in Tables 1, 2 and 6 of this report must be used. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thicknesses, h_{min} as given in Tables 1, 2 and 6 must be used. Additional combinations for minimum edge distance, c_{min}, and spacing, s_{min}, may be derived from linear interpolation between the given boundary values as described in Figure 4.

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

For anchors installed in the top of concrete over steel deck assemblies, the anchors must be installed in accordance with Figure 5D.

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-5 and Eq-6 as follows:

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

$$V_{allowable,ASD} = \frac{\phi V_n}{\alpha} \quad \text{(Eq-6)}$$

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 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).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 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 shall include all applicable factors to account for non-ductile failure modes and required over-strength.

The requirements for member thickness, edge distance and spacing, as described in this report, must apply. An example of allowable stress design values for illustrative purposes is shown in Table 9 and Figure 6 of this report.

4.2.2 Interaction of Tensile and Shear Forces: The interaction shall be calculated and consistent with ACI 318-14 17.6 or ACI 318 (-11, -08, -05) D.7, as applicable, as follows:

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

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

For all other cases: $\frac{T}{T_{allowable}}+\frac{V}{V_{allowable}} \leq 1.2$ (Eq-7)

4.3 Installation:

Installation parameters are provided in Tables 1, 2 and 6, and Figures A, 1, 3, 5A, 5B, 5C and 5D. Anchor locations must comply with this report and the plans and specifications approved by the code official. The Power-Stud+ SD2 carbon steel anchors and Power-Stud+ SD4 and Power-Stud+ SD6 stainless steel anchors must be installed according to 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 size. The minimum drilled hole depths are given in Tables 1, 2 and 6. 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 A and 3). 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 Tables 1, 2 and 6 are achieved.

For installation of SD2 anchors in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more than $^{1}/_{8}$ inch (3.2 mm). For member thickness and edge distance requirements for installations into the soffit of concrete on steel deck assemblies, see Figure 5A, 5B and 5C.

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; or 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, hole dimensions, hole cleaning procedure, anchor spacing, edge distances, concrete member thickness, anchor embedment, tightening torque and adherence to themanufacturer's 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 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 a 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-diameter (6.4 mm) anchors must be installed in uncracked normal-weight or lightweight concrete; $^{3}/_{8}$-inch- to $^{3}/_{4}$-inch-diameter (9.5 mm to 19.1 mm) anchors must be installed 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); and installed in the soffit or in the top of cracked and uncracked normal weight or sand-lightweight concrete over steel deck profiles having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

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

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

5.6 Strength Design values must be established in accordance with Section 4.1 of this report.

5.7 Allowable Stress Design values must be established in accordance with Section 4.2 of this report.

5.8 Anchor spacing(s) and edge distance(s), as well as minimum member thickness, must comply with Tables 1, 2 and 6, and Figures 5A, 5B, 5C and 5D.

5.9 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.

5.10 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.

5.11 Anchors 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.

5.12 The $^{3}/_{8}$-inch-diameter to $^{3}/_{4}$-inch-diameter (9.5 mm to 19.1 mm) anchors may be used to resist short-term loading due to wind or seismic forces in locations designated as Seismic Design Categories A through F under the IBC, subject to the conditions of this report. 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.

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

- 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.

5.14 Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

5.15 Use of anchors made of stainless steel as specified in this report are permitted for exterior exposure or damp environments.

5.16 Use of anchors made of stainless steel as specified in this report are permitted for contact with preservative-treated and fire-retardant-treated wood.

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 No. 18 and Test No. 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear, respectively; and quality control documentation.

7.0 IDENTIFICATION

The anchors are identified by dimensional characteristics and packaging. A length letter code head marking is stamped on each anchor on the exposed threaded stud end which is visible after installation. Table D shows the length code identification system. For the Power-Stud+ SD2 anchors, a plus sign "+" and the number "2" are also visible after installation. For the Power-Stud+ SD4 and Power-Stud+ SD6 anchors, a plus sign "+" is also marked with a number on all anchors with the exception of the $^{1}/_{4}$-inch-diameter (6.4 mm) anchors. The number "4" designates the Power-Stud+ SD4 and the number "6" designates the Power-Stud+ SD6. Packages are identified with the anchor name, type and size, the company name as set forth in Table A, and the evaluation report number (ESR-2502).

TABLE A—PRODUCT NAMES BY COMPANY AND DESIGN INDEX

Company Name	Product Name	Installation Specifications	Tesion Design Data			Shear Design Date		
			Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit	Concrete	Top of Concrete Over Steel Deck	Steel Deck Soffit
DEWALT	Power-Stud+ SD2	Table 1 and Table 2	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
	Power-Stud+ SD4 and Power-Stud+ SD6	Table 6	Table 7	Table 7	Not applicable	Table 8	Table 8	Not applicable
Powers Fasteners	Power-Stud+ SD2	Table 1 and Table 2	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
	Power-Stud+ SD4 and Power-Stud+ SD6	Table 6	Table 7	Table 7	Not applicable	Table 8	Table 8	Not applicable

TABLE B—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 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
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
	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

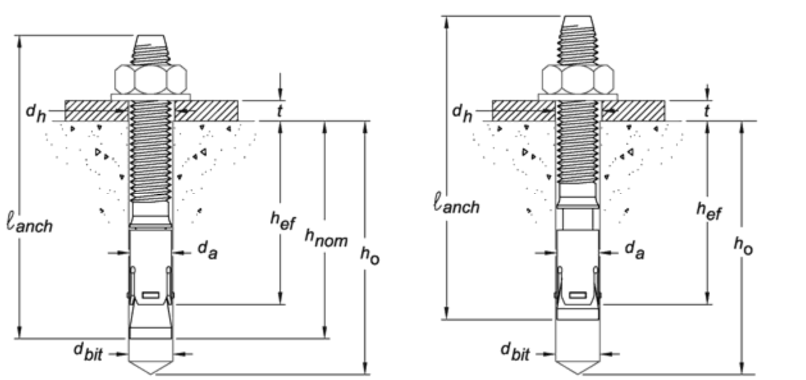


FIGURE 1—POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 ANCHOR DETAIL
Before (Left Picture) and After (Right Picture) Application of Installation Torque

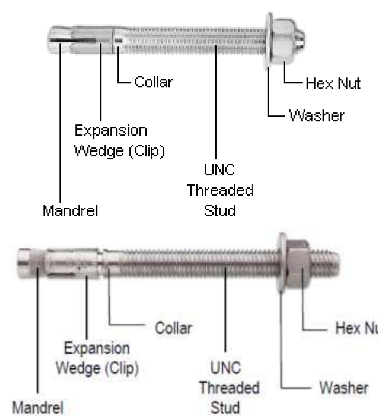
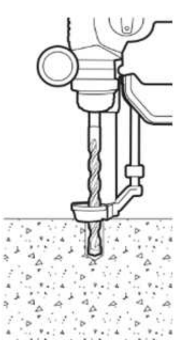
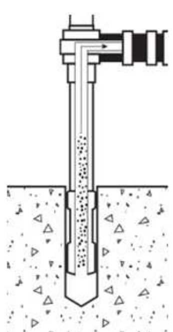


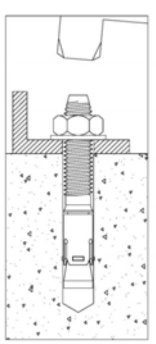
FIGURE 2—POWER-STUD+ SD2 (Top Picture), POWER-STUD+ SD4 AND POWER-STUD+ SD6 (Bottom Picture), ANCHOR ASSEMBLY



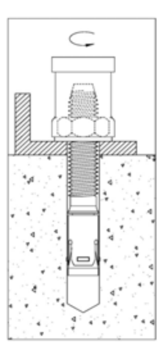
1.) Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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}. Note: the threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

FIGURE 3— POWER-STUD+ SD2, POWER-STUD+ SD4 AND POWER-STUD+ SD6 INSTALLATION INSTRUCTIONS

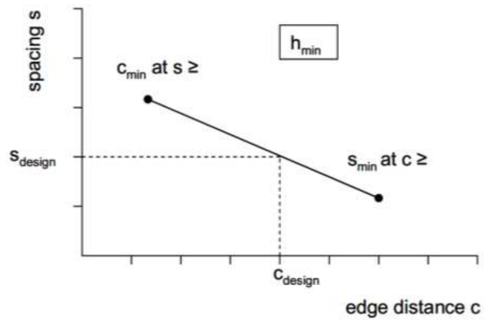
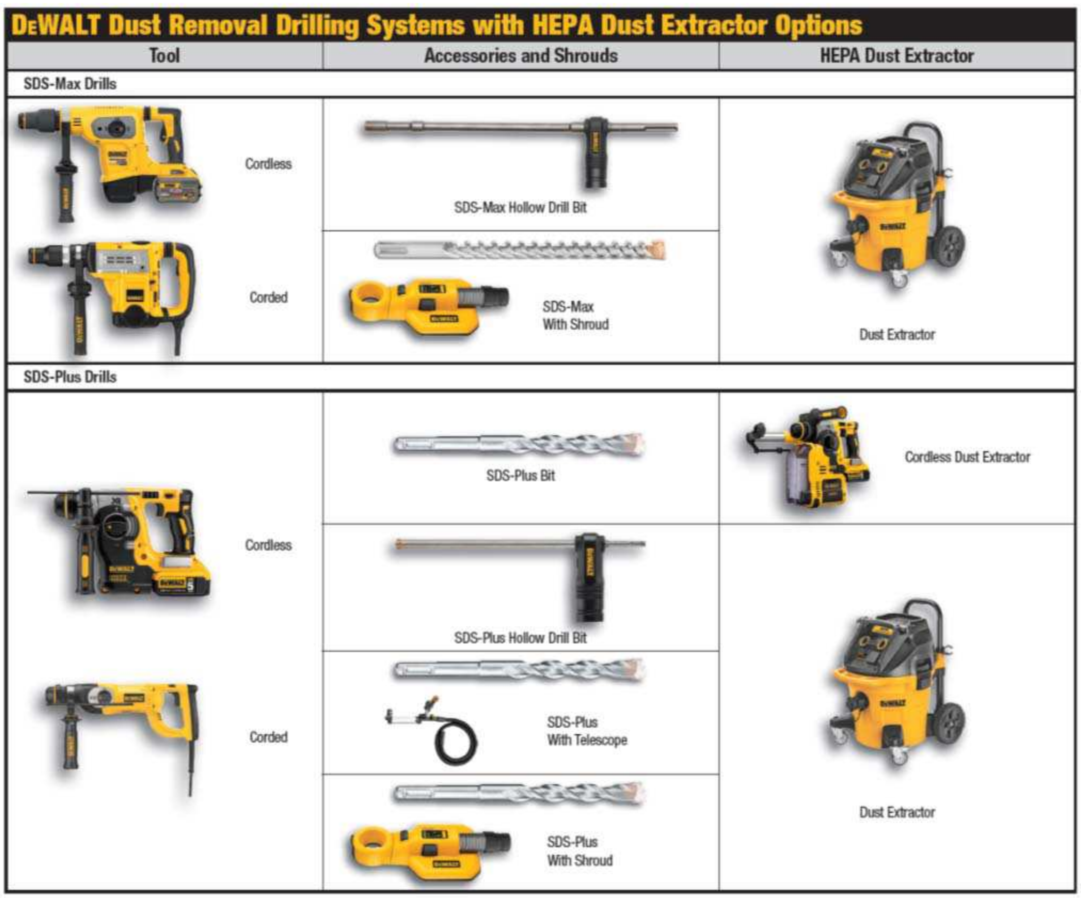


FIGURE 4—INTERPOLATION OF MINIMUM EDGE DISTANCE AND MINIMUM ANCHOR SPACING[1]

[1]This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given in Tables 1, 2, and 6 for a given anchor diameter under the same effective embedment depth, h_{ef}, and corresponding minimum member thickness, h_{min}.



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 1—POWER-STUD+ SD2 ANCHOR INSTALLATION SPECIFICATIONS

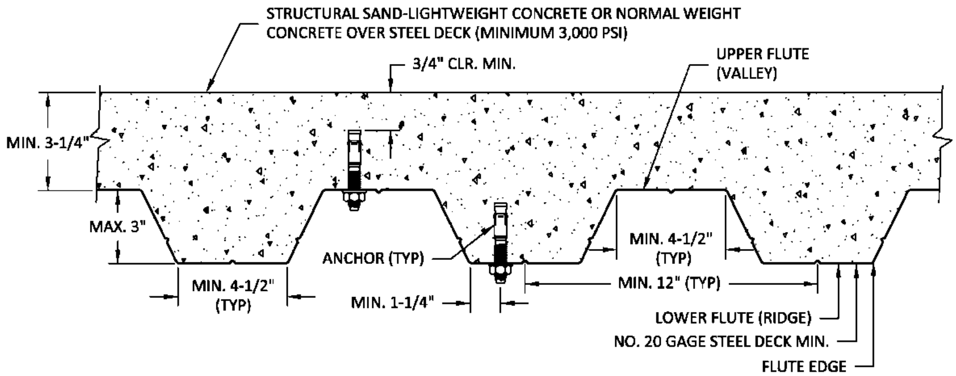
ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE[4] (inch)									
			3/8	1/2				5/8			3/4	
Outside diameter of anchor	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)				0.625 (15.9)			0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	7/16 (11.1)	9/16 (14.3)				11/16 (17.5)			13/16 (20.6)	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI	1/2 ANSI				5/8 ANSI			3/4 ANSI	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2 3/8 (60)	2 1/2 (64)		3 3/4 (83)		3 7/8 (98)	4 7/8 (124)		4 1/2 (114)	5 3/4 (146)
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)		3.25 (83)		3.25 (83)	4.25 (108)		3.75 (95)	5.00 (127)
Minimum concrete member thickness	h_{min}	in. (mm)	4 (102)	4 1/2 (114)	6 (152)	5 3/4 (146)	5 3/4 (146)	5 3/4 (146)	6 1/2 (165)	8 (203)	7 (178)	10 (254)
Critical edge distance[2]	c_{ac}	in. (mm)	6 1/2 (165)	8 (203)		10 (254)		8 (203)	15 3/4 (400)	10 (254)	12 (305)	12 (305)
Minimum edge distance[2]	c_{min}	in. (mm)	2 1/2 (64)	4 (102)	2 3/4 (70)	4 (102)	2 3/4 (70)	4 1/4 (108)	4 1/4 (108)		5 (127)	4 1/2 (114)
Minimum spacing distance[2]	s_{min}	in. (mm)	3 1/2 (89)	6 (152)	6 (152)	4 (102)	6 (152)	4 1/4 (108)	4 1/4 (108)		6 (152)	6 (152)
Minimum hole depth[2]	h_o	in. (mm)	2 5/8 (67)	2 3/4 (70)		4 (102)		4 1/4 (108)	5 1/4 (133)		5 (127)	6 1/4 (159)
Minimum overall anchor length[3]	ℓ_{anch}	in. (mm)	3 (76)	3 3/4 (95)		4 1/2 (114)		4 3/4 (121)	6 (152)		5 1/2 (159)	7 (178)
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)	40 (54)				60 (81)			110 (149)	
Torque wrench / socket size	-	in.	9/16	3/4				15/16			1 1/8	
Nut height	-	In.	21/64	7/16				35/64			41/64	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.
[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
[2]For installations through the soffit of steel deck into concrete see the installation details in Figures 5A, 5B and 5C of this report. In addition, anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
[3]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 and possible fixture attachment.
[4]The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report, provided the concrete thickness above the upper flute meets the minimum thicknesses as specified in Table 2 and Figure 5D of this report.

TABLE 2—POWER-STUD+ SD2 ANCHORS SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED STEEL DECK ASSEMBLIES ACCORDING TO FIGURE 5D[3,4,5]

ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE (inch)			
			3/8		1/2	
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI		1/2 ANSI	
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	2 3/8 (60)		2 1/2 (64)	
Effective embedment	h_{ef}	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness [2]	$h_{min,deck}$	in. (mm)	2 1/2 (64)		2 1/2 (64)	
Critical edge distance	$c_{ac,deck,top}$	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	4 (102)	2 3/4 (70)	4 (102)	8 (203)
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	3 1/2 (89)	6 (152)	8 (203)	4 (102)
Minimum hole depth	h_o	in. (mm)	2 1/2 (64)		2 1/2 (64)	
Installation torque	T_{inst}	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench / socket size	-	in.	9/16		3/4	
Nut height	-	In.	21/64		7/16	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.
[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
[2]The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness refers to the concrete thickness above the upper flute (topping thickness). See Figure 5D of this report.
[3]For all other anchor diameters and embedment depths, refer to Table 1 for applicable values of h_{min}, c_{min} and s_{min}.
[4]Design capacities shall be based on calculations according to values in Tables 3 and 4 of this report.

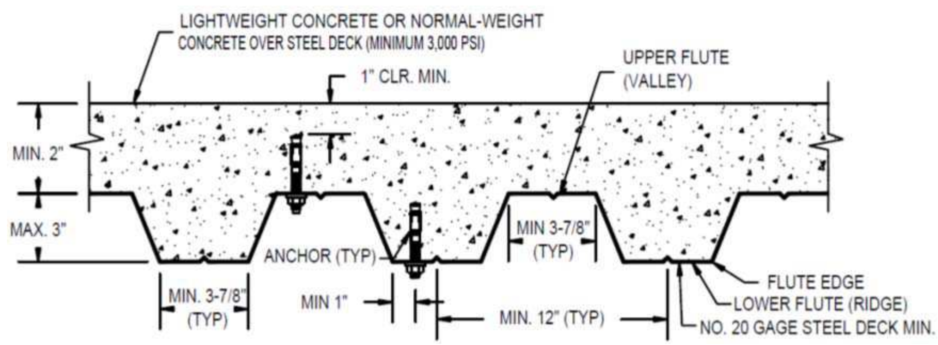


[1] SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5A provided the minimum hole clearance is satisfied.

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.

[2] See Table 5 of this report for design data.

FIGURE 5A—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

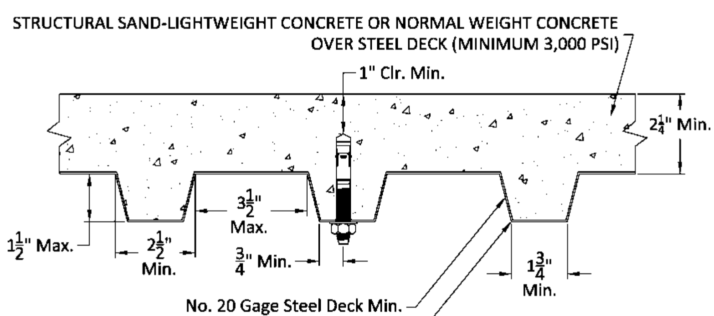


[1] SD2 anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Figure 5B provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5B profiles may be installed with a maximum $^{15}/_{16}$-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.

[2] See Table 5 of this report for design data.

FIGURE 5B—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]



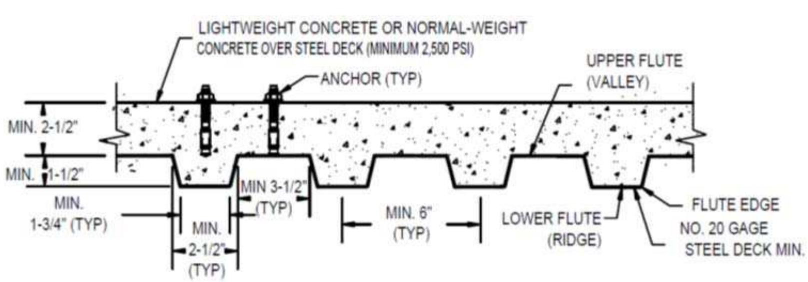
[1] SD2 anchors may be placed in the lower flute of the steel deck profiles in accordance with Figure 5C provided the minimum hole clearance is satisfied.

Anchors in the lower flute of Figure 5C 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.

[2] Anchors may be placed in the upper flute of the steel deck profiles in accordance with Figure 5C 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.

[3] See table 5 of this report for design data.

FIGURE 5C—POWER-STUD+ SD2 INSTALLATION DETAIL FOR ANCHORS IN THE SOFFIT OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2,3]



[1] Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Figure 5D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated the and minimum spacing distance and minimum edge distances are satisfied as given in Table 2 of this report.

[2] For anchors installed in the top of concrete over steel deck profiles with concrete thickness above the upper flute (topping thickness) greater than or equal to the minimum concrete member thicknesses specified in Table 1 the minimum spacing distance and minimum edge distances may be used from those tables, as applicable.

FIGURE 5D—INSTALLATION DETAIL FOR ANCHORS IN THE TOP OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

TABLE 3—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE[1,2,12]

Design Characteristic	Notation	Units	Nominal Anchor Size (inch) $^3/_8$	$^1/_2$		$^5/_8$		$^3/_4$	
Anchor category	1, 2 or 3	-	1	1		1		1	
STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)[4]									
Minimum specified yield strength (neck)	f_y	ksi (N/mm^2)	96.0 (662)	85.0 (586)		85.0 (586)		70.0 (483)	
Minimum specified ultimate strength (neck)	f_{uta}	ksi (N/mm^2)	120.0 (827)	106.0 (731)		106.0 (731)		90.0 (620)	
Effective tensile stress area (neck)	$A_{se,N}$	in^2 (mm^2)	0.0552 (35.6)	0.1007 (65.0)		0.1619 (104.5)		0.2359 (153.2)	
Steel strength in tension[5]	N_{sa}	lbf (kN)	6,625 (29.5)	10,445 (46.5)		13,080 (58.2)		21,230 (94.4)	
Reduction factor for steel strength[3]	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[9]									
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24		24		24	
Effectiveness factor for cracked concrete	k_{cr}	-	17	17		17		17	
Modification factor for cracked and uncracked concrete[6]	$\Psi_{c,N}$	-	1.0 See note 6	1.0 See note 6		1.0 See note 6		1.0 See note 6	
Critical edge distance	c_{ac}	in. (mm)	See Table 1						
Reduction factor for concrete breakout strength in tension[3]	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[9]									
Characteristic pullout strength, uncracked concrete (2,500 psi)[7]	$N_{p,uncr}$	lbf (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi)[7]	$N_{p,cr}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[9]									
Characteristic pullout strength, seismic (2,500 psi)[7,10]	$N_{p,eq}$	lbf (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See Note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)						
Mean axial stiffness values service load range[11] — Uncracked concrete	β	lbf/in. (kN/mm)	865,000 (1517)	717,000 (1258)		569,000 (998)		420,000 (747)	
Mean axial stiffness values service load range[11] — Cracked concrete	β	lbf/in. (kN/mm)	49,500 (87)	57,000 (100)		64,500 (113)		72,000 (126)	

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 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, shall 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, 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 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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+ SD2 is considered a ductile steel element in tension as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
[5]Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.
[6]For all design cases $\Psi_{c,N}$=1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[7]For all design cases $\Psi_{c,P}$=1.0. For the calculation of N_{pn}, see Section 4.1.4 of this report.
[8]Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
[9]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[10]Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.
[11]Actual stiffness of the mean value varies consdierbly depending on concrete strength, loading and geometry of application.
[12]Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.

TABLE 4—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD2 ANCHORS IN CONCRETE[1,2,8]

Design Characteristic	**Notation**	**Units**	**Nominal Anchor Diameter (inch)**						
			3/8	1/2		5/8		3/4	
Anchor category	1, 2 or 3	-	1	1		1		1	
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]									
Minimum specified yield strength (threads)	f_y	ksi (N/mm^2)	76.8 (530)	68.0 (469)		68.0 (469)		56.0 (386)	
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	100.0 (690)	88.0 (607)		88.0 (607)		80.0 (551)	
Effective tensile stress area (threads)	$A_{se,V}$	in^2 (mm^2)	0.0775 (50.0)	0.1419 (65.7)		0.2260 (104.9)		0.3345 (215.8)	
Steel strength in shear[5]	V_{sa}	lbf (kN)	3,115 (13.9)	4,815 (21.4)		10,170 (45.2)		12,610 (56.1)	
Reduction factor for steel strength[3]	ϕ	-	0.65						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)[6]									
Load-bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Nominal anchor diameter	d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Reduction factor for concrete breakout strength in shear[3]	ϕ	-	0.70 (Condition B)						
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)[6]									
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	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)									
Steel strength in shear, seismic[7]	$V_{sa,eq}$	lbf (kN)	2,460 (11.0)	4,815 (21.4)		6,770 (30.1)		8,060 (35.9)	
Reduction factor for steel strength in shear, seismic[3]	ϕ	-	0.65						

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 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, shall 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, as applicalbe. 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, as applicable, requirements for Condition A, see ACI 318-14 17.3.3 or ACI 318-11 D.4.3, 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+ SD2 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 are based on test results per ACI 355.2, Section 9.4 and must be used for design.
[6]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[7]Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.
[8]Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies, see Section 4.1 and Figures 5A, 5B, 5C and 5D of this report.

TABLE 5—TENSION AND SHEAR DESIGN DATA FOR POWER-STUD+ SD2 ANCHORS IN THE SOFFIT OF CONCRETE-FILLED STEEL DECK ASSEMBLIES[1,2,7,8]

Design Characteristic		Notation	Units	Nominal Anchor Size (inch)					
				$^{3}/_{8}$	$^{1}/_{2}$		$^{5}/_{8}$		$^{3}/_{4}$
Anchor category		1, 2 or 3	-	1	1		1		1
Effective embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum nominal embedment depth		h_{nom}	in. (mm)	$2^{3}/_{8}$ (60)	$2^{1}/_{2}$ (64)	$3^{3}/_{4}$ (83)	$3^{7}/_{8}$ (98)	$4^{7}/_{8}$ (124)	$4^{1}/_{2}$ (114)
Minimum hole depth		h_o	in. (mm)	$2^{5}/_{8}$ (67)	$2^{3}/_{4}$ (70)	4 (102)	$4^{1}/_{4}$ (108)	$5^{1}/_{4}$ (133)	5 (127)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[1]									
According to Figure 5A $4^{1}/_{2}$-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,445 (6.4)	1,465 (6.5)	2,600 (11.6)	3,305 (14.7)	5,215 (23.2)	3,470 (15.4)
According to Figure 5B $3^{7}/_{8}$-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	
According to Figure 5C $1^{3}/_{4}$-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$	lbf (kN)	1,250 (5.6)	1,435 (6.4)				
Reduction factor for pullout strength[6]		ϕ	-	0.65 (Condition B)					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[4]									
According to Figure 5A $4^{1}/_{2}$-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	3,815 (17.0)	5,040 (22.4)	4,015 (17.9)	6,670 (29.7)	4,325 (19.2)
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck.eq}$	lbf (kN)	1,715 (7.6)	3,815 (17.0)	5,040 (22.4)	2,675 (11.9)	4,445 (19.8)	2,820 (12.5)
According to Figure 5B $3^{7}/_{8}$-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	5,370 (23.9)	6,070 (27.0)	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	3,580 (15.9)	4,045 (18.0)	
According to Figure 5C $1^{3}/_{4}$-inch-wide deck flute	Steel strength in shear, concrete over steel deck[5]	$V_{sa,deck}$	lbf (kN)	2,170 (9.7)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck[5]	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)				
Reduction factor for steel strength in shear, concrete over steel deck[6]		ϕ	-	0.65					

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm^2, 1 lbf = 0.0044 kN.

[1]For all design cases $\Psi_{c,P}$ = 1.0. For the calculation of N_{pn}, see Section 4.1.4 of this report.
[2]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).
[3]Values for $N_{p,deck,cr}$ are applicable for seismic loading; see Section 4.1.8.2 of this report.
[4]Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
[5]Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ 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 17.5.2 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, is not required for anchors installed in the deck soffit (flute).
[6]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, 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 D.4.4.
[7]Installations must comply with Sections 4.1.11 and 4.3 and Figures 5A, 5B and 5C of this report.
[8]Anchors shall have an axial spacing along the flute soffit equal to the greater of 3hef or 1.5 times the flute width.

TABLE 6—POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHOR INSTALLATION SPECIFICATIONS

ANCHOR PROPERTY AND SETTING INFORMATION	NOTATION	UNITS	NOMINAL ANCHOR SIZE[3] (inch)				
			1/4	3/8	1/2	5/8	3/4
Outside diameter of anchor	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
Minimum nominal embedment depth[1]	h_{nom}	in. (mm)	1 3/4 (44)	1 7/8 (48)	2 1/2 (64)	3 1/4 (83)	4 1/2 (114)
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
Minimum concrete member thickness	h_{min}	in. (mm)	3 1/4 (83)	3 1/4 (83); 4 (102)	4 (102)	5 (127)	6 (152)
Critical edge distance	c_{ac}	in. (mm)	5 (127)	5 (127)	7 1/2 (191)	9 1/2 (241)	9 (229)
Minimum edge distance	c_{min}	in. (mm)	1 3/4 (45)	3 (76); 3 1/2 (89)	6 (8); 3 (76)	4 1/2 (114); 8 1/2 (216)	5 (127); 9 (229)
Minimum spacing distance	s_{min}	in. (mm)	2 (51)	5 1/2 (140); 3 (76)	3 (76); 6 (8)	8 1/2 (216); 5 (127)	9 (229); 5 (127)
Minimum hole depth	h_o	in. (mm)	1 7/8 (48)	2 (51)	2 5/8 (67)	3 1/2 (89)	4 3/4 (121)
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	2 1/4 (57)	2 3/4 (70)	3 3/4 (95)	4 1/2 (114)	5 1/2 (140)
Installation torque	T_{inst}	ft.-lb. (N-m)	6 (8)	25 (34)	40 (54)	60 (81)	110 (149)
Torque wrench / socket size	-	in.	7/16	9/16	3/4	15/16	1 1/8
Nut height	-	In.	7/32	21/64	7/16	35/64	41/64

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

[1]The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.

[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 and possible fixture attachment.

[3]The anchors may be installed in the top of concrete-filled steel deck floor and roof assemblies in accordance with Section 4.3 of this report provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table.

TABLE 7—TENSION DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE[1,8]

Design Characteristic	Notation	Units	Nominal Anchor Size (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor category	1, 2 or 3	-	1	1	1	1	1
STEEL STRENGTH IN TENSION (ACI318-14 17.4.1 or ACI 318-11 D.5.1)							
Minimum specified yield strength (neck)	f_y	ksi (N/mm^2)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)
Minimum specified ultimate strength (neck)	f_{uta}	ksi (N/mm^2)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 621)
Effective tensile stress area (neck)	$A_{se,N}$	in^2 (mm^2)	0.0249 (16.1)	0.0530 (34.2)	0.1020 (65.8)	0.1630 (105.2)	0.238 (151)
Steel strength in tension	N_{sa}	lbf (kN)	2,240 (10.0)	4,780 (21.3)	9,160 (40.8)	14,635 (65.1)	21,380 (95.1)
Reduction factor for steel strength[2,3]	ϕ	-	0.75				
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)[7]							
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75 (95)
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24	24	24
Effectiveness factor for cracked concrete	k_{cr}	-	Not applicable	17	21	21	21
Modification factor for cracked and uncracked concrete	$\Psi_{c,N}$	-	1.0 See note 5	1.0 See note 5	1.0 See note 5	1.0 See note 5	1.0 See note 5
Critical edge distance	c_{ac}	in. (mm)	See Table 6				
Reduction factor for concrete breakout strength in tension[4]	ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)[8]							
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lbf (kN)	1,510 (6.7)	See note 7	See note 7	See note 7	8,520 (37.8)
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 7	See note 7	See note 7
Reduction factor for pullout strength[4]	ϕ	-	0.65 (Condition B)				
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)[8]							
Characteristic pullout strength, seismic (2,500 psi)[6,9]	$N_{p,eq}$	lbf (kN)	Not applicable	1,645 (7.3)	See note 7	See note 7	See note 7
Reduction factor for pullout strength[4]	ϕ	-	0.65 (Condition B)				
Mean axial stiffness values for service load range[10] – Uncracked concrete	β	lbf/in (kN/mm)	171,400 (30,060)	490,000 (86,000)	459,000 (80,500)	234,000 (41,000)	395,000 (69,300)
Mean axial stiffness values for service load range[10] – Cracked concrete	β	lbf/in (kN/mm)	Not applicable	228,000 (40,000)	392,000 (68,800)	193,000 (33,800)	76,600 (13,400)

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 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, shall apply.
[2]The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
[3]The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
[4]The tabulated value of ϕ for concrete breakout strength and pullout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength and pullout strength must be determined in accordance with ACI 318-11 D.4.4.
[5]For all design cases $\Psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[6]For all design cases $\Psi_{c,P}$ =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]Tabulated values for characteristic pullout strength in tension are for seismic applications are based on test results per ACI 355.2, Section 9.5.
[10]Actual stiffness of the mean value varies depending on concrete strength, loading and geometry of application.

TABLE 8—SHEAR DESIGN INFORMATION FOR POWER-STUD+ SD4 AND POWER-STUD+ SD6 STAINLESS STEEL ANCHORS IN CONCRETE[1,7]

Design Characteristic	Notation	Units	Nominal Anchor Diameter				
			$^1/_4$	$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$
Anchor category	1, 2 or 3	-	1	1	1	1	1
STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)[4]							
Minimum specified yield strength (threads)	f_y	ksi (N/mm^2)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)	60.0 (414)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm^2)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)	90.0 (621)
Effective shear stress area (threads)	$A_{se,V}$ [A_{se}][9]	in^2 (mm^2)	0.0318 (20.5)	0.0780 (50.3)	0.142 (91.6)	0.226 (145.8)	0.334 (212)
Steel strength in shear[6]	V_{sa}	lbf (kN)	1,115 (5.0)	1,470 (6.6)	3,170 (14.1)	7,455 (33.2)	11,955 (53,2)
Reduction factor for steel strength[2,3]	ϕ	-	0.65				
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)							
Load-bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	3.75
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)
Reduction factor for concrete breakout strength in shear[4]	ϕ	-	0.70 (Condition B)				
PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)							
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	1.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	1.50 (38)	2.00 (51)	2.75 (70)	$3^3/_4$ (95)
Reduction factor for pryout strength[5]	ϕ	-	0.70 (Condition B)				
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)							
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lbf (kN)	Not applicable	1,305 (5.8)	2,765 (12.3)	5,240 (23.3)	7,745 (34.45)
Reduction factor for steel strength in shear, seismic[2]	ϕ	-	0.65				

For **SI:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 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 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, shall apply.
[2]The tabulated value of ϕ for steel strength applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11Section 9.2, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for steel strength must be determined in accordance with ACI 318-11 D.4.4.
[3]The anchors are ductile steel elements as defined in ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
[4]The tabulated value of ϕ for concrete breakout strength applies when both the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for Condition B are satisfied. If the load combinations of Section 1605.2 of the IBC, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used and the requirements of ACI 318-14 14.3.3 or ACI 318-11 D.4.3, for Condition A are satisfied, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for concrete breakout strength must be determined in accordance with ACI 318-11 D.4.4.
[5]The tabulated value of for pryout strength applies if the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 Section 9.2 are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ for pryout strength must be determined in accordance with ACI 318-11 D.4.4, Condition B.
[6]Tabulated values for steel strength in shear must be used for design.
[7]Anchors are permitted to be used in lightweight concrete in accordance with Section 4.1.12 of this report.
[8]Tabulated values for steel strength in shear are for seismic applications are based on test results per ACI 355.2, Section 9.6.

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

Nominal Anchor Diameter (in.)	Product	Nominal Embedment Depth (in.)	Effective Embedment (in.)	Allowable Tension Load (pounds)
$^1/_4$	Power-Stud+ SD4 and Power-Stud+ SD6	$1^3/_4$	1.50	665
$^3/_8$	Power-Stud+ SD2	$2^3/_8$	2.00	1,220
	Power-Stud+ SD4 and Power-Stud+ SD6	$1^7/_8$	1.50	970
$^1/_2$	Power-Stud+ SD2	$2^1/_2$	2.00	1,490
	Power-Stud+ SD4 and Power-Stud+ SD6	$2^1/_2$	2.00	1,865
	Power-Stud+ SD2	$3^3/_4$	3.25	2,905
$^5/_8$	Power-Stud+ SD4 and Power-Stud+ SD6	$3^1/_4$	2.75	2,405
	Power-Stud+ SD2	$3^7/_8$	3.25	3,090
	Power-Stud+ SD2	$4^7/_8$	4.25	4,615
$^3/_4$	Power-Stud+ SD4 and Power-Stud+ SD6	$4^1/_2$	3.75	3,740
	Power-Stud+ SD2	$4^1/_2$	3.75	3,825
	Power-Stud+ SD2	$5^3/_4$	5.00	5,890

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

[1]Single anchor with static tension load only.
[2]Concrete determined to remain uncracked for the life of the anchorage.
[3]Load combinations from ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable (no seismic loading considered).
[4]30% dead load and 70% live load, controlling load combination 1.2*D* + 1.6*L*.
[5]Calculation of weighted average for 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 strength design resistance in tension, $\boldsymbol{\phi N_n}$, and the allowable stress design value, $\boldsymbol{T_{allowable,ASD}}$, for a $^3/_8$-inch diameter Power-Stud+ SD2 anchor assuming the given conditions in Table 7.

Calculation in accordance with ACI 318-14 Chapter 17, ACI 318-11 Appendix D and this report:	ACI 318-14 Ref.	ACI 318-11 Ref.	Report Ref.
Step 1. Calculate steel strength of a single anchor in tension: $\boldsymbol{\phi N_{sa}} = (0.75)(6{,}625) = 4{,}969\ lbs.$	17.4.1.2	D.5.1.2	Table 3
Step 2. Calculate concrete breakout strength of a single anchor in tension: $\phi N_{cb} = \phi \frac{A_{Nc}}{A_{Nc0}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b$ $N_b = k_c \lambda_a \sqrt{f'_c} (h_{ef})^{1.5}$ $N_b = (24)(1.0)\sqrt{2{,}500}(2.0)^{1.5} = 3{,}394\ lbs.$ $\boldsymbol{\phi N_{cb}} = (0.65)\frac{(36.0)}{(36.0)}(1.0)(1.0)(1.0)(3{,}394) = 2{,}206\ lbs.$	17.4.2.1	D.5.2.1	Table 3
Step 3. Calculate pullout strength of a single anchor: $\phi N_{pn} = \phi N_{p,uncr} \psi_{c,P} \left(\frac{f'_c}{2{,}500}\right)^n$ $\boldsymbol{\phi N_{pn}}$ = (0.65)(2,775)(1.0)(1.0)$^{0.5}$ = 1804 *lbs.*	17.4.2.2	D.5.2.2	Table 3
Step 4. Determine controlling factored resistance strength in tension: $\boldsymbol{\phi N_n} = \min\lvert \phi N_{sa}, \phi N_{cb}, \phi N_{pn} \rvert = \phi N_{pn} = 1{,}804\ lbs.$	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 allowable stress design value: $\boldsymbol{T_{allowable,ASD}} = \frac{\boldsymbol{\phi N_n}}{\boldsymbol{\alpha}} = \frac{\mathbf{1{,}804}}{\mathbf{1.48}} = \mathbf{1{,}220}\ \boldsymbol{lbs.}$	-	-	§ 4.2

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

ICC-ES Evaluation Report

ESR-2502 LABC and LARC Supplement

Reissued May 2018

This report is subject to renewal May 2019.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

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

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 STAINLESS STEEL ANCHORS AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN 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®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors in cracked and uncracked concrete, described in ICC-ES master evaluation report ESR-2502, have also been evaluated for compliance with the codes noted below as adopted by 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®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2502, comply with LABC Chapter 19, and LARC, and are subjected to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The Power-Stud®+ SD2 carbon steel anchors, Power-Stud®+ SD4 stainless steel anchors and Power-Stud®+ SD6 stainless steel anchors described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-2502.
- The design, installation, conditions of use and labeling of the anchors are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the master evaluation report ESR-2502.
- 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 May 2018.

ICC-ES Evaluation Report

ESR-2502 FBC Supplement

Reissued May 2018
This report is subject to renewal May 2019.

www.icc-es.org | (800) 423-6587 | (562) 699-0543 *A Subsidiary of the International Code Council®*

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

EVALUATION SUBJECT:

POWER-STUD®+ SD2 CARBON STEEL ANCHORS, POWER-STUD®+ SD4 STAINLESS STEEL ANCHORS AND POWER-STUD®+ SD6 STAINLESS STEEL ANCHORS IN 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+ SD2 Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, recognized in ICC-ES master evaluation report ESR-2502, have also been evaluated for compliance with the codes noted below:

Compliance with the following codes:

- 2014 and 2010 *Florida Building Code—Building*
- 2014 and 2010 *Florida Building Code—Residential*

2.0 PURPOSE OF THIS SUPPLEMENT

The Power-Stud+ SD2 Carbon Steel Anchors, Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in Cracked and Uncracked Concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-2502, comply with the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code®* (IBC) provisions noted in the master evaluation report and the following conditions apply:

- Design wind loads must be based on Section 1609 of the 2014 and 2010 *Florida Building Code—Building* or Section R301.2.1.1 of the 2014 and 2010 *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the 2014 and 2010 *Florida Building Code—Building*, as applicable.

Use of the Power-Stud+ SD2 Anchors in cracked and uncracked concrete for compliance with the High-Velocity Hurricane Zone provisions of the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, has not been evaluated, and is outside the scope of this supplemental report.

Use of the Power-Stud+ SD4 Stainless Steel Anchors and Power-Stud+ SD6 Stainless Steel Anchors in cracked and uncracked concrete has also been found to be in compliance with the High-Velocity Hurricane Zone (HVHZ) provisions of the 2014 and 2010 *Florida Building Code—Building* and the 2014 and 2010 *Florida Building Code—Residential*, provided that the design wind loads for use of the anchors in the HVHZ are based on Section 1620 of the *Florida Building Code—Building.*

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 May 2018.