

GENERAL INFORMATION

POWER-STUD® + SD1

Wedge Expansion Anchor

PRODUCT DESCRIPTION

The Power-Stud+ SD1 anchor is a fully threaded, torque-controlled, wedge expansion anchor which is designed for consistent performance in cracked and uncracked concrete. Suitable base materials include normal-weight concrete, lightweight concrete, concrete over steel deck and grouted concrete masonry. The anchor is manufactured with a zinc plated carbon steel body and expansion clip for premium performance. Nut and washer are included.

GENERAL APPLICATIONS AND USES

- Structural connections, i.e., beam and column anchorage
- Safety-related attachments
- Barriers and guards
- Fencing and railing
- Mezzanines and racking
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Trapeze / overhead utilities
- Ledgers, angles and brackets
- Equipment anchorage
- Seismic and wind loading

FEATURES AND BENEFITS

- + Consistent performance in high and low strength concrete
- + Nominal drill bit size is the same as the anchor diameter
- + Anchor can be installed through standard 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

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2818 and ELC-2818 for cracked and uncracked concrete
- International Code Council, Evaluation Service (ICC-ES), ESR-2966 for masonry
- Code compliant with the 2021 IBC/IRC, 2018 IBC/IRC, 2015 IBC/IRC, and 2012 IBC/IRC
- Tested in accordance with ACI 355.2/ASTM E488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318 and CSA A23.3 (-19) Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (anchor Category 1)
- Tested in accordance with ASTM E488 and ICC-ES AC01 for use in masonry
- City of Los Angeles, LABC and LARC Supplement (within ESR-2818 and ESR-2966)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-2818 and ESR-2966)
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes
- FM Approvals (Factory Mutual) – see FM Approval Guide for sizes

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+ SD1 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

MATERIAL SPECIFICATIONS

Anchor component	Specification
Anchor Body	Medium carbon steel
Hex nut	Carbon steel, ASTM A563, Grade A
Washer	Carbon Steel, ASTM F844; meets dimensional requirements of ANSI B18.22.2, Type A Plain
Expansion wedge (clip)	Carbon Steel
Plating	Zinc plating according to ASTM B633, SC1 Type III (Fe/Zn 5) Minimum plating requirements for Mild Service Condition.
See Tension Design Information table for yield and ultimate strengths of the anchor body.	

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POWER-STUD+ SD1
ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

- Zinc plated carbon steel body with expansion clip, nut and washer

ANCHOR SIZE RANGE (TYP.)

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

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete
- Concrete over steel deck
- Grouted concrete masonry (CMU)



INSTALLATION SPECIFICATIONS

Installation Specifications for Power-Stud+ SD1 in Concrete^{1,2,3}

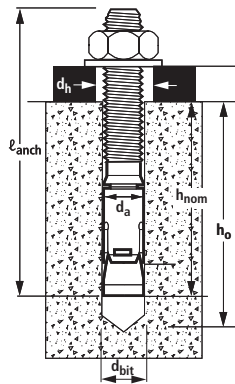
Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter							
			1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Anchor diameter	d_a (d)	in.	0.250	0.375	0.500	0.625	0.750	0.875	1.000	1.250
Minimum diameter of hole clearance in fixture	d_h	in.	5/16	7/16	9/16	11/16	13/16	1	1-1/8	1-3/8
Nominal drill bit diameter (ANSI)	d_{bit}	in.	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum nominal embedment depth ¹	h_{nom}	in.	1-1/8	1-5/8	2-1/4	2-3/4	3-3/8	3-7/8	4-1/2	5-1/2
Minimum hole depth	h_o	in.	$h_{nom} + 1/8$		$h_{nom} + 1/4$			$h_{nom} + 3/8$		$h_{nom} + 1/2$
Installation torque	T_{inst}	ft.-lbf.	4	20	40	80	110	175	225	375
Torque wrench/socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8	1-5/16	1-1/2	1-7/8
Nut height	-	in.	7/32	21/64	7/16	35/64	41/64	3/4	55/64	1-1/16
Washer O.D.	-	in.	5/8	13/16	1-1/16	1-5/16	1-15/32	1-3/4	2	2-1/2

See Strength Design Information for installation specifications in strict accordance with ICC-ES ESR-2818 and ELC-2818.

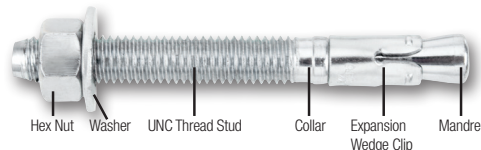
1. See Performance Data tables for additional embedment depths.

2. The minimum base material thickness should be $1.5h_{nom}$ or 3", whichever is greater.

Power-Stud+ SD1 Anchor Detail



Power-Stud+ SD1 Anchor Assembly



Head Marking



Legend

- Letter Code = Length Identification Mark
- '+' Symbol = Strength Design Compliant Anchor (see ordering information)
- Number 1 = Carbon Steel Body and Expansion Clip (number 1 not on 1/4" diameter anchors)

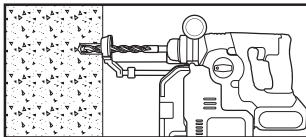
Length Identification

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

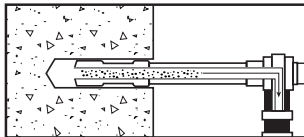
Length identification mark indicates overall length of anchor.

INSTALLATION INSTRUCTIONS

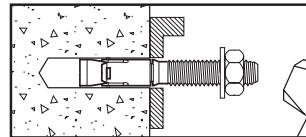
Installation Instructions for Power-Stud+ SD1



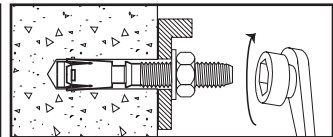
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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

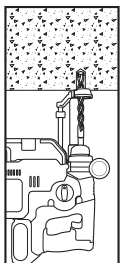


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom} .

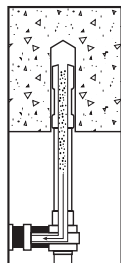


Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst} . Note: The threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

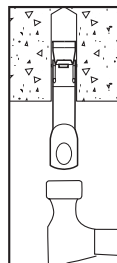
Installation Instructions for Power-Stud+ SD1 Tie Wire Version



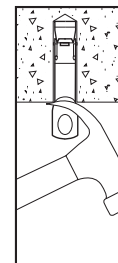
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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



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



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

PERFORMANCE DATA (ASD)

Ultimate Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete^{1,2}

Nominal Anchor Diameter d in.	Minimum Embedment Depth h _{min} in. (mm)	Minimum Concrete Compressive Strength							
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28)	1,320 (5.9)	1,160 (5.2)	1,435 (6.4)	1,255 (5.6)	1,660 (7.4)	1,255 (5.6)	1,660 (7.4)	1,255 (5.6)
	1-3/4 (44)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)	2,775 (12.4)	1,255 (5.6)
3/8	1-5/8 (41)	2,240 (10.9)	2,320 (10.3)	2,685 (12)	2,540 (11.3)	3,100 (13.8)	2,540 (11.3)	3,100 (13.8)	2,540 (11.3)
	2-3/8 (60)	3,485 (15.5)	2,540 (11.3)	3,815 (17)	2,540 (11.3)	4,410 (19.6)	2,540 (11.3)	5,400 (24)	2,540 (11.3)
1/2	2-1/4 (57)	3,800 (16.9)	3,840 (17.1)	4,155 (18.5)	4,195 (18.7)	4,800 (21.4)	4,195 (18.7)	4,800 (21.4)	4,195 (18.7)
	2-1/2 (64)	3,910 (17.4)	4,195 (18.7)	4,285 (19.1)	4,195 (18.7)	4,950 (22)	4,195 (18.7)	6,060 (27)	4,195 (18.7)
	3-3/4 (95)	7,955 (35.4)	4,195 (18.7)	8,715 (38.8)	4,195 (18.7)	10,065 (44.8)	4,195 (18.7)	12,325 (54.8)	4,195 (18.7)
5/8	2-3/4 (70)	4,960 (22.1)	6,220 (27.7)	5,440 (24.3)	6,815 (30.3)	6,285 (28)	6,815 (30.3)	6,285 (28)	6,815 (30.3)
	3-3/8 (86)	6,625 (29.5)	6,815 (30.3)	7,260 (32.3)	6,815 (30.3)	8,380 (37.3)	6,815 (30.3)	10,265 (45.7)	6,815 (30.3)
	4-5/8 (117)	11,260 (50.1)	6,815 (30.3)	12,335 (54.9)	6,815 (30.3)	14,245 (63.4)	6,815 (30.3)	14,465 (65.7)	6,815 (30.3)
3/4	3-3/8 (86)	7,180 (31.9)	11,480 (51.5)	7,860 (32.2)	12,580 (56.0)	9,075 (40.5)	12,580 (56.0)	9,075 (40.5)	12,580 (56.0)
	4 (102)	9,530 (42.4)	12,580 (56.0)	10,440 (46.5)	12,580 (56.0)	12,060 (53.6)	12,580 (56.0)	14,770 (65.7)	12,580 (56.0)
	5-5/8 (143)	17,670 (78.6)	12,580 (56.0)	19,355 (86.1)	12,580 (56.0)	22,350 (99.4)	12,580 (56.0)	25,065 (111.5)	12,580 (56.0)
7/8	3-7/8 (98)	9,120 (40.6)	10,680 (47.5)	10,005 (44.5)	11,690 (52.0)	11,555 (51.4)	11,690 (52.0)	11,555 (51.4)	11,690 (52.0)
	4-1/2 (114)	11,320 (50.4)	11,690 (52.0)	12,405 (55.2)	11,690 (52.0)	15,125 (67.3)	11,690 (52.0)	19,470 (86.6)	11,690 (52.0)
	6-1/4 (159)	15,105 (67.2)	15,795 (70.3)	16,545 (73.6)	17,305 (77.0)	19,105 (85.0)	19,980 (88.9)	19,105 (85.0)	19,980 (88.9)
1	4-1/2 (114)	12,400 (55.2)	19,320 (85.9)	13,580 (60.4)	21,155 (94.1)	15,680 (69.7)	21,155 (94.1)	15,680 (69.7)	21,155 (94.1)
	5-1/2 (140)	16,535 (73.6)	21,155 (94.1)	18,115 (80.6)	21,155 (94.1)	20,915 (93)	21,155 (94.1)	25,615 (114)	21,155 (94.1)
	8 (203)	19,640 (87.4)	21,155 (94.1)	21,530 (95.8)	21,155 (94.1)	24,865 (110.6)	21,155 (94.1)	24,865 (110.6)	21,155 (94.1)
1-1/4	5-1/2 (140)	18,520 (82.5)	26,560 (118.1)	20,275 (90.9)	29,105 (129.4)	23,410 (105.0)	29,105 (129.4)	23,410 (105.0)	29,105 (129.4)
	6-1/2 (165)	22,485 (100.0)	29,105 (129.4)	24,630 (109.6)	29,105 (129.4)	28,440 (126.5)	29,105 (129.4)	37,360 (166.2)	29,105 (129.4)

1. Tabulated load values are for anchors installed in uncracked concrete with no edge or spacing considerations. Concrete compressive strength must be at the specified minimum at the time of installation.

2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.


Allowable Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete^{1,2,3,4,5}

Nominal Anchor Diameter d (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)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28)	330 (1.5)	290 (1.3)	360 (1.6)	315 (1.4)	415 (1.8)	315 (1.4)	415 (1.8)	315 (1.4)
	1-3/4 (44)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)
3/8	1-5/8 (41)	610 (2.7)	580 (2.6)	670 (3.0)	635 (2.8)	775 (3.4)	635 (2.8)	775 (3.4)	635 (2.8)
	2-3/8 (60)	870 (3.9)	635 (2.8)	955 (4.2)	635 (2.8)	1,105 (4.9)	635 (2.8)	1,350 (6.0)	635 (2.8)
1/2	2-1/4 (57)	950 (4.2)	960 (4.3)	1,040 (4.6)	1,050 (4.7)	1,200 (5.3)	1,050 (4.7)	1,200 (5.3)	1,050 (4.7)
	2-1/2 (64)	980 (4.4)	1,050 (4.7)	1,070 (4.8)	1,050 (4.7)	1,240 (5.5)	1,050 (4.7)	1,515 (6.7)	1,050 (4.7)
	3-3/4 (95)	1,990 (8.9)	1,050 (4.7)	2,180 (9.7)	1,050 (4.7)	2,515 (11.2)	1,050 (4.7)	3,080 (13.7)	1,050 (4.7)
5/8	2-3/4 (70)	1,240 (5.5)	1,555 (6.9)	1,360 (6.0)	1,705 (7.6)	1,570 (7.0)	1,705 (7.6)	1,570 (7.0)	1,705 (7.6)
	3-3/8 (86)	1,655 (7.4)	1,705 (7.6)	1,815 (8.1)	1,705 (7.6)	2,095 (9.3)	1,705 (7.6)	2,565 (11.4)	1,705 (7.6)
	4-5/8 (117)	2,815 (12.5)	1,705 (7.6)	3,085 (13.7)	1,705 (7.6)	3,560 (15.8)	1,705 (7.6)	3,615 (16.1)	1,705 (7.6)
3/4	3-3/8 (86)	1,795 (8.0)	2,870 (12.8)	1,965 (8.7)	3,145 (14.0)	2,270 (10.1)	3,145 (14.0)	2,270 (10.1)	3,145 (14.0)
	4 (102)	2,385 (10.6)	3,145 (14.0)	2,610 (11.6)	3,145 (14.0)	3,015 (13.4)	3,145 (14.0)	3,620 (16.1)	3,145 (14.0)
	5-5/8 (143)	4,420 (19.7)	3,145 (14.0)	4,840 (21.5)	3,145 (14.0)	5,590 (24.9)	3,145 (14.0)	6,265 (27.9)	3,145 (14.0)
7/8	3-7/8 (98)	2,280 (10.1)	2,670 (11.9)	2,500 (11.1)	2,925 (13.0)	2,890 (12.9)	2,925 (13.0)	2,890 (12.9)	2,925 (13.0)
	4-1/2 (114)	2,830 (12.6)	2,925 (13.0)	3,100 (13.8)	2,925 (13.0)	3,780 (16.8)	2,925 (13.0)	4,870 (21.7)	2,925 (13.0)
	6-1/4 (159)	3,775 (16.8)	3,950 (17.6)	4,135 (18.4)	4,325 (19.2)	4,775 (21.2)	4,995 (22.2)	4,775 (21.2)	4,995 (22.2)
1	4-1/2 (114)	3,100 (13.8)	4,830 (21.5)	3,395 (15.1)	5,290 (23.5)	3,920 (17.4)	5,290 (23.5)	3,920 (17.4)	5,290 (23.5)
	5-1/2 (140)	4,135 (18.4)	5,290 (23.5)	4,530 (20.2)	5,290 (23.5)	5,230 (23.3)	5,290 (23.5)	6,405 (28.5)	5,290 (23.5)
	8 (203)	4,910 (21.8)	5,290 (23.5)	5,380 (23.9)	5,290 (23.5)	6,215 (27.6)	5,290 (23.5)	6,215 (27.6)	5,290 (23.5)
1-1/4	5-1/2 (140)	4,630 (20.6)	6,640 (29.5)	5,070 (22.6)	7,275 (32.4)	5,850 (26.0)	7,275 (32.4)	5,850 (26.0)	7,275 (32.4)
	6-1/2 (165)	5,620 (25.0)	7,275 (32.4)	6,160 (27.4)	7,275 (32.4)	7,110 (31.6)	7,275 (32.4)	9,340 (41.5)	7,275 (32.4)

1. Tabulated load values are for anchors installed in uncracked concrete. Concrete compressive strength must be at the minimum at the time of installation.
2. Allowable load capacities are calculated using an applied safety factor of 4.0.
3. Allowable load capacities must be multiplied by reduction factors when anchor spacing or edge distances are less than critical distances.
4. Linear interpolation may be used to determine allowable loads for intermediate embedments and compressive strengths.
5. For lightweight concrete multiply tabulated allowable load values by a reduction factor of 0.60.

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Minimum Spacing s_{min} (in)	1-1/2	2-1/4	2-1/4	3-1/2	3	4-1/2	5	3-3/4	6	4-1/4	4-1/2	6	6-1/2	5-1/4	6-1/2	5-1/4	6	8	6	7-1/2	8
Spacing Distance (inches)	1-1/2	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.95	0.78	0.86	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.98	0.80	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.83	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.85	0.93	-	0.85	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.90	0.98	0.84	0.88	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.95	1.00	0.87	0.92	-	-	0.87	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.98	1.00	0.89	0.93	-	-	0.88	-	0.72	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.90	0.95	0.91	-	0.90	-	0.73	0.86	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.94	0.98	0.94	0.79	0.92	-	0.75	0.88	-	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.97	1.00	0.97	0.81	0.95	-	0.77	0.91	-	-	0.87	-	0.77	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	0.83	0.98	0.88	0.79	0.93	0.87	-	0.89	-	0.78	0.86	-	0.75	-	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	0.86	1.00	0.90	0.80	0.95	0.89	0.79	0.91	0.85	0.79	0.87	-	0.76	-	-
	7	1.00	1.00	1.00	1.00	1.00	0.88	1.00	0.93	0.82	0.98	0.91	0.81	0.93	0.87	0.80	0.89	-	0.77	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.96	0.84	1.00	0.93	0.82	0.95	0.89	0.82	0.91	-	0.78	0.85	-
	8	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.99	0.86	1.00	0.95	0.83	0.97	0.91	0.83	0.93	0.84	0.78	0.86	0.82
	8-1/2	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.88	1.00	0.97	0.85	0.99	0.93	0.84	0.94	0.85	0.79	0.88	0.83
	9	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.89	1.00	0.99	0.86	1.00	0.94	0.85	0.96	0.87	0.80	0.89	0.84
	9-1/2	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.91	1.00	1.00	0.87	1.00	0.96	0.86	0.98	0.89	0.81	0.90	0.85
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.89	1.00	0.98	0.87	1.00	0.90	0.82	0.92	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.90	1.00	1.00	0.88	1.00	0.92	0.83	0.93	0.87
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.91	1.00	1.00	0.89	1.00	0.93	0.84	0.94	0.88
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.93	1.00	1.00	0.90	1.00	0.95	0.84	0.96	0.90
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.92	1.00	0.96	0.85	0.97	0.91
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.93	1.00	0.98	0.86	0.98	0.92
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.94	1.00	1.00	0.87	1.00	0.93
	13 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.95	1.00	1.00	0.88	1.00	0.94
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.96	1.00	1.00	0.89	1.00	0.95
	14 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.90	1.00	0.96
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.90	1.00	0.97
	15 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.91	1.00	0.99
	16 1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00
	20-5/8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Shear (F_{vs})

Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Minimum Spacing s_{min} (in)	1-1/2	2-1/4	2-1/4	3-1/2	3	4-1/2	5	3-3/4	6	4-1/4	4-1/2	6	6-1/2	5-1/4	6-1/2	5-1/4	6	8	6	7-1/2	8
Spacing Distance (inches)	1-1/2	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	1-3/4	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.97	0.85	0.92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.99	0.87	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.88	0.95	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.90	0.96	-	0.91	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.93	0.99	0.90	0.93	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.97	1.00	0.92	0.95	-	-	0.93	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.98	1.00	0.93	0.96	-	-	0.93	-	0.82	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.94	0.97	0.95	-	0.94	-	0.82	0.92	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.96	0.99	0.97	0.86	0.96	-	0.83	0.93	-	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.98	1.00	0.98	0.87	0.97	-	0.85	0.95	-	-	0.93	-	0.87	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.99	0.91	0.86	0.96	0.92	-	0.94	-	0.88	0.92	-	0.86	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	0.93	0.87	0.97	0.93	0.88	0.95	0.91	0.88	0.93	-	0.86	-
	7	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	0.95	0.88	0.99	0.94	0.88	0.96	0.92	0.89	0.94	-	0.87	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	0.97	0.89	1.00	0.96	0.89	0.97	0.93	0.90	0.95	-	0.87	0.91
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	0.99	0.90	1.00	0.97	0.90	0.99	0.94	0.90	0.96	0.90	0.88	0.92
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.92	1.00	0.98	0.91	1.00	0.96	0.91	0.97	0.91	0.88	0.93
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.93	1.00	0.99	0.92	1.00	0.97	0.91	0.98	0.92	0.89	0.94
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.94	1.00	1.00	0.92	1.00	0.98	0.92	0.99	0.93	0.89	0.94
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.93	1.00	0.99	0.93	1.00	0.94	0.90	0.95
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.94	1.00	1.00	0.93	1.00	0.95	0.90	0.96
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.95	1.00	1.00	0.94	1.00	0.96	0.91	0.97
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.97	0.91	0.98
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.95	1.00	0.98	0.92	0.98
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.96	1.00	0.99	0.92	0.99
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.97	1.00	1.00	0.93	1.00
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.97	1.00	1.00	0.93	1.00
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	1.00
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.94	1.00
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	0.95	1.00
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00
	20-5/8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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

Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1-1/4
Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6-1/2
Min. Edge Distance C_{min} (in)	1-3/4	1-3/4	3	2-1/4	4	3-1/4	2-3/4	5	5-1/2	4-1/4	6	5	6	7	7	7	8	8	8	10	8
Edge Distance (inches)	1-3/4	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.57	0.57	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.64	0.64	-	0.35	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.71	0.71	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	0.79	0.79	-	0.42	-	-	0.34	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	0.86	0.86	0.60	0.46	-	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/4	0.93	0.93	0.65	0.50	-	0.41	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	1.00	0.70	0.54	-	0.44	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	1.00	0.80	0.62	0.57	0.50	0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	1.00	0.85	0.65	0.61	0.53	0.53	-	-	0.43	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	0.90	0.69	0.64	0.56	0.56	-	-	0.45	-	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.77	0.71	0.63	0.63	0.59	-	0.50	-	0.45	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.85	0.79	0.69	0.69	0.65	0.92	0.55	-	0.50	-	-	-	-	-	-	-	-
	6	1.00	1.00	1.00	0.92	0.86	0.75	0.75	0.71	1.00	0.60	0.60	0.55	0.38	-	-	-	-	-	-	-
	6-1/2	1.00	1.00	1.00	1.00	0.93	0.81	0.81	0.76	1.00	0.65	0.65	0.59	0.41	-	-	-	-	-	-	-
	7	1.00	1.00	1.00	1.00	1.00	0.88	0.88	0.82	1.00	0.70	0.70	0.64	0.44	0.61	0.61	0.33	-	-	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.94	0.88	1.00	0.75	0.75	0.68	0.47	0.65	0.65	0.36	-	-	-	-
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.80	0.80	0.73	0.50	0.70	0.70	0.38	0.59	0.67	0.29	-
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85	0.85	0.77	0.53	0.74	0.74	0.40	0.63	0.71	0.31	-
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	0.90	0.82	0.56	0.78	0.78	0.43	0.67	0.75	0.33	-
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.95	0.86	0.59	0.83	0.83	0.45	0.70	0.79	0.35	-
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.63	0.87	0.87	0.48	0.74	0.83	0.36	0.57
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.66	0.91	0.91	0.50	0.78	0.88	0.38	0.60
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.96	0.96	0.52	0.81	0.92	0.40	0.63
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	1.00	0.55	0.85	0.96	0.42	0.66
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	0.57	0.89	1.00	0.44	0.69
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.60	0.93	1.00	0.45	0.71
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.62	0.96	1.00	0.47	0.74
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.64	1.00	1.00	0.49	0.77
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.67	1.00	1.00	0.51	0.80
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.69	1.00	1.00	0.53	0.83
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.71	1.00	1.00	0.55	0.86
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.74	1.00	1.00	0.56	0.89
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	1.00	1.00	0.58	0.91
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.79	1.00	1.00	0.60	0.94
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.62	0.97
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.64	1.00
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.86	1.00	1.00	0.65	1.00
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.67	1.00
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.69	1.00
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.71	1.00
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.73	1.00
	21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.76	1.00
	22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00
	23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00
	24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00
	25	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00
	26	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
	27	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00
	27-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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

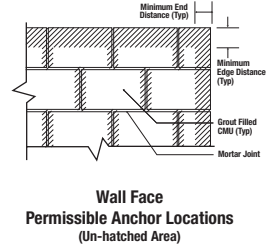
Diameter (in)	1/4	1/4	3/8	3/8	1/2	1/2	1/2	5/8	5/8	5/8	3/4	3/4	3/4	7/8	7/8	7/8	1	1	1	1-1/4	1 1/4
Nominal Embedment h_{nom} (in)	1-1/8	1-3/4	1-5/8	2-3/8	2-1/4	2-1/2	3-3/4	2-3/4	3-3/8	4-5/8	3-3/8	4	5-5/8	3-7/8	4-1/2	6-1/4	4-1/2	5-1/2	8	5-1/2	6 1/2
Min. Edge Distance C_{min} (in)	1-3/4	1-3/4	3	2-1/4	4	3-1/4	2-3/4	5	5-1/2	4-1/4	6	5	6	7	7	7	8	8	8	10	8
Edge Distance (inches)	1-3/4	0.67	0.39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2	0.76	0.44	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.86	0.50	-	0.38	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.95	0.56	-	0.42	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	2-3/4	1.00	0.61	-	0.46	-	-	0.28	-	-	-	-	-	-	-	-	-	-	-	-	-
	3	1.00	0.67	0.80	0.50	-	-	0.31	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/4	1.00	0.72	0.87	0.54	-	0.54	0.33	-	-	-	-	-	-	-	-	-	-	-	-	-
	3-1/2	1.00	0.78	0.93	0.58	-	0.58	0.36	-	-	-	-	-	-	-	-	-	-	-	-	-
	4	1.00	0.89	1.00	0.67	0.76	0.67	0.41	-	-	-	-	-	-	-	-	-	-	-	-	-
	4-1/4	1.00	0.94	1.00	0.71	0.81	0.71	0.44	-	-	0.35	-	-	-	-	-	-	-	-	-	-
	4-1/2	1.00	1.00	1.00	0.75	0.86	0.75	0.46	-	-	0.38	-	-	-	-	-	-	-	-	-	-
	5	1.00	1.00	1.00	0.83	0.95	0.83	0.51	0.78	-	0.42	-	0.53	-	-	-	-	-	-	-	-
	5-1/2	1.00	1.00	1.00	0.92	1.00	0.92	0.56	0.86	0.67	0.46	-	0.59	-	-	-	-	-	-	-	-
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.62	0.94	0.73	0.50	0.80	0.64	0.42	-	-	-	-	-	-	-
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.67	1.00	0.79	0.54	0.87	0.69	0.46	-	-	-	-	-	-	-
	7	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.85	0.58	0.93	0.75	0.49	0.81	0.67	0.44	-	-	-	-
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.77	1.00	0.91	0.63	1.00	0.80	0.53	0.87	0.71	0.48	-	-	-	-
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00	0.97	0.67	1.00	0.85	0.56	0.93	0.76	0.51	0.79	0.61	0.39	-
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.71	1.00	0.91	0.60	0.99	0.81	0.54	0.84	0.65	0.41	-
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.75	1.00	0.96	0.63	1.00	0.86	0.57	0.89	0.69	0.44	-
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.79	1.00	1.00	0.67	1.00	0.90	0.60	0.94	0.72	0.46	-
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83	1.00	1.00	0.70	1.00	0.95	0.63	0.99	0.76	0.48	0.76
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.74	1.00	1.00	0.67	1.00	0.80	0.51	0.80
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.77	1.00	1.00	0.70	1.00	0.84	0.53	0.84
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.81	1.00	1.00	0.73	1.00	0.88	0.56	0.88
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.76	1.00	0.91	0.58	0.91
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.79	1.00	0.95	0.61	0.95
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.83	1.00	0.99	0.63	0.99
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.86	1.00	1.00	0.65	1.00
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.89	1.00	1.00	0.68	1.00
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.70	1.00
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.73	1.00
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	0.75	1.00
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80	1.00
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.82	1.00
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85	1.00
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00
	21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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

CODE LISTED
ICC-ES ESR-2966



Nominal Anchor Diameter d in.	Installation Torque T _{inst} ft-lbf (N-m)	Min. Embed. Depth h _{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Grout-Filled Concrete Masonry			
					f'm = 1,500 psi		f'm = 2,000 psi	
					Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	20 (27)	2-3/8 (60)	4 (102)	4 (102)	2,225 (10.0)	445 (2.0)	2,670 (12.0)	535 (2.4)
1/2	40 (54)	2-1/2 (64)	4 (102)	4 (102)	2,650 (11.9)	530 (2.4)	3,180 (14.3)	635 (2.9)
5/8	50 (68)	3-3/8 (86)	4 (102)	4 (102)	3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)
3/4	80 (108)	3-3/8 (86)	12 (305)	12 (305)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
			20 (508)	20 (508)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
		4-3/4 (121)	12 (305)	12 (305)	7,580 (34.1)	1,515 (6.8)	8,755 (39.4)	1,750 (7.9)



1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr} , between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min} , of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge distance and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.

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

CODE LISTED
ICC-ES ESR-2966



Nominal Anchor Diameter d in.	Installation Torque T _{inst} ft-lbf (N-m)	Min. Embed. Depth h _{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	20 (27)	2-3/8 (60)	4 (102)	4 (102)	Perpendicular or parallel to wall edge or end	2,975 (13.4)	595 (2.7)	3,570 (16.1)	715 (3.2)
1/2	40 (54)	2-1/2 (64)	4 (102)	12 (305)	Perpendicular or parallel to wall edge or end	2,800 (12.6)	560 (2.5)	3,360 (15.1)	670 (3.0)
			12 (305)	4 (102)	Parallel to wall end	4,025 (18.1)	805 (3.6)	4,830 (21.7)	965 (4.3)
			4 (102)	12 (305)	Parallel to wall edge				
			4 (102)	4 (102)	Perpendicular or parallel to wall edge or end	3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
5/8	50 (68)	3-3/8 (86)	12 (305)	4 (102)	Parallel to wall end	5,325 (24.0)	1,065 (4.8)	6,390 (28.8)	1,280 (5.8)
			4 (102)	12 (305)	Parallel to wall edge				
			12 (305)	12 (305)	Perpendicular or parallel to wall edge or end	8,850 (39.4)	1,770 (7.9)	9,375 (41.7)	1,875 (8.3)
3/4	80 (108)	3-3/8 (86)	20 (508)	20 (508)		10,200 (45.4)	2,040 (9.1)	10,800 (48.0)	2,160 (9.6)
			12 (305)	12 (305)		12,735 (56.7)	2,545 (11.3)	12,735 (56.7)	2,545 (11.3)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr} , between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min} , of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.

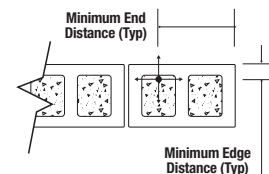
Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in the Tops of Grout Filled Concrete Masonry Walls^{1,2,3,4}
CODE LISTED
 ICC-ES ESR-2966


Nominal Anchor Diameter d in.	Installation Torque T _{inst} ft-lbf (N-m)	Minimum Embed. Depth h _{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Grout-Filled Concrete Masonry			
					f'm = 1,500 psi		f'm = 2,000 psi	
					Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	20 (27)	2-3/8 (60)	1-3/4 (45)	12 (305)	1,475 (6.6)	295 (1.3)	1,770 (8.0)	355 (1.6)
1/2	40 (54)	2-1/2 (64)	2-1/4 (57)		2,225 (9.9)	445 (2.0)	2,575 (11.5)	515 (2.3)
		5 (127)			3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
5/8	50 (68)	3-3/8 (86)	2-1/4 (57)		3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)
		6-1/4 (159)			3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)

Minimum End Distance (Typ)

Minimum Edge Distance (Typ)

Top of Wall



Top of Wall

1. Tabulated load values are for anchors installed in minimum 6" wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using and applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_c, between anchors of 16 times the anchor diameter.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled the Tops of Concrete Masonry Walls^{1,2,3,4}
CODE LISTED
 ICC-ES ESR-2966


Nominal Anchor Diameter d in.	Installation Torque T _{inst} ft-lbf (N-m)	Minimum Embed. Depth h _{nom} in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	20 (27)	2-3/8 (60)	1-3/4 (45)	12 (305)	Perpendicular to wall toward minimum edge	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
					Parallel to wall edge	2,425 (10.9)	485 (2.2)	2,910 (13.1)	580 (2.6)
1/2	40 (54)	2-1/2 (64)	2-1/4 (57)	12 (305)	Any	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		Perpendicular to wall toward minimum edge			1,400 (6.3)	280 (1.3)	1,680 (7.6)	325 (1.5)	
		Parallel to wall edge			2,825 12.7	565 (2.5)	3,390 (15.3)	680 (3.1)	
		Any			1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)	
5/8	50 (68)	3-3/8 (86)	2-1/4 (57)	12 (305)	Perpendicular to wall toward minimum edge	1,700 (7.7)	340 (1.5)	2,040 (9.2)	410 (1.8)
		Parallel to wall edge			3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)	
		6-1/4 (159)			Any	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C90. Mortar must be Type N, S or M. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_c, between anchors of 16 times the anchor diameter.

LIMIT STATES INFORMATION

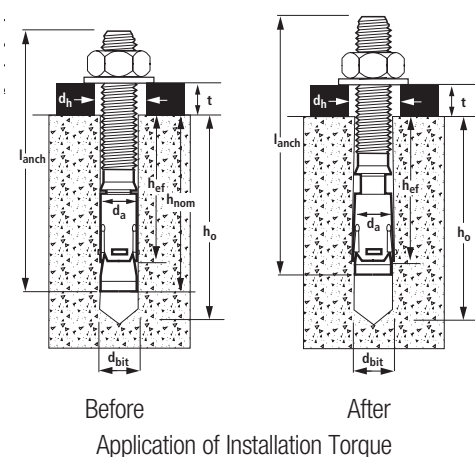
Power-Stud+ SD1 Anchor Installation Specifications in Concrete

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

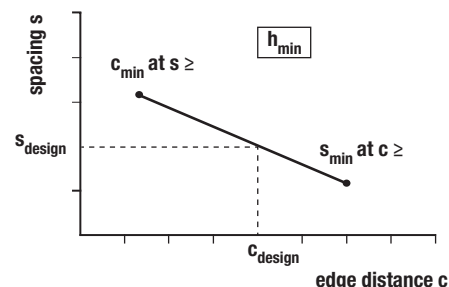
For SI: 1 inch = 25.4 mm, 1 ft.-lbf = 1.356 N-m.

- The information presented in this table is to be used in conjunction with the design criteria of ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D and CSA A23.3 (-19, -14), as applicable.
- The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, nut height and washer thickness, and consideration of a possible fixture attachment.
- The 1/4-inch-diameter (6.4 mm) anchors may be installed in the topside of uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table. The 3/8-inch (9.5 mm) anchors may be installed in the topside of cracked and uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table under Anchors Installed in Concrete Construction.
- For installations in the topside of concrete-filled steel deck assemblies, see the installation detail in Figure 1.
- For installations through the soffit of steel deck assemblies into concrete, see the installation details in Figures 2A and 2B. In accordance with the figures, anchors shall have an axial spacing along the flute equal to the greater of 3h_{ef} or 1.5 times the flute width.
- For installation of 5/8-inch diameter anchors through the soffit of the steel deck into concrete, the installation torque is 50 ft.-lbf. For installation of 3/4-inch-diameter anchors through the soffit of the steel deck into concrete, installation torque is 80 ft.-lbf.
- Anchors with the following minimum lengths are also suitable for installations without a fixture or for use with cold-formed steel members provided the thickness of the fixture attachment does not exceed 20 gauge (0.036-inch base metal thickness):
For 3/8-inch-diameter anchors with a 2-3/8-inch nominal embedment, 2-3/4-inch long anchors.
For 3/4-inch-diameter anchors with a 4-inch nominal embedment, 4-3/4-inch long anchors.

Power-Stud+ SD1 Anchor Detail

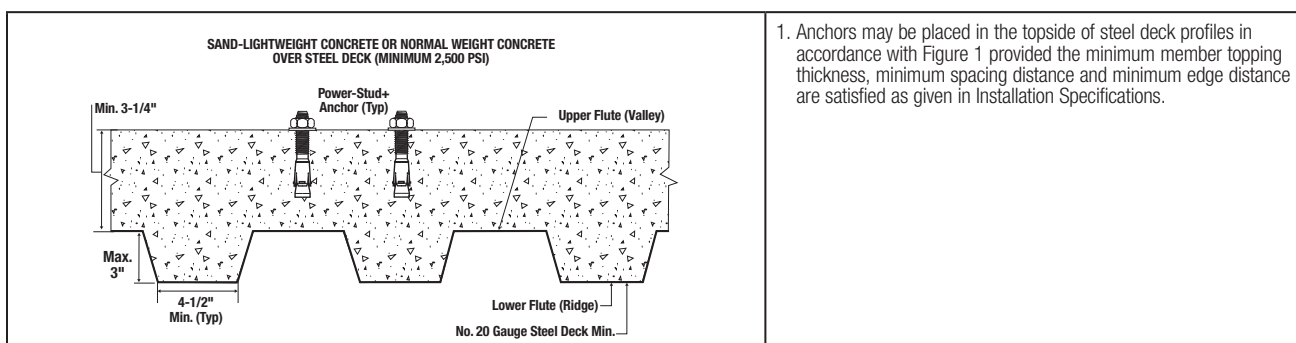


Interpolation of Minimum Edge Distance and Anchor Spacing



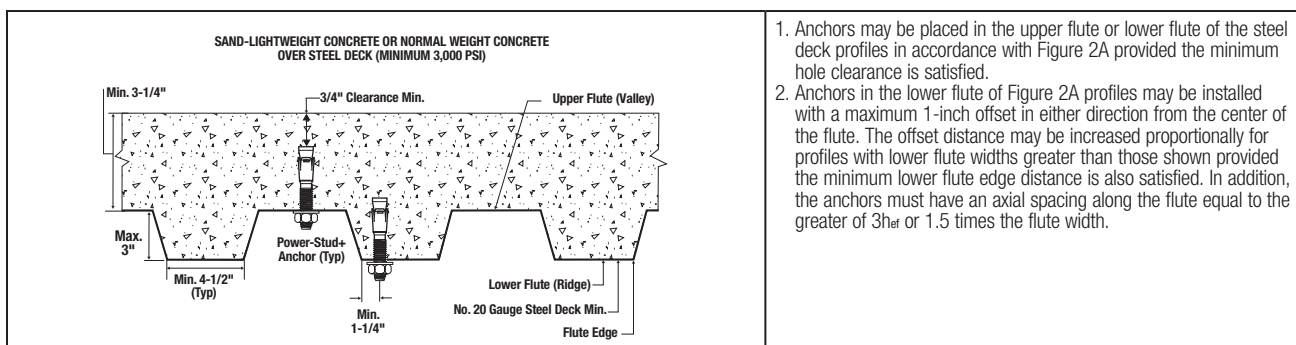
This interpolation applies to the cases when two sets of minimum edge distances, c_{min} , and minimum spacing distances, s_{min} , are given for a selected anchor diameter effective embedment depth, h_{ef} , and corresponding minimum member thickness, h_{min} .

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



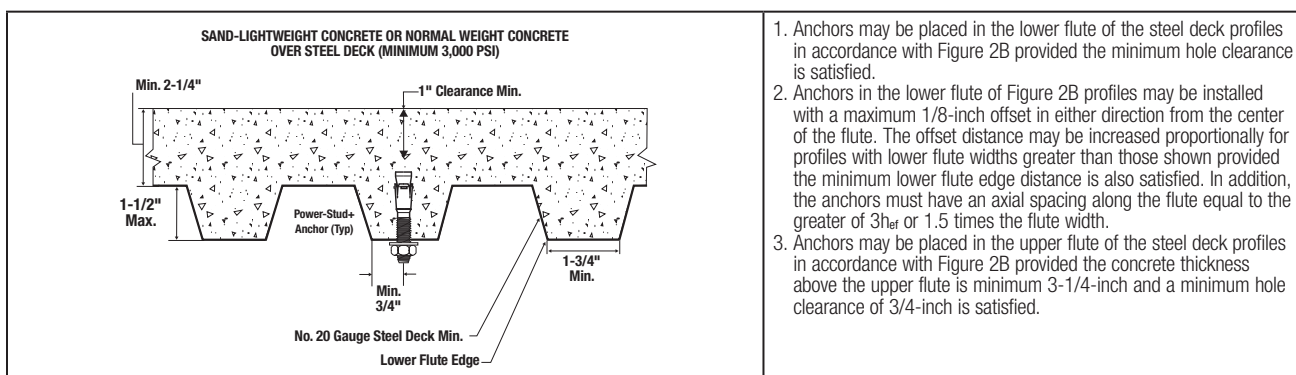
1. Anchors may be placed in the topside of steel deck profiles in accordance with Figure 1 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Installation Specifications.

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



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

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



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

Tension Design Information for Power-Stud+ SD1 Anchor in Concrete
CODE LISTED
 ICC-ES ELC-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch	5/8 inch	3/4 inch	7/8 inch	1 inch	1-1/4 inch			
Anchor category	1, 2 or 3	-	1	1	1	1	1	1	1	1			
STEEL STRENGTH IN TENSION ¹													
Minimum specified yield strength (neck)	f _{ya}	N/mm ²	606	606	551	551	441	400	400	400			
Minimum specified ultimate tensile strength (neck)	f _{uta}	N/mm ²	758	758	689	689	552	517	517	517			
Effective tensile stress area (neck)	A _{se,N}	mm ²	14.2	34.3	65.7	104.9	150.9	207.5	273.1	484			
Steel strength in tension ⁴	N _{sa}	kN	10.0	24.3	40.4	64.3	84.5	109.0	143.5	250			
Steel embedment material resistance factor for reinforcement	ϕ _s	-	0.85										
Resistance modification factor for steel strength, tension ^{3,4}	R	-	0.80										
CONCRETE BREAKOUT STRENGTH IN TENSION ⁵													
Effective embedment depth	h _{ef}	mm	38	51	51	83	70	102	79	114	89	111	137
Effectiveness factor for uncracked concrete	k _{uncr}	-	10	10	10	10	10	10	10	10	10	10	11
Effectiveness factor for cracked concrete	k _{cr}	-	N/A	7	7	7	7	9	7	9	10	10	10
Modification factor for cracked and uncracked concrete ⁵	Ψ _{c,N}	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Critical edge distance (uncracked concrete only)	C _{ac}	mm	See Table 1										
Material resistance factor for concrete	ϕ _c	-	0.65										
Resistance modification factor for tension, concrete failure modes, Condition B ³	R	-	1.0										
PULLOUT STRENGTH IN TENSION (NON SEISMIC-APPLICATIONS) ⁶													
Characteristic pullout strength, uncracked concrete (17.2 MPa) ⁶	N _{p,uncr}	kN	See note 7	12.8	14.3	24.6	See note 7	See note 7	See note 7	See note 7	See note 7	See note 7	See note 7
Characteristic pullout strength, cracked concrete (17.2 MPa) ⁶	N _{p,cr}	kN	N/A	9.1	See note 7	11.2	See note 7	19.8	See note 7	See note 7	See note 7	See note 7	50.5
Material resistance factor for concrete	ϕ _c	-	0.65										
Resistance modification factor for tension, pullout strength, Condition B ³	R	-	1.0										
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS ⁶													
Characteristic pullout strength, seismic (17.2 MPa) ^{6,9}	N _{p,eq}	kN	N/A	9.1	See note 7	11.1	See note 7	19.8	See note 7	See note 7	See note 7	See note 7	50.5
Material resistance factor for concrete	ϕ _c	-	0.65										
Resistance modification factor for pullout strength, seismic, Condition B ³	R	-	1.0										

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

- The data in this table is intended to be used with the design provisions of CSA A23.3 (-19, -14, -04) Annex D, as applicable; for anchors resisting seismic load combinations the additional requirements CSA A23.3 (-19, -14, -04) D.4.3, as applicable, must apply.
- Installation must comply with published instructions and details.
- All values of R for use with the load combinations of Division B, Part 4, Section 4.1.3 of the 2020 NBCC, 2015 NBCC or 2010 NBCC, CSA A23.3-19 Annex C, CSA A23.3-14 Annex C or CSA A23.3-04 Annex C, as applicable. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-19 Annex C, CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c), as applicable, is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the strength reduction factors associated with Condition A may be used.
- The Power-Stud+ SD1 is considered a ductile steel element as defined CSA A23.3-19 D.2, CSA A23.3-14 D.2 or CSA A23.3-04 D.2, as applicable. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
- For all design cases use $\Psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
- For all design cases use $\Psi_{c,P} = 1.0$. For the calculation of $N_{p,r}$, see CSA A23.3 (-19, -14, -04) D.6.3.
- Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
- Anchors are permitted to be used in lightweight concrete in accordance with CSA A23.3 (-19, -14, -04) D.4.6.
- Tabulated values for characteristic pullout strength in tension are for seismic applications and based on test results in accordance with ACI 355.2 (Section 9.5), as referenced in CSA Annex D, Section D.4.3.4.

Shear Design Information for Power-Stud+ SD1 Anchor in Concrete
CODE LISTED
 ICC-ES ELC-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter										
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1
STEEL STRENGTH IN SHEAR ¹													
Minimum specified yield strength (threads)	f _{ya}	N/mm ²	482	552	485		485		441		400	400	400
Minimum specified ultimate strength (threads)	f _{uta}	N/mm ²	606	689	607		607		552		517	517	517
Effective tensile stress area (threads)	A _{se,V}	mm ²	20.5	50.0	91.5		145.8		212.4		293.4	384.8	615
Steel strength in shear ⁵	V _{sa}	kN	4.1	13.3	20.6		40.2		47.3	54.8	39.2	48.6	79.0
Resistance modification factor for steel strength, shear ^{3,4}	R	-	0.75										
CONCRETE BREAKOUT STRENGTH IN SHEAR ⁶													
Load bearing length of anchor (h _{ef} or 8d _a , whichever is less)	L _e	mm	38	51	51	83	70	102	79	114	88.9	111	137
Nominal anchor diameter	d _a	mm	6.4	9.5	12.7		15.9		19.1		22.2	25.4	31.8
Resistance modification factor for shear, concrete failure modes, Condition B ³	R	-	1.0										
PRYOUT STRENGTH IN SHEAR ⁸													
Coefficient for prout strength (1.0 for h _{ef} < 2.5 in., 2.0 for h _{ef} ≥ 2.5 in.)	k _{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h _{ef}	mm	38	51	51	83	70	102	79	114	89	111	137
Resistance modification factor for prout strength ⁹	R	-	1.0										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS													
Steel strength in shear, seismic ^{5,7}	V _{sa,eq}	kN	N/A	10.9	17.6		26.7		38.2	42.9	39.2	43.8	79.0
Resistance modification factor for steel strength, shear, seismic ³	R	-	0.75										
For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm ² ; 1 lbf = 0.0044 kN.													
1. The data in this table is intended to be used with the design provisions of CSA A23.3 (-19, -14, -04) Annex D, as applicable; for anchors resisting seismic load combinations the additional requirements CSA A23.3 (-19, -14, -04) D.4.3, as applicable, must apply.													
2. Installation must comply with published instructions and details.													
3. All values of R for use with the load combinations of Division B, Part 4, Section 4.1.3 of the 2020 NBCC, 2015 NBCC or 2010 NBCC, CSA A23.3-19 Annex C, CSA A23.3-14 Annex C or CSA A23.3-04 Annex C, as applicable. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-19 D.5.3(c), CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c), as applicable, is not provided, or where pullout or prout strength governs. For cases where the presence of supplementary reinforcement can be verified, the strength reduction factors associated with Condition A may be used.													
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by CSA A23.3-19 D.2, CSA A23.3-14 D.2 or CSA A23.3-04 D.2, as applicable.													
5. Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation D.31 in CSA A23.3-19, CSA A23.3-14.													
6. Anchors are permitted to be used in lightweight concrete in accordance with CSA A23.3 (-19, -14, -04) D.4.6.													
7. Tabulated values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2 (Section 9.6), as referenced in CSA A23.3-19 Annex D, CSA A23.3-14 Annex D, Section D.4.3.4.													

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Power-Stud+ SD1 in Cracked Concrete^{1,2,3,4,5,6}

Nominal Anchor Size Diameter (in.)	Nominal Embed. h_{nom} (mm)	Minimum Concrete Compressive Strength									
		$f'_c = 17.2$ Mpa		$f'_c = 20.7$ Mpa		$f'_c = 27.6$ Mpa		$f'_c = 41.4$ Mpa		$f'_c = 55.2$ Mpa	
		N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)
1/4	-	-	-	-	-	-	-	-	-	-	-
3/8	60	5.9	6.9	6.5	7.5	7.5	8.5	9.2	8.5	10.58	8.5
1/2	64	6.9	6.9	7.5	7.5	8.7	8.7	10.7	10.7	12.31	12.3
	95	7.3	13.1	8.0	13.1	9.2	13.1	11.3	13.1	13.02	13.1
5/8	86	11.1	12.9	12.1	14.1	14.0	16.3	17.1	19.9	19.79	23.0
	117	12.9	25.1	14.1	25.6	16.3	25.6	19.9	25.6	23.02	25.6
3/4	102	17.1	25.5	18.7	28.0	21.6	30.2	26.5	30.2	30.50	30.2
	143	24.9	33.0	27.2	33.0	31.4	33.0	38.5	33.0	44.42	33.0
7/8	114	20.4	25.0	22.3	25.0	25.8	25.0	31.6	25.0	36.48	25.0
1	140	31.6	31.0	34.6	31.0	39.9	31.0	48.9	31.0	56.45	31.0
1-1/4	165	32.8	50.4	36.0	50.4	41.5	50.4	51.0	50.4	58.71	50.4

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

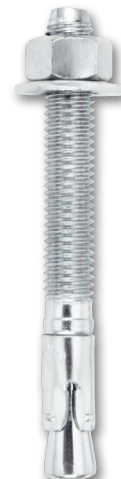
Tension and Shear Design Strengths for Power-Stud+ SD1 in Uncracked Concrete^{1,2,3,4,5,6}

Nominal Anchor Size Diameter (in.)	Nominal Embed. h_{nom} (mm)	Minimum Concrete Compressive Strength									
		$f'_c = 17.2$ Mpa		$f'_c = 20.7$ Mpa		$f'_c = 27.6$ Mpa		$f'_c = 41.4$ Mpa		$f'_c = 55.2$ Mpa	
		N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)	N. Tension (kN)	V. Shear (kN)
1/4	44	6.3	2.6	6.8	2.6	6.8	2.6	6.8	2.6	6.8	2.6
3/8	60	8.3	8.5	9.1	8.5	10.5	8.5	12.9	8.5	14.9	8.5
1/2	64	9.3	9.8	10.2	10.8	11.7	12.4	14.4	13.1	16.6	13.1
	95	16.0	13.1	17.5	13.1	20.2	13.1	24.8	13.1	27.5	13.1
5/8	86	15.8	18.0	17.3	19.7	20.0	22.8	24.5	25.6	28.3	25.6
	117	27.8	25.6	30.5	25.6	35.2	25.6	43.1	25.6	43.7	25.6
3/4	102	19.0	30.2	20.8	30.2	24.0	30.2	29.4	30.2	33.9	30.2
	143	35.5	33.0	38.9	33.0	44.9	33.0	55.0	33.0	57.5	33.0
7/8	114	22.7	25.0	24.8	25.0	28.7	25.0	35.1	25.0	40.5	25.0
1	140	31.6	31.0	34.6	31.0	39.9	31.0	48.9	31.0	56.5	31.0
1-1/4	165	47.6	50.4	52.1	50.4	60.2	50.4	73.7	50.4	85.2	50.4

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

- 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} .
- Calculations were performed according to CSA A23.3-19 Annex D. 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.
- Strength reduction factors (ϕ) were based on CSA A23.3-19 Annex C for load combinations. Condition B is assumed.
- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.
- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with CSA A23.3-19 Annex D.
- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see CSA A23.3-19 Annex D. For other design conditions including seismic considerations please see CSA A23.3-19 Annex D.
- For seismic design in accordance with CSA A23.3, the tabulated tension design strengths in cracked concrete for concrete breakout and pullout strength must be multiplied by a factor of 0.75.

ORDERING INFORMATION



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

Cat. No.	Anchor Size	Approx. Thread Length	Pack Qty.	Carton Qty.	Suggested ANSI Carbide Drill Bit (Cat. No.)				
					Full Head SDS-Plus	SDS-Plus	SDS-Max	Hollow Bit SDS-Plus	Hollow Bit SDS-Max
7400SD1-PWR	1/4" x 1-3/4"	3/4"	100	600	DW5517	DW5416	-	-	-
7402SD1-PWR	1/4" x 2-1/4"	1-1/4"	100	600	DW5517	DW5417	-	-	-
7404SD1-PWR	1/4" x 3-1/4"	2-1/4"	100	600	DW5517	DW5417	-	-	-
7410SD1-PWR	3/8" x 2-1/4"	7/8"	50	300	DW5527	DW5427	-	-	-
7412SD1-PWR	3/8" x 2-3/4"	1-3/8"	50	300	DW5527	DW5427	-	-	-
7413SD1-PWR	3/8" x 3"	1-5/8"	50	300	DW5527	DW5427	-	-	-
7414SD1-PWR	3/8" x 3-1/2"	2-1/8"	50	300	DW5527	DW5427	-	-	-
7415SD1-PWR	3/8" x 3-3/4"	2-3/8"	50	300	DW5527	DW5427	-	-	-
7416SD1-PWR	3/8" x 5"	3-5/8"	50	300	DW55300	DW5429	-	-	-
7417SD1-PWR	3/8" x 7"	5-5/8"	50	300	DW55300	DW5429	-	-	-
7420SD1-PWR	1/2" x 2-3/4"	1"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7422SD1-PWR	1/2" x 3-3/4"	2"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7423SD1-PWR	1/2" x 4-1/2"	2-3/4"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7424SD1-PWR	1/2" x 5-1/2"	3-3/4"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7426SD1-PWR	1/2" x 7"	5-1/4"	25	100	DW5539	DW5438	DW5803	DWA54012	-
7427SD1-PWR	1/2" x 8-1/2"	6-3/4"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7428SD1-PWR	1/2" x 10"	8-1/4"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7430SD1-PWR	5/8" x 3-1/2"	1-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7432SD1-PWR	5/8" x 4-1/2"	2-1/2"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7433SD1-PWR	5/8" x 5"	3"	25	100	-	DW5446	DW5806	DWA54058	DWA54058
7434SD1-PWR	5/8" x 6"	4"	25	75	-	DW5446	DW5806	DWA54058	DWA54058
7436SD1-PWR	5/8" x 7"	5"	25	75	-	DW5447	DW5806	DWA54058	DWA54058
7438SD1-PWR	5/8" x 8-1/2"	6-1/2"	25	50	-	DW5447	DW5809	DWA54058	DWA54058
7439SD1-PWR	5/8" x 10"	8"	25	75	-	DW5447	DW5809	DWA54058	DWA54034
7440SD1-PWR	3/4" x 4-1/4"	1-3/4"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7441SD1-PWR	3/4" x 4-3/4"	2-1/4"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7442SD1-PWR	3/4" x 5-1/2"	3"	20	60	-	DW5453	DW5810	DWA54034	DWA54034
7444SD1-PWR	3/4" x 6-1/4"	3-3/4"	20	60	-	DW5455	DW5810	DWA54034	DWA54034
7446SD1-PWR	3/4" x 7"	4-1/2"	20	60	-	DW5455	DW5810	DWA54034	DWA54034
7448SD1-PWR	3/4" x 8-1/2"	6"	10	40	-	DW5455	DW5812	DWA54034	DWA54034
7449SD1-PWR	3/4" x 10"	7-1/2"	10	30	-	DW5455	DW5812	DWA54034	DWA54034
7451SD1-PWR	3/4" x 12"	9-1/2"	10	30	-	DW5456	DW5812	DWA54034	DWA54034
7450SD1-PWR	7/8" x 6"	2-3/4"	10	20	-	-	DW5815	-	DWA54078
7452SD1-PWR	7/8" x 8"	4-3/4"	10	40	-	-	DW5815	-	DWA54078
7454SD1-PWR	7/8" x 10"	6-3/4"	10	30	-	-	DW5816	-	DWA54078
7461SD1-PWR	1" x 6"	2-3/8"	10	30	-	-	DW5818	-	DWA58001
7463SD1-PWR	1" x 9"	5-3/8"	10	30	-	-	DW5819	-	DWA58001
7465SD1-PWR	1" x 12"	8-3/8"	5	15	-	-	DW5819	-	DWA58001
7473SD1-PWR	1-1/4" x 9"	4-3/4"	5	15	-	-	DW5820	-	-
7475SD1-PWR	1-1/4" x 12"	7-3/4"	5	15	-	-	DW5825	-	-

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design. Anchors not long enough to meet the minimum nominal embedments published for strength design are outside the scope of ICC-ES ESR-2818.

The published size includes the diameter and the overall length of the anchor. Allow for fixture thickness (as applicable) plus one anchor diameter for the nut and washer thickness when selecting a length.

All anchors are packaged with nuts and washers.

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

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

Cat. No.	Anchor Size	Eyelet Hole Size	Pack Qty.	Carton Qty.
7409SD1-PWR	1/4" x 2"	9/32"	100	500

The Tie Wire Power-Stud+ is not listed in ICC-ES ESR-2818.

The minimum nominal embedment is 1-1/8" (see performance data in concrete).

