

**GENERAL INFORMATION**

**POWER-STUD® +SD2**

*Wedge Expansion Anchor*

**PRODUCT DESCRIPTION**

The Power-Stud+ SD2 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, sand-lightweight concrete and concrete over steel deck. The anchor is manufactured with a zinc plated carbon steel body and stainless steel expansion clip for premium performance.

**GENERAL APPLICATIONS AND USES**

- Structural connections, i.e., beam and column anchorage
- Utility and safety-related attachments
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., cable trays and strut, pipe supports, fire sprinklers
- Seismic and wind loading
- Medium to heavy duty purposes

**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-2502 for Concrete, Code Compliant with the 2015, IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, 2009 IRC, 2006 IBC, and 2006 IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318 (Strength Design method using 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)
- FM Global (Factory Mutual) - File No. 3033795, 3/8" and 1/2" diameters  
Pipe hanger components for automatic sprinkler systems
- Underwriters Laboratories (UL Listed) - File No. EX1289 - See listing.

**GUIDE SPECIFICATIONS**

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 09 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD2 as supplied by Powers Fasteners, Inc., Brewster, NY. 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 A 563, Grade A
Washer	Carbon Steel, ASTM F 844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	Type 316 Stainless Steel
Plating (anchor body, nut and washer)	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

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POWER-STUD+ SD2 ASSEMBLY

**THREAD VERSION**

- UNC threaded stud

**ANCHOR MATERIALS**

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

**ANCHOR SIZE RANGE (TYP.)**

- 3/8" diameter through 3/4" diameter

**SUITABLE BASE MATERIALS**

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck
- Grouted-filled concrete masonry (CMU)



This Product Available In



Powers Design Assist®  
 Real-Time Anchor Design Software  
[www.powersdesignassist.com](http://www.powersdesignassist.com)

**INSTALLATION SPECIFICATIONS**

**Installation Table for Power-Stud+ SD2<sup>4</sup>**

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size							
			3/8"		1/2"		5/8"		3/4"	
Anchor diameter	d <sub>a</sub>	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 <sub>h</sub>	in. (mm)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter	d <sub>bit</sub>	in.	3/8 ANSI		1/2 ANSI		5/8 ANSI		3/4 ANSI	
Minimum nominal embedment depth <sup>1</sup>	h <sub>nom</sub>	in. (mm)	2-3/8 (60)		2-1/2 (64)		3-3/4 (95)		3-7/8 (98)	
Effective embedment	h <sub>ef</sub>	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		4-1/4 (108)	
Minimum hole depth <sup>2</sup>	h <sub>o</sub>	in. (mm)	2-5/8 (67)		2-3/4 (70)		4 (102)		4-1/4 (108)	
Minimum concrete member thickness	h <sub>min</sub>	in. (mm)	4 (102)		4-1/2 (114)		6 (152)		5-3/4 (146)	
Minimum overall anchor length <sup>3</sup>	ℓ <sub>anch</sub>	in. (mm)	3 (76.2)		3-3/4 (95)		4-1/2 (114)		4-3/4 (121)	
Minimum edge distance <sup>2</sup>	c <sub>min</sub>	in. (mm)	2-1/2 (63.5)		4 (102)		2-3/4 (70)		4-1/4 (108)	
Minimum spacing distance <sup>2</sup>	s <sub>min</sub>	in. (mm)	3-1/2 (88.9)		6 (152)		6 (152)		4-1/4 (108)	
Critical edge distance <sup>2</sup>	c <sub>ac</sub>	in. (mm)	6-1/2 (165.1)		8 (203)		10 (254)		8 (203)	
Installation torque	T <sub>inst</sub>	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.

- The embedment depth, h<sub>nom</sub>, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- For installations through the soffit of steel deck into concrete see the installation details in Figure A, B, and C. In addition, anchors shall have an axial spacing along the flute equal to the greater of 3h<sub>ef</sub> or 1.5 times the flute width. The hole diameter in the steel deck must not exceed the hole diameter in the concrete by more than 1/8-inch (3.2 mm).
- 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.
- The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with the installation specifications and design information provided the concrete thickness above the upper flute meets the minimum thicknesses specified in the tables; see Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies table and installation detail D.

**Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies<sup>3,4</sup>**

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			3/8"		1/2"	
Nominal drill bit diameter	d <sub>bit</sub>	in.	3/8 ANSI		1/2 ANSI	
Minimum nominal embedment depth <sup>1</sup>	h <sub>nom</sub>	in. (mm)	2-3/8 (60)		2-1/2 (64)	
Effective embedment	h <sub>ef</sub>	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness <sup>2</sup>	h <sub>min,deck</sub>	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Critical edge distance	c <sub>ac,deck,top</sub>	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	c <sub>min,deck,top</sub>	in. (mm)	4 (102)		2-3/4 (70)	
Minimum spacing distance	s <sub>min,deck,top</sub>	in. (mm)	3-1/2 (89)		6 (152)	
Minimum hole depth	h <sub>o</sub>	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Installation torque	T <sub>inst</sub>	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench socket size	-	in.	9/16		3/4	
Nut height	-	in.	21/64		7/16	

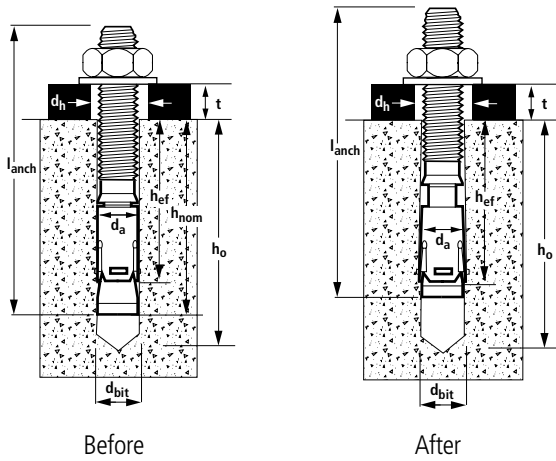
For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

- The embedment depth, h<sub>nom</sub>, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies 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 Installation Detail D.
- For all other anchor diameters and embedment depths, refer to the installation table for applicable values of h<sub>min</sub>, c<sub>min</sub> and s<sub>min</sub>.
- Design capacities shall be based on calculations according to values in Tension and Shear Design Information for Anchors in Concrete tables.

**MECHANICAL ANCHORS**

**POWER-STUD® +SD2**  
Wedge Expansion Anchor

**Power-Stud+ SD2 Anchor Detail**



**Head Marking**



**Legend**

- Letter Code = Length Identification Mark
- '+' Symbol = Strength Design Compliant Anchor
- Number Code = Carbon Steel Body and Stainless Steel Expansion Clip

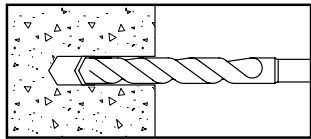
**Length Identification**

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

Length identification mark indicates overall length of anchor.

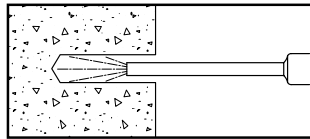
**INSTALLATION INSTRUCTIONS**

**Installation Instructions for Power-Stud+ SD2**



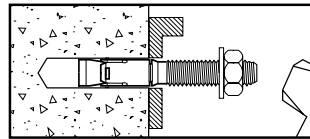
**Step 1**

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.



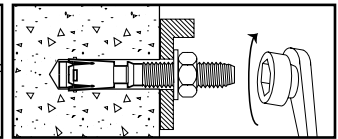
**Step 2**

Remove dust and debris from the hole, using a hand pump, compressed air or a vacuum to remove loose particles left from 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,  $T_{inst}$ .

**Installation Detail A: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)<sup>1</sup>**

1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A 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.

**Installation Detail B: Power-Stud+ SD2 Installed in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)<sup>1</sup>**

1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B 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.

**Installation Detail C: Power-Stud+ SD2 Installed in the Soffit of Concrete over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)<sup>1,2</sup>**

1. Anchors may be placed in the lower flute of the steel deck profiles in accordance with installation Detail C provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail C 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 installation Detail C 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.

**Installation Detail D: Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies (see dimensional profile requirements)<sup>1,2</sup>**

1. Anchors may be placed in the top side of concrete over steel deck profiles in accordance with Detail D provided the minimum concrete thickness above the upper flute (topping thickness) is as illustrated and the minimum spacing distance and minimum edge distances are satisfied as given in Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies Table.
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 Installation Table for the Power-Stud+ SD2, the minimum spacing distance and minimum edge distances may be used from this table, as applicable.

**PERFORMANCE DATA**

**Tension Design Information<sup>1,2,11</sup>**

**CODE LISTED**  
ICC-ES ESR-2502



Design Characteristic	Notation	Units	Nominal Anchor Diameter (inch)							
			3/8	1/2	5/8	3/4		3/4		
Anchor category	1,2 or 3	-	1	1	1	1		1		
<b>STEEL STRENGTH IN TENSION (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)<sup>8</sup></b>										
Minimum specified yield strength (neck)	$f_y$	ksi (N/mm <sup>2</sup> )	96.0 (662)	85.0 (586)	85.0 (586)	85.0 (586)		70.0 (483)		
Minimum specified ultimate tensile strength (neck)	$f_{uta}$	ksi (N/mm <sup>2</sup> )	120.0 (827)	106.0 (731)	106.0 (731)	106.0 (731)		90.0 (620)		
Effective tensile stress area (neck)	$A_{se,N}$	in <sup>2</sup> (mm <sup>2</sup> )	0.0552 (35.6)	0.1007 (65.0)	0.1619 (104.5)	0.2359 (153.2)		0.2359 (153.2)		
Steel strength in tension	$N_{sa}$	lb (kN)	6,625 (29.4)	10,445 (46.5)	13,080 (58.2)	21,230 (94.4)		21,230 (94.4)		
Reduction factor for steel strength <sup>3</sup>	$\phi$	-	0.75							
<b>CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)<sup>8</sup></b>										
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	$k_{ucr}$	-	24	24	24	24		24		
Effectiveness factor for cracked concrete	$k_{cr}$	-	17	17	17	17		17		
Modification factor for cracked and uncracked concrete <sup>5</sup>	$\psi_{c,N}$	-	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)	6-1/2 (165)	8 (203)	10 (254)	8 (203)	10 (254)	12 (305)	12 (305)	
Reduction factor for concrete breakout strength <sup>3</sup>	$\phi$	-	0.65 (Condition B)							
<b>PULLOUT STRENGTH IN TENSION (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)<sup>8</sup></b>										
Characteristic pullout strength, uncracked concrete (2,500 psi) <sup>6</sup>	$N_{p,uncr}$	lb (kN)	2,775 (12.3)	See note 7	6,615 (29.4)	See note 7	See note 7	See note 7	See note 7	
Characteristic pullout strength, cracked concrete (2,500 psi) <sup>6</sup>	$N_{p,cr}$	lb (kN)	2,165 (9.6)	See note 7	4,375 (19.5)	See note 7	See note 7	See note 7	7,795 (35.1)	
Reduction factor for pullout strength <sup>3</sup>	$\phi$	-	0.65 (Condition B)							
<b>PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.5.3.3)<sup>8</sup></b>										
Characteristic pullout strength, seismic (2,500 psi) <sup>6,9</sup>	$N_{p,eq}$	lb (kN)	2,165 (9.6)	See note 7	4,375 (19.5)	See note 7	See note 7	See note 7	7,795 (35.1)	
Reduction factor for pullout strength <sup>3</sup>	$\phi$	-	0.65 (Condition B)							
Mean axial stiffness values service load range	Uncracked concrete	$\beta$	lbf/in (kN/mm)	865,000 (151)	717,00 (126)	569,000 (100)	420,000 (74)		420,000 (74)	
	Cracked concrete	$\beta$	lbf/in (kN/mm)	49,500 (9)	57,000 (10)	64,500 (11)	72,000 (13)		72,000 (13)	

- The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3, as applicable, shall apply.
- Installation must comply with published instructions and details.
- All values of  $\phi$  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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318 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  $\phi$  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.
- The Power-Stud+ SD2 is considered a ductile steel element in tension as defined by ACI 318-14 2.3 or ACI 318 D.1, as applicable. Tabulated values for steel strength in tension are based on test results per ACI 355.2 and must be used for design.
- For all design cases use  $\psi_{c,N} = 1.0$ . Select appropriate effectiveness factor for cracked concrete ( $k_{cr}$ ) or uncracked concrete ( $k_{ucr}$ ).
- For all design cases use  $\psi_{c,P} = 1.0$ . For concrete compressive strength greater than 2,500 psi,  $N_{pn} = (\text{pullout strength value from table}) * (\text{specified concrete compressive strength}/2500)$ . For concrete over steel deck the value of 2500 must be replaced with the value of 3000. For all anchors  $n = 1/2$  with the exception of the 3/8" anchor size for cracked concrete where  $n = 1/3$ .
- 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 sand-lightweight concrete provided that  $N_b$ ,  $N_{eq}$  and  $N_{pn}$  are multiplied by a factor of 0.60 (not required for steel deck).
- Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.
- Mean values shown; actual stiffness varies considerable depending on concrete strength, loading and geometry of application.
- Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.

**MECHANICAL ANCHORS**

**POWER-STUD<sup>®</sup> +SD2**

Wedge Expansion Anchor

**Shear Design Information<sup>1,2,8</sup>**

**CODE LISTED**  
ICC-ES ESR-2502



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			
<b>STEEL STRENGTH IN SHEAR (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)<sup>6</sup></b>									
Minimum specified yield strength (threads)	$f_y$	ksi (N/mm <sup>2</sup> )	76.8 (530)	68.0 (469)	68.0 (469)	56.0 (386)			
Minimum specified ultimate tensile strength (threads)	$f_{uta}$	ksi (N/mm <sup>2</sup> )	100.0 (690)	88.0 (607)	88.0 (607)	80.0 (551)			
Effective tensile stress area (threads)	$A_{se, v}$	in <sup>2</sup> (mm <sup>2</sup> )	0.0775 (50.0)	0.1419 (65.7)	0.2260 (104.9)	0.3345 (215.8)			
Steel strength in shear <sup>5</sup>	$V_{sa}$	lb (kN)	3,115 (13.9)	4,815 (21.4)	10,170 (45.2)	12,610 (56.1)			
Reduction factor for steel strength <sup>3</sup>	$\phi$	-	0.65						
<b>CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)<sup>6</sup></b>									
Load bearing length of anchor ( $h_{ef}$ or $8d_o$ , whichever is less)	$\ell_e$	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 concrete breakout strength <sup>3</sup>	$\phi$	-	0.70 (Condition B)						
<b>PRYOUT STRENGTH IN SHEAR (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)<sup>6</sup></b>									
Coefficient for prout 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
Characteristic pullout strength, cracked concrete (2,500 psi) <sup>6</sup>	$h_{ef}$	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 pullout strength <sup>3</sup>	$\phi$	-	0.70 (Condition B)						
<b>STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)</b>									
Steel Strength in shear, seismic <sup>7</sup>	$V_{sa, eq}$	lb (kN)	2,460 (11.0)	4,815 (21.4)	6,770 (30.1)	8,060 (35.9)			
Reduction factor for pullout strength <sup>3</sup>	$\phi$	-	0.65 (Condition B)						

- The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318 D.3.3 shall apply, as applicable.
- Installation must comply with published instructions and details.
- All values of  $\phi$  were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of  $\phi$  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  $\phi$  factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318 Section 9.2 are used.
- 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.
- Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and shall be used for design.
- Anchors are permitted to be used in sand-lightweight concrete provided that  $V_b$  and  $V_{cp}$  are multiplied by a factor of 0.60 (not required for steel deck).
- Reported values for steel strength in shear for seismic applications are based on test results per ACI 355.2, Section 9.6.
- Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see installation details A, B, C and D.

**MECHANICAL ANCHORS**

**POWER-STUD® +SD2**  
Wedge Expansion Anchor

**Tension and Shear Design Data for Power-Stud+ SD2 Anchors in the Soffit of Concrete-Filled Steel Deck Assemblies<sup>1,2,7</sup>**

**CODE LISTED**  
ICC-ES ESR-2502

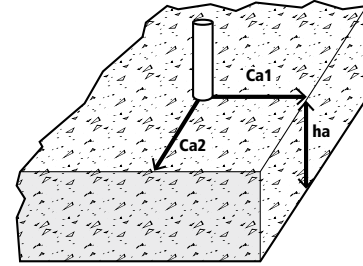


Design Characteristics		Notation	Units	Nominal Anchor Size (inch)					
				0.375	0.5	0.625	0.75		
Anchor Category		1, 2 or 3	-	1	1	1	1		
Effective Embedment		$h_{ef}$	in. (mm)	2.00 (51)	2.00 (51)   3.25 (83)	3.25 (83)   4.25 (108)	3.75 (95)		
<b>PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK<sup>1</sup></b>									
According to Detail A 4-1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck <sup>2</sup>	$N_{p,deck,uncr}$	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 <sup>2,3</sup>	$N_{p,deck,cr}$	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 Detail B 3-7/8-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck <sup>2</sup>	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck <sup>2,3</sup>	$N_{p,deck,cr}$	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	Not Applicable	Not Applicable	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck <sup>2</sup>	$N_{p,deck,uncr}$	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 <sup>2,3</sup>	$N_{p,deck,cr}$	lbf (kN)	1,250 (5.6)	1,435 (6.4)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for pullout strength <sup>4</sup>		$\phi$	-	0.65					
<b>STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK<sup>4,5</sup></b>									
According to Detail A 4-1/2-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	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	$V_{sa,deck,eq}$	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 Detail B 3-7/8-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lbf (kN)	3,040 (13.5)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
	Steel strength in shear, seismic, concrete over steel deck	$V_{sa,deck,eq}$	lbf (kN)	2,400 (10.6)	2,675 (11.9)	4,930 (21.9)	Not Applicable	Not Applicable	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	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	$V_{sa,deck,eq}$	lbf (kN)	1,715 (7.6)	2,880 (12.8)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for steel strength in shear, concrete over steel deck <sup>6</sup>		$\phi$	-	0.65					

- For all design cases  $\Psi_{c,p} = 1.0$ . For concrete compressive strength greater than 3,000 psi,  $N_{pn} = (\text{pullout strength value from table}) * (\text{specified concrete compressive strength}/2500)^n$ . For all anchors  $n=1/2$  with exception of the 3/8-inch-diameter anchor size, where  $n=1/3$ .
- 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 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).
- Values for  $N_{p,deck,cr}$  are applicable for seismic loading.
- Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
- 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 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).
- All values of  $\phi$  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  $\phi$  must be determined in accordance with ACI 318-11 D.4.4.
- Anchors shall have an axial spacing along the flute soffit equal to the greater of  $3h_{ef}$  or 1.5 times the flute width.

**Factored Design Strength ( $\phi N_n$  and  $\phi V_n$ ) Calculated in Accordance with ACI 318 Appendix D:**

- 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 318-11 Appendix 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.
- 3- Strength reduction factors ( $\phi$ ) were based on ACI 318 Section 9.2 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 Appendix D.
- 6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 Appendix D. For other design conditions including seismic considerations please see ACI 318 Appendix D.



**MECHANICAL ANCHORS**

**POWER-STUD® +SD2**  
Wedge Expansion Anchor

**Tension and Shear Design Strengths for Power-Stud+ SD2 in Cracked Concrete**

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	
		$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)
3/8	2-3/8	1,405	1,685	1,495	1,845	1,645	2,025	1,885	2,025	2,075	2,025
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,010
	3-3/4	2,845	3,130	3,115	3,130	3,595	3,130	4,405	3,130	5,085	3,130
5/8	3-7/8	3,235	4,220	3,545	4,620	4,095	5,335	5,015	6,535	5,790	6,610
	4-7/8	4,840	6,610	5,305	6,610	6,125	6,610	7,500	6,610	8,660	6,610
3/4	4-1/2	4,010	7,590	4,395	8,195	5,075	8,195	6,215	8,195	7,175	8,195
	5-3/4	5,065	8,195	5,550	8,195	6,410	8,195	7,850	8,195	9,065	8,195

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

**Tension and Shear Design Strengths for Power-Stud+ SD2 in Uncracked Concrete**

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	
		$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)	$\phi N_n$ Tension (lbs.)	$\phi V_n$ Shear (lbs.)
3/8	2-3/8	1,805	2,025	1,975	2,025	2,280	2,025	2,795	2,025	3,225	2,025
1/2	2-1/2	2,205	2,375	2,415	2,605	2,790	3,005	3,420	3,130	3,945	3,130
	3-3/4	4,300	3,130	4,710	3,130	5,440	3,130	6,660	3,130	7,690	3,130
5/8	3-7/8	4,570	5,905	5,005	6,470	5,780	6,610	7,080	6,610	8,175	6,610
	4-7/8	6,835	6,610	7,485	6,610	8,645	6,610	9,810	6,610	9,810	6,610
3/4	4-1/2	5,665	8,195	6,205	8,195	7,165	8,195	8,775	8,195	10,130	8,195
	5-3/4	8,720	8,195	9,555	8,195	11,030	8,195	13,510	8,195	15,600	8,195

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

Factored design strengths may be converted to allowable loads using an appropriate conversion factor,  $\phi$ , for the controlling load combination. See ICC-ES ESR-2502 or contact Powers for more information regarding the procedure to convert factored design strengths to allowable loads.





**Converted Allowable Loads for Power-Stud+ SD2 in Cracked Concrete<sup>1,2</sup>**

Nominal Anchor Size (in.)	Nominal Embed. h <sub>nom</sub> (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	
		T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)
3/8	2-3/8	1,005	1,205	1,070	1,320	1,175	1,445	1,345	1,445	1,480	1,445
1/2	2-1/2	1,120	1,205	1,220	1,320	1,410	1,520	1,730	1,860	1,995	2,150
	3-3/4	2,030	2,235	2,225	2,235	2,570	2,235	3,145	2,235	3,630	2,235
5/8	3-7/8	2,310	3,015	2,530	3,300	2,925	3,810	3,580	4,670	4,135	4,720
	4-7/8	3,455	4,720	3,790	4,720	4,375	4,720	5,355	4,720	6,185	4,720
3/4	4-1/2	2,865	5,420	3,140	5,855	3,625	5,855	4,440	5,855	5,125	5,855
	5-3/4	3,620	5,855	3,965	5,855	4,580	5,855	5,605	5,855	6,475	5,855

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α: 1.2(0.5) + 1.6(0.5) = 1.4.

**Converted Allowable Loads for Power-Stud+ SD2 in Uncracked Concrete<sup>1,2</sup>**

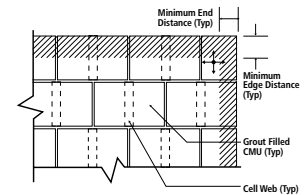
Nominal Anchor Size (in.)	Nominal Embed. h <sub>nom</sub> (in.)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi		f'c = 3,000 psi		f'c = 4,000 psi		f'c = 6,000 psi		f'c = 8,000 psi	
		T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)	T <sub>allowable,ASD</sub> Tension (lbs.)	V <sub>allowable,ASD</sub> Shear (lbs.)
3/8	2-3/8	1,290	1,445	1,410	1,445	1,630	1,445	1,995	1,445	2,305	1,445
1/2	2-1/2	1,575	1,695	1,725	1,860	1,995	2,145	2,445	2,235	2,820	2,235
	3-3/4	3,070	2,235	3,365	2,235	3,885	2,235	4,755	2,235	5,495	2,235
5/8	3-7/8	3,265	4,220	3,575	4,620	4,130	4,720	5,055	4,720	5,840	4,720
	4-7/8	4,880	4,720	5,345	4,720	6,175	4,720	7,005	4,720	7,005	4,720
3/4	4-1/2	4,045	5,855	4,430	5,855	5,120	5,855	6,270	5,855	7,235	5,855
	5-3/4	6,230	5,855	6,825	5,855	7,880	5,855	9,650	5,855	11,145	5,855

1. Allowable load values are calculated using a conversion factor, α, from Factored Design Strengths and conditions shown on the previous page.
2. Tabulated allowable load values assume 50% dead load and 50% live load, with controlling load combination 1.2D + 1.6L. Calculated weighted average for the conversion factor, α: 1.2(0.5) + 1.6(0.5) = 1.4.

**Ultimate and Allowable Load Capacities for Power-Stud+ SD2 in Grouted Filled Concrete Masonry<sup>1,2,3</sup>**



Nominal Anchor Size (mm)	Minimum Embedment Depth (mm)	Installation Location <sup>3</sup>	Minimum Masonry Compressive Strength, f'm = 1,500 psi (10.4 MPa)			
			Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8 (9.5)	2-1/2 (50.8)	Wall Face/End Min. 2-1/2" Edge and End Distances	1,670 (7.4)	335 (1.5)	2,075 (9.2)	415 (1.8)
1/2 (12.7)	2-1/2 (50.8)	Wall Face/End Min. 3" Edge and End Distances	2,295 (10.2)	460 (2.0)	1,310 (5.8)	260 (1.2)
	3-3/4 (95.3)	Top of Wall Min. 1-3/4" Edge and 4" Edge Distances	3,320 (14.8)	665 (3.0)	1,140 (5.1)	230 (1.0)



**Face Shell**  
Permissible Anchor Locations  
(Un-hatched Area / Through Face Shell)

1. Tabulated load values are for anchors installed in minimum 6-inch wide, minimum Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at the specified minimum at the time of installation.
2. Allowable load capacities listed are calculated using 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. Anchor installations into grouted masonry walls are limited to one per masonry cell.

**ORDERING INFORMATION**

**Power-Stud+ SD2 (Carbon Steel Body with Stainless Steel Expansion Clip)**

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt. /100 (lbs.)	ANSI Carbide Drill Bit Cat. No.				
						SDS-Plus		SDS-Max	Spline	
						Fathead	SDS-Plus/S-4 Plus	4-X Cutter SDS-Max	4-X Cutter Head Spline	Single Tip Spline
7413SD2	3/8" x 3"	1-3/4"	50	300	10	00727	00333			01401
7414SD2	3/8" x 3-1/2"	2-1/4"	50	300	12	00727	00333			01402
7415SD2	3/8" x 3-3/4"	2-1/2"	50	300	13	00727	00333			01402
7416SD2	3/8" x 5"	3-3/4"	50	300	16	00729	00334			01402
7422SD2	1/2" x 3-3/4"	2-1/8"	50	200	23	00739	00346	08801		01407
7423SD2	1/2" x 4-1/2"	2-7/8"	50	200	28	00741	00348	08801		01407
7424SD2	1/2" x 5-1/2"	3-7/8"	50	150	32	00741	00348	08801		01408
7426SD2	1/2" x 7"	5-3/8"	25	100	44	00741	00348	08801		01408
7427SD2	1/2" x 8-1/2"	6-7/8"	25	100	46	00741	00349	08802		01409
7435SD2	5/8" x 4-3/4"	2-7/8"	25	100	52		00359	08809	07017	01418
7433SD2	5/8" x 5"	3-1/8"	25	50	57		00359	08809	07017	01419
7434SD2	5/8" x 6"	4-1/8"	25	75	64		00359	08809	07020	01419
7436SD2	5/8" x 7"	5-1/8"	25	75	72		00361	08809	07020	01419
7438SD2	5/8" x 8-1/2"	6-5/8"	25	75	84		00361	08810	07020	01420
7442SD2	3/4" x 5-1/2"	3-1/4"	20	60	88		00368	08817	07031	01433
7444SD2	3/4" x 6-1/4"	4"	20	60	90		00370	08817	07033	01433
7446SD2	3/4" x 7"	4-3/4"	20	60	95		00370	08817	07033	01433
7448SD2	3/4" x 8-1/2"	6-1/4"	10	40	95		00370	08818	07033	01433

The published size includes the diameter and the overall length of the anchor.  
All anchors are packaged with nuts and washers.



**Installation Accessories**

Cat. No.	Description	Box Qty
08466	Adjustable torque wrench with 1/2" square drive (25 to 250 ft.-lbs.)	1
08280	Hand pump / dust blower	1



**MECHANICAL ANCHORS**

**POWER-STUD® +SD2**  
Wedge Expansion Anchor