

GENERAL INFORMATION

POWER-STUD® + SD2

High Performance 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, 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
- Interior applications / low level corrosion environment
- Tension zone applications, i.e., safety-related attachments
- Seismic and wind loading (SDC A - F)
- Utility supports, e.g. pipe, strut, trapeze, bracing
- Equipment anchorage, angles, brackets and ledgers
- Barriers, guards and fencing
- Mezzanines, racking and railing

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 cracked and uncracked concrete
- 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 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)
- City of Los Angeles, LABC and LARC Supplement (within ESR-2502)
- Florida Building Code, FBC Supplement including HVHZ (within ESR-2502)
- FM Approvals (Factory Mutual) – see FM Approval Guide for sizes
- Underwriters Laboratory (UL Listed) – File No. EX1289 and VFXT7.EX1289, see listing for sizes

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 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)	316 Stainless Steel
Plating (anchor body, nut and washer)	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+ 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" through 3/4" diameters

SUITABLE BASE MATERIALS

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



INSTALLATION SPECIFICATIONS

Installation Table for Power-Stud+ SD2

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size							
			3/8"		1/2"		5/8"		3/4"	
Anchor diameter	d _a	in. (mm)	0.375 (9.5)		0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	
Minimum diameter of hole clearance in fixture	d _h	in. (mm)	7/16 (11.1)		9/16 (14.3)		11/16 (17.5)		13/16 (20.6)	
Nominal drill bit diameter (ANSI)	d _{bit}	in.	3/8		1/2		5/8		3/4	
Minimum nominal embedment depth ¹	h _{nom}	in. (mm)	2-3/8 (60)		2-1/2 (64)		3-3/4 (95)		3-7/8 (98)	
Effective embedment	h _{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/4 (83)	
Minimum hole depth ²	h _o	in. (mm)	2-5/8 (67)		2-3/4 (70)		4 (102)		4-1/4 (108)	
Minimum concrete member thickness	h _{min}	in. (mm)	4 (102)		4-1/2 (114) 6 (152)		5-3/4 (146)		5-3/4 (146) 6-1/2 (165) 8 (203)	
Minimum overall anchor length ³	ℓ _{anch}	in.	3		3-3/4		4-1/2		4-3/4	
Minimum edge distance ²	c _{min}	in. (mm)	2-1/2 (64)		4 (102) 2-3/4 (70)		4 (102) 2-3/4 (70)		4-1/4 (108)	
Minimum spacing distance ²	s _{min}	in. (mm)	3-1/2 (89)		6 (152) 6 (152)		4 (102) 6 (152)		4-1/4 (108)	
Critical edge distance ² (uncracked concrete only)	c _{ac}	in. (mm)	6-1/2 (165)		8 (203)		10 (254)		8 (203) 15-3/4 (400) 10 (254)	
Installation torque	T _{inst}	ft.-lb. (N-m)	20 (27)		40 (54)		60 (81)		110 (149)	
Torque wrench socket size	-	in.	9/16		3/4		15/16		1-1/8	
Nut height	-	in.	21/64		7/16		35/64		41/64	
Washer O.D.	-	in.	13/16		1-1/16		1-5/16		1-15/32	

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

- The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- 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_a or 1.5 times the flute width.
- 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.

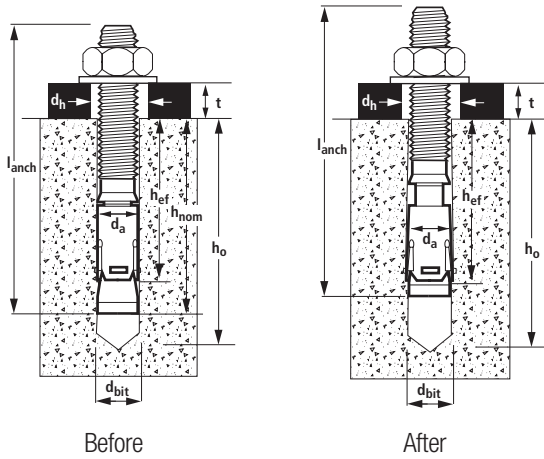
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies^{3,4}

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			3/8"		1/2"	
Nominal drill bit diameter (ANSI)	d _{bit}	in.	3/8		1/2	
Minimum nominal embedment depth ¹	h _{nom}	in. (mm)	2-3/8 (60)		2-1/2 (64)	
Effective embedment	h _{ef}	in. (mm)	2.00 (51)		2.00 (51)	
Minimum concrete member thickness ²	h _{min,deck}	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Critical edge distance for topside of concrete-filled steel deck assemblies with minimum topping thickness (uncracked concrete only)	c _{ac,deck,top}	in. (mm)	8 (203)		9 (229)	
Minimum edge distance	c _{min,deck,top}	in. (mm)	4 (102)		4 (102) 8 (203)	
Minimum spacing distance	s _{min,deck,top}	in. (mm)	3-1/2 (89)		6 (152) 8 (203) 4 (102)	
Minimum hole depth	h _o	in. (mm)	2-1/2 (64)		2-1/2 (64)	
Installation torque	T _{inst}	ft.-lb. (N-m)	20 (27)		40 (54)	
Torque wrench socket size	-	in.	9/16		3/4	
Nut height	-	in.	21/64		7/16	
Washer O.D.	-	in.	13/16		1-1/16	

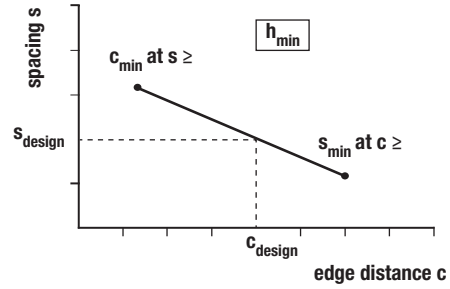
For St: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

- The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
- 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_{min}, c_{min} and s_{min}.
- Design capacities shall be based on calculations according to values in Tension Design Information and Shear Design Information tables.

Power-Stud+ SD2 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_{eff} , and corresponding minimum member thickness, h_{min} .

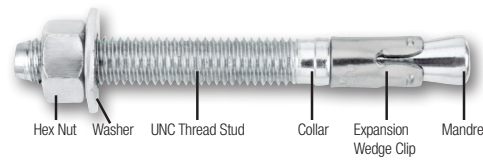
Head Marking



Legend

- Letter Code = Length Identification Mark
- '+' Symbol = Strength Design Compliant Anchor
- Number Code 2 = Carbon Steel Body and Stainless Steel Expansion Clip

Power-Stud+ SD2 Anchor Assembly



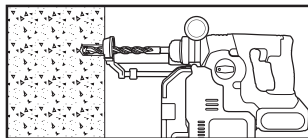
Length Identification

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.

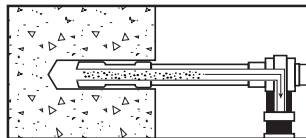
INSTALLATION INSTRUCTIONS

Installation Instructions for Power-Stud+ SD2



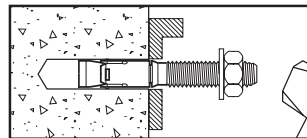
Step 1

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.



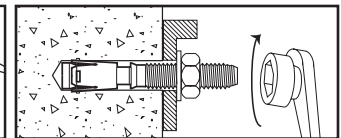
Step 2

Remove dust and debris from the hole 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

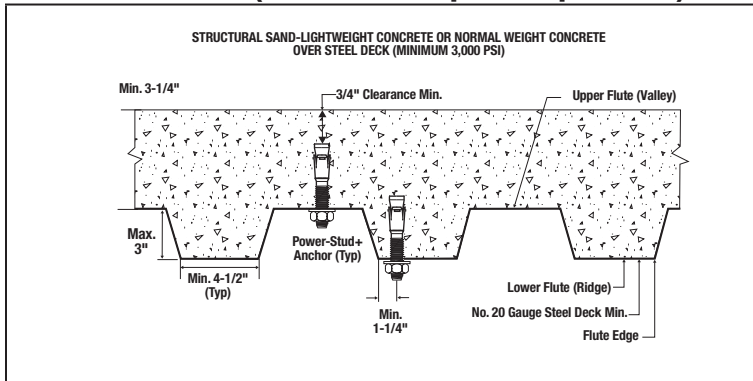
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom} .



Step 4

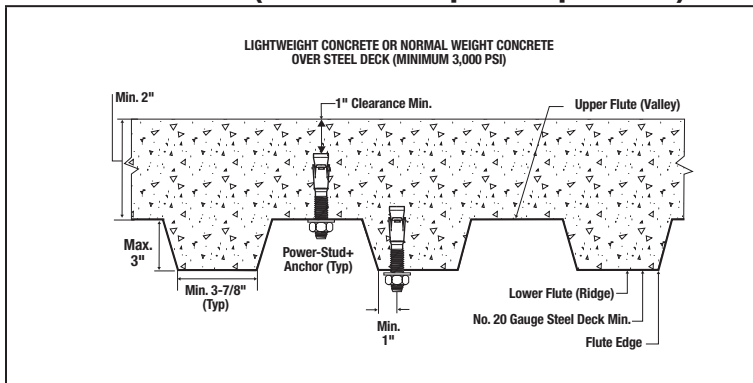
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst} .

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



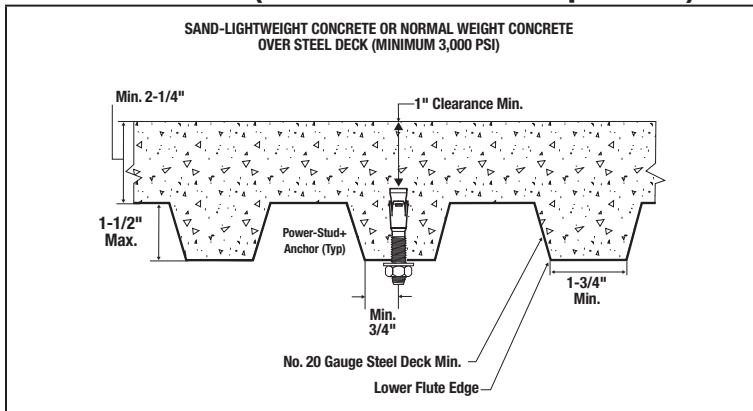
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A profiles may be installed with a maximum 1-inch offset in either direction 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)¹



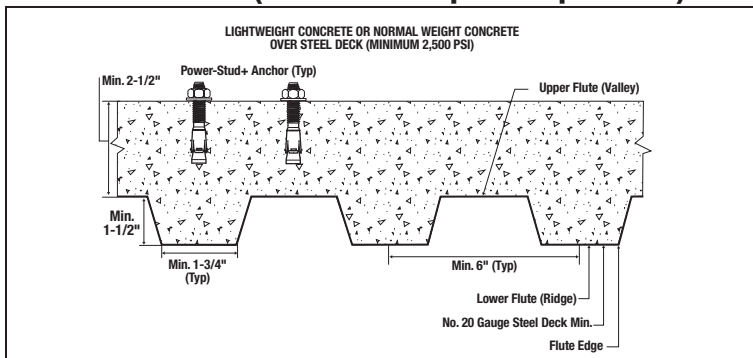
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B profiles may be installed with a maximum 15/16 -inch offset in either direction from the center of 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)^{1,2}



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)^{1,2}



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.

STRENGTH DESIGN INFORMATION

Tension Design Information for Power-Stud+ SD2 in Concrete^{1,2,12}

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			
Minimum nominal embedment depth ¹	h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)	3-3/4 (95)	3-7/8 (98)	4-7/8 (124)	4-1/2 (114)	5-3/4 (146)
Effective embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN TENSION (ACI 318-19 17.6.1, ACI 318-14 17.4.1 or ACI 318-11 D.5.1)¹									
Minimum specified yield strength (neck)	f_y	ksi (N/mm ²)	96.0 (662)	85.0 (586)	85.0 (586)	85.0 (586)	85.0 (586)	70.0 (483)	70.0 (483)
Minimum specified ultimate tensile strength (neck)	f_{uta}	ksi (N/mm ²)	120.0 (827)	106.0 (731)	106.0 (731)	106.0 (731)	106.0 (731)	90.0 (620)	90.0 (620)
Effective tensile stress area (neck)	$A_{se, N}$	in ² (mm ²)	0.0552 (35.6)	0.1007 (65.0)	0.1007 (65.0)	0.1619 (104.5)	0.1619 (104.5)	0.2359 (153.2)	0.2359 (153.2)
Steel strength in tension ⁵	N_{sa}	lb (kN)	6,625 (29.4)	10,445 (46.5)	10,445 (46.5)	13,080 (58.2)	13,080 (58.2)	21,230 (94.4)	21,230 (94.4)
Reduction factor for steel strength ³	ϕ	-	0.75						
CONCRETE BREAKOUT STRENGTH IN TENSION (ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318-11 D.5.2)⁸									
Effectiveness factor for uncracked concrete	k_{ucr}	-	24	24	24	24	24	24	24
Effectiveness factor for cracked concrete	k_{cr}	-	17	17	17	17	17	17	17
Modification factor for cracked and uncracked concrete ⁶	$\psi_{c,N}$	-	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6	1.0 See note 6
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Installation Table						
Critical edge distance for topside of concrete-filled steel deck assemblies with minimum topping thickness (uncracked concrete only)	$c_{ac,deck,top}$	in. (mm)	See Anchor Setting Information Table for top of concrete-filled steel deck assemblies with minimum topping thickness						
Reduction factor for concrete breakout strength ³	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION (ACI 318-19 17.6.3, ACI 318-14 17.4.3 or ACI 318-11 D.5.3)⁹									
Characteristic pullout strength, uncracked concrete (2,500 psi) ⁷	$N_{p,uncr}$	lb (kN)	2,775 (12.3)	See note 8	6,615 (29.4)	See note 8	See note 8	See note 8	See note 8
Characteristic pullout strength, cracked concrete (2,500 psi) ⁷	$N_{p,cr}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)						
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.3, ACI 318-14 17.2.3.3 or ACI 318-11 D.5.3.3.3)⁹									
Characteristic pullout strength, seismic (2,500 psi) ¹⁰	$N_{p,eq}$	lb (kN)	2,165 (9.6)	See note 8	4,375 (19.5)	See note 8	See note 8	See note 8	7,795 (35.1)
Reduction factor for pullout strength ³	ϕ	-	0.65 (Condition B)						
Mean axial stiffness values service load range ¹¹	Uncracked concrete	β	lbf/in (kN/mm)	865,000 (151)	717,00 (126)	569,000 (100)	569,000 (100)	420,000 (74)	420,000 (74)
	Cracked concrete	β	lbf/in (kN/mm)	49,500 (9)	57,000 (10)	64,500 (11)	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 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, 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 ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -14)-Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318 (-19 or -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 (-19 or -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 in lieu of calculation.
- 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, $N_{pn} = (\text{pullout strength value from table}) \times (\text{specified concrete compressive strength}/2500)$. For concrete over steel deck the value of 2500 must be replaced with the value of 3000 in the denominator. 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 lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n . λ shall be determined in accordance with the corresponding version of ACI 318.
- Tabulated 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[®] + SD2

High Performance Wedge Expansion Anchor

Shear Design Information for Power-Stud+ SD2 in Concrete^{1,2,8}

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	1	1	1
Minimum nominal embedment depth ¹	h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)	3-3/4 (95)	3-7/8 (98)	4-7/8 (124)	4-1/2 (114)	5-3/4 (146)
Effective Embedment	h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
STEEL STRENGTH IN SHEAR (ACI 318-19 17.7.1, ACI 318-14 17.5.1 or ACI 318-11 D.6.1)¹									
Minimum specified yield strength (threads)	f_y	psi (N/mm ²)	76,800 (530)	68,000 (469)	68,000 (469)	68,000 (469)	68,000 (469)	68,000 (469)	56,000 (386)
Minimum specified ultimate tensile strength (threads)	f_{uta}	psi (N/mm ²)	100,000 (690)	88,000 (607)	88,000 (607)	88,000 (607)	88,000 (607)	88,000 (607)	80,000 (551)
Effective tensile stress area (threads)	$A_{se, v}$	in ² (mm ²)	0.0775 (50.0)	0.1419 (91.6)	0.1419 (91.6)	0.2260 (145.8)	0.2260 (145.8)	0.3345 (215.8)	0.3345 (215.8)
Steel strength in shear ⁵	V_{sa}	lb (kN)	3,115 (13.9)	4,815 (21.4)	4,815 (21.4)	10,170 (45.2)	10,170 (45.2)	12,610 (56.1)	12,610 (56.1)
Reduction factor for steel strength ³	ϕ	-	0.65						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS (ACI 318-19 17.10.1, ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)									
Steel strength in shear, seismic ⁷	$V_{sa, eq}$	lb (kN)	2,460 (11.0)	4,815 (21.4)	4,815 (21.4)	6,770 (30.1)	6,770 (30.1)	8,060 (35.9)	8,060 (35.9)
Reduction factor for steel strength, seismic ³	ϕ	-	0.65 (Condition B)						
CONCRETE BREAKOUT STRENGTH IN SHEAR (ACI 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318-11 D.6.2)⁶									
Load bearing length of anchor	ℓ_e	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)	5.00 (127)
Reduction factor for concrete breakout strength ³	ϕ	-	0.70 (Condition B)						
PRYOUT STRENGTH IN SHEAR (ACI 318-19 17.7.3, ACI 318-14 17.5.3 or ACI 318-11 D.6.3)⁶									
Coefficient for pryout strength	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Reduction factor for pryout strength ³	ϕ	-	0.70 (Condition B)						
<p>1. The data in this table is intended to be used with the design provisions of ACI 318 (-19 or -14) Chapter 17 or ACI 318 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-19 17.10, ACI 318-14 17.2.3 or ACI 318 D.3.3 shall apply, as applicable.</p> <p>2. Installation must comply with published instructions and details.</p> <p>3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -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 ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318 (-19 or -14) Chapter 17 or ACI 318-11 Appendix D, as applicable, requirements for Condition A, see ACI 318-19 17.5.3, ACI 318-14 17.3.3 or ACI 318-11 D.4.3, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318 Section 9.2 are used.</p> <p>4. The Power-Stud+ SD2 is considered a ductile steel element as defined by ACI 318 (-19 or -14) 2.3 or ACI 318-11 D.1, as applicable.</p> <p>5. 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.</p> <p>6. Anchors are permitted to be used in sand-lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.</p> <p>7. Reported values for steel strength in shear for seismic applications are based on test results per ACI 355.2, Section 9.6.</p> <p>8. Anchors are permitted for use in concrete-filled steel deck floor and roof assemblies; see Installation Details A, B, C and D.</p>									

MECHANICAL ANCHORS

POWER-STUD® + SD2
High Performance Wedge Expansion Anchor

**Tension and Shear Design Data for Power-Stud+ SD2 Anchors
in the Soffit of Concrete-Filled Steel Deck Assemblies^{1,2,7}**

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		
Minimum Nominal Embedment Depth		h_{nom}	in. (mm)	2-3/8 (60)	2-1/2 (64)	3-3/4 (83)	3-7/8 (98)	4-7/8 (124)	4-1/2 (114)
Effective Embedment		h_{ef}	in. (mm)	2.00 (51)	2.00 (51)	3.25 (83)	3.25 (83)	4.25 (108)	3.75 (95)
Minimum Hole Depth		h_o	in. (mm)	2-5/8 (67)	2-3/4 (70)	4 (102)	4-1/4 (108)	5-1/4 (133)	5 (27)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK¹									
According to Detail A 4-1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,855 (8.3)	2,065 (9.2)	3,930 (17.5)	4,665 (20.8)	7,365 (32.8)	4,900 (21.8)
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	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 ²	$N_{p,deck,uncr}$	lbf (kN)	2,235 (9.9)	2,785 (12.4)	5,600 (24.9)	4,480 (19.9)	7,265 (32.3)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	lbf (kN)	1,745 (7.8)	1,975 (8.8)	3,695 (16.4)	3,175 (14.1)	5,145 (22.9)	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck ²	$N_{p,deck,uncr}$	lbf (kN)	1,600 (7.1)	2,025 (9.0)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck ^{2,3}	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	lbf (kN)	1,250 (5.6)	1,435 (6.4)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Reduction factor for pullout strength ⁶		ϕ	-	0.65					
STEEL STRENGTH IN SHEAR FOR ANCHORS IN SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL WEIGHT CONCRETE OVER STEEL DECK^{4,5}									
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 ⁶		ϕ	-	0.65					
<ol style="list-style-type: none"> 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 318-19 17.6.2, 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 318-19 17.7.2, ACI 318-14 17.5.2 or ACI 318 D.6.2, as applicable and the pryout capacity in accordance with ACI 318-19 17.7.3, 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 ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. Anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width. 									

MECHANICAL ANCHORS

POWER-STUD[®] + SD2
High Performance Wedge Expansion Anchor

DESIGN STRENGTH TABLES (SD)

Tension and Shear Design Strengths for Power-Stud+ SD2 in Cracked Concrete^{1,2,3,4,5,6,7,8}



Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		$f'c = 2,500$ psi		$f'c = 3,000$ psi		$f'c = 4,000$ psi		$f'c = 6,000$ psi		$f'c = 8,000$ psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
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^{1,2,3,4,5,6,7}

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		$f'c = 2,500$ psi		$f'c = 3,000$ psi		$f'c = 4,000$ psi		$f'c = 6,000$ psi		$f'c = 8,000$ psi	
		ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)	ϕN_n Tension (lbs.)	ϕV_n Shear (lbs.)
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

- 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 (-19 or -14) Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef} , for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.
- 3- Strength reduction factors (ϕ) were based on ACI 318 (-19 or -14) Section 5.3 for load combinations. Condition B is assumed.
- 4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.
- 5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318 (-19 or -14) Chapter 17.
- 6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318 (-19 or -14) Chapter 17. For other design conditions including seismic considerations please see ACI 318 (-19 or -14) Chapter 17.
- 7- The tabulated design strengths may be converted to allowable stress design values. Divide by conversion factor calculated as a weighted average of the load factors for the controlling load combination.
- 8- For seismic design in accordance with ACI 318, the tabulated tension design strengths in cracked concrete for concrete breakout and pullout strength must be multiplied by a factor of 0.75.

MECHANICAL ANCHORS

POWER-STUD® + SD2
High Performance Wedge Expansion Anchor

PERFORMANCE DATA (ASD)

Converted Allowable Loads for Power-Stud+ SD2 in Cracked Concrete^{1,2}

Nominal Anchor Size (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	
		$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ 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 Strength Tables and conditions shown previously.
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^{1,2}

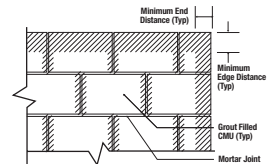
Nominal Anchor Size (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		$f'c = 2,500$ psi		$f'c = 3,000$ psi		$f'c = 4,000$ psi		$f'c = 6,000$ psi		$f'c = 8,000$ psi	
		$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ Shear (lbs.)	$T_{allowable, ASD}$ Tension (lbs.)	$V_{allowable, ASD}$ 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 Strength Tables and conditions shown previously.
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^{1,2,3}



Nominal Anchor Size in.	Installation Torque T_{inst} ft.-lb. (N-m)	Minimum Embedment Depth (mm)	Installation Location ³	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	20 (27)	2-1/2 (51)	Wall Face or 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	40 (54)	2-1/2 (51)	Wall Face or 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)	Top of Wall Min. 1-3/4" Edge and 4" End Distances	3,320 (14.8)	665 (3.0)	1,140 (5.1)	230 (1.0)



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 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. The tabulated values are for anchors installed at a minimum of 16 anchor diameters on center for 100 percent capacity.

ORDERING INFORMATION

Power-Stud+ SD2 (Carbon Steel Body with Stainless Steel 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
7413SD2-PWR	3/8" x 3"	1-3/4"	50	300	DW5527	DW5427	-	-	-
7414SD2-PWR	3/8" x 3-1/2"	2-1/4"	50	300	DW5527	DW5427	-	-	-
7415SD2-PWR	3/8" x 3-3/4"	2-1/2"	50	300	DW5527	DW5427	-	-	-
7416SD2-PWR	3/8" x 5"	3-3/4"	50	300	DW55300	DW5429	-	-	-
7422SD2-PWR	1/2" x 3-3/4"	2-1/8"	50	200	DW5537	DW5437	DW5803	DWA54012	-
7423SD2-PWR	1/2" x 4-1/2"	2-7/8"	50	200	DW5539	DW5438	DW5803	DWA54012	-
7424SD2-PWR	1/2" x 5-1/2"	3-7/8"	50	150	DW5539	DW5438	DW5803	DWA54012	-
7426SD2-PWR	1/2" x 7"	5-3/8"	25	100	DW5539	DW5438	DW5803	DWA54012	-
7427SD2-PWR	1/2" x 8-1/2"	6-7/8"	25	100	DW5539	DW5439	DW5804	DWA54012	-
7435SD2-PWR	5/8" x 4-3/4"	2-7/8"	25	100	-	DW5446	DW5806	DWA54058	DWA58058
7433SD2-PWR	5/8" x 5"	3-1/8"	25	50	-	DW5446	DW5806	DWA54058	DWA58001
7434SD2-PWR	5/8" x 6"	4-1/8"	25	75	-	DW5446	DW5806	DWA54058	DWA58001
7436SD2-PWR	5/8" x 7"	5-1/8"	25	75	-	DW5447	DW5806	DWA54058	DWA58001
7438SD2-PWR	5/8" x 8-1/2"	6-5/8"	25	75	-	DW5447	DW5809	DWA54058	DWA58001
7442SD2-PWR	3/4" x 5-1/2"	3-1/4"	20	60	-	DW5453	DW5810	DWA54074	DWA58034
7444SD2-PWR	3/4" x 6-1/4"	4"	20	60	-	DW5455	DW5810	DWA54074	DWA58034
7446SD2-PWR	3/4" x 7"	4-3/4"	20	60	-	DW5455	DW5810	DWA54074	DWA58034
7448SD2-PWR	3/4" x 8-1/2"	6-1/4"	10	40	-	DW5455	DW5812	DWA54074	DWA58034

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).



MECHANICAL ANCHORS

POWER-STUD® + SD2
High Performance Wedge Expansion Anchor