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
- 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 and ELC-2502 for cracked and uncracked concrete
- Code Compliant with the 2020/2015 NBCC and 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 and CSA A23.3 (-19, -14, -04) Annex D 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.	

SECTION CONTENTS

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)

TENSION ZONE CRACKED CONCRETE
SEISMIC REGION QUALIFICATION
CODE LISTED ICC-ES ESR-2502 CONCRETE
CODE LISTED ICC-ES ELC-2502 CONCRETE
DDA DEWALT DESIGN ASSIST
DUSTX+ ANCHOR INSTALLATION SYSTEM

INSTALLATION SPECIFICATIONS

Power-Stud+ SD2 Anchor Installation Table

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size											
			3/8"	1/2"				5/8"			3/4"			
Outside diameter of anchor	d_a	mm (in.)	9.5 (0.375)	12.7 (0.500)				15.9 (0.625)			19.1 (0.750)			
Minimum diameter of hole clearance in fixture	d_h	mm (in.)	11.1 (7/16)	14.3 (9/16)				17.5 (11/16)			20.6 (13/16)			
Nominal drill bit diameter	d_{bit}	in.	3/8 ANSI	1/2 ANSI				5/8 ANSI			3/4 ANSI			
Minimum nominal embedment depth[2]	h_{nom}	mm	60	64		83		98	124		114	146		
Effective embedment	h_{ef}	mm	51	51		83		83	108		95	127		
Minimum concrete member thickness	h_{min}	mm	102	114	152	146	146	146	165	203	178	254		
Critical edge distance	c_{ac}	mm	165	203		254		203	400	254	305	305		
Minimum edge distance	c_{min}	mm	64	102	70	102	70	108	108		127	114		
Minimum spacing distance	s_{min}	mm	89	152	152	102	152	108	108		152	152		
Minimum hole depth	h_o	mm	67	70		102		108	133		127	159		
Minimum overall anchor length[3]	ℓ_{anch}	mm	76	95		114		121	152		159	178		
Installation torque	T_{inst}	N-m	27	54				81			149			
Torque wrench / socket size	-	in.	9/16	3/4				15/16			1-1/8			
Nut height	-	in.	21/64	7/16				35/64			4-1/64			

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

1. The information presented in this table is to be used in conjunction with the design criteria of CSA A23.3 (-19, -14, -04) Annex D, as applicable.
2. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
3. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achievethe minimum nominal embedment depth and possible fixture attachment.

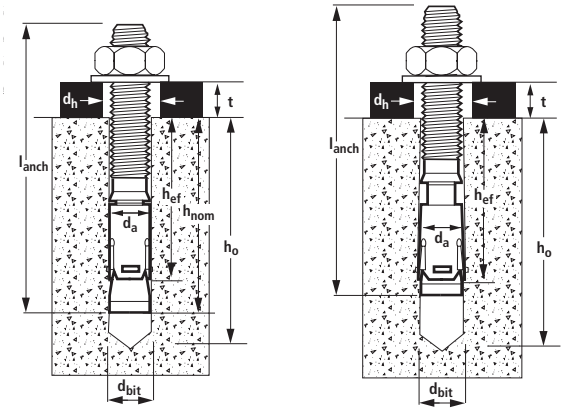
Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies[3,4]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			3/8"		1/2"	
Nominal drill bit diameter (ANSI)	d_{bit}	in.	3/8 ANSI		1/2 ANSI	
Minimum nominal embedment depth[1]	h_{nom}	mm (in.)	60 (2-3/8)		64 (2-1/2)	
Effective embedment	h_{ef}	mm (in.)	51 (2.00)		51 (2.00)	
Minimum concrete member thickness[2]	$h_{min,deck}$	mm (in.)	64 (2-1/2)		64 (2-1/2)	
Critical edge distance for topside of concrete-filled steel deck assemblies with minimum topping thickness (uncracked concrete only)	$c_{ac,deck,top}$	mm (in.)	203 (8)		229 (9)	
Minimum edge distance	$c_{min,deck,top}$	mm (in.)	102 (4)	70 (2-3/4)	102 (4)	203 (8)
Minimum spacing distance	$s_{min,deck,top}$	mm (in.)	89 (3-1/2)	152 (6)	203 (8)	102 (4)
Minimum hole depth	h_o	mm (in.)	64 (2-1/2)		64 (2-1/2)	
Installation torque	T_{inst}	N-m (ft.-lb.)	27 (20)		54 (40)	
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 SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m.

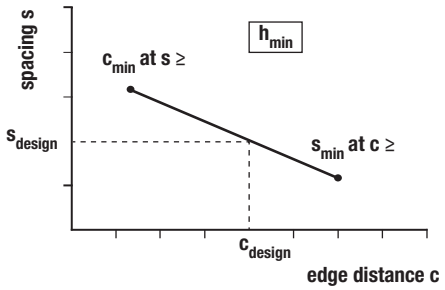
1. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor prior to tightening.
2. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies provided the concrete thickness above the upper flute 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.
3. For all other anchor diameters and embedment depths, refer to the installation table for applicable values of h_{min}, c_{min} and s_{min}.
4. Design capacities shall be based on calculations according to values in Tension Design Information and Shear Design Information tables.

Power-Stud+ SD2 Anchor Detail



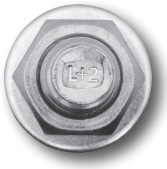
Before After

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}.

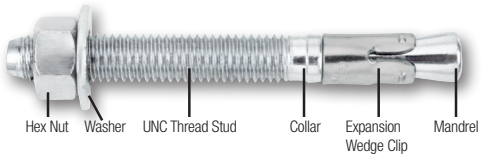
Head Marking



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

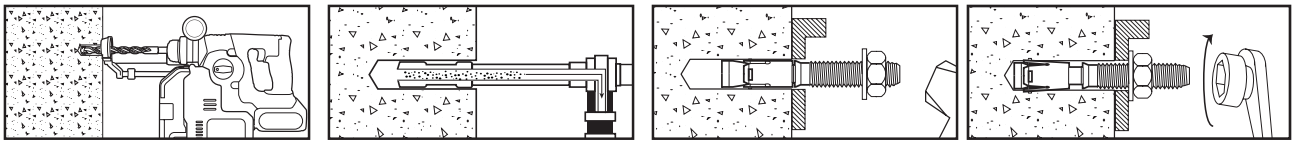


Length Identification

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



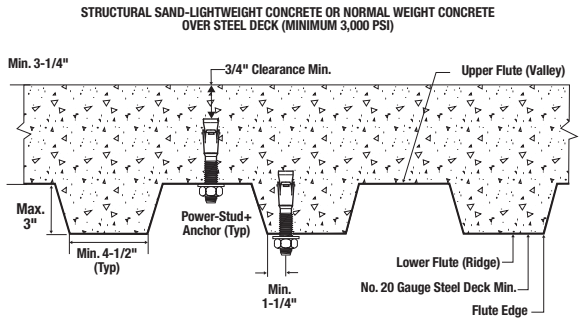
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.

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}.

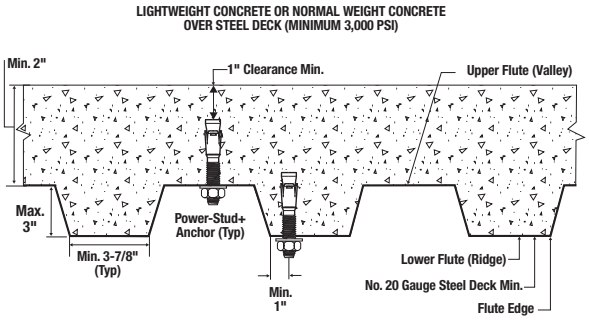
Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}.

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



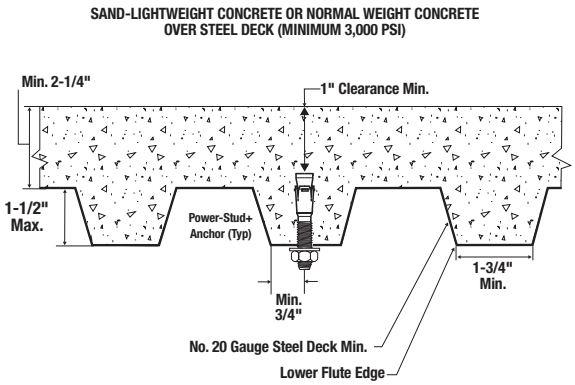
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with installation Detail A provided the minimum hole clearance is satisfied. Anchors in the lower flute of installation Detail A profiles may be installed with a maximum 1-inch offset in either direction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



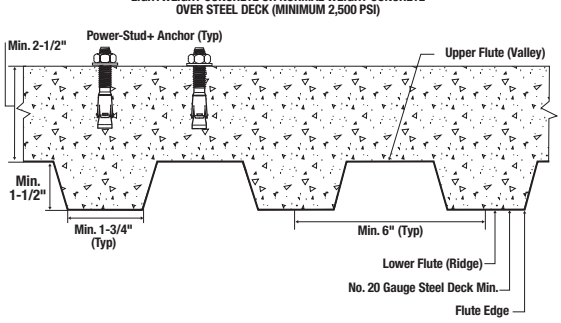
1. Anchors may be placed in the upper flute or lower flute of the steel deck profiles in accordance with Detail B provided the minimum hole clearance is satisfied. Anchors in the lower flute of Detail B profiles may be installed with a maximum 15/16 -inch offset in either direction from the center of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

LIMIT STATES 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		
STEEL STRENGTH IN TENSION[4]										
Minimum specified yield strength (neck)	f_y	N/mm²	662	586		586		483		
Minimum specified ultimate tensile strength (neck)	f_{uta}	N/mm²	827	731		731		620		
Effective tensile stress area (neck)	$A_{se,N}$	mm²	35.6	65.0		104.5		153.2		
Steel strength in tension[5]	N_{sa}	kN	29.5	46.5		58.2		94.4		
Steel embedment material resistance factor for reinforcement	ϕ_s	-	0.85							
Reduction modification factor for steel strength[3]	R	-	0.80							
CONCRETE BREAKOUT STRENGTH IN TENSION[9]										
Effective embedment	h_{ef}	mm	51	51	83	83	108	95	127	
Effectiveness factor for uncracked concrete	k_{ucr}	-	10	10		10		10		
Effectiveness factor for cracked concrete	k_{cr}	-	7	7		7		7		
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		
Material resistance factor for concrete	ϕ_c	-	0.65							
Critical edge distance	c_{ac}	mm	See note 6							
Resistance modification factor for tension, concrete failure modes, Condition B[3]	R	-	1.0							
PULLOUT STRENGTH IN TENSION[9]										
Characteristic pullout strength, uncracked concrete (217.2 MPa)[7]	$N_{p,uncr}$	kN	12.3	See note 8	29.4	See note 8	See note 8	See note 8	See note 8	
Characteristic pullout strength, cracked concrete (17.2 MPa)[7]	$N_{p,cr}$	kN	9.6	See note 8	19.5	See note 8	See note 8	See note 8	35.1	
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[9]										
Characteristic pullout strength, seismic (17.2 MPa)[7,10]	$N_{p,eq}$	kN	9.6	See note 8	19.5	See note 8	See note 8	See note 8	35.1	
Material resistance factor for concrete	ϕ_c	-	0.65							
Resistance modification factor for pullout strength, seismic, Condition B[3]	R		1.0							
Mean axial stiffness values service load range[11] — Uncracked concrete	β	kN/mm	1517	1258		998		747		
Mean axial stiffness values service load range[11] — Cracked concrete	β	kN/mm	87	100		113		126		

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 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 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
4. The Power-Stud+ SD2 is considered a ductile steel element in tension 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 tension are based on test results per ACI 355.2 and must be used for design in lieu of calculation.
6. For all design cases $\Psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
7. For all design cases $\Psi_{c,P}$ =1.0. For the calculation of N_{cpr}, see CSA A23.3 (-19, -14, -04) D.6.3.
8. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
9. Anchors are permitted to be used in lightweight concrete in accordance with CSA A23.3 (-19, -14, -04) D.4.
10. Tabulated values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2 (Section 9.5), as referenced in CSA
11. Actual stiffness of the mean value varies considerably depending on concrete strength, loading and geometry of application.

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	
STEEL STRENGTH IN SHEAR[4]									
Minimum specified yield strength (threads)	f_y	N/mm²	530	469		469		386	
Minimum specified ultimate strength (threads)	f_{uta}	N/mm²	690	607		607		551	
Effective tensile stress area (threads)	$A_{se,v}$	mm²	50.0	65.7		104.9		215.8	
Steel strength in shear[5]	V_{sa}	kN	13.9	21.4		45.2		56.1	
Steel embedment material resistance factor for reinforcement	ϕ_s	-	0.85						
Resistance modification factor for steel strength, shear[3,4]	R	-	0.75						
CONCRETE BREAKOUT STRENGTH IN SHEAR[6]									
Load-bearing length of anchor		mm	51	51	83	83	103	95	127
Nominal anchor diameter	$V_{sa,eq}$	mm	9.5	12.7		15.9		19.1	
Steel embedment material resistance factor for reinforcement	ϕ_s	-	0.65						
Resistance modification factor for shear, concrete failure modes, Condition B[3]	R	-	1.0						
PRYOUT STRENGTH IN SHEAR[6]									
Coefficient for pryout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	1.0	1.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	mm	51	51	83	83	108	95	127
Steel embedment material resistance factor for reinforcement	ϕ_s	-	0.65						
Resistance modification factor for pryout strength[3]	R	-	1.0						
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS									
Steel strength in shear, seismic[7]	$V_{sa,eq}$	kN	11.0	21.4		30.1		35.9	
Steel embedment material resistance factor for reinforcement	ϕ_s	-	0.85						
Resistance modification factor for steel strength, shear, seismic[3]	R	-	0.75						

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 ksi = 6.895 N/mm², 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 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.
4. The Power-Stud+ SD2 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 are based on test results per ACI 355.2, Section 9.4 and must be used for design. These tabulated values are lower than calculated results using equation D.31 in CSA A23.3-19 or 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- Section D.4.3.4.

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}	mm (in.)	60 (2-3/8)	64 (2-1/2)	83 (3-3/4)	98 (3-7/8)	124 (4-7/8)	114 (4-1/2)
Effective Embedment		h_{ef}	mm (in.)	51 (2.00)	51 (2.00)	83 (3.25)	83 (3.25)	108 (4.25)	95 (3.75)
Minimum Hole Depth		h_o	mm (in.)	67 (2-5/8)	70 (2-3/4)	102 (4)	108 (4-1/4)	133 (5-1/4)	27 (5)
PULLOUT STRENGTH IN TENSION FOR ANCHORS IN SOFFIT OF SAND LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[1]									
According to Detail A 4-1/2-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	kN (lbf)	8.3 (1,855)	9.2 (2,065)	17.5 (3,930)	20.8 (4,665)	32.8 (7,365)	21.8 (4,900)
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	kN (lbf)	6.4 (1,445)	6.5 (1,465)	11.6 (2,600)	14.7 (3,305)	23.2 (5,215)	15.4 (3,470)
According to Detail B 3-7/8-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	kN (lbf)	9.9 (2,235)	12.4 (2,785)	24.9 (5,600)	19.9 (4,480)	32.3 (7,265)	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	kN (lbf)	7.8 (1,745)	8.8 (1,975)	16.4 (3,695)	14.1 (3,175)	22.9 (5,145)	Not Applicable
According to Detail C 1-3/4-inch-wide deck flute	Characteristic pullout strength, uncracked concrete over steel deck[2]	$N_{p,deck,uncr}$	kN (lbf)	7.1 (1,600)	9.0 (2,025)	Not Applicable	Not Applicable	Not Applicable	Not Applicable
	Characteristic pullout strength, cracked concrete over steel deck[2,3]	$N_{p,deck,cr}$ ($N_{p,deck,eq}$)	kN (lbf)	5.6 (1,250)	6.4 (1,435)	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					

1. For all design cases $\Psi_{c,P} = 1.0$. For concrete compressive strength greater than 20.68 MPa [3,000 psi], N_{pn}=(pullout strength value from table) * (specified concrete compressive strength/20.68)^n. For all anchors n=1/2 with exception of the 3/8-inch-diameter anchor size, where n=1/3.
2. Values for $N_{p,deck}$ are for sand-lightweight concrete ($f'_{c,min}$ = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-19 17.6.2, ACI 318-14 17.4.2 or ACI 318 D.5.2 and CSA A23.3 (-19, -14, -04) Annex D, as applicable, is not required for anchors installed in the deck soffit (flute).
3. Values for $N_{p,deck,cr}$ are applicable for seismic loading.
4. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
5. Values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete ($f'_{c,min}$ = 20.68 MPa [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 and CSA A23.3 (-19, -14, -04) Annex D, 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 and CSA A23.3 (-19, -14, -04) Annex D, as applicable, is not required for anchors installed in the deck soffit (flute).
6. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318 (-19 or -14) Section 5.3 or ACI 318-11 Section 9.2 and CSA A23.3 (-19, -14, -04) Annex D, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
7. Anchors shall have an axial spacing along the flute soffit equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

Tension and Shear Design Strengths for Power-Stud+ SD2 in Cracked Concrete[1,2,3,4,5,6]

Nominal Anchor 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	
		Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)
3/8	60	6.2	6.9	6.6	7.5	7.3	8.7	8.4	8.9	9.2	8.9
1/2	64	6.9	6.9	7.5	7.5	8.7	8.7	10.7	10.7	12.3	12.3
	95	12.7	13.6	13.9	13.6	16.0	13.6	19.7	13.6	22.7	13.6
5/8	98	14.3	17.4	15.7	19.1	18.1	22.0	22.1	27.0	25.6	28.8
	124	21.2	28.8	23.2	28.8	26.8	28.8	32.9	28.8	37.9	28.8
3/4	114	17.5	31.3	19.2	34.3	22.1	35.8	27.1	35.8	31.3	35.8
	143	22.8	35.8	25.0	35.8	28.9	35.8	35.4	35.8	40.8	35.8

□ - 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]

Nominal Anchor 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	
		Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)	Nr Tension (kN)	Vr Shear (kN)
3/8	60	8.0	8.9	8.8	8.9	10.1	8.9	12.4	8.9	14.3	8.9
1/2	64	9.8	9.8	10.8	10.8	12.4	12.4	15.2	13.6	17.6	13.6
	95	19.1	13.6	20.9	13.6	24.2	13.6	29.6	13.6	31.6	13.6
5/8	86	20.4	24.4	22.4	26.7	25.8	28.8	31.6	28.8	36.5	28.8
	117	30.3	28.8	33.2	28.8	38.3	28.8	39.6	28.8	39.6	28.8
3/4	102	25.0	35.8	27.4	35.8	31.6	35.8	38.7	35.8	44.7	35.8
	143	38.6	35.8	42.3	35.8	48.9	35.8	59.9	35.8	64.2	35.8

□ - 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 following methodology in CSA A23.3 (-19,-14,-04), Annex D. The load level corresponding to the failure mode 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 in shear are calculated using the effective embedment values, hef, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Material Resistance factors (ø) are in accorance with CSA A23.3 (-19,-14,-04) Annex D, Sections 8.4.2 and 8.4.3. Mondification Factors (R) are in accordance with CSA A23.3 (-19,-14,-04) Annex D, Section D.5.3 Condition B; it is assumed that supplementary reinforcement not present. Material resistance factors for steel strength are taken as 0.85 for tension and shear; Modification factors are taken as 0.80 for Tension and 0.75 for Shear; values correspond to ductile steel elements.

4- Tabular values are permitted for short-term 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 CSA A23.3 (-19,-14,-04) Annex D, Section D.8.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see CSA A23.3 Annex D and information contained in this product supplement. For other design conditions including seismic considerations please see CSA A23.3 Annex D.

PERFORMANCE DATA (ASD)

Converted Allowable Loads for Power-Stud+ SD2 in Cracked Concrete[1,2]

Nominal Anchor Size (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	
		$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)
3/8	60	4.5	4.9	4.7	5.4	5.2	6.2	6.0	6.3	6.6	6.3
1/2	64	4.9	4.9	5.4	5.4	6.2	6.2	7.6	7.6	8.8	8.8
	95	9.1	9.7	9.9	9.7	11.5	9.7	14.1	9.7	16.2	9.7
5/8	98	10.2	12.4	11.2	13.6	12.9	15.7	15.8	19.3	18.3	20.6
	124	15.1	20.6	16.6	20.6	19.2	20.6	23.5	20.6	27.1	20.6
3/4	114	12.5	22.4	13.7	24.5	15.8	25.5	19.4	25.5	22.4	25.5
	143	16.3	25.5	17.9	25.5	20.6	25.5	25.3	25.5	29.2	25.5

1. Allowable load values are calculated using a conversion factor, α, from the Factored Resistances 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.

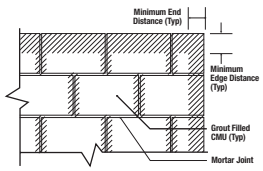
Converted Allowable Loads for Power-Stud+ SD2 in Uncracked Concrete[1,2]

Nominal Anchor Size (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	
		$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)	$T_{allowable,ASD}$ Tension (kN)	$V_{allowable,ASD}$ Shear (kN)
3/8	60	5.7	6.3	6.3	6.3	7.2	6.3	8.9	6.3	10.2	6.3
1/2	64	7.0	7.0	7.7	7.7	8.9	8.9	10.9	9.7	12.6	9.7
	95	13.7	9.7	15.0	9.7	17.3	9.7	21.2	9.7	22.6	9.7
5/8	98	14.6	17.4	16.0	19.1	18.4	20.6	22.6	20.6	26.1	20.6
	124	21.6	20.6	23.7	20.6	27.4	20.6	28.3	20.6	28.3	20.6
3/4	114	17.9	25.5	19.6	25.5	22.6	25.5	27.7	25.5	31.9	25.5
	143	27.9	25.5	30.2	25.5	34.9	25.5	42.8	25.5	45.9	25.5

1. Allowable load values are calculated using a conversion factor, α, from the Factored Resistances 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[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)			
				Ulimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ulimate 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)



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

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).