Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section | Page | Paragraph | Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers DEWALT® AC200+(tm) -
Dewalt Screw-Bolt+ By Powers
Dewalt Power-Stud SD1 By Powers
Dewalt LokBolt AS By Powers

The attached submittal package includes the product description, specifications, drawings, and performance data for use in the evaluation of the request.

SUBMITTED BY:

Name: Signature:

Company:

Address:

Date: Telephone: Fax:

FOR USE BY THE ARCHITECT AND/OR ENGINEER

☐ **Approved** ☐ **Approved as Noted** ☐ **Not Approved**

(If not approved, please briefly explain why the product was not accepted.)

By: Date:

Remarks:

Questions or inquiries? Contact us at engineering@powers.com, or call 1.800.524.3244

Table of Contents

DEWALT® Engineered By Powers DEWALT® AC200+(tm) Submittal Section:

COMPETITIVE COMPARISON

AC200+ VS. HILTI* HY200 VS. SIMPSON* AT-XP

Product Comparison

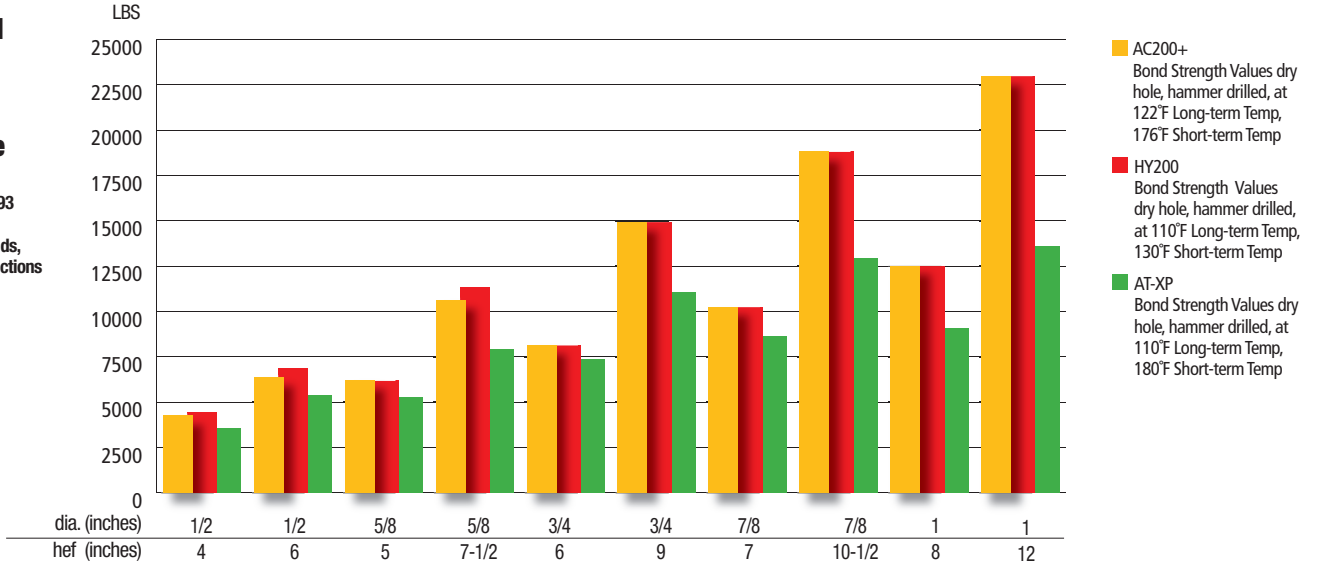
Product Name	AC200+	HY 200	AT-XP
Company	DEWALT	Hilti*	Simpson Strong-Tie*
Description	Adhesive Anchoring System	Adhesive Anchoring System	Adhesive Anchoring System
Rod Size Range (inch)	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4
Rebar Size Range	#3, #4, #5, #6, #7, #8, #9 #10	#3, #4, #5, #6, #7, #8, #9 #10	#3, #4, #5, #6, #7, #8, #10
ICC-ES ESR (concrete)	ESR-4027	ESR-3187	ER-263 (IAPMO-ES)
Revision Date	2017 January	2016 November	2016 September
Cracked Concrete	Yes	Yes	Yes
Seismic Approval in Concrete	Yes	Yes	Yes
LEED	Yes	Yes	Yes
VOC	Yes	Yes	Yes
NSF 61 (potable drinking water)	Yes	Yes	Yes

* Hilti is a registered trademark of Hilti Corporation *AT-XP and Simpson are registered trademarks of Simpson Strong-Tie Company Inc.

Factored Tension Loads Cracked Concrete

2500 psi, Rod ASTM A193 Grade B7 Sustained Loads, Periodic Inspections

AC200+
HY200
AT-XP



AC200+
Bond Strength Values dry hole, hammer drilled, at 122°F Long-term Temp, 176°F Short-term Temp

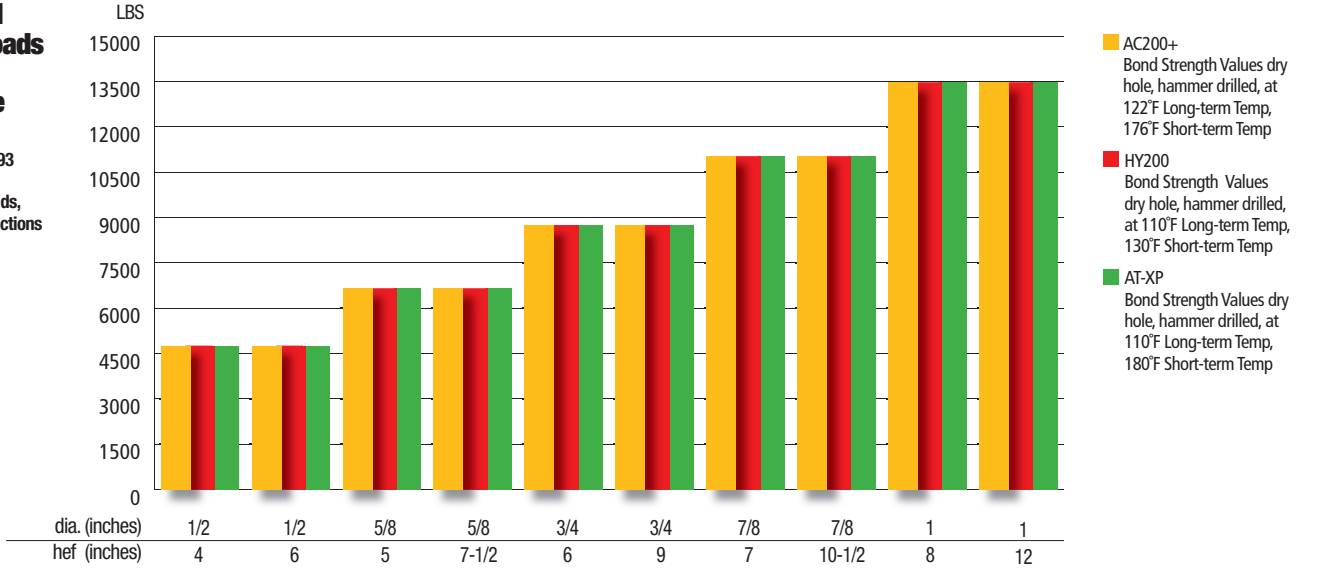
HY200
Bond Strength Values dry hole, hammer drilled, at 110°F Long-term Temp, 130°F Short-term Temp

AT-XP
Bond Strength Values dry hole, hammer drilled, at 110°F Long-term Temp, 180°F Short-term Temp

Factored Shear Loads Cracked Concrete

2500 psi, Rod ASTM A193 Grade B7 Sustained Loads, Periodic Inspections

AC200+
HY200
AT-XP



AC200+
Bond Strength Values dry hole, hammer drilled, at 122°F Long-term Temp, 176°F Short-term Temp

HY200
Bond Strength Values dry hole, hammer drilled, at 110°F Long-term Temp, 130°F Short-term Temp

AT-XP
Bond Strength Values dry hole, hammer drilled, at 110°F Long-term Temp, 180°F Short-term Temp

Source: ESR-4027 (Revised: 2017 Jan), ESR-3187 (Revised: 2016 Nov), ER-263 (IAPMO-ES) (Revised: 2016 Sept)

COMPETITIVE COMPARISON

AC200+ VS. HILTI* HY 200

Product Comparison

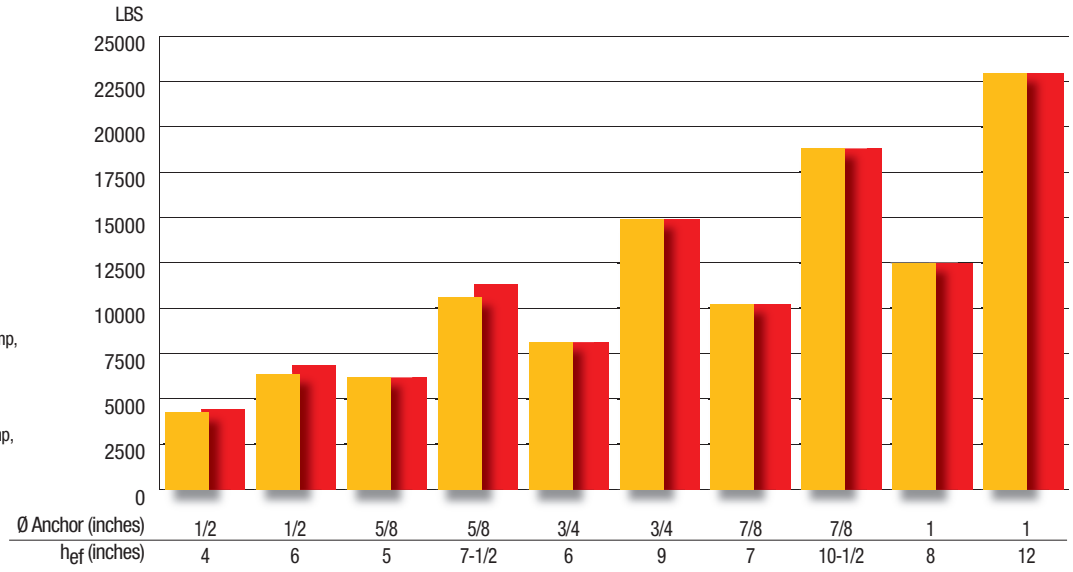
Product Name	AC200+	HY 200
Company	DEWALT	Hilti*
Description	Adhesive Anchoring System	Epoxy Anchoring System
Size Range (inch)	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4 #3, #4, #5, #6, #7, #8, #9, #10	3/8, 1/2, 5/8, 3/4, 7/8, 1, 1-1/4 #3, #4, #5, #6, #7, #8, #9, #10
ICC-ES ESR (concrete)	ESR-4027	ESR-3187
Revision Date	2017 Jan	2016 Nov
Cracked Concrete	Yes	Yes
Seismic Approval in Concrete	Yes	Yes
LEED	Yes	Yes
VOC	Yes	Yes
NSF 61 (potable drinking water)	Yes	Yes

* Hilti is a registered trademark of Hilti Corporation

Factored Tension Loads Cracked Concrete

2500 psi, Rod ASTM A193 Grade B7 Dry concrete, sustained loading and periodic special inspection

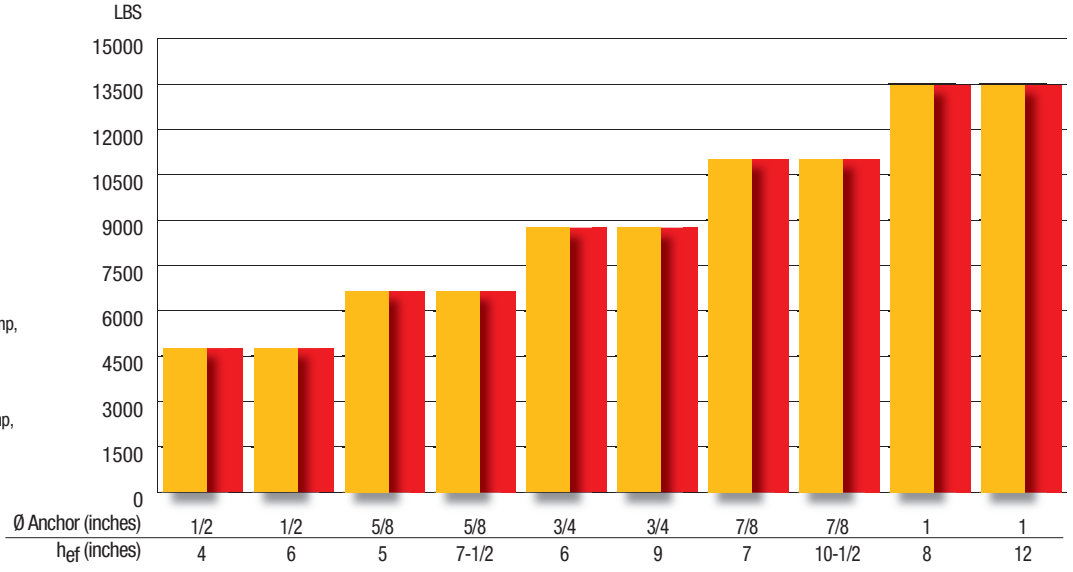
- AC200+ Bond Strength Values at 122°F Long-term Temp, 176°F Short-term Temp
- HY200 Bond Strength Values at 110°F Long-term Temp, 130°F Short-term Temp



Factored Shear Loads Cracked Concrete

2500 psi, Rod ASTM A193 Grade B7 Dry concrete, sustained loading and periodic special inspection

- AC200+ Bond Strength Values at 122°F Long-term Temp, 176°F Short-term Temp
- HY200 Bond Strength Values at 110°F Long-term Temp, 130°F Short-term Temp



Source: ESR-4027 (Revised: 2017 Jan), ESR-3187 (Revised: 2016 Nov)

GENERAL INFORMATION

AC200+

Acrylic Injection Adhesive Anchoring System

PRODUCT DESCRIPTION

The AC200+ is a two-component, high strength adhesive anchoring system. The system includes injection adhesive in plastic cartridges, mixing nozzles, dispensing tools and hole cleaning equipment. The AC200+ is designed for bonding threaded rod and reinforcing bar hardware into drilled holes in concrete base materials.

GENERAL APPLICATIONS AND USES

- Bonding threaded rod and reinforcing bar into hardened concrete
- Evaluated for installation and use in dry and wet concrete
- Can be installed in a wide range of base material temperatures

FEATURES AND BENEFITS

+ Designed for use with threaded rod and reinforcing bar hardware elements
+ Evaluated and recognized for freeze/thaw performance
+ Cartridge design allows for multiple uses using extra mixing nozzles
+ Mixing nozzles proportion adhesive and provide simple delivery method into drilled holes
+ Evaluated and recognized for long term and short term loading (see performance tables)

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES) ESR-4027 for cracked and uncracked concrete
- Code Compliant with 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.4, ASTM E 488, and ICC-ES AC308 for use in structural concrete (Design according to ACI 318-14, Chapter 17 and ACI 318-11/08 Appendix D)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading
- Compliant with NSF/ANSI 61 for drinking water system components - health effects; minimum requirements for materials in contact with potable water and water treatment

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, and 05 05 19 Post-Installed Concrete Anchors. Adhesive anchoring system shall be AC200+ as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and requirements of the Authority Having Jurisdiction.

CODE LISTED
ICC-ES ESR-4027
CONCRETE

SECTION CONTENTS

PACKAGING

Coaxial Cartridge

- 10 fl. oz.

Dual (side-by-side) Cartridge

- 12 fl. oz.
- 28 fl. oz.

STORAGE LIFE & CONDITIONS

Dual cartridge: Eighteen months
Coaxial cartridge: Eighteen months
In a dry, dark environment with temperature ranging from 41°F to 90°F (5°C to 32°C)

ANCHOR SIZE RANGE (TYP.)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 10 reinforcing bar (rebar)

SUITABLE BASE MATERIALS

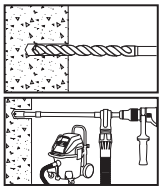
- Normal-weight concrete
- Lightweight concrete

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry concrete
- Water-saturated concrete (wet)

INSTALLATION INSTRUCTIONS (SOLID BASE MATERIALS)

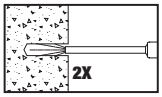
DRILLING



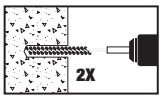
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits, including hollow bits, must meet ANSI Standard B212.15.

- Precaution: Use suitable eye and skin protection. Avoid inhalation of dust during drilling and/or removal.
- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.
- Drilling in dry concrete is recommended when using hollow drill bits (vacuum must be on).

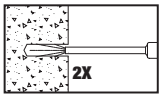
HOLE CLEANING DRY OR WET/WATER-SATURATED HOLES (BLOW 2X, BRUSH 2X, BLOW 2X)



2a- Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 90 psi / 6 bar) a minimum of two times (2x), until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.



2b- Determine brush diameter (see hole cleaning equipment selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use ($\phi_{brush} > D_{min}$, see hole cleaning equipment selection table). The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter. If the back of the drilled hole is not reached a brush extension shall be used.

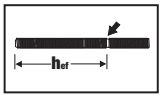


2c- Finally blow the hole clean again with compressed air (min. 90 psi / 6 bar) a minimum of two times (2x), until the return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

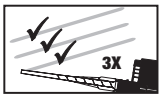
PREPARING

3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use. Review published working and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For permitted range of the base material temperature, see published gel and curing times.

- Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
- Note: Always use a new mixing nozzle with new cartridge of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.



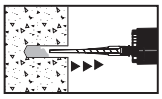
4- Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



5- Adhesives must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent **GRAY** color.

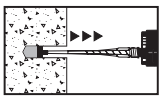
- Review and note the published working and cure times (reference gel time and curing time table) prior to injection of the mixed adhesive into the cleaned anchor hole.

INSTALLATION



6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. For embedment depth greater than 7-1/2 inches an extension tube supplied by DeWALT (3/8" Dia. CAT. #08281-PWR) must be used with the mixing nozzle.

WITH PISTON PLUG:

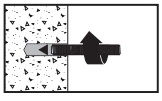


Piston plugs (see hole cleaning equipment selection table) must be used with and attached to the mixing nozzle and extension tube for:

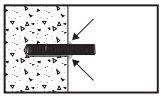
- Overhead installations and installations between horizontal and overhead
- All installations with drill hole depth > 10" (250mm) with anchor rod 5/8" to 1-1/4" diameter and rebar sizes #5 to #10

Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use.

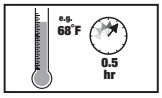


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



8- Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and overhead the anchor must be secured from moving/falling during the cure time (e.g. wedges). Minor adjustments to the anchor may be performed during the gel time but the anchor shall not be moved after placement and during cure.

CURING AND LOADING



9- Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (reference gel time and curing time table).

- Do not disturb, torque or load the anchor until it is fully cured.

10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference installation specifications for threaded rod and reinforcing bar table) by using a calibrated torque wrench.

- Take care not to exceed the maximum torque for the selected anchor.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table

Temperature of base material °F	Gel (working) time	Full curing time
23°F (-5°C) to 31°F (-1°C)	50 minutes	5 hours
32°F (0°C) to 40°F (4°C)	25 minutes	3.5 hours
41°F (5°C) to 49°F (9°C)	15 minutes	2 hours
50°F (10°C) to 58°F (14°C)	10 minutes	1 hour
59°F (15°C) to 67°F (19°C)	6 minutes	40 minutes
68°F (20°C) to 85°F (29°C)	3 minutes	30 minutes
86°F (30°C) to 104°F (40°C)	2 minutes	30 minutes

Linear interpolation for intermediate base material temperature is possible.
Cartridge temperature must be between 41ºF (5ºC) and 104ºF (40ºC).

Hole Cleaning Equipment Selection Table for AC200+

Rod Diameter (inch)	Rebar Size (No.)	ANSI Drill Bit Diameter (inch)	Min. Brush Diameter, D_{min} (inches)	Brush Length, L (inches)	Steel Wire Brush[1,2] (Cat. #)	Blowout Tool	Number of cleaning actions
Solid Base Material							
3/8	-	7/16	0.458	5-3/8	PFC1671050	Compressed air nozzle only, Cat #8292 (min. 90 psi)	2x blowing 2x brushing 2x blowing
-	#3	1/2	0.520	5-3/8	PFC1671100		
1/2	-	9/16	0.582	5-3/8	PFC1671150		
-	#4	5/8	0.650	5-3/8	PFC1671200		
5/8	-	11/16	0.709	5-3/8	PFC1671225		
-	#5	3/4	0.777	5-3/8	PFC1671250		
3/4	#6	7/8	0.905	5-3/8	PFC1671300		
7/8	#7	1	1.030	5-3/8	PFC1671350		
1	#8	1-1/8	1.160	5-3/8	PFC1671400		
1-1/4	#9	1-3/8	1.140	5-3/8	PFC1671450		
-	#10	1-1/2	1.535	5-3/8	PFC1671500		

1. An SDS-plus adaptor (Cat. #PFC1671830) is required to attach a steel wire brush to the drill tool. For hand brushing, attach manual brush wood handle (Cat. #PFC1671000) to the steel brush.
2. A brush extension (Cat. #PFC1671820) must be used with a steel wire brush for holes drilled deeper than the listed brush length.

Adhesive Piston Plugs[1,2,3]

Rod Diameter (inch)	Rebar Size (No.)	ANSI Drill Bit Diameter (inch)	Plug Size (inch)	Plastic Plug (Cat. #)	Piston Plug
Solid Base Materials					
5/8	-	11/16	11/16	08258	
-	#5	3/4	3/4	08259	
3/4	#6	7/8	7/8	08300	
7/8	#7	1	1	08301	
1	#8	1-1/8	1-1/8	08303	
1-1/4	#9	1-3/8	1-3/8	08305	
-	#10	1-1/2	1-1/2	08309	

1. All overhead or upwardly inclined installations require the use of piston plugs where one is tabulated together with the anchor size.
2. All installations require the use of piston plugs where one is tabulated together with the anchor size and where the embedment depth is greater than 10 inches.
3. A flexible plastic extension tube (Cat#08297) or equivalent approved by DEWALT must be used with piston plugs.

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

Dry Concrete: cured concrete that, at the time of adhesive anchor installation, has not been exposed to water for the preceding 14 days.
Water-Saturated Concrete (wet): cured concrete that, at the time of adhesive anchor installation, has been exposed to water over a sufficient length of time to have the maximum possible amount of absorbed water into the concrete pore structure to a depth equal to the anchor embedment depth.

STRENGTH DESIGN (SD)

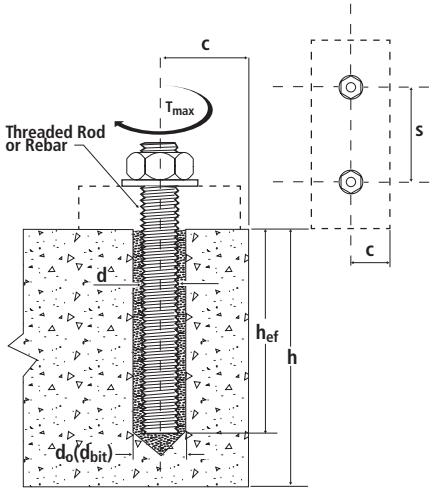
Installation Specifications for Threaded Rod and Reinforcing Bar[1]

CODE LISTED ICC-ES ESR-4027

Dimension/Property	Notation	Units	Nominal Anchor Size											
Threaded Rod	-	-	3/8	-	1/2	-	5/8	-	3/4	7/8	1	-	1-1/4	-
Reinforcing Bar	-	-	-	#3	-	#4	-	#5	#6	#7	#8	#9	-	#10
Nominal anchor diameter	d_a	in. (mm)	0.375 (9.5)		0.500 (12.7)		0.625 (15.9)		0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)	1.250 (31.8)	
Nominal ANSI drill bit size	d_o [d_{bit}]	in.	7/16 ANSI	1/2 ANSI	9/16 ANSI	5/8 ANSI	11/16 ANSI	3/4 ANSI	7/8 ANSI	1 ANSI	1-1/8 ANSI	1-3/8 ANSI	1-3/8 ANSI	1-1/2 ANSI
Minimum embedment	$h_{ef,min}$	in. (mm)	2-3/8 (60)		2-3/4 (70)		3-1/8 (79)		3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)	
Maximum embedment	$h_{ef,max}$	in. (mm)	7-1/2 (191)		10 (254)		12-1/2 (318)		15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)	
Minimum concrete member thickness	h_{min}	in. (mm)	hef + 1-1/4 (hef + 30)				hef + 2do							
Minimum spacing distance	s_{min}	in. (mm)	1-7/8 (48)		2-1/2 (62)		3 (76)		3-5/8 (92)	4-1/4 (108)	4-3/4 (121)	5-1/4 (133)	5-7/8 (149)	
Minimum edge distance (100% T_{max})	c_{min}	in. (mm)	1-5/8 (41)		1-3/4 (44)		2 (51)		2-3/8 (60)	2-1/2 (64)	2-3/4 (70)	3 (75)	3-1/4 (80)	
Maximum Torque[2]	T_{max}	ft-lbs	15[3]		30		44		66	96	147	185	221	
Minimum edge distance, reduced[2,4,5] (45% T_{max})	$c_{min,red}$	in (mm)	-		-		1-3/4 (44)		1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	2-3/4 (70)	2-3/4 (70)	
Maximum Torque, reduced[2]	$T_{max,red}$	ft-lbs	7[3]		14		20		30	43	66	83	99	

1. For use with the design provisions of ACI 318-14 Ch. 17 or ACI 318-11 Appendix D as applicable, ICC-ES AC308, Section 4.2 and ESR-4027
2. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved
3. For ASTM A36/F1554 Grade 36 carbon steel threaded rods, T_{max} = 11 ft.-lb, $T_{max,red}$ = 5.
4. For installations at the reduced minimum edge distance, $c_{min,red}$, the maximum toque applied must be max torque reduced, $T_{max,red}$.
5. For installations at the reduced minimum edge distance, $c_{min,red}$, the miminim spacing, s_{min} = 5 x d_a.

Detail of Steel Hardware Elements used with Injection Adhesive System



Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification (ASTM)	Nominal Anchor Size (inch)	Minimum Ultimate Strength f_u psi (MPa)	Minimum Yield Strength f_y psi (MPa)
Carbon Rod	ASTM A36 or F1554, Grade 36	3/8 through 1-1/4	58,000 (400)	36,000 (250)
	ASTM F1554 Grade 55		75,000 (517)	55,000 (380)
	ASTM A193 Grade B7		125,000 (860)	105,000 (724)
	ASTM F1554 Grade 105		125,000 (860)	105,000 (724)
	ASTM A449	3/8 through 1	120,000 (828)	92,000 (635)
	ASTM A449	1-1/4	105,000 (720)	81,000 (560)
	ASTM F568M Class 5.8	3/4 through 1-1/4	72,500 (500)	58,000 (400)
Stainless Rod (Alloy 304 / 316)	ASTM F593 CW1	3/8 through 5/8	100,000 (690)	65,000 (450)
	ASTM F593 CW2	3/4 through 1-1/4	85,000 (590)	45,000 (310)
	ASTM A193/A193M Grade B8/B8M2, Class 2B	3/8 through 1-1/4	95,000 (655)	75,000 (515)
Grade 60 Reinforcing Bar	ASTM A615, A767, A996 Grade 60	3/8 through 1-1/4 (#3 through #10)	90,000 (620)	60,000 (414)
	ASTM A706 Grade 60		80,000 (550)	60,000 (414)
Grade 40 Reinforcing Bar	ASTM A615 Grade 40	3/8 through 3/4 (#3 through #6)	60,000 (415)	40,000 (275)

Steel Tension and Shear Design for Threaded Rod in Normal Weight Concrete (For use with load combinations taken from ACI 318-14 Section 5.3)

CODE LISTED
ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Rod Diameter[1] (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Threaded rod nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Threaded rod effective cross-sectional area		A_{se}	inch² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A 36 and ASTM F 1554 Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lbf (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F 1554 Grade 55	Nominal strength as governed by steel strength(for a single anchor)	N_{sa}	lbf (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.0)	72,680 (323.3)
		v_{sa}	lbf (kN)	3,485 (15.5)	6,385 (28.4)	10,170 (45.2)	15,050 (67.0)	20,775 (92.4)	27,255 (121.2)	43,610 (194.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A 193 Grade B7 and ASTM F 1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lbf (kN)	5,815 (25.9)	10,640 (7.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A 449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,300 (41.4)	17,025 (75.7)	27,120 (120.6)	40,140 (178.5)	55,905 (248.7)	72,685 (323.3)	101,755 (452.6)
		V_{sa}	lbf (kN)	5,580 (24.8)	10,215 (45.4)	16,270 (72.4)	24,085 (107.1)	33,540 (149.2)	43,610 (194.0)	61,050 (271.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F 568M Class 5.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	5,620 (25.0)	10,290 (45.8)	16,385 (72.9)	24,250 (107.9)	33,475 (148.9)	43,915 (195.4)	70,260 (312.5)
		V_{sa}	lbf (kN)	3,370 (15.0)	6,175 (27.5)	9,830 (43.7)	14,550 (64.7)	20,085 (89.3)	26,350 (117.2)	42,155 (187.5)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM F 593 CW Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lbf (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM A 193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	7,365 (32.8)	13,480 (60.0)	21,470 (95.5)	31,775 (141.3)	43,860 (195.1)	57,545 (256.0)	92,065 (409.5)
		V_{sa}	lbf (kN)	4,420 (19.7)	8,085 (36.0)	12,880 (57.3)	19,065 (84.8)	26,315 (117.1)	34,525 (153.6)	55,240 (245.7)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for steel element material types are based on minimum specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable, except where noted. Nuts and washers must be appropriate for the rod. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Steel Tension and Shear Design for Reinforcing Bars in Normal Weight Concrete (For use with load combinations taken from ACI 318-14 Section 5.3)

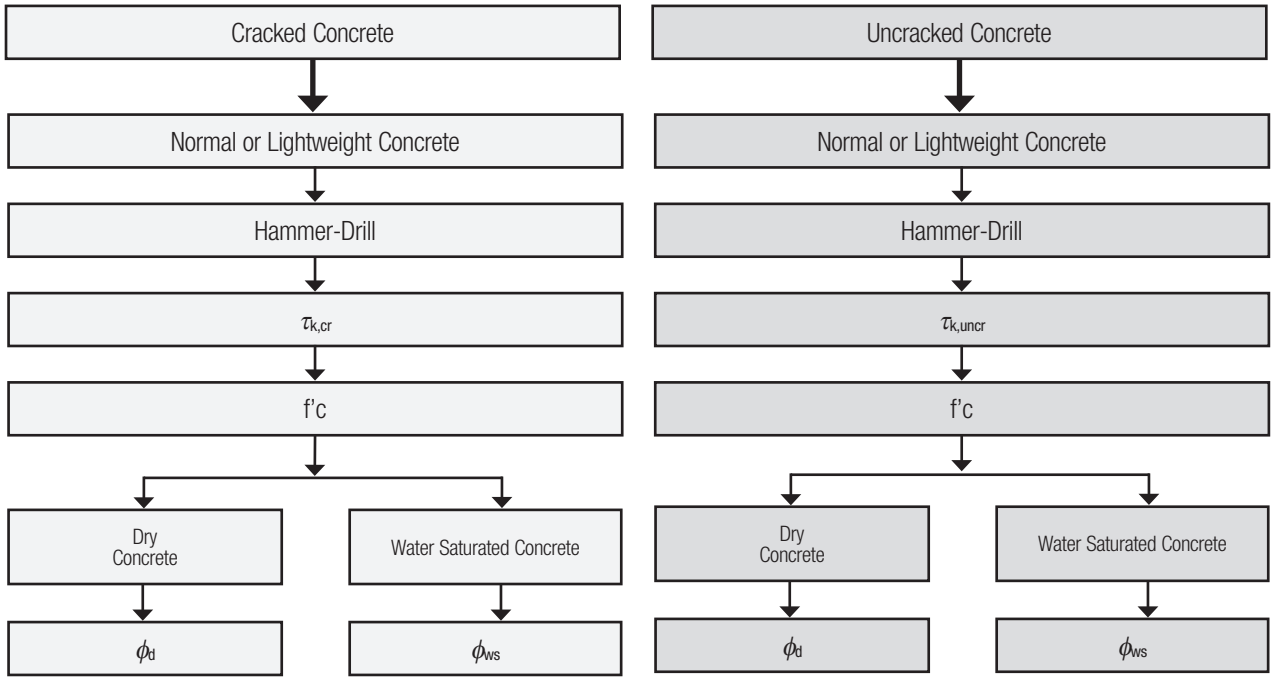
CODE LISTED ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Rebar nominal outside diameter		d	inch (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.7)	1.250 (32.3)
Rebar effective cross-sectional area		A_{se}	inch² (mm²)	0.110 (71.0)	0.200 (129.0)	0.310 (200.0)	0.440 (283.9)	0.600 (387.1)	0.790 (509.7)	1.000 (645.2)	1.270 (819.4)
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.1)	54,000 (240.2)	71,100 (316.3)	90,000 (400.3)	114,300 (508.4)
		V_{sa}	lbf (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lbf (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (94.0)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction factor for seismic shear	$\alpha_{V,seis}$		0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.75							
	Strength reduction factor for shear[2]	ϕ	-	0.65							
ASTM A 615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lbf (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A 615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lbf (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf.

1. Values provided for reinforcing bar material types based on minimum specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
2. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

FLOWCHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH



Concrete Breakout Design Information for Threaded Rod and in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information	Symbol	Units	Nominal Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1-1/4
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)						
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3-1/8 (79)	3-5/8 (90)	4-1/8 (105)	4-3/4 (120)	5-7/8 (150)
Minimum edge distance[2]	c_{min}	inch (mm)	1-5/8 (41)	1-3/4 (44)	2 (51)	2-3/8 (60)	2-1/2 (64)	2-3/4 (70)	3-1/4 (80)
Minimum edge distance, reduced[2] (45% T_{max})	$c_{min,red}$	inch (mm)	-	-	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		h_{ef} + 2d_o where d_o is hole diameter;				
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$						
		(mm)	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$						
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70						

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \cdot \sqrt{h_{ef} \cdot f'c}}{\pi \cdot d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Threaded Rod in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1-1/4
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	25 (635)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1,041 (7.2)	1,041 (7.2)	1,111 (7.7)	1,219 (8.4)	1,212 (8.4)	1,206 (8.3)	1,146 (7.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,601 (17.9)	2,415 (16.7)	2,262 (15.6)	2,142 (14.8)	2,054 (14.2)	2,000 (13.8)	1,990 (13.7)
Temperature Range B 161°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	905 (6.2)	906 (6.2)	966 (6.7)	1060 (7.3)	1054 (7.3)	1049 (7.2)	997 (6.9)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,263 (15.6)	2,101 (14.5)	1,968 (13.6)	1,863 (12.8)	1,787 (12.3)	1,740 (12.0)	1732 (11.9)
Temperature Range C 212°F (100°C) Maximum Long-Term Service Temperature; 320°F (160°C) Maximum Short-Term Service Temperature[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	652 (4.5)	653 (4.5)	696 (4.8)	764 (5.3)	760 (5.2)	756 (5.2)	719 (5.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm2)	1631 (11.2)	1514 (10.4)	1418 (9.8)	1343 (9.3)	1288 (8.9)	1254 (8.6)	1248 (8.6)
Dry concrete	Anchor Category	-	-	1						
	Strength reduction factor	ϕ_d	-	0.65						
Water-saturated concrete	Anchor Category	-	-	2						
	Strength reduction factor	ϕ_{ws}	-	0.55						
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	0.95						

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of (f'c / 2,500)$^{0.10}$ [For SI: (f'c / 17.2)$^{0.10}$].
2. Short-term elevated concrete base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
3. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind, bond strengths may be increased by 23 percent for the temperature range C.

Concrete Breakout Design Information for Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information	Symbol	Units	Nominal Bar Size							
			#3	#4	#5	#6	#7	#8	#9	#10
Effectiveness factor for cracked concrete	$k_{c,cr}$	- (SI)	17 (7.1)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	- (SI)	24 (10.0)							
Minimum embedment	$h_{ef,min}$	inch (mm)	2-3/8 (60)	2-3/4 (70)	3-1/8 (79)	3-1/2 (89)	3-1/2 (89)	4 (102)	4-1/2 (114)	5 (127)
Maximum embedment	$h_{ef,max}$	inch (mm)	7-1/2 (191)	10 (254)	12-1/2 (318)	15 (381)	17-1/2 (445)	20 (508)	22-1/2 (572)	25 (635)
Minimum anchor spacing	s_{min}	inch (mm)	1-7/8 (48)	2-1/2 (64)	3 (79)	3-5/8 (92)	4-1/4 (105)	4-3/4 (120)	5-1/4 (133)	5-7/8 (150)
Minimum edge distance[2]	c_{min}	inch (mm)	1-5/8 (41)	1-3/4 (44)	2 (51)	2-3/8 (60)	2-1/2 (64)	2-3/4 (70)	3 (75)	3-1/4 (80)
Minimum edge distance, reduced[2]	$c_{min,red}$	inch (mm)	-	-	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)	2-3/4 (70)	2-3/4 (70)
Minimum member thickness	h_{min}	inch (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)		h_{ef} + 2d_o where d_o is hole diameter;					
Critical edge distance—splitting (for uncracked concrete only)[3]	c_{ac}	inch	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$							
		(mm)	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1\text{-}0.7 \frac{h}{h_{ef}}]$							
Strength reduction factor for tension, concrete failure modes, Condition B[4]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[4]	ϕ	-	0.70							

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N. For pound-inch units: 1 mm = 0.03937 inch, 1 N = 0.2248 lbf.

1. Additional setting information is described in the installation instructions.
2. For installation between the minimum edge distance, c_{min}, and the reduced minimum edge distance, $c_{min,red}$, the maximum torque applied must be reduced (multiplied) by a factor of 0.45.
3. $\tau_{k,uncr}$ need not be taken as greater than: $\tau_{k,uncr} = \frac{k_{uncr} \cdot \sqrt{h_{ef} \cdot f'c}}{\pi \cdot d}$ and $\frac{h}{h_{ef}}$ need not be taken as larger than 2.4.
4. Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, are used in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318 D.4.4.

Bond Strength Design Information for Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED ICC-ES ESR-4027

Design Information		Symbol	Units	Nominal Bar Size							
				#3	#4	#5	#6	#7	#8	#9	#10
Minimum embedment		$h_{ef,min}$	inch (mm)	2-3/8 (60.0)	2-3/4 (70.0)	3-1/8 (79.0)	3-1/2 (89.0)	3-1/2 (89.0)	4 (102.0)	4-1/2 (114.0)	5 (127.0)
Maximum embedment		$h_{ef,max}$	inch (mm)	7-1/2 (191.0)	10 (254.0)	12-1/2 (318.0)	15 (381.0)	17-1/2 (445.0)	20 (508.0)	22-1/2 (572.0)	25 (635.0)
Temperature Range A 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1,088 (7.5)	1,053 (7.3)	1,128 (7.8)	1,169 (8.1)	1,174 (8.1)	1,156 (8.0)	1,141 (7.9)	1,164 (8.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,200 (15.2)	2,101 (14.5)	2,028 (14.0)	1,969 (13.6)	1,921 (13.2)	1,881 (13.0)	1,846 (12.7)	1,815 (12.5)
Temperature Range B 161°F (72°C) Maximum Long-Term Service Temperature; 248°F (120°C) Maximum Short-Term Service Temperature[2]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	947 (6.5)	916 (6.3)	982 (6.8)	1,017 (7.0)	1,021 (7.0)	1,006 (6.9)	993 (6.8)	1,012 (7.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,914 (13.2)	1,828 (12.6)	1,764 (12.2)	1,713 (11.8)	1,672 (11.5)	1,636 (11.3)	1,616 (11.1)	1,579 (10.9)
Temperature Range C 212°F (100°C) Maximum Long-Term Service Temperature; 320°F (160°C) Maximum Short-Term Service Temperature[2,3]	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	682 (4.7)	660 (4.6)	707 (4.9)	733 (5.1)	736 (5.1)	725 (5.0)	715 (4.9)	730 (5.0)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,379 (9.5)	1,317 (9.1)	1,271 (8.8)	1,235 (8.5)	1,205 (8.3)	1,179 (8.1)	1,157 (8.0)	1,138 (7.8)
Dry concrete	Anchor Category	-	-	1							
	Strength reduction factor	ϕ_d	-	0.65							
Water-saturated concrete	Anchor Category	-	-	2							
	Strength reduction factor	ϕ_{ws}	-	0.55							
Reduction factor for seismic tension[9]		$\alpha_{N,seis}$	-	0.95		1.00					

For SI: 1 inch = 25.4 mm, 1 psi = 0.006894 MPa. For pound-inch units: 1 mm = 0.03937 inch, 1 MPa = 145.0 psi.

1. Bond strength values correspond to a normal-weight concrete compressive strength f'c = 2,500 psi (17.2 MPa). For concrete compressive strength, f'c between 2,500 psi and 8,000 psi (17.2 MPa and 55.2 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'c / 2{,}500)^{0.10}$ [For SI: $(f'c / 17.2)^{0.10}$].
2. Short-term elevated concrete base material service temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling. Long-term elevated concrete base material service temperatures are roughly constant over significant periods of time.
3. Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only, such as wind, bond strengths may be increased by 23 percent for the temperature range C.

ADHESIVES

AC200+
Acrylic Injection Adhesive Anchoring System

Tension and Shear Design Strength for Threaded Rod Installed in Uncracked Concrete (Bond or Concrete Strength)
Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition
Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9]

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,425	4,745	5,105	5,500
	3	4,055	4,010	4,440	4,555	5,125	5,570	6,280	7,400	6,710	8,775
	7-1/2	7,445	7,935	8,155	9,015	9,395	11,015	9,785	13,710	10,070	16,015
	4-1/2	14,940	18,190	15,215	20,070	15,655	23,445	16,305	29,180	16,780	34,085
1/2	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	9,665	12,365	11,080	15,080
	6	11,465	13,235	12,560	15,035	14,500	18,390	16,150	23,515	16,620	27,470
	10	24,660	31,215	25,110	34,445	25,845	40,235	26,915	50,085	27,700	58,500
5/8	3-1/8	4,310	4,120	4,720	4,680	5,450	5,720	6,675	7,600	7,710	9,295
	5	8,720	9,985	9,555	11,345	11,030	13,875	13,510	18,430	15,600	22,540
	7-1/2	16,020	19,725	17,550	22,410	20,265	27,410	23,635	35,695	24,325	41,695
	12-1/2	34,470	46,550	36,750	52,320	37,825	61,110	39,390	76,070	40,540	87,310
3/4	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	20,505	30,695
	9	21,060	26,855	23,070	30,510	26,640	37,320	32,225	49,325	33,165	57,615
	15	45,315	63,370	49,640	72,000	51,575	84,420	53,710	105,080	55,280	119,060
7/8	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,840	37,485
	10-1/2	26,540	32,800	29,070	37,265	33,570	45,580	41,115	60,540	43,290	71,360
	17-1/2	57,100	77,405	62,550	87,940	67,315	104,575	70,100	130,170	72,150	152,045
1	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	50,230	71,990	55,055	86,235
	20	69,765	92,055	76,425	104,585	85,610	126,375	89,155	157,310	91,755	183,745
1-1/4	5	8,720	8,170	9,555	9,285	11,030	11,355	13,510	15,085	15,600	18,450
	10	24,665	26,380	27,020	29,975	31,200	36,660	38,210	48,690	44,125	59,555
	15	45,315	52,110	49,640	59,200	57,320	72,410	70,200	96,175	81,060	117,630
	25	97,500	122,990	106,805	139,730	123,330	170,905	138,610	219,325	142,655	256,185

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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}
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.
2. Calculations were performed according to ACI 318-14 Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318-14 Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Tension and Shear Design Strength in Threaded Rod Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9]

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
3/8	2-3/8	1,895	1,835	1,930	2,075	1,985	2,135	2,065	2,225	2,125	2,290
	3	2,390	2,865	2,435	3,255	2,505	3,980	2,610	5,285	2,685	5,785
	7-1/2	3,585	5,665	3,655	6,440	3,760	7,865	3,915	8,435	4,030	8,680
	4-1/2	5,980	12,875	6,090	13,115	6,265	13,495	6,525	14,055	6,715	14,465
1/2	2-3/4	2,520	2,360	2,760	2,680	3,065	3,280	3,190	4,355	3,285	5,325
	4	4,250	4,785	4,330	5,435	4,455	6,650	4,640	8,830	4,775	10,285
	6	6,375	9,455	6,495	10,740	6,685	13,135	6,960	14,990	7,165	15,430
	10	10,630	22,300	10,825	23,315	11,140	23,995	11,600	24,985	11,940	25,715
5/8	3-1/8	3,050	2,940	3,345	3,340	3,860	4,085	4,730	5,430	4,980	6,640
	5	6,175	7,135	6,765	8,105	7,430	9,910	7,740	13,165	7,965	16,100
	7-1/2	10,635	14,090	10,830	16,005	11,145	19,575	11,610	25,000	11,945	25,730
	12-1/2	17,725	33,250	18,050	37,370	18,575	40,010	19,345	41,670	19,910	42,885
3/4	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	12,225	17,925	12,585	21,925
	9	14,920	19,185	16,340	21,795	17,610	26,655	18,340	35,230	18,875	40,655
	15	28,005	45,265	28,520	51,425	29,350	60,300	30,565	65,835	31,460	67,755
7/8	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	17,030	26,775
	10-1/2	18,800	23,430	20,590	26,620	23,780	32,555	24,820	43,240	25,545	50,970
	17-1/2	37,900	55,290	38,595	62,815	39,720	74,695	41,365	89,095	42,570	91,695
1	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	22,130	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	32,255	51,425	33,200	61,595
	20	49,255	65,755	50,160	74,705	51,625	90,270	53,760	112,365	55,330	119,170
1-1/4	5	6,175	5,835	6,765	6,630	7,815	8,110	9,570	10,775	11,050	13,175
	10	17,470	18,845	19,140	21,410	22,100	26,185	27,065	34,780	31,255	42,540
	15	32,095	37,220	35,160	42,285	40,600	51,720	47,895	68,695	49,290	84,020
	25	69,060	87,850	74,475	99,810	76,650	122,075	79,820	156,660	82,150	176,940

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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}
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.
2. Calculations were performed according to ACI 318-14 Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318-14 Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Tension and Shear Design Strength for Reinforcing Bar Installed in Uncracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9]

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_a Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	2,855	2,570	3,125	2,920	3,610	3,575	4,365	4,705	4,495	4,840
	3	4,055	4,010	4,440	4,555	5,125	5,570	5,515	7,025	5,675	8,205
	7-1/2	7,445	7,935	7,720	8,820	7,945	10,300	8,275	12,820	8,515	14,975
	4-1/2	12,635	17,010	12,870	18,770	13,245	21,925	13,790	27,290	14,195	30,570
#4	2-3/4	3,555	3,305	3,895	3,755	4,500	4,590	5,510	6,095	6,365	7,455
	4	6,240	6,700	6,835	7,610	7,895	9,310	9,365	12,210	9,640	14,260
	6	11,465	13,235	12,560	15,035	13,490	17,870	14,050	22,240	14,460	25,980
	10	21,450	29,525	21,845	32,580	22,485	38,055	23,415	47,370	24,100	51,905
#5	3-1/8	4,310	4,120	4,720	4,680	5,450	5,725	6,675	7,600	7,710	9,295
	5	8,720	10,005	9,555	11,365	11,030	13,900	13,510	18,465	14,540	21,955
	7-1/2	16,020	19,760	17,550	22,450	20,265	27,460	21,190	34,235	21,805	39,985
	12-1/2	32,355	45,455	32,950	50,155	33,910	58,585	35,315	72,925	36,345	78,280
#6	3-1/2	5,105	5,015	5,595	5,700	6,460	6,970	7,910	9,255	9,135	11,320
	6	11,465	13,595	12,560	15,445	14,500	18,895	17,760	25,095	20,325	30,585
	9	21,060	26,855	23,070	30,510	26,640	37,320	29,625	47,690	30,490	55,705
	15	45,235	63,325	46,065	69,880	47,410	81,620	49,370	101,600	50,815	109,445
#7	3-1/2	5,105	4,930	5,595	5,605	6,460	6,855	7,910	9,100	9,135	11,130
	7	14,445	16,605	15,825	18,865	18,275	23,075	22,380	30,650	25,840	37,485
	10-1/2	26,540	32,800	29,070	37,265	33,570	45,580	39,340	59,480	40,485	69,475
	17-1/2	57,100	77,405	61,170	87,160	62,960	101,810	65,565	126,730	67,475	145,335
#8	4	6,240	6,115	6,835	6,945	7,895	8,495	9,665	11,280	11,160	13,800
	8	17,650	19,750	19,335	22,435	22,325	27,440	27,340	36,450	31,570	44,580
	12	32,425	39,005	35,520	44,315	41,015	54,200	50,230	71,990	51,780	84,145
	20	69,765	92,055	76,425	104,585	80,520	123,310	83,850	153,495	86,295	179,295
#9	4-1/2	7,445	7,110	8,155	8,080	9,420	9,880	11,535	13,125	13,320	16,055
	9	21,060	23,055	23,070	26,190	26,640	32,035	32,625	42,550	37,675	52,040
	13-1/2	38,690	45,540	42,380	51,740	48,940	63,280	59,940	84,050	64,315	99,830
	22-1/2	83,245	107,440	91,190	122,065	100,010	146,245	104,150	182,045	107,190	212,640
#10	5	8,720	8,160	9,555	9,270	11,030	11,335	13,510	15,060	15,600	18,420
	10	24,665	26,430	27,020	30,025	31,200	36,725	38,210	48,780	44,125	59,660
	15	45,315	52,205	49,640	59,310	57,320	72,545	70,200	96,350	78,065	116,085
	25	97,500	123,170	106,805	139,935	121,395	170,075	126,420	211,705	130,110	247,285

☐ - Concrete Breakout Strength ☐ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in uncracked 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}
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.
2. Calculations were performed according to ACI 318-14 Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318-14 Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Tension and Shear Design Strength for Reinforcing Bar Installed in Cracked Concrete (Bond or Concrete Strength) Drilled with a Hammer-Drill and Carbide Bit in a Dry Hole Condition Temperature Range A: 122°F (50°C) Maximum Long-Term Service Temperature; 176°F (80°C) Maximum Short-Term Service Temperature[1,2,3,4,5,6,7,8,9]

Nominal Rod Size (in.)	Embed. Depth hef (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_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)	ϕN_{cb} or ϕN_{a} Tension (lbs.)	ϕV_{cb} or ϕV_{cp} Shear (lbs.)
#3	2-3/8	1,980	1,835	2,015	2,085	2,075	2,235	2,160	2,325	2,225	2,395
	3	2,500	2,865	2,545	3,255	2,620	3,980	2,730	5,020	2,810	5,860
	7-1/2	3,750	5,665	3,820	6,300	3,930	7,355	4,090	8,815	4,210	9,070
	4-1/2	6,250	12,150	6,365	13,405	6,550	14,105	6,820	14,690	7,020	15,120
#4	2-3/4	2,520	2,360	2,760	2,680	3,100	3,280	3,225	4,355	3,320	5,325
	4	4,300	4,785	4,380	5,435	4,505	6,650	4,695	8,720	4,830	10,185
	6	6,450	9,455	6,570	10,740	6,760	12,765	7,040	15,165	7,245	15,610
	10	10,750	21,090	10,950	23,270	11,270	24,270	11,735	25,275	12,075	26,015
#5	3-1/8	3,050	2,940	3,345	3,340	3,860	4,090	4,730	5,430	5,055	6,640
	5	6,175	7,145	6,765	8,120	7,545	9,930	7,855	13,190	8,085	15,680
	7-1/2	10,795	14,115	10,995	16,035	11,315	19,615	11,785	24,455	12,130	26,125
	12-1/2	17,995	32,465	18,325	35,825	18,860	40,625	19,640	42,305	20,215	43,540
#6	3-1/2	3,620	3,580	3,965	4,070	4,575	4,980	5,605	6,610	6,470	8,085
	6	8,120	9,710	8,895	11,035	10,270	13,495	11,725	17,925	12,065	21,845
	9	14,920	19,185	16,340	21,795	16,890	26,655	17,585	34,065	18,100	38,985
	15	26,855	45,235	27,350	49,915	28,150	58,300	29,310	63,135	30,170	64,975
#7	3-1/2	3,620	3,525	3,965	4,000	4,575	4,895	5,605	6,500	6,470	7,950
	7	10,230	11,860	11,210	13,475	12,945	16,485	15,850	21,895	16,495	26,775
	10-1/2	18,800	23,430	20,590	26,620	23,085	32,555	24,040	42,485	24,745	49,625
	17-1/2	36,710	55,290	37,385	62,260	38,475	72,720	40,070	86,300	41,240	88,820
#8	4	4,420	4,365	4,840	4,960	5,590	6,065	6,845	8,060	7,905	9,855
	8	12,500	14,105	13,695	16,025	15,815	19,600	19,365	26,035	21,215	31,845
	12	22,965	27,860	25,160	31,655	29,050	38,715	30,920	51,425	31,820	60,105
	20	47,210	65,755	48,080	74,705	49,485	88,080	51,530	109,640	53,035	114,230
#9	4-1/2	5,275	5,080	5,780	5,770	6,670	7,060	8,170	9,375	9,435	11,465
	9	14,920	16,465	16,340	18,710	18,870	22,880	23,110	30,390	26,500	37,170
	13-1/2	27,405	32,530	30,020	36,955	34,665	45,200	38,625	60,035	39,750	71,305
	22-1/2	58,965	76,740	60,060	87,190	61,815	104,460	64,375	130,030	66,250	142,695
#10	5	6,175	5,830	6,765	6,620	7,815	8,100	9,570	10,755	11,050	13,155
	10	17,470	18,880	19,140	21,445	22,100	26,230	27,065	34,840	31,255	42,615
	15	32,095	37,290	35,160	42,365	40,600	51,815	48,645	68,825	50,065	82,920
	25	69,060	87,980	75,645	99,955	77,855	121,485	81,075	151,220	83,440	176,635

□ - Concrete Breakout Strength □ - Bond Strength/Pryout Strength

1. Tabular values are provided for illustration and are applicable for single anchors installed in cracked 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}
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.
2. Calculations were performed according to ACI 318-14 Ch.17 and ICC-ES AC308. The load level corresponding to the failure mode listed [Concrete breakout strength, bond strength/pryout strength] must be checked against the tabulated steel strength of the corresponding threaded rod or rebar size and type, the lowest load level controls.
3. Strength reduction factors (ϕ) for concrete breakout strength are based on ACI 318-14 Section 5.3 for load combinations. Condition B was assumed.
4. Strength reduction factors (ϕ) for bond strength are determined from reliability testing and qualification in accordance with ICC-ES AC308 and are tabulated in this product information and in ESR-4027.
5. Tabular values are permitted for static loads only, seismic loading is not considered with these tables. Periodic special inspection must be performed where required by code, see ESR-4027 for applicable information.
6. For anchors subjected to tension resulting from sustained loading a supplemental check must be performed according to ACI 318-14 17.3.1.2.
7. For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Ch.17.
8. Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths, please see ACI 318-14 Ch.17, ICC-ES AC308 and information included in this product supplement. For other design conditions including seismic considerations please see ACI 318-14 Ch.17 and ICC-ES AC308 and ESR-4027.
9. Long term concrete temperatures are roughly constant over significant periods of time. Short-term elevated temperatures are those that occur over brief intervals, e.g. as a result of diurnal cycling.

Tension Design of Steel Elements (Steel Strength)[1,2]

Steel Elements - Threaded Rod and Reinforcing Bar										
Nominal Rod/Rebar Size (in. or No.)	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)	ϕN_{sa} Tension (lbs.)
3/8 or #3	3,370	4,360	7,265	6,975	3,655	5,040	5,525	6,435	6,600	4,290
1/2 or #4	6,175	7,980	13,300	12,770	6,690	9,225	10,110	11,700	12,000	7,800
5/8 or #5	9,835	12,715	21,190	20,340	10,650	14,690	16,105	18,135	18,600	12,090
3/4 or #6	14,550	18,815	31,360	30,105	15,765	18,480	23,830	25,740	26,400	17,160
7/8 or #7	20,085	25,970	43,285	41,930	21,760	25,510	32,895	35,100	36,000	-
1 or #8	26,350	34,070	56,785	54,515	28,545	33,465	43,160	46,215	47,400	-
#9	-	-	-	-	-	-	-	58,500	60,000	-
1-1/4 or #10	42,160	54,510	9,100	76,315	45,670	53,540	69,050	74,295	76,200	-

■ - Steel Strength

1. Steel tensile design strength according to ACI 318-14 Ch.17, $\phi N_{sa} = \phi \bullet A_{se,N} \bullet f_{uta}$
2. The tabulated steel design strength in tension must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

Shear Design of Steel Elements (Steel Strength)[1,2]

Steel Elements - Threaded Rod and Reinforcing Bar										
Nominal Rod/Rebar Size (in. or No.)	ASTM A36 and ASTM F1554 Grade 36	ASTM F1554 Grade 55	ASTM A193 Grade B7 and ASTM F1554 Grade 105	ASTM A449	ASTM F568M Class 5.8	ASTM F593 CW Stainless (Types 304 and 316)	ASTM A193 Grade B8/ B8M2, Class 2B Stainless (Types 304 and 316)	ASTM A615 Grade 60 Rebar	ASTM A706 Grade 60 Rebar	ASTM A615 Grade 40 Rebar
	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)	ϕV_{sa} Shear (lbs.)
3/8 or #3	1,755	2,265	3,775	3,625	2,020	2,790	2,870	3,565	3,430	2,375
1/2 or #4	3,210	4,150	6,915	6,640	3,705	5,110	5,255	6,480	6,240	4,320
5/8 or #5	5,115	6,610	11,020	10,575	5,900	8,135	8,375	10,045	9,670	6,695
3/4 or #6	7,565	9,785	16,305	15,655	8,730	10,235	12,390	14,255	13,730	9,505
7/8 or #7	10,445	13,505	22,505	21,805	12,050	14,130	17,105	19,440	18,720	-
1 or #8	13,700	17,715	29,525	28,345	15,810	18,535	22,445	25,595	24,650	-
#9	-	-	-	-	-	-	-	32,400	31,200	-
1-1/4 or #10	21,920	28,345	4,735	39,685	25,295	29,655	35,905	41,150	39,625	-

■ - Steel Strength

1. Steel shear design strength according to ACI 318-14 Ch.17, $\phi V_{sa} = \phi \bullet 0.60 \bullet A_{se,V} \bullet f_{uta}$
2. The tabulated steel design strength in shear must be checked against the bond strength/concrete capacity design strength to determine the controlling failure mode, the lowest load level controls.

ORDERING INFORMATION

AC200+ Cartridges

Cat. No.	Description	Std. Box	Std. Ctn.	Pallet
PFC1271050	AC200+ 10 fl. oz. Quik-Shot	12	36	648
PFC1271100	AC200+ 12 fl. oz. Dual cartridge	-	12	540
PFC1271150	AC200+ 28 fl. oz. Dual cartridge	-	8	240

One AC200+ mixing nozzle is packaged with each cartridge.
AC200+ mixing nozzles must be used to ensure complete and proper mixing of the adhesive.

Cartridge System Mixing Nozzles

Cat. No.	Description	Std. Pkg.	Std. Ctn.
PFC1641600	Mixing nozzle (with 8" extension)	2	24
08281	Mixing nozzle extension, 8" long	2	24
08297	Mixing nozzle extension, 20" long	1	12

Dispensing Tools for Injection Adhesive

Cat. No.	Description	Std. Box	Std. Ctn.
08437	Manual caulking gun for Quik-Shot	1	12
08479	High performance caulking gun for Quik-Shot	1	12
08485	12 fl. oz. Standard metal manual tool	1	20
08495	28 fl. oz. High performance manual tool	1	-
08496	28 fl. oz. High performance pneumatic tool	1	-
DCE595D1	28 fl. oz. 20v Battery powered dispensing tool	1	-

Hole Cleaning Tools and Accessories

Cat No.	Description	Std. Box
PFC1671050	Premium Wire brush for 7/16" ANSI hole (3/8" rod)	1
PFC1671100	Premium Wire brush for 1/2" hole (#3 rebar)	1
PFC1671150	Premium Wire brush for 9/16" ANSI hole (1/2" rod)	1
PFC1671200	Premium Wire brush for 5/8" ANSI hole (#4 rebar)	1
PFC1671225	Premium Wire brush for 11/16" ANSI hole (5/8" rod)	1
PFC1671250	Premium Wire brush for 3/4" ANSI hole (#5 rebar)	1
PFC1671300	Premium Wire brush for 7/8" ANSI hole (3/4" rod or #6 rebar)	1
PFC1671350	Premium Wire brush for 1" ANSI hole (7/8" rod or #7 rebar)	1
PFC1671400	Premium Wire brush for 1-1/8" ANSI hole (1" rod or #8 rebar)	1
PFC1671450	Premium Wire brush for 1-3/8" ANSI hole (1-1/4" rod or #9 rebar)	1
PFC1671500	Premium Wire brush for 1-1/2" ANSI hole (#10 rebar)	1
PFC1671830	Premium SDS-plus adapter for steel brushes	1
PFC1671000	Premium manual brush wood handle	1
PFC1671820	Premium Steel brush extension, 12" length	1
08292	Air compressor nozzle with extension, 18" length	1

Adhesive Piston Plugs

Cat. #	Description	ANSI Drill Bit Dia.	Threaded Rod Dia.	Reinforcing Bar Size	Std. Bag"
08258	11/16" Plug	11/16"	5/8"	#5	10
08259	3/4" Plug	3/4"	5/8"	#5	10
08300	7/8" Plug	7/8"	3/4"	#6	10
08301	1" Plug	1"	7/8"	#7	10
08303	1-1/8" Plug	1-1/8"	1"	#8	10
08305	1-3/8" Plug	1-3/8"	1-1/4"	#9	10
08309	1-1/2" Plug	1-1/2"	-	#10	10

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

REPORT HOLDER:

DEWALT

701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286

EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

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

EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2015, 2012 and 2009 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

AC200+ adhesive anchors are used to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads in cracked and uncracked normal-weight or lightweight concrete with a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The anchor system complies with anchors as described in Section 1901.3 of the 2015 IBC, Section 1909 of the 2012 IBC and is an alternative to cast-in-place and post-installed anchors described in Section 1908 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchor systems may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 General:

The AC200+ Adhesive Anchor System is comprised of AC200+ two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment and adhesive injection accessories.

AC200+ adhesive may be used with continuously threaded steel rods or deformed steel reinforcing bars. The primary components of the AC200+ Adhesive Anchor System, including the AC200+ adhesive cartridge, static mixing nozzle, and steel anchor elements, are shown in Figures 1 and 2 of this report. The manufacturer's published installation instructions (MPII), included with each adhesive unit package, are shown in Figure 3 of this report.

3.2 Materials:

3.2.1 AC200+ Adhesive: AC200+ adhesive is an injectable two-component vinylester-urethane hybrid adhesive. The two components are kept separate by means of a labelled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by DEWALT, which is attached to the cartridge. AC200+ is available in cartridges: 10-ounce (280 mL), 12-ounce (345 mL) and 28-ounce (825 mL).

Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge stored in a dry, dark, and cool environment.

3.2.2 Hole Cleaning Equipment: Hole cleaning equipment is comprised of steel wire brushes supplied by DEWALT, and air blowers which are shown in Figure 3 of this report.

3.2.3 Dispensers: AC200+ adhesive must be dispensed with manual dispensers, pneumatic dispensers, or electric powered dispensers supplied by DEWALT.

3.2.4 Steel Anchor Elements:

3.2.4.1 Threaded Steel Rods: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters described in Tables 4 and 10 and Figure 3 of this report. Specifications for grades of threaded rod, including the mechanical properties, and corresponding nuts and washers, are included in Table 2 of this report. Carbon steel threaded rods must be furnished with a minimum 0.0002-inch-thick (0.005 mm) zinc electroplated coating complying with ASTM B633 SC1 or a minimum 0.0021-inch-thick (0.053 mm) mechanically deposited zinc coating complying with ASTM B695, Class 55. The stainless steel threaded rods must comply with Table 2 of this report. Steel grades and types of material (carbon, stainless) for the washers and nuts must match the

threaded rods. Threaded steel rods must be clean, straight and free of indentations or other defects along their length. The embedded end may be flat cut or cut on the bias to a chisel point.

3.2.4.2 Steel Reinforcing Bars: Steel reinforcing bars are deformed reinforcing bars as described in Table 3 of this report. Tables 7 and 13 and Figure 3 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be clean, straight, and free of mill scale, rust, mud, oil and other coatings (other than zinc) that may impair the bond with the adhesive. Reinforcing bars must not be bent after installation except as set forth in ACI 318-14 Section 26.6.3.1 (b) or ACI 318-11 Section 7.3.2, as applicable, with the additional condition that the bars must be bent cold, and heating of reinforcing bars to facilitate field bending is not permitted.

3.2.4.3 Ductility: In accordance with ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, in order for a steel anchor element to be considered ductile, the tested elongation must be at least 14 percent and reduction of area must be at least 30 percent. Steel elements with a tested elongation less than 14 percent or a reduction of area less than 30 percent, or both, are considered brittle. Values for various steel materials are provided in Table 2 of this report. Where values are nonconforming or unstated, the steel must be considered brittle.

3.3 Concrete:

Normal-weight and lightweight concrete must comply with Sections 1903 and 1905 of the IBC. The specified compressive strength of the concrete must be from 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: The design strength of anchors under the 2015 IBC, as well as the 2015 IRC, must be determined in accordance with ACI 318-14 and this report. The design strength of anchors under the 2012 and 2009 IBC, as well as the 2012 and 2009 IRC, must be determined in accordance with ACI 318-11 and this report.

The strength design of anchors must comply with ACI 318-14 17.3.1 or 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable.

Design parameters are provided in Tables 4 through Table 15 of this report. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable.

Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with ACI 318-11 Appendix C.

4.1.2 Static Steel Strength in Tension: The nominal static steel strength of a single anchor in tension, N_{sa}, in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, and the associated strength reduction factors, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are provided in Tables 4, 7, 10 and 13 of this report for the corresponding anchor steel.

4.1.3 Static Concrete Breakout Strength in Tension: The nominal static concrete breakout strength of a single anchor or group of anchors in tension, N_{cb} or N_{cbg}, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with the following addition:

The basic concrete breakout strength of a single anchor in tension, N_b, must be calculated in accordance with ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of $k_{c,cr}$ and $k_{c,uncr}$ as provided in Tables 5, 8, 11 and 14 of this report. Where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, N_b must be calculated using $k_{c,uncr}$ and $\Psi_{c,N}$ = 1.0. For anchors in lightweight concrete see ACI 318-14 17.2.6 or ACI 318-11 D.3.6, as applicable. The value of f'_c used for calculation must be limited to 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable. The value of f'_c used for calculation must be limited to 2,500 psi (17.2 MPa) maximum for metric reinforcing bars in cracked concrete. Additional information for the determination of nominal bond strength in tension is given in Section 4.1.4 of this report.

4.1.4 Static Bond Strength in Tension: The nominal static bond strength of a single adhesive anchor or group of adhesive anchors in tension, N_a or N_{ag}, must be calculated in accordance with ACI 318-14 17.4.5 or ACI 318-11 D.5.5, as applicable.

Bond strength values ($\tau_{k,cr}$, $\tau_{k,uncr}$) are a function of concrete compressive strength, concrete state (cracked, uncracked), concrete type (normalweight, lightweight) and installation conditions (dry concrete, water-saturated concrete). Special inspection level is qualified as periodic for all anchors except as shown in Section 4.3 of this report (the selection of continuous special inspection level does not provide an increase in anchor category or associated strength reduction factor for design). The following table summarizes the requirements:

Strength reduction factors for determination of the bond strength are given in Tables 6, 9, 12 and 15 of this report.

CONCRETE STATE	BOND STRENGTH	CONCRETE TYPE	CONCRETE COMPRESSIVE STRENGTH	PERMISSIBLE INSTALLATION CONDITIONS	ASSOCIATED STRENGTH REDUCTION FACTOR
Cracked	$\tau_{k,cr}$	Normalweight, Lightweight	f'_c	Dry concrete	ϕ_d
				Water-saturated concrete	ϕ_{ws}
Uncracked	$\tau_{k,uncr}$			Dry concrete	ϕ_d
				Water-saturated concrete	ϕ_{ws}

Adjustments to the bond strength may also be made for increased concrete compressive strength as noted in the footnotes to the corresponding tables and this section.

The bond strength values in Tables 6, 9, 12 and 15 of this report correspond to concrete compressive strength f'_c equal to 2,500 psi (17.2 MPa). For concrete compressive strength, f'_c, between 2,500 psi and 8,000 psi (17.2 MPa and 55 MPa), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.10}$ [For **SI:** $(f'_c / 17.2)^{0.10}$]. The value of f'_c used for calculation must be limited to 2,500 psi (17.2 MPa) maximum for metric reinforcing bars in cracked concrete. Where applicable, the modified bond strength values must be used in lieu of $\tau_{k,cr}$ and $\tau_{k,uncr}$ in ACI 318-14 Equations (17.4.5.1d) and

(17.4.5.2) or ACI 318-11 Equations (D-21) and (D-22), as applicable.

The resulting nominal bond strength must be multiplied by the associated strength reduction factor ϕ_d or ϕ_{ws}, as applicable.

4.1.5 Static Steel Strength in Shear: The nominal static steel strength of a single anchor in shear as governed by the steel, V_{sa}, in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, and the strength reduction factor, ϕ, in accordance with ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are given in Tables 4, 7, 11 and 13 of this report for the corresponding anchor steel.

4.1.6 Static Concrete Breakout Strength in Shear: The nominal static concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, must be calculated in accordance with ACI 318-14 17.5.2 or 318-11 D.6.2, as applicable, based on information given in Tables 5, 8, 12 and 14 in this report.

The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable using the values of d given in Tables 5, 8, 12 and 14 for the corresponding anchor steel in lieu of d_a. In addition, h_{ef} must be substituted for ℓ_e. In no case shall ℓ_e exceed 8d. The value of f'_c shall be limited to a maximum of 8,000 psi (55 MPa) in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.7 Static Concrete Pryout Strength in Shear: The nominal static pryout strength of a single anchor or group of anchors in shear, V_{cp} or V_{cpg}, shall be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable.

4.1.8 Interaction of Tensile and Shear Forces: For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.9 Minimum Member Thickness h_{min}, Anchor Spacing s_{min}, Edge Distance c_{min}: In lieu of ACI 318-14 17.7.1 and 17.7.3 or ACI 318-11 D.8.1 and D.8.3, as applicable, values of s_{min} and c_{min} described in this report must be observed for anchor design and installation. The minimum member thicknesses, h_{min}, described in this report must be observed for anchor design and installation. For adhesive anchors that will remain untorqued, ACI 318-14 17.7.4 or ACI 318-11 D.8.4, as applicable.

For anchors that will be torqued during installation, the maximum torque, T_{max}, must be reduced for edge distances less than the values given in Tables 5, 8, 11 and 14, as applicable. T_{max} is subject to the edge distance, c_{min}, and anchor spacing, s_{min}, and shall comply with the following requirements:

INSTALLATION TORQUE SUBJECT TO EDGE DISTANCE			
NOMINAL ANCHOR SIZE, *d*	**MINIMUM EDGE DISTANCE, c_{min}**	**MINIMUM ANCHOR SPACING, s_{min}**	**MAXIMUM TORQUE, T_{max}**
$^5/_8$ in. to 1 in. #5 to #8 M16 to M24 ø14 to ø25	1.75 in. (44.5 mm)	5*d*	0.45·T_{max}
$1^1/_4$ in. #9 to #10 M27 to M30 ø28 to ø32	2.75 in. (70 mm)		

For values of T_{max} see Figure 2 of this report.

4.1.10 Critical Edge Distance c_{ac} and $\psi_{cp,Na}$: The modification factor $\psi_{cp,Na}$, must be determined in accordance with ACI 318-14 17.4.5.5 or ACI 318-11 D.5.5.5, as applicable, except as noted below:

For all cases where c_{Na}/c_{ac}<1.0, $\psi_{cp,Na}$ determined from ACI 318-14 Eq. 17.4.5.5b or ACI 318-11 Eq. D-27, as applicable, need not be taken less than c_{Na}/c_{ac}. For all other cases, $\psi_{cp,Na}$ shall be taken as 1.0.

The critical edge distance, c_{ac} must be calculated according to Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11, in lieu of ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable.

$$c_{ac} = h_{ef} \cdot \left(\frac{\tau_{k,\,uncr}}{1160}\right)^{0.4} \cdot \left[3.1 - 0.7\frac{h}{h_{ef}}\right]$$

(Eq. 17.4.5.5c for ACI 318-14 or Eq. D-27a for ACI 318-11)

where

$\left[\frac{h}{h_{ef}}\right]$ need not be taken as larger than 2.4; and

$\tau_{k,uncr}$ = the characteristic bond strength stated in the tables of this report whereby $\tau_{k,uncr}$ need not be taken as larger than:

$$\tau_{k,uncr} = \frac{k_{uncr}\sqrt{h_{ef} f'_c}}{\pi \cdot d_a} \qquad \text{Eq. (4-1)}$$

4.1.11 Requirements for Seismic Design Categories C, D, E and F: In structures assigned to Seismic Design Category C, D, E or F under the IBC or IRC, anchors must be designed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, except as described below.

The nominal steel shear strength, V_{sa}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 4, 7, 11 and 13 for the corresponding anchor steel. The nominal bond strength $\tau_{k;cr}$ must be adjusted by $\alpha_{N,seis}$ as given in Tables 6, 9, 12 and 15 for threaded rods.

As an exception to ACI 318-11 Section D.3.3.4.2: Anchors designed to resist wall out-of-plane forces with design strengths equal to or greater than the force determined in accordance with ASCE 7 Equation 12.11-1 or 12.14-10 shall be deemed to satisfy Section ACI 318-11 D.3.3.4.3(d).

Under ACI 318-11 D.3.3.4.3(d), in lieu of requiring the anchor design tensile strength to satisfy the tensile strength requirements of ACI 318-11 D.4.1.1, the anchor design tensile strength shall be calculated from ACI 318-11 D.3.3.4.4.

The following exceptions apply to ACI 318-11 D.3.3.5.2:

1. For the calculation of the in-plane shear strength of anchor bolts attaching wood sill plates of bearing or non-bearing walls of light-frame wood structures to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

1.1. The allowable in-plane shear strength of the anchor is determined in accordance with AF&PA NDS Table 11E for lateral design values parallel to grain.

1.2. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

1.3. Anchor bolts are embedded into concrete a minimum of 7 inches (178 mm).

1.4. Anchor bolts are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the wood sill plate.

1.5. Anchor bolts are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the wood sill plate.

1.6. The sill plate is 2-inch or 3-inch nominal thickness.

2. For the calculation of the in-plane shear strength of anchor bolts attaching cold-formed steel track of bearing or non-bearing walls of light-frame construction to foundations or foundation stem walls, the in-plane shear strength in accordance with ACI 318-11 D.6.2 and D.6.3 need not be computed and ACI 318-11 D.3.3.5.3 need not apply provided all of the following are satisfied:

2.1. The maximum anchor nominal diameter is $^5/_8$ inch (16 mm).

2.2. Anchors are embedded into concrete a minimum of 7 inches (178 mm).

2.3. Anchors are located a minimum of $1^3/_4$ inches (45 mm) from the edge of the concrete parallel to the length of the track.

2.4. Anchors are located a minimum of 15 anchor diameters from the edge of the concrete perpendicular to the length of the track.

2.5. The track is 33 to 68 mil designation thickness.

Allowable in-plane shear strength of exempt anchors, parallel to the edge of concrete shall be permitted to be determined in accordance with AISI S100 Section E3.3.1.

3. In light-frame construction, bearing or nonbearing walls, shear strength of concrete anchors less than or equal to 1 inch [25 mm] in diameter attaching a sill plate or track to foundation or foundation stem wall need not satisfy ACI 318-11 D.3.3.5.3(a) through (c) when the design strength of the anchors is determined in accordance with ACI 318-11 D.6.2.1(c).

4.2 Installation:

Installation parameters are illustrated in Figure 1 of this report. Installation must be in accordance with ACI 318-14 17.8.1 and 17.8.2 or ACI 318-11 D.9.1 and D.9.2. Anchor locations must comply with this report and the plans and specifications approved by the code official. Installation of the AC200+ Adhesive Anchor System must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 3 of this report.

The adhesive anchor system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly inclined and horizontal orientation applications are to be installed using piston plugs in accordance with the MPII as shown in Figure 3 of this report. The piston plugs must be used with an appropriate hole diameter size and attached to the mixing nozzle and extension tube supplied by DEWALT.

4.3 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 and 2012 IBC, 1704.4 and 1704.15 of the 2009 IBC and this report. The special inspector must be on the jobsite initially during anchor installation to verify the anchor type, adhesive expiration date, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, anchor spacing, edge distances, concrete thickness, anchor embedment, tightening torque, and adherence to the manufacturers printed installation instructions.

The special inspector must verify the initial installations of each type and size of adhesive anchor by construction personnel on site. Subsequent installations of the same anchor type and size by the same construction personnel are permitted to be performed in the absence of the special inspector. Any change in the anchor product being installed or the personnel performing the installation requires an initial inspection. For ongoing installations over an extended period, the special inspector must make regular inspections to confirm correct handling and installation of the product.

Continuous special inspection of adhesive anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed in accordance with ACI 318-14 17.8.2.4, 26.7.1(h) and 26.13.3.2 (c) or ACI 318-11 D.9.2.4, as applicable.

Under the IBC, additional requirements as set forth in Sections 1705, 1706 or 1707 must be observed, where applicable.

4.4 Compliance with NSF/ANSI Standard 61:

The AC200+ Adhesive Anchor System complies with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2015, 2012, 2009 and 2006 *International Plumbing Code*® (IPC) and is certified for use as an anchoring adhesive for installing threaded rods less than or equal to 1.3 inches (33 mm) in diameter in concrete for water treatment applications.

5.0 CONDITIONS OF USE

The AC200+ Adhesive Anchor System described in this report complies with or is a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 AC200+ adhesive anchors must be installed in accordance with the manufacturer's printed installation instructions included with each cartridge and provided in Figure 3 of this report.

5.2 The anchors described in this report must be installed in cracked and uncracked normal-weight concrete having a specified compressive strength f'_c = 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.3 The values of f'_c used for calculation purposes must not exceed 8,000 psi (55 MPa). The value of f'_c used for calculation of tension resistance must be limited to 2,500 psi (17.2 MPa) maximum for metric reinforcing bars in cracked concrete.

5.4 Anchors must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 3 of this report.

5.5 Loads applied to the anchors must be adjusted in accordance with Section 1605.2 of the IBC for strength design.

5.6 In structures assigned to Seismic Design Categories C, D, E, and F under the IBC or IRC, anchor strength must be adjusted in accordance with Section 4.1.11 of this report.

5.7 AC200+ adhesive anchors are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchor, subject to the conditions of this report.

5.8 Strength design values are established in accordance with Section 4.1 of this report.

5.9 Minimum anchor spacing and edge distance as well as minimum member thickness must comply with the values described in this report.

5.10 Prior to anchor installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.11 Anchors are not permitted to support fire-resistive construction. Where not otherwise prohibited by the code, AC200+ adhesive anchors are permitted for installation in fire-resistive construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support gravity load–bearing structural elements are within a fire-resistive envelope or a fire-resistive membrane, are protected by approved fire-resistive materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support non-structural elements.

5.12 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.13 Use of zinc-plated carbon steel threaded rods or steel reinforcing bars is limited to dry, interior locations.

5.14 Use of hot-dipped galvanized carbon steel and stainless steel rods is permitted for exterior exposure or damp environments.

5.15 Steel anchoring materials in contact with preservative-treated and fire-retardant-treated wood shall be of zinc-coated steel or stainless steel. The minimum coating weights for zinc-coated steel shall be in accordance with ASTM A153.

5.16 Periodic special inspection must be provided in accordance with Section 4.3 in this report. Continuous special inspection for anchors installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.3 of this report.

5.17 Installation of anchors in horizontal or upwardly inclined orientations to resist sustained tension loads must be performed by personnel certified by an applicable certification program in accordance with ACI 318-14 17.8.2.2 or 17.8.2.3 or ACI 318-11 D.9.2.2 or D.9.2.3, as applicable.

5.18 AC200+ Adhesive Anchors may be used to resist tension and shear forces in floor, wall for overhead installations into concrete with a temperature between 23°F and 104°F (-5°C and 40°C) for threaded rods and rebar.

5.19 Anchors shall not be used for applications where the concrete temperature can vary from 40°F (5°C) or less to 80°F (27°C) or higher within a 12-hour period. Such applications may include but are not limited to anchorage of building facade systems and other applications subject to direct sun exposure.

5.20 AC200+ adhesive is manufactured under a quality-control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

Data in accordance with the ICC-ES Acceptance Criteria for Post-installed Adhesive Anchors in Concrete (AC308), dated June 2016, which incorporates requirements in ACI 355.4-11 for use in cracked and uncracked concrete; including, but not limited to, tests under freeze/thaw conditions, tests under sustained load, tests for installation including installation direction, tests at elevated temperatures, tests for resistance of alkalinity, tests for resistance to sulfur, and tests for seismic tension and shear.

7.0 IDENTIFICATION

AC200+ adhesive is identified by packaging labelled with the company's name (DEWALT) and address, anchor name, the lot number, the expiration date, and the evaluation report number (ESR-4027). Threaded rods, nuts, washers, and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.

TABLE 1—DESIGN TABLE INDEX

DESIGN TABLE		Fractional		Metric	
		Table	Page	Table	Page
	Steel Strength - N_{sa}, V_{sa}	Table 4	7	Table 10	11
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	8	Table 11	11
	Bond Strength - N_a, N_{ag}	Table 6	8	Table 12	12
DESIGN TABLE		**Fractional**		**Metric**	
		Table	**Page**	**Table**	**Page**
	Steel Strength - N_{sa}, V_{sa}	Table 7	9	Table 13	12
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 8	10	Table 14	13
	Bond Strength - N_a, N_{ag}	Table 9	10	Table 15	13

TABLE 2—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON AND STAINLESS STEEL THREADED ROD MATERIALS[1]

	THREADED ROD SPECIFICATION		MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	f_{uta}/f_{ya}	ELONGATION, MIN. PERCENT[11]	REDUCTION OF AREA, MIN. PERCENT	SPECIFICATION FOR NUTS[12]
CARBON STEEL	ASTM A193[2] Grade B7	psi (MPa)	125,000 (860)	105,000 (720)	1.19	16	50	ASTM A194 / A563 Grade DH
	ASTM A36[3] / F1554[4], Grade 36	psi (MPa)	58,000 (400)	36,000 (250)	1.61	23	40	ASTM A194 / A563 Grade A
	ASTM F1554[4] Grade 55	psi (MPa)	75,000 (515)	55,000 (380)	1.36	23	40	
	ASTM F1554[4] Grade 105	psi (MPa)	125,000 (860)	105,000 (725)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A449[5] (3/8" to1" dia.)	psi (MPa)	120,000 (830)	92,000 (635)	1.30	14	35	
	ASTM A449[5] (1-1/4" dia.)	psi (MPa)	105,000 (720)	81,000 (560)	1.30	14	35	
	ASTM F568M[6] Class 5.8 (equivalent to ISO 898-1)	psi (MPa)	72,500 (500)	58,000 (400)	1.25	10	35	A563 Grade DH DIN 934 (8-A2K)[13]
	ISO 898-1[7] Class 5.8	MPa (psi)	500 (72,500)	400 (58,000)	1.25	22	-	EN ISO 4032 Grade 6
	ISO 898-1[7] Class 8.8	MPa (psi)	800 (118,000)	640 (92,800)	1.25	12	52	EN ISO 4032 Grade 8
STAINLESS STEEL	ASTM F593[8] CW1 $^3/_8$ to $^5/_8$ in.	psi (MPa)	100,000 (690)	65,000 (450)	1.54	20	-	ASTM F594 Alloy Group 1, 2 or 3
	ASTM F593[8] CW2 $^3/_4$ to $1^1/_4$ in.	psi (MPa)	85,000 (590)	45,000 (310)	1.89	25	-	
	ASTM A193/A193M[9] Grade B8/B8M2, Class 2B	psi (MPa)	95,000 (655)	75,000 (515)	1.27	25	40	ASTM A194/A194M
	ISO 3506-1[10] A4-70 M10-M24	MPa (psi)	700 (101,500)	450 (65,250)	1.56	40	-	EN ISO 4032
	ISO 3506-1[10] A4-50 M27-M30	MPa (psi)	500 (72,500)	210 (30,450)	2.38	40	-	EN ISO 4032

[1]Adhesive must be used with continuously threaded carbon or stainless steel rod (all-thread) having thread characteristics complying with ANSI B1.1 UNC Coarse Thread Series.
[2]Standard Specification for Alloy-Steel and Stainless steel Bolting Materials for High temperature of High Pressure service and Other Special Purpose Applications.
[3]Standard Specification for Carbon Structural steel
[4]Standard Specification for Anchor Bolts, Steel 36, 55 and 105-ksi Yield Strength
[5]Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/50 ksi Minimum Tensile Strength, General Use.
[6]Standard Specification for Carbon and Alloy Steel external Threaded Metric Fasteners
[7]Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, Screws and Studs
[8]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[9]Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
[10]Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, Screws and Studs
[11]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[12]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
[13]Nuts for metric rods.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH, f_{ya}
ASTM A615[1], A767[3], A996[4] Grade 60	psi (MPa)	90,000 (620)	60,000 (414)
ASTM A706[2], A767[3] Grade 60	psi (MPa)	80,000 (550)	60,000 (414)
ASTM A615[1], Grade 40	psi (MPa)	60,000 (415)	40,000 (275)
DIN 488[5] BSt 500	MPa (psi)	550 (79,750)	500 (72,500)

[1]Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
[2]Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
[3]Standard specification for Zinc-Coated (Galvanized) steel Bars for Concrete Reinforcement.
[4]Standard specification for Rail-Steel and Axle-steel Deformed bars for Concrete Reinforcement.
[5]Reinforcing steel, reinforcing steel bars; dimensions and masses

TABLE 4—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Threaded rod O.D.		d	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Threaded rod effective cross-sectional area		A_{se}	in.² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36/F1554, Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lb (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F1554 Grade 55	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	5,815 (25.9)	10,645 (47.6)	16,950 (75.5)	25,090 (111.7)	34,630 (154.1)	45,430 (202.1)	72,685 (323.1)
		V_{sa}	lb (kN)	3,490 (15.5)	6,385 (28.6)	10,170 (45.3)	15,055 (67)	20,780 (92.5)	27,260 (121.3)	43,610 (193.9)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A193 Grade B7 ASTM F1554 Grade 105	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,685 (43.1)	17,735 (78.9)	28,250 (125.7)	41,810 (186.0)	57,710 (256.7)	75,710 (336.8)	121,135 (538.8)
		V_{sa}	lb (kN)	5,810 (25.9)	10,640 (47.3)	16,950 (75.4)	25,085 (111.6)	34,625 (154.0)	45,425 (202.1)	72,680 (323.3)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM A449	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,300 (41.4)	17,030 (76.2)	27,120 (120.9)	40,140 (178.8)	55,405 (246.7)	72,685 (323.7)	101,755 (450.0)
		V_{sa}	lb (kN)	5,580 (24.8)	10,220 (45.7)	16,270 (72.5)	24,085 (107.3)	33,240 (148)	43,610 (194.2)	61,055 (270.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						
ASTM F568M Class 5.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	5,620 (25)	10,290 (46)	16,385 (73)	24,250 (108)	33,470 (149)	43,910 (195.5)	70,260 (312.5)
		V_{sa}	lb (kN)	3,370 (15)	6,175 (27.6)	9,830 (43.8)	14,550 (64.8)	20,085 (89.4)	26,350 (117.3)	42,155 (187.5)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM F593 CW Stainless	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ASTM A193/A193M Grade B8/B8M2, Class 2B	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	7,365 (32.8)	13,480 (60.3)	21,470 (95.6)	31,780 (141.5)	43,860 (195.2)	57,540 (256.1)	92,065 (409.4)
		V_{sa}	lb (kN)	4,420 (19.7)	8,090 (36.2)	12,880 (57.4)	19,070 (84.9)	26,320 (117.1)	34,525 (153.7)	55,240 (245.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.75						
	Strength reduction factor for shear[2]	ϕ	-	0.65						

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must comply with requirements for the rod.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (inch)						
			$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)						
Min. anchor spacing	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	3 (76)	$3^3/_4$ (95)	$4^1/_4$ (108)	$4^3/_4$ (121)	$5^7/_8$ (149)
Min. edge distance	c_{min}	in. (mm)	$1^5/_8$ (41)	$1^3/_4$ (44)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	$3^1/_4$ (82)
					For smaller edge distances see Section 4.1.9 of this report.				
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$[3]				
Critical edge distance - splitting (for uncracked concrete)[2]	c_{ac}	-	See Section 4.1.10 of this report.						
Strength reduction factor for tension, concrete failure modes, Condition B[2]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70						

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[3] d_0 = hole diameter.

TABLE 6—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				$^3/_8$	$^1/_2$	$^5/_8$	$^3/_4$	$^7/_8$	1	$1^1/_4$
Minimum embedment		$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	5 (127)
Maximum embedment		$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	25 (635)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2601 (17.9)	2415 (16.6)	2262 (15.6)	2142 (14.8)	2054 (14.2)	2000 (13.8)	1990 (13.7)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1041 (7.2)	1041 (7.2)	1111 (7.7)	1219 (8.4)	1212 (8.4)	1206 (8.3)	1146 (7.9)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2263 (15.6)	2101 (14.5)	1968 (13.6)	1863 (12.8)	1787 (12.3)	1740 (12.0)	1732 (11.9)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	905 (6.2)	906 (6.2)	966 (6.7)	1060 (7.3)	1054 (7.3)	1049 (7.2)	997 (6.9)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1631 (11.2)	1514 (10.4)	1418 (9.8)	1343 (9.3)	1288 (8.9)	1254 (8.6)	1248 (8.6)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	652 (4.5)	653 (4.5)	696 (4.8)	764 (5.3)	760 (5.2)	756 (5.2)	719 (5.0)
Dry concrete	Anchor category	–	-	1						
	Strength reduction factor	ϕ_d	-	0.65						
Water-saturated concrete	Anchor category	–	-	2						
	Strength reduction factor	ϕ_{ws}	-	0.55						
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95						

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23 percent for temperature range C.

TABLE 7—STEEL DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS [1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Reinforcing bar O.D.		d	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)	1.250 (31.8)
Reinforcing bar effective cross-sectional area		A_{se}	in.² (mm²)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)	1.270 (819)
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.0)	54,000 (240.0)	71,100 (316.0)	90,000 (400.0)	114,300 (508.0)
		V_{sa}	lb (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	8,800 (39.1)	16,000 (71.2)	24,800 (110.3)	35,200 (156.6)	48,000 (213.5)	63,200 (281.1)	80,000 (355.9)	101,600 (452.0)
		V_{sa}	lb (kN)	5,280 (23.5)	9,600 (42.7)	14,880 (66.2)	21,120 (93.9)	28,800 (128.1)	37,920 (168.7)	48,000 (213.5)	60,960 (271.2)
	Reduction for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor ϕ for tension[2]	ϕ	-	0.75							
	Strength reduction factor ϕ for shear[2]	ϕ	-	0.65							
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lb (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.

[2]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size							
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in.-lb. (SI)	24 (10)							
Min. anchor spacing	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	3 (76)	$3^3/_4$ (95)	$4^1/_4$ (108)	$4^3/_4$ (121)	$5^1/_4$ (133)	$5^7/_8$ (149)
Min. edge spacing	c_{min}	in. (mm)	$1^5/_8$ (41)	$1^3/_4$ (44)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	3 (76)	$3^1/_4$ (82)
					For smaller edge distances see Section 4.1.9 of this report.					
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$[3]					
Critical edge spacing – splitting (for uncracked concrete)	c_{ac}	-	See Section 4.1.10 of this report.							
Strength reduction factor for tension, concrete failure modes, Condition B[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70							

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[3]d_0 = hole diameter.

TABLE 9—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				No.3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Minimum embedment		$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Maximum embedment		$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)	25 (635)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	2,200 (15.2)	2,100 (14.5)	2,030 (14.0)	1,970 (13.6)	1,920 (13.2)	1,880 (13.0)	1,845 (12.7)	1,815 (12.5)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	1,090 (7.5)	1,055 (7.3)	1,130 (7.8)	1,170 (8.1)	1,175 (8.1)	1,155 (8.0)	1,140 (7.9)	1,165 (8.0)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,915 (13.2)	1,830 (12.6)	1,765 (12.2)	1,715 (11.8)	1,670 (11.5)	1,635 (11.3)	1,615 (11.1)	1,580 (10.9)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	945 (6.5)	915 (6.3)	980 (6.8)	1,015 (7.0)	1,020 (7.0)	1,005 (6.9)	995 (6.8)	1,010 (7.0)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	psi (N/mm²)	1,380 (9.5)	1,315 (9.1)	1,270 (8.8)	1,235 (8.5)	1,205 (8.3)	1,180 (8.1)	1,155 (8.0)	1,140 (7.8)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	psi (N/mm²)	680 (4.7)	660 (4.6)	705 (4.9)	735 (5.1)	735 (5.1)	725 (5.0)	715 (4.9)	730 (5.0)
Dry concrete	Anchor category	–	-	1							
	Strength reduction factor	ϕ_d	-	0.65							
Water-saturated concrete	Anchor category	–	-	2							
	Strength reduction factor	ϕ_d	-	0.55							
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95		1.00					

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength f'_c between 2,500 psi and 8,000 psi, tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 23 percent for temperature range C.

TABLE 10—STEEL DESIGN INFORMATION FOR METRIC THREADED ROD[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm)						
				M10	M12	M16	M20	M24	M27	M30
Threaded rod O.D.		d	mm (in.)	10 (0.39)	12 (0.47)	16 (0.63)	20 (0.79)	24 (0.94)	27 (1.06)	30 (1.18)
Threaded rod effective cross-sectional area		A_{se}	mm² (in.²)	58.0 (0.090)	84.3 (0.131)	157 (0.243)	245 (0.380)	353 (0.547)	459 (0.711)	561 (0.870)
ISO 898-1 Class 5.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	29.0 (6,518)	42.2 (9,473)	78.5 (17,643)	122.5 (27,532)	176.5 (39,668)	229.5 (51,580)	280.5 (63,043)
		V_{sa}	kN (lb)	17.4 (3,911)	25.3 (5,684)	47.1 (10,586)	73.5 (16,519)	105.9 (23,801)	137.7 (30,948)	168.3 (37,826)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	46.4 (10,428)	67.4 (15,157)	125.6 (28,229)	196 (44,051)	282.4 (63,470)	367.2 (82,528)	448.8 (100,868)
		V_{sa}	kN (lb)	27.8 (6,257)	40.5 (9,094)	75.4 (16,937)	117.6 (26,431)	169.4 (38,082)	220.3 (49,517)	269.3 (60,521)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						
ISO 3506-1, A4 stainless steel[3]	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	40.6 (9,125)	59 (13,263)	109.9 (24,700)	171.5 (38,545)	247.1 (55,536)	229.5 (51,580)	280.5 (63,043)
		V_{sa}	kN (lb)	24.4 (5,475)	35.4 (7,958)	65.9 (14,820)	102.9 (23,127)	148.3 (33,322)	137.7 (30,948)	168.3 (37,826)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	Strength reduction factor for tension[2]	ϕ	-	0.65						
	Strength reduction factor for shear[2]	ϕ	-	0.60						

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 (b) or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable. Nuts and washers must comply with requirements for the rod.
[2]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[3]A4-70 Stainless steel (M8-M24); A4-50 Stainless steel (M27-M30)

TABLE 11—CONCRETE BREAKOUT DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (mm)						
			M10	M12	M16	M20	M24	M27	M30
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)						
Min. anchor spacing	s_{min}	mm (in.)	50 (2)	60 ($2^3/_8$)	75 (3)	95 ($3^3/_4$)	115 ($4^1/_2$)	125 (5)	140 ($5^1/_2$)
Min. edge distance	c_{min}	mm (in.)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	60 ($2^3/_8$)	65 ($2^1/_2$)	75 (3)	80 ($3^1/_8$)
					For smaller edge distances, see Section 4.1.9 of this report.				
Min. member thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + $1^1/_4$)		h_{ef} + $2d_0$[3]				
Critical edge distance - splitting (for uncracked concrete)[2]	c_{ac}	-	See Section 4.1.10 of this report.						
Strength reduction factor for tension, concrete failure modes, Condition B[2]	ϕ	-	0.65						
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70						

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[3] d_0 = hole diameter.

TABLE 12—BOND STRENGTH DESIGN INFORMATION FOR METRIC THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				M10	M12	M16	M20	M24	M27	M30
Minimum embedment		$h_{ef,min}$	mm (in.)	60 (2.4)	70 (2.8)	80 (3.1)	90 (3.5)	96 (3.8)	108 (4.3)	120 (4.7)
Maximum embedment		$h_{ef,max}$	mm (in.)	200 (7.9)	240 (9.4)	320 (12.6)	400 (15.7)	480 (18.9)	540 (21.3)	600 (23.6)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	17.7 (2,571)	16.9 (2,453)	15.6 (2,256)	14.6 (2,112)	13.9 (2,020)	13.7 (1,985)	13.7 (1,980)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	7.2 (1,039)	7.2 (1,043)	7.7 (1,110)	8.4 (1,217)	8.3 (1,209)	8.3 (1,204)	7.9 (1,149)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	15.4 (2,237)	14.7 (2,134)	13.5 (1,963)	12.7 (1,837)	12.1 (1,757)	11.9 (1,727)	11.9 (1,723)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	6.2 (904)	6.3 (908)	6.7 (966)	7.3 (1,058)	7.2 (1,052)	7.2 (1,047)	6.9 (999)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	11.1 (1,612)	10.6 (1,538)	9.8 (1,415)	9.1 (1,324)	8.7 (1,266)	8.6 (1,245)	8.6 (1,241)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	4.5 (651)	4.5 (654)	4.8 (696)	5.3 (763)	5.2 (758)	5.2 (755)	5.0 (720)
Dry concrete	Anchor category	–	-	1						
	Strength reduction factor	ϕ_d	-	0.65						
Water-saturated concrete	Anchor category	–	-	2						
	Strength reduction factor	ϕ_{ws}	-	0.55						
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95						

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23 percent for temperature range C.

TABLE 13—STEEL DESIGN INFORMATION FOR METRIC REINFORCING BARS [1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Reinforcing bar O.D.		d	mm (in.)	10 (0.315)	12 (0.394)	14 (0.472)	16 (0.551)	20 (0.630)	25 (0.787)	28 (1.102)	32 (1.260)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (in.²)	78.5 (0.112)	113.1 (0.175)	153.9 (0.239)	201.1 (0.312)	314.2 (0.487)	490.9 (0.761)	615.8 (0.954)	804.2 (1.247)
DIN 488 BSt 500	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	43.2 (9,739)	62.2 (14,024)	84.7 (19,088)	110.6 (24,932)	172.8 (38,956)	270.0 (60,868)	338.7 (76,353)	442.3 (99,727)
		V_{sa}	kN (lb)	25.9 (5,843)	37.3 (8,414)	50.8 (11,453)	66.4 (14,959)	103.7 (23,373)	162.0 (36,521)	203.2 (45,812)	265.4 (59,836)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Strength reduction factor for tension[2]	ϕ	-	0.65							
	Strength reduction factor for shear[2]	ϕ	-	0.60							

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-14 Eq. 17.4.1.2 and Eq. 17.5.1.2 b or ACI 318-11 Eq. (D-2) and Eq. (D-29), as applicable.
[2]The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, are used. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.

TABLE 14—CONCRETE BREAKOUT DESIGN INFORMATION METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

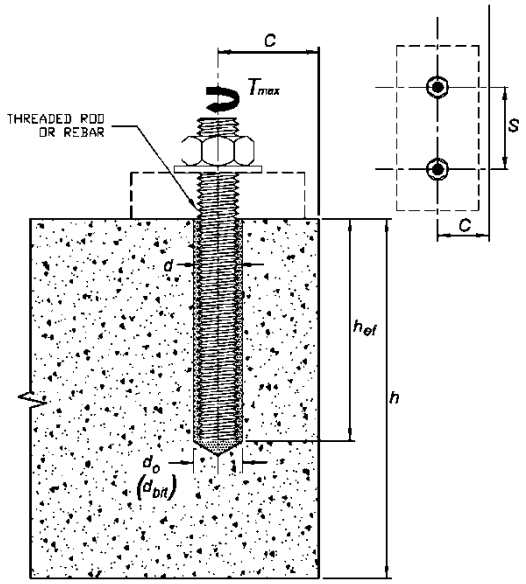
DESIGN INFORMATION	Symbol	Units	Nominal Bar Size							
			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)							
Min. anchor spacing	s_{min}	mm (in.)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	95 ($3^3/_4$)	120 ($4^5/_8$)	130 ($5^1/_4$)	150 ($5^7/_8$)
Min. edge spacing	c_{min}	mm (in.)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	85 ($3^1/_8$)
					For smaller edge distances, see Section 4.1.9 of this report.					
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$ [3]					
Critical edge spacing – splitting (for uncracked concrete)[2]	c_{ac}	-	See Section 4.1.10 of this report.							
Strength reduction factor for tension, concrete failure modes, Condition B[2]	ϕ	-	0.65							
Strength reduction factor for shear, concrete failure modes, Condition B[2]	ϕ	-	0.70							

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. The tabulated value of ϕ applies when the load combinations of Section 1605.2 of the IBC, ACI 318-14 5.3 or ACI 318-11 9.2, as applicable, as set forth in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4.
[3]d_0 = hole diameter.

TABLE 15—BOND STRENGTH DESIGN INFORMATION METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Minimum embedment		$h_{ef,min}$	mm (in.)	60 (2.4)	70 (2.8)	75 (3.0)	80 (3.1)	90 (3.5)	100 (3.9)	112 (4.4)	128 (5.0)
Maximum embedment		$h_{ef,max}$	mm (in.)	200 (7.9)	240 (9.4)	280 (11.0)	320 (12.6)	400 (15.7)	500 (19.7)	560 (22.0)	640 (25.2)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	15.1 (2,183)	14.6 (2,121)	14.0 (2,025)	14.0 (2,025)	13.5 (1,954)	13.0 (1,886)	12.8 (1,852)	12.5 (1,813)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	7.5 (1,082)	7.3 (1,060)	7.9 (1,144)	8.2 (1,193)	8.2 (1,188)	8.0 (1,158)	7.9 (1,144)	8.0 (1,163)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	13.1 (1,899)	12.7 (1,845)	12.1 (1,762)	12.1 (1,762)	11.7 (1,700)	11.3 (1,640)	11.1 (1,611)	10.9 (1,577)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	6.5 (942)	6.4 (922)	6.9 (996)	7.2 (1,038)	7.1 (1,034)	6.9 (1,008)	6.9 (995)	7.0 (1,012)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	9.4 (1,369)	9.2 (1,329)	8.8 (1,270)	8.8 (1,270)	8.4 (1,225)	8.2 (1,182)	8.0 (1,161)	7.8 (1,136)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	4.7 (678)	4.6 (665)	4.9 (718)	5.2 (748)	5.1 (745)	5.0 (726)	4.9 (717)	5.0 (729)
Dry concrete	Anchor category	–	-	1							
	Strength reduction factor	ϕ_d	-	0.65							
Water-saturated concrete	Anchor category	–	-	2							
	Strength reduction factor	ϕ_{ws}	-	0.55							
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95		1.00					

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength f'_c between 2,500 psi and 8,000 psi, tabulated characteristic bond strength may not be increased. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 23 percent for temperature range C.



THREADED ROD

REINFORCING BAR

FIGURE 1—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

CARTRIDGES

DISPENSING TOOL

STATIC MIXING NOZZLE

FIGURE 2—AC200+ ADHESIVE ANCHOR SYSTEM

DEWALT ENGINEERED BY Powers

AC200+ Instruction Card

Follow steps #1 through #10 for recommended installation

1. Setting instructions for solid base material - For any application not covered by this document please contact DEWALT

Drilling

1. Drill a hole into the base material with a hammer drill tool to the size and embedment required by the selected steel hardware element (see Table 4). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15.
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal.

In case of standing water in the drilled hole, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

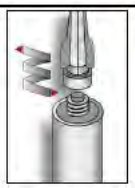
Hole cleaning

2a. Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.

2b. Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by DEWALT) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use ($Ø_{brush} > D_{min}$, see Table 3a or 3b). The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter. If the back of the drilled hole is not reached a brush extension shall be used.

2c. Finally blow the hole clean again with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

Preparing



3. Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use. Review working and cure times. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures. For the permitted range of the base material temperature see Table 2. Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.
Note: *Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.*

4. Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.

5. Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray color.
Review and note the published working and cure times (see Table 2) prior to injection of the mixed adhesive into the cleaned anchor hole.

Installation

6. Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. For embedment depths greater than 7-1/2" an extension tube supplied by DEWALT (3/8" dia., Cat# 08281-PWR) must be used with the mixing nozzle.
Piston plugs (see Table 3a or 3b) must be used with and attached to mixing nozzle and extension tube for:
- overhead installations and installations between horizontal and overhead
- all installations with drill hole depth d_0 >10" (250mm)

with piston plug:

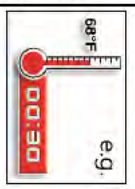
with anchor rod 5/8" to 1-1/4" (M16 to M30) diameter and rebar sizes #5 to #10 (Ø14 to Ø32).

Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure. Attention! Do not install anchors overhead or upwardly inclined without installation hardware supplied by DEWALT and also receiving proper training and/or certification. Contact DEWALT for details prior to use.

7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.

8. Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and overhead the anchor must be secured from moving/falling during the cure time (e.g. wedges). Minor adjustments to the anchor may be performed during the gel time but the anchor shall not be moved after placement and during cure.

Curing and fixture



9. Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table 2).
Do not disturb, torque or load the anchor until it is fully cured.

10. After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4) by using a calibrated torque wrench.
Take care not to exceed the maximum torque for the selected anchor.

2. Gel (working) times and curing times

Temperature of base material						Gel (working) time	Full curing time
23 °F	(-5 °C)	to	31 °F	(-1 °C)		50 min	5 h
32 °F	(0 °C)	to	40 °F	(+4 °C)		25 min	3.5 h
41 °F	(+5 °C)	to	49 °F	(+9 °C)		15 min	2 h
50 °F	(+10 °C)	to	58 °F	(+14 °C)		10 min	1 h
59 °F	(+15 °C)	to	67 °F	(+19 °C)		6 min	40 min
68 °F	(+20 °C)	to	85 °F	(+29 °C)		3 min	30 min
86 °F	(+30 °C)	to	104 °F	(+40 °C)		2 min	30 min

Cartridge temperature must be between 41°F (+5°C) and 104°F (+40°C)

FIGURE 3—MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

3a. Parameter cleaning and setting tools (fractional sizes)

Threaded Rod	Rebar	d_0 Drill bit - ⌀	d_b Brush - ⌀		$d_{b,min}$ min. Brush - ⌀		Cat. #	Piston plug	Cat. #
[inch]	[inch]	[inch]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
3/8"	-	7/16	13.5	0.528	11.6	0.458	PFC1671050	No plugs required	
-	#3	1/2	14.3	0.562	13.2	0.520	PFC1671100		
1/2"	-	9/16	16.3	0.654	14.8	0.582	PFC1671150		
-	#4	5/8	18.3	0.720	16.5	0.650	PFC1671200		
5/8"		11/16	20.0	0.787	18.0	0.709	PFC1671225	11/16"	08258-PWR
	#5	3/4	21.5	0.846	19.5	0.777	PFC1671250	3/4"	08259-PWR
3/4"	#6	7/8	24.8	0.976	23.0	0.905	PFC1671300	7/8"	08300-PWR
7/8"	#7	1	28.5	1.122	26.2	1.030	PFC1671350	1"	08301-PWR
1"	#8	1 1/8	31.8	1.252	29.5	1.160	PFC1671400	1-1/8"	08303-PWR
1-1/4"	#9	1 3/8	38.2	1.504	35.8	1.410	PFC1671450	1-3/8"	08305-PWR
-	#10	1 1/2	41.4	1.630	39.0	1.535	PFC1671500	1-1/2"	08309-PWR

3b. Parameter cleaning and setting tools (metric sizes)

Threaded Rod	Rebar	d_0 Drill bit - ⌀	d_b Brush - ⌀		$d_{b,min}$ min. Brush - ⌀		Cat. #	Piston plug	Cat. #
[mm]	[mm]	[mm]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
M10	-	12	13.5	0.53	12.5	0.41	DFC1670120	No plugs required	
M12	10	14	15.5	0.61	14.5	0.49	DFC1670140		
-	12	16	17.5	0.69	16.5	0.57	DFC1670160		
M16	14	18	20	0.79	18.5	0.65	DFC1670180	18mm	DFC1690100
-	16	20	22	0.87	20.5	0.73	DFC1670190	20mm	DFC1690150
M20	-	22	24	0.94	22.5	0.81	DFC1670220	22mm	DFC1690180
-	20	25	27	1.06	24.5	0.89	DFC1670240	25mm	DFC1690250
M24	-	28	30	1.18	28.5	0.96	DFC1670280	28mm	DFC1690300
M27	-	30	31.8	1.25	30.5	1.12	DFC1670310	30mm	DFC1690310
-	25	32	34	1.34	32.5	1.20	DFC1670320	32mm	DFC1690350
M30	28	35	37	1.46	35.5	1.28	DFC1670330	35mm	DFC1690400
-	32	40	43.5	1.71	40.5	1.40	DFC1670340	40mm	DFC1690420

4. Anchor property / Setting information (fractional and metric sizes)

	Nominal threaded rod (fractional)							Nominal threaded rod (metric)							Reinforcing bar (fractional)								Reinforcing bar (metric)							
	inch; ft.-lb.							mm; Nm							inch; ft.-lb.								mm; Nm							
Anchor size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M10	M12	M16	M20	M24	M27	M30	#3	#4	#5	#6	#7	#8	#9	#10	⌀ 10	⌀ 12	⌀ 14	⌀ 16	⌀ 20	⌀ 25	⌀ 28	⌀ 32
d_s = Nominal anchor rod diameter	0.375	0.500	0.625	0.750	0.875	1.000	1.250	10	12	16	20	24	27	30	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	10	12	14	16	20	25	28	32
d_o (d_{bit}) = Nominal ANSI drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	12	14	18	22	28	30	35	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	14	16	18	20	25	32	35	40
T_{max} = Maximum torque	15[2]	30	44	66	96	147	221	20	40	80	120	170	250	300	15[2]	30	44	66	96	147	185	221	20	40	45	80	120	175	250	300
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	70	80	90	96	108	120	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	60	70	75	80	90	100	112	128
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25	200	240	320	400	480	540	600	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	200	240	280	320	400	500	560	640
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-7/8	50	60	80	100	120	135	150	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-1/4	5-7/8	50	60	70	80	100	125	140	160
c_{min} = Min. edge distance with 100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4	45	45	55	60	70	75	80	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	45	45	50	55	60	70	75	85
c_{min} = Min. edge distance with 45% T_{max}[1]	-		1.75				2.75	-	45					70	-	1.75					2.75		-	45				70		
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_o$					h_{ef} + 30	h_{ef} + $2d_o$						h_{ef} + 1-1/4	h_{ef} + $2d_o$							h_{ef} + 30	h_{ef} + $2d_o$						

[1] s_{min} = 5xd_s. [2] for ASTM 36 and F1554 Grade 36, T_{max} = 11 ft.-lb.

5. UM-H adhesive anchor system and accessories

Injection tools		Cartridge	Extra mixing nozzles	Piston plug	Compressed air nozzle (min. 90 psi)	SDS connector	Extension with wood handle
10 fl. oz. caulking gun	Cat. #08437-PWR - Standard Cat. #08479-PWR - High performance	AC200+ 10 fl. oz. Quik-Shot w/nozzle Cat. #PFC1271050	AC200+ mixing nozzle Cat. #PFC1641600			 (Cat. #PFC1671830)	 (Cat#PFC1671000)
12 fl. oz. dispenser	Cat. #08485-PWR - Standard	AC200+ 12 fl. oz. dual cart. w/nozzle Cat. #PFC1271100	AC200+ mixing nozzle Cat. #PFC1641600			Extension tube	Brush extension
28 fl. oz. manual and powered dispenser	Cat. #08495-PWR - Standard Cat. #08496-PWR - High performance Cat. #DCE595D1 - High performance	AC200+ 28 fl. oz. dual cart. w/nozzle Cat. #PFC1271150	AC200+ mixing nozzle Cat. #PFC1641600	(Cat# Table 3a or 3b)	If the back of the drilled hole is not reached an extension shall be used.	(Cat. #08281-PWR)	 (Cat#PFC1671820)

DEWALT ENGINEERED BY Powers **AC200+**

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FIGURE 3—MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII) (Continued)

ICC-ES Evaluation Report

ESR-4027 FBC Supplement

Issued January 2017

This report is subject to renewal January 2018.

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

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EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 REPORT PURPOSE AND SCOPE

Purpose:

The purpose of this evaluation report supplement is to indicate that the AC200+ adhesive anchors, recognized in ICC-ES master evaluation report ESR-4027, have also been evaluated for compliance with the codes noted below.

Applicable code editions:

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

2.0 CONCLUSIONS

The AC200+ adhesive anchors, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4027, comply with the *Florida Building Code—Building* and the *Florida Building Code—Residential*, provided the design and installation are in accordance with the 2012 *International Building Code®* (IBC) provisions noted in the master report, and the following conditions:

- Design wind loads must be based on Section 1609 of the *Florida Building Code—Building* or Section 301.2.1.1 of the *Florida Building Code—Residential*, as applicable.
- Load combinations must be in accordance with Section 1605.2 or Section 1605.3 of the *Florida Building Code—Building*.

Use of the AC200+ adhesive anchors with stainless steel threaded rod materials and reinforcing bars has also been found to be in compliance with the High-Velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* when the following condition is met:

- The design wind loads for use of the anchors in the High-velocity Hurricane Zone are based on Section 1620 of the *Florida Building Code —Building.*

Use of the AC200+ adhesive anchors with carbon steel standard steel threaded rod materials for compliance with the High-velocity Hurricane Zone provisions of the *Florida Building Code—Building* and the *Florida Building Code—Residential* has not been evaluated and is outside the scope of the supplemental report.

For products falling under Florida Rule 9N-3, verification that the report holder's quality-assurance program is audited by a quality-assurance entity approved by the Florida Building Commission for the type of inspections being conducted is the responsibility of an approved validation entity (or the code official, when the report holder does not possess an approval by the Commission).

This supplement expires concurrently with the master report, issued January 2017.

COMPETITIVE COMPARISON

SCREW-BOLT+™ VS. HILTI* KH-EZ

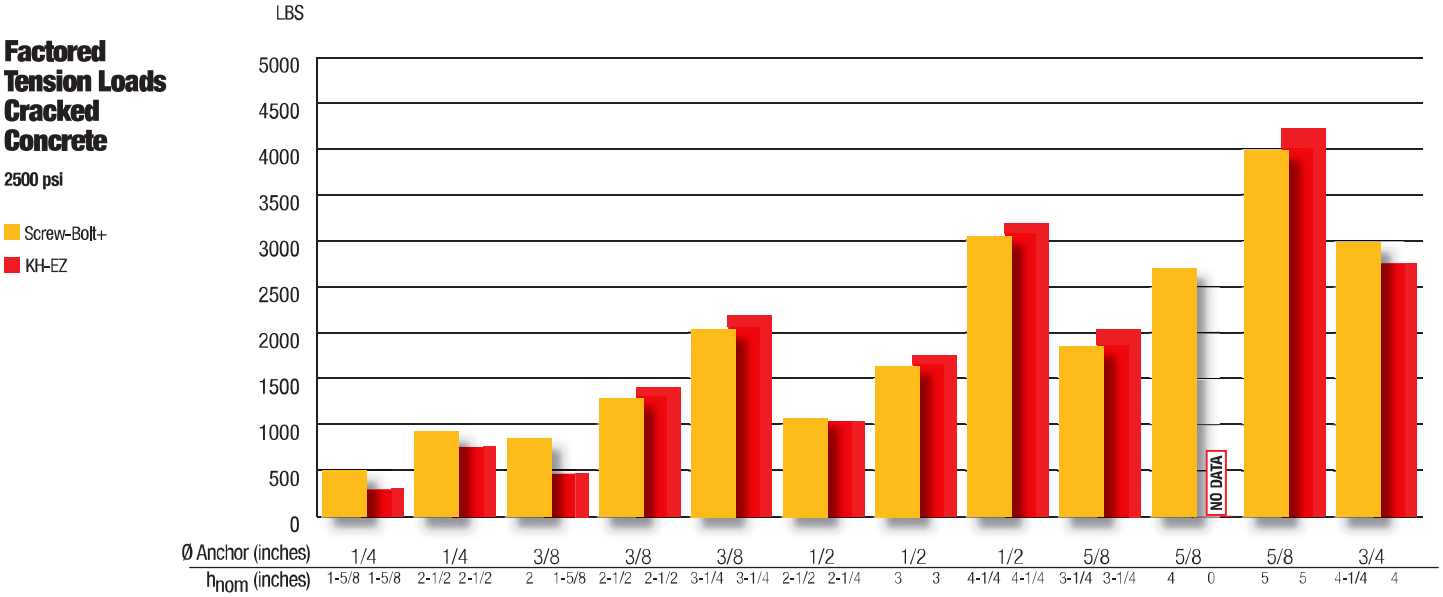
Product Comparison

Product Name	Screw-Bolt+	KH-EZ
Company	DEWALT	Hilti*
Description	Carbon Steel Screw Anchor	Carbon Steel Screw Anchor
Size Range (inch)	1/4, 3/8, 1/2, 5/8, 3/4	1/4, 3/8, 1/2, 5/8, 3/4
ICC-ES ESR (concrete)	ESR-3889	ESR-3027
Issued	2016 Nov	2015 Dec
Cracked Concrete	Yes	Yes
Seismic	Yes	Yes
Concrete-filled Steel Deck	Yes	Yes

* Hilti is a registered trademark of Hilti Corporation

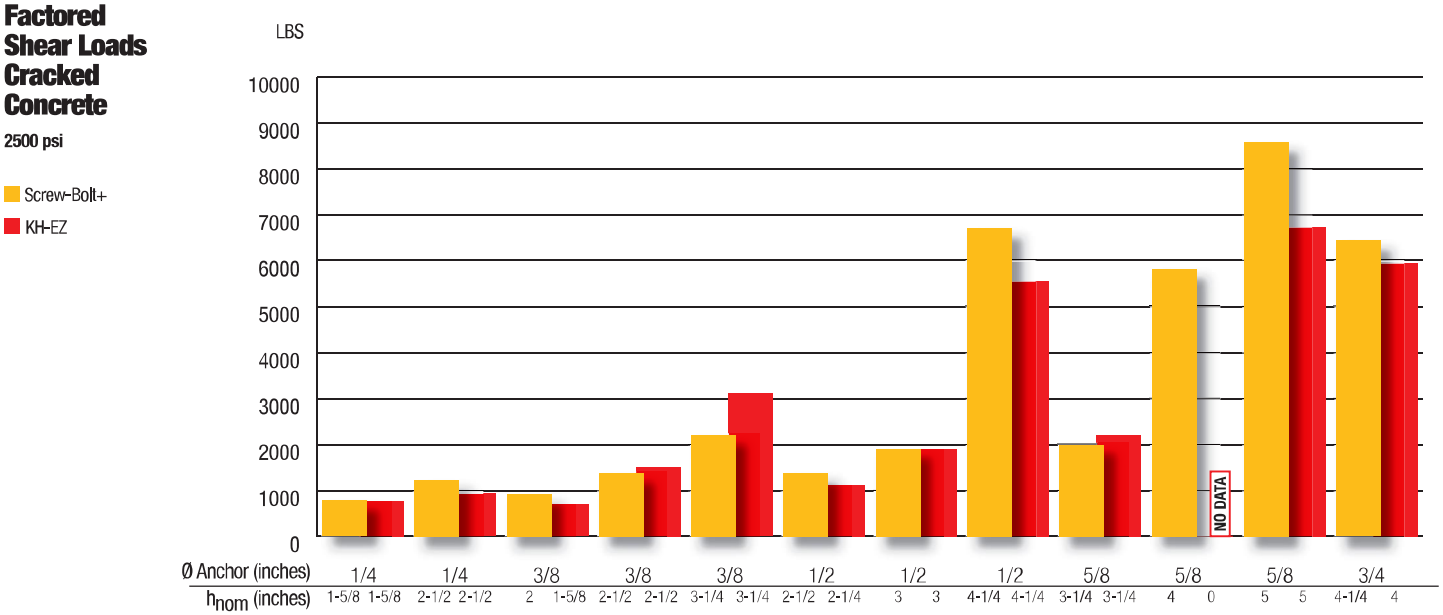
Factored Tension Loads Cracked Concrete

2500 psi



Factored Shear Loads Cracked Concrete

2500 psi



Source: ESR-3889 (Issued: 2016 Nov), ESR-3027 (Issued: 2015 Dec)

GENERAL INFORMATION

SCREW-BOLT+™

High Performance Screw Anchor

PRODUCT DESCRIPTION

The Screw-Bolt+ anchor is a one piece, heavy duty screw anchor with a finished hex head. It is simple to install, easy to identify and fully removable. The patented thread design, designed for use with standard ANSI drill bits, reduces installation torque and enhances productivity. The steel threads along the anchor body tap into the hole during installation to provide keyed engagement and allow for reduced edge and spacing distances. The Screw-Bolt+ finish is available in bright zinc-plated and mechanically galvanized. Suitable base materials include normal-weight concrete, sand-lightweight concrete, concrete over steel deck, concrete masonry and solid clay brick.

GENERAL APPLICATIONS AND USES

- Racking, shelving and material handling
- Support ledgers and sill plate attachments
- Temporary attachments
- Glazing and window attachments
- Retrofits, repairs and maintenance
- Fencing and railing
- Seismic and wind loading

FEATURES AND BENEFITS

+ Designed for standard ANSI tolerance drill bits
+ Patented thread design offers low installation torque
+ Tough threads for tapping high strength concrete
+ Ratchet teeth on underside of hex washer head lock against the fixture
+ Can be installed closer to the edge than traditional expansion anchors
+ Fully removeable and reinstallable in same hole
+ Fast installation with powered impact wrench
+ Diameter, length and identifying marking stamped on head of each anchor
+ One-piece, finished head design

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-3889 for concrete, Code compliant with 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC.
- Tested in accordance with ACI 355.2 and ICC-ES AC193 for use in structural applications in concrete under the design provisions of ACI 318 (Strength Design Method)
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)
- Evaluated and qualified by an accredited independent testing laboratory for reliability against brittle failure, e.g. hydrogen embrittlement

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Screw anchors shall be Screw-Bolt+ 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 and hex washer head	Case hardened low carbon steel
Plating Standard zinc plated or mechanically galvanized versions	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.
	Mechanically Galvanized Zinc plating according to ASTM B 695, Class 55

SECTION CONTENTS

SCREW-BOLT+

HEAD STYLES

Hex Washer Head

ANCHOR MATERIALS

Zinc plated carbon steel or mechanically galvanized

ANCHOR SIZE RANGE (TYP.)

- 1/4" diameter through 3/4" diameter (see ordering information)

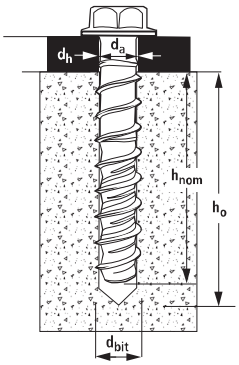
SUITABLE BASE MATERIALS

- Normal-weight concrete
- Sand-lightweight concrete
- Concrete over steel deck

CODE LISTED
ICC-ES ESR-3889
CONCRETE

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Anchor Detail



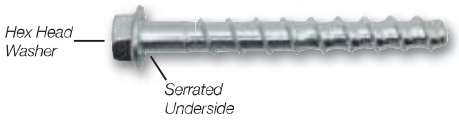
Nomenclature

d_a = Diameter of Anchor
d_{bit} = Diameter of Drill Bit
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

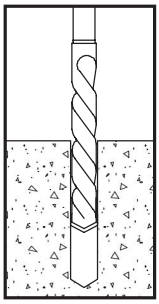
Hex Head Marking

Legend

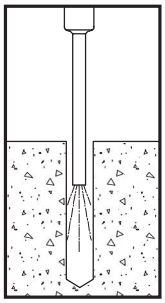
Diameter and Length Identification Mark



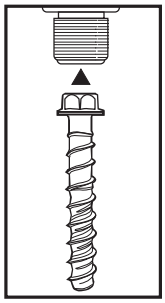
Installation Instructions for Screw-Bolt+



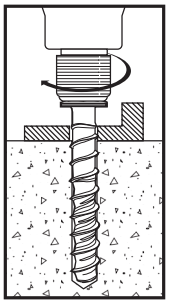
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI standard B212.15



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



Step 3
Select a torque wrench or powered impact wrench and do not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$ respectively for the selected anchor diameter and embedment. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

REFERENCE DATA (ASD)

Installation Specifications for Screw-Bolt+ in Concrete and Supplemental Information[2]

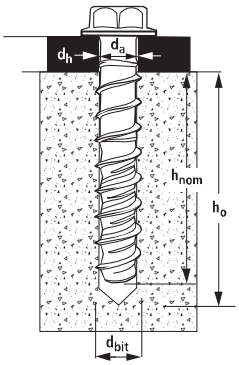
Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.35)	0.375 (9.53)	0.500 (12.70)	0.625 (15.88)	0.750 (19.05)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth	h_{nom}	in. (mm)	1 (25)	1-1/2 (38)	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)
Minimum hole depth	h_o	in. (mm)	1-3/8 (35)	1-7/8 (48)	2-1/8 (54)	2-7/8 (73)	2-7/8 (73)
Minimum member thickness[1]	h_{min}	in. (mm)	3 (76)	3 (76)	3 (76)	3-3/4 (95)	3-3/4 (95)
Minimum edge distance	c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Minimum spacing	s_{min}	in. (mm)	1-1/2 (38)	2 (51)	2-3/4 (70)	2-3/4 (70)	3 (76)
Max Installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	45 (61)	60 (81)	70 (95)
Max impact wrench power (torque)	$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	300 (407)	300 (407)	700 (950)	700 (950)
Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Effective tensile stress area (screw anchor body)	A_{se}	in^2 (mm^2)	0.045 (29.0)	0.094 (60.6)	0.176 (113.5)	0.274 (176.8)	0.399 (257.4)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm^2)	100 (690)	92.5 (638)	115 (794)	95 (656)	95 (656)
Minimum specified yield strength	f_y	ksi (N/mm^2)	80 (552)	74 (511)	92 (635)	76 (524)	76 (524)

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

1. The minimum base material thickness shall be the greater of $1.5 \bullet h_{nom}$ or 3 inches.
2. See load capacities in normal weight concrete for additional embedment depths.

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Anchor Detail



Nomenclature

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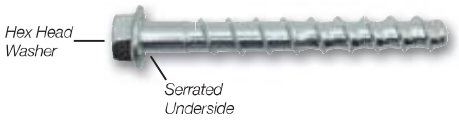
d_h = Diameter of Clearance Hole
h = Base Material Thickness. The value of h should be $1.5h_{nom}$ or 3", whichever is greater
h_{nom} = Minimum Nominal Embedment
h_o = Minimum Hole Depth

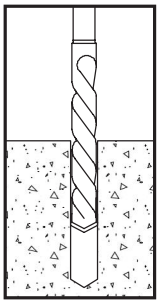
Hex Head Marking

Legend

Diameter and Length Identification Mark



Installation Instructions for Screw-Bolt+



Step 1
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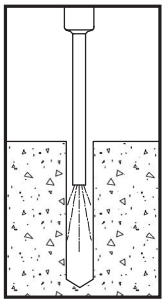
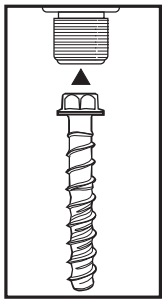
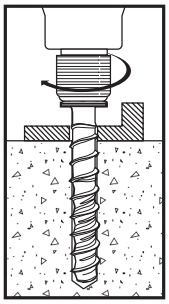


Step 2
Remove dust and debris from hole during drilling (e.g. dust extractor, hollow bit) or following drilling (e.g. suction, forced air) to extract loose particles created during drilling.



Step 3
Select a torque wrench or powered impact wrench and do not exceed the maximum torque, $T_{inst,max}$ or $T_{impact,max}$ respectively for the selected anchor diameter and embedment. Attach an appropriate sized hex socket/driver to the impact wrench. Mount the screw anchor head into the socket.



Step 4
Drive the anchor into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

REFERENCE DATA (ASD)

Installation Specifications for Screw-Bolt+ in Concrete and Supplemental Information[2]

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)				
			1/4	3/8	1/2	5/8	3/4
Anchor outside diameter	d	in. (mm)	0.250 (6.35)	0.375 (9.53)	0.500 (12.70)	0.625 (15.88)	0.750 (19.05)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI	1/2 ANSI	5/8 ANSI	3/4 ANSI
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)	7/8 (22.2)
Minimum embedment depth	h_{nom}	in. (mm)	1 (25)	1-1/2 (38)	1-3/4 (44)	2-1/2 (64)	2-1/2 (64)
Minimum hole depth	h_o	in. (mm)	1-3/8 (35)	1-7/8 (48)	2-1/8 (54)	2-7/8 (73)	2-7/8 (73)
Minimum member thickness[1]	h_{min}	in. (mm)	3 (76)	3 (76)	3 (76)	3-3/4 (95)	3-3/4 (95)
Minimum edge distance	c_{min}	in. (mm)	1-1/2 (38)	1-1/2 (38)	1-3/4 (44)	1-3/4 (44)	1-3/4 (44)
Minimum spacing	s_{min}	in. (mm)	1-1/2 (38)	2 (51)	2-3/4 (70)	2-3/4 (70)	3 (76)
Max Installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	45 (61)	60 (81)	70 (95)
Max impact wrench power (torque)	$T_{impact,max}$	ft.-lbf. (N-m)	150 (203)	300 (407)	300 (407)	700 (950)	700 (950)
Impact wrench socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8
Maximum head height	-	in.	21/64	3/8	31/64	37/64	43/64
Maximum washer diameter	-	in.	37/64	3/4	1-1/16	1-1/8	1-13/32
Effective tensile stress area (screw anchor body)	A_{se}	in^2 (mm^2)	0.045 (29.0)	0.094 (60.6)	0.176 (113.5)	0.274 (176.8)	0.399 (257.4)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm^2)	100 (690)	92.5 (638)	115 (794)	95 (656)	95 (656)
Minimum specified yield strength	f_y	ksi (N/mm^2)	80 (552)	74 (511)	92 (635)	76 (524)	76 (524)

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

1. The minimum base material thickness shall be the greater of $1.5 \bullet h_{nom}$ or 3 inches.
2. See load capacities in normal weight concrete for additional embedment depths.

Ultimate Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2]

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1 (25)	1,325 (5.9)	1,660 (7.4)	1,400 (6.2)	1,755 (7.8)	1,530 (6.8)	1,910 (8.5)	1,725 (7.7)	2,080 (9.3)	1,725 (7.7)	2,080 (9.3)
	1-5/8 (41)	2,835 (12.6)	1,660 (7.4)	2,995 (13.3)	1,755 (7.8)	3,265 (14.5)	1,910 (8.5)	3,265 (14.5)	2,080 (9.3)	3,265 (14.5)	2,080 (9.3)
	2-1/2 (64)	3,650 (16.2)	2,025 (9.0)	3,855 (17.1)	2,140 (9.5)	4,200 (18.7)	2,335 (10.4)	4,270 (19.0)	2,545 (11.3)	4,270 (19.0)	2,545 (11.3)
3/8	1-1/2 (38)	2,630 (11.7)	3,550 (15.8)	2,880 (12.8)	3,890 (17.3)	3,330 (14.8)	4,490 (20.0)	4,075 (18.1)	5,500 (24.5)	4,075 (18.1)	6,355 (28.3)
	2 (51)	3,670 (16.3)	4,320 (19.2)	4,020 (17.9)	4,735 (21.1)	4,645 (20.7)	5,465 (24.3)	4,725 (21.0)	6,345 (28.2)	5,455 (24.3)	6,345 (28.2)
	3-1/4 (83)	7,420 (33.0)	6,325 (28.1)	8,130 (36.2)	6,930 (30.8)	9,065 (40.3)	8,000 (35.6)	9,065 (40.3)	8,565 (38.1)	10,350 (46.0)	8,565 (38.1)
	4-1/2 (114)	10,905 (48.5)	6,325 (28.1)	11,945 (53.1)	6,930 (30.8)	13,795 (61.4)	8,000 (35.6)	15,075 (67.1)	8,565 (38.1)	15,075 (67.1)	8,565 (38.1)
1/2	1-3/4 (44)	2,840 (12.6)	5,985 (26.6)	3,115 (13.9)	6,555 (29.2)	3,595 (16.0)	7,570 (33.7)	4,400 (19.6)	9,270 (41.2)	4,400 (19.6)	10,705 (47.6)
	2-1/2 (64)	6,680 (29.7)	8,035 (35.7)	7,320 (32.6)	8,800 (39.1)	8,450 (37.6)	10,160 (45.2)	8,450 (37.6)	11,545 (51.4)	8,450 (37.6)	11,545 (51.4)
	4-1/4 (108)	13,260 (59.0)	9,395 (41.8)	14,525 (64.6)	10,290 (45.8)	16,480 (73.3)	11,885 (52.9)	16,480 (73.3)	13,520 (60.1)	16,480 (73.3)	13,520 (60.1)
	5-1/2 (140)	15,730 (70.0)	9,395 (41.8)	17,235 (76.7)	10,290 (45.8)	19,900 (88.5)	11,885 (52.9)	21,310 (94.8)	13,520 (60.1)	21,310 (94.8)	13,520 (60.1)
5/8	2-1/2 (64)	5,735 (25.5)	10,615 (47.2)	6,285 (28.0)	11,630 (51.7)	7,255 (32.3)	13,425 (59.7)	8,885 (39.5)	16,445 (73.2)	8,885 (39.5)	17,170 (76.4)
	3-1/4 (83)	9,755 (43.4)	12,065 (53.7)	10,685 (47.5)	13,220 (58.8)	12,340 (54.9)	15,265 (67.9)	12,340 (54.9)	17,170 (76.4)	12,340 (54.9)	17,170 (76.4)
	5 (127)	14,455 (64.3)	13,675 (60.8)	15,830 (70.4)	14,980 (66.6)	18,280 (81.3)	17,295 (76.9)	19,295 (85.8)	19,485 (86.7)	22,280 (99.1)	19,485 (86.7)
	6-1/4 (159)	20,520 (91.3)	13,675 (60.8)	22,475 (100.0)	14,980 (66.6)	25,955 (115.5)	17,295 (76.9)	31,785 (141.4)	19,485 (86.7)	31,785 (141.4)	19,485 (86.7)
3/4	2-1/2 (64)	6,035 (26.8)	11,615 (51.7)	6,610 (29.4)	12,725 (56.6)	7,635 (34.0)	14,690 (65.3)	9,350 (41.6)	17,995 (80.0)	9,350 (41.6)	20,775 (92.4)
	4-1/4 (108)	11,900 (52.9)	17,055 (75.9)	13,035 (58.0)	18,685 (83.1)	15,050 (66.9)	21,575 (96.0)	17,745 (78.9)	24,270 (108.0)	20,490 (91.1)	24,270 (108.0)
	5 (127)	19,020 (84.6)	17,055 (75.9)	20,835 (92.7)	18,685 (83.1)	24,055 (107.0)	21,575 (96.0)	29,460 (131.0)	24,270 (108.0)	29,460 (131.0)	24,270 (108.0)
	6-1/4 (159)	20,495 (91.2)	17,055 (75.9)	22,450 (99.9)	18,685 (83.1)	25,920 (115.3)	21,575 (96.0)	31,750 (141.2)	24,270 (108.0)	31,750 (141.2)	24,270 (108.0)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at a minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)		f'c = 8,000 psi (55.2 MPa)	
		Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1 (25)	330 (1.5)	415 (1.8)	350 (1.6)	440 (2.0)	385 (1.7)	480 (2.1)	430 (1.9)	520 (2.3)	430 (1.9)	520 (2.3)
	1-5/8 (41)	710 (3.2)	415 (1.8)	750 (3.3)	440 (2.0)	815 (3.6)	480 (2.1)	815 (3.6)	520 (2.3)	815 (3.6)	520 (2.3)
	2-1/2 (64)	915 (4.1)	505 (2.2)	965 (4.3)	535 (2.4)	1,050 (4.7)	585 (2.6)	1,070 (4.8)	635 (2.8)	1,070 (4.8)	635 (2.8)
3/8	1-1/2 (38)	660 (2.9)	890 (4.0)	720 (3.2)	975 (4.3)	835 (3.7)	1,125 (5.0)	1,020 (4.5)	1,375 (6.1)	1,020 (4.5)	1,590 (7.1)
	2 (51)	920 (4.1)	1,080 (4.8)	1,005 (4.5)	1,185 (5.3)	1,160 (5.2)	1,365 (6.1)	1,180 (5.2)	1,585 (7.1)	1,365 (6.1)	1,585 (7.1)
	3-1/4 (83)	1,855 (8.3)	1,580 (7.0)	2,035 (9.1)	1,735 (7.7)	2,265 (10.1)	2,000 (8.9)	2,265 (10.1)	2,140 (9.5)	2,590 (11.5)	2,140 (9.5)
	4-1/2 (114)	2,725 (12.1)	1,580 (7.0)	2,985 (13.3)	1,735 (7.7)	3,450 (15.3)	2,000 (8.9)	3,770 (16.8)	2,140 (9.5)	3,770 (16.8)	2,140 (9.5)
1/2	1-3/4 (44)	710 (3.2)	1,495 (6.7)	780 (3.5)	1,640 (7.3)	900 (4.0)	1,895 (8.4)	1,100 (4.9)	2,320 (10.3)	1,100 (4.9)	2,675 (11.9)
	2-1/2 (64)	1,670 (7.4)	2,010 (8.9)	1,830 (8.1)	2,200 (9.8)	2,115 (9.4)	2,540 (11.3)	2,115 (9.4)	2,885 (12.8)	2,115 (9.4)	2,885 (12.8)
	4-1/4 (108)	3,315 (14.7)	2,350 (10.5)	3,630 (16.1)	2,575 (11.5)	4,120 (18.3)	2,970 (13.2)	4,120 (18.3)	3,380 (15.0)	4,120 (18.3)	3,380 (15.0)
	5-1/2 (140)	3,935 (17.5)	2,350 (10.5)	4,310 (19.2)	2,575 (11.5)	4,975 (22.1)	2,970 (13.2)	5,330 (23.7)	3,380 (15.0)	5,330 (23.7)	3,380 (15.0)
5/8	2-1/2 (64)	1,435 (6.4)	2,655 (11.8)	1,570 (7.0)	2,910 (12.9)	1,815 (8.1)	3,355 (14.9)	2,220 (9.9)	4,110 (18.3)	2,220 (9.9)	4,295 (19.1)
	3-1/4 (83)	2,440 (10.9)	3,015 (13.4)	2,670 (11.9)	3,305 (14.7)	3,085 (13.7)	3,815 (17.0)	3,085 (13.7)	4,295 (19.1)	3,085 (13.7)	4,295 (19.1)
	5 (127)	3,615 (16.1)	3,420 (15.2)	3,960 (17.6)	3,745 (16.7)	4,570 (20.3)	4,325 (19.2)	4,825 (21.5)	4,870 (21.7)	5,570 (24.8)	4,870 (21.7)
	6-1/4 (159)	5,130 (22.8)	3,420 (15.2)	5,620 (25.0)	3,745 (16.7)	6,490 (28.9)	4,325 (19.2)	7,945 (35.3)	4,870 (21.7)	7,945 (35.3)	4,870 (21.7)
3/4	2-1/2 (64)	1,510 (6.7)	2,905 (12.9)	1,655 (7.4)	3,180 (14.1)	1,910 (8.5)	3,675 (16.3)	2,340 (10.4)	4,500 (20.0)	2,340 (10.4)	5,195 (23.1)
	4-1/4 (108)	2,975 (13.2)	4,265 (19.0)	3,260 (14.5)	4,670 (20.8)	3,765 (16.7)	5,395 (24.0)	4,435 (19.7)	6,070 (27.0)	5,125 (22.8)	6,070 (27.0)
	5 (127)	4,755 (21.2)	4,265 (19.0)	5,210 (23.2)	4,670 (20.8)	6,015 (26.8)	5,395 (24.0)	7,365 (32.8)	6,070 (27.0)	7,365 (32.8)	6,070 (27.0)
	6-1/4 (159)	5,125 (22.8)	4,265 (19.0)	5,615 (25.0)	4,670 (20.8)	6,480 (28.8)	5,395 (24.0)	7,940 (35.3)	6,070 (27.0)	7,940 (35.3)	6,070 (27.0)

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

LOAD ADJUSTMENT FACTORS FOR NORMAL-WEIGHT CONCRETE

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

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance c_{min} (in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	1.00	0.77	0.64	0.85	0.74	0.59	0.55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1-3/4	1.00	0.83	0.67	0.93	0.79	0.62	0.57	0.87	0.71	0.58	0.54	0.73	0.65	0.56	0.53	0.73	0.59	0.56	0.53
	2	1.00	0.88	0.71	1.00	0.84	0.65	0.59	0.94	0.76	0.60	0.56	0.78	0.68	0.58	0.54	0.78	0.61	0.58	0.54
	2-1/4	1.00	0.94	0.75	1.00	0.89	0.68	0.61	1.00	0.80	0.63	0.57	0.82	0.71	0.60	0.56	0.82	0.63	0.60	0.56
	2-1/2	1.00	1.00	0.78	1.00	0.95	0.71	0.63	1.00	0.84	0.65	0.59	0.87	0.75	0.62	0.57	0.87	0.66	0.62	0.57
	2-3/4	1.00	1.00	0.82	1.00	1.00	0.74	0.65	1.00	0.88	0.67	0.61	0.91	0.78	0.64	0.59	0.91	0.68	0.64	0.59
	3	1.00	1.00	0.86	1.00	1.00	0.77	0.67	1.00	0.92	0.69	0.62	0.96	0.81	0.66	0.60	0.96	0.70	0.66	0.60
	3-1/2	1.00	1.00	0.93	1.00	1.00	0.83	0.71	1.00	1.00	0.74	0.65	1.00	0.87	0.69	0.63	1.00	0.75	0.69	0.63
	4	1.00	1.00	1.00	1.00	1.00	0.88	0.75	1.00	1.00	0.78	0.69	1.00	0.94	0.73	0.66	1.00	0.79	0.73	0.66
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.94	0.79	1.00	1.00	0.82	0.72	1.00	1.00	0.77	0.69	1.00	0.84	0.77	0.69
	5	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.87	0.75	1.00	1.00	0.81	0.72	1.00	0.89	0.81	0.72
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.91	0.79	1.00	1.00	0.85	0.75	1.00	0.93	0.85	0.75
	6	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.96	0.82	1.00	1.00	0.89	0.78	1.00	0.98	0.89	0.78
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.85	1.00	1.00	0.92	0.81	1.00	1.00	0.92	0.81
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.96	0.84	1.00	1.00	0.96	0.84
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.87	1.00	1.00	1.00	0.87
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.90	1.00	1.00	1.00	0.90
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.93	1.00	1.00	1.00	0.93
	9	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
	10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Tension (F_{NS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.89	0.73	0.66	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1-3/4	0.94	0.77	0.68	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2	1.00	0.80	0.70	0.88	0.77	0.67	0.63	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-1/4	1.00	0.83	0.72	0.93	0.80	0.69	0.64	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-1/2	1.00	0.86	0.74	0.97	0.83	0.70	0.65	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-3/4	1.00	0.89	0.76	1.00	0.86	0.72	0.66	0.92	0.78	0.67	0.64	0.80	0.73	0.65	0.63	N/A	N/A	N/A	N/A
	3	1.00	0.92	0.78	1.00	0.89	0.74	0.67	0.95	0.80	0.68	0.65	0.83	0.74	0.66	0.64	0.83	0.69	0.66	0.64
	3-1/2	1.00	0.99	0.82	1.00	0.94	0.77	0.70	1.00	0.85	0.71	0.67	0.88	0.78	0.68	0.65	0.88	0.71	0.68	0.65
	4	1.00	1.00	0.86	1.00	1.00	0.80	0.72	1.00	0.89	0.73	0.68	0.92	0.81	0.70	0.67	0.93	0.74	0.71	0.67
	4-1/2	1.00	1.00	0.90	1.00	1.00	0.83	0.74	1.00	0.93	0.75	0.70	0.97	0.85	0.72	0.68	0.97	0.76	0.73	0.69
	5	1.00	1.00	0.94	1.00	1.00	0.86	0.76	1.00	0.98	0.78	0.72	1.00	0.88	0.75	0.70	1.00	0.79	0.75	0.70
	5-1/2	1.00	1.00	0.97	1.00	1.00	0.89	0.78	1.00	1.00	0.80	0.74	1.00	0.92	0.77	0.72	1.00	0.81	0.77	0.72
	6	1.00	1.00	1.00	1.00	1.00	0.93	0.81	1.00	1.00	0.82	0.75	1.00	0.95	0.79	0.73	1.00	0.84	0.79	0.73
	6-1/2	1.00	1.00	1.00	1.00	1.00	0.96	0.83	1.00	1.00	0.85	0.77	1.00	0.98	0.81	0.75	1.00	0.86	0.81	0.75
	7	1.00	1.00	1.00	1.00	1.00	0.99	0.85	1.00	1.00	0.87	0.79	1.00	1.00	0.83	0.76	1.00	0.89	0.83	0.77
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.87	1.00	1.00	0.90	0.81	1.00	1.00	0.85	0.78	1.00	0.91	0.85	0.78
	8	1.00	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	0.92	0.83	1.00	1.00	0.87	0.80	1.00	0.94	0.87	0.80
	8-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.92	1.00	1.00	0.94	0.84	1.00	1.00	0.89	0.81	1.00	0.96	0.89	0.81
	9	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.97	0.86	1.00	1.00	0.91	0.83	1.00	0.99	0.91	0.83
	9-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	0.99	0.88	1.00	1.00	0.93	0.84	1.00	1.00	0.93	0.85
	10	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	1.00	1.00	0.90	1.00	1.00	0.95	0.86	1.00	1.00	0.95	0.86
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.97	0.88	1.00	1.00	0.97	0.88
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93	1.00	1.00	0.99	0.89	1.00	1.00	0.99	0.89
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	0.91	1.00	1.00	1.00	0.91
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	1.00	0.92	1.00	1.00	1.00	0.93
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	1.00	1.00	0.96
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	1.00	1.00	0.99
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

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

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Min. Edge Distance c_{min}(in)		1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4	1-3/4
Edge Distance (inches)	1-1/2	0.58	0.63	0.59	0.40	0.37	0.31	0.32	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1-3/4	0.68	0.73	0.69	0.46	0.43	0.36	0.38	0.35	0.31	0.30	0.31	0.27	0.26	0.25	0.26	0.26	0.22	0.22	0.23
	2	0.78	0.84	0.78	0.53	0.49	0.41	0.43	0.41	0.35	0.35	0.36	0.30	0.29	0.29	0.30	0.30	0.25	0.26	0.27
	2-1/4	0.87	0.94	0.88	0.59	0.55	0.46	0.48	0.46	0.40	0.39	0.40	0.34	0.33	0.32	0.33	0.33	0.28	0.29	0.30
	2-1/2	0.97	1.00	0.98	0.66	0.61	0.51	0.54	0.51	0.44	0.43	0.45	0.38	0.36	0.36	0.37	0.37	0.31	0.32	0.33
	2-3/4	1.00	1.00	1.00	0.73	0.67	0.56	0.59	0.56	0.49	0.48	0.49	0.42	0.40	0.40	0.41	0.41	0.34	0.35	0.37
	3	1.00	1.00	1.00	0.79	0.73	0.61	0.64	0.61	0.53	0.52	0.54	0.46	0.44	0.43	0.45	0.44	0.38	0.39	0.40
	3-1/2	1.00	1.00	1.00	0.92	0.85	0.72	0.75	0.71	0.62	0.61	0.63	0.53	0.51	0.50	0.52	0.52	0.44	0.45	0.47
	4	1.00	1.00	1.00	1.00	0.97	0.82	0.86	0.81	0.71	0.69	0.72	0.61	0.58	0.57	0.59	0.59	0.50	0.51	0.53
	4-1/2	1.00	1.00	1.00	1.00	1.00	0.92	0.97	0.91	0.80	0.78	0.81	0.68	0.66	0.65	0.67	0.67	0.56	0.58	0.60
	5	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	0.87	0.90	0.76	0.73	0.72	0.74	0.74	0.63	0.64	0.66
	5-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.95	0.99	0.84	0.80	0.79	0.82	0.82	0.69	0.71	0.73
	6	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.88	0.86	0.89	0.89	0.75	0.77	0.80
	6-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.95	0.93	0.97	0.96	0.81	0.84	0.86
	7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	0.90	0.93
	7-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.96	1.00
	8	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Reduction Factors - Shear (F_{VS})

Diameter (in)		1/4			3/8				1/2				5/8				3/4			
Nominal Embedment h_{nom} (in)		1	1-5/8	2-1/2	1-1/2	2	3-1/4	4-1/2	1-3/4	2-1/2	4-1/4	5-1/2	2-1/2	3-1/4	5	6-1/4	2-1/2	4-1/4	5	6-1/4
Minimum Spacing s_{min} (in)		1-1/2	1-1/2	1-1/2	2	2	2	2	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	2-3/4	3	3	3	3
Spacing Distance (inches)	1-1/2	0.60	0.60	0.60	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	1-3/4	0.61	0.62	0.61	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2	0.63	0.64	0.63	0.59	0.58	0.57	0.57	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-1/4	0.65	0.66	0.65	0.60	0.59	0.58	0.58	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-1/2	0.66	0.67	0.66	0.61	0.60	0.59	0.59	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	2-3/4	0.68	0.69	0.68	0.62	0.61	0.59	0.60	0.59	0.58	0.58	0.58	0.57	0.57	0.57	0.57	N/A	N/A	N/A	N/A
	3	0.69	0.71	0.70	0.63	0.62	0.60	0.61	0.60	0.59	0.59	0.59	0.58	0.57	0.57	0.57	0.57	0.56	0.56	0.57
	3-1/2	0.73	0.74	0.73	0.65	0.64	0.62	0.63	0.62	0.60	0.60	0.60	0.59	0.59	0.58	0.59	0.59	0.57	0.57	0.58
	4	0.76	0.78	0.76	0.68	0.66	0.64	0.64	0.64	0.62	0.62	0.62	0.60	0.60	0.60	0.60	0.60	0.58	0.59	0.59
	4-1/2	0.79	0.81	0.79	0.70	0.68	0.65	0.66	0.65	0.63	0.63	0.63	0.61	0.61	0.61	0.61	0.61	0.59	0.60	0.60
	5	0.82	0.85	0.83	0.72	0.70	0.67	0.68	0.67	0.65	0.64	0.65	0.63	0.62	0.62	0.62	0.62	0.60	0.61	0.61
	5-1/2	0.86	0.88	0.86	0.74	0.72	0.69	0.70	0.69	0.66	0.66	0.66	0.64	0.63	0.63	0.64	0.64	0.61	0.62	0.62
	6	0.89	0.92	0.89	0.76	0.74	0.70	0.71	0.70	0.68	0.67	0.68	0.65	0.65	0.64	0.65	0.65	0.63	0.63	0.63
	6-1/2	0.92	0.95	0.92	0.79	0.76	0.72	0.73	0.72	0.69	0.69	0.69	0.66	0.66	0.66	0.66	0.66	0.64	0.64	0.64
	7	0.95	0.99	0.96	0.81	0.78	0.74	0.75	0.74	0.71	0.70	0.71	0.68	0.67	0.67	0.67	0.67	0.65	0.65	0.66
	7-1/2	0.99	1.00	0.99	0.83	0.80	0.76	0.77	0.75	0.72	0.72	0.72	0.69	0.68	0.68	0.69	0.69	0.66	0.66	0.67
	8	1.00	1.00	1.00	0.85	0.82	0.77	0.79	0.77	0.74	0.73	0.74	0.70	0.69	0.69	0.70	0.70	0.67	0.67	0.68
	9	1.00	1.00	1.00	0.90	0.87	0.81	0.82	0.80	0.77	0.76	0.77	0.73	0.72	0.72	0.72	0.72	0.69	0.69	0.70
	10	1.00	1.00	1.00	0.94	0.91	0.84	0.86	0.84	0.80	0.79	0.80	0.75	0.74	0.74	0.75	0.75	0.71	0.71	0.72
	11	1.00	1.00	1.00	0.98	0.95	0.87	0.89	0.87	0.82	0.82	0.83	0.78	0.77	0.76	0.77	0.77	0.73	0.74	0.74
	12	1.00	1.00	1.00	1.00	0.99	0.91	0.93	0.91	0.85	0.85	0.86	0.80	0.79	0.79	0.80	0.80	0.75	0.76	0.77
	13	1.00	1.00	1.00	1.00	1.00	0.94	0.96	0.94	0.88	0.88	0.89	0.83	0.82	0.81	0.82	0.82	0.77	0.78	0.79
	14	1.00	1.00	1.00	1.00	1.00	0.98	1.00	0.97	0.91	0.90	0.92	0.85	0.84	0.84	0.85	0.85	0.79	0.80	0.81
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.93	0.95	0.88	0.86	0.86	0.87	0.87	0.81	0.82	0.83
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.96	0.98	0.91	0.89	0.88	0.90	0.90	0.83	0.84	0.85
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	1.00	0.93	0.91	0.91	0.92	0.92	0.86	0.86	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.94	0.93	0.95	0.94	0.88	0.89	0.90
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.96	0.95	0.97	0.97	0.90	0.91	0.92
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.98	1.00	0.99	0.92	0.93	0.94
	21	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.95	0.97
	22	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.97	0.99
	23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.99	1.00
	24	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Ultimate Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	Minimum Concrete Compressive Strength					
			f'_c = 2,500 psi (17.3 MPa)		f'_c = 3,000 psi (20.7 MPa)		f'_c = 4,000 psi (27.6 MPa)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	2,060 (9.2)	1,300 (5.8)	2,260 (10.1)	1,420 (6.3)	2,600 (11.6)	1,640 (7.3)
	2-1/2 (64)		3,380 (15.0)	1,580 (7.0)	3,700 (16.5)	1,740 (7.7)	4,280 (19.0)	2,000 (8.9)
3/8	1-1/2 (38)	1-1/2 (38)	2,120 (9.4)	1,060 (4.7)	2,320 (10.3)	1,160 (5.2)	2,680 (11.9)	1,340 (6.0)
	2 (51)		2,600 (11.6)	1,560 (6.9)	2,840 (12.6)	1,700 (7.6)	3,280 (14.6)	1,960 (8.7)
	3-1/4 (83)		4,460 (19.8)	2,080 (9.3)	4,880 (21.7)	2,280 (10.1)	5,640 (25.1)	2,640 (11.7)
	4-1/2 (114)		7,680 (34.2)	2,080 (9.3)	8,420 (37.5)	2,280 (10.1)	9,720 (43.2)	2,640 (11.7)
1/2	1-3/4 (44)	1-3/4 (38)	2,840 (12.6)	2,040 (9.1)	3,115 (13.9)	2,220 (9.9)	3,595 (16.0)	2,580 (11.5)
	2-1/2 (64)		3,820 (17.0)	2,360 (10.5)	4,180 (18.6)	2,580 (11.5)	4,820 (21.4)	2,980 (13.3)
	4-1/4 (108)		6,860 (30.5)	3,280 (14.6)	7,520 (33.5)	3,580 (15.9)	8,680 (38.6)	4,140 (18.4)
	5-1/2 (140)		12,600 (56.0)	3,280 (14.6)	13,800 (61.4)	3,580 (15.9)	15,940 (70.9)	4,140 (18.4)
5/8	3-1/4 (83)	1-3/4 (44)	5,260 (23.4)	2,800 (12.5)	5,760 (25.6)	3,060 (13.6)	6,640 (29.5)	3,540 (15.7)
	5 (127)		8,360 (37.2)	3,660 (16.3)	9,160 (40.7)	4,020 (17.9)	10,580 (47.1)	4,640 (20.6)
	6-1/4 (159)		10,240 (45.5)	3,660 (16.3)	11,200 (49.8)	4,020 (17.9)	12,940 (57.6)	4,640 (20.6)
3/4	4-1/4 (108)	1-3/4 (44)	7,240 (32.2)	3,460 (15.4)	7,920 (35.2)	3,780 (16.8)	9,160 (40.7)	4,360 (19.4)
	5 (127)		9,140 (40.7)	3,460 (15.4)	10,020 (44.6)	3,780 (16.8)	11,560 (51.4)	4,360 (19.4)
	6-1/4 (159)		14,420 (64.1)	3,460 (15.4)	15,800 (70.3)	3,780 (16.8)	18,240 (81.1)	4,360 (19.4)

1. Tabulated load values are for anchors installed in concrete. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working load.

Allowable Load Capacities for Screw-Bolt+ in Normal-Weight Concrete at Minimum Edge[1,2,3,4]

Nominal Anchor Diameter d in.	Minimum Nominal Embedment Depth in. (mm)	Minimum Edge Distance in. (mm)	Minimum Concrete Compressive Strength					
			f'_c = 2,500 psi (17.3 MPa)		f'_c = 3,000 psi (20.7 MPa)		f'_c = 4,000 psi (27.6 MPa)	
			Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)	Tension lbs (kN)	Shear lbs (kN)
1/4	1-5/8 (41)	1-1/2 (38)	515 (2.3)	325 (1.4)	565 (2.5)	355 (1.6)	650 (2.9)	410 (1.8)
	2-1/2 (64)		845 (3.8)	395 (1.8)	925 (4.1)	435 (1.9)	1,070 (4.8)	500 (2.2)
3/8	1-1/2 (38)	1-1/2 (38)	530 (2.4)	265 (1.2)	580 (2.6)	290 (1.3)	670 (3.0)	335 (1.5)
	2 (51)		650 (2.9)	390 (1.7)	710 (3.2)	425 (1.9)	820 (3.6)	490 (2.2)
	3-1/4 (83)		1,115 (5.0)	520 (2.3)	1,220 (5.4)	570 (2.5)	1,410 (6.3)	660 (2.9)
	4-1/2 (114)		1,920 (8.5)	520 (2.3)	2,105 (9.4)	570 (2.5)	2,430 (10.8)	660 (2.9)
1/2	1-3/4 (44)	1-3/4 (38)	710 (3.2)	510 (2.3)	780 (3.5)	555 (2.5)	900 (4.0)	645 (2.9)
	2-1/2 (64)		955 (4.2)	590 (2.6)	1,045 (4.6)	645 (2.9)	1,205 (5.4)	745 (3.3)
	4-1/4 (108)		1,715 (7.6)	820 (3.6)	1,880 (8.4)	895 (4.0)	2,170 (9.7)	1,035 (4.6)
	5-1/2 (140)		3,150 (14.0)	820 (3.6)	3,450 (15.3)	895 (4.0)	3,985 (17.7)	1,035 (4.6)
5/8	3-1/4 (83)	1-3/4 (44)	1,315 (5.8)	700 (3.1)	1,440 (6.4)	765 (3.4)	1,660 (7.4)	885 (3.9)
	5 (127)		2,090 (9.3)	915 (4.1)	2,290 (10.2)	1,005 (4.5)	2,645 (11.8)	1,160 (5.2)
	6-1/4 (159)		2,560 (11.4)	915 (4.1)	2,800 (12.5)	1,005 (4.5)	3,235 (14.4)	1,160 (5.2)
3/4	4-1/4 (108)	1-3/4 (44)	1,810 (8.1)	865 (3.8)	1,980 (8.8)	945 (4.2)	2,290 (10.2)	1,090 (4.8)
	5 (127)		2,285 (10.2)	865 (3.8)	2,505 (11.1)	945 (4.2)	2,890 (12.9)	1,090 (4.8)
	6-1/4 (159)		3,605 (16.0)	865 (3.8)	3,950 (17.6)	945 (4.2)	4,560 (20.3)	1,090 (4.8)

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

INSTALLATION SPECIFICATIONS

Screw-Bolt+ Installation Specifications in Concrete and Supplemental Information[1,2,3,4]

CODE LISTED
ICC-ES ESR-3889

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.35)		0.375 (9.525)			0.500 (12.7)			0.625 (15.9)			0.750 (19.05)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI		3/8 ANSI			1/2 ANSI			5/8 ANSI			7/8 ANSI
Minimum nominal embedment depth[5]	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Minimum hole depth	h_{hole}	in. (mm)	2 (51)	2-7/8 (73)	2-3/8 (60)	2-7/8 (73)	3-5/8 (92)	2-7/8 (73)	3-3/8 (86)	4-5/8 (117)	3-5/8 (92)	4-3/8 (111)	5-3/8 (137)	4-5/8 (117)
Minimum concrete member thickness	h_{min}	in. (mm)	3-1/4 (83)	4 (102)	3-1/2 (89)	4 (102)	5 (127)	4-1/2 (114)	5-1/4 (133)	6-3/4 (171)	5 (127)	6 (152)	7 (178)	6 (152)
Minimum edge distance[6]	c_{min}	in. (mm)	1-1/2 (38)		c_{min} = 1-1/2 (38) for $s_{min} \geq$ 3 (76) s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)			1-3/4 (44)			1-3/4 (44)			1-3/4 (44)
Minimum spacing distance[6]	s_{min}	in. (mm)	1-1/2 (38)					2-3/4 (70)			2-3/4 (70)			3 (76)
Critical edge distance	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)	5.00 (127)	6.30 (160)	7.80 (198)	3.30 (84)	5.90 (150)	8.10 (206)	6.30 (160)	7.90 (201)	10.10 (257)	10.90 (277)
Minimum overall anchor length[7]	ℓ_{anch}	in. (mm)	1-3/4 (44)	3 (76)	2-1/2 (64)	3 (76)	4 (102)	3 (76)	4 (102)	5 (127)	4 (102)	5 (127)	6 (152)	5 (127)
Maximum Installation torque	$T_{inst,max}$	ft.-lbf. (N-m)	19 (26)	25 (34)	25 (34)	25 (34)	40 (54)	45 (61)	45 (61)	60 (81)	60 (81)			70 (95)
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lbf (N-m).	150 (203)		300 (407)			300 (407)			700 (950)			700 (950)
Impact wrench socket size	-	in.	7/16		9/16			3/4			15/16			1-1/8
Maximum head height	-	in.	21/64		3/8			31/64			37/64			43/64
Maximum washer diameter	-	in.	37/64		3/4			1-1/16			1-1/8			1-13/32
Effective tensile stress area (screw anchor body)	A_{se}	in^2 (mm^2)	0.045 (29.0)		0.094 (60.6)			0.176 (113.5)			0.274 (176.8)			0.399 (257.4)
Minimum specified ultimate strength	f_{uta}	ksi (N/mm^2)	100 (690)		92.5 (638)			115 (794)			95 (656)			95 (656)
Minimum specified yield strength	f_y	ksi (N/mm^2)	80 (552)		74 (511)			92 (635)			76 (524)			76 (524)
Mean axial stiffness[8] Uncracked concrete	β_{uncr}	lbf/in (kN/mm)	1,252,000 (211)		1,157,000 (195)			1,014,000 (171)			919,000 (155)			1,028,000 (173)
Mean axial stiffness[8] Cracked concrete	β_{cr}	lbf/in (kN/mm)	355,000 (60)		330,000 (56)			349,000 (59)			378,000 (64)			419,000 (71)

For SI: 1 inch = 25.4 mm; 1 ksi = 6.894 N/mm^2; 1 ft-lb = 1.356 N-m; 1 lb = 0.0044 kN.

1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. For installations in the topside of concrete-filled steel deck assemblies with minimum concrete member thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). See the table for anchor setting information for installation on the top of concrete-filled steel deck assemblies and the top of concrete over steel deck installation detail.
3. For installations in the topside of concrete-filled steel deck assemblies with sand-lightweight concrete fill, the maximum installation torque, $T_{inst,max}$, is 18 ft.-lb.
4. For installations through the soffit of steel deck assemblies into concrete, see the design information table for installation in the soffit of concrete-filled steel deck assemblies and the installation details in the soffit of concrete over steel deck for the applicable steel deck profile. Tabulated minimum spacing values are based on anchors installed along the flute with axial spacing equal to the greater of 3h_{ef} or 1.5 times the flute width.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. Additional combinations for minimum edge distance, c_{min}, and minimum spacing distance, s_{min}, may be derived by linear interpolation between the given boundary values for the 3/8-inch diameter anchors.
7. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment. The minimum nominal anchor length is measured from under the head to the tip of the anchor.
8. Mean values shown, actual stiffness varies considerably depending on concrete strength, loading and geometry of application.

Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness[1,2,3,4]

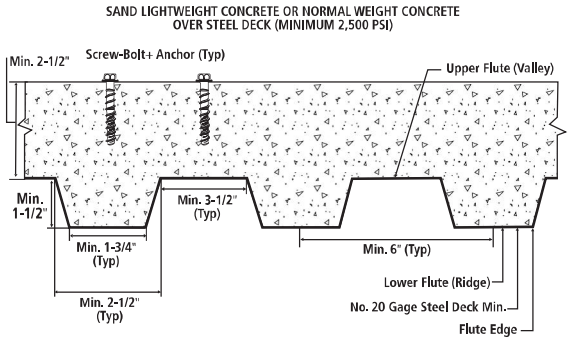
CODE LISTED
ICC-ES ESR-3889

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)			
			1/4		3/8	1/2
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)	0.500 (12.7)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	3/8 (9.5)		1/2 (12.7)	5/8 (15.9)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI		3/8 ANSI	1/2 ANSI
Minimum nominal embedment depth[5]	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)
Minimum hole depth	h_o	in. (mm)	2 (51)	2-1/2 (64)	2-3/8 (60)	2-1/2 (64)
Minimum concrete member thickness (topping thickness)	$h_{min,deck}$	in. (mm)	2-1/2 (64)	2-1/2 (64)	2-1/2 (64)	2-1/2 (64)
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1-1/2 (38)		2 (51)	2-1/2 (64)
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	1-1/2 (38)		2 (51)	2-1/2 (64)
Critical edge distance	$c_{ac,deck,top}$	in. (mm)	3 (76)	4 (102)	3.5 (89)	6 (152)
Minimum nominal anchor length[6]	ℓ_{anch}	in. (mm)	1-3/4 (44)	3 (76)	2-1/2 (64)	3 (76)
Maximum impact wrench power (torque)	$T_{impact,max}$	ft.-lb. (N-m)	150 (203)		300 (407)	300 (407)
Max. installation torque	$T_{inst,max}$	ft.-lb. (N-m)	18[7] (26)	25 (34)	25 (34)	45 (61)
Wrench socket size	-	in.	7/16		9/16	3/4
Max. head height	-	in.	21/64		3/8	31/64
Max. washer diameter	-	in.	37/64		3/4	1-1/16

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

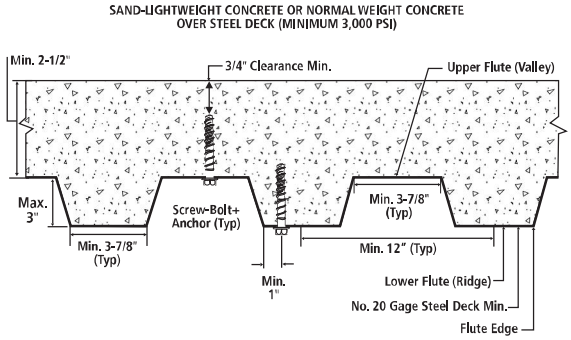
1. The anchors may be installed in the topside of concrete-filled steel deck floor and roof assemblies in accordance with this table, the anchor installation specifications in concrete table and the top of concrete over steel deck installation detail provided the concrete thickness above the upper flute meets the minimum thicknesses specified in this table. Minimum concrete member thickness, $h_{min,deck}$, refers to the concrete thickness above the upper flute (topping thickness). See the top of concrete over steel deck installation detail.
2. Applicable to the following conditions:
   For 1/4-inch-diameter anchors with 1-5/8-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/4-inch.
   For 1/4-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-inch.
   For 3/8-inch-diameter anchors with 2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 3-1/2-inch.
   For 1/2-inch-diameter anchors with 2-1/2-inch nominal embedment, 2-1/2-inch ≤ $h_{min,deck}$ < 4-1/2-inch.
3. For all other anchor diameters and embedment depths, refer to the anchor installation specifications in concrete table for applicable values of h_{min}, c_{min} and s_{min}, which can be substituted for $h_{min,deck}$, $c_{min,deck,top}$ and $s_{min,deck,top}$, respectively.
4. Design capacities shall be based on calculations according to values in Tension Design Information and the Shear Design Information tables.
5. The embedment depth, h_{nom}, is measured from the outside surface of the concrete member to the embedded end of the anchor.
6. The listed minimum overall anchor length is based on the anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, including consideration of a fixture attachment for hex head anchors. The minimum nominal anchor length is measured from under the head to the tip of the anchor.
7. For installations in the topside of concrete-filled steel deck assemblies with normal-weight concrete fill, a maximum installation torque, $T_{inst,max}$, of 19 ft.-lb is allowed.

Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness (See Dimensional Profile Requirements)[1,2]



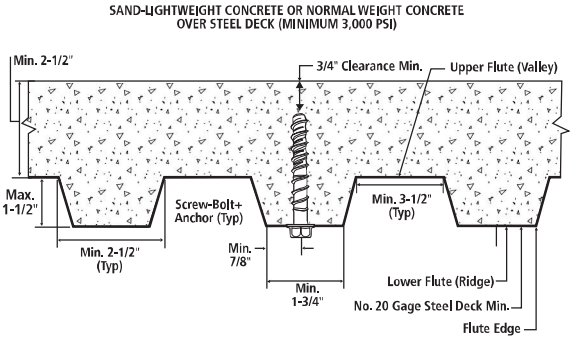
1. Anchors may be placed in the top side of concrete over steel deck profiles provided the minimum concrete thickness above the upper flute (topping thickness), minimum spacing distance and minimum edge distances are satisfied as given in Anchor Setting Information for Installation on the Top of Concrete-Filled Steel Deck Assemblies with Minimum Topping Thickness table.
2. For all other anchor diameters and embedment depths installed in the top of concrete over steel deck profiles with topping thickness greater than or equal to the minimum concrete member thicknesses given in the Installation Specifications in Concrete table, the minimum spacing distances and minimum edge distances must be used from the Installation Specifications in Concrete table, as applicable.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute 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 (e.g. 1-1/4 -inch offset for 4-1/2-inch wide flute).
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

Screw-Bolt+ Installation Detail for Anchors in the Soffit of Concrete Over Steel Deck Floor and Roof Assemblies (See Dimensional Profile Requirements)[1,2,3]



1. Anchors may be placed in the upper flute or lower flute of the concrete-filled steel deck profiles provided the minimum hole clearance of 3/4-inch is satisfied for the selected anchor. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table.
2. Anchors in the lower flute may be installed in the center of the flute. An offset distance may be given proportionally for profiles with flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.
3. See the Tension and Shear Design information for Anchors Installed in the Soffit of Concrete-Filled Steel Deck Assemblies table for design data.

STRENGTH DESIGN (SD)

Tension Design Information For Screw-Bolt+ Anchor In Concrete[1,2]

CODE LISTED
ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Tension (ACI 318-14 17.4.1 or ACI 318-11 D.5.1)														
Steel strength in tension	N_{sa}[10]	lb (kN)	4,535 (20.2)		8,730 (38.8)			20,475 (91.1)			26,260 (116.8)			38,165 (169.8)
Reduction factor for steel strength[3,4]	ϕ	-	0.65											
Concrete Breakout Strength in Tension (ACI 318-14 17.4.2 or ACI 318-11 D.5.2)														
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Critical edge distance	c_{ac}	in. (mm)	4.30 (109)	6.10 (155)	5.00 (127)	6.30 (160)	7.80 (198)	3.30 (84)	5.90 (150)	8.10 (206)	6.30 (160)	7.90 (201)	10.10 (257)	10.90 (277)
Critical edge distance, topside of concrete-filled steel decks with minimum topping thickness[9]	$c_{ac,deck,top}$	in. (mm)	3.00 (76)	4.00 (102)	3.50 (89)	-[11]	-[11]	6.00 (152)	-[11]	-[11]	-[11]	-[11]	-[11]	-[11]
Effectiveness factor for uncracked concrete	k_{uncr}	-	27	24	30	24	24	30	24	24	30	24	24	27
Effectiveness factor for cracked concrete	k_{cr}	-	17		17			17			21			17
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0		1.0			1.0			1.0			1.0
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension (Non-Seismic Applications) (ACI 318-14 17.4.3 or ACI 318-11 D.5.3)														
Characteristic pullout strength, uncracked concrete (2,500 psi)[6,10]	$N_{p,uncr}$	lb (kN)	See Note 7		See Note 7			See Note 7			See Note 7			See Note 7
Characteristic pullout strength, cracked concrete (2,500 psi)[6,10]	$N_{p,cr}$	lb (kN)	765 (3.4)	1,415 (6.3)	See Note 7			1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	3,080 (13.7)	4,720 (21.0)	6,900 (30.7)	See Note 7
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											
Pullout Strength in Tension for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Characteristic pullout strength, seismic (2,500 psi)[6,8,10]	N_{eq}	lb	360 (1.6)	1,170 (5.2)	900 (4.0)	1,645 (7.3)	2,765 (12.3)	1,645 (7.3)	2,515 (11.2)	4,700 (20.9)	1,910 (8.5)	2,445 (10.9)	3,370 (15.0)	4,085 (18.2)
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											

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

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. 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 complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 Section D.4.3(c), as applicable for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Select the appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) and use $\Psi_{c,N} = 1.0$.
6. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 2,500 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 2{,}500)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
7. Pullout strength does not control design of indicated anchors and does not need to be calculated for indicated anchor size and embedment.
8. Reported values for characteristic pullout strength in tension for seismic applications are based on test results per ACI 355.2, Section 9.5.Y
9. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
10. Anchors are permitted to be used in lightweight concrete provided the modification factor λa equal to 0.8λ is applied to all values of f'c affecting N_n.
11. Tabulated critical edge distance values, $c_{ac,deck,top}$, are for anchors installed in the top of concrete over steel deck profiles with a minimum concrete thickness, $h_{min,deck}$, of 2.5 inches above the upper flute (topping thickness). For minimum topping thickness greater than or equal to the minimum concrete member thicknesses, h_{min}, given in the Installation Specifications table, the associated critical edge distance, c_{ac}, for indicated anchor diameters and embedment depths may be used in the calculation of $\Psi_{cp,N}$ as applicable.

Shear Design Information for Screw-Bolt+ Anchor in Concrete[1,2,7,8]

CODE LISTED
ICC-ES ESR-3889

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4		3/8			1/2			5/8			3/4
Anchor category	1, 2 or 3	-	1		1			1			1			1
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Steel Strength in Shear (ACI 318-14 17.5.1 or ACI 318-11 D.6.1)														
Steel strength in shear[5]	V_{sa}	lb (kN)	1,635 (7.3)	2,040 (9.1)	3,465 (15.4)	3,465 (15.4)	4,345 (19.3)	8,860 (39.4)	8,860 (39.4)	11,175 (49.7)	12,310 (54.8)	12,310 (54.8)	15,585 (69.3)	19,260 (85.7)
Reduction factor for steel strength[3,4]	ϕ	-	0.60											
Steel Strength in Shear for Seismic Applications (ACI 318-14 17.2.3.3 or ACI 318-11 D.3.3.3)														
Steel strength in shear, seismic[6]	V_{eq}	lb (kN)	1,360 (6.1)	1,700 (7.7)	2,415 (10.9)	2,415 (10.9)	3,030 (13.6)	7,090 (31.9)	7,090 (31.9)	8,940 (40.2)	9,845 (44.3)	9,845 (44.3)	12,465 (56.1)	15,405 (69.3)
Reduction factor for steel strength in shear for seismic[3,4]	ϕ	-	0.60											
Concrete Breakout Strength in Shear (ACI 318-14 17.5.2 or ACI 318-11 D.6.2)														
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Load bearing length of anchor	ℓ_e	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)											
Pryout Strength in Shear (ACI 318-14 17.5.3 or ACI 318-11 D.6.3)														
Coefficient for pryout strength	k_{cp}	-	1	1	1	1	1	1	1	2	1	2	2	2
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)											

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

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-17 17.2.3 or ACI 318-11 D.3.3, as applicable shall apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, the appropriate value of ϕ must be determined in accordance with ACI 318-11 Section D.4.4. For reinforcement that complies with ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3, or ACI 318-11 Section 9.2 are used.
4. The anchors are considered a brittle steel elements as defined by ACI 318-14 2.3 or ACI 318-11 D.1.
5. Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of the calculated results using equation 17.5.1.2(b) of ACI 318-14 or equation D-29 in ACI 318-11 D.6.1.2.
6. Reported values for steel strength in shear are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.6 and must be used for design.
7. Anchors are permitted in the topside of concrete-filled steel deck assemblies in accordance with the Installation Detail for Anchors in the Top of Concrete Over Steel Deck Floor and Roof Assemblies with Minimum Topping Thickness.
8. Anchors are permitted to be used in lightweight concrete in provided the modification factor λa equal to 0.8λ is applied to all values of f'c affecting N_n.

Tension and Shear Design Information for Screw-Bolt+ Anchor in the Soffit (Through the Underside) of Concrete-Filled Steel Deck Assemblies[1,2,3,4,5,6]

CODE LISTED ICC-ES ESR-3889

Anchor Property/Setting Information	Notation	Units	Nominal Anchor Diameter (inch)											
			1/4		3/8			1/2			5/8			3/4
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-5/8 (41)	2-1/2 (64)	2 (51)	2-1/2 (64)	3-1/4 (83)	2-1/2 (64)	3 (76)	4-1/4 (108)	3-1/4 (64)	4 (64)	5 (127)	4-1/4 (108)
Effective Embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.33 (34)	1.75 (44)	2.39 (61)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (57)	2.88 (73)	3.73 (95)	3.08 (78)
Minimum hole depth	h_o	in. (mm)	1-3/4 (44)	2-5/8 (67)	2-1/8 (54)	2-5/8 (67)	3-3/8 (86)	2-5/8 (67)	3-1/8 (79)	4-3/8 (111)	3-3/8 (86)	4-1/8 (10.5)	5-1/8 (130)	4-3/8 (111)
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 3-7/8-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	5-1/2 (140)	6-1/4 (159)	6-1/4 (159)
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,430 (6.4)	2,555 (11.4)	2,275 (10.1)	2,655 (11.8)	3,235 (14.4)	2,600 (11.6)	3,555 (15.8)	5,975 (26.6)	2,610 (11.6)	4,150 (18.5)	6,195 (27.6)	6,085 (27.1)
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	615 (2.7)	1,115 (5.0)	1,290 (5.7)	1,880 (8.4)	2,290 (10.2)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	1,600 (7.1)	3,340 (14.9)	4,945 (22.0)	3,835 (17.1)
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	290 (1.3)	920 (4.1)	890 (4.0)	1,570 (7.0)	2,015 (9.0)	1,230 (5.5)	2,330 (10.4)	4,030 (17.9)	990 (4.4)	1,730 (7.7)	2,415 (10.7)	3,410 (15.2)
Reduction factor for pullout strength[8]	ϕ	-	0.65											
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,155 (5.1)	2,595 (11.5)	2,470 (11.0)	2,470 (11.0)	3,225 (14.3)	2,435 (10.8)	2,435 (10.8)	5,845 (26.0)	2,650 (11.8)	2,650 (11.8)	6,325 (28.1)	5,175 (23.0)
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	960 (4.3)	2,165 (9.6)	1,725 (7.7)	1,900 (8.5)	2,250 (10.0)	1,950 (8.7)	2,095 (9.3)	4,675 (20.8)	2,120 (9.4)	2,325 (10.3)	5,060 (22.5)	4,140 (18.4)
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60											
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete (Minimum 1-3/4-inch-wide deck flute)														
Minimum concrete member thickness[7]	$h_{min,deck,total}$	in. (mm)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	4 (102)	N/A		N/A			N/A
Characteristic pullout strength, uncracked concrete over steel deck, (3,000 psi)	$N_{p,deck,uncr}$	lb (kN)	1,760 (7.8)	2,075 (9.2)	1,440 (6.4)	2,135 (9.5)	3,190 (14.2)	1,720 (7.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck, (3,000 psi)	$N_{p,deck,cr}$	lb (kN)	760 (3.4)	910 (4.0)	815 (3.6)	1,510 (6.7)	2,260 (10.1)	1,280 (5.7)	N/A		N/A			N/A
Characteristic pullout strength, cracked concrete over steel deck,seismic, (3,000 psi)	$N_{p,deck,eq}$	lb (kN)	355 (1.6)	750 (3.3)	565 (2.5)	1,260 (5.6)	1,985 (8.8)	1,280 (5.7)	N/A		N/A			N/A
Reduction factor for pullout strength[8]	ϕ	-	0.65						N/A		N/A			N/A
Steel strength in shear, concrete over steel deck	$V_{sa,deck}$	lb (kN)	1,880 (8.4)	2,315 (10.3)	2,115 (9.4)	2,115 (9.4)	2,820 (12.5)	2,095 (9.3)	N/A		N/A			N/A
Steel strength in shear, concrete over steel deck, seismic	$V_{sa,deck,eq}$	lb (kN)	1,565 (7.0)	1,930 (8.6)	1,475 (6.6)	1,625 (7.2)	1,965 (8.7)	1,675 (7.5)	N/A		N/A			N/A
Reduction factor for steel strength in shear for concrete over steel deck[8]	ϕ	-	0.60		0.60			0.60	N/A		N/A			N/A

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

1. Installation must comply with published instructions and details.
2. Values for $N_{p,deck}$ and $N_{p,deck,cr}$ 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 (through underside).
3. Values for $N_{p,deck,eq}$ are applicable for seismic loading and must be used in lieu of $N_{p,deck,cr}$.
4. For all design cases $\Psi_{c,P} = 1.0$. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 1/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.3}$ for psi or $(f'c / 17.2)^{0.3}$ for MPa. The characteristic pullout strength, N_{pn}, for concrete compressive strengths greater than 3,000 psi for 3/8-inch- to 3/4-inch-diameter anchors may be increased by multiplying the value in the table by $(f'c / 3{,}000)^{0.5}$ for psi or $(f'c / 17.2)^{0.5}$ for MPa.
5. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.
6. Values of $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the soffit (through underside).
7. The minimum concrete member thickness, $h_{min,deck,total}$, is the minimum overall thickness of the concrete-filled steel deck (depth and topping thickness).
8. All values of ϕ 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 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4 (ACI 318-08).

FACTORED RESISTANCE STRENGTH (ØNn AND ØVn) CALCULATED IN ACCORDANCE WITH ACI 318-14 CHAPTER 17:

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
- c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

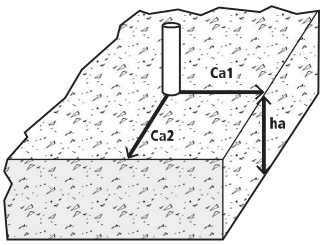
2- Calculations were performed according to ACI 318-14, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14, Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14, Chapter 17. For other design conditions including seismic considerations please see ACI 318-14, Chapter 17.



Tension and Shear Design Strength Installed in Cracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth 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.)
1/4	1-5/8	495	780	525	855	575	980	645	980	705	980
	2-1/2	920	1,225	970	1,225	1,060	1,225	1,195	1,225	1,305	1,225
3/8	2	845	915	930	1,000	1,070	1,155	1,315	1,415	1,515	1,635
	2-1/2	1,280	1,375	1,400	1,510	1,620	1,740	1,980	2,080	2,290	2,080
	3-1/4	2,040	2,200	2,235	2,410	2,580	2,605	3,165	2,605	3,650	2,605
1/2	2-1/2	1,070	1,270	1,170	1,395	1,355	1,610	1,655	1,970	1,915	2,275
	3	1,635	1,900	1,790	2,085	2,070	2,405	2,535	2,945	2,925	3,400
	4-1/4	3,055	4,325	3,345	4,735	3,865	5,470	4,735	6,695	5,465	6,705
5/8	3-1/4	1,850	1,995	2,030	2,185	2,345	2,525	2,870	3,090	3,315	3,570
	4	2,700	4,155	2,960	4,550	3,415	5,255	4,185	6,435	4,830	7,385
	5	3,980	6,040	4,360	6,615	5,035	7,640	6,165	9,350	7,120	9,350
3/4	4-1/4	2,985	6,135	3,270	6,720	3,780	7,760	4,625	9,505	5,340	10,975

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

Tension and Shear Design Strength Installed in Uncracked Concrete

Nominal Anchor Diameter (in.)	Nominal Embed. Depth 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.)
1/4	1-5/8	1,155	980	1,265	980	1,460	980	1,785	980	2,065	980
	2-1/2	2,110	1,225	2,310	1,225	2,665	1,225	2,950	1,225	2,950	1,225
3/8	2	1,495	1,610	1,640	1,765	1,890	2,035	2,315	2,080	2,675	2,080
	2-1/2	1,805	1,945	1,980	2,080	2,285	2,080	2,795	2,080	3,230	2,080
	3-1/4	2,880	2,605	3,155	2,605	3,645	2,605	4,465	2,605	5,155	2,605
1/2	2-1/2	2,255	1,780	2,475	1,950	2,855	2,255	3,495	2,760	4,040	3,185
	3	2,495	2,685	2,730	2,940	3,155	3,395	3,865	4,160	4,460	4,805
	4-1/4	4,530	6,050	4,960	6,630	5,725	6,705	7,015	6,705	8,100	6,705
5/8	3-1/4	3,270	3,520	3,580	3,855	4,135	4,455	5,065	5,455	5,845	6,295
	4	3,810	5,815	4,175	6,370	4,820	7,355	5,905	7,385	6,820	7,385
	5	5,620	8,455	6,155	9,265	7,110	9,350	8,705	9,350	10,050	9,350
3/4	4-1/4	4,745	8,590	5,195	9,410	6,000	10,865	7,350	11,555	8,485	11,555

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

FACTORED RESISTANCE STRENGTH (ØN$_n$ AND ØV$_n$) CALCULATED IN ACCORDANCE WITH ACI 318-14, CHAPTER 17:

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 $c_{a1} = c_{min}$).
- c_{a2} is greater than or equal to 1.5 times c_{a1}.

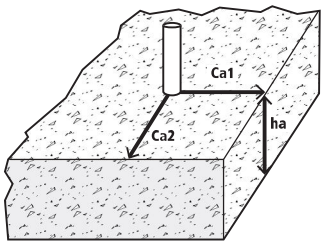
2- Calculations were performed according to ACI 318-14, Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14, Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14, Chapter 17. For other design conditions including seismic considerations please see ACI 318-14, Chapter 17.



Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ 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	
		ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)
1/4	1-5/8	495	370	525	405	575	470	645	575	705	660
	2-1/2	920	450	970	495	1,060	570	1,195	700	1,305	810
3/8	2	785	445	860	485	990	560	1,215	685	1,405	790
	2-1/2	1,115	500	1,220	550	1,410	635	1,725	775	1,995	895
	3-1/4	1,685	595	1,845	650	2,130	755	2,610	920	3,015	1,065
1/2	2-1/2	1,070	675	1,170	740	1,355	855	1,655	1,045	1,915	1,205
	3	1,520	760	1,665	835	1,925	960	2,355	1,180	2,720	1,360
	4-1/4	2,595	935	2,840	1,025	3,280	1,180	4,015	1,445	4,640	1,670
5/8	3-1/4	1,585	800	1,735	875	2,005	1,010	2,455	1,240	2,835	1,430
	4	2,220	920	2,430	1,010	2,805	1,165	3,435	1,425	3,970	1,645
	5	3,160	1,045	3,460	1,145	3,995	1,325	4,895	1,620	5,650	1,870
3/4	4-1/4	2,430	985	2,660	1,080	3,075	1,245	3,765	1,525	4,345	1,760

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

Tension and Shear Design Strength at Minimum Edge Distance, c_{min} for Screw-Bolt+ 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	
		ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)	ØN$_n$ Tension (lbs.)	ØV$_{sa}$ Shear (lbs.)
1/4	1-5/8	460	495	505	540	580	625	710	765	820	885
	2-1/2	860	635	940	695	1,085	800	1,330	980	1,535	1,130
3/8	2	550	595	605	650	700	750	855	920	990	1,065
	2-1/2	655	700	720	765	830	885	1,015	1,085	1,175	1,250
	3-1/4	1,095	835	1,200	915	1,385	1,055	1,695	1,290	1,955	1,490
1/2	2-1/2	1,615	945	1,770	1,035	2,045	1,195	2,505	1,465	2,890	1,690
	3	1,185	1,065	1,300	1,165	1,500	1,345	1,835	1,650	2,120	1,905
	4-1/4	2,190	1,310	2,400	1,430	2,770	1,655	3,390	2,025	3,915	2,340
5/8	3-1/4	1,495	1,120	1,635	1,225	1,890	1,415	2,310	1,735	2,670	2,000
	4	1,715	1,290	1,875	1,410	2,165	1,630	2,655	1,995	3,065	2,305
	5	2,470	1,465	2,705	1,605	3,125	1,855	3,830	2,270	4,420	2,620
3/4	4-1/4	1,635	1,380	1,790	1,510	2,070	1,745	2,535	2,135	2,925	2,465

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

ORDERING INFORMATION

Screw-Bolt+

Cat. No.		Anchor Size	Box Qty.	Ctn. Qty.	20V Max* SDS Plus Rotary Hammers			Flexvolt SDS Max
					DCH273P2DH 1" L-Shape	DCH133M2 1" D-Handle	DCH293R2 1-1/8" L-Shape w/ E-Clutch	DCH481X2 1-9/16" w/ E-Clutch
Zinc Plated	Galvanized				Carbide Bits			
PFM1411000	-	1/4" x 1-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411020	-	1/4" x 1-3/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411060	-	1/4" x 2-1/4"	100	600	DW5517	DW5417	DW5417	-
PFM1411080	-	1/4" x 2-5/8"	100	500	DW5517	DW5417	DW5417	-
PFM1411100	-	1/4" x 3"	100	500	DW5517	DW5417	DW5417	-
PFM1411160	-	3/8" x 1-3/4"	50	300	DW5527	DW5427	DW5427	-
PFM1411220	-	3/8" x 2-1/2"	50	300	DW5527	DW5427	DW5427	-
PFM1411240	PFM1461240	3/8" x 3"	50	250	DW5527	DW5427	DW5427	-
PFM1411280	PFM1461280	3/8" x 4"	50	250	DW5527	DW5427	DW5427	-
PFM1411300	PFM1461300	3/8" x 5"	50	250	DW5529	DW5429	DW5429	-
PFM1411320	PFM1461320	3/8" x 6"	50	150	DW5529	DW5429	DW5429	-
PFM1411340	-	1/2" x 2"	50	200	DW5537	DW5437	DW5437	-
PFM1411360	-	1/2" x 2-1/2"	50	200	DW5537	DW5437	DW5437	-
PFM1411380	-	1/2" x 3"	50	150	DW5537	DW5437	DW5437	-
PFM1411420	PFM1461420	1/2" x 4"	50	150	DW5537	DW5437	DW5437	-
PFM1411460	PFM1461460	1/2" x 5"	25	100	DW5538	DW5438	DW5438	-
PFM1411480	PFM1461480	1/2" x 6"	25	75	DW5538	DW5438	DW5438	-
PFM1411520	PFM1461520	1/2" x 8"	25	100	DW5538	DW5438	DW5438	-
PFM1411540	-	5/8" x 3"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411580	-	5/8" x 4"	25	100	DW5471	DW5446	DW5471	DW5806
PFM1411600	PFM1461600	5/8" x 5"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411640	PFM1461640	5/8" x 6"	25	75	DW5471	DW5446	DW5471	DW5806
PFM1411680	PFM1461680	5/8" x 8"	25	50	DW5471	DW5447	DW5471	DW5806
PFM1411700	-	3/4" x 3"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411720	-	3/4" x 4"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411760	-	3/4" x 5"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411800	PFM1461800	3/4" x 6"	20	60	DW5474	DW5453	DW5474	DW5810
PFM1411840	PFM1461850	3/4" x 8"	10	40	DW5474	DW5455	DW5474	DW5810
PFM1411880	-	3/4" x 10"	10	20	DW5475	DW5455	DW5475	DW5812

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for Strength Design.

The published size includes the diameter and length of the anchor measured from under the head.

- Optimum Tool Match
- Maximum Tool Match
- Not Recommended

Suggested Impact Wrench and Socket

Nominal Anchor Size	Socket Size	Impact Rated Socket		20V Max* Impact Wrenches	
1/4	7/16	DWMT74479B		DCF883L2 3/8" Impact Wrench	
3/8	9/16	DWMT75122B		DCF880M2 1/2" Impact Wrench	
1/2	3/4	DWMT75113B		DCF899P2 High Torque 1/2" (Use In Speed Setting #2)	
5/8	15/16	DWMT75104B			
3/4	1-1/8	DWMT75125B			

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

REPORT HOLDER:

DEWALT

701 EAST JOPPA ROAD
TOWSON, MARYLAND 21286

EVALUATION SUBJECT:

SCREW-BOLT+™ SCREW ANCHORS AND HANGERMATE®+ ROD HANGER SCREW ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

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DIVISION: 03 00 00—CONCRETE
Section: 03 16 00—Concrete Anchors

DIVISION: 05 00 00—METALS
Section: 05 05 19—Post-Installed Concrete Anchors

REPORT HOLDER:

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701 EAST JOPPA ROAD
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engineering@powers.com

EVALUATION SUBJECT:

SCREW-BOLT+™ SCREW ANCHORS AND HANGERMATE®+ ROD HANGER SCREW ANCHORS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2015, 2012 and 2009 *International Residential Code®* (IRC)

Property evaluated:

Structural

2.0 USES

The Screw-Bolt+ screw anchors and Hangermate+ rod hanger screw anchors are used to resist static, wind and seismic tension and shear loads in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The $^1/_4$-inch-, $^3/_8$-inch- and $^1/_2$-inch-diameter (6.4 mm, 9.5 mm and 12.7 mm) Screw-Bolt+ anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

The $^1/_4$-inch-, $^3/_8$-inch-, $^1/_2$-inch-, $^5/_8$-inch, and $^3/_4$-inch-diameter (6.4 mm 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm) Screw-Bolt+ anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The $^1/_4$-inch- and $^3/_8$-inch-diameter (6.4 mm and 9.5 mm) Hangermate+ anchors may be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

The anchors are an alternative to cast-in-place anchors described in Section 1901.3 of the 2015 IBC, Section 1908 and 1909 of the 2012 IBC, and Sections 1911 and 1912 of the 2009 IBC. The anchors may also be used where an engineered design is submitted in accordance with Section R301.1.3 of the IRC.

3.0 DESCRIPTION

3.1 Screw-Bolt+ Anchors:

Screw-Bolt+ screw anchors are comprised of an anchor body with hex washer head. Available diameters are $^1/_4$-inch, $^3/_8$-inch, $^1/_2$-inch, $^5/_8$-inch and $^3/_4$-inch (6.4 mm, 9.5 mm, 12.7 mm, 15.9 mm and 19.1 mm). The anchor body and hex washer head are manufactured from low-carbon steel which is case hardened and have minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633 or minimum 0.0021-inch (53 µm) mechanical zinc plating in accordance with ASTM B695, Class 55. The Screw-Bolt+ screw anchor is illustrated in Figures 1A and 1B.

The hex head of the anchor is formed with an integral washer and serrations on the underside. The anchor body is formed with dual lead threads and a chamfered tip. The screw anchors are installed in a predrilled hole with a powered impact wrench or torque wrench. The threads on the anchor tap into the sides of the predrilled hole and interlock with the base material during installation.

3.2 Hangermate+ Anchors:

Hangermate+ rod hanger screw anchors are comprised of a nominally $^1/_4$-inch-diameter one-piece anchor body, with a hex coupler head version containing internal threads that accepts threaded rods and bolts in $^1/_4$-inch and $^3/_8$-inch (6.4 mm and 9.5 mm) diameters or a stud head version containing external threads in $^3/_8$-inch (9.5 mm) diameter.

The anchor body and hex coupler head are manufactured from low-carbon steel which is case hardened, and have minimum 0.0002-inch (5 µm) zinc plating in accordance with ASTM B633. The Hangermate+ rod hanger screw anchor is illustrated in Figures 1A and 1B.

The hex coupler head of the anchor is formed with serrations on the underside, and with internal threads into the topside that accepts threaded rods or threaded bolt steel insert elements. The anchor body is formed with dual lead threads and a chamfered tip. The anchors are installed in a predrilled hole with a powered impact wrench or torque wrench. The threads on the anchor body tap into the sides of the predrilled concrete hole and interlock with the base material during installation.

3.3 Threaded Steel Insert Elements for Hangermate+:

Threaded steel insert elements must be threaded into the Hangermate+ anchors to form a connection. The material properties of the steel inserts must comply national or international specifications (e.g., ASTM A36; ASTM A307, ASTM F1554, Grade 36; ASTM A307, SAE J429, Grade 2, ASTM A193, Grade B7), or equivalent.

3.4 Concrete:

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

3.5 Steel Deck Panels:

Steel deck panels for anchors must comply with the configurations in Figures 5A, 5B, 6A and 6B of this report and have a minimum base-metal thickness of 0.035 inch (0.89 mm) [No. 20 gage]. Steel deck must comply with ASTM A653/A 653M SS Grade 50, and have a minimum yield strength of 50 ksi (345 MPa).

4.0 DESIGN AND INSTALLATION

4.1 Strength Design:

4.1.1 General: Design strength of anchors complying with the 2015 IBC, as well as Section R301.1.3 of the 2015 IRC must be determined in accordance with ACI 318-14 Chapter 17 and this report.

Design strength of anchors complying with the 2012 IBC, as well as Section R301.1.3 of the 2012 IRC, must be determined in accordance with ACI 318-11 Appendix D and this report.

Design strength of anchors complying with the 2009 IBC, as well as Section R301.1.3 of the 2009 IRC, must be determined in accordance with ACI 318-08 Appendix D and this report.

A design example in accordance with the 2015 and 2012 IBC is given in Figure 7 of this report.

Design parameters provided in Tables 3, 4 and 5 of this report are based on the 2015 IBC (ACI 318-14) and the 2012 IBC (ACI 318-11) unless noted otherwise in Section 4.1.1 through 4.1.12 of this report.

The strength design of anchors must comply with ACI 318-14 17.3.1 or ACI 318-11 D.4.1, as applicable, except as required in ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Strength reduction factors, ϕ, as given in ACI 318-14 17.3.3 or ACI 318-11 D.4.3, as applicable, and noted in Tables 3, 4 and 5 of this report, must be used for load combinations calculated in accordance with Section 1605.2 of the IBC, Section 5.3 of ACI 318-14, and Section 9.2 of ACI 318-11, as applicable. Strength reduction factors, ϕ, as given in ACI 318-11 D.4.4 must be used for load combinations calculated in accordance with Appendix C of ACI 318-11. The value of f'_c used in the calculation must be limited to a maximum of 8,000 psi (55.2 MPa), in accordance with ACI 318-14 17.2.7 or ACI 318-11 D.3.7, as applicable.

4.1.2 Requirements for Static Steel Strength in Tension, N_{sa}: The nominal static steel strength of a single anchor in tension, N_{sa}, calculated in accordance with ACI 318-14 17.4.1.2 or ACI 318-11 D.5.1.2, as applicable, is given in Table 3 of this report. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

4.1.3 Requirements for Static Concrete Breakout Strength in Tension, N_{cb} or N_{cbg}: The nominal concrete breakout strength of a single anchor or a group of anchors in tension, N_{cb} or N_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in tension in cracked concrete, N_b, must be calculated according to ACI 318-14 17.4.2.2 or ACI 318-11 D.5.2.2, as applicable, using the values of h_{ef} and k_{cr} as given in Table 3 of this report. The nominal concrete breakout strength in tension in regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.2.6 or ACI 318-11 D.5.2.6, as applicable, must be calculated with the value of k_{uncr} as given in Table 3 of this report and with $\psi_{c,N}$ = 1.0.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required.

4.1.4 Requirements for Static Pullout Strength in Tension, N_{pn}: The nominal pullout strength of a single anchor or a group of anchors, in accordance with ACI 318-14 17.4.3 or ACI 318-11 D.5.3, as applicable, in cracked and uncracked concrete, $N_{p,cr}$ and $N_{p,uncr}$, respectively, is given in Table 3. In lieu of ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, $\Psi_{c,P}$ = 1.0 for all design cases. The nominal pullout strength in cracked concrete may be adjusted by calculation according to Eq-1:

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

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

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on pullout strength. For the $^1/_4$-inch-diameter anchors, n is 0.3. For all other cases, n is 0.5.

In regions where analysis indicates no cracking in accordance with ACI 318-14 17.4.3.6 or ACI 318-11 D.5.3.6, as applicable, the nominal pullout strength in tension of the anchors can be adjusted by calculation according to Eq-2:

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

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

where f'_c is the specified concrete compressive strength and n is the factor defining the influence of concrete compressive strength on pullout strength. For the $^1/_4$-inch-diameter anchors, n is 0.3. For all other cases, n is 0.5.

Where values for $N_{p,cr}$ or $N_{p,uncr}$ are not provided in Table 3 of this report, the pullout strength in tension need not be considered or evaluated.

The nominal pullout strength in tension of anchors installed in the upper and lower flute soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, is provided in Table 5. The nominal pullout strength in cracked concrete can be adjusted by calculation according to Eq-1, whereby the value of $N_{p,deck,cr}$ must be substituted for $N_{p,cr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator. The nominal pullout strength in uncracked concrete can be adjusted by calculation according to Eq-2, whereby the value of $N_{p,deck,uncr}$ must be substituted for $N_{p,uncr}$ and the value of 3,000 psi (20.7 MPa) must be substituted for the value of 2,500 psi (17.2 MPa) in the denominator.

4.1.5 Requirements for Static Steel Strength in Shear, V_{sa}: The nominal steel strength in shear, V_{sa}, of a single anchor in accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, is given in Table 4 of this report and must be used in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2b or ACI 318-11, Eq. D-29, as applicable. Strength reduction factors, ϕ, corresponding to brittle steel elements must be used.

The nominal shear strength of anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, $V_{sa,deck}$, as shown in Figures 5A, 5B, 6A and 6B is given in Table 5 of this report, in lieu of the values derived by calculation from ACI 318-14 Eq. 17.5.1.2b or ACI 318-11, Eq. D-29, as applicable.

4.1.6 Requirements for Static Concrete Breakout Strength in Shear, V_{cb} or V_{cbg}: The nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, with modifications as described in this section. The basic concrete breakout strength of a single anchor in shear, V_b, must be calculated in accordance with ACI 318-14 17.5.2.2 or ACI 318-11 D.6.2.2, as applicable, using the value of ℓ_e and d_a given in Table 4 of this report.

For anchors installed in the topside of concrete-filled steel deck assemblies, the nominal concrete breakout strength of a single anchor or group of anchors in shear, V_{cb} or V_{cbg}, respectively, must be calculated in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, using the actual member topping thickness, $h_{min,deck}$, in the determination of A_{vc}. Minimum member topping thickness for anchors in the topside of concrete-filled steel deck assemblies is given in Tables 1 and 2 of this report, as applicable.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete breakout strength in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, is not required.

4.1.7 Requirements for Static Concrete Pryout Strength in Shear, V_{cp} or V_{cpg}: The nominal concrete pryout strength of a single anchor or group of anchors, V_{cp} or V_{cpg}, respectively, must be calculated in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, using the value of k_{cp} provided in Table 4, and the value of N_{cb} or N_{cbg} as calculated in Section 4.1.3 of this report.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, calculation of the concrete pryout strength in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, is not required.

4.1.8 Requirements for Seismic Design:

4.1.8.1 General: For load combinations including seismic loads, the design must be performed in accordance with ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable. Modifications to ACI 318-14 17.2.3 shall be applied under 2015 IBC Section 1905.1.8. For the 2012 IBC, Section 1905.1.9 shall be omitted. Modifications to ACI 318-08 D.3.3 shall be applied under Section 1908.1.9 of the 2009 IBC.

The nominal steel strength and nominal concrete breakout strength for anchors in tension, and the nominal concrete breakout strength and pryout strength for anchors in shear, must be calculated according to ACI 318-14 17.4 and 17.5 or ACI 318-11 D.5 and D.6, respectively, as applicable, taking into account the corresponding values in Tables 3 and 4 of this report.

The anchors comply with ACI 318-14 2.3 or ACI 318-11 D.1, as applicable, as brittle steel elements and must be designed in accordance with ACI 318-14 17.2.3.4, 17.2.3.5, 17.2.3.6, or 17.2.3.7; ACI 318-11 D.3.3.4, D.3.3.5, D.3.3.6 or D.3.3.7; or ACI 318-08 D.3.3.4, D.3.3.5 or D.3.3.6, as applicable.

The $^1/_4$-inch-diameter (6.4 mm), $^3/_8$-inch-diameter (9.5 mm), $^1/_2$-inch-diameter (12.7 mm), $^5/_8$-inch-diameter (15.9 mm) and $^3/_4$-inch-diameter (19.1 mm) Screw-Bolt+ anchors and the $^1/_4$-inch-diameter (6.4 mm) and $^3/_8$-inch-diameter (9.5 mm) Hangermate+ anchors may be installed in regions designated as IBC Seismic Design Categories A through F.

4.1.8.2 Seismic Tension: The nominal steel strength and nominal concrete breakout strength for anchors in tension must be calculated according to ACI 318-14 17.4.1 and 17.4.2, or ACI 318-11 D.5.1 and D.5.2, respectively, as applicable, as described in Sections 4.1.2 and 4.1.3 of this report. In accordance with ACI 318-14 17.4.3.2 or ACI 318-11 D.5.3.2, as applicable, the appropriate value for nominal pullout strength in tension for seismic loads, $N_{p,eq}$ described in Table 3 of this report, must be used in lieu of N_p. $N_{p,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report.

Where values for $N_{p,eq}$ are not provided in Table 3, the pullout strength in tension for seismic forces need not be evaluated.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, the nominal pullout strength in tension for seismic loads, $N_{p,deck,eq}$, is provided in Table 5 and must be used in lieu of $N_{p,cr}$. $N_{p,deck,eq}$ may be adjusted by calculations for concrete compressive strength in accordance with Eq-1 of this report where the value of 3,000 psi or 20.7 MPa must be substituted for the value of 2,500 psi or 17.2 MPa in the denominator.

4.1.8.3 Seismic Shear: The nominal concrete breakout strength and pryout strength for anchors in shear must be calculated according to ACI 318-14 17.5.2 or 17.5.3, or ACI 318-11 D.6.2 and D.6.3, respectively, as applicable, as described in Sections 4.1.6 and 4.1.7 of this report. In accordance with ACI 318-14 17.5.1.2 or ACI 318-11 D.6.1.2, as applicable, the appropriate value

for nominal steel strength in shear for seismic loads, $V_{sa,eq}$ described in Table 4 of this report, must be used in lieu of V_{sa}.

For anchors installed in the soffit of sand-lightweight or normal-weight concrete-filled steel deck floor and roof assemblies, as shown in Figures 5A, 5B, 6A and 6B, the appropriate value for nominal steel strength in shear for seismic loads, $V_{sa,deck,eq}$, described in Table 5 must be used in lieu of V_{sa}.

4.1.9 Requirements for Interaction of Tensile and Shear Forces: The effects of combined tensile and shear forces must be determined in accordance with ACI 318-14 17.6 or ACI 318-11 D.7, as applicable.

4.1.10 Requirements for Critical Edge Distance, c_{ac}: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout strength in tension for uncracked concrete, calculated according to ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, must be further multiplied by the factor $\psi_{cp,N}$ given by Eq-3:

$$\psi_{cp,N} = \frac{c}{c_{ac}} \quad \text{(Eq-3)}$$

whereby the factor $\psi_{cp,N}$ need not be taken less than $\frac{1.5h_{ef}}{c_{ac}}$. For all other cases, $\psi_{cp,N} = 1.0$. In lieu of using ACI 318-14 17.7.6 or ACI 318-11 D.8.6, as applicable, values of c_{ac} provided in Tables 1 and 2 of this report must be used.

4.1.11 Requirements for Minimum Member Thickness, Minimum Anchor Spacing and Minimum Edge Distance: In lieu of ACI 318-14 17.7.1 and 17.7.3, or ACI 318-11 D.8.1 and D.8.3, respectively, as applicable, the values of s_{min} and c_{min} as given in Table 1 of this report must be used. In lieu of ACI 318-14 17.7.5 or ACI 318-11 D.8.5, as applicable, minimum member thicknesses, h_{min}, as given in Table 1 of this report must be used.

For anchors installed in the topside of concrete-filled steel deck assemblies, the anchors must be installed in accordance with Tables 1 and 2 and Figure 4 of this report.

For anchors installed through the soffit of steel deck assemblies, the anchors must be installed in accordance with Figures 5A, 5B, 6A, and 6B, and shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.

4.1.12 Requirements for Lightweight Concrete: For the use of anchors in lightweight concrete, the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'_c}$ affecting N_n and V_n.

For ACI 318-14 (2015 IBC), ACI 318-11 (2012 IBC) and ACI 318-08 (2009 IBC), λ shall be determined in accordance with the corresponding version of ACI 318.

For anchors installed in the soffit of sand-lightweight concrete-filled steel deck and floor and roof assemblies, further reduction of the pullout values provided in this report is not required.

4.2 Allowable Stress Design (ASD):

4.2.1 General: Design values for use with allowable stress design load combinations calculated in accordance with Section 1605.3 of the IBC must be established using Eq-4 and Eq-5 as follows:

$$T_{allowable,ASD} = \frac{\phi N_n}{\alpha} \quad \text{(Eq-4)}$$

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

where:

$T_{allowable,ASD}$ = Allowable tension load (lbf or kN)

$V_{allowable,ASD}$ = Allowable shear load (lbf or kN)

ϕN_n = Lowest design strength of an anchor or anchor group in tension as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or kN).

ϕV_n = Lowest design strength of an anchor or anchor group in shear as determined in accordance with ACI 318-14 Chapter 17 and 2015 IBC Section 1905.1.8, ACI 318-11 Appendix D, ACI 318-08 Appendix D and 2009 IBC Section 1908.1.9, and Section 4.1 of this report, as applicable (lbf or kN).

α = Conversion factor calculated as a weighted average of the load factors for the controlling load combination. In addition, α must include all applicable factors to account for non-ductile failure modes and required over-strength.

The limits on edge distance, anchor spacing and member thickness as given in Tables 1 and 2 of this report must apply. An example of Allowable Stress Design tension values for illustrative purposes is shown in Table 6 of this report.

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

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

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

For all other cases: $\frac{T}{T_{allowable}} + \frac{V}{V_{allowable}} \le 1.2$ (Eq-6)

4.3 Installation:

Installation parameters are provided in Tables 1 and 2, and Figures 1A, 2 and 3 of this report. Anchor locations must comply with this report and plans and specifications approved by the code official. The Screw-Bolt+ and Hangermate+ screw anchors must be installed according to the manufacturer's published installation instructions and this report. Recommendations for installation equipment is given in Table A. Anchors must be installed in holes drilled using carbide-tipped masonry drill bits complying with ANSI B212.15.

The Screw-Bolt+ and Hangermate+ screw anchors are permitted to be loosened by a maximum of one full turn and retightened with a torque wrench or powered impact wrench to facilitate fixture attachment or realignment. Complete removal and reinstallation of the anchor is not allowed.

For anchor installation in the topside of concrete-filled steel deck assemblies, installation must comply with Tables 1 and 2 and Figure 4, as applicable.

For installation in the soffit of concrete on steel deck assemblies, the hole diameter in the steel deck must not exceed the diameter of the hole in the concrete by more than $^1/_8$ inch (3.2 mm). For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Table 5 and Figures 5A, 5B, 6A, and 6B.

4.4 Special Inspection:

Periodic special inspection is required, in accordance with Section 1705.1.1 and Table 1705.3 of the 2015 IBC or 2012 IBC, as applicable; Section 1704.15 and Table 1704.4 of the 2009 IBC; or Section 1704.13 of the 2006 IBC, as applicable. The special inspector must make periodic inspections during anchor installation to verify anchor type, anchor dimensions, concrete type, concrete compressive strength, hole dimensions, drill bit size and type, anchor spacing, edge distances, concrete thickness, anchor embedment, maximum impact wrench power and adherence to the manufacturer's published installation instructions. The special inspector must be present as often as required in accordance with the "statement of special inspection."

5.0 CONDITIONS OF USE

The Screw-Bolt+ and Hangermate+ screw anchors described in this report comply with, or are a suitable alternative to what is specified in, those codes listed in Section 1.0 of this report, subject to the following conditions:

5.1 The anchors must be installed in accordance with the manufacturer's published installation instructions and this report. In case of a conflict, this report governs.

5.2 Anchor sizes, dimensions, and minimum embedment depths are as set forth in this report.

5.3 The $^1/_4$-inch to $^3/_4$-inch (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- and $^3/_8$-inch-diameter (6.4 mm and 9.5 mm) Hangermate+ anchors must be installed in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.4 The $^1/_4$-inch to $^1/_2$-inch (6.4 mm to 12.7 mm) Screw-Bolt+ anchors may be installed in the topside of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 2,500 psi to 8,500 psi (17.2 MPa to 58.6 MPa).

5.5 The $^1/_4$-inch to $^3/_4$-inch (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- and $^3/_8$-inch-inch-diameter (6.4 mm and 9.5 mm) Hangermate+ anchors must be installed in the soffit of cracked and uncracked normal-weight or sand-lightweight concrete-filled steel deck having a minimum specified compressive strength, f'_c, of 3,000 psi (20.7 MPa).

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

5.7 Strength design values must be established in accordance with Section 4.1 of this report.

5.8 Allowable design values must be established in accordance with Section 4.2 of this report.

5.9 Anchor spacing(s) and edge distance(s), and minimum member thickness, must comply with Tables 1 and 2, and Figures 4, 5A, 5B, 6A, and 6B of this report.

5.10 Reported values for the Hangermate+ with an internally threaded head do not consider the steel insert element which must be verified by the design professional. Shear design values in this report for the Hangermate+ with an internally threaded head are for threaded rod or steel inserts with an ultimate strength, $F_u \geq 125$ ksi; threaded rod or steel inserts with an F_u less than 125 ksi are allowed provided the steel strength shear values are multiplied by the ratio of F_u (ksi) of the steel insert and 125 ksi.

5.11 Prior to installation, calculations and details demonstrating compliance with this report must be submitted to the code official. The calculations and details must be prepared by a registered design professional where required by the statutes of the jurisdiction in which the project is to be constructed.

5.12 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of anchors subjected to fatigue or shock loading is unavailable at this time, the use of these anchors under such conditions is beyond the scope of this report.

5.13 The $^1/_4$-inch- to $^3/_4$-inch-diameter (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- and $^3/_8$-inch-diameter (6.4 mm and 9.5 mm) Hangermate+ anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.

5.14 The $^1/_4$-inch- to $^3/_4$-inch-diameter (6.4 mm to 19.1 mm) Screw-Bolt+ anchors and $^1/_4$-inch- and $^3/_8$-inch-diameter (6.4 mm and 9.5 mm) Hangermate+ anchors may be used to resist short-term loading due to wind or seismic forces (Seismic Design Categories A through F under the IBC), subject to the conditions of this report.

5.15 Anchors are not permitted to support fire-resistance-rated construction. Where not otherwise prohibited by code, Screw-Bolt+ and Hangermate+ anchors are permitted for installation in fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

- Anchors are used to resist wind or seismic forces only.
- Anchors that support a fire-resistance-rated envelope or a fire-resistance-rated membrane, are protected by approved fire-resistance-rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
- Anchors are used to support nonstructural elements.

5.16 Anchors have been evaluated for reliability against brittle failure and found to be not significantly sensitive to stress-induced hydrogen embrittlement.

5.17 Use of carbon steel anchors with zinc plating in accordance with ASTM B633 as described in Section 3.1 and 3.2 of this report is limited to dry, interior locations.

5.18 Special inspection must be provided in accordance with Section 4.4.

5.19 Screw-Bolt+ and Hangermate+ are manufactured under an approved quality control program with inspections by ICC-ES.

6.0 EVIDENCE SUBMITTED

6.1 Data in accordance with the ICC-ES Acceptance Criteria for Mechanical Anchors in Concrete Elements (AC193), dated October 2015, which incorporates requirements in ACI 355.2-07 / ACI 355.2-04, for use in cracked and uncracked concrete; including Test No. 11 (AC193, Annex 1, Table 4.2) for reliability of screw anchors against brittle failure, and optional service-condition Test No. 18 and Test No. 19 (AC193, Annex 1, Table 4.2) for seismic tension and shear.

6.2 Quality control documentation.

7.0 IDENTIFICATION

The Screw-Bolt+ and Hangermate+ screw anchors are identified in the field by dimensional characteristics and packaging. A diameter and length marking is stamped on the hex head of each Screw-Bolt+ screw anchor; these are visible after installation for verification. Packages are identified with the anchor name; part number; type; anchor size and length; and the evaluation report number ESR-3889).

TABLE A—RECOMMENDED INSTALLATION EQUIPMENT MATRIX

CATALOG NUMBER								20V MAX** SDS PLUS ROTARY HAMMERS			FLEXVOLT SDS MAX	20V MAX** IMPACT WRENCHES		
ZINC PLATED	GALVANIZED	ANCHOR	LENGTH	HOLE SIZE	SOCKET SIZE	QTY	MASTER QTY	DCH273P2DH 1" L-Shape	DCH133M2 1" D-Handle	DCH293R2 1-1/8" L-Shape w/ E-Clutch	DCH481X2 1-9/16" W/ E-Clutch	DCF883L2 3/8" Impact Wrench	DCF880M2 1/2" Impact Wrench	DCF899P2 High Torque 1/2" (Speed #2)
								CARBIDE BITS				IMPACT RATED SOCKETS		
*PFM1411000	-	1/4" x 1-1/4"	1-1/4"	1/4"	7/16"	100	600	DW5517	DW5417	DW5417	–	DWMT74479B	–	–
PFM1411020	-	1/4" x 1-3/4"	1-3/4"	1/4"	7/16"	100	600	DW5517	DW5417	DW5417	–	DWMT74479B	–	–
PFM1411060	-	1/4" x 2-1/4"	2-1/4"	1/4"	7/16"	100	600	DW5517	DW5417	DW5417	–	DWMT74479B	–	–
PFM1411080	-	1/4" x 2-5/8"	2-5/8"	1/4"	7/16"	100	500	DW5517	DW5417	DW5417	DWMT74479B	–	–	
PFM1411100	-	1/4" x 3"	3"	1/4"	7/16"	100	500	DW5517	DW5417	DW5417	–	DWMT74479B	–	–
*PFM1411160	-	3/8" x 1-3/4"	1-3/4"	3/8"	9/16"	50	300	DW5527	DW5427	DW5427	–	–	DWMT75122B	–
PFM1411220	-	3/8" x 2-1/2"	2-1/2"	3/8"	9/16"	50	300	DW5527	DW5427	DW5427	–	–	DWMT75122B	–
PFM1411240	PFM1461240	3/8" x 3"	3"	3/8"	9/16"	50	250	DW5527	DW5427	DW5427	–	–	DWMT75122B	–
PFM1411280	PFM1461280	3/8" x 4"	4"	3/8"	9/16"	50	250	DW5527	DW5427	DW5427	–	–	DWMT75122B	–
PFM1411300	PFM1461300	3/8" x 5"	5"	3/8"	9/16"	50	250	DW5529	DW5429	DW5429	–	–	DWMT75122B	–
PFM1411320	PFM1461320	3/8" x 6"	6"	3/8"	9/16"	50	150	DW5529	DW5429	DW5429			DWMT75122B	–
*PFM1411340	-	1/2" x 2"	2"	1/2"	3/4"	50	200	DW5537	DW5437	DW5437	–	–	–	DWMT75113B
PFM1411360	-	1/2" x 2-1/2"	2-1/2"	1/2"	3/4"	50	200	DW5537	DW5437	DW5437	–	–	–	DWMT75113B
PFM1411380	-	1/2" x 3"	3"	1/2"	3/4"	50	150	DW5537	DW5437	DW5437	–	–	–	DWMT75113B
PFM1411420	PFM1461420	1/2" x 4"	4"	1/2"	3/4"	50	150	DW5537	DW5437	DW5437	–	–	–	DWMT75113B
PFM1411460	PFM1461460	1/2" x 5"	5"	1/2"	3/4"	25	100	DW5538	DW5438	DW5438	–	–	–	DWMT75113B
PFM1411480	PFM1461480	1/2" x 6"	6"	1/2"	3/4"	25	75	DW5538	DW5438	DW5438	–	–	–	DWMT75113B
PFM1411520	PFM1461520	1/2" x 8"	8"	1/2"	3/4"	25	100	DW5538	DW5438	DW5438	–	–	–	DWMT75113B
*PFM1411540	-	5/8" x 3"	3"	5/8"	15/16"	25	100	DW5471	DW5446	DW5471	DW5806	–	–	DWMT75104B
PFM1411580	-	5/8" x 4"	4"	5/8"	15/16"	25	100	DW5471	DW5446	DW5471	DW5806	–	–	DWMT75104B
PFM1411600	PFM1461600	5/8" x 5"	5"	5/8"	15/16"	25	75	DW5471	DW5446	DW5471	DW5806	–	–	DWMT75104B
PFM1411640	PFM1461640	5/8" x 6"	6"	5/8"	15/16"	25	75	DW5471	DW5446	DW5471	DW5806	–	–	DWMT75104B
PFM1411680	PFM1461680	5/8" x 8"	8"	5/8"	15/16"	25	50	DW5471	DW5447	DW5471	DW5806	–	–	DWMT75104B
*PFM1411700	-	3/4" x 3"	3"	3/4"	1-1/8"	20	60	DW5474	DW5453	DW5474	DW5810	–	–	DWMT75125B
*PFM1411720	-	3/4" x 4"	4"	3/4"	1-1/8"	20	60	DW5474	DW5453	DW5474	DW5810	–	–	DWMT75125B
PFM1411760	-	3/4" x 5"	5"	3/4"	1-1/8"	20	60	DW5474	DW5453	DW5474	DW5810	–	–	DWMT75125B
PFM1411800	PFM1461800	3/4" x 6"	6"	3/4"	1-1/8"	20	60	DW5474	DW5453	DW5474	DW5810	–	–	DWMT75125B
PFM1411840	PFM1461840	3/4" x 8"	8"	3/4"	1-1/8"	10	40	DW5474	DW5455	DW5474	DW5810	–	–	DWMT75125B
PFM1411880	PFM1461850	3/4" x 10"	10"	3/4"	1-1/8"	10	20	DW5475	DW5455	DW5475	DW5812	–	–	DWMT75125B

* denotes sizes which are less than the minimum standard anchor length for Strength Design. The published size length of the anchor is measured from under the head.

Maximum **Optimum** – (Not Recommended) without a workload) is 20 volts. Nominal voltage is 18.

** Maximum initial battery voltage (measured

TABLE B—INSTALLATION AND DESIGN INDEX[1]

Product Name	Installation Specifications	Tension Design Data			Shear Design Data		
		Concrete	Top of Steel Deck	Steel Deck Soffit	Concrete	Top of Steel Deck	Steel Deck Soffit
Screw-Bolt+	Tables 1, 2 and 5	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5
Hangermate+	Table 1 and 5	Table 3	Table 3	Table 5	Table 4	Table 4	Table 5

		, $^5/_8$", $^3/_4$"	A through F
	Uncracked	$^1/_4$", $^3/_8$", $^1/_2$", $^5/_8$", $^3/_4$"	A through F

For **SI:** 1 inch = 25.4 mm. For **pound-inch** units: 1 mm = 0.03937 inch.

[1]Reference ACI 318-14 17.3.1.1 or ACI 318-11 D.4.1.1, as applicable. The controlling strength is decisive from all appropriate failure modes (i.e. steel, concrete breakout, pullout, pryout, as applicable) and design assumptions.

[2]See Section 4.1.8 for requirements for seismic design, where applicable.

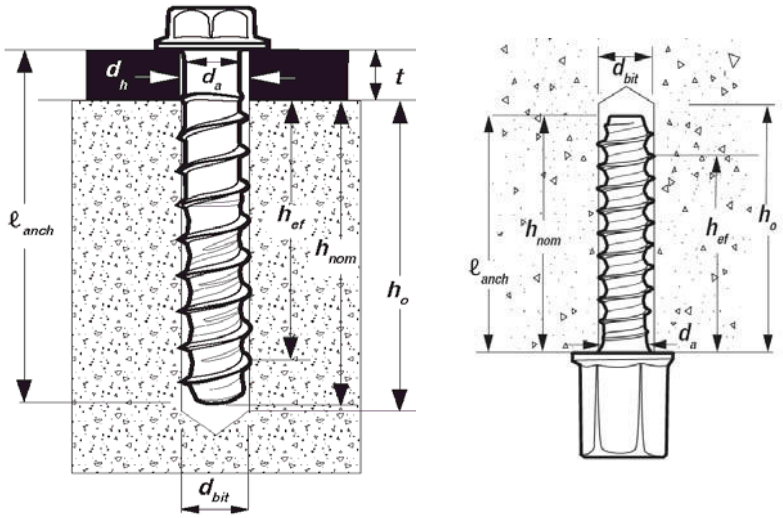
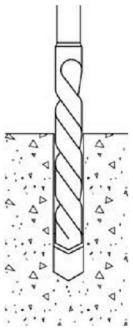
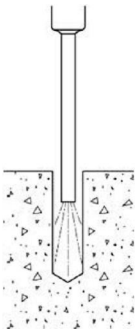


FIGURE 1A—SCREW-BOLT+ ANCHOR DETAIL (Left Picture) AND HANGERMATE+ ANCHOR DETAIL (Right Picture)

FIGURE 1B—SCREW-BOLT+ (Top Picture) AND HANGERMATE+ (Bottom Pictures – Internally Threaded Head and External Thread Head Rod Hanger Versions)



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

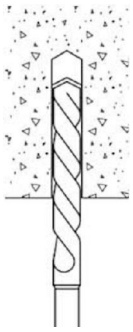


2.) Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.

3.) Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, respectively, for the selected anchor diameter and embedment (See Table 1). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.

4.) Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the fixture. The anchor must be snug after installation. Do not spin the hex socket off the anchor to disengage.

FIGURE 2—SCREW-BOLT+ INSTALLATION INSTRUCTIONS



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

2.) Remove dust and debris from hole using a hand pump, compressed air or a vacuum to remove loose particles left from drilling.

3.) Select a powered impact wrench or torque wrench and do not exceed the maximum torque, $T_{impact,max}$ or $T_{inst,max}$, respectively, for the selected anchor diameter and embedment (See Table 1). Attach an appropriate sized hex socket to the wrench. Mount the screw anchor head into the socket.

4.) Drive the anchor with an impact wrench or torque wrench through the fixture and into the hole until the head of the anchor comes into contact with the member surface. Do not spin the hex socket off the anchor to disengage. Insert threaded rod or threaded bolt element into Hangermate+.

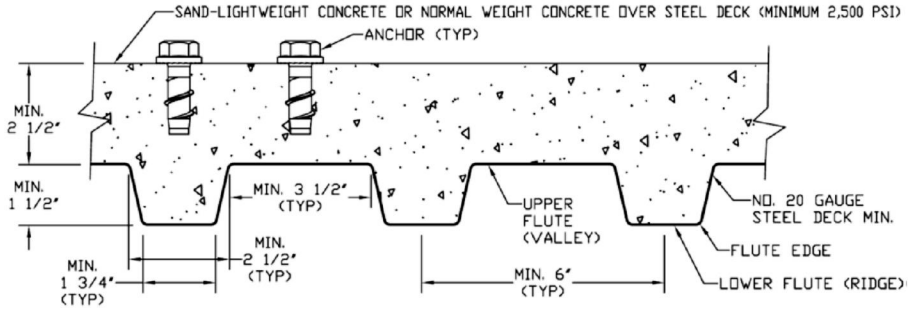
FIGURE 3—HANGERMATE+ INSTALLATION INSTRUCTIONS (Internally Threaded Rod Hanger Version Illustrated)

TABLE 1—SCREW-BOLT+ AND HANGERMATE+ ANCHOR INSTALLATION AND SUPPLEMENTAL INFORMATION[1,2,4]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)													
			1/4 Hangermate+		1/4 Screw-Bolt+		3/8 Screw-Bolt+			1/2 Screw-Bolt+			5/8 Screw-Bolt+			3/4 Screw-Bolt+
Head style	-	-	Threaded		Hex Head		Hex Head			Hex Head			Hex Head			Hex Head
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)		0.250 (6.4)		0.375 (9.5)			0.500 (12.7)			0.625 (15.9)			0.750 (19.1)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	N/A		3/8 (9.5)		1/2 (12.7)			5/8 (15.9)			3/4 (19.1)			7/8 (22.2)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI		1/4 ANSI		3/8 ANSI			1/2 ANSI			5/8 ANSI			3/4 ANSI
Minimum nominal embedment depth[5]	h_{nom}	in. (mm)	1 5/8 (41)	2 1/2 (64)	1 5/8 (41)	2 1/2 (64)	2 (51)	2 1/2 (64)	3 1/4 (83)	2 1/2 (64)	3 (76)	4 1/4 (108)	3 1/4 (83)	4 (102)	5 (127)	4 1/4 (108)
Effective embedment	h_{ef}	in. (mm)	1.20 (30)	1.94 (49)	1.20 (30)	1.94 (49)	1.33 (33)	1.75 (44)	2.39 (60)	1.75 (44)	2.17 (55)	3.23 (82)	2.24 (56)	2.88 (73)	3.73 (94)	3.08 (78)
Minimum hole depth	h_o	in. mm	2 (51)	2 7/8 (73)	2 (51)	2 7/8 (73)	2 3/8 (60)	2 7/8 (73)	3 5/8 (92)	2 7/8 (73)	3 3/8 (86)	4 5/8 (117)	3 5/8 (86)	4 3/8 (111)	5 3/8 (137)	4 5/8 (117)
Minimum concrete member thickness	h_{min}	in. (mm)	3 1/4 (83)	4 (102)	3 1/4 (83)	4 (102)	3 1/2 (89)	4 (102)	5 (127)	4 1/2 (114)	5 1/4 (133)	6 3/4 (171)	5 (127)	6 (152)	7 (178)	6 (152)
Minimum edge distance[6]	c_{min}	in. (mm)	1 1/2 (38)		1 1/2 (38)		c_{min} = 1 1/2 (38) for $s_{min} \geq$ 3 (76);			1 3/4 (44)			1 3/4 (44)			1 3/4 (44)
Minimum spacing distance[6]	s_{min}	in. (mm)	1 1/2 (38)		1 1/2 (38)		s_{min} = 2 (51) for $c_{min} \geq$ 2 (51)			2 3/4 (70)			2 3/4 (70)			3 (76)
Critical edge distance	c_{ac}	in. (mm)	4.3 (110)	6.1 (156)	4.3 (110)	6.1 (156)	5.0 (127)	6.3 (160)	7							

TABLE 2—ANCHOR SETTING INFORMATION FOR INSTALLATION ON THE TOP OF CONCRETE-FILLED STEEL DECK ASSEMBLIES WITH MINIMUM TOPPING THICKNESS[1,2,3,4]

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Size (inch)		
			$^1/_4$ Screw-Bolt+	$^3/_8$ Screw-Bolt+	$^1/_2$ Screw-Bolt+
Head style	-	-	Hex Head	Hex Head	Hex Head
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9	



URE 4—INSTALLATION DETAIL FOR ANCHORS IN THE TOP OF CONCRETE OVER STEEL DECK FLOOR AND ROOF ASSEMBLIES WITH MINIMUM TOPPING THICKNESS (SEE DIMENSIONAL PROFILE REQUIREMENTS)[1,2]

GENERAL INFORMATION

POWER-STUD®+ SD1

Wedge Expansion Anchor

PRODUCT DESCRIPTION

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

GENERAL APPLICATIONS AND USES

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

FEATURES AND BENEFITS

+ Consistent performance in high and low strength concrete
+ Nominal drill bit size is the same as the anchor diameter
+ Anchor can be installed through standard fixture holes
+ Length ID code and identifying marking stamped on head of each anchor
+ Anchor design allows for follow-up expansion after setting under tensile loading

APPROVALS AND LISTINGS

- International Code Council, Evaluation Service (ICC-ES), ESR-2818 for cracked and uncracked concrete
- International Code Council, Evaluation Service (ICC-ES), ESR-2966 for masonry
- Code compliant with the 2015 IBC, 2015 IRC, 2012 IBC, 2012 IRC, 2009 IBC, and 2009 IRC
- Tested in accordance with ACI 355.2/ASTM E 488 and ICC-ES AC193 for use in structural concrete under the design provisions of ACI 318-14 Chapter 17 or ACI 318-11/08 Appendix D
- Evaluated and qualified by an accredited independent testing laboratory for recognition in cracked and uncracked concrete including seismic and wind loading (Category 1 anchors)
- Tested in accordance with ICC-ES AC01 for use in Masonry
- Underwriters Laboratories (UL Listed) - File No. EX1289, see listing for sizes

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors, 04 05 19.16 - Masonry Anchors and 05 05 19 - Post-Installed Concrete Anchors. Expansion anchors shall be Power-Stud+ SD1 as supplied by DEWALT, Towson, MD. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

POWER-STUD+ SD1 ASSEMBLY

THREAD VERSION

- UNC threaded stud

ANCHOR MATERIALS

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

ANCHOR SIZE RANGE (TYP.)

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

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Structural sand-lightweight concrete
- Concrete over steel deck
- Grouted concrete masonry (CMU)

CODE LISTED
ICC-ES ESR-2818
CONCRETE

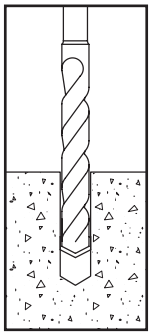
CODE LISTED
ICC-ES ESR-2966
MASONRY

MATERIAL SPECIFICATIONS

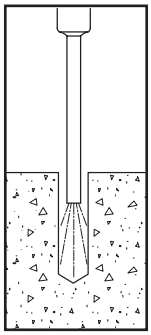
Anchor component	Specification
Anchor Body	Medium carbon steel
Hex nut	Carbon steel, ASTM A 563, Grade A
Washer	Carbon Steel, ASTM F 844; meets dimensional requirements of ANSI B18.22.2. Type A Plain
Expansion wedge (clip)	Carbon Steel
Plating	Zinc plating according to ASTM B 633, SC1 Type III (Fe/Zn 5). Minimum plating requirements for Mild Service Condition.

INSTALLATION INSTRUCTIONS

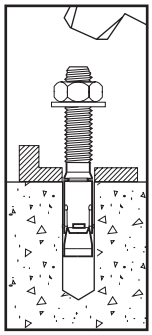
Installation Instructions for Power-Stud+ SD1



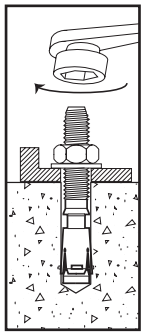
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



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

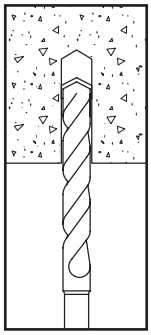


Step 3
Position the washer on the anchor and thread on the nut. If installing through a fixture, drive the anchor through the fixture into the hole. Be sure the anchor is driven to the minimum required embedment depth, h_{nom}.

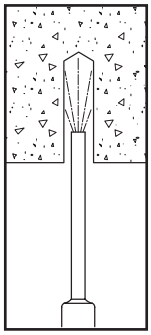


Step 4
Tighten the anchor with a torque wrench by applying the required installation torque, T_{inst}. Note: The threaded stud will draw up during tightening of the nut; the expansion wedge (clip) remains in original position.

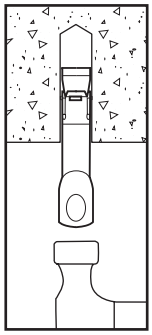
Installation Instructions for Power-Stud+ SD1 Tie Wire Version



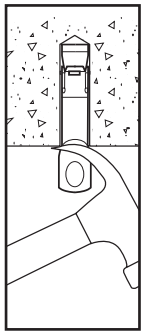
Step 1
Using the proper drill bit size, drill a hole into the base material to the required depth. The tolerances of the drill bit used should meet the requirements of ANSI Standard B212.15.



Step 2
Remove 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.

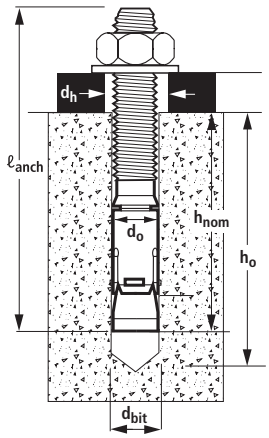


Step 3
Drive the anchor into the hole until the head is firmly seated against the base material. Be sure the anchor is driven to the required embedment depth.

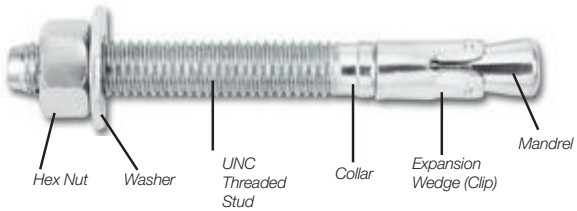


Step 4
Set the anchor with a prying action using a claw hammer.

Power-Stud+ SD1 Anchor Detail



Power-Stud+ SD1 Anchor Assembly



Head Marking

Legend

Letter Code = Length Identification Mark

'+' Symbol = Strength Design Compliant Anchor (see ordering information)

Number Code = Carbon Steel Body and Carbon Steel Expansion Clip (not on 1/4" diameter anchors)

Length Identification

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

REFERENCE DATA (ASD)

Installation Specifications for Power-Stud+ SD1 in Concrete[1,2]

Anchor Property/ Setting Information	Notation	Units	Nominal Anchor Diameter							
			1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/4
Anchor diameter	d_o	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)	9/16 (14.3)	11/16 (17.5)	13/16 (20.6)	1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)
Nominal drill bit diameter	d_{bit}	in.	1/4" ANSI	3/8" ANSI	1/2" ANSI	5/8" ANSI	3/4" ANSI	7/8" ANSI	1" ANSI	1-1/4" ANSI
Minimum nominal embedment depth	h_{nom}	in. (mm)	1-1/8 (29)	1-5/8 (41)	2-1/4 (57)	2-3/4 (70)	3-3/8 (86)	4-1/2 (114)	4-1/2 (114)	6-1/2 (165)
Minimum hole depth	h_o	in. (mm)	1-1/4 (48)	1-3/4 (44)	2-1/2 (64)	3-1/8 (79)	3-5/8 (92)	4-7/8 (122)	4-7/8 (122)	7-1/4 (184)
Installation torque	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)	40 (54)	80 (108)	110 (149)	175 (237)	225 (305)	375 (508)
Torque wrench/ socket size	-	in.	7/16	9/16	3/4	15/16	1-1/8	1-5/16	1-1/2	1-7/8
Nut height	-	In.	7/32	21/64	7/16	35/64	41/64	3/4	55/64	1-1/16

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

1. The minimum base material thickness should be $1.5h_{nom}$ or 3", whichever is greater.
2. See Performance Data in Concrete for additional embedment depths.

Ultimate Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2]

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

1. Tabulated load values are for anchors installed in uncracked concrete with no edge or spacing considerations. Concrete compressive strength must be at the specified minimum at the time of installation.
2. Ultimate load capacities must be reduced by a minimum safety factor of 4.0 or greater to determine allowable working loads.

Allowable Load Capacities for Power-Stud+ SD1 in Normal-Weight Concrete[1,2,3,4]

Nominal Anchor Diameter (in.)	Minimum Embedment Depth in. (mm)	Minimum Concrete Compressive Strength							
		f'c = 2,500 psi (17.3 MPa)		f'c = 3,000 psi (20.7 MPa)		f'c = 4,000 psi (27.6 MPa)		f'c = 6,000 psi (41.4 MPa)	
		Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)	Tension lbs. (kN)	Shear lbs. (kN)
1/4	1-1/8 (28)	-	-	360 (1.6)	315 (1.4)	415 (1.8)	315 (1.4)	-	-
	1-3/4 (44)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)	695 (3.1)	315 (1.4)
3/8	1-5/8 (41)	-	-	670 (3.0)	635 (2.8)	775 (3.4)	635 (2.8)	-	-
	2-3/8 (60)	870 (3.9)	635 (2.8)	955 (4.2)	635 (2.8)	1,105 (4.9)	635 (2.8)	1,350 (6.0)	635 (2.8)
1/2	2-1/4 (57)	-	-	1,040 (4.6)	1,050 (4.7)	1,200 (5.3)	1,050 (4.7)	-	-
	2-1/2 (64)	980 (4.4)	1,050 (4.7)	1,070 (4.8)	1,050 (4.7)	1,240 (5.5)	1,050 (4.7)	1,515 (6.7)	1,050 (4.7)
	3-3/4 (95)	1,990 (8.9)	1,050 (4.7)	2,180 (9.7)	1,050 (4.7)	2,515 (11.2)	1,050 (4.7)	3,080 (13.7)	1,050 (4.7)
5/8	2-3/4 (70)	-	-	1,360 (6.0)	1,705 (7.6)	1,570 (7.0)	1,705 (7.6)	-	-
	3-3/8 (86)	1,655 (7.4)	1,705 (7.6)	1,815 (8.1)	1,705 (7.6)	2,095 (9.3)	1,705 (7.6)	2,565 (11.4)	1,705 (7.6)
	4-5/8 (117)	2,815 (12.5)	1,705 (7.6)	3,085 (13.7)	1,705 (7.6)	3,560 (15.8)	1,705 (7.6)	3,615 (16.1)	1,705 (7.6)
3/4	3-3/8 (86)	-	-	1,965 (8.7)	3,145 (14.0)	2,270 (10.1)	3,145 (14.0)	-	-
	4 (102)	2,385 (10.6)	3,145 (14.0)	2,610 (11.6)	3,145 (14.0)	3,015 (13.4)	3,145 (14.0)	3,620 (16.1)	3,145 (14.0)
	5-5/8 (143)	4,420 (19.7)	3,145 (14.0)	4,840 (21.5)	3,145 (14.0)	5,590 (24.9)	3,145 (14.0)	6,265 (27.9)	3,145 (14.0)
7/8	3-7/8 (98)	-	-	2,500 (11.1)	2,925 (13.0)	2,890 (12.9)	2,925 (13.0)	-	-
	4-1/2 (114)	2,830 (12.6)	2,925 (13.0)	3,100 (13.8)	2,925 (13.0)	3,780 (16.8)	2,925 (13.0)	4,870 (21.7)	2,925 (13.0)
1	4-1/2 (114)	-	-	3,395 (15.1)	5,290 (23.5)	3,920 (17.4)	5,290 (23.5)	-	-
	5-1/2 (140)	4,135 (18.4)	5,290 (23.5)	4,530 (20.2)	5,290 (23.5)	5,230 (23.3)	5,290 (23.5)	6,405 (28.5)	5,290 (23.5)
	8 (203)	-	-	5,380 (23.9)	5,290 (23.5)	6,215 (27.6)	5,290 (23.5)	-	-
1-1/4	5-1/2 (140)	-	-	5,070 (22.6)	7,275 (32.4)	5,850 (26.0)	7,275 (32.4)	-	-
	6-1/2 (165)	5,620 (25.0)	7,275 (32.4)	6,160 (27.4)	7,275 (32.4)	7,110 (31.6)	7,275 (32.4)	9,340 (41.5)	7,275 (32.4)

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

Spacing Distance and Edge Distance Tension (F_{NS}, F_{NC}) Adjustment Factors for Normal-Weight Concrete

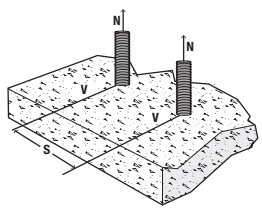
Dia. (in)		1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)		1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
s_{min} (in.)		2-1/4	3-1/2	4-1/2	5	6	4-1/4	6	6-1/2	6-1/2	8	8
Spacing Distance (inches)	2	-	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.78	-	-	-	-	-	-	-	-	-	-
	2-1/2	0.80	-	-	-	-	-	-	-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

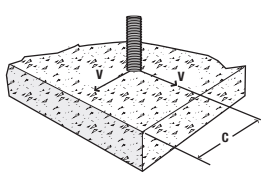
Dia. (in)		1/4	3/8	1/2	1/2	5/8	5/8	3/4	3/4	7/8	1	1-1/4
h_{nom} (in.)		1-3/4	2-3/8	2-1/2	3-3/4	3-3/8	4-5/8	4	5-5/8	4-1/2	5-1/2	6-1/2
c_{ac} (in.)		3-1/2	6-1/2	8	8	6	10	11	16	11-1/2	12	20
c_{min} (in.)		1-3/4	2-1/4	3-1/4	2-3/4	5-1/2	4-1/4	5	6	7	8	8
Edge Distance (inches)	1-3/4	0.50	-	-	-	-	-	-	-	-	-	-
	2	0.57	-	-	-	-	-	-	-	-	-	-
	2-1/4	0.64	0.35	-	-	-	-	-	-	-	-	-
	2-1/2	0.71	0.38	-	-	-	-	-	-	-	-	-
	2-3/4	0.79	0.42	-	0.34	-	-	-	-	-	-	-
	3	0.86	0.46	-	0.38	-	-	-	-	-	-	-
	3-1/4	0.93	0.50	0.41	0.41	-	-	-	-	-	-	-
	3-1/2	1.00	0.54	0.44	0.44	-	-	-	-	-	-	-
	4	1.00	0.62	0.50	0.50	-	-	-	-	-	-	-
	4-1/4	1.00	0.65	0.53	0.53	-	0.43	-	-	-	-	-
	4-1/2	1.00	0.69	0.56	0.56	-	0.45	-	-	-	-	-
	5	1.00	0.77	0.63	0.63	-	0.50	0.45	-	-	-	-
	5-1/2	1.00	0.85	0.69	0.69	0.92	0.55	0.50	-	-	-	-
	6	1.00	0.92	0.75	0.75	1.00	0.60	0.55	0.38	-	-	-
	6-1/2	1.00	1.00	0.81	0.81	1.00	0.65	0.59	0.41	-	-	-
	7	1.00	1.00	0.88	0.88	1.00	0.70	0.64	0.44	0.61	-	-
	7-1/2	1.00	1.00	0.94	0.94	1.00	0.75	0.68	0.47	0.65	-	-
	8	1.00	1.00	1.00	1.00	1.00	0.80	0.73	0.50	0.70	0.67	0.40
	8-1/2	1.00	1.00	1.00	1.00	1.00	0.85	0.77	0.53	0.74	0.71	0.43
	9	1.00	1.00	1.00	1.00	1.00	0.90	0.82	0.56	0.78	0.75	0.45
	9-1/2	1.00	1.00	1.00	1.00	1.00	0.95	0.86	0.59	0.83	0.79	0.48
	10	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.63	0.87	0.83	0.50
	10-1/2	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.66	0.91	0.88	0.53
	11	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.69	0.96	0.92	0.55
	11-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.72	1.00	0.96	0.58
	12	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.75	1.00	1.00	0.60
	12-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.78	1.00	1.00	0.63
	13	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.81	1.00	1.00	0.65
	13-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.84	1.00	1.00	0.68
	14	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	1.00	1.00	0.70
	14-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	1.00	1.00	0.73
	15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	0.75
	15-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	1.00	0.78
	16	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.80
	16-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.83
	17	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.85
	17-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88
	18	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.90
	18-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.93
	19	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95
	19-1/2	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98
	20	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Spacing Distance and Edge Distance Shear (F_{VS}, F_{VC}) Adjustment Factors for Normal-Weight Concrete

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

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

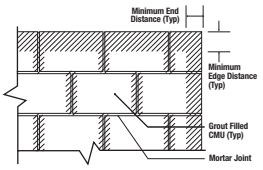




Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5,6,7]

CODE LISTED
ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	20 (27)	2,225 (10.0)	445 (2.0)	2,670 (12.0)	535 (2.4)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	4 (101.6)	40 (54)	2,650 (11.9)	530 (2.4)	3,180 (14.3)	635 (2.9)
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	50 (68)	3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
			20 (508.0)	20 (508.0)	80 (108)	7,575 (33.7)	1,515 (6.7)	8,175 (36.4)	1,635 (7.3)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)	80 (108)	7,580 (34.1)	1,515 (6.8)	8,755 (39.4)	1,750 (7.9)



Wall Face
Permissible Anchor Locations
(Un-hatched Area)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. Allowable tension values for anchors installed into bed joints of grouted masonry wall faces with a minimum of 12" edge distance and end distance may be increased by 20 percent for the 1/2-inch diameter and 10 percent for the 5/8-inch diameter.
7. 3/4 inch diameter anchor not included in ICC-ES ESR-2966.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Faces[1,2,3,4,5,6]

CODE LISTED
ICC-ES ESR-2966

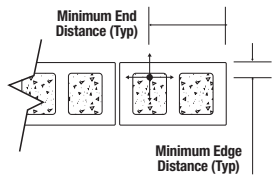
Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Min. Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	20 (27)	2,975 (13.4)	595 (2.7)	3,570 (16.1)	715 (3.2)
1/2	1/2 ANSI	2-1/2 (63.5)	4 (101.6)	12 (304.8)	Perpendicular or parallel to wall edge or end	40 (54)	2,800 (12.6)	560 (2.5)	3,360 (15.1)	670 (3.0)
			12 (304.8)	4 (101.6)	Parallel to wall end		4,025 (18.1)	805 (3.6)	4,830 (21.7)	965 (4.3)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
5/8	5/8 ANSI	3-3/8 (85.7)	4 (101.6)	4 (101.6)	Perpendicular or parallel to wall edge or end	50 (68)	3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
			12 (304.8)	4 (101.6)	Parallel to wall end		5,325 (24.0)	1,065 (4.8)	6,390 (28.8)	1,280 (5.8)
			4 (101.6)	12 (304.8)	Parallel to wall edge					
3/4	3/4 ANSI	3-3/8 (85.7)	12 (304.8)	12 (304.8)	Perpendicular or parallel to wall edge or end	80 (108)	8,850 (39.4)	1,770 (7.9)	9,375 (41.7)	1,875 (8.3)
			20 (508.0)	20 (508.0)			10,200 (45.4)	2,040 (9.1)	10,800 (48.0)	2,160 (9.6)
		4-3/4 (120.7)	12 (304.8)	12 (304.8)			12,735 (56.7)	2,545 (11.3)	12,735 (56.7)	2,545 (11.3)

1. Tabulated load values for 3/8", 1/2" and 5/8" diameter anchors are installed in minimum 6" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
2. Tabulated load values for 3/4" diameter anchors are installed in minimum 8" wide, Grade N, Type II, lightweight, medium-weight or normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N. Masonry compressive strength must be at specified minimum at the time of installation.
3. Allowable load capacities listed are calculated using an applied safety factor of 5.0.
4. The tabulated values are applicable for anchors installed into grouted masonry wall faces at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter. The spacing distance between two anchors may be reduced to minimum distance, s_{min}, of 8 times the anchor diameter provided the allowable tension loads are multiplied by a reduction factor 0.80 and allowable shear loads are multiplied by a reduction factor of 0.90. Linear interpolation for calculation of allowable loads may be used for intermediate anchor spacing distances.
5. Anchors may be installed in the grouted cells and in cell webs and bed joints not closer than 1-3/8" from head joints. The minimum edge and end distances must also be maintained.
6. 3/4 inch diameter anchor not included in ICC-ES ESR-2966.

Ultimate and Allowable Load Capacities in Tension for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
						f'm = 1,500 psi		f'm = 2,000 psi	
						Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)	Ultimate Load Tension lbs. (kN)	Allowable Load Tension lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	20 (27)	1,475 (6.6)	295 (1.3)	1,770 (8.0)	355 (1.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)		40 (54)	2,225 (9.9)	445 (2.0)	2,575 (11.5)	515 (2.3)
		5 (127)				3,425 (15.4)	685 (3.1)	4,110 (18.5)	820 (3.7)
5/8	5/8 ANSI	3-3/8 (85.7)			50 (68)	3,825 (17.2)	765 (3.4)	4,590 (20.7)	920 (4.1)



Top of Wall

1. Tabulated load values are for anchors installed in minimum 8-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. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

Ultimate and Allowable Load Capacities in Shear for Power-Stud+ SD1 in Grout Filled Concrete Masonry Wall Tops[1,2,3,4]

CODE LISTED ICC-ES ESR-2966

Nominal Anchor Diameter in.	Nominal Drill Bit Diameter in.	Minimum Embed. Depth in. (mm)	Min. Edge Distance in. (mm)	Min. End Distance in. (mm)	Direction of Loading	Installation Torque T_{inst} ft-lbf (N-m)	Grout-Filled Concrete Masonry			
							f'm = 1,500 psi		f'm = 2,000 psi	
							Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)	Ultimate Load Shear lbs. (kN)	Allowable Load Shear lbs. (kN)
3/8	3/8 ANSI	2-3/8 (60.3)	1-3/4 (44.5)	12 (304.8)	Perpendicular to wall toward minimum edge	20 (27)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
					Parallel to wall edge		2,425 (10.9)	485 (2.2)	2,910 (13.1)	580 (2.6)
1/2	1/2 ANSI	2-1/2 (63.5)	2-1/4 (57.1)	12 (304.8)	Any	40 (54)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		5 (127)			Perpendicular to wall toward minimum edge		1,400 (6.3)	280 (1.3)	1,680 (7.6)	325 (1.5)
					Parallel to wall edge		2,825 12.7	565 (2.5)	3,390 (15.3)	680 (3.1)
5/8	5/8 ANSI	3-3/8 (85.7)	2-1/4 (57.1)	12 (304.8)	Any	50 (68)	1,150 (5.2)	230 (1.0)	1,380 (6.2)	275 (1.2)
		6-1/4 (158.8)			Perpendicular to wall toward minimum edge		1,700 (7.7)	340 (1.5)	2,040 (9.2)	410 (1.8)
					Parallel to wall edge		3,525 (15.9)	705 (3.2)	4,230 (19.0)	845 (3.8)

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 an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending upon the application such as life safety.
3. Anchors must be installed in the grouted cells and the minimum edge and end distances must be maintained.
4. The tabulated values are applicable for anchors installed in top of grouted masonry walls at a critical spacing distance, s_{cr}, between anchors of 16 times the anchor diameter.

STRENGTH DESIGN (SD)

Power-Stud+ SD1 Anchor Installation Specifications in Concrete[1]

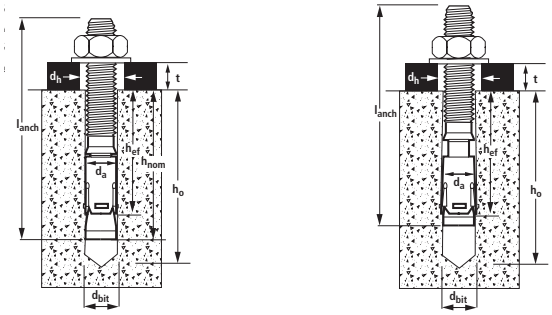
CODE LISTED
ICC-ES ESR-2818

Anchor Property / Setting Information	Notation	Units	Nominal Anchor Diameter															
			1/4 inch	3/8 inch			1/2 inch				5/8 inch			3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)			0.500 (12.7)				0.625 (15.9)			0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Minimum diameter of hole clearance in fixture	d_h	in. (mm)	5/16 (7.5)	7/16 (11.1)			9/16 (14.3)				11/16 (17.5)			13/16 (20.6)		1 (25.4)	1-1/8 (28.6)	1-3/8 (34.9)
Nominal drill bit diameter	d_{bit}	in.	1/4 ANSI	3/8 ANSI			1/2 ANSI				5/8 ANSI			3/4 ANSI		7/8 ANSI	1 ANSI	1-1/4 ANSI
Nominal embedment depth	h_{nom}	in. (mm)	1-3/4 (44)	2-3/8 (60)			2-1/2 (64)		3-3/4 (95)		3-3/8 (86)		4-5/8 (117)	4 (102)	5-5/8 (143)	4-1/2 (114)	5-1/2 (140)	6-1/2 (165)
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)			2.00 (51)		3.25 (83)		2.75 (70)		4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)
Minimum hole depth	h_{hole}	in. (mm)	1-7/8 (48)	2-1/2 (64)			2-3/4 (70)		4 (102)		3-3/4 (95)		5 (127)	4-1/4 (108)	5-7/8 (149)	4-7/8 (124)	5-7/8 (149)	7-1/4 (184)
Minimum overall anchor length[2]	ℓ_{anch}	in. (mm)	2-1/4 (57)	3 (76)			3-3/4 (95)		4-1/2 (114)		4-1/2 (114)		6 (152)	5-1/2 (140)	7 (178)	8 (203)	9 (229)	9 (229)
Installation torque[6]	T_{inst}	ft.-lbf. (N-m)	4 (5)	20 (27)			40 (54)				80 (108)			110 (149)		175 (237)	225 (305)	375 (508)
Torque wrench/socket size	-	in.	7/16	9/16			3/4				15/16			1-1/8		1-5/16	1-1/2	1-7/8
Nut height	-	in.	7/32	21/64			7/16				35/64			41/64		3/4	55/64	1-1/16
Anchors Installed in Concrete Construction																		
Minimum member thickness	h_{min}	in. (mm)	3-1/4 (83)	3-3/4 (95)		4 (102)	4 (102)		6 (152)		6 (152)		7 (178)	6 (152)	10 (254)	10 (254)	10 (254)	12 (305)
Minimum edge distance	c_{min}	in. (mm)	1-3/4 (45)	6 (152)	2-3/4 (70)	2-1/4 (57)	6 (152)	3-1/4 (95)	4 (102)	2-3/4 (70)	6 (152)	5-1/2 (140)	4-1/4 (108)	5 (127)	6 (152)	7` (178)	8 (203)	8 (203)
Minimum spacing distance	s_{min}	in. (mm)	2-1/4 (57)	3-1/2 (89)	9 (229)	3-3/4 (95)	4-1/2 (114)	10 (254)	5 (127)	6 (152)	6 (152)	11 (270)	4-1/4 (108)	6 (152)	6-1/2 (165)	6-1/2 (165)	8 (203)	8 (203)
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	3-1/2 (89)	6-1/2 (165)			8 (203)		8 (203)		6 (152)		10 (254)	11 (279)	16 (406)	11-1/2 (292)	12 (305)	20 (508)
Anchors Installed in the Topside of Concrete-filled Steel Deck Assemblies[3,4]																		
Minimum member topping thickness	$h_{min,deck}$	in. (mm)	3-1/4 (83)	3-1/4 (83)			3-1/4 (83)		See note 3		See note 3			See note 3		See note 3	See note 3	See note 3
Minimum edge distance	$c_{min,deck,top}$	in. (mm)	1-3/4 (45)	2-3/4 (70)			4-1/2 (114)											
Minimum spacing distance	$s_{min,deck,top}$	in. (mm)	2-1/4 (57)	4 (102)			6-1/2 (165)											
Critical edge distance (uncracked concrete only)	$c_{ac,deck,top}$	in. (mm)	3-1/2 (89)	6-1/2 (165)			6 (152)											
Anchors Installed Through the Soffit of Steel Deck Assemblies into Concrete[5]																		
Minimum member topping thickness (see detail in Figure 2A)	$h_{min,deck}$	in. (mm)	Not Applicable	3-1/4 (95)			3-1/4 (95)				3-1/4 (95)			3-1/4 (95)		Not Applicable	Not Applicable	Not Applicable
Minimum edge distance, lower flute (see detail in Figure 2A)	c_{min}	in. (mm)		1-1/4 (32)			1-1/4 (32)				1-1/4 (32)			1-1/4 (32)				
Minimum axial spacing distance along flute (see detail in Figure 2A)	s_{min}	in. (mm)		6-3/4 (171)			6-3/4 (171)		9-3/4 (248)		8-1/4 (210		12 (305)	9-3/8 (238)	14-1/4 (362)			
Minimum member topping thickness (see detail in Figure 2B)	$h_{min,deck}$	in. (mm)		2-1/4 (57)			2-1/4 (57)				Not Applicable			Not Applicable		Not Applicable	Not Applicable	Not Applicable
Minimum edge distance, lower flute (see detail in Figure 2B)	c_{min}	in. (mm)		3/4 (19)			3/4 (19)											
Minimum axial spacing distance along flute (see detail in Figure 2B)	s_{min}	in. (mm)		6 (152)			6 (152)		9-3/4 (248)									

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

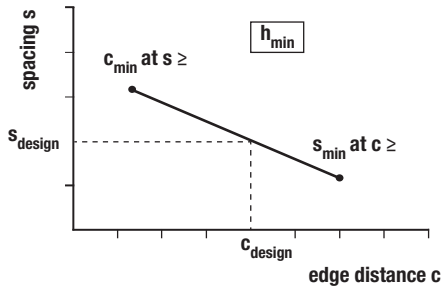
1. The information presented in this table is to be used in conjunction with the design criteria of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable.
2. The listed minimum overall anchor length is based on anchor sizes commercially available at the time of publication compared with the requirements to achieve the minimum nominal embedment depth, nut height and washer thickness, and consideration of a possible fixture attachment.
3. The 1/4 -inch-diameter (6.4 mm) anchors may be installed in the topside of uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table. The 3/8 -inch (9.5 mm) through 1-1/4 -inch-diameter (31.8 mm) anchors may be installed in the topside of cracked and uncracked concrete-filled steel deck assemblies where concrete thickness above the upper flute meets the minimum member thicknesses specified in this table under Anchors Installed in Concrete Construction.
4. For installations in the topside of concrete-filled steel deck assemblies, see the installation detail in Figure 1.
5. For installations through the soffit of steel deck assemblies into concrete, see the installation details in Figures 2A and 2B. In accordance with the figures, anchors shall have an axial spacing along the flute equal to the greater of $3h_{ef}$ or 1.5 times the flute width.
6. For installation of 5/8 -inch diameter anchors through the soffit of the steel deck into concrete, the installation torque is 50 ft.-lbf. For installation of 3/4-inch-diameter anchors through the soffit of the steel deck into concrete, installation torque is 80 ft.-lbf.

Power-Stud+ SD1 Anchor Detail



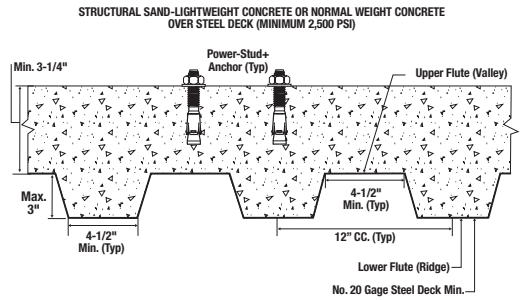
Application of Installation Torque

Interpolation of Minimum Edge Distance and Anchor Spacing



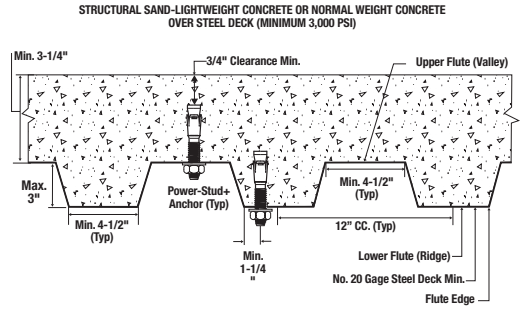
This interpolation applies to the cases when two sets of minimum edge distances, c_{min}, and minimum spacing distances, s_{min}, are given in the SD Installation Specifications for Concrete table for a given anchor diameter under the same effective embedment depth, h_{ef}, and corresponding minimum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

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



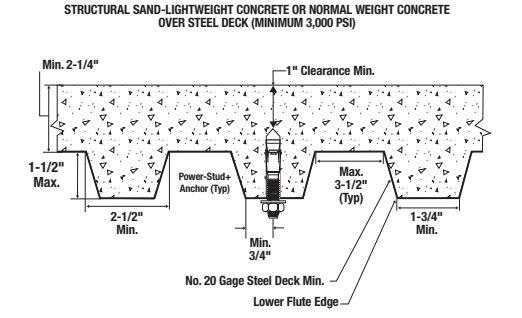
Anchors may be placed in the topside of steel deck profiles in accordance with Figure 1 provided the minimum member topping thickness, minimum spacing distance and minimum edge distance are satisfied as given in Installation Specifications.

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



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

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



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

Tension Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

CODE LISTED
ICC-ES ESR-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch	
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1	
STEEL STRENGTH IN TENSION[4]														
Minimum specified yield strength	f_{ya}	ksi (N/mm²)	88.0 (606)	88.0 (606)	80.0 (551)		80.0 (551)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)	
Minimum specified ultimate tensile strength (neck)	f_{uta}[12]	ksi (N/mm²)	110.0 (758)	110.0 (758)	100.0 (689)		100.0 (689)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)	
Effective tensile stress area (neck)	$A_{se,N}$	in² (mm²)	0.0220 (14.2)	0.0531 (34.3)	0.1018 (65.7)		0.1626 (104.9)		0.2376 (150.9)		0.327 (207.5)	0.430 (273.1)	0.762 (484)	
Steel strength in tension[4]	N_{sa}[12]	lb (kN)	2,255 (10.0)	5,455 (24.3)	9,080 (40.4)		14,465 (64.3)		19,000 (84.5)		24,500 (109.0)	32,250 (143.5)	56,200 (250)	
Reduction factor for steel strength[3]	ϕ	-	0.75											
CONCRETE BREAKOUT STRENGTH IN TENSION[8]														
Effective embedment depth	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (89)	4.375 (111)	5.375 (137)	
Effectiveness factor for uncracked concrete	k_{uncr}	-	24	24	24		24		24	24	24	24	27	
Effectiveness factor for cracked concrete	k_{cr}	-	Not Applicable	17	17		17		21	17	21	24	24	
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$[12]	-	1.0	1.0	1.0		1.0		1.0		1.0	1.0	1.0	
Critical edge distance (uncracked concrete only)	c_{ac}	in. (mm)	See Installation Specifications											
Reduction factor for concrete breakout strength[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION (NON SEISMIC-APPLICATIONS)[8,9]														
Characteristic pullout strength, uncracked concrete (2,500 psi)[6]	$N_{p,uncr}$	lb (kN)	See note 7	2,865 (12.8)	3,220 (14.3)	5,530 (24.6)	See note 7	See note 7	See note 7		See note 7	See note 7	See note 7	
Characteristic pullout strength, cracked concrete (2,500 psi)[6]	$N_{p,cr}$	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)	
Reduction factor for pullout strength[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION FOR SEISMIC APPLICATIONS[8,9]														
Characteristic pullout strength, seismic (2,500 psi)[6,10]	$N_{p,eq}$[12]	lb (kN)	Not Applicable	2,035 (9.1)	See note 7	2,505 (11.2)	See note 7	4,450 (19.8)	See note 7		See note 7	See note 7	11,350 (50.5)	
Reduction factor for pullout strength, seismic[3]	ϕ	-	0.65 (Condition B)											
PULLOUT STRENGTH IN TENSION FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK														
Characteristic pullout strength, uncracked concrete over steel deck(Figure 2A)[6,11]	$N_{p,deck,uncr}$	lb (kN)	Not Applicable	1,940 (8.6)	3,205 (14.2)		2,795 (12.4)		3,230 (14.4)		Not Applicable	Not Applicable	Not Applicable	
Characteristic pullout strength, cracked concrete over steel deck (Figure 2A)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)					
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2A)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,375 (6.1)	2,390 (10.6)		1,980 (8.8)		2,825 (12.4)					
Characteristic pullout strength, uncracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,uncr}$	lb (kN)		1,665 (7.4)	1,900 (8.5)		Not Applicable		Not Applicable					
Characteristic pullout strength, cracked concrete over steel deck (Figure 2B)[6,11]	$N_{p,deck,cr}$	lb (kN)		1,180 (5.2)	1,420 (6.3)									
Characteristic pullout strength, cracked concrete over steel deck, seismic (Figure 2B)[6,11]	$N_{p,deck,eq}$	lb (kN)		1,180 (5.2)	1,420 (6.3)									
Reduction factor for pullout strength, steel deck[3]	ϕ	-	0.65 (Condition B)											

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

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318 -11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ apply to the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 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.
5. For all design cases use $\Psi_{c,N} = 1.0$. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
6. For all design cases use $\Psi_{c,P} = 1.0$. For concrete compressive strength greater than 2,500 psi N_{pn} = (pullout strength from table)*(specified concrete compressive strength/2,500)$^{0.5}$. For concrete over steel deck the value of 2,500 must be replaced with the value of 3,000.
7. Pullout strength does not control design of indicated anchors. Do not calculate pullout strength for indicated anchor size and embedment.
8. Anchors are permitted to be used in lightweight concrete provided the modification factor λ_a equal to 0.8λ is applied to all values of $\sqrt{f'c}$ affecting N_n and V_n. λ shall be determined in accordance with the corresponding version of ACI 318.
9. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
10. Tabulated values for characteristic pullout strength in tension are for seismic applications and based on test results in accordance with ACI 355.2, Section 9.5.
11. Values for $N_{p,deck}$ are for sand-lightweight concrete (f'c, min = 3,000 psi) and additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.4.2 or ACI 318-11 D.5.2, as applicable, is not required for anchors installed in the deck soffit (flute).

Shear Design Information for Power-Stud+ SD1 Anchor in Concrete (For use with load combinations taken from ACI 318-14, Section 5.3 or ACI 318-11, Section 9.2)[1,2]

CODE LISTED ICC-ES ESR-2818

Design Characteristic	Notation	Units	Nominal Anchor Diameter											
			1/4 inch	3/8 inch	1/2 inch		5/8 inch		3/4 inch		7/8 inch	1 inch	1-1/4 inch
Anchor category	1, 2 or 3	-	1	1	1		1		1		1	1	1
STEEL STRENGTH IN SHEAR[4]													
Minimum specified yield strength (threads)	f_{ya}	ksi (N/mm²)	70.0 (482)	80.0 (552)	70.4 (485)		70.4 (485)		64.0 (441)		58.0 (400)	58.0 (400)	58.0 (400)
Minimum specified ultimate strength (threads)	f_{uta}	ksi (N/mm²)	88.0 (606)	100.0 (689)	88.0 (607)		88.0 (607)		80.0 (552)		75.0 (517)	75.0 (517)	75.0 (517)
Effective tensile stress area (threads)	$A_{se,V}$	in² (mm²)	0.0318 (20.5)	0.0775 (50.0)	0.1419 (91.5)		0.2260 (145.8)		0.3345 (212.4)		0.462 (293.4)	0.6060 (384.8)	0.969 (615)
Steel strength in shear[5]	V_{sa}	lb (kN)	925 (4.1)	2,990 (13.3)	4,620 (20.6)		9,030 (40.2)		10,640 (47.3)	11,655 (54.8)	8,820 (39.2)	10,935 (48.6)	17,750 (79.0)
Reduction factor for steel strength[3]	ϕ	-	0.65										
CONCRETE BREAKOUT STRENGTH IN SHEAR[6,7]													
Load bearing length of anchor (h_{ef} or $8d_o$, whichever is less)	ℓ_e	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Nominal anchor diameter	d_a	in. (mm)	0.250 (6.4)	0.375 (9.5)	0.500 (12.7)		0.625 (15.9)		0.750 (19.1)		0.875 (22.2)	1.000 (25.4)	1.25 (31.8)
Reduction factor for concrete breakout[3]	ϕ	-	0.70 (Condition B)										
PRYOUT STRENGTH IN SHEAR[6,7]													
Coefficient for pryout strength (1.0 for $h_{ef} < 2.5$ in., 2.0 for $h_{ef} \geq 2.5$ in.)	k_{cp}	-	1.0	1.0	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Effective embedment	h_{ef}	in. (mm)	1.50 (38)	2.00 (51)	2.00 (51)	3.25 (83)	2.75 (70)	4.00 (102)	3.125 (79)	4.75 (114)	3.50 (88.9)	4.375 (111)	5.375 (137)
Reduction factor for pryout strength[3]	ϕ	-	0.70 (Condition B)										
STEEL STRENGTH IN SHEAR FOR SEISMIC APPLICATIONS													
Steel strength in shear, seismic[8]	$V_{sa,eq}$	lb (kN)	N/A	2,440 (10.9)	3,960 (17.6)		6,000 (26.7)		8,580 (38.2)	9,635 (42.9)	8,820 (39.2)	9,845 (43.8)	17,750 (79.0)
Reduction factor for steel strength in shear for seismic[3]	ϕ	-	0.65										
STEEL STRENGTH IN SHEAR FOR FOR ANCHORS INSTALLED THROUGH THE SOFFIT OF SAND-LIGHTWEIGHT AND NORMAL-WEIGHT CONCRETE OVER STEEL DECK[9,10]													
Steel strength in shear, concrete over steel deck (Figure 2A)[9]	$V_{sa,deck}$	lb (kN)	Not Applicable	2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		5,505 (24.5)		Not Applicable	Not Applicable	Not Applicable
Steel strength in shear, concrete over steel deck, seismic (Figure 2A)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,290 (10.2)		3,710 (16.5)		4,570 (20.3)				
Steel strength in shear, concrete over steel deck (Figure 2B)[9]	$V_{sa,deck}$	lb (kN)		2,120 (9.4)	2,785 (12.4)		Not Applicable		Not Applicable				
Steel strength in shear, concrete over steel deck, seismic (Figure 2B)[9]	$V_{sa,deck,eq}$	lb (kN)		2,120 (9.4)	2,785 (12.4)								
Reduction factor for steel strength in shear, steel deck[3]	ϕ	-	0.65										

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

1. The data in this table is intended to be used with the design provisions of ACI 318-14 Chapter 17 or ACI 318-11 Appendix D, as applicable; for anchors resisting seismic load combinations the additional requirements of ACI 318-14 17.2.3 or ACI 318-11 D.3.3, as applicable, must apply.
2. Installation must comply with published instructions and details.
3. All values of ϕ were determined from the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2. If the load combinations of ACI 318-11 Appendix C are used, then the appropriate value of ϕ must be determined in accordance with ACI 318-11 D.4.4. For reinforcement that meets ACI 318-14 Chapter 17 or ACI 318-11 Appendix D requirements for Condition A, see ACI 318-14 17.3.3(c) or ACI 318-11 D.4.3(c), as applicable, for the appropriate ϕ factor when the load combinations of IBC Section 1605.2, ACI 318-14 Section 5.3 or ACI 318-11 Section 9.2, as applicable, are used.
4. The Power-Stud+ SD1 is considered a ductile steel element as defined by ACI 318-14 2.3 or ACI 318-11 D.1, as applicable.
5. Tabulated values for steel strength in shear must be used for design. These tabulated values are lower than calculated results using equation D-20 in ACI 318-08.
6. 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.
7. For anchors in the topside of concrete-filled steel deck assemblies, see Figure 1.
8. 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.
9. Tabulated values for $V_{sa,deck}$ and $V_{sa,deck,eq}$ are for sand-lightweight concrete (f'c, min = 3,000 psi); additional lightweight concrete reduction factors need not be applied. In addition, evaluation for the concrete breakout capacity in accordance with ACI 318-14 17.5.2 or ACI 318-11 D.6.2, as applicable, and the pryout capacity in accordance with ACI 318-14 17.5.3 or ACI 318-11 D.6.3, as applicable, are not required for anchors installed in the deck soffit (flute).
10. Shear loads for anchors installed through steel deck into concrete may be applied in any direction.

STRENGTH DESIGN PERFORMANCE DATA

Factored design strength ϕN_n and ϕV_n
Calculated in accordance with ACI 318-14 Chapter 17
Compliant with the International Building Code

Tension and Shear Design Strengths for Power-Stud+ SD1 in Cracked Concrete[1-6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_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.)
1/4	1-3/4	-	-	-	-	-	-	-	-	-	-
3/8	2-3/8	1,325	1,685	1,450	1,845	1,675	1,945	2,050	1,945	2,365	1,945
1/2	2-1/2	1,565	1,685	1,710	1,845	1,975	2,130	2,420	2,605	2,795	3,005
	3-3/4	1,630	3,005	1,785	3,005	2,060	3,005	2,520	3,005	2,915	3,005
5/8	3-3/8	2,520	3,125	2,760	3,425	3,185	3,955	3,905	4,845	4,505	5,590
	4-5/8	2,895	5,870	3,170	5,870	3,660	5,870	4,480	5,870	5,175	5,870
3/4	4	3,770	6,210	4,130	6,800	4,770	6,915	5,840	6,915	6,735	6,915
	5-5/8	5,720	7,575	6,265	7,575	7,235	7,575	8,860	7,575	10,230	7,575
7/8	4-1/2	4,470	5,735	4,895	5,735	5,655	5,735	6,925	5,735	7,995	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	7,380	11,540	8,080	11,540	9,330	11,540	11,430	11,540	13,195	11,540

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

Tension and Shear Design Strengths for Power-Stud+ SD1 in Uncracked Concrete[1-6]

Nominal Anchor Diameter (in.)	Nominal Embed. h_{nom} (in.)	Minimum Concrete Compressive Strength									
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi		f'_c = 8,000 psi	
		ϕN_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.)
1/4	1-3/4	1,435	600	1,570	600	1,690	600	1,690	600	1,690	600
3/8	2-3/8	1,860	1,945	2,040	1,945	2,335	1,945	2,885	1,945	3,330	1,945
1/2	2-1/2	2,095	2,375	2,295	2,605	2,645	3,005	3,240	3,005	3,745	3,005
	3-3/4	3,595	3,005	3,940	3,005	4,545	3,005	5,570	3,005	6,430	3,005
5/8	3-3/8	3,555	4,375	3,895	4,795	4,500	5,535	5,510	5,870	6,365	5,870
	4-5/8	6,240	5,870	6,835	5,870	7,895	5,870	9,665	5,870	10,850	5,870
3/4	4	4,310	6,915	4,720	6,915	5,450	6,915	6,675	6,915	7,710	6,915
	5-5/8	8,075	7,575	8,845	7,575	10,215	7,575	12,510	7,575	14,250	7,575
7/8	4-1/2	5,105	5,735	5,595	5,735	6,460	5,735	7,910	5,735	9,135	5,735
1	5-1/2	7,140	7,110	7,820	7,110	9,030	7,110	11,060	7,110	12,770	7,110
1-1/4	6-1/2	10,935	11,540	11,980	11,540	13,830	11,540	16,940	11,540	19,560	11,540

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

1- Tabular values are provided for illustration and are applicable for single anchors installed in normal-weight concrete with minimum slab thickness, $h_a = h_{min}$, and with the following conditions:
   - c_{a1} is greater than or equal to the critical edge distance, c_{ac} (table values based on $c_{a1} = c_{ac}$).
   - c_{a2} is greater than or equal to 1.5 times c_{a1}.

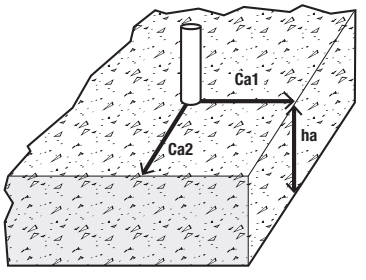
2- Calculations were performed according to ACI 318-14 Chapter 17. The load level corresponding to the controlling failure mode is listed. (e.g. For tension: steel, concrete breakout and pullout; For shear: steel, concrete breakout and pryout). Furthermore, the capacities for concrete breakout strength in tension and pryout strength in shear are calculated using the effective embedment values, h_{ef}, for the selected anchors as noted in the design information tables. Please also reference the installation specifications for more information.

3- Strength reduction factors (ø) were based on ACI 318-14 Section 5.3 for load combinations. Condition B is assumed.

4- Tabular values are permitted for static loads only, seismic loading is not considered with these tables.

5- For designs that include combined tension and shear, the interaction of tension and shear loads must be calculated in accordance with ACI 318-14 Chapter 17.

6- Interpolation is not permitted to be used with the tabular values. For intermediate base material compressive strengths please see ACI 318-14 Chapter 17. For other design conditions including seismic considerations please see ACI 318-14 Chapter 17.



ORDERING INFORMATION

Power-Stud+ SD1 (Carbon Steel Body and 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
7400SD1	1/4" x 1-3/4"	3/4"	100	600	3	00711	00320	-	-	-
7402SD1	1/4" x 2-1/4"	1-1/4"	100	600	4	00713	00321	-	-	-
7404SD1	1/4" x 3-1/4"	2-1/4"	100	600	5	00713	00321	-	-	-
7410SD1	3/8" x 2-1/4"	7/8"	50	300	8	00727	00333	-	-	01401
7412SD1	3/8" x 2-3/4"	1-3/8"	50	300	9	00727	00333	-	-	01401
7413SD1	3/8" x 3"	1-5/8"	50	300	10	00727	00333	-	-	01401
7414SD1	3/8" x 3-1/2"	2-1/8"	50	300	12	00727	00333	-	-	01402
7415SD1	3/8" x 3-3/4"	2-3/8"	50	300	13	00727	00333	-	-	01402
7416SD1	3/8" x 5"	3-5/8"	50	300	15	00729	00334	-	-	01402
7417SD1	3/8" x 7"	5-5/8"	50	300	21	00729	00334	-	-	01403
7420SD1	1/2" x 2-3/4"	1"	50	200	19	00739	00346	08801	-	01407
7422SD1	1/2" x 3-3/4"	2"	50	200	23	00739	00346	08801	-	01407
7423SD1	1/2" x 4-1/2"	2-3/4"	50	200	27	00741	00348	08801	-	01407
7424SD1	1/2" x 5-1/2"	3-3/4"	50	150	30	00741	00348	08801	-	01408
7426SD1	1/2" x 7"	5-1/4"	25	100	38	00741	00348	08801	-	01408
7427SD1	1/2" x 8-1/2"	6-3/4"	25	100	44	00741	00349	08802	-	01409
7428SD1	1/2" x 10"	8-1/4"	25	100	53	00741	00349	08802	-	01409
7430SD1	5/8" x 3-1/2"	1-1/2"	25	100	37	-	00359	08809	07017	-
7432SD1	5/8" x 4-1/2"	2-1/2"	25	100	43	-	00359	08809	07017	-
7433SD1	5/8" x 5"	3"	25	100	47	-	00359	08809	07017	-
7434SD1	5/8" x 6"	4"	25	75	53	-	00359	08809	07020	-
7436SD1	5/8" x 7"	5"	25	75	60	-	00361	08809	07020	-
7438SD1	5/8" x 8-1/2"	6-1/2"	25	50	70	-	00361	08810	07020	-
7439SD1	5/8" x 10"	8"	25	75	87	-	00361	08810	07020	-
7440SD1	3/4" x 4-1/4"	1-3/4"	20	60	63	-	00368	08817	07031	-
7441SD1	3/4" x 4-3/4"	2-1/4"	20	60	68	-	00368	08817	07031	-
7442SD1	3/4" x 5-1/2"	3"	20	60	76	-	00368	08817	07031	-
7444SD1	3/4" x 6-1/4"	3-3/4"	20	60	83	-	00370	08817	07033	-
7446SD1	3/4" x 7"	4-1/2"	20	60	91	-	00370	08817	07033	-
7448SD1	3/4" x 8-1/2"	6"	10	40	107	-	00370	08818	07033	-
7449SD1	3/4" x 10"	7-1/2"	10	30	123	-	00370	08818	07033	-
7451SD1	3/4" x 12"	9-1/2"	10	30	144	-	00371	08818	07035	-
7450SD1	7/8" x 6"	2-3/4"	10	20	128	-	-	08829	07043	01443
7452SD1	7/8" x 8"	4-3/4"	10	40	161	-	-	08829	07043	01443
7454SD1	7/8" x 10"	6-3/4"	10	30	187	-	-	08830	07043	01443
7461SD1	1" x 6"	2-3/8"	10	30	168	-	-	08833	07049	01449
7463SD1	1" x 9"	5-3/8"	10	30	234	-	-	08834	07049	01449
7465SD1	1" x 12"	8-3/8"	5	15	307	-	-	08834	07051	01450
7473SD1	1-1/4" x 9"	4-3/4"	5	15	374	-	-	08846	07064	01464
7475SD1	1-1/4" x 12"	7-3/4"	5	15	476	-	-	08847	07066	01465

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

Cat. No.	Anchor Size	Thread Length	Box Qty.	Carton Qty.	Wt./100 (lbs.)
7409SD1	1/4" x 2"	N/A	100	500	3

Installation Accessories

Cat. No.	Description	Box Qty
08280	Hand pump / dust blower	1

Shaded catalog numbers denote sizes which are less than the minimum standard anchor length for strength design.
The published size includes the diameter and the overall length of the anchor.
All anchors are packaged with nuts and washers (not including tie wire version).
See the DEWALT website or Buyers Guide for additional information on carbide drill bits.

GENERAL INFORMATION

LOK-BOLT AS®

Sleeve Anchor

PRODUCT DESCRIPTION

The Lok-Bolt AS is an all-steel pre-assembled single unit sleeve anchor which is designed for use in concrete or masonry base materials. The anchors are available in multiple head styles for multiple applications and a finished appearance. Anchor extender sleeves can be added to create longer lengths.

GENERAL APPLICATIONS AND USES

- Door and window frame installations
- Masonry applications
- Electrical / Mechanical applications
- Mounting fixtures on walls
- General purpose anchoring

FEATURES AND BENEFITS

+ Variety of head styles, lengths and sizes
+ All steel component design
+ Preassembled anchor for immediate installation
+ Sleeve design keeps anchor centered in hole
+ Sleeve has 360° contact area for even stress distribution
+ Versatile – can be used for solid and hollow concrete or masonry applications
+ Designed to allow fixture to draw snug against the base material during tightening

GUIDE SPECIFICATIONS

CSI Divisions: 03 16 00 - Concrete Anchors and 05 05 19 - Post-Installed Concrete Anchors
Expansion anchors shall be Lok-Bolt AS as supplied by Powers Fasteners, Inc., Brewster, NY. Anchors shall be installed in accordance with published instructions and the Authority Having Jurisdiction.

SECTION CONTENTS

HEX HEAD

HEAD STYLES

- Hex Head
- Acorn Nut
- Round Head
- Combo Flat Head
- Threshold Flat Head
- Rod Hanger
- Tie-Wire

ANCHOR MATERIALS

- Zinc Plated Carbon Steel
- Type 304 Stainless Steel

ANCHOR SIZE RANGE (TYP.)

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

SUITABLE BASE MATERIALS

- Normal-Weight Concrete
- Grouted Concrete Masonry (CMU)
- Hollow Concrete Masonry (CMU)
- Brick Masonry

MATERIAL SPECIFICATIONS

Anchor Component	Carbon Steel Version	Stainless Steel Version
Plow-Bolt	AISI 1010/1018	Type 304 Stainless Steel
Expansion Sleeve	AISI 1010	Type 304 Stainless Steel
Extender	AISI 1010	N/A
Zinc Plating	ASTM B 633, SCI, Type III (Fe/Zn5)	N/A

INSTALLATION SPECIFICATIONS

Acorn Nut and Hex Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d					
	1/4"	5/16"	3/8"	1/2"	5/8"	3/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8	1/2	5/8	3/4
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16	9/16	11/16	15/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18	3/8-16	1/2-13	5/8-11
Nut Height (in.)	3/16	7/32	17/64	21/64	7/16	35/64
Washer O.D., d_w (in.)	1/2	5/8	13/16	1	1-3/8	1-3/4
Wrench Size (in.)	3/8	7/16	1/2	9/16	3/4	15/16

Round Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18
Head Height (in.)	11/64	13/64	15/64
Head Width, d_{hd} (in.)	29/64	9/16	43/64

Combo Flat Head Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	1/4	5/16	3/8
Fixture Clearance Hole, d_h (in.)	5/16	3/8	7/16
Plow Bolt Size (UNC)	10-24	1/4-20	5/16-18
Head Height (in.)	5/32	3/16	15/64
Head Width, d_{hd} (in.)	1/2	5/8	3/4

Rod Hanger Lok-Bolt AS

Dimension	Nominal Anchor Diameter, d		
	1/4"	5/16"	3/8"
ANSI Drill Bit Size, d_{bit} (in.)	5/16	3/8	1/2
Plow Bolt Size (UNC)	1/4-20	5/16-18	3/8-16
Coupling Height (in.)	7/8	1	1-1/4
Washer O.D., d_w (in.)	5/8	13/16	1
Coupling Wrench Size (in.)	3/8	1/2	11/16

Threshold Lok-Bolt AS

Dimension	Anchor Size, d
	1/4"
ANSI Drill Bit Size, d_{bit} (in.)	1/4
Fixture Clearance Hole, d_h (in.)	5/16
Plow Bolt Size (UNC)	10-24
Head Height (in.)	5/64
Head Width, d_{hd} (in.)	23/64

Tie-Wire Lok-Bolt AS

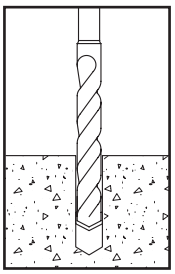
Dimension	Anchor Size, d
	5/16"
ANSI Drill Bit Size, d_{bit} (in.)	5/16
Fixture Clearance Hole, d_h (in.)	3/8
Plow Bolt Size (UNC)	1/4-20
Head Height (in.)	1-9/16
Head Width, d_{hd} (in.)	31/64

INSTALLATION INSTRUCTIONS

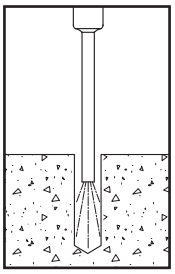
Hex/Acorn/Flat Head Round Versions

Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.

The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15

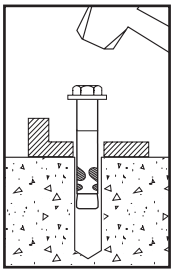


Blow the hole clean of dust and other material. Do not expand the anchor prior to installation.

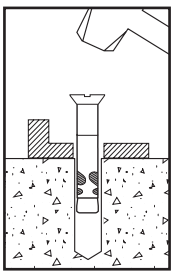


Hex Head/Acorn Nut
Position the washer on the anchor and thread on the nut.

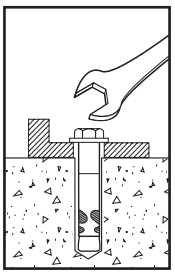
Drive the anchor through the fixture into the anchor hole until the nut and washer are firmly seated against the fixture. Be sure the anchor is driven to the required embedment depth.



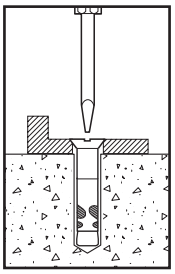
Flat Head/Round Head
Drive the anchor through the fixture until the anchor is firmly seated. Be sure the anchor is driven to the required embedment depth.



Hex Head/Acorn Nut
Tighten the anchor by turning the nut or head 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



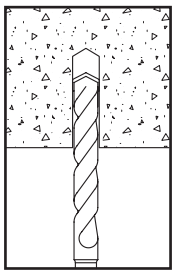
Flat Head/Round Head
Tighten the anchor by turning the head 3 to 5 turns past finger tight.



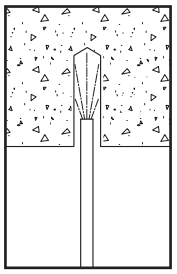
Rod Hanger Version

Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.

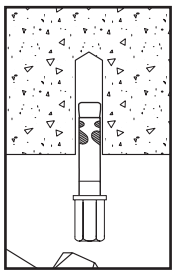
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



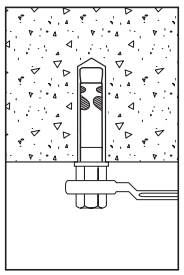
Blow the hole clean of dust and other material. Do not expand the anchor prior to installation.



Drive the anchor into the hole until the anchor is at the required embedment depth.



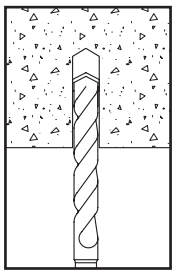
Tighten the coupler nut and washer up to the concrete surface and tighten the anchor by turning the nut 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



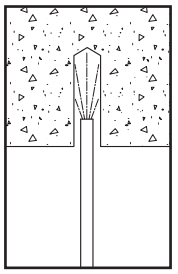
Tie-Wire Version

Using the proper diameter bit, drill a hole into the base material to a depth of at least 1/2" or one anchor diameter deeper than the embedment required.

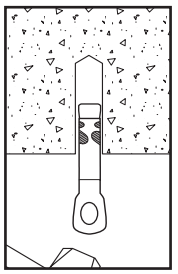
The tolerances of the drill bit used must meet the requirements of ANSI Standard B212.15



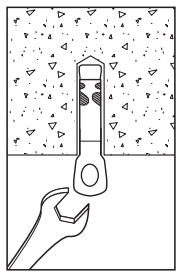
Blow the hole clean of dust and other material. Do not expand the anchor prior to installation.



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



Tighten the tie wire nut by turning the head 3 to 5 turns past finger tight or by applying the guide installation torque from the finger tight position.



PERFORMANCE DATA

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Lok-Bolt AS Anchors in Normal Weight Concrete[1,2,3]

Nominal Anchor Diameter d in.	Min. Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.		Minimum Concrete Compressive Strength, f'c											
				3,000 psi				3,500 psi				4,000 psi			
				Ultimate		Allowable		Ultimate		Allowable		Ultimate		Allowable	
		Carbon	Stainless	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1/2	2	-	225	1,000	55	250	240	1,000	60	250	260	1,000	65	250
	1	6	4	910	1,120	230	280	980	1,120	245	280	1,050	1,120	265	280
5/16	1	12	-	1,205	2,360	300	590	1,300	2,360	325	590	1,390	2,360	350	590
3/8	1-1/4	18	18	1,875	4,110	470	1,030	2,040	4,110	510	1,030	2,165	4,110	540	1,030
1/2	1-1/2	26	26	2,235	4,860	560	1,215	2,420	4,860	605	1,215	2,580	4,860	645	1,215
5/8	2	50	40	4,870	4,860	1,220	1,215	5,260	4,860	1,315	1,215	5,625	4,860	1,405	1,215
3/4	2-1/4	90	60	5,045	11,040	1,260	2,760	5,450	11,040	1,365	2,760	5,825	11,040	1,455	2,760

1. The ultimate load values listed above must be reduced by a minimum safety factor of 4.0 or greater to determine the allowable working load. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
2. Allowable load capacities listed are calculated using an applied safety factor of 4.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. Tabulated load values are for anchors installed at a minimum spacing distance between anchors and an edge distance of 12 times the anchor diameters.

Ultimate and Allowable Load Capacities for Carbon and Stainless Steel Lok-Bolt AS Anchors in Hollow or Solid Concrete Masonry[1,2,3,4]

Nominal Anchor Diameter d in.	Minimum Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.	Minimum Edge Dist. in.	Minimum End Dist. in.	Ultimate Loads		Allowable Loads	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1	4	3-3/4	4	800	1,140	160	225
5/16	1	8			905	1,570	180	310
3/8	1-1/4	15			1,100	1,570	220	310
1/2	1-1/2	18			1,525	1,570	305	310
5/8	1-1/2	30			2,250	1,770	450	355

1. Tabulated load values are for anchors installed in minimum 6 inch wide, Grade N, Type II, normal-weight concrete masonry units conforming to ASTM C 90. Mortar must be minimum Type N, S, or M. Masonry prism compressive strength must be 1,500 psi minimum at time of installation.
2. Allowable load capacities listed are calculated using an applied safety factor of 5.0. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety or overhead.
3. A suitable anchor length must be selected which includes consideration of a fixture to engage the base material at the minimum embedment depth when anchoring into hollow concrete masonry. (e.g. attachment thickness + face shell thickness embedment + one half inch = suitable anchor length)
4. The consistence of hollow concrete block masonry base material can vary greatly. Consideration of job site testing should be given to verify conformance of base materials and anchor performance in actual conditions.

Ultimate and Allowable Load Capacties for Carbon or Stainless Steel Lok-Bolt AS Anchors in Solid Clay Brick Masonry[1,2]

Nominal Anchor Diameter d in.	Minimum Embed. Depth h_v in.	Guide Installation Torque ft.-lbs.	Minimum Edge Dist. in.	Minimum End Dist. in.	f'm ≥ 1,500 psi (10.4 MPa)			
					Ultimate		Allowable	
					Tension lbs.	Shear lbs.	Tension lbs.	Shear lbs.
1/4	1	4	4	1-1/2	800	950	160	190
3/8	1-1/4	15	8	8	1,100	3,000	220	600
1/2	1-1/2	26	8	8	1,560	3,150	310	630
5/8	2	40	8	8	2,470	5,250	495	1,050

1. Tabulated load values are for anchors installed in Grade SW, multiple wythe solid clay brick masonry conforming to ASTM C 62.
2. Allowable load capacities listed are calculated using a safety factor of 5.0 or greater. Consideration of safety factors of 10 or higher may be necessary depending on the application, such as life safety.

ORDERING INFORMATION

Hex Nut Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5005S	-	5/16" x 1-1/2"	5/16"	100	1000
5010S	-	5/16" x 2-3/8"	5/16"	100	500
5015S	6152S	3/8" x 1-7/8"	3/8"	50	500
5020S	6153S	3/8" x 3"	3/8"	50	500
5022S	-	3/8" x 4"	3/8"	50	250
5025S	6156S	1/2" x 2-1/2"	1/2"	25	250
5030S	6157S	1/2" x 3"	1/2"	25	250
5034S	6160S	1/2" x 3-3/4"	1/2"	25	125
5033S	-	1/2" x 5-1/4"	1/2"	25	125
5032S	-	1/2" x 6"	1/2"	10	100
5035S	-	5/8" x 2-1/2"	5/8"	25	125
5038S	-	5/8" x 3"	5/8"	25	125
5040S	6164S	5/8" x 4-1/4"	5/8"	10	100
5045S	-	5/8" x 5-3/4"	5/8"	10	100
5050S	-	3/4" x 2-3/4"	3/4"	10	100
5055S	-	3/4" x 4-1/4"	3/4"	10	40
5060S	-	3/4" x 6-1/4"	3/4"	10	30
5065S	-	3/4" x 8-1/4"	3/4"	10	30

Acorn Nut Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5125S	-	1/4" x 5/8"	1/4"	100	1000
5150S	6150S	1/4" x 1-3/8"	1/4"	100	1000
5175S	-	1/4" x 2-1/4"	1/4"	100	1000

Round Head Lok-Bolt AS, Slotted

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5205S	-	1/4" x 1-3/8"	1/4"	100	1000
5210S	6180S	1/4" x 2-1/4"	1/4"	100	1000
5215S	-	1/4" x 3"	1/4"	100	1000
5220S	-	1/4" x 3-3/4"	1/4"	100	1000
5225S	-	5/16" x 2-3/8"	5/16"	100	1000
5230S	-	5/16" x 3-3/8"	5/16"	100	500
5235S	-	3/8" x 2-3/4"	3/8"	50	500
5240S	-	3/8" x 3-3/4"	3/8"	50	250

Combo Flat Head Lok-Bolt AS

Catalog Number		Size	Drill Dia.	Std. Box	Std. Ctn.
Carbon Steel	Stainless Steel				
5305S	-	1/4" x 1-1/2"	1/4"	100	1000
5310S	6170S	1/4" x 2-1/4"	1/4"	100	1000
5315S	6172S	1/4" x 3"	1/4"	100	1000
5320S	-	1/4" x 4"	1/4"	100	500
5325S	-	1/4" x 5-1/4"	1/4"	100	500
5330S	-	5/16" x 2-1/2"	5/16"	100	1000
5340S	-	3/8" x 2-3/4"	3/8"	50	500
5345S	6174S	3/8" x 4"	3/8"	50	250
5350S	6175S	3/8" x 5"	3/8"	50	250
5360S	6176S	3/8" x 6"	3/8"	50	250

Threshold Flat Head Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5500S	1/4" x 2"	1/4"	100	1000

Rod Hanger Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5810S	1/4" x 1-1/2"	5/16"	50	250
5815S	3/8" x 1-7/8"	3/8"	50	250
5825S	1/2" x 2-1/4"	1/2"	25	125

Tie-Wire Lok-Bolt AS

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5700S	5/16" x 2-3/8"	5/16"	100	1000

Lok-Bolt AS Extenders

Cat #	Size	Drill Dia.	Std. Box	Std. Ctn.
5684S	3/8" x 1-1/4"	3/8"	50	500