Product Submittal/Substitution Request

TO:

PROJECT:

PROJECT LOCATION:

SPECIFIED ITEM:

Section	Page	Paragraph	Description

PRODUCT SUBMIT TAL / SUBSTITUTION REQUESTED:

DEWALT® Engineered By Powers® AC200+(tm) -

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

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DEWALT® AC200+(tm) Submittal Section:

Product Pages:

– General Information
– Design Tables
– Installation Instructions
– Ordering Information

Code Reports & Agency Listings:

– ICC–ES Approval: ESR–4027 (Cracked And Uncracked Concrete)

GENERAL INFORMATION

AC200+™

Acrylic Injection Adhesive Anchoring System
and Post-Installed Reinforcing Bar Connections

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 and for post-installed reinforcing bar connections.

GENERAL APPLICATIONS AND USES

- Bonding threaded rod and reinforcing bar into hardened concrete
- Evaluated for installation and use in dry and wet concrete
- Fast curing system which can be installed in a wide range of base material temperatures; qualified for structural applications in concrete and masonry as low as 14ºF (-10ºC)
- Qualified for seismic (earthquake) and wind loading

FEATURES AND BENEFITS

+ Designed for use with threaded rod and reinforcing bar hardware elements
+ Evaluated and recognized for freeze/thaw performance
+ Versatile system which can be used in a wide range of embedments in low and high strength concrete
+ 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 the International Building Code/International Residential Code: 2018 IBC/IRC, 2015 IBC/IRC, 2012 IBC/IRC, and 2009 IBC/IRC
- Tested in accordance with ACI 355.4, ASTM E488, 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
- Conforms to requirements of ASTM C881 and AASHTO M235, Types I, II, IV and V, Grade 3, Class A
- Department of Transportation listings - see www.DEWALT.com or contact transportation agency

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.

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PACKAGING

Coaxial Cartridge

- 9.5 fl. oz.

Dual (side-by-side) Cartridge

- 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 (TYPICAL)

- 3/8" to 1-1/4" diameter threaded rod
- No. 3 to No. 10 reinforcing bar (rebar)
- 10M to 30M reinforcing bar (CA rebar)

SUITABLE BASE MATERIALS

- Normal-weight concrete
- Lightweight concrete

PERMISSIBLE INSTALLATION CONDITIONS (ADHESIVE)

- Dry concrete
- Water-saturated concrete (wet)
- Water-filled holes

STRENGTH DESIGN (SD)

Installation Specifications for Threaded Rod and Reinforcing Bar[1]

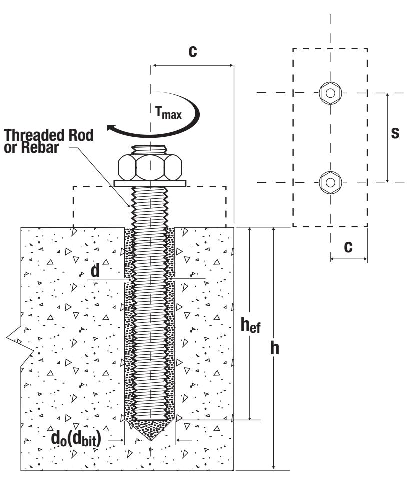
CODE LISTED
ICC-ES ESR-4027

STRENGTH DESIGN SD TABLES

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**	**10M**	**-**	**#4**	**-**	**#5**	**15M**	**#6**	**20M**	**#7**	**25M**	**#8**	**#9**	**30M**	**-**	**#10**
Nominal anchor diameter	d_a	in. (mm)	0.375 (9.5)		0.445 (11.3)	0.500 (12.7)		0.625 (15.9)		0.630 (16.0)	0.750 (19.1)	0.768 (19.5)	0.875 (22.2)	0.992 (25.2)	1.000 (25.4)	1.125 (28.6)	1.177 (29.9)	1.250 (31.8)	
Nominal ANSI drill bit size	d_o [d_{bit}]	in.	7/16 ANSI	1/2 ANSI	9/16 ANSI	9/16 ANSI	5/8 ANSI	11/16 ANSI	3/4 ANSI	3/4 ANSI	7/8 ANSI	1 ANSI	1 ANSI	1-1/4 ANSI	1-1/8 ANSI	1-3/8 ANSI	1-1/2 ANSI	1-3/8 ANSI	1-1/2 ANSI
Minimum embedment	$h_{ef,min}$	in. (mm)	2-3/8 (60)		2.8 (70)	2-3/4 (70)		3-1/8 (79)		3.1 (80)	3-1/2 (89)	3.5 (90)	3-1/2 (89)	3.9 (100)	4 (102)	4-1/2 (114)	4.7 (120)	5 (127)	
Maximum embedment	$h_{ef,max}$	in. (mm)	7-1/2 (191)		8.9 (225)	10 (254)		12-1/2 (318)		12.6 (320)	15 (381)	15.4 (390)	17-1/2 (445)	19.8 (505)	20 (508)	22-1/2 (572)	23.5 (600)	25 (635)	
Minimum concrete member thickness	h_{min}	in. (mm)	h_{ef} + 1-1/4 (h_{ef} + 30)					$h_{ef} + 2d_o$											
Minimum spacing distance	s_{min}	in. (mm)	1-7/8 (48)		2 (50)	2-1/2 (62)		3 (76)		3.2 (80)	3-5/8 (92)	3.9 (100)	4-1/4 (108)	4.9 (125)	4-3/4 (121)	5-1/4 (133)	5.9 (150)	5-7/8 (149)	
Minimum edge distance (100% T_{max})	c_{min}	in. (mm)	1-5/8 (41)		1.7 (45)	1-3/4 (44)		2 (51)		2.2 (55)	2-3/8 (60)	2-3/8 (60)	2-1/2 (64)	2.7 (70)	2-3/4 (70)	3 (75)	3 (75)	3-1/4 (80)	
Maximum Torque[3]	T_{max}	ft-lbs	15[4]		-	30		44		-	66	66	96	-	147	185	-	221	
Minimum edge distance, reduced[2,4,5] (45% T_{max})	$c_{min,red}$	in (mm)	-		-	-		1-3/4 (45)		1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	1-3/4 (45)	2-3/4 (70)	2-3/4 (70)	2-3/4 (70)	
Maximum Torque, reduced[3]	$T_{max,red}$	ft-lbs	7		-	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. For No. 8 rebar an 1-1/4" ANSI drill bit is also suitable for use.
3. Torque may not be applied to the anchors until the full cure time of the adhesive has been achieved.
4. For ASTM A36/F1554 Grade 36 carbon steel threaded rods with 3/8-inch-diameter, Tmax = 11 ft.-lbs.
5. For installations at the reduced minimum edge distance, $c_{min,red}$, the maximum toque applied must be max torque reduced, $T_{max,red}$.
6. For installations at the reduced minimum edge distance, $c_{min,red}$, the miminim spacing, s_{min} = 5 x da.

Detail of Steel Hardware Elements used with Injection Adhesive System



Threaded Rod and Deformed Reinforcing Bar Material Properties

Steel Description (General)	Steel Specification	Nominal Anchor Size	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)
Grade 400 Metric Reinforcing Bar (CA)	CAN/CSA G30.18	10M through 30M	78,300 (540)	58,000 (400)

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

STRENGTH DESIGN SD TABLES

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 tension²	ϕ	-	0.65							
	Strength reduction factor for shear²	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 tension²	ϕ	-	0.75							
	Strength reduction factor for shear²	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 tension²	ϕ	-	0.65							
	Strength reduction factor for shear²	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.

Design Information		Symbol	Units	Nominal Reinforcing Bar Size (Rebar)[1]				
				10 M	15 M	20 M	25 M	30 M
Reinforcing bar O.D.		d	mm (in.)	11.4 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (inch²)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463	498.8 (0.773)	702.2 (1.088)
CAN/CSA G30.18 Grade 400	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24,410)	161.5 (36,255)	270.0 (60,550)	380.0 (85,240)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,755)	161.5 (36,330)	227.5 (51,145)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65				
	Strength reduction factor for tension²	ϕ	-	0.65				
	Strength reduction factor for shear²	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. 17.5.1.2b 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, 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 D.4.4.

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 | mm	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$ | $c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$						
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: $\tau_{k,uncr} = \frac{k_{uncr} \bullet \sqrt{h_{ef} \bullet f'c}}{\pi \bullet d}$ 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						
Water-filled holes	Anchor Category	-	-	3						
	Strength reduction factor	ϕ_{wf}	-	0.45						
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 (US Customary)							
			#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 | mm	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$ | $c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$							
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 (US Customary)							
				#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							
Water-filled holes	Anchor Category	-	-	3							
	Strength reduction factor	ϕ_{wf}	-	0.45							
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.

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

CODE LISTED
ICC-ES ESR-4027
STRENGTH DESIGN TABLES SD

Design Information	Symbol	Units	Nominal Bar Size (CA)				
			10M	15M	20M	25M	30M
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (-)	7 (17)				
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (-)	10 (24)				
Minimum embedment	$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment	$h_{ef,max}$	mm (in.)	225 (8.9)	320 (12.6)	390 (15.4)	505 (19.8)	600 (23.5)
Minimum anchor spacing	s_{min}	mm (in.)	55 (2-1/2)	80 (3-1/8)	95 (3-3/4)	120 (4-5/8)	150 (5-7/8)
Minimum edge distance[2]	c_{min}	mm (in.)	40 (1-3/4)	50 (2)	60 (2-3/8)	70 (2-3/4)	85 (3-1/8)
Minimum edge distance, reduced[2]	$c_{min,red}$	mm (in.)	-	40 (1-3/4)	40 (1-3/4)	40 (1-3/4)	70 (2-3/4)
Minimum member thickness	h_{min}	mm (in.)	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 | mm	$c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{1160})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$ | $c_{ac} = h_{ef} \cdot (\frac{\tau_{uncr}}{8})^{0.4} \cdot [3.1-0.7 \frac{h}{h_{ef}}]$				
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 Metric Reinforcing Bars in Holes Drilled with a Hammer Drill and Carbide Bit[1]

CODE LISTED
ICC-ES ESR-4027
STRENGTH DESIGN TABLES SD

Design Information		Symbol	Units	Nominal Bar Size (CA)				
				10M	15M	20M	25M	30M
Minimum embedment		$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment		$h_{ef,max}$	mm (in.)	225 (8.9)	320 (12.6)	390 (15.4)	505 (19.8)	600 (23.5)
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	$\tau_{k,cr}$	N/mm² (psi)	14.5 (2,110)	13.2 (1,916)	12.5 (1,814)	11.7 (1,690)	11.1 (1,612)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	7.2 (1,041)	7.5 (1,087)	7.2 (1,045)	6.7 (965)	6.3 (915)
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	$\tau_{k,cr}$	N/mm² (psi)	12.7 (1,836)	11.5 (1,667)	10.9 (1,578)	10.1 (1,470)	9.7 (1,402)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	6.2 (906)	6.5 (946)	6.3 (909)	5.8 (840)	5.5 (796)
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	$\tau_{k,cr}$	N/mm² (psi)	9.1 (1,633)	8.3 (1,201)	7.8 (1,137)	7.3 (1,059)	7.0 (1,010)
	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	5.6 (806)	5.8 (841)	5.6 (809)	5.2 (747)	4.9 (708)
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				
Water-filled holes	Anchor Category	-	-	3				
	Strength reduction factor	ϕ_{wf}	-	0.45				
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.

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]

STRENGTH DESIGN SD TABLES

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
	4-1/2	7,445	7,935	8,155	9,015	9,395	11,015	9,785	13,710	10,070	16,015
	7-1/2	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]

STRENGTH DESIGN TABLES SD

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
	4-1/2	3,585	5,665	3,655	6,440	3,760	7,865	3,915	8,435	4,030	8,680
	7-1/2	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
	4-1/2	7,445	7,935	7,720	8,820	7,945	10,300	8,275	12,820	8,515	14,975
	7-1/2	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]

STRENGTH DESIGN SD TABLES

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
	4-1/2	3,750	5,665	3,820	6,300	3,930	7,355	4,090	8,815	4,210	9,070
	7-1/2	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 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 Rebar Size	Embed. Depth h_{ef} in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.2 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)	
		ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_{a} Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)
10M	2.4 (61)	2,900 (12.9)	2,580 (11.5)	3,175 (14.1)	2,930 (13.0)	3,670 (16.3)	3,585 (15.9)	4,495 (20.0)	4,760 (21.2)	5,170 (23.0)	5,550 (24.7)
	3.6 (90)	5,235 (23.3)	5,440 (24.2)	5,735 (25.5)	6,180 (27.5)	6,625 (29.5)	7,560 (33.6)	7,445 (33.1)	9,370 (41.7)	7,665 (34.1)	10,820 (48.1)
	5.3 (136)	9,620 (42.8)	10,755 (47.8)	10,420 (46.4)	12,075 (53.7)	10,725 (47.7)	13,940 (62.0)	11,170 (49.7)	17,075 (76.0)	11,495 (51.1)	19,715 (87.7)
	7.5 (191)	14,375 (63.9)	18,220 (81.0)	14,640 (65.1)	19,960 (88.8)	15,070 (67.0)	23,045 (102.5)	15,690 (69.8)	28,225 (125.6)	16,150 (71.8)	32,595 (145.0)
15M	3.1 (79)	4,255 (18.9)	4,050 (18.0)	4,665 (20.8)	4,600 (20.5)	5,385 (24.0)	5,625 (25.0)	6,595 (29.3)	7,475 (33.3)	7,615 (33.9)	9,140 (40.7)
	5.0 (128)	8,825 (39.3)	10,105 (44.9)	9,665 (43.0)	11,480 (51.1)	11,160 (49.6)	14,045 (62.5)	13,555 (60.3)	17,950 (79.8)	13,950 (62.1)	20,725 (92.2)
	7.6 (192)	16,210 (72.1)	19,960 (88.8)	17,760 (79.0)	22,680 (100.9)	19,525 (86.9)	26,695 (118.7)	20,335 (90.5)	32,695 (145.4)	20,930 (93.1)	37,750 (167.9)
	12.6 (320)	31,050 (138.1)	44,995 (200.1)	31,620 (140.7)	49,290 (219.3)	32,545 (144.8)	56,915 (253.2)	33,890 (150.8)	69,705 (310.1)	34,880 (155.2)	75,125 (334.2)
20M	3.5 (89)	5,105 (22.7)	4,995 (22.2)	5,595 (24.9)	5,675 (25.2)	6,460 (28.7)	6,945 (30.9)	7,910 (35.2)	9,220 (41.0)	9,135 (40.6)	11,280 (50.2)
	6.1 (156)	11,870 (52.8)	14,045 (62.5)	13,005 (57.8)	15,955 (71.0)	15,015 (66.8)	19,515 (86.8)	18,390 (81.8)	25,390 (112.9)	19,620 (87.3)	29,320 (130.4)
	9.2 (234)	21,810 (97.0)	27,750 (123.4)	23,890 (106.3)	31,525 (140.2)	27,460 (122.1)	37,770 (168.0)	28,595 (127.2)	46,260 (205.8)	29,430 (130.9)	53,415 (237.6)
	15.4 (390)	43,665 (194.2)	63,590 (282.9)	44,470 (197.8)	69,660 (309.9)	45,765 (203.6)	80,435 (357.8)	47,660 (212.0)	98,515 (438.2)	49,050 (218.2)	105,650 (470.0)
25M	3.9 (99)	6,005 (26.7)	5,855 (26.0)	6,580 (29.3)	6,650 (29.6)	7,600 (33.8)	8,135 (36.2)	9,305 (41.4)	10,805 (48.1)	10,745 (47.8)	13,215 (58.8)
	7.9 (202)	17,440 (77.6)	19,590 (87.1)	19,105 (85.0)	22,255 (99.0)	22,060 (98.1)	27,220 (121.1)	27,020 (120.2)	36,155 (160.8)	30,525 (135.8)	41,845 (186.1)
	11.9 (302)	32,040 (142.5)	38,700 (172.1)	35,100 (156.1)	43,970 (195.6)	40,530 (180.3)	53,780 (239.2)	44,490 (197.9)	66,015 (293.6)	45,790 (203.7)	76,230 (339.1)
	19.8 (504)	67,940 (302.2)	90,755 (403.7)	69,190 (307.8)	99,420 (442.2)	71,205 (316.7)	114,800 (510.7)	74,155 (329.9)	140,600 (625.4)	76,320 (339.5)	162,350 (722.2)
30M	4.7 (119)	7,950 (35.4)	7,510 (33.4)	8,705 (38.7)	8,530 (37.9)	10,055 (44.7)	10,435 (46.4)	12,315 (54.8)	13,860 (61.7)	14,215 (63.2)	16,950 (75.4)
	9.4 (239)	22,540 (100.3)	24,470 (108.8)	24,695 (109.8)	27,805 (123.7)	28,515 (126.8)	34,005 (151.3)	34,920 (155.3)	45,165 (200.9)	40,325 (179.4)	53,080 (236.1)
	14.1 (359)	41,410 (184.2)	48,350 (215.1)	45,365 (201.8)	54,930 (244.3)	52,380 (233.0)	67,185 (298.9)	59,745 (265.8)	83,745 (372.5)	61,490 (273.5)	96,700 (430.1)
	23.5 (598)	89,105 (396.4)	114,045 (507.3)	92,910 (413.3)	126,110 (561.0)	95,620 (425.3)	145,620 (647.8)	99,575 (442.9)	178,350 (793.3)	102,480 (455.9)	205,940 (916.1)

- 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 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[1,2,3,4,5,6,7,8,9t]

Nominal Rebar Size	Embed. Depth h_{ef} in. (mm)	Minimum Concrete Compressive Strength									
		f'c = 2,500 psi (17.2 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)	
		ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)	ϕN_{cb} or ϕN_a Tension lbs. (MPa)	ϕV_{cb} or ϕV_{cp} Shear lbs. (MPa)
10M	2.40 (61)	2,055 (9.1)	1,670 (7.4)	2,250 (10.0)	1,830 (8.1)	2,600 (11.6)	2,115 (9.4)	3,180 (14.1)	2,590 (11.5)	3,675 (16.3)	2,990 (13.3)
	3.56 (90)	3,710 (16.5)	3,255 (14.5)	4,065 (18.1)	3,565 (15.9)	4,690 (20.9)	4,120 (18.3)	5,745 (25.6)	5,045 (22.4)	6,635 (29.5)	5,825 (25.9)
	5.34 (136)	6,815 (30.3)	5,935 (26.4)	7,465 (33.2)	6,500 (28.9)	8,620 (38.3)	7,505 (33.4)	10,560 (47.0)	9,195 (40.9)	11,495 (51.1)	10,615 (47.2)
	7.50 (191)	11,350 (50.5)	9,810 (43.6)	12,430 (55.3)	10,745 (47.8)	14,355 (63.9)	12,410 (55.2)	15,690 (69.8)	15,200 (67.6)	16,150 (71.8)	17,550 (78.1)
15M	3.10 (79)	3,015 (13.4)	2,890 (12.9)	3,305 (14.7)	3,190 (14.2)	3,815 (17.0)	3,685 (16.4)	4,670 (20.8)	4,515 (20.1)	5,395 (24.0)	5,210 (23.2)
	5.04 (128)	6,250 (27.8)	6,595 (29.3)	6,845 (30.4)	7,225 (32.1)	7,905 (35.2)	8,345 (37.1)	9,685 (43.1)	10,220 (45.5)	11,180 (49.7)	11,800 (52.5)
	7.56 (192)	11,480 (51.1)	12,015 (53.4)	12,580 (56.0)	13,165 (58.6)	14,525 (64.6)	15,200 (67.6)	17,790 (79.1)	18,615 (82.8)	20,540 (91.4)	21,495 (95.6)
	12.60 (320)	24,705 (109.9)	25,620 (114.0)	27,065 (120.4)	28,065 (124.8)	31,250 (139.0)	32,405 (144.1)	33,890 (150.8)	39,690 (176.5)	34,880 (155.2)	45,830 (203.9)
20M	3.50 (89)	3,620 (16.1)	3,570 (15.9)	3,965 (17.6)	4,055 (18.0)	4,575 (20.4)	4,730 (21.0)	5,605 (24.9)	5,790 (25.8)	6,470 (28.8)	6,685 (29.7)
	6.14 (156)	8,410 (37.4)	9,390 (41.8)	9,210 (41.0)	10,285 (45.7)	10,635 (47.3)	11,875 (52.8)	13,030 (58.0)	14,545 (64.7)	15,045 (66.9)	16,795 (74.7)
	9.21 (234)	15,450 (68.7)	17,105 (76.1)	16,925 (75.3)	18,740 (83.4)	19,540 (86.9)	21,640 (96.3)	23,935 (106.5)	26,500 (117.9)	27,635 (122.9)	30,600 (136.1)
	15.35 (390)	33,240 (147.9)	36,430 (162.0)	36,415 (162.0)	39,905 (177.5)	42,045 (187.0)	46,080 (205.0)	47,660 (212.0)	56,435 (251.0)	49,050 (218.2)	65,165 (289.9)
25M	3.90 (99)	4,255 (18.9)	4,180 (18.6)	4,660 (20.7)	4,750 (21.1)	5,385 (24.0)	5,810 (25.8)	6,590 (29.3)	7,125 (31.7)	7,610 (33.9)	8,230 (36.6)
	7.94 (202)	12,355 (55.0)	13,355 (59.4)	13,535 (60.2)	14,630 (65.1)	15,625 (69.5)	16,890 (75.1)	19,140 (85.1)	20,685 (92.0)	22,100 (98.3)	23,890 (106.3)
	11.91 (302)	22,695 (101.0)	24,325 (108.2)	24,865 (110.6)	26,650 (118.5)	28,710 (127.7)	30,770 (136.9)	35,160 (156.4)	37,685 (167.6)	40,600 (180.6)	43,515 (193.6)
	19.84 (504)	48,835 (217.2)	51,810 (230.5)	53,495 (238.0)	56,755 (252.5)	61,770 (274.8)	65,535 (291.5)	74,155 (329.9)	80,260 (357.0)	76,320 (339.5)	92,680 (412.3)
30M	4.70 (119)	5,630 (25.0)	5,365 (23.9)	6,165 (27.4)	6,095 (27.1)	7,120 (31.7)	7,455 (33.2)	8,720 (38.8)	9,230 (41.1)	10,070 (44.8)	10,660 (47.4)
	9.42 (239)	15,965 (71.0)	16,900 (75.2)	17,490 (77.8)	18,510 (82.3)	20,195 (89.8)	21,375 (95.1)	24,735 (110.0)	26,180 (116.5)	28,565 (127.1)	30,230 (134.5)
	14.13 (359)	29,335 (130.5)	30,785 (136.9)	32,135 (142.9)	33,725 (150.0)	37,105 (165.1)	38,940 (173.2)	45,445 (202.1)	47,690 (212.1)	52,475 (233.4)	55,070 (245.0)
	23.54 (598)	63,115 (280.7)	65,565 (291.6)	69,140 (307.6)	71,820 (319.5)	79,835 (355.1)	82,930 (368.9)	97,780 (434.9)	101,570 (451.8)	102,480 (455.9)	117,280 (521.7)

☐ - 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]

Nominal Rod/Rebar Size	Steel Elements - Threaded Rod and Reinforcing Bar										
	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	CAN/CSA G30.18 Grade 400
	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.)	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	-
10M	-	-	-	-	-	-	-	-	-	-	12,175
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	-
15M	-	-	-	-	-	-	-	-	-	-	24,410
3/4" or #6	14,550	18,815	31,360	30,105	15,765	18,480	23,830	25,740	26,400	17,160	-
20M	-	-	-	-	-	-	-	-	-	-	36,255
7/8" or #7	20,085	25,970	43,285	41,930	21,760	25,510	32,895	35,100	36,000	-	-
25M	-	-	-	-	-	-	-	-	-	-	60,550
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	-	-
30M	-	-	-	-	-	-	-	-	-	-	85,240
1-1/4" or #10	42,160	54,510	90,850	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]

Nominal Rod/Rebar Size	Steel Elements - Threaded Rod and Reinforcing Bar										
	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	CAN/CSA G30.18 Grade 400
	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.)	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	-
10M	-	-	-	-	-	-	-	-	-	-	7,305
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	-
15M	-	-	-	-	-	-	-	-	-	-	14,645
3/4" or #6	7,565	9,785	16,305	15,655	8,730	10,235	12,390	14,255	13,730	9,505	-
20M	-	-	-	-	-	-	-	-	-	-	21,755
7/8" or #7	10,445	13,505	22,505	21,805	12,050	14,130	17,105	19,440	18,720	-	-
25M	-	-	-	-	-	-	-	-	-	-	36,330
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	-	-
30M	-	-	-	-	-	-	-	-	-	-	51,145
1-1/4" or #10	21,920	28,345	47,250	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.

Development Lengths for Common Reinforcing Bar Connections[1,2,3,6]

Design Information	Symbol	Reference Standard	Units	Nominal Rebar Size (US)							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal rebar diameter	d_b	ASTM A615/A706, Grade 60 (fy = 60 ksi)	in. (mm)	0.375 (9.5)	0.5 (12.7)	0.625 (15.9)	0.75 (19.1)	0.875 (22.2)	1 (25.4)	1.128 (28.6)	1.27 (32.3)
Nominal rebar area	A_b		in^2 (mm^2)	0.11 (71)	0.2 (127)	0.31 (198)	0.44 (285)	0.6 (388)	0.79 (507)	1 (645)	1.27 (817)
Development length in f'c = 2,500 psi concrete[4,5]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	in. (mm)	12 (305)	14.4 (366)	18 (457)	21.6 (549)	31.5 (800)	36 (914)	40.6 (1031)	45.7 (1161)
Development length in f'c = 3,000 psi concrete[4,5]			in. (mm)	12 (305)	13.1 (334)	16.4 (417)	19.7 (501)	28.8 (730)	32.9 (835)	37.1 (942)	41.7 (1060)
Development length in f'c = 4,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	14.2 (361)	17.1 (434)	24.9 (633)	28.5 (723)	32.1 (815)	36.2 (920)
Development length in f'c = 6,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	13.9 (354)	20.3 (516)	23.2 (590)	26.2 (666)	29.5 (750)
Development length in f'c = 8,000 psi concrete[4,5]			in. (mm)	12 (305)	12 (305)	12 (305)	12.1 (307)	17.6 (443)	20.1 (511)	22.7 (577)	25.6 (649)

Design Information	Symbol	Reference Standard	Units	Nominal Rebar Size (CA)				
				10M	15M	20M	25M	30M
Nominal rebar diameter	d_b	CA/CSA G30.18 Grade 400 (fy = 58 ksi)	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Nominal rebar area	A_b		mm^2 (in^2)	100 (0.16)	200 (0.31)	300 (0.46)	500 (0.77)	700 (1.09)
Development length in f'c = 2,500 psi concrete[4,6]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	mm (in.)	315 (12.4)	445 (17.5)	678 (26.7)	876 (34.5)	1041 (41.0)
Development length in f'c = 3,000 psi concrete[4,6]			mm (in.)	305 (12.0)	407 (16.0)	620 (24.4)	800 (31.5)	950 (37.4)
Development length in f'c = 4,000 psi concrete[4,6]			mm (in.)	305 (12.0)	353 (13.9)	536 (21.1)	693 (27.3)	823 (32.4)
Development length in f'c = 6,000 psi concrete[4,6]			mm (in.)	305 (12.0)	305 (12.0)	438 (17.3)	566 (22.3)	672 (26.4)
Development length in f'c = 8,000 psi concrete[4,6]			mm (in.)	305 (12.0)	305 (12.0)	379 (14.9)	490 (19.3)	582 (22.9)

For SI: 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa; for pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

1. Calculated development lengths in accordance with ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3, as applicable, for reinforcing bars are valid for static, wind, and earthquake loads.
2. Calculated development lengths in SDC C through F must comply with ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.
3. For Class B splices, minimum length of lap for tension lap splices is $1.3l_d$ in accordance with ACI 318-14 25.5.2 and ACI 318-11 12.15.1, as applicable.
4. For lightweight concrete, $\lambda = 0.75$; therefore multiply development lengths by 1.33 (increase development length by 33 percent), unless the provisions of ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d), as applicable, are met to permit alternate values of λ (e.g for sand-lightweight concrete, $\lambda = 0.85$; therefore multiply development lengths by 1.18). Refer to ACI 318-14 19.2.4 or ACI 318-11 8.6.1, as applicable.
5. $\left(\frac{c_b + K_{tr}}{d_b}\right) = 2.5$, $\psi_t = 1.0$, $\psi_e = 1.0$, $\psi_s = 0.8$ for $d_b \le$ #6, 1.0 for $d_b >$ #6. Refer to ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.
6. Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318-14 Chapter 25 or ACI 318-11 Chapter 12, as applicable.

Installation Parameters for Common Post-Installed Reinforcing Bar Connections

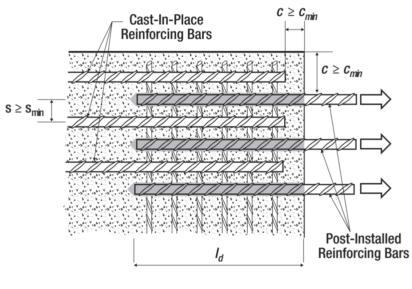
Parameter	Symbol	Units	Nominal Rebar Size (US)							
			#3	#4	#5	#6	#7	#8	#9	#10
Nominal hole diameter[1]	d_o	in.	1/2	5/8	3/4	7/8	1	1-1/8 | 1-1/4	1-3/8	1-1/2
Effective embedment	h_{ef}	in.	2-3/8 to 22-1/2	2-3/4 to 30	3-1/8 to 37-1/2	3-1/2 to 45	3-1/2 to 52-1/2	4 to 60	4-1/2 to 67-1/2	5 to 75

Parameter	Symbol	Units	Nominal Rebar Size (CA)				
			10M	15M	20M	25M	30M
Nominal hole diameter[1]	d_o	in.	9/16	3/4	1	1-1/4	1-1/2
Effective embedment	h_{ef}	mm	70 to 680	80 to 960	90 to 1170	100 to 1510	120 to 1795

For SI: 1 inch = 25.4 mm,; for pound-inch units: 1 mm = 0.03937 inches.

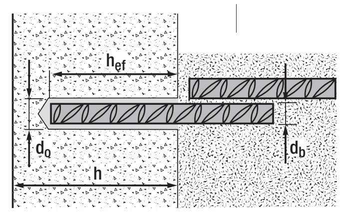
1. For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned hole without resistance.
2. Consideration should be given regarding the commercial availability of carbide drill bits (including hollow drill bits), as applicable, with lengths necessary to achieve effective embedments for post-installed reinforcing bar connections.

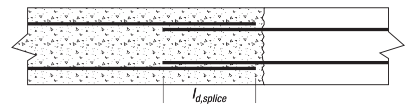
Installation Detail for Post-Installed Reinforcing Bar Connection



Development Length

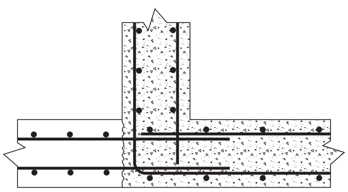
c = edge distance
s = spacing



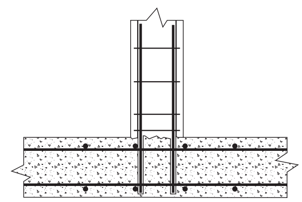


d_b = nomial bar diameter
d_o = nominal hole diameter
h_{ef} = effective embedment
h = member thickness

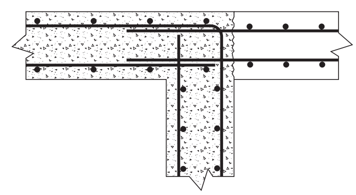
Examples of Development Length Application Details for Post-Installed Reinforcing Bar Connections Provided for Illustrator



Tension Lap Splice with Existing Reinforcement for Footing and Foundation Extensions



Tension Development of Column, Cap or Wall Dowels



Tension Lap Splice with Existing Flexural Reinforcement For Slab and Beam Extensions

Hole Cleaning Tools and Accessories for Post-Installed Rebar Connections[1,2,3,4,5,6,7]

Rebar Size	Drill Bit Size (inch)	Brush Size (inch)	Brush Length (inches)	Wire Brush (Cat. No.)	Plug Size (inch)	Piston Plug (Cat. No.)
No. 3	1/2	1/2	6	PFC1671010	N/A	N/A
10M	9/16	9/16	6	PFC1671150	N/A	N/A
No. 4	5/8	5/8	6	PFC1671200	N/A	N/A
No. 5	3/4	3/4	6	PFC1671250	3/4	PFC1691520
15M	3/4	3/4	6	PFC1671250	3/4	PFC1691520
No. 6	7/8	7/8	6	PFC1671300	7/8	PFC1691530
20M	1	1	6	PFC1671350	1	PFC1691540
No. 7	1	1	6	PFC1671350	1	PFC1691540
25M	1-1/4	1-1/4	6	PFC1671450	1-1/4	PFC1691555
No. 8	1-1/8	1-1/8	6	PFC1671425	1-1/8	PFC1691550
	1-1/4	1-1/4	6	PFC1671450	1-1/4	PFC1691555
No. 9	1-3/8	1-3/8	6	PFC1671450	1-3/8	PFC1691560
30M	1-1/2	1-1/2	6	PFC1671500	1-1/2	PFC1691570
No. 10	1-1/2	1-1/2	6	PFC1671500	1-1/2	PFC1691570

1. If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (brushing and blowing following drilling) is not required.
2. Holes may be drilled with hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow bits).
3. For any case, it must be possible for the reinforcing bar to be inserted into the cleaned drill hole without resistance.
4. A brush extension (Cat.#08282) must be used with a steel wire brush for holes drilled deeper than the listed brush length.
5. Brush adaptors for power tool connections are available for drill chuck (Cat.#08296) and SDS (Cat.#08283).
6. A flexible extension tube (Cat.#08297) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used if the bottom or back of the anchor hole is not reached with the mixing nozzle only.
7. All overhead (i.e upwardly inclined) installations require the use of piston plugs during where one is tabulated together with the anchor size (see table). N/A = Not applicable. All horizontal installations require the use of piston plugs where one is tabulated together with the anchor size and where the embedment depth is greater than 8 inches. A flexible extension tube (Cat.#08297) or flexible extension hose (Cat.#PFC1640600) or equivalent approved by DEWALT must be used with piston plugs.

Wire Brush

Brush Extension

Drill Chuck Adapter

SDS Adapter

Premium Piston Plug

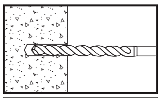
Compressed Air Nozzle

DustX+™ System

DUST X+ ANCHOR INSTALLATION SYSTEM

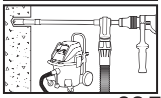
INSTALLATION INSTRUCTIONS (SOLID BASE MATERIALS)

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.

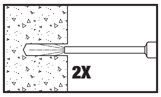


- Note! In case of standing water in the drilled hole (flooded hole condition), all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

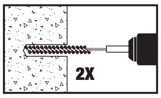
Drilling in dry base material is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED); OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

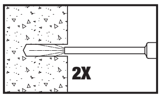
HOLE CLEANING DRY OR WET/WATER-SATURATED HOLES (BLOW 2X, BRUSH 2X, BLOW 2X)



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). If the back of the drilled hole is not reached an extension shall be used.

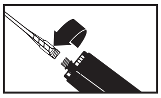


2b- Determine brush diameter (see hole cleaning equipment selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied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



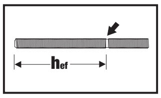
2c- Finally blow the hole clean again with compressed air (min. 90 psi / 6 bar) a minimum of two times (2x). If the back of the drilled hole is not reached an extension shall be used. When finished the hole should be clean and free of dust, debris, ice, grease, oil or other foreign material.

PREPARING

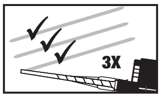


3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge temperature must be between 41°F - 104°F (5°C - 40°C) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge adhesive temperature must be conditioned to 50ºF (10ºC) minimum.. 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. Unless otherwise noted 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.



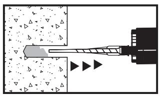
4- Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



5- Adhesives must be properly mixed to achieve published properties. For new cartridges and nozzles, 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

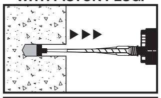


6- Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. A plastic extension tube (Cat# 08281 or 08297) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle (see reference tables for installation).

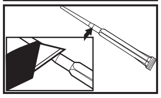
Note! Piston plugs (see hole cleaning equipment selection table) must be used with and attached to the mixing nozzle and extension tube for:

- Overhead installations and installations between horizontal and overhead in concrete with anchors larger than 1/2", #4 and 10M.
- All installations with drill hole depth > 10" (250mm)

WITH PISTON PLUG:

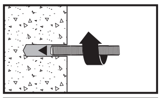


Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

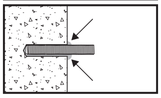


In the case that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the preforation on the front port before attachment of the tubing. Verify the mixing element is inside the nozzle before use.

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.

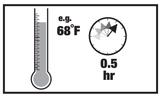


7- The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



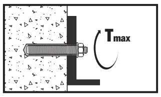
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel (working) time only.

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.

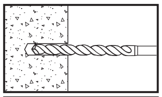


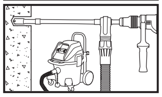
10- After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (reference installation specifications for threaded rod and reinforcing bar table) by using a calibrated torque wrench.

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

INSTALLATION INSTRUCTIONS (POST-INSTALLED REBAR)

HAMMER DRILLING





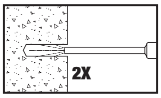
1- Drill a hole into the base material with rotary hammer drill (i.e. percussion drill) and a carbide drill bit to the size and embedment required by the selected steel hardware element (reference installation specifications for threaded rod and reinforcing bar). The tolerances of the carbide drill bits,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

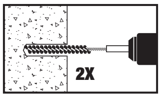
Drilling in dry base materials is recommended when using hollow drill bits (vacuum must be on).

GO TO STEP 3 FOR HOLES DRILLED WITH DUSTX+™ EXTRACTION SYSTEM (NO FURTHER HOLE CLEANING IS REQUIRED); OTHERWISE GO TO STEP 2A FOR HOLE CLEANING INSTRUCTIONS.

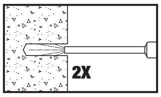
HOLE CLEANING DRY OR WET HOLES (BLOW 2X, BRUSH 2X, BLOW 2X)



2a- Starting from the bottom or back of the drilled hole, blow the hole clean a minimum of two times (2x). Use a compressed air nozzle (min. 90 psi) for all sizes of reinforcing bar (rebar).



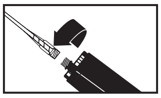
2b- Determine brush diameter (see hole cleaning accessories for post-installed rebar selection table) for the drilled hole and brush the hole by hand or attach the brush with adaptor to a rotary drill tool or battery screw gun. Brush the hole with the selected wire brush a minimum of two times (2x). 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. The wire brush diameter must be checked periodically during use. The brush should resist insertion into the drilled hole, if not, the brush is too small and must be replaced with proper brush diameter (i.e. new wire brush).



2c- Repeat Step 2a again by blowing the hole clean a minimum of two times (2x).

When finished the hole should be clean and free of dust, debris, oil or other foreign material.

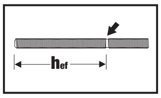
PREPARING



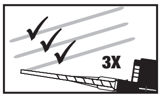
3- Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Review published gel (working) and cure times. Cartridge adhesive temperature must be between 41°F - 104°F (5°C - 40°C) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge adhesive temperature must be conditioned to 50ºF (10ºC) minimum.

Note: 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 published gel and cure times.
Attach a supplied mixing nozzle to the cartridge. Unless otherwise noted 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.



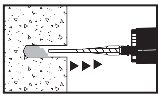
4- Prior to inserting the rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



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.

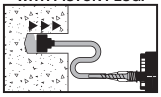
Review and note the published gel (working) and cure times prior to injection of the mixed adhesive into the cleaned anchor hole.

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. A flexible extension tube (Cat.# 08297) or flexible extension hose (Cat.# PFC1640600) or equivalent approved by DEWALT must be used with the mixing nozzle if the bottom or back of the anchor hole is not reached with the mixing nozzle (see reference tables for installation). (see hole cleaning tools and accessories for post-installed rebar table).

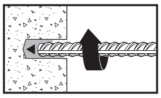
WITH PISTON PLUG:



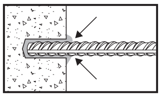
Note! Piston plugs must be used with and attached to mixing nozzle and extension tube for overhead (i.e. upwardly inclined) installations and horizontal installations with rebar sizes larger than #4 and 10M. Insert piston plug to the back of the drilled hole and inject as described in the method above. During injection of the adhesive the piston plug will be naturally extruded from the drilled hole by the adhesive pressure.

- In the case that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the preforation on the front port before attachment of the tubing. Verify the mixing element is inside the nozzle before use.

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.

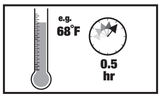


7- The reinforcing bar should be free of dirt, grease, oil or other foreign material. Push clean rebar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



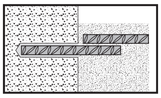
8- Ensure that the anchor element is installed to the specific embedment depth. Adhesive must completely fill the annular gap at the concrete surface. Following installation of the anchor element, remove excess adhesive. Protect the anchor element threads from fouling with adhesive. For all installations the anchor element must be restrained from movement throughout the specified curing period (as necessary) through the use of temporary wedges, external supports, or other methods. Minor adjustment to the position of the anchor element may be performed during the gel (working) time only.

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 rebar connection, new concrete can be poured (placed) to the installed rebar connection.

REFERENCE INSTALLATION TABLES

Gel (working) Time and Curing Table

Temperature of base material	Gel (working) time	Full curing time
14°F (-10°C) to 22°F (-6°C)	60 minutes	24 hours
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) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge temperature must be conditioned to 50ºF (10ºC) minimum.

Hole Cleaning Equipment Selection Table for AC200+

Rod Diameter (inch)	Rebar Size	ANSI Drill Bit Diameter (inch)	Brush Length (inches)	Steel Wire Brush[1,2] (Cat. #)	Blowout Tool	Number of cleaning actions
Solid Base Material						
3/8	-	7/16	6	PFC1671050	Compressed air nozzle only, Cat #8292 (min. 90 psi)	2x blowing 2x brushing 2x blowing
-	#3	1/2	6	PFC1671100		
1/2	10M	9/16	6	PFC1671150		
-	#4	5/8	6	PFC1671200		
5/8	-	11/16	6	PFC1671225		
-	#5 I 15M	3/4	6	PFC1671250		
3/4	#6	7/8	6	PFC1671300		
7/8	#7 I 20M	1	6	PFC1671350		
1	#8	1-1/8	6	PFC1671400		
-	#8 I 25M	1-1/4	6	PFC1671450		
1-1/4	#9	1-3/8	6	PFC1671450		
-	#10 I 30M	1-1/2	6	PFC1671500		

1. For any case, it must be possible for the steel anchor element to be inserted into the cleaned drill hole without resistance.
2. 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.
3. A brush extension (Cat. #PFC1671820) must be used with a steel wire brush for holes drilled deeper than the listed brush length.

Piston Plugs for Adhesive Anchors[1,2,3]

Plug Size (inch)	ANSI Drill Bit Diameter (inch)	Piston Plug (Cat. #)	Piston Plug
Solid Base Materials			
11/16	11/16	08258	
3/4	3/4	08259	
7/8	7/8	08300	
1	1	08301	
1-1/8	1-1/8	08303	
1-1/4	1-1/4	08307	
1-3/8	1-3/8	08305	
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. #08281 or #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.
Water-Filled Holes (flooded): cured concrete that is water-saturated and where the drilled hole contains standing water at the time of anchor installation.

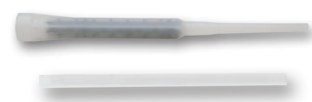
ORDERING INFORMATION

AC200+ Cartridges

Cat. No.	Description	Std. Box	Std. Ctn.	Pallet
PFC1271050	AC200+ 9.5 fl. oz. Quik-Shot	12	36	648
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
DCE560D1	Cordless 20v battery powered dispensing tool for Quik-Shot	1	-
08494	28 fl. oz. Standard all metal manual tool	1	-
08496	28 fl. oz. High performance pneumatic tool	1	-
DCE595D1	28 fl. oz. cordless 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	1
PFC1671100	Premium Wire brush for 1/2" hole	1
PFC1671150	Premium Wire brush for 9/16" ANSI hole	1
PFC1671200	Premium Wire brush for 5/8" ANSI hole	1
PFC1671225	Premium Wire brush for 11/16" ANSI hole	1
PFC1671250	Premium Wire brush for 3/4" ANSI hole	1
PFC1671300	Premium Wire brush for 7/8" ANSI hole	1
PFC1671350	Premium Wire brush for 1" ANSI hole	1
PFC1671400	Premium Wire brush for 1-1/8" ANSI hole	1
PFC1671450	Premium Wire brush for 1-1/4" I 1-3/8" ANSI hole	1
PFC1671500	Premium Wire brush for 1-1/2" ANSI hole	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

Piston Plugs for Adhesive Anchors

Cat. #	Description	ANSI Drill Bit Dia.	Std. Bag
08258	11/16" Plug	11/16"	10
08259	3/4" Plug	3/4"	10
08300	7/8" Plug	7/8"	10
08301	1" Plug	1"	10
08303	1-1/8" Plug	1-1/8"	10
08307	1-1/4" Plug	1-1/4	10
08305	1-3/8" Plug	1-3/8"	10
08309	1-1/2" Plug	1-1/2"	10

Piston Plugs for Post-Installed Rebar Connections

Cat. No.	Description	ANSI Drill Bit Dia.	Qty.
PFC1691520	3/4" Plug	3/4	10
PFC1691530	7/8" Plug	7/8	10
PFC1691540	1" Plug	1	10
PFC1691550	1-1/8" Plug	1-1/8	10
PFC1691555	1-1/4" Plug	1-1/4	10
PFC1691560	1-3/8" Plug	1-3/8	10
PFC1691570	1-1/2" Plug	1-1/2	10

SDS Max 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5806	5/8"	8"	13-1/2"
DW5809	5/8"	16"	21-1/2"
DW5807	5/8"	31"	36"
DW5808	11/16"	16"	21-1/2"
DW5810	3/4"	8"	13-1/2"
DW5812	3/4"	16"	21-1/2"
DW5813	3/4"	31"	36"
DW5814	13/16"	16"	21-1/2"
DW5815	7/8"	8"	13-1/2"
DW5816	7/8"	16"	21-1/2"
DW5851	7/8"	31"	36"
DW5817	27/32"	16"	21-1/2"
DW5818	1"	8"	13-1/2"
DW5819	1"	16"	22-1/2"
DW5852	1"	24"	29"
DW5820	1"	31"	36"
DW5821	1-1/8"	10"	15"
DW5822	1-1/8"	18"	22-1/2"
DW5853	1-1/8"	24"	29"
DW5854	1-1/8"	31"	36"
DW5824	1-1/4"	10"	15"
DW5825	1-1/4"	18"	22-1/2"

SDS+ Full Head Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5502	3/16"	2"	4-1/2"
DW5503	3/16"	4"	6-1/2"
DW5504	3/16"	5"	8-1/2"
DW5506	3/16"	10"	12"
DW5512	7/32"	8"	10"
DW5517	1/4"	4"	6"
DW5518	1/4"	6"	8-1/2"
DW55200	1/4"	10"	12"
DW5521	1/4"	12"	14"
DW5524	5/16"	4"	6"
DW5526	5916"	10"	12"
DW5527	3/8"	4"	6-1/2"
DW5529	3/8"	8"	10"
DW55300	3/8"	10"	12"
DW5531	3/8"	16"	18"
DW5537	1/2"	4"	6"
DW5538	1/2"	8"	10-1/2"
DW5539	1/2"	10"	12"
DW5540	1/2"	16"	18"

SDS+ 4-Cutter Carbide Drill Bits

Cat. No.	Diameter	Usable Length	Overall Length
DW5471	5/8"	8"	10"
DW5472	5/8"	16"	18"
DW5474	3/4"	8"	10"
DW5475	3/4"	16"	18"
DW5477	7/8"	8"	10"
DW5478	7/8"	16"	18"
DW5479	1"	8"	10"
DW5480	1"	16"	18"
DW5481	1-1/8"	8"	10"
DW5482	1-1/8"	6"	18"

Dust Extraction

Cat. No.	Description
DWV012	10 Gallon Wet/Dry Hepa/Rrp Dust Extractor DWV9402 Fleece bag (5 pack) for DEWALT dust extractors DWV9316 Replacement Anti-Static Hose DWV9320 Replacement HEPA Filter Set (Type 1)
DWH050K	Dust Extraction with two interchangeable drilling heads
DCB1800M3T1	1800 Watt Portable Power Station & Parallel Battery Charger with 3 20V Max* 5Ah Batteries and 1 60V Max* Flexvolt® Battery

Hollow Drill Bits

	Cat. No.	Diameter	Overall Length	Usable Length	Recommended Hammer
SDS+	DWA54012	1/2"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54916	9/16"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54058	5/8"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
	DWA54034	3/4"	14-1/2"	9-3/4"	DCH133 / DCH273 / DCH293
SDS Max	DWA58058	5/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58958	5/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58116	11/16"	24-3/4"	15-3/4"	DCH481 / D25603K
	DWA58034	3/4"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58934	3/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58078	7/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58001	1"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58901	1"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58118	1-1/8"	23-5/8"	15-3/4"	DCH481 / D25603K
	DWA58918	1-1/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58114	1-1/4"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58138	1-3/8"	47-1/4"	39-3/8"	DCH481 / D25603K
	DWA58112	1-1/2"	47-1/4"	39-3/8"	DCH481 / D25603K

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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

EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS IN CRACKED AND UNCRACKED CONCRETE (DEWALT)

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Section: 03 16 00—Concrete Anchors

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Section: 05 05 19—Post-Installed Concrete Anchors

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1.0 EVALUATION SCOPE

Compliance with the following codes:

- 2018, 2015, 2012 and 2009 *International Building Code®* (IBC)
- 2018, 2015, 2012 and 2009 *International Residential Code®* (IRC)

For evaluation for compliance with the *National Building Code of Canada®* (NBCC), see listing report ELC-4027.

For evaluation for compliance with codes adopted by Los Angeles Department of Building and Safety (LADBS) see ESR-4027 LABC and LARC Supplement.

Property evaluated:

Structural

2.0 USES

The AC200+ Adhesive Anchor System is used as anchorage and the Post-Installed Reinforcing Bar Connections are used as reinforcing bar connections (for development length and splice length) 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) to resist static, wind or earthquake (IBC Seismic Design Categories A through F) tension and shear loads.

The anchor system complies with anchors as described in Section 1901.3 of the 2018 and 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.

Post-installed reinforcing bar connections are an alternative to cast-in-place reinforcing bar connection governed by ACI 318 and IBC Chapter 19.

3.0 DESCRIPTION

3.1 General:

The AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections are comprised of AC200+ two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment, adhesive injection accessories, and steel anchor elements, which are continuously threaded steel rods (to form the AC200+ Adhesive Anchor System) or deformed steel reinforcing bars (to form the AC200+ Post-Installed Reinforcing Bar Connections).

AC200+ adhesive may be used with continuously threaded steel rods or deformed steel reinforcing bars. The primary components of the AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections, including the AC200+ adhesive cartridge, static mixing nozzle, and steel anchor elements, are shown in Figures 1 and 4 of this report. The manufacturer's published installation instructions (MPII), included with each adhesive unit package, are shown in Figure 5 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 9.5-ounce (280 mL) and 28-ounce (825 mL) cartridges.

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: Standard hole cleaning equipment and dust extraction system equipment (i.e. suction, vacuum) are available from the report holder.

3.2.2.1 Standard Hole Cleaning: Standard hole cleaning equipment used after drilling is comprised of steel wire brushes supplied by DEWALT and compressed air nozzle (applicable for both post-installed adhesive anchor system and post-installed reinforcing bar connection system). Standard hole cleaning equipment is shown in Figure 5.

3.2.2.2 DustX+™ Extraction System: The DustX+™ extraction system automatically cleans the holes during drilling using hollow drill bits with a carbide head meeting the requirements of ANSI B212.15 and a DEWALT DWV012 / DWV902M vacuum equipped with an automatic filter cleaning system or equivalent approved by DEWALT (applicable for post-installed adhesive anchors and post-installed reinforcing bar connections). After drilling with the DustX+ system, no further hole cleaning is required. See Figure 2 for an illustration of the DustX+™ extraction system.

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 for use in Post-Installed Anchor Applications: Threaded steel rods must be clean and continuously threaded (all-thread) in diameters described in Tables 4 and 10 and Figure 5 of this report. The embedded portions of the threaded rods 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. 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 for use in Post-Installed Anchor Applications: Steel reinforcing bars must be deformed reinforcing bars as described in Table 3 of this report. Tables 7 and 13, and Figure 5 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 Steel Reinforcing Bars for Use in Post-Installed Reinforcing Bar Connections: Steel reinforcing bars used in post-installed reinforcing bar connections must be deformed reinforcing bars (rebars) as depicted in Figure 3. Tables 17 and 18, and Figure 5 summarize reinforcing bar size ranges. The embedded portions of reinforcing bars must be 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 Section 26.6.3.1(a) of ACI 318-14 or Section 7.3.2 of ACI 318-11, 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.

3.2.4.4 Ductility: In accordance with ACI 318-14 Section 2.3 or ACI 318-11 Appendix D Section 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.

3.2.4.5 Concrete: Normalweight 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 of Post-Installed Anchors:

4.1.1 General: The design strength of anchors under the 2018 and 2015 IBC, as well as the 2018 and 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 Table 4 through Table 16 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 (τk,cr, τk,uncr) are a function of concrete compressive strength, concrete state (cracked, uncracked), concrete type (normalweight, lightweight) and installation conditions (dry concrete, water-saturated concrete, water-filled holes). Drilling method is hammer-drill (i.e., rotary impact drills or rock drills with a carbide drill bit [including hollow drill bits]). Special inspection level is qualified as periodic for all anchors except as shown in Section 4.4 of this report. The selection of continuous special inspection level, with an onsite proof loading program, does not provide a benefit of a lower anchor category or an increase in the associated strength reduction factors for design. The following table summarizes the requirements:

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

Strength reduction factors for determination of the bond strength are given in Tables 6, 9, 12, 15 and 16 of this report. 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, 15 and 16 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, ϕ_{ws} or ϕ_{wf}, 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 the following anchor sizes with 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 15M to 25M	1.75 in. (45 mm)	5d	$0.45 \cdot T_{max}$
$1^1/_4$ in. #9 to #10 M27 to M30 ø28 to ø32 30M	2.75 in. (70 mm)		

For values of T_{max}, see Figure 5 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 where

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

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

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 Strength Design of Post-Installed Reinforcing Bars:

4.2.1 General: The design of straight post-installed deformed reinforcing bars must be determined in accordance with ACI 318 rules for cast-in place reinforcing bar development and splices and this report.

Examples of typical applications for the use of post-installed reinforcing bars are illustrated in Figure 3 of this report.

4.2.2 Determination of bar development length l_d: Values of l_d must be determined in accordance with the ACI 318 development and splice length requirements for straight cast-in place reinforcing bars.

Exceptions:

1. For uncoated and zinc-coated (galvanized) post-installed reinforcing bars, the factor Ψ_e shall be taken as 1.0. For all other cases, the requirements in ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (b) shall apply.

2. When using alternate methods to calculate the development length (e.g., anchor theory), the applicable factors for post-installed anchors generally apply.

4.2.3 Minimum Member Thickness, h_{min}, Minimum Concrete Cover, $c_{c,min}$, Minimum Concrete Edge Distance, $c_{b,min}$, Minimum Spacing, $s_{b,min}$: For post-installed reinforcing bars, there is no limit on the minimum member thickness. In general, all requirements on concrete cover and spacing applicable to straight cast-in bars designed in accordance with ACI 318 shall be maintained.

For post-installed reinforcing bars installed at embedment depths, h_{ef}, larger than 20d (h_{ef} > 20d), the minimum concrete cover shall be as follows:

REBAR SIZE	MINIMUM CONCRETE COVER, $c_{c,min}$
d_b ≤ No. 6 (16mm)	$1^3/_{16}$ in.(30mm)
No. 6 < d_b ≤ No.10 (16mm < d_b ≤ 32mm)	$1^9/_{16}$ in. (40mm)

The following requirements apply for minimum concrete edge and spacing for h_{ef} > 20d:

Required minimum edge distance for post-installed reinforcing bars (measured from the center of the bar):

$c_{b,min} = d_0/2 + c_{c,min}$

Required minimum center-to-center spacing between post-installed bars:

$s_{b,min} = d_0 + c_{c,min}$

Required minimum center-to-center spacing from existing (parallel) reinforcing:

$s_{b,min} = d_b/2$ *(existing reinforcing)* $+ d_0/2 + c_{c,min}$

4.2.4 Design Strength in Seismic Design Categories C, D, E and F: In structures assigned to Seismic Category C, D, E or F under the IBC or IRC, design of straight post-installed reinforcing bars must take into account the provisions of ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable.

4.3 Installation:

Installation parameters are illustrated in Figure 5 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 and post-installed rebar locations must comply with this report and the plans and specifications approved by the code official. Installation of the AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 5 of this report.

The adhesive anchor system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly included and horizontal orientation applications are to be installed using piston plugs for the $^5/_8$-inch through $1^1/_4$-inch (M16 through M30) diameter threaded steel rods and No. 5 through No. 10 (14 mm through 32 mm) steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by DEWALT as described in Figure 5 in this report. Upwardly included and horizontal orientation installation for the $^3/_8$-inch and $^1/_2$-inch (M10 and M12) diameter threaded steel rods, and No. 3 and No. 4 (10 mm and 12 mm) steel reinforcing bars may be injected directly to the end of the hole using a mixing nozzle with a hole depth $h_0 \le 10$" (250 mm).

Installation of anchors in horizontal or upwardly inclined orientations shall be fully restrained from movement throughout the specified curing period through the use of temporary wedges, external supports, or other methods. Where temporary restraint devices are used, their use shall not result in impairment of the anchor shear resistance

4.4 Special Inspection:

Periodic special inspection must be performed where required in accordance with Section 1705.1.1 and Table 1705.3 of the 2018, 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 or post-installed reinforcing bar installation to verify the anchor or post-installed reinforcing bar type and dimensions, adhesive expiration date, concrete type, concrete compressive strength, hole dimensions, hole cleaning procedures, spacing, edge distances, concrete thickness, anchor or post-installed reinforcing bar 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 or post-installed reinforcing bar by construction personnel on site. Subsequent installations of the same anchor or post-installed reinforcing bar 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 or post-installed reinforcing bar 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 or post-installed reinforcing bars 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.

4.5 Compliance with NSF/ANSI Standard 61:

The AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections comply with the requirements of NSF/ANSI Standard 61, as referenced in Section 605 of the 2018, 2015, 2012 and 2009 *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 and Post-Installed Reinforcing Bar Connections 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 AC200+ adhesive anchors and post-installed reinforcing bars must be installed in accordance with the manufacturer's printed installation instructions included with each cartridge and provided in Figure 5 of this report.

5.2 The anchors and post-installed reinforcing bars described in this report must be installed in cracked and uncracked normalweight 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 concrete shall have attained its minimum design strength prior to installation of the anchors and post-installed reinforcing bars.

5.4 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 used as anchorage in cracked concrete only.

5.5 Anchors and post-installed reinforcing bars must be installed in concrete base materials in holes predrilled in accordance with the instructions provided in Figure 5 of this report.

5.6 Loads applied to the anchors and post-installed reinforcing bars must be adjusted in accordance with Section 1605.2 of the IBC for strength design.

5.7 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 and post-installed reinforcing bars must comply with section 4.2.4 of this report.

5.8 AC200+ adhesive anchors and post-installed reinforcing bars are permitted to be installed in concrete that is cracked or that may be expected to crack during the service life of the anchors and post-installed reinforcing bars, subject to the conditions of this report.

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

5.10 Post-installed reinforcing bar development and splice lengths are established in accordance with Section 4.2 of this report.

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

5.12 Post-installed reinforcing bar spacing, minimum member thickness, and cover distance must be in accordance with the provisions of ACI 318 for cast-in place bars and Section 4.2.3 of this report.

5.13 Prior to installation of anchors and post-installed reinforcing bars, 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.

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

- Anchors and post-installed reinforcing bars are used to resist wind or seismic forces only.
- Anchors and post-installed reinforcing bars 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 and post-installed reinforcing bars are used to support non-structural elements.

5.15 Since an ICC-ES acceptance criteria for evaluating data to determine the performance of adhesive anchors and post-installed reinforcing bars 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.

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

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

5.18 Steel anchoring elements 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.

5.19 Periodic special inspection must be provided in accordance with Section 4.4 in this report. Continuous special inspection for anchors and post-installed reinforcing bars installed in horizontal or upwardly inclined orientations to resist sustained tension loads must be provided in accordance with Section 4.4 of this report.

5.20 Installation of anchors and post-installed reinforcing bars 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.

5.21 AC200+ Adhesive Anchors and Post-Installed Reinforcing Bars may be used to resist tension and shear forces in wall (horizontal) and for overhead (upwardly inclined) installations into concrete with a temperature between 23°F and 104°F (-5°C and 40°C); and between 14°F and 104°F (-10°C and 40°C) for floor (downward) installations.

5.22 Anchors and post-installed reinforcing bars shall not be used for installations 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.

5.23 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 October 2017 (Editorially revised March 2018), 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, tests for seismic tension and shear, and tests for post-installed reinforcing bar connections.

7.0 IDENTIFICATION

7.1 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 must be standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.

7.2 The report holder's contact information is the following:

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

TABLE 1A—DESIGN USE AND REPORT TABLE INDEX FOR POST-INSTALLED ADHESIVE ANCHORS

POST-INSTALLED ADHESIVE ANCHORS – TREADED RODS AND REINFORCING BARS						
DESIGN STRENGTH[1]		THREADED ROD (FRACTIONAL)	DEFORMED REINFORCING BAR (FRACTIONAL)	THREADED ROD (METRIC)	DEFORMED REINFORCING BAR (METRIC)	
					EU	CA
Steel	N_{sa}, V_{sa}	Table 4	Table 7	Table 10	Table 13	Table 13
Concrete	N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	Table 8	Table 11	Table 14	Table 14
Bond[2]	N_a, N_{ag}	Table 6	Table 9	Table 12	Table 15	Table 16

Concrete Type	Concrete State	Threaded Rod Diameter (inch)	Reinforcing Bar Size (No.)	Drilling Method[3]	Minimum and Maximum Embedment	Seismic Design Categories[4]
Normal-weight and lightweight	Cracked	$^3/_8$, $^1/_2$, $^5/_8$, $^3/_4$, $^7/_8$, 1, $1^1/_4$	3, 4, 5, 6, 7, 8, 9, 10	Hammer-drill	Table 6	A through F
	Uncracked	$^3/_8$, $^1/_2$, $^5/_8$, $^3/_4$, $^7/_8$, 1, $1^1/_4$	3, 4, 5, 6, 7, 8, 9, 10	Hammer-drill	Table 9	A and B

Concrete Type	Concrete State	Threaded Rod Diameter (mm)	Reinforcing Bar Size, EU and CA (Ø and M)	Drilling Method[3]	Minimum and Maximum Embedment	Seismic Design Categories[4]
Normal-weight and lightweight	Cracked	10, 12, 16, 20, 24, 27, 30	10, 12, 14, 16, 20, 25, 28, 32	Hammer-drill	Table 15	A through F
			10, 15, 20, 25, 30		Table 16	
	Uncracked	10, 12, 16, 20, 24, 27, 30	10, 12, 14, 16, 20, 25, 28, 32	Hammer-drill	Table 15	A and B
			10, 15, 20, 25, 30		Table 16	

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 318-11 D.4.1.1, as applicable for post-installed adhesive anchors. The controlling strength is decisive from all appropriate failure modes (i.e. steel, concrete, bond) and design assumptions.
[2]See Section 4.1.4 of this report for bond strength determination of post-installed adhesive anchors.
[3]Hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow drill bits).
[4]See Section 4.1.11 for requirements for seismic design of post-installed adhesive anchors, where applicable.

TABLE 1B—DESIGN USE AND REPORT TABLE INDEX FOR POST-INSTALLED REINFORCING BAR CONNECTIONS[1]

POST-INSTALLED REINFORCING BARS (Table 17)			
Concrete Type	Reinforcing Bar Size	Drilling Method[2]	Seismic Design Categories[3]
Normal-weight and lightweight	#3, #4, #5, #6, #7, #8, #9, #10	Hammer-drill	A through F
	Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32	Hammer-drill	A through F
	10M, 15M, 20M, 25M, 30M	Hammer-drill	A through F

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

[1]Determination of development length for post-installed reinforcing bar connections; see Section 4.2 of this report for requirements.
[2]Hammer-drill, i.e. rotary impact drills or rock drills with a carbide drill bit (including hollow drill bits).
[3]See Section 4.2.4 for requirements for seismic design of post-installed reinforcing bar connections, where applicable.

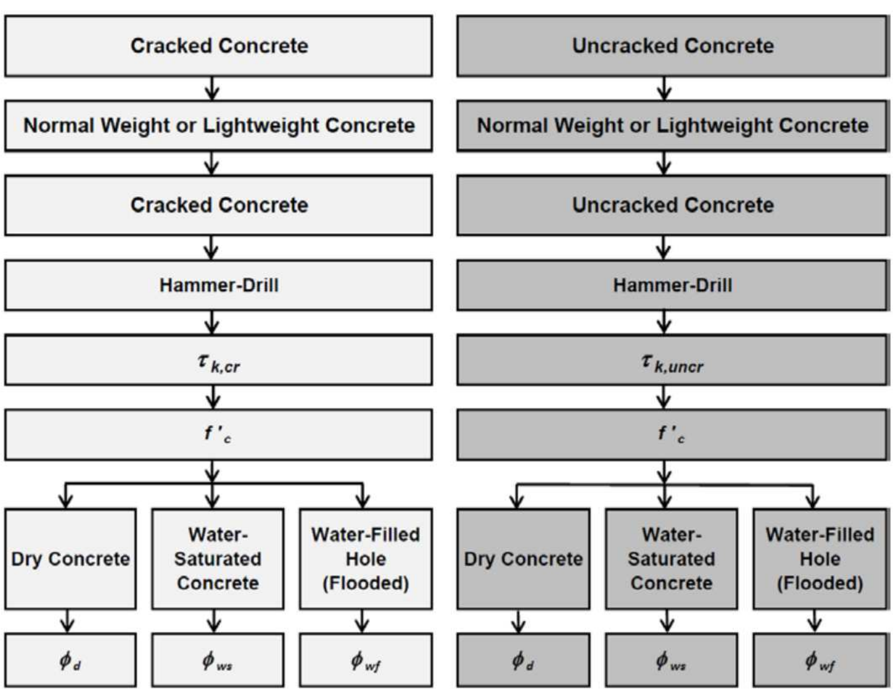


FIGURE A—FLOWCHART FOR THE ESTABLISHMENT OF DESIGN BOND STRENGTH FOR POST-INSTALLED ADHESIVE ANCHORS

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

	THREADED ROD SPECIFICATION		MIN. 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.
[14]Minimum percent reduction of area not reported in the referenced standard.

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)
CAN/CSA-G30.18[6] Grade 400	MPa (psi)	540 (78,300)	400 (58,000)

[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
[6]Billet-Steel Bars for Concrete Reinforcement.

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)	$1^3/_4$ (45)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	$3^1/_4$ (82)
					For edge distances to $1^3/_4$-inch (44 mm) See Section 4.1.9 of this report.				For edge distances to $2^3/_4$-inch (70 mm) see Section 4.1.9.
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 only)	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 5, 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						
Water-filled holes	Anchor category	–		3						
	Strength reduction factor	ϕ_{wf}		0.45						
Reduction factor for seismic tension		$\alpha_{N,seis}$	-	0.95						

[1]Bond strength 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.

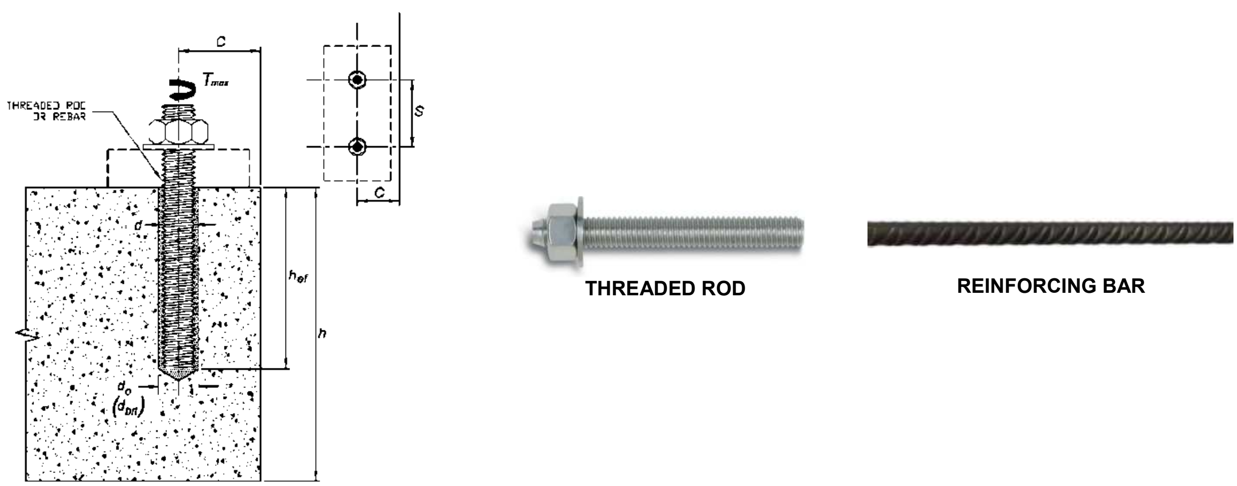


FIGURE 1—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

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)	$1^{3}/_{4}$ (45)	2 (51)	$2^{3}/_{8}$ (60)	$2^{1}/_{2}$ (64)	$2^{3}/_{4}$ (70)	3 (76)	$3^{1}/_{4}$ (82)
					For edge distances to $1^{3}/_{4}$-inch (45 mm) See Section 4.1.9 of this report.					For edge distances to $2^{3}/_{4}$-inch (70 mm) see Section 4.1.9.
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 only)	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 5, 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_{ws}	-	0.55							
Water-filled holes	Anchor Category	–		3							
	Strength reduction factor	ϕ_{wf}		0.45							
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 edge distances to 45 mm ($1^3/_4$-inch) see Section 4.1.9 of this report				For edge distances to 70 mm ($2^3/_4$-inch) see Section 4.1.9.
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 only)	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 5, 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						
Water-filled holes	Anchor category	–		3						
	Strength reduction factor	ϕ_{wf}		0.45						
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 COMMON METRIC EU AND METRIC CANADIAN REINFORCING BARS[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (EU)							
				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							

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (CA)				
				10 M	15 M	20 M	25 M	30 M
Reinforcing bar O.D.		d	mm (in.)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (in.²)	100.3 (0.155)	201.1 (0.312)	298.6 (0.463)	498.8 (0.773)	702.2 (1.088)
CAN/CSA-G30.18 Grade 400	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	54.0 (12,175)	108.5 (24.410)	161.5 (36,255)	270.0 (60,550)	380.0 (85,240)
		V_{sa}	kN (lb)	32.5 (7,305)	65.0 (14,645)	97.0 (21,755)	161.5 (36,330)	227.5 (51.145)
	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 COMMON EU METRIC AND CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size (EU and CA)												
			ø 10	**10 M**	**ø 12**	**ø 14**	**15 M**	**ø 16**	**ø 20**	**20 M**	**ø 25**	**25 M**	**ø 28**	**30 M**	**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)	55 (2 1/8)	60 (2 3/8)	70 (2 3/4)	80 (3 1/8)	75 (3)	95 (3 3/4)	100 (3 7/8)	120 (4 5/8)	125 (5.0)	130 (5 1/4)	150 (5 7/8)	
Min. edge spacing	c_{min}	mm (in.)	40 (1 5/8)	40 (1 3/4)	45 (1 3/4)	50 (2)	50 (2)		60 (2 3/8)	60 (2 3/8)	70 (2 3/4)	75 (3)		85 (3 1/8)	
						For edge distances to 45 mm (1 3/4-inch) see Section 4.1.9 of this report.							For edge distances to 70 mm (2 3/4-inch) see Section 4.1.9		
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 only)	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 5, 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 COMMON EU METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (EU)							
				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							
Water-filled holes	Anchor category	–	-	3							
	Strength reduction factor	ϕ_{wf}	-	0.45							
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.

TABLE 16—BOND STRENGTH DESIGN INFORMATION COMMON CANADIAN METRIC REINFORCING BARS IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size (CA)				
				10 M	15 M	20 M	25 M	30 M
Minimum embedment		$h_{ef,min}$	mm (in.)	70 (2.8)	80 (3.1)	90 (3.5)	100 (3.9)	120 (4.7)
Maximum embedment		$h_{ef,max}$	mm (in.)	225 (8.9)	320 (12.6)	390 (15.4)	505 (19.8)	600 (23.5)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	14.5 (2,110)	13.2 (1,916)	12.5 (1,814)	11.7 (1,690)	11.1 (1,612)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	7.2 (1,041)	7.5 (1,087)	7.2 (1,045)	6.7 (965)	6.3 (915)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	12.7 (1,836)	11.5 (1,667)	10.9 (1,578)	10.1 (1,470)	9.7 (1,402)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	6.2 (906)	6.5 (946)	6.3 (909)	5.8 (840)	5.5 (796)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete	$\tau_{k,uncr}$	N/mm² (psi)	9.1 (1,633)	8.3 (1,201)	7.8 (1,137)	7.3 (1,059)	7.0 (1,010)
	Characteristic bond strength in cracked concrete	$\tau_{k,cr}$	N/mm² (psi)	5.6 (806)	5.8 (841)	5.6 (809)	5.2 (747)	4.9 (708)
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				
Water-filled holes	Anchor category	–	-	3				
	Strength reduction factor	ϕ_{wf}	-	0.45				
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.

The DEWALT drilling systems shown below collect and remove dust with a HEPA dust extractor during the hole drilling operation in dry base materials using hammer-drills (see step 1 of the manufacturer's published installation instructions).

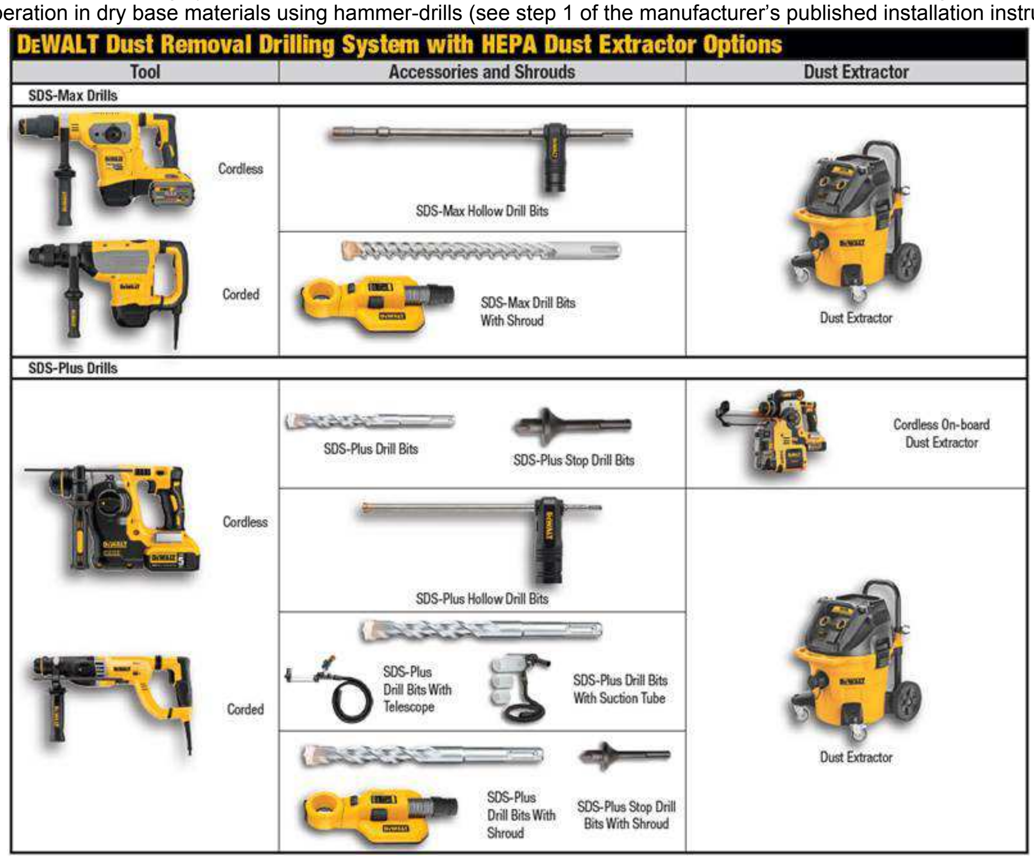


FIGURE 2—EXAMPLES DEWALT DUST REMOVAL DRILLING SYSTEMS WITH HEPA DUST EXTRACTORS FOR ILLUSTRATION

TABLE 17—DEVELOPMENT LENGTHS FOR COMMON REINFORCING BAR CONNECTIONS PROVIDED FOR ILLUSTRATION[1,2,3,7]

FRACTIONAL REINFORCING BARS

DESIGN INFORMATION	SYMBOL	REFERENCE STANDARD	UNITS	NOMINAL REBAR SIZE (US)							
				#3	#4	#5	#6	#7	#8	#9	#10
Nominal rebar diameter	d_b	ASTM A615/A706, Grade 60 (f_y = **60 ksi**)	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)	1.128 (28.6)	1.270 (32.3)
Nominal rebar area	A_b		in^2 (mm^2)	0.11 (71)	0.20 (127)	0.31 (198)	0.44 (285)	0.60 (388)	0.79 (507)	1.00 (645)	1.27 (817)
Development length in f'_c = **2,500 psi** concrete[4,5]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	in. (mm)	12.0 (305)	14.4 (366)	18.0 (457)	21.6 (549)	31.5 (800)	36.0 (914)	40.6 (1031)	45.7 (1161)
Development length in f'_c = **3,000 psi** concrete[4,5]			in. (mm)	12.0 (305)	13.1 (334)	16.4 (417)	19.7 (501)	28.8 (730)	32.9 (835)	37.1 (942)	41.7 (1060)
Development length in f'_c = **4,000 psi** concrete[4,5]			in. (mm)	12.0 (305)	12.0 (305)	14.2 (361)	17.1 (434)	24.9 (633)	28.5 (723)	32.1 (815)	36.2 (920)
Development length in f'_c = **6,000 psi** concrete[4,5]			in. (mm)	12.0 (305)	12.0 (305)	12.0 (305)	13.9 (354)	20.3 (516)	23.2 (590)	26.2 (666)	29.5 (750)
Development length in f'_c = **8,000 psi** concrete[4,5]			in. (mm)	12.0 (305)	12.0 (305)	12.0 (305)	12.1 (307)	17.6 (443)	20.1 (511)	22.7 (577)	25.6 (649)

METRIC REINFORCING BARS

DESIGN INFORMATION	SYMBOL	REFERENCE STANDARD	UNITS	NOMINAL REBAR SIZE (EU)							
				Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal rebar diameter	d_b	DIN 488, BSt 500 (BS 4449: 2005) (f_y = **72.5 ksi**)	mm (in)	10 (0.394)	12 (0.472)	14.0 (0.551)	16 (0.630)	20 (0.787)	25 (0.984)	28 (1.102)	32 (1.260)
Nominal rebar area	A_b		mm^2 (in^2)	78.5 (0.12)	113 (0.18)	154 (0.23)	201 (0.31)	314 (0.49)	491 (0.76)	616 (0.96)	804 (1.25)
Development length in f'_c = **2,500 psi** concrete[4,6]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	mm (in)	348 (13.7)	417 (16.4)	487 (19.2)	556 (21.9)	870 (34.2)	1087 (42.8)	1217 (47.9)	1392 (54.8)
Development length in f'_c = **3,000 psi** concrete[4,6]			mm (in)	318 (12.5)	381 (15.0)	445 (17.5)	508 (20.0)	794 (31.3)	992 (39.1)	1112 (43.8)	1271 (50.0)
Development length in f'_c = **4,000 psi** concrete[4,6]			mm (in)	305 (12.0)	330 (13.0)	385 (15.2)	439 (17.3)	688 (27.1)	859 (33.8)	963 (37.9)	1100 (43.3)
Development length in f'_c = **6,000 psi** concrete[4,6]			mm (in)	305 (12.0)	305 (12.0)	314 (12.4)	359 (14.2)	562 (22.1)	702 (27.6)	786 (30.9)	899 (35.4)
Development length in f'_c = **8,000 psi** concrete[4,6]			mm (in)	305 (12.0)	305 (12.0)	305 (12.0)	311 (12.3)	486 (29.1)	608 (23.9)	681 (26.8)	778 (30.6)

DESIGN INFORMATION	SYMBOL	REFERENCE STANDARD	UNITS	NOMINAL REBAR SIZE (CA)				
				10M	15M	20M	25M	30M
Nominal rebar diameter	d_b	CAN/CSA G30.18, Grade 400 (f_y = **58 ksi**)	mm (in)	11.3 (0.445)	16.0 (0.630)	19.5 (0.768)	25.2 (0.992)	29.9 (1.177)
Nominal rebar area	A_b		mm^2 (in^2)	100 (0.16)	200 (0.31)	300 (0.46)	500 (0.77)	700 (1.09)
Development length in f'_c = **2,500 psi** concrete[4,6]	l_d	ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3 as applicable	mm (in)	315 (12.4)	445 (17.5)	678 (26.7)	876 (34.5)	1041 (41.0)
Development length in f'_c = **3,000 psi** concrete[4,6]			mm (in)	305 (12.0)	407 (16.0)	620 (24.4)	800 (31.5)	950 (37.4)
Development length in f'_c = **4,000** psi concrete[4,6]			mm (in)	305 (12.0)	353 (13.9)	536 (21.1)	693 (27.3)	823 (32.4)
Development length in f'_c = **6,000 psi** concrete[4,6]			mm (in)	305 (12.0)	305 (12.0)	438 (17.3)	566 (22.3)	672 (26.4)
Development length in f'_c = **8,000 psi** concrete[4,6]			mm (in)	305 (12.0)	305 (12.0)	379 (14.9)	490 (19.3)	582 (22.9)

For **SI**: 1 inch ≡ 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006897 MPa; for **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Calculated development lengths in accordance with Section 4.2.2 of this report and ACI 318-14 25.4.2.3 or ACI 318-11 12.2.3, as applicable, for reinforcing bars are valid for static, wind, and earthquake loads.

[2]Calculated development lengths in SDC C through F must comply with ACI 318-14 Chapter 18 or ACI 318-11 Chapter 21, as applicable, and Section 4.2.4 of this report.

[3]For Class B splices, minimum length of lap for tension lap splices is $1.3l_d$ in accordance with ACI 318-14 25.5.2 and ACI 318-11 12.15.1, as applicable.

[4]For lightweight concrete, λ = 0.75; therefore multiply development lengths by 1.33 (increase development length by 33 percent), unless the provisions of ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4 (d), as applicable, are met to permit alternate values of λ (e.g for sand-lightweight concrete, λ = 0.85; therefore multiply development lengths by 1.18). Refer to ACI 318-14 19.2.4 or ACI 318-11 8.6.1, as applicable.

[5] $\left(\frac{c_b+K_{tr}}{d_b}\right) = 2.5$, $\psi_t=1.0$, $\psi_e=1.0$, $\psi_s=0.8$ for $d_b \leq$ #6,1.0 for $d_b >$ #6. Refer to ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.

[6] $\left(\frac{c_b+K_{tr}}{d_b}\right) = 2.5$, $\psi_t=1.0$, $\psi_e=1.0$, $\psi_s=0.8$ for $d_b \leq 19$ mm, 1.0 for $d_b > 19$ mm. Refer to ACI 318-14 25.4.2.4 or ACI 318-11 12.2.4, as applicable.

[7]Calculations may be performed for other steel grades and concrete compressive strengths per ACI 318-14 Chapter 25 or ACI 318-11 Chapter 12, as applicable.

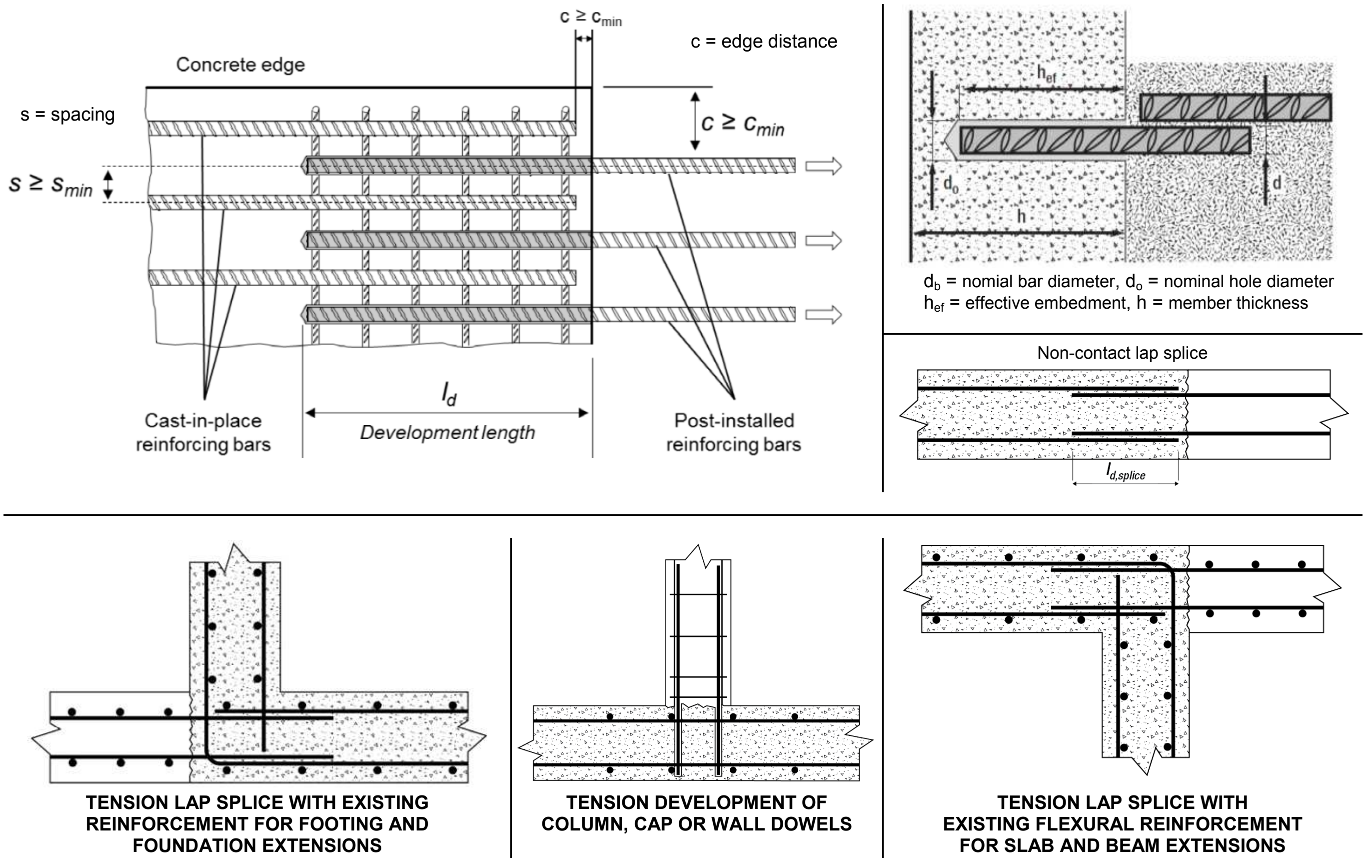


FIGURE 3—INSTALLATION DETAIL FOR POST-INSTALLED REINFORCING BAR CONNECTIONS (Top Pictures), EXAMPLES OF DEVELOPMENT LENGTH APPLICATION DETAILS FOR POST-INSTALLED REINFORCING BAR CONNECTIONS PROVIDED FOR ILLUSTRATION (Bottom Pictures)

TABLE 18—INSTALLATION PARAMETERS FOR COMMON POST-INSTALLED REINFORCING BAR CONNECTIONS[3]

FRACTIONAL REINFORCING BARS										
PARAMETER	SYMBOL	UNITS	NOMINAL REBAR SIZE (US)							
			#3	#4	#5	#6	#7	#8	#9	#10
Nominal hole diameter[1]	d_o	in.	1/2	5/8	3/4	7/8	1	1 1/8	1 3/8	1 1/2
Effective embedment[2]	h_{ef}	in.	2 3/8 to 22 1/2	2 3/4 to 30	3 1/8 to 37 1/2	3 1/2 to 45	3 1/2 to 52 1/2	4 to 60	4 1/2 to 67 1/2	5 to 75

METRIC REINFORCING BARS										
PARAMETER	SYMBOL	UNITS	NOMINAL REBAR SIZE (EU)							
			Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal hole diameter[1]	d_o	mm	14	16	18	20	25	32	35	40
Effective embedment[2]	h_{ef}	mm	60 to 600	70 to 720	75 to 840	90 to 1200	95 to 1440	100 to 1500	112 to 1680	128 to 1920

PARAMETER	SYMBOL	UNITS	NOMINAL REBAR SIZE (CA)				
			10M	15M	20M	25M	30M
Nominal hole diameter[1]	d_o	in.	9/16	3/4	1	1 1/4	1 1/2
Effective embedment[2]	h_{ef}	mm	70 to 680	80 to 960	90 to 1170	100 to 1510	120 to 1795

For **SI**: 1 inch ≡ 25.4 mm,; for **pound-inch** units: 1 mm = 0.03937 inches.

[1]For any case, it must be possible for the reinforcing bar (rebar) to be inserted into the cleaned drill hole without resistance.
[2]Consideration should be given regarding the commercial availability of carbide drill bits (including hollow drill bits) and diamond core drill bits, as applicable, with lengths necessary to achieve the effective embedment for post-installed reinforcing bar connections.
[3]The DEWALT DustX+ extraction system can be used to automatically clean holes drilled in concrete with a hammer-drill; drilling in dry concrete is required.

FIGURE 4—AC200+ ADHESIVE ANCHOR SYSTEM INCLUDING TYPICAL STEEL ANCHOR ELEMENTS

DEWALT AC200+ Instruction Card

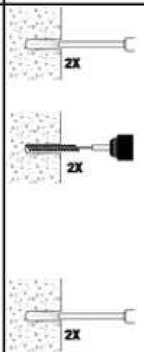
Follow steps #1 through #10 for recommended installation

1. Setting instructions for Adhesive Anchors and Post-installed Rebar Connections in solid base material

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 (see Table III). Tolerances of carbide drill bits including hollow drill bits must meet ANSI Standard B212.15
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal (*see dust extraction equipment by DEWALT to minimize dust emissions*).
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).
→ ***Go to Step 3 for holes drilled with DustX+™ extraction system (no further hole cleaning is required). Otherwise go to Step 2a for hole cleaning instructions.***

Hole cleaning

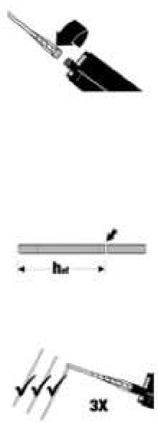


2a Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times. If the back of the drilled hole is not reached an extension shall be used with the mixing nozzle.

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 (see Table 3a or 3b as applicable). 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

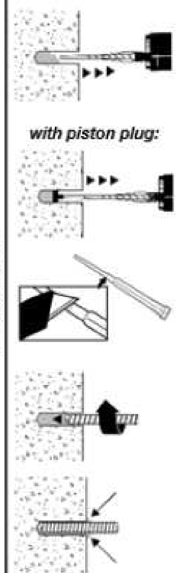


3 Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. Cartridge adhesive temperature must be between 41°F - 104°F (5°C - 40°C) when in use; except for installations in base material temperatures between 14ºF and 23ºF (-10ºC and -5ºC) the cartridge adhesive temperature must be conditioned to 50ºF (10ºC) minimum. 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; installations installations into concrete with a temperature between 14°F and 22°F (-10°C and -6°C) are for downward installations only. 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. Consideration should be given to the reduced gel (working) time of the adhesive in warm temperatures.

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 must be used with the mixing nozzle if the bottom or back of the hole is not reached with the mixing nozzle only.

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 (upwardly inclined)
- all installations with drill hole depth d_o >10" (250mm) 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.
- In the case that flexible tubing is used (Cat. #PFC1640600), the mixing nozzle may be trimmed at the perforation on the front port before attachment of the tubing.

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. Following installation of the anchor, remove excess adhesive. 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.

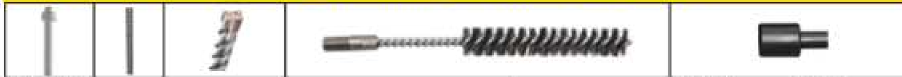
10 After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4) by using a calibrated torque wrench.
Take care not to exceed the maximum torque for the selected anchor.

2. Gel (working) times and curing times

Temperature of base material					Gel (working) time	Full curing time
14 °F	(-10 °C)	to	22 °F	(-6 °C)	60 mins	24 hrs
23 °F	(-5 °C)	to	31 °F	(-1 °C)	50 mins	5 hrs
32 °F	(0 °C)	to	40 °F	(+4 °C)	25 mins	3.5 hrs
41 °F	(+5 °C)	to	49 °F	(+9 °C)	15 mins	2 hrs
50 °F	(+10 °C)	to	58 °F	(+14 °C)	10 mins	1 hrs
59 °F	(+15 °C)	to	67 °F	(+19 °C)	6 mins	40 mins
68 °F	(+20 °C)	to	85 °F	(+29 °C)	3 mins	30 mins
86 °F	(+30 °C)	to	104 °F	(+40 °C)	2 mins	30 mins

FIGURE 5—MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII)

3a. Standard hole cleaning / piston plug info (fractional sizes)[1]



Threaded Rod [inch]	Rebar [inch]	d_0, Drill bit - Ø [inch]	d_b, Brush - Ø [mm]	d_b, Brush - Ø [inch]	Cat. #	Piston plug (size)	Cat. # Standard	Cat. # Premium
3/8"	-	7/16	13.5	0.528	PFC1671050	Piston plugs not required		
-	#3	1/2	14.3	0.562	PFC1671100			
1/2"	-	9/16	16.3	0.654	PFC1671150			
-	#4	5/8	18.3	0.720	PFC1671200			
5/8"	-	11/16	20.0	0.787	PFC1671225	11/16"	08258-PWR	-
-	#5	3/4	21.5	0.846	PFC1671250	3/4"	08259-PWR	PFC1691520
3/4"	#6	7/8	24.8	0.976	PFC1671300	7/8"	08300-PWR	PFC1691530
7/8"	#7	1	28.5	1.122	PFC1671350	1"	08301-PWR	PFC1691540
1"	#8	1 1/8	31.8	1.252	PFC1671400	1-1/8"	08303-PWR	PFC1691550
1-1/4"	#9	1 3/8	38.2	1.504	PFC1671450	1-3/8"	08305-PWR	PFC1691560
-	#10	1 1/2	41.4	1.630	PFC1671500	1-1/2"	08309-PWR	PFC1691570

[1]Note for Tables 3a and 3b: If the DEWALT DustX+ extraction system is used to automatically clean the holes during drilling, standard hole cleaning (brushing and blowing following drilling) is not required.

3b. Standard hole cleaning / piston plug info (EU metric and CA metric sizes)[1]

Threaded Rod [mm]	Rebar EU [mm]	Rebar CA [mm]	d_0, Drill bit - Ø EU [mm]	d_0, Drill bit - Ø CA [inch]	d_b, Brush - Ø [mm]	d_b, Brush - Ø [inch]	Cat. # EU	Cat. # CA	Piston plug (size) EU	Piston plug (size) CA	Cat. # EU	Cat. # CA
M10	-		12	-	13.5	0.53	DFC1670120	-	Piston plugs not required			
M12	10	10M	14	9/16	15.5	0.61	DFC1670140	PFC1671150				
-	12		16	-	17.5	0.69	DFC1670160	-				
-	15M		-	3/4	19	0.75	PFC1671250	-	3/4"		-	08259-PWR
M16	14		18	-	20	0.79	DFC1670180	-	18mm		DFC1690100	-
-	16		20	-	22	0.87	DFC1670190	-	20mm		DFC1690150	-
M20	-		22	-	24	0.94	DFC1670220	-	22mm		DFC1690180	-
-	20	20M	25	1	27	1.06	DFC1670240	PFC1671350	25mm	1"	DFC1690250	08301-PWR
M24	-		28	-	30	1.18	DFC1670280	-	28mm		DFC1690300	-
M27	-		30	-	31.8	1.25	DFC1670310	-	30mm		DFC1690310	-
-	25	25M	32	$1^1/_4$	34	1.34	DFC1670320	PFC1671425	32mm	$1^1/_4$"	DFC1690350	08290-PWR
M30	28		35	-	37	1.46	DFC1670330	-	35mm		DFC1690400	-
-	30M		-	$1^1/_2$	-	1.50	PFC1691570	-	$1^1/_2$"		-	08291-PWR
-	32		40	-	43.5	1.71	DFC1670340	-	40mm		DFC1690420	-

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

Nominal threaded rod (fractional) — Units: inch, ft.-lb.

Nominal Anchor Size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"
d_a = Nominal anchor diameter	0.375	0.500	0.625	0.750	0.875	1.00	1.250
d_0 (d_{bit}) = Nominal ANSI drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8
T_{max} = Maximum torque	15[1]	30	44	66	96	147	221
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-7/8
c_{min} = Min. edge distance w/100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4
c_{min} = Min. edge distance w/45% T_{max}	-		1-3/4				2-3/4
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_0$				

Nominal threaded rod (metric) — Units: mm, N-m

Nominal Anchor Size	M10	M12	M16	M20	M24	M27	M30
d_a = Nominal anchor diameter	10	12	16	20	24	27	30
d_0 (d_{bit}) = Nominal ANSI drill bit size	12	14	18	22	28	30	35
T_{max} = Maximum torque	20	40	80	120	170	250	300
$h_{ef,min}$ = Minimum embedment	60	70	80	90	96	108	120
$h_{ef,max}$ = Maximum embedment	200	240	320	400	480	540	600
s_{min} = Min. spacing	50	60	80	100	120	135	150
c_{min} = Min. edge distance w/100% T_{max}	45	45	55	60	70	75	80
c_{min} = Min. edge distance w/45% T_{max}	-		45			70	
h_{min} = Minimum member thickness	h_{ef} + 30		h_{ef} + $2d_0$				

Reinforcing bar (fractional) — Units: inch, ft.-lb.

Nominal Anchor Size	#3	#4	#5	#6	#7	#8	#9	#10
d_a = Nominal anchor diameter	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
d_0 (d_{bit}) = Nominal ANSI drill bit size	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2
T_{max} = Maximum torque	15[1]	30	44	66	96	147	185	221
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-1/4	5-7/8
c_{min} = Min. edge distance w/100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4
c_{min} = Min. edge distance w/45% T_{max}	-		1-3/4				2-3/4	
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_0$					
Nominal Post-installed Rebar Size								
$h_{ef,max}$ = Maximum embedment for Post-installed Rebar Connections	22-1/2	30	37-1/2	45	52-1/2	60	67-1/2	75

Reinforcing bar (metric) — Units: mm, N-m

Nominal Anchor Size	Ø10	10M	Ø12	Ø14	15M	Ø16	20M	Ø20	Ø25	25M	Ø28	30M	Ø32
d_a = Nominal anchor diameter	10		12	14	15	16	20		25		28	30	32
d_0 (d_{bit}) = Nominal ANSI drill bit size	14	9/16"	16	18	3/4"	20	1"	25	32	$1^1/_4$"	35	$1^1/_2$"	40
T_{max} = Maximum torque	20		40	45	80	80	120		175		250	275	300
$h_{ef,min}$ = Minimum embedment	60	70	70	75	80	80	90	90	100	100	112	120	128
$h_{ef,max}$ = Maximum embedment	200	225	240	280	320	320	390	400	500	505	560	600	640
s_{min} = Min. spacing	50		60	70	80	80	100		125		140	150	160
c_{min} = Min. edge distance w/100% T_{max}	45		45	50	55		60		70		75	70	85
c_{min} = Min. edge distance w/45% T_{max}	-			45							70		
h_{min} = Minimum member thickness	h_{ef} + 30			h_{ef} + $2d_0$									
Nominal Post-installed Rebar Size													
$h_{ef,max}$ = Maximum embedment for Post-installed Rebar Connections	600	680	720	840	960	960	1170	1200	1500	1510	1680	1795	1920

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

5. Adhesive Anchor and Post-installed Rebar Connection systems and accessories

Dispensing tools		Cartridge	Extra mixing nozzles
10 fl. oz. manual and powered caulking guns	Cat. #08437-PWR – Standard metal Cat. #08479-PWR - High performance Cat. #DCE560D1 – Cordless battery	AC200+ 9.5 fl. oz. Quik-Shot w/nozzle Cat. #PFC1271050	AC200+ mixing nozzle Cat. #PFC1641600
28 fl. oz. manual and powered dispensers	Cat. #08495-PWR – Standard metal Cat. #08496-PWR - High performance Cat. #DCE595D1 – Cordless battery Cat. #08496 - Pneumatic	AC200+ 28 fl. oz. Dual cart. w/nozzle Cat. #PFC1271150	AC200+ mixing nozzle Cat. #PFC1641600

Piston plugs

See Table 3a or 3b for sizes and Cat. #

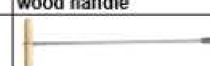
Compressed air nozzle (min. 90 psi)

Note: If the back of the drilled hole is not reached an extension to the nozzle shall be used.

SDS connector for brush

Cat. #PFC1671830

Brush extension with wood handle



Cat. #PFC1671000

Extension tubes for nozzles

Cat. #08281 or #08297 (Cat. #PFC1640600 for flex tubing)

Brush extension

Cat. #PFC1671820

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FIGURE 5—MANUFACTURER'S PUBLISHED INSTALLATION INSTRUCTIONS (MPII) (Continued)

ICC-ES Evaluation Report

ESR-4027 LABC and LARC Supplement

Reissued January 2018
Revised December 2018
This report is subject to renewal January 2020.

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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

EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS 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 Anchor System and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in ICC-ES master evaluation report ESR-4027, have also been evaluated for compliance with the codes noted below as adopted by Los Angeles Department of Building and Safety (LADBS).

Applicable code editions:

- 2017 *City of Los Angeles Building Code* (LABC)
- 2017 *City of Los Angeles Residential Code* (LARC)

2.0 CONCLUSIONS

The AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections in cracked and uncracked concrete, described in Sections 2.0 through 7.0 of the master evaluation report ESR-4027, comply with LABC Chapter 19*,* and LARC, and are subjected to the conditions of use described in this report.

3.0 CONDITIONS OF USE

The AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections described in this evaluation report must comply with all of the following conditions:

- All applicable sections in the master evaluation report ESR-4027.
- The design, installation, conditions of use and labeling of the AC200+ Adhesive Anchor System and Post-Installed Reinforcing Bar Connections are in accordance with the 2015 *International Building Code®* (2015 IBC) provisions noted in the master evaluation report ESR-4027.
- The design, installation and inspection are in accordance with additional requirements of LABC Chapters 16 and 17, as applicable.
- Under the LARC, an engineered design in accordance with LARC Section R301.1.3 must be submitted.
- The allowable and strength design values listed in the master evaluation report and tables are for the connection of the anchors or reinforcing bars to the concrete. The connection between the anchors or the reinforcing bars and the connected members shall be checked for capacity (which may govern).

This supplement expires concurrently with the master report, reissued January 2018 and revised December 2018.

ICC-ES Evaluation Report

ESR-4027 FBC Supplement

Reissued 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:

DEWALT

EVALUATION SUBJECT:

AC200+™ ADHESIVE ANCHOR SYSTEM AND POST-INSTALLED REINFORCING BAR CONNECTIONS 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:

- 2017 *Florida Building Code—Building*
- 2017 *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 2015 *International Building Code®* provisions noted in the master report.

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.*

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, reissued January 2018 and revised December 2018.