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ICC-ES Listing Report
ELC-4246

Reissued May 2024

This listing is subject to renewal May 2025.

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

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

Product Certification System:

The ICC-ES product-certification system includes evaluating reports of tests of standard manufactured product, prepared by accredited testing laboratories and provided by the listee, to verify compliance with applicable codes and standards. The system also involves factory inspections, and assessment and surveillance of the listee's quality system.

Product: Chemofast EP 1000 Adhesive Anchor System in Cracked and Uncracked Concrete

Listee: CHEMOFAST ANCHORING GMBH

Compliance with the following standards:

Annex D, Anchorage of CSA A23.3-14, Design of Concrete Structures, CSA Group.

Compliance with the following codes:

Chemofast EP 1000 Adhesive Anchor System, as described in this listing report, are in conformance with CSA A23.3-14, Annex D, as referenced in the applicable section of the following code editions:

- *National Building Code of Canada®* 2015

  Applicable Section: Division B, Part 4, Section 4.3.3.

Description of anchors:

The Chemofast EP 1000 Adhesive Anchor System is comprised of Chemofast EP 1000 two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment and adhesive injection accessories, and steel anchor elements, which are continuously threaded steel rods or steel reinforcing bars (to form the Chemofast EP 1000 Adhesive Anchor System).

The primary components of the Chemofast EP 1000 Adhesive Anchor System, including the Chemofast EP 1000 adhesive cartridge, static mixing nozzle, dispenser, and steel anchor elements, are shown in Figures 1 and 2 of this listing report. The manufacturer's printed installation instructions (MPII), included with each adhesive unit package, are shown in Figure 3 of this listing report.

Hole Cleaning Equipment:

Standard Equipment: Hole cleaning equipment is comprised of steel wire brushes supplied by Chemofast Anchoring GmbH, and air blowers which are shown in Figure 1 of this listing report. The Chemofast dust extraction system shown in Figure 1 of this report removes dust with a HEPA dust extractor during the hole drilling and cleaning operation.

Hollow Drill Bit System: The Chemofast hollow drill bit system shown in Figure 1 is comprised of Heller Duster Expert Hollow drill bit with carbide tips conforming to ANSI B212.15 attached to a class M vacuum that has a minimum air flow rating of 90cfm (150m^3/h, 42l/s). The vacuum dust extractor system removes the drilling dust during the drilling operation, eliminating the need for additional hole cleaning.

Listings are not to be construed as representing aesthetics or any other attributes not specifically addressed, nor are they to be construed as an endorsement of the subject of the listing or a recommendation for its use. There is no warranty by ICC Evaluation Service, LLC, express or implied, as to any finding or other matter in this listing, or as to any product covered by the listing.

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Drilling and cleaning	Tool	Accessories and Shrouds	Vacuum
Dust extraction system for standard drilling and cleaning equipment	 Rotary Drill Hammer	 SDS-Plus and SDS-Max Drill Bit  Capture Device CAT# 01128	 Dust Extractor
Chemofast hollow drill bit system		 Heller Duster Expert SDS-Plus and SDS-Max Hollow Drill Bit	 Class M vacuum with a minimum air flow rating of 90cfm (150m³/h resp. 42l/s).

FIGURE 1—CHEMOFAST DUST REMOVAL DRILLING SYSTEM WITH HEPA DUST EXTRACTOR OPTIONS

VARIOUS AVAILABLE TWO-COMPONENT CARTRIDGES

STATIC MIXING NOZZLE

CHEMOFAST DISPENSER

FIGURE 2— EP 1000 ADHESIVE ANCHOR SYSTEM

Identification:

1. Chemofast EP 1000 adhesive is identified by packaging labeled with the manufacturer's name (Chemofast Anchoring GmbH) and address, anchor name, the lot number, the expiration date, and the evaluation report number (ELC-4246) and the ICC-ES listing mark. Threaded rods, nuts, washers, and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this listing report.

2. The report holder's contact information is the following:

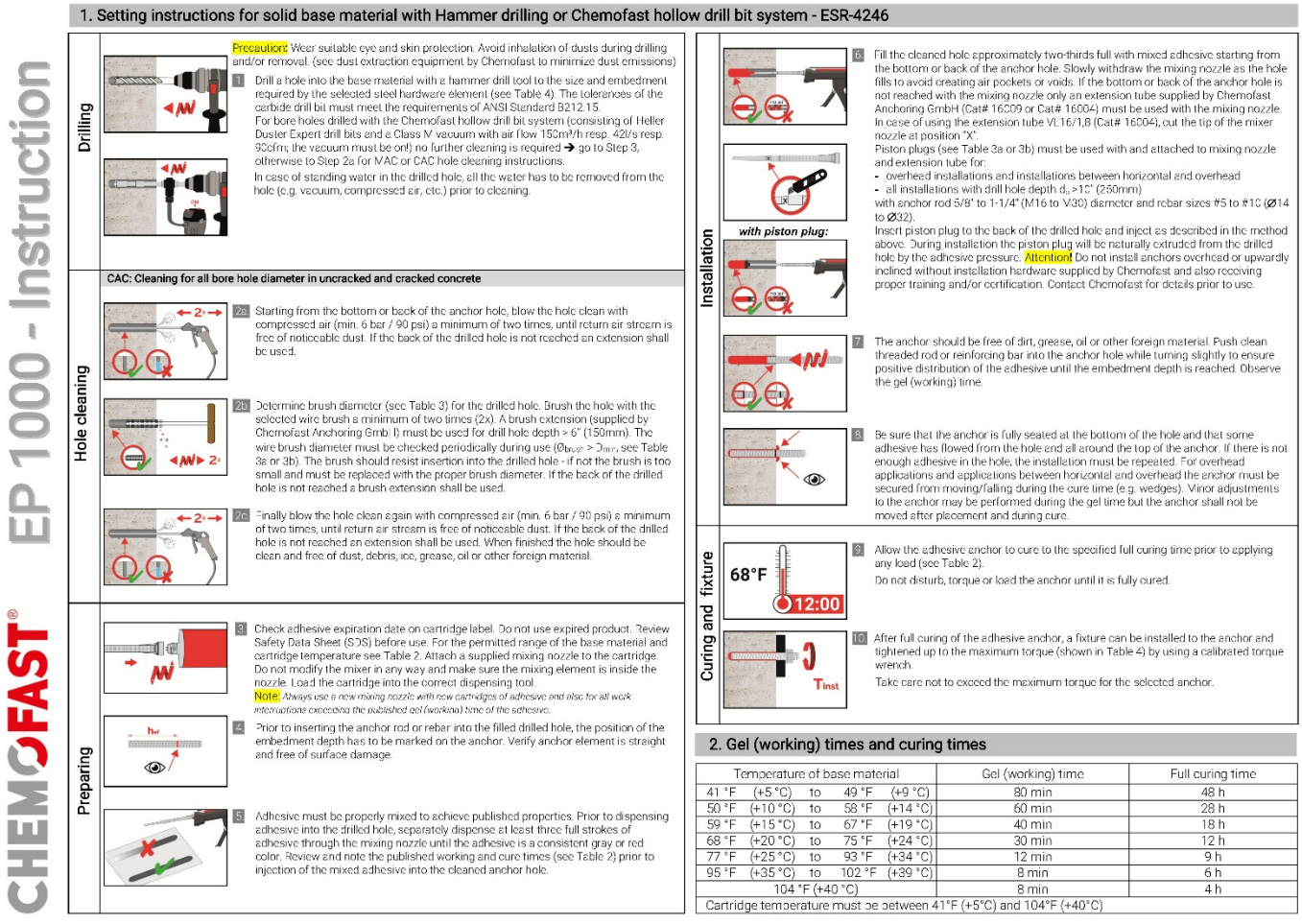
   CHEMOFAST ANCHORING GMBH
   HANNS-MARTIN-SCHLEYER-STRASSE 23
   WILLICH 47877
   GERMANY
   +49 (2154) 8123-0
   www.chemofast.de
   info@chemofast.de

Installation: Installation parameters are illustrated in Figures 3 and 4 of this listing report. Installation must be in accordance with CSA A23.3-14 D.10 and D.10.2, as applicable. Anchor locations must comply with this listing report and the plans and specifications approved by the code official. Installation of the Chemofast EP 1000 Adhesive Anchor System must conform to the manufacturer's printed installation instructions included in each unit package as described in Figure 3 of this listing report.

The adhesive anchor system may be installed in downwards, horizontally and upwardly inclined orientation applications (e.g. overhead). If the bottom or back of the bore hole is not reached with the mixing nozzle, a mixer extension tube, supplied by Chemofast must be attached to the mixing nozzle as described in Figure 3 of this listing report. Additionally, horizontal or upwardly inclined orientation applications of all bore hole depths, and downwards applications with a bore hole depth of more than 10 inch (250 mm) are to be installed using piston plugs for the $^{5}/_{8}$-inch and M16 through $1^{1}/_{4}$-inch and M30 diameter threaded steel rods, and No. 5 and ø16 through No. 10 and ø32, steel reinforcing bars, installed in the specified hole diameter, and attached to the mixing nozzle and extension tube supplied by Chemofast as described in Figure 3 in this listing report. For installation with the $^{3}/_{8}$-inch, $^{1}/_{2}$-inch, M8, M10 and M12 diameter threaded steel rods, and No. 3, No. 4, ø8, ø10 and ø12 steel reinforcing bars only, a piston plug is not required.

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.

Installation of anchors in horizontal or upwardly included orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program in accordance with CSA A23.3-14 D.10.2.2 or D.10.2.3, as applicable.



2. Gel (working) times and curing times

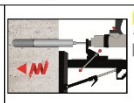
Temperature of base material	Gel (working) time	Full curing time
41 °F (+5 °C) to 49 °F (+9 °C)	80 min	48 h
50 °F (+10 °C) to 58 °F (+14 °C)	60 min	28 h
59 °F (+15 °C) to 67 °F (+19 °C)	40 min	18 h
68 °F (+20 °C) to 75 °F (+24 °C)	30 min	12 h
77 °F (+25 °C) to 93 °F (+34 °C)	12 min	9 h
95 °F (+35 °C) to 102 °F (+39 °C)	8 min	6 h
104 °F (+40 °C)	8 min	4 h
Cartridge temperature must be between 41°F (+5°C) and 104°F (+40°C)		

FIGURE 3—INSTALLATION INSTRUCTIONS

CHEMOFAST® EP 1000 - Instruction

1. Setting instructions for solid base material with Diamond drilling - ESR-4246

Drilling



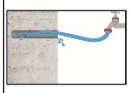
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemofast to minimize dust emissions)

1 Drill a hole into the base material with a diamond drill tool to the size and embedment required by the selected steel hardware element (see Table 4).

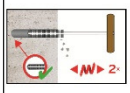
In case of standing water in the drilled hole, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

Hole cleaning

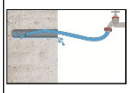
SPCAC: Cleaning for all bore hole diameter in uncracked concrete



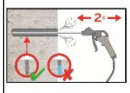
2a Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.



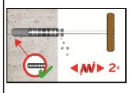
2b Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during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



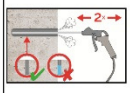
2c Finally, starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.



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

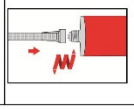


2e Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during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



2f 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.

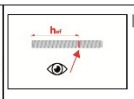
Preparing



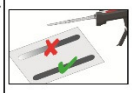
3 Check adhesive expiration date on cartridge label. Do not use expired product. Review Safety Data Sheet (SDS) before use. For the permitted range of the base material and cartridge temperature see Table 2. Attach a supplied mixing nozzle to the cartridge. Do not modify the mixer in any way and make sure the mixing element is inside the nozzle. Load the cartridge into the correct dispensing tool.

Note: *Always use a new mixing nozzle with new cartridges of adhesive and also for all work interruptions exceeding the published gel (working) time of the adhesive.*

Preparing

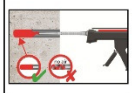


4 Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.



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 or red color. Review and note the published working and cure times (see Table 2) prior to injection of the mixed adhesive into the cleaned anchor hole.

Installation



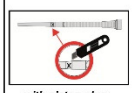
6 Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. If the bottom or back of the anchor hole is not reached with the mixing nozzle only an extension tube supplied by Chemofast Anchoring GmbH (Cat# 16009 or Cat# 16004) must be used with the mixing nozzle. In case of using the extension tube VL16/1,8 (Cat# 16004), cut the tip of the mixer nozzle at position "X".

Piston plugs (see Table 3a or 3b) must be used with and attached to mixing nozzle and extension tube for:

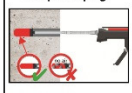
- overhead installations and installations between horizontal and overhead
- all installations with drill hole depth d_h >10" (250mm)

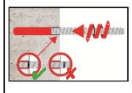
with anchor rod 5/8" to 1-1/4" (M16 to M30) diameter and rebar sizes #5 to #10 (Ø14 to Ø32).

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

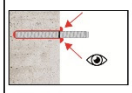


with piston plug:



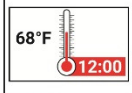


7 The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



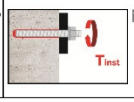
8 Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and overhead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

Curing and fixture



9 Allow the adhesive anchor to cure to the specified full curing time prior to applying any load (see Table 2).

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



10 After full curing of the adhesive anchor, a fixture can be installed to the anchor and tightened up to the maximum torque (shown in Table 4) by using a calibrated torque wrench.

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

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

Threaded Rod	Rebar	d_0 Drill bit - Ø	d_b Brush - Ø		d_{bmin} min. Brush - Ø		Cat. #	Piston plug	Cat. #
[inch]	[inch]	[inch]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
3/8"	-	7/16	13.5	0.528	11.6	0.458	16111	No plugs required	
-	#3	1/2	14.3	0.562	13.2	0.520	16112		
1/2"	-	9/16	16.3	0.652	14.8	0.582	16114		
-	#4	5/8	18.3	0.720	16.5	0.650	16116		
5/8"		11/16	20.0	0.787	18.0	0.709	16117	11/16	40355
	#5	3/4	21.5	0.846	19.5	0.777	16118	3/4	40341
3/4"	#6	7/8	24.8	0.976	23.0	0.935	16121	7/8	40343
7/8"	#7	1	28.5	1.122	26.2	1.330	16123	1	40345
1"	#8	1 1/8	31.8	1.252	29.5	1.160	16125	1 1/8	40346
1-1/4"	#9	1 3/8	38.2	1.504	35.8	1.410	16128	1 3/8	40349
-	#10	1 1/2	41.4	1.630	39.0	1.535	16129	1 1/2	40350

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

Threaded Rod	Rebar	d_0 Drill bit - Ø	d_b Brush - Ø		d_{bmin} min. Brush - Ø		Cat. #	Piston plug	Cat. #
[mm]	[mm]	[mm]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
M8	-	10	11.5	0.45	10.5	0.41	16110	No plugs required	
M10	-	12	13.5	0.53	12.5	0.41	16111		
M12	10	14	15.5	0.61	14.5	0.49	16113		
-	12	16	17.5	0.69	16.5	0.57	16115		
M16	14	18	20	0.79	18.5	0.65	16117	18	40340
-	16	20	22	0.87	20.5	0.73	16119	20	40342
M20	-	22	24	0.94	22.5	0.81	16120	22	40343
-	20	25	27	1.06	24.5	0.89	16122	25	40345
M24	-	28	30	1.18	28.5	0.96	16124	28	40346
M27	-	30	31.8	1.25	30.5	1.12	16125	30	40347
-	25	32	34	1.34	32.5	1.20	16126	32	40348
M30	28	35	37	1.46	35.5	1.28	16127	35	40349
-	32	40	43.5	1.71	40.5	1.40	16130	40	40351

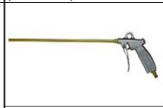
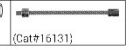
4. Anchor property / Setting information (fractional and metric sizes)

	Nominal threaded rod (fractional) inch; ft-lb							Nominal threaded rod (metric) mm; Nm							
Anchor size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M8	M10	M12	M16	M20	M24	M27	M30
d_a = Nominal anchor rod diameter	0.375	0.500	0.625	0.750	0.875	1.000	1.250	8	10	12	16	20	24	27	30
d_0 (d_{bit}) = Nominal ANSI drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	10	12	14	18	22	28	30	35
Parameter valid for anchors															
T_{max} = Maximum torque	15[2]	30	44	66	96	147	221	10	20	40	80	120	170	250	300
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	60	70	80	90	96	108	120
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25	160	200	240	320	400	480	540	600
$s_{cr,p}$ = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-7/8	40	50	60	80	100	120	135	150
$c_{ac,p}$ = Min. edge distance (100% T_{max})	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4	35	40	45	55	60	70	75	80
$c_{cr,p}$ = Min. edge distance (45% T_{max}[1])	-			1.75			2.75	-			45				70
h_{min} = Minimum member thickness	h_{ef} + 1-1/4			h_{ef} + $2d_o$				h_{ef} + 30			h_{ef} + $2d_o$				
Parameter valid for post-installed rebar															
$h_{ef,min}$ = Minimum embedment	-							-							
$h_{ef,max}$ = Maximum embedment (PR)	-							-							

	Reinforcing bar (fractional) inch; ft-lb								Reinforcing bar (metric) mm; Nm									
Anchor size	#3	#4	#5	#6	#7	#8	#9	#10	Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
d_a = Nominal anchor rod diameter	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	8	10	12	14	16	20	25	28	32
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	12	14	16	18	20	25	32	35	40
Parameter valid for anchors																	
T_{max} = Maximum torque	15[2]	30	44	66	96	147	185	221	10	20	40	45	80	120	175	250	300
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	60	60	70	75	80	90	100	112	128
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	160	200	240	280	320	400	500	560	640
$s_{cr,p}$ = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-1/4	5-7/8	40	50	60	70	80	100	125	140	160
$c_{ac,p}$ = Min. edge distance (100% T_{max})	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	35	40	45	50	55	60	70	75	85
$c_{cr,p}$ = Min. edge distance (45% T_{max}[1])	-			1.75			2.75		-			45				70	
h_{min} = Minimum member thickness	h_{ef} + 1-1/4			h_{ef} + $2d_o$					h_{ef} + 30			h_{ef} + $2d_o$					
Parameter valid for post-installed rebar																	
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	60	60	70	75	80	90	100	112	128
$h_{ef,max}$ = Maximum embedment (PR)	22-1/2	30	37-1/2	45	52-1/2	60	67-1/2	75	480	600	720	840	960	1200	1500	1680	1920

[1] s_{min} = $3d_a$; [2] for ASTM A36 and ™1554 Grade 36, T_{max} = 11 ft-lb

5. EP 1000 adhesive anchor system and accessories

Injection tools		Cartridge system	Extra mixing nozzles	Piston Plug	Compressed air nozzle (min. 90 psi)	Extension tube VL10/0,75	Extension with wood handle
14 to 20 fl. oz. dispenser	Cat. #30306 - Manual tool Cat. #30222 - Manual tool Cat. #30224 - Pneumatic tool	EP1000 14.8 fl. oz. (440mL)	EP 1000 mixing nozzle Cat. #40154	 (Cat# Table 3a or 3b)	 The bore hole ground is not reached an extension shall be used.	(Cat. #16009)	 (Cat#16132)
		EP1000 20 fl. oz. (585mL)				Extension tube VL16/1,8	Brush extension
47 fl. oz. dispensers	Cat. #30221 - Pneumatic tool	EP 1000 47 fl. oz. (1400mL)				(Cat. #16004)	 (Cat#16131)

6. Post-installed rebar $h_{ef} \geq 20d$

Cartridge	Injection tools	d_a	h_{ef}	Extension tube
14 to 20 fl. oz.	Manual tool	≤ #5 ≤ 16 [mm]	≤ 27-1/2 [inch] ≤ 700 [mm]	VL10/0,75 (Cat.#16009) or V_16/1,8 (Cat.#16004)
14 to 20 fl. oz. 47 fl. oz.	Pneumatic tool	≤ #5 ≤ 16 [mm]	≤ 51-1/2 [inch] ≤ 1300 [mm]	
14 to 20 fl. oz. 47 fl. oz.	Pneumatic tool	≤ #8 ≤ 25 [mm]	≤ 39-1/2 [inch] ≤ 1000 [mm]	
47 fl. oz.	Pneumatic tool	≤ #10 ≤ 32 [mm]	≤ 75 [inch] ≤ 1920 [mm]	V_16/1,8 (Cat.#16004)

CHEMOFAST®
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FIGURE 3—INSTALLATION INSTRUCTIONS (Continued)

Anchor setting information:

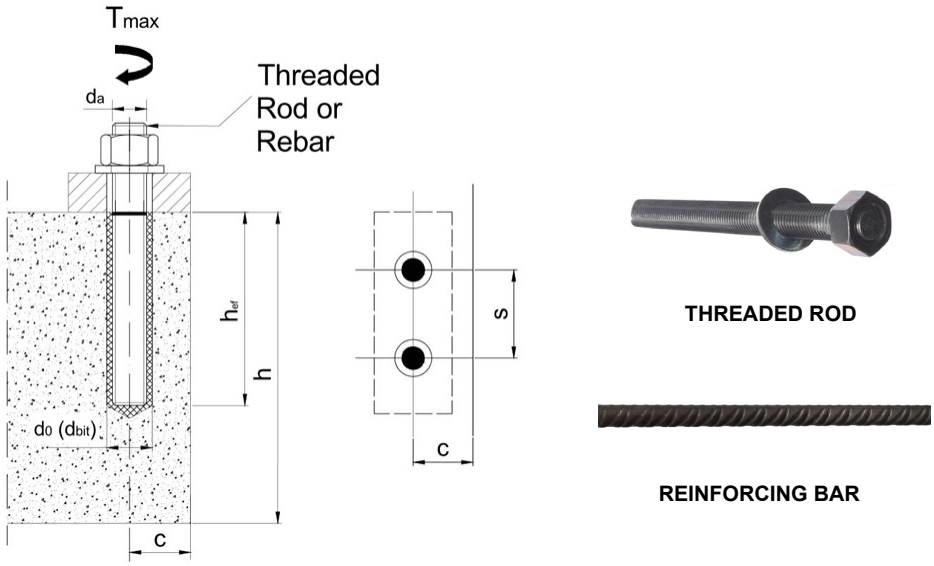

FIGURE 4—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

Installation Torque Subject to Edge Distance:

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

INSTALLATION TORQUE SUBJECT TO EDGE DISTANCE			
NOMINAL ANCHOR SIZE, *D*	**MINIMUM EDGE DISTANCE, c_{ai}**	**MINIMUM ANCHOR SPACING, s_{ai}**	**MAXIMUM TORQUE, T_{max}**
$^5/_8$ in. to 1 in. M16 to M27	1.75 in. (45 mm)	5*d*	0.45·T_{max}
$1^1/_4$ in. M30	2.75 in. (70 mm)		

Ultimate Limit States Design:

Design resistance of anchors for compliance with the 2015 NBCC must be determined in accordance with CSA A23.3-14 Annex D, and this listing report.

Design table index is provided in Table 1 and design parameters are provided in Tables 2 through 15 of this listing report are based on the 2015 NBCC (CSA A23.3-14). The limit states design of anchors must comply with CSA A23.3-14 D.5.1, except as required in CSA A23.3-14 D.4.3.1.

Material resistance factors must be ϕ_c = 0.65 and ϕ_s = 0.85 in accordance with CSA A23.3-14 Sections 8.4.2 and 8.4.3, and resistance modification factor, *R,* as given in CSA A23.3-14 Section D.5.3, and noted in Tables 4 through 15 of this listing report, must be used for load combinations calculated in accordance with Division B, Part 4, Section 4.1.3 of the 2015 NBCC, or Annex C of CSA A23.3-14. The nominal strength, N_{sa} or V_{sa}, in Tables 4, 7, 10 and 13 of this listing report must be multiplied by ϕ_s and *R* to determine the factored resistance, N_{sar} or V_{sar}. The nominal concrete breakout strength, N_{cb}, N_{cbg}, V_{cb}, and V_{cbg}, in Tables 5, 8, 11 and 14 of this listing report must be multiplied by ϕ_c and *R* to determine the factored resistance, N_{cbr}, N_{cbgr}, V_{cbr}, and V_{cbgr}.

The factored bond resistance, N_{bar}, must be multiplied by ϕ_c and the permissible installation condition factors for dry concrete, R_d, water-saturated concrete, R_{ws}, and water-filled hole, R_{wf} for the corresponding installation conditions. The bond strength must further be modified with the factor, K_{wf}, for cases the holes are water-filled as given in Tables 6, 9, 12 and 15.

For anchors to be installed in seismic regions described in NBCC 2015: The factored resistance shear strength, V_{sar}, must be adjusted by $\alpha_{V,seis}$ as given in Tables 4, 7, 10 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.

TABLE 1—DESIGN TABLE INDEX

DESIGN STRENGTH - THREADED RODS		Fractional	Metric
	Steel Strength - N_{sa}, V_{sa}	Table 3	Table 10
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 5	Table 11
	Bond Strength - N_a, N_{ag}	Table 6	Table 12
DESIGN STRENGTH[1] – REINFORCING STEEL		**Fractional**	**Metric**
	Steel Strength - N_{sa}, V_{sa}	Table 7	Table 13
	Concrete Strength - N_{pn}, N_{sb}, N_{sbg}, N_{cb}, N_{cbg}, V_{cb}, V_{cbg}, V_{cp}, V_{cpg}	Table 8	Table 14
	Bond Strength - N_a, N_{ag}	Table 9	Table 15

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

THREADED ROD SPECIFICATION			MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YIELD STRENGTH 0.2 PERCENT OFFSET, f_{ya}	f_{uta}/f_{ya}	ELONGATION, MIN. PERCENT[11]	REDUCTION OF AREA, MIN. PERCENT	SPECIFICATION FOR NUTS[12]
CARBON STEEL	ASTM A193[2] Grade B7 all sizes	psi (MPa)	125,000 (862)	105,000 (724)	1.19	16	50	ASTM A194 / A563 Grade DH
	ASTM A36[3] / F1554[4], Grade 36 all sizes	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 (517)	55,000 (380)	1.36	23	40	
	ASTM F1554[4] Grade 105	psi (MPa)	125,000 (860)	105,000 (724)	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A449[5] $^3/_8$ to 1 in.	psi (MPa)	120,000 (830)	92,000 (635)	1.30	14	35	
	ASTM A449[5] $1^1/_4$ in	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	ASTM 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 (116,000)	640 (92,800)	1.25	12	52	EN ISO 4032 Grade 8
STAINLESS STEEL	ASTM F593[8] CW1 $^3/_8$ to $^5/_8$ in. (316)	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. (316)	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 (M8-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 Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
[9]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[10]Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, Screws and Studs.
[11]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[12]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
[13]Nuts for metric rods.

TABLE 3—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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.80						
	Resistance modification factor for shear[2]	R	-	0.75						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.80						
	Resistance modification factor for shear[2]	R	-	0.75						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.80						
	Resistance modification factor for shear[2]	R	-	0.75						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.80						
	Resistance modification factor for shear[2]	R	-	0.75						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.70						
	Resistance modification factor for shear[2]	R	-	0.65						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.70						
	Resistance modification factor for shear[2]	R	-	0.65						
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	$\alpha_{V,seis}$	-	0.73						
	Resistance modification factor for tension[2]	R	-	0.80						
	Resistance modification factor for shear[2]	R	-	0.75						

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with CSA A23.3-14 Eq. D.2 and Eq. D.3. Nuts and washers must comply with requirements for the rod.

[2]The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.

TABLE 4—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON CARBON REINFORCING BARS

REINFORCING SPECIFICATION	UNITS	MINIMUM SPECIFIED ULTIMATE STRENGTH, f_{uta}	MINIMUM SPECIFIED YEILD STRENGTH, f_{ya}
ASTM A615[1], A767[3], A996[4] Grade 60	psi (MPa)	90,000 (620)	60,000 (414)
ASTM A706[2], A757[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 (80,000)	500 (72,500)

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

TABLE 5—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH ALL DRILLING METHODS[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1 1/4
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)						
Min. anchor spacing	s_{min}	in. (mm)	1 7/8 (48)	2 1/2 (64)	3 (76)	3 3/4 (95)	4 1/4 (108)	4 3/4 (121)	5 7/8 (149)
Min. edge distance	c_{min}	in. (mm)	1 5/8 (41)	1 3/4 (44)	2 (51)	2 3/8 (60)	2 1/2 (64)	2 3/4 (70)	3 1/4 (82)
					See Installation Torque Subject to Edge Distance Section of this listing report for smaller edge distance with 0.45 T_{max}				
Min. member thickness	h_{min}	in. (mm)	h_{ef} + 1 1/4 (h_{ef} + 30)		h_{ef} + 2d_0[3]				
Critical edge distance - splitting (for uncracked concrete)[2]	c_{ac}	-	2·h_{ef}						
Critical anchor spacing – splitting	s_{ac}	-	2·c_{ac}						
Resistance modification factor for tension, concrete failure modes, Condition B[2]	R	-	1.00						
Resistance modification factor for shear, concrete failure modes, Condition B[2]	R	-	1.00						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in CSA A23.3-14 D.5. The tabulated value of material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[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 (OR CHEMOFAST HOLLOW CARBIDE DRILL 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: 110°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,475 (17.1)	2,400 (16.5)	2,315 (16.0)	2,235 (15.4)	2,155 (14.9)	2,075 (14.3)	1,915 (13.2)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,150 (7.9)	1,415 (9.8)	1,455 (10.0)	1,515 (10.4)	1,535 (10.6)	1,555 (10.7)	1,550 (10.7)
Temperature range B: 110°F / 153°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,845 (19.6)	2,755 (19.0)	2,665 (18.4)	2,570 (17.7)	2,480 (17.1)	2,385 (16.5)	2,205 (15.2)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,325 (9.1)	1,630 (11.2)	1,675 (11.5)	1,740 (12.0)	1,765 (12.2)	1,785 (12.3)	1,785 (12.3)
Temperature range C: 122°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,325 (16.0)	2,250 (15.5)	2,175 (15.0)	2,100 (14.5)	2,025 (14.0)	1,950 (13.4)	1,800 (12.4)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,145 (7.9)	1,390 (9.6)	1,400 (9.6)	1,420 (9.8)	1,440 (9.9)	1,460 (10.1)	1,455 (10.0)
CAC[4] cleaning	Dry Concrete	Anchor category	–	-	1						
		Resistance modification factor	R_d	-	1.00						
	Water-saturated Concrete	Anchor category	–	-	1						
		Resistance modification factor	R_{ws}	-	1.00						
	Water-filled holes	Anchor category	–	-	3						
		Resistance modification factor	R_{wf}	-	0.75						
		Modification factor for water filled holes	K_{wf}	-	1.0						
HDB[4] cleaning	Dry Concrete	Anchor category	–	-	1						
		Resistance modification factor	R_d	-	1.00						
	Water-saturated Concrete	Anchor category	–	-	Not applicable	2					
		Resistance modification factor	R_{ws}	-		0.85					
	Water-filled holes	Anchor category	–	-		3					
		Resistance modification factor	R_{wf}	-		0.75					
		Modification factor for water filled holes	K_{wf}	-		0.87	0.91	0.95	1.0		
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1			0.98	0.97	0.95	0.92

[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 $(f'_c / 2500)^{0.1}$ [For **SI**: $(f'_c / 17.2)^{0.1}$].

[2]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 10 percent for temperature range A and B and by 16 percent for temperature range C.

[3]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.

Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C);
Temperature range B: Maximum short term temperature = 153°F (67°C), maximum long term temperature = 110°F (43°C);
Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

[4]CAC: compressed air cleaning see Figure 3; HDB: cleaning during drilling action with hollow drill bit system

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	$\alpha_{V,seis}$	-	0.76							
	Resistance modification factor for tension[2]	R	-	0.70							
	Resistance modification factor for shear[2]	R	-	0.65							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb	8,800	16,000	24,800	35,200	48,000	63,200	80,000	101,600
			(kN)	(39.1)	(71.2)	(110.3)	(156.6)	(213.5)	(281.1)	(355.9)	(452.0)
		V_{sa}	lb	5,280	9,600	14,880	21,120	28,800	37,920	48,000	60,960
			(kN)	(23.5)	(42.7)	(66.2)	(93.9)	(128.1)	(168.7)	(213.5)	(271.2)
	Reduction for seismic shear	$\alpha_{V,seis}$	----	0.76							
	Resistance modification factor for tension[2]	R	----	0.80							
	Resistance modification factor for shear[2]	R	----	0.75							
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	$\alpha_{V,seis}$	-	0.76							
	Resistance modification factor for tension[2]	R	-	0.70							
	Resistance modification factor for shear[2]	R	-	0.65							

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with CSA A23.3-14 Eq. D.2 and Eq. D.3.
[2]The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[3]In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6.

TABLE 8—CONCRETE BREAKOUT DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT REINFORCING BARS IN HOLES DRILLED WITH ALL DRILLING METHODS[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)	$3^1/_8$ (79)	$3^3/_4$ (95)	$4^3/_8$ (111)	5 (127)	$5^5/_8$ (143)	$6^1/_4$ (159)
Min. edge spacing[4]	c_{min}	in. (mm)	$1^5/_8$ (41)	$1^3/_4$ (44)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	3 (76)	$3^1/_4$ (82)
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$[3]					
Critical edge spacing – splitting (for uncracked concrete)[2]	c_{ac}	-	$2 \cdot h_{ef}$							
Critical anchor spacing – splitting	s_{ac}	-	$2 \cdot c_{ac}$							
Resistance modification factor for tension, concrete failure modes, Condition B[2]	R	-	1.00							
Resistance modification factor for shear, concrete failure modes, Condition B[2]	R	-	1.00							

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in CSA A23.3-14 D.5. The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[3]d_0 = hole diameter.
[4]The edge distances, c_{min} less than the values given in the table may be reduced subject to the anchor spacing, s_{min} in accordance with Installation Torque Subject to Edge Distance Section.

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

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)							
					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: 110°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,060 (14.2)	2,035 (14.0)	2,015 (13.9)	1,990 (13.7)	1,965 (13.6)	1,945 (13.4)	1,920 (13.2)	1,895 (13.1)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,350 (9.3)	1,740 (12.0)	1,725 (11.9)	1,695 (11.7)	1,680 (11.6)	1,650 (11.4)	1,635 (11.3)	1,605 (11.1)
Temperature range B: 110°F / 153°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,365 (16.3)	2,340 (16.1)	2,315 (16.0)	2,285 (15.8)	2,260 (15.6)	2,235 (15.4)	2,205 (15.2)	2,180 (15.0)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,550 (10.7)	2,000 (13.8)	1,985 (13.7)	1,945 (13.4)	1,930 (13.3)	1,895 (13.1)	1,880 (13.0)	1,845 (12.7)
Temperature range C: 122°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,935 (13.3)	1,915 (13.2)	1,890 (13.0)	1,870 (12.9)	1,845 (12.7)	1,825 (12.6)	1,805 (12.4)	1,780 (12.3)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,340 (9.2)	1,635 (11.4)	1,620 (11.2)	1,590 (11.0)	1,580 (10.9)	1,550 (10.7)	1,535 (10.6)	1,510 (10.4)
CAC[4] cleaning	Dry Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_{ws}	-	1.00							
	Water-filled holes	Anchor category	–	-	3							
		Resistance modification factor	R_{wf}	-	0.75							
		Modification factor for water filled holes	K_{wf}	-	1.0							
HDB[4] cleaning	Dry Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated Concrete	Anchor category	–	-	Not applicable	2						
		Resistance modification factor	R_{ws}	-		0.85						
	Water-filled holes	Anchor category	–	-		3						
		Resistance modification factor	R_{wf}	-		0.75						
		Modification factor for water filled holes	K_{wf}	-		0.86	0.91	0.95	1			
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1			0.98	0.97	0.95	0.92	

[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 $(f'_c / 2500)^{0.1}$ [For **SI**: $(f'_c / 17.2)^{0.1}$].

[2]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 10 percent for temperature range A and B and by 16 percent for temperature range C.

[3]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.

Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C);
Temperature range B: Maximum short term temperature = 153°F (67°C), maximum long term temperature = 110°F (43°C);
Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

[4]CAC: compressed air cleaning see Figure 3; HDB: cleaning during drilling action with hollow drill bit system

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

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (mm)							
				M8	M10	M12	M16	M20	M24	M27	M30
Threaded rod O.D.		d	mm (in.)	8 (0.31)	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)	36.6 (0.057)	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)	18.3 (4,114)	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)	11.0 (2,648)	14.5 (3,260)	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	$\alpha_{V,seis}$	-	0.78							
	Resistance modification reduction factor for tension[2]	R	-	0.70							
	Resistance modification reduction factor for shear[2]	R	-	0.65							
ISO 898-1 Class 8.8	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	29.3 (6,582)	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)	17.6 (3,949)	23.0 (5,216)	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	$\alpha_{V,seis}$	-	0.78							
	Resistance modification factor for tension[2]	R	-	0.70							
	Resistance modification factor for shear[2]	R	-	0.65							
ISO 3506-1, A4 stainless steel[3]	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	25.6 (5,760)	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)	15.4 (3,456)	20.3 (4,564)	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	$\alpha_{V,seis}$	-	0.78							
	Resistance modification factor for tension[2]	R	-	0.70							
	Resistance modification factor for shear[2]	R	-	0.65							

[1]Values provided for common rod material types based on specified strengths and calculated in accordance with CSA A23.3-14 Eq. D.2 and Eq. D.3.
[2]The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[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 ALL DRILLING MEHTODS[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (mm)							
			M8	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.)	40 ($1^5/_8$)	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.)	35 ($1^3/_8$)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	60 ($2^3/_8$)	65 ($2^1/_2$)	75 (3)	80 ($3^1/_8$)
						See Installation Torque Subject to Edge Distance Section of this listing report for smaller edge distance with 0.45 T_{max}				
Min. member thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + $1^1/_4$)			h_{ef} + $2d_0$[3]				
Critical edge distance - splitting (for uncracked concrete)[2]	c_{ac}	-	$2 \cdot h_{ef}$							
Resistance modification factor for tension, concrete failure modes, Condition B[2]	R	-	1.00							
Resistance modification factor for shear, concrete failure modes, Condition B[2]	R	-	1.00							

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in CSA A23.3-14 D.5. The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[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 (OR CHEMOFAST HOLLOW CARBIDE DRILL BIT)[1]

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)							
					M8	M10	M12	M16	M20	M24	M27	M30
Minimum embedment			$h_{ef,min}$	mm (in.))	60 (2.4)	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.)	120 (4.7)	200 (7.9)	240 (9.4)	320 (12.6)	400 (15.7)	480 (18.9)	540 (21.3)	600 (23.6)
Temperature range A: 110°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,515 (17.3)	2,465 (17.0)	2,415 (16.6)	2,315 (16.0)	2,215 (15.3)	2,110 (14.6)	2,035 (14.0)	1,960 (13.5)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,130 (7.8)	1,165 (8.0)	1,405 (9.7)	1,455 (10.0)	1,520 (10.5)	1,550 (10.7)	1,570 (10.8)	1,570 (10.8)
Temperature range B: 110°F / 153°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,890 (19.9)	2,835 (19.5)	2,775 (19.1)	2,660 (18.3)	2,545 (17.5)	2,425 (16.7)	2,340 (16.1)	2,255 (15.5)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,300 (9.0)	1,335 (9.2)	1,615 (11.1)	1,675 (11.5)	1,750 (12.1)	1,780 (12.3)	1,805 (12.4)	1,805 (12.4)
Temperature range C: 122°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,365 (16.3)	2,315 (16.0)	2,270 (15.6)	2,175 (15.0)	2,080 (14.3)	1,985 (13.7)	1,915 (13.2)	1,840 (12.7)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,125 (7.7)	1,155 (8.0)	1,380 (9.5)	1,400 (9.6)	1,430 (9.9)	1,455 (10.0)	1,475 (10.2)	1,475 (10.2)
CAC[4] cleaning	Dry Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_{ws}	-	1.00							
	Water-filled holes	Anchor category	–	-	3							
		Resistance modification factor	R_{wf}	-	0.75							
		Modification factor for water filled holes	K_{wf}	-	1.0							
HDB[4] cleaning	Dry Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated Concrete	Anchor category	–	-	Not applicable		2					
		Resistance modification factor	R_{ws}	-			0.85					
	Water-filled holes	Anchor category	–	-			3					
		Resistance modification factor	R_{wf}	-			0.75					
		Modification factor for water filled holes	K_{wf}	-			0.86	0.91	0.96	1		
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1			0.99	0.98	0.96	0.94	0.93

[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 $(f'_c / 2500)^{0.1}$ [For **SI**: $(f'_c / 17.2)^{0.1}$].

[2]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 10 percent for temperature range A and B and by 16 percent for temperature range C.

[3]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.

Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C);
Temperature range B: Maximum short term temperature = 153°F (67°C), maximum long term temperature = 110°F (43°C);
Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

[4]CAC: compressed air cleaning see Figure 3; HDB: cleaning during drilling action with hollow drill bit system

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

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size								
				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Reinforcing bar O.D.		d	mm (in.)	8 (0.315)	10 (0.394)	12 (0.472)	14 (0.551)	16 (0.630)	20 (0.787)	25 (0.984)	28 (1.102)	32 (1.260)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (in.²)	50 (0.078)	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)	27.5 (6,182)	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)	16.5 (3,709)	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	$\alpha_{V,seis}$	-	0.75								
	Resistance modification factor for tension[2]	R	-	0.70								
	Resistance modification factor for shear[2]	R	-	0.65								

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with CSA A23.3-14 Eq. D.2 and Eq. D.3.
[2]The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.

TABLE 14—CONCRETE BREAKOUT DESIGN INFORMATION METRIC REINFORCING BARS IN HOLES DRILLED WITH ALL DRILLING METHODS[1]

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size								
			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)								
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)								
Min. anchor spacing	s_{min}	mm (in.)	40 ($1^5/_8$)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	95 ($3^3/_4$)	120 ($4^5/_8$)	130 ($5^1/_4$)	150 ($5^7/_8$)
Min. edge spacing[4]	c_{min}	mm (in.)	35 ($1^3/_8$)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	85 ($3^1/_8$)
Min. member thickness	h_{min}	mm (in.)	h_{ef} + 30 (h_{ef} + $1^1/_4$)			h_{ef} + 2d_0 [3]					
Critical edge spacing – splitting (for uncracked concrete)[2]	c_{ac}	-	2·h_{ef}								
Resistance modification factor for tension, concrete failure modes, Condition B[2]	R	-	1.00								
Resistance modification factor for shear, concrete failure modes, Condition B[2]	R	-	1.00								

[1]Additional setting information is described in Figure 3, installation instructions.
[2]Condition A requires supplemental reinforcement, while Condition B applies where supplemental reinforcement is not provided or where pullout or pryout governs, as set forth in CSA A23.3-14 D.5. The tabulated value of the material resistance factors ϕ_c and ϕ_s, and resistance modification factor, R, applies when the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or Annex C of CSA A23.3-14 are used.
[3]d_0 = hole diameter.
[4]The edge distances, c_{min} less than the values given in the table may be reduced subject to the anchor spacing, s_{min} in accordance with Installation Torque Subject to Edge Distance Section.

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

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)								
					Ø 8	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)	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.)	120 (4.7)	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: 110°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,070 (14.3)	2,055 (14.2)	2,040 (14.1)	2,025 (14.0)	2,010 (13.9)	1,985 (13.7)	1,945 (13.4)	1,925 (13.3)	1,895 (13.1)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,345 (9.3)	1,345 (9.3)	1,740 (12.0)	1,735 (12.0)	1,725 (11.9)	1,690 (11.7)	1,650 (11.4)	1,620 (11.2)	1,605 (11.1)
Temperature range B: 110°F / 153°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,380 (16.4)	2,365 (16.3)	2,345 (16.2)	2,330 (16.1)	2,315 (15.9)	2,280 (15.7)	2,235 (15.4)	2,210 (15.2)	2,180 (15.0)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,550 (10.7)	1,550 (10.7)	2,000 (13.8)	1,995 (13.7)	1,985 (13.7)	1,945 (13.4)	1,900 (13.1)	1,865 (12.8)	1,845 (12.7)
Temperature range C: 122°F / 176°F[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,945 (13.4)	1,930 (13.3)	1,920 (13.2)	1,905 (13.1)	1,890 (13.0)	1,865 (12.8)	1,830 (12.6)	1,810 (12.5)	1,780 (12.3)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,340 (9.2)	1,340 (9.2)	1,635 (11.3)	1,630 (11.2)	1,620 (11.2)	1,590 (10.9)	1,550 (10.7)	1,525 (10.5)	1,505 (10.4)
CAC[4] cleaning	Dry Concrete	Anchor category	–	-	1								
		Resistance modification factor	R_d	-	1.00								
	Water-saturated Concrete	Anchor category	–	-	1								
		Resistance modification factor	R_{ws}	-	1.00								
	Water-filled holes	Anchor category	–	-	3								
		Resistance modification factor	R_{wf}	-	0.75								
		Modification factor for water filled holes	K_{wf}	-	1.0								
HDB[4] cleaning	Dry Concrete	Anchor category	–	-	1								
		Resistance modification factor	R_d	-	1.00								
	Water-saturated Concrete	Anchor category	–	-	Not applicable		2						
		Resistance modification factor	R_{ws}	-			0.85						
	Water-filled holes	Anchor category	–	-			3						
		Resistance modification factor	R_{wf}	-			0.75						
		Modification factor for water filled holes	K_{wf}	-			0.86	0.91	0.96	1			
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1				0.99	0.98	0.96	0.94	0.93

[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 $(f'_c / 2500)^{0.1}$ [For **SI**: $(f'_c / 17.2)^{0.1}$].

[2]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 10 percent for temperature range A and B and by 16 percent for temperature range C.

[3]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.

Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°C);
Temperature range B: Maximum short term temperature = 153°F (67°C), maximum long term temperature = 110°F (43°C);
Temperature range C: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C).

[4]CAC: compressed air cleaning see Figure 3; HDB: cleaning during drilling action with hollow drill bit system.

Conditions of listing:

1. The listing report addresses only conformance with the standards and code sections noted above.
2. Approval of the product's use is the sole responsibility of the local code official.
3. The listing report applies only to the materials tested and as submitted for review by ICC-ES.
4. Anchor sizes, dimensions, minimum embedment depths and other installation parameters are as set forth in this listing report.
5. Anchors must be limited to use in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 17.2 MPa (2,500 psi) to 58.6 MPa (8,500 psi).
6. The values of f'_c, used for calculation purposes must not exceed 55 MPa.

7. Limit states design values must be established in accordance with this listing report.

8. The use of fatigue or shock loading for these anchors under such conditions is beyond the scope of this listing report.

9. Anchors may be used to resist short-term loading due to wind or seismic forces in locations designed according to NBCC 2015.

10. Where not otherwise prohibited in the code as referenced in CSA A23.3-14, Chemofast EP 1000 Adhesive Anchor System are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:

    a. Anchors are used to resist wind or seismic forces only.

    b. Anchors that support a fire-resistance-rated envelope or a fire- resistance-rated membrane are protected by approved fire-resistance- rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.

    c. Anchors are used to support nonstructural elements.

11. Use of zinc-coated carbon steel anchors is limited to dry, interior locations.

12. Use of anchors made of stainless steel as specified in this report are permitted for exterior exposure and damp environments.

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

14. Installation of anchors in horizontal or upwardly inclined orientations to resist sustained tension loads shall be performed by personnel certified by an applicable certification program, and the certification shall include written and performance tests in accordance with the ACI/CRSI Adhesive Anchor Installer Certification program, or equivalent in accordance with CSA A23.3-14 D.10.2.3. The installation shall be continuously inspected during installation by an inspector specially approved for that purpose. The special inspector shall furnish a report to the licensed design professional and building official that the work covered by the report has been performed and that the materials used and the installation procedures used conform with the approved contract documents and the MPII in accordance with CSA A23.3-14 D.10.2.4.

15. Chemofast EP 1000 adhesive anchors may be used to resist tension and shear forces in floor, wall for overhead installations into concrete with a temperature between 40°F and 104°F (5°C and 40°C) for threaded rods and rebar.

16. Anchors 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 façade systems and other applications subject to direct sun exposure.