ICC-ES Listing Report

ELC-4901

Issued May 2023

This listing is subject to renewal May 2024.

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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 products, 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 800 Adhesive Anchor System in Cracked and Uncracked Concrete

Listee: CHEMOFAST ANCHORING GmbH

Compliance with the following standards:

- Annex D, Anchorage, of CSA A23.3-19, Design of Concrete Structures, CSA Group.

Compliance with the following codes:

Chemofast EP 800 adhesive anchor system in cracked and uncracked concrete, as described in this listing report, are in conformance with CSA A23.3-19, Annex D, as referenced in the applicable section of the following code edition:

- *National Building Code of Canada*® 2020
  Applicable Section: Division B, Part 4, Section 4.3.3.

Description of adhesive anchor system:

The Chemofast EP 800 adhesive anchor system is comprised of Chemofast EP 800 two-component adhesive filled in cartridges, static mixing nozzles and manual or powered dispensing tools, hole cleaning equipment and adhesive injection accessories. The Chemofast EP 800 adhesive may be used with continuously threaded steel rods or steel reinforcing bars. The primary components of the Chemofast EP 800 adhesive anchor system, including the Chemofast EP 800 adhesive cartridge, static mixing nozzle, dispenser, and steel anchor elements, are shown in Figure 1.

THREADED ROD

REINFORCING BAR

VARIOUS AVAILABLE TWO-COMPONENT CARTRIDGES

STATIC MIXING NOZZLE

CHEMOFAST DISPENSER

FIGURE 1—EP 800 ADHESIVE ANCHOR SYSTEM

The Chemofast EP 800 adhesive is an injectable two-component epoxy adhesive. The two components are kept separate by means of a labeled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by Chemofast, which is attached to the cartridge. Chemofast EP 800 is available in 9.5-ounce (280ml), 13.5-ounce (400ml), 20 up to 20.5-ounce (600 up to 610ml) and 50.5-ounce (1500 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.

Identification:

1. The ICC-ES mark of conformity, electronic labeling, or the listing report number (ELC-4901) along with the name, registered trademark, or registered logo of the report holder must be included in the product label.

2. In addition, Chemofast EP 800 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 listing report number (ELC-4901). Threaded rods, nuts, washers, and deformed reinforcing bars are standard steel anchor elements and must conform to applicable national or international specifications as set forth in Tables 2 and 3 of this report.

3. The report holder’s contact information is the following:

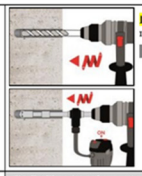
   CHEMOFAST ANCHORING GMBH
   HANNS-MARTIN-SCHLEYER-STRASSE 23
   47877 WILLICH
   GERMANY
   +49 (2154) 8123-0
   www.chemofast.de
   info@chemofast.de

Installation: Installation parameters are illustrated in Figure 4 and Table 1. Installation of the Chemofast EP 800 Adhesive Anchor System must conform to the manufacturer’s printed installation instructions included in each unit package as described in Figure 2. 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 2 of this 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 installed in the specified hole diameter and attached to the mixing nozzle and extension tube supplied by Chemofast as described in Figure 2.

CHEMOFAST® EP 800 - Instruction Card

1. Setting instructions for solid base material with Hammer drilling or Chemofast hollow drill bit system

Drilling

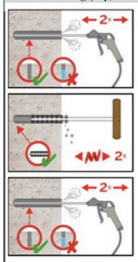


Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemofast to minimize dust emissions)

1. Drill a hole into the base material with a hammer drill tool to the size and embedment required by the selected steel hardware element (see Table 4). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15.
For bore holes drilled with the Chemofast hollow drill bit system (consisting of Heller Duster Expert drill bits and a Class M vacuum with air flow 150m³/h resp. 42l/s resp. 90cfm; the vacuum must be on!) no further cleaning is required ➔ go to Step 3, otherwise to Step 2a for CAC hole cleaning instructions.
In case of standing water in the drilled hole, except for submerged concrete, all the water has to be removed from the hole (e.g. vacuum, compressed air, etc.) prior to cleaning.

Hole cleaning

CAC: Cleaning (dry, water saturated and water-filled) for all bore hole diameter in uncracked and cracked concrete

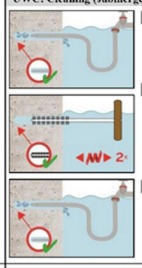


2a. Starting from the bottom or back of the anchor hole, blow the hole clean with compressed air (min. 6 bar / 90 psi) a minimum of two times, until return air stream is free of noticeable dust. If the back of the drilled hole is not reached an extension shall be used.

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

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

UWC: Cleaning (submerged) for all bore hole diameter in uncracked and cracked concrete

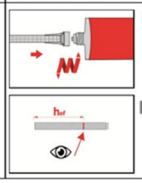


2a. Starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.

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 ($d_{brush} > d_{b,min}$, 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.

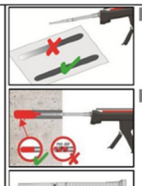
Preparing



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.*

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.

Installation



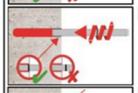
5. Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and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

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_o >10" (250mm)
- all installations in submerged bore holes

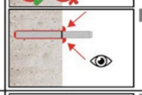
with anchor rod 5/8" to 1-1/4" (M16 to M30) and rebar sizes #5 to #11 (Ø14 to Ø36).

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. 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.

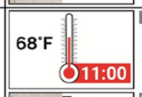


7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



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 minimum 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. Working and curing times

Temperature of base material	Maximum working time	Initial curing time[1)]	Full curing time
41 °F (+5 °C) to 49 °F (+9 °C)	80 min	24 h	48 h
50 °F (+10 °C) to 58 °F (+14 °C)	60 min	15 h	30 h
59 °F (+15 °C) to 67 °F (+19 °C)	40 min	10 h	20 h
68 °F (+20 °C) to 76 °F (+24 °C)	30 min	5 h	11h
77 °F (+25 °C) to 85 °F (+29 °C)	12 min	4 h	9 h
86 °F (+30 °C) to 103 °F (+39 °C)	8 min	3 h	6 h
104 °F (+40 °C)	7 min	2 h	4 h

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

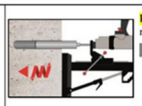
[1)] Initial cure times are for post-installed rebar applications only. After the initial curing time, the installation of connecting reinforcements and formwork attachments is permitted.

FIGURE 2—INSTALLATION INSTRUCTIONS

CHEMOFAST® EP 800 - Instruction Card

1. Setting instructions for solid base material with Diamond drilling

Drilling



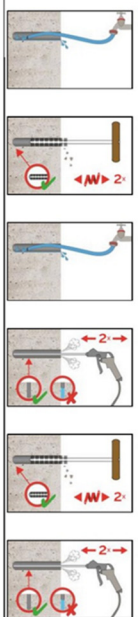
Precaution: Wear suitable eye and skin protection. Avoid inhalation of dusts during drilling and/or removal. (see dust extraction equipment by Chemofast to minimize dust emissions)

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 ($d_{brush} > d_{b,min}$, 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.

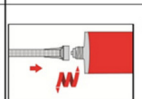
2c. Finally, starting from the bottom or back of the bore hole, rinse/flush the hole clean until clean water comes out. If the back of the drilled hole is not reached an extension shall be used.

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.

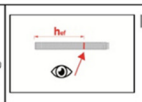
2e. Determine brush diameter (see Table 3) for the drilled hole. Brush the hole with the selected wire brush a minimum of two times (2x). A brush extension (supplied by Chemofast Anchoring GmbH) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use ($d_{brush} > d_{b,min}$, 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.

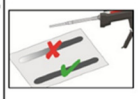
Preparing



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.*



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.

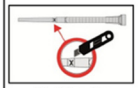


5. Adhesive must be properly mixed to achieve published properties. Prior to dispensing adhesive into the drilled hole, separately dispense at least three full strokes of adhesive through the mixing nozzle until the adhesive is a consistent gray or red color. Review and note the published working and 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_o >10" (250mm)

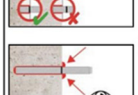
with anchor rod 5/8" to 1-1/4" (M16 to M30) and rebar sizes #5 to #10 (Ø14 to Ø32).



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. 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.

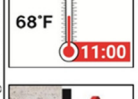
7. The anchor should be free of dirt, grease, oil or other foreign material. Push clean threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. Observe the gel (working) time.



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 minimum 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 - ∅	d_b Brush - ∅		$d_{b,min}$ min. Brush - ∅		Cat. #	Piston plug	Cat. #
[inch]	[inch]	[inch]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
3/8"	-	7/16	13.5	0.53	11.6	0.46	16111	No plugs required	
-	#3	1/2	14.3	0.56	13.2	0.52	16112		
1/2"	-	9/16	16.3	0.65	14.8	0.58	16114		
-	#4	5/8	18.3	0.72	16.5	0.65	16116		
5/8"		11/16	20.0	0.79	18.0	0.71	16117	11/16	40355
	#5	3/4	21.5	0.85	19.5	0.78	16118	3/4	40341
3/4"	#6	7/8	24.8	0.98	23.0	0.91	16121	7/8	40343
7/8"	#7	1	28.5	1.12	26.2	1.03	16123	1	40345
1"	#8	1 1/8	31.8	1.25	29.5	1.16	16125	1 1/8	40346
1-1/4"	#9	1 3/8	38.2	1.50	35.8	1.41	16128	1 3/8	40349
-	#10	1 1/2	41.4	1.63	39.0	1.54	16129	1 1/2	40350
-	#11	1 3/4	47.0	1.85	45.0	1.77	16080	1-3/4	40352

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

Threaded Rod	Rebar	d_0 Drill bit - ∅	d_b Brush - ∅		$d_{b,min}$ min. Brush - ∅		Cat. #	Piston plug	Cat. #
[mm]	[mm]	[mm]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
M10	-	12	13.5	0.53	12.5	0.41	16111	No plugs required	
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	0.79	18.5	0.65	16117	18	40340
-	16	20	22.0	0.87	20.5	0.73	16119	20	40342
M20	-	22	24.0	0.94	22.5	0.81	16120	22	40343
-	20	25	27.0	1.06	24.5	0.89	16122	25	40345
M24	-	28	30.0	1.18	28.5	0.96	16124	28	40346
M27	-	30	31.8	1.25	30.5	1.12	16125	30	40347
-	25	32	34.0	1.34	32.5	1.20	16126	32	40348
M30	28	35	37.0	1.46	35.5	1.28	16127	35	40349
-	32	40	43.5	1.71	40.5	1.40	16130	40	40351
-	36	45	47.0	1.85	45.0	1.77	16080	45	40352

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

	Nominal threaded rod (fractional) inch; ft.-lb.							Nominal threaded rod (metric) mm; Nm							Reinforcing bar (fractional) inch; ft.-lb.									Reinforcing bar (metric) mm; Nm								
Anchor size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M10	M12	M16	M20	M24	M27	M30	#3	#4	#5	#6	#7	#8	#9	#10	#11	∅ 10	∅ 12	∅ 14	∅ 16	∅ 20	∅ 25	∅ 28	∅ 32	∅ 36
d_a = Nominal anchor rod diameter	0.375	0.500	0.625	0.750	0.875	1.000	1.250	10	12	16	20	24	27	30	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	1-3/8	10	12	14	16	20	25	28	32	36
d_o (d_{bit}) = Nominal ANSI drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	12	14	18	22	28	30	35	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	1-3/4	14	16	18	20	25	32	35	40	45
Parameter valid for anchors																																
T_{max} = Maximum torque	20[2]	30	44	66	96	147	221	20	40	80	120	170	250	300	20[2]	30	44	66	96	147	185	221	-	20	40	45	80	120	175	250	300	-
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	70	80	90	96	108	120	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	-	60	70	75	80	90	100	112	128	-
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25	200	240	320	400	480	540	600	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	-	200	240	280	320	400	500	560	640	-
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-7/8	50	60	80	95	115	130	145	1-7/8	2-1/2	3	3-3/4	4-1/4	4-3/4	5-1/4	5-7/8	-	50	60	70	80	95	120	135	150	-
c_{min} = 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	40	45	55	60	70	75	80	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	-	40	45	50	55	60	70	75	85	-
c_{min} = Min. edge distance (45% T_{max}[1])	-		1.75				2.75	-		45				70	-		1.75			2.75		-	-			45			70		-
h_{min} = Minimum member thickness	h_{ef} + 1-1/4		h_{ef} + $2d_o$					h_{ef} + 30		h_{ef} + $2d_o$					h_{ef} + 1-1/4		h_{ef} + $2d_o$							h_{ef} + 30		h_{ef} + $2d_o$						
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	5-1/2	60	70	75	80	90	100	112	128	128
$h_{ef,max}$ = Maximum embedment (PIR)	-							-							22-1/2	30	37-1/2	45	52-1/2	60	67-1/2	75	82-1/2	600	720	840	960	1200	1500	1680	1920	2160

[1] s_{min} = 5xd_o. [2] for ASTM 36 and F1554 Grade 36, T_{max} = 15 ft.-lb.

5. EP 800 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
9,5 fl. oz. dispenser	Cat. #30006 Manual tool	EP800 9,5 fl. oz. (280mL)	Mixing nozzle Cat. #40154	(Cat# Table 3a or 3b)	If the bore hole ground is not reached an extension shall be used.	(Cat. #16009)	(Cat#16132)
13,5 fl. oz. dispenser	Cat. #30215 Manual tool	EP800 13,5 fl. oz. (400mL)				Extension tube VL16/1,8	Brush extension
20 to 20.5 fl. oz. dispenser	Cat. #30216 Manual tool Cat. #30220 Pneumatic tool	EP800 20 to 20.5 fl. oz. (600 to 610 mL)				(Cat. #16004)	(Cat#16131)
50.5 fl. oz. dispensers	Cat. #30202 Pneumatic tool	EP 800 50.5 fl. oz. (1500mL)					

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

Cartridge	Injection tools	d_s	h_{ef}	Extension tube
9,5 to 20.5 fl. oz.	Manual tool	≤ #5 ≤ 16 [mm]	≤ 27-1/2 [inch] ≤ 700 [mm]	VL10/0,75 (Cat.#16009) or VL16/1,8 (Cat.#16004)
9,5 to 20.5 fl. oz. 50.5 fl. oz.	Pneumatic tool	≤ #5 ≤ 16 [mm]	≤ 51-1/2 [inch] ≤ 1300 [mm]	
9,5 to 20.5 fl. oz. 50.5 fl. oz.	Pneumatic tool	≤ #8 ≤ 25 [mm]	≤ 39-1/2 [inch] ≤ 1000 [mm]	
50.5 fl. oz.	Pneumatic tool	≤ #11 ≤ 36 [mm]	≤ 75 [inch] ≤ 2160 [mm]	VL16/1,8 (Cat.#16004)

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FIGURE 2—INSTALLATION INSTRUCTIONS (Continued)

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 3—CHEMOFAST DUST REMOVAL DRILLING SYSTEM WITH HEPA DUST EXTRACTOR OPTIONS

Anchor setting information:

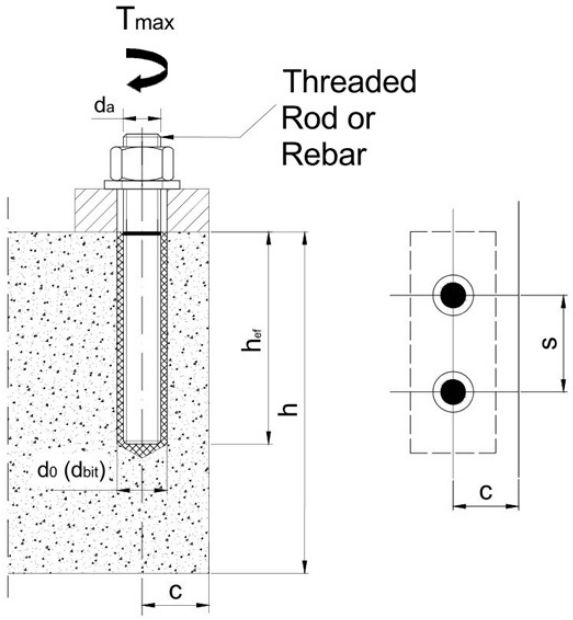

FIGURE 4—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

TABLE 1—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 five anchor diameters (5d). 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. M16 to M27	1.75 in. (45 mm)	5*d*	$0.45 \cdot T_{max}$
$1^1/_4$ in. M30	2.75 in. (70 mm)		

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

Ultimate Limit States Design:

Design resistance of anchors for compliance with the 2020 NBCC must be determined in accordance with CSA A23.3-19 Annex D, and this listing report.

Design parameters provided in Tables 2 through 15 of this listing report are based on the 2020 NBCC (CSA A23.3-19). The limit states design of anchors must comply with CSA A23.3-19 D.5.1, except as required in CSA A23.3-19 D.4.3.1.

Material resistance factors must be $\phi_c = 0.65$ and $\phi_s = 0.85$ in accordance with CSA A23.3-14 Sections 8.4.2 and 8.4.3, and resistance modification factor, *R,* as given in CSA A23.3-19 Section D.5.3, and noted in Tables 4, 5, 7, 8, 10, 11, 13 and 14 of this listing report, must be used for load combinations calculated in accordance with Division B, Part 4, Section 4.1.3 of the 2020 NBCC, or Annex C of CSA A23.3-19. The nominal strength, N_{sa} or V_{sa}, in Tables 4, 7, and 10 of this listing report must be multiplied by ϕ_s and R to determine the factored resistance, N_{sar} or V_{sar}.

The bond strength must be adjusted by the permissible installation condition factors for dry concrete, R_d, water-saturated concrete, R_{ws}, water-filled holes, R_{wf}, and underwater concrete, R_{uw}, for the corresponding installation conditions as given in Tables 6, 9, 12 and 15.

For anchors to be installed in seismic regions described in NBCC 2020. The factored resistance in shear, V_{sar}, must be adjusted by $\alpha_{V,seis}$ as given in tables 4, 7, and 10 for the corresponding anchor steel. The nominal bond strength $\tau_{k,cr}$ must be adjusted by $\alpha_{N,seis}$ a as given in Tables 6, 9, 12 and 15 for threaded rods.

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	MPa	862	724	1.19	16	50	ASTM A194 / A563 Grade DH
	ASTM A36[3] / F1554[4], Grade 36 all sizes	MPa	400	250	1.61	23	40	ASTM A194 / A563 Grade A
	ASTM F1554[4] Grade 55	MPa	517	380	1.36	23	40	
	ASTM F1554[4] Grade 105	MPa	860	724	1.19	15	45	ASTM A194 / A563 Grade DH
	ASTM A449[5] 3/8 to 1 in.	MPa	830	635	1.30	14	35	
	ASTM A449[5] 1 1/4 in	MPa	720	560	1.30	14	35	
	ASTM F568M[6] Class 5.8 (equivalent to ISO 898-1)	MPa	500	400	1.25	10	35	ASTM A563 Grade DH DIN 934 (8-A2K)[13]
	ISO 898-1[7] Class 5.8	MPa	500	400	1.25	22	-	EN ISO 4032 Grade 6
	ISO 898-1[7] Class 8.8	MPa	800	640	1.25	12	52	EN ISO 4032 Grade 8
STAINLESS STEEL	ASTM F593[8] CW1 3/8 to 5/8 in. (316)	MPa	690	450	1.54	20	-	ASTM F594 Alloy Group 1, 2 or 3
	ASTM F593[8] CW2 3/4 to 1 1/4 in. (316)	MPa	590	310	1.89	25	-	
	ASTM A193/A193M[9] Grade B8/B8M2, Class 2B	MPa	655	515	1.27	25	40	ASTM A194/A194M
	ISO 3506-1[10] A4-70 (M8-M24)	MPa	700	450	1.56	40	-	EN ISO 4032
	ISO 3506-1[10] A4-50 (M27-M30)	MPa	500	210	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—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] Grade 75	MPa	690	520
ASTM A615[1], A767[3], A996[4] Grade 60	MPa	620	414
ASTM A706[2], A757[3] Grade 60	MPa	550	414
ASTM A615[1], Grade 40	MPa	415	275
DIN 488[5] BSt 500	MPa	550	500

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

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

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod O.D.		d_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (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}	kN	20.0	36.6	58.3	86.3	119.1	156.3	250.0
		V_{sa}	kN	12.0	22.0	35.0	51.8	71.4	93.8	150.0
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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}	kN	25.9	47.6	75.5	111.7	154.1	202.1	323.1
		V_{sa}	kN	15.5	28.6	45.3	67	92.5	121.3	193.9
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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}	kN	43.1	78.9	125.7	186	256.7	336.8	538.8
		V_{sa}	kN	25.9	47.3	75.4	111.6	154	202.1	323.3
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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}	kN	41.4	76.2	120.9	178.8	246.7	323.7	450
		V_{sa}	kN	24.8	45.7	72.5	107.3	148	194.2	270
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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}	kN	25	46	73	108	149	195.5	312.5
		V_{sa}	kN	15	27.6	43.8	64.8	89.4	117.3	187.5
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Resistance modification factor for tension[3]	R	-	0.70						
	Resistance modification factor for shear[3]	R	-	0.65						
ASTM F593 CW Stainless	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	34.5	63.1	100.5	126.5	174.6	229	366.4
		V_{sa}	kN	20.7	37.9	60.3	75.9	104.7	137.4	219.8
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Resistance modification factor for tension[3]	R	-	0.70						
	Resistance modification factor for shear[3]	R	-	0.65						
ASTM A193/A193M Grade B8/B8M2, Class 2B	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	32.8	60.3	95.6	141.5	195.2	256.1	409.4
		V_{sa}	kN	19.7	36.2	57.4	84.9	117.1	153.7	245.6
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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 A23.3-19 Eq. D.2 and Eq. D.3, as applicable. Nuts and washers must comply with requirements for the rod.

[2]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 2020 NBCC or Annex C of CSA A23.3-19 are used. Values correspond to ductile steel elements.

[3]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 2020 NBCC or Annex C of CSA A23.3-19 are used. Values correspond to brittle steel elements.

TABLE 5—CONCRETE BREAKOUT 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
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.)	48 (1 7/8)	60 (2 3/8)	76 (3)	95 (3 3/4)	108 (4 1/4)	121 (4 3/4)	149 (5 7/8)
Min. edge distance	c_{min}	mm (in.)	41 (1 5/8)	44 (1 3/4)	51 (2)	60 (2 3/8)	64 (2 1/2)	70 (2 3/4)	82 (3 1/4)
					See Table 1 of this 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}	-	$2h_{ef}$						
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						

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 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 2, 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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 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			$h_{ef,min}$	mm (in.)	60.3 (2 3/8)	69.9 (2 3/4)	79.4 (3 1/8)	88.9 (3 1/2)	88.9 (3 1/2)	101.6 (4)	127.0 (5)
Maximum embedment			$h_{ef,max}$	mm (in.)	191 (7 1/2)	254 (10)	318 (12 1/2)	381 (15)	445 (17 1/2)	508 (20)	635 (25)
Temperature range A[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	15.1	14.7	14.3	13.8	13.4	13	12.1
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	10.5	10.6	9.4	10.7	10.5	10.3	9.9
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	11.8	11.5	11.2	10.8	10.5	10.1	9.5
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	8.2	8.3	7.4	8.3	8.2	8	7.8
Permissible installation conditions	Dry concrete	Anchor Category	-	-	1						
		Resistance modification factor	R_d	-	1.00						
	Water-saturated concrete	Anchor Category	-	-	2						
		Resistance modification factor	R_{ws}	-	0.85						
	Water-filled hole (flooded)	Anchor Category	-	-	3						
		Resistance modification factor	R_{wf}	-	0.75						
		Modification factor for Water-filled holes	K_{wf}	-	0.85						
	Underwater (submerged)	Anchor Category	-	-	2						
		Resistance modification factor	R_{uw}	-	0.85						
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1.00	1.00	0.90	1.00	0.95	1.00	1.00

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 N/mm²). For concrete compressive strength, f'_c between 2,500 (17.2 N/mm²) psi and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.21}$ [For SI: $(f'_c / 17.2)^{0.21}$] for uncracked concrete, and $(f'_c / 2500)^{0.14}$ [For SI: $(f'_c / 17.2)^{0.14}$] for cracked concrete.
[2]Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°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 17 percent.

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_a	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.128 (28.6)	1.270 (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 Grade 75	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	48.9	89	137.9	195.7	266.9	351.4	444.8	564.9
		V_{sa}	kN	29.4	53.4	82.7	117.4	160.1	210.8	266.9	338.9
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Resistance modification factor for tension[3]	R	-	0.70							
	Resistance modification factor for shear[3]	R	-	0.65							
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	44	80.1	124.1	176	240	316	400	508
		V_{sa}	kN	26.4	48	74.5	105.7	144.1	189.8	240.2	305
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Resistance modification factor for tension[3]	R	-	0.70							
	Resistance modification factor for shear[3]	R	-	0.65							
ASTM A706 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	39.1	71.2	110.3	156.6	213.5	281.1	355.9	452
		V_{sa}	kN	23.5	42.7	66.2	93.9	128.1	168.7	213.5	271.2
	Reduction for seismic shear	$\alpha_{V,seis}$	----	0.70							
	Resistance modification factor ϕ for tension[2]	R	----	0.80							
	Resistance modification factor ϕ for shear[2]	R	----	0.75							
ASTM A615 Grade 40	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN	29.4	53.4	82.7	117.4	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	kN	17.6	32	49.6	70.5				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Resistance modification factor for tension[3]	R	-	0.70							
	Resistance modification factor for shear[3]	R	-	0.65							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with CSA A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 are used. Values correspond to ductile steel elements.
[3]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 2020 NBCC or Annex C of CSA A23.3-19 are used. Values correspond to brittle steel elements.
[4]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 A HAMMER DRILL AND CARBIDE BIT (OR CHEMOFAST HOLLOW CARBIDE DRILL 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	$k_{c,cr}$	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.)	48 ($1^7/_8$)	60 ($2^3/_8$)	77 (3)	95 ($3^3/_4$)	108 ($4^1/_4$)	121 ($4^3/_4$)	135 ($5^1/_4$)	149 ($5^7/_8$)
Min. edge spacing[4]	c_{min}	mm (in.)	41 ($1^5/_8$)	44 ($1^3/_4$)	51 (2)	60 ($2^3/_8$)	64 ($2^1/_2$)	70 ($2^3/_4$)	76 (3)	82 ($3^1/_4$)
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}	-	$2h_{ef}$							
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							

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]Additional setting information is described in Figure 2, 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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 are used.
[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			$h_{ef,min}$	mm (in.)	60.3 ($2^3/_8$)	69.9 ($2^3/_4$)	79.4 ($3^1/_8$)	88.9 ($3^1/_2$)	88.9 ($3^1/_2$)	101.6 (4)	114 ($4^1/_2$)	127.0 (5)
Maximum embedment			$h_{ef,max}$	mm (in.)	191 ($7^1/_2$)	254 (10)	318 ($12^1/_2$)	381 (15)	445 ($17^1/_2$)	508 (20)	572 (22.5)	635 (25)
Temperature range A[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	13.4	13.1	12.9	12.7	12.4	12.2	11.7	11.7
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	10	10	9	10	10	10	9.8	9.8
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	10.5	10.3	10.1	9.9	9.7	9.5	9.1	9.2
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	7.8	7.8	7.1	7.8	7.8	7.8	7.7	7.7
Permissible installation conditions	Dry concrete	Anchor Category	-	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated concrete	Anchor Category	-	-	2							
		Resistance modification factor	R_{ws}	-	0.85							
	Water-filled hole (flooded)	Anchor Category	-	-	3							
		Resistance modification factor	R_{wf}	-	0.75							
		Modification factor for Water-filled holes	K_{wf}	-	0.85							
	Underwater (submerged)	Anchor Category	-	-	2							
		Resistance modification factor	R_{uw}	-	0.85							
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1.00							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 N/mm²). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.18}$ [For SI: $(f'_c / 17.2)^{0.18}$].
[2]Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°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 17 percent.

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_a	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	29.0	42.2	78.5	122.5	176.5	229.5	280.5
		V_{sa}	kN	14.5	25.3	47.1	73.5	105.9	137.7	168.3
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	Resistance modification factor for tension[2]	R	-	0.70						
	Resistance modification 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	46.4	67.4	125.6	196	282.4	367.2	448.8
		V_{sa}	kN	23.0	40.5	75.4	117.6	169.4	220.3	269.3
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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	40.6	59	109.9	171.5	247.1	229.5	280.5
		V_{sa}	kN	20.3	35.4	65.9	102.9	148.3	137.7	168.3
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70						
	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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 are used. Values correspond to brittle steel elements.
[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 (OR CHEMOFAST HOLLOW CARBIDE DRILL 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 ($2^3/_8$)	80 ($3^1/_8$)	95 ($3^3/_4$)	115 ($4^1/_2$)	130 ($5^1/_8$)	145 ($5^1/_2$)
Min. edge distance	c_{min}	mm (in.)	40 ($1^5/_8$)	45 ($1^3/_4$)	55 ($2^1/_4$)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	80 ($3^1/_8$)
					See Table 1 of this 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}	-	$2h_{ef}$						
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 2, 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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 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)						
					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 (7.8)	240 (14.8)	320 (12.6)	400 (15.8)	480 (18.8)	540 (21.4)	600 (23.6)
Temperature range A[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	15	14.8	14.2	13.7	13.2	12.7	12.3
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	10.5	10.6	9.4	10.7	10.5	10.3	9.9
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	11.8	11.6	11.1	10.7	10.3	10	9.7
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	8.2	8.3	7.4	8.3	8.2	8	7.8
Permissible installation conditions	Dry Concrete	Anchor category	–	-	1						
		Resistance modification factor	R_d	-	1.00						
	Water-saturated Concrete	Anchor category	–	-	2						
		Resistance modification factor	R_{ws}	-	0.85						
	Water-filled hole (flooded)	Anchor category	–	-	3						
		Resistance modification factor	R_{wf}	-	0.75						
		Modification factor for water filled holes	K_{wf}	-	0.85						
	Underwater (submerged)	Anchor Category	-	-	2						
		Resistance modification factor	R_{uw}	-	0.85						
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1.00	1.00	0.90	0.94	0.94	1.00	1.00

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 N/mm²). For concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.21}$ [For **SI**: $(f'_c / 17.2)^{0.21}$] for uncracked concrete and $(f'_c / 2500)^{0.14}$ [For **SI**: $(f'_c / 17.2)^{0.14}$] for cracked concrete. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°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 17 percent.

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

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Reinforcing bar O.D.		d_a	mm (in.)	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)	78.5 (0.121)	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	43.2	62.2	84.7	110.6	172.8	270.0	338.7	442.3
		V_{sa}	kN	25.9	37.3	50.8	66.4	103.7	162.0	203.2	265.4
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.70							
	Resistance modification factor for tension, concrete failure modes, Condition B[2]	R	-	0.70							
	Resistance modification factor for shear, concrete failure modes, Condition B[2]	R	-	0.65							

[1]Values provided for common bar material types based on specified strengths and calculated in accordance with ACI 318-19 Eq. 17.6.1.2 and Eq. 17.7.1.2b or 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]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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 are used.

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

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size							
			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)							
Min. anchor spacing	s_{min}	mm (in.)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	80 ($3^1/_8$)	95 ($3^3/_4$)	120 ($4^5/_8$)	135 ($5^1/_4$)	150 ($5^7/_8$)
Min. edge spacing	c_{min}	mm (in.)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	55 ($2^1/_4$)	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}	-	$2h_{ef}$							
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 2, 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 A23.3-19 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 2020 NBCC or Annex C of CSA A23.3-19 are used.
[3]d_0 = hole diameter.

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 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	13.3	13.2	13	12.8	12.5	12.2	12	11.7
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	10	10	10	9	10	10	9.8	9.8
Temperature range B[2,3]	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm²	10.4	10.3	10.2	10	9.7	9.5	9.4	9.2
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm²	7.8	7.8	7.8	7.1	7.8	7.8	7.7	7.7
Permissible installation conditions	Dry Concrete	Anchor category	–	-	1							
		Resistance modification factor	R_d	-	1.00							
	Water-saturated Concrete	Anchor category	–	-	2							
		Resistance modification factor	R_{ws}	-	0.85							
	Water-filled hole (flooded)	Anchor category	–	-	3							
		Resistance modification factor	R_{wf}	-	0.75							
		Modification factor for water filled holes	K_{wf}	-	0.85							
	Underwater (submerged)	Anchor Category	-	-	2							
		Resistance modification factor	R_{uw}	-	0.85							
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	1.0							

For **SI:** 1 inch = 25.4 mm, 1 lbf = 4.448 N, 1 psi = 0.006894 MPa.
For **pound-inch** units: 1 mm = 0.03937 inches, 1 N = 0.2248 lbf, 1 MPa = 145.0 psi.

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi (17.2 N/mm²). For uncracked concrete compressive strength, f'_c between 2,500 psi (17.2 N/mm²) and 8,000 psi (55.2 N/mm²), the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.18}$ [For SI: $(f'_c / 17.2)^{0.18}$]. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 140°F (60°C), maximum long term temperature = 110°F (43°C); Temperature range B: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 110°F (43°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 17 percent.

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 2,500 psi (17.2 MPa) to 8,500 psi (58.6 MPa).
6. The values of f'_c, used for calculation purposes must not exceed 55 MPa. The values of f'_c, used for calculation of tension resistance must be limited to 17.2 Mpa maximum for EU metric reinforcing bars used as anchorage in cracked concrete only.
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 2020.
10. Where not otherwise prohibited in the code as referenced in CSA A23.3-19, Chemofast EP 800 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 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.

    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 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.
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 A23.3-19 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 A23.3-19 D.10.2.4.