ICC-ES Listing Report

ELC-4466

Issued May 2021

This listing is subject to renewal May 2022.

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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 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: Würth Wit-Uh 300 Adhesive Anchor System in Cracked and Uncracked Concrete

Listee: ADOLF WÜRTH GmbH & CO. KG

Compliance with the following standards:

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

Compliance with the following codes:

Würth WIT-UH 300 adhesive anchor system in cracked and uncracked concrete, 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 edition:

- *National Building Code of Canada*® 2015
  Applicable Section: Division B, Part 4, Section 4.3.3.

Description of adhesive anchor system:

The Würth WIT-UH 300 Adhesive Anchor System comprised of Würth WIT-UH 300 two-component adhesive filled in cartridges, static mixing nozzles, dispensing tools, hole cleaning equipment, and adhesive injection accessories. The Würth WIT-UH 300 adhesive may be used with continuously threaded steel rods or deformed steel reinforcing bars. The primary components of the Würth WIT-UH 300 Adhesive Anchor System, including the Würth WIT-UH 300 adhesive cartridge, static mixing nozzle, and steel anchor elements, are shown in Figure 1.

THREADED ROD

REINFORCING BAR

VARIOUS AVAILABLE TWO-COMPONENT CARTRIDGES

ADOLF WÜRTH GmbH & CO. KG DISPENSER

STATIC MIXING NOZZLE

FIGURE 1— WÜRTH WIT-UH 300 ADHESIVE ANCHOR SYSTEM INCLUDING TYPICAL STEEL ANCHOR ELEMENTS

The Würth WIT-UH 300 adhesive is an injectable two-component vinylester-urethane hybrid adhesive. The two components are kept separate by means of a labelled dual-cylinder cartridge. The two components combine and react when dispensed through a static mixing nozzle, supplied by Adolf Würth GmbH & Co. KG, which is attached to the cartridge. Würth WIT-UH 300 is available in: coaxial cartridge: 5-ounce (150 mL), 9.5-ounce (280 mL) up to 11-ounce (333 mL) and 13 up to 14-ounce (380 up to 420 mL) and side-by-side cartridges: 8-ounce (235 mL), 11.5-ounce (345 mL) up to 12-ounce (360 mL) and 28-ounce (825 mL). Each cartridge label is marked with the adhesive expiration date. The shelf life, as indicated by the expiration date, applies to an unopened cartridge stored in a dry, dark, and cool environment.

Identification:

1. Würth WIT-UH 300 adhesive is identified by packaging labelled with the company's name (Adolf Würth GmbH & Co. KG) and address, anchor name, the lot number, the expiration date, and the evaluation report; company name; listing report number (ELC-4466), 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 report or equivalent.

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

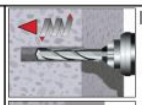
   ADOLF WÜRTH GmbH & CO. KG
   REINHOLD-WÜRTH-STRASSE 12-17
   74653 KÜNZELSAU
   GERMANY
   +49 (7940) 15 0
   www.wuerth.de
   info@wuerth.de

Installation: The installation parameters are illustrated in Figure 4 and Table 1. Installation of the Würth WIT-UH 300 adhesive anchor system must conform to the manufacturer's printed installation instructions (MPII) included in each unit package as described in Figure 2. The adhesive anchor system may be used for upwardly inclined orientation applications (e.g. overhead). Upwardly inclined and horizontal orientation applications are to be installed using piston plugs in accordance with the MPII as shown in Figure 2 of this report. The piston plugs must be used with an appropriate hole diameter size and attached to the mixing nozzle and extension tube supplied by Adolf Würth GmbH & Co. KG.

Würth WIT-UH 300 - Instruction Card

1. Setting instructions for solid base material - For any application not covered by this document please contact Adolf Würth GmbH & Co. KG (ESR-4466)

Drilling



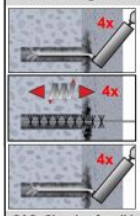
1. Drill a hole into the base material with a hammer drill tool to the size and embedment required by the selected steel hardware element (see Table 4). The tolerances of the carbide drill bit must meet the requirements of ANSI Standard B212.15.

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

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

MAC: Cleaning for bore holes $d_0 \leq 3/4"$ (20mm) and bore hole depth $h_0 \leq 10d_s$ (uncracked concrete only!)



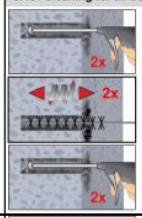
2a Starting from the bottom or back of the anchor hole, blow the hole clean with handpump a minimum of four times.
If the back of the drilled hole is not reached an extension shall be used.

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 Würth) must be used for drill hole depth > 6" (150mm).

The wire brush diameter must be checked periodically during use ($Ø_{brush} > D_{min}$, see Table 3a or 3b). The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter. If the back of the drilled hole is not reached a brush extension shall be used.

2c Finally blow the hole clean again with a handpump a minimum of four times. 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.

CAC: Cleaning 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 Würth) must be used for drill hole depth > 6" (150mm). The wire brush diameter must be checked periodically during use ($Ø_{brush} > D_{min}$, see Table 3a or 3b). The brush should resist insertion into the drilled hole - if not the brush is too small and must be replaced with the proper brush diameter. If the back of the drilled hole is not reached a brush extension shall be used.

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

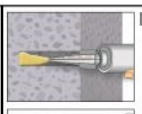
Preparing

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

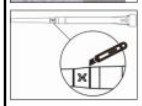
4. Prior to inserting the anchor rod or rebar into the filled drilled hole, the position of the embedment depth has to be marked on the anchor. Verify anchor element is straight and free of surface damage.

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

Installation



6. Fill the cleaned hole approximately two-thirds full with mixed adhesive starting from the bottom or back of the anchor hole. Slowly withdraw the mixing nozzle as the hole fills to avoid creating air pockets or voids. If the bottom or back of the anchor hole is not reached with the mixing nozzle only an extension tube supplied by Würth (Cat# 0903488123 or Cat# 0903488122) must be used with the mixing nozzle.



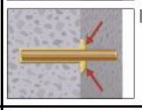
In case of using the extension tube VL16/1,8 (Cat# 0903488122), cut the tip of the mixer nozzle at position "X".

with piston plug:

Piston plugs (see Table 3a or 3b) must be used with and attached to mixing nozzle and extension tube for:
- overhead installations and installations between horizontal and overhead
- all installations with drill hole depth $d_0 > 10"$ (250mm)

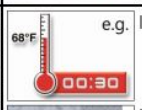
with anchor rod 5/8" to 1-1/4" (M16 to M30) diameter and rebar sizes #5 to #10 (Ø14 to Ø32).
Insert piston plug to the back of the drilled hole and inject as described in the method above. During installation the piston plug will be naturally extruded from the drilled hole by the adhesive pressure. **Attention!** Do not install anchors overhead or upwardly inclined without installation hardware supplied by Würth and also receiving proper training and/or certification. Contact Würth for details prior to use.

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

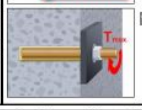


8. Be sure that the anchor is fully seated at the bottom of the hole and that some adhesive has flowed from the hole and all around the top of the anchor. If there is not enough adhesive in the hole, the installation must be repeated. For overhead applications and applications between horizontal and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

Curing and fixture



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



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

2. Gel (working) times and curing times

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

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

Threaded Rod	Rebar	d_0 Drill bit - Ø	d_b Brush - Ø		$d_{b,min}$ 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	0903489512	No plugs required	
-	#3	1/2	14.3	0.562	13.2	0.520	0903489513		
1/2"	-	9/16	16.3	0.654	14.8	0.582	0903489515		
-	#4	5/8	18.3	0.720	16.5	0.650	0903489517		
5/8"		11/16	20.0	0.787	18.0	0.709	0903489518	11/16	0903488063
	#5	3/4	21.5	0.846	19.5	0.777	0903489519	3/4	0903488064
3/4"	#6	7/8	24.8	0.976	23.0	0.905	0903489523	7/8	0903488062
7/8"	#7	1	28.5	1.122	26.2	1.030	0903489526	1	0903488059
1"	#8	1 1/8	31.8	1.252	29.5	1.160	0903489530	1 1/8	0903488052
1-1/4"	#9	1 3/8	38.2	1.504	35.8	1.410	0903489536	1 3/8	0903488060
-	#10	1 1/2	41.4	1.630	39.0	1.535	0903489039	1 1/2	0903488065

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

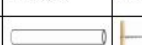
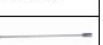
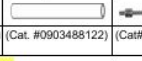
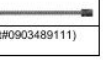
Threaded Rod	Rebar	d_0 Drill bit - Ø	d_b Brush - Ø		$d_{b,min}$ min. Brush - Ø		Cat. #	Piston plug	Cat. #
[mm]	[mm]	[mm]	[mm]	[inch]	[mm]	[inch]	[-]	(No.)	[-]
M10	-	12	13.5	0.53	12.5	0.41	0903489512	No plugs required	
M12	10	14	15.5	0.61	14.5	0.49	0903489514		
-	12	16	17.5	0.69	16.5	0.57	0903489516		
M16	14	18	20	0.79	18.5	0.65	0903489518	VS 18	0903488057
-	16	20	22	0.87	20.5	0.73	0903489520	VS 20	0903488058
M20	-	22	24	0.94	22.5	0.81	0903489522	VS 22	0903488062
-	20	25	27	1.06	24.5	0.89	0903489525	VS 25	0903488059
M24	-	28	30	1.18	28.5	0.96	0903489528	VS 28	0903488052
M27	-	30	31.8	1.25	30.5	1.12	0903489530	VS 30	0903488066
-	25	32	34	1.34	32.5	1.20	0903489532	VS 32	0903488053
M30	28	35	37	1.46	35.5	1.28	0903489535	VS 35	0903488060
-	32	40	43.5	1.71	40.5	1.40	0903489540	VS 40	0903488061

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

	Nominal threaded rod (fractional)							Nominal threaded rod (metric)							Reinforcing bar (fractional)								Reinforcing bar (metric)							
	inch; ft.-lb.							mm; Nm							inch; ft.-lb.								mm; Nm							
Anchor size	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1-1/4"	M10	M12	M16	M20	M24	M27	M30	#3	#4	#5	#6	#7	#8	#9	#10	∅ 10	∅ 12	∅ 14	∅ 16	∅ 20	∅ 25	∅ 28	∅ 32
d_s = Nominal anchor rod diameter	0.375	0.500	0.625	0.750	0.875	1.000	1.250	10	12	16	20	24	27	30	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4	10	12	14	16	20	25	28	32
d_o (d_{bit}) = Nominal ANSI drill bit size	7/16	9/16	11/16	7/8	1	1-1/8	1-3/8	12	14	18	22	28	30	35	1/2	5/8	3/4	7/8	1	1-1/8	1-3/8	1-1/2	14	16	18	20	25	32	35	40
Parameter valid for anchors																														
T_{max} = Maximum torque	15[2]	30	44	66	96	147	221	20	40	80	120	170	250	300	15[2]	30	44	66	96	147	185	221	20	40	45	80	120	175	250	300
$h_{ef,min}$ = Minimum embedment	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	5	60	70	80	90	96	108	120	2-3/8	2-3/4	3-1/8	3-1/2	3-1/2	4	4-1/2	5	60	70	75	80	90	100	112	128
$h_{ef,max}$ = Maximum embedment	7-1/2	10	12-1/2	15	17-1/2	20	25	200	240	320	400	480	540	600	7-1/2	10	12-1/2	15	17-1/2	20	22-1/2	25	200	240	280	320	400	500	560	640
s_{min} = Min. spacing	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-7/8	50	60	80	100	120	135	150	1-7/8	2-1/2	3	3-5/8	4-1/4	4-3/4	5-1/4	5-7/8	50	60	70	80	100	125	140	160
c_{min} = Min. edge distance with 100% T_{max}	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3-1/4	45	45	55	60	70	75	80	1-5/8	1-3/4	2	2-3/8	2-1/2	2-3/4	3	3-1/4	45	45	50	55	60	70	75	85
c_{min} = Min. edge distance with 45% T_{max} [1]	-			1.75			2.75	-			45			70	-			1.75			2.75		-			45			70	
h_{min} = Minimum member thickness	h_{ef} + 1-1/4			h_{ef} + 2d_o				h_{ef} + 30			h_{ef} + 2d_o				h_{ef} + 1-1/4			h_{ef} + 2d_o					h_{ef} + 30			h_{ef} + 2d_o			
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	70	75	80	90	100	112	128
$h_{ef,max}$ = Maximum embedment (PIR)	-							-							22-1/2	30	37-1/2	45	52-1/2	60	67-1/2	75	600	720	840	960	1200	1500	1680	1920

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

5. WIT-UH 300 adhesive anchor system and accessories

Injection tools		Cartridge system	Extra mixing nozzles	Piston Plug	Handpump	Extension tube VL10/0,75	Extension with wood handle
9.5 to 11 fl. oz. dispenser	Cat. #0891003 – Manual tool Cat. #0891003330 – Battery tool	WIT-UH 300 5 fl. oz. WIT-UH 300 9.5 to 11 fl. oz.	WIT-UH 300 mixing nozzle Cat. #0903488102		 (Cat. #0903990001)	 (Cat. #0903488123)	 (Cat#0903489103)
13 to 14 fl. oz. dispenser	Cat. #08910380 – Manual tool Cat. #0891004420 – Pneu. tool Cat. #0891003420 – Battery tool	WIT-UH 300 13 to 14 fl. oz.			**Compressed air nozzle (min. 90 psi)**	**Extension tube VL16/1,8**	**Brush extension**
28 fl. oz. dispensers	Cat. #0891004825 – Pneu. tool Cat. #0891003825 – Battery tool	WIT-UH 300 28 fl. oz.		(Cat# Table 3a or 3b)	 If the bore hole ground is not reached an extension shall be used.	 (Cat. #0903488122)	 (Cat#0903489111)

6. Post-installed rebar hef ≥ 20d

Cartridge	Injection tools	d_s	h_{ef}	Extension tube
9.5 to 11 fl. oz. 11.5 to 12 fl. oz. 13 to 14 fl. oz.	Manual tool	≤ #5 ≤ 16 [mm]	≤ 27-1/2 [inch] ≤ 700 [mm]	VL10/0,75 (Cat.# 0903488123)
9.5 to 11 fl. oz. 11.5 to 12 fl. oz. 13 to 14 fl. oz. 28 fl. oz.	Pneumatic tool	≤ #5 ≤ 16 [mm]	≤ 39-1/2 [inch] ≤ 1000 [mm]	
9.5 to 11 fl. oz. 11.5 to 12 fl. oz. 13 to 14 fl. oz. 28 fl. oz.	Pneumatic tool	≤ #8 ≤ 25 [mm]	≤ 27-1/2 [inch] ≤ 700 [mm]	
28 fl. oz.	Pneumatic tool	≤ #10 ≤ 32 [mm]	≤ 75 [inch] ≤ 1920 [mm]	VL16/1,8 Cat.#0903488122

Adolf Würth GmbH & Co. KG **www.wuerth.de**
Reinhold Würth Strasse 12-17 **P: +49 7940 15-0**
74653 Künzelsau, Germany **F: +49 7940 15-1000** [Rev. c]

FIGURE 2—MANUFACTURER'S PRINTED INSTALLATION INSTRUCTIONS (MPII)

Tool	Accessories and Shrouds	HEPA Dust Extractor
SDS-Max and SDS-Plus Drills		
 Rotary Drill Hammer	 SDS-Plus and SDS-Max Hollow Drill Bit  SDS-Plus and SDS-Max Drill Bit  Capture Device CAT# 0903990010	 Dust Extractor

FIGURE 3— WÜRTH DUST REMOVAL DRILLING SYSTEM WITH HEPA DUST EXTRACTOR OPTIONS

Anchor setting information:

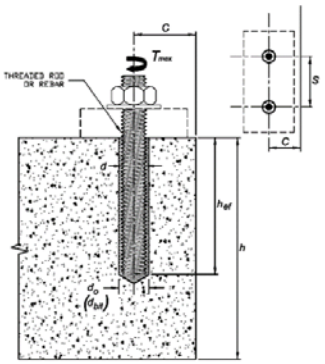


FIGURE 4—INSTALLATION PARAMETERS FOR THREADED RODS AND REINFORCING BARS

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 the values given in Tables 5, 8, 11 and 14, as applicable. T_{max} is subject to the edge distance, c_{min}, and anchor spacing, s_{min}, and shall comply with the following requirements:

INSTALLATION TORQUE SUBJECT TO EDGE DISTANCE			
NOMINAL ANCHOR SIZE, *d*	**MINIMUM EDGE DISTANCE, c_{min}**	**MINIMUM ANCHOR SPACING, s_{min}**	**MAXIMUM TORQUE, T_{max}**
$^5/_8$ in. to 1 in. #5 to #8 M16 to M24 ø14to ø25	1.75 in. (44.5 mm)	5*d*	$0.45 \cdot T_{max}$
$1^1/_4$ in. #9 to #10 M27 to M30 ø28 to ø32	2.75 in. (70 mm)		

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

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 parameters are provided in Table 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, 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 2015 NBCC, or Annex C of CSA A23.3-14. 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, and water-saturated concrete, R_{ws}, 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 2015. 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 ROD MATERIALS[1]

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

[1]Adhesive must be used with continuously threaded carbon or stainless steel rod (all-thread) having thread characteristics complying with ANSI B1.1 UNC Coarse Thread Series.
[2]Standard Specification for Alloy-Steel and Stainless steel Bolting Materials for High temperature of High Pressure service and Other Special Purpose Applications.
[3]Standard Specification for Carbon Structural steel
[4]Standard Specification for Anchor Bolts, Steel 36, 55 and 105-ksi Yield Strength
[5]Standard Specification for Hex Cap Screws, Bolts and Studs, Heat Treated, 120/105/50 ksi (837/724/621 MPa) Minimum Tensile Strength, General Use.
[6]Standard Specification for Carbon and Alloy Steel external Threaded Metric Fasteners
[7]Mechanical properties of fasteners made of carbon steel and alloy steel - Part 1: Bolts, Screws and Studs
[8]Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
[9]Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
[10]Mechanical properties of corrosion-resistant stainless steel fasteners - Part 1: Bolts, Screws and Studs
[11]Based on 2-in. (50 mm) gauge length except for ASTM A193, which is based on a gauge length of 4d.
[12]Nuts and washers of other grades and style having specified proof load stress greater than the specified grade and style are also suitable. Nuts must have specified proof load stresses equal to or greater than the minimum tensile strength of the specified threaded rod.
[13]Nuts for metric rods.

TABLE 3—SPECIFICATIONS AND PHYSICAL PROPERTIES OF COMMON STEEL REINFORCING BARS[1]

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

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

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

DESIGN INFORMATION		Symbol	Units	Nominal Rod Diameter (inch)						
				3/8	1/2	5/8	3/4	7/8	1	1 1/4
Threaded rod O.D.		*d*	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.250 (31.8)
Threaded rod effective cross-sectional area		A_{se}	in.² (mm²)	0.0775 (50)	0.1419 (92)	0.2260 (146)	0.3345 (216)	0.4617 (298)	0.6057 (391)	0.9691 (625)
ASTM A36/F1554, Grade 36	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	4,495 (20.0)	8,230 (36.6)	13,110 (58.3)	19,400 (86.3)	26,780 (119.1)	35,130 (156.3)	56,210 (250.0)
		V_{sa}	lb (kN)	2,695 (12.0)	4,940 (22.0)	7,860 (35.0)	11,640 (51.8)	16,070 (71.4)	21,080 (93.8)	33,725 (150.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	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	$\alpha_{V,seis}$	-	0.60						
	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	$\alpha_{V,seis}$	-	0.60						
	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	$\alpha_{V,seis}$	-	0.60						
	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	$\alpha_{V,seis}$	-	0.60						
	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}	lb (kN)	7,750 (34.5)	14,190 (63.1)	22,600 (100.5)	28,430 (126.5)	39,245 (174.6)	51,485 (229.0)	82,370 (366.4)
		V_{sa}	lb (kN)	4,650 (20.7)	8,515 (37.9)	13,560 (60.3)	17,060 (75.9)	23,545 (104.7)	30,890 (137.4)	49,425 (219.8)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	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}	lb (kN)	7,365 (32.8)	13,480 (60.3)	21,470 (95.6)	31,780 (141.5)	43,860 (195.2)	57,540 (256.1)	92,065 (409.4)
		V_{sa}	lb (kN)	4,420 (19.7)	8,090 (36.2)	12,880 (57.4)	19,070 (84.9)	26,320 (117.1)	34,525 (153.7)	55,240 (245.6)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.60						
	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, 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 2015 NBCC or Annex C of CSA A23.3-14 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 2015 NBCC or Annex C of CSA A23.3-14 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[1]

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (inch)						
			3/8	1/2	5/8	3/4	7/8	1	1 1/4
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in-lb (SI)	24 (10)						
Min. anchor spacing	s_{min}	in. (mm)	1 7/8 (48)	2 1/2 (64)	3 (76)	3 3/4 (95)	4 1/4 (108)	4 3/4 (121)	5 7/8 (149)
Min. edge distance	c_{min}	in. (mm)	1 5/8 (41)	1 3/4 (44)	2 (51)	2 3/8 (60)	2 1/2 (64)	2 3/4 (70)	3 1/4 (82)
					For smaller edge distances see Table 1 of this report for reduced minimum edge distances				
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}	-	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 4, 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 6—BOND STRENGTH DESIGN INFORMATION FOR U.S. CUSTOMARY UNIT THREADED ROD IN HOLES DRILLED WITH A HAMMER DRILL AND CARBIDE BIT[1]

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)						
					3/8	1/2	5/8	3/4	7/8	1	1 1/4
Minimum embedment			$h_{ef,min}$	in. (mm)	2 3/8 (60)	2 3/4 (70)	3 1/8 (79)	3 1/2 (89)	3 1/2 (89)	4 (102)	5 (127)
Maximum embedment			$h_{ef,max}$	in. (mm)	7 1/2 (191)	10 (254)	12 1/2 (318)	15 (381)	17 1/2 (445)	20 (508)	25 (635)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,600 (17.9)	2,415 (16.6)	2,260 (15.6)	2,140 (14.8)	2,055 (14.2)	2,000 (13.8)	1,990 (13.7)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,040 (7.2)	1,040 (7.2)	1,110 (7.7)	1,220 (8.4)	1,210 (8.4)	1,205 (8.3)	1,145 (7.9)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,265 (15.6)	2,100 (14.5)	1,970 (13.6)	1,865 (12.8)	1,785 (12.3)	1,740 (12.0)	1,730 (11.9)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	905 (6.2)	905 (6.2)	965 (6.7)	1,060 (7.3)	1,055 (7.3)	1,050 (7.2)	995 (6.9)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,630 (11.2)	1,515 (10.4)	1,420 (9.8)	1,345 (9.3)	1,290 (8.9)	1,255 (8.6)	1,250 (8.6)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	650 (4.5)	655 (4.5)	695 (4.8)	765 (5.3)	760 (5.2)	755 (5.2)	720 (5.0)
Dry concrete	MAC[4] cleaning	Anchor category	–	-	2	2	2	Not applicable			
		Strength reduction factor	R_d	-	0.55	0.55	0.55				
	CAC cleaning	Anchor category	–	-	1	1	1	1	1	1	1
		Strength reduction factor	R_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	MAC[4] cleaning	Anchor category	–	-	3	2	2	Not applicable			
		Strength reduction factor	R_{ws}	-	0.45	0.55	0.55				
	CAC cleaning	Anchor category	–	-	2	2	2	2	2	2	2
		Strength reduction factor	R_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	0.95						

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of (f'_c / 2500)$^{0.10}$.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23 percent for temperature range C.
[4]MAC cleaning is only permitted for installation in uncracked concrete up to an embedment depth of 10 times anchor diameter.

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

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No. 10
Reinforcing bar O.D.		d	in. (mm)	0.375 (9.5)	0.500 (12.7)	0.625 (15.9)	0.750 (19.1)	0.875 (22.2)	1.000 (25.4)	1.125 (28.6)	1.250 (31.8)
Reinforcing bar effective cross-sectional area		A_{se}	in.² (mm²)	0.110 (71)	0.200 (129)	0.310 (200)	0.440 (284)	0.600 (387)	0.790 (510)	1.000 (645)	1.270 (819)
ASTM A615, A767, A996 Grade 60	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	lb (kN)	9,900 (44.0)	18,000 (80.1)	27,900 (124.1)	39,600 (176.0)	54,000 (240.0)	71,100 (316.0)	90,000 (400.0)	114,300 (508.0)
		V_{sa}	lb (kN)	5,940 (26.4)	10,800 (48.0)	16,740 (74.5)	23,760 (105.7)	32,400 (144.1)	42,660 (189.8)	54,000 (240.2)	68,580 (305.0)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	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}	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	$\alpha_{V,seis}$	----	0.65							
	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}	lb (kN)	6,600 (29.4)	12,000 (53.4)	18,600 (82.7)	26,400 (117.4)	In accordance with ASTM A615, Grade 40 bars are furnished only in sizes No. 3 through No. 6			
		V_{sa}	lb (kN)	3,960 (17.6)	7,200 (32.0)	11,160 (49.6)	15,840 (70.5)				
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Resistance modification factor for tension[3]	R	-	0.70							
	Resistance modification factor for shear[3]	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. Values correspond to ductile steel elements
[3]The tabulated value of material resistance factors ϕ_c and ϕ_s, and resistance modsification 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. Values correspond to brittle steel elements.

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

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size							
			No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	No. 9	No.10
Effectiveness factor for cracked concrete	$k_{c,cr}$	in-lb (SI)	17 (7)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	in.-lb. (SI)	24 (10)							
Min. anchor spacing	s_{min}	in. (mm)	$1^7/_8$ (48)	$2^1/_2$ (64)	3 (76)	$3^3/_4$ (95)	$4^1/_4$ (108)	$4^3/_4$ (121)	$5^1/_4$ (133)	$5^7/_8$ (149)
Min. edge spacing	c_{min}	in. (mm)	$1^5/_8$ (41)	$1^3/_4$ (44)	2 (51)	$2^3/_8$ (60)	$2^1/_2$ (64)	$2^3/_4$ (70)	3 (76)	$3^1/_4$ (82)
					For smaller edge distances see Table 1 of this report for reduced minimum edge distances					
Min. member thickness	h_{min}	in. (mm)	$h_{ef} + 1^1/_4$ (h_{ef} + 30)		$h_{ef} + 2d_0$ [3]					
Critical edge spacing – splitting (for uncracked concrete)	c_{ac}	-	$2h_{ef}$							
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 4, 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.5.3. 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 2015 NBCC or Annex C of CSA A23.3-14 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			$h_{ef,min}$	in. (mm)	$2^3/_8$ (60)	$2^3/_4$ (70)	$3^1/_8$ (79)	$3^1/_2$ (89)	$3^1/_2$ (89)	4 (102)	$4^1/_2$ (114)	5 (127)
Maximum embedment			$h_{ef,max}$	in. (mm)	$7^1/_2$ (191)	10 (254)	$12^1/_2$ (318)	15 (381)	$17^1/_2$ (445)	20 (508)	$22^1/_2$ (572)	25 (635)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	2,200 (15.2)	2,100 (14.5)	2,030 (14.0)	1,970 (13.6)	1,920 (13.2)	1,880 (13.0)	1,845 (12.7)	1,815 (12.5)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	1,090 (7.5)	1,055 (7.3)	1,130 (7.8)	1,170 (8.1)	1,175 (8.1)	1,155 (8.0)	1,140 (7.9)	1,165 (8.0)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,915 (13.2)	1,830 (12.6)	1,765 (12.2)	1,715 (11.8)	1,670 (11.5)	1,635 (11.3)	1,615 (11.1)	1,580 (10.9)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	945 (6.5)	915 (6.3)	980 (6.8)	1,015 (7.0)	1,020 (7.0)	1,005 (6.9)	995 (6.8)	1,010 (7.0)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	psi (N/mm²)	1,380 (9.5)	1,315 (9.1)	1,270 (8.8)	1,235 (8.5)	1,205 (8.3)	1,180 (8.1)	1,155 (8.0)	1,140 (7.8)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	psi (N/mm²)	680 (4.7)	660 (4.6)	705 (4.9)	735 (5.1)	735 (5.1)	725 (5.0)	715 (4.9)	730 (5.0)
Dry concrete	MAC[4] cleaning	Anchor category	–	-	2	2	2	Not applicable				
		Strength reduction factor	R_d	-	0.55	0.55	0.55					
	CAC cleaning	Anchor category	–	-	1	1	1	1	1	1	1	1
		Strength reduction factor	R_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	MAC[4] cleaning	Anchor category	–	-	3	2	2	Not applicable				
		Strength reduction factor	R_{ws}	-	0.45	0.55	0.55					
	CAC cleaning	Anchor category	–	-	2	2	2	2	2	2	2	2
		Strength reduction factor	R_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength f'_c between 2,500 psi and 8,000 psi, tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2{,}500)^{0.10}$.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 23 percent for temperature range C.
[4]MAC cleaning is only permitted for installation in uncracked concrete up to an embedment depth of 10 times anchor diameter.

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

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

DESIGN INFORMATION	Symbol	Units	Nominal Rod Diameter (mm)						
			M10	M12	M16	M20	M24	M27	M30
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)						
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)						
Min. anchor spacing	s_{min}	mm (in.)	50 (2)	60 ($2^3/_8$)	75 (3)	95 ($3^3/_4$)	115 ($4^1/_2$)	125 (5)	140 ($5^1/_2$)
Min. edge distance	c_{min}	mm (in.)	40 ($1^5/_8$) .	45 ($1^3/_4$)	50 (2)	60 ($2^3/_8$)	65 ($2^1/_2$)	75 (3)	80 ($3^1/_8$)
					For smaller edge distances see Table 1 of this report for reduced minimum edge distances				
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 4, 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 D.5.3. 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 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[1]

DESIGN INFORMATION			Symbol	Units	Nominal Rod Diameter (inch)						
					M10	M12	M16	M20	M24	M27	M30
Minimum embedment			$h_{ef,min}$	mm (in.)	60 (2.4)	70 (2.8)	80 (3.1)	90 (3.5)	96 (3.8)	108 (4.3)	120 (4.7)
Maximum embedment			$h_{ef,max}$	mm (in.)	200 (7.9)	240 (9.4)	320 (12.6)	400 (15.7)	480 (18.9)	540 (21.3)	600 (23.6)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	17.7 (2,571)	16.9 (2,453)	15.6 (2,256)	14.6 (2,112)	13.9 (2,020)	13.7 (1,985)	13.7 (1,980)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	7.2 (1,039)	7.2 (1,043)	7.7 (1,110)	8.4 (1,217)	8.3 (1,209)	8.3 (1,204)	7.9 (1,149)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	15.4 (2,237)	14.7 (2,134)	13.5 (1,963)	12.7 (1,837)	12.1 (1,757)	11.9 (1,727)	11.9 (1,723)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	6.2 (904)	6.3 (908)	6.7 (966)	7.3 (1,058)	7.2 (1,052)	7.2 (1,047)	6.9 (999)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	11.1 (1,612)	10.6 (1,538)	9.8 (1,415)	9.1 (1,324)	8.7 (1,266)	8.6 (1,245)	8.6 (1,241)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	4.5 (651)	4.5 (654)	4.8 (696)	5.3 (763)	5.2 (758)	5.2 (755)	5.0 (720)
Dry concrete	MAC[4] cleaning	Anchor category	–	-	2	2	2	Not applicable			
		Strength reduction factor	R_d	-	0.55	0.55	0.55				
	CAC cleaning	Anchor category	–	-	1	1	1	1	1	1	1
		Strength reduction factor	R_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	MAC[4] cleaning	Anchor category	–	-	3	2	2	Not applicable			
		Strength reduction factor	R_{ws}	-	0.45	0.55	0.55				
	CAC cleaning	Anchor category	–	-	2	2	2	2	2	2	2
		Strength reduction factor	R_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	0.95						

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength, f'_c between 2,500 psi and 8,000 psi, the tabulated characteristic bond strength may be increased by a factor of $(f'_c / 2500)^{0.10}$. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C).
Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short-term loads only such as wind, bond strengths may be increased by 23 percent for temperature range C.
[4]MAC cleaning is only permitted for installation in uncracked concrete up to an embedment depth of 10 times anchor diameter.

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

DESIGN INFORMATION		Symbol	Units	Nominal Bar Size							
				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Reinforcing bar O.D.		d	mm (in.)	10 (0.315)	12 (0.394)	14 (0.472)	16 (0.551)	20 (0.630)	25 (0.787)	28 (1.102)	32 (1.260)
Reinforcing bar effective cross-sectional area		A_{se}	mm² (in.²)	78.5 (0.112)	113.1 (0.175)	153.9 (0.239)	201.1 (0.312)	314.2 (0.487)	490.9 (0.761)	615.8 (0.954)	804.2 (1.247)
DIN 488 BSt 500	Nominal strength as governed by steel strength (for a single anchor)	N_{sa}	kN (lb)	43.2 (9,739)	62.2 (14,024)	84.7 (19,088)	110.6 (24,932)	172.8 (38,956)	270.0 (60,868)	338.7 (76,353)	442.3 (99,727)
		V_{sa}	kN (lb)	25.9 (5,843)	37.3 (8,414)	50.8 (11,453)	66.4 (14,959)	103.7 (23,373)	162.0 (36,521)	203.2 (45,812)	265.4 (59,836)
	Reduction factor for seismic shear	$\alpha_{V,seis}$	-	0.65							
	Resistance modification factor for tension[2]	R	-	1.00							
	Resistance modification factor for shear[2]	R	-	1.00							

[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.

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

DESIGN INFORMATION	Symbol	Units	Nominal Bar Size							
			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Effectiveness factor for cracked concrete	$k_{c,cr}$	SI (in-lb)	7 (17)							
Effectiveness factor for uncracked concrete	$k_{c,uncr}$	SI (in-lb)	10 (24)							
Min. anchor spacing	s_{min}	mm (in.)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	95 ($3^3/_4$)	120 ($4^5/_8$)	130 ($5^1/_4$)	150 ($5^7/_8$)
Min. edge spacing	c_{min}	mm (in.)	40 ($1^5/_8$)	45 ($1^3/_4$)	50 (2)	50 (2)	60 ($2^3/_8$)	70 ($2^3/_4$)	75 (3)	85 ($3^1/_8$)
					For smaller edge distances see Table 1 of this report for reduced minimum edge distances					
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}	-	$2h_{ef}$							
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 4, 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.5.3. 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 2015 NBCC or Annex C of CSA A23.3-14.
[3]d_0 = hole diameter.

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

DESIGN INFORMATION			Symbol	Units	Nominal Bar Size							
					Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Minimum embedment			$h_{ef,min}$	mm (in.)	60 (2.4)	70 (2.8)	75 (3.0)	80 (3.1)	90 (3.5)	100 (3.9)	112 (4.4)	128 (5.0)
Maximum embedment			$h_{ef,max}$	mm (in.)	200 (7.9)	240 (9.4)	280 (11.0)	320 (12.6)	400 (15.7)	500 (19.7)	560 (22.0)	640 (25.2)
Temperature range A[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	15.1 (2,183)	14.6 (2,121)	14.0 (2,025)	14.0 (2,025)	13.5 (1,954)	13.0 (1,886)	12.8 (1,852)	12.5 (1,813)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	7.5 (1,082)	7.3 (1,060)	7.9 (1,144)	8.2 (1,193)	8.2 (1,188)	8.0 (1,158)	7.9 (1,144)	8.0 (1,163)
Temperature range B[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	13.1 (1,899)	12.7 (1,845)	12.1 (1,762)	12.1 (1,762)	11.7 (1,700)	11.3 (1,640)	11.1 (1,611)	10.9 (1,577)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	6.5 (942)	6.4 (922)	6.9 (996)	7.2 (1,038)	7.1 (1,034)	6.9 (1,008)	6.9 (995)	7.0 (1,012)
Temperature range C[2,3]:	Characteristic bond strength in uncracked concrete		$\tau_{k,uncr}$	N/mm² (psi)	9.4 (1,369)	9.2 (1,329)	8.8 (1,270)	8.8 (1,270)	8.4 (1,225)	8.2 (1,182)	8.0 (1,161)	7.8 (1,136)
	Characteristic bond strength in cracked concrete		$\tau_{k,cr}$	N/mm² (psi)	4.7 (678)	4.6 (665)	4.9 (718)	5.2 (748)	5.1 (745)	5.0 (726)	4.9 (717)	5.0 (729)
Dry concrete	MAC[4] cleaning	Anchor category	–	-	2	2	2	2	Not Applicable			
		Strength reduction factor	R_d	-	0.55	0.55	0.55	0.55				
	CAC cleaning	Anchor category	–	-	1	1	1	1	1	1	1	1
		Strength reduction factor	R_d	-	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Water-saturated concrete	MAC[4] cleaning	Anchor category	–	-	3	2	2	2	Not Applicable			
		Strength reduction factor	R_{ws}	-	0.45	0.55	0.55	0.55				
	CAC cleaning	Anchor category	–	-	2	2	2	2	2	2	2	2
		Strength reduction factor	R_{ws}	-	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Reduction factor for seismic tension			$\alpha_{N,seis}$	-	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00

[1]Bond strength values correspond to concrete compressive strength f'_c = 2,500 psi. For concrete compressive strength f'_c between 2,500 psi and 8,000 psi, tabulated characteristic bond strength may not be increased. See Section 4.1.4 of this report.
[2]Temperature range A: Maximum short term temperature = 176°F (80°C), maximum long term temperature = 122°F (50°C); Temperature range B: Maximum short term temperature = 248°F (120°C), maximum long term temperature = 161°F (72°C); Temperature range C: Maximum short term temperature = 320°F (160°C), maximum long term temperature = 212°F (100°C). Short term elevated concrete temperatures are those that occur over brief intervals, e.g. as result of diurnal cycling. Long term concrete temperatures are roughly constant over significant periods of time.
[3]Characteristic bond strengths are for sustained loads including dead and live loads. For load combinations consisting of short term loads only, such as wind and seismic, bond strengths may be increased by 23 percent for temperature range C.
[4]MAC cleaning is only permitted for installation in uncracked concrete up to an embedment depth of 10 times anchor diameter.

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.
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, Würth WIT-UH 300 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.