ICC-ES Listing Report

ELC-1917
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This listing is subject to renewal September 2023.

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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: Hilti Kwik Bolt TZ (KB-TZ) Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete

Listee: HILTI, INC.

Compliance with the following standards:

- Annex D, Anchorage of CSA A23.3 (-14, -04), Design of Concrete Structures, CSA Group.

Compliance with the following codes:

Hilti Kwik Bolt TZ (KB-TZ) Carbon and Stainless Steel Anchors in Cracked and Uncracked Concrete, as described in this listing report, are in conformance with CSA A23.3 (-14, 04), Annex D, as referenced in the applicable section of the following code editions:

- *National Building Code of Canada*® 2015 and 2010
  Applicable Section: Division B, Part 4, Section 4.3.3.

Description of anchors:

KB-TZ anchors are torque-controlled, mechanical expansion anchors. KB-TZ anchors consist of a stud (anchor body), wedge (expansion elements), nut, and washer. The anchor (carbon steel version) is illustrated in Figure 1. The stud is manufactured from carbon steel or AISI Type 304 or Type 316 stainless steel materials. Carbon steel KB-TZ anchors have a minimum 5 µm zinc plating. The expansion elements for the carbon and stainless steel KB-TZ anchors are fabricated from Type 316 stainless steel. The hex nut for carbon steel conforms to ASTM A563-04, Grade A, and the hex nut for stainless steel conforms to ASTM F594-09.

The anchor body is comprised of a high-strength rod threaded at one end and a tapered mandrel at the other end. The tapered mandrel is enclosed by a three-section expansion element which freely moves around the mandrel. The expansion element movement is restrained by the mandrel taper and by a collar. The anchor is installed in a predrilled hole with a hammer. When torque is applied to the nut of the installed anchor, the mandrel is drawn into the expansion element, which is in turn expanded against the wall of the drilled hole.

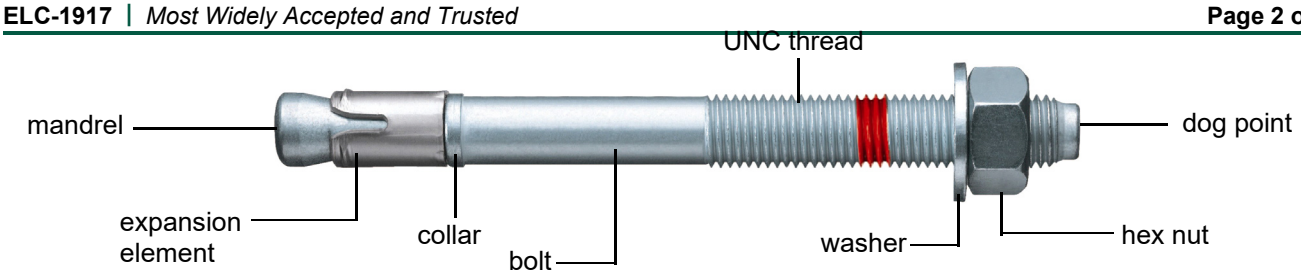


FIGURE 1—HILTI CARBON STEEL KWIK BOLT TZ (KB-TZ)

Identification:

1. The anchors are identified by packaging labeled with the manufacturer's name (Hilti, Inc.) and contact information, anchor name, anchor size, and listing number (ELC-1917), and the ICC-ES listing mark. The anchors have the letters KB-TZ embossed on the anchor stud and four notches embossed into the anchor head, and these are visible after installation for verification. Table 2 and Figure 4 summarizes the length code identification system.

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

   HILTI, INC.
   7250 DALLAS PARKWAY, SUITE 1000
   PLANO, TEXAS 75024
   (800) 879-8000
   www.us.hilti.com
   HiltiTechEng@us.hilti.com

Installation: Installation parameters are provided in Figures 2 and 3 and Tables 1A and 1B. Anchor locations must comply with this listing report and plans and specifications approved by the authority having jurisdiction. The Hilti KB-TZ must be installed in accordance with manufacturer's published instructions and this listing report. In case of conflict, this listing report governs. Anchors must be installed in holes drilled into the concrete using carbide-tipped masonry drill bits complying with ANSI B212.15-1994 or using the Hilti SafeSet System™ with Hilti TE-YD or TE-CD Hollow Drill Bits complying with ANSI B212.15-1994 with a Hilti vacuum with a minimum value for the maximum volumetric flow rate of 129 CFM (61 ℓ/s). The Hollow Drill Bits are not permitted for use with the 3/8" and 3/4" diameter KB-TZ anchors. The minimum drilled hole depth, h_0, is given in Tables 1A and 1B. When drilling dust is not removed after hole drilling, make sure to drill deep enough to achieve h_{nom}, taking into account the depth of debris remaining in the hole. If dust and debris is removed from the drilled hole with the Hilti TE-YD or TE-CD Hollow Drill Bits, compressed air or a manual pump, h_{nom} is achieved at the specified value of h_0 noted in Tables 1A and 1B. The anchor must be hammered into the predrilled hole until h_{nom} is achieved. The nut must be tightened against the washer until the torque values specified in Tables 1A and 1B are achieved. The 3/8", 1/2", and 5/8" anchors may be installed using the Hilti Safe-Set™ System consisting of the Hilti SIW-6AT-A22 Impact Wrench used together with the Hilti SI-AT-A22 Adaptive Torque Module in accordance with the manufacturer's published installation instructions as shown in Figure 3A.

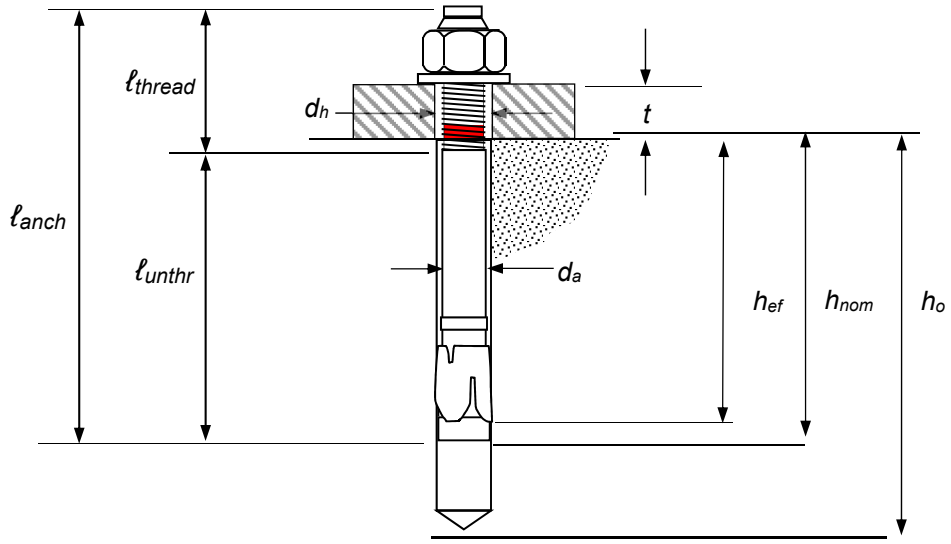
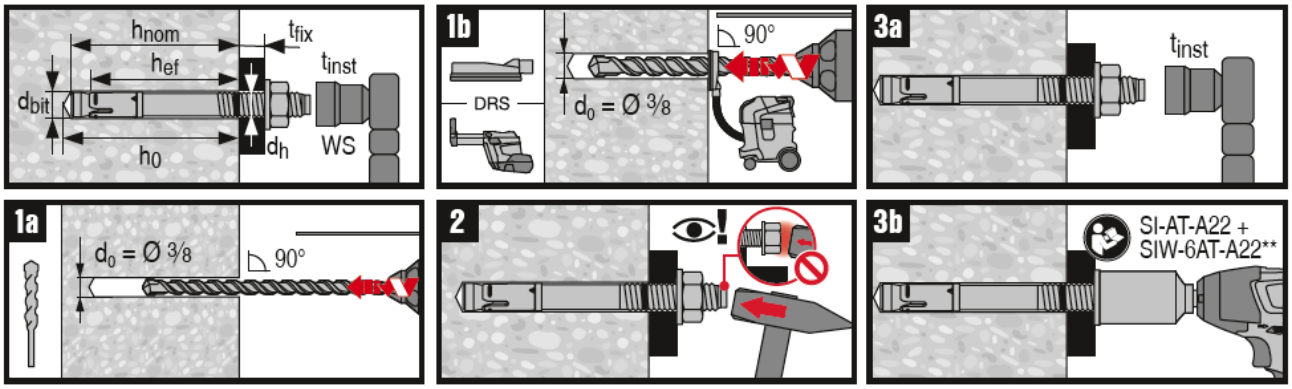
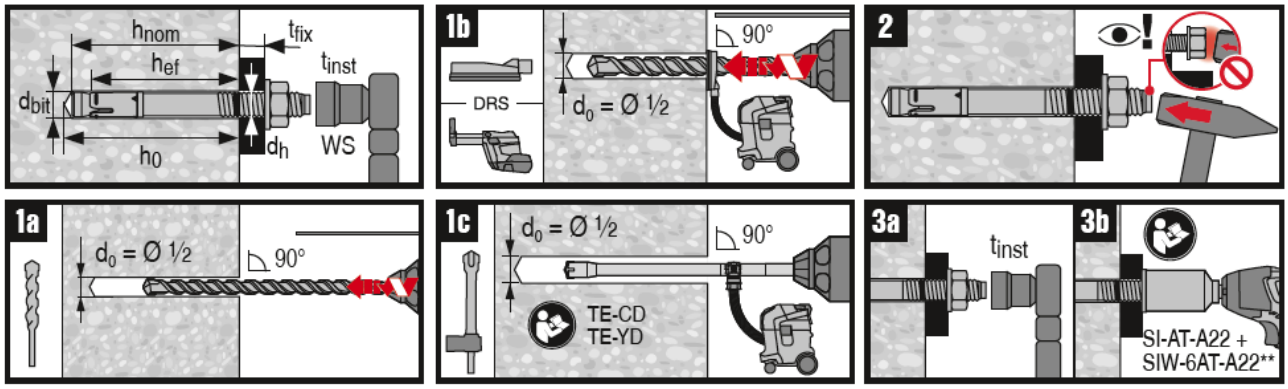


FIGURE 2—KB-TZ INSTALLED

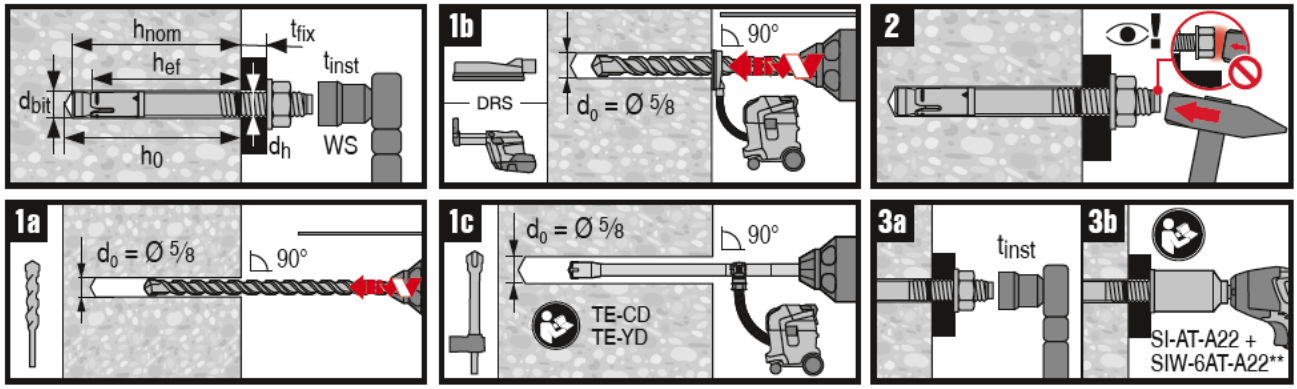
3/8" Diameter



1/2" Diameter



5/8" Diameter



3/4" Diameter

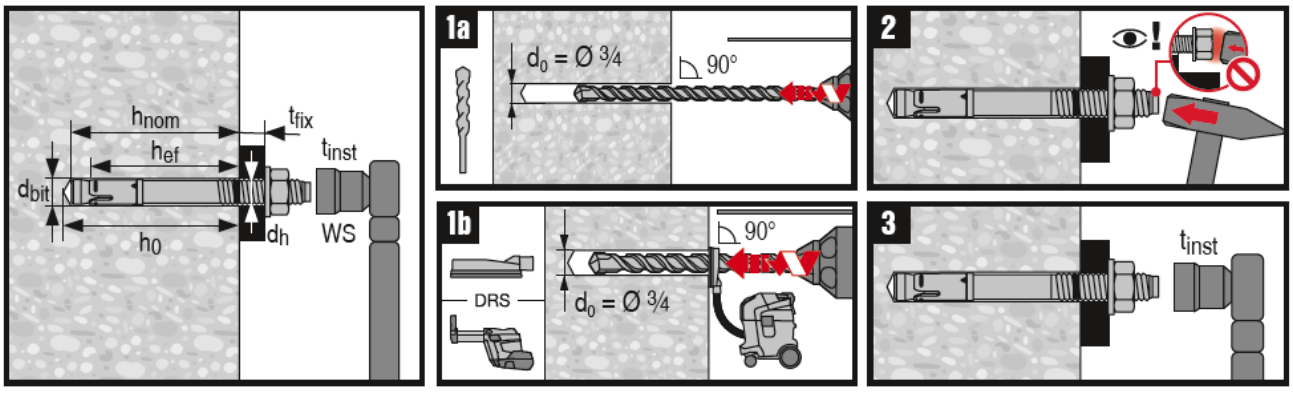


FIGURE 3—INSTALLATION INSTRUCTIONS

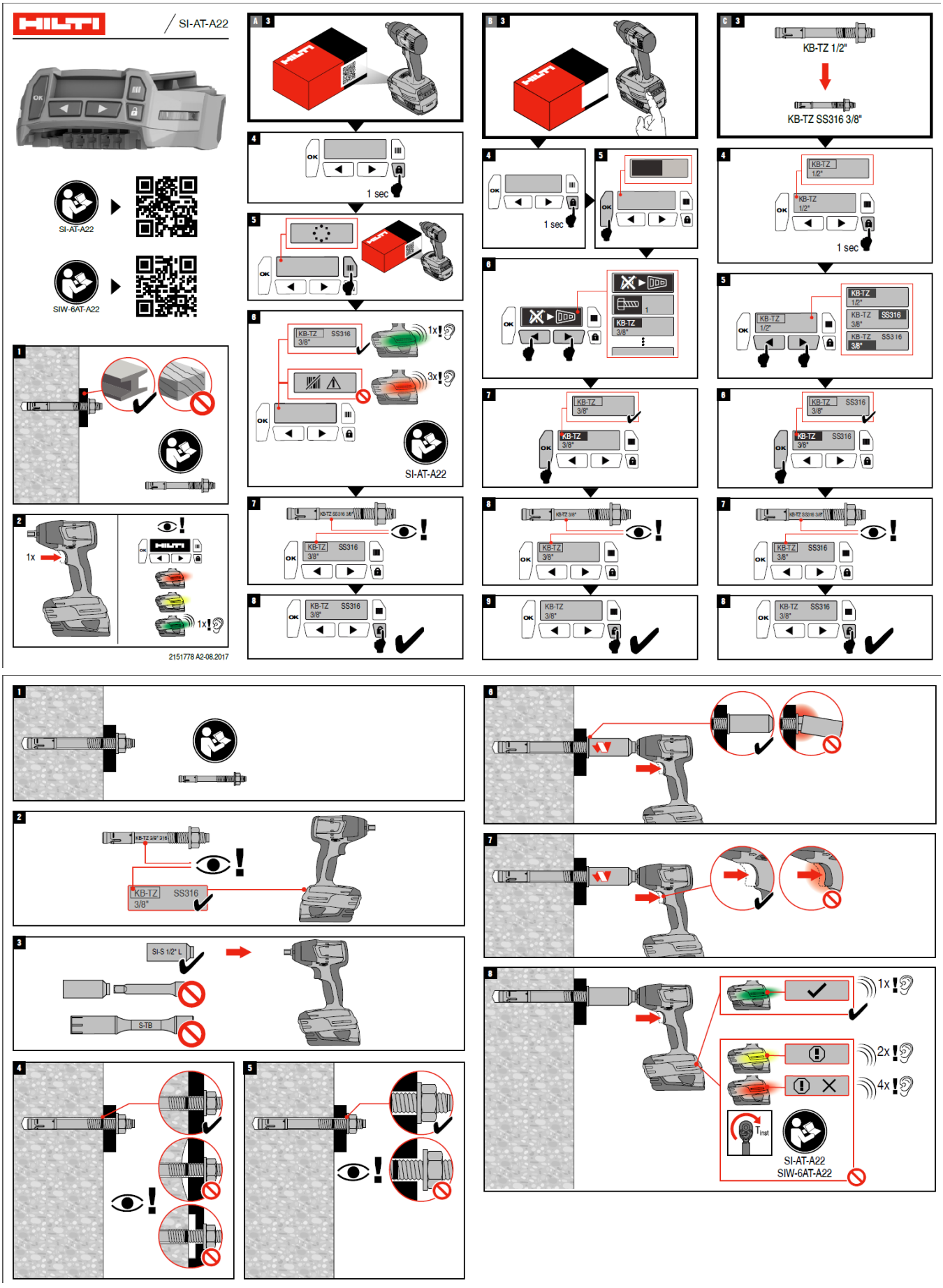


FIGURE 3A—INSTALLATION INSTRUCTIONS USING SI-AT-A22 ADAPTIVE TORQUE SYSTEM

<table>
<tr><td>Hilti SafeSet™ System with Hollow Drill Bit</td><td colspan="2"> 
Hilti TE-CD or TE-YD Hollow Carbide Drill Bit with a Hilti Vacuum (per section 4.3)</td></tr>
<tr><td>Hilti SafeSet™ System with the Adaptive Torque Tool</td><td colspan="2"> 
Hilti SIW-6AT-A22 Impact Wrench with the Hilti SI-AT-A22 Adaptive Torque Module</td></tr>
<tr><td>Hilti Dust Removal Systems</td><td> 
Hilti Rotary Hammer Drill with DRS (Dust Removal System) Module</td><td> 
Hilti TE DRS-D Dust Removal System with Hilti Vacuum</td></tr>
</table>

FIGURE 3B—HILTI SYSTEM COMPONENTS

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 resistance of anchors for compliance with the 2010 NBCC must be determined in accordance with CSA A23.3-04 Annex D and this listing report.

Design parameters provided in Tables 3 and 4 of this listing report are based on the 2015 NBCC and 2010 NBCC (CSA A23.3-14 and CSA A23.3-04). The limit states design of anchors must comply with CSA A23.3-14 D.5.1 or CSA A23.3-04 D.5.1, as applicable, except as required in CSA A23.3-14 D.4.3.1 or CSA A23.3-04 D.4.3.1, as applicable.

Material resistance factors must be $\phi_c = 0.65$ and $\phi_s = 0.85$ in accordance with CSA A23.3 (-14, 04) Sections 8.4.2 and 8.4.3, and resistance modification factor, *R,* as given in CSA A23.3-14 Section D.5.3, or CSA A23.3-04 Section D.5.4, as applicable, and noted in Tables 3 and 4 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, Division B, Part 4, Section 4.1.3 of the 2010 NBCC, or Annex C of CSA A23.3-14 or Annex C of CSA A23.3-04, as applicable. The factored steel strength N_{sar} or V_{sar}, in tables 3 and 4 of this listing report have been multiplied by ϕ_s and R to determine the factored resistance. The factored pullout strengths $N_{cpr,uncr}$, $N_{cpr,cr}$ or $N_{cpr,eq}$ in Tables 3 and 4 of this listing report have been multiplied by ϕ_c and R to determine the factored resistance.

Requirements for Factored Pullout Resistance in Tension: The factored pullout resistance of a single anchor in accordance with CSA A23.3-14 D.6.3.1 and D.6.3.2, or CSA A23.3-04 D.6.3.1 and D.6.3.2, as applicable, in cracked and uncracked concrete, $N_{cpr,\,cr}$ and $N_{cpr,\,uncr}$, respectively, is given in Tables 3 and 4. For all design cases, $\Psi_{c,\,P}$ = 1.0. In accordance with CSA A23.3-14 D.6.3, or CSA A23.3-04 D.6.3, as applicable, the factored pullout resistance in cracked concrete may be calculated in accordance with the following equation:

$$N_{cpr,cr,f_c'} = N_{cpr,cr}\sqrt{\frac{f_{c'}}{17.2}}\ \text{(N, MPa)} \quad \text{(Eq-1)}$$

In regions where analysis indicates no cracking in accordance with CSA A23.3-14 D.6.3.6, or CSA A23.3-04 D.6.3.6, as applicable, the factored pullout resistance in tension may be calculated in accordance with the following equation:

$$N_{cpr,uncr,f_c'} = N_{cpr,uncr}\sqrt{\frac{f_{c'}}{17.2}}\ \text{(N,MPa)} \quad \text{(Eq-2)}$$

Where values for $N_{cpr,\,cr}$ or $N_{cpr,\,uncr}$ are not provided in Table 3 or Table 4, the pullout resistance in tension need not be evaluated.

Requirements for Critical Edge Distance: In applications where $c < c_{ac}$ and supplemental reinforcement to control splitting of the concrete is not present, the concrete breakout resistance in tension for uncracked concrete must be calculated in accordance with CSA A23.3-14 D.6.2 or CSA A23.3-04 D.6.2, as applicable.

In lieu of using CSA A23.3-14 D.9.7, or CSA A23.3-04 D.9.7, as applicable, values of c_{ac} must comply with Table 3 or Table 4.

TABLE 1A—SETTING INFORMATION (CARBON STEEL ANCHORS)

SETTING INFORMATION	Symbol	Units	Nominal anchor diameter (in.)											
			3/8			1/2			5/8			3/4		
Anchor O.D.	d_a	in. (mm)	0.375 (9.5)			0.5 (12.7)			0.625 (15.9)			0.75 (19.1)		
Nominal bit diameter	d_{bit}	in.	3/8			1/2			5/8			3/4		
Effective min. embedment	h_{ef}	mm	38	51	70	51	83		79	102		83	95	121
Nominal embedment	h_{nom}	mm	46	59	78	60	91		91	113		97	110	136
Min. hole depth	h_o	mm	51	67	86	67	102		95	121		102	114	146
Min. thickness of fastened part[1]	t_{min}	mm	0	0	0	19	6		9	19		0	0	23
Required Installation torque	T_{inst}	Nm	34			54			81			149		
Min. dia. of hole in fastened part	d_h	mm	11.1			14.3			17.5			20.6		
Standard anchor lengths	ℓ_{anch}	mm	76	95	127	95	114	140	178	121	152	216	254	140	178	203	254
Threaded length (incl. dog point)	ℓ_{thread}	mm	38	57	93	41	60	86	124	38	70	133	171	63	103	128	179
Unthreaded length	ℓ_{unthr}	mm	39			54			83			77		

[1]The minimum thickness of the fastened part is based on use of the anchor at minimum embedment and is controlled by the length of thread. If a thinner fastening thickness is required, increase the anchor embedment to suit.

TABLE 1B—SETTING INFORMATION (STAINLESS STEEL ANCHORS)

SETTING INFORMATION	Symbol	Units	Nominal anchor diameter (in.)														
			3/8			1/2				5/8				3/4			
Anchor O.D.	d_a	in. (mm)	0.375 (9.5)			0.5 (12.7)				0.625 (15.9)				0.75 (19.1)			
Nominal bit diameter	d_{bit}	in.	3/8			1/2				5/8				3/4			
Effective min. embedment	h_{ef}	mm	51			51		83		79		102		95		121	
Nominal embedment	h_{nom}	mm	59			60		91		91		113		110		136	
Min. hole depth	h_o	mm	67			67		102		95		121		114		146	
Min. thickness of fastened part[1]	t_{min}	mm	6			19		6		9		19		3		41	
Required Installation torque	T_{inst}	Nm	34			54				81				149			
Min. dia. of hole in fastened part	d_h	mm	11.1			14.3				17.5				20.6			
Standard anchor lengths	ℓ_{anch}	mm	76	95	127	95	114	140	178	121	152	216	254	140	203	254	
Threaded length (incl. dog point)	ℓ_{thread}	mm	22	41	73	41	60	86	124	38	70	133	171	38	102	152	
Unthreaded length	ℓ_{unthr}	mm	54			54				83				102			

[1]The minimum thickness of the fastened part is based on use of the anchor at minimum embedment and is controlled by the length of thread. If a thinner fastening thickness is required, increase the anchor embedment to suit.

TABLE 2—LENGTH IDENTIFICATION SYSTEM (CARBON STEEL AND STAINLESS STEEL ANCHORS)

Length ID marking on bolt head		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
Length of anchor, ℓ_{anch} (mm)	From	38	51	64	76	89	102	114	127	140	152	165	178	191	203	216	229	241	254	279	305	330	356	381
	Up to but not including	51	64	76	89	102	114	127	140	152	165	178	191	203	216	229	241	254	279	305	330	356	381	406

FIGURE 4—BOLT HEAD WITH LENGTH IDENTIFICATION CODE AND KB-TZ HEAD NOTCH EMBOSSMENT

TABLE 3—DESIGN INFORMATION, CARBON STEEL KB-TZ

DESIGN INFORMATION	Symbol	Units	Nominal anchor diameter															
			3/8				1/2				5/8			3/4				
Anchor O.D.	d_a	in. (mm)	0.375 (9.5)				0.5 (12.7)				0.625 (15.9)			0.75 (19.1)				
Effective min. embedment[1]	h_{ef}	mm	38	51		70	51		83		79	102		83	95		121	
Min. member thickness	h_{min}	mm	83	102	127	127	102	152	152	203	127	152	203	140	152	203	203	
Critical edge distance	c_{ac}	mm	152	111	102	105	140	114	191	152	165	222	171	305	254	203	229	
Min. edge distance	c_{min}	mm	203	64		64	70		60		92	83		241	121		105	
	for $s \geq$	mm	203	127		127	146		146		156	149		127	267		225	
Min. anchor spacing	s_{min}	mm	203	64		64	70		60		89	76		127	127		102	
	for $c \geq$	mm	203	92		92	105		89		121	108		241	241		197	
Min. hole depth in concrete	h_o	mm	51	67		86	67		102		98	121		102	117		146	
Min. specified yield strength	f_y	N/mm^2	690				585				585			585				
Min. specified ult. strength	f_{uta}	N/mm^2	862				731				731			731				
Effective tensile stress area	$A_{se,N}$	mm^2	33.6				65.0				104.6			152.8				
Steel embed, material resistance factor for reinforcement	ϕ_s	-	0.85															
Resistance modification factor for tension, steel failure modes[2]	R	-	0.80															
Resistance modification factor for shear, steel failure modes[2]	R	-	0.75															
Factored steel resistance in tension	N_{sar} (N_{sr})[9]	kN	19.7				32.3				52.0			76.0				
Factored steel resistance in shear	V_{sar}(V_{sr})[9]	kN	6.2	10.2			15.6				23.0			38.8				
Factored steel resistance in shear, seismic	$V_{sar,eq}$	kN	6.2	6.4			15.6				21.5			33.3				
Anchor category[3]			2	1														
Effectiveness factor k_{uncr} uncracked concrete			10															
Effectiveness factor k_{cr} cracked concrete[4]			7															
$\Psi_{c,N} = k_{uncr}/k_{cr}$ [5]			1.0															
Coefficient for pryout strength, k_{cp}			1.0			2.0	1.0		2.0									
Concrete material resistance factor	ϕ_c	-	0.65															
Resistance modification factor for tension and shear, concrete failure modes, Condition B[6]	R	-	0.85	1.0														
Factored pullout resistance uncracked concrete[7]	$N_{cpr,uncr}$	kN	5.3	7.3		11.9	NA		15.9		NA	26.5		NA	23.9		30.9	
Factored pullout resistance cracked concrete[7]	$N_{cpr,cr}$	kN	NA	6.6		9.2	NA		14.2		NA			NA				
Axial stiffness in service load range[8]	β_{uncr}	kN/mm	105.07															
	β_{cr}	kN/mm	23.64															

For **SI**: 1 inch = 25.4 mm. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.224 lbf, 1 MPa = 145 psi

[1]See Fig. 2.
[2]The KB-TZ is a ductile steel element as defined by CSA A23.3-14 D.2 or CSA A23.3-04 D.2, as applicable.
[3]See CSA A23.3-14 D.5.3 or CSA A23.3-04 D.5.4, as applicable.
[4]See CSA A23.3-14 D.6.2.2 or CSA A23.3-04 D.6.2.2, as applicable.
[5]For all design cases $\Psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[6]For use with the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or 2010 NBCC, CSA A23.3-14 Annex C or CSA A23.3-04 Annex C, as applicable. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c), as applicable, is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the strength reduction factors associated with Condition A may be used.
[7]For all design cases $\Psi_{c,P}$ =1.0. NA (not applicable) denotes that this value does not control for design.
[8]Mean values shown, actual stiffness may vary considerably depending on concrete strength, loading and geometry of application.
[9]The notation in parenthesis is for the CSA A23.3-04.

TABLE 4—DESIGN INFORMATION, STAINLESS STEEL KB-TZ

DESIGN INFORMATION	Symbol	Units	Nominal anchor diameter											
			3/8		1/2				5/8			3/4		
Anchor O.D.	d_a	in. (mm)	0.375 (9.5)		0.5 (12.7)				0.625 (15.9)			0.75 (19.1)		
Effective min. embedment[1]	h_{ef}	mm	51		51		83		79	102		95		121
Min. member thickness	h_{min}	mm	102	127	102	152	152	203	127	152	203	152	203	203
Critical edge distance	c_{ac}	mm	111	98	140	114	191	152	178	225	152	254	178	229
Min. edge distance	c_{min}	mm	64		73		54		83	60		108		102
	for $s \geq$	mm	127		146		133		140	140		254		216
Min. anchor spacing	s_{min}	mm	57		73		51		70	60		127		102
	for $c \geq$	mm	89		114		83		105	108		241		178
Min. hole depth in concrete	h_o	mm	67		67		102		98	121		117		146
Min. specified yield strength	f_y	N/mm^2	634		634				634			525		
Min. specified ult. Strength	f_{uta}	N/mm^2	793		793				793			700		
Effective tensile stress area	$A_{se,N}$	mm^2	33.6		65.0				104.6			152.8		
Steel embed, material resistance factor for reinforcement	ϕ_s	-	0.85											
Resistance modification factor for tension, steel failure modes[2]	R	-	0.80											
Resistance modification factor for shear, steel failure modes[2]	R	-	0.75											
Steel strength in tension	N_{sar} (N_{sr})[9]	kN	18.1		35.1				56.4			72.7		
Steel strength in shear	V_{sar} (V_{sr})[9]	kN	13.4		19.5				28.0			44.6		
Steel strength in shear, seismic	$V_{sar,eq}$	kN	8.0		19.5				26.5			36.5		
Anchor category[3]			1		2		1							
Effectiveness factor k_{uncr} uncracked concrete			10											
Effectiveness factor k_{cr} cracked concrete[4]			7		10		7		7	7		10		7
$\Psi_{C,N} = k_{uncr}/k_{cr}$ [5]			1.0											
Coefficient for pryout strength, k_{cp}			1.0				2.0							
Concrete material resistance factor	ϕ_c	-	0.65											
Resistance modification factor for tension and shear, concrete failure modes, Condition B[6]	R	-	1.0		0.85		1							
Pullout resistance uncracked concrete[7]	$N_{cpr,uncr}$	kN	7.6		NA		16.6		NA			NA		34.8
Pullout resistance cracked concrete[7]	$N_{cpr,cr}$	kN	6.8		7.8		NA		NA	16.9		23.5		NA
Pullout resistance in tension, seismic	$N_{cpr,eq}$	kN	6.8		6.7		NA		NA	16.9		23.5		NA
Axial stiffness in service load range[8]	β_{uncr}	kN/mm	21											
	β_{cr}	kN/mm	15.8											

For **SI**: 1 inch = 25.4 mm. For pound-inch units: 1 mm = 0.03937 inches, 1 N = 0.224 lbf, 1 MPa = 145 psi

[1]See Fig. 2.
[2]The KB-TZ is a ductile steel element as defined by CSA A23.3-14 D.2 or CSA A23.3-04 D.2, as applicable.
[3]See CSA A23.3-14 D.5.3 or CSA A23.3-04 D.5.4, as applicable.
[4]See CSA A23.3-14 D.6.2.2 or CSA A23.3-04 D.6.2.2, as applicable.
[5]For all design cases $\Psi_{c,N}$ =1.0. The appropriate effectiveness factor for cracked concrete (k_{cr}) or uncracked concrete (k_{uncr}) must be used.
[6]For use with the load combinations of Division B, Part 4, Section 4.1.3 of the 2015 NBCC or 2010 NBCC, CSA A23.3-14 Annex C or CSA A23.3-04 Annex C, as applicable. Condition B applies where supplementary reinforcement in conformance with CSA A23.3-14 D.5.3(c) or CSA A23.3-04 D.5.4(c), as applicable, is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the strength reduction factors associated with Condition A may be used.
[7]For all design cases $\Psi_{c,P}$ =1.0. NA (not applicable) denotes that this value does not control for design.
[8]Mean values shown, actual stiffness may vary considerably depending on concrete strength, loading and geometry of application.
[9]The notation in parenthesis is for the CSA A23.3-04.

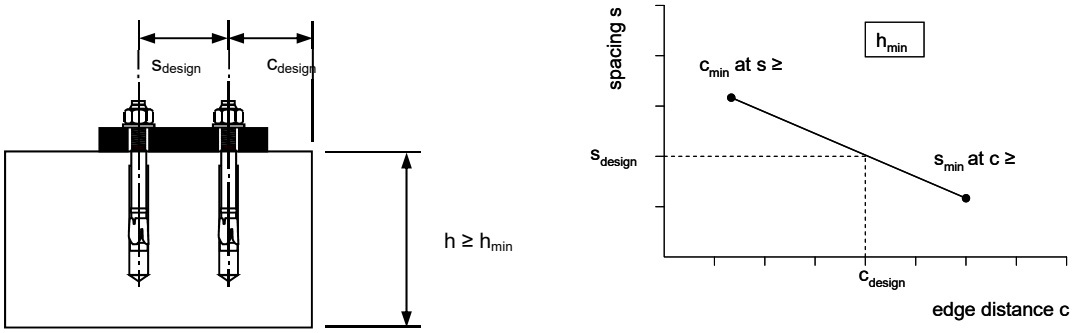


FIGURE 5—INTERPOLATION OF MINIMUM EDGE DISTANCE AND ANCHOR SPACING

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 report.
5. The anchors must be installed in accordance with the manufacturer's published instructions and this listing report. In case of conflict, this listing report governs.
6. Anchors must be limited to use in cracked and uncracked normal-weight concrete and lightweight concrete having a specified compressive strength, f'_c, of 20 MPa to 55 MPa.
7. The values of f'_c used for calculation purposes must not exceed 55 MPa.
8. Anchor spacing and edge distance as well as minimum member thickness must comply with Tables 3 and 4, and Figure 5.
9. The use of fatigue or shock loading for these anchors under such conditions is beyond the scope of this listing report.
10. Anchors may be installed in regions of concrete where cracking has occurred or where analysis indicates cracking may occur ($f_t > f_r$), subject to the conditions of this report.
11. Anchors may be used to resist short-term loading due to wind or seismic forces in locations designed according to NBCC 2010 and NBCC 2015.
12. Where not otherwise prohibited in the code as referenced in CSA A23.3-14 or CSA A23.3-04, as applicable, KB-TZ anchors are permitted for use with fire-resistance-rated construction provided that at least one of the following conditions is fulfilled:
    - Anchors are used to resist wind or seismic forces only.
    - Anchors that support a fire-resistance-rated envelope or a fire- resistance-rated membrane are protected by approved fire-resistance- rated materials, or have been evaluated for resistance to fire exposure in accordance with recognized standards.
    - Anchors are used to support nonstructural elements.
13. Use of zinc-coated carbon steel anchors is limited to dry, interior locations.
14. Use of anchors made of stainless steel as specified in this report are permitted for exterior exposure and damp environments.
15. Use of anchors made of stainless steel as specified in this report are permitted for contact with preservative-treated and fire-retardant-treated wood.
16. Anchors are manufactured by Hilti AG under an approved quality-control program with inspections by ICC-ES.