Attached are page(s) from the 2011 Hilti North American Product Technical Guide. For complete details on this product, including data development, product specifications, general suitability, installation, corrosion, and spacing & edge distance guidelines, please refer to the Technical Guide, or contact Hilti.

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Mechanical Anchoring Systems 3.3

3.3.1 HDA Undercut Anchor

3.3.1.1 Product Description

The Hilti HDA Undercut Anchor is a heavy duty mechanical undercut anchor whose undercut segments incorporate carbide tips so as to perform a self-undercutting process designed to develop a ductile steel failure. The HDA system includes either the HDA-P preset or HDA-T through-set style anchors, stop drill bits, setting tool, and roto-hammer drill for M10, M12, M16 and M20 models. The HDA is available in a sherardized and type 316 stainless steel versions for outdoor environments offered in two lengths to accommodate various material thicknesses to be fastened.

Product Features

- Undercut segments provide cast-in-place like performance with limited expansion stresses
- Bolt meets ductility requirements of ACI 318 Section D1
- Self-undercutting wedges provide an easy, fast and reliable anchor installation
- Excellent performance in cracked concrete
- Undercut keying load transfer allows for reduced edge distances and anchor spacings
- Through-set style provides increased shear capacity
- Fully removable
- Type 316 stainless steel for corrosive environments
- Sherardized zinc coating has equivalent corrosion resistance to hot dipped galvanizing

Guide Specifications

Undercut Anchors Undercut anchors shall be of an undercut style with brazed tungsten carbides on the embedded end that perform the self-undercutting process. Undercut portion of anchor shall have a minimum projected bearing area equal to or greater than 2.5 times the nominal bolt area. The bolt shall conform to ISO 898 class 8.8 strength requirements. Anchors dimensioned and supplied by Hilti.

Installation Refer to 3.3.1.4.

HDA-P
Undercut Anchor
Pre-Set Type

HDA-T
Undercut Anchor
Through-Set Type

Listings/Approvals

ICC-ES (International Code Council)
ESR-1546

City of Los Angeles
Research Report based on 2011 LABC pending

European Technical Approval (ETA)
ETA-99/0009
ETA-99/0016

Qualified under NQA-1 Nuclear Quality Program

Independent Code Evaluation

IBC 2009 pending

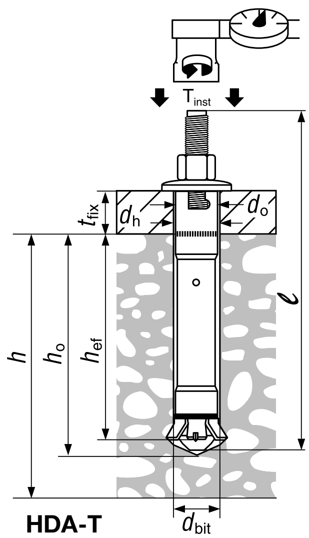
IBC® / IRC® 2006 (AC 193 / ACI 355.2)

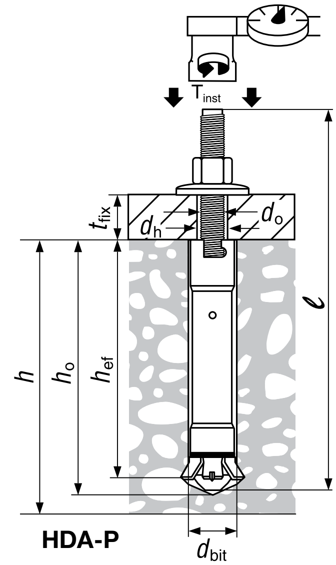
3.3.1.2 Material Specifications

	Mechanical Properties			
	f_y		f_{ut}	
	ksi	(MPa)	ksi	(MPa)
HDA-T/-TF/-P/-PF carbon steel cone bolt; strength requirements of ISO 898, class 8.8	92.8	(640)	116	(800)
HDA-T/-TF/-P/-PF carbon steel sleeve M10 & M12	–		123	(850)
HDA-T/-TF/-P/-PF carbon steel sleeve M16	–		101.5	(700)
HDA-T/-TF/-P/-PF carbon steel sleeve M20	–		79.8	(550)
HDA-TR/-PR stainless steel cone bolt M10, M12 and M16	87	(600)	116	(800)
HDA-TR/-PR stainless steel sleeve M10 and M12	–		123	(850)
HDA-TR/-PR stainless steel sleeve M16	–		101.5	(700)
HDA-T/-TF/-P/-PF galvanized carbon steel hexagonal nut				
HDA-TR/-PR nut conforms to DIN 934, grade A4-80				
HDA-T/-TF/-TR/-P/-PF/-PR galvanized carbon steel washer				
HDA-T/-P components are electroplated min. 5 μm zinc				
HDA-TF/-PF sherardized components have average 53 μm zinc				

3.3.1 HDA Undercut Anchor

3.3.1.3 Technical Data





Anchor Nomenclature

- **Hilti Design Anchor**
- **P** pre-set before baseplate
- **T** through-set after/through baseplate
- **Blank** carbon steel zinc plated
- **F** carbon steel sherardized
- **R** 316 stainless steel
- **Drill bit diameter** (mm)
- **Metric**
- **Thread diameter** (mm)

HDA-PF 22 M 12 x 125 / 50

- **Minimum embedment of undercut**
- **Maximum fastening thickness**

Table 1 - HDA Specifications

	Anchor Size	HDA-T/HDA-P	M10 x 100/20	M12 x 125/30	M12 x 125/50	M16 x 190/40	M16 x 190/60	M20 x 250/50	M20 x 250/100
h_{min}	Minimum thickness of concrete	mm (in.)	170 (6-3/4)	190 (7-1/2)	190 (7-1/2)	270 (10-5/8)	270 (10-5/8)	350 (13-3/4)	350 (13-3/4)
ℓ	Total anchor length	mm (in.)	150 (5.90)	190 (7.48)	210 (8.27)	275 (10.83)	295 (11.61)	360 (14.17)	410 (16.14)
	length I.D. code		I	L	N	R	S	V	W
t_{fix}	Fastening Thickness								
	HDA-T, min.[1]	mm (in.)	10 (0.39)	10 (0.39)	10 (0.39)	15 (0.59)	15 (0.59)	20 (0.79)	20 (0.79)
	HDA-T, max.	mm (in.)	20 (0.79)	30 (1.18)	50 (1.97)	40 (1.58)	60 (2.36)	50 (1.97)	100 (3.94)
	HDA-P, max.	mm (in.)	20 (0.79)	30 (1.18)	50 (1.97)	40 (1.58)	60 (2.36)	50 (1.97)	100 (3.94)
d_{bit}	Nom. dia. of drill bit[2]	mm	20	22	22	30	30	37	37
h_o	Min. depth of drill hole	mm (in.)	107 (4.21)	134.5 (5.30)	134.5 (5.30)	203 (7.99)	203 (7.99)	266 (10.47)	266 (10.47)
h_{ef}	Effective anchoring depth	mm (in.)	100 (3.94)	125 (4.92)	125 (4.92)	190 (7.48)	190 (7.48)	250 (9.84)	250 (9.847)
d_h	Recommended clearance hole (min.)								
	HDA-T	mm (in.)	21 (7/8)	23 (15/16)	23 (15/16)	32 (1-1/4)	32 (1-1/4)	40 (1-9/16)	40 (1-9/16
	HDA-P	mm (in.)	12 (1/2)	14 (9/16)	14 (9/16)	18 (3/4)	18 (3/4)	22 (7/8)	22 (7/8)
d_o	Anchor Diameter HDA-T	mm (in.)	19 (0.748)	21 (0.827)	21 (0.827)	29 (1.142)	29 (1.142)	36 (1.42)	36 (1.42)
	HDA-P	mm (in.)	10 (0.394)	12 (0.472)	12 (0.472)	16 (0.630)	16 (0.630)	20 (0.78)	20 (0.78)
d_w	Washer diameter	mm (in.)	27.5 (1.08)	33.5 (1.32)	33.5 (1.32)	45.5 (1.79)	45.5 (1.79)	50 (1.97)	50 (1.97)
S_w	Width across flats	mm (in.)	17	19	19	24	24	30	30
T_{inst}	Installation torque	Nm (ft-lb)	50 (37)	80 (59)	80 (59)	120 (88)	120 (88)	300 (221)	300 (221)
	Sleeve properties								
A_{sl}	Cross sectional area	mm^2 (in^2)	196 (0.304)	223 (0.346)	223 (0.346)	445 (0.690)	445 (0.690)	675.6 (1.047)	675.6 (1.047)
S_{sl}	Elastic section modulus	mm^3 (in^3)	596 (0.0364)	779 (0.0475)	779 (0.0475)	2110 (0.1288)	2110 (0.1288)	3950 (0.241)	3950 (0.241)
	Bolt properties								
A_b	Bolt nominal area	mm^2 (in^2)	78.5 (0.122)	113 (0.175)	113 (0.175)	201 (0.312)	201 (0.312)	314.16 (0.487)	314.16 (0.487)
A_t	Bolt tension area	mm^2 (in^2)	58 (0.090)	84.3 (0.131)	84.3 (0.131)	157 (0.243)	157 (0.243)	245 (0.380)	245 (0.380)
S_b	Elastic section modulus	mm^3 (in^3)	67 (0.0041)	117 (0.0071)	117 (0.0071)	293 (0.0179)	293 (0.0179)	541.3 (0.033)	541.3 (0.033)

1 Minimum thickness of fastened part as required to ensure engagement of full sleeve cross section in shear.

2 Metric stop drill bit must be used. See Section 3.3.1.4 for correct procedure and use of matched tolerance diamond core bits if required.

3.3.1.3.1 Design Information – Undercut Anchors

Undercut anchors represent the state of the art in post-installed anchor technology. When properly designed and proportioned, they transfer tension loads to the concrete in much the same way as cast-in-place headed bolts, that is, via bearing. Since friction is less critical in developing tension capacity, lower expansion forces are transmitted to the concrete. This reduces the overall stress state in the concrete prior to and during loading. The Hilti HDA Undercut Anchor System is the result of extensive research to determine the optimum geometry for load transfer at the bearing surface. Besides allowing for easy installation, the self-undercutting system automatically results in an excellent fit between the anchor bearing surface and the undercut, critical for limiting initial displacements. The HDA is equipped with a shear sleeve machined from high grade carbon steel. When used in the HDA-P preset configuration, shear loads are transferred through the threaded bolt to the sleeve and subsequently to the concrete in bearing. In HDA-T through-set applications, the sleeve engages the part to be fastened, thus substantially increasing the ultimate shear capacity of the anchorage. At ultimate, the sleeve and bolt act in concert to develop the full shear capacity of the anchor.

The HDA Undercut Anchor is proportioned to consistently develop the bolt strength in tension at critical edge distances and spacings. At spacings and edge distances less than critical, concrete cone failure will generally limit the ultimate load. The reduction of expansion forces allows for designed installations at minimum edge distances and spacings significantly less than those typically used for other types of mechanical expansion anchors. The predictability of the failure modes associated with the HDA Undercut Anchor allow for increased repeatability in determining ultimate capacities for a particular design condition.

The HDA Undercut Anchor was extensively tested prior to market introduction. Testing included static tension, shear, and oblique loading of both single anchors and groups, shock, seismic groups, seismic and shock loading. Exhaustive testing of the HDA performance in cracks confirms it’s suitability for installation in tension zones.

3.3.1.3.2 Design Method

3.3.2.3.2.1 Strength Design (LRFD)

ACI 318 Appendix D replaces the strength design provisions of the IBC and provides a comprehensive and rational framework for calculating anchor capacity. The applicability of the method to the HDA Undercut Anchor is based on the similarity of performance and failure modes established for the HDA with those associated for cast-in-place headed bolts.

This method can also be used for design in Canada according to CSA A23.3-94 providing the appropriate *f* factors for steel and concrete. See Table 9.

3.3.2.3.2.2 Allowable Stress Design (ASD)

Compatible with existing Hilti design methods. Test data to develop the average ultimate load capacity, and evaluating the data using the 5% fractile method to determine the allowable working load. See ESR-1546 Section 4.2.

3.3.1 HDA Undercut Anchor

Table 2 — HDA Strength Design Information

Design parameter	Symbol	Units	Nominal anchor diameter						
			M10		M12		M16		M20
			HDA HDA-F	HDA-R	HDA HDA-F	HDA-R	HDA HDA-F	HDA-R	HDA
Anchor O.D.	d_o	mm	19		21		29		35
		(in.)	(0.75)		(0.83)		(1.14)		(1.38)
Effective min. embedment depth[1]	$h_{ef,min}$	mm	100		125		190		250
		(in.)	(3.94)		(4.92)		(7.48)		(9.84)
Minimum edge distance	c_{min}	mm	80		100		150		200
		(in.)	(3-1/8)		(4)		(5-7/8)		(7-7/8)
Minimum anchor spacing	s_{min}	mm	100		125		190		250
		(in.)	(4)		(5)		(7-1/2)		(9-7/8)
Minimum member thickness	h_{min}	mm	170		190		270		350
		(in.)	(6-3/4)		(7-1/2)		(10-5/8)		(13-3/4)
Anchor category[2]	1,2 or 3	–	1						
Strength reduction factor for tension, steel failure modes[3]	Φ	–	0.75						
Strength reduction factor for shear steel failure modes	Φ	–	0.65						
Strength reduction factor for tension, concrete failure modes[3]	Φ	Cond. A	0.75						
		Cond. B	0.65						
Strength reduction factor for shear, concrete failure modes[3]	Φ	Cond. A	0.75						
		Cond. B	0.70						
Yield strength of anchor steel	f_{ya}	lb/in²	92,800	87,000	92,800	87,000	92,800	87,000	92,800
Ultimate strength of anchor steel	f_{uta}	lb/in²	116,000						
Tensile stress area	A_{se}	in²	0.090		0.131		0.234		0.380
Steel strength in tension	N_{sa}	lb	10,440		15,196		28,188		44,080
Effectiveness factor cracked concrete[4]	k_{cr}	–	30						30
Effectiveness factor uncracked concrete[4]	k_{cr}	–	24						24
k_{uncr}/k_{cr}[5]	$\Psi_{c,N}$	–	1.25						1.25
Pullout strength cracked concrete[6]	$N_{p,cr}$	lb	8,992		11,240		22,481		33,721
Steel strength in shear static[7] HDA-P/PF/PR	V_{sa}	lb	5,013	6,070	7,284	8,992	13,556	16,861	20,772
Steel strength in shear, seismic[7,8] HDA-P/PF/PR	V_{eq}	lb	4,496	5,620	6,519	8,093	12,140	15,062	18,659
Axial stiffness in service load range in cracked/uncracked concrete	ß	1000 lb/in	80/100						

1 Actual h_{ef} for HDA-T is given by $h_{ef,min} + (t_{fix} - t_{actual})$ where t_{fix} is given in Table 1 and t_{actual} is the thickness of the part(s) being fastened.

2 See ACI 318 D.4.4.

3 For use with the load combinations of ACI 318 9.2. Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.

4 See ACI 318 D.5.2.2.

5 See ACI 318 D.5.2.6.

6 See ESR-1546, Section 4.1.3.

7 For HDA-T see Table 3.

8 See ESR-1546, Section 4.1.6.

9 See ACI 318 RD.5.2.7. The critical edge distance c_{ac} does not exceed 1.5 h_{ef}. Therefore, ψ equals 1.0.

Table 3 - Steel Strength in Shear, HDA-T (lb)

	Anchor Designation	Thickness of fastened part(s) mm	Thickness of fastened part(s) in.	Steel Strength in Shear, Static Vsa	Steel Strength in Shear, Seismic[1] V_{eq}
HDA-T HDA-TF	HDA-T 20-M10x100	10 ≤ t < 15	3/8 ≤ t < 5/8	13,938	12,589
		15 ≤ t < 20	5/8 ≤ t < 13/16	15,737	14,163
	HDA-T 22-M12x125	10 ≤ t < 15	3/8 ≤ t < 5/8	16,636	15,062
		15 ≤ t ≤ 50	5/8 ≤ t < 2	18,659	16,636
	HDA-T 30-M16x190	15 ≤ t < 20	5/8 ≤ t < 13/16	30,574	27,427
		20 ≤ t < 25	13/16 ≤ t < 1	34,621	31,248
		25 ≤ t < 30	1 ≤ t < 1-3/16	38,218	34,396
		30 ≤ t ≤ 60	1-3/16 ≤ t < 2-3/8	41,365	37,093
	HDA-T 37-M20x250	20 ≤ t < 35	13/16 ≤ t < 1-3/8	45,187	40,690
		35 ≤ t < 50	1 ≤ t < 2	50,807	45,636
		50 ≤ t ≤ 100	2 ≤ t < 4	54,629	49,233
HDA-TR	HDA-T 37-M20x250	10 ≤ t < 15	3/8 ≤ t < 5/8	15,512	13,938
		15 ≤ t < 20	5/8 ≤ t < 13/16	16,186	14,613
	HDA-TR 22-M12x125	10 ≤ t < 15	3/8 ≤ t < 5/8	20,233	17,985
		15 ≤ t ≤ 50	5/8 ≤ t < 2	22,256	20,008
	HDA-TR 30-M16x190	15 ≤ t < 20	5/8 ≤ t < 13/16	35,745	32,148
		20 ≤ t < 25	13/16 ≤ t < 1	37,768	33,946
		25 ≤ t < 30	1 ≤ t < 1-3/16	39,566	35,520
		30 ≤ t ≤ 60	1-3/16 ≤ t < 2-3/8	40,915	36,869

1 The nominal steel strength V_{eq} for the HDA-P shall be taken from Table 2.

TABLE 4 - HDA-P/T and HDA PF/TF and HDA PR/TR Allowable Nonseismic Tension (ASD), Normal Weight Uncracked Concrete (lb) [1,2,3,4,5,6]

Nominal Anchor Diameter	Effective Embedment h_{ef} mm	Effective Embedment h_{ef} in.	Concrete Compressive Strength f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M10	100	3.94	5,440	5,960	6,880	8,430
M12	125	4.92	7,605	8,330	9,615	11,880
M16	190	7.48	14,250	15,610	18,025	22,075
M20	250	9.84	21,505	23,555	27,200	33,315

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

4 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

5 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

6 $ASD = \Phi_{concrete} \cdot N_{p,uncr} / \alpha = 0.65 \cdot N_{p,uncr} / 1.4$

TABLE 5 - HDA-P/T and HDA PF/TF and HDA PR/TR Allowable Nonseismic Tension (ASD), Normal Weight Cracked Concrete (lb) [1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment mm	Effective Embedment in.	Concrete Compressive Strength f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M10	100	3.94	4,350	4,770	5,505	6,745
M12	125	4.92	6,080	6,665	7,695	9,425
M16	190	7.48	11,400	12,485	14,420	17,660
M20	250	9.84	17,205	18,845	21,760	26,650

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 4. Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$.

5 $ASD = \Phi_{concrete} \cdot N_{p,cr} / \alpha = 0.65 \cdot N_{p,cr} / 1.4$

3.3.1 HDA Undercut Anchor

TABLE 6 - HDA-P/T and HDA PF/TF and HDA PR/TR Allowable Seismic Tension (ASD), Normal Weight Cracked Concrete (lb)[1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment		Concrete Compressive Strength			
	mm	in.	f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M10	100	3.94	3,531	3,870	4,465	5,470
M12	125	4.92	4,560	5,405	6,245	7,645
M16	190	7.48	9,250	10,130	11,700	14,330
M20	250	9.84	13,960	15,290	17,660	21,625

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

5 5. ASD = $\Phi_{concrete} \cdot \Phi_{seismic} \cdot N_{p,cr} / \alpha = 0.65 \cdot 0.75 \cdot N_{p,cr} / 1.294$

Table 7 - HDA-P/PF/PR Allowable Nonseismic and Seismic Shear (ASD), Steel (lb)[1,2]

Design parameter	M10		M12		M16		M20
	HDA	HDA-R	HDA	HDA-R	HDA	HDA-R	HDA
Allowable steel capacity, nonseismic[3,4,5]	2,685	3,250	3,900	4,815	7,260	9,035	10,385
Allowable steel capacity, seismic[6,7,8]	2,410	3,010	3,260	4,045	6,070	7,530	9,330

1 For single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For nonseismic, the ACI 318 required strength = 1.6D + 1.2L and the ACSE 7-05 factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

5 Nonseismic ASD = Φsteel · Vsa / α = 0.75 · Vsa / 1.4

6 For seismic, the ACI 318 required strength = 1.2D + 1.0E and the ACSE 7-05 factored load = 1.0D + 0.7E.

7 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

8 Seismic ASD = $\Phi_{steel} \cdot \Phi_{seismic} \cdot V_{eq} / \alpha = 0.75 \cdot 0.75 \cdot V_{eq} / 1.294$

Table 8 - HDA-T/TF/TR Allowable Nonseismic and Seismic Shear (ASD), Steel[1,2]

Anchor Designation	Fixture Thickness		Allowable Steel Capacity	
	mm	in.	V_{sa} Nonseismic[3,4,5]	V_{eq} Seismic[6,7,8]
HDA-T 20-M10x100	10<t<15	3/8<t<5/8	7,465	5,470
	15<t<20	5/8<t<13/16	8,430	6,155
HDA-T 22-M12x125	10<t<15	3/8<t<5/8	8,910	6,545
	15<t<50	5/8<t<2	9,995	7,230
HDA-T 30-M16x190	15<t<20	5/8<t<13/16	16,380	11,920
	20<t<25	13/16<t<1	18,545	13,585
	25<t<20	1<t<1-3/16	20,475	14,950
	30<t<60	1-3/16<t<2-3/8	22,160	16,125
HDA-T 37-M20x250	20<t<35	13/16<t<1-3/8	24,205	17,690
	35<t<50	1-3/8<t<2	27,220	19,840
	50<t<100	2<t<4	29,265	21,400
HDA-TR 20-M10x100	10<t<15	3/8<t<5/8	8,310	6,060
	15<t<20	5/8<t<13/16	8,670	6,350
HDA-TR 22-M12x125	10<t<15	3/8<t<5/8	10,840	7,820
	15<t<50	5/8<t<2	11,925	8,695
HDA-TR 30-M16x190	15<t<20	5/8<t<13/16	19,150	13,975
	20<t<25	13/16<t<1	20,235	14,755
	25<t<20	1<t<1-3/16	21,195	15,440
	30<t<60	1-3/16<t<2-3/8	21,920	16,025

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For nonseismic, the ACI 318 required strength = 1.6D + 1.2L and the ACSE 7-05 factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

5 Nonseismic ASD = $\Phi_{steel} \cdot V_{sa} / \alpha = 0.75 \cdot V_{sa} / 1.4$

6 For seismic, the ACI 318 required strength = 1.2D + 1.0E and the ACSE 7-05 factored load = 1.0D + 0.7E.

7 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

8 Seismic ASD = $\Phi_{steel} \cdot \Phi_{seismic} \cdot V_{eq} / \alpha = 0.75 \cdot 0.75 \cdot V_{eq} / 1.294$

TABLE 9 - HDA Design Information in accordance with CSA A23,3-04 Annex D 1

Design parameter	Symbol	Units	Nominal anchor diameter							Ref.
			M10		M12		M16		M20	A23,3-04
			HDA	HDA-R	HDA	HDA-R	HDA	HDA-R	HDA	
Anchor O.D.	d_o	mm	19		21		29		35	
Effective min. embedment depth[1]	$h_{ef,min}$	mm	100		125		190		250	
Minimum edge distance	c_{min}	mm	80		100		150		200	
Minimum anchor spacing	s_{min}	mm	100		125		190		250	
Minimum member thickness	h_{min}	mm	170		190		270		350	
Anchor category[2]	1,2 or 3	–	1		1		1		1	D.5.4c
Concrete material resistance factor for concrete	Φ_c	–	0.65		0.65		0.65		0.65	8.4.2
Steel embedment material resistance factor for reinforcement	Φ_s	–	0.85		0.85		0.85		0.85	8.4.3
Strength reduction factor for tension, steel failure modes[3]	R		0.80		0.80		0.80		0.80	D.4.3
Strength reduction factor for shear, steel failure modes	R		0.75		0.75		0.75		0.75	8.5.4a
Strength reduction factor for tension, concrete failure modes	R	Cond. A	1.15		1.15		1.15		1.15	8.5.4c
	R	Cond. B	1.00		1.00		1.00		1.00	8.5.4c
Strength reduction factor for shear, concrete failure modes	R	Cond. A	1.15		1.15		1.15		1.15	8.5.4c
	R	Cond. B	1.00		1.00		1.00		1.00	8.5.4c
Yield strength of anchor steel	f_y	MPa	640	600	640	600	640	600	640	
Ultimate strength of anchor steel	f_{ut}	MPa	800		800		800		800	
Effective cross-sectional area of anchor	A_{se}	mm^2	58.1		84.5		156.8		245.2	D.6.1.2
Factored steel resistance in tension	N_{sr}	kN	31.6		46.0		85.3		133.4	D.6.1.2
Coefficient for factored concrete breakout resistance in tension	k		10		10		10		10	D.6.2.6
Steel strength in shear, seismic[7,8] HDA-P/PF/PR	$\Psi_{c,N}$		1.25		1.25		1.25		1.25	D.6.2.6
Factored pullout resistance in 20 MPa cracked concrete	$N_{pr,cr}$	kN	27.9	27.9	34.9	34.9	69.8	69.8	104.7	D.6.3.6
Factored steel resistance in shear HDA-P/PR, static	V_{sr}	kN	14.2	17.2	20.7	25.5	38.4	47.8	58.9	D.7.1.2c
Factored steel resistance in shear HDA-P/PR, seismic	$V_{sr,seismic}$	kN	12.7	15.9	18.5	22.9	34.4	42.7	52.9	

1. For more information, please visit www.hilti.ca and navigate Service/Downloads, then Technical Downloads and open the Limit States Design Guide.
2. Effective area A_{se} was revised in the document in 2011. The original area were estimates based on 70% of the gross area calculated using the nominal diameter. The revised values are the actual tensile stress areas.

3.3.1 HDA Undercut Anchor

Table 10 - Steel Strength in Shear, HDA -T (kN), in accordance with CSA A233,3-04 Annex D1

Anchor Designation	Thickness of fastened part(s)	Steel Strength in Shear, Static (kN)[b]	Steel Strength in Shear, Seismic[1] (kN)[a,b]
	mm	V_{sr}	$V_{sr,seismic}$
HDA-T 20-M10x100	10 ≤ t < 15	39.5	35.7
	15 ≤ t < 20	44.6	40.2
HDA-T 22-M12x125	10 ≤ t < 15	47.2	42.7
	15 ≤ t ≤ 50	52.9	47.2
HDA-T 30-M16x190	15 ≤ t < 20	86.7	77.8
	20 ≤ t < 25	98.2	88.6
	25 ≤ t < 30	108.4	97.5
	30 ≤ t ≤ 60	117.3	105.2
HDA-T 37-M20x250	20 ≤ t < 35	128.1	115.4
	35 ≤ t < 50	144.1	129.4
	50 ≤ t ≤ 100	154.9	139.6

Stainless Steel Anchors	mm	V_{sr}	$V_{sr,seismic}$
HDA-T 20-M10x100	10 ≤ t < 15	44.0	39.5
	15 ≤ t < 20	45.9	41.4
HDA-TR 22-M12x125	10 ≤ t < 15	57.4	51.0
	15 ≤ t ≤ 50	63.1	56.7
HDA-TR 30-M16x190	15 ≤ t < 20	101.4	91.2
	20 ≤ t < 25	107.1	96.3
	25 ≤ t < 30	112.2	100.7
	30 ≤ t ≤ 60	116.0	104.6

a The nominal steel strength $V_{sr,seismic}$ for the HDA-P shall be taken from the HDA Design Information Table

b For groups of anchors, multiply value by number of anchors, n

Table 11 - Equipment required for setting HDA Anchors

Hda Carbon Steel - Zinc Plated

Anchor	Hilti Hammer Drill[1]								
	TE 25 (1st gear)	TE 35	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80- ATC
	connection end								
	TE-C			TE-Y					
HDA-P 20-M10x100/20	●		●	●	●				
HDA-T 20-M10x100/20	●		●	●	●				
HDA-P 22-M12x125/30	●		●	●	●				
HDA-T 22-M12x125/30	●		●	●	●				
HDA-P 22-M12x125/50	●		●	●	●				
HDA-T 22-M12x125/50	●		●	●	●				
HDA-P 30-M16x190/40						●	●	●	●
HDA-T 30-M16x190/40						●	●	●	●
HDA-P 30-M16x190/60						●	●	●	●
HDA-T 30-M16x190/60						●	●	●	●
HDA-P 37-M20x250/50						●		●	●
HDA-T 37-M20x250/50						●		●	●
HDA-P 37-M20x250/100						●		●	●
HDA-T 37-M20x250/100						●		●	●

1 To ensure IBC compliance, please reference ICC-ES ESR-1546 or call Hilti Technical Support.

Hda-R Stainless Steel

Anchor	Hilti Hammer Drill[1]								
	TE 25 (1st gear)	TE 35	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80- ATC
	connection end								
	TE-C			TE-Y					
HDA-PR 20-M10x100/20	●	●	●						
HDA-TR 20-M10x100/20	●	●	●	●	●				
HDA-PR 22-M12x125/30	●	●	●	●	●				
HDA-TR 22-M12x125/30	●	●	●	●	●				
HDA-PR 22-M12x125/50	●	●	●	●	●				
HDA-TR 22-M12x125/50	●	●	●	●	●				
HDA-PR 30-M16x190/40						●	●	●	●
HDA-PR 30-M16x190/60						●	●	●	●
HDA-PR 30-M16x190/60						●	●	●	●
HDA-TR 30-M16x190/60						●	●	●	●

1 To ensure IBC compliance, please reference ICC-ES ESR-1546 or call Hilti Technical Support.

Hda-F Carbon Steel - Sherardized (Heavy-Duty Galvanization)

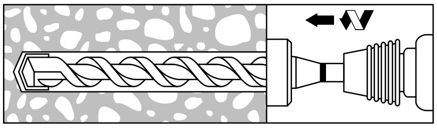
Anchor	Hilti Hammer Drill[1]								
	TE 25 (1st gear)	TE 35	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80- ATC
	connection end								
	TE-C			TE-Y					
HDA-PF 20-M10x100/20		●	●		●				
HDA-TF 20-M10x100/20		●	●		●				
HDA-PF 22-M12x125/30		●	●		●				
HDA-TF 22-M12x125/30		●	●		●				
HDA-PF 22-M12x125/50		●	●		●				
HDA-TF 22-M12x125/50		●	●		●				
HDA-PF 30-M16x190/40						●	●	●	●
HDA-TF 30-M16x190/40						●	●	●	●
HDA-PF 30-M16x190/60						●	●	●	●
HDA-TF 30-M16x190/60						●	●	●	●

1 To ensure IBC compliance, please reference ICC-ES ESR-1546 or call Hilti Technical Support.

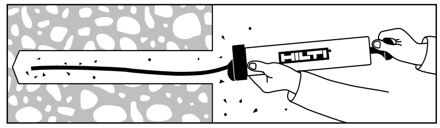
3.3.1 HDA Undercut Anchor

3.3.1.4 Installation Instructions

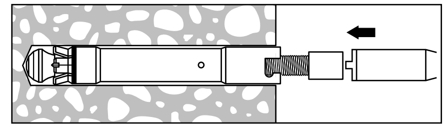
Setting Operation HDA-P/-PR/-PF (Preset Style)



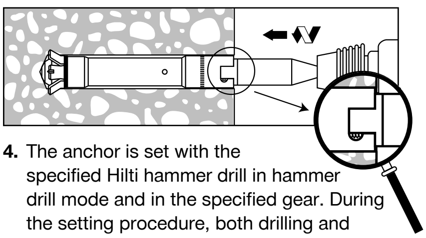
1. Drill a hole to the required depth using a stop drill bit matched to the anchor, (refer to specification table and ordering info.). If rebar is encountered, use a Hilti metric matched tolerance diamond core bit to drill through the rebar. Remove the concrete core and finish drilling the hole with the stop drill bit. Always consult with the Engineer of Record before cutting rebar.



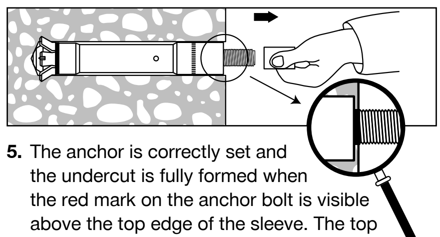
2. Clean hole with a shop vacuum, compressed air or a hand air pump to remove drilling debris.



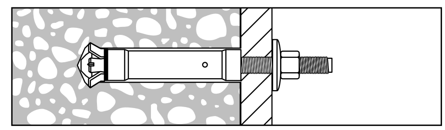
3. Insert the anchor into the hole by hand, so that the cone sits on the bottom of the drilled hole. Do not remove the plastic cap which protects the threaded rod. Using the assigned setting tool and Hilti hammer drill, the setting tool is guided over the anchor rod and engages the grooves in the sleeve. **It is critical to use the specified Hilti hammer drills.**



4. The anchor is set with the specified Hilti hammer drill in hammer drill mode and in the specified gear. During the setting procedure, both drilling and impact energy are transferred to the sleeve by the setting tool, causing the sleeve to slide over the conical end of the anchor bolt while forming the undercut in the base material. On the setting tool, the red ring indicates the progress of the setting operation. When this marking is flush with the concrete surface, check the anchor for proper setting (refer to step 5).

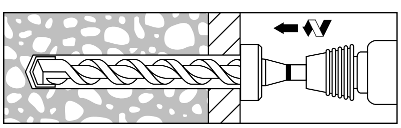


5. The anchor is correctly set and the undercut is fully formed when the red mark on the anchor bolt is visible above the top edge of the sleeve. The top edge of the anchor sleeve must be positioned dimension h_s below the concrete surface. If the anchor setting time exceeds 60 seconds for M10, M12 or M16 anchors or 120 seconds for M20 anchors the installation failed and the anchors must not be loaded.

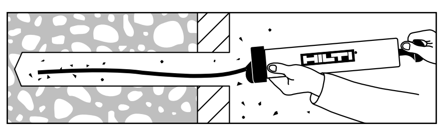


6. Remove the plastic thread protector cap. Secure the part to be fastened by using the conical spring washer and nut provided. Apply a torque not to exceed the maximum values given in the Specification Table. Torque is not required to set the anchor.

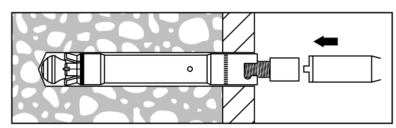
Setting Operation HDA-T/-TR/-TF (Through-Set Style)



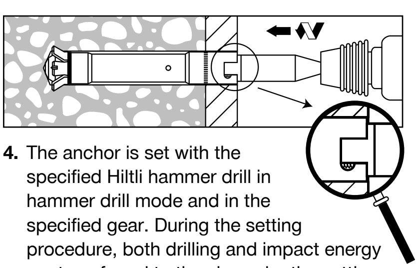
1. Drill a hole to the required depth using a stop drill bit matched to the anchor, (refer to specification table and ordering info.). If rebar is encountered, use a Hilti metric matched tolerance diamond core bit to drill through the rebar. Remove the concrete core and finish drilling the hole with the stop drill bit. Always consult with the Engineer of Record before cutting rebar.



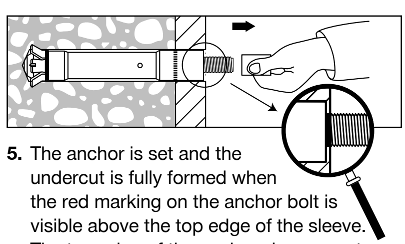
2. Clean hole with a shop vacuum, compressed air or a hand pump.



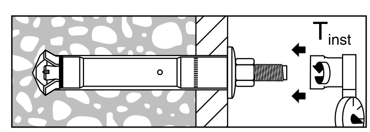
3. Insert the anchor into the hole by hand, so that the cone sits on the bottom of the drilled hole. Do not remove the plastic cap which protects the threaded rod. Using the assigned setting tool and Hilti hammer drill, the setting tool is guided over the anchor rod and engages the grooves in the sleeve. **It is critical to use the specified Hilti hammer drills.**



4. The anchor is set with the specified Hiltli hammer drill in hammer drill mode and in the specified gear. During the setting procedure, both drilling and impact energy are transferred to the sleeve by the setting tool, causing the sleeve to slide over the conical end of the anchor bolt while forming the undercut in the base material. On the setting tool, the red ring indicates the progress of the setting operation. When this marking is flush with the connected part, check the anchor for proper setting (refer to step 5).



5. The anchor is set and the undercut is fully formed when the red marking on the anchor bolt is visible above the top edge of the sleeve. The top edge of the anchor sleeve must be positioned dimension h_s below the surface of the fixture. If anchor setting time exceeds 60 seconds for M10, M12 or M16 anchors or 120 seconds for M20 anchors the installation failed and the anchor must not be loaded.



6. Remove the plastic thread protector cap. Secure the part to be fastened by using the conical spring washer and nut provided. Apply a torque not to exceed the maximum values given in the Specification Table. Torque is not required to set the anchor.

	h_s (mm)	
dia.	min.	max.
M10	2	6
M12	2	7
M16	2	8
M20	2	8

The HDA Undercut Anchor, designed to carry significant, safety-relevant loads, **must** be installed correctly with the prescribed tools to function properly. Carefully follow **all** instructions located inside the box. Installer training is also available upon request.

3.3.1.5 Ordering Information

HDA-T Anchor



Description	HDA-T	HDA-TF	HDA-TR	HDA	Stop Drill Bit	Diamond Core Bit	Setting Tool
rod dia. x embed./ max. fixture thickness	Galvanized	Sherardised	316 Stainless	Box Qty	Description (mm) dia. x drill depth	Diameter	Description
M10x100/20	●	●	●	12	TE-C-B20x120	20mm	TE-C-ST 20 M10
					TE-Y-B20x120		TE-Y-ST 20 M10
M12x125/30	●	●	●	8	TE-C-B22x155	22mm	TE-C-ST 22 M12
					TE-Y-B22x155		TE-Y-ST 22 M12
M12x125/50	●	●	●	8	TE-C-B22x175	22mm	TE-C-ST 22 M12
					TE-Y-B22x175		TE-Y-ST 22 M12
M16x190/40	●	●	●	4	TE-Y B30x230	30mm	TE-Y-ST 30 M16
M16x190/60				4	TE-Y B30x250		
M20x250/50	●			2	TE-Y B37x300	37mm (1-3/8")	TE-Y-ST 37 M20
M20x250/100	●			2	TE-Y B37x350		

1 The drilling depth with the diamond core bit must not exceed 2/3 of the specified minimum drill hole depth. The last 1/3 of the drill hole depth must be completed with the specified stop drill bit (hammer drill). Always consult the engineer of record before cutting rebar.

HDA-P Anchor



Description	HDA-P	HDA-PF	HDA-PR	HDA	Stop Drill Bit	Diamond Core Bit	Setting Tool
rod dia. x embed./ max. fixture thickness	Galvanized	Sherardised	316 Stainless	Box Qty	Description (mm) dia. x drill depth	Diameter	Description
M10x100/20	●	●	●	12	TE-C B20x100	20mm	TE-C-ST 20 M10
					TE-Y B20x100		TE-Y-ST 20 M10
M12x125/30	●	●	●	8	TE-C B22x125	22mm	TE-C-ST 22 M12
					TE-Y B22x125		TE-Y-ST 22 M12
M12x125/50	●	●	●	8	TE-C-B22x175	22mm	TE-C-ST 22 M12
					TE-Y-B22x175		TE-Y-ST 22 M12
M16x190/40	●	●	●	4	TE-Y B30x190	30mm	TE-Y-ST 30 M16
M16x190/60	●	●	●	4			
M20x250/50	●			2	TE-Y B37x250	37mm	TE-Y-ST 37 M20
M20x250/100	●			2			

1 The drilling depth with the diamond core bit must not exceed 2/3 of the specified minimum drill hole depth. The last 1/3 of the drill hole depth must be completed with the specified stop drill bit (hammer drill). Always consult the engineer of record before cutting rebar.

3.3.1 HDA Removal Tool

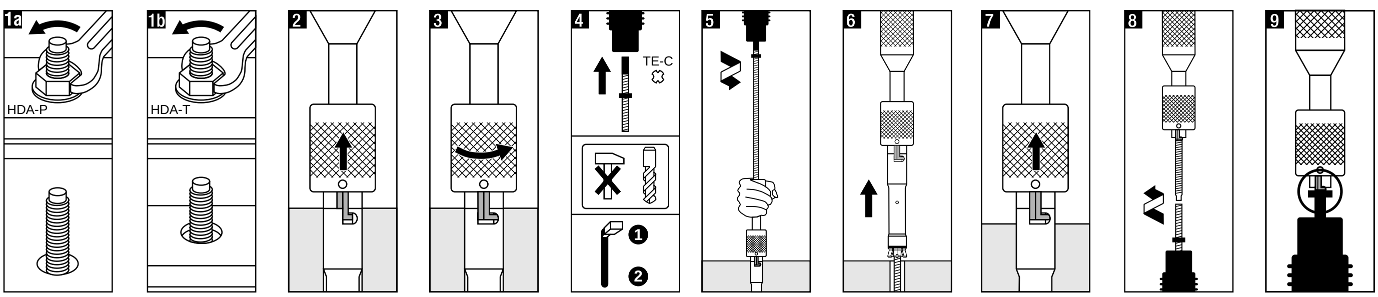
3.3.1.6 HDA Removal

The Hilti HDA Removal Tool is designed to remove the Hilti HDA Undercut Mechanical Anchor that were installed in standard applications in accordance with Hilti guidelines.

Product Features

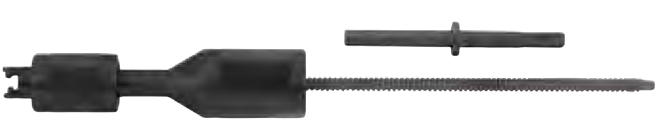
- Complete removal of HDA design anchors for temporary applications
- The removal process strips the threads to prevent reuse of anchors for safety purposes
- Suitable for rotary hammers with TE-C style chucks

Removal Instructions



1. Remove the nut and washer from the threaded rod, (also remove fastening part for HDA-P applications).
2. Push back the grip (against this spring pressure).
3. Allow the two drive lugs to engage the groove in the anchor sleeve using a slight twisting movement of the grip. Release the grip.
4. Insert the adapter (drive) into the drill chuck and lock. The TE 40 is recommended.
   Important:
   - Switch off the hammering action (the removal tool will be permanently damaged if this step is neglected.).
   - Use slow speed. This is setting 1 for the TE 40.
5. Put adapter (drive) onto the threaded spindle of the removal tool and switch on the drill.
6. The anchor sleeve will be extracted.
7. Disengage the drive lugs from the groove by lifting up and twisting the grip.
8. To return the tool to its starting position, put the adapter (drive) on the other end of the threaded spindle.
9. Switch on the hammer drill until the adapter stop reaches the removal tool.

Removal Tool with Adapter



Description	Qty/Pkg	Applicable Anchor Sizes
TE-C-HDA-RT 20-M10	1	HDA M10
TE-C-HDA-RT 22-M12	1	HDA M12
TE-C-HDA-RT 30-M16	1	HDA M16
TE-C-HDA-RT 37-M20	1	HDA M20

HSL-3 Heavy-duty Expansion Anchor 3.3.2

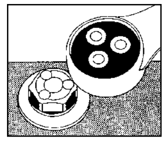
3.3.2.1 HSL-3 Product Description

HSL-3 Heavy-duty Expansion Anchor

HSL-3-G Heavy-duty Expansion Anchor with Threaded Rod

Counter sunk version available as special

HSL-3-B Heavy-duty Expansion Anchor with Torque Cap



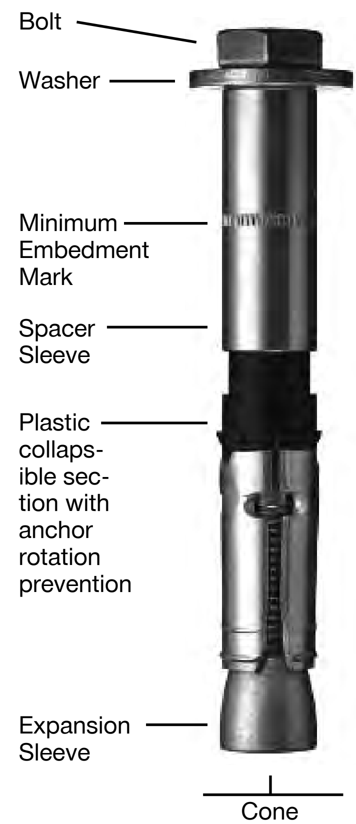
Red Setting Indicator
Three accurately sized shear pins are provided in the red indicator cap. As the required installation torque (T_{inst}) is reached the red indicator cap shears off. A green seal on the bolt head appears which indicates that the anchor has been set properly.

Maximum fastened thickness (mm)
Metric

HSL-3-G M 12 / 25

Heavy duty Expansion Anchor	blank-bolt G stud B torque cap	Metric thread size (mm); not hole diameter

Example: HSL-3-G M12/25
This is an HSL-3 stud anchor. The thread size is 12 mm and this anchor can attach up to a 25 mm thick plate



The Hilti HSL-3 Heavy-duty Expansion Anchor is a torque-controlled expansion bolt designed for high performance in static and dynamic application including the tension zone of concrete structures where cracking can be expected. HSL-3 anchors are available in metric sizes from M8 to M24. With a variety of head configurations, including bolt, stud and torque cap. All versions are available in zinc-plated carbon steel.

Product Features

- Approved for use in the concrete tension zone (cracked concrete)
- Data for use with the Strength Design provisions of ACI 318 Appendix D and ACI 349 Appendix B
- Allowable Stress Design data for use with ASD
- High load capacity
- Force-controlled expansion which allows for follow-up expansion
- Reliable clamping of part fastened to overcome gaps
- Suitable for dynamic loading, including seismic, fatigue and shock
- No spinning of the anchor in hole when tightening bolt or nut
- Seismic qualification per ICC-ES AC193 and the requirements of ACI 318 Appendix D

Guide Specifications

Expansion Anchors: Carbon steel anchor consists of hex head bolt (threaded stud), sleeve, expansion sleeve, expansion cone, collapsible plastic sleeve, (nut) and washer. Anchors shall be torque controlled expansion bolt as manufactured by Hilti.

Listings/Approvals

ICC-ES (International Code Council)
ESR-1545
European Technical Approval (ETA)
ETA-02/0042
Qualified under NQA-1 Nuclear Quality Program

Independent Code Evaluation

IBC® / IRC® 2009 (AC 193 / ACI 355.2)
IBC® / IRC® 2006 (AC 193 / ACI 355.2)
UBC® 1997 (AC 01)

3.3.2.2 Material Specifications

Carbon Steel Bolt or Threaded Rod for HSL-3 (Bolt), HSL-3 (Stud) and HSL-3-B conform to DIN EN ISO 898-1, Grade 8.8, f_y > 93 ksi, f_u > 116 ksi
Carbon Steel Nut conforms to DIN 934, Grade 8, f_u > 116 ksi
Carbon Steel Washer conforms to DIN 1544, Grade St37, f_u > 100 ksi
Carbon Steel Expansion Cone conforms to DIN 1654-4, f_u > 80 ksi
Carbon Steel Expansion Sleeve (M8-M16) conforms to DIN 10139 and (M20-M24) conforms to DIN 2393-2
Carbon Steel Spacing Sleeve conforms to DIN 2393 T1, f_u > 100 ksi
Collapsible Sleeve is made from acetal polyoxymethylene (POM) resin

3.3.2 HSL-3 Heavy-duty Expansion Anchor

3.3.2.3 Technical Data

Table 1 — HSL-3 Specifications

Details			HSL-3 Anchor Thread Diameter (mm)											
			M8		M10		M12		M16		M20		M24	
nominal drill bit diameter[1]	d_{bit}	mm	12		15		18		24		28		32	
Hilti matched-tolerance carbide-tipped drill bit	–	–	TE-CX 12/22		TE-CX 15/27		TE-C 18/22		TE-C-T 24/27		TE-C-T 28/27		TE-YX 32/3	
			TE-YX 12/35		TE-YX 15/35		TE-YX 18/32		TE-YX 24/32		TE-YX 28/32			
minimum base material thickness to obtain smallest critical edge distance	h_{min}	mm	110 (120)		120 (140)		135 (160)		160 (200)		190 (250)		225 (300	
		(in.)	4 3/8 (4-3/4)		4 3/4 (5-1/2)		5 3/8 (6 1/4)		6 1/4 (7-7/8)		7 1/2 (9-7/8)		8 7/8 (11-7/8)	
minimum hole depth	h_o	mm	80		90		105		125		155		180	
		(in.)	(3-1/8)		(3-1/2)		(4-1/8)		(4-7/8)		(6-1/8)		(7-1/8)	
effective embedment depth	$h_{ef,min}$	mm	60		70		80		100		125		150	
		(in.)	(2-3/8)		(2-3/4)		(3-1/8)		(3-7/8)		(4-7/8)		(5-7/8)	
minimum clearance hole diameter in part being fastened	d_h	mm	14		17		20		26		31		35	
		(in.)	(9/16)		(11/16)		(13/16)		(1)		(1-1/4)		(1-3/8)	
max. cumulative gap between part(s) being fastened and concrete surface	–	mm	4		5		8		9		12		16	
		(in.)	(1/8)		(3/16)		(5/16)		(3/8)		(1/2)		(5/8)	
maximum thickness of part fastened HSL-3, HSL-3-B	t	mm	20	40	20	40	25	50	25	50	30	60	30	60
		(in.)	(3/4)	(1-1/2)	(3/4)	(1-1/2)	(1)	(2)	(1)	(2)	(1-1/8)	(2-1/4)	(1-1/8)	(2-1/4)
overall length of anchor HSL-3, HSL-3-B	–	mm	98	118	110	130	131	156	153	178	183	213	205	235
		(in.)	(3-7/8)	(4-5/8)	(4-3/8)	(5 1/8)	(5-1/8)	(6 1/8)	(6)	(7)	(7-1/4)	(8-3/8)	(8)	(9-1/4)
maximum thickness of part fastened HSL-3-G	t	mm	20		20		25	50	25	50	30	60		
		(in.)	(3/4)		(3/4)		(1)	(2)	(1)	(2)	(1-1/8)	(2-1/4)		
overall length of anchor HSL-3-G	–	mm	102		115		139	164	163	188	190	220		
		(in.)	(4)		(4-1/2)		(5-1/2)	(6-3/8)	(6-3/8)	(7-3/8)	(7-1/2)	(8-3/4)		
washer diameter	d_w	mm	20		25		30		40		45		50	
		(in.)	(3/4)		(1)		(1-1/8)		(1-9/16)		(1-3/4)		(2)	
installation torque HSL-3	T_{inst}	mm	25		50		80		120		200		250	
		(in.)	(18)		(37)		(59)		(89)		(148)		(185)	
installation torque HSL-3-G	T_{inst}	mm	20		35		60		80		160			
		(in.)	(15)		(26)		(44)		(59)		(118)			
wrench size HSL-3, HSL-3-G	–	mm	13		17		19		24		30		36	
wrench size HSL-3-B	–	mm					24		30		36		41	

1 Use metric bits only.

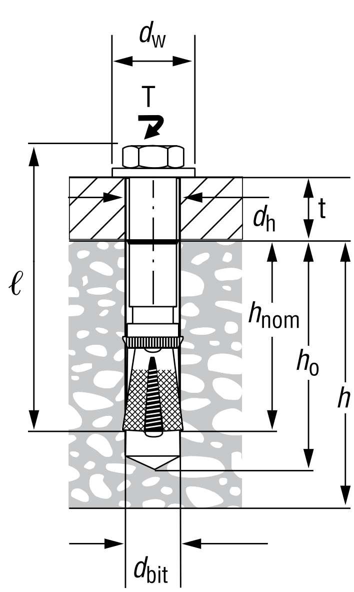


Table 2 — HSL-3 Strength Design Information

Design Parameter		Symbol	Units	Nominal Anchor Diameter					
				M8	M10	M12	M16	M20	M24
Anchor O.D.		d_o	mm	12	15	18	24	28	32
			in.	0.47	0.59	0.71	0.94	1.10	1.26
Effective min. embedment depth[1]		$h_{ef,min}$	mm	60	70	80	100	125	150
			in.	2.36	2.76	3.15	3.94	4.92	5.91
Anchor category[2]		1,2 or 3	–	1					
Strength reduction factor for tension, steel failure modes[3]		Φ	–	0.75					
Strength reduction factor for shear, steel failure modes[3]		Φ	–	0.65					
Strength reduction factor for tension, concrete failure modes[3]		Φ	Cond. A	0.75					
			Cond. B	0.65					
Strength reduction factor for shear, concrete failure modes[3]		Φ	Cond. A	0.75					
			Cond. B	0.70					
Yield strength of anchor steel		f_y	lb/in^2	92,800					
Ultimate strength of anchor steel		f_u	lb/in^2	116,000					
Tensile stress area		A_{se}	in^2	0.057	0.090	0.131	0.243	0.280	0.547
Steel strength in tension		N_{sa}	lb	6,612	10,440	15,196	28,188	44,080	63,452
Effectiveness factor uncracked concrete		k_{uncr}	–	24					
Effectiveness factor cracked concrete		k_{cr}	–	17	24				
k_{uncr}/k_{cr}[5]		$\Psi_{c,N}$	–	1.41	1.00				
Pullout strength uncracked concrete		$N_{p,uncr}$	lb	4,204	-	-	-	-	-
Pullout strength cracked concrete		$N_{p,cr}$	lb	2,810	4,496	-	-	-	-
Steel strength in shear HSL-3,-B		V_{sa}	lb	7,239	10,229	14,725	26,707	39,521	45,951
Steel strength in shear HSL-3-G		V_{sa}	lb	6,070	8,385	12,162	22,683	33,159	
Tension pullout strength seismic		N_{eq}	lb	-	-	-	-	-	14,320
Steel strength in shear, seismic HSL-3,-SH,-SK		V_{eq}	lb	4,609	8,453	11,892	24,796	29,135	38,173
Steel strength in shear, seismic HSL-3-G			lb	3,777	6,924	9,824	21,065	24,459	
Axial stiffness in service load range	uncracked concrete	$ß_{uncr}$	1000 lb/in.	300					
	cracked concrete	$ß_{uncr}$		30	70	130			

1 See Table 1.

2 See ACI 318 Section D.4.4.

3 For use with the load combinations of ACI 318 Section 9.2. Condition A applies where the potential concrete failure surfaces are crossed by supplementary reinforcement proportioned to tie the potential concrete failure prism into the structural member. Condition B applies where such supplementary reinforcement is not provided, or where pullout or pryout strength governs.

4 See ACI 318 Section D.5.2.2.

5 See ACI 318 Section D.5.2.6.

3.3.2 HSL-3 Heavy-duty Expansion Anchor

Table 3 — Edge Distance, Spacing and Member Thickness Requirements[1,2]

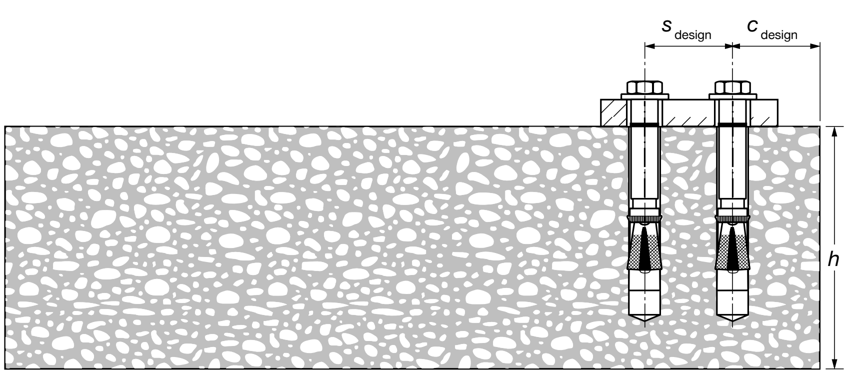
Case[3]	Dimensional Parameter	Symbol	Units	Nominal Anchor Diameter					
				M8	M10	M12	M16	M20	M24
A	Minimum concrete thickness	$h_{min,A}$	in.	4-3/4	5-1/2	6-1/4	7-7/8	9-7/8	11-7/8
			(mm)	(120)	(140)	(160)	(200)	(250)	(300)
A	Critical edge distance[2]	$c_{cr,A}$	in.	4-3/8	4-3/8	4-3/4	5-7/8	8-7/8	8-7/8
			(mm)	(110)	(110)	(120)	(150)	(225)	(225)
A	Minimum edge distance[3]	$c_{min,AA}$	in.	2-3/8	2-3/4	3-1/2	4-3/4	5	5-7/8
			(mm)	(60)	(70)	(90)	(120)	(125)	(150)
A	Minimum anchor spacing[3]	$s_{min,AA}$	in.	5-1/2	9-1/2	11	12-5/8	13-3/4	11-7/8
			(mm)	(140)	(240)	(280)	(320)	(350)	(300)
A	Minimum edge distance	$c_{min,AB}$	in.	3-3/8	5	6-1/8	7-7/8	8-1/4	8-1/4
			(mm)	(85)	(125)	(155)	(200)	(210)	(210)
A	Minimum anchor spacing	$s_{min,AB}$	in.	2-3/8	2-3/4	3-1/8	4	5	5-7/8
			(mm)	(60)	(70)	(80)	(100)	(125)	(150)
B	Minimum concrete thickness	$h_{min,B}$	in.	4-3/8	4-3/4	5-3/8	6-1/4	7-1/2	8-7/8
			(mm)	(110)	(120)	(135)	(160)	(190)	(225)
B	Critical edge distance[2]	$c_{cr,B}$	in.	5-7/8	6-7/8	7-7/8	9-7/8	12-3/8	14-3/4
			(mm)	(150)	(175)	(200)	(250)	(312.5)	(375)
B	Minimum edge distance[3]	$c_{min,BA}$	in.	2-3/8	3-1/2	4-3/8	6-1/4	7-7/8	8-7/8
			(mm)	(60)	(90)	(110)	(160)	(200)	(225)
B	Minimum anchor spacing[3]	$s_{min,BA}$	in.	7	10-1/4	12-5/8	15	15-3/4	15
			(mm)	(180)	(260)	(320)	(380)	(400)	(380)
B	Minimum edge distance[3]	$c_{min,BB}$	in.	4	6-1/4	7-7/8	10-5/8	11-7/8	12-5/8
			(mm)	(100)	(160)	(200)	(270)	(300)	(320)
B	Minimum anchor spacing[3]	$s_{min,BB}$	in.	2-3/8	2-3/4	3-1/8	4	5	5-7/8
			(mm)	(60)	(70)	(80)	(100)	(125)	(150)

1 In lieu of ACI 318 D.3.3. minimum edge distance, spacing and member thickness shall comply with ESR-1545 Table 4.

2 The concrete breakout strength calculated according to ACI 318 D.5.2, shall be further multiplied by $\Psi_{ed,N}$. See ESR-1545 Section 4.1.2.

3 Denotes admissible combinations of h_{min}, c_{cr}, c_{min}, and s_{min}. For example, $h_{min,A} + c_{min,AA} + s_{min,AA}$ or $h_{min,A} + c_{cr,A} + c_{min,AB} + s_{min,AB}$ are admissible, but $h_{min,A} + c_{cr,B} + c_{min,AB} + s_{min,BB}$ is not. However, other admissible combinations for minimum edge distance c_{min} and spacing s_{min} for $h_{min,A}$ or $h_{min,B}$ may be derived by linear interpolation between boundary values (see example for $h_{min,A}$ below).

Example of Allowable Interpolation of Minimum Edge Distance and Minimum Spacing



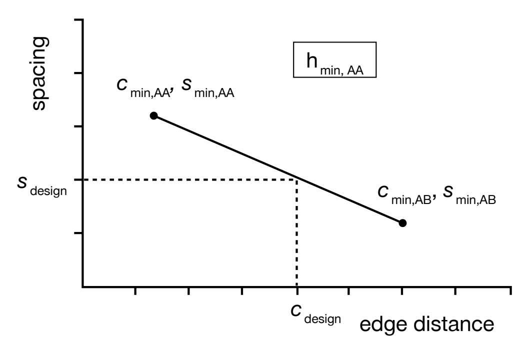


TABLE 4 - HSL-3 Allowable Nonseismic Tension (ASD), Normal Weight Uncracked Concrete (lb)[1,2,3,4,5,6]

Nominal Anchor Diameter	Effective Embedment h_{ef}		Concrete Compressive Strength			
	mm	in.	f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M8	60	2.36	1,950	2,140	2,470	3,024
M10	70	2.76	2,550	2,790	3,225	3,950
M12	80	3.15	3,115	3,410	3,940	4,825
M16	100	3.94	4,350	4,770	5,505	6,745
M20	125	4.92	6,080	6,665	7,694	9,425
M24	150	5.91	7,995	8,760	10,115	12,385

1 Single anchors with nonseismic tension with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

4 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

5 5. Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

6 $ASD = \Phi_{concrete} \cdot N_{p,uncr} / \alpha = 0.65 \cdot N_{p,uncr} / 1.4$

TABLE 5 - HSL-3 Allowable Nonseismic Tension (ASD), Normal Weight Cracked Concrete (lb)[1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment h_{ef}		Concrete Compressive Strength			
	mm	in.	f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M8	60	2.36	1,435	1,570	1,812	2,220
M10	70	2.76	2,550	2,790	3,225	3,950
M12	80	3.15	3,115	3,410	3,940	4,825
M16	100	3.94	4,350	4,770	5,505	6,745
M20	125	4.92	6,080	6,665	7,694	9,425
M24	150	5.91	7,995	7,285	8,410	10,300

1 Single anchors with nonseismic tension with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 4. Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

5 $ASD = \Phi_{concrete} \cdot N_{p,cr} / \alpha = 0.65 \cdot N_{p,cr} / 1.4$

TABLE 6 - HSL-3 Allowable Nonseismic Shear (ASD), Steel[1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment h_{ef}		Allowable steel capacity, shear	
	mm	in.	HSL-3, HSL-3-B	HSL-3-G
M8	60	2.36	2,470	2,025
M10	70	2.76	4,530	3,710
M12	80	3.15	6,370	5,265
M16	100	3.94	13,285	11,285
M20	125	4.92	15,610	13,105
M24	150	5.91	20,450	

1 Single anchors with nonseismic shear with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 2. Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 3. For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Calculation for weighted average for $\alpha = 0.5 \cdot 1.6 + 0.5 \cdot 1.2 = 1.4$.

5 $ASD = \Phi_{steel} \cdot V_{sa} / \alpha = 0.75 \cdot V_{sa} / 1.4$

3.3.2 HSL-3 Heavy-duty Expansion Anchor

TABLE 7 - HSL-3 Allowable Seismic Tension (ASD), Normal Weight Cracked Concrete (lb)[1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment h_{ef}		Concrete Compressive Strength			
	mm	in.	f'_c = 2,500 psi	f'_c = 3,000 psi	f'_c = 4,000 psi	f'_c = 6,000 psi
M8	60	2.36	1,165	1,570	1,470	1,800
M10	70	2.76	2,070	2,265	2,615	3,205
M12	80	3.15	2,525	2,770	3,195	3,915
M16	100	3.94	3,530	3,870	4,465	5,470
M20	125	4.92	4,935	5,405	6,245	7,645
M24	150	5.91	5,395	5,910	6,824	8,360

1 Single anchors with seismic tension with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

5 $ASD = \Phi_{concrete} \cdot \Phi_{seismic} \cdot N_{p,cr} / \alpha = 0.65 \cdot 0.75 \cdot N_{p,cr} / 1.294$

TABLE 8 - HSL-3 Allowable Seismic Shear (ASD), Steel[1,2,3,4,5]

Nominal Anchor Diameter	Effective Embedment h_{ef}		Allowable steel capacity, shear	
	mm	in.	HSL-3, HSL-3-B	HSL-3-G
M8	60	2.36	2,005	1,640
M10	70	2.76	3,675	3,010
M12	80	3.15	5,170	4,270
M16	100	3.94	10,780	9,155
M20	125	4.92	12,665	10,630
M24	150	5.91	16,595	

1 Single anchors with seismic shear with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$.

5 Seismic $ASD = \Phi_{steel} \cdot \Phi_{seismic} \cdot V_{eq} / \alpha = 0.75 \cdot 0.75 \cdot V_{eq} / 1.294$

TABLE 9 - HSL- 3 Design Information in accordance with CSA A23.3-04 Annex D[1]

Design Parameter	Symbol	Units	Nominal Anchor Diameter						Ref.
			M8	M10	M12	M16	M20	M24	A23.3-04
Anchor O.D.	d_o	mm	**12**	**15**	**18**	**24**	**28**	**32**	
		in.	0.47	0.59	0.71	0.94	1.1	1.26	
Effective minimum embedment depth	$h_{ef,min}$	mm	60	70	80	100	125	150	
		in.	2.36	2.76	3.15	3.94	4.92	5.91	
Anchor category	1,2 or 3	–	1						D.5.4c
Concrete material resistance factor for concrete	Φ_c	–	0.65						8.4.2
Steel embedment material resistance factor for reinforcement	Φ_s	–	0.85						8.4.3
Strength reduction factor for tension, steel failure modes	R	–	0.80						D.5.4a
Strength reduction factor for shear, steel failure modes	R	–	0.75						D.5.4a
Strength reduction factor for tension, concrete failure modes	R	Cond. A	1.15						D.5.4c
	R	Cond. B	1.00						D.5.4c
Strength reduction factor for shear, concrete failure modes	R	Cond. A	1.15						D.5.4c
	R	Cond. B	1.00						D.5.4c
Yield strength of anchor steel	f_y	MPa	640						
Ultimate strength of anchor steel	f_{ut}	MPa	800						
Effective cross-sectional area of anchor	A_{se}	mm^2	36.8	58.1	84.5	156.8	245.2	352.9	D.6.1.2
Factored Steel Resistance in tension	N_{sr}	kN	20.0	31.6	46.0	85.3	133.3	191.9	D.6.1.2
Coefficient for factored concrete breakout resistance in tension	k	–	7	10					D.6.2.6
Modification factor for resistance in tension to account for uncracked concrete	$\Psi_{c,n}$	–	1.40	1.00					D.6.2.6
Factored pullout resistance in 20 Mpa uncracked concrete	$N_{p,uncr}$	kN	12.3	N/A					D 6.3.2
Factored pullout resistance in 20 MPa cracked concrete	N_{pr}	kN	8.7	14.0	N/A				D.6.3.2
Factored Steel Resistance in shear HSL-3, -B	V_{sr}	kN	20.5	29.0	41.8	75.7	112.1	130.3	D.7.1.2c
Factored Steel Resistance in shear HSL-3-G	V_{sr}	kN	17.2	23.8	34.5	64.3	94.0	N/A	D.7.1.2c
Factored pullout resistance in 20 MPa Concrete, seismic	$N_{pr,seismic}$	kN	N/A					33.4	
Factored Steel Resistance in shear, seismic HSL-3, -B, -SH, -SK	$V_{sr,seismic}$	kN	13.1	24.0	33.7	70.3	82.6	108.2	
Factored Steel Resistance in shear, seismic HSL-3-G	$V_{sr,seismic}$	kN	10.7	19.6	27.9	59.7	69.4	N/A	
Axial stiffness in service load range, uncracked concrete	β_{uncr}	kN/mm	52.5						
Axial stiffness in service load range, cracked concrete	β_{cr}	kN/mm	5.3	12.3	22.8				

1. For more information, please visit www.hilti.ca and navigate Service/Downloads, then Technical Downloads and open the Limit States Design Guide.

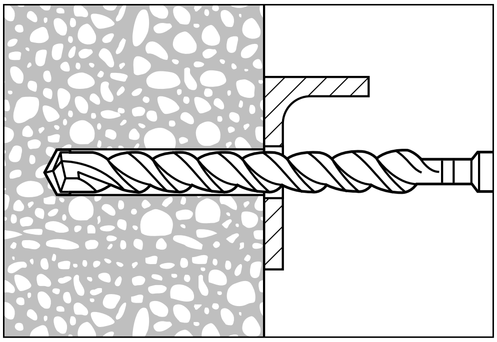
2. Effective area Ase was revised in the document in 2011. The original area were estimates based on 70% of the gross area calculated using the nominal diameter. The revised values are the actual tensile stress areas.

3.3.2 HSL-3 Heavy-duty Expansion Anchor

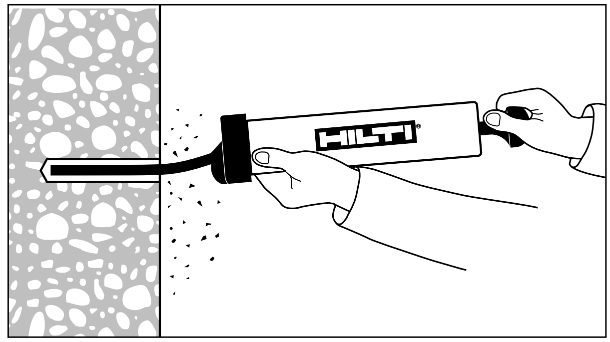
TABLE 10 - HSL- 3 Design Information in accordance with CSA A23.3-04 Annex D[1]

Edge Distance, Spacing and Member Thickness Requirements	Symbol	Units	Nominal Anchor Diameter					
			M8	M10	M12	M16	M20	M24
Anchor O.D.	h_{min}	mm	120	140	160	200	250	300
Effective minimum embedment depth	c_{ac}	mm	110	110	120	150	225	225
Anchor category	c_{min}	mm	60	70	90	120	125	150
Concrete material resistance factor for concrete	s_{min}	mm	60	70	80	100	125	150
Combination of edge distance and spacing								
For M8:	$s_{design} \geq$	mm	greater of [332 - (3.20 x c_{design})] mm or s_{min}					
For M10:	$s_{design} \geq$	mm	greater of [456 - (3.09 x c_{design})] mm or s_{min}					
For M12:	$s_{design} \geq$	mm	greater of [557 - (3.08 x c_{design})] mm or s_{min}					
For M16:	$s_{design} \geq$	mm	greater of [650 - (2.75 x c_{design})] mm or s_{min}					
For M20:	$s_{design} \geq$	mm	greater of [681 - (2.65 x c_{design})] mm or s_{min}					
For M24:	$s_{design} \geq$	mm	greater of [675 - (2.50 x c_{design})] mm or s_{min}					

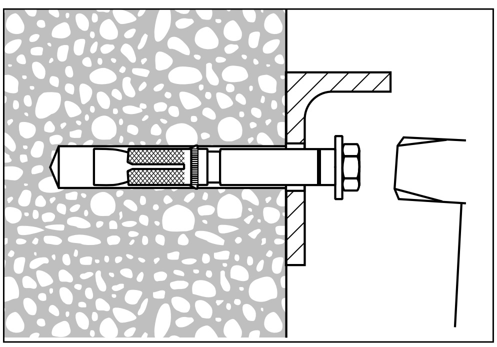
3.3.2.4 HSL-3 Installation Instructions



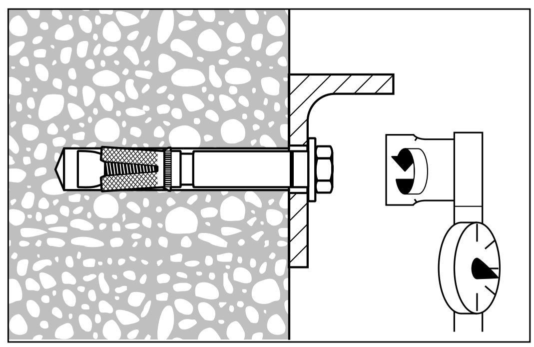
1. Using the correct diameter metric bit, drill hole to minimum required hole depth or deeper.



2. Remove drilling debris with a vacuum, blow out device or compressed air.



3. Using a hammer, tap the anchor through the part being fastened into the drilled hole until the washer is in contact with the fastened part. Do not expand anchor by hand prior to installation.



4. Using a torque wrench, apply the specified installation torque. HSL-3-B does not require use of a torque wrench. Tighten until torque cap shears off.

3.3.2.5 Ordering Information

HSL-3 Bolt Version

Description	Box Qty
HSL-3 M 8/20	40
HSL-3 M 8/40	40
HSL-3 M 10/20	20
HSL-3 M 10/40	20
HSL-3 M 12/25	20
HSL-3 M 12/50	20
HSL-3 M 16/25	10
HSL-3 M 16/50	10
HSL-3 M 20/30	6
HSL-3 M 20/60	6
HSL-3 M 24/30	4
HSL-3 M 24/60	4

HSL-3-B Torque Cap

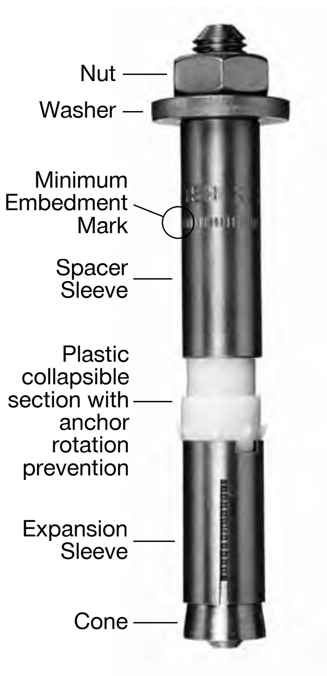
Description	Box Qty
HSL-3-B M 12/5	20
HSL-3-B M 12/25	20
HSL-3-B M 12/50	10
HSL-3-B M 16/10	10
HSL-3-B M 16/25	10
HSL-3-B M 20/30	6
HSL-3-B M 24/30	4

Counter sunk HSL-3 available upon request as a special item.

HSL-3-G Stud Version

Description	Box Qty
HSL-3-G M 8/20	40
HSL-3-G M 10/20	20
HSL-3-G M 12/25	20
HSL-3-G M 12/50	10
HSL-3-G M 16/25	10
HSL-3-G M 16/50	10
HSL-3-G M 20/30	6
HSL-3-G M 20/60	6

3.3.3 HSL Heavy Duty Expansion Anchor



3.3.3.1 Product Description

HSL-I M12 Flush Anchor with Torque Nut

Flush mount applications accommodated by short removable stud

HSLG-R Stainless Steel with Threaded Rod

The Hilti HSL Heavy Duty Sleeve Anchor is a torque controlled expansion bolt designed for high performance in static and dynamic load applications. HSL anchors are available in metric sizes from 12 mm to 20 mm diameters.

Product Features

- High load capacity
- Spacer sleeve provides enhanced shear capacity
- Force controlled expansion
- Reliable pull-down of part fastened to overcome gaps
- Suitable for dynamic loading (fatigue, seismic, and shock loading)
- No spinning of anchor in hole when tightening bolt or nut
- Good performance in Hilti Matched Tolerance DD-B or DD-C Diamond Core Bit holes

Guide Specifications

Expansion Anchors Carbon (Stainless) steel anchor consists of threaded rod, sleeve, expansion sleeve, expansion cone and collapsible plastic sleeve, (nut) and washer. Anchors shall be torque controlled expansion bolt as manufactured by Hilti.

Installation Refer to Section 3.3.3.4

Dynamic Loading

The HSL anchor has been tested under shock, seismic and fatigue (2 x 10^6 cycles) loading conditions. Contact your Hilti Field Engineer for additional information.

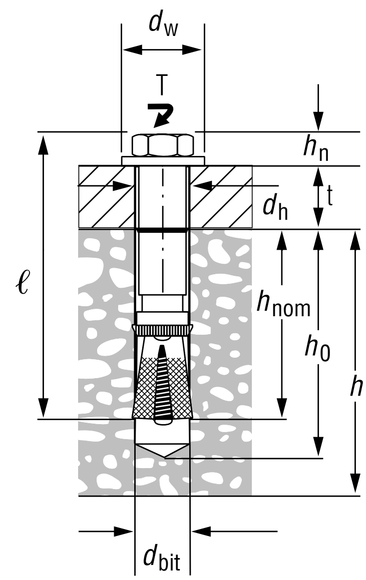
3.3.3.2 Material Specifications

Carbon Steel Bolt or threaded rod conform to ISO 898-1, Class 8.8, $f_y \geq 93$ ksi, $f_u \geq 116$ ksi
Carbon Steel expansion sleeve conforms to DIN 2393, Grade ST-52-3
Carbon Steel nut conforms to DIN 934, Grade 8, $f_u \geq 116$ ksi
Stainless steel threaded rod conforms to DIN 267, Type A4-70, $f_y = 65$ ksi, $f_u \geq 102$ ksi
Stainless steel expansion sleeve conforms to DIN 17440, $f_u \geq 102$ ksi
Stainless Steel cone conforms to DIN 17440, $f_u \geq 102$ ksi
Stainless Steel washer conforms to DIN 17441, 74 ksi $\leq f_u \leq$ 103 ksi
Stainless Steel nut conforms to DIN 934
Collapsible sleeve is made of Acetal resin plastic
Carbon Steel cone conforms to DIN 1654, Type CQ35, $f_u \geq 87$ ksi
Carbon Steel washer conforms to DIN 1544, Grade ST37, $f_u \geq 91$ ksi

3.3.3.3 Technical Data

Table 1 - HSL Specifications

Details			HSL Anchor Thread Diameter (mm)					
			12	12	16	16	20	20
d_{bit}	nominal bit dia.	mm	18		24		28	
h_O	min. hole depth	mm	100		125		150	
		(in.)	(4)		(5)		(6)	
h_{nom}	min. depth of embedment	mm	80		105		130	
		(mm)	(3-3/16)		(4-1/8)		(5-1/8)	
t	Max. thickness fastened	mm	25	50	25	50	30	60
		(mm)	(1)	(2)	(1)	(2)	(1-1/8)	(2-1/4)
ℓ	anchor length	mm	120	145	148	173	183	213
		(mm)	(4-3/4)	(5-3/4)	(5-3/4)	(6-3/4	(7-1/4)	(8-3/8)
h_n	head height + washer	mm	11		14		17	
		(in.)	(7/16)		(9/16)		(11/16)	
T_{inst}	installation torque	Nm	80		200		400	
		(ft lb)	(60)		(150)		(300)	
	wrench size (mm)	HSL/HSLG	19		24		30	
d_h	min. dia. fixture hole	mm	22		28		33	
		(in.)	(13/16)		(1-1/8)		(1-5/16)	
d_w	washer diameter	mm	30		40		45	
		(in.)	(1-3/16)		(1-9/16)		(1-3/4)	
h_{min}	min. base material thickness	mm	160		180		220	
		(in.)	(6-1/4)		(7)		(8-3/4)	



3.3.3 HSL Heavy Duty Expansion Anchor

Table 2 - Stainless Steel HSLG-R Allowable Loads in Normal-Weight Concrete

Anchor Diameter	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)
M10	75 (3)	6.8 (1535)	13.7 (3090)	9.1 (2055)	14.8 (3325)	11.5 (2575)	15.8 (3560)	11.5 (2595)	16.4 (3690)
M12	80 (3-3/16)	8.7 (1960)	20.2 (4540)	11.3 (2530)	21.8 (4890)	13.8 (3105)	23.3 (5245)	17.5 (3925)	25.0 (5615)
M16	105 (4-1/8)	17.6 (3965)	34.7 (7805)	20.9 (4705)	39.9 (8965)	24.2 (5450)	45.0 (10125)	30.7 (6900)	46.9 (10550)
M20	130 (5-1/8)	25.1 (5650)	52.9 (11900)	30.7 (6910)	58.7 (13195)	36.4 (8175)	64.5 (14490)	44.5 (10005)	64.5 (14490)

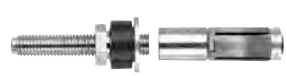
Table 3 - Stainless Steel HSLG-R Ultimate Loads in Normal-Weight Concrete

Anchor Diameter	Embedment Depth mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)	Tension kN (lb)	Shear kN (lb)
M10	75 (3)	23.8 (5350)	47.8 (10785)	31.9 (7165)	51.6 (11595)	40.0 (8985)	55.2 (12410)	40.3 (9055)	57.3 (12880)
M12	80 (3-3/16)	30.4 (6830)	70.5 (15845)	39.3 (8830)	75.9 (17070)	48.2 (10835)	81.4 (18300)	60.9 (13700)	87.1 (19590)
M16	105 (4-1/8)	61.6 (13840)	121.1 (27220)	73.0 (16420)	139.1 (31270)	84.5 (19005)	157.1 (35320)	107.0 (24065)	163.7 (36800)
M20	130 (5-1/8)	87.7 (19715)	184.7 (41510)	107.3 (24115)	204.7 (46025)	126.9 (28520)	224.8 (50540)	155.3 (34910)	224.8 (50540)

Table 4 - HSL-I M12 Allowable Loads in 4000 psi Normal Weight Concrete[1]

Description	Anchor Length	Embedment	Tension	Shear
	(mm)	(mm)	(lb)	(lb)
HSL - I M12 65/80	113	65	2,335	2,265
	130	80	3,150	2,350

1 Allowable loads calculated using a 4:1 factor of safety.



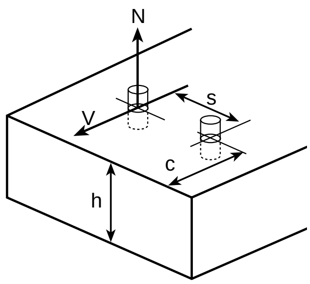
Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0$$

Refer to Section 3.1.8.3

HSL Heavy Duty Expansion Anchor 3.3.3

Anchor Spacing and Edge Distance Guidelines



Anchor Spacing Adjustment Factors

s = Actual Spacing

s_{min} = 1.0 h_{nom}

s_{cr} = 3.0 h_{ef}

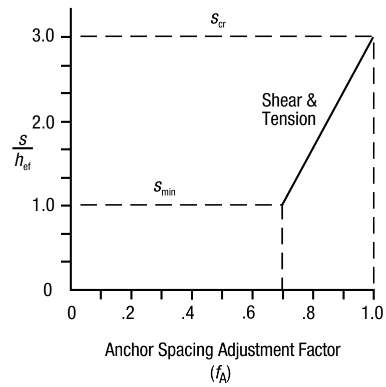
Edge Distance Adjustment Factors

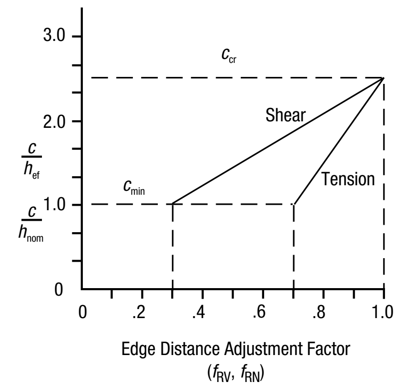
c = Actual Edge Distance	
c_{min} = 1.0h_{nom} c_{cr} = 2.5h_{ef}	Tension
c_{min} = 1.0 h_{nom} c_{cr} = 2.5h_{nom}	Shear

Anchor Size	h_{nom} in.	(mm)
M10	75	(3)
M12	80	(3-3/16)
M16	105	(4-1/8)
M20	130	(5-1/8)

h_{ef} - actual embedment depth

h_{nom} - standard embedment depth





Load Adjustment Factors (Anchor Spacing) f_A						Load Adjustment Factors (Edge Disdtance) f_R									
Tension/Shear						Tension f_{RN}						Shear f_{RV}			
Spacing s		Anchor Diameter				Edge Distance c		Anchor Diameter				Anchor Diameter			
mm	(in.)	M10	M12	M16	M20	mm	(in.)	M10	M12	M16	M20	M10	M12	M16	M20
65	(2-1/2)					65	(2-1/2)								
75	(3)	.70				75	(3)	.70				.30			
80	(3-1/8)	.71	.70			80	(3-1/8)	.71	.70			.33	.30		
105	(4-1/8)	.76	.74	.70		105	(4-1/8)	.78	.76	.70		.48	.44	.30	
130	(5-1/8)	.81	.79	.73	.70	130	(5-1/8)	.85	.83	.74	.70	.64	.59	.41	.30
155	(6-1/8)	.86	.84	.77	.72	155	(6-1/8)	.91	.88	.79	.73	.80	.74	.52	.39
175	(6-7/8)	.90	.87	.80	.75	162	(6-3/8)	.93	.90	.80	.75	.84	.78	.55	.41
195	(7-5/8)	.94	.91	.82	.77	187	(7-3/8)	1.0	.96	.85	.78	1.0	.92	.66	.50
225	(8-7/8)	1.0	.97	.87	.80	200	(7-7/8)		1.0	.88	.80		1.0	.72	.55
240	(9-3/8)		1.0	.89	.82	225	(8-7/8)		1.0	.92	.84		1.0	.83	.64
275	(10-3/4)			.94	.86	265	(10-3/8)			1.0	.91			1.0	.79
315	(12-3/8)			1.0	.91	275	(10-3/4)			1.0	.92			1.0	.82
350	(13-3/4)				.95	300	(11-3/4)			1.0	.96			1.0	.91
395	(15-1/2)				1.0	325	(12-3/4)				1.0				1.0
430	(17)					350	(13-3/4)				1.0				1.0
470	(18-1/2)					390	(15-3/8)								

s_{min} = 1.0 h_{nom} s_{cr} = 3.0 h_{ef}

$$f_A = 0.15 \frac{s}{h_{ef}} + 0.55$$

for $s_{cr} > s > s_{min}$

c_{min} = 1.0 h_{nom} c_{cr} = 2.5 h_{ef}

$$f_{RN} = (0.30) \left(\frac{c - 1.0\,h_{nom}}{2.5\,h_{ef} - 1.0\,h_{nom}} \right) + 0.70$$

for $c_{cr} > c > c_{min}$

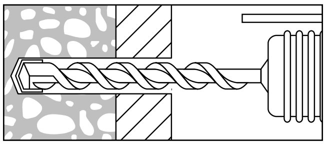
c_{min} = 1.0 h_{nom} c_{cr} = 2.5 h_{nom}

$$f_{RV} = 0.47 \frac{c}{h_{nom}} - 0.17$$

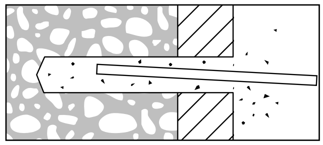
for $c_{cr} > c > c_{min}$

3.3.3 HSL Heavy Duty Expansion Anchor

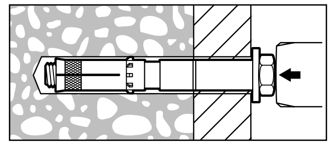
3.3.3.4 Installation Instructions



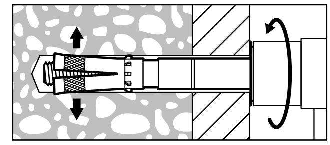
1. Drill a hole with the prescribed Hilti metric carbide or diamond core bit. **Note:** the HSL can be installed in a bottomless hole.



2. Clean the hole using compressed air.



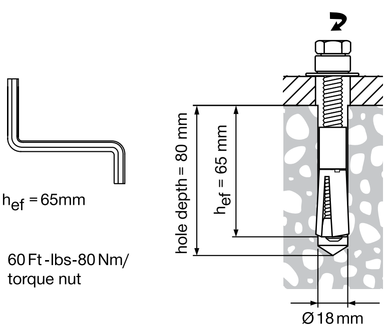
3. Using a hammer, tap the pre-assembled anchor through the object being anchored and into the hole. The anchor should be seated firmly against the base plate. **Note:** Do not expand the anchor by hand before tapping it into the hole.



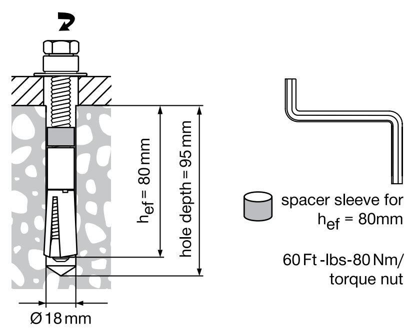
4. Tighten bolt or nut to the specified torque, using a torque wrench.

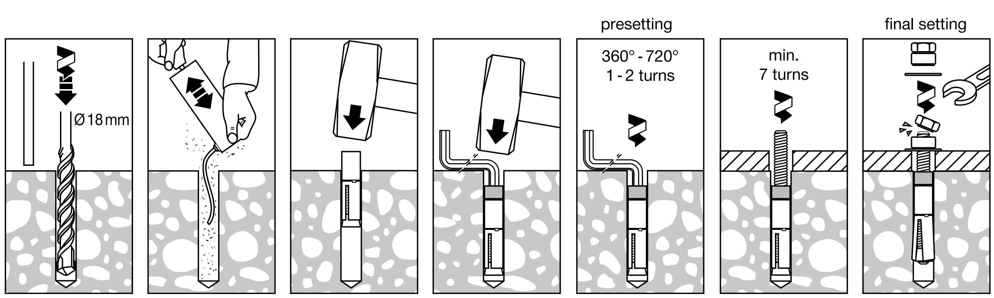
Setting Instructions for the HSL-I M12-0 65/80

HSL-I M12-0 65



HSL-I M12-0 80

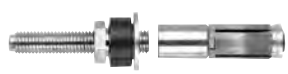




3.3.3.5 Ordering Information

HSLG-R Stainless Steel Anchor
Material: Stainless Steel type 316

Description	Box Qty
HSLG-R M 10/20	20
HSLG-R M 12/25	20
HSLG-R M 16/25	10
HSLG-R M 20/30	6



HSL-I Flush Anchor
(Internally Threaded)

Description	Box Qty
HSL-I M12 65/80	20

3.3.4.1 KWIK Bolt TZ Product Description

The KWIK Bolt TZ (KB-TZ) is a torque controlled expansion anchor which is especially suited to seismic and cracked concrete applications. This anchor line is available in carbon steel, type 304 and type 316 stainless steel versions. The anchor diameters range from 3/8- and 3/4-inch in a variety of lengths. Applicable base materials include normal-weight concrete, structural lightweight concrete, and lightweight concrete over metal deck.

Guide Specifications

Torque controlled expansion anchors shall be KWIK Bolt TZ (KB-TZ) supplied by Hilti meeting the description in Federal Specification A-A 1923A, type 4. The anchor bears a length identification mark embossed into the impact section (dog point) of the anchor surrounded by four embossed notches identifying the anchor as a Hilti KWIK Bolt TZ in the installed condition. Anchors are manufactured to meet one of the following conditions:

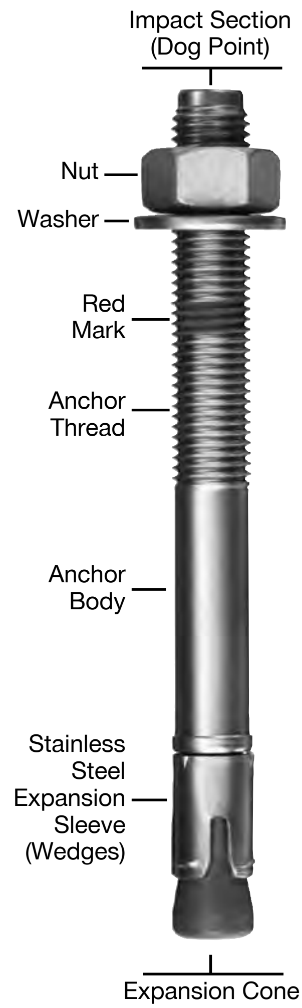
- The carbon steel anchor body, nut, and washer have an electro-plated zinc coating conforming to ASTM B633 to a minimum thick-ness of 5 µm. The stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut and washer conform to type 304. Stainless steel expansion sleeve conforms to type 316.
- Stainless steel anchor body, nut, washer, and expansion sleeve con-form to type 316 stainless steel.

Product Features

- Product and length identification marks facilitate quality control after installation.
- Through fixture installation and variable thread lengths improve productivity and accommodate various base plate thicknesses.
- Type 316 Stainless Steel wedges provide superior performance in cracked concrete.
- Ridges on expansion wedges provide increased reliability.
- Mechanical expansion allows immediate load application.
- Raised impact section (dog point) prevents thread damage during installation.
- Bolt meets ductility requirements of ACI 318 Section D1.

Installation

Drill hole in base material to the appropriate depth using a Hilti carbide tipped drill bit. Drive the anchor into the hole using a hammer. A minimum of four threads must be below the fastening surface prior to applying installation torque. Tighten the nut to the installation torque.



Listings/Approvals

ICC-ES (International Code Council)
ESR-1917

FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler Systems (3/8" - 3/4")

UL (Underwriters Laboratories)
Pipe Hanger Equipment for Fire Protection Services (3/8" - 3/4")

Independent Code Evaluation

IBC® / IRC® 2009 (AC 193 / ACI 355.2)
IBC® / IRC® 2006

Supplemental Design Provisions for ACI 318 Appendix D

Design strengths are determined in accordance with ACI 318 Appendix D and ICC Evaluation Service ESR-1917 Hilti KWIK Bolt TZ Carbon and Stainless Steel Anchors in Concrete. The relevant design parameters are reiterated in Tables 1, 2, and 3 of this document. Supplemental provisions required for the design of the KB-TZ are enumerated in Section 4.0 of ESR-1917 (DESIGN AND INSTALLATION). Note that these design parameters are supplemental to the design provisions of ACI 318.

3.3.4 KWIK Bolt TZ Expansion Anchor

3.3.4.2 Material Properties

Carbon steel with electroplated zinc

- Carbon steel KB-TZ anchors have the following minimum bolt fracture loads[1]

Anchor Diameter (in.)	Shear (lb)	Tension (lb)
3/8	NA	6,744
1/2	7,419	11,240
5/8	11,465	17,535
3/4	17,535	25,853

- Carbon steel anchor components plated in accordance with ASTM B633 to a minimum thickness of 5µm.
- Nuts conform to the requirements of ASTM A 563, Grade A, Hex.
- Washers meet the requirements of ASTM F 844.
- Expansion sleeves (wedges) are manufactured from type 316 stainless steel.

Stainless steel

- Stainless steel KB-TZ anchors are made of type 304 or 316 material and have the following minimum bolt fracture loads[1]

Anchor Diameter (in.)	Shear (lb)	Tension (lb)
3/8	5,058	6,519
1/2	8,543	12,364
5/8	13,938	19,109
3/4	22,481	24,729

- All nuts and washers are made from type 304 or type 316 stainless steel respectively.
- Nuts meet the dimensional requirements of ASTM F 594.
- Washers meet the dimensional requirements of ANSI B18.22.1, Type A, plain.
- Expansion Sleeve (wedges) are made from type 316 stainless steel.

1 Bolt fracture loads are determined by testing in jig as part of product QC. These loads are not intended for design purposes. See Tables 2 and 3.

3.3.4.3 Technical Data

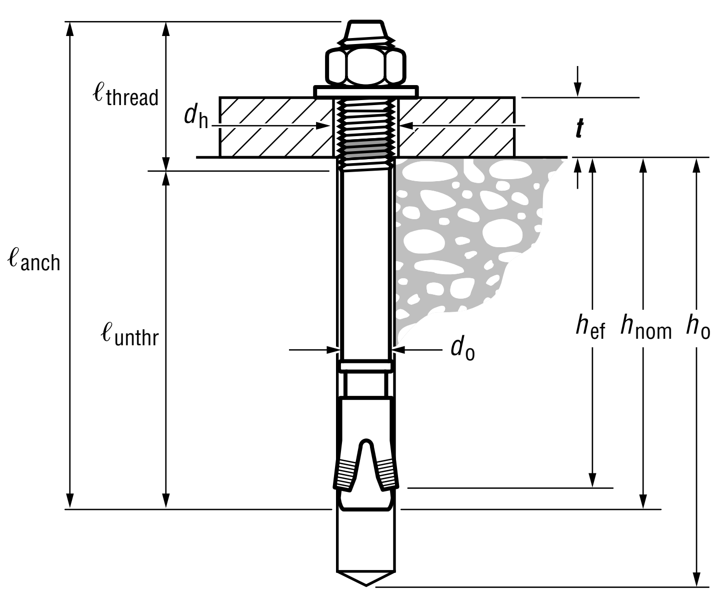
Table 1 — KWIK Bolt TZ Specification Table

Setting Information	Symbol	Units	3/8	1/2		5/8		3/4	
			Nominal anchor diameter (in.)						
Anchor O.D.	d_o	in.	0.375	0.5		0.625		0.75	
		(mm)	(9.5)	(12.7)		(15.9)		(19.1)	
Nominal bit diameter	d_{bit}	in.	3/8	1/2		5/8		3/4	
Effective minimum embedment	h_{ef}	in.	2	2	3-1/4	3-1/8	4	3-3/4	4-3/4
		(mm)	(51)	(51)	(83)	(79)	(102)	(95)	(121)
Min. hole depth	h_o	in.	2-5/8	2-5/8	4	3-3/4	4-3/4	4-5/8	5-3/4
		(mm)	(67)	(67)	(102)	(95)	(121)	(117)	(146)
Min. thickness of fixture[1]	t_{min}	in.	1/4	3/4	1/4	3/8	3/4	1/8	1-5/8
		(mm)	(6)	(19)	(6)	(9)	(19)	(3)	(41)
Max. thickness of fixture	t_{max}	in.	2-1/4	4	2-3/4	5-5/8	4-3/4	4-5/8	3-5/8
		(mm)	(57)	(101)	(70)	(143)	(121)	(117)	(92)
Installation torque	T_{inst}	ft-lb	25	40		60		110	
		(Nm)	(34)	(54)		(81)		(149)	
Minimum diameter of hole	d_h	in.	7/16	9/16		11/16		13/16	
		(mm)	(11.1)	(14.3)		(17.5)		(20.6)	

Setting Information	Symbol	Units	3/8			1/2				5/8				3/4		
Available anchor lengths	ℓ_{anch}	in.	3	3-3/4	5	3-3/4	4-1/2	5-1/2	7	4-3/4	6	8-1/2	10	5-1/2	8	10
		(mm)	(76)	(95)	(127)	(95)	(114)	(140)	(178)	(121)	(152)	(216)	(254)	(140)	(203)	(254)
Threaded length including dog point	ℓ_{thread}	in.	7/8	1-5/8	2-7/8	1-5/8	2-3/8	3-3/8	4-7/8	1-1/2	2-3/4	5-1/4	6-3/4	1-1/2	4	6
		(mm)	(22)	(41)	(73)	(41)	(60)	(86)	(178)	(38)	(70)	(133)	(171)	(38)	(102)	(152)
Unthreaded length	ℓ_{unthr}	in.	2-1/8			2-1/8				3-1/4				4		
		(mm)	(54)			(54)				(83)				(102)		
Installation embedment	h_{nom}	in.	2-1/4			2-3/8		3-5/8		3-5/8		4-1/2		4-3/8		5-3/8
		(mm)	(57)			(60)		(92)		(92)		(114)		(111)		(137)

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.

Figure 1 — KWIK Bolt TZ Installed



3.3.4 KWIK Bolt TZ Expansion Anchor

Table 2 — Carbon Steel KWIK Bolt TZ Strength Design Information

Setting Information	Symbol	Units	Nominal anchor diameter											
			3/8		1/2				5/8			3/4		
Anchor O.D.	d_o	in. (mm)	0.375 (9.5)		0.5 (12.7)				0.625 (15.9)			0.75 (19.1)		
Effective minimum embedment[1]	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/8 (79)	4 (102)		3-3/4 (95)		4-3/4 (121)
Min. member thickness	h_{min}	in. (mm)	4 (102)	5 (127)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	8 (203)
Critical edge distance	c_{ac}	in. (mm)	4-3/8 (111)	4 (102)	5-1/2 (140)	4-1/2 (114)	7-1/2 (191)	6 (152)	6-1/2 (165)	8-3/4 (222)	6-3/4 (171)	10 (254)	8 (203)	9 (229)
Min. edge distance	$c_{a,min}$	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-5/8 (92)	3-1/4 (83)		4-3/4 (121)		4-1/8 (105)
	for s ≥	in. (mm)	5 (127)		5-3/4 (146)		5-3/4 (146)		6-1/8 (156)	5-7/8 (149)		10-1/2 (267)		8-7/8 (225)
Min. anchor spacing	s_{min}	in. (mm)	2-1/2 (64)		2-3/4 (70)		2-3/8 (60)		3-1/2 (89)	3 (76)		5 (127)		4 (102)
	for c ≥	in. (mm)	3-5/8 (92)		4-1/8 (105)		3-1/2 (89)		4-3/4 (121)	4-1/4 (108)		9-1/2 (241)		7-3/4 (197)
Min. hole depth in concrete	h_o	in. (mm)	2-5/8 (67)		2-5/8 (67)		4 (102)		3-7/8 (98)	4-3/4 (121)		4-5/8 (117)		5-3/4 (146)
Min. specified yield strength	f_{ya}	lb/in² (N/mm²)	100,000 (690)		84,800 (585)				84,800 (585)			84,800 (585)		
Min. specified ult. strength	f_{uta}	lb/in² (N/mm²)	115,000 (793)		106,000 (731)				106,000 (731)			106,000 (731)		
Effective tensile stress area	A_{se}	in.² (mm²)	0.052 (33.6)		0.101 (65.0)				0.162 (104.6)			0.237 (152.8)		
Steel strength in tension	N_{sa}	lb (kN)	6,500 (28.9)		10,705 (47.6)				17,170 (76.4)			25,120 (111.8)		
Steel strength in shear	V_{sa}	lb (kN)	3,595 (16.0)		5,495 (24.4)				8,090 (36.0)			13,675 (60.8)		
Steel strength in shear, seismic	V_{eq}	lb (kN)	2,255 (10.0)		5,495 (24.4)				7,600 (33.8)			11,745 (52.2)		
Steel strength in shear, concrete on metal deck[2]	$V_{sa,deck}$	lb (kN)	2,130[10] (9.5)		3,000 (13.3)		4,945 (22)		4,600[10] (20.5)	6,040[10] (26.9)		NP		
Pullout strength uncracked concrete[3]	$N_{p,uncr}$	lb (kN)	2515 (11.2)		NA		5,515 (24.5)		NA	9,145 (40.7)		8,280 (36.8)		10,680 (47.5)
Pullout strength cracked concrete[3]	$N_{p,cr}$	lb (kN)	2270 (10.1)		NA		4,915 (21.9)		NA			NA		
Pullout strength concrete on metal deck[4]	$N_{p,deck,cr}$	lb (kN)	1,460 (6.5)		1,460 (6.5)		2,620 (11.7)		2,000 (8.9)	4,645 (20.7)		NP		
Anchor category[5]			1											
Effectiveness factor k_{uncr} uncracked concrete			24											
Effectiveness factor k_{cr} cracked concrete[6]			17											
$\psi_{c,N} = k_{uncr}/k_{cr}$[7]			1.41											
Coefficient for pryout strength, k_{cp}			1.0				2.0							
Strength reduction factor Φ for tension, steel failure modes[8]			0.75											
Strength reduction factor Φ for shear, steel failure modes[8]			0.65											
Strength reduction factor Φ for tension, concrete failure modes, Condition B[9]			0.65											
Strength reduction factor Φ for shear, concrete failure modes			0.70											

1 See Fig. 1.

2 NP (not permitted) denotes that the condition is not supported.

3 NA (not applicable) denotes that this value does not control for design.

4 NP (not permitted) denotes that the condition is not supported. Values are for cracked concrete. Values are applicable to both static and seismic load combinations.

5 See ACI 318 D.4.4.

6 See ACI 318 D.5.2.2.

7 See ACI 318 D.5.2.6.

8 The KB-TZ is a ductile steel element as defined by ACI 318 D.1.

9 For use with the load combinations of ACI 318 Chapter 9 Section 9.2. Condition B applies where supplementary reinforcement in conformance with ACI 318 D.4.4 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.

10 For seismic applications, multiply the value of $V_{sa,deck}$ for the 3/8-inch-diameter by 0.63 and the 5/8-inch-diameter by 0.94.

KWIK Bolt TZ Expansion Anchor 3.3.4

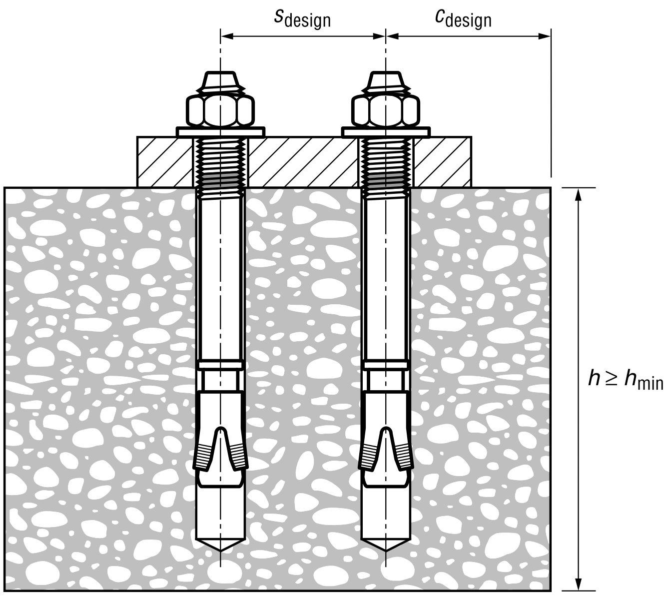
Table 3 — Stainless Steel KWIK Bolt TZ Strength Design Information

Setting Information	Symbol	Units	Nominal anchor diameter											
			3/8		1/2				5/8			3/4		
Anchor O.D.	d_o	in. (mm)	0.375 (9.5)		0.5 (12.7)				0.625 (15.9)			0.75 (19.1)		
Effective minimum embedment[1]	h_{ef}	in. (mm)	2 (51)		2 (51)		3-1/4 (83)		3-1/8 (79)	4 (102)		3-3/4 (95)		4-3/4 (121)
Min. member thickness	h_{min}	in. (mm)	4 (102)	5 (127)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	
Critical edge distance	c_{ac}	in. (mm)	4-3/8 (111)	3-7/8 (98)	5-1/2 (140)	4-1/2 (114)	7-1/2 (191)	6 (152)	7 (178)	8-7/8 (225)	6 (152)	10 (254)	7 (178)	9 (229)
Min. edge distance	$c_{a,min}$	in. (mm)	2-1/2 (64)		2-7/8 (73)		2-1/8 (54)		3-1/4 (83)	2-3/8 (60)		4-1/4 (108)		4 (102)
	for s ≥	in. (mm)	5 (127)		5-3/4 (146)		5-1/4 (133)		5-1/2 (140)	5-1/2 (140)		10 (254)		8-1/2 (216)
Min. anchor spacing	s_{min}	in. (mm)	2-1/4 (57)		2-7/8 (73)		2 (51)		2-3/4 (70)	2-3/8 (60)		5 (127)		4 (102)
	for c ≥	in. (mm)	3-1/2 (89)		4-1/2 (114)		3-1/4 (83)		4-1/8 (105)	4-1/4 (108)		9-1/2 (241)		7 (178)
Min. hole depth in concrete	h_o	in. (mm)	2-5/8 (67)		2-5/8 (67)		4 (102)		3-3/4 (95)	4-3/4 (121)		4-5/8 (117)		5-3/4 (146)
Min. specified yield strength	f_{ya}	lb/in2 (N/mm2)	92,000 (634)		92,000 (634)				92,000 (634)			76,125 (525)		
Min. specified ult. strength	f_{uta}	lb/in2 (N/mm2)	115,000 (793)		115,000 (793)				115,000 (793)			101,500 (700)		
Effective tensile stress area	A_{se}	in2 (mm2)	0.052 (33.6)		0.101 (65.0)				0.162 (104.6)			0.237 (152.8)		
Steel strength in tension	N_{sa}	lb (kN)	5,980 (26.6)		11,615 (51.7)				18,630 (82.9)			24,055 (107.0)		
Steel strength in shear	V_{sa}	lb (kN)	4,870 (21.7)		6,880 (30.6)				9,350 (41.6)			12,890 (57.3)		
Steel strength in tension, seismic[2]	N_{eq}	lb (kN)	NA		2,735 (12.2)		NA		NA			NA		
Steel strength in shear, seismic[2]	V_{eq}	lb (kN)	2,825 (12.6)		6,880 (30.6)				11,835 (52.6)			14,615 (65.0)		
Pullout strength uncracked concrete[2]	$N_{p,uncr}$	lb (kN)	2,630 (11.7)		NA		5,760 (25.6)		NA			NA		12,040 (53.6)
Pullout strength cracked concrete[2]	$N_{p,cr}$	lb (kN)	2,340 (10.4)		3,180 (14.1)		NA		NA	5,840 (26.0)		8,110 (36.1)		NA
Anchor category[3]			1		2		1							
Effectiveness factor k_{uncr} uncracked concrete			24											
Effectiveness factor k_{cr} cracked concrete[4]			17		24		17		17	17		24		17
$\psi_{c,N} = k_{uncr}/k_{cr}$ [5]			1.41		1.00		1.41		1.41	1.41		1.00		1.41
Coefficient for pryout strength, k_{cp}			1.0				2.0							
Strength reduction factor Φ for tension, steel failure modes[6]			0.75											
Strength reduction factor Φ for shear, steel failure modes[6]			0.65		0.55		0.65							
Strength reduction factor Φ for tension, concrete failure modes, Condition B[7]			0.65											
Strength reduction factor Φ for shear, concrete failure modes			0.70											

1 See Fig. 1.
2 NA (not applicable) denotes that this value does not control for design.
3 See ACI 318 D.4.4.
4 See ACI 318 D.5.2.2.
5 See ACI 318 D.5.2.6.
6 The KB-TZ is a ductile steel element as defined by ACI 318 D.1.
7 For use with the load combinations of ACI 318 Chapter 9 Section 9.2. Condition B applies where supplementary reinforcement in conformance with ACI 318 D.4.4 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.

3.3.4 KWIK Bolt TZ Expansion Anchor

Figure 2 — Interpolation of Minimum Edge Distance and Anchor Spacing



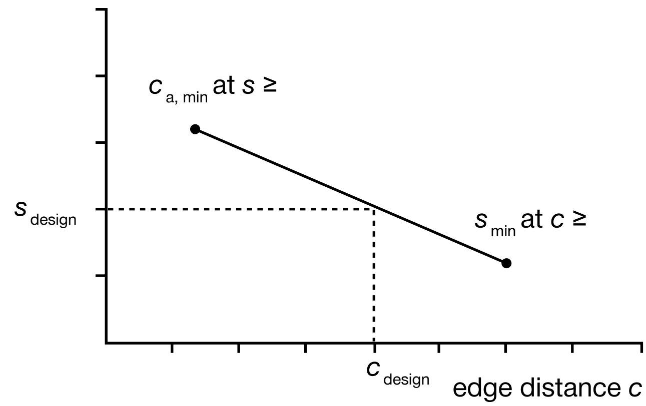
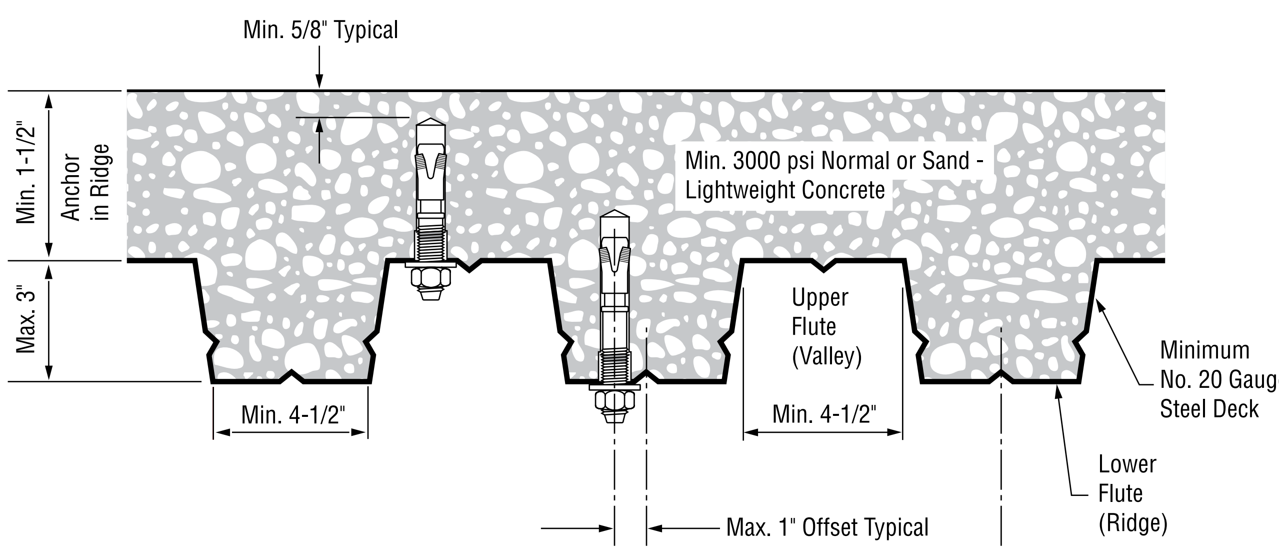


Table 4 — Mean Axial Stiffness Values (1,000 lb/in.) for KWIK Bolt TZ Carbon and Stainless Steel Anchors in Normal-Weight Concrete[1]

Concrete condition	carbon steel KB-TZ, all diameters	stainless steel KB-TZ, all diameters
uncracked concrete	700	120
cracked concrete	500	90

1 Mean values shown. Actual stiffness may vary considerably depending on concrete strength, loading and geometry of application.

Figure 3 — Installation in Concrete over Metal Deck Floor



KWIK Bolt TZ Expansion Anchor 3.3.4

Allowable Stress Design

Design values for use with allowable stress design (working stress design) shall be established as follows: $R_{allow,ASD} = \frac{R_d}{\alpha}$

where $R_d = \Phi R_k$ represents the limiting design strength in tension (ΦN_n) or shear (ΦV_n) as calculated according to ACI 318 D.4.1.1 and D.4.1.2

Table 5 - KWIK Bolt TZ Carbon and Stainless Steel Allowable Nonseismic Tension (ASD), Normal-Weight Uncracked Concrete (lb)[1,2,3,4,5,6]

Diameter	h_{ef} (in.)	Concrete Compressive Strength							
		f'_c = 2,500 psi		f'_c = 3,000 psi		f'_c = 4,000 psi		f'_c = 6,000 psi	
		Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel
3/8	2	1,168	1,221	1,279	1,338	1,477	1,545	1,809	1,892
1/2	2	1,576	1,576	1,726	1,726	1,993	1,993	2,441	2,441
	3-1/4	2,561	2,674	2,805	2,930	3,239	3,383	3,967	4,143
5/8	3-1/8	3,078	3,078	3,372	3,372	3,893	3,893	4,768	4,768
	4	4,246	4,457	4,651	4,883	5,371	5,638	6,578	6,905
3/4	3-3/4	3,844	4,046	4,211	4,432	4,863	5,118	5,956	6,268
	4-3/4	4,959	5,590	5,432	6,124	6,272	7,071	7,682	8,660

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

4 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

5 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

6 $ASD = \Phi_{concrete} \cdot N_{p,uncr} / \alpha = 0.65 \cdot N_{p,uncr} / 1.4$

Table 6 - KWIK Bolt TZ Carbon and Stainless Steel Allowable Nonseismic Tension (ASD), Normal-Weight Cracked Concrete (lb)[1,2,3,4,5]

Diameter	h_{ef} (in.)	Concrete Compressive Strength							
		f'_c = 2500 psi		f'_c = 3000 psi		f'_c = 4000 psi		f'_c = 6000 psi	
		Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel
3/8	2	1,054	1,086	1,155	1,190	1,333	1,374	1,633	1,683
1/2	2	1,116	1,476	1,223	1,617	1,412	1,868	1,729	2,287
	3-1/4	2,282	2,312	2,500	2,533	2,886	2,886	3,535	3,582
5/8	3-1/8	2,180	2,180	2,388	2,388	2,758	2,925	3,377	3,377
	4	3,157	2,711	3,458	2,970	3,994	3,430	4,891	4,201
3/4	3-3/4	2,866	3,765	3,139	4,125	3,625	4,763	4,440	5,833
	4-3/4	4,085	4,085	4,475	4,475	5,168	5,168	6,329	6,329

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

5 $ASD = \Phi_{concrete} \cdot N_{p,cr} / \alpha = 0.65 \cdot N_{p,cr} / 1.4$

3.3.4 KWIK Bolt TZ Expansion Anchor

Table 7 - KWIK Bolt TZ Carbon and Stainless Steel Allowable Nonseismic Shear (ASD), Steel (lb)[1,2,3,4,5,6]

Diameter (in.)	Allowable Steel Capacity, Shear	
	Carbon Steel	Stainless Steel
3/8	1,925	2,530
1/2	2,945	3,685
5/8	4,335	5,290
3/4	7,325	8,415

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 ASD = $\Phi_{steel} \cdot V_{sa} / \alpha = 0.75 \cdot V_{sa} / 1.4$

Table 8 - KWIK Bolt TZ Carbon and Stainless Steel Allowable Seismic Tension (ASD), Normal-Weight Cracked Concrete (lb)[1,2,3,4,5]

Diameter	h_{ef} (in.)	Concrete Compressive Strength[2]							
		f'_c = 2500 psi		f'_c = 3000 psi		f'_c = 4000 psi		f'_c = 6000 psi	
		Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel	Carbon Steel	Stainless Steel
3/8	2	774	882	937	966	1,082	1,115	1,225	1,366
1/2	2	906	1,198	992	1,312	1,146	1,515	1,297	1,856
	3-1/4	1,852	1,876	2,028	2,055	2,342	2,373	2,651	2,907
5/8	3-1/8	1,769	1,769	1,938	1,938	2,238	2,238	2,533	2,741
	4	2,562	2,200	2,806	2,410	3,240	2,783	3,668	3,408
3/4	3-3/4	2,325	3,055	2,547	3,347	2,941	3,865	3,330	4,733
	4-3/4	3,315	3,315	3,632	3,632	4,193	4,193	4,747	5,136

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

5 ASD = $\phi_{concrete} \cdot \phi_{seismic} \cdot N_{p,uncr} / \alpha = 0.65 \cdot 0.75 \cdot N_{p,uncr} / 1.294$

Table 9 - KWIK Bolt TZ Carbon and Stainless Steel Allowable Seismic Shear (ASD), Steel (lb)[1,2,3,4,5]

Diameter (in.)	Allowable Steel Capacity, Shear	
	Carbon Steel	Stainless Steel
3/8	1,565	1,915
1/2	2,390	2,590
5/8	3,515	4,005
3/4	5,945	6,375

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

5 Seismic ASD = $\Phi_{steel} \cdot \Phi_{seismic} \cdot V_{eq} / \alpha = 0.75 \cdot 0.75 \cdot Veq / 1.294$

KWIK Bolt TZ Expansion Anchor 3.3.4

Table 10 - KWIK Bolt TZ Allowable Tension and Shear Loads (ASD), Installed into the Underside of Lightweight Concrete over Metal Deck Slab[1,2]

Nominal Anchor Diameter	Embedment Depth h_{ef} (in.)	Tension Nonseismic[3,4,5] (lb)	Tension Seismic[7,8,9] (lb)	Shear Nonseismic[3,4,6] (lb)	Shear Seismic[7,8,10] (lb)
3/8	2	680	50	1,140	930
1/2	2	680	550	1,607	1,310
1/2	3 1/4	1,215	990	2,650	2,155
5/8	3 1/8	929	755	2,465	2,005
5/8	4	2,157	1,755	3,235	2,635

1 Single anchors with no edge or anchor spacing reductions and no supplementary reinforcement (Condition B).

2 Strength design load combinations from ACI 318 Section 9.2. ASD load combinations from ASCE 7-05, Section 2.

3 For strength design, the required strength = 1.6D + 1.2L. For ASD, the factored load = 1.0D + 1.0L. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

4 Assuming a 50% dead and 50% live contributions, $\alpha = (1.6 \cdot 0.5 + 1.2 \cdot 0.5) / (1.0 \cdot 0.5 + 1.0 \cdot 0.5) = 1.4$

5 $ASD = \Phi_{concrete} \cdot N_{p,deck,cr} / \alpha = 0.65 \cdot N_{p,deck,cr} / 1.4$

6 $ASD = \Phi_{steel} \cdot V_{s,deck} / \alpha = 0.75 \cdot V_{s,deck} / 1.4$

7 For strength design, the required strength = 1.2D + 1.0E. For ASD, the factored load = 1.0D + 0.7E. Conversion factor α is calculated by dividing the ACI 318 required strength by the ASCE 7 factored load.

8 Assuming a 50% dead and 50% earthquake contributions, $\alpha = (1.2 \cdot 0.5 + 1.0 \cdot 0.5) / (1.0 \cdot 0.5 + 0.7 \cdot 0.5) = 1.294$

9 $ASD = \Phi_{concrete} \cdot \Phi_{seismic} \cdot N_{p,deck,cr} / \alpha = 0.65 \cdot 0.75 \cdot N_{p,deck,cr} / 1.294$

10 10. Seismic $ASD = \Phi_{concrete} \cdot \Phi_{seismic} \cdot V_{s,deck} / \alpha = 0.75 \cdot 0.75 \cdot V_{s,deck} / 1.294$

Table 11 — KWIK Bolt TZ Length Identification System

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} (in.)	From	1 1/2	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15
	Up to but not including	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	6	6 1/2	7	7 1/2	8	8 1/2	9	9 1/2	10	11	12	13	14	15	16

Figure 4 — Bolt Head with Length Identification Mark and KWIK Bolt TZ Head Notch Embossment

3.3.4 KWIK Bolt TZ Expansion Anchor

TABLE 12 - KWIK Bolt TZ Design Information in accordance with CSA A23.3-04 Annex D[1]

Design Parameter	Symbol	Units	Nominal anchor diameter												Ref.
			3/8		1/2				5/8			3/4			A23.3-04
Anchor O.D.	d_o	mm	9.5		12.7				15.9			19.1			
		(in.)	0.375		0.5				0.625			0.75			
Effective min. embedment depth	$h_{ef, min}$	mm	51		51		83		79	102		95		121	
		(in.)	2		2		3-1/4		3-1/8	4		3-3/4		4-3/4	
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	102	140	114	191	152	165	222	171	254	203	229	
Minimum edge distance	c_{ac}	mm	64		70		60		92	83		121		105	
	for s >	mm	127		146		146		156	149		267		225	
Minimum anchor spacing	s_{min}	mm	64		70		60		89	76		127		102	
	for c >	mm	92		105		89		121	108		241		197	
Minimum hole depth in concrete	h_o	mm	67		67		102		98	121		117		146	
Min. edge distance	1, 2 or 3		1												D.5.4c
Concrete material resistance factor for concrete	Φ_c		0.65												8.4.2
Steel embedment material resistance factor for reinforcement	Φ_s		0.85												8.4.3
Strength reduction factor for tension, steel failure modes	R		0.80												D.5.4a
Strength reduction factor for shear, steel failure modes	R		0.75												D.5.4a
Strength reduction factor for tension, concrete failure modes	R	Cond. A	1.15												D.5.4c
	R	Cond. B	1.00												D.5.4c
Strength reduction factor for shear, concrete failure modes	R	Cond. A	1.15												D.5.4c
	R	Cond. B	1.00												D.5.4c
Yield strength of anchor steel	f_y	MPa	690		585				585			585			
Ultimate strength of anchor steel	f_{ut}	MPa	862		731				731			731			
Effective cross-sectional area	A_{se}	mm^2	33.6		65.0				104.6			152.8			
Coefficient for factored concrete breakout resistance in tension	k		7												D.6.2.6
Modification factor for resistance in tension to account for uncracked concrete	$\Psi_{c,N}$		1.4												D.6.2.6
Factored Steel Resistance in tension	N_{sr}	kN	19.7		32.3				52.0			76.0			D.6.1.2
Factored Steel Resistance in shear	V_{sr}	kN	10.2		18.2				29.9			45.2			D.7.1.2c
Factored Steel Resistance in shear, seismic	$V_{sr, seismic}$	kN	6.4		18.2				29.9			40.4			
Factored Steel Resistance in shear, concrete on metal deck	$V_{sr, deck}$	kN	6.0		8.5		14.0		13.0	17.1		Not Permitted			
Factored pullout resistance in 20 MPa uncracked concrete	$N_{pr, uncr}$	kN	7.8		N/A		17.1		N/A	28.4		25.7		33.2	D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete	$N_{pr, cr}$	kN	7.1		N/A		15.3		N/A			N/A			D.6.3.2
20 MPa cracked concrete	$N_{pr,deck\ cr}$	kN	4.5		4.5		8.1		6.2	14.4		Not Permitted			D.6.3.2

1 For more information, please visit www.hilti.ca and navigate Service/Downloads, then Technical Downloads and open the Limit States Design Guide.

KWIK Bolt TZ Expansion Anchor 3.3.4

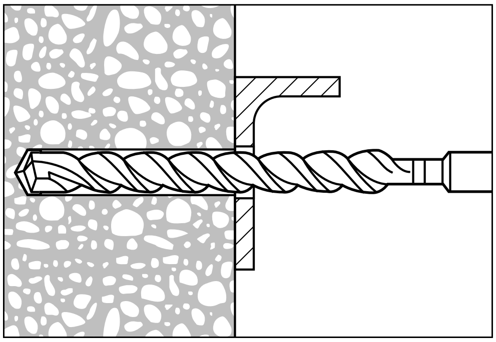
TABLE 13 - KWIK Bolt RTZ Design Information in accordance with CSA A23.3-04 Annex D[1]

Design Parameter	Symbol	Units	Nominal anchor diameter												Ref.
			3/8		1/2				5/8			3/4			A23.3-04
Anchor O.D.	d_o	mm	9.5		12.7				15.9			19.1			
		(in.)	0.375		0.5				0.625			0.75			
Effective min. embedment depth	$h_{ef,\,min}$	mm	51		51		83		79	102		95		121	
		(in.)	2		2		3-1/4		3-1/8	4		3-3/4		4-3/4	
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	
Minimum edge distance	c_{ac}	mm	64		73		54		83	60		108		102	
	for s >	mm	127		146		133		140	140		254		216	
Minimum anchor spacing	s_{min}	mm	57		73		51		70	60		127		102	
	for c >	mm	89		114		83		105	108		241		178	
Minimum hole depth in concrete	h_o	mm	67		67		102		98	121		117		146	
Anchor category	1, 2 or 3		1												D.5.4c
Concrete material resistance factor for concrete	ϕ_c		0.65												8.4.2
Steel embedment material resistance factor for reinforcement	ϕ_s		0.85												8.4.3
Strength reduction factor for tension, steel failure modes	R		0.80												D.5.4a
Strength reduction factor for shear, steel failure modes	R		0.75												D.5.4a
Strength reduction factor for tension, concrete failure modes	R	Cond. A	1.15												D.5.4c
	R	Cond. B	1.00												D.5.4c
Strength reduction factor for shear, concrete failure modes	R	Cond. A	1.15												D.5.4c
	R	Cond. B	1.00												D.5.4c
Yield strength of anchor steel	f_y	MPa	634		634				634			525			
Ultimate strength of anchor steel	f_{ut}	MPa	793		793				793			700			
Effective cross-sectional area	A_{se}	mm^2	33.6		65.0				104.6			152.8			
Coefficient for factored concrete breakout resistance in tension	k		7		10		7		7			10		7	D.6.2.6
Modification factor for resistance in tension to account for uncracked concrete	$\psi_{c,N}$		1.40		1.00		1.40		1.40			1.00		1.40	D.6.2.6
Factored Steel Resistance in tension	N_{sr}	kN	18.1		35.1				56.4			72.7			D.6.1.2
Factored Steel Resistance in shear	V_{sr}	kN	13.8		19.5				33.6			56.9			D.7.1.2c
Factored Steel Resistance in shear, seismic	$V_{sr,\,seismic}$	kN	8.0		19.5				33.6			41.4			
Factored pullout resistance in 20 MPa uncracked concrete	$N_{pr,\,cr}$	kN	8.2		N/A		17.9		N/A			N/A		37.4	D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete	$N_{pr,\,cr}$	kN	7.3		9.9		N/A		N/A	18.1		25.2	N/A		D.6.3.2

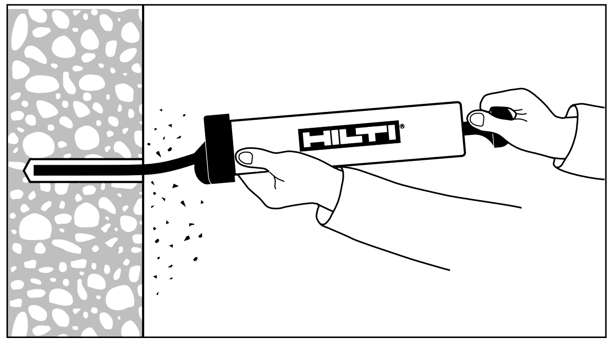
1 For more information, please visit www.hilti.ca and navigate Service/Downloads, then Technical Downloads and open the Limit States Design Guide.

3.3.4 KWIK Bolt TZ Expansion Anchor

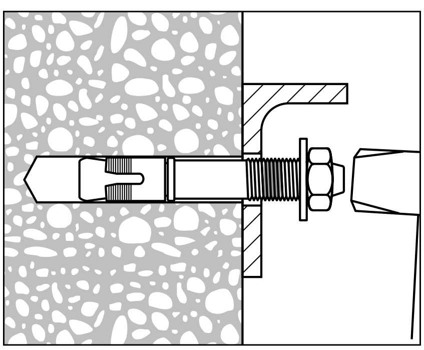
3.3.4.4 KWIK Bolt TZ Anchor Installation Instructions into normal-weight and lightweight concrete



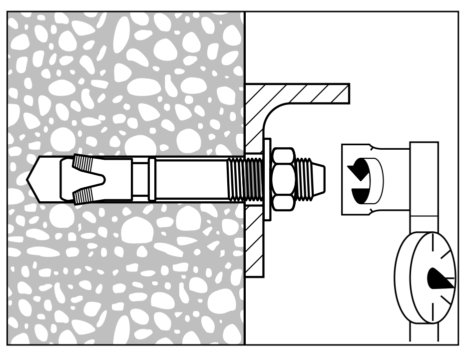
1. Hammer drill a hole to the same nominal diameter as the KWIK Bolt TZ. The minimum hole depth must conform with the instructions for use adhered to the packaging and the ICC-ES evaluation report, if applicable. The fixture may be used as a drilling template to ensure proper anchor location.



2. Clean hole.



3. Drive the KWIK Bolt TZ into the hole using a hammer. The anchor must be driven until at least 4 threads are below the surface of the fixture.



4. Tighten the nut to the installation torque.

3.3.4.5 KWIK Bolt TZ Anchor Ordering Information

Description	Length (in.)	Threaded Length (in.)	Box Quantity
KB-TZ 3/8x3	3	7/8	50
KB-TZ 3/8x3-3/4	3-3/4	1-5/8	50
KB-TZ 3/8x5	5	2-7/8	50
KB-TZ 1/2x3-3/4	3-3/4	1-5/8	20
KB-TZ 1/2x4-1/2	4-1/2	2-3/8	20
KB-TZ 1/2x5-1/2	5-1/2	3-3/8	20
KB-TZ 1/2x7	7	4-7/8	20
KB-TZ 5/8x4-3/4	4-3/4	1-1/2	15
KB-TZ 5/8x6	6	2-3/4	15
KB-TZ 5/8x8-1/2	8-1/2	5-1/4	15
KB-TZ 5/8x10	10	6-3/4	15
KB-TZ 3/4x5-1/2	5 1/2	1-1/2	10
KB-TZ 3/4x8	8	4	10
KB-TZ 3/4x10	10	6	10
KB-TZ SS304 3/8x3	3	7/8	50
KB-TZ SS304 3/8x3-3/4	3-3/4	1-5/8	50
KB-TZ SS304 3/8x5	5	2-7/8	50
KB-TZ SS304 1/2x3-3/4	3-3/4	1-5/8	20
KB-TZ SS304 1/2x4-1/2	4-1/2	2-3/8	20
KB-TZ SS304 1/2x5-1/2	5-1/2	3-3/8	20
KB-TZ SS304 1/2x7	7	4-7/8	20
KB-TZ SS304 5/8x4-3/4	4-3/4	1-1/2	15
KB-TZ SS304 5/8x6	6	2-3/4	15
KB-TZ SS304 5/8x8-1/2	8-1/2	5-1/4	15
KB-TZ SS304 5/8x10	10	6-3/4	15
KB-TZ SS304 3/4x5-1/2	5-1/2	1-1/2	10
KB-TZ SS304 3/4x8	8	4	10
KB-TZ SS304 3/4x10	10	6	10
KB-TZ SS316 3/8x3	3	7/8	50
KB-TZ SS316 3/8x3-3/4	3-3/4	1-5/8	50
KB-TZ SS316 1/2x3-3/4	3-3/4	1-5/8	20
KB-TZ SS316 1/2x4-1/2	4-1/2	2-3/8	20
KB-TZ SS316 1/2x5-1/2	5-1/2	3-3/8	20
KB-TZ SS316 5/8x4-3/4	4-3/4	1-1/2	15
KB-TZ SS316 5/8x6	6	2-3/4	15
KB-TZ SS316 3/4x5-1/2	5-1/2	1-1/2	10
KB-TZ SS316 3/4x10	10	6	10

3.3.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

Listings/Approvals

ICC-ES (International Code Council)
ESR-3027
(Cracked & Uncracked Concrete)
AC 106 ESR Pending
(Grout filled concrete masonry)
City of Los Angeles
Research Report No. 25897

Independent Code Evaluation

IBC® / IRC® 2009 (AC 193 / ACI 355.2)
IBC® / IRC® 2006 (AC 193 / ACI 355.2)
IBC® / IRC® 2003 (AC 193 / ACI 355.2)

3.3.5.1 Product Description

Hilti KWIK HUS-EZ (KH-EZ) anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat treated. It has a minimum 0.0003 inch (8 μm) zinc coating in accordance with DIN EN ISO 4042. The KWIK HUS-EZ (KH-EZ) system is available in a variety of lengths with diameters of 1/4 inch, 3/8 inch, 1/2 inch, 5/8 inch and 3/4 inch (6.4mm, 9.5mm, 12.7mm, 15.9mm and 19.1mm). The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the concrete on the sides of the hole and interlock with the base material during installation. Applicable base materials include normal-weight concrete, structural lightweight concrete lightweight concrete over metal deck, and grout filled concrete masonry.

Guide Specifications

Screw anchors shall be KWIK HUS-EZ as supplied by Hilti, Inc. Anchors shall be manufactured from heat treated carbon steel material, zinc plated to a minimum thickness of 8μm. Anchor head shall display name of manufacturer, product name, diameter and length. Anchors shall be installed using a drill bit of same nominal diameter as anchor.

Product Features

- Suitable for cracked and uncracked normal weight and lightweight concrete, and grout filled concrete masonry.
- Suitable for seismic and nonseismic loads.
- Quick and easy to install.
- Length and diameter identification clearly stamped on head facilitates quality control and inspection after installation.
- Through fixture installation improves productivity and accurate installation.
- Thread design enables quality setting and exceptional load values in wide variety of base material strengths.
- Anchor is fully removable
- Anchor size is same as drill bit size and uses standard diameter drill bits.
- Suitable for reduced edge distances and spacing.

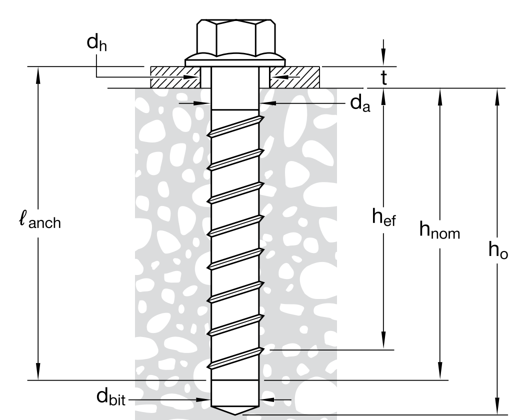
3.3.5.2 Material Specifications

Hilti KWIK HUS-EZ anchors are manufactured from carbon steel. The anchors are bright zinc plated to a minimum thickness of 8μm.

3.3.5.3 Technical Data

The data contained in Tables 1-5 of this section have been evaluated in accordance with AC 193. For more detail, see ICC-ES ESR 3027.

Figure 1 — KWIK HUS-EZ anchor installation details



KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor 3.3.5

Table 1 — KWIK HUS-EZ Specification Table[1,2,3]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)											
			1/4		3/8			1/2			5/8		3/4	
Nominal Diameter	d_a	in.	1/4		3/8			1/2			5/8		3/4	
Drill Bit Diameter	d_{bit}	in.	1/4		3/8			1/2			5/8		3/4	
Baseplate Clearance Hole Diameter	d_h	in.	3/8		1/2			5/8			3/4		7/8	
Installation Torque[4]	T_{inst}	ft-lbf	18		40			45			85		115	
Impact Wrench Torque Rating[3]	T_{impact}	ft-lbf	114	137	114	450		137	450		450		450	
Nominal Embedment depth	h_{nom}	in.	1-5/8	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.11	1.86	2.50	1.50	2.16	3.22	2.39	3.88	2.92	4.84
Minimum Hole Depth	h_o	in.	2	2-7/8	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	6-5/8
Critical Edge Distance[2]	c_{ac}	in.	2.00	2.78	2.10	2.92	3.75	2.75	3.75	5.25	3.63	5.81	4.41	7.28
Minimum Spacing at critical edge Distance	$s_{min,cac}$	in.	1.50		2.25			3					4	
Minimum Edge Distance[2]	c_{min}	in.	1.50					1.75						
Minimum Spacing at Minimum Edge Distance	s_{min}	in.	3										4	
Minimum ConcreteThickness	h_{min}	in.	3.25	4.125	3.25	4	4.875	4.5	4.75	6.75	5	7	6	8.125
Wrench socket size	-	in.	7/16		9/16			3/4			15/16		1-1/8	
Head height	-	in.	0.24		0.35			0.49			0.57		0.70	
Effective tensile stress area	A_{se}	in.^{2}	0.045		0.086			0.161			0.268		0.392	
Minimum specified ultimate strength	f_{uta}	psi	134,000		106,225	120,300		112,540			90,180		81,600	

For SI**:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm

1 The data presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

2 For installations through the soffit of steel deck into concrete (see Figure 2) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.

3 Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torquing can damage the anchor and/or reduce its holding capacity.

4 $T_{inst,max}$ applies to installations using a calibrated torque wrench.

3.3.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

Table 2 — KWIK HUS EZ (KH EZ) Tension Strength Design Information[1,2,3,4,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)											
			1/4		3/8			1/2			5/8		3/4	
Anchor Category 1,2 or 3			1											
Nominal Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Tension (ACI 318 D 5.1)[6]														
Tension Resistance of Steel	N_{sa}	lb.	6070		9125	10335		18120			24210		32013	
Reduction Factor for Steel Strength[2]	Φ_{sa}	-	0.65											
Concrete Breakout Strength in Tension (ACI 318 D.5.2)														
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Critical Edge Distance	c_{ac}	in.	2.00	2.78	2.10	2.92	3.74	2.75	3.67	5.25	3.63	5.82	4.81	7.28
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	24					27						
Effectiveness Factor — Cracked Concrete	k_{cr}	-	17											
Modification factor for cracked and uncracked concrete[5]	$\Psi_{c,N}$	-	1.0											
Reduction Factor for Concrete Breakout Strength[2]	Φ_{cb}	-	0.65 (Condition B)											
Pullout Strength in Tension (Non Seismic Applications) (ACI318 D.5.3)														
Characteristic pullout strength, uncracked concrete (2,500psi)	$N_{p,uncr}$	lb.	1305[4]	2348[4]	N/A									
Characteristic pullout strength, cracked concrete (2500 psi)	$N_{p,cr}$	lb.	632[4]	1166[4]	728[4]	N/A								
Reduction factor for pullout strength[2]	Φ_p	-	0.65 (Condition B)											
Pullout Strength in Tension (Seismic Applications) (ACI 318 D.5.3)														
Characteristic Pullout Strength, Seismic (2,500 psi)	N_{eq}	lb.	632[4]	1166[4]	728[4]	N/A								
Reduction Factor for Pullout Strength[2] (2,500 psi)	Φ_{eq}	-	0.65 (Condition B)											
Axial Stiffness in Service Load Range														
Uncracked Concrete	β_{uncr}	lb/in.	760,000											
Cracked Concrete	β_{cr}		293,000											

For SI**:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm

1 The data in this table is intended for use with the design provisions of ACI 318 Appendix D; for anchors resisting seismic load combinations the additional requirements of D.3.3 shall apply.

2 Values of Φ in this table apply when the load combinations for ACI 318 Section 9.2, IBC Section 1605.2.1 are used and the requirements of ACI 318 D.4.4 for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of Φ must be used. For situations where reinforcement meets the requirements of Condition A, ACI 318 Section D.4.4 provides the appropriate φ factor.

3 N/A denotes that pullout resistance does not govern and does not need to be considered.

4 The characteristic pullout resistance for concrete compressive strengths greater than 2500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{1/2}$ for psi or $(f'_c/17.2)^{1/2}$ for MPa.

5 For sand-lightweight concrete, multiply concrete capacity values and pullout values by 0.60.

Table 3 — KWIK HUS EZ (KH EZ) Shear Strength Design Information[1,2,3,4,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)											
			1/4		3/8			1/2			5/8		3/4	
Anchor Category	1,2 or 3	1												
Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Shear (ACI 318 D 6.1)[4, 5]														
Shear Resistance of Steel — Static	V_{sa}	lb.	1548		4057	5185		9245			11221		16662	
Shear Resistance of Steel — Seismic	V_{eq}	lb.	1393		2524	3111		5547			6733		11556	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.60											
Concrete Breakout Strength in Shear (ACI 318 D.6.2)														
Nominal Diameter	d_a	in.	0.250		0.375			0.500			0.625		0.750	
Load Bearing Length of Anchor	ℓ_e	in.	1.18	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Reduction Factor for Concrete Breakout Strength	Φ_{cb}	-	0.70											
Concrete Pryout Strength in Shear (ACI 318 D.6.3)														
Coefficient for Pryout Strength	k_{cp}	1.0					2.0	1.0		2.0	1.0	2.0		
Reduction Factor for Pryout Strength	Φ_{cp}	-	0.70											

For SI**:** 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm

1 The data in this table is intended for use with the design provisions of ACI 318 Appendix D

2 Values of Φ in this table apply when the load combinations for ACI 318 Section 9.2, IBC Section 1605.2.1 are used and the requirements of ACI 318 D.4.4 for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of Φ must be used. For situations where reinforcement meets the requirements of Condition A, ACI 318 D.4.4 provides the appropriate Φ factor.

3 Reported values for steel strength in shear are based on test results per ACI 355.2, Section 9.4 and must be used for design in lieu of calculated results using equation D-20 of ACI 318.

4 The KWIK HUS-EZ (KH-EZ) is considered a brittle steel element as defined by ACI 318 D.1.

5 For sand-lightweight concrete, multiply concrete breakout and concrete pryout values by 0.60.

3.3.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

Table 4 – KWIK HUS-EZ (KH-EZ) Tension and Shear Design Data for Installation in the Underside of Concrete-Filled Profile Steel Deck Assemblies[1,2,3,4,5]

Characteristic	Symbol	Units	Lower Flute											Upper Flute				
			Anchor Diameter															
			1/4		3/8			1/2			5/8		3/4	1/4		3/8		1/2
Embedment	h_{nom}	in.	1-5/8	2-1/2	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	1-5/8	2-1/2	1-5/8	2-1/2	2-1/4
Minimum Hole Depth	h_{hole}	in.	2	2-7/8	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	2	2-7/8	1-7/8	2-7/8	2-5/8
Effective Embedment Depth	h_{ef}	in.	1.18	1.92	1.11	1.86	2.50	1.52	2.16	3.22	2.39	3.88	2.92	1.18	1.92	1.11	1.86	1.52
Pullout Resistance, (uncracked concrete)	$N_{p,deck,uncr}$	lb.	1210	1875	1285	2240	3920	1305	3060	5360	4180	9495	4180	1490	1960	1015	2920	1395
Pullout Resistance (cracked concrete and seismic loads)	$N_{p,deck,cr}$	lb.	860	1330	1120	1965	3430	925	2170	3795	3070	7385	2630	1055	1390	885	2560	985
Steel Strength in Shear	$V_{sa,deck}$	lb.	1205	2210	1670	1511	3605	1605	2922	3590	3470	4190	3762	1205	3265	3935	6090	7850
Steel Strength in Shear, Seismic	$V_{sa,deck,eq}$	lb.	1080	1988	935	905	2163	963	1750	2154	2082	2514	2609	1080	2937	2203	3650	4710

1 Installation must comply with Figure 2.

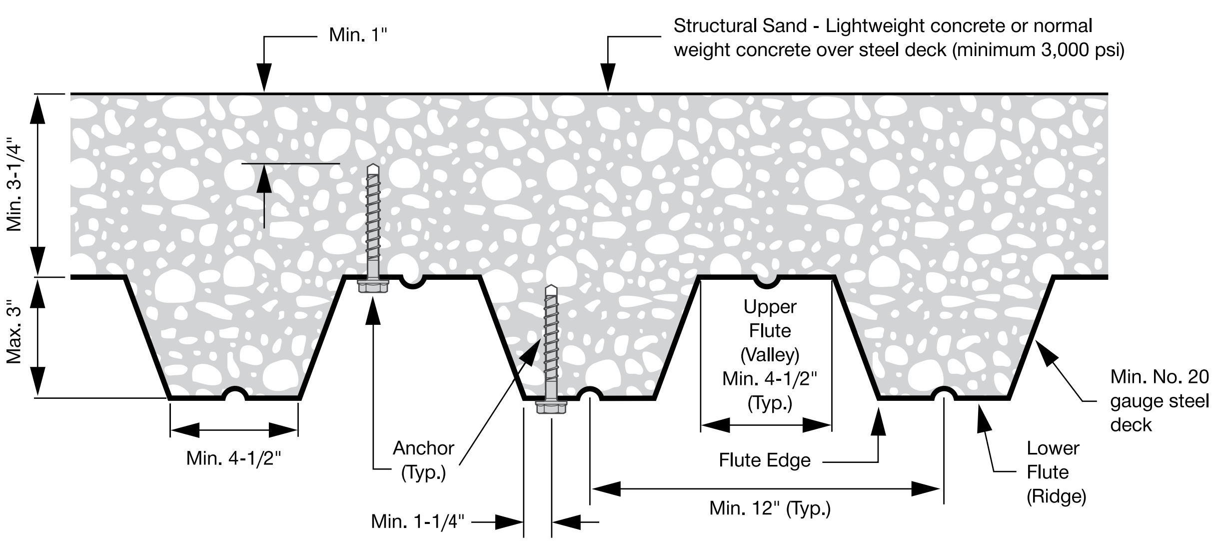
2 The values in this table are derived in accordance with ACI 318 Appendix D, Section D.5.3.2.

3 The values for ϕ_p in tension can be found in Table 2 of this report and the values for ϕ_{sa} in shear can be found in Table 3.

4 For installations through the soffit of steel deck into concrete (see Figure 2) anchors installed in the lower flute shall be installed with a maximum 1 inch offset in either direction from the centerline of the flute.

5 The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c / 3{,}000)^{1/2}$ for psi or $(f'_c / 20.7)^{1/2}$ for MPa.

Figure 2 – Installation of KWIK HUS-EZ (KH-EZ) in Soffit of Concrete Over Steel Deck Floor and Roof Assemblies



1 Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum concrete cover above the drilled hole is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor 3.3.5

Table 5 – KWIK HUS-EZ (KH-EZ) Allowable Stress Design Values for Illustrative Purposes[1,2,3,4,5,6,7,8,9,12]

Nominal Anchor Diameter [in.]	Embedment Depth, h_{nom} [in.]	Effective Embedment Depth, h_{ef} [in.]	Allowable Tension Load[10] [lbs]	Allowable Shear Load[11] [lbs]
1/4	1 5/8	1.18	589	645
	2-1/2	1.92	1060	645
3/8	1-5/8	1.11	633	682
	2-1/2	1.86	1374	1480
	3-1/4	2.50	2141	2160
1/2	2-1/4	1.52	1142	1230
	3	2.16	1934	2083
	4-1/4	3.22	3521	3852
5/8	3-1/4	2.39	2252	2425
	5	3.88	4657	4675
3/4	4	2.92	3041	6549
	6-1/4	4.84	6489	6943

For SI**:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1 Single anchor with static tension or shear load only.

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Load combinations are taken from ACI 318 Section 9.2 (no seismic loading).

4 40% dead load and 60% live load, controlling load combination 1.2D + 1.6L.

5 Calculation of weighted average for conversion factor $\alpha = 1.2(0.4) + 1.6(0.6) = 1.44$.

6 f'_c = 2,500 psi (normal weight concrete).

7 $c_{a1} = c_{a2} \geq c_{ac}$, see Table 1.

8 $h \geq h_{min}$, see Table 1.

9 Values are for Condition B where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

10 Allowable Tension Load = factored Load (Lessor of N_p or Concrete Breakout from Table 2) ÷ 1.44

11 Allowable Shear Load = factored Load (Lessor of V_{sa} or Concrete Pryout from Table 3) ÷ 1.44

12 Values are for single anchors installed without influence of base material edge distance or adjacent anchors.

3.3.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

Table 6 – Allowable Tension Loads for KWIK HUS-EZ Installed in Grout-Filled Masonry Walls (lb)[1,2,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Loads @ C_{cr} and S_{cr}	Spacing			Edge Distance		
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min} [6]	Critical - C_{cr} (inches)[5]	Minimum C_{min} (inches)[5]	Load Reduction Factor[6]
1/4	1 5/8	530	4	2	0.70	4	4	1.00
	2 1/2	910		4	1.00			
3/8	1 5/8	535	4	2	0.70	4	4	1.00
	2 1/2	895	6	4	0.80			
	3 1/4	1210						
1/2	2 1/4	710	4	2	0.60	4	4	1.00
	3	1110	8	4				
	4 1/4	1515						
5/8	3 1/4	1155	10	4	0.60	10	4	1.00
	5	1735						
3/4	4	1680	12	4	0.60	12	4	1.00
	6 1/4	2035						

Table 7 – Allowable Shear Loads for KWIK HUS-EZ Installed in Grout-Filled Masonry Walls (lb)[1,2,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Load at C_{cr} and S_{cr}	Spacing			Edge Distance			
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min} [6]	Critical - C_{cr} (inches)[5]	Minimum - C_{min} (inches)[5]	Load Reduction Factor at C_{min}	
								Load Direction Perpendicular to Edge	Load Direction Parallel to Edge
1/4	1 5/8	675	4	4	1.00	4	4	1.00	1.00
	2 1/2	840						1.00	1.00
3/8	1 5/8	1140	6	4	0.94	6	4	0.61	1.00
	2 1/2	1165						0.70	1.00
	3 1/4	1190						0.70	1.00
1/2	2 1/4	1845	8	4	0.88	8	4	0.50	1.00
	3	2055						0.45	0.94
	4 1/4	2745						0.40	0.89
5/8	3 1/4	3040	10	4	0.36	10	4	0.36	0.82
	5	3485						0.34	0.92
3/4	4	3040	10	4	0.36	12	4	0.36	0.82
	6 1/4	3485						0.34	0.92

1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Anchors may not be installed within one inch in any direction of a vertical joint.

3 Embedment depth is measured from the outside face of the concrete masonry embedment.

4 S_{cr} is anchor spacing where full load values in the Table may be used. S_{min} is the minimum anchor spacing for which values are available and installation is recommended. Spacing is measured from the center of one anchor to the center of an adjacent anchor.

5 C_{cr} is the edge distance where full load values in the table may be used. C_{min} is the minimum edge distance for which values are available and installation is recommended. Edge distance is measured from the center of the anchor to the closest edge.

6 Load reduction factors are multiplicative, both spacing and edge distance load reduction factors must be considered.

Load values for anchors installed at less than C_{cr} or S_{cr} must be multiplied by the appropriate load reduction factor based on actual edge distance (C) or spacing (S).

7 Linear interpolation of load values between minimum spacing (S_{min}) and critical spacing (S_{cr}) and between minimum edge distance (C_{min}) and critical edge distance (C_{cr}) is permitted.

8 For combined loading: For 1/4" diameter - $\frac{T_{applied}}{T_{allowable}} + \frac{V_{applied}}{V_{allowable}} \leq 1$ For 3/8" - 3/4" diameter - $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor 3.3.5

Table 8 – KWIK HUS-EZ Allowable Loads Installed In Top of Grout-Filled Concrete Masonry Construction (lb)

Anchor Diameter (inches)	Minimum Embedment Depth (inches)[2]	Minimum Edge Distance (inches)	Minimum Spacing (inches)	Minimum End Distance (inches)	Tension	Shear	
						Perpendicular to Edge of Masonry Wall	Parallel to Edge of Masonry Wall
1/2	4 1/4	1 3/4	8	4	680	305	1110
5/8	5	1 3/4	10	5	1310	305	1165

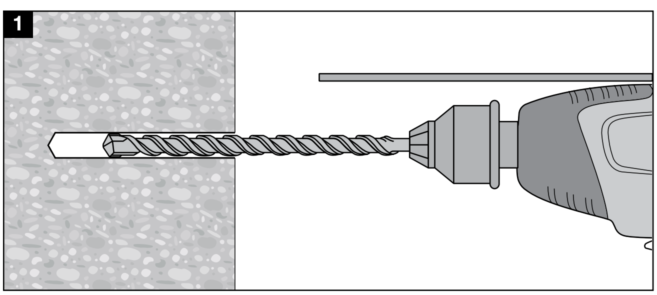
1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Embedment depth is measured from the top of the masonry construction.

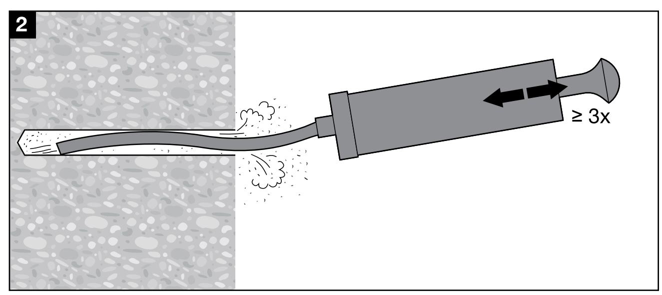
3 For combined loading: For 1/4" diameter - $\frac{T_{applied}}{T_{allowable}} + \frac{V_{applied}}{V_{allowable}} \leq 1$ For 3/8" - 3/4" diameter - $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

3.3.5.4 Installation Instructions

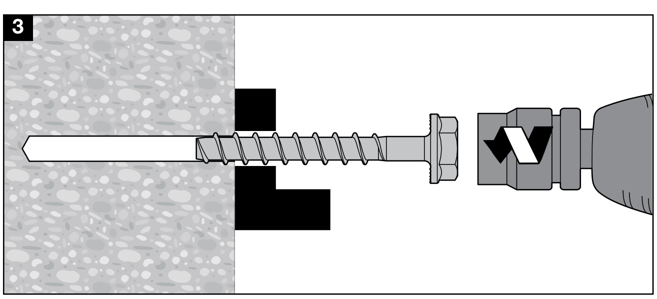
Drill holes in base material using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Table 1. Prior to installation, dust and debris must be removed from the drilled hole using a hand pump, compressed air or a vacuum. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The impact wrench torque, T_{impact} and installation torque, T_{inst} for the manual torque wrench must be in accordance with Table 1. The KWIK HUS-EZ (KH-EZ) may be loosened by a maximum of one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment. For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 2.



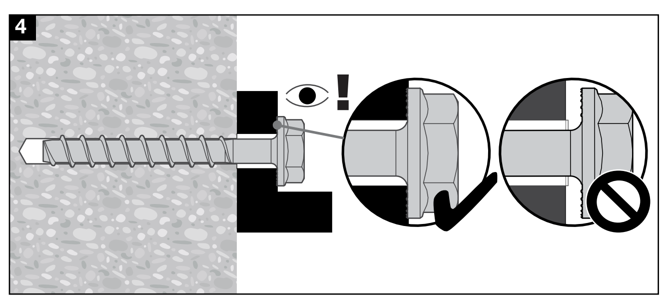
Drill hole in base material using proper diameter drill bit.



Clean drilled hole to remove debris.



Fasten anchor tightly against fastened part.



Install anchor using proper impact tool or torque wrench.

3.3.5.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

The data below is developed from testing performed in accordance with ACI 355.2. It is intended for applications designed according to CSA A23.3-04 Update No. 3 (August 2009) Design Of Concrete Structures Annex D and is generally suitable for the conditions described in the introduction of Annex D.

Table 9 — KWIK HUS-EZ Design Information (For use with CSA A23.3-04)

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)												Code Ref.
			1/4		3/8			1/2			5/8		3/4		
Anchor Category 1,2 or 3			1												
Nominal Embedment Depth	h_{nom}	mm	41	64	41	64	83	57	76	108	83	127	102	159	
Concrete material resistance factor for concrete	Φ_c	-	0.65												8.4.2
Steel material resistance factor	Φ_s	-	0.85												8.4.3
Ultimate strength of anchor steel	f_{ut}	MPa	924		732	829		776			622		563		
Effective cross-sectional area of anchor	A_{se}	mm^2	29.0		55.5			103.9			172.9		252.9		
Minimum Edge Distance	c_{min}	mm	38					44							
Minimum Spacing	s_{min}	mm	76										102		
Minimum Concrete Thickness	h_{min}	mm	83	102	83	102	121	114	140	171	127	178	152	203	
Steel Strength in Tension (CSA A23.3 D.6.1)[2]															
Factored Steel Resistance in tension	N_{sr}	kN	14.9		24.2	27.4		48.0			64.0		84.7		D.6.1.2
Reduction Factor for Steel Strength	R	-		0.70											D.5.4b
Concrete Breakout Strength in Tension (CSA A23.3 D.6.2)															
Effective Embedment Depth	h_{ef}	mm	30	49	28	47	64	39	55	82	61	99	74	123	
Critical Edge Distance	c_{ac}	mm	51	71	53	74	95	70	93	133	92	148	112	185	
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	10												D.6.2.2
Effectiveness Factor — Cracked Concrete	k_{cr}	-	7												
Modification factor for resistance in tension to account for uncracked concrete	$\Psi_{c,N}$	-	1.4												D.6.2.6
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)												D.5.4c

Table 9 (Continued)

Characteristic	Symbol	Units	Nominal Anchor Diameter(inches)												Code Ref.
			1/4		3/8			1/2			5/8		3/4		
Anchor Category 1,2 or 3			1												
Nominal Embedment Depth	h_{nom}	mm	41	64	41	64	83	57	76	108	83	127	102	159	
Pullout Strength in Tension — Non Seismic Applications (CSA A23.3 D.6.3)[1]															
Factored Pullout Resistance, uncracked concrete (20 MPa)	$N_{pr,uncr}$	kN	4.1	7.3	N/A										D.6.3.2
Factored Pullout Resistance, cracked concrete (20 MPa)	$N_{pr,cr}$	kN	2.0	3.6	2.3	N/A									D.6.3.2
Reduction Factor for pullout strength	R	-	1.15 (Condition A), 1.00 (Condition B)												
Pullout Strength in Tension — Seismic Applications (CSA A23.3 D.6.3)[1]															
Factored Pullout Resistance, Seismic (20 MPa)	$N_{pr,seis}$	kN	2.0	3.6	2.3	N/A									D.6.3.2
Reduction Factor for pullout strength	R	-	1.15 (Condition A), 1.00 (Condition B)												
Axial Stiffness in Service Load Range															
Uncracked Concrete	$ß_{uncr}$	lb/in.	760000												
Cracked Concrete	$ß_{cr}$	lb/in.	293000												
Steel Strength in Shear (CSA A23.3 D.7.1)[2]															
Factored Shear Resistance of Steel – Static	V_{sr}	kN	3.8		11.1	12.7		22.7			27.6		40.9		D.7.1.2c
Factored Shear Resistance of Steel – Seismic	$V_{sr,seis}$	kN	3.4		6.2	7.6		13.6			16.5		28.4		D.7.1.2c
Reduction Factor for Steel Strength	R	-	0.65												D.5.4b
Concrete Breakout Strength in Shear (CSA A23.3 D.7.2)															
Nominal Diameter	d_o	mm	6.4		9.5			12.7			15.9		19.1		
Load Bearing Length of Anchor	ℓ_e	mm	49		28	47	64	39	55	82	61	99	74	123	
Reduction Factor for Concrete Breakout Strength	R			1.15 (Condition A), 1.00 (Condition B)											
Concrete Pryout Strength in Shear (CSA A23.3 D.7.3)															
Coefficient for Pryout Strength	k_{cp}		1.0				2.0	1.0		2.0	1.0	2.0			
Reduction Factor for Pryout Strength	R			1.15 (Condition A), 1.00 (Condition B)											

1 N/A denotes that pullout resistance does not govern and does not need to be considered.

2 The KWIK HUS-EZ (KH-EZ) is considered a brittle steel element as defined by CSA A23.3 D.2.

This table replaces Table 3 and Table 4 of this Supplement (and Table 3 and Table 4 of ESR-3027) for anchorage design in normal weight concrete in accordance with CSA A23.3-04.

3.3.5 KWIK HUS-EZ (KH-EZ) Carbon Steel Screw Anchor

3.3.5.6 Ordering Information

Order Information

Description	Hole Diameter	Total Length without Anchor Head	Minimum Embedment Depth	Qty (pcs) / Box
KH-EZ 1/4"x1-7/8"	1/4"	1-7/8"	1-5/8"	100
KH-EZ 1/4"x2-5/8"	1/4"	2-5/8"	2-1/2"	100
KH-EZ 1/4"x3"	1/4"	3"	2-1/2"	100
KH-EZ 1/4"x3-1/2"	1/4"	3-1/2"	2-1/2"	100
KH-EZ 1/4"x4"	1/4"	4"	2-1/2"	100
KH-EZ 3/8"x1-7/8"	3/8"	1-7/8"	1-5/8"	50
KH-EZ 3/8"x2-1/8"	3/8"	2-1/8"	1-5/8"	50
KH-EZ 3/8"x3"	3/8"	3"	2-1/2"	50
KH-EZ 3/8"x3-1/2"	3/8"	3-1/2"	2-1/2"	50
KH-EZ 3/8"x4"	3/8"	4"	3-1/4"	50
KH-EZ 3/8"x5"	3/8"	5"	3-1/4"	30
KH-EZ 1/2"x2-1/2"	1/2"	2-1/2"	2-1/4"	30
KH-EZ 1/2"x3"	1/2"	3"	2-1/4"	30
KH-EZ 1/2"x3-1/2"	1/2"	3-1/2"	3"	25
KH-EZ 1/2"x4"	1/2"	4"	3"	25
KH-EZ 1/2"x4-1/2"	1/2"	4-1/2"	4 1/4"	25
KH-EZ 1/2"x5"	1/2"	5"	4 1/4"	25
KH-EZ 1/2"x6"	1/2"	6"	4-1/4"	25
KH-EZ 5/8"x3-1/2"	5/8"	3-1/2"	3-1/4"	15
KH-EZ 5/8"x4"	5/8"	4"	3-1/4"	15
KH-EZ 5/8"x5-1/2"	5/8"	5-1/2"	3-1/4"	15
KH-EZ 5/8"x6-1/2"	5/8"	6-1/2"	3-1/4"	15
KH-EZ 5/8"x8"	5/8"	8"	3-1/4"	15
KH-EZ 3/4"x4-1/2"	3/4"	4-1/2"	4"	10
KH-EZ 3/4"x5-1/2"	3/4"	5-1/2"	4"	10
KH-EZ 3/4"x7"	3/4"	7"	4"	10
KH-EZ 3/4"x8"	3/4"	8"	4"	10
KH-EZ 3/4"x9"	3/4"	9"	4"	10

3.3.6.1 Product Description

The KWIK Bolt 3 (KB3) is a torque controlled expansion anchor, which provides consistent performance for a wide range of mechanical anchor applications. This anchor series is available in carbon steel with zinc electroplated coating, carbon steel with hot-dip galvanized coating, 304 stainless steel and 316 stainless steel versions.The threaded stud version of the anchor is available in a variety of diameters ranging from 1/4-in. to 1-in. depending on the steel and coating type. Applicable base materials include normal-weight concrete, structural lightweight concrete, lightweight concrete over metal deck, and grout filled concrete masonry.

Guide Specifications

Torque controlled expansion anchors shall be KWIK Bolt 3 supplied by Hilti meeting the description in Federal Specification A-A 1923A, Type 4. The anchor bears a length identification mark embossed into the impact section (dog point) of the anchor identifying the anchor as a Hilti KWIK Bolt 3 in the installed condition. Anchors are manufactured to meet one of the following conditions:

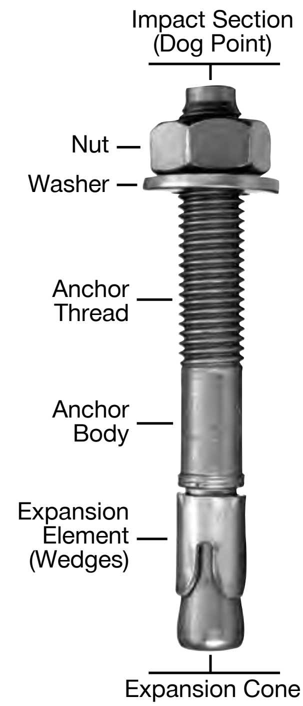
1. The carbon steel anchor body, nut and washer have an electro-plated zinc coating conforming to ASTM B 633 to a minimum thickness of 5 μm.
2. The carbon steel hot-dip galva-nized anchor body, nut, and washer conform to ASTM A 153. The stainless steel expansion elements conform to either type 304 or type 316.
3. The stainless steel anchor body, nut, and washer conform to type 304. The stainless steel expansion elements conform to either type 304 or type 316.
4. The stainless steel anchor body, nut, and washer conform to type 316. The stainless steel expansion elements conform to type 316.

Product Features

- Length identification code facilitates quality control and inspection after installation.
- Through fixture installation and variable thread lengths improve productivity and accommodate various base plate thicknesses.
- Raised impact section (Dog Point) prevents thread damage during installation.
- Anchor size is same as drill bit size for easy installation. For temporary applications anchors may be driven into drilled holes after usage.
- Mechanical expansion allows immediate load application.

Installation

Drill hole in concrete, structural lightweight concrete, or grout filled concrete masonry using a Hilti carbide tipped drill bit and a Hilti rotary hammer drill. Remove dust from the hole with oil free compressed air or vacuum. Alternately for 1/2-, 5/8-, 3/4- and 1-inch diameter KWIK Bolt 3 anchors, the hole may be drilled using a matched tolerance Hilti DD-C wet diamond core bit for anchoring applications. The slurry must be flushed from the diamond cored hole prior to anchor installation. The minimum hole depth must exceed the anchor embedment prior to torquing by at least by one hole diameter. Drive the anchor into the hole using a hammer. A minimum of six threads must be below the surface of the fixture. Tighten the nut to the installation torque.



Listings/Approvals

ICC-ES (International Code Council)
ESR-2302

ICC-ES ESR-1385
Grout filled concrete masonry

City of Los Angeles
Research Report No. 25577
Research Report No. 25577M for masonry

FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler (3/8” - 3/4”)

UL (Underwriters Laboratories)
UL 203 Pipe Hanger Equipment for Fire Protection Services (3/8” - 3/4”)

Miami-Dade County
NOA No. 06-0810.13
Qualified under an NQA-1 Nuclear Quality Program

*Please refer to the reports to verify that the type and diameter specified is included

Independent Code Evaluation

IBC® / IRC® 2009
(AC 193 / ACI 355.2, AC 01)

IBC® / IRC® 2006
(AC 193 / ACI 355.2, AC 01)

IBC® / IRC® 2003
(AC 193 / ACI 355.2)

3.3.6 KWIK Bolt 3 Expansion Anchor

3.3.6.2 Material Properties

Carbon Steel with Electroplated Zinc

All Carbon Steel KWIK Bolt 3 and Rod Coupling Anchors, excluding the 3/4 x 12 and 1-inch diameter sizes, have the tensile bolt fracture loads shown in Table 5.

All carbon steel 3/4 x 12 and 1 inch diameter sizes and carbon steel countersunk KWIK Bolt 3 anchor bodies have mechanical properties as listed in Table 5.

Carbon steel anchor components plated in accordance with ASTM B633 to a minimum thickness of 5 µm.

Nuts conform to the requirements of ASTM A 563, Grade A, Hex.

Washers meet the requirements of ASTM F 844.

Expansion elements (wedges) are manufactured from carbon steel, except the following anchors have stainless steel wedges:

- All 1/4-inch diameter anchors
- KB3 3/4x12
- All 1-inch diameter anchors
- All countersunk KWIK Bolt 3

Carbon Steel with Hot-Dip Galvanized Coating

Anchor bodies manufactured from carbon steel have the tensile bolt fracture loads shown in Table 5.

Carbon steel anchor components hot-dip galvanized according to ASTM A 153, Class C (43 µm min.).

Nuts conform to the requirements of ASTM A 563, Grade A, Hex.

Washers meet the requirements of ASTM F 844.

Stainless steel expansion elements (wedges) are manufactured from either type 304 or type 316.

Stainless Steel

Anchor bodies smaller than 3/4-inch, excluding all Countersunk KWIK Bolt 3 anchors, are produced from type 304 or type 316 stainless steel having the bolt fracture loads shown in Table 5.

Anchor bodies 3/4-inch and larger, and all stainless steel Countersunk KWIK Bolt 3 anchor bodies, are produced from AISI 304 or 316 stainless steel having the mechanical properties shown in Table 5.

Nuts meet the dimensional requirements of ASTM F 594.

Washers meet the dimensional requirements of ANSI B18.22.1, Type A, plain.

Stainless steel expansion elements for type 304 anchors are made from either type 304 or type 316. Stainless steel expansion elements for type 316 anchors are made from type 316. All stainless steel nuts and washers for type 304 and type 316 anchors are manufactured from type 304 and type 316, respectively.

3.3.6.3 Strength Design (LRFD

This section provides ACI 318 strength design information for the KWIK Bolt 3 used where the required post-installed anchor design must comply with the IBC 2003, IBC 2006 and IBC 2009. Testing was conducted in accordance with ACI 355.2 and ICC-ES AC193 in uncracked concrete. Engineering design based on this section is limited to uncracked concrete and seismic design categories A & B.

For more detailed information, please contact Hilti Technical Support. Note that the allowable load tables are not developed using the same safety factors as the allowable load Table 6 to 15 provided in the allowable load Section 4.3.5.4 of the 2008 Product Technical Guide and should not be interchanged. Edge distance and anchor spacing guidelines are specific for each design method. The installation torques for the 5/8-, 3/4- and 1-inch diameter anchors have been reduced in order to maintain reasonable spacing guidelines as developed in accordance with ACI 355.2.

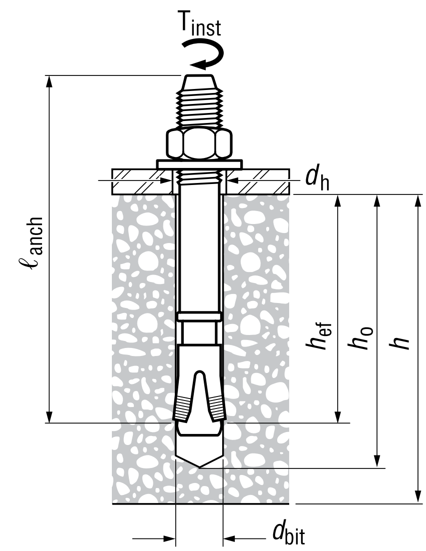


Figure 1 - KWIK Bolt 3 Installation

Table 1 - Installation Information Strength Design

Setting Information	Symbol	Units	Nominal anchor diameter									
			1/4	3/8	1/2		5/8		3/4		1	
Anchor O.D.	d_o	in. (mm)	0.25 (6.4)	0.375 (9.5)	0.5 (12.7)		0.625 (15.9)		0.75 (19.1)		1 (25.4)	
ANSI drill bit diameter	d_{bit}	in.	1/4	3/8	1/2		5/8		3/4		1	
Effective minimum embedment	h_{ef}	in. (mm)	1-1/2 (38)	2 (51)	2 (51)	3-1/4 (83)	3-1/8 (79)	4 (102)	3-3/4 (95)	5 (127)	4 (102)	5-3/4 (146)
Min hole depth	h_o	in. (mm)	2 (51)	2-5/8 (67)	2-5/8 (67)	4 (102)	3-7/8 (98)	4-3/4 (121)	4-1/2 (114)	5-3/4 (146)	5 (127)	6-3/4 (171)
Installation torque	T_{inst}	ft-lb (Nm)	4 (5)	20 (27)	40 (54)		60 (81)		110 (149)		150 (203)	
Expansion element clearance hole	d_h	in. (mm)	5/16 (7.9)	7/16 (11.1)	9/16 (14.3)		11/16 (17.5)		13/16 (20.6)		1-1/8 (28.6)	

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 2 - Carbon Steel KB3 Strength Design

Design Information	Symbol	Units	Nominal anchor diameter												
			1/4	3/8		1/2				5/8			3/4		
Anchor O.D.	d_o	in.	0.25	0.375		0.5				0.625			0.75		
		(mm)	(6.4)	(9.5)		(12.7)				(15.9)			(19.1)		
Effective min. embedment[2]	h_{ef}	in.	1-1/2	2		2		3-1/4		3-1/8	4		3-3/4		5
		(mm)	(38)	(51)		(51)		(83)		(79)	(102)		(95)		(127)
Min. member thickness	h_{min}	in.	4	4	5	4	6	6	8	5	6	8	6	8	8
		(mm)	(102)	(102)	(127)	(102)	(152)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	(203)
Critical edge distance	c_{cr}	in.	2-3/4	4-1/2	3-7/8	4-7/8	3-5/8	6-3/4	5-5/8	7-1/2	9-1/2	7-1/2	9-3/4	7-1/2	9-1/2
		(mm)	(70)	(114)	(98)	(124)	(92)	(171)	(143)	(191)	(241)	(191)	(248)	(191)	(241)
Min. edge distance	c_{min}	in.	1-3/8	2	1-1/2	2-1/8	2	1-5/8	1-5/8	2-1/4	1-3/4	1-3/4	2-3/4	2-5/8	2-1/2
		(mm)	(35)	(51)	(38)	(54)	(51)	(41)	(41)	(57)	(44)	(44)	(70)	(67)	(64)
	for s ≥	in.	1-3/4	2-7/8	3-1/2	4-7/8	4-3/4	4-1/4	4	5-1/4	4-3/4	4	6-7/8	6-1/2	6-3/8
		(mm)	(44)	(73)	(89)	(124)	(121)	(108)	(102)	(133)	(121)	(102)	(175)	(165)	(162)
Min. anchor spacing	s_{min}	in.	1-1/4	1-3/4	1-3/4	2-1/2	2-1/4	2	1-7/8	2-3/8	2-1/8	2-1/8	3-3/4	3-3/8	3-1/4
		(mm)	(32)	(44)	(44)	(64)	(57)	(51)	(48)	(60)	(54)	(54)	(95)	(86)	(83)
	for c ≥	in.	1 -5/8	2-3/8	2-3/8	2-5/8	2-3/8	2-1/4	2	3-1/8	2-3/8	2-1/4	3-3/4	3-3/8	3-3/8
		(mm)	(41)	(60)	(60)	(67)	(60)	(57)	(51)	(79)	(60)	(57)	(95)	(86)	(86)
Min. hole depth in concrete	h_0	in.	2	2-5/8		2-5/8		4		3-7/8	4-3/4		4-1/2		5-3/4
		(mm)	(51)	(67)		(67)		(102)		(98)	(121)		(114)		(146)
Min. specified yield strength	f_y	psi	84,800	84,800		84,800				84,800			84,800		
		(N/mm²)	(585)	(585)		(585)				(585)			(585)		
Min. specified ultimate strength	f_{ut}	psi	106,000	106,000		106,000				106,000			106,000		
		(N/mm²)	(731)	(731)		(731)				(731)			(731)		
Effective tensile stress area	A_{se}	in²	0.02	0.06		0.11				0.17			0.24		
		(mm²)	(12.9)	(38.7)		(71.0)				(109.7)			(154.8)		
Steel strength in tension	N_s	lb	2,120	6,360		11,660				18,020			25,440		
		(kN	(9.4)	(28.3)		(51.9)				(80.2)			(113.2)		
Steel strength in shear	V_s	lb	1,640	4,470		6,635		6,750		12,230			15,660		16,594
		(kN)	(7.3)	(19.9)		(29.5)		(30.0)		(54.4)			(69.7)		(73.8)
Steel strength in shear, concrete on metal deck[3]	$V_{sa,deck}$	lb		1,930		2,840		3,155		6,585			NP		
		(kN)		(8.6)		(12.6)		(14.0)		(29.3)					
Pullout strength uncracked concrete[4]	$N_{p,uncr}$	lb	1,575	NA		NA		6,800		NA			NA		10,585
		(kN)	(7.0)					(30.2)							
Pullout strength concrete on metal deck[5]	$N_{p,deck,uncr}$	lb	1,750	2,245		2,730				4,765			NP		
		(kN)	(7.8)	(10.0)		(12.1)				(21.2)					
Anchor category[6]	1, 2 or 3	–	1												
Effectiveness factor k_{uncr} uncracked concrete[7]	k_{uncr}	–	24												
Installation torque	T_{inst}	ft-lb	4	20		40				60			110		
		(Nm)	(5)	(27)		(54)				(81)			(149)		
Axial stiffness in service load range	ß	(lb/in)	116,150	162,850		203,500		191,100		222,150	170,700		207,400		164,000
COV $ß_{uncr}$	ß	%	60	42		29		29		25	21		19		24
Strength reduction factor Φ for tension, steel failure modes[8]			0.75												
Strength reduction factor Φ for shear, steel failure modes[8]			0.65												
Strength reduction factor Φ for tension, concrete failure modes, Condition B[9]			0.65												
Strength reduction factor Φ for shear concrete, failure modes, Condition B[9]			0.70												

For **SI**: 1 inch = 25.4 mm, 1lbf = 4.45 N, 1 psi = 0.006895 MPa. For pound-in units: 1 mm = 0.03937 inches

1 For KB3 into the soffit of sand lightweight or normal-weight concrete on metal deck floor and roof assemblies, see Fig. 5.

2 See Figure 2.

3 NP (not permitted) denoted that the condition is not supported.

4 NA (not applicable denotes that the condition does not govern for design.

5 NP (not permitted) denoted that the condition is not supported.

6 See ACI 318 Section D.4.4.

7 See ACI 318 Section D.5.2.2.

8 The carbon Steel KB3 is a ductile steel element as defined by ACI 318 Section D.1.

9 For use with the load combinations of ACI 318 Section 9.2 or IBC Section 1605.2.1. Condition B applies where supplementary reinforcement in conformance with ACI 318 Section D.4.4 is not provided, or where pull-out or pry out strength governs. For cases where the prescence of supplimentray reinfircement can be verified, the strength reduction factors associated with Condition A may be used.

Table 3 - Stainless Steel KB3 Strength Design Information

Design Information	Symbol	Units	Nominal anchor diameter														
			1/4	3/8		1/2				5/8			3/4			1	
Anchor O.D.	d_o	in.	0.25	0.375		0.5				0.625			0.75			1	
		(mm)	(6.4)	(9.5)		(12.7)				(15.9)			(19.1)			(25.4)	
Effective min. embedment[1]	h_{ef}	in.	1.5	2		2		3.25		3.125	4		3.75		5	4	5.75
		(mm)	(38)	(51)		(51)		(83)		(79)	(102)		(95)		(127)	(102)	(146)
Min. member thickness	h_{min}	in.	4	4	5	4	6	6	8	5	6	8	6	8	8	8	10
		(mm)	(102)	(102)	(127)	(102)	(152)	(152)	(203)	(127)	(152)	(203)	(152)	(203)	(203)	(203)	(254)
Critical edge distance[2]	c_{cr}	in.	3	4.375	3.875	4.875	4	6.75	5.75	7.375	9.5	7.5	10.5	9.25	9.75	10	11
		(mm)	(76)	(111)	(98)	(124)	(102)	(171)	(146)	(187)	(241)	(191)	(267)	(235)	(248)	(254)	(279)
Min. edge distance[2]	c_{min}	in.	1.375	2	1.625	2.5	1.875	1.625	1.625	3.25	2.5	2.5	3.25	3	2.875	3.5	3
		(mm)	(35)	(51)	(41)	(64)	(48)	(41)	(41)	(83)	(64)	(64)	(83)	(76)	(73)	(89)	(76)
	for s ≥	in.	1.75	4	3.625	5	4.625	4.5	4.25	5.625	5.25	5	7	6.875	6.625	6.75	6.75
		(mm)	(44)	(102)	(92)	(127)	(117)	(114)	(108)	(143)	(133)	(127)	(178)	(175)	(168)	(172)	(172)
Min. anchor spacing	s_{min}	in.	1.25	2	1.75	2.5	2.25	2.125	1.875	3.125	2.125	2.125	4	3.5	3.5	5	4.75
		(mm)	(32)	(51)	(44)	(64)	(57)	(54)	(48)	(79)	(54)	(54)	(102)	(89)	(89)	(127)	(121)
	for c ≥	in.	1.625	3.25	2.5	2.875	2.375	2.375	2.125	3.875	3	2.75	4.125	3.75	3.75	4.25	3.75
		(mm)	(41)	(83)	(64)	(73)	(60)	(60)	(54)	(98)	(76)	(70)	(105)	(95)	(95)	(108)	(95)
Min. hole depth in concrete	h_0	in.	2	2.625		2.625		4		3.875	4.75		4.5		5.75	5	6.75
		(mm)	(51)	(67)		(67)		(102)		(98)	(121)		(114)		(146)	(127)	(171)
Min. specified yield strength	f_y	psi	92000	92,000		92,000				92,000			76,000			76,000	
		(N/mm²)	(634)	(634)		(634)				(634)			(524)			(524)	
Min. specified ult. strength	f_{ut}	psi	115000	115,000		115,000				115,000			90,000			90,000	
		(N/mm²)	(793)	(793)		(793)				(793)			(621)			(621)	
Effective tensile stress area	A_{se}	in²	0.02	0.06		0.11				0.17			0.24			0.47	
		(mm²)	(12.9)	(38.7)		(71.0)				(109.7)			(154.8)			(303.2)	
Steel strength in tension	N_{sa}	lb	2300	6,900		12,650				19,550			21,600			42,311	
		(kN	(10.2)	(30.7)		(56.3)				(87.0)			(96.1)			(188.2)	
Steel strength in shear	V_{sa}	lb	1680	4,980		4,195		6,940		8,955	14,300		11,900		23,545	12,510	30,000
		(kN)	(7.5)	(22.2)		(18.7)		(30.9)		(39.8)	(63.6)		(52.9)		(104.7)	(55.6)	(133.5)
Steel strength in shear, concrete on metal deck	$V_{sa,deck}$	lb	2,020	2,580		1,745				5,690			NP			NP	
		(kN)	(9.0)	(11.5)		(7.8)				(25.3)							
Pullout strength uncracked concrete	$N_{p,uncr}$	lb	1325	3,120		3,310		6,340		6,230	7,830		8,555		10,830	NA	15,550
		(kN)	(5.9)	(13.9)		(14.7)		(28.2)		(27.7)	(34.8)		(38.1)		(48.2)		(69.2)
Pullout strength concrete on metal deck[5]	$N_{p,deck,uncr}$	lb	1805	2,580		1,945				4,430			NP			NP	
		(kN)	(8.0)	(11.5)		(8.7)				(19.7)							
Anchor category[6]	1, 2 or 3	–	2	1													
Effectiveness factor uncracked concrete[7]	k_{uncr}	–	24														
Installation torque	T_{inst}	ft-lb	4	20		40				60			110			150	
		(Nm)	(5)	(27)		(54)				(81)			(149)			(203)	
Axial stiffness in service load range	ß	(lb/in)	57,400	158,300		154,150		77,625		227,600	189,200		275,600		187,000	126,400	174,800
COV	ß	%	40	34		36		17		31	22		35		21	38	22
Strength reduction factor Φ for tension, steel failure modes			0.75														
Strength reduction factor Φ for shear, steel failure modes[8]			0.65														
Strength reduction factor Φ for tension concrete failure modes, Condition B[9]			0.65														
Strength reduction factor Φ for shear concrete failure modes, Condition B[9]			0.70														

1 See Figure 1.

2 For KB3 into the soffit of sand lightweight or normal-weight concrete on metal deck floor and roof assemblies, see Figure 3.

3 NP (not permitted) denoted that the condition is not supported.

4 NA (not applicable denotes that the condition does not govern for design.

5 NP (not permitted) denoted that the condition is not supported.

6 See ACI 318 Section D.4.4.

7 See ACI 318 Section D.5.2.2.

8 The KB3 is a ductile steel element as defined by ACI 318 Section D.1.

9 For use with the load combinations of ACI 318 Section 9.2. Condition B applies where supplementary reinforcement in conformance with ACI 318 Section D.4.4 is not provided, or where pull-out or pry out strength governs. For cases where the presence of supplementary reinforcement can be verified, the strength reduction factors associated with Condition A may be used.

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 4 - Hot-Dip Galvanized KB3 Strength Design Information

Design Information	Symbol	Units	Nominal anchor Diameter									
			1/2				5/8			3/4		
Anchor O.D.	d_o	in. (mm)	0.5 (12.)				0.625 (15.9)			0.75 (19.1)		
Effective min. embedment[2]	h_{ef}	in. (mm)	2 (51)		3.25 (83)		3.125 (79)	4 (102)		3.75 (95)		5 (127)
Min. member thickness	h_{min}	in. (mm)	4 (102)	6 (152)	6 (152)	8 (203)	5 (127)	6 (152)	8 (203)	6 (152)	8 (203)	8 (203)
Critical edge distance	c_{cr}	in. (mm)	4.875 (124)	3.625 (92)	6.75 (171)	5.625 (143)	7.5 (191)	9.5 (241)	7.5 (191)	9.75 (248)	7.5 (191)	9.5 (241)
Min. edge distance	c_{min}	in. (mm)	3.25 (83)	2.625 (67)	2 (51)		2.25 (57)	2 (51)	1.875 (48)	3.5 (89)		3.625 (92)
	for s ≥	in. (mm)	6.25 (159)	5.5 (140)	4.875 (124)		5.25 (133)	5 (127)	4.75 (121)	7.5 (191)		7.375 (187)
Min. anchor spacing	s_{min}	in. (mm)	3.125 (79)	2.75 (70)	2.375 (60)	2.125 (54)	2.5 (64)	2.125 (54)	2.125 (54)	4 (102)		3.875 (98)
	for c ≥	in. (mm)	3.75 (95)	2.75 (70)	2.625 (67)	2.25 (57)	3.5 (89)	2.5 (64)	2.25 (57)	6.5 (165)		4.75 (121)
Min. hole depth in concrete	h_0	in. (mm)	2.625 (67)		4 (102)		3.875 (98)	4.75 (121)		4.5 (114)		5.75 (146)
Min. specified yield strength	f_y	psi (N/mm²)	84,800 (585)				84,800 (585)			84,800 (585)		
Min. specified ult. strength	f_{ut}	psi (N/mm²)	106,000 (731)				106,000 (731)			106,000 (731)		
Effective tensile stress area	A_{se}	in² (mm²)	0.11 (71.0)				0.17 (109.7)			0.24 (154.8)		
Steel strength in tension	N_{sa}	lb (kN	11,660 (51.9)				18,020 (80.2)			25,440 (113.2)		
Steel strength in shear	V_{sa}	lb (kN)	4,200 (18.7)		5,870 (26.1)		11,635 (51.8)			17,000 (75.6)		
Pullout strength uncracked concrete[4]	$N_{p,uncr}$	lb (kN)	NA		6,540 (29.1)		6,465 (28.8)		9,375 (41.7)	NA		10,175 (45.3)
Anchor category[7]	1, 2 or 3	–	1									
Effectiveness factor uncracked concrete[7]	k_{uncr}	–	24									
Installation torque	T_{inst}	ft-lb (Nm)	40 (54)				60 (81)			110 (149)		
Axial stiffness in service load range	ß	(lb/in)	177,000		332,850		347,750	190,130		364,725		314,650
COV	ß	%	42		18		37	36		27		21
Strength reduction factor f for tension, steel failure modes[5]			0.75									
Strength reduction factor f for shear, steel failure modes[5]			0.65									
Strength reduction factor f for tension concrete failure modes, Condition B[6]			0.65									
Strength reduction factor f for shear concrete failure modes, Condition B[6]			0.70									

1 See Table 16 and the associated figure.

2 NA (not applicable) denotes that this value does not govern for design.

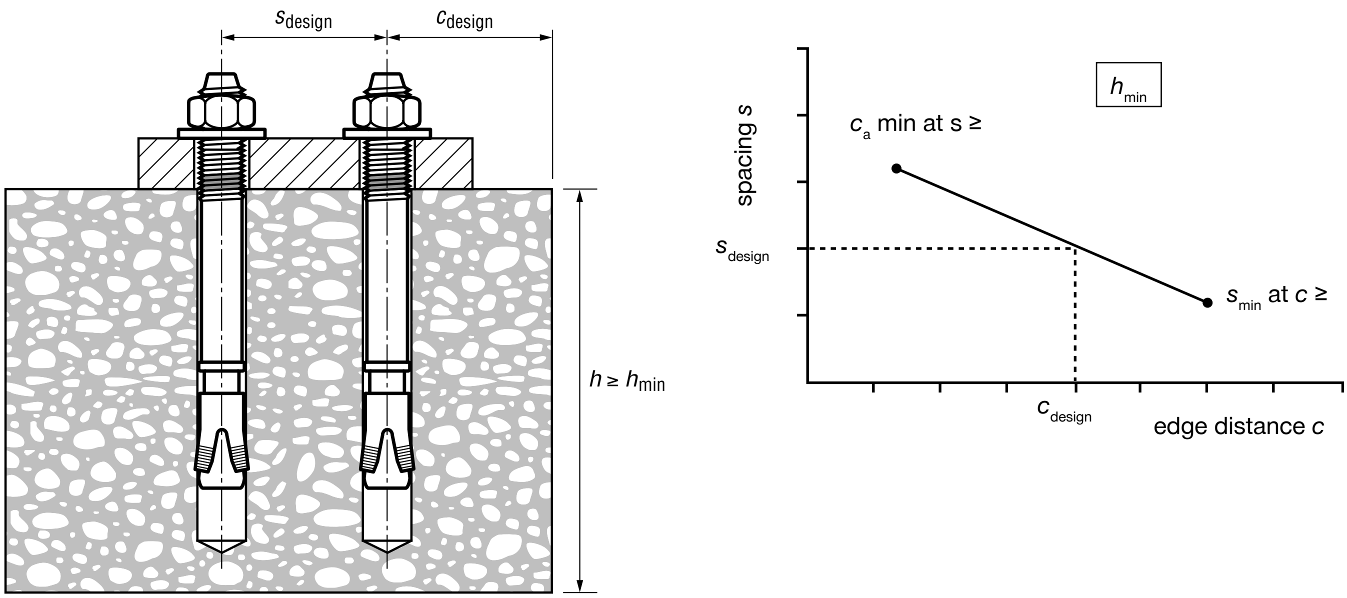
3 See ACI 318 Section D.4.4.

4 See ACI 318 Section D.5.2.2.

5 The KB3 is a ductile steel element as defined by ACI 318 Section D.1

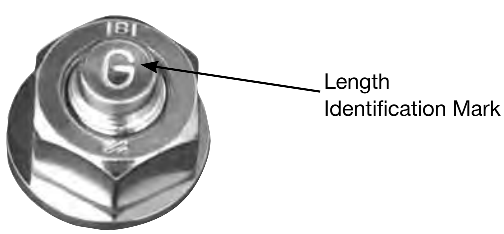
6 For use with the load combinations of ACI 318 Section 9.2. Condition B applies where supplementary reinforcement in conformance with ACI 318 Section D.4.4 is not provided, or where pull-out or pry out strength governs. For cases where the prescence of supplimentray reinfircement can be verified, the strength reduction factors associated with Condition A may be used.

Figure 2 - Interpolation of Minimum Edge Distance and Anchor Spacing



Length Identification System

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
Length of anchor, (in.)	From	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2	6	6-1/2	7	7-1/2	8	8-1/2	9	9-1/2	10	11	12
	Up to but not including	2	2-1/2	3	3-1/2	4	4-1/2	5	5-1/2	6	6-1/2	7	7-1/2	8	8-1/2	9	9-1/2	10	11	12	13



3.3.6 KWIK Bolt 3 Expansion Anchor

3.3.6.4 Allowable Stress Design

Table 5 - KWIK Bolt 3 Specifications and Properties[1]

Details / Bolt Size			in. (mm)	1/4 (6.4)			3/8 (9.5)			1/2 (12.7)		
d_{bit}	nominal bit diameter[2]		in.	1/4			3/8			1/2		
$h_{min}/h_{nom}/h_{deep}$	depth of embedment		in. (mm)	1-1/8 (29)	2 (51)	3 (76)	1-5/8 (41)	2-1/2 (64)	3-1/2 (89)	2-1/4 (57)	3-1/2 (89)	4-3/4 (121)
h_o	minimum/standard/deep hole depth		in. (mm)	1-3/8 (35)	2-1/4 (57)	3-1/4 (83)	2 (51)	2-7/8 (73)	3-7/8 (89)	2-3/4 (70)	4 (102)	5-1/4 (133)
d_h	fixture hole		in. (mm)	5/16 (8)			7/16 (11)			9/16 (14)		
T_{inst} Installation Torque	Normal weight & Light weight Concrete	Carbon Steel HDG	ft-lb (Nm)	4 (5)			20 (27)			40 (54)		
		Stainless Steel	ft-lb (Nm)	6 (8)			20 (27)			40 (54)		
	Grout Filled Block	Carbon Steel	ft-lb (Nm)	4 (5)			15 (20)			25 (34)		
h	min. base material thickness		in.	3 inch (76 mm) or 1.3 times embedment, whichever number is greater								
Bolt Fracture Load	Carbon Steel			2900 lb[4,6]			7200 lb[4,6]			12400 lb[4]		
	HDG			no offering			no offering			12400 lb[4]		
	Stainless Steel			2900 lb[4,7]			7200 lb[4,7]			12400 lb[4]		

Details / Bolt Size			in. (mm)	5/8 (15.9)			3/4 (19.1)			1 (25.4)		
d_{bit}	nominal bit diameter[2]		in.	5/8			3/4			1		
$h_{min}/h_{nom}/h_{deep}$	depth of embedment		in. (mm)	2-3/4 (70)	4 (102)	5-1/2 (140)	3-1/4 (83)	4-3/4 (121)	6-1/2[3] (165)	4-1/2 (114)	6 (152)	9 (229)
h_o	minimum/standard/deep hole depth		in. (mm)	3-3/8 (86)	4-5/8 (117)	6-1/8 (156)	4 (102)	5-1/2 (140)	7 (178)	5-1/2 (140)	7 (178)	10 (254)
d_h	fixture hole		in. (mm)	11/16 (17)			13/16 (21)			1-1/8 (29)		
T_{inst} Installation Torque	Normal weight & Light weight Concrete	Carbon Steel HDG	ft-lb (Nm)	60 (81)			110 (149)			150 (203)		
		Stainless Steel	ft-lb (Nm)	60 (81)			110 (149)			150 (203)		
	Grout Filled Block	Carbon Steel	ft-lb (Nm)	65 (88)			120 (163)			–		
h	min. base material thickness		in.	3 inch (76 mm) or 1.3 times embedment, whichever number is greater								
Bolt Fracture Load	Carbon Steel			19600 lb[4]			28700 lb[4,8]			$f_{ut} \geq 88$ ksi, $f_y \geq 75$ ksi[5]		
	HDG			19600 lb[4]			28700 lb[4]			no offering		
	Stainless Steel			21900 lb[4]			$f_{ut} \geq 76$ ksi, $f_y \geq 64$ ksi[5]			$f_{ut} \geq 76$ ksi, $f_y \geq 64$ ksi[5]		

1 See KWIK Bolt 3 Product Line Table in Section 3.3.6.6 for a full list and anchor length and thread length configurations.

2 Loads for KWIK Bolt 3 are applicable for both carbide drill bits and matched tolerance Hilti DD-B or DD-C diamond core bits in sizes ranging from 1/2 inch to 1 inch.

3 The deep embedment depth for stainless steel KWIK Bolt 3 anchors is 8 inch (203 mm).

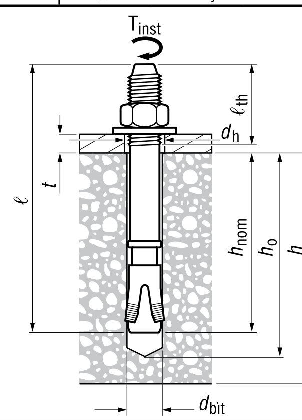
4 Bolt fracture loads are determined by testing in a jig as part of product quality control. These values are not intended for design purposes.

5 Bolt strength specified by minimum tensile and yield strength. Bolt fracture load not applicable.

6 Bolt fracture load not applicable to carbon steel Countersunk KWIK Bolt 3. The tensile and yield strengths are $f_{ut} \geq 105$ ksi and $f_y \geq 90$ ksi.

7 Bolt fracture load not applicable to stainless steel Countersunk KWIK Bolt 3. The tensile and yield strengths are $f_{ut} \geq 90$ ksi and $f_y \geq 76$ ksi.

8 For 3/4 x 12, $f_{ut} \geq 88$ ksi and $f_y \geq 75$ ksi. Bolt fracture load not applicable.



KWIK Bolt 3 Expansion Anchor 3.3.6

Table 6 - Carbon Steel KWIK Bolt 3 Allowable Loads in Normal-Weight Concrete[1]

<table>
<tr><th rowspan="2">Anchor Diameter in. (mm)</th><th rowspan="2">Embedment Depth in. (mm)</th><th colspan="2">f'_c = 2000 psi (13.8 MPa)</th><th colspan="2">f'_c = 3000 psi (20.7 MPa)</th><th colspan="2">f'_c = 4000 psi (27.6 MPa)</th><th colspan="2">f'_c = 6000 psi (41.4 MPa)</th></tr>
<tr><th>Tension lb (kN)</th><th>Shear lb (kN)</th><th>Tension lb (kN)</th><th>Shear lb (kN)</th><th>Tension lb (kN)</th><th>Shear lb (kN)</th><th>Tension lb (kN)</th><th>Shear lb (kN)</th></tr>
<tr><td rowspan="3">1/4 (6.4)</td><td>1-1/8 (29)</td><td>300 (1.3)</td><td rowspan="3">530 (2.4)</td><td>365 (1.6)</td><td rowspan="3">530 (2.4)</td><td>430 (1.9)</td><td rowspan="3">530 (2.4)</td><td>550 (2.4)</td><td rowspan="3">530 (2.4)</td></tr>
<tr><td>2 (51)</td><td>635 (2.8)</td><td>715 (3.2)</td><td>800 (3.6)</td><td rowspan="2">845 (3.8)</td></tr>
<tr><td>3 (76)</td><td>755 (3.4)</td><td>795 (3.5)</td><td>840 (3.7)</td></tr>
<tr><td rowspan="3">3/8 (9.5)</td><td>1-5/8 (41)</td><td>730 (3.2)</td><td>1135 (5.0)</td><td>910 (4.0)</td><td>1275 (5.7)</td><td>1095 (4.9)</td><td rowspan="3">1315 (5.8)</td><td>1090 (4.8)</td><td rowspan="3">1315 (5.8)</td></tr>
<tr><td>2-1/2 (64)</td><td>1260 (5.6)</td><td rowspan="2">1315 (5.8)</td><td>1555 (6.9)</td><td rowspan="2">1315 (5.8)</td><td>1850 (8.2)</td><td>2060 (9.2)</td></tr>
<tr><td>3-1/2 (89)</td><td>1580 (7.0)</td><td>1770 (7.9)</td><td>1965 (8.7)</td><td>2150 (9.6)</td></tr>
<tr><td rowspan="3">1/2 (12.7)</td><td>2-1/4 (57)</td><td>1235 (5.5)</td><td>1865 (8.3)</td><td>1430 (6.4)</td><td>2300 (10.2)</td><td>1620 (7.2)</td><td>2405 (10.7)</td><td>1975 (8.8)</td><td rowspan="3">2415 (10.7)</td></tr>
<tr><td>3-1/2 (89)</td><td>1930 (8.6)</td><td rowspan="2">2415 (10.7)</td><td>2185 (9.7)</td><td rowspan="2">2415 (10.7)</td><td>2440 (10.9)</td><td rowspan="2">2415 (10.7)</td><td>3240 (14.4)</td></tr>
<tr><td>4-3/4 (121)</td><td>2135 (9.5)</td><td>2355 (10.5)</td><td>2575 (11.5)</td><td>3620 (16.1)</td></tr>
<tr><td rowspan="3">5/8 (15.9)</td><td>2-3/4 (70)</td><td>1920 (8.5)</td><td>2750 (12.2)</td><td>2065 (9.2)</td><td>3410 (15.2)</td><td>2210 (9.8)</td><td>3785 (16.8)</td><td>2830 (12.6)</td><td rowspan="3">3910 (17.4)</td></tr>
<tr><td>4 (102)</td><td>2660 (11.8)</td><td rowspan="2">3910 (17.4)</td><td>3020 (13.4)</td><td rowspan="2">3910 (17.4)</td><td>3385 (15.1)</td><td rowspan="2">3910 (17.4)</td><td>4770 (21.2)</td></tr>
<tr><td>5-1/2 (140)</td><td>3285 (14.6)</td><td>3695 (16.4)</td><td>4100 (18.2)</td><td>5325 (23.7)</td></tr>
<tr><td rowspan="3">3/4 (19.1)</td><td>3-1/4 (83)</td><td>2120 (9.4)</td><td>4090 (18.2)</td><td>2425 (10.8)</td><td>4900 (21.8)</td><td>2730 (12.1)</td><td>5310 (23.6)</td><td>3785 (16.8)</td><td>5310 (23.6)</td></tr>
<tr><td>4-3/4 (121)</td><td>3240 (14.4)</td><td rowspan="2">5340 (23.8)</td><td>4260 (18.9)</td><td rowspan="2">5340 (23.8)</td><td>5285 (23.5)</td><td rowspan="2">5495 (24.4)</td><td>6155 (27.4)</td><td rowspan="2">6225 (27.7)</td></tr>
<tr><td>6-1/2 (165)</td><td>4535 (20.2)</td><td>5860 (26.1)</td><td>7185 (32)</td><td>7005 (31.2)</td></tr>
<tr><td rowspan="3">1 (25.4)</td><td>4-1/2 (114)</td><td>3330 (14.8)</td><td>7070 (31.4)</td><td>4050 (18.0)</td><td>7600 (33.8)</td><td>4670 (20.8)</td><td>8140 (36.2)</td><td>5070 (22.6)</td><td rowspan="3">9200 (40.9)</td></tr>
<tr><td>6 (152)</td><td>4930 (21.9)</td><td rowspan="2">9200 (40.9)</td><td>6000 (26.7)</td><td rowspan="2">9200 (40.9)</td><td>7070 (31.4)</td><td rowspan="2">9200 (40.9)</td><td>8400 (37.4)</td></tr>
<tr><td>9 (229)</td><td>6670 (29.7)</td><td>7670 (34.1)</td><td>8670 (38.6)</td><td>10670 (47.5)</td></tr>
</table>

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 7 - Carbon Steel KWIK Bolt 3 Ultimate Loads in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	f'_c = 2000 psi (13.8 MPa)		f'_c = 3000 psi (20.7 MPa)		f'_c = 4000 psi (27.6 MPa)		f'_c = 6000 psi (41.4 MPa)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	1-1/8 (29)	1120 (5.0)		1370 (6.1)		1615 (7.2)		2060 (9.2)	
	2 (51)	2375 (10.5)	1995 (8.9)	2690 (12.0)	1995 (8.9)	3000 (13.3)	1995 (8.9)	3165 (14.1)	1995 (8.9)
	3 (76)	2830 (12.6)		2990 (13.3)		3150 (14.0)			
3/8 (9.5)	1-5/8 (41)	2740 (12.2)	4250 (18.9)	3420 (15.2)	4790 (21.3)	4100 (18.2)		4095 (18.2)	
	2-1/2 (64)	4720 (21.0)	4930 (21.9)	5830 (25.9)	4930 (21.9)	6935 (30.8)	4930 (21.9)	7730 (34.4)	4930 (21.9)
	3-1/2 (89)	5925 (26.4)		6645 (29.6)		7365 (32.8)		8055 (35.8)	
1/2 (12.7)	2-1/4 (57)	4635 (20.6)	7000 (31.1)	5355 (23.8)	8630 (38.4)	6075 (27.0)	9030 (40.2)	7410 (33.0)	
	3-1/2 (89)	7240 (32.2)	9065 (40.3)	8195 (36.5)	9065 (40.3)	9145 (40.7)	9065 (40.3)	12140 (54.0)	9065 (40.3)
	4-3/4 (121)	8000 (35.6)		8830 (39.3)		9655 (42.9)		13585 (60.4)	
5/8 (15.9)	2-3/4 (70)	7210 (32.1)	10315 (45.9)	7750 (34.5)	12790 (56.9)	8285 (36.9)	14195 (63.1)	10615 (47.2)	
	4 (102)	9975 (44.4)	14650 (65.2)	11335 (50.4)	14650 (65.2)	12690 (56.4)	14650 (65.2)	17890 (79.6)	14650 (65.2)
	5-1/2 (140)	12315 (54.8)		13850 (61.6)		15385 (68.4)		19970 (88.8)	
3/4 (19.1)	3-1/4 (83)	7955 (35.4)	15335 (68.2)	9100 (40.5)	18375 (81.7)	10245 (45.6)	19910 (88.6)	14185 (63.1)	19910 (88.6)
	4-3/4 (121)	12150 (54.0)	20030 (89.1)	15985 (71.1)	20030 (89.1)	19820 (86.2)	20605 (91.7)	23085 (102.7)	23355 (103.9)
	6-1/2 (165)	17000 (75.6)		21970 (97.7)		26935 (119.8)		26260 (116.8)	
1 (25.4)	4-1/2 (114)	12500 (55.6)	26500 (117.9)	15200 (67.6)	28500 (126.8)	17500 (77.8)	30500 (135.7)	19000 (84.5)	
	6 (152)	18500 (82.3)	34500 (153.5)	22500 (100.1)	34500 (153.5)	26500 (117.9)	34500 (153.5)	31500 (140.1)	34500 (153.5)
	9 (229)	25000 (111.2)		28750 (127.9)		32500 (144.6)		40000 (177.9)	

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

KWIK Bolt 3 Expansion Anchor 3.3.6

Table 8 - Stainless Steel KWIK Bolt 3 Allowable Loads in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	f'_c = 2000 psi (13.8 MPa)		f'_c = 3000 psi (20.7 MPa)		f'_c = 4000 psi (27.6 MPa)		f'_c = 6000 psi (41.4 MPa)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	1-1/8 (29)	260 (1.2)	595 (2.6)	320 (1.4)	675 (3.0)	380 (1.7)	725 (3.2)	470 (2.1)	805 (3.6)
	2 (51)	540 (2.4)	675 (3.0)	625 (2.8)		705 (3.1)	805 (3.6)	910 (4.0)	
	3 (76)	685 (3)		750 (3.3)		810 (3.6)			
3/8 (9.5)	1-5/8 (41)	605 (2.7)	880 (3.9)	670 (3.0)	1110 (4.9)	730 (3.2)	1345 (6.0)	950 (4.2)	1690 (7.5)
	2-1/2 (64)	1285 (5.7)	1570 (7.0)	1430 (6.4)	1570 (7.0)	1575 (7.0)	1590 (7.1)	1940 (8.6)	1590 (7.1)
	3-1/2 (89)	1620 (7.2)		1755 (7.8)		1885 (8.4)		2035 (9.1)	
1/2 (12.7)	2-1/4 (57)	1015 (4.5)	1875 (8.3)	1230 (5.5)	2130 (9.5)	1450 (6.4)	2380 (10.6)	1620 (7.2)	2740 (12.2)
	3-1/2 (89)	1445 (6.4)	3010 (13.4)	1975 (8.8)	3010 (13.4)	2510 (11.2)	3045 (13.5)	2655 (11.8)	3045 (13.5)
	4-3/4 (121)	1990 (8.9)		2250 (10.0)				2985 (13.3)	
5/8 (15.9)	2-3/4 (70)	1650 (7.3)	2875 (12.8)	1755 (7.8)	3485 (15.5)	1860 (8.3)	4095 (18.2)	2335 (10.4)	4625 (20.6)
	4 (102)	2455 (10.9)	4625 (20.6)	2900 (12.9)	4625 (20.6)	3340 (14.9)	4625 (20.6)	4395 (19.5)	
	5-1/2 (140)	3480 (15.5)		3885 (17.3)		4290 (19.1)		6260 (27.8)	
3/4 (19.1)	3-1/4 (83)	1550 (6.9)	3945 (17.5)	1950 (8.7)	4260 (18.9)	2350 (10.5)	5645 (25.1)	2610 (11.6)	5645 (25.1)
	4-3/4 (121)	2510 (11.2)	5535 (24.6)	3250 (14.5)	5535 (24.6)	3870 (17.2)		4670 (20.8)	
	8 (203)	2930 (13.0)		3735 (16.6)		4530 (20.2)		5120 (22.8)	
1 (25.4)	4-1/2 (114)	3120 (13.9)	6080 (27.0)	3870 (17.2)	6770 (30.1)	4610 (20.5)	7470 (33.2)	4800 (21.4)	7470 (33.2)
	6 (152)	4400 (19.6)	7470 (33.2)	6400 (28.5)	7470 (33.2)	7200 (32.0)		7330 (32.6)	
	9 (229)	5600 (24.9)		8000 (35.6)		9390 (41.8)		9390 (41.8)	

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 9 - Stainless Steel KWIK Bolt 3 Ultimate Loads in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	f'_c = 2000 psi (13.8 MPa)		f'_c = 3000 psi (20.7 MPa)		f'_c = 4000 psi (27.6 MPa)		f'_c = 6000 psi (41.4 MPa)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	1-1/8 (29)	980 (4.4)	2240 (10.0)	1205 (5.4)	2530 (11.3)	1430 (6.4)	2725 (12.1)	1755 (7.8)	3020 (13.4)
	2 (51)	2035 (9.1)	2530 (11.3)	2340 (10.4)		2640 (11.7)	3020 (13.4)	3415 (15.2)	
	3 (76)	2580 (11.5)		2810 (12.5)		3040 (13.5)			
3/8 (9.5)	1-5/8 (41)	2275 (10.1)	3300 (14.7)	2505 (11.1)	4175 (18.6)	2735 (12.2)	5045 (22.4)	3560 (15.8)	6015 (26.8)
	2-1/2 (64)	4825 (21.5)	5900 (26.2)	5365 (23.9)	5900 (26.2)	5905 (26.3)	5954 (26.5)	7270 (32.3)	5954 (26.5)
	3-1/2 (89)	6075 (27.0)		6575 (29.2)		7075 (31.5)		7625 (33.9)	
1/2 (12.7)	2-1/4 (57)	3805 (16.9)	7030 (31.3)	4620 (20.6)	7980 (35.5)	5435 (24.2)	8930 (39.7)	6080 (27.0)	10285 (45.7)
	3-1/2 (89)	5415 (24.1)	11290 (50.2)	7410 (33.0)	11290 (50.2)	9405 (41.8)	11410 (50.8)	9950 (44.3)	11410 (50.8)
	4-3/4 (121)	7460 (33.2)		8435 (37.5)				11200 (49.8)	
5/8 (15.9)	2-3/4 (70)	6185 (27.5)	10790 (48.0)	6580 (29.3)	13075 (58.2)	6975 (31.0)	15360 (68.3)	8760 (39.0)	17355 (77.2)
	4 (102)	9205 (40.9)	17355 (77.2)	10870 (48.4)	17355 (77.2)	12530 (55.7)	17355 (77.2)	16490 (73.4)	
	5-1/2 (140)	13040 (58.0)		14560 (64.8)		16080 (71.5)		23475 (104.4)	
3/4 (19.1)	3-1/4 (83)	5800 (25.8)	14790 (65.8)	7300 (32.5)	15980 (71.1)	8800 (39.1)	21160 (94.1)	9800 (43.6)	21160 (94.1)
	4-3/4 (121)	9400 (41.8)	20750 (92.3)	11950 (53.2)	20750 (92.3)	14500 (64.5)		17500 (77.8)	
	8 (203)	11000 (48.9)		14000 (62.3)		17000 (75.6)		19200 (85.4)	
1 (25.4)	4-1/2 (114)	11700 (52.0)	22800 (101.4)	14500 (64.5)	25400 (113.0)	17300 (77.0)	28000 (124.6)	18000 (80.1)	28000 (124.6)
	6 (152)	16500 (73.4)	28000 (124.6)	21750 (96.7)	28000 (124.6)	27000 (120.1)		27500 (122.3)	
	9 (229)	21000 (93.4)		28100 (125.0)		35200 (156.6)		35200 (156.6)	

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

Table 10 - Hot-Dip Galvanized KWIK Bolt 3 Allowable Loads in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	f'_c = 2000 psi (13.8 MPa) Tension lb (kN)	f'_c = 2000 psi (13.8 MPa) Shear lb (kN)	f'_c = 3000 psi (20.7 MPa) Tension lb (kN)	f'_c = 3000 psi (20.7 MPa) Shear lb (kN)	f'_c = 4000 psi (27.6 MPa) Tension lb (kN)	f'_c = 4000 psi (27.6 MPa) Shear lb (kN)	f'_c = 6000 psi (41.4 MPa) Tension lb (kN)	f'_c = 6000 psi (41.4 MPa) Shear lb (kN)
1/2 (12.7)	2-1/4 (57)	1125 (5.0)	1785 (7.9)	1265 (5.6)	1785 (7.9)	1400 (6.2)	2190 (9.7)	1655 (7.4)	2190 (9.7)
	3-1/2 (89)	1895 (8.4)	2190 (9.7)	2115 (9.4)	2190 (9.7)	2335 (10.4)		3105 (13.8)	
	4-3/4 (121)	2215 (9.9)		2530 (11.3)		2845 (12.7)		3740 (16.6	
5/8 (15.9)	2-3/4 (70)	1785 (7.9)	3780 (16.8)	1965 (8.7)	3780 (16.8)	2140 (9.5)	3780 (16.8)	2745 (12.2)	3790 (16.8)
	4 (102)	2545 (11.3)		3155 (14.0)		3765 (16.7)		5280 (23.5)	
	5-1/2 (140)	3375 (15.0)		4030 (17.9)		4030 (17.9)		6055 (26.9)	
3/4 (19.1)	3-1/4 (83)	2355 (10.5)	4240 (18.9)	2545 (11.3)	4240 (18.9)	2735 (12.2)	5340 (23.8)	2825 (12.6)	5340 (23.8)
	4-3/4 (121)	3730 (16.6)	5340 (23.8)	4350 (19.3)	5340 (23.8)	4970 (22.1)		5805 (25.8)	
	8 (203)	5115 (22.8)		5805 (25.8)		6495 (28.9)		7520 (33.5)	

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

Table 11 - Hot-Dip Galvanized KWIK Bolt 3 Ultimate Loads in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)	Embedment Depth in. (mm)	f'_c = 2000 psi (13.8 MPa) Tension lb (kN)	f'_c = 2000 psi (13.8 MPa) Shear lb (kN)	f'_c = 3000 psi (20.7 MPa) Tension lb (kN)	f'_c = 3000 psi (20.7 MPa) Shear lb (kN)	f'_c = 4000 psi (27.6 MPa) Tension lb (kN)	f'_c = 4000 psi (27.6 MPa) Shear lb (kN)	f'_c = 6000 psi (41.4 MPa) Tension lb (kN)	f'_c = 6000 psi (41.4 MPa) Shear lb (kN)
1/2 (12.7)	2-1/4 (57)	4220 (18.8)	6695 (29.8)	4740 (21.1)	6695 (29.8)	5255 (23.4)	8210 (36.5)	6210 (27.6)	8210 (36.5)
	3-1/2 (89)	7100 (31.6)	8210 (36.5)	7935 (35.3)	8210 (36.5)	8765 (39.0)		11645 (51.8)	
	4-3/4 (121)	8310 (37.0)		9495 (42.2)		10675 (47.5)		14030 (62.4)	
5/8 (15.9)	2-3/4 (70)	6690 (29.8)	14170 (63.0)	7360 (32.7)	14170 (63.0)	8030 (35.7)	14170 (63.0)	10295 (45.8)	14170 (63.0)
	4 (102)	9550 (42.5)		11835 (52.6)		14120 (62.8)		19800 (88.1)	
	5-1/2 (140)	12650 (56.3)		15115 (67.2)		17575 (78.2)		22705 (101.0)	
3/4 (19.1)	3-1/4 (83)	8825 (39.3)	15900 (70.7)	9545 (42.5)	15900 (70.7)	10260 (45.6)	20030 (89.1)	10600 (47.2)	20030 (89.1)
	4-3/4 (121)	13995 (62.3)	20030 (89.1)	16315 (72.6)	20030 (89.1)	18635 (82.9)		21765 (96.8)	
	6-1/2 (165)	19180 (85.3)		21770 (96.8)		24355 (108.3)		28210 (125.5)	

1 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 12 - Carbon Steel KWIK Bolt 3 Allowable Loads in Lightweight Concrete[1,2]

Anchor Diameter in. (mm)	Anchor Depth in. (mm)		Tension f'_c = 2000 psi (13.8 MPa) lb (kN)		Tension f'_c = 3000 psi (20.7 MPa) lb (kN)		Tension f'_c = 4000 psi (27.6 MPa) lb (kN)		Shear f'_c = 2000 psi (13.8 MPa) lb (kN)	
1/4	1-1/8	(29)	275	(1.2)	335	(1.5)	400	(1.8)	400	(1.8)
(6.4)	2	(51)	595	(2.6)	675	(3.0)	750	(3.3)	400	(1.8)
3/8	1-5/8	(41)	585	(2.6)	685	(3.0)	785	(3.5)	890	(4.0)
(9.5)	2-1/2	(64)	1120	(5.0)	1340	(6.0)	1560	(6.9)	1345	(5.9)
1/2	2-1/4	(57)	1160	(5.2)	1340	(6.0)	1520	(6.8)	1750	(7.8)
(12.7)	3-1/2	(89)	1810	(8.1)	2050	(9.1)	2285	(10.2)	2835	(12.6)
5/8	2-3/4	(70)	1560	(6.9)	1815	(8.1)	2070	(9.2)	2580	(11.5)
(15.9)	4	(102)	2485	(11.1)	2830	(12.6)	3170	(14.1)	3360	(14.9)
3/4	3-1/4	(83)	1920	(8.5)	2240	(10.0)	2560	(11.4)	3835	(17.1)
(19.1)	4-3/4	(121)	3035	(13.5)	3995	(17.8)	4955	(22)	5010	(22.3)

1 Allowable loads based on safety factor of 4.0.

2 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

Table 13 - Stainless Steel KWIK Bolt 3 Allowable Loads in Lightweight Concrete[1,2]

Anchor Diameter in. (mm)	Anchor Depth in. (mm)		Tension f'_c = 2000 psi (13.8 MPa) lb (kN)		Tension f'_c = 3000 psi (20.7 MPa) lb (kN)		Tension f'_c = 4000 psi (27.6 MPa) lb (kN)		Shear f'_c = 2000 psi (13.8 MPa) lb (kN)	
1/4	1-1/8	(29)	245	(1.1)	300	(1.3)	355	(1.6)	545	(2.4)
(6.4)	2	(51)	510	(2.3)	585	(2.6)	660	(2.9)	630	(2.8)
3/8	1-5/8	(41)	560	(2.5)	625	(2.8)	685	(3.0)	825	(3.7)
(9.5)	2-1/2	(64)	920	(4.1)	1200	(5.3)	1475	(6.6)	1345	(6.0)
1/2	2-1/4	(57)	950	(4.2)	1155	(5.1)	1360	(6.0)	1755	(7.8)
(12.7)	3-1/2	(89)	1355	(6.0)	1855	(8.3)	2350	(10.5)	2955	(13.1)
5/8	2-3/4	(70)	1470	(6.5)	1605	(7.1)	1745	(7.8)	2695	(12.0)
(15.9)	4	(102)	2300	(10.2)	2715	(12.1)	3130	(13.9)	4500	(20.0)

1 Allowable loads based on safety factor of 4.0.

2 Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

Table 14 - Carbon Steel KWIK Bolt 3 Allowable Loads for Anchor installed at 1-3/4 in. Edge Distance in Normal-Weight Concrete[1]

Anchor Diameter in. (mm)		Minimum Depth Embedment in. (mm)		f'_c = 2000 psi (13.8 MPa) Tension in. (mm)		Shear Perpendicular to Edge in. (mm)		Shear Parallel to Edge in. (mm)	
3/8	(9.5)	3	(76)	955	(4.2)	410	(1.8)	915	(4.1)
1/2	(12.7)	3	(76)	930	(4.1)	375	(1.7)	1000	(4.4)
		4-1/2	(114)	1285	(5.7)	445	(2.0)	1415	(6.3)

1 Allowable loads based on safety factor of 4.0. Intermediate load values for other concrete strengths and embedments can be calculated by linear interpolation.

Table 15 - KWIK Bolt 3 Carbon Steel and Stainless Steel KWIK Bolt 3 Allowable Loads, installed into the Underside of Lightweight Concrete on Metal Profile Deck[1]

Anchor Material	Anchor Diameter in. (mm)		Embedment Depth in. (mm)		f'_c = 3000 psi (20.7 MPa)			
					Tension lb (kN)		Shear lb (kN)	
Carbon Steel	1/4	(6.4)	2	(51)	620	(2.8)	713	(3.2)
	3/8	(9.5)	2-1/2	(64)	1035	(4.6)	1370	(6.1)
	1/2	(12.7)	3-1/2	(89)	1725	(7.7)	2435	(10.8)
	5/8	(15.9)	4	(102)	2220	(9.9)	3160	(14.1)
Stainless Steel	1/4	(6.4)	2	(51)	615	(2.7)	650	(2.9)
	3/8	(9.5)	2-1/2	(64)	1015	(4.5)	1450	(6.4)
	1/2	(12.7)	3-1/2	(89)	1475	(6.6)	2200	(9.8)
	5/8	(15.9)	4	(102)	2220	(9.8)	3355	(14.9)

1 Allowable loads based on using a safety factor of 4.0.

Figure 3 - Installation in Concrete over Metal Deck

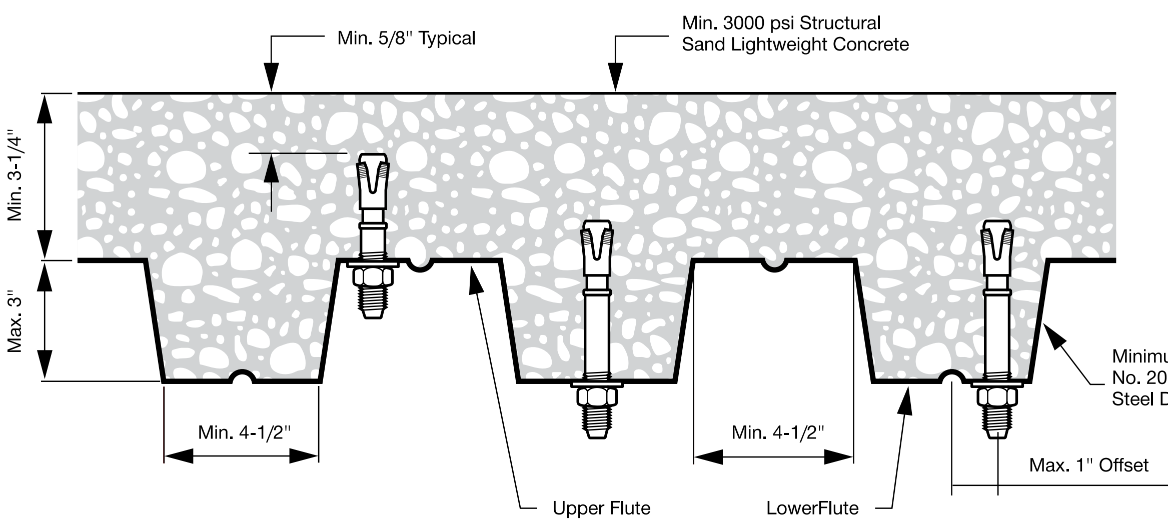


Table 16 - Countersunk KWIK Bolt Allowable Loads in Normal-Weight Concrete[1]

Anchor Material	Anchor Diameter in. (mm)		Embedment Depth in. (mm)		f'_c = 3000 psi (20.7 MPa)			
					Tension lb (kN)		Shear[2] lb (kN)	
Carbon Steel	1/4	(6.4)	1-1/8	(29)	365	(1.6)	350	(1.6)
	3/8	(9.5)	1-5/8	(41)	810	(3.6)	750	(3.3)
Stainless Steel	1/4	(6.4)	1-1/8	(29)	320	(1.4)	500	(2.2
	3/8	(9.5)	1-5/8	(41)	670	(3.0)	1330	(5.9)

1 Allowable loads based on using a safety factor of 4.0.

2 Shear values acting thru threads of anchor bolt. If acting through the empty shell, reduce loads by 70%.

3.3.6 KWIK Bolt 3 Expansion Anchor

Table 17 - Carbon Steel KWIK Bolt 3 Allowable Loads for Anchors Installed in Top of Grout-Filled Concrete Masonry Wall[1]

Anchor Diameter in. (mm)	Anchor Diameter in. (mm)	Tension lb (kN)	Shear V_1 lb (kN)	Shear V_2 lb (kN)
1/2 (12.7)	3 (76)	645 (2.9)	310 (1.4)	615 (2.7)
5/8 (15.9)	3-1/2 (89)	850 (3.8)	310 (1.4)	615 (2.7)

1 Masonry prism strength must be at least 1500 psi at the time of installation in accordance with UBC Standard 21-17.

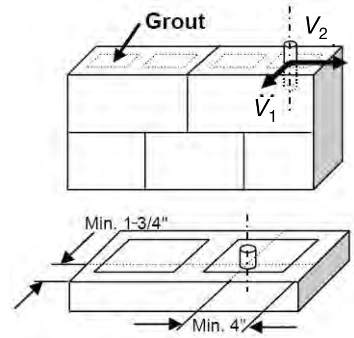


Table 18 - HHDCA Ceiling Hanger Allowable Loads[1]

Anchor Diameter	Minimum Embedment	Normal Weight Concrete[2]		Lightweight Concrete[3]	Lightweight Concrete[3]
		Tension	Shear	Tension	Shear
in. (mm)	in. (mm)	lb (kN)	lb (kN)	lb (kN)	lb (kN)
1/4 (6.4)	1-1/4 (32)	410 (1.8)	425 (1.9)	260 (1.2)	294 (1.3)

1 Allowable loads based on using a safety factor of 4.0.

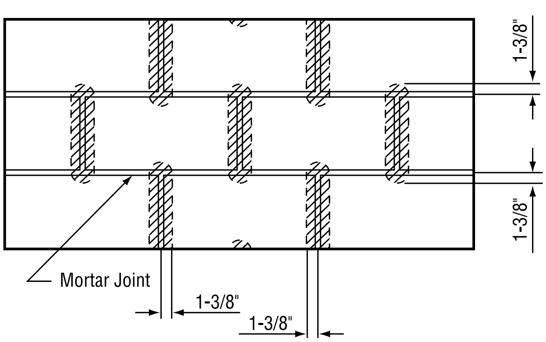
2 Allowable loads are for anchors installed into normal-weight concrete having a minimum compressive strength of 3500 psi at the time of installation.

3 Allowable loads are for anchors installed into lightweight concrete having a minimum compressive strength of 3000 psi at the time of installation.

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \text{ (Ref. Section 3.1.8.3)}$$

Figure 4 - Installation in Grout-filled Concrete Masonry Unit



1 Anchor installation is allowed in all non-shaded areas.

KWIK Bolt 3 Expansion Anchor 3.3.6

Table 19 - Carbon Steel KWIK Bolt 3 Allowable Loads in Grout-Filled Concrete Masonry Units[1, 2, 3, 4, 5, 6]

Anchor Diameter in. (mm)	Anchor Depth in. (mm)	Minimum Distance from Edge of Block in. (mm)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	1-1/8 (29)	4 (102)	150 (0.7)	380 (1.7)
		12 (305)		
	2 (51)	4 (102)	540 (2.4)	445 (2.0)
		12 (305)		
3/8 (9.5)	1-5/8 (41)	4 (102)	320 (1.4)	735 (3.3)
		12 (305)	340 (1.5)	940 (4.2)
	2-1/2 (64)	4 (102)	780 (3.5)	1010 (4.5)
		12 (305)		1395 (6.2)
1/2 (12.7)	2-1/4 (57)	4 (102)	630 (2.8)	830 (3.7)
		12 (305)	665 (3.0)	1465 (6.5)
	3-1/2 (89)	4 (102)	905 (4.0)	1080 (4.8)
		12 (305)		2375 (10.6)
5/8 (15.9)	2-3/4 (70)	4 (102)	815 (3.6)	890 (4.0)
		12 (305)	865 (3.8)	2165 (9.6)
	4 (102)	4 (102)	1240 (5.5)	970 (4.3)
		12 (305)	1295 (5.8)	2770 (12.3)
3/4 (19.1)	3-1/4 (83)	4 (102)	1035 (4.6)	785 (3.5)
		12 (305)		3135 (13.8)
	4-3/4 (121)	4 (102)	1645 (7.3)	825 (3.7)
		12 (305)	1710 (7.6)	3305 (14.7)

1 Values are for anchors installed in Type 1 Grade N, lightweight, medium-weight, or normal-weight concrete masonry units conforming to UBC Standard 21-4. The masonry units must be fully grouted with coarse grout conforming to UBC Standard 21-15, Type S, N, or M. Masonry prism compressive strength must be at least 1500 psi at the time of installation when tested in accordance with UBC Standard 21-17.

2 Anchors must be installed a minimum of 1-3/8 inch from any vertical mortar joint (see figure).

3 Anchor locations are limited to one per masonry cell.

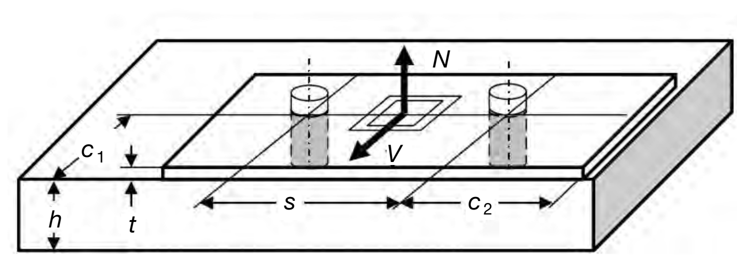
4 Embedment depth is measured from the outside face of the concrete masonry unit.

5 Linear interpolation to determine load values at intermediate edge distances is permitted.

6 All allowable loads based on safety factor of 4.0

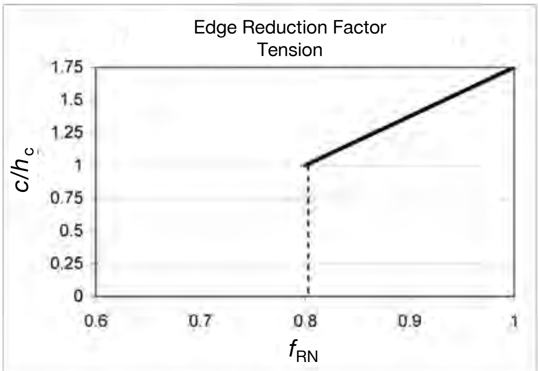
Anchor Spacing and Edge Distance Guidelines

1. s = on-center fastening spacing
   c = edge distance from center of bolt.
2. Apply appropriate load reduction factors for tension and shear if anchor spacing and/or edge distance is less the the critical spacing (s_{cr}) or edge distance (c_{cr}).
3. See Section 3.1.8 for determinig compounded spacing and edge distance reduction as well as intermediate load values for concrete strengths and embedments.

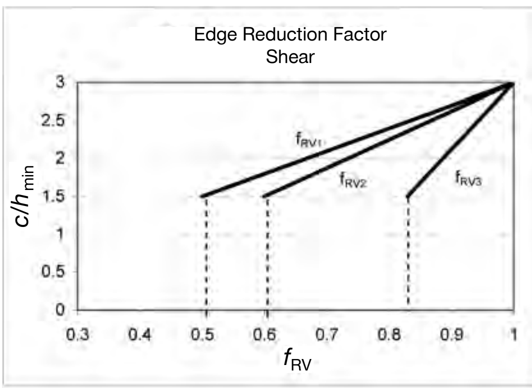


3.3.6 KWIK Bolt 3 Expansion Anchor

Edge Distance Adjustment Factors

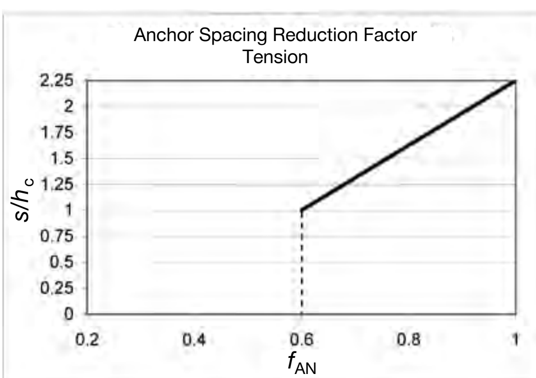


Adjustment Conditions	Critical Edge Distance	Minimum Edge Distance
Emb Ratio	c/h_c = 1.75	c/h_c = 1.00
Reduction	f_{RN} = 1.00	f_{RN} = 0.80
$h_c = h_{act}$ $h_c = h_{nom}$	for $h_{min} \le h_{act} \le h_{nom}$ for $h_{act} > h_{nom}$	
h_{act} = Actual Embedment c = Actual Edge Distance f_{RN} = Edge Distance Reduction Factor for Tension Loading		

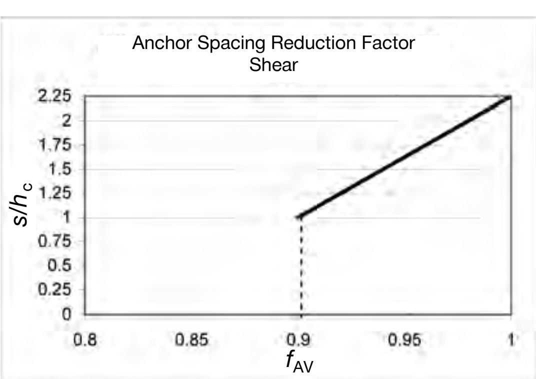


Shear Plane Correlation	Shear Conditions	f_{RV} Reduction factor at Min. Edge Distance
f_{RV1}	Shear towards edge	f_{RV1} = 0.50
f_{RV2}	Shear parallel edge	f_{RV2} = 0.60
f_{RV3}	Shear away from edge	f_{RV3} = 0.83
embedment to edge distance ratio at critical edge distance		c/h_{min} = 3.00
embedment to edge distance ratio at minimum edge distance		c/h_{min} = 1.50
c = Actual Edge Distance h_{min} = Min Embedment for Specific Anchor Diamete		

Anchor Spacing Adjustment Factors



Adjustment Conditions	Critical Anchor Spacing	Minimum Anchor Spacing
Emb Ratio	s/h_c = 2.25	s/h_c = 1.00
Reduction	f_{AN} = 1.00	f_{RN} = 0.60
$h_c = h_{act}$ $h_c = h_{nom}$	for $h_{min} \le h_{act} \le h_{nom}$ for $h_{act} > h_{nom}$	
h_{act} = Actual Embedment c = Actual Anchor Spacing Distance f_{AN} = Anchor Spacing Reduction Factor for Tension Loading		



Adjustment Conditions	Critical Anchor Spacing	Minimum Anchor Spacing
Emb Ratio	s/h_c = 2.25	s/h_c = 1.00
Reduction	f_{AV} = 1.00	f_{AV} = 0.60
$h_c = h_{act}$ $h_c = h_{nom}$	for $h_{min} \le h_{act} \le h_{nom}$ for $h_{act} > h_{nom}$	
h_{act} = Actual Embedment c = Actual Anchor Spacing Distance f_{AV} = Anchor Spacing Reduction Factor for Shear Loading		

KWIK Bolt 3 Expansion Anchor 3.3.6

Influence of Edge Distance and Anchor Spacing on Anchor Performance

Load Adjustment Factors for 1/4" Diameter Anchors

Adjustment Factor 1/4 in.		Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		Edge Distance Shear ⊥ Toward Edge f_{RV1}	Edge Distance Shear II Toward Edge f_{RV1}	Edge Distance Shear ⊥ Away from Edge f_{RV3}
Embedment Depth, in.		1-1/8	≥ 2	1-1/8	≥ 2	1-1/8	≥ 2	≥ 1-1/8	≥ 1-1/8	≥ 1-1/8
Spacing in.	1-1/8	0.60		0.80		0.90				
	1-11/16	0.75		0.93		0.94		0.50	0.60	0.83
	1-3/4	0.78		0.95		0.94		0.52	0.61	0.84
	2	0.85	0.60	1.00	0.80	0.96	0.90	0.59	0.67	0.86
	2 -1/4	0.92	0.64		0.83	0.98	0.91	0.67	0.73	0.89
	2-1/2	0.99	0.68		0.87	1.00	0.92	0.74	0.79	0.91
	3	1.00	0.76		0.93		0.94	0.89	0.91	0.96
	3-3/8		0.82		0.98		0.96	1.00	1.00	1.00
	3-1/2		0.84		1.00		0.96	1.00	1.00	1.00
	4		0.92				0.98			
	4-1/2		1.00				1.00			
	4-3/4									
	5									

Load Adjustment Factors for 3/8" Diameter Anchors

Adjustment Factor 3/8 in.		Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		**Edge Distance Shear** ⊥ Toward Edge f_{RV1}	**Edge Distance Shear** II Toward Edge f_{RV1}	**Edge Distance Shear** ⊥ Away from Edge f_{RV3}
Embedment Depth, in.		1-5/8	≥ 2-1/2	1-5/8	≥ 2-1/2	1-5/8	≥ 2-1/2	≥ 1-5/8	≥ 1-5/8	≥ 1-5/8
Spacing in.	1-5/8	0.60		0.80		0.90				
	2	0.67		0.86		0.92				
	2-1/4	0.72		0.90		0.93				
	2-1/2	0.77	0.60	0.94	0.80	0.94	0.90	0.51	0.61	0.83
	3	0.87	0.66	1.00	0.85	0.97	0.92	0.62	0.69	0.87
	3-1/4	0.92	0.70		0.88	0.98	0.92	0.67	0.73	0.89
	3-1/2	0.97	0.73		0.91	0.99	0.93	0.72	0.77	0.90
	3-3/4	1.00	0.76		0.93	1.00	0.94	0.77	0.82	0.92
	4		0.79		0.96		0.95	0.82	0.86	0.94
	4-1/2		0.86		1.00		0.96	0.92	0.94	0.97
	5		0.92				0.98	1.00	1.00	1.00
	5-5/8		1.00				1.00			
	5-3/4									

Load Adjustment Factors for 1/2" Diameter Anchors

Adjustment Factor 1/2 in.		Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		**Edge Distance Shear** ⊥ Toward Edge f_{RV1}	**Edge Distance Shear** II Toward Edge f_{RV1}	**Edge Distance Shear** ⊥ Away from Edge f_{RV3}
Embedment Depth, in.		2-1/4	≥ 3-1/2	2-1/4	≥ 3-1/2	2-1/4	≥ 3-1/2	≥ 2-1/4	≥ 2-1/4	≥ 2-1/4
Spacing in.	2-1/4	0.60		0.80		0.90				
	2-1/2	0.64		0.83		0.91				
	3	0.71		0.89		0.93				
	3-3/8	0.76		0.93		0.94		0.50	0.60	0.83
	3-3/4	0.81	0.62	0.98	0.82	0.95	0.91	0.56	0.64	0.85
	4-1/4	0.88	0.67	1.00	0.86	0.97	0.92	0.63	0.70	0.87
	4-3/4	0.96	0.71		0.90	0.99	0.93	0.70	0.76	0.90
	5	1.00	0.74		0.91	1.00	0.93	0.74	0.79	0.91
	5-3/4		0.81		0.97		0.95	0.85	0.88	0.95
	6		0.83		1.00		0.96	0.89	0.91	0.96
	6-1/2		0.87				0.97	0.96	0.97	0.99
	7-1/4		0.94				0.99	1.00	1.00	1.00
	7-3/4		1.00				1.00			

Standard Anchor Embedments (in.)

1/4	h_{min}	1-1/8
	h_{nom}	2
	h_{deep}	3
3/8	h_{min}	1-5/8
	h_{nom}	2-1/2
	h_{deep}	3-1/2
1/2	h_{min}	2-1/4
	h_{nom}	3-1/2
	h_{deep}	4-3/4

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing — Tension

$h_{min} \le h_{act} \le h_{nom}$: $$f_{AN} = \frac{s/h_{act} + 0.88}{3.13}$$

$h_{act} \ge h_{nom}$: $$f_{AN} = \frac{s/h_{nom} + 0.88}{3.13}$$

Edge Distance — Tension

$h_{min} \le h_{act} \le h_{nom}$: $$f_{RN} = \frac{c/h_{act} + 2}{3.75}$$

$h_{act} \ge h_{nom}$: $$f_{RN} = \frac{c/h_{nom} + 2}{3.75}$$

Spacing — Shear

$h_{min} \le h_{act} \le h_{nom}$: $$f_{AV} = \frac{s/h_{act} + 10.25}{12.5}$$

$h_{act} \ge h_{nom}$: $$f_{AV} = \frac{s/h_{nom} + 10.25}{12.5}$$

Edge Distance — Shear

$h_{act} \ge h_{min}$

perpendicular toward edge

$$f_{RV1} = \frac{c}{3h_{min}}$$

parallel to edge

$$f_{RV2} = \frac{c/h_{min} + 0.75}{3.75}$$

perpendicular away from edge

$$f_{RV3} = \frac{c/h_{min} + 5.82}{8.82}$$

Note: Edge distance and anchor spacing for all lightweight and sand-lightweight concrete are obtained by dividing the normal-weight dimensions by 0.75 and 0.85, respectively.

3.3.6 KWIK Bolt 3 Expansion Anchor

Influence of Edge Distance and Anchor Spacing on Anchor Performance

Load Adjustment Factors for 5/8" Diameter Anchors

Adjustment Factor 5/8 in.	Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		Edge Distance Shear ⊥ Toward Edge f_{RV1}	Edge Distance Shear II Toward Edge f_{RV1}	Edge Distance Shear ⊥ Away from Edge f_{RV3}
Embedment Depth, in.	2-3/4	≥ 4	2-3/4	≥ 4	2-3/4	≥ 4	≥ 2-3/4	≥ 2-3/4	≥ 2-3/4
Spacing in. 2-3/4	0.60		0.80		0.90				
3-1/2	0.69		0.87		0.92				
4	0.75	0.60	0.92	0.80	0.94	0.90			
4-1/4	0.77	0.62	0.95	0.82	0.94	0.91	0.52	0.61	0.84
4-3/4	0.83	0.66	1.00	0.85	0.96	0.92	0.58	0.66	0.86
5-1/2	0.92	0.72		0.90	0.98	0.93	0.67	0.73	0.89
6	0.98	0.76		0.93	0.99	0.94	0.73	0.78	0.91
6-1/4	1.00	0.78		0.95	1.00	0.95	0.76	0.81	0.92
7		0.84		1.00		0.96	0.85	0.88	0.95
7-1/2		0.88				0.97	0.91	0.93	0.97
7-3/4		0.90				0.98	0.94	0.95	0.98
8-1/2		0.96				0.99	1.00	1.00	1.00
9		1.00							

Load Adjustment Factors for 3/4" Diameter Anchors

Adjustment Factor 3/4 in.	Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		Edge Distance Shear ⊥ Toward Edge f_{RV1}	Edge Distance Shear II Toward Edge f_{RV1}	Edge Distance Shear ⊥ Away from Edge f_{RV3}
Embedment Depth, in.	3-1/4	≥ 4-3/4	3-1/4	≥ 4-3/4	3-1/4	≥ 4-3/4	≥ 3-1/4	≥ 3-1/4	≥ 3-1/4
Spacing in. 3-3/8	0.61		0.81		0.90				
4	0.67		0.86		0.92				
5	0.77	0.62	0.94	0.81	0.94	0.90	0.51	0.61	0.83
5-3/4	0.85	0.67	1.00	0.86	0.96	0.92	0.59	0.67	0.86
6-1/4	0.90	0.70		0.88	0.97	0.93	0.64	0.71	0.88
6-1/2	0.92	0.72		0.90	0.98	0.93	0.67	0.73	0.89
7	0.97	0.75		0.93	0.99	0.94	0.72	0.77	0.90
7-1/2	1.00	0.79		0.95	1.00	0.95	0.77	0.82	0.92
8-1/4		0.84		1.00		0.96	0.85	0.88	0.95
9		0.89				0.97	0.92	0.94	0.97
9-3/4		0.94				0.98	1.00	1.00	1.00
10-1/4		0.97				0.99			
10-3/4		1.00				1.00			

Load Adjustment Factors for 1" Diameter Anchors

Adjustment Factor 1 in.	Spacing Tension/Shear f_{AN}		Edge Distance Tension f_{RN}		Spacing Shear f_{AV}		Edge Distance Shear ⊥ Toward Edge f_{RV1}	Edge Distance Shear II Toward Edge f_{RV1}	Edge Distance Shear ⊥ Away from Edge f_{RV3}
Embedment Depth, in.	4-1/2	≥ 6	4-1/2	≥ 6	4-1/2	≥ 6	≥ 4-1/2	≥ 4-1/2	≥ 4-1/2
Spacing in. 4-1/2	0.60		0.80		0.90				
6	0.71	0.60	0.89	0.80	0.93	0.90			
7	0.78	0.65	0.95	0.84	0.94	0.91	0.52	0.61	0.84
8	0.85	0.71	1.00	0.89	0.96	0.93	0.59	0.67	0.86
9	0.92	0.76		0.93	0.98	0.94	0.67	0.73	0.89
9-3/4	0.97	0.80		0.97	0.99	0.95	0.72	0.78	0.91
10-1/4	1.00	0.83		0.99	1.00	0.96	0.76	0.81	0.92
11-1/4		0.88		1.00		0.97	0.83	0.87	0.94
11-5/8		0.90				0.98	0.86	0.89	0.95
12-1/2		0.95				0.99	0.93	0.94	0.97
13		0.97				0.99	0.96	0.97	0.99
13-1/2		1.00				1.00	1.00	1.00	1.00
14-3/4									

Standard Anchor Embedments (in.)

5/8	h_{min}	2-3/4
	h_{nom}	4
	h_{deep}	5-1/2
3/4	h_{min}	3-1/4
	h_{nom}	4-3/4
	h_{deep}	6-1/2[1]
1	h_{min}	4-1/2
	h_{nom}	6
	h_{deep}	9

1. Embedment depth shown reflects embedment for carbon steel anchor, deep embedment depth for stainless steel anchor is 8 inch.

Note: Tables apply for listed embedment depths. Reduction factors for other embedment depths must be calculated using equations below.

Spacing — Tension

$h_{min} \le h_{act} \le h_{nom}$: $f_{AN} = \dfrac{s/h_{act} + 0.88}{3.13}$

$h_{act} \ge h_{nom}$: $f_{AN} = \dfrac{s/h_{nom} + 0.88}{3.13}$

Edge Distance — Tension

$h_{min} \le h_{act} \le h_{nom}$: $f_{RN} = \dfrac{c/h_{act} + 2}{3.75}$

$h_{act} \ge h_{nom}$: $f_{RN} = \dfrac{c/h_{nom} + 2}{3.75}$

Spacing — Shear

$h_{min} \le h_{act} \le h_{nom}$: $f_{AV} = \dfrac{s/h_{act} + 10.25}{12.5}$

$h_{act} \ge h_{nom}$: $f_{AV} = \dfrac{s/h_{nom} + 10.25}{12.5}$

Edge Distance — Shear

$h_{act} \ge h_{min}$

perpendicular toward edge

$$f_{RV1} = \frac{c}{3h_{min}}$$

parallel to edge

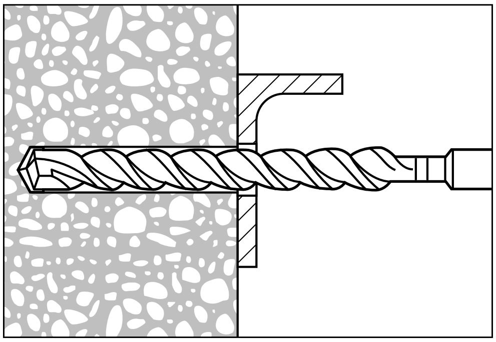
$$f_{RV2} = \frac{c/h_{min} + 0.75}{3.75}$$

perpendicular away from edge

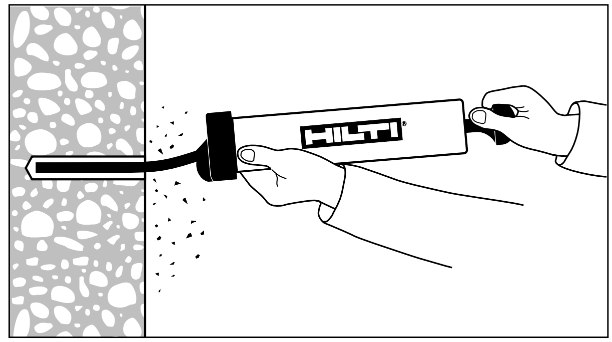
$$f_{RV3} = \frac{c/h_{min} + 5.82}{8.82}$$

Note: Edge distance and anchor spacing for all lightweight and sand-lightweight concrete are obtained by dividing the normal-weight dimensions by 0.75 and 0.85, respectively.

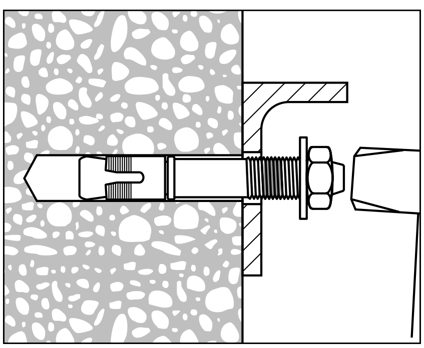
3.3.6.5 Installation Instructions



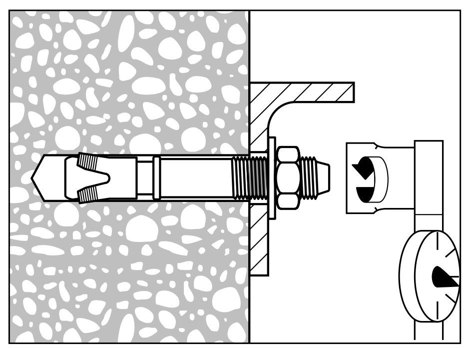
1. Hammer drill a hole to the same nominal diameter as the KWIK Bolt 3. The hole depth must exceed the anchor embedment by at least one diameter. The fixture may be used as a drilling template to ensure proper anchor location.



2. Clean hole.



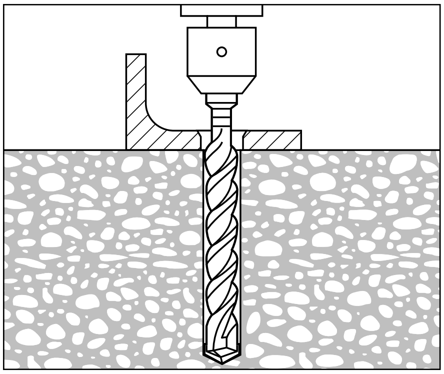
3. Drive the KWIK Bolt 3 into the hole using a hammer. The anchor must be driven until at least 6 threads are below the surface of the fixture.



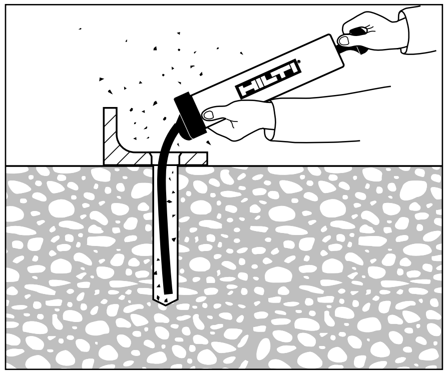
4. Tighten the nut to the installation torque.

3.3.6 KWIK Bolt 3 Expansion Anchor

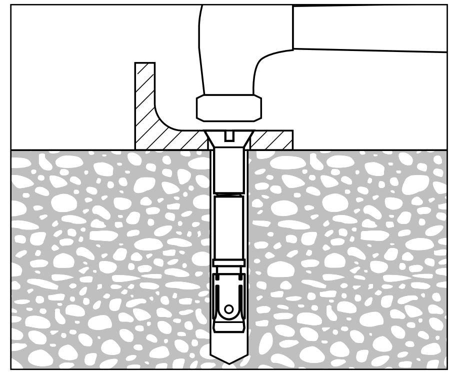
Countersunk KWIK Bolt 3 Anchor Installation Instructions



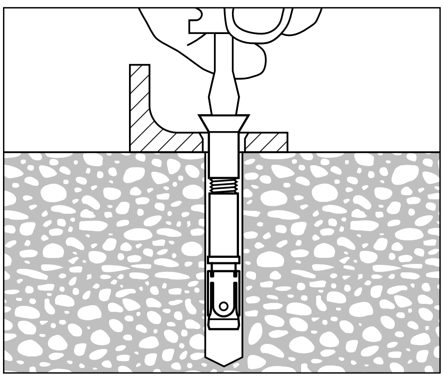
1. Drill.



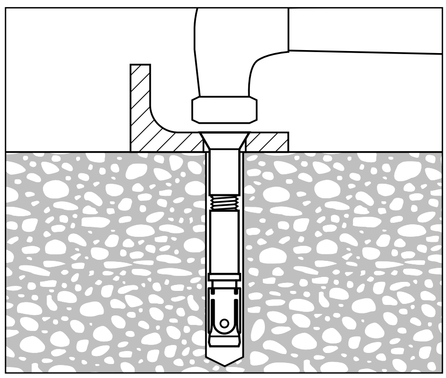
2. Clean.



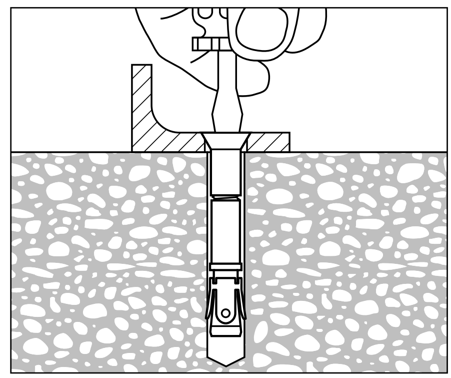
3. Thread post nut completely onto anchor. Tap into hole.



4. Loosen screw two full turns.

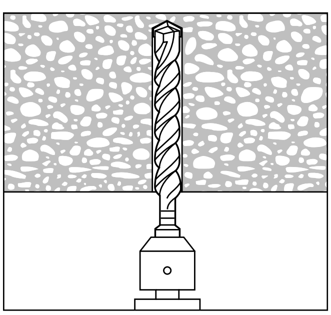


5. Tap-in again.

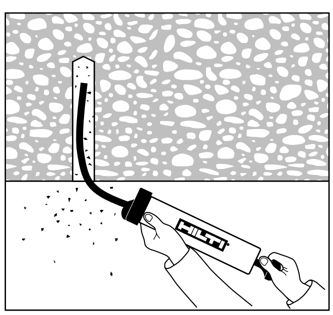


6. Tighten.

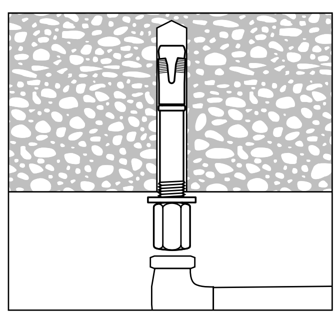
Rod Coupling KWIK Bolt 3 Anchor Installation Instructions



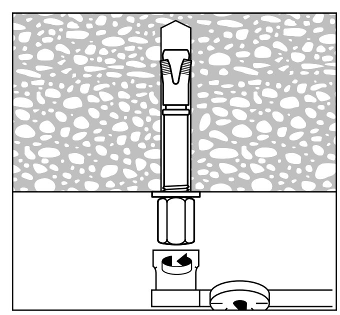
1. Drill.



2. Clean.

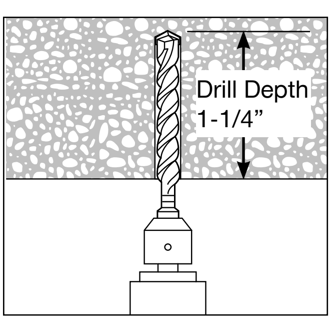


3. Tap-in.

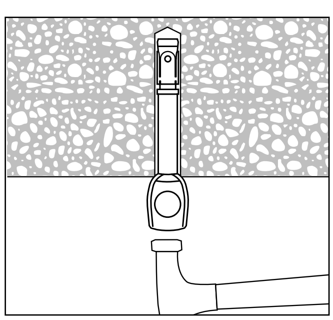


4. Tighten.

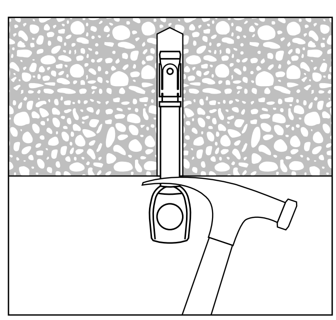
Hilti Ceiling KWIK Bolt (HHDCA) Anchor Installation Instructions



1. Drill hole using 1/4” bit.



2. Tap in.



3. Pry downward.

3.3.6.6 Ordering Information

KWIK Bolt 3 Anchor Product Line

Size	Length (ℓ) in.	(mm)	Thread Length (ℓ_{th}) in.	(mm)	ID Stamp	Box	Carbon Steel	304 SS	316 SS	HDG
1/4 x 1-3/4	1-3/4	(44)	3/4	(18)	A	100	●	●		
1/4 x 2-1/4	2-1/4	(57)	7/8	(22)	B		●	●	●	
1/4 x 3-1/4	3-1/4	(83)	2	(51)	D		●	●		
			7/8	(22)					●	
1/4 x 4-1/2	4-1/2	(114)	2-7/8	(75)	G		●	●		
3/8 x 2-1/4	2-1/4	(57)	7/8	(22)	B	50	●	●		
3/8 x 3	3	(76)	1-1/4	(32)	D				●	
			1-1/2	(40)			●	●		
3/8 x 3-3/4	3-3/4	(95)	1-1/4	(32)	E				●	
			2-1/4	(59)			●	●		
3/8 x 5	5	(127)	3-1/2	(91)	H		●	●		
3/8 x 7	7	(178)	5-1/2	(142)	L		●	●		
1/2 x 2-3/4	2-3/4	(70)	1-1/4	(33)	C	25	●	●		
1/2 x 3-3/4	3-3/4	(95)	1-5/16	(35)	E				●	
			2-3/16	(56)			●	●		●
1/2 x 4-1/2	4-1/2	(114)	1-5/16	(35)	G				●	
			2-7/8	(75)			●	●		●
1/2 x 5-1/2	5-1/2	(140)	1-5/16	(35)	I				●	
			3-3/4	(96)			●	●		●
1/2 x 7	7	(178)	4-3/4	(121)	L		●	●		●
5/8 x 3-3/4	3-3/4	(95)	1-1/2	(41)	E	15	●	●	●	
5/8 x 4-3/4	4-3/4	(121)	1-1/2	(41)	G				●	
			2-3/4	(70)			●	●		●
5/8 x 6	6	(152)	1-1/2	(41)	J			●	●	
			4	(102)			●			●
5/8 x 7	7	(178)	4-3/4	(121)			●			
5/8 x 8-1/2	8-1/2	(216)	6-1/2	(166)	O		●	●		
5/8 x 10	10	(254)	7	(180)	R		●	●		
3/4 x 4-3/4	4-3/4	(121)	1-1/2	(41)	G	20		●	●	
			2-7/16	(62)		10	●			●
						20		●		
3/4 x 5-1/2	5-1/2	(140)	1-1/2	(41)	I	20		●		
			3-7/16	(85)		10	●			●
						20		●		
3/4 x 7	7	(178)	1-1/2	(41)	L	10		●		
			4-5/8	(119)			●			
3/4 x 8	8	(203)	5-3/4	(146)	N		●	●		●
3/4 x 10	10	(254)	5-7/8	(152)	R		●	●	●	
3/4 x 12	12	(305)	5-7/8	(152)	T		●	●		
1 x 6	6	(152)	2-1/4	(57)	J	5	●	●	●	
1 x 9	9	(114)	2-1/4	(57)	P		●	●		
1 x 12	12	(114)	6	(152)	T		●	●		

3.3.6 KWIK Bolt 3 Expansion Anchor

Countersunk KWIK Bolt Anchor Product Line

Size	Length in.	(mm)	Box	Carbon Steel	304 SS
C1/4 x 2	**2**	(51)	100	•	
C1/4 x 3	**3**	(76)	100	•	•
C1/4 x 5	**5**	(127)	100	•	
C3/8 x 2-1/4	**2-1/4**	(57)	100	•	
C3/8 x 3	**3**	(76)	100	•	
C3/8 x 4	**4**	(102)	50	•	•
C3/8 x 5	**5**	(127)	50	•	

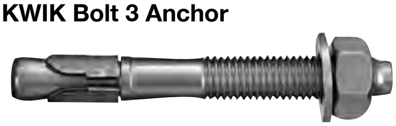
Rod Coupling KWIK Bolt 3 Anchor Product Line

Size	Length in.	(mm)	Thread Length in.	(mm)	ID Stamp	Box Quantity
3/8 x 2-1/4	**2-1/4**	(57)	**7/8**	(22)	B	100

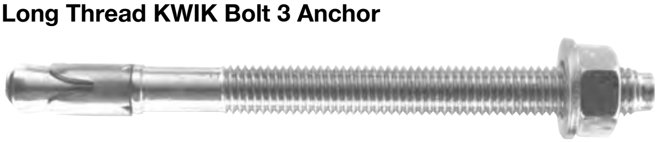
HHDCA Ceiling Anchor Product Line

Size	Length in.	(mm)	Eyelet Size in.	Box Quantity
1/4 x 2	**2-1/32**	(52)	**5/16**	100

KWIK Bolt 3 Anchor



Long Thread KWIK Bolt 3 Anchor



Countersunk KWIK Bolt 3 Anchor

Rod Coupling KWIK Bolt 3 Anchor (3/8” x 2 1/4” only)

HHDCA Ceiling Hanger (1/4” x 2” only)

KWIK HUS (KH) Carbon Steel Screw Anchor 3.3.7

3.3.7.1 Product Description

Hilti KWIK HUS (KH) anchors are comprised of a body with hex washer head. The anchor is manufactured from carbon steel and is heat treated. It has a minimum 0.0003 inch (8 µm) zinc coating in accordance with DIN EN ISO 4042. The anchoring system is available in a variety of lengths with diameters of 3/8 inch, 1/2 inch, 5/8 inch and 3/4 inch (6.4mm, 9.5mm, 12.7mm, 15.9mm and 19.1mm). The hex head is larger than the diameter of the anchor and is formed with serrations on the underside. The anchor body is formed with threads running most of the length of the anchor body. The anchor is installed in a predrilled hole with a powered impact wrench or torque wrench. The anchor threads cut into the base material on the sides of the hole and interlock with the base material during installation. Applicable base materials include normal-weight concrete, structural lightweight concrete lightweight concrete over metal deck, and grout filled concrete masonry.

Guide Specifications

Screw anchors shall be KWIK HUS as supplied by Hilti, Inc. Anchors shall be manufactured from heat treated carbon steel material, zinc plated to a minimum thickness of 8µm. Anchor head shall display product name, (KH) diameter and length. Anchors shall be installed using a drill bit of same nominal diameter as anchor.

Product Features

- Quick and easy to install.
- Length and diameter identification clearly stamped on head facilitates quality control and inspection after installation.
- Through fixture installation improves productivity and accurate installation.
- Thread design enables quality setting and exceptional load values in wide variety of base material strengths.
- Anchor is fully removable
- Anchor size is same as drill bit size and uses standard diameter drill bits.
- Suitable for reduced edge distances and spacing.
- Suitable for uncracked normal weight concrete, lightweight concrete and grout filled concrete masonry.

3.3.7.2 Material Specifications

Hilti KWIK HUS anchors are manufactured from carbon steel. The anchors are dull zinc plated to a minimum thickness of 8µm.

Listings/Approvals

ICC-ES (International Code Council)
AC 106 ESR Pending
(Grout filled concrete masonry)

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

3.3.7.3 Technical Data

Figure 1 — KWIK HUS (KH) Anchor Installation Details

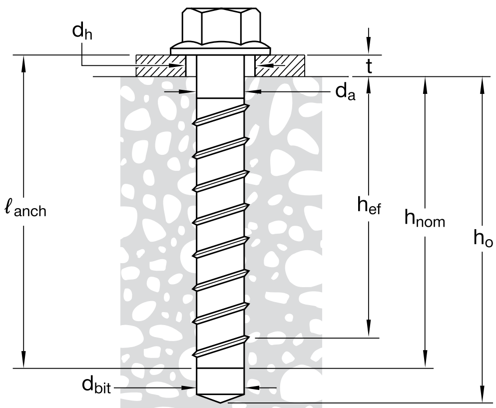


Table 1 – KWIK HUS (KH) Specification Table[1,2,3]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)									
			3/8			1/2			5/8		3/4	
Nominal Diameter	d_a	in.	3/8			1/2			5/8		3/4	
Drill Bit Diameter	d_{bit}	in.	3/8			1/2			5/8		3/4	
Baseplate Clearance Hole Diameter	d_h	in.	1/2			5/8			3/4		7/8	
Installation Torque[4]	T_{inst}	ft-lbf	40			45			85		115	
Impact Wrench Torque Rating[3]	T_{impact}	ft-lbf	114	450		137	450		450		450	
Minimum Nominal Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Minimum Hole Depth	h_o	in.	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	6-5/8
Critical Edge Distance[2]	c_{ac}	in.	2.50	3.12	3.74	2.75	3.70	5.25	3.63	5.81	4.41	7.28
Minimum Spacing at Critical Edge Distance	$s_{min,cac}$	in.	2.25			3					4	
Minimum Edge Distance[2]	c_{min}	in.	1.50			1.75						
Minimum Spacing at Minimum Edge Distance	s_{min}	in.	3								4	
Minimum Concrete Thickness	h_{min}	in.	3.25	4	4.875	3.75	4.75	6.75	5	7	6	8.125
Wrench Socket Size	-	in.	9/16			3/4			15/16		1-1/8	
Head Height	-	in.	0.35			0.49			0.57		0.70	
Effective tensile stress area	A_{se}	in.^{2}	0.086			0.161			0.268		0.392	
Minimum specified ultimate strength	f_{ut}	psi	107,120			97,140			90,180		81,600	

For SI: 1 inch = 25.4 mm, 1 ft-lbf = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2, 1 lb/in = 0.175 N/mm

1 The data presented in this table is to be used in conjunction with the design criteria of ACI 318 Appendix D.

2 For installations through the soffit of steel deck into concrete (see figure 2) anchors installed in the lower flute may be installed with a maximum 1 inch offset in either direction from the center of the flute.

3 Because of variability in measurement procedures, the published torque of an impact tool may not correlate properly with the above setting torques. Over-torquing can damage the anchor and/or reduce its holding capacity.

4 T_{inst} applies to installations using a calibrated torque wrench.

Table 2 – KWIK HUS (KH) Tension and Shear Strength Design Information[1,2,3,4,5]

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)									
			3/8			1/2			5/8		3/4	
Anchor Category 1,2 or 3			1									
Nominal Embedment Depth	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	6-1/4
Steel Strength in Tension (ACI 318 D.5.1)												
Tension Resistance of Steel	N_{sa}	lb.	9,213			15,640			24,210		32,013	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.65									
Concrete Breakout Strength in Tension (ACI 318 D.5.2)												
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Critical Edge Distance	c_{ac}	in.	2.10	2.92	3.30	2.75	3.88	5.25	3.63	5.82	4.41	7.28
Effectiveness Factor – Uncracked Concrete	k_{uncr}	-	24						27			
Reduction Factor for Concrete Breakout Strength – Tension	Φ_{cb}	-	0.65 (Condition B)									
Characteristic Pullout Strength, Uncracked Concrete (2,500psi)	$N_{p,uncr}$	lb.	N/A									
Steel Strength in Shear (ACI 318 D.6.1)												
Shear Resistance of Steel – Static	V_{sa}	lb.	5,155			8,186			11,221		16,662	
Reduction Factor for Steel Strength	Φ_{sa}	-	0.60									
Concrete Breakout in Shear (ACI 318 D.6.2)												
Nominal Diameter	d_a	in.	0.375			0.500			0.625		0.750	
Load Bearing Length of Anchor	ℓ_e	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	4.84
Reduction Factor for Concrete Breakout Strength — Shear	Φ_{cb}	-	0.70									
Concrete Pryout Strength in Shear (ACI 318 D.6.3)												
Coefficient for Pryout Strength	k_{cp}	-	1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0
Reduction Factor for Pryout Strength	Φ_{cp}	-	0.70									

For SI: 1 inch = 25.4 mm, 1 ft-lb = 1.356 N-m, 1 psi = 6.89 Pa, 1 in^2 = 645 mm^2

1 The data in this table is intended for use with the design provisions of ACI 318 Appendix D.

2 Values of Φ in this table applies when the load combinations for ACI 318 Section 9.2, IBC Section 1605.2.1 are used and the requirements of ACI 318 D.4.4 for Condition B are met. If the load combinations of ACI 318 Appendix C are used, the appropriate value of Φ must be used. For situations where reinforcement meets the requirements of Condition A, ACI 318 Section D.4.4 provides the appropriate Φ factor.

3 N/A denotes that pullout resistance does not govern and does not need to be considered.

4 The characteristic pullout resistance for concrete compressive strengths greater than 2500 psi may be increased by multiplying the value in the table by $(f'_c/2{,}500)^{1/2}$ for psi or $(f'_c/17.2)^{1/2}$ for MPa.

5 For sand-lightweight concrete, multiply concrete capacity values and pullout values by 0.60.

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

Table 3 – KWIK HUS (KH) Tension and Shear Design Data for installation in the Underside of Concrete-filled Profile Steel Deck Assemblies[1,2,3,4,5]

Characteristic	Symbol	Units											Upper Flute			
			3/8			1/2			5/8		3/4	1/4		3/8		1/2
Embedment	h_{nom}	in.	1-5/8	2-1/2	3-1/4	2-1/4	3	4-1/4	3-1/4	5	4	1-5/8	2-1/2	1-5/8	2-1/2	2-1/4
Minimum Hole Depth	h_{hole}	in.	1-7/8	2-3/4	3-1/2	2-5/8	3-3/8	4-5/8	3-5/8	5-3/8	4-3/8	2	2-7/8	1-7/8	2-7/8	2-5/8
Effective Embedment Depth	h_{ef}	in.	1.11	1.86	2.20	1.52	2.16	3.22	2.39	3.88	2.92	1.18	1.92	1.11	1.86	1.52
Pullout Resistance, (uncracked concrete)	$N_{p,deck,uncr}$	lb.	1285	2240	3920	1305	3060	5360	4180	9495	4180	1490	1960	1015	2920	1395
Steel Strength in Shear	$V_{sa,deck}$	lb.	1670	1511	3605	1605	2922	3590	3470	4190	3762	1205	3265	3935	6090	7850

1 Installation must comply with Figure 2.

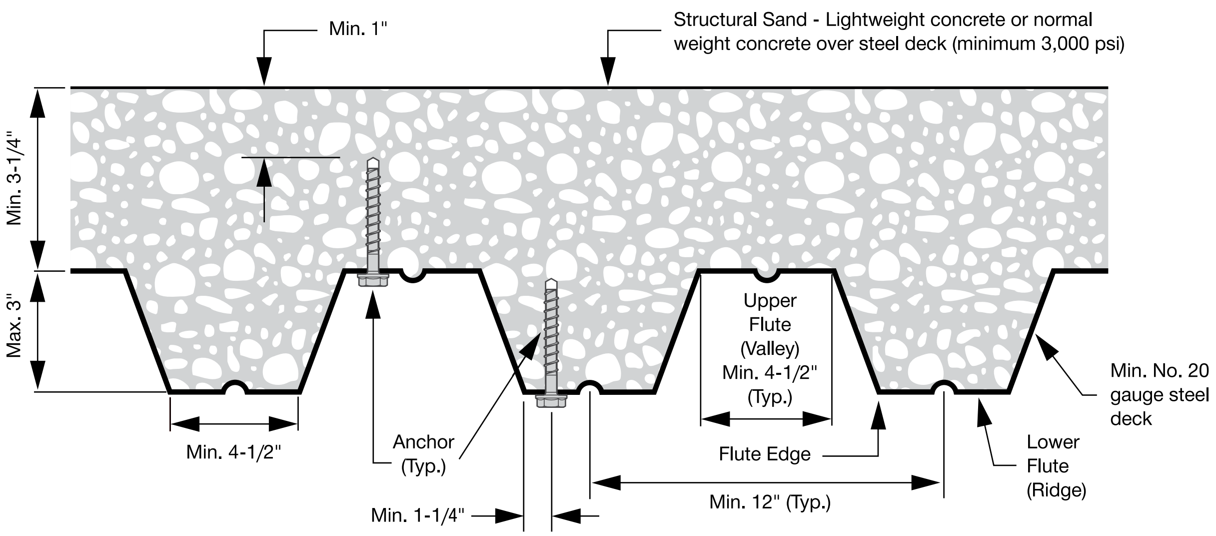
2 The values in this table shall be used with the appropriate equal in ACI 318 Appendix D_1 equations D.5.3.1 and D.5.3.2.

3 The values for Φ_p in tension can be found in Table 2 of this report and the values for Φ_{sa} in shear can be found in Table 3.

4 For installations through the soffit of steel deck into concrete (see Figure 2) anchors installed in the lower flute shall be installed with a maximum 1 inch offset in either direction from the centerline of the flute.

5 The characteristic pullout resistance for concrete compressive strengths greater than 2,500 psi may be increased by multiplying the value in the table by $(f'_c / 3,000)^{1/2}$ for psi or $(f'_c / 20.7)^{1/2}$ for MPa.

Figure 2 – Installation of KWIK HUS (KH) in Soffit of Concrete over Steel Deck Floor and Roof Assemblies



1 Anchors may be placed in the upper or lower flute of the steel deck profile provided the minimum concrete cover above the drilled hole is satisfied. Anchors in the lower flute may be installed with a maximum 1-inch offset in either direction from the center of the flute. The offset distance may be increased proportionally for profiles with lower flute widths greater than those shown provided the minimum lower flute edge distance is also satisfied.

KWIK HUS (KH) Carbon Steel Screw Anchor 3.3.7

Table 4 – KWIK HUS (KH) Allowable Stress Design Values for Illustrative Purposes[1,2,3,4,5,6,7,8,9,12]

Nominal Anchor Diameter [in.]	Embedment Depth, h_{nom} [in.]	Effective Embedment Depth, h_{ef} [in.]	Allowable Tension Load[10] [lbs]	Allowable Shear Load[11] [lbs]
3/8	1-5/8	1.11	633	682
	2-1/2	1.86	1374	1480
	3-1/4	2.20	1768	1903
1/2	2-1/4	1.52	1142	1093
	3	2.16	1934	1852
	4-1/4	3.22	3521	3411
5/8	3-1/4	2.39	2252	2425
	5	3.88	4657	4675
3/4	4	2.92	3041	6549
	6-1/4	4.84	6489	6943

For SI**:** 1 inch = 25.4 mm, 1 lbf = 4.45 N.

1 Single anchor with static tension or shear load only.

2 Concrete determined to remain uncracked for the life of the anchorage.

3 Load combinations are taken from ACI 318 Section 9.2 (no seismic loading).

4 40% dead load and 60% live load, controlling load combination 1.2D + 1.6L.

5 Calculation of weighted average for conversion factor $\alpha = 1.2(0.4) + 1.6(0.6) = 1.44$.

6 f'_c = 2,500 psi (normal weight concrete).

7 $c_{a1} = c_{a2} \geq c_{ac}$.

8 $h \geq h_{min}$.

9 Values are for Condition B where supplementary reinforcement in accordance with ACI 318 D.4.4 is not provided.

10 Allowable tension load = factored load (Concrete Breakout from Table 2) ÷ 1.44

11 Allowable Shear Load = factored Load (Lessor of V_{sa} or Concrete Pryout from Table 2) ÷ 1.44

12 Values are for single anchors installed without influence of base material edge distance or adjacent anchors.

3.3.7 KWIK HUS (KH) Carbon Steel Screw Anchor

Table 5 – Allowable Tension Loads for KWIK HUS installed in Grout-filled Masonry Walls (lb)[1,2,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Loads @ C_{cr} and S_{cr}	Spacing			Edge Distance		
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min}[6]	Critical - C_{cr} (inches)[5]	Minimum C_{min} (inches)[5]	Load Reduction Factor[6]
3/8	1 5/8	535	4	2	0.70	4	4	1.00
	2 1/2	895	6	4	0.80			
	3 1/4	1210						
1/2	2 1/4	710	4	2	0.60	4	4	1.00
	3	1110	8	4				
	4 1/4	1515						
5/8	3 1/4	1155	10	4	0.60	10	4	1.00
	5	1735						
3/4	4	1680	12	4	0.60	12	4	1.00
	6 1/4	2035						

Table 6 – Allowable Shear Loads for KWIK HUS installed in Grout-filled Masonry Walls (lb)[1,2,3,7,8]

Anchor Diameter (inches)	Embedment (inches)[3]	Load at C_{cr} and S_{cr}	Spacing			Edge Distance			
			Critical - S_{cr} (inches)[4]	Minimum - S_{min} (inches)[4]	Load Reduction Factor at S_{min}[6]	Critical - C_{cr} (inches)[5]	Minimum - C_{min} (inches)[5]	Load Reduction Factor at C_{min}	
								Load Direction Perpendicular to Edge	Load Direction Parallel to Edge
3/8	1 5/8	1140	6	4	0.94	6	4	0.61	1.00
	2 1/2	1165						0.70	1.00
	3 1/4	1190						0.70	1.00
1/2	2 1/4	1845	8	4	0.88	8	4	0.50	1.00
	3	2055						0.45	0.94
	4 1/4	2745						0.40	0.89
5/8	3 1/4	3040	10	4	0.36	10	4	0.36	0.82
	5	3485						0.34	0.92
3/4	4	3040	10	4	0.36	12	4	0.36	0.82
	6 1/4	3485						0.34	0.92

1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Anchors may not be installed within one inch in any direction of a vertical joint.

3 Embedment depth is measured from the outside face of the concrete masonry embedment.

4 S_{cr} is anchor spacing where full load values in the Table may be used. S_{min} is the minimum anchor spacing for which values are available and installation is recommended. Spacing is measured from the center of one anchor to the center of an adjacent anchor.

5 C_{cr} is the edge distance where full load values in the table may be used. C_{min} is the minimum edge distance for which values are available and installation is recommended. Edge distance is measured from the center of the anchor to the closest edge.

6 Load reduction factors are multiplicative, both spacing and edge distance load reduction factors must be considered.

Load values for anchors installed at less than C_{cr} or S_{cr} must be multiplied by the appropriate load reduction factor based on actual edge distance (C) or spacing (S).

7 Linear interpolation of load values between minimum spacing (S_{min}) and critical spacing (S_{cr}) and between minimum edge distance (C_{min}) and critical edge distance (C_{cr}) is permitted.

8 For combined loading: $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

KWIK HUS (KH) Carbon Steel Screw Anchor 3.3.7

Table 7 – KWIK HUS Allowable Loads installed in Top of Grout-Filled Concrete Masonry Construction (lb)

Anchor Diameter (inches)	Minimum Embedment Depth (inches)[2]	Minimum Edge Distance (inches)	Minimum Spacing (inches)	Minimum End Distance (inches)	Tension	Shear	
						Perpendicular to Edge of Masonry Wall	Parallel to Edge of Masonry Wall
1/2	4 1/4	1 3/4	8	4	680	305	1110
5/8	5	1 3/4	10	5	1310	305	1165

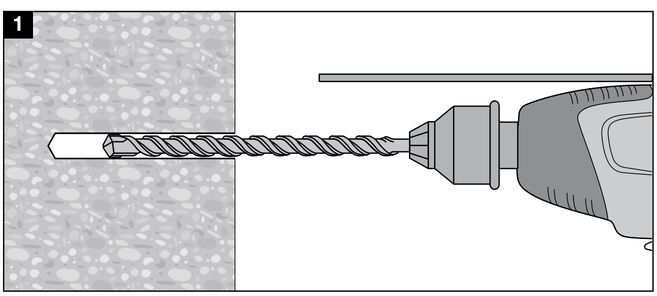
1 All values are for anchors installed in fully grouted masonry with minimum masonry prism strength of 1500psi. Concrete masonry units shall be light-weight or normal-weight.

2 Embedment depth is measured from the top of the masonry construction.

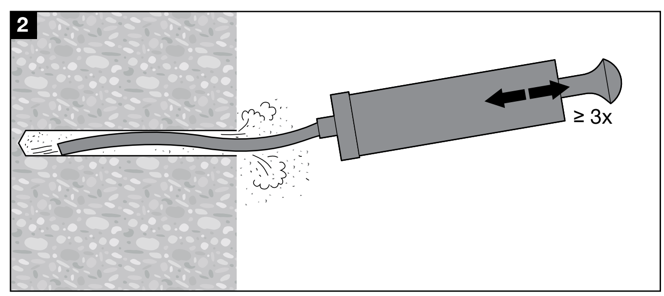
3 For combined loading: $\left(\frac{T_{applied}}{T_{allowable}}\right)^{5/3} + \left(\frac{V_{applied}}{V_{allowable}}\right)^{5/3} \leq 1$

3.3.7.4 Installation Instructions

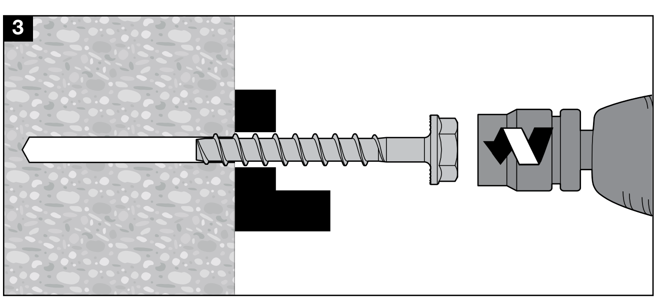
Drill holes in base material using carbide-tipped masonry drill bits complying with ANSI B212.15-1994. The nominal drill bit diameter must be equal to that of the anchor. The minimum drilled hole depth is given in Table 1. Prior to installation, dust and debris must be removed from the drilled hole using a hand pump, compressed air or a vacuum. The anchor must be installed into the predrilled hole using a powered impact wrench or installed with a torque wrench until the proper nominal embedment depth is obtained. The impact wrench torque, T_{impact} and installation torque, T_{inst} for the manual torque wrench must be in accordance with Table 1. The KWIK HUS (KH) may be loosened by a maximum of one turn and reinstalled with a socket wrench or powered impact wrench to facilitate fixture attachment or realignment. For member thickness and edge distance restrictions for installations into the soffit of concrete on steel deck assemblies, see Figure 2.



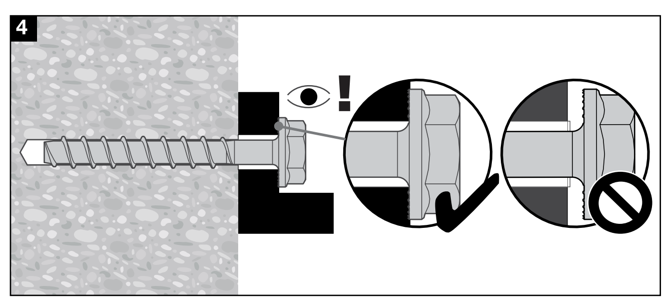
Drill hole in base material using proper diameter drill bit.



Clean drilled hole to remove debris.



Fasten anchor tightly against fastened part.



Install anchor using proper impact tool or torque wrench.

3.3.7.5 KWIK HUS (KH) Carbon Steel Screw Anchor

The data below is developed from testing performed in accordance with ACI 355.2. It is intended for applications designed according to CSA A23.3-04 Update No. 3 (August 2009) Design of Concrete Structures Annex D and is generally suitable for the conditions described in the introduction of Annex D.

Table 8 – Disign Information for use with CSA A23.3-04

Characteristic	Symbol	Units	Nominal Anchor Diameter (inches)										Code Ref.
			3/8			1/2			5/8		3/4		
Anchor Category (1, 2 or 3)			1										
Nominal Embedment Depth	h_{nom}	mm	41	64	83	57	76	108	83	127	102	159	
Concrete material resistance factor for concrete	ϕ_c	-	0.65										8.4.2
Steel material resistance factor	ϕ_s	-	0.85										8.4.3
Ultimate strength of anchor steel	f_{ut}	MPa	739			670			622		563		
Effective cross-sectional area of anchor	A_{se}	mm^2	55.5			103.9			172.9		252.9		
Minimum Edge Distance	c_{min}	mm	44										
Minimum Spacing	s_{min}	mm	76						102				
Minimum Concrete Thickness	h_{min}	mm	83	102	121	95	127	152	127	178	152	203	
Steel Strength in Tension (CSA A23.3 D.6.1)[2]													
Factored Steel Resistance in tension	N_{sr}	kN	24.4			41.4			64.0		84.7		D.6.1.2
Reduction Factor for Steel Strength	R	-	0.70										D.5.4b
Concrete Breakout Strength in Tension (CSA A23.3 D.6.2)													
Effective Embedment Depth	h_{ef}	mm	28	47	56	39	55	82	61	99	74	123	
Critical Edge Distance	c_{ac}	mm	64	79	95	70	99	133	92	148	112	185	
Effectiveness Factor — Uncracked Concrete	k_{uncr}	-	10										D.6.2.2
Modification factor for uncracked concrete	$\psi_{c,N}$	-	1.4										D.6.2.6
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)										D.5.4c
Pullout Strength in Tension (CSA A23.3 D.6.3)[1]													
Factored Pullout Resistance, uncracked concrete (20 MPa)	$N_{pr,uncr}$	kN	N/A										D.6.3.2
Reduction Factor for pullout strength	R	1.15 (Condition A), 1.00 (Condition B)											
Steel Strength in Shear (CSA A23.3 D.7.1)[2]													
Factored Shear Resistance of Steel - Static	V_{sr}	kN	12.7			20.1			27.6		40.9		D.7.1.2c
Reduction Factor for Steel Strength	R		0.65										D.5.4b
Concrete Breakout Strength in Shear (CSA A23.3 D.7.2)													
Nominal Diameter	d_o	mm	9.5			12.7			15.9		19.1		
Load Bearing Length of Anchor	ℓ_e	mm	28	47	56	39	55	82	61	99	74	123	
Reduction Factor for Concrete Breakout Strength	R	-	1.15 (Condition A), 1.00 (Condition B)										
Concrete Pryout Strength in Shear (CSA A23.3 D.7.3)													
Coefficient for Pryout Strength	k_{cp}		1.0	1.0	1.0	1.0	1.0	2.0	1.0	2.0	2.0	2.0	
Reduction Factor for Pryout Strength	R		1.15 (Condition A), 1.00 (Condition B)										

1 N/A denotes that pullout resistance does not govern and does not need to be considered.

2 The KWIK HUS (KH) is considered a brittle steel element as defined by CSA A23.3 D.2.

3 The KWIK HUS (KH) is suitable for uncracked concrete applications only. For cracked concrete applications (i.e. tension zone anchorages), consider the KWIK HUS (KH) anchor

This table replaces Table 2 of this Supplement for anchorage design in normal weight concrete in accordance with CSA A23.3-04.

3.3.7.6 Ordering Information



Description	Hole Diameter	Total Length without Anchor Head	Minimum Embedment Depth	Qty (pcs) Box
KH 3/8" x 2-1/8"	3/8"	2-1/8"	1-5/8"	50
KH 3/8" x 3"	3/8"	3"	2-1/2"	50
KH 3/8" x 3-1/2"	3/8"	3-1/2"	2-1/2"	50
KH 3/8" x 4"	3/8"	4"	3-1/4"	50
KH 3/8" x 5"	3/8"	5"	3-1/4"	30
KH 1/2" x 3"	1/2"	3"	2-1/4"	30
KH 1/2" x 3-1/2"	1/2"	3-1/2"	3"	25
KH 1/2" x 4"	1/2"	4"	3"	25
KH 1/2" x 4-1/2"	1/2"	4-1/2"	4- 1/4"	25
KH 1/2" x 5"	1/2"	5"	4-1/4"	25
KH 1/2" x 6"	1/2"	6"	4-1/4"	25
KH 5/8" x 4"	5/8"	4"	3-1/4"	15
KH 5/8" x 5-1/2"	5/8"	5-1/2"	3-1/4"	15
KH 5/8" x 6-1/2"	5/8"	6-1/2"	3-1/4"	15
KH 3/4" x 4-1/2"	3/4"	4-1/2"	4"	10
KH 3/4" x 5-1/2"	3/4"	5-1/2"	4"	10
KH 3/4" x 7"	3/4"	7"	4"	10
KH 3/4" x 9"	3/4"	9"	4"	10

3.3.8 HCA Coil Anchor

3.3.8.1 Product Description

The Hilti HCA Coil Anchor is a bolt type expansion anchor for use in concrete.

Product Features

- Reusable type anchors, providing major cost savings*
- Bolt type anchor enables low profile fastenings
- Preassembled units allow quick production fastening
- Utilizes a disposable, low cost expansion coil which minimizes reuse costs
- Heat treated to Grade 5 specification, which provides high shear load capacity

Guide Specifications

Expansion Anchor – Expansion anchors shall be bolt style which meet the mechanical properties of a Grade 5 bolt. Anchors are to be zinc plated in accordance with ASTM B633, SC1, Type III. Anchors shall be Hilti HCA designation as supplied by Hilti.

Installation – Install bolt type anchors in holes drilled with Hilti carbide tipped drill bits or DD-B or DD-C diamond core bits. Install anchors as per manufacturer's recommendation.

* Test results when reused four uses: maximum 20% reduction in tensile capacity; no reduction in shear.

3.3.8.2 Material Specifications

	Mechanical Properties min. f_u ksi (MPa)
1/4" HCA Carbon Steel meets the requirements of case of hardened AISI 1018	100 (690)
3/8"– 3/4" HCA Carbon Steel meets the chemical requirements of AISI 1035 and heat treated to Grade 5 specification	120 (830)
Coil meets the requirements of plain carbon steel	
Carbon Steel HCA and coil are plated in accordance with ASTM B633, SC1, Type III	

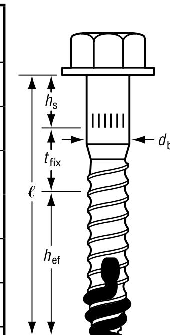
Table 2 - HCA Lengths[2]

Diameter	Length ℓ in. (mm)	
1/4	1-3/4	(44)
	2-1/2	(64)
	3-1/2	(89)
3/8	2-1/4	(57)
	3	(76)
	5	(127)
1/2	3	(76)
	4	(102)
	5-1/2	(140)
	7	(178)
3/8	3-1/2	(89)
	5	(127)
	8	(203)
3/4	4-1/2	(114)
	6	(152)
	10	(254)

3.3.8.3 Technical Data

Table 1 - HCA Specification Table

Details \ Bolt Size		in.	1/4	3/8	1/2	5/8	3/4
d_{bit}	nominal bit diameter[1]	in.	1/4	3/8	1/2	5/8	3/4
h_s	depth set mark	in.	3/8	5/8	5/8	3/4	1
ℓ	anchor length min./max. (other lengths available)	in.	1-3/4	2-1/4	3	3-1/2	4-1/2
		in.	3-1/2	5	7	8	10
d_h	coil clearance hole in plate	in.	5/16	7/16	9/16	11/16	13/16
T_{inst}	installation torque	ft-lb	10	40	80	130	180
h	min. base material thickness	in.	3" or 1.3 h_{ef} whichever is greater				



1 Hilti carbide-tipped drill bit or matched tolerance Hilti DD-B or DD-C diamond core bits

2 Maximum thickness to be fastened $t = \ell - (h_{ef} + h_s)$

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \text{ (Ref. Section 4.1.8.3)}$$

Table 3 - Carbon Steel HCA Allowable Concrete/Steel Capacity in Concrete[1]

Anchor Diameter in.	Embedment Depth in.	Allowable Concrete Capacity[3,4], lb							
		2000 psi		4000 psi		6000 psi		Allowable Steel Strength[2], lb	
		Tension[5]	Shear	Tension[5]	Shear	Tension[5]	Shear	Tension	Shear
1/4	3/4	230	230	325	330	400	400	1620	1080
	1	355	380	500	535	615	655		
3/8	1-1/2	650	850	920	1205	990	1475	4355	2905
	2	1005	1390	1420	1965	1740	2410		
1/2	2	1005	1515	1420	2145	1740	2625	7775	5180
	3	1845	3020	2605	4270	3190	5230		
5/8	2-3/8	1300	2175	1835	3075	2250	3765	12145	8095
	3-7/8	2705	5000	3825	7070	4685	8660		
3/4	3-1/4	2080	3915	2940	5540	3600	6780	17495	11665
	4-1/2	3385	6810	4790	9630	5865	11705		

1 Apply any applicable edge distance and anchor spacing reduction factors to the concrete capacity prior to determining if concrete or steel capacity control design. See Table 5 in this Section.

2 Steel strength based on 0.22 $F_u A_g$ for shear and 0.33 $F_u A_g$ for tension.

3 Concrete strength based on a safety factor of 4.0.

4 Test results when reused four times: maximum 20% reduction in tensile capacity; no reduction in shear.

Table 4 - Carbon Steel HCA Ultimate Concrete/Steel Capacity in Concrete[1]

Anchor Diameter in.	Embedment Depth in.	Ultimate Concrete Capacity[3,4], lb							
		2000 psi		4000 psi		6000 psi		Ultimate Steel Strength[2], lb	
		Tension[5]	Shear	Tension[5]	Shear	Tension[5]	Shear	Tension	Shear
1/4	3/4	920	930	1305	1315	1595	1610	3675	2830
	1	1420	1515	2005	2145	2460	2625		
3/8	1-1/2	2610	3410	3690	4825	4515	5910	9900	7615
	2	4015	5565	5675	7865	6950	9635		
1/2	2	4015	6065	5675	8575	6950	10505	17665	13570
	3	7375	12080	10430	17085	12770	20930		
5/8	2-3/8	5195	8700	7345	12305	9000	15070	27605	21240
	3-7/8	10825	19995	15305	28275	18745	34630		
3/4	3-1/4	8315	15660	11760	22150	14400	27125	39760	30590
	4-1/2	13545	27235	19160	38515	23465	47170		

1 Apply any applicable edge distance and anchor spacing reduction factors to the concrete capacity prior to determining if concrete or steel capacity control design. See Table 5 in this Section.

2 Steel strength based on 0.57 $F_u A_g$ for shear and 0.75 $F_u A_g$ for tension.

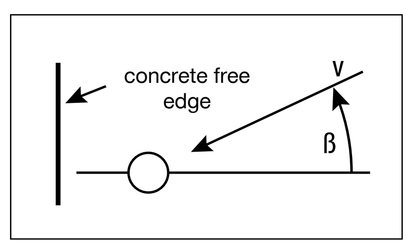
3 Concrete capacity based on Concrete Capacity Design method and verified by test data.

4 Test results when reused four times: maximum 20% reduction in tensile capacity; no reduction in shear.

Table 5 - HCA Edge Distance and Anchor Spacing Guidelines[1,2]

Load Direction		Critical	Minimum	Influence Factor[3]
Spacing	Tension	3.0 h_{ef}	1.0 h_{ef}	f_{AN} = 0.70
	Shear	2.0 h_{ef}	1.0 h_{ef}	f_{AV} = 0.70
Edge Distance	Tension	1.5 h_{ef}	0.8 h_{ef}	f_{RN} = 0.75
	Shear (⊥ toward edge)[4]	2.5 h_{ef}	1.0 h_{ef}	f_{RV1} = 0.25
	Shear (II or ⊥ away from edge)[4]	2.5 h_{ef}	1.0 h_{ef}	f_{RV2} = 0.50

See Note 4



1 For edge and spacing distances between critical and minimum spacing/edge distances, use linear interpolation.

2 Influence factors are cumulative.

3 Influence factor at minimum spacing/edge distance. Influence factor at critical equals 1.0.

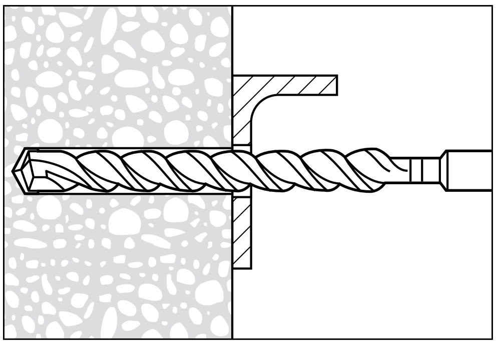
4 For shear loads in between perpendicular toward edge and parallel with edge, use the following equation, $f_{RV\beta} = 0.25 / (\cos \beta + 0.5 \sin \beta)$ for $55° \le \beta < 90°$. For $0° \le \beta < 55°$, use influence factor for shear perpendicular toward edge.

3.3.8 HCA Coil Anchor

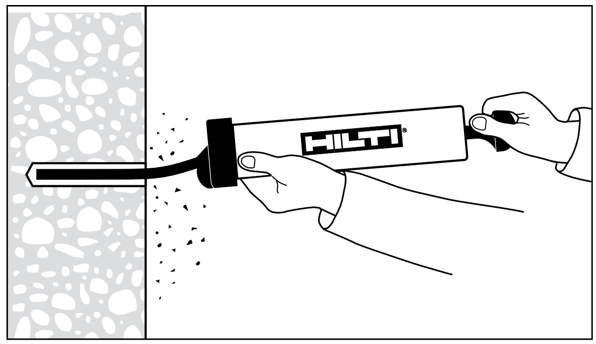
3.3.8.4 Installation Instructions

Important Installation Considerations

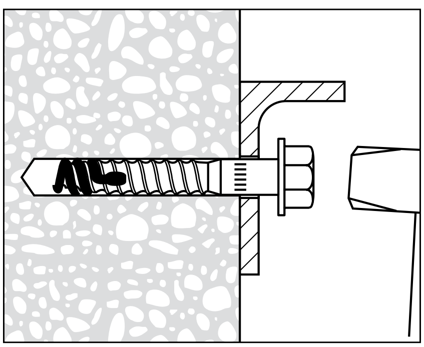
1. Hole depth is determined by the anchor length minus fixture thickness plus 1/4" minimum.
2. When reassembling the coil tab onto the tapered end of the bolt, the flattened portion (tang) must be in the direction of the head.
3. Anchors are to be initially inserted to where the depth set mark is flush with the surface of the fixture. Tap the anchor to the depth mark before tightening.



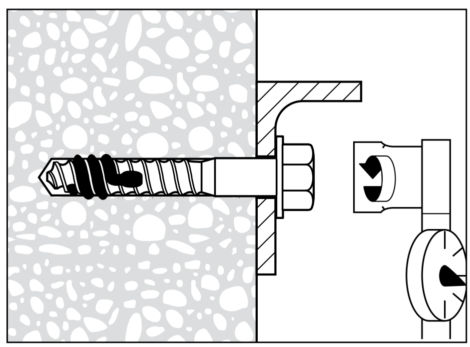
Drill hole same diameter as anchor



Clean hole



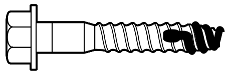
Insert (tap anchor) to anchor's **depth set mark**



Tighten to installation torque

3.3.8.5 Ordering Information

HCA HEX HEAD



Description	Box Qty.	Bit Dia.	Fixture Thickness at minimum embedment depth
HCA 1/4" X 1-3/4"	100	1/4"	5/8"
HCA 1/4" X 2-1/2"	100	1/4"	1-3/8"
HCA 1/4" X 3-1/2"	100	1/4"	2-3/8"
HCA 3/8" X 2-1/4"	100	3/8"	1/8"
HCA 3/8" X 3"	100	3/8"	7/8"
HCA 3/8" X 5"	50	3/8"	2-7/8"
HCA 1/2" X 3"	50	1/2"	3/8"
HCA 1/2" X 4"	25	1/2"	1-3/8"
HCA 1/2" X 5-1/2"	25	1/2"	2-7/8"
HCA 1/2" X 7"	25	1/2"	4-3/8"
HCA 5/8" X 3-1/2"	25	5/8"	3/8"
HCA 5/8" X 5"	25	5/8"	1-7/8"
HCA 5/8" X 8"	20	5/8"	4-7/8"
HCA 3/4" X 4-1/2"	20	3/4"	1/4"
HCA 3/4" X 6"	10	3/4"	1-3/4"
HCA 3/4" X 10"	10	3/4"	5-3/4"

HCT Replacement Coil

Description	Box Qty.
HCT 1/4"	100
HCT 3/8"	100
HCT 1/2"	100
HCT 5/8"	100
HCT 3/4"	50

* Test results when reused four times: maximum 20% reduction in tensile capacity; no reduction in shear.

3.3.9.1 Product Description

The Hilti HDI/HDI-L Drop-in anchor is an internally threaded, flush mounted expansion anchor for use in concrete.

Product Features

HDI

- Anchor, setting tool and Hilti drill bit form a matched tolerance system to provide reliable fastenings
- Allows shallow embedment without sacrificing performance
- Lip provides flush installation, consistent anchor depth, and easy rod alignment (HDI-L)
- Lip allows accurate flush surface setting, independent of hole depth (HDI-L)
- Ideal for repetitive fastenings with threaded rods of equal length
- Intelligent expansion section adapts to the base material and reduces number of hammer blows up to 50% (HDI-L)

Guide Specifications

Expansion Anchor Expansion anchors shall be flush or shell type and zinc plated in accordance with ASTM B633, SC 1, Type III. Anchors shall be Hilti HDI/HDI-L anchors as supplied by Hilti.

Installation Install shell or flush type anchors in holes drilled with Hilti carbide tipped drill bits. Install anchors as per manufacturer's recommendations.

3.3.9.2 Material Specifications

HDI/HDI-L, 1/4", 3/8", 1/2", and HDI 5/8" and 3/4" are manufactured from mild carbon steel which is plated with a zinc finish for corrosion protection in accordance with ASTM B633, SC 1, Type III

HDI Stainless Steel material meets the requirements of AISI 303

Listings/Approvals

FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler Systems (3/8" - 3/4")
(HDI and HDI-L)

UL (Underwriters Laboratories)
UL 203 Pipe Hanger Equipment for Fire Protection Services (3/8" - 3/4")

FM APPROVED   c UL us LISTED

3.3.9.3 Technical Data

Table 1 - HDI/HDI-L Specification Table

Details \ Anchor Size			HDI/HDI-L			HDI	
		in. (mm)	1/4 (6.4)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
d_{bit}	nominal bit diameter	in.	3/8	1/2	5/8	27/32	1
h_{nom} / ℓ / h_1	std. depth of embedment / anchor length / hole depth	in.	1	1-9/16	2	2-9/16	3-3/16
		(mm)	(25)	(40)	(51)	(65)	(81)
ℓ_{th}	useable thread length	in.	7/16	5/8	11/16	7/8	1-3/8
		(mm)	(11)	(15)	(17)	(22)	(34)
	threads per inch		20	16	13	11	10
h	min. base material thickness	in.	3	3-1/8	4	5-1/8	6-3/8
		(mm)	(76)	(79)	(102)	(130)	(162)
T_{inst}	installation torque	ft-lb	4	11	22	37	80
		(Nm)	(5.4)	(14.9)	(29.8)	(50.2)	(108.5)

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \quad \text{(Ref. Section 4.1.8.3)}$$

3.3.9 HDI and HDI-L Drop-in Anchor

Table 2 - Carbon Steel HDI Allowable Loads in Concrete[1]

Anchor size in. (mm)	2000 psi (13.8 MPa)				4000 psi (27.6 MPa)				6000 psi (41.4 MPa)			
	Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L
1/4 (6.4)	500 (2.2)	500 (2.2)	450 (8.0)	450 (8.0)	570 (2.5)	570 (2.5)	625 (2.8)	625 (2.8)	790 (3.5)	790 (3.5)	700 (3.1)	700 (3.1)
3/8 (9.5)	890 (4.0)	890 (4.0)	965 (4.3)	965 (4.3)	1115 (5.0)	1115 (5.0)	1250 (5.6)	1250 (5.6)	1360 (6.0)	1360 (6.0)	1500 (6.7)	1500 (6.7)
1/2 (12.7)[2]	1120 (5.0)	1120 (5.0)	1500 (6.7)	1500 (6.7)	1785 (7.9)	1785 (7.9)	2125 (9.5)	1940 (8.6)	2345 (10.4)	2345 (10.4)	2500 (11.1)	2500 (11.1)
5/8 (15.9)	1875 (8.3)	–	2500 (11.1)	–	2920 (13.0)	–	3250 (14.5)	–	3715 (16.5)	–	3750 (16.7)	–
3/4 (19.1)	2500 (11.1)	–	3875 (17.2)	–	4065 (18.1)	–	5000 (22.2)	–	5565 (24.8)	–	5500 (24.5)	–

1 The ultimate shear and allowable shear values are based on the use of SAE Grade 5 bolts, (f_y = 85 ksi, f_{ult} = 120 ksi) with the exception of the 1/4" HDI/HDI-L in f'_c = 6000 psi concrete which is based upon the use of a SAE Grade 8 bolt (f_y = 120 ksi, f_{ult} = 150 ksi).

2 Allowable and Ultimate tension loads for the HDI 1/2 are applicable to the HDI-S 1/2.

Table 3 - Carbon Steel HDI Ultimate Loads in Concrete[1]

Anchor size in. (mm)	2000 psi (13.8 MPa)				4000 psi (27.6 MPa)				6000 psi (41.4 MPa)			
	Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L	HDI	HDI-L
1/4 (6.4)	1995 (8.9)	1995 (8.9)	1800 (8.0)	1800 (8.0)	2270 (10.1)	2270 (10.1)	2500 (11.1)	2500 (11.1)	3150 (14.0)	3150 (14.0)	2800 (12.5)	2800 (12.5)
3/8 (9.5)	3555 (15.8)	3555 (15.8)	3850 (17.1)	3850 (17.1)	4460 (19.8)	4460 (19.8)	5000 (22.2)	5000 (22.2)	5430 (24.2)	5430 (24.2)	6000 (26.7)	6000 (26.7)
1/2 (12.7)[2]	4470 (19.9)	4470 (19.9)	6000 (26.7)	6000 (26.7)	7140 (31.8)	7140 (31.8)	8500 (37.8)	7750 (34.4)	9375 (41.7)	9375 (41.7)	10000 (44.5)	10000 (44.5)
5/8 (15.9)	7500 (33.4)	–	10000 (44.5)	–	11685 (52.0)	–	13000 (57.8)	–	14865 (66.1)	–	15000 (66.7)	–
3/4 (19.1)	10000 (44.5)	–	15500 (69.0)	–	16260 (72.3)	–	20000 (89.0)	–	22250 (99.0)	–	22000 (97.9)	–

1 The ultimate shear and allowable shear values are based on the use of SAE Grade 5 bolts, (f_y = 85 ksi, f_{ult} = 120 ksi) with the exception of the 1/4" HDI/HDI-L in f'_c = 6000 psi concrete which is based upon the use of a SAE Grade 8 bolt (f_y = 120 ksi, f_{ult} = 150 ksi).

2 Allowable and Ultimate tension loads for the HDI 1/2 are applicable to the HDI-S 1/2.

Table 4 - Carbon Steel HDI Allowable Loads in Lightweight Concrete and Lightweight Concrete over Metal Deck[1,2]

Anchor size in. (mm)	Anchor Installed in 3000 psi (20.7 MPa)		Anchor Installed Through Steel Deck Upper Flute		Anchor Installed Through Steel Deck Lower Flute	
	Lt. Wt. Concrete[3]		Into 3000 psi (20.7 MPa) Lt. Wt. Concrete[4]		Into 3000 psi (20.7 MPa) Lt. Wt. Concrete[4]	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	465 (2.1)	340 (1.5)	530 (2.4)	335 (1.5)	375 (1.7)	250 (1.1)
3/8 (9.5)	755 (3.4)	940 (4.2)	880 (3.9)	1010 (4.5)	500 (2.2)	500 (2.2)
1/2 (12.7)	1135 (5.0)	1700 (7.6)	1105 (4.9)	1755 (7.8)	625 (2.8)	750 (3.3)
5/8 (15.9)	1465 (6.5)	2835 (12.6)	-	-	875 (3.9)	875 (3.9)
3/4 (19.1)	2075 (9.2)	3680 (16.4)	-	-	1250 (5.5)	1000 (4.4)

1 The allowable values are based on the use of SAE Grade 2 bolts installed in the anchors.

2 Based on using a safety factor of 4.0.

3 The tabulated shear and tensile values are for anchors installed in structural lightweight concrete having the designated ultimate compressive strength at the time of installation. The concrete must comply with ASTM C 330-05.

4 The tabulated shear and tensile values are for anchors installed through 20 gauge intermediate decking into structural lightweight concrete having the designated
ultimate strength at the time of installation. The concrete must comply with ASTM C 330-05.

Table 5 - Stainless Steel HDI Allowable Loads in Concrete

Anchor size in. (mm)	4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
SS HDI – 1/4 (6.4)	480 (2.1)	600 (2.7)	740 (3.3)	600 (2.7)
SS HDI – 3/8 (9.5)	1040 (4.6)	1230 (5.5)	1460 (6.5)	1230 (5.5)
SS HDI – 1/2 (12.7)	1840 (8.2)	2760 (12.4)	2410 (10.7)	2760 (12.3)
SS HDI – 5/8 (15.9)	2630 (11.7)	4510 (20.1)	3770 (16.8)	4510 (20.1)
SS HDI – 3/4 (19.1)	3830 (17.0)	5580 (24.8)	5030 (22.4)	5580 (24.8)

Note: The ultimate and allowable shear values are based on the use of Type 18-8 bolts.

Table 6 - Stainless Steel HDI Ultimate Loads in Concrete

Anchor Size in. (mm)	4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
SS HDI – 1/4 (6.4)	1930) (8.6	2400 (10.7)	2950 (13.1)	2400 (10.7)
SS HDI – 3/8 (9.5)	4170 (18.5)	4920 (21.9)	5850 (26.0)	4920 (21.9)
SS HDI – 1/2 (12.7)	7350 (32.7)	11040 (49.1)	9630 (42.8)	11040 (49.1)
SS HDI – 5/8 (15.9)	10540 (46.9)	18040 (80.2)	15100 (67.2)	18040 (80.2)
SS HDI – 3/4 (19.1)	15340 (68.2)	22320 (99.3)	20130 (89.5)	22320 (99.3)

Anchor Spacing and Edge Distance Guidelines (See Anchoring Technology Section 4.1.8.2)

Anchor Spacing Adjustment Factors

s = Actual Spacing

s_{min} = 2.0 h_{nom}

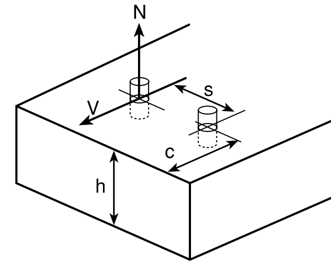
s_{cr} = 3.5 h_{nom}

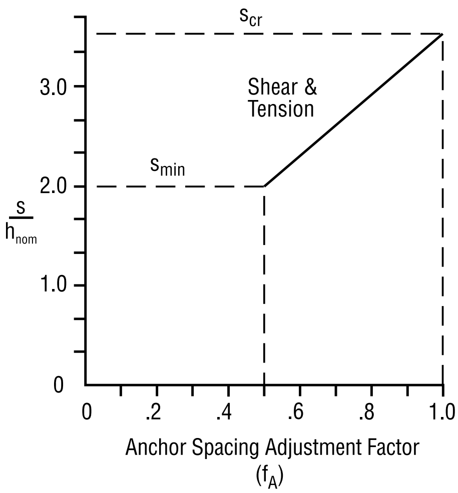
Edge Distance Adjustment Factors

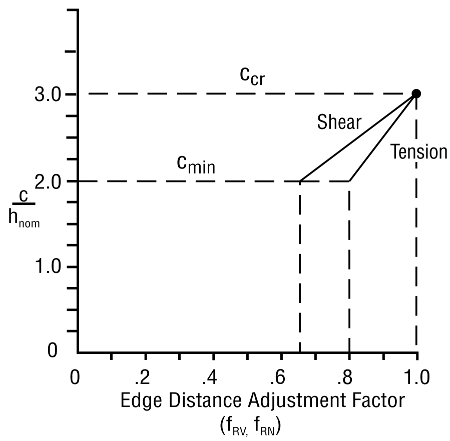
c = Actual edge distance

c_{min} = 2.0 h_{nom}

c_{cr} = 3.0 h_{nom}







Influence of Anchor Spacing and Edge Distance f_A, f_R

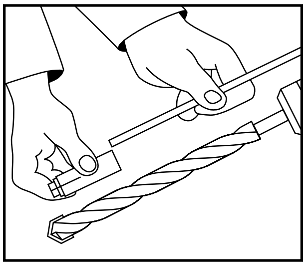
Anchor Size		h_{nom}	
in.	(mm)	in.	(mm)
1/4	(6.4)	1	(25)
3/8	(9.5)	1-9/16	(40)
1/2	(12.7)	2	(51)
5/8	(15.8)	2-9/16	(65)
3/4	(19.1)	3-3/16	(81)

h_{nom} = standard embedment depth

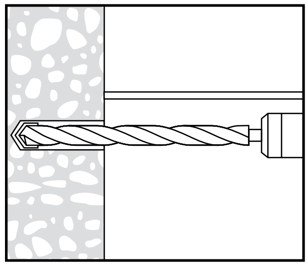
Load Adjustment Factors (Anchor Spacing) f_A							Load Adjustment Factors (Edge Disdtance) f_R											
Tension/Shear Loads							Tension f_{RN}							Shear f_{RV}				
Spacing s		Anchor Diameter					Edge Distance c		Anchor Diameter					Anchor Diameter				
in.	(mm)	1/4	3/8	1/2	5/8	3/4	in.	(mm)	1/4	3/8	1/2	5/8	3/4	1/4	3/8	1/2	5/8	3/4
2	(51)	.50					2	(51)	.80					.65				
2-1/2	(64)	.67					2-1/2	(64)	.90					.83				
3	(76)	.83	.50				3	(76)	1.0	.80				1.0	.65			
3-1/2	(89)	1.0	.58				3-1/2	(89)		.85					.73			
4	(102)		.69	.50			4	(102)		.91	.80				.85	.65		
4-1/2	(114)		.79	.58			4-1/2	(114)		.98	.85				.96	.74		
5	(127)		.90	.67	.50		5	(127)		1.0	.90	.80			1.0	.83	.65	
5-1/2	(140)		1.0	.75	.55		5-1/2	(140)			.95	.83				.91	.70	
6	(152)			.83	.61	.50	6	(152)			1.0	.87				1.0	.77	
7	(178)			1.0	.74	.57	6-1/2	(165)				.91	.80				.84	.65
8	(203)				.87	.67	7	(178)				.95	.84				.91	.72
9	(229)				1.0	.77	8	(203)				1.0	.90				1.0	.83
10	(254)					.88	9	(229)					.96					.94
11	(279)					.98	10	(254)					1.0					1.0
12	(305)					1.0												
s_{min} = 2.0 h_{nom} s_{cr} = 3.5 h_{nom}; $f_A = 0.33 \frac{s}{h_{nom}} - 0.17$ for $s_{cr} > s > s_{min}$							c_{min} =2.0 h_{nom} c_{cr} = 3.0 h_{nom}; $f_{RN} = 0.2 \frac{c}{h_{nom}} + 0.4$ for $c_{cr} > c > c_{min}$							c_{min} = 2.0 h_{nom} c_{cr} = 3.0 h_{nom}; $f_{RV} = 0.35 \frac{c}{h_{nom}} - 0.05$ for $c_{cr} > c > c_{min}$				

3.3.9 HDI and HDI-L Drop-in Anchor

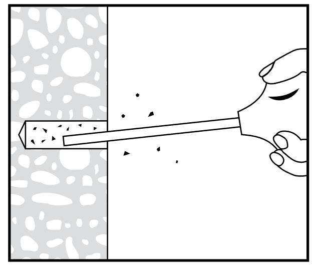
3.3.9.4 Installation Instructions



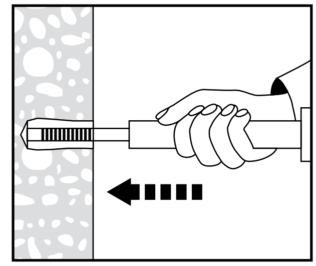
1. Adjust depth gauge so that anchor will be flush with the concrete surface when installed.



2. Hammer drill hole.



3. Clean hole.



4. Install anchor using proper setting tool. Setting tool to be driven into anchor until setting tool shoulder meets top of anchor.

3.3.9.5 Ordering Information

HDI Anchors

Carbon Steel

Anchor Thread Size	Description	Description	Description	Box Qty.
1/4”	HDI 1/4	HDI-L 1/4		100
3/8”	HDI 3/8	HDI-L 3/8		50
1/2”	HDI 1/2	HDI-L 1/2	HDI-S 1/2	50
5/8”	HDI 5/8	–		25
3/4”	HDI 3/4	–		25

HDI Anchors

Stainless Steel

Anchor Thread Size	Description	Box Qty.
1/4”	HDI 1/4 (SS 303)	100
3/8”	HDI 3/8 (SS 303)	50
1/2”	HDI 1/2 (SS 303)	50
5/8”	HDI 5/8 (SS 303)	25
3/4”	HDI 3/4 (SS 303)	25

Setting Tools for HDI, HDI-L and HDI-S

Anchor Thread Size	Description
1/4”	HST 1/4 Setting Tool
3/8”	HST 3/8 Setting Tool
1/2”	HST 1/2 Setting Tool
5/8”	HST 5/8 Setting Tool
3/4”	HST 3/4 Setting Tool

Anchor Thread Size	Description
3/8”	HSD-MM 3/8” (TE-C-24SD10 3/8” Setting tool)
1/2”	HSD-MM 1/2” (TE-C-24SD12 1/2” Setting tool)

1 Use automatic setting tools with TE-C style (SDS plus) hammer drills.

HDI-P Drop-in Anchor 3.3.10

3.3.10.1 Product Description

The Hilti HDI-P Drop-In anchor is an internally threaded, flush mounted expansion anchor for solid and hollow concrete.

Product Features

- Optimized 3/4"– anchor length to allow reliable fastenings in hollow core panels, precast plank and post tensioned slabs
- Shallow drilling enables fast installation
- Lip provides flush installation, consistent anchor depth and easy rod alignment
- Setting tool leaves mark on flange when anchor is set properly to enable inspection and verification of proper expansion

Guide Specifications

Expansion Anchor Expansion anchors shall be flush or shell type and zinc plated in accordance with ASTM B633, SC 1, Type III. Anchors shall be Hilti HDI-P anchors as supplied by Hilti.

Installation Install shell or flush type anchors in holes drilled with Hilti carbide tipped drill bits. Install anchors in accordance with manufacturer's instructions.

3.3.10.2 Material Specifications

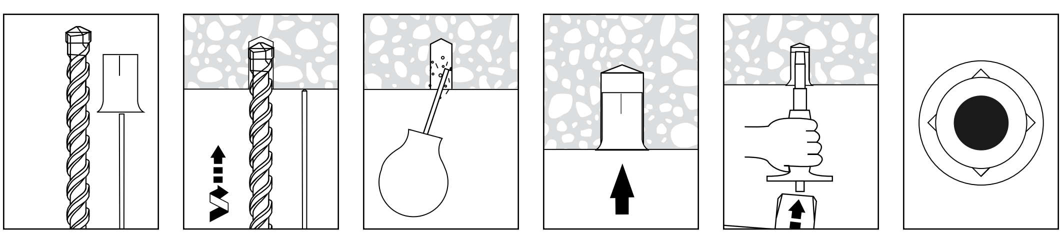
The HDI-P is manufactured from mild carbon steel, which is zinc plated for corrosion protection in accordance with ASTM B633, SC 1, Type III

3.3.10.3 Technical Data

HDI-P Specification Table

			Average Ultimate Loads, lb (kN)				Allowable Loads, lb (kN)			
		Bit	4000 psi Concrete		Hollow Core		4000 psi Concrete		Hollow Core	
	Length	Size	(27.6 MPa)		(Spancrete)		(27.6 MPa)		(Spancrete)	
Desc.	in. (mm)	in.	Tension	Shear	Tension	Shear	Tension	Shear	Tension	Shear
HDI-P 3/8	3/4 (19.1)	1/2	1900 (8.5)	3000 (13.3)	2100 (9.3)	4000 (17.8)	380 (1.7)	600 (2.7)	420 (1.9)	800 (3.6)

3.3.10.4 Installation Instructions



1. Set depth gauge on drill.
2. Hammer-drill hole.
3. Clean hole.
4. Insert anchor.
5. Insert setting tool and strike with hammer until anchor is fully set.
6. Collar of setting tool will leave an indentation on flange of anchor when properly expanded.

3.3.10.5 Ordering Information

HDI-P Anchor

Description	Bit Dia.	Box Qty.
HDI-P 3/8	1/2"	100

Setting Tools for HDI-P Anchors

Description
HSD-G 3/8" – 3/4" Setting Tool w/ hand guard
HST-P 3/8" – 3/4" Setting Tool

3.3.11 HCI-WF/MD Cast-in Anchor

HCI-WF

HCI-MD

Listings/Approvals

FM (Factory Mutual)
Pipe Hanger Components for Automatic Sprinkler Systems (3/8" - 3/4")

UL (Underwriters Laboratories)
UL 203 Pipe Hanger Equipment for Fire Protection Services (3/8" - 3/4")

3.3.11.1 Product Description

The Hilti HCI-WF/MD is an internally threaded cast-in anchor suitable for use with either wood (WF) or metal deck (MD) form work. The HCI-WF/MD is ideally suited for a variety of rod hanging applications and offers significant anchor installation time savings over traditional post-installed anchor solutions.

Product Features

- Installation from above
  - No overhead drilling and anchor installation.
  - No ladders or platforms needed.
- Hexagon head prevents spinning in concrete.
- Identification decals for flexible color application.
- WF: Large plastic flange helps ensure anchor is flush with wood form to prevent concrete from entering threads.
- WF: Easy break-off nails
- MD: Protective plastic sleeve to prevent concrete/firestop spray /insulation spray from entering threads.
- MD: Flange prepared for additional screws if required for pre-concrete rod installation.
- MD: Strong placement spring for reliable placement.

Guide Specifications

Anchor:

HCI-WF: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating and contained by a plastic flange. Anchor shall have break-off nails for attachment to the surface of wood forms. Anchor will bear the diameter and manufacturer name on its hexagon head. Anchors shall be HCI-WF as supplied by Hilti.

HCI-MD: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating. Anchor shall have a protective plastic sleeve, steel flange with pre-drilled additional fastening holes and placement spring for attachment to metal deck, anchor is to be secured by clamping the deck between the steel flange and the protective plastic sleeve. Anchor shall bear the diameter and manufacturer name on its hexagon head. Anchors shall be HCI-MD as supplied by Hilti.

Installation:

HCI-WF: Prior to pouring the concrete over the wood form, place the anchor (nails down) on the surface of the wood form at the pre-determined location. Drive the anchor down until plastic flange is flush with the surface of the wood form. When all anchors are installed, pour the concrete. When wood form is removed, the colored flange is exposed and the three break-off nails usually remain. Wear eye protection. Removal of the nails is best done by striking with hammer. After the concrete has properly cured and reached its design compressive strength, install the threaded rod, ensuring full thread engagement.

HCI-MD: Prior to pouring concrete, drill a hole through the metal deck at the pre-determined location (either lower or upper flute of the deck), using the specified diameter metal hole saw. From the topside of the deck, place the plastic sleeve through the hole. By stepping on the head of the anchor (or by using a hammer), push it through the hole, compressing the spring until the anchor plastic sleeve snaps into place (i.e. the metal deck is between the sleeve and the flange of the anchor). After all inserts are installed, pour the concrete. After the concrete has properly cured and achieved its design compressive strength, install the threaded rod, ensuring full thread engagement. To install threaded rod before concrete pour, secure anchor to steel deck material with two screws.

3.3.11.2 Material Specifications

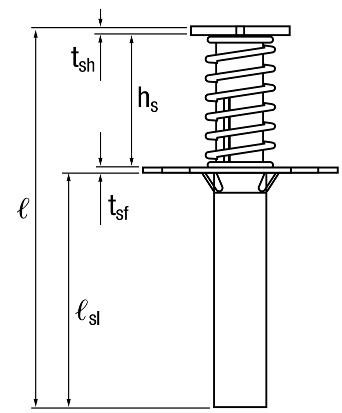
Component	HCI-WF	HCI-MD
Insert Body	Heat Treated Carbon Steel	Heat Treated Carbon Steel
Flange	Engineered Plastic	Heat Treated Carbon Steel
Spring	N/A	Carbon Steel Wire
Plating	Zinc – yellow chromate	Zinc – yellow chromate
Protective Sleeve	N/A	Engineered Plastic

3.3.11.3 Technical Data

Table 1 - HCI-MD Specification Table

Details / Nominal Anchor Dia. (Thread Size)		in. (mm)	1/4 (6.4)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
d_{bit}	Metal hole saw diameter	in.	7/8	7/8	1-3/16	1-3/16	1-1/4
h_s	Height of spring (assembled)	in.	1-7/8	1-7/8	1-7/8	1-7/8	1-7/8
		(mm)	(47.6)	(47.6)	(47.6)	(47.6)	(47.6)
ℓ_{th}	Thread length (minimum)	in.	1/4	3/8	1/2	5/8	3/4
		(mm)	(6.4)	(9.5)	(12.7)	(15.9)	(19.1)
ℓ_{sl}	Length of sleeve	in.	3-3/8	3-3/8	3-3/8	3-3/8	3-3/8
		(mm)	(85.7)	(85.7)	(85.7)	(85.7)	(85.7)
ℓ	Overall length	in.	5-7/16	5-7/16	5-7/16	5-7/16	5-7/16
		(mm)	(138)	(138)	(138)	(138)	(138)
T_{sh}	Steel head thickness	in.	1/8	1/8	1/8	1/8	1/8
		(mm)	(3.18)	(3.18)	(3.18)	(3.18)	(3.18)
T_{sf}	Steel flange thickness	in.	5/64	5/64	5/64	5/64	5/64
		(mm)	(2.00)	(2.00)	(2.00)	(2.00)	(2.00)
h	Min. slab thickness[1]	in.	4	4	4	4	4
		(mm)	(102)	(102)	(102)	(102)	(102)

1 Measured at the location of installation.

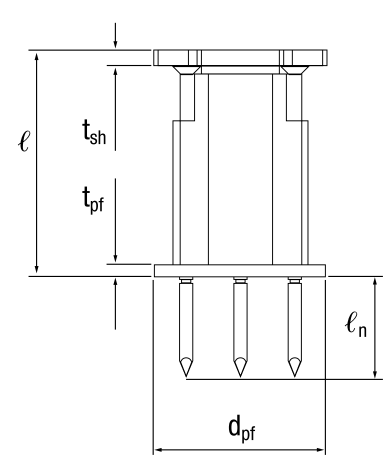


HCI-MD

Table 2 - HCI-WF Specification Table

Details / Nominal Anchor Dia. (Thread Size)		in. (mm)	1/4 (6.4)	3/8 (9.5)	1/2 (12.7)	5/8 (15.9)	3/4 (19.1)
ℓ_{th}	Thread length (minimum)	in.	1/4	3/8	1/2	5/8	3/4
		(mm)	(6.4)	(9.5)	(12.7)	(15.9)	(19.1)
d_{pf}	Plastic flange diameter	in.	1-1/2	1-1/2	1-1/2	1-1/2	1-3/4
		(mm)	(38.0)	(38.0)	(38.0)	(38.0)	(44.5)
t_{pf}	Plastic flange thickness	in.	7/64	7/64	7/64	7/64	7/64
		(mm)	(2.78)	(2.78)	(2.78)	(2.78)	(2.78)
ℓ	Overall length (w/o break-off nail)	in.	2	2	2-3/16	2-3/16	2-3/16
		(mm)	(51)	(51)	(55.6)	(55.6)	(55.6)
t_{sh}	Steel head thickness	in.	1/8	1/8	1/8	1/8	1/8
		(mm)	(3.18)	(3.18)	(3.18)	(3.18)	(3.18)
ℓ_n	Length of break-off nail	in.	7/8	7/8	7/8	7/8	7/8
		(mm)	(22.2)	(22.2)	(22.2)	(22.2)	(22.2)
h	Minimum slab thickness[1]	in.	4	4	4	4	4
		(mm)	(102)	(102)	(102)	(102)	(102)

1 Measured at the location of installation.



HCI-WF

3.3.11 HCI-WF/MD Cast-in Anchor

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \quad \text{(Ref. Section 4.1.9.6)}$$

Table 3 - HCI-MD Ultimate Loads in 3000 psi (20.7 Mpa) Lightweight Concrete Over Metal Deck[1,2]

Nominal Anchor Diameter	Embedment Depth	Minimum Spacing	Minimum End Distance	Anchor installed in the Upper Flute of the Deck		Anchor installed in the Lower Flute of the Deck[3]		
				Tension	Shear	Tension	Shear lb (kN)	
in. (mm)	in. (mm)	in. (mm)	in. (mm)	lb (kN)	lb (kN)	lb (kN)	II to flute	⊥ to flute
1/4 (6.4)	2 (51)	9 (229)	12 (305)	6250 (27.8)	6940 (30.9)	3280 (14.6)	4660 (20.7)	3825 (17.0)
3/8 (9.5)	2 (51)	9 (229)	12 (305)	6250 (27.8)	6940 (30.9)	3280 (14.6)	4660 (20.7)	3825 (17.0)
1/2 (12.7)	2 (51)	9 (229)	12 (305)	9485 (42.2)	11010 (49.0)	4710 (21.0)	4660 (20.7)	3825 (17.0)
5/8 (15.9)	2 (51)	9 (229)	12 (305)	9485 (42.2)	11010 (49.0)	4710 (21.0)	4660 (20.7)	3825 (17.0)
3/4 (19.1)	2 (51)	9 (229)	12 (305)	11195 (49.8)	11010 (49.0)	5010 (22.3)	4660 (20.7)	3825 (17.0)

1 Allowable loads should be calculated using a minimum safety factor of 4.

2 Load values based on base material or anchor failure modes. Engineer of record must independently evaluate rod/bolt capacity.

3 Anchors installed in lower flute of metal deck should be installed as close to the center as possible. Load values for anchors installed a maximum of 1-3/8” offset from center of flute. For deck dimensions, see Figure 3 in the KWIK Bolt 3 section.

Table 4 - HCI-WF Ultimate Loads in 3000 psi (20.7 Mpa) Lightweight Concrete[1,2]

Nominal Anchor Diameter in. (mm)	Embedment Depth in. (mm)	Minimum Insert Spacing in. (mm)	Minimum Insert Edge Distance in. (mm)	Tension lb (kN)	Shear lb (kN)
1/4 (6.4)	1-7/8 (48)	9 (229)	6 (152)	6000 (26.7)	4945 (22.0)
3/8 (9.5)	1-7/8 (48)	9 (229)	6 (152)	6000 (26.7)	4945 (22.0)
1/2 (12.7)	2 (51)	9 (229)	6 (152)	6000 (26.7)	10510 (46.8)
5/8 (15.9)	2 (51)	9 (229)	6 (152)	6000 (26.7)	10510 (46.8)
3/4 (19.1)	2 (51)	9 (229)	6 (152)	6000 (26.7)	10510 (46.8)

1 Allowable loads should be calculated using a minimum safety factor of 4.

2 Load values based on base material or anchor failure modes. Engineer of record must independently evaluate rod/bolt capacity.

Table 5 - Underwriters Laboratories Inc. (UL)[1,2] and Factory Mutual (FM)

Anchor/Rod Diameter	HCI-MD						HCI-WF		
	Upper Flute			Lower Flute					
in.	UL Max Pipe Size (in.)	UL Test Load[3] (lb)	FM Max Pipe Size (in.)	UL Max Pipe Size (in.)	UL Test Load[3] (lb)	FM Max Pipe Size (in.)	UL Max Pipe Size (in.)	UL Test Load[3] (lb)	FM Max Pipe Size (in.)
3/8	4	1500	4	4	1500	4	4	1500	4
1/2	8	4050	8	8	4050	8	8	4050	8
5/8	12	7900	12	–	–	–	8	4050	–
3/4	12	7900	12	–	–	–	8	4050	–

1 Intended for installation and use in accordance with NFPA 13.

2 All diameter HCI-MD and HCI-WF anchors are suitable for use in air handling spaces at a minimum 9’ spacing.

3 UL Listing based upon resisting the tabulated load for one minute.

3.3.11.4 Installation Instructions

Installation Procedure for HCI-MD

1. Prior to pouring concrete, drill a hole through the metal deck, using the specified diameter metal hole saw.

2. From the topside of the deck, place the plastic sleeve through the hole.

3. By stepping on the head of the anchor (or by using a hammer), push it through the hole until the anchor plastic sleeve snaps into place (i.e. the deck is between the sleeve and the flange of the anchor). After all inserts are installed, pour the concrete.

4. After the concrete has properly cured and achieved its design compressive strength, install the threaded rod, ensuring full thread engagement. (Note: Rod may be installed prior to concrete pour, but should not be loaded or disturbed until concrete has cured and achieved its design compressive strength .

Installation Procedure for HCI-WF

1. Prior to pouring the concrete over the wood form, place the anchor (nails down) on the surface of the wood form.

2,3. Drive the anchor down until flush with the surface of the wood form. When all anchors are installed, pour the concrete. When wood form is removed, the three break-off nails usually remain. Wearing eye protection, remove these nails.

4. After the concrete has properly cured and reached its design compressive strength, install the threaded rod, ensuring full thread engagement.

3.3.11.5 Ordering Information

HCI – WF Cast – In Anchor for use in Wood Forms

Description	Packaging Content
HCI – WF 1/4"	150
HCI – WF 3/8"	150
HCI – WF 1/2"	100
HCI – WF 5/8"	100
HCI – WF 3/4"	100

Color Identification Decals for use with HCI-WF

Description	Packaging Content
HCI – WFID Decal Color: Blue	300
HCI – WFID Decal Color: Green	300

HCI – MD Cast – In Anchor for use in Metal Deck and Accessories

Description	Packaging Content	Hole Saw Diameter
HCI – MD 1/4"	100	7/8"
HCI – MD 3/8"	100	7/8"
HCI – MD 1/2"	60	1-3/16"
HCI – MD 5/8"	60	1-3/16"
HCI – MD 3/4"	60	1-1/4"

Color Identification Decals for use with HCI – MD

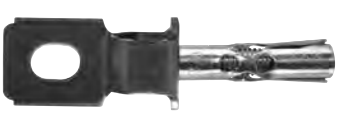
Description	Packaging Content
HCI – MDID Decal Color: Blue	300
HCI – MDID Decal Color: Green	300

3.3.12 HLC Sleeve Anchor

Bolt Head (HLC-H)

Hex Nut – HLC-HX

Flat Phillips Head – HLC-FPH



Tie-Wire Head – HLC-T

Acorn Nut – HLC-AC

Round Head Slotted – HLC-RS

Rod Coupling – HLC-RC

3.3.12.1 Product Description

Hilti HLC Sleeve Anchors are mechanical expansion anchors consisting of an externally threaded stud with an expanding sleeve for use in concrete and hollow and solid masonry base materials.

Product Features

- Stud bolt type anchor design allows easy through-type fastenings and setting in bottomless hole.
- Pre-assembled anchor allows easy/fast installation.
- Anchor size is same as drill bit size allowing easy installation.
- Variety of head styles, lengths/sizes allow versatile application/use.
- Comprehensive testing to provide performance data in block, masonry/concrete base materials.
- Bulged mid-section with round and diamond shaped openings help prevent anchor from spinning in the hole or dropping out when being set overhead.

Guide Specifications

Expansion Anchor Expansion anchors shall be stud or flush sleeve type and zinc plated in accordance with ASTM B633, Type II or stainless steel in accordance with AISI grade 304. Anchors shall be Hilti sleeve anchors as supplied by Hilti.

Installation Install sleeve anchors in holes drilled with Hilti carbide tipped drill bits. Install anchors in accordance with manufacturer's recommendations.

3.3.12.2 Material Specifications

Carbon steel sleeves and spacers are manufactured from cold rolled steel

Carbon steel anchors are zinc plated to minimum 5 µm thickness in accordance with ASTM B633, Type II

Stainless steel anchor material (stud, sleeve, nuts and washers) meet the requirements for AISI 304 stainless steel

3.3.12.3 Technical Data

Sleeve Anchor Specification Table

Details / Anchor Size			in.	1/4	5/16	3/8	1/2	5/8	3/4
			(mm)	(6.4)	(7.9)	(9.5)	(12.7)	(15.9)	(19.1)
d	Thread diameter		in.	3/16	1/4	5/16	3/8	1/2	5/8
d_{bit}	Bit diameter[1]		in.	1/4	5/16	3/8	1/2	5/8	3/4
h_{min}	minimum depth of embedment		in.	1	1	1-1/4	1-1/2	2	2
			(mm)	(25)	(25)	(32)	(38)	(51)	(51)
h_o	Minimum Hole depth		in.	1-3/8	1-3/8	1-3/4	2-1/8	2-5/8	2-5/8
			(mm)	(35)	(35)	(45)	(54)	(67)	(67)
T_{inst}	Installation torque	HLC-HX, FPH, AC, RS, RC	ft-lb	2.2	5	10	15	60	90
			(Nm)	(3)	(6.8)	(13.6)	(20)	(81.4)	(122.1)
		HLC-H	ft-lb	–	12	18	35	–	–
			(Nm)		(16)	(24.4)	(47.4)		

1 Hilti carbide tipped drill bits

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_{rec}}\right)^{5/3} + \left(\frac{V_d}{V_{rec}}\right)^{5/3} \leq 1.0 \quad \text{(Ref. Section 3.1.8.3)}$$

Carbon Steel Sleeve Anchor Allowable Loads in Concrete[1,2]

Sleeve Anchor Size in.	(mm)	Bolt Diameter in.	(mm)	Embedment Depth in.	(mm)	2000 psi (13.8 MPa) Tension lb	(kN)	Shear lb	(kN)	4000 psi (27.6 MPa) Tension lb	(kN)	Shear lb	(kN)	6000 psi (41.4 MPa) Tension lb	(kN)	Shear lb	(kN)
1/4[3]	(6.4)	3/16	(4.8)	1	(25)	225	(1.0)	305	(1.4)	250	(1.1)	305	(1.4)	250	(1.1)	305	(1.4)
5/16	(7.9)	1/4	(6.4)	1	(25)	350	(1.5)	560	(2.5)	450	(2.0)	560	(2.5)	500	(2.2)	560	(2.5)
3/8[3]	(9.5)	5/16	(7.9)	1-1/4	(32)	450	(2.0)	870	(3.9)	565	(2.5)	870	(3.9)	700	(3.1)	890	(4.4)
1/2	(12.7)	3/8	(9.5)	1-1/2	(38)	675	(3.0)	1250	(5.6)	925	(4.1)	1325	(5.9)	1100	(4.9)	1325	(5.9)
5/8	(15.9)	1/2	(12.7)	2	(51)	1035	(4.6)	1750	(7.8)	1500	(6.7)	2295	(10.2)	1950	(8.7)	2295	(10.2)
3/4	(19.1)	5/8	(15.9)	2	(51)	1125	(5.0)	1750	(7.8)	1500	(6.7)	3000	(13.3)	1950	(8.7)	3010	(13.4)

1 Based on a safety factor of 4.0.

2 Refer to KWIK Bolt 3 data, in Section 3.3.6.4, for spacing and edge distance guidelines in Concrete.

3 For 1/4" and 3/8" flat phillips and round head anchors, shear values should be reduced by 57% due to the potential of the shear acting through the hollow portion of the head.

Stainless Steel Sleeve Anchor Allowable Loads[1]

Anchor Size in.	(mm)	Embedment Depth in.	(mm)	Concrete[2] 2000 psi (13.8 MPa) Tension lb	(kN)	Shear lb	(kN)	Concrete[2] 4000 psi (27.6 MPa) Tension lb	(kN)	Shear lb	(kN)	Hollow C-90 Concrete Block[3,4] Tension lb	(kN)	Shear lb	(kN)
1/4	(6.4)	1-1/8	(29)	235	(1.0)	450	(2.0)	300	(1.3)	450	(2.0)	200	(0.9)	400	(1.8)
5/16	(7.9)	1-1/4	(32)	310	(1.4)	675	(3.0)	410	(1.8)	675	(3.0)	335	(1.5)	600	(2.7)
3/8	9.5)	1-1/2	(38)	450	(2.0)	1000	(4.4)	600	(2.7)	1000	(4.4)	470	(2.1)	890	(4.0)

1 Based on using a safety factor of 4.0.

2 Refer to KWIK Bolt 3 data, in Section 3.3.6.4 for spacing and edge distance guidelines in Concrete.

3 ASTM Specification C90, Type II.

4 Refer to HY 20 data, in Section 3.2.9.3, for spacing and edge distance guidelines in Hollow Concrete Block.

Carbon Steel Sleeve Anchor Allowable Loads in Grout Filled Block[1,2,3,4,5,6,7]

Anchor Size in.	(mm)	Embed. Depth in.	(mm)	Edge Distance in.	(mm)	Tension lb	(kN)	Shear lb	(kN)
1/4	(6.4)	1	(25)	4	(101)	290	(1.3)	305	(1.4)
				≥ 12	(305)				
5/16	(7.9)	1	(25)	4	(101)	385	(1.7)	500	(2.2)
				≥ 12	(305)				
3/8	(9.5)	1-1/4	(32)	4	(101)	435	(1.9)	725	(3.2)
				≥ 12	(305)				
1/2	(12.7)	1-1/2	(38)	4	(101)	605	(2.7)	865	(3.8)
				≥ 12	(305)			1145	(5.1)
5/8	(15.9)	2	(51)	4	(101)	710	(3.2)	1050	(4.7)
				≥ 12	(305)			1815	(8.1)
3/4	(19.1)	2	(51)	4	(101)	840	(3.7)	1050	(4.7)
				≥ 12	(305)			1970	(8.8)

1 Values are for Lightweight, Medium Weight or Normal Weight concrete masonry units conforming to ASTM C90 with 2000 psi grout conforming to ASTM C474.

2 Embedment depth is measured from the outside face of the concrete masonry unit.

3 Values are for anchors located in the grouted cell, bed joint, cross web or any combination of the above.

4 For anchors installed in the “T” joint or head joint reduce tension values by 20%.

5 Values for edge distances between 4 inches and 12 inches may be calculated by linear interpolation.

6 Anchors are limited to one per unit cell.

7 Based on using a safety factor of 4.0.

Carbon Steel Sleeve Anchor Allowable Loads in Hollow Concrete Block[1,2,3]

Sleeve Anchor Size in.	(mm)	Embedment Depth in.	(mm)	Tension lb	(kN)	Shear lb	(kN)
1/4	(6.4)	1	(25)	350	(1.5)	305	(1.4)
5/16	(7.9)	1	(25)	375	(1.7)	560	(2.5)
3/8	(9.5)	1-1/4	(32)	435	(1.9)	800	(3.5)
1/2	(12.7)	1-1/2	(38)	565	(2.5)	1125	(5.0)

1 Based on using a safety factor of 4.0.

2 ASTM Specification C90, Type II.

3 Refer to HY 20 data, in Section 3.2.9.3, for spacing and edge distance guidelines in Hollow Concrete Block.

Carbon Steel Sleeve Anchor Allowable Loads in Clay Brick[1,2,3]

Anchor Size in.	(mm)	Embedment Depth in.	(mm)	Tension lb	(kN)	Shear lb	(kN)
1/4	(6.4)	1	(25)	295	(1.3)	335	(1.5)
5/16	(7.9)	1	(25)	345	(1.5)	530	(2.3)
3/8	(9.5)	1-1/4	(32)	375	(1.7)	850	(3.8)
1/2	(12.7)	1-1/2	(38)	435	(1.9)	1230	(5.5)

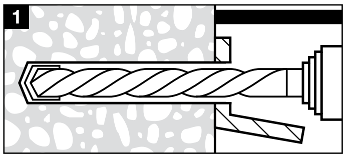
1 Based on using a safety factor of 4.0.

2 Due to wide strength variations encountered in masonry, these values should be considered as guide values.

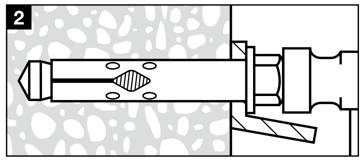
3 Refer to HY 20 data, in Section 3.2.9.3, for spacing and edge distance guidelines in brick.

3.3.12 HLC Sleeve Anchor

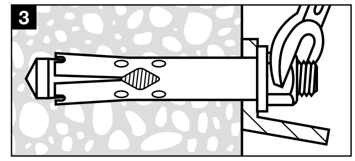
3.3.12.4 Installation Instructions



1. **Drill:** Drill the hole. Clean hole with blow out bulb. For hollow masonry, switch to drilling only mode before penetrating backside.



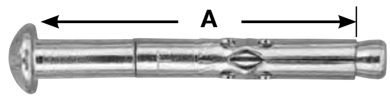
2. **Insert:** Drive the sleeve anchor into the hole. For the bolt version, place the nut flush to the top of the bolt before driving the sleeve anchor.



3. **Set:** Tighten anchor to the recommended torque value. Over-torquing will reduce the pullout and shear loads, up to the point of complete failure.

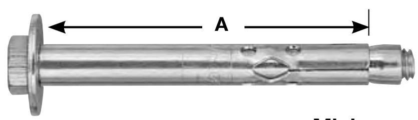
3.3.12.5 Ordering Information

Round Head Slotted (RS)



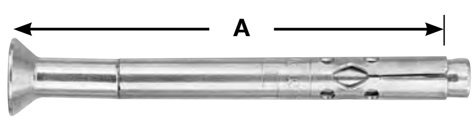
Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-RS 1/4 x 1-1/4	**1/4**	**3/16**	**1**	(25)	**1/4**	(6.4)	100
HLC-RS 1/4 x 2	**1/4**	**3/16**	**1**	(25)	**1**	(25)	100
HLC-RS 1/4 x 4	**1/4**	**3/16**	**1**	(25)	**3**	(76)	100

Bolt Head (H)



Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-H 5/16 x 1-5/8	**5/16**	**1/4**	**1**	(25)	**5/8**	(16)	100
HLC-H 5/16 x 2-5/8	**5/16**	**1/4**	**1**	(25)	**1-5/8**	(41)	100
HLC-H 3/8 x 1-7/8	**3/8**	**5/16**	**1-1/4**	(32)	**5/8**	(16)	50
HLC-H 3/8 x 3	**3/8**	**5/16**	**1-1/4**	(32)	**1-3/4**	(44)	50
HLC-H 1/2 x 2-1/4	**1/2**	**3/8**	**1-1/2**	(38)	**3/4**	(20)	50
HLC-H 1/2 x 3	**1/2**	**3/8**	**1-1/2**	(38)	**1-1/2**	(38)	25
HLC-H 1/2 x 4	**1/2**	**3/8**	**1-1/2**	(38)	**2-1/2**	(64)	25

Flat Phillips Head (FPH)



Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-FPH 1/4 x 1-3/8	**1/4**	**3/16**	**1**	(25)	**3/8**	(10)	100
HLC-FPH 1/4 x 2	**1/4**	**3/16**	**1**	(25)	**1**	(25)	100
HLC-FPH 1/4 x 3	**1/4**	**3/16**	**1**	(25)	**2**	(51)	100
HLC-FPH 1/4 x 4	**1/4**	**3/16**	**1**	(25)	**3**	(76)	100
HLC-FPH 3/8 x 2-7/8	**3/8**	**5/16**	**1-1/4**	(32)	**1-1/2**	(38)	50
HLC-FPH 3/8 x 4	**3/8**	**5/16**	**1-1/4**	(32)	**2-3/4**	(70)	50
HLC-FPH 3/8 x 5	**3/8**	**5/16**	**1-1/4**	(32)	**3-3/4**	(95)	25
HLC-FPH 3/8 x 6	**3/8**	**5/16**	**1-1/4**	(32)	**4-3/4**	(120)	25

1 Hilti carbide tipped drill bits

Definition of Nomenclature

Outside diameter of sleeve, see tables for threaded bolt diameter

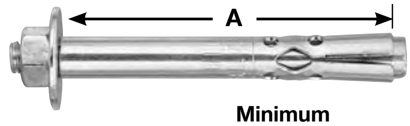
HLC-AC 1/4 X 1-3/8

Nut Configuration

A: the overall length from bottom of washer to end of sleeve

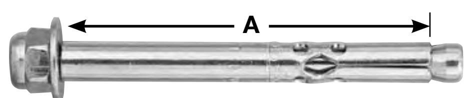
HLC Sleeve Anchor 3.3.12

Hex Nut (HX)



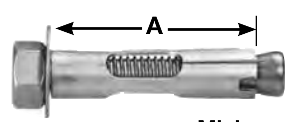
Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-HX 5/16 x 1-5/8	**5/16**	**1/4**	**1**	(25)	**1/2**	(38)	100
HLC-HX 5/16 x 2-5/8	**5/16**	**1/4**	**1**	(25)	**1/2**	(13)	100
HLC-HX 3/8 x 1-7/8	**3/8**	**5/16**	**1-1/4**	(32)	**5/8**	(16)	50
HLC-HX 3/8 x 3	**3/8**	**5/16**	**1-1/4**	(32)	**1-3/4**	(44)	50
HLC-HX 1/2 x 2-1/4	**1/2**	**3/8**	**1-1/2**	(38)	**3/4**	(19)	25
HLC-HX 1/2 x 3	**1/2**	**3/8**	**1-1/2**	(38)	**1-1/2**	(38)	25
HLC-HX 1/2 x 4	**1/2**	**3/8**	**1-1/2**	(38)	**2-1/2**	(64)	25
HLC-HX 1/2 x 6	**1/2**	**3/8**	**1-1/2**	(38)	**4-1/2**	(114)	15
HLC-HX 5/8 x 2-1/4	**5/8**	**1/2**	**2**	(51)	**1/4**	(6)	25
HLC-HX 5/8 x 4-1/4	**5/8**	**1/2**	**2**	(51)	**2-1/4**	(57)	10
HLC-HX 5/8 x 6	**5/8**	**1/2**	**2**	(51)	**4**	(102)	10
HLC-HX 3/4 x 2-1/2	**3/4**	**5/8**	**2**	(51)	**1/2**	(13)	10
HLC-HX 3/4 x 4-1/4	**3/4**	**5/8**	**2-1/2**	(64)	**1-3/4**	(44)	10
HLC-HX 3/4 x 61/4	**3/4**	**5/8**	**2-1/2**	(64)	**3-3/4**	(95)	10

Acorn Head (AC)



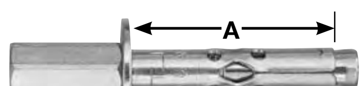
Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-AC 1/4 x 1-3/8	**1/4**	**3/16**	**1**	(25)	**3/8**	(10)	100
HLC-AC 1/4 x 2-1/4	**1/4**	**3/16**	**1**	(25)	**1-1/4**	(32)	100

304SS Sleeve Anchors



Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Fastens Materials Up To in.	(mm)	Box Qty
HLC-HX 304SS 1/4 x 2-1/4	**1/4**	**3/16**	**1-1/8**	(29)	**1-1/8**	(29)	100
HLC-HX 304SS 5/16 x 1-1/2	**5/16**	**1/4**	**1-1/4**	(32)	**1/4**	(6.4)	100
HLC-HX 304SS 5/16 x 2-1/2	**5/16**	**1/4**	**1-1/4**	(32)	**1-1/4**	(32)	100
HLC-HX 304SS 3/8 x 1-7/8	**3/8**	**5/16**	**1-1/2**	(38)	**3/8**	(9.5)	50
HLC-HX 304SS 3/8 x 3	**3/8**	**5/16**	**1-1/2**	(38)	**1-1/2**	(38)	50

Rod Coupling (RC)



Description	Bit Diameter[1] In.	Bolt Diameter In.	Minimum Embed. Depth in.	(mm)	Rod Coupler	Box Qty
HLC-RC 3/8 x 1-7/8	**3/8**	**5/16**	**1-1/4**	(32)	**5/16" x 3/8"**	50
HLC-RC 1/2 x 2-1/4	**1/2**	**3/8**	**1-1/2**	(38)	**3/8" x 1/2"**	25

1 Hilti carbide tipped drill bits

Definition of Nomenclature

Outside diameter of sleeve, see tables for threaded bolt diameter

HLC-AC 1/4 X 1-3/8

Nut Configuration

A: the overall length from bottom of washer to end of sleeve

3.3.13 KWIK-CON II+ Fastening System

Listings/Approvals

Metro-Dade County
Pending

3.3.13.1 Product Description

The Hilti KWIK-CON II+ Fastening System for concrete and masonry consists of the KWIK-CON II+ fastener, the KWIK-CON II+ drive tool, and a Hilti matched tolerance carbide-tipped drill bit.

Product Features

- Choice of head styles—Torx Hex Washer Head for fast, secure driving; Torx or Phillips Flat Head for countersinking applications
- Matched tolerance carbide-tipped drill bit supplied with each box of 100 KWIK-CON II+ fasteners
- Exclusive internal TORX drive
- Choice of 1/4” or 3/16” diameter fasteners
- Fasteners protected by corrosive resistant coating; stainless steel fasteners available in select sizes
- High quality Hilti SDS and straight shank drill bits (Refer to section 4.3.12.5)

Guide Specifications

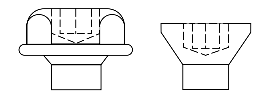
Concrete Screw Anchors
Concrete or masonry screw anchors shall be manufactured from AISI 1021 cold rolled steel case hardened to a minimum Rockwell Hardness C 45 or stainless steel conforming to AISI 410. The concrete or masonry screw anchors shall have a trilobular, cold formed thread design and 8 threads per inch. Screw anchors shall have one of the following head designs: Tapered flat head with T-25 TORX recess,Tapered flat head with T-27 TORX recess or 5/16” hex washer with internal T-25 TORX recess. Anchor plating shall be in accordance with ASTM B633 SC 2 Type II to a minimum thickness of 8 µm. Anchors shall be Hilti KWIK-CON II anchors as supplied by Hilti.

Installation
Concrete or masonry screw anchors shall be installed in holes drilled with matched tolerance Hilti carbide-tipped drill bits supplied with each box of KWIK-CON II anchors. Installation shall be in accordance with manufacturer’s installation instructions.

3.3.13.2 Material Specifications

		Mechanical Properties	
		f_y ksi	min. f_u ksi
Material Composition 1018 to 1022 cold rolled steel (case hardened to HRC 45 minimum)	3/16"	137	138
	1/4"	157	163
or 410 Stainless Steel	3/16"	157	184
	1/4"	170	194

Head Styles
Tapered flat head with #3 Phillips recess (3/16" and 1/4" diameter anchors)
Tapered flat head with T-25 TORX recess (3/16" diameter anchor)
Tapered flat head with T-27 TORX recess (1/4" diameter anchor)
5/16” hex washer with internal T-25 TORX recess (3/16" and 1/4" diameter anchors)



Head Diameter
0.507" maximum (3/16" and 1/4" tapered Philliips flat head and 1/4" tapered T-27 TORX flat head anchors)
0.385" maximum (3/16" tapered T-25 TORX flat head anchor)
0.432" maximum (3/16" and 1/4" T-25 TORX hex washer head anchors)

Thread Diameter
Nominal 3/16"; Major: 0.217"; Minor[2]: 0.145"
Nominal 1/4"; Major: 0.283"; Minor[2]: 0.190"

Shank Diameter
3/16" – 0.170"
1/4" – 0.224"

Lengths
1-1/4", 1-3/4", 2-1/4", 2-3/4", 3-1/4",3-3/4",4" (See Ordering Information Section 4.3.10.5)

Thread Design
Trilobular, cold formed

Threads per inch
3/16" anchor = 8 T.P.I.
1/4" anchor = 8 T.P.I.

Inches of Thread per fastener
1.875" maximum

Plating
8 µm zinc/chromate plating in accordance with ASTM B633, Sc 2, Type II, on carbon steel anchors

Bending Capacity
Ductility at 10° minimum

1 Mechanical properties based on limited (30 samples) testing of actual KWIK-CON II samples (i.e. not based on minimum steel properties).

2 Minor diameter based on average root diamter of 30 KWIK-CON II samples (i.e. not a controlled dimension).

3.3.13 KWIK-CON II+ Fastening System

3.3.13.3 Technical Data

Table 1 - Tension and Shear Allowable Loads in Concrete [1, 2]

Anchor Dia. in.	Embedment Depth in. (mm)	2000 psi (13.8 MPa)		4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	100 (0.44)	260 (1.16)	125 (0.56)	260 (1.16)	185 (0.82)	280 (1.25)
3/16	1-3/4 (44)	275 (1.22)	260 (1.16)	295 (1.31)	265 (1.18)	325 (1.45)	300 (1.33)
1/4	1 (25)	190 (0.85)	325 (1.45)	240 (1.07)	390 (1.73)	275 (1.22)	540 (2.40)
1/4	1-3/4 (44)	425 (1.89)	560 (2.49)	625 (2.78)	600 (2.82)	650 (2.89)	600 (2.67)

1 Published load values represent the average test results of testing conducted in local base materials using Hilti matched-tolerance drill bits. Because of variations in materials, on-site testing is necessary to determine actual performance at any specific site.

2 Allowable working loads are based on a safety factor of 4.0.

Table 2 - Tension and Shear Ultimate Loads in Concrete[1]

Anchor Dia. in.	Embedment Depth in. (mm)	2000 psi (13.8 MPa)		4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
		Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	400 (1.78)	1050 (4.67)	500 (2.22)	1050 (4.67)	750 (3.34)	1150 (5.12)
3/16	1-3/4 (44)	1100 (4.89)	1050 (4.67)	1180 (5.25)	1070 (4.76)	1300 (5.78)	1200 (5.34)
1/4	1 (25)	760 (3.38)	1300 (5.78)	970 (4.31)	1575 (7.01)	1100 (4.89)	2175 (9.68)
1/4	1-3/4 (44)	1700 (7.56)	2250 (10.0)	2500 (11.1)	2400 (11.3)	2600 (11.6)	2400 (10.7)

1 Published load values represent the average test results of testing conducted in local base materials using Hilti matched-tolerance drill bits. Because of variations in materials, on-site testing is necessary to determine actual performance at any specific site.

2 Allowable working loads are based on a safety factor of 4.0.

Table 3 - Tension and Shear Allowable Loads in Hollow Block[1,2]

Anchor Dia. in.	Embed. Depth in. (mm)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	150 (0.67)	225 (1.00)
3/16	1-3/4 (44)	290 (1.29)	300 (1.33)
1/4	1 (25)	165 (0.73)	275 (1.22)
1/4	1-3/4 (44)	310 (1.38)	400 (1.78)

1 ASTM Specification C90 Grade N. Type II pilot holes drilled with TKB matched tolerance bits for concrete blocks.

2 Allowable working loads are based on a safety factor of 4.0.

Table 4 - Tension and Shear Allowable Loads in Red Brick[1, 2]

Anchor Dia. in.	Embed. Depth in. (mm)	Tension lb (kN)	Shear lb (kN)
3/16	1 (25)	125 (0.56)	235 (1.05)
3/16	1-3/4 (44)	350 (1.56)	300 (1.33)
1/4	1 (25)	205 (0.91)	415 (1.85)
1/4	1-3/4 (44)	350 (1.56)	500 (2.22)

1 This test was performed on individual specimens of ASTM C62 common red brick. Due to the wide variations encountered in the compressive strength of brick, these values should be considered Guide Values.

2 Allowable working loads are based on a safety factor of 4.0.

The anchors are installed a minimum of 12 diameters on center with a minimum edge distance of six diameters for 100 percent anchor efficiency. Spacing and edge distance may be reduced to six diameter spacing and three diameter edge distance providing values are reduced 50 percent. Linear interpolation may be used for intermediate spacing and edge margins.

Combined Shear and Tension Loading

$$\left(\frac{N_d}{N_d}\right) + \left(\frac{V_d}{V_d}\right) \leq 1.0 \quad \text{(Ref. Section 4.1.9.6)}$$

3.3.13.4 Installation Instructions

Determining the Correct KWIK-CON II+ Fastener & Hole Depth

The Hilti KWIK-CON II+ masonry fastening system consists of the KWIK-CON II+ fastener, the KWIK-CON II+ drive tool, and a TKC or TKB matched tolerance carbide-tipped drill bit. Consistent performance and maximum pullout strength can be assured only when all three elements of the system are properly used.

Fastener Length

The length of the KWIK-CON II+ fastener to be used is determined by combining the thickness of the fixture being attached (A) with the desired depth of embedment in the masonry material (B). It is recommended that a minimum of 1" and a maximum of 1-3/4" embedment be used in determining fastener length.

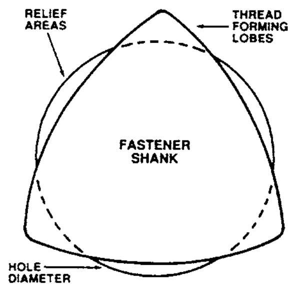
KWIK-CON II+ fasteners are available in 1/4" and 3/16" diameters. The diameter of the fastener and the depth of embedment affect pullout strengths. Application strength requirements and safety factors should be considered when determining the depth of embedment and fastener diameter. For assistance, contact your local Hilti Sales Representative.

Hole Depth

A TKC matched tolerance carbide tipped drill bit is supplied with each box of KWIK-CON II+ fasteners. The correct hole depth (B+C) can normally be obtained by drilling the full length of this bit. In all cases, the hole must be at least 1/2" deeper than the depth of the fastener embedment.

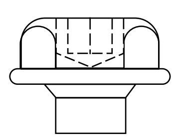
Hole Diameter

The diameter of the drilled hole is also important to the performance of the KWIK-CON II+ masonry fastening system. Using Hilti TKC (concrete) or TKB (block) matched tolerance carbide-tipped bits will help assure consistent fastener performance and maximum pullout strength.

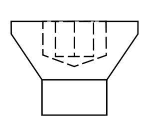


Head Styles

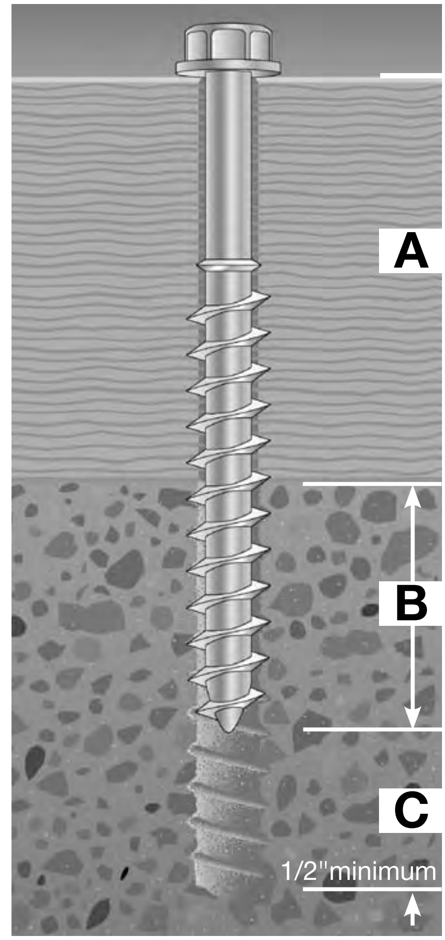
Head Styles
TORX Hex Washer Head Uses either TORX or hex drives Washer head provides a bearing surface for fast, secure fastening.
TORX or Phillips Flat Head Used when a countersunk appearance is desirable



Torx Hex Washer Head Internal Torx



Torx or Phillips Flat Head



A = Fixture being attached

B = KWIK-CON II+ embedment minimum of 1", maximum of 1-3/4" is recommended

A + B = Length KWIK-CON II+ to be used

B + C = Depth of hole drilled must be at least 1/2" deeper than KWIK-CON II+ embedment

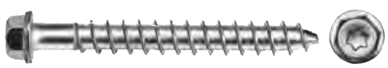
3.3.13 KWIK-CON II+ Fastening System

3.3.13.5 Ordering Information

KWIK-CON II+ Fasteners (100 per box including 1 bit except bulk which are 1,000 pieces per box without bit)

5/16" Magnetic Nut Setter or T-25 TORX Bit

Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
KWIK-CON II+ 316-114 THWH	3/16	1-1/4	1-1/4	0
KWIK-CON II+ 316-114 THWH Bulk	3/16	1-1/4	1-1/4	0
KWIK-CON II+ 316-134 THWH	3/16	1-3/4	1-3/4	0
KWIK-CON II+ 316-134 THWH Bulk	3/16	1-3/4	1-3/4	0
KWIK-CON II+ 316-214 THWH	3/16	2-1/4	1-3/4	1/2
KWIK-CON II+ 316-234 THWH	3/16	2-3/4	1-3/4	1
KWIK-CON II+ 316-234 THWH Bulk	3/16	2-3/4	1-3/4	1
KWIK-CON II+ 316-314 THWH	3/16	3-1/4	1-3/4	1-1/2
KWIK-CON II+ 316-334 THWH	3/16	3-3/4	1-3/4	2
KWIK-CON II+ 316-4 THWH	3/16	4	1-3/4	2-1/4

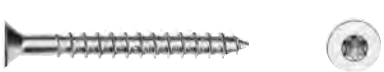


5/16" Magnetic Nut Setter or T-25 Bit

Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
KWIK-CON II+ 14-114 THWH	1/4	1-1/4	1-1/4	0
KWIK-CON II+ 14-114 THWH Bulk	1/4	1-1/4	1-1/4	0
KWIK-CON II+ 14-134 THWH	1/4	1-3/4	1-3/4	0
KWIK-CON II+ 14-134 THWH Bulk	1/4	1-3/4	1-3/4	0
KWIK-CON II+ 14-214 THWH	1/4	2-1/4	1-3/4	1/2
KWIK-CON II+ 14-234 THWH	1/4	2-3/4	1-3/4	1
KWIK-CON II+ 14-234 THWH Bulk	1/4	2-3/4	1-3/4	1
KWIK-CON II+ 14-314 THWH	1/4	3-1/4	1-3/4	1-1/2
KWIK-CON II+ 14-334 THWH	1/4	3-3/4	1-3/4	2
KWIK-CON II+ 14-334 THWH Bulk	1/4	3-3/4	1-3/4	2
KWIK-CON II+ 14-4 THWH	1/4	4	1-3/4	2-1/4
KWIK-CON II+ 14-114 THWH Stainless Steel	1/4	1-1/4	1-1/4	0
KWIK-CON II+ 14-234 THWH Stainless Steel	1/4	2-3/4	1-3/4	1

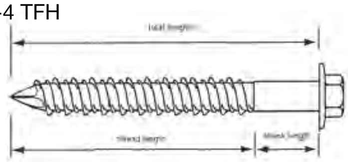
T-25 TORX Bit

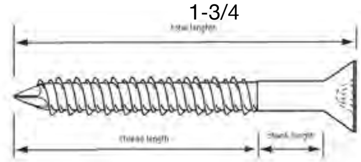
Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
KWIK-CON II+ 316-114 TFH	3/16	1-1/4	1-1/8	0
KWIK-CON II+ 316-134 TFH	3/16	1-3/4	1-5/8	0
KWIK-CON II+ 316-134 TFH Bulk	3/16	1-3/4	1-5/8	0
KWIK-CON II+ 316-214 TFH	3/16	2-1/4	1-3/4	3/8
KWIK-CON II+ 316-234 TFH	3/16	2-3/4	1-3/4	7/8
KWIK-CON II+ 316-234 TFH Bulk	3/16	2-3/4	1-3/4	7/8
KWIK-CON II+ 316-314 TFH	3/16	3-1/4	1-3/4	1-3/8
KWIK-CON II+ 316-334 TFH	3/16	3-3/4	1-3/4	1-7/8
KWIK-CON II+ 316-334 TFH Bulk	3/16	3-3/4	1-3/4	1-7/8
KWIK-CON II+ 316-4 TFH	3/16	4	1-3/4	2-1/8



T-27 TORX Bit

Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
KWIK-CON II+ 14-114 TFH	1/4	1-1/4	1-1/16	0
KWIK-CON II+ 14-134 TFH	1/4	1-3/4	1-9/16	0
KWIK-CON II+ 14-134 TFH Bulk	1/4	1-3/4	1-9/16	0
KWIK-CON II+ 14-214 TFH	1/4	2-1/4	1-3/4	5/16
KWIK-CON II+ 14-234 TFH	1/4	2-3/4	1-3/4	13/16
KWIK-CON II+ 14-314 TFH	1/4	3-1/4	1-3/4	1-5/16
KWIK-CON II+ 14-314 TFH Bulk	1/4	3-1/4	1-3/4	1-5/16
KWIK-CON II+ 14-334 TFH	1/4	3-3/4	1-3/4	1-13/16
KWIK-CON II+ 14-4 TFH	1/4	4	1-3/4	2-1/16

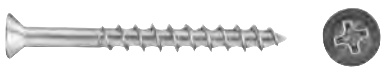




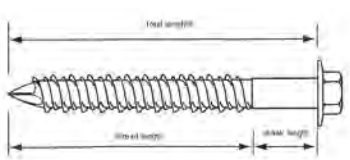
KWIK-CON II+ Fastening System 3.3.13

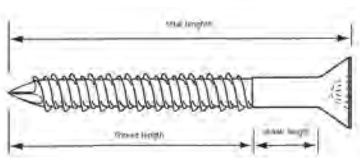
KWIK-CON II+ Fasteners (100 per box including 1 bit except bulk which are 1,000 pieces per box without bit)

Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
	#3 Phillips Bit			
KWIK-CON II+ 316-114 PFH	3/16	1-1/4	1-1/16	0
KWIK-CON II+ 316-134 PFH	3/16	1-3/4	1-9/16	0
KWIK-CON II+ 316-134 PFH Bulk	3/16	1-3/4	1-9/16	0
KWIK-CON II+ 316-214 PFH	3/16	2-1/4	1-3/4	5/16
KWIK-CON II+ 316-234 PFH	3/16	2-3/4	1-3/4	13/16
KWIK-CON II+ 316-234 PFH Bulk	3/16	2-3/4	1-3/4	13/16
KWIK-CON II+ 316-314 PFH	3/16	3-1/4	1-3/4	1-5/16
KWIK-CON II+ 316-334 PFH	3/16	3-3/4	1-3/4	1-13/16
KWIK-CON II+ 316-4 PFH	3/16	4	1-3/4	2-1/16
KWIK-CON II+ 316-114 PFH Stainless Steel	3/16	1-1/4	1-1/16	0
KWIK-CON II+ 316-234 PFH Stainless Steel	3/16	2-3/4	1-3/4	13/16



Description	Diameter (In.)	Total Length (In.)	Thread Length (In.)	Shank Length (In.)
	#3 Phillips Bit			
KWIK-CON II+ 14-114 PFH	1/4	1-1/4	1-1/16	0
KWIK-CON II+ 14-134 PFH	1/4	1-3/4	1-9/16	0
KWIK-CON II+ 14-134 PFH Bulk	1/4	1-3/4	1-9/16	0
KWIK-CON II+ 14-214 PFH	1/4	2-1/4	1-3/4	5/16
KWIK-CON II+ 14-234 PFH	1/4	2-3/4	1-3/4	13/16
KWIK-CON II+ 14-234 PFH Bulk	1/4	2-3/4	1-3/4	13/16
KWIK-CON II+ 14-314 PFH	1/4	3-1/4	1-3/4	1-5/16
KWIK-CON II+ 14-334 PFH	1/4	3-3/4	1-3/4	1-13/16
KWIK-CON II+ 14-4 PFH	1/4	4	1-3/4	2-1/16





KWIK-CON II+ Hex Driver System

Description	Box Qty
KWIK-CON Hex Driver Deluxe Kit	1
KWIK-CON Hex Driver	1
5/16" Hex Driver (all THWH)	1
5/16" Hex Nut Setter/Depth Locator	1
Insert Bit Holder/Depth Locator	1
#3 Phillips Driver (all PFH)	1
T-25 TORX Driver (3/16" TFH)	1
T-27 TORX Driver (1/4" TFH)	1

KWIK-CON II+ Matched Tolerance Drill Bits

Description	Bit Diameter (In.)	Box Qty
For 1/4" KWIK-CON II+ Applications in Dense Concrete (2000 psi+)		
TKC Large Concrete Bit SDS+ Hex	0.2402	1
TKC Large Concrete Bit TM Hex	0.2402	1
For 1/4" KWIK-CON II+ Applications in Light Concrete, Brick or Block		
TKB Large Block Bit SDS+ Hex	0.2260	1
TKB Large Block Bit TM Hex	0.2260	1
For 3/16" KWIK-CON II+ Applications in Dense Concrete (2000 psi+)		
TKC Small Concrete Bit SDS+ Hex	0.1902	1
TKC Small Concrete Bit TM Hex	0.1902	1
For 3/16" KWIK-CON II+ Applications in Light Concrete, Brick or Block		
TKB Small Block Bit SDS+ Hex	0.1752	1
TKB Small Block Bit TM Hex	0.1752	1

3.3.14 Metal Hit Anchor

3.3.14.1 Product Description

The Hilti Metal Hit Anchor is a drive-in type expansion anchor consisting of a zinc plated or stainless steel drive pin and an alloy expanding body for light duty fastenings in concrete and masonry.

Product Features

- Quick and easy fastening for maximum speed and installation
- Low profile mushroom head style provides a clean, tamper proof fastening
- Anchor design allows easy through-type fastenings even in bottomless holes
- Consistent load values provide light duty fastenings in concrete and masonry
- Choice of stainless steel or carbon steel finish allows outdoor or indoor use

3.3.14.2 Material Specifications

Body material: Aluminum/Zinc Alloy

Drive Pin: Zinc plated carbon steel conforming to AISI 1018. Type 304 Stainless Steel (Stainless Steel Version)

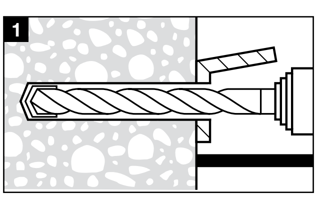
3.3.14.3 Technical Data

Metal Hit Allowable Loads in Normal Weight Concrete

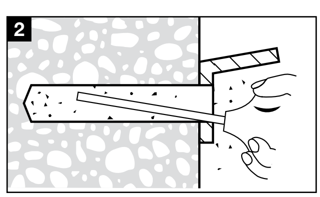
Anchor Size in.	Embed. Depth in. (mm)		Concrete						Hollow Concrete block				Red Clay block			
			Tension lb (kN)				Shear lb (kN)		Tension lb (kN)		Shear lb (kN)		Tension lb (kN)		Shear lb (kN)	
			2000psi		4000psi		2000psi									
3/16	5/8	(16)	–		–		–		180	(0.8)	180	(0.8)	–		–	
1/4	3/4	(19)	135	(0.6)	210	(0.9)	280	(1.2)	255	(1.1)	320	(1.4)	180	(0.8)	280	(1.2)
1/4	1	(25)	160	(0.7)	240	(1.1)	315	(1.4)	310	(1.4)	320	(1.4)	245	(1.1)	290	(1.3)

For overhead application reduce the allowable load values by a factor of 2.

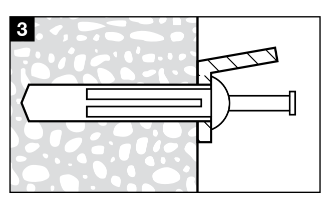
3.3.14.4 Installation Instructions



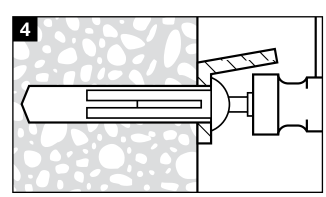
1. Drill hole at least 1/4" deeper than anchor.



2. Clean hole.



3. Install anchor through fixture.



4. Hammer in nail until nail head is flush with anchor body. Do not overdrive.

3.3.14.5 Ordering Information

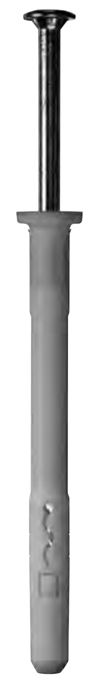
Description	Carbon Item No.	Stainless Item No.	Bolt Diameter[1] In.	Box Qty
Metal Hit 3/16" x 7/8"	66137	N/A	3/16	100
Metal Hit 1/4" x 3/4"	15538	N/A	1/4	100
Metal Hit 1/4" x 1"	66138	230567	1/4	100
Metal Hit 1/4" x 1-1/4"	66139	230568	1/4	100
Metal Hit 1/4" x 1-1/2"	66140	230569	1/4	100
Metal Hit 1/4" x 2"	45453	230570	1/4	100

3.3.15.1 Product Description

The HPS-1 Impact Anchor consists of a carbon or stainless steel drive-screw and a plastic expansion body, which combine to form an easy-to-install yet removable fastening, for light duty applications in concrete and masonry.

Product Features

- Recessed philips drive connection in the screw head provides protection during hammering, allowing simple setting and removal
- Anchor collar and screw head form a compact unit which allows countersinking in soft wood and solid clamping action with metal parts
- Expanding head opens in hollow base material to provide reliable keying effect
- One type anchor reduces inventory, provides versatile use in brick, hollow block and concrete
- Can be set with hammer or screw driver for quick and easy installation
- Available with 304 Stainless Steel Nail for use in corrosive environments
- Plastic body is temperature resistant from –40°F to 176°F. Anchor can be installed from 14°F to 104°F. Both temperature ranges allow use in extreme climactic conditions
- Suitable for through-hole fastenings to improve productivity
- Easy removal adds to HPS-1 versatility.



3.3.15.2 Material Specifications

Corrosion resistant body made of polyamide 6.6 plastic
Carbon steel drive screw material meets the requirements of AISI 1010
Carbon steel drive screw zinc plated to minimum 5 µm thickness in accordance with ASTM B633, SC 1, Type III
Stainless steel drive screw material meets the requirements of AISI 304

3.3.15.3 Technical Data

HPS-1 Allowable Loads[1]

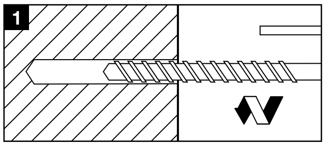
Base Material	Anchor	HPS-1 3/16 to 1 3/16 to 1-1/2	HPS-1 1/4 to 1	HPS-1 1/4 to 1-5/8 1/4 to 2-1/16 1/4 to 2-5/8	HPS-1 5/16 to 1-5/8 5/16 to 2-1/2	HPS-1 5/16 to 3-5/8 5/16 to 4-3/8
Concrete 2000 psi (13.8 MPa)	Tension lb (N)	30 (133)	55 (245)	70 (311)	80 (356)	90 (400)
	Shear lb (N)	95 (422)	130 (578)	135 (600)	215 (956)	110 (489)
Brick Masonry	Tension lb (N)	35 (155)	40 (178)	45 (200)	45 (200)	N/A
	Shear lb (N)	105 (467)	145 (645)	165 (734)	220 (979)	N/A
Hollow Concrete Block (Normal Wt.)	Tension lb (N)	50 (222)	55 (245)	60 (600)	65 (289)	N/A
	Shear lb (N)	120 (534)	140 (623)	160 (712)	185 (823)	N/A
Min. Embed. Depth – Concrete	in. (mm)	3/4 (19)	7/8 (22)	1 (25)	1-3/16 (30)	1-3/16 (30)
Min. Embed. Depth – Hollow Base	in. (mm)	5/8 (16)	13/16 (21)	13/16 (21)	1 (25)	N/A

1 Representative results of testing and a safety factor of 5.0.

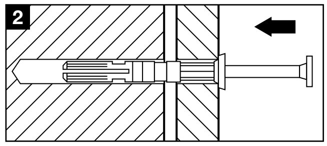
3.3.15 HPS-1 Impact Anchor

3.3.15.4 Installation Instructions

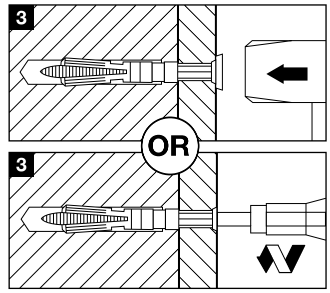
Solid Base Materials



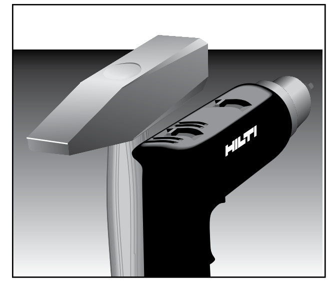
1. Drill hole (depth = anchor length minus thickness fastened plus 1/2”).



2. Insert anchor.

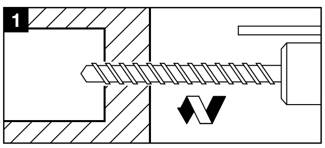


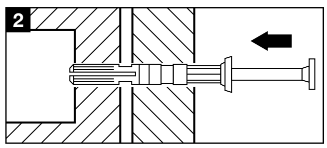
3. Set the anchor with a hammer or with an electric screwdriver.

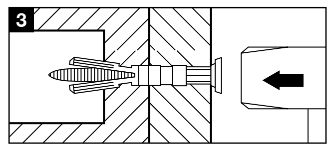


- Drive with a hammer or an electric screwdriver
- An accurately matched anchor length provides optimized holding power by allowing for expansion in the first part of the brick or block.

Hollow Base Materials







3.3.15.5 Ordering Information

Carbon Steel

Description	Fastenable Material Thickness in Concrete max In.	(mm)	Fastenable Material Thickness in Hollow Base Materials max In.	(mm)	Bit Diameter In.	Box Qty
HPS-1 3/16 x 1	3/16	(5)	3/8	(9)	3/16	200
HPS-1 3/16 x 1-1/2	5/8	(15)	3/4	(19)	3/16	200
HPS-1 1/4 x 1	1/8	(3)	3/16	(5)	1/4	200
HPS-1 1/4 x 1-5/8	5/8	(15)	3/4	(19)	1/4	100
HPS-1 1/4 x 2-1/16	1	(25)	1-3/16	(30)	1/4	100
HPS-1 1/4 x 2-5/8	1-5/8	(41)	1-3/4	(44)	1/4	100
HPS-1 5/16 x 1-5/8	3/8	(9)	5/8	(15)	5/16	100
HPS-1 5/16 x 2-1/2	1-3/16	(30)	1-3/8	(35)	5/16	50
HPS-1 5/16 x 3-5/8	2-3/8	(60)	N/A		5/16	50
HPS-1 5/16 x 4-3/8	3-1/8	(85)	N/A		5/16	50

Stainless Steel

Description	Fastenable Material Thickness in Concrete max In.	(mm)	Fastenable Material Thickness in Hollow Base Materials max In.	(mm)	Bit Diameter In.	Box Qty
HPS-1 R 3/16 x 1	3/16	(5)	3/8	(9)	3/16	200
HPS-1 R 3/16 x 1-1/2	5/8	(15)	3/4	(19)	3/16	200
HPS-1 R 1/4 x 1	1/8	(3)	3/16	(5)	1/4	200
HPS-1 R 1/4 x 1-5/8	5/8	(15)	3/4	(19)	1/4	100
HPS-1 R 1/4 x 2-1/16	1	(25)	1-3/16	(30)	1/4	100
HPS-1 R 1/4 x 2-5/8	1-5/8	(41)	1-3/4	(44)	1/4	100
HPS-1 R 5/16 x 3-5/8	2-3/8	(60)	N/A		5/16	50
HPS-1 R 5/16 x 4-3/8	3-1/8	(85)	N/A		5/16	50

1 Hilti carbide tipped drill bits

3.3.16.1 Product Description

The Hilti HTB TOGGLER® Bolt fastening system consists of a metal channel threaded to accept a machine bolt, and unique plastic legs and locking cap for fastening in a wide range of hollow-wall materials.

Product Features

- Unique installation legs and locking cap facilitate fastening in wide range of drywall and hollow wall materials up to 2-1/4" thick
- One piece metal channel provides greater holding power
- Plastic pull ring assists in setting lock cap
- Anchor is adjustable for various base material thicknesses providing easier installation as well as minimizing inventory investment
- Remains mounted in the wall without screw for convenient handling, installation and reuse
- Available in stainless steel and carbon steel for different environments
- Comprehensive offering with and without machine screws

3/16" & 1/4" 3/8" & 1/2"

3.3.16.2 Material Specifications

Zinc plated metal channel material meets the requirements for AISI 1010 steel

3.3.16.3 Technical Data

HTB TOGGLER® Bolt Allowable Loads[1]

Toggler Bolt Size in.	Hole Dia. in.	1/2" Drywall Tension lb (N)	1/2" Drywall Shear lb (N)	5/8" Drywall Tension lb (N)	5/8" Drywall Shear lb (N)	Hollow Concrete Block Tension lb (kN)	Hollow Concrete Block Shear lb (N)
3/16	1/2	30 (133)	70 (311)	45 (200)	95 (423)	140 (623)	160 (712)
1/4	1/2	35 (155)	85 (378)	50 (222)	105 (467)	160 (712)	240 (1068)
3/8	3/4	35 (155)	70 (311)	50 (222)	105 (467)	200 (890)	380 (1690)
1/2	3/4	35 (155)	85 (378)	50 (222)	110 (489)	240 (1068)	420 (1868)

1 Based on using a safety factor of 4.0.

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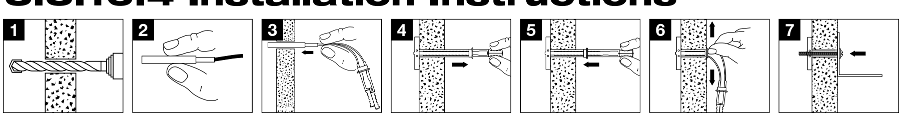
3.3.16.4 Installation Instructions



1 Drill correct size hole into wall cavity.
2 Position the metal channel parallel with the plastic legs.
3 Insert the metal channel through the drilled hole into the wall cavity.
4 Pull the metal channel firmly against the inner wall cavity by tugging the plastic pull ring.
5 Slide the plastic cap forward along the legs until it is seated flush to the work surface.
6 Snap the plastic legs off flush at the plastic cap by pushing outward.
7 Secure the item to be fastened with the proper size machine screw and screw driver. NOTE: Maximum torque on screw or rod is 5 ft-lb.

3.3.16.5 Ordering Information

Description	Machine Screw Dia. (In.)	Machine Screw Length (In.)	Bit Dia. (in.)[1]	Box Qty
HTB TOGGLER® Bolt 3/16" with SRH screw[1]	3/16	2-1/2	1/2	100
HTB TOGGLER® Bolt 3/16" with PFH screw[2]	3/16	2-1/2	1/2	100
HTB TOGGLER® Bolt 3/16" w/o screw[3]	3/16	–	1/2	100
HTB TOGGLER® Bolt 1/4" with SRH screw[1]	1/4	2-1/2	1/2	100
HTB TOGGLER® Bolt 1/4" with PFH screw[2]	1/4	2-1/2	1/2	100
HTB TOGGLER® Bolt 1/4" w/o screw[3]	1/4	–	1/2	100
HTB TOGGLER® Bolt 3/8" with SRH screw[1]	3/8	2-1/2	3/4	25
HTB TOGGLER® Bolt 3/8" w/o screw[3]	3/8	–	3/4	25
HTB TOGGLER® Bolt 1/2" with SRH screw[1]	1/2	2-1/2	3/4	25
HTB TOGGLER® Bolt 1/2" w/o screw[3]	1/2	–	3/4	25

1 Round Head (Combination Slotted/Phillips)
2 Phillips Flat Head
3 Machine screws not included

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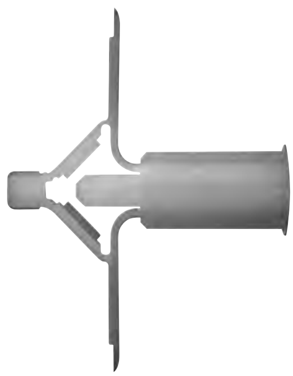
3.3.17 HLD Kwik Tog



3.3.17.1 Product Description

The Hilti HLD KWIK Tog is a plastic anchor designed to accept #8 or #10 screws for light duty applications in hollow or solid base materials

Product Features

- Unique one piece design for easy setting
- Three convenient sizes for use in a variety of hollow base materials from 1/4" drywall to block and concrete
- Leg braces provide added support
- Ribs on body help prevent anchor from spinning during installation
- Remains mounted in the wall without screw for convenient handling, installation and reuse

3.3.17.2 Material Specifications

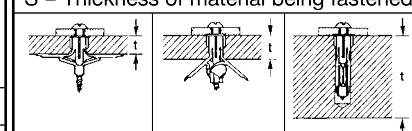
Plastic: polypropylene for use in temperature range from –40°F to 140°F

3.3.17.3 Technical Data

Base Material Thickness (in.)	Drill Bit Dia. (in.)	L	d
HLD KWIK Tog 2 specially designed for 1/2" sheetrock			
5/32" to 1/2"	3/8"	1-1/4" + S	#8 / #10
17/32" to 19/32"	3/8"	1-1/4" + S	#8 / #10
greater than 1-3/8"	3/8"	1-9/16" + S	#10 / #12
HLD KWIK Tog 3 specially designed for 5/8" sheetrock			
5/8" to 3/4"	3/8"	1-1/2" + S	#8 / #10
3/4" to 7/8"	3/8"	1-1/2" + S	#8 / #10
greater than 1-5/8"	3/8"	1-13/16" + S	#10 / #12
HLD KWIK Tog 4			
15/16" to 1-1/8"	3/8"	1-7/8" + S	#8 / #10
1-1/8" to 1-1/4"	3/8"	1-7/8" + S	#8 / #10
greater than 2"	11/32"	2-3/16" + S	#10 / #12

Specification Table

S = Thickness of material being fastened

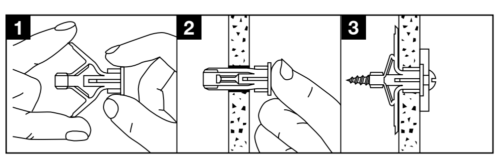


HLD KWIK-Tog Allowable Loads[1]

Description	1/2" Drywall Tension lb (N)	5/8" Drywall Tension lb (N)	Hollow Concrete Block Tension lb (N)
HLD 2	20 (89)	25 (111)	40 (178)
HLD 3	–	35 (156)	50 (222)
HLD 4	–	–	70 (311)

1 Based on using a safety factor of 5.0.

3.3.17.4 Installation Instructions



1. Compress wings together.
2. Insert anchor through drilled hole.
3. Insert and tighten screw through fixture to expand wings.

3.3.17.5 Ordering Information

HLD KWIK-Tog Anchor Program

Description	Bit Dia. (In.)	Hollow Base Matl. Thickness (In.)	Allowable Load in 5/8" Drywall Tension lb	(kN)	Recommenmded Screw Size[1] Hollow Base Matl.	Solid Base Mtl.	Qty Per Bag
HLD KWIK Tog 2 (HLD2)	3/8	3/16 to 5/8	25	(0.11)	#8 or #10	#10	150
HLD KWIK Tog 3 (HLD3)	3/8	5/8 to 7/8	35	(0.16)	#8 or #10	#10	100
HLD KWIK Tog 4 (HLD4)	3/8	15/16 to 1-1/4	–	–	#8 or #10	#10	100

1 Screw not included

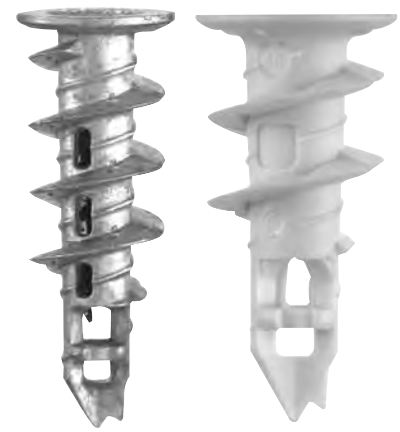
HSP/HFP Drywall Anchor 3.3.18

3.3.18.1 Product Description

The Hilti HSP/HFP Drywall Anchor is a self-drilling anchor designed for fast and reliable fastenings in drywall.

Product Features

- Shark tooth design for correct positioning and quick installation
- Cuts its own thread, no predrilling necessary
- Can be set with electric or standard screwdriver for quick and simple installation
- Removability adds to the anchor versatility
- Available in non-conductive nylon or zinc for a variety of applications
- Available with and without screws for your convenience


HSP HFP

3.3.18.2 Material Specifications

HSP Die cast zinc conforming to DIN 1734

HFP Polyamide 6.6 plastic; glass fiber reinforced

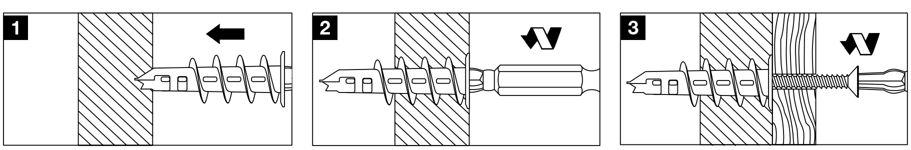
3.3.18.3 Technical Data

HSP/HFP Drywall Anchor Allowable Loads[1]

Gypsum Wall Board Thickness	1/2"				5/8"			
Description	Tension		Shear		Tension		Shear	
	lb	(N)	lb	(N)	lb	(N)	lb	(N)
HSP with Screw # 8 x 1-3/16	15	(70)	40	(180)	22	(100)	60	(270)
HFP with Screw # 8 x 1-3/16	15	(70)	40	(180)	22	(100)	60	(270)

1 Based on using a safety factor of 5.0.

3.3.18.4 Installation Instructions



1. Push the teeth of the anchor into the drywall panel.
2. Drive the anchor (clockwise rotation) until it lies flush with the wall.
3. Drive and tighten the screw with the Hilti Insert Bit.

3.3.18.5 Ordering Information

Description	Anchor Length (in.)	Screw Dia.	Box Qty
HSP	1-1/2	# 8	100
HSP-S Delivered with 100 screws, # 8 x 1-3/16"	1-1/2	# 8	100
HFP	1-1/8	# 8	100
HFP-S Delivered with 100 screws, # 8 x 1-3/16"	1-1/8	# 8	100
D-B PH2 HSP/HFP Phillips Head Bit	–	–	5

3.3.19 IDP Insulation Anchor

3.3.19.1 Product Description

The Hilti IDP Insulation Anchor is a plastic anchor designed for attaching insulation to concrete and masonry.

Product Features

- Specially structured head helps ensure bonding of plaster applied directly over the anchor
- Suitable for insulation thickness up to 4-3/4" for enhanced versatility
- Installation in concrete or masonry allows versatile use
- No metal reduces potential condensation behind finish coat of EIFS

3.3.19.2 Material Specifications

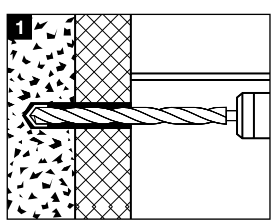
Plastic: polypropylene (not UV resistant)
In-place temperature range: -40°F to 176°F (-40°C to 80°C)
Temperature when setting: 32°F to 104°F (0°C to 40°C)

3.3.19.3 Technical Data

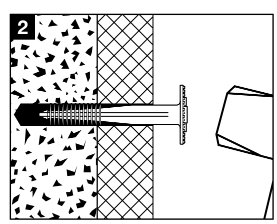
Description	Anchor Length in. (mm)		Bit[1] Dia. in. (mm)	Minimum Embed. Depth in. (mm)		Insulation Thickness in. (mm)		Average Ultimate Pullout[4] Concrete[2] lb (N)	Hollow Concrete Block[3] lb (N)	Brick lb (N)
IDP 0/2	2	(50)	5/16	1-1/8	(29)	0 to 7/8	(0-20)	110 (489)	45 (200)	55 (245)
IDP 2/4	2-3/4	(70)	5/16	1-1/8	(29)	7/8 to 1-3/4	(20-40)			
IDP 4/6	3-1/2	(90)	5/16	1-1/8	(29)	1-3/4 to 2-3/8	(40-60)			
IDP 6/8	4-1/4	(110)	5/16	1-1/8	(29)	2-3/8 to 3-1/8	(60-80)			
IDP 8/10	5	(130)	5/16	1-1/8	(29)	3-1/8 to 4	(80-100)			
IDP 10/12	6	(150)	5/16	1-1/8	(29)	4 to 4-3/4	(100-120)			

1 Hilti carbide tipped drill bits
2 Concrete strength f'_c = 2500 psi (17.2 MPa).
3 Hollow Concrete Block meets ASTM C90 Grade N Type II.
4 Pullout values may be limited by the strength of the material fastened.

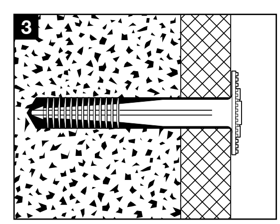
3.3.19.4 Installation Instructions



1. Drill a 5/16" diameter hole through insulation into base material.



2. Hammer anchor into place until washer is flush with insulation.



3. Anchor is set. For outdoor application, anchor head must be covered by finish.

3.3.19.5 Ordering Information

Description	Box Qty
IDP 0/2	250
IDP 2/4	250
IDP 4/6	250
IDP 6/8	250
IDP 8/10	250
IDP 10/12	250