The following excerpt are pages from the North American Product Technical Guide, Volume 2: Anchor Fastening, Edition 21.

Please refer to the publication in its entirety for complete details on this product including data development, product specifications, general suitability, installation, corrosion and spacing and edge distance guidelines.
US&CA: https://submittals.us.hilti.com/PTGVol2/

To consult directly with a team member regarding our anchor fastening products, contact Hilti's team of technical support specialists between the hours of 7:00am – 6:00pm CST.
US: 877-749-6337 or HNATechnicalServices@hilti.com
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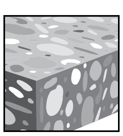
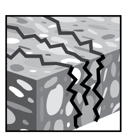
3.3.1 HDA UNDERCUT ANCHORS

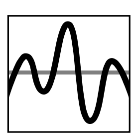
PRODUCT DESCRIPTION

HDA undercut anchors

Anchor system		Features and benefits
HDA-P undercut anchor pre-set type 	HDA-T undercut anchor through-set type 	• Undercut segments provide cast-in-place like performance with limited expansion stresses • Self-undercutting wedges provide an easy, fast and reliable anchor installation • Excellent performance in cracked concrete • Suitable for dynamic loads including seismic, fatigue and shock. See Anchor Selector Guide • 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-dip galvanization • ACI 349-01 Nuclear Design Guide is available. Call Hilti Technical Support


Uncracked concrete


Cracked concrete


Seismic design categories A-F

Profis anchor design software

Approvals/Listings	
ICC-ES (International Code Council)	ESR-1546 in concrete per ACI 318-Ch. 17 / ACI 355.2/ ICC-ES AC193
European Technical Approval	ETA-99/0009, ETA-99/0016
City of Los Angeles	Research Report No. 25939
Nuclear Quality Assurance	Qualified under NQA-1 Nuclear Quality Program

MATERIAL SPECIFICATIONS

HDA-P and HDA-T carbon steel with electroplated zinc

Cone bolts meet strength requirements of ISO 898, class 8.8. Minimum yield strength is 92.8 ksi (640 MPa) and minimum tensile strength is 116 ksi (800 MPa).

Sleeve for the M10 and M12 has a minimum tensile strength of 123 ksi (850 MPa).

Sleeve for the M16 has a minimum tensile strength of 101.5 ksi (700 MPa).

Sleeve for the M20 has a minimum tensile strength of 79.8 ksi (550 MPa).

The nut and washer are carbon steel.

All carbon steel components have a minimum 5 µm zinc plating thickness.

HDA-PR and HDA-TR stainless steel

Cone bolts have a minimum yield strength is 87 ksi (600 MPa) and minimum tensile strength is 116 ksi (800 MPa).

Sleeve for the M10 and M12 has a minimum tensile strength of 123 ksi (850 MPa).

Sleeve for the M16 has a minimum tensile strength of 101.5 ksi (700 MPa).

Nut conforms to DIN 934, grade A4-80.

HDA-PF and HDA-TF carbon steel with sherardized heavy zinc plating

Cone bolts meet strength requirements of ISO 898, class 8.8. Minimum yield strength is 92.8 ksi (640 MPa) and minimum tensile strength is 116 ksi (800 MPa).

Sleeve for the M10 and M12 has a minimum tensile strength of 123 ksi (850 MPa).

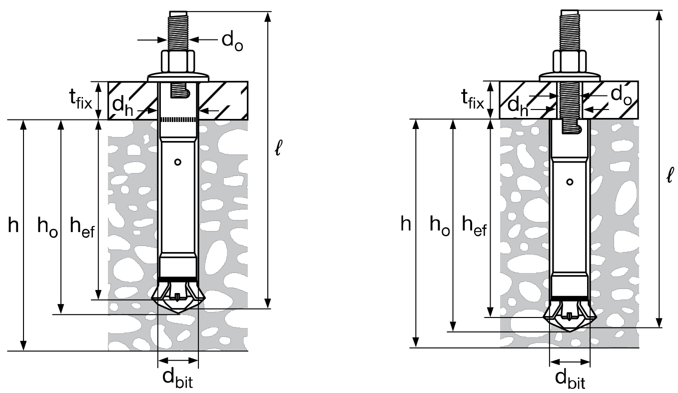
Sleeve for the M16 has a minimum tensile strength of 101.5 ksi (700 MPa).

Nuts and washers are carbon steel.

All carbon steel components have an average zinc plating thickness of 53 µm in accordance with ASTM A153.

INSTALLATION PARAMETERS

Figure 1 — Hilti HDA specifications



HDA-T **HDA-P**

Anchor nomenclature

HDA-PF M12 x 125 / 50

- **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
- **Metric**
- **Thread diameter** (mm)
- **Minimum embedment of undercut**
- **Maximum fixture thickness**

Table 1 — Hilti HDA specifications

Setting information	Symbol	Units	Nominal anchor diameter			
			M10	M12	M16	M20
Cone bolt thread diameter	d_o	mm	10	12	16	20
Nominal bit diameter[1]	d_{bit}	mm	20	22	30	37
Effective minimum embedment	h_{ef}	mm (in.)	100 (3.9)	125 (4.9)	190 (7.5)	250 (9.8)
Hole depth	h_o	mm (in.)	107 (4.2)	135 (5.3)	203 (8.0)	266 (10.5)
Max.fixture thickness, HDA-P	t_{fix}		See Section 3.3.1			
Fixture hole diameter, HDA-P	d_h	mm (in.)	12 (1/2)	14 (9/16)	18 (3/4)	22 (7/8)
Max.fixture thickness, HDA-T	t_{fix}		See Table 5			
Fixture hole diameter, HDA-T	d_h	mm (in.)	21 (7/8)	23 (15/16)	32 (1-1/4)	40 (1-9/16)
Length of anchor	ℓ		See Section 3.3.1			
Minimum concrete member thickness[2]	h_{min}	in. (mm)	7-1/8 (180)	7-1/2 (200)	10-5/8[3] (270)	13-3/4 (350)
Installation torque	T_{inst}	ft-lb (Nm)	37 (50)	59 (80)	89 (120)	221 (300)
Wrench size		mm	17	19	24	30

1 HDA must be installed with the specified Hilti hammer drill and Hilti metric stop bit. See section 3.3.1.5.
2 Minimum concrete thickness for HDA-P. For HDA-T, additional thickness needed to account for thin fixture which will increase effective embedment.
3 When setting the anchor with TE 70, h_{min} ≥ 300mm (11.8 in) for HDA M16.

HILTI

DESIGN INFORMATION IN CONCRETE PER ACI 318

ACI 318 Chapter 17 design

The load values contained in this section are Hilti Simplified Design Tables. The load tables in this section were developed using the Strength Design parameters and variables of ESR-1546 and the equations within ACI 318 Chapter 17. For a detailed explanation of the Hilti Simplified Design Tables, refer to section 3.1.8. Data tables from ESR-1546 are not contained in this section, but can be found at www.icc-es.org or at www.hilti.com.

Table 2 — Hilti HDA-P and HDA-T carbon and stainless steel design strength with concrete/pullout failure in uncracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. mm (in.)	Tension - ϕN_n				Shear - ϕV_n			
		f'_c = 2,500 psi lb (kN)	f'_c = 3,000 psi lb (kN)	f'_c = 4,000 psi lb (kN)"	f'_c = 6,000 psi lb (kN)	f'_c = 2,500 psi lb (kN)	f'_c = 3,000 psi lb (kN)	f'_c = 4,000 psi lb (kN)	f'_c = 6,000 psi lb (kN)
M10	100	7,615	8,345	9,635	11,800	16,405	17,970	20,750	25,415
	(3.9)	(33.9)	(37.1)	(42.9)	(52.5)	(73.0)	(79.9)	(92.3)	(113.1)
M12	125	10,645	11,660	13,465	16,490	22,925	25,115	29,000	35,515
	(4.9)	(47.4)	(51.9)	(59.9)	(73.4)	(102.0)	(111.7)	(129.0)	(158.0)
M16	190	19,945	21,850	25,230	30,900	42,965	47,065	54,345	66,560
	(7.5)	(88.7)	(97.2)	(112.2)	(137.4)	(191.1)	(209.4)	(241.7)	(296.1)
M20	250	30,105	32,980	38,080	46,640	64,845	71,035	82,025	100,460
	(9.8)	(133.9)	(146.7)	(169.4)	(207.5)	(288.4)	(316.0)	(364.9)	(446.9)

Table 3 — Hilti HDA-P and HDA-T carbon and stainless steel design strength with concrete/pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. mm (in.)	Tension - ϕN_n				Shear - ϕV_n			
		f'_c = 2,500 psi lb (kN)	f'_c = 3,000 psi lb (kN)	f'_c = 4,000 psi lb (kN)"	f'_c = 6,000 psi lb (kN)	f'_c = 2,500 psi lb (kN)	f'_c = 3,000 psi lb (kN)	f'_c = 4,000 psi lb (kN)	f'_c = 6,000 psi lb (kN)
M10	100	5,845	6,405	7,395	9,055	13,125	14,375	16,600	20,330
	(3.9)	(26.0)	(28.5)	(32.9)	(40.3)	(58.4)	(63.9)	(73.8)	(90.4)
M12	125	7,305	8,005	9,240	11,320	18,340	20,090	23,200	28,415
	(4.9)	(32.5)	(35.6)	(41.1)	(50.4)	(81.6)	(89.4)	(103.2)	(126.4)
M16	190	14,615	16,005	18,485	22,640	34,370	37,650	43,475	53,245
	(7.5)	(65.0)	(71.2)	(82.2)	(100.7)	(152.9)	(167.5)	(193.4)	(236.8)
M20	250	21,920	24,010	27,725	33,955	51,875	56,830	65,620	80,365
	(9.8)	(97.5)	(106.8)	(123.3)	(151.0)	(230.8)	(252.8)	(291.9)	(357.5)

1 See section 3.1.8 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 9 as necessary. Compare to the steel values in tables 4 and 5. The lesser of the values is to be used for the design.

4 Tabular values are for normal-weight concrete only. For sand-lightweight multiply the design loads by λ_a = 0.68.

5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension only by $\alpha_{N,seis}$ = 0.75. No reduction needed for seismic shear. See section 3.1.8 for additional information on seismic applications.

Table 4 — Steel strength for Hilti HDA-P carbon steel and stainless steel anchors[1,2]

Nominal anchor diameter	HDA-P carbon steel anchors			HDA-PR stainless steel anchors		
	Tensile ϕN_{sa} [3] lb (kN)	Shear ϕV_{sa} [4] lb (kN)	Seismic shear $\phi V_{sa,eq}$ [5] lb (kN)	Tensile ϕN_{sa} [3] lb (kN)	Shear ϕV_{sa} [4] lb (kN)	Seismic shear $\phi V_{sa,eq}$ [5] lb (kN)
M10	7,830 (34.8)	3,260 (14.5)	2,920 (13.0)	7,830 (34.8)	3,945 (17.5)	3,655 (16.3)
M12	11,395 (50.7)	4,735 (21.1)	4,235 (18.8)	11,395 (50.7)	5,845 (26.0)	5,260 (23.4)
M16	21,140 (94.0)	8,810 (39.2)	7,890 (35.1)	21,140 (94.0)	10,960 (48.8)	9,790 (43.5)
M20	33,060 (147.1)	13,500 (60.1)	12,130 (54.0)	n/a	n/a	n/a

1 See section 3.1.8 to convert design strength value to ASD value.
2 Hilti HDA-P Carbon and Stainless steel anchors are to be considered ductile steel elements.
3 Tensile = $\phi A_{se,N}\ f_{uta}$ as noted in ACI 318 Chapter 17.
4 Shear values determined by static shear tests with $\phi V_{sa} \leq \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Chapter 17.
5 Seismic shear values determined by seismic shear tests with $\phi V_{sa,eq} \leq \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Chapter 17. See section 3.1.8 for additional information on seismic applications.

Table 5 — Steel strength for Hilti HDA-T carbon steel and stainless steel anchors[1,2]

Nominal anchor diameter	Thickness of fastened parts t_{fix} in. (mm)	HDA-T carbon steel anchors			HDA-TR stainless steel anchors		
		Tensile ϕN_{sa} [3] lb (kN)	Shear ϕV_{sa} [4] lb (kN)	Seismic shear $\phi V_{sa,eq}$ [5] lb (kN)	Tensile ϕN_{sa} [3] lb (kN)	Shear ϕV_{sa} [4] lb (kN)	Seismic shear $\phi V_{sa,eq}$ [5] lb (kN)
M10	$5/8 \leq t_{fix} < 13/16$ $(15 \leq t_{fix} \leq 20)$	7,830 (34.8)	9,060 (40.3)	8,185 (36.4)	7,830 (34.8)	10,080 (44.8)	9,060 (40.3)
M12	$5/8 \leq t_{fix} < 13/16$ $(15 \leq t_{fix} < 20)$	11,395 (50.7)	10,815 (48.1)	9,790 (43.5)	11,395 (50.7)	13,155 (58.5)	11,690 (52.0)
	$13/16 \leq t_{fix} < 2$ $(20 \leq t_{fix} \leq 50)$		12,130 (54.0)	10,815 (48.1)		14,465 (64.3)	13,005 (57.8)
M16	$13/16 \leq t_{fix} < 1$ $(20 \leq t_{fix} < 25)$	21,140 (94.0)	19,875 (88.4)	17,825 (79.3)	21,140 (94.0)	23,235 (103.4)	20,900 (93.0)
	$1 \leq t_{fix} < 1\text{-}3/16$ $(25 \leq t_{fix} < 30)$		22,505 (100.1)	20,315 (90.4)		24,550 (109.2)	22,065 (98.1)
	$1\text{-}3/16 \leq t_{fix} \leq 1\text{-}3/8$ $(30 \leq t_{fix} < 35)$		24,845 (110.5)	22,355 (99.4)		25,715 (114.4)	23,090 (102.7)
	$1\text{-}3/8 < t_{fix} < 2\text{-}3/8$ $(35 \leq t_{fix} \leq 60)$		26,885 (119.6)	24,110 (107.2)		26,595 (118.3)	23,965 (106.6)
M20	$1 \leq t_{fix} < 1\text{-}9/16$ $(25 \leq t_{fix} < 40)$	33,060 (147.1)	29,370 (130.6)	26,450 (117.7)	n/a	n/a	n/a
	$1\text{-}9/16 \leq t_{fix} < 2\text{-}1/8$ $(40 \leq t_{fix} < 55)$		33,025 (146.9)	29,665 (132.0)			
	$2\text{-}1/8 \leq t_{fix} < 4$ $(55 \leq t_{fix} \leq 100)$		35,510 (158.0)	32,005 (142.4)			

1 See section 3.1.8 to convert design strength value to ASD value.
2 Hilti HDA-T Carbon and Stainless steel anchors are to be considered ductile steel elements.
3 Tensile = $\phi A_{se,N}\ f_{uta}$ as noted in ACI 318 Chapter 17
4 Shear values determined by static shear tests with $\phi V_{sa} \leq \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Chapter 17
5 Seismic shear values determined by seismic shear tests with $\phi V_{sa,eq} \leq \phi\ 0.60\ A_{se,V}\ f_{uta}$ as noted in ACI 318 Chapter 17 See section 3.1.8 for additional information on seismic applications.

Table 6 — Load adjustment factors for M10 and M12 Hilti HDA-P and HDA-T carbon and stainless steel anchors in uncracked concrete[1,2]

M10 and M12 HDA-P and HDA-T uncracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear: ⊥ toward edge f_{RV}		Edge distance in shear: II to and away from edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Nominal diameter			M10	M12	M10	M12	M10	M12	M10	M12	M10	M12	M10	M12
Effective embedment h_{ef}		mm (in.)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	3-1/8	(79)	n/a	n/a	0.66	n/a	n/a	n/a	0.14	n/a	0.28	n/a	n/a	n/a
	3-1/2	(89)	n/a	n/a	0.70	n/a	n/a	n/a	0.17	n/a	0.33	n/a	n/a	n/a
	4	(102)	0.67	n/a	0.76	0.66	0.56	n/a	0.20	0.15	0.40	0.31	n/a	n/a
	4-1/2	(114)	0.69	n/a	0.82	0.71	0.56	n/a	0.24	0.18	0.48	0.37	n/a	n/a
	5	(127)	0.71	0.67	0.88	0.76	0.57	0.56	0.28	0.22	0.56	0.43	n/a	n/a
	6	(152)	0.75	0.70	1.00	0.86	0.59	0.57	0.37	0.28	0.74	0.57	n/a	n/a
	7	(178)	0.80	0.74		0.96	0.60	0.58	0.47	0.36	0.93	0.71	n/a	n/a
	7-1/8	(181)	0.80	0.74		0.97	0.60	0.59	0.48	0.37	0.96	0.73	0.64	n/a
	7-1/2	(191)	0.82	0.75		1.00	0.61	0.59	0.52	0.40	1.00	0.79	0.66	n/a
	8	(203)	0.84	0.77			0.61	0.60	0.57	0.44		0.87	0.68	0.62
	9	(229)	0.88	0.80			0.63	0.61	0.68	0.52		1.00	0.72	0.66
	10	(254)	0.92	0.84			0.64	0.62	0.80	0.61			0.76	0.69
	11	(279)	0.97	0.87			0.66	0.63	0.92	0.70			0.79	0.73
	12	(305)	1.00	0.91			0.67	0.64	1.00	0.80			0.83	0.76
	14	(356)		0.97			0.70	0.67		1.00			0.90	0.82
	16	(406)		1.00			0.73	0.69					0.96	0.88
	18	(457)					0.76	0.72					1.00	0.93
	20	(508)					0.79	0.74						0.98
	24	(610)					0.84	0.79						1.00
	30	(762)					0.93	0.86						
	36	(914)					1.00	0.93						
	42	(1067)						1.00						

Table 7 — Load adjustment factors for M10 and M12 Hilti HDA-P and HDA-T carbon and stainless steel anchors in cracked concrete[1,2]

M10 and M12 HDA-P and HDA-T cracked concrete			Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear: ⊥ toward edge f_{RV}		Edge distance in shear: II to and away from edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Nominal diameter			M10	M12	M10	M12	M10	M12	M10	M12	M10	M12	M10	M12
Effective embedment h_{ef}		mm (in.)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)	100 (3.94)	125 (4.92)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm)	3-1/8	(79)	n/a	n/a	0.66	n/a	n/a	n/a	0.12	n/a	0.25	n/a	n/a	n/a
	3-1/2	(89)	n/a	n/a	0.70	n/a	n/a	n/a	0.15	n/a	0.29	n/a	n/a	n/a
	4	(102)	0.67	n/a	0.76	0.66	0.55	n/a	0.18	0.14	0.36	0.27	n/a	n/a
	4-1/2	(114)	0.69	n/a	0.82	0.71	0.56	n/a	0.21	0.16	0.43	0.33	n/a	n/a
	5	(127)	0.71	0.67	0.88	0.76	0.57	0.56	0.25	0.19	0.50	0.38	n/a	n/a
	6	(152)	0.75	0.70	1.00	0.86	0.58	0.57	0.33	0.25	0.66	0.50	n/a	n/a
	7	(178)	0.80	0.74		0.96	0.59	0.58	0.42	0.32	0.83	0.64	n/a	n/a
	7-1/8	(181)	0.80	0.74		0.97	0.59	0.58	0.43	0.33	0.86	0.65	0.62	n/a
	7-1/2	(191)	0.82	0.75		1.00	0.60	0.58	0.46	0.35	0.92	0.71	0.63	n/a
	8	(203)	0.84	0.77			0.61	0.59	0.51	0.39	1.00	0.78	0.65	0.60
	9	(229)	0.88	0.80			0.62	0.60	0.61	0.46		0.93	0.69	0.63
	10	(254)	0.92	0.84			0.63	0.61	0.71	0.54		1.00	0.73	0.67
	11	(279)	0.97	0.87			0.65	0.62	0.82	0.63			0.76	0.70
	12	(305)	1.00	0.91			0.66	0.63	0.94	0.71			0.80	0.73
	14	(356)		0.97			0.69	0.66	1.00	0.90			0.86	0.79
	16	(406)		1.00			0.71	0.68		1.00			0.92	0.84
	18	(457)					0.74	0.70					0.98	0.89
	20	(508)					0.77	0.72					1.00	0.94
	24	(610)					0.82	0.77						1.00
	30	(762)					0.90	0.83						
	36	(914)					0.98	0.90						
	42	(1067)					1.00	0.97						
	> 48	(1219)						1.00						

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

Table 8 — Load adjustment factors for M16 and M20 Hilti HDA-P and HDA-T carbon and stainless steel anchors in uncracked concrete[1,2]

M16 and M20 HDA-P and HDA-T uncracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear: ⊥ toward edge f_{RV}		Edge distance in shear: II to and away from edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Nominal diameter		M16	M20	M16	M20	M16	M20	M16	M20	M16	M20	M16	M20
Effective embedment h_{ef}	mm (in.)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 6	(152)	n/a	n/a	0.66	n/a	n/a	n/a	0.15	n/a	0.30	n/a	n/a	n/a
7	(178)	n/a	n/a	0.72	n/a	n/a	n/a	0.19	n/a	0.38	n/a	n/a	n/a
7-1/8	(181)	n/a	n/a	0.73	n/a	n/a	n/a	0.20	n/a	0.39	n/a	n/a	n/a
7-1/2	(191)	0.67	n/a	0.75	n/a	0.56	n/a	0.21	n/a	0.42	n/a	n/a	n/a
8	(203)	0.68	n/a	0.78	0.66	0.56	n/a	0.23	0.15	0.46	0.31	n/a	n/a
9	(229)	0.70	n/a	0.85	0.71	0.57	n/a	0.28	0.18	0.55	0.37	n/a	n/a
10	(254)	0.72	0.67	0.91	0.76	0.58	0.56	0.32	0.22	0.65	0.43	n/a	n/a
11	(279)	0.75	0.69	0.98	0.81	0.59	0.57	0.37	0.25	0.75	0.50	0.59	n/a
12	(305)	0.77	0.70	1.00	0.86	0.59	0.57	0.43	0.28	0.85	0.57	0.61	n/a
14	(356)	0.81	0.74		0.96	0.61	0.58	0.54	0.36	1.00	0.71	0.66	0.58
16	(406)	0.86	0.77		1.00	0.63	0.60	0.66	0.44		0.87	0.71	0.62
18	(457)	0.90	0.80			0.64	0.61	0.78	0.52		1.00	0.75	0.66
20	(508)	0.95	0.84			0.66	0.62	0.92	0.61			0.79	0.69
24	(610)	1.00	0.91			0.69	0.64	1.00	0.80			0.87	0.76
30	(762)		1.00			0.74	0.68		1.00			0.97	0.85
36	(914)					0.78	0.72					1.00	0.93
42	(1067)					0.83	0.75						1.00
> 48	(1219)					0.88	0.79						

3.3.1

Table 9 — Load adjustment factors for M16 and M20 Hilti HDA-P and HDA-T carbon and stainless steel anchors in cracked concrete[1,2]

M16 and M20 HDA-P and HDA-T cracked concrete		Spacing factor in tension f_{AN}		Edge distance factor in tension f_{RN}		Spacing factor in shear[3] f_{AV}		Edge distance in shear: ⊥ toward edge f_{RV}		Edge distance in shear: II to and away from edge f_{RV}		Conc. thickness factor in shear[4] f_{HV}	
Nominal diameter		M16	M20	M16	M20	M16	M20	M16	M20	M16	M20	M16	M20
Effective embedment h_{ef}	mm (in.)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)	190 (7.48)	250 (9.84)
Spacing (s) / edge distance (c_a) / concrete thickness (h) - in. (mm): 6	(152)	n/a	n/a	0.66	n/a	n/a	n/a	0.13	n/a	0.27	n/a	n/a	n/a
7	(178)	n/a	n/a	0.72	n/a	n/a	n/a	0.17	n/a	0.34	n/a	n/a	n/a
7-1/8	(181)	n/a	n/a	0.73	n/a	n/a	n/a	0.17	n/a	0.35	n/a	n/a	n/a
7-1/2	(191)	0.67	n/a	0.75	n/a	0.55	n/a	0.19	n/a	0.38	n/a	n/a	n/a
8	(203)	0.68	n/a	0.78	0.66	0.56	n/a	0.21	0.14	0.41	0.27	n/a	n/a
9	(229)	0.70	n/a	0.85	0.71	0.57	n/a	0.25	0.16	0.49	0.33	n/a	n/a
10	(254)	0.72	0.67	0.91	0.76	0.57	0.56	0.29	0.19	0.58	0.38	n/a	n/a
11	(279)	0.75	0.69	0.98	0.81	0.58	0.56	0.33	0.22	0.67	0.44	0.57	n/a
12	(305)	0.77	0.70	1.00	0.86	0.59	0.57	0.38	0.25	0.76	0.50	0.59	n/a
14	(356)	0.81	0.74		0.96	0.60	0.58	0.48	0.32	0.96	0.64	0.64	0.56
16	(406)	0.86	0.77		1.00	0.62	0.59	0.59	0.39	1.00	0.78	0.68	0.60
18	(457)	0.90	0.80			0.63	0.60	0.70	0.46		0.93	0.72	0.63
20	(508)	0.95	0.84			0.65	0.61	0.82	0.54		1.00	0.76	0.67
24	(610)	1.00	0.91			0.68	0.63	1.00	0.71			0.84	0.73
30	(762)		1.00			0.72	0.67		1.00			0.94	0.82
36	(914)					0.76	0.70					1.00	0.89
42	(1067)					0.81	0.73						0.97
> 48	(1219)					0.85	0.77						1.00

1 Linear interpolation not permitted.

2 When combining multiple load adjustment factors (e.g. for a 4 anchor pattern in a corner with thin concrete member) the design can become very conservative. To optimize the design, use PROFIS Engineering or perform anchor calculation using design equations from ACI 318 Chapter 17.

3 Spacing factor reduction in shear, f_{AV}, assumes an influence of a nearby edge. If no edge exists, then $f_{AV} = f_{AN}$.

4 Concrete thickness reduction factor in shear, f_{HV}, assumes an influence of a nearby edge. If no edge exists, then f_{HV} = 1.0.

DESIGN INFORMATION IN CONCRETE PER ACI 318

Limit State Design of anchors is described in the provisions of CSA A23.3 Annex D for post-installed anchors tested and assessed in accordance with ACI 355.2 for mechanical anchors and ACI 355.4 for adhesive anchors. This section contains the Limit State Design tables with unfactored characteristic loads that are based on the published loads in ICC Evaluation Services ESR-1546. These tables are followed by factored resistance tables. The factored resistance tables have characteristic design loads that are prefactored by the applicable reduction factors for a single anchor with no anchor-to-anchor spacing or edge distance adjustments for the convenience of the user of this document. All the figures in the previous ACI 318 Chapter 17 design section are applicable to Limit State Design and the tables will reference these figures.

For a detailed explanation of the tables developed in accordance with CSA A23.3 Annex D, refer to Section 3.1.8. Technical assistance is available by contacting Hilti Canada at (800) 363-4458 or at www.hilti.com.

Table 10 — Steel resistance for Hilti HDA-P carbon steel and stainless steel anchors[1,2]

Nominal anchor diameter	HDA-P carbon steel anchors			HDA-PR stainless steel anchors		
	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)
M10	7,100 (31.6)	3,195 (14.2)	2,865 (12.7)	7,100 (31.6)	3,870 (17.2)	3,585 (15.9)
M12	10,335 (46.0)	4,645 (20.7)	4,155 (18.5)	10,335 (46.0)	5,730 (25.5)	5,160 (23.0)
M16	19,170 (85.3)	8,640 (38.4)	7,740 (34.4)	19,170 (85.3)	10,750 (47.8)	9,600 (42.7)
M20	29,975 (133.3)	13,240 (58.9)	11,895 (52.9)	n/a	n/a	n/a

1 See section 3.1.8 to convert design strength value to ASD value.
2 Hilti HDA-P/-PR anchors are to be considered ductile steel elements.
3 Tensile $N_{sar} = A_{se,N}\ \phi_s\ f_{uta}\ R$ as noted in CSA A23.3 Annex D.
4 Shear determined by static shear tests with $V_{sar} < A_{se,V}\ \phi_s\ 0.6\ f_{uta}\ R$ as noted in CSA A23.3, Annex D.
5 Seismic shear values determined by seismic shear tests with $V_{sar,eq} < A_{se,V}\ \phi_s\ 0.6\ f_{uta}\ R$ as noted in CSA A23.3, Annex D. See Section 3.1.8 for additional information on seismic applications.

Table 11 — Steel resistance for Hilti HDA-T carbon steel and stainless steel anchors[1,2]

Nominal anchor diameter	Thickness of fastened parts t_{fix} in. (mm)	HDA-T carbon steel anchors			HDA-TR stainless steel anchors		
		Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)	Tensile[3] N_{sar} lb (kN)	Shear[4] V_{sar} lb (kN)	Seismic shear[5] $V_{sar,eq}$ lb (kN)
M10	5/8 ≤ t_{fix} < 13/16 (15 ≤ t_{fix} ≤ 20)	7,100 (31.6)	8,885 (39.5)	8,025 (35.7)	7,100 (31.6)	9,890 (44.0)	8,885 (39.5)
M12	5/8 ≤ t_{fix} < 13/16 (15 ≤ t_{fix} < 20)	10,335 (46.0)	10,605 (47.2)	9,600 (42.7)	10,335 (46.0)	12,900 (57.4)	11,465 (51.0)
	13/16 ≤ t_{fix} < 2 (20 ≤ t_{fix} ≤ 50)		11,895 (52.9)	10,605 (47.2)		14,190 (63.1)	12,755 (56.7)
M16	13/16 ≤ tfix < 1 (20 ≤ t_{fix} < 25)	19,170 (85.3)	19,490 (86.7)	17,485 (77.8)	19,170 (85.3)	22,785 (101.4)	20,495 (91.2)
	1 ≤ t_{fix} < 1-3/16 (25 ≤ t_{fix} < 30)		22,070 (98.2)	19,920 (88.6)		24,080 (107.1)	21,640 (96.3)
	1-3/16 ≤ t_{fix} ≤ 1-3/8 (30 ≤ t_{fix} < 35)		24,365 (108.4)	21,925 (97.5)		25,225 (112.2)	22,645 (100.7)
	1-3/8 < t_{fix} < 2-3/8 (35 ≤ t_{fix} ≤ 60)		26,370 (117.3)	23,650 (105.2)		26,085 (116.0)	23,505 (104.6)
M20	1 ≤ t_{fix} < 1-9/16 (25 ≤ t_{fix} < 40)	29,975 (133.3)	28,805 (128.1)	25,940 (115.4)	N/A	N/A	N/A
	1-9/16 ≤ t_{fix} < 2-1/8 (40 ≤ t_{fix} < 55)		32,390 (144.1)	29,090 (129.4)			
	2-1/8 ≤ t_{fix} < 4 (55 ≤ t_{fix} ≤ 100)		34,825 (154.9)	31,385 (139.6)			

1 See section 3.1.8 to convert design strength value to ASD value.
2 Hilti T/-TR anchors are to be considered ductile steel elements.
3 Tensile $N_{sar} = A_{se,N}\ \phi_s\ f_{uta}\ R$ as noted in CSA A23.3, Annex D.
4 Shear determined by static shear tests with $V_{sar} < A_{se,V}\ \phi_s\ 0.6\ f_{uta}\ R$ as noted in CSA A23.3, Annex D.
5 Seismic shear values determined by seismic shear tests with $V_{sar,eq} < A_{se,V}\ \phi_s\ 0.6\ f_{uta}\ R$ as noted in CSA A23.3, Annex D. See Section 3.1.8 for additional information on seismic applications.

Table 12 — Hilti HDA carbon and stainless steel design information in accordance with CSA A23.3[1]

Design parameter	Symbol	Units	Nominal anchor diameter							Ref A23.3
			M10		M12		M16		M20	
			HDA	HDA-R	HDA	HDA-R	HDA	HDA-R	HDA	
Anchor O.D.	d_a	mm (in)	19 (0.75)		21 (0.83)		29 (1.14)		35 (1.38)	
Effective minimum embedment[2]	h_{ef}	mm (in)	100 (3.94)		125 (4.92)		190 (7.48)		250 (9.84)	
Min. concrete thickness	h_{min}	-	See tables 1 of this section, or 3A and 3B of ESR-1546							
Critical edge distance	c_{ac}	-	1.5 x hef : See section 4.1.11 of ESR-1546							
Min. edge distance	c_{min}	mm (in)	80 (3.15)		100 (3.94)		150 (5.91)		200 (7.87)	
Min. anchor spacing	s_{min}	mm (in)	100 (3.94)		125 (4.92)		190 (7.48)		250 (9.84)	
Min. specified yield strength	f_{ya}	psi (N/mm^2)	92,800 (640)							
Min. specified ult. strength	f_{uta}	psi (N/mm^2)	116,000 (800)							
Effective tensile stress area	$A_{se,N}$	in^2 (mm^2)	0.090 (58.1)		0.131 (84.5)		0.243 (156.8)		0.380 (245.2)	
Steel embed. material resistance factor for reinforcement	ϕ_s	-	0.85							8.4.3
Resistance modification factor for tension, steel failure modes[3]	R	-	0.80							D.5.3
Resistance modification factor for shear, steel failure modes[3]	R	-	0.75							D.5.3
Factored steel resistance in tension	N_{sar}	-	See tables 10 and 11 of this section							D.6.1.2
Factored steel resistance in shear	V_{sar}	-	See tables 10 and 11 of this section							D.7.1.2
Factored steel resistance in shear, seismic	$V_{sar,eq}$	-	See tables 10 and 11 of this section							
Coeff. for factored concrete breakout resistance, uncracked concrete	$k_{c,uncr}$	-	12.5							D.6.2.2
Coeff. for factored concrete breakout resistance, cracked concrete	$k_{c,cr}$	-	10							D.6.2.2
Modification factor for anchor resistance, tension, uncracked concrete[4]	$\psi_{c,N}$	-	1.0							D.6.2.6
Anchor category	-	-	1							D.5.3 (c)
Concrete material resistance factor	ϕ_c	-	0.65							8.4.2
Resistance modification factor for tension and shear, concrete failure modes, Condition B[5]	R	-	1.00							D.5.3 (c)
Factored pullout resistance in 20 MPa uncracked concrete[6]	$N_{pr,uncr}$	lb (kN)	N/A							D.6.3.2
Factored pullout resistance in 20 MPa cracked concrete[6]	$N_{pr,cr}$	lb (kN)	6,295 (28.0)		7,870 (35.0)		15,745 (70.0)		23,615 (105.0)	D.6.3.2

1 Design information in this table is taken from ICC-ES ESR-1546, dated March 2020 and converted for use with CSA A23.3 Annex D.

2 See figure 1 of this section.

3 The HDA is considered a ductile steel element as defined by CSA A23.3 Annex D section D.2.

4 For all design cases, $\psi_{c,N}$ = 1.0. The appropriate coefficient for breakout resistance for cracked concrete ($k_{c,cr}$) or uncracked concrete ($k_{c,uncr}$) must be used.

5 For use with the load combinations of CSA A23.3 Chapter 8. Condition B applies where supplementary reinforcement in conformance with CSA A23.3 section D.5.3 is not provided, or where pullout or pryout strength governs. For cases where the presence of supplementary reinforcement can be verified, the resistance modification factors associated with Condition A may be used.

6 For all design cases, $\psi_{c,P}$ = 1.0. NA (not applicable) denotes that this value does not control for design. See section 4.1.4 of ESR-1546 for additional information.

Table 13 — Hilti HDA-P and HDA-T carbon and stainless steel factored resistance with concrete/pullout failure in uncracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. mm (in.)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
M10	100 (3.94)	8,170 (36.3)	9,135 (40.6)	10,005 (44.5)	11,550 (51.4)	16,335 (72.7)	18,265 (81.3)	20,010 (89.0)	23,105 (102.8)
M12	125 (4.92)	11,415 (50.8)	12,765 (56.8)	13,980 (62.2)	16,145 (71.8)	22,830 (101.6)	25,525 (113.6)	27,965 (124.4)	32,290 (143.6)
M16	190 (7.48)	21,395 (95.2)	23,920 (106.4)	26,200 (116.6)	30,255 (134.6)	42,785 (190.3)	47,840 (212.8)	52,405 (233.1)	60,510 (269.2)
M20	250 (9.84)	32,290 (143.6)	36,100 (160.6)	39,545 (175.9)	45,665 (203.1)	64,580 (287.3)	72,200 (321.2)	79,095 (351.8)	91,330 (406.3)

Table 14 — Hilti HDA-P and HDA-T carbon and stainless steel factored resistance with concrete/pullout failure in cracked concrete[1,2,3,4,5]

Nominal anchor diameter	Effective embed. mm (in.)	Tension - N_r				Shear - V_r			
		f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)	f'_c = 20 MPa (2,900 psi) lb (kN)	f'_c = 25 MPa (3,625 psi) lb (kN)	f'_c = 30 MPa (4,350 psi) lb (kN)	f'_c = 40 MPa (5,800 psi) lb (kN)
M10	100 (3.94)	6,295 (28.0)	7,040 (31.3)	7,710 (34.3)	8,905 (39.6)	13,070 (58.1)	14,615 (65.0)	16,005 (71.2)	18,485 (82.2)
M12	125 (4.92)	7,870 (35.0)	8,800 (39.1)	9,640 (42.9)	11,130 (49.5)	18,265 (81.3)	20,420 (90.8)	22,370 (99.5)	25,830 (114.9)
M16	190 (7.48)	15,745 (70.0)	17,600 (78.3)	19,280 (85.8)	22,265 (99.0)	34,230 (152.3)	38,270 (170.2)	41,925 (186.5)	48,410 (215.3)
M20	250 (9.84)	23,615 (105.0)	26,400 (117.4)	28,920 (128.6)	33,395 (148.5)	51,665 (229.8)	57,760 (256.9)	63,275 (281.5)	73,065 (325.0)

1 See section 3.1.8 to convert design strength value to ASD value.

2 Linear interpolation between embedment depths and concrete compressive strengths is not permitted.

3 Apply spacing, edge distance, and concrete thickness factors in tables 6 to 9 as necessary. Compare to the steel values in tables 10 and 11. The lesser of the values is to be used for the design.

4 Tabular values are for normal-weight concrete only. For lightweight concrete multiply design strength by λ_a as follows: for sand-lightweight, λ_a = 0.68; for all-lightweight, λ_a = 0.60

5 Tabular values are for static loads only. Seismic design is not permitted for uncracked concrete. For seismic tension loads, multiply cracked concrete tabular values in tension only by $\alpha_{N,seis}$ = 0.75. No reduction needed for seismic shear. See section 3.1.8 for additional information on seismic applications.

INSTALLATION AND REMOVAL INSTRUCTIONS

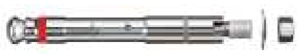
Installation Instructions For Use (IFU) are included with each product package. They can also be viewed or downloaded online at www.hilti.com. Because of the possibility of changes, always verify that downloaded IFU are current when used. Proper installation is critical to achieve full performance.

HDA Undercut Anchors are fully removable. The removal process strips the anchor threads to prevent reuse of anchors for safety purposes.

Training is available on request. Contact Hilti Technical Services for applications and conditions not addressed in IFU.

ORDERING INFORMATION

HDA-T anchor

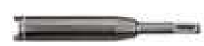


Description	HDA-T	HDA-TF	HDA-TR	HDA	Stop drill bit	Diamond core bit[1]	Setting tool
bolt dia. x h_{ef} / $t_{fix,max}$ overall length ℓ	Galvanized	Sherardised	316 Stainless	Box Qty	Description (mm) dia. x drill depth	Diameter (mm)	Description
M10x100/20 150 mm	●	●	●	12	TE-C-B20x120 TE-Y-B20x120	20	TE-C-ST 20 M10 TE-Y-ST 20 M10
M12x125/30 190 mm	●	●	●	8	TE-C-B22x155 TE-Y-B22x155	22	TE-C-ST 22 M12 TE-Y-ST 22 M12
M12x125/50 210 mm	●	●	●	8	TE-C-B22x175 TE-Y-B22x175	22	TE-C-ST 22 M12 TE-Y-ST 22 M12
M16x190/40 275 mm	●	●	●	4	TE-Y B30x230	30	TE-Y-ST 30 M16
M16x190/60 295 mm	●	●	●	4	TE-Y B30x250		
M20x250/50 360 mm	●			2	TE-Y B37x300	37	TE-Y-ST 37 M20
M20x250/100 410 mm	●			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 hammer drill and stop drill bit. Always consult the engineer of record before cutting rebar.

HDA-P anchor

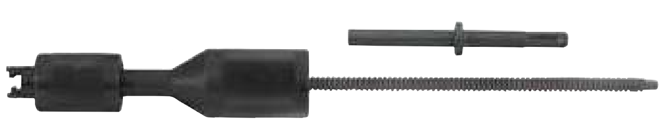




Description	HDA-P	HDA-PF	HDA-PR	HDA	Stop drill bit	Diamond core bit[1]	Setting tool
bolt dia. x h_{ef} / $t_{fix,max}$ overall length ℓ	Galvanized	Sherardised	316 Stainless	Box Qty	Description (mm) dia. x drill depth	Diameter (mm)	Description
M10x100/20 150 mm	●	●	●	12	TE-C B20x100 TE-Y B20x100	20	TE-C-ST 20 M10 TE-Y-ST 20 M10
M12x125/30 190 mm	●	●	●	8	TE-C B22x125 TE-Y B22x125	22	TE-C-ST 22 M12 TE-Y-ST 22 M12
M12x125/50 210 mm	●	●	●	8	TE-C-B22x125 TE-Y-B22x125	22	TE-C-ST 22 M12 TE-Y-ST 22 M12
M16x190/40 275 mm	●	●	●	4	TE-Y B30x190	30	TE-Y-ST 30 M16
M16x190/60 295 mm	●	●	●	4			
M20x250/50 360 mm	●			2	TE-Y B37x250	37	TE-Y-ST 37 M20
M20x250/100 410 mm	●			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 hammer drill and stop drill bit. Always consult the engineer of record before cutting rebar.

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

HAMMER DRILLS REQUIRED FOR SETTING HDA ANCHORS

HDA carbon steel — zinc plated

Anchor	Hilti hammer drill[1]								
	TE 25 (1st gear)	TE 36-A	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70[2]/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80-ATC
	connection end								
	TE-C			TE-Y					
HDA-P M10x100/20	●	●	●	●	●				
HDA-T M10x100/20	●	●	●	●	●				
HDA-P M12x125/30	●	●	●	●	●				
HDA-T M12x125/30	●	●	●	●	●				
HDA-P M12x125/50	●	●	●	●	●				
HDA-T M12x125/50	●	●	●	●	●				
HDA-P M16x190/40						●	●	●	●
HDA-T M16x190/40						●	●	●	●
HDA-P M16x190/60						●	●	●	●
HDA-T M16x190/60						●	●	●	●
HDA-P M20x250/50						●		●	●
HDA-T M20x250/50						●		●	●
HDA-P M20x250/100						●		●	●
HDA-T M20x250/100						●		●	●

HDA-R stainless steel

Anchor	Hilti hammer drill[1]								
	TE 25 (1st gear)	TE 36-A	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70[2]/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80-ATC
	connection end								
	TE-C			TE-Y					
HDA-PR M10x100/20	●	●	●						
HDA-TR M10x100/20	●	●	●	●	●				
HDA-PR M12x125/30	●	●	●	●	●				
HDA-TR M12x125/30	●	●	●	●	●				
HDA-PR M12x125/50	●	●	●	●	●				
HDA-TR M12x125/50	●	●	●	●	●				
HDA-PR M16x190/40						●	●	●	●
HDA-PR M16x190/60						●	●	●	●
HDA-PR M16x190/60						●	●	●	●
HDA-TR M16x190/60						●	●	●	●

HDA-F carbon steel — sherardized (heavy-duty galvanization)

Anchor	Hilti hammer drill[1]								
	TE 25 (1st gear)	TE 36-A	TE 40/ 40-AVR	TE 56/ 56-ATC	TE 60- ATC	TE 70[2]/ 70-ATC	TE 75	TE-76/ 76-ATC	TE 80-ATC
	connection end								
	TE-C			TE-Y					
HDA-PFM10x100/20		●	●		●				
HDA-TF M10x100/20		●	●		●				
HDA-PF M12x125/30		●	●		●				
HDA-TF M12x125/30		●	●		●				
HDA-PF M12x125/50		●	●		●				
HDA-TF M12x125/50		●	●		●				
HDA-PF M16x190/40						●	●	●	●
HDA-TF M16x190/40						●	●	●	●
HDA-PF M16x190/60						●	●	●	●
HDA-TF M16x190/60						●	●	●	●

1 To ensure IBC compliance, reference ESR-1546 or contact Hilti Technical Support.

2 Increase h_{min} when setting the HDA M16 with the TE 70. See Table 1 of this section, or ESR-1546 Table 3A and 3B.