Deutsches Institut für Bautechnik

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-18/0974 of 30 November 2020

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Hilti undercut anchor HDA
Product family to which the construction product belongs	Post-installed fasteners in concrete under fatigue cyclic loading
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Plants
This European Technical Assessment contains	22 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330250-00-0601, Edition 06/2020
This version replaces	ETA-18/0974 issued on 20 June 2019

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Specific Part

1 Technical description of the product

The Hilti undercut anchor HDA consists of a Hilti Cone bolt HDA -P or HDA -T with ring, sleeve, bolt and cap, a Hilti sealing washer, a spherical washer, nut and a lock nut and an injection mortar Hilti HIT-HY 200-A or Hilti HIT-HY 200-R.

The product description is given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic fatigue resistance under cyclic tension loading (Assessment method A)	
Characteristic steel fatigue resistance	See Annexes C1 and C4
Characteristic concrete cone, pull-out, splitting and blow out fatigue resistance	
Characteristic combined pull- out /concrete cone fatigue resistance	
Characteristic fatigue resistance under cyclic shear loading (Assessment method A)	
Characteristic steel fatigue resistance	See Annexes C2 to C5
Characteristic concrete edge fatigue resistance	
Characteristic concrete pry out fatigue resistance	

Essential characteristic	Performance
Characteristic fatigue resistance under cyclic combined tension and shear loading (Assessment method A)	
Characteristic steel fatigue resistance	See Annex C5
Load transfer factor for cyclic tension and shear loading	
Load transfer factor	See Annex C1 to C5

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with European Assessment Document No. 330250-00-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 30 November 2020 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

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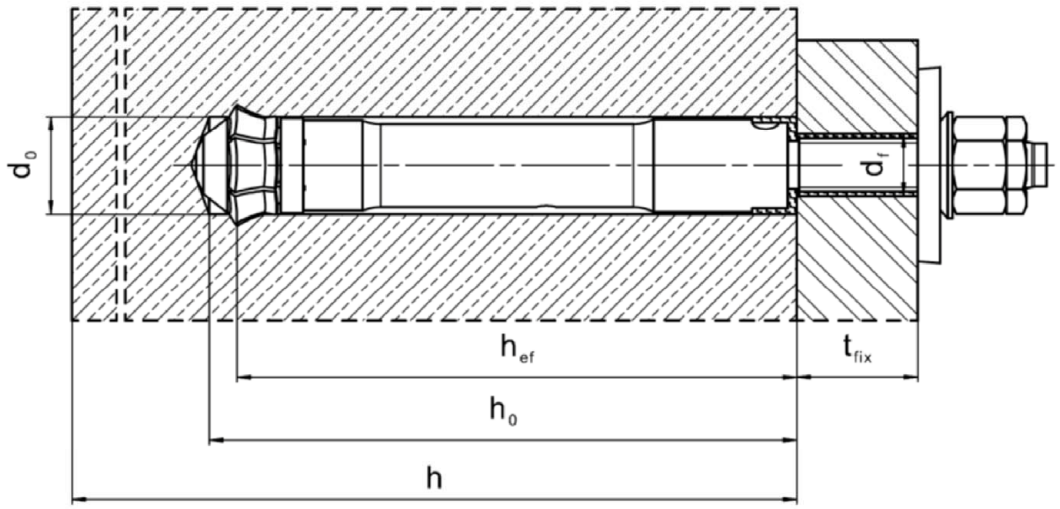
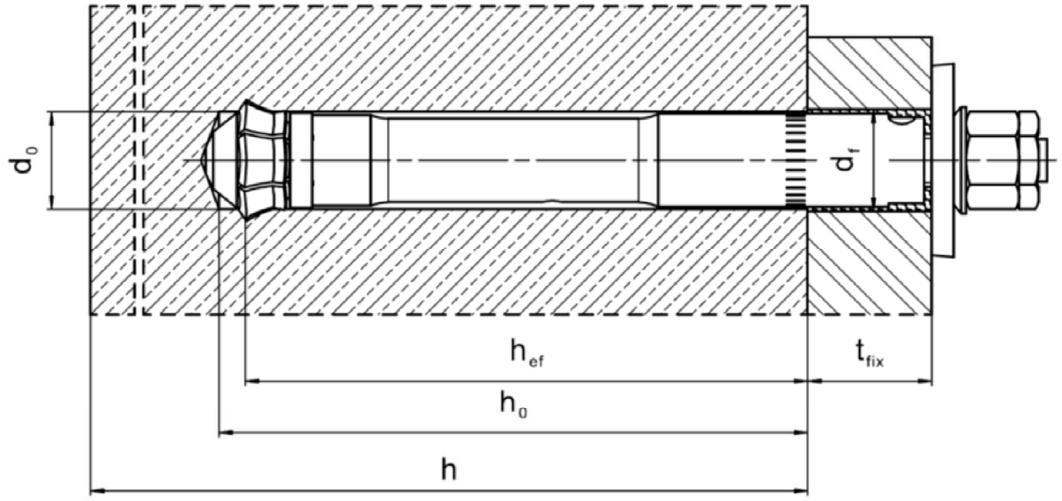
Installed condition

Hilti HDA-P installed with Hilti filling set (pre-setting)



Hilti HDA-T installed with Hilti filling set (through-setting)



Hilti undercut anchor HDA	
Product description Installed condition	**Annex A1**

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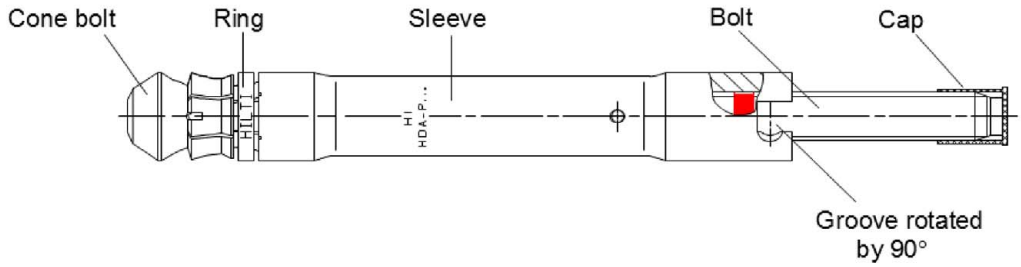
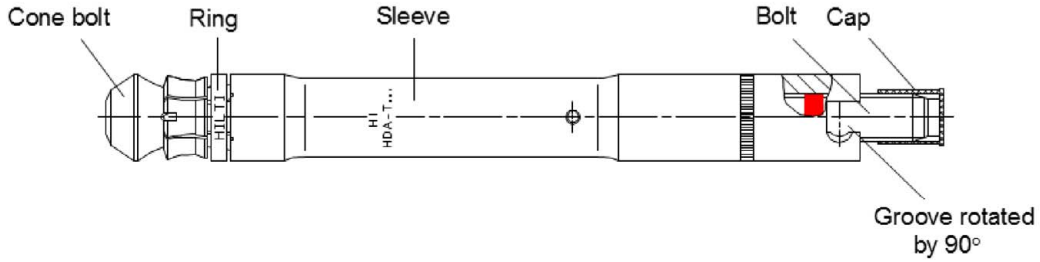
Product description

Hilti undercut anchor HDA-P

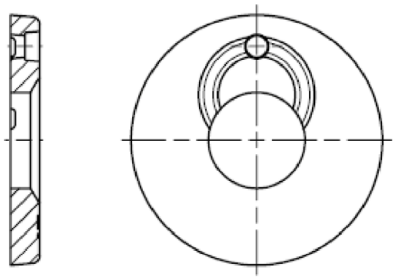


Hilti undercut anchor HDA-T

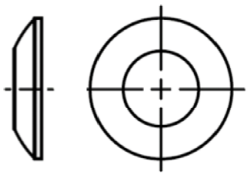


Hilti filling set

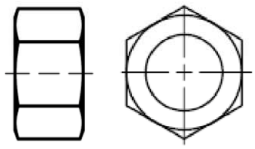
Sealing washer



Spherical washer



Hexagon nut



Lock nut

Hilti undercut anchor HDA	
Product description Product types and parts	**Annex A2**

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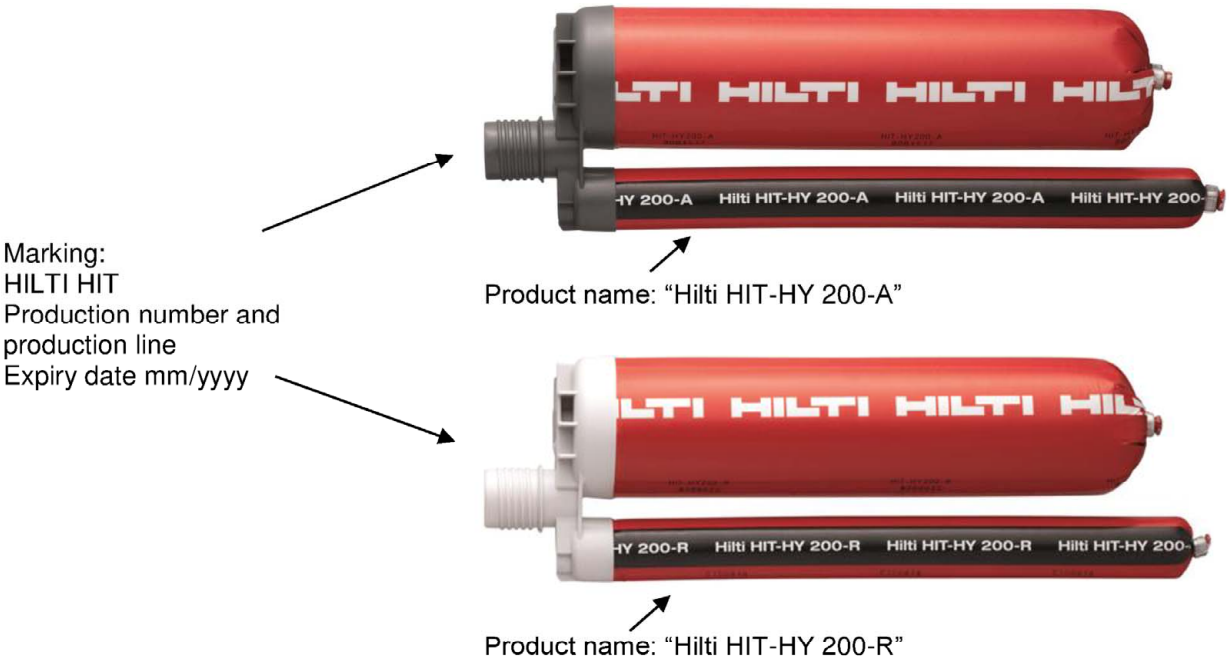
Injection mortar Hilti HIT-HY 200-A and Hilti HIT-HY 200-R: hybrid system with aggregate
Foil pack 330 ml and 500 ml



Static mixer Hilti HIT-RE-M

Hilti undercut anchor HDA	**Annex A3**
Product description Product types and parts	

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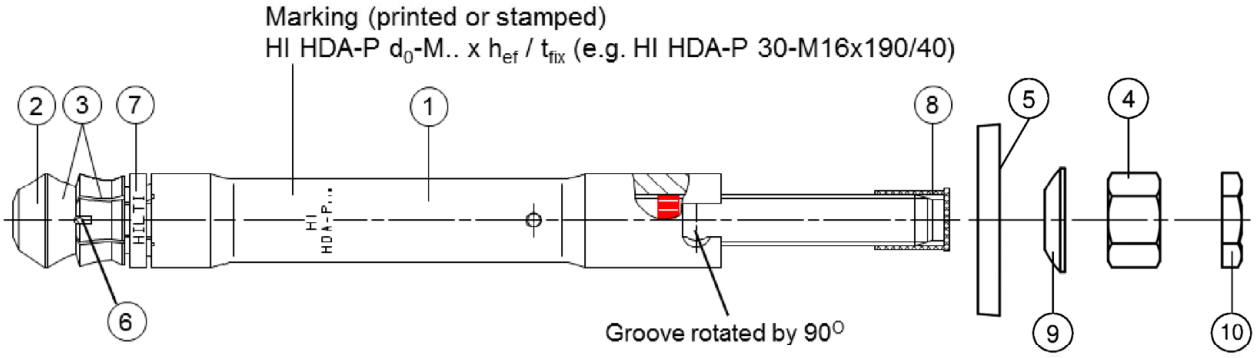
Product materials and marking



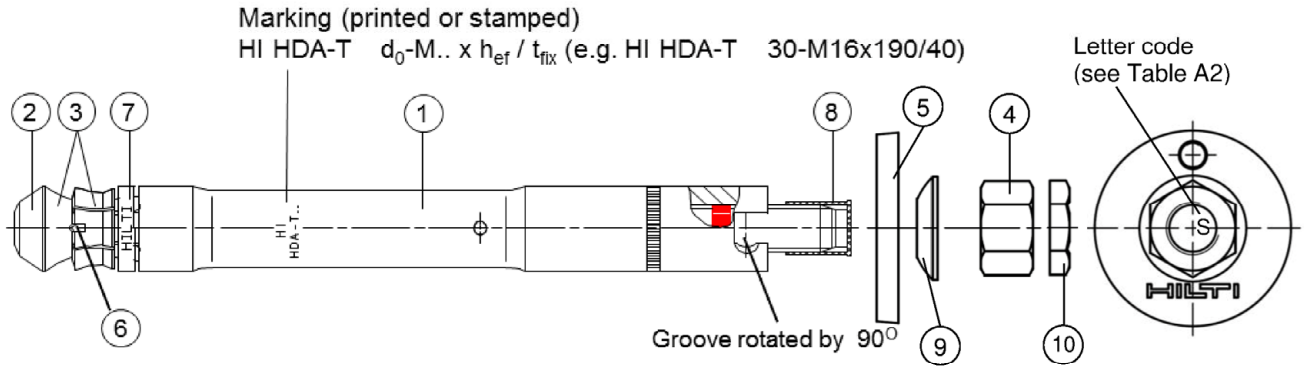


Table A1: Materials HDA-P and HDA-T and Hilti filling set

Part	Designation	HDA-P / HDA-T (galvanized ≥ 5µm)
1	Sleeve	Machined carbon steel with brazed tungsten carbide tips
2	Bolt	M10 - M16: Cold formed steel, steel strength 8.8 M20: Cone machined, rod steel strength 8.8
3	Coating of bolt and sleeve	Galvanized 5-25µm
4	Hexagon nut	M10 - M16: Class 8, h=1*d, galvanized M20: Class 8, galvanized
5	Filling washer	Electroplated zinc coated ≥ 5 µm
6	Cutting edges	Tungsten carbide
7	Ring	Plastic ring
8	Cap	Plastic cap
9	Spherical washer	Electroplated zinc coated ≥ 5 µm
10	Lock nut	Electroplated zinc coated ≥ 5 µm

Hilti undercut anchor HDA

Product description
Product materials and marking

Annex A4

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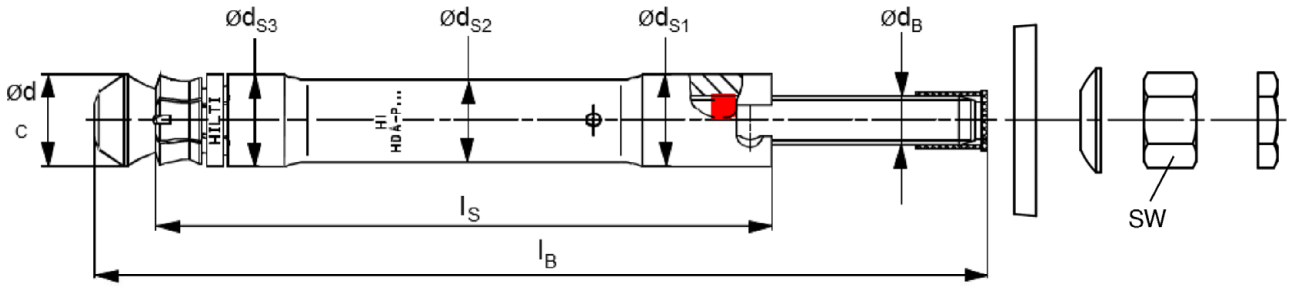
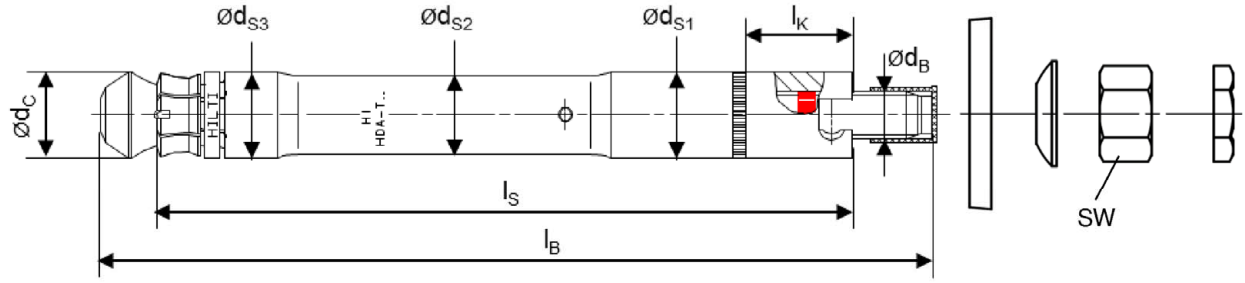
Table A2: Fastener dimensions

Fastener type	$t_{fix,max}$ [mm]	l_B [mm]	Length code letter	l_S [mm]	l_k [mm]	SW	d_{S1} [mm]	d_{S2} [mm]	d_{S3} [mm]	d_C [mm]	d_B [mm]
HDA-P M10x100/20	20	150	I	100	-	17	19	16,8	18,5	19,5	10
HDA-T M10x100/20	20	150	I	120	17	17	19	16,8	18,5	19,5	10
HDA-P M12x125/30	30	190	L	125	-	19	21	18,8	20,5	21,4	12
HDA-P M12x125/50	50	210	N	125	-	19	21	18,8	20,5	21,4	12
HDA-T M12x125/30	30	190	L	155	27	19	21	18,8	20,5	21,4	12
HDA-T M12x125/50	50	210	N	175	47	19	21	18,8	20,5	21,4	12
HDA-P M16x190/40	40	275	R	190	-	24	29	26	29	29	16
HDA-P M16x190/60	60	295	S	190	-	24	29	26	29	29	16
HDA-T M16x190/40	40	275	R	230	35,5	24	29	26	29	29	16
HDA-T M16x190/60	60	295	S	250	55,5	24	29	26	29	29	16
HDA-P M20x250/50	50	360	V	250	-	30	35	32	35	36	20
HDA-P M20x250/100	100	410	X	250	-	30	35	32	35	36	20
HDA-T M20x250/50	50	360	V	300	45	30	35	32	35	36	20
HDA-T M20x250/100	100	410	X	350	95	30	35	32	35	36	20

Pre-setting anchor HDA-P (pre-positioning)



Through-fastening anchor HDA-T (post-positioning)



Hilti undercut anchor HDA

Product description
Fastener dimensions

Annex A5

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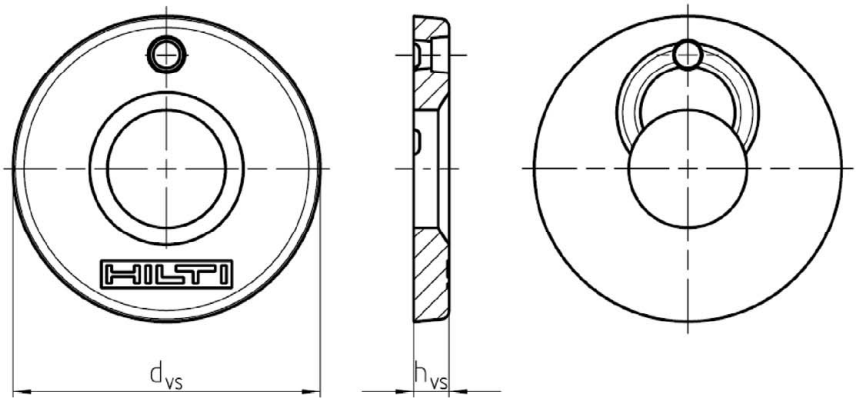
Table A3: Hilti filling washer dimensions

Fastener size	Hilti filling set size	Hilti filling washer	
		Diameter d_{vs} [mm]	Thickness h_{vs} [mm]
HDA-P M10	M10	42	5
HDA-T M10			
HDA-P M12	M12	44	5
HDA-T M12			
HDA-P M16	M16	52	6
HDA-T M16			
HDA-P M20	M20	60	6
HDA-T M20			

Hilti filling washer



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Specifications of intended use

Anchorages subject to:

- Fatigue cycling loading.

Note: static and quasi-static load according to ETA-99/0009.

Base material:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.
- Cracked and uncracked concrete.

Use conditions (environmental conditions):

- Structures subject to dry internal conditions.

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under fatigue cycling loading are designed in accordance with: EN 1992-4:2018 and EOTA Technical Report TR 061:2020-01.

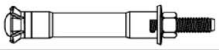
Installation:

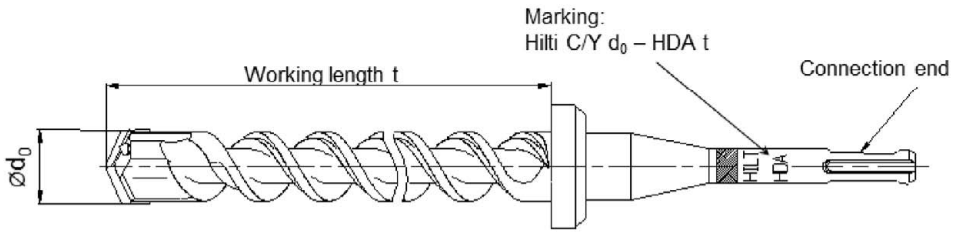
- Drilling technique: hammer drilling with Hilti stop drill bit.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Fastener installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools (hammer drill, setting tool, stop drill bit, filling set).
- The drill hole is realized with the specified Hilti stop drill bit by hammer drilling technique.
- The fastener is inserted in the cleaned drill hole by hand.
- With the specified setting tool and hammer drill, the fastener is expanded in the drill hole until the marking of the setting tool matches with the surface of the concrete (HDA-P) or with the surface of the fixture (HDA-T).
- The fastener is completely expanded, if the coloured ring of the rod exceeds beyond the upper end of the sleeve. In case the coloured ring is not visible yet out of the sleeve, the setting must be continued.
- After the complete expansion of the fastener, the recess of the sleeve with respect to the concrete surface (HDA-P) or to the surface of the fixture (HDA-T) shall be in the range specified in Table B3, Annex B4.
- Application of the torque moment given in Table B3, Annex B4 using a calibrated torque wrench.

Hilti undercut anchor HDA	**Annex B1**
Intended use Specifications	

Deutsches Institut für Bautechnik DIBt

Table B1: Required stop drill bits for HDA

Fastener 	Stop drill bit with TE-C connection end 	TE-Y connection end 	Nominal Working length t [mm]	Drill bit diameter d_0 [mm]
HDA-P M10x100/20	TE-C-HDA-B 20x100	TE-Y-HDA-B 20x100	107	20
HDA-T M10x100/20	TE-C-HDA-B 20x120	TE-Y-HDA-B 20x120	127	20
HDA-P M12x125/30 HDA-P M12x125/50	TE-C HDA-B 22x125	TE-Y HDA-B 22x125	133	22
HDA-T M12x125/30	TE-C HDA-B 22x155	TE-Y HDA-B 22x155	163	22
HDA-T M12x125/50	TE-C HDA-B 22x175	TE-Y HDA-B 22x175	183	22
HDA-P M16x190/40 HDA-P M16x190/60	-	TE-Y HDA-B 30x190	203	30
HDA-T M16x190/40	-	TE-Y HDA-B 30x230	243	30
HDA-T M16x190/60	-	TE-Y HDA-B 30x250	263	30
HDA-P M20x250/50 HDA-P M20x250/100	-	TE-Y HDA-B 37x250	266	37
HDA-T M20x250/50	-	TE-Y HDA-B 37x300	316	37
HDA-T M20x250/100	-	TE-Y HDA-B 37x350	366	37



Hilti undercut anchor HDA

Intended use
Required stop drill bits

Annex B2

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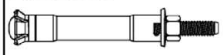
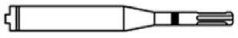
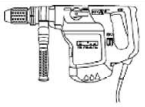
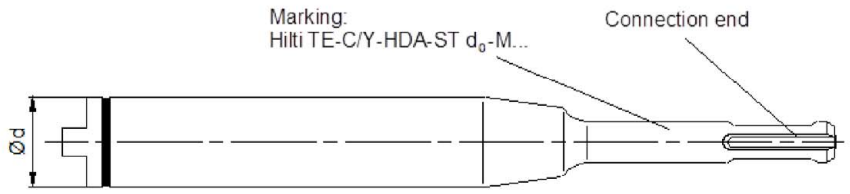
Table B2: Required setting tools and hammer drills for the setting of HDA

Fastener 	Setting tool 			Hammer drill 										
		Ød [mm]	Connection end	TE 24	TE 25 [1]	TE 30-A36	TE 40 (AVR)	TE 56 [2] TE 56-ATC [2]	TE 60 TE 60-ATC	TE 70 [2] [3] TE 70-ATC [2] [3]	TE 75 [2]	TE 76 [2] TE 76-ATC [2]	TE 80 -ATC (AVR)
HDA-P/T M10x100/20	TE-C-HDA-ST 20-M10	20	TE-C	■	■	■	■						
	TE-Y-HDA-ST 20-M10	20	TE-Y					■	■				
HDA-P/T M12x125/30 HDA-P/T M12x125/50	TE-C-HDA-ST 22-M12	22	TE-C	■	■	■	■						
	TE-Y-HDA-ST 22-M12	22	TE-Y					■	■				
HDA-P/T M16x190/40 HDA-P/T M16x190/60	TE-Y-HDA-ST 30-M16	30	TE-Y							■	■	■	■
HDA-P/T M20x250/50 HDA-P/T M20x250/100	TE-Y-HDA-ST 37-M20	37	TE-Y							■		■	■

[1] TE25: first gear only.

[2] TE56 (-ATC), TE70 (-ATC), TE75, TE76 (-ATC): use with max. impact energy.

[3] TE70: only with concrete member thickness $h_{min} \geq 300$ mm.



Hilti undercut anchor HDA

Intended use
Required setting tools and hammer drills for the setting

Annex B3

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Table B3: Installation parameters

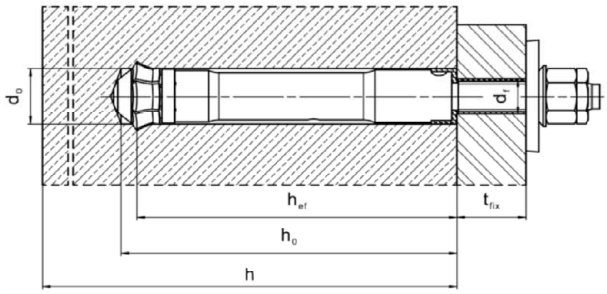
Fastener type Pre-setting / Through-setting			HDA M10		HDA M12		HDA M16		HDA M20	
			P	T	P	T	P	T	P	T
Nominal diameter of drill bit	d_0	[mm]	20		22		30		37	
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	20,55		22,55		30,55		37,70	
Depth of drill hole	h_1	[mm]	107	≥107	133	≥133	203	≥203	266	≥266
Diameter of clearance hole in the fixture	d_f	[mm]	12	21	14	23	18	32	22	40
Minimum fixture thickness	$t_{fix,min}$	[mm]	10	15	10	20	10	20	10	20
Maximum fixture thickness	$t_{fix,max}$	[mm]	see Table A2, Annex A5							
Sleeve recess[1)]	h_S	[mm]	$2 \leq h_S \leq 6$		$2 \leq h_S \leq 7$		$2 \leq h_S \leq 8$		$2 \leq h_S \leq 8$	
Installation torque	T_{inst}	[Nm]	50		80		120		300	

[1)] sleeve recess after setting of the fastener:

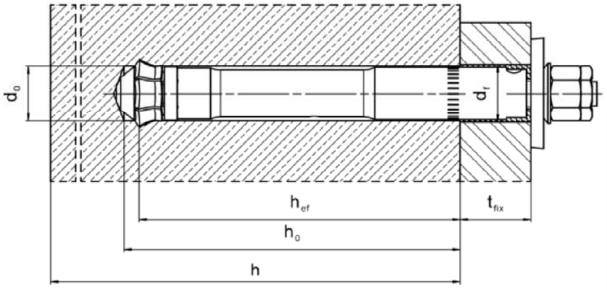
a) Pre-setting anchor HDA-P:
distance from surface of the concrete member to top edge of the anchor sleeve, see Annex A1.

b) Through-fastening anchor HDA-T:
distance from top edge of the fixture to top edge of the anchor sleeve, see Annex A1.

Pre-setting anchor
HDA-P (pre-positioning)



Through-setting anchor
HDA-T (post-positioning)



Hilti undercut anchor HDA

Intended use
Installation parameters

Annex B4

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Table B4: Minimum thickness of concrete member, HDA-P

Fastener type			HDA-P M10	HDA-P M12	HDA-P M16	HDA-P M20
Minimum thickness of concrete member	h_{min}	[mm]	180	200	270	350

Table B5: Minimum thickness of concrete member, HDA-T

Fastener type			HDA-T M10	HDA-T M12		HDA-T M16		HDA-T M20	
Maximum fixture thickness	$t_{fix,max}$ [1]	[mm]	20	30	50	40	60	50	100
Minimum thickness of concrete member	h_{min} [2]	[mm]	200-t_{fix}	230-t_{fix}	250-t_{fix}	310-t_{fix}	330-t_{fix}	400-t_{fix}	450-t_{fix}

[1] $t_{fix,max}$ maximum fastenable thickness, see Table B3, Annex B4.

[2] h_{min} is dependent on the actual fixture thickness t_{fix} (use of a stop drill bit).

e.g. HDA-T 22-M12x125/50: t_{fix} = 20mm → h_{min} = 250-20 = 230mm

t_{fix} = 50mm → h_{min} = 250-50 = 200mm

Table B6: Minimum spacing and minimum edge distances of fasteners

HDA-P / HDA-T			M10	M12	M16	M20
Cracked concrete						
Minimum spacing [1]	s_{min}	[mm]	100	125	190	250
Minimum edge distance [2]	c_{min}	[mm]	80	100	150	200
Uncracked concrete						
Minimum spacing [1]	s_{min}	[mm]	100	125	190	250
Minimum edge distance [2]	c_{min}	[mm]	80	100	150	200

[1] ratio s_{min} / h_{ef} = 1,0

[2] ratio c_{min} / h_{ef} = 0,8

Hilti undercut anchor HDA

Intended use
Minimum concrete thickness, minimum spacing and minimum edge distance

Annex B5

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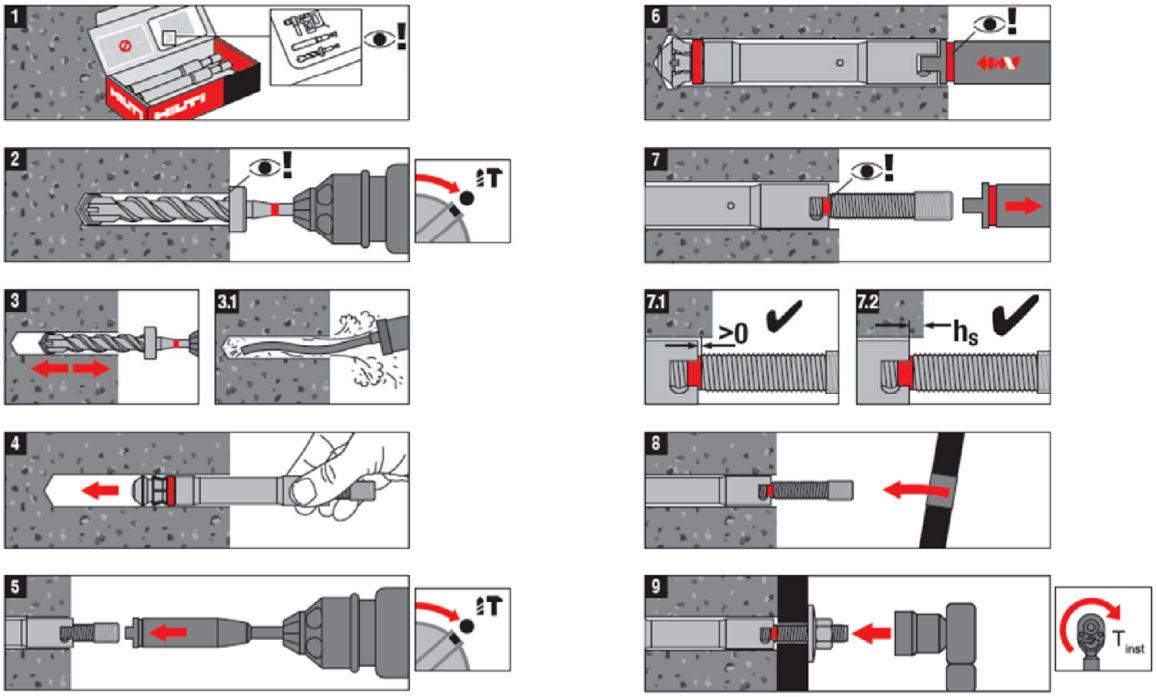
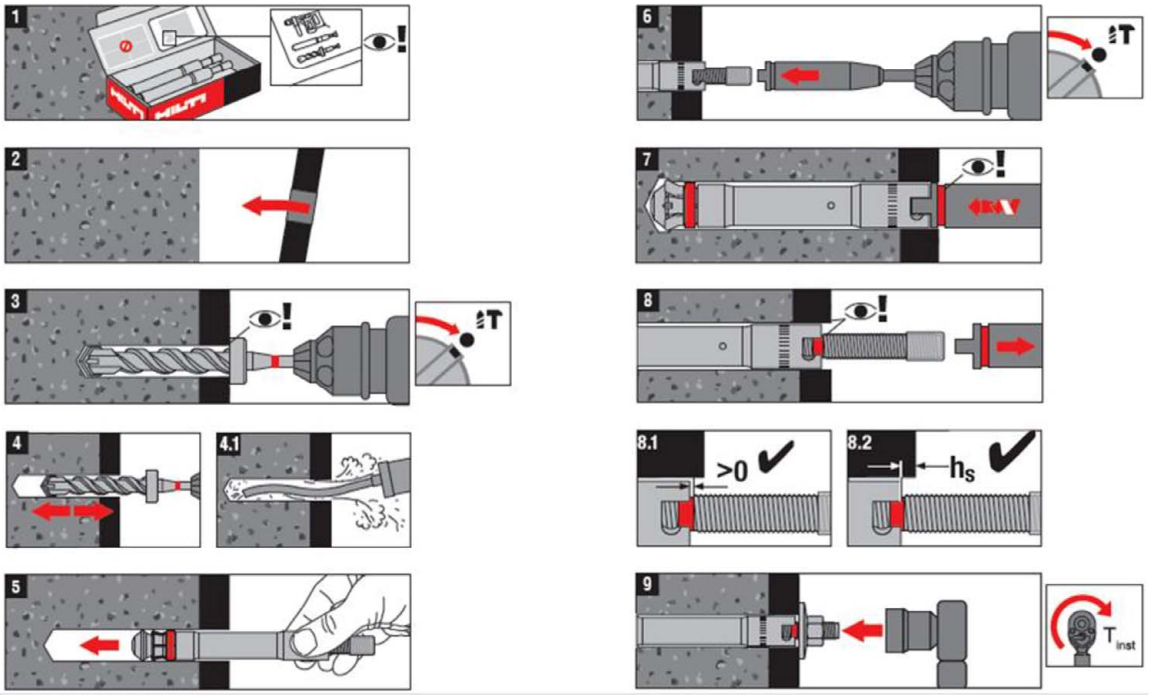
Installation instructions: HDA-P (pre-positioning)



Installation instructions: HDA-T (post-positioning)



Hilti undercut anchor HDA	
Intended use Installation instructions	**Annex B6**

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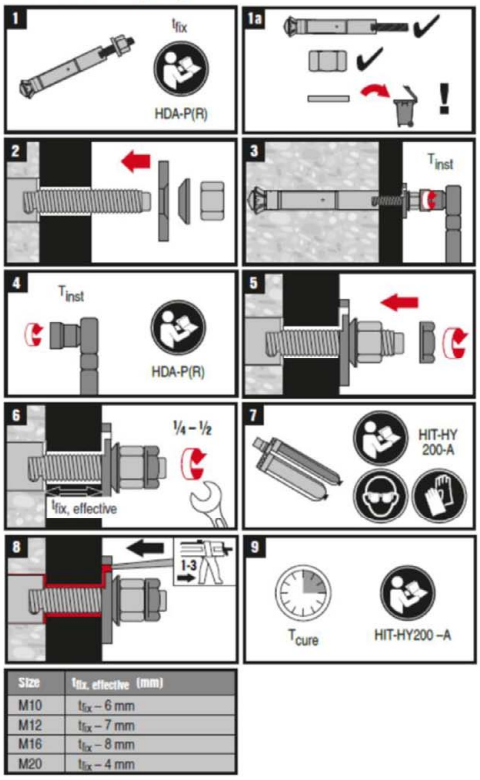
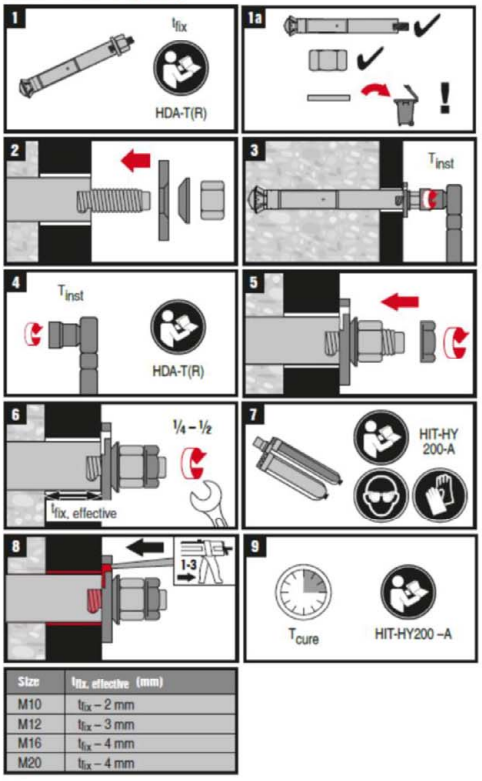
Installation instructions for the filling set

HDA-P(R)



Size	$t_{fix,\ effective}$ (mm)
M10	t_{fix} – 6 mm
M12	t_{fix} – 7 mm
M16	t_{fix} – 8 mm
M20	t_{fix} – 4 mm

HDA-T(R)



Size	$t_{fix,\ effective}$ (mm)
M10	t_{fix} – 2 mm
M12	t_{fix} – 3 mm
M16	t_{fix} – 4 mm
M20	t_{fix} – 4 mm

Table B7: Maximum working time and minimum curing time HY 200-A

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
> 0 °C to 5 °C	25 min	2 hours
> 5 °C to 10 °C	15 min	75 min
> 10 °C to 20 °C	7 min	45 min
> 20 °C to 30 °C	4 min	30 min
> 30 °C to 40 °C	3 min	30 min

Table B8: Maximum working time and minimum curing time HY 200-R

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
> 0 °C to 5 °C	1 hour	4 hours
> 5 °C to 10 °C	40 min	2,5 hours
> 10 °C to 20 °C	15 min	1,5 hours
> 20 °C to 30 °C	9 min	1 hour
> 30 °C to 40 °C	6 min	1 hour

Hilti undercut anchor HDA

Intended use
Installation instructions of the filling set

Annex B7

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Table C1: Essential characteristics under tension fatigue load in concrete (design method I acc. to TR 061)

HDA-P / HDA-T			**M10**	**M12**	**M16**	**M20**
Steel failure						
Characteristic resistance		[kN]	$\Delta N_{Rk,s,0,n}$			
Number of cycles	n	$\leq 10^5$	15,4	20,3	48,3	64,9
		$\leq 3 \cdot 10^5$	12,3	17,9	34,8	49,5
		$\leq 10^6$	10,4	16,8	26,5	38,0
		∞	9,2	16,3	22,7	26,7
Partial factor	$\gamma_{Ms,N,fat}$	[-]	acc. to TR 061, Eq. (3)			
Concrete failure						
Effective embedment depth	h_{ef}	[mm]	100	125	190	250
Reduction factor[1)]		[-]	$\eta_{k,c,N,fat,n}$			
Number of cycles	n	$\leq 10^5$	0,64			
		$\leq 3 \cdot 10^5$	0,64			
		$\leq 10^6$	0,64			
		∞	0,64			
Partial factor	$\gamma_{Mc,fat}$	[-]	1,5			
Load transfer factor for fastener groups	ψ_{FN}	[-]	0,77			

[1)] $\Delta N_{Rk,(c,sp,cb),0,n} = \eta_{k,c,N,fat,n} \cdot N_{Rk,(c,sp,cb)}$ with $N_{Rk,(c,sp,cb)}$ according to ETA-99/0009.

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Table C2: Essential characteristics under shear fatigue load in concrete (design method I acc. to TR 061)

HDA-P			M10	M12	M16	M20
Steel failure						
Characteristic resistance		[kN]	$\Delta V_{Rk,s,0,n}$			
Number of cycles	n	$\leq 10^5$	5,0	8,8	14,9	29,1
		$\leq 3 \cdot 10^5$	3,3	6,7	11,2	22,4
		$\leq 10^6$	2,6	6,1	9,6	18,9
		∞	2,5	6,0	9,0	17,5
Partial factor	$\gamma_{Ms,V,fat}$	[-]	acc. to TR 061, Eq. (3)			
Concrete failure						
Effective length of fastener	l_f	[mm]	70	88	90	120
Effective outside diameter of fastener	d_{nom}	[mm]	19	21	29	35
Reduction factor[1)]		[-]	$\eta_{k,c,V,fat,n}$			
Number of cycles	n	$\leq 10^5$	0,55			
		$\leq 3 \cdot 10^5$	0,55			
		$\leq 10^6$	0,55			
		∞	0,55			
Partial factor	$\gamma_{Mc,fat}$	[-]	1,5			
Load transfer factor for fastener groups	ψ_{FV}	[-]	0,83			

[1)] $\Delta V_{Rk,(c,cp),0,n} = \eta_{k,c,V,fat,n} \cdot V_{Rk,(c,cp)}$ with $V_{Rk,(c,cp)}$ according to ETA-99/0009.

Hilti undercut anchor HDA

Performances
Essential characteristics under shear fatigue load in concrete
(design method I acc. to TR 061)

Annex C2

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Table C3: Essential characteristics under shear fatigue load in concrete (design method I acc. to TR 061)

HDA-T				**M10**	**M12**	**M16**	**M20**
Steel failure							
Characteristic resistance			[kN]	$\Delta V_{Rk,s,0,n}$			
Number of cycles	n	$\leq 10^5$		15,9	21,8	34,2	29,1
		$\leq 3 \cdot 10^5$		12,6	18,5	27,7	22,4
		$\leq 10^6$		10,3	16,5	24,4	18,9
		∞		8,5	15,0	23,0	17,5
Partial factor	$\gamma_{Ms,V,fat}$		[-]	acc. to TR 061, Eq. (3)			
Concrete failure							
Effective length of fastener	l_f		[mm]	70	88	90	120
Effective outside diameter of fastener	d_{nom}		[mm]	19	21	29	35
Reduction factor[1)]			[-]	$\eta_{k,c,V,fat,n}$			
Number of cycles	n	$\leq 10^5$		0,55			
		$\leq 3 \cdot 10^5$		0,55			
		$\leq 10^6$		0,55			
		∞		0,55			
Partial factor	$\gamma_{Mc,fat}$		[-]	1,5			
Load transfer factor for fastener groups	ψ_{FV}		[-]	0,83			

[1)] $\Delta V_{Rk,(c,cp),0,n} = \eta_{k,c,V,fat,n} \cdot V_{Rk,(c,cp)}$ with $V_{Rk,(c,cp)}$ according to ETA-99/0009.

Hilti undercut anchor HDA

Performances
Essential characteristics under shear fatigue load in concrete
(design method I acc. to TR 061)

Annex C3

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Table C4: Essential characteristics under tension fatigue load in concrete (design method II acc. to TR 061)

HDA-P / HDA-T			M10	M12	M16	M20
Steel failure						
Characteristic resistance	$\Delta N_{Rk,s,0,\infty}$	[kN]	9,2	16,3	22,7	26,7
Partial factor	$\gamma_{Ms,N,fat}$	[-]	1,35			
Concrete failure						
Effective embedment depth	h_{ef}	[mm]	100	125	190	250
Reduction factor[1)]	$\eta_{k,c,N,fat,\infty}$	[-]	0,64			
Partial factor	$\gamma_{Mc,fat}$	[-]	1,5			
Load transfer factor for fastener groups	ψ_{FN}	[-]	0,77			

[1)] $\Delta N_{Rk,(c,sp,cb),0,\infty} = \eta_{k,c,N,fat,\infty} \cdot N_{Rk,(c,sp,cb)}$ with $N_{Rk,(c,sp,cb)}$ according to ETA-99/0009.

Table C5: Essential characteristics under shear fatigue load in concrete (design method II acc. to TR 061)

HDA-P			M10	M12	M16	M20
Steel failure						
Characteristic resistance	$\Delta V_{Rk,s,0,\infty}$	[kN]	2,5	6,0	9,0	17,5
Partial factor	$\gamma_{Ms,V,fat}$	[-]	1,35			
Concrete failure						
Effective length of fastener	l_f	[mm]	70	88	90	120
Effective outside diameter of fastener	d_{nom}	[mm]	19	21	29	35
Reduction factor[1)]	$\eta_{k,c,V,fat,\infty}$	[-]	0,55			
Partial factor	$\gamma_{Mc,fat}$	[-]	1,5			
Load transfer factor for fastener groups	ψ_{FV}	[-]	0,83			

[1)] $\Delta V_{Rk,(c,cp),0,\infty} = \eta_{k,c,V,fat,\infty} \cdot V_{Rk,(c,cp)}$ with $V_{Rk,(c,cp)}$ according to ETA-99/0009.

Hilti undercut anchor HDA

Performances
Essential characteristics under tension and shear fatigue load in concrete (design method II acc. to TR 061)

Annex C4

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Table C6: Essential characteristics under shear fatigue load in concrete (design method II acc. to TR 061)

HDA-T			M10	M12	M16	M20
Steel failure						
Characteristic resistance	$\Delta V_{Rk,s,0,\infty}$	[kN]	8,5	15,0	23,0	17,5
Partial factor	$\gamma_{Ms,V,fat}$	[-]	1,35			
Concrete failure						
Effective length of fastener	l_f	[mm]	70	88	90	120
Effective outside diameter of fastener	d_{nom}	[mm]	19	21	29	35
Reduction factor[1)]	$\eta_{k,c,V,fat,\infty}$	[-]	0,55			
Partial factor	$\gamma_{Mc,fat}$	[-]	1,5			
Load transfer factor for fastener groups	ψ_{FV}	[-]	0,83			

[1)] $\Delta V_{Rk,(c,cp),0,\infty} = \eta_{k,c,V,fat,\infty} \cdot V_{Rk,(c,cp)}$ with $V_{Rk,(c,cp)}$ according to ETA-99/0009.

Table C7: Essential characteristics for combined fatigue load in concrete (design method I and II acc. to TR 061)

HDA-P / HDA-T			M10	M12	M16	M20
Exponent for combined fatigue load	α_{sn}	[-]	1,0			1,25
	α_c	[-]	1,5			