Deutsches Institut für Bautechnik
DIBt

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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-11/0493 of 10 December 2021

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	Injection system Hilti HIT-HY 200-A
Product family to which the construction product belongs	Bonded fastener for use in concrete
Manufacturer	Hilti Aktiengesellschaft 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Plants
This European Technical Assessment contains	44 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 330499-01-0601 Edition 04/2020
This version replaces	ETA-11/0493 issued on 14 December 2020

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Specific Part

1 Technical description of the product

The injection system Hilti HIT-HY 200-A is a bonded fastener consisting of a foil pack with injection mortar Hilti HIT-HY 200-A and a steel element according to Annex A.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

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 fastener 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 and/or 100 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 resistance to tension load (static and quasi-static loading)	See Annex C1, C2, C4, C5, C7, C8, C10, C11, B3 to B6
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C3, C6, C9, C12
Displacements under short-term and long-term loading	See Annex C13 to C16
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C17 to C21

3.2 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed

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

In accordance with the European Assessment Document EAD 330499-01-0601 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 at Deutsches Institut für Bautechnik.

The following standards and documents are referred to in this European Technical Assessment:

- EN 1992-1-1:2004 + AC:2010 Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings
- EN 1992-1-2:2004 + AC:2008 Eurocode 2: Design of concrete structures - Part 1-2: General rules - Structural fire design
- EN 1992-4:2018 Eurocode 2 - Design of concrete structures - Part 4: Design of fastenings for use in concrete
- EN 1993-1-4:2006 + A1:2015: Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
- EN 1998-1:2004 + AC:2009 Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings
- EN 10088-1:2014 Stainless steels - Part 1: List of stainless steels
- EN 206:2013 + A1:2016 Concrete - Specification, performance, production and conformity
- EN 10204:2004 Metallic products – Types of inspection documents
- DIN 488-1:2009-08 Reinforcing steels – Part 1: Grades, properties, marking
- EOTA TR 055: Design of fastenings based on EAD 330232-00-0601, EAD 330499-00-0601 and EAD 330747-00-0601, February 2018

Issued in Berlin on 10 Dezember 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Pascal Stiller

Installed condition

Figure A1:

Threaded rod, HAS-U-…, HIT-V-… and AM 8.8

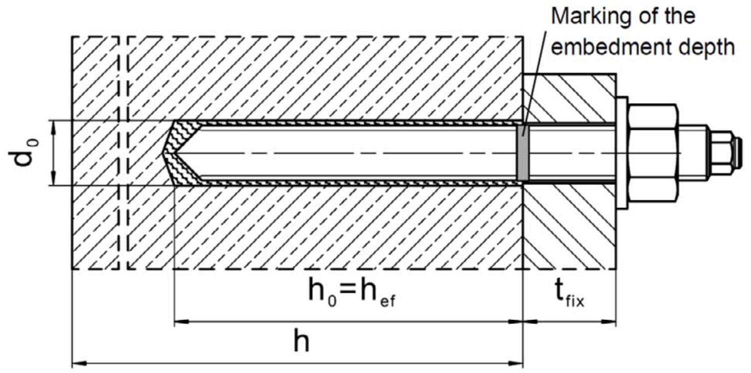


Figure A2:

Threaded rod, HAS-U-…, HIT-V-… and AM 8.8 with Hilti Filling Set

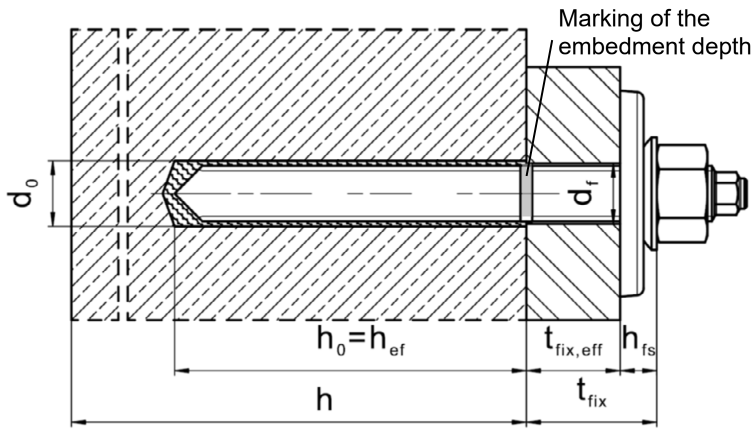
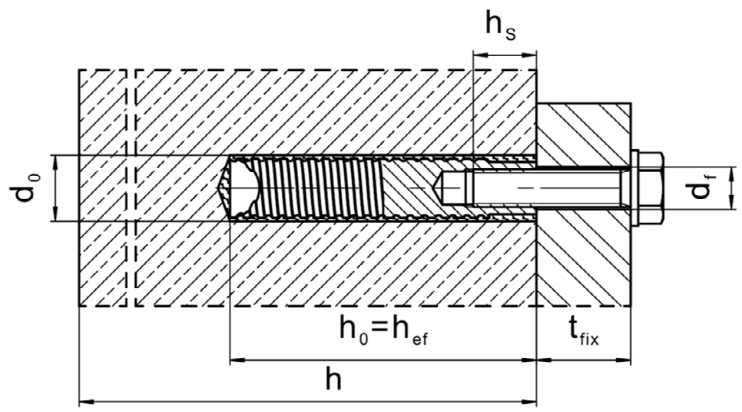


Figure A3:

Internally threaded sleeve HIS-(R)N

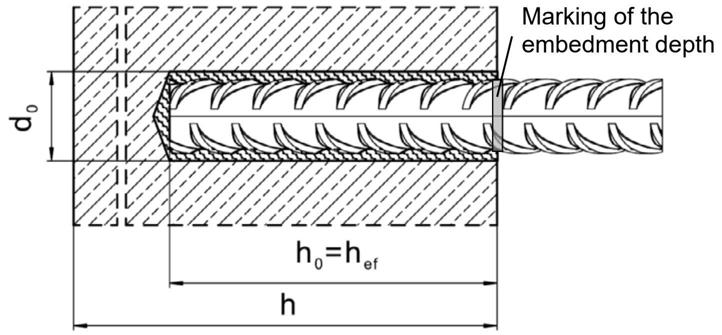


Injection system Hilti HIT-HY 200-A	**Annex A1**
Product description Installed condition	

Installed condition

<u>Figure A4:</u>

Reinforcing bar



Injection system Hilti HIT-HY 200-A	Annex A2
Product description Installed condition	

Product description: Injection mortar and steel elements

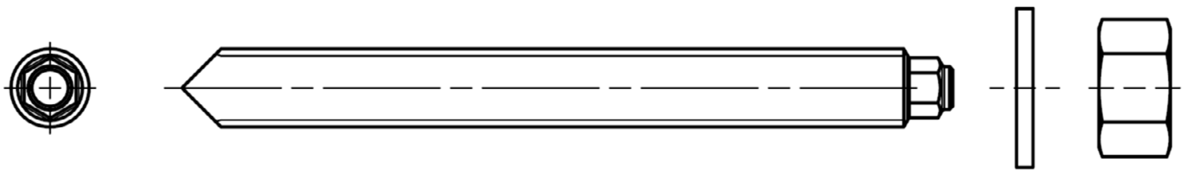
Injection mortar Hilti HIT-HY 200-A: hybrid system with aggregate
330 ml and 500 ml

Marking:
HILTI-HIT
Production number and
production line
Expiry date mm/yyyy

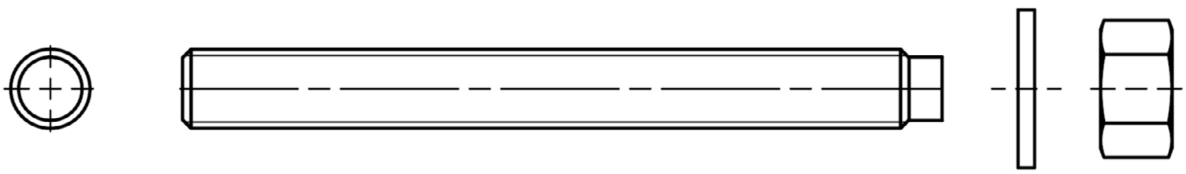
Product name: “Hilti HIT-HY 200-A”

Static mixer Hilti HIT-RE-M

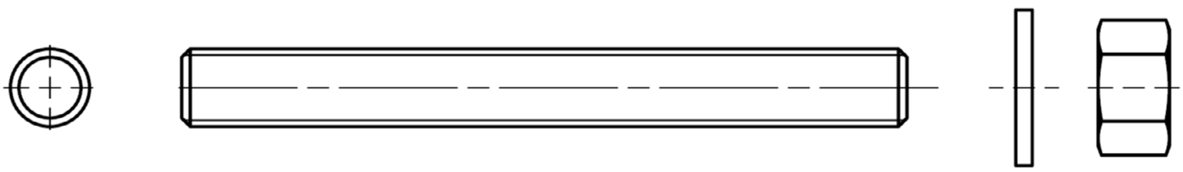
Steel elements



HAS-U-…: M8 to M30 washer nut



HIT-V-…: M8 to M30 washer nut

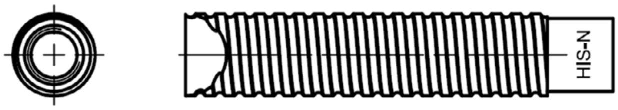


Threaded rod: M8 to M30 washer nut
Hilti AM 8.8 meter rod electroplated zinc coated: M8 to M30, 1m to 3m
Hilti AM HDG 8.8 meter rod hot dip galvanized: M8 to M30, 1m to 3m

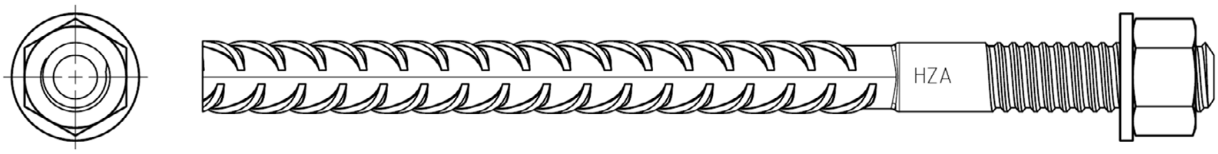
Commercial standard threaded rod:
- Materials and mechanical properties according to Table A1.
- Inspection certificate 3.1 according to EN 10204. The document shall be stored.
- Marking of embedment depth.

Injection system Hilti HIT-HY 200-A	Annex A3
Product description Injection mortar / Static mixer / Steel elements	

Steel elements



Internally threaded sleeve: HIS-(R)N M8 to M20



Hilti Tension Anchor: HZA M12 to M27 and HZA-R M12 to M24

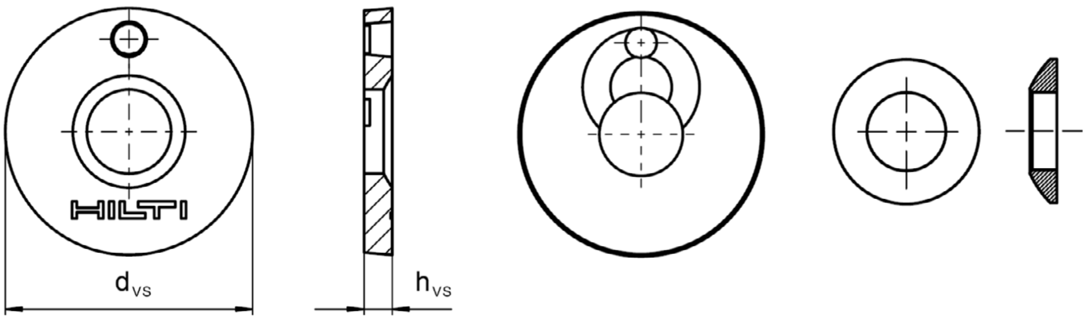
Reinforcing bar (rebar): ϕ 8 to ϕ 32

- Materials and mechanical properties according to Table A1
- Dimensions according to Annex B6

Hilti Filling Set to fill the annular gap between steel element and fixture

Sealing washer

Spherical washer



Hilti Filling Set			**M16**	**M20**	**M24**
Diameter of sealing washer	d_{VS}	[mm]	52	60	70
Thickness of sealing washer	h_{VS}	[mm]		6	
Thickness of Hilti Filling Set	h_{fs}	[mm]	11	13	15

Injection system Hilti HIT-HY 200-A

Product description
Injection mortar / Static mixer / Steel elements

Annex A4

Table A1: Materials

Designation	**Material**
Reinforcing bars (rebars)	
Rebar EN 1992-1-1, Annex C	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCI of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$
Steel elements made of zinc coated steel	
HAS-U 5.8 (HDG), HIT-V 5.8(F), Threaded rod	Strength class 5.8, f_{uk} = 500 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm, (F) or (HDG) hot dip galvanized ≥ 45 µm
HAS-U 8.8 (HDG), HIT-V 8.8 (F), Threaded rod	Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², Elongation at fracture (l_0=5d) > 12% ductile Electroplated zinc coated ≥ 5 µm, (F) or (HDG) hot dip galvanized ≥ 45 µm
Hilti Meter rod AM 8.8 (HDG)	Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm² Elongation at fracture (l_0 = 5d) > 12% ductile, Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm
Hilti tension anchor HZA	Round steel with threaded part: electroplated zinc coated ≥ 5 µm Rebar: Bars class B according to NDP or NCI of EN 1992-1-1/NA
Internally threaded sleeve HIS-N	Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm
Nut	Strength class of nut adapted to strength class of threaded rod Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm
Hilti Filling Set (F)	Filling washer: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm Spherical washer: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm Lock nut: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 45 µm

Table A1: continued

Steel elements made of stainless steel corrosion resistance class (CRC) III according EN 1993-1-4	
HAS-U A4, HIT-V-R	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; For > M24: strength class 50, f_{uk} = 500 N/mm², f_{yk} = 210 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile
Threaded rod	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; For > M24: strength class 50, f_{uk} = 500 N/mm², f_{yk} = 210 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Hilti tension anchor HZA-R	Round steel with threaded part: Stainless steel 1.4404, 1.4362, 1.4571 EN 10088-1 Rebar: Bars class B according to NDP or NCI of EN 1992-1-1/NA
Internally threaded sleeve HIS-RN	Stainless steel 1.4401, 1.4571 EN 10088-1
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Nut	For ≤ M24: strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; For > M24: strength class 50, f_{uk} = 500 N/mm², f_{yk} = 210 N/mm²; Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Steel elements made of high corrosion resistant steel corrosion resistance class (CRC) V according EN 1993-1-4	
HAS-U HCR, HIT-V-HCR	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 12% ductile
Threaded rod	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², Elongation at fracture (l_0=5d) > 12% ductile High corrosion resistant steel 1.4529, 1.4565 EN 10088-1
Washer	High corrosion resistant steel 1.4529, 1.4565 EN 10088-1
Nut	For ≤ M20: f_{uk} = 800 N/mm², f_{yk} = 640 N/mm², For > M20: f_{uk} = 700 N/mm², f_{yk} = 400 N/mm², High corrosion resistant steel 1.4529, 1.4565 EN 10088-1

Specifications of intended use

Anchorages subject to:
- Static and quasi static loading.
- Seismic performance category C1 and C2 (see Table B1).

Base material:
- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206.
- Strength classes C20/25 to C50/60 according to EN 206.
- Cracked and uncracked concrete.

Temperature in the base material:
- **at installation**
  -10 °C to +40 °C for the standard variation of temperature after installation
- **in-service**
  Temperature range I: -40 °C to +40 °C
  (max. long term temperature +24 °C and max. short term temperature +40 °C)
  Temperature range II: -40 °C to +80 °C
  (max. long term temperature +50 °C and max. short term temperature +80 °C)
  Temperature range III: -40 °C to +120 °C
  (max. long term temperature +72 °C and max. short term temperature +120 °C)

Table B1: Specifications of intended use

	HIT-HY 200-A with …			
Steel elements	HAS-U-…, HIT-V-…, AM 8.8	Rebar	HZA(-R)	HIS-(R)N
Hammer drilling with hollow drill bit TE-CD or TE-YD	✓	✓	✓	✓
Hammer drilling	✓	✓	✓	✓
Diamond drilling with roughening tool TE-YRT	✓	✓	✓	✓
Static and quasi static loading in cracked and uncracked concrete	M8 to M30	ϕ 8 to ϕ 32	M12 to M27	M8 to M20
Seismic performance category C1	M10 to M30	ϕ 10 to ϕ 32	M12 to M27	-
Seismic performance category C2	M16 to M24, HAS-U (-8.8, -8.8 HDG, A4, HCR) HIT-V 8.8 (-8.8, -8.8 F, -R, HCR), AM (8.8, 8.8 HDG) Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	-	-	-

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according EN 1993-1-4
  corresponding to corrosion resistance classes Annex A6 Table A1 (stainless steels).

Design:

- Fastenings are designed under the responsibility of an engineer experienced in fastenings and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be fastened. The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- The anchorages are designed in accordance with:
  EN 1992-4 and EOTA Technical Report TR 055.

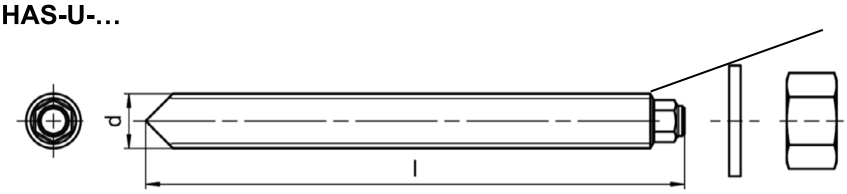
Installation:

- Use category: dry or wet concrete (not in flooded holes) for all drilling techniques.
- Drilling technique:
  - Hammer drilling,
  - Hammer drilling with Hilti hollow drill bit TE-CD, TE-YD,
  - Diamond coring with roughening with Hilti roughening tool TE-YRT.
- Installation direction D3: downward, horizontal and upward (e.g. overhead) installation admissible for all elements.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Table B2: Installation parameters of threaded rod, HAS-U-…, HIT-V-… and AM 8.8

Threaded rod, HAS-U- …, HIT-V-…, AM 8.8			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Diameter of element	d	[mm]	8	10	12	16	20	24	27	30
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	60 to 160	60 to 200	70 to 240	80 to 320	90 to 400	96 to 480	108 to 540	120 to 600
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26	30	33
Thickness of Hilti Filling Set	h_{fs}	[mm]	-	-	-	11	13	15	-	-
Effective fixture thickness with Hilti Filling Set	$t_{fix,eff}$	[mm]	$t_{fix,eff} = t_{fix} – h_{fs}$							
Minimum thickness of concrete member	h_{min}	[mm]	h_{ef} + 30 ≥ 100 mm			$h_{ef} + 2 \cdot d_0$				
Maximum installation torque	max T_{inst}	[Nm]	10	20	40	80	150	200	270	300
Minimum spacing	s_{min}	[mm]	40	50	60	75	90	115	120	140
Minimum edge distance	c_{min}	[mm]	40	45	45	50	55	60	75	80

HAS-U-…



Marking:

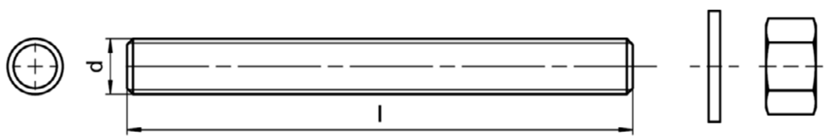
Steel grade number and length identification letter: e.g. 8L

HIT-V-…

Marking:

5.8 - l	=	HIT-V-5.8	M…x l
5.8F - l	=	HIT-V-5.8F	M…x l
8.8 - l	=	HIT-V-8.8	M…x l
8.8F - l	=	HIT-V-8.8F	M…x l
R - l	=	HIT-V-R	M ...x l
HCR - l	=	HIT-V-HCR	M ...x l

Hilti meter rod AM (HDG) 8.8



Injection system Hilti HIT-HY 200-A

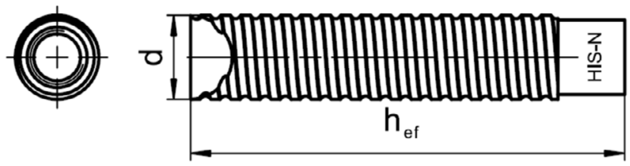
Intended Use
Installation parameters of threaded rod, HAS-U-…, HIT-V-… and AM 8.8

Annex B3

Table B3: Installation parameters of internally threaded sleeve HIS-(R)N

Internally threaded sleeve HIS-(R)N…			**M8**	**M10**	**M12**	**M16**	**M20**
Outer diameter of sleeve	d	[mm]	12,5	16,5	20,5	25,4	27,6
Nominal diameter of drill bit	d_0	[mm]	14	18	22	28	32
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	90	110	125	170	205
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22
Minimum thickness of concrete member	h_{min}	[mm]	120	150	170	230	270
Maximum installation torque	max T_{inst}	[Nm]	10	20	40	80	150
Thread engagement length min-max	h_s	[mm]	8-20	10-25	12-30	16-40	20-50
Minimum spacing	s_{min}	[mm]	60	75	90	115	130
Minimum edge distance	c_{min}	[mm]	40	45	55	65	90

Internally threaded sleeve HIS-(R)N…



Marking:
Identifying mark - HILTI and
embossing "HIS-N" (for C-steel)
embossing "HIS-RN" (for stainless steel)

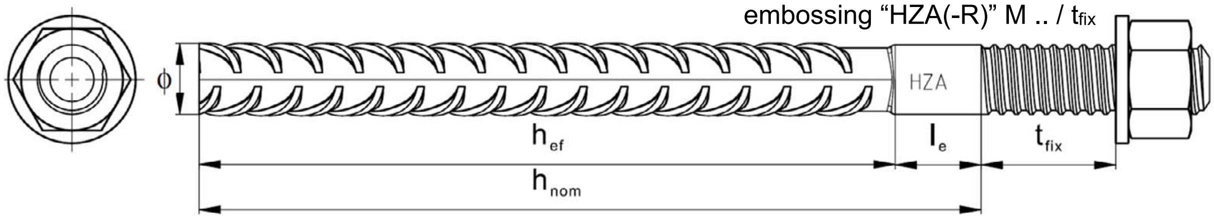
Table B4: Installation parameters of Hilti tension anchor HZA-R

Hilti tension anchor HZA-R …			**M12**	**M16**	**M20**	**M24**
Rebar diameter	ϕ	[mm]	12	16	20	25
Nominal embedment depth and drill hole depth	$h_{nom} = h_0$	[mm]	170 to 240	180 to 320	190 to 400	200 to 500
Effective embedment depth ($h_{ef} = h_{nom} - l_e$)	h_{ef}	[mm]	$h_{nom} - 100$			
Length of smooth shaft	l_e	[mm]	100			
Nominal diameter of drill bit	d_0	[mm]	16	20	25	32
Maximum diameter of clearance hole in the fixture	d_f	[mm]	14	18	22	26
Maximum installation torque	max T_{inst}	[Nm]	40	80	150	200
Minimum thickness of concrete member	h_{min}	[mm]	$h_{nom} + 2 \cdot d_0$			
Minimum spacing	s_{min}	[mm]	65	80	100	130
Minimum edge distance	c_{min}	[mm]	45	50	55	60

Table B5: Installation parameters of Hilti tension anchor HZA

Hilti tension anchor HZA…			**M12**	**M16**	**M20**	**M24**	**M27**
Rebar diameter	ϕ	[mm]	12	16	20	25	28
Nominal embedment depth and drill hole depth	$h_{nom} = h_0$	[mm]	90 to 240	100 to 320	110 to 400	120 to 500	140 to 560
Effective embedment depth ($h_{ef} = h_{nom} - l_e$)	h_{ef}	[mm]	$h_{nom} - 20$				
Length of smooth shaft	l_e	[mm]	20				
Nominal diameter of drill bit	d_0	[mm]	16	20	25	32	35
Maximum diameter of clearance hole in the fixture	d_f	[mm]	14	18	22	26	30
Maximum installation torque	max T_{inst}	[Nm]	40	80	150	200	270
Minimum thickness of concrete member	h_{min}	[mm]	$h_{nom} + 2 \cdot d_0$				
Minimum spacing	s_{min}	[mm]	65	80	100	130	140
Minimum edge distance	c_{min}	[mm]	45	50	55	60	75

Marking:
embossing "HZA(-R)" M .. / t_{fix}



Injection system Hilti HIT-HY 200-A

Intended Use
Installation parameters of Hilti tension anchor HZA-(R)

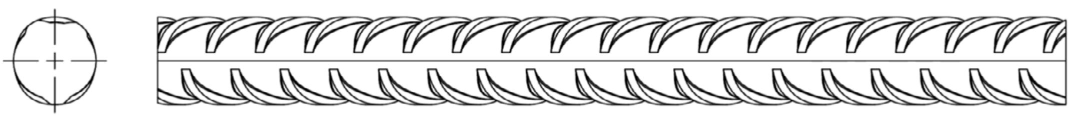
Annex B5

Table B6: Installation parameters of reinforcing bar

Reinforcing bar (rebar)			**ϕ 8**	**ϕ 10**	**ϕ 12**		**ϕ 14**	**ϕ 16**	**ϕ 20**	**ϕ 25**	**ϕ 26**	**ϕ 28**	**ϕ 30**	**ϕ 32**
Diameter	ϕ	[mm]	8	10	12		14	16	20	25	26	28	30	32
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	60 to 160	60 to 200	70 to 240		75 to 280	80 to 320	90 to 400	100 to 500	104 to 520	112 to 560	120 to 600	128 to 640
Nominal diameter of drill bit	d_0	[mm]	10 / 12[1)]	12 / 14[1)]	14[1)]	16[1)]	18	20	25	32	32	35	37	40
Minimum thickness of concrete member	h_{min}	[mm]	h_{ef} + 30 ≥ 100 mm			$h_{ef} + 2 \cdot d_0$								
Minimum spacing	s_{min}	[mm]	40	50	60		70	80	100	125	130	140	150	160
Minimum edge distance	c_{min}	[mm]	40	45	45		50	50	65	70	75	75	80	80

1) Each of the two given values can be used.

Reinforcing bar



For rebar bolt

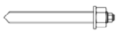
- Minimum value of related rib area $f_{R,min}$ according to EN 1992-1-1
- Rib height of the bar h_{rib} shall be in the range $0{,}05 \cdot \phi \leq h_{rib} \leq 0{,}07 \cdot \phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)

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

Temperature in the base material T [1)]	Maximum working time t_{work}	Minimum curing time t_{cure}
-10 °C to -5 °C	1,5 h	7 h
> -5 °C to 0 °C	50 min	4 h
> 0 °C to 5 °C	25 min	2 h
> 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

1) The minimum foil pack temperature is 0 °C.

Table B8: Parameters of drilling, cleaning and setting tools

Steel elements				Drill and clean					Installation
Threaded rod, HAS-U-…, HIT-V-…, AM 8.8	HIS-(R)N	Rebar	HZA(-R)	Hammer drilling	Hammer drilling: Hollow drill bit[1]	Diamond coring	Diamond coring: Roughening tool	Brush	Piston plug
									
Size	size	size	size	d_0 [mm]	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-SZ
M8	-	ϕ8	-	10	-	-	-	10	-
M10	-	ϕ8 / ϕ10	-	12	12	-	-	12	12
M12	M8	ϕ10 / ϕ12	-	14	14	-	-	14	14
-	-	ϕ12	M12	16	16	-	-	16	16
M16	M10	ϕ14	-	18	18	18	18	18	18
-	-	ϕ16	M16	20	20	20	20	20	20
M20	M12	-	-	22	22	22	22	22	22
-	-	ϕ20	M20	25	25	25	25	25	25
M24	M16	-	-	28	28	28	28	28	28
M27	-	-	-	30	-	30	30	30	30
-	M20	ϕ25 / ϕ26	M24	32	32	32	32	32	32
M30	-	ϕ28	M27	35	35	35	35	35	35
-	-	ϕ30	-	37	-	-	-	37	37
-	-	ϕ32	-	40	-	-	-	40	40

1) With vacuum cleaner Hilti VC 20/40/60 (automatic filter cleaning activated) or vacuum cleaner with activated automatic filter cleaning as well as volumetric flow rate at turbine ≥ 57 l/s, volumetric flow rate at end of hose ≥ 106 m³/h and partial vacuum ≥ 16 kPa.

Cleaning alternatives

Manual Cleaning (MC):
Hilti hand pump for blowing out drill holes with diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.

Compressed air cleaning (CAC):
Air nozzle with an orifice opening of minimum 3,5 mm in diameter.

Automatic Cleaning (AC):
Cleaning is performed during drilling with Hilti TE-CD and TE-YD drilling system including vacuum cleaner..

Table B9: Hilti roughening tool TE-YRT – tool parameters

Associated components			
Diamond coring		Roughening tool TE-YRT	Wear gauge RTG…
			
d_0 [mm]		d_0 [mm]	size
nominal	measured		
18	17,9 to 18,2	18	18
20	19,9 to 20,2	20	20
22	21,9 to 22,2	22	22
25	24,9 to 25,2	25	25
28	27,9 to 28,2	28	28
30	29,9 to 30,2	30	30
32	31,9 to 32,2	32	32
35	34,9 to 35,2	35	35

Table B10: Hilti roughening tool TE-YRT – roughening and blowing times

	Roughening time $t_{roughen}$	**Minimum blowing time** $t_{blowing}$
h_{ef} [mm]	$t_{roughen}$ [sec] = h_{ef} [mm] / 10	$t_{blowing}$ [sec] = $t_{roughen}$ [sec] + 20
0 to 100	10	30
101 to 200	20	40
201 to 300	30	50
301 to 400	40	60
401 to 500	50	70
501 to 600	60	80

Hilti roughening tool TE-YRT and wear gauge RTG

Hilti roughening tool TE-YRT	
Wear gauge RTG	

Injection system Hilti HIT-HY 200-A	**Annex B9**
Intended Use Parameters for use of the Hilti Roughening tool TE-YRT	

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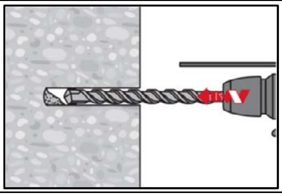
Installation instruction

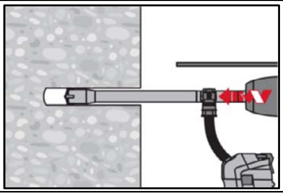
Hole drilling

a) Hammer drilling



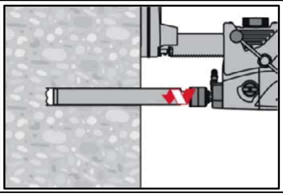
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

b) Hammer drilling with Hilti hollow drill bit

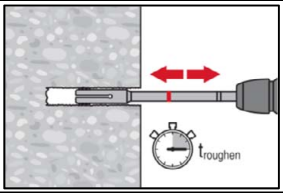


Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit attached to Hilti vacuum cleaner VC 20/40/60 or with a vacuum cleaner according to Table B8, in each case with automatic cleaning of the filter activated. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. After drilling is completed, proceed to the "injection preparation" step in the installation instruction.

c) Diamond coring with roughening with Hilti roughening tool TE-YRT:



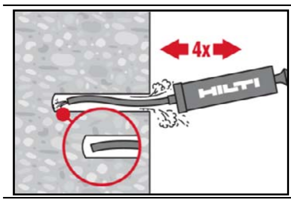
Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
For the use in combination with Hilti roughening tool TE-YRT see parameters in Table B9.



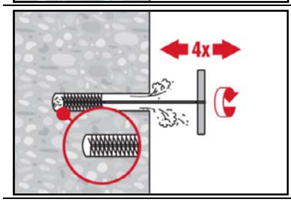
Before roughening water needs to be removed from the drill hole.
Check usability of the roughening tool with the wear gauge RTG.
Roughen the drill hole over the whole length to the required h_{ef}.
Roughening time $t_{roughen}$ see Table B10.

Drill hole cleaning Just before injection of the mortar, the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.

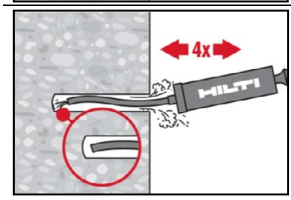
Manual Cleaning (MC) Uncracked concrete only.
For drill hole diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.



The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust.



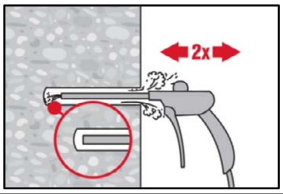
Brush 4 times with the specified brush (see Table B8) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



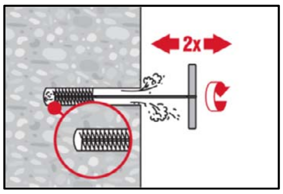
Blow out again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.

Injection system Hilti HIT-HY 200-A	Annex B10
Intended Use Installation instructions	

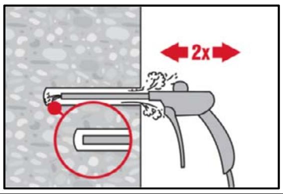
Compressed air cleaning (CAC) for all drill hole diameters d_0 and all drill hole depths h_0



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

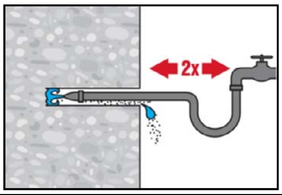


Brush 2 times with the specified brush (see Table B8) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.

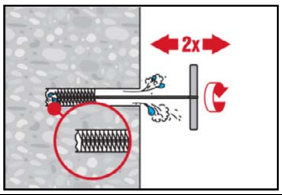


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

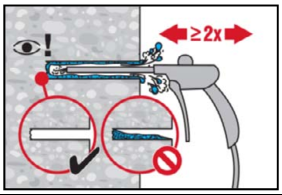
Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT.



Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



Brush 2 times with the specified brush (see Table B8) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it. The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water. Remove all water from the drillhole until drillhole is completely dried before mortar injection ($t_{blowing}$ see Table B10). For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

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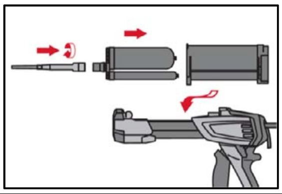
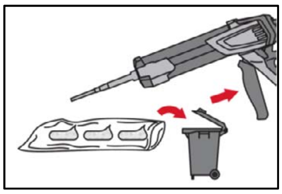
Injection preparation



Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into dispenser.

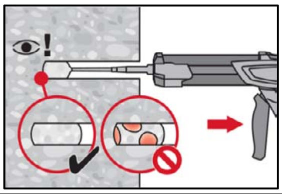


The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack, an initial amount of adhesive has to be discarded. Discarded quantities are

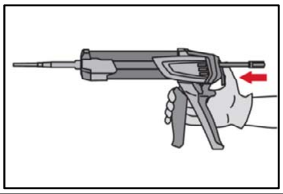
2 strokes	for 330 ml foil pack,
3 strokes	for 500 ml foil pack,
4 strokes	for 500 ml foil pack ≤ 5 °C.

The minimum foil pack temperature is 0°C.

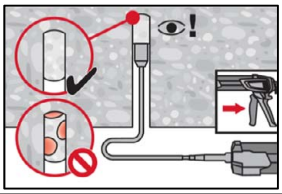
Inject adhesive from the back of the drill hole without forming air voids.



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull. Fill approximately 2/3 of the drill hole to ensure that the annular gap between the steel element and the concrete is completely filled with adhesive along the embedment length.
In water saturated concrete it is required to set the fastener immediately after cleaning the drillhole.

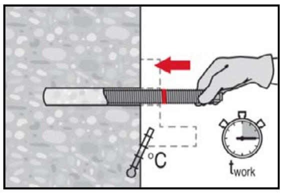


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

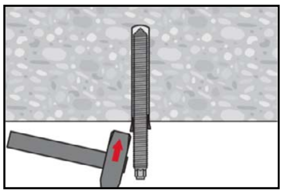


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B8). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

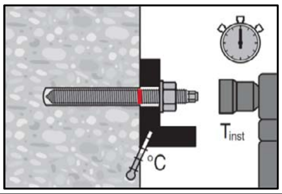
Setting the steel element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set steel element to the required embedment depth before working time t_{work} has elapsed. The working time t_{work} is given in Table B7.

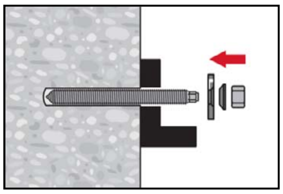


For overhead installation use piston plugs and fix embedded parts with e.g. wedges (Hilti HIT-OHW).

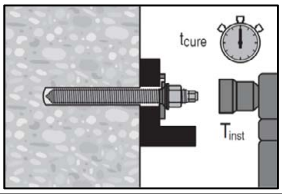


Loading: After required curing time t_{cure} (see Table B7) the fastening can be loaded.
The applied installation torque shall not exceed the values max T_{inst} given in Table B2 to Table B5.

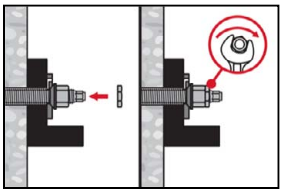
Installation of Hilti Filling Set



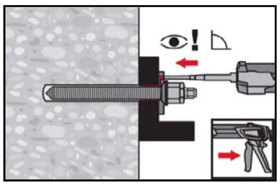
Use Hilti Filling Set with standard nut. Observe the correct orientation of filling washer and spherical washer.



The applied installation torque shall not exceed the values max T_{inst} given in Table B2 to Table B5.



Optional:
Installation of lock nut. Tighten with a ¼ to ½ turn. (Not for size M24.)



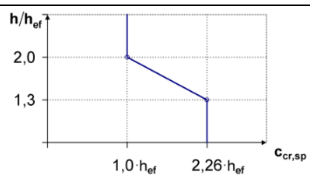
Fill the annular gap between steel element and fixture with 1-3 strokes of a Hilti injection mortar HIT-HY … or HIT-RE … .
Follow the installation instructions supplied with the respective Hilti injection mortar.
After required curing time t_{cure} the fastening can be loaded.

Injection system Hilti HIT-HY 200-A

Intended Use
Installation instructions

Annex B13

Table C1: Essential characteristics for threaded rod, HAS-U-…, HIT-V-… and AM 8.8 under tension load in concrete

Threaded rod, HAS-U-…, HIT-V-… and AM 8.8			M8	M10	M12	M16	M20	M24	M27	M30
For a working life of 50 and 100 years										
Installation factor										
Hammer drilling	γ_{inst}	[-]	1,0							
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD	γ_{inst}	[-]	1)	1,0						
Diamond coring with roughening with Hilti roughening tool TE-YRT	γ_{inst}	[-]	1)			1,0				
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$							
Partial factor grade 5.8	$\gamma_{Ms,N}$ 2)	[-]	1,5							
Partial factor grade 8.8	$\gamma_{Ms,N}$ 2)	[-]	1,5							
Partial factor HAS-U A4, HIT-V-R, Threaded rod CRC **III** (Table A1)	$\gamma_{Ms,N}$ 2)	[-]	1,87						2,86	
Partial factor HAS-U HCR, HIT-V-HCR, Threaded rod CRC V (Table A1)	$\gamma_{Ms,N}$ 2)	[-]	1,5					2,1		
Concrete cone failure										
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0							
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7							
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$							
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$							
Splitting failure										
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2,0$		$1,0 \cdot h_{ef}$							
	$2,0 > h / h_{ef} > 1,3$		$4,6 \cdot h_{ef} - 1,8 \cdot h$							
	$h / h_{ef} \leq 1,3$		$2,26 \cdot h_{ef}$							
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							

1) No performance assessed.
2) In absence of national regulations.

Injection system Hilti HIT-HY 200-A

Performances
Essential characteristics under tension load in concrete

Annex C1

Table C1: continued

Threaded rod, HAS-U-…, HIT-V-… and AM 8.8	M8	M10	M12	M16	M20	M24	M27	M30
Combined pullout and concrete cone failure for a working life of 50 years								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range I: 40 °C / 24 °C $\tau_{Rk,ucr}$ [N/mm²]	18							
Temperature range II: 80 °C / 50 °C $\tau_{Rk,ucr}$ [N/mm²]	15							
Temperature range III: 120 °C / 72 °C $\tau_{Rk,ucr}$ [N/mm²]	13							
Characteristic bond resistance in cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C $\tau_{,cr}$ [N/mm²]	7,5		8,5			9,0		
Temperature range II: 80 °C / 50 °C $\tau_{Rk,cr}$ [N/mm²]	6,0		7,0			7,5		
Temperature range III: 120 °C / 72 °C $\tau_{Rk,cr}$ [N/mm²]	5,5		6,0			6,5		
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete								
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$								
Temperature range I to III : ψ_c [-]	$(f_{ck}/20)^{0,1}$							
Influence of sustanined load								
Temperature range I: 40 °C / 24 °C ψ^0_{sus} [-]	0,74							
Temperature range II: 80 °C / 50 °C ψ^0_{sus} [-]	0,89							
Temperature range III: 120 °C / 72 °C ψ^0_{sus} [-]	0,72							
Combined pullout and concrete cone failure for a working life of 100 years								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range I: 40 °C / 24 °C $\tau_{Rk,ucr,100}$ [N/mm²]	17							
Temperature range II: 80 °C / 50 °C $\tau_{Rk,ucr,100}$ [N/mm²]	14							
Temperature range III: 120 °C / 72 °C $\tau_{Rk,ucr,100}$ [N/mm²]	12							
Characteristic bond resistance in cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C $\tau_{Rk,cr,100}$ [N/mm²]	6,5		8,0					
Temperature range II: 80 °C / 50 °C $\tau_{Rk,cr,100}$ [N/mm²]	5,5		7,0					
Temperature range III: 120 °C / 72 °C $\tau_{Rk,cr,100}$ [N/mm²]	5,0		6,0					
Influence factors ψ on bond resistance $\tau_{Rk,100}$ in cracked and uncracked concrete								
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$								
Temperature range I to III : ψ_c [-]	$(f_{ck}/20)^{0,1}$							

Injection system Hilti HIT-HY 200-A

Performances
Essential characteristics under tension load in concrete

Annex C2

Table C2: Essential characteristics for threaded rod, HAS-U-…, HIT-V-… and AM 8.8 under shear load in concrete

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			M8	M10	M12	M16	M20	M24	M27	M30
For a working life of 50 and 100 years										
Steel failure without lever arm										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$k_6 \cdot A_s \cdot f_{uk}$							
Factor grade 5.8	k_6	[-]	0,6							
Factor grade 8.8	k_6	[-]	0,5							
Factor HAS-U A4, HIT-V-R, Threaded rod CRC III (Table A1)	k_6	[-]	0,5							
Factor HAS-U HCR, HIT-V-HCR, Threaded rod CRC V (Table A1)	k_6	[-]	0,5							
Partial factor grade 5.8	$\gamma_{Ms,V}$ 1)	[-]	1,25							
Partial factor grade 8.8	$\gamma_{Ms,V}$ 1)	[-]	1,25							
Partial factor HAS-U A4, HIT-V-R, Threaded rod CRC III (Table A1)	$\gamma_{Ms,V}$ 1)	[-]	1,56						2,38	
Partial factor HAS-U HCR, HIT-V-HCR, Threaded rod CRC V (Table A1)	$\gamma_{Ms,V}$ 1)	[-]	1,25					1,75		
Ductility factor	k_7	[-]	1,0							
Steel failure with lever arm										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$							
Ductility factor	k_7	[-]	1,0							
Concrete pry-out failure										
Pry-out factor	k_8	[-]	2,0							
Concrete edge failure										
Effective length of fastener	l_f	[mm]	min (h_{ef}; 12 · d_{nom})						min (h_{ef}; 8 · d_{nom}; 300)	
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30

1) In absence of national regulations.

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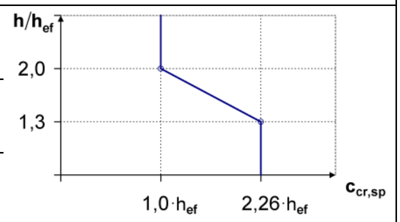
Annex C3

Table C3: Essential characteristics for internally threaded sleeve HIS-(R)N under tension load in concrete

HIS-(R)N			M8	M10	M12	M16	M20
For a working life of 50 years							
Installation factor							
Hammer drilling	γ_{inst}	[-]	1,0				
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD	γ_{inst}	[-]	1,0				
Diamond coring with roughening with Hilti roughening tool TE-YRT	γ_{inst}	[-]	[1]	1,0			
Steel failure							
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$N_{Rk,s}$	[kN]	25	46	67	125	116
Partial factor	$\gamma_{Ms,N}$[2]	[-]	1,50				
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$N_{Rk,s}$	[kN]	26	41	59	110	166
Partial factor	$\gamma_{Ms,N}$[2]	[-]	1,87				2,4
Concrete cone failure							
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0				
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7				
Edge distance	$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$				
Spacing	$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$				
Splitting failure							
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$		$1{,}0 \cdot h_{ef}$				
	$2{,}0 > h / h_{ef} > 1{,}3$		$4{,}6\, h_{ef} - 1{,}8\, h$				
	$h / h_{ef} \leq 1{,}3$		$2{,}26\, h_{ef}$				
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				

1) No performance assessed.
2) In absence of national regulations.

Table C3: continued

HIS-(R)N			M8	M10	M12	M16	M20
Combined pullout and concrete cone failure for a working life of 50 years							
Effective embedment depth	h_{ef}	[mm]	90	110	125	170	205
Effective fastener diameter	d_1	[mm]	12,5	16,5	20,5	25,4	27,6
Characteristic bond resistance in uncracked concrete C20/25							
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,ucr}$	[N/mm²]	13				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,ucr}$	[N/mm²]	11				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,ucr}$	[N/mm²]	9,5				
Characteristic bond resistance in cracked concrete C20/25							
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,cr}$	[N/mm²]	7				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,cr}$	[N/mm²]	5,5				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,cr}$	[N/mm²]	5				
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete							
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$							
Temperature range I to III :	ψ_c	[-]	$(f_{ck}/20)^{0,1}$				
Influence of sustained load							
Temperature range I: 40 °C / 24 °C	ψ^0_{sus}	[-]	0,74				
Temperature range II: 80 °C / 50 °C	ψ^0_{sus}	[-]	0,89				
Temperature range III: 120 °C / 72 °C	ψ^0_{sus}	[-]	0,72				

Injection system Hilti HIT-HY 200-A

Performances
Essential characteristics under tension load in concrete

Annex C5

Table C4: Essential characteristics for internally threaded sleeve HIS-(R)N under shear load in concrete

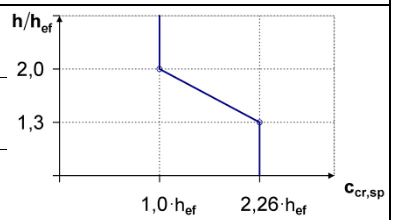
HIS-(R)N			**M8**	**M10**	**M12**	**M16**	**M20**
For a working life of 50 years							
Steel failure without lever arm							
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$V^0_{Rk,s}$	[kN]	13	23	34	63	58
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,25				
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$V^0_{Rk,s}$	[kN]	13	20	30	55	83
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,56				2,0
Ductility factor	k_7	[-]	1,0				
Steel failure with lever arm							
Characteristic resistance HIS-N with screw or threaded rod grade 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519
Characteristic resistance HIS-RN with screw or threaded rod grade 70	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454
Ductility factor	k_7	[-]	1,0				
Concrete pry-out failure							
Pry-out factor	k_8	[-]	2,0				
Concrete edge failure							
Effective length of fastener	l_f	[mm]	90	110	125	170	205
Outside diameter of fastener	d_{nom}	[mm]	12,5	16,5	20,5	25,4	27,6

[1] In absence of national regulations.

Injection system Hilti HIT-HY 200-A	**Annex C6**
Performances Essential characteristics under shear load in concrete	

Table C5: Essential characteristics for Hilti tension anchor HZA / HZA-R under tension load in concrete

Hilti tension anchor HZA, HZA-R				M12	M16	M20	M24	M27
For a working life of 50 years								
Installation factor								
Hammer drilling		γ_{inst}	[-]	1,0				
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD		γ_{inst}	[-]	1,0				
Diamond coring with roughening with Hilti roughening tool TE-YRT		γ_{inst}	[-]	[1]	1,0			
Steel failure								
Characteristic resistance HZA		$N_{Rk,s}$	[kN]	46	86	135	194	253
Characteristic resistance HZA-R		$N_{Rk,s}$	[kN]	62	111	173	248	[1]
Partial factor		$\gamma_{Ms,N}$[2]	[-]	1,4				
Concrete cone failure								
Effective anchorage depth	HZA	h_{ef}	[mm]	h_{nom}				
	HZA-R	h_{ef}	[mm]	h_{nom}				[1]
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0				
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7				
Edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$				
Spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$				
Splitting failure relevant for uncracked concrete								
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$			$1{,}0 \cdot h_{ef}$				
	$2{,}0 > h / h_{ef} > 1{,}3$			$4{,}6 \cdot h_{ef} - 1{,}8 \cdot h$				
	$h / h_{ef} \leq 1{,}3$			$2{,}26 \cdot h_{ef}$				
Spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				



[1] No performance assessed.
[2] In absence of national regulations.

Table C5: continued

Hilti tension anchor HZA, HZA-R				**M12**	**M16**	**M20**	**M24**	**M27**
Diameter of rebar		d	[mm]	12	16	20	25	28
Effective anchorage depth	HZA	h_{ef}	[mm]	$h_{nom} - 20$				
	HZA-R	h_{ef}	[mm]	$h_{nom} - 100$				1)
Combined pull-out and concrete cone failure for a working life of 50 years								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,ucr}$	[N/mm²]	12				
Temperature range II:	80 °C / 50 °C	$\tau_{Rk,ucr}$	[N/mm²]	10				
Temperature range III:	120 °C / 72 °C	$\tau_{Rk,ucr}$	[N/mm²]	8,5				
Characteristic bond resistance in cracked concrete C20/25								
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,cr}$	[N/mm²]	7				
Temperature range II:	80 °C / 50 °C	$\tau_{Rk,cr}$	[N/mm²]	5,5				
Temperature range III:	120 °C / 72 °C	$\tau_{Rk,cr}$	[N/mm²]	5				
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete								
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$								
Temperature range I to III :		ψ_c	[-]	$(f_{ck}/20)^{0,1}$				
Influence of sustained load								
Temperature range I:	40 °C / 24 °C	ψ^0_{sus}	[-]	0,74				
Temperature range II:	80 °C / 50 °C	ψ^0_{sus}	[-]	0,89				
Temperature range III:	120 °C / 72 °C	ψ^0_{sus}	[-]	0,72				

1) No performance assessed

Table C6: Essential characteristics for Hilti tension anchor HZA, HZA-R under shear load in concrete

Hilti tension anchor HZA, HZA-R			**M12**	**M16**	**M20**	**M24**	**M27**
For a working life of 50 years							
Steel failure without lever arm							
Characteristic resistance HZA	$V^0_{Rk,s}$	[kN]	23	43	67	97	126
Characteristic resistance HZA-R	$V^0_{Rk,s}$	[kN]	31	55	86	124	[1]
Partial factor	$\gamma_{Ms,V}$[2]	[-]	1,5				
Ductility factor	k_7	[-]	1,0				
Steel failure with lever arm							
Characteristic resistance HZA	$M^0_{Rk,s}$	[Nm]	72	183	357	617	915
Characteristic resistance HZA-R	$M^0_{Rk,s}$	[Nm]	97	234	457	790	[1]
Ductility factor	k_7	[-]	1,0				
Concrete pry-out failure							
Pry-out factor	k_8	[-]	2,0				
Concrete edge failure							
Effective length of fastener	l_f	[mm]	min (h_{nom}; 12 · d_{nom})				min (h_{nom}; 8 · d_{nom}; 300)
Outside diameter of fastener	d_{nom}	[mm]	12	16	20	24	27

[1] No performance assessed.
[2] In absence of national regulations.

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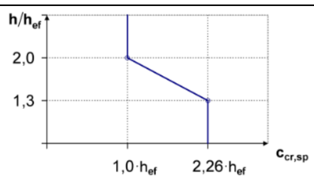
Annex C9

Table C7: Essential characteristics for rebar under tension load in concrete

Rebar			φ 8	φ 10	φ 12	φ 14	φ 16	φ 20	φ 25	φ 26	φ 28	φ 30	φ 32
For a working life of 50 years													
Installation factor													
Hammer drilling	γ_{inst}	[-]	1,0										
Hammer drilling with Hilti hollow drill bit TE-CD or TE-YD	γ_{inst}	[-]	1,0										
Diamond coring with roughening with Hilti roughening tool TE-YRT	γ_{inst}	[-]	1)			1,0							
Steel failure													
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ 2)										
Characteristic resistance Rebar B500B acc. to DIN 488-1	$N_{Rk,s}$	[kN]	28	43	62	85	111	173	270	292	339	388	442
Partial factor	$\gamma_{Ms,N}$ 3)	[-]	1,4										
Concrete cone failure													
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0										
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7										
Edge distance	$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$										
Spacing	$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$										
Splitting failure relevant for uncracked concrete													
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{ef} \geq 2{,}0$		$1{,}0 \cdot h_{ef}$										
	$2{,}0 > h / h_{ef} > 1{,}3$		$4{,}6 \cdot h_{ef} - 1{,}8 \cdot h$										
	$h / h_{ef} \leq 1{,}3$		$2{,}26 \cdot h_{ef}$										
Spacing	$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$										

1) No performance assessed.
2) f_{uk} according to rebar specification.
3) In absence of national regulations.

Table C7: continued

Rebar				ϕ 8	ϕ 10	ϕ 12	ϕ 14	ϕ 16	ϕ 20	ϕ 25	ϕ 26	ϕ 28	ϕ 30	ϕ 32
Diameter of rebar		d	[mm]	8	10	12	14	16	20	25	26	28	30	32
Combined pull-out and concrete cone failure for a working life of 50 years														
Characteristic bond resistance in uncracked concrete C20/25														
Temperature range I:	40°C/24°C	$\tau_{Rk,ucr}$	[N/mm²]	12										
Temperature range II:	80°C/50°C	$\tau_{Rk,ucr}$	[N/mm²]	10										
Temperature range III:	120°C/72°C	$\tau_{Rk,ucr}$	[N/mm²]	8,5										
Characteristic bond resistance in cracked concrete C20/25														
Temperature range I:	40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	1)	5	7								
Temperature range II:	80°C/50°C	$\tau_{Rk,cr}$	[N/mm²]	1)	4	5,5								
Temperature range III:	120°C/72°C	$\tau_{Rk,cr}$	[N/mm²]	1)	3,5	5								
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete														
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$														
Temperature range I to III :		ψ_c	[-]	$(f_{ck}/20)^{0,1}$										
Influence of sustained load														
Temperature range I:	40°C/24°C	ψ^0_{sus}	[-]	0,74										
Temperature range II:	80°C/50°C	ψ^0_{sus}	[-]	0,89										
Temperature range III:	120°C/72°C	ψ^0_{sus}	[-]	0,72										

1) No performance assessed.

Table C8: Essential characteristics for rebar under shear load in concrete

Rebar			ϕ 8	ϕ 10	ϕ 12	ϕ 14	ϕ 16	ϕ 20	ϕ 25	ϕ 26	ϕ 28	ϕ 30	ϕ 32
For a working life of 50 years													
Steel failure without lever arm													
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0{,}5 \cdot A_s \cdot f_{uk}$ 1)										
Characteristic resistance Rebar B500B acc. to DIN 488-1	$V^0_{Rk,s}$	[kN]	14	22	31	42	55	86	135	146	169	194	221
Partial factor	$\gamma_{Ms,V}$ 2)	[-]	1,5										
Ductility factor	k_7	[-]	1,0										
Steel failure with lever arm													
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$ 1)										
Characteristic resistance Rebar B500B acc. to DIN 488-1	$M^0_{Rk,s}$	[Nm]	33	65	112	178	265	518	1012	1139	1422	1749	2123
Ductility factor	k_7	[-]	1,0										
Concrete pry-out failure													
Pry-out factor	k_8	[-]	2,0										
Concrete edge failure													
Effective length of fastener	l_f	[mm]	min (h_{ef}; $12 \cdot d_{nom}$)						min (h_{nom}; $8 \cdot d_{nom}$; 300)				
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	14	16	20	25	26	28	30	32

1) f_{uk} according to rebar specification
2) In absence of national regulations.

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Performances
Essential characteristics under shear load in concrete

Annex C12

Table C9: Displacements under tension load

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Uncracked concrete temperature range I : 40°C / 24°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,02	0,03	0,03	0,04	0,06	0,07	0,07	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,06	0,08	0,10	0,13	0,14	0,16
Uncracked concrete temperature range II : 80°C / 50°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,05	0,06	0,08	0,09	0,10	0,12
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,06	0,09	0,11	0,13	0,15	0,16
Uncracked concrete temperature range III : 120°C / 72°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,04	0,05	0,06	0,08	0,10	0,12	0,13	0,16
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,07	0,09	0,11	0,13	0,15	0,17
Cracked concrete temperature range I : 40°C / 24°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,07							
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16							
Cracked concrete temperature range II : 80°C / 50°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,10							
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22							
Cracked concrete temperature range III : 120°C / 72°C										
Displacement	δ_{N0}	[mm/(N/mm²)]	0,13							
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29							

Table C10: Displacements under shear load

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Displacement	δ_{V0}	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

Table C11: Displacements under tension load

HIS-(R)N			M8	M10	M12	M16	M20
Uncracked concrete temperature range I : 40°C / 24°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,05	0,06	0,07	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,09	0,11	0,13	0,14
Uncracked concrete temperature range II : 80°C / 50°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,06	0,08	0,10	0,11
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,11	0,13	0,15
Uncracked concrete temperature range III : 120°C / 72°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,08	0,10	0,13	0,14
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,11	0,14	0,15
Cracked concrete temperature range I : 40°C / 24°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,11				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16				
Cracked concrete temperature range II : 80°C / 50°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,15				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22				
Cracked concrete temperature range III : 120°C / 72°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,20				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29				

Table C12: Displacements under shear load

HIS-(R)N			M8	M10	M12	M16	M20
Displacement	δ_{V0}	[mm/kN]	0,06	0,06	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/kN]	0,09	0,08	0,08	0,06	0,06

Table C13: Displacements under tension load

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
Uncracked concrete temperature range I : 40°C / 24°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,06	0,07	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,08	0,13	0,13	0,15
Uncracked concrete temperature range II : 80°C / 50°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,05	0,06	0,08	0,10	0,11
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06	0,09	0,14	0,14	0,15
Uncracked concrete temperature range III : 120°C / 72°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06	0,08	0,10	0,12	0,14
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,09	0,14	0,14	0,16
Cracked concrete temperature range I : 40°C / 24°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,11				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16				
Cracked concrete temperature range II : 80°C / 50°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,15				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22				
Cracked concrete temperature range III : 120°C / 72°C							
Displacement	δ_{N0}	[mm/(N/mm²)]	0,20				
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29				

Table C14: Displacements under shear load

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
Displacement	δ_{V0}	[mm/kN]	0,05	0,04	0,04	0,03	0,03
	$\delta_{V\infty}$	[mm/kN]	0,08	0,06	0,06	0,05	0,05

Table C15: Displacements under tension load

Rebar			ϕ 8	ϕ 10	ϕ 12	ϕ 14	ϕ 16	ϕ 20	ϕ 25	ϕ 26	ϕ 28	ϕ 30	ϕ 32
Uncracked concrete temperature range I : 40°C / 24°C													
Displacement	δ_{N0}	[mm/(N/mm²)]	0,02	0,03	0,03	0,04	0,04	0,06	0,07	0,08	0,08	0,09	0,09
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,06	0,07	0,08	0,10	0,13	0,14	0,15	0,16	0,17
Uncracked concrete temperature range II : 80°C / 50°C													
	δ_{N0}	[mm/(N/mm²)]	0,03	0,04	0,05	0,05	0,06	0,08	0,10	0,11	0,11	0,12	0,12
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,06	0,07	0,09	0,11	0,14	0,15	0,15	0,16	0,17
Uncracked concrete temperature range III : 120°C / 72°C													
Displacement	δ_{N0}	[mm/(N/mm²)]	0,04	0,05	0,06	0,07	0,08	0,10	0,12	0,13	0,14	0,15	0,16
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,04	0,05	0,07	0,08	0,09	0,11	0,14	0,15	0,16	0,17	0,18
Cracked concrete temperature range I : 40°C / 24°C													
Displacement	δ_{N0}	[mm/(N/mm²)]	0,11										
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,16										
Cracked concrete temperature range II : 80°C / 50°C													
Displacement	δ_{N0}	[mm/(N/mm²)]	0,15										
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,22										
Cracked concrete temperature range III : 120°C / 72°C													
Displacement	δ_{N0}	[mm/(N/mm²)]	0,20										
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,29										

Table C16: Displacements under shear load

Rebar			ϕ 8	ϕ 10	ϕ 12	ϕ 14	ϕ 16	ϕ 20	ϕ 25	ϕ 26	ϕ 28	ϕ 30	ϕ 32
Displacement	δ_{V0}	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03	0,03
	$\delta_{V\infty}$	[mm/kN]	0,09	0,08	0,07	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,04

Injection system Hilti HIT-HY 200-A

Performances
Displacements with rebar

Annex C16

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Table C17: Essential characteristics for threaded rod, HAS-U-…, HIT-V-… and AM 8.8 under tension load for seismic performance category C1

Threaded rod, HAS-U-…, HIT-V-… and AM 8.8			**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
For a working life of 50 and 100 years									
Steel failure									
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	$A_s \cdot f_{uk}$						
Combined pullout and concrete cone failure for a working life of 50 years									
Characteristic bond resistance in cracked concrete C20/25									
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,C1}$	[N/mm²]	5,2	7,0					
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,C1}$	[N/mm²]	3,9	5,7					
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,C1}$	[N/mm²]	3,5	4,8					
Combined pullout and concrete cone failure for a working life of 100 years									
Characteristic bond resistance in cracked concrete C20/25									
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,100,C1}$	[N/mm²]	4,5	6,3					
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,100,C1}$	[N/mm²]	3,7	5,2					
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,100,C1}$	[N/mm²]	3,1	4,4					
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ and $\tau_{Rk,100,C1}$ in cracked concrete									
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$									
Temperature range I to III :	ψ_c	[-]	1,0						

Table C18: Essential characteristics for threaded rod, HAS-U-…, HIT-V-… and AM 8.8 under shear load for seismic performance category C1

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
For a working life of 50 and 100 years									
Annular gap factor without Hilti filling set	α_{gap}	[-]	0,5						
Annular gap factor with Hilti filling set	α_{gap}	[-]	1,0						
Steel failure without lever arm									
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	$0,35 \cdot A_s \cdot f_{uk}$						

Table C19: Essential characteristics for Hilti tension anchor HZA, HZA-R under tension load for seismic performance category C1

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
For a working life of 50 years							
Steel failure							
Characteristic resistance HZA	$N_{Rk,s,C1}$	[kN]	46	86	135	194	253
Characteristic resistance HZA-R	$N_{Rk,s,C1}$	[kN]	62	111	173	248	[1]
Partial factor	$\gamma_{Ms,N,C1}$ [2]	[-]			1,4		
Combined pull-out and concrete cone failure							
Diameter of rebar	d	[mm]	12	16	20	25	28
Characteristic bond resistance in cracked concrete C20/25							
Temperature range I: 40°C / 24°C	$\tau_{Rk,C1}$	[N/mm²]			6,1		
Temperature range II: 80°C / 50°C	$\tau_{Rk,C1}$	[N/mm²]			4,8		
Temperature range III: 120°C / 72°C	$\tau_{Rk,C1}$	[N/mm²]			4,4		
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ in cracked concrete							
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$							
Temperature range I to III :	ψ_c	[-]			1,0		

[1] No performance assessed.
[2] In absence of national regulations.

Table C20: Essential characteristics for Hilti tension anchor HZA, HZA-R under shear load for seismic performance category C1

Hilti tension anchor HZA, HZA-R			M12	M16	M20	M24	M27
For a working life of 50 years							
Annular gap factor without Hilti filling set	α_{gap}	[-]			0,5		
Steel failure without lever arm							
Characteristic resistance HZA	$V_{Rk,s,C1}$	[kN]	16	30	47	68	88
Characteristic resistance HZA-R	$V_{Rk,s,C1}$	[kN]	22	39	60	124	[1]
Partial factor	$\gamma_{Ms,V,C1}$ [2]	[-]			1,5		

[1] No performance assessed.
[2] In absence of national regulations.

Table C21: Essential characteristics for rebar under tension load for seismic performance category C1

Rebar			φ 10	φ 12	φ 14	φ 16	φ 20	φ 25	φ 26	φ 28	φ 30	φ 32
For a working life of 50 years												
Steel failure												
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	$A_s \cdot f_{uk}$ [1]									
Characteristic resistance for rebar B500B acc. to DIN 488-1	$N_{Rk,s,C1}$	[kN]	43	62	85	111	173	270	292	339	388	442
Combined pull-out and concrete cone failure												
Diameter of rebar	d	[mm]	10	12	14	16	20	25	26	28	30	32
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 40°C/24°C	$\tau_{Rk,C1}$	[N/mm²]	4,4	6,1								
Temperature range II: 80°C/50°C	$\tau_{Rk,C1}$	[N/mm²]	3,5	4,8								
Temperature range III: 120°C/72°C	$\tau_{Rk,C1}$	[N/mm²]	3	4,4								
Influence factors ψ on bond resistance $\tau_{Rk,C1}$ in cracked concrete												
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$												
Temperature range I to III :	ψ_c	[-]	1,0									

[1] f_{uk} according to rebar specification

Table C22: Essential characteristics for rebar under shear loads for seismic performance category C1

Rebar			φ 10	φ 12	φ 14	φ 16	φ 20	φ 25	φ 26	φ 28	φ 30	φ 32
For a working life of 50 years												
Annular gap factor without Hilti filling set	α_{gap}	[-]	0,5									
Steel failure without lever arm												
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	$0,35 \cdot A_s \cdot f_{uk}$ [1]									
Characteristic resistance for rebar B500B acc. to DIN 488-1	$V_{Rk,s,C1}$	[kN]	15	22	29	39	60	95	102	118	135	155

[1] f_{uk} according to rebar specification

Table C23: Essential characteristics for threaded rod, HAS-U-…, HIT-V… and AM 8.8 under tension load for seismic performance category C2

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			M16	M20	M24
For a working life of 50 and 100 years					
Steel failure					
Characteristic resistance HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR) , AM (8.8, 8.8 HDG) Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	$N_{Rk,s,C2}$	[kN]		$A_s \cdot f_{uk}$	
Combined pullout and concrete cone failure					
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes and hammer drilled holes with Hilti hollow drill bit TE-CD or TE-YD					
Temperature range I: 40 °C/24 °C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	3,9	4,3	3,5
Temperature range II: 80 °C/50 °C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	3,3	3,7	2,9
Temperature range III: 120 °C/72 °C	$\tau_{Rk,C2} = \tau_{Rk,100,C2}$	[N/mm²]	2,8	3,2	2,5
Influence factors ψ on bond resistance $\tau_{Rk,C2}$ and $\tau_{Rk,100,C2}$ in cracked concrete					
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$					
Temperature range I to III :	ψ_c	[-]		1,0	

Table C24: Essential characteristics for threaded rod, HAS-U-…, HIT-V-… and AM 8.8 under shear load for seismic performance category C2

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8			M16	M20	M24
For a working life of 50 and 100 years					
Annular gap factor without Hilti filling set	α_{gap}	[-]		0,5	
Annular gap factor with Hilti filling set	α_{gap}	[-]		1,0	
Steel failure without lever arm with Hilti Filling Set					
Characteristic resistance					
HAS-U 8.8, HIT-V 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	46	77	103
Steel failure without lever arm without Hilti Filling Set					
Characteristic resistance					
HAS-U 8.8, HIT-V 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	40	71	90
HAS-U A4, HIT-V-R	$V_{Rk,s,C2}$	[kN]	35	62	79
HAS-U-HCR, HIT-V-HCR	$V_{Rk,s,C2}$	[kN]	40	71	79
HAS-U 8.8 HDG, HIT-V-F 8.8, AM-HDG 8.8	$V_{Rk,s,C2}$	[kN]	30	46	66
Threaded rod, electroplated zinc coated 8.8	$V_{Rk,s,C2}$	[kN]	28	50	63
Threaded rod CRC III (Table A1)	$V_{Rk,s,C2}$	[kN]	25	43	55
Threaded rod CRC V (Table A1)	$V_{Rk,s,C2}$	[kN]	28	50	55

Injection system Hilti HIT-HY 200-A

Performances
Essential characteristics under tension and shear load
for seismic performance category C2

Annex C20

Table C25: Displacements under tension load for seismic performance category C2

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8…		**M16**	**M20**	**M24**
Displacement DLS, HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR), AM (8.8, 8.8 HDG), Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	$\delta_{N,C2(DLS)}$ [mm]	0,2	0,5	0,4
Displacement ULS, HAS-U (-8.8, -8.8 HDG, A4, HCR), HIT-V (-8.8, -8.8 F, -,R, HCR), AM (8.8, 8.8 HDG), Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	$\delta_{N,C2(ULS)}$ [mm]	0,6	0,8	1,0

Table C26: Displacements under shear load for seismic performance category C2

Threaded rod, HAS-U-…, HIT-V-…, AM 8.8…		**M16**	**M20**	**M24**
Installation with Hilti Filling Set				
Displacement DLS, HAS-U 8.8, HIT-V 8.8, AM 8.8	$\delta_{V,C2(DLS)}$ [mm]	1,2	1,4	1,1
Displacement ULS, HAS-U 8.8, HIT-V 8.8, AM 8.8	$\delta_{V,C2(ULS)}$ [mm]	3,2	3,8	2,6
Installation without Hilti Filling Set				
Displacement DLS, HAS-U (-8.8, A4, HCR), HIT-V (-8.8, -R, HCR), AM 8.8, Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	$\delta_{V,C2(DLS)}$ [mm]	3,2	2,5	3,5
Displacement DLS, HAS-U 8.8 HDG, HIT-V-F 8.8, AM HDG 8.8	$\delta_{V,C2(DLS)}$ [mm]	2,3	3,8	3,7
Displacement ULS, HAS-U (-8.8, A4, HCR), HIT-V (-8.8, -R, HCR), AM 8.8, Threaded rod (electroplated zinc coated 8.8 and CRC III, V, Table A1)	$\delta_{V,C2(ULS)}$ [mm]	9,2	7,1	10,2
Displacement ULS, HAS-U 8.8 HDG, HIT-V-F 8.8, AM HDG 8.8	$\delta_{V,C2(ULS)}$ [mm]	4,3	9,1	8,4