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-19/0233 of 23 March 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	Injection system Hilti HIT-RE 500-HC-Rail
Product family to which the construction product belongs	Bonded fastener for use in concrete
Manufacturer	Hilti Aktiengesellschaft Feldkircherstrasse 100 9494 SCHAAN FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Corporation
This European Technical Assessment contains	27 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

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Specific Part

1 Technical description of the product

The Injection system Hilti HIT-RE 500-HC-Rail is a bonded anchor consisting of a foil pack with injection mortar Hilti HIT- RE 500-HC-Rail 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 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 resistance to static and quasi-static loading tension load	See Annex B3, B4, C1, C3 and C5
Characteristic resistance to static and quasi-static loading shear load	See Annex C2, C4 and C6
Displacements for static and quasi-static loading	See Annex C7 to C9
Characteristic resistance for seismic performance category C1	No performance assessed
Characteristic resistance and displacements for seismic performance category C2	No performance assessed
Durability	See Annex B2

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.

Issued in Berlin on 23 March 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Aksünger

Deutsches Institut für Bautechnik DIBt

Installed condition

Figure A1:

Threaded rod, HAS-U-…, HIT-V-…

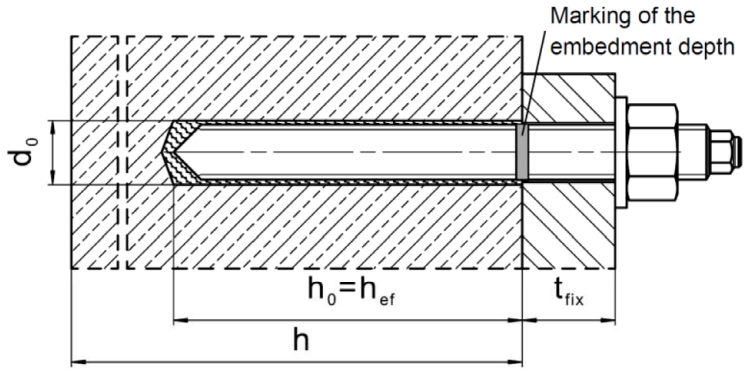


Figure A2:

Reinforcing bar

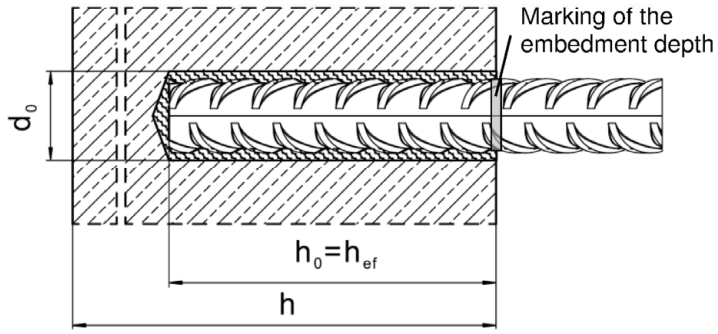
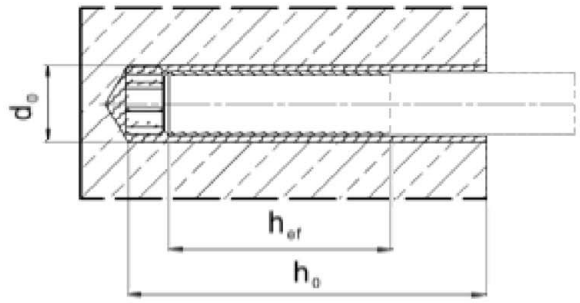


Figure A3:

HCC-DCT 27x350



Injection System Hilti HIT-RE 500-HC-Rail	Annex A1
Product description Installed condition	

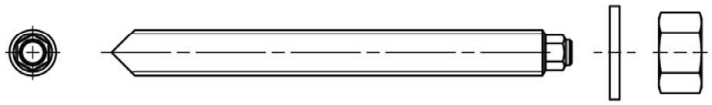
Deutsches Institut für Bautechnik DIBt

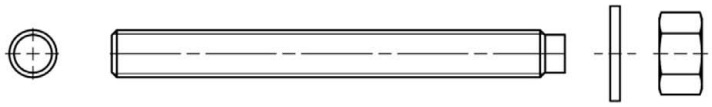
Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-RE 500-HC-Rail: epoxy resin system with aggregate
580 ml

Static mixer Hilti HIT-RE-M

Steel elements





Reinforcing bar (rebar): ϕ 28

- Materials and mechanical properties according to Table A1
- Dimensions according to Annex B3

HCC-DCT 27x350

Injection System Hilti HIT-RE 500-HC-Rail	**Annex A2**
Product description Injection mortar / Static mixer / Steel elements	

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Table A1: Materials

Designation	Material
Reinforcing bars (rebars)	
Rebar: EN 1992-1-1: 2004 and AC:2010, Annex C	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$
Metal parts made of zinc coated steel	
HAS-U-5.8(F), 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) 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
HCC-DCT	Strength class 8.8, f_{uk} = 800 N/mm², f_{yk} = 640 N/mm² Elongation at fracture (l0 = 5d) > 12% ductile, Electroplated zinc coated ≥ 5 µm, (HDG) hot dip galvanized ≥ 45 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
Metal parts made of stainless steel corrosion resistance class III according to EN 1993-1-4:2006+A1:2015	
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) > 8% 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) > 8% ductile Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014
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 10088-1:2014
Metal parts made of high corrosion resistant steel corrosion resistance class V according to EN 1993-1-4:2006+A1:2015	
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 (l0=5d) > 8% 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 (l0=5d) > 8% ductile High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
Washer	High corrosion resistant steel 1.4529, 1.4565 EN 10088-1:2014
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 10088-1:2014

Injection System Hilti HIT-RE 500-HC-Rail

Product description
Materials

Annex A3

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Specifications of intended use

Anchorages subject to:

- Static and quasi static loading.

Base material:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206-1:2013+A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206-1:2013+A1:2016.
- Cracked and uncracked concrete.

Temperature in the base material:

- **at installation**

  +5 °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 +70 °C
  (max. long term temperature +43 °C and max. short term temperature +70 °C)

Table B1: Specifications of intended use

	HIT-RE 500-HC-Rail with …		
Elements	HAS-U-…, HIT-V-… 	Rebar	HCC-DCT 
Hammer drilling 	✓	✓	-
Diamond drilling without roughening tool TE-YRT 	-	-	✓
Diamond drilling with roughening tool TE-YRT 	-	-	✓ [1)]
Static and quasi static loading in uncracked concrete	M27	ϕ 28	27
Static and quasi static loading in cracked concrete	M27	ϕ 28	27

[1)] HCC-DCT in cracked concrete only for Diamond drilling with roughening tool TE-YRT

Injection System Hilti HIT-RE 500-HC-Rail	Annex B1
Intended Use Specifications	

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according EN 1993-1-4:2006+A1:2015-06 correspoding to corrosion resistance classes Table A1 Annex A3. (stainless steels)

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.).
- The anchorages are designed in accordance with:
  EN 1992-4:2018 and EOTA Technical Report TR 055.

Installation:

- Use category: dry or wet concrete (not in water-filled holes)
- Drilling technique:
  - Hammer drilling
  - Diamond coring
  - Diamond coring with roughening with Hilti roughening tool TE-YRT
- Installation direction D1: downward only
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Injection System Hilti HIT-RE 500-HC-Rail	**Annex B2**
Intended Use Specifications	

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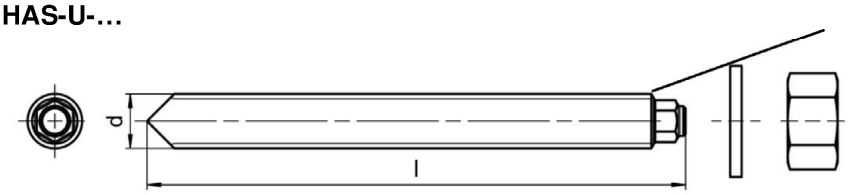
Table B2: Installation parameters of threaded rod, HAS-U-… and HIT-V-…

Threaded rod, HAS-U- …, HIT-V-…			**M27**
Diameter of element	d	[mm]	27
Nominal diameter of drill bit	d_0	[mm]	30
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	108 to 540
Maximum diameter of clearance hole in the fixture	d_f	[mm]	30
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 2 \cdot d_0$
Maximum torque moment	T_{max}	[Nm]	270
Minimum spacing	s_{min}	[mm]	120
Minimum edge distance	c_{min}	[mm]	75

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

Injection System Hilti HIT-RE 500-HC-Rail

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

Annex B3

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Table B3: Installation parameters of reinforcing bar

Reinforcing bar (rebar)			**ϕ 28**
Diameter	ϕ	[mm]	28
Effective embedment depth and drill hole depth	$h_{ef} = h_0$	[mm]	112 to 560
Nominal diameter of drill bit	d_0	[mm]	35
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 2 \cdot d_0$
Minimum spacing	s_{min}	[mm]	140
Minimum edge distance	c_{min}	[mm]	75

Reinforcing bar

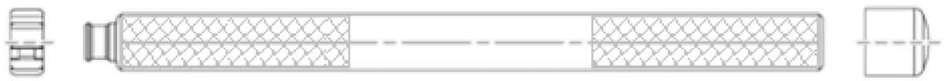
For rebar bolt

- Minimum value of related rib area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar h_{rib} shall be in the range $0{,}05 \cdot \phi \le h_{rib} \le 0{,}07 \cdot \phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)

Table B4: Installation parameters of HCC-DCT

HCC-DCT			**27**
Diameter	d	[mm]	27
Effective embedment depth	h_{ef}	[mm]	88
Effective drill hole depth	h_0	[mm]	155
Nominal diameter of drill bit	d_0	[mm]	32
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 2 \cdot d_0$
Minimum spacing	s_{min}	[mm]	140
Minimum edge distance	c_{min}	[mm]	75

HCC-DCT Rail rod



Injection System Hilti HIT-RE 500-HC-Rail	**Annex B4**
Intended Use Installation parameters of reinforcing bar (rebar) Installation parameters of HCC-DCT	

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Table B5: Maximum working time and minimum curing time Hilti-RE 500-HC-Rail

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
5 °C to 9 °C	2,5 hours	72 hours
10 °C to 14 °C	2 hours	48 hours
15 °C to 19 °C	1 hours	24 hours
20 °C to 29 °C	40 min	18 hours
30 °C to 40 °C	20 min	6 hours

Table B6: Parameters of cleaning and setting tools

Elements			Drill and clean				Installation
Threaded rod, HAS-U-…, HIT-V-…	Rebar	HCC-DCT	Hammer drilling	Diamond coring		Brush	Piston plug
					Roughening tool		
							
size	size	size	d_0 [mm]	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-SZ
M27	-	-	30	-	-	30	30
-	-	27	-	32	32	32	32
-	ϕ28	-	35	-	-	35	35

Cleaning alternatives

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

Injection System Hilti HIT-RE 500-HC-Rail	Annex B5
Intended Use Maximum working time and minimum curing time Parameters of cleaning and setting tools ; Cleaning alternatives	

Deutsches Institut für Bautechnik DIBt

Table B7: Parameters for use of Hilti roughening tool TE-YRT

Associated components				Installation
Diamond coring		Roughening tool TE-YRT	Wear gauge RTG…	Minimum roughening time $t_{roughen}$
				
d_0 [mm]		d_0 [mm]	size	$t_{roughen}$ [sec] = h_{ef} [mm] / 10
nominal	measured			
32	31,9 to 32,2	32	32	h_{ef} [mm]: 301 to 400 → $t_{roughen}$ [sec]: 40

Hilti roughening tool TE-YRT and wear gauge RTG

TE-YRT	
RTG	

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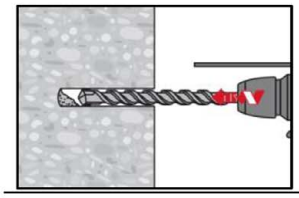
Installation instruction

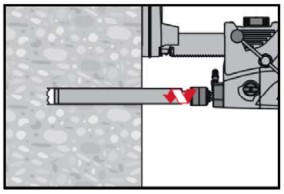
Hole drilling

a) Hammer drilling



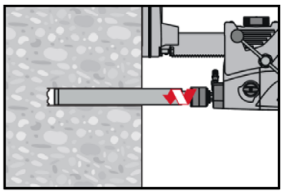
Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

b) Diamond coring for uncracked concrete only

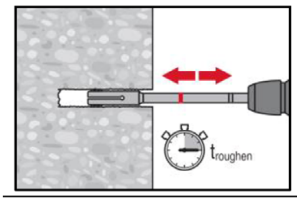


Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.

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



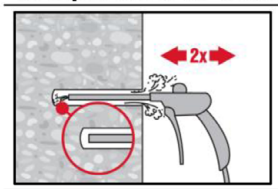
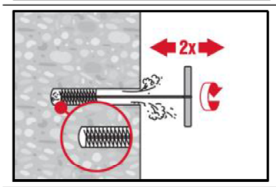
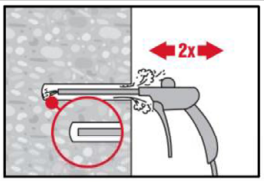
Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.
For the use in combination with Hilti roughening tool TE-YRT see parameters in Table B6.



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}.

Injection System Hilti HIT-RE 500-HC-Rail	Annex B7
Intended Use Installation instructions	

Deutsches Institut für Bautechnik DIBt

Drill hole cleaning	Just before setting an anchor, the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.
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 hole 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 B6) 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.

Injection System Hilti HIT-RE 500-HC-Rail	**Annex B8**
Intended Use Installation instructions	

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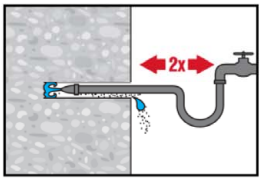
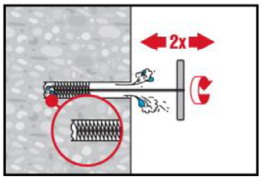
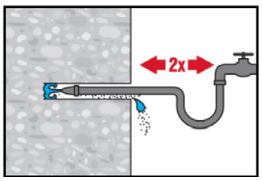
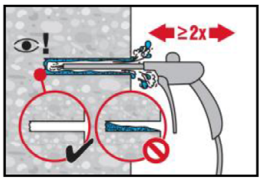
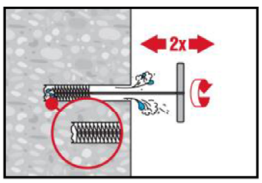
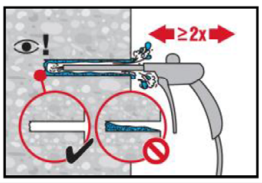
Cleaning of diamond cored holes

	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 B6) 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.
	Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.
	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. 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 size (brush Ø ≥ drill hole Ø, see Table B6 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 – 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 and water.

Injection System Hilti HIT-RE 500-HC-Rail

Intended Use
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Annex B9

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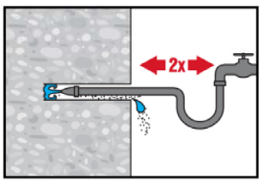
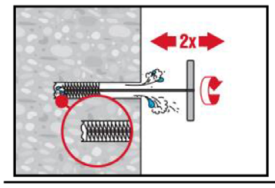
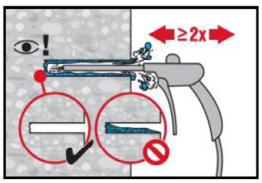
Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT:
For all drill hole diameters d_0 and all drill hole depths h_0.



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 B6) 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.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

Injection System Hilti HIT-RE 500-HC-Rail	**Annex B10**
Intended Use Installation instructions	

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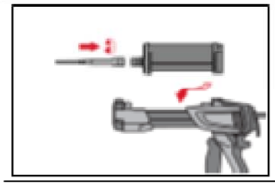
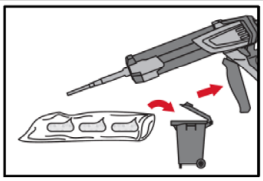
Injection preparation

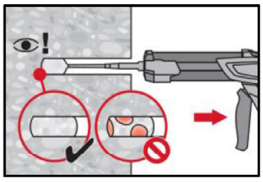


Tightly attach Hilti mixing nozzle HIT-RE-M to hard cartridge manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser. Insert hard cartridge into dispenser.

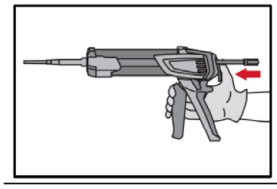


The hard cartridge opens automatically as dispensing is initiated. Prior to dispensing into the drill hole, squeeze out separately 3 full strokes.

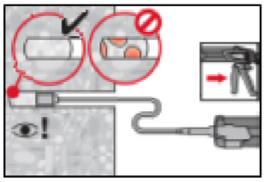
Inject adhesive from the back of the drill hole without forming air voids.



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 anchor 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.

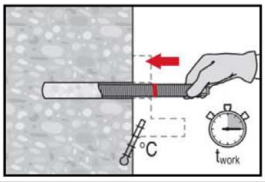


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

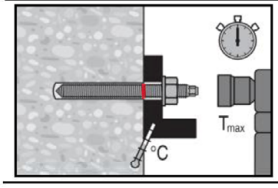


Installation with embedment depth h_{ef} > 250mm.
Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B6). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth before working time t_{work} (see Table B5) has elapsed.



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

Injection System Hilti HIT-RE 500-HC-Rail	**Annex B11**
Intended Use Installation instructions	

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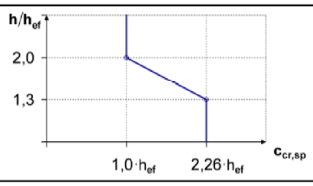
Table C1: Essential characteristics for threaded rod, HAS-U-… and HIT-V-... under tension load in concrete

Threaded rod, HAS-U-…, HIT-V-…				**M27**
Installation safety factor				
Hammer drilling		γ_{inst}	[-]	1,4
Steel failure				
Characteristic resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$
Partial factor grade 5.8		$\gamma_{Ms,N}$ [1)]	[-]	1,5
Partial factor grade 8.8		$\gamma_{Ms,N}$ [1)]	[-]	1,5
Partial factor HAS-U A4, HIT-V-R		$\gamma_{Ms,N}$ [1)]	[-]	2,86
Partial factor HAS-U HCR, HIT-V-HCR		$\gamma_{Ms,N}$ [1)]	[-]	2,1
Combined pullout and concrete cone failure				
Characteristic bond resistance in uncracked concrete C20/25				
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,ucr}$	[N/mm²]	12
Temperature range II:	70 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	5
Characteristic bond resistance in cracked concrete C20/25				
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,cr}$	[N/mm²]	5,5
Temperature range II:	70 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	2
Sustained load factor		ψ^0_{sus}	[-]	No performance assessed
Influence factors ψ on bond resistance τ_{Rk}				
Cracked and uncracked concrete: Factor for concrete strength		ψ_c	C30/37	1,04
			C40/45	1,07
			C50/60	1,1
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) In absence of national regulations.

Injection System Hilti HIT-RE 500-HC-Rail

Performances
Essential characteristics under tension load in concrete

Annex C1

Deutsches Institut für Bautechnik DIBt

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

Threaded rod, HAS-U-…, HIT-V-…			**M27**
Steel failure without lever arm			
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0,5 \cdot A_s \cdot f_{uk}$
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	$\gamma_{Ms,V}$ [1)]	[-]	2,38
Partial factor HAS-U HCR, HIT-V-HCR	$\gamma_{Ms,V}$ [1)]	[-]	1,75
Ductility factor	k_7	[-]	1,0
Steel failure with lever arm			
Bending moment	$M^0_{Rk,s}$	[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}; 300)
Outside diameter of fastener	d_{nom}	[mm]	27

1) In absence of national regulations.

Injection System Hilti HIT-RE 500-HC-Rail

Performances
Essential characteristics under shear load in concrete

Annex C2

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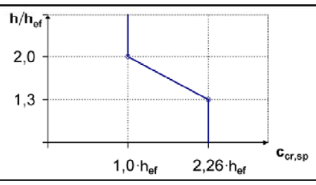
Table C3: Essential characteristics for rebar under tension load in concrete

Rebar			**ϕ 28**
Installation safety factor			
Hammer drilling	γ_{inst}	[-]	1,4
Steel failure			
Characteristic resistance Rebar B500B acc. to DIN 488:2009-08	$N_{Rk,s}$	[kN]	339
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,4
Combined pull-out and concrete cone failure			
Diameter of rebar	d	[mm]	28
Characteristic bond resistance in uncracked concrete C20/25			
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr}$	[N/mm²]	11
Temperature range II: 70°C/43°C	$\tau_{Rk,ucr}$	[N/mm²]	4,5
Characteristic bond resistance in cracked concrete C20/25			
Temperature range I: 40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	5
Temperature range II: 70°C/43°C	$\tau_{Rk,cr}$	[N/mm²]	2
Sustained load factor	ψ^0_{sus}	[-]	No performance assessed
Influence factors ψ on bond resistance τ_{Rk}			
Cracked and uncracked concrete: Factor for concrete strength	ψ_c	C30/37	1,04
		C40/45	1,07
		C50/60	1,1
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 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) In absence of national regulations.

Injection System Hilti HIT-RE 500-HC-Rail

Performances
Essential characteristics under tension load in concrete

Annex C3

Deutsches Institut für Bautechnik DIBt

Table C4: Essential characteristics for rebar under shear load in concrete

Rebar			**ϕ 28**
Steel failure without lever arm			
Characteristic resistance Rebar B500B acc. to DIN 488:2009-08	$V^0_{Rk,s}$	[kN]	169
Partial factor	$\gamma_{Ms,V}$ [1)]	[-]	1,5
Ductility factor	k_7	[-]	1,0
Steel failure with lever arm			
Rebar B500B acc. to DIN 488:2009-08	$M^0_{Rk,s}$	[Nm]	1422
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}; 300)
Outside diameter of fastener	d_{nom}	[mm]	28

1) In absence of national regulations.

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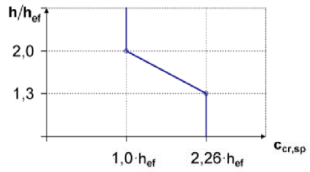
Table C5: Essential characteristics for HCC-DCT 27x350 under tension load in concrete

HCC-DCT				**27**
Installation safety factor				
Diamond coring		γ_{inst}	[-]	1,4
Diamond coring with roughening with Hilti roughening tool TE-YRT		γ_{inst}	[-]	1,4
Steel failure				
Characteristic resistance		$N_{Rk,s}$	[kN]	458
Partial factor grade 8.8		$\gamma_{Ms,N}$ [1)]	[-]	1,5
Combined pullout and concrete cone failure				
Characteristic bond resistance in uncracked concrete C20/25				
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,ucr}$	[N/mm²]	10
Temperature range II:	70 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	7,5
Characteristic bond resistance in cracked concrete C20/25				
Temperature range I:	40 °C / 24 °C	$\tau_{Rk,cr}$	[N/mm²]	8
Temperature range II:	70 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	6
Sustained load factor		ψ^0_{sus}	[-]	No performance assessed
Influence factors ψ on bond resistance τ_{Rk}				
Cracked and uncracked concrete: Factor for concrete strength		ψ_c	C30/37	1,04
			C40/45	1,07
			C50/60	1,1
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) In absence of national regulations.

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Table C6: Essential characteristics for HCC-DCT 27x350 under shear load in concrete

HCC-DCT			**27**
Steel failure without lever arm			
Characteristic resistance	$V^0_{Rk,s}$	[kN]	229
Partial factor grade 8.8	$\gamma_{Ms,V}$ [1)]	[-]	1,25
Ductility factor	k_7	[-]	1,0
Steel failure with lever arm			
Bending moment	$M^0_{Rk,s}$	[Nm]	1855
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}; 300)
Outside diameter of fastener	d_{nom}	[mm]	27

1) In absence of national regulations.

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Table C7: Displacements under tension load

Threaded rod, HAS-U-…, HIT-V-…			**M27**
Uncracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,08
Uncracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,09
Cracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,28
Cracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,08
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,28

Table C8: Displacements under shear load

Threaded rod, HAS-U-…, HIT-V-…			**M27**
Displacement	δ_{V0}	[mm/kN]	0,03
	$\delta_{V\infty}$	[mm/kN]	0,05

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Table C9: Displacements under tension load

Rebar			**ϕ 28**
Uncracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,04
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06
Uncracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,04
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07
Cracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,24
Cracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,24

Table C10: Displacements under shear load

Rebar			**ϕ 28**
Displacement	δ_{V0}	[mm/kN]	0,03
	$\delta_{V\infty}$	[mm/kN]	0,04

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Table C11: Displacements under tension load

HCC-DCT			**27**
Uncracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06
Uncracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,03
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07
Cracked concrete temperature range I : 40°C / 24°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06
Cracked concrete temperature range II : 70°C / 43°C			
Displacement	δ_{N0}	[mm/(N/mm²)]	0,06
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,06

Table C12: Displacements under shear load

HCC-DCT			**27**
Displacement	δ_{V0}	[mm/kN]	0,03
	$\delta_{V\infty}$	[mm/kN]	0,05