Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

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European Technical Assessment ETA-19/0465 of 10 September 2024

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Hilti HIT-HY 170 with HAS-U
Product family to which the construction product belongs	Bonded fasteners and bonded expansion fasteners for use in concrete
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Corporation
This European Technical Assessment contains	21 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 330499-02-0601, Edition 12/2023
This version replaces	ETA-19/0465 issued on 6 September 2023

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Specific Part

1 Technical description of the product

The Injection system Hilti HIT-HY 170 is a bonded anchor consisting of a foil pack with injection mortar Hilti HIT-HY 170 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 for static and quasi-static tension load	See Annex C1, C2, B3
Characteristic resistance for static and quasi-static shear load	See Annex C2
Displacements for static and quasi-static loads	See Annex C3
Characteristic resistance for seismic performance category C1	No performance assessed
Characteristic resistance and displacements for seismic performance category C2	See Annex C4 and C5

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	class A1
Resistance to fire	No performance assessed

3.3 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 330499-02-0601 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 1992-4:2018	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 10088-1:2014	Stainless steels - Part 1: List of stainless steels
-	EN ISO 10684:2004 + AC:2009	Fasteners - Hot dip galvanized coatings
-	EN 206:2013 + A1:2016	Concrete - Specification, performance, production and conformity
-	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 September 2024 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Stiller

Installed condition

Figure A1:

Threaded rod, HAS…, HAS-U… and AM 8.8

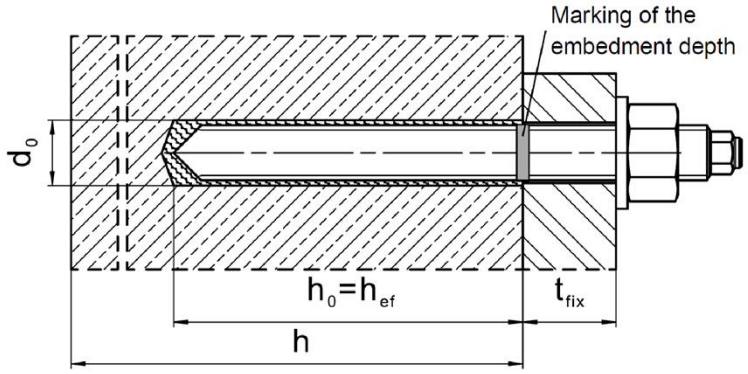
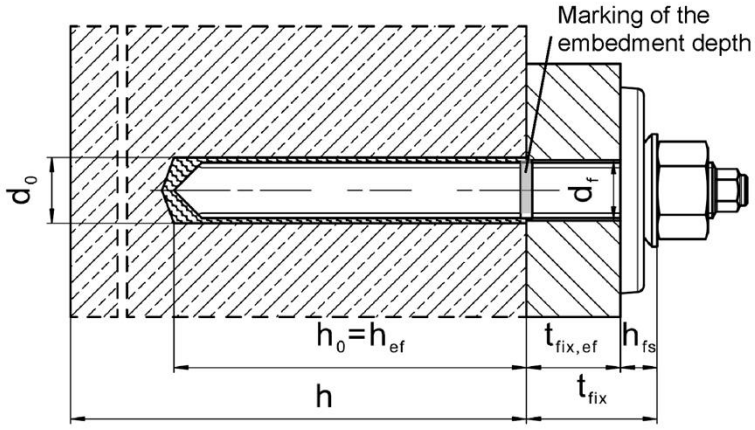


Figure A2:

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



Injection system Hilti HIT-HY 170 with HAS-U	
Product description Installed condition	**Annex A1**

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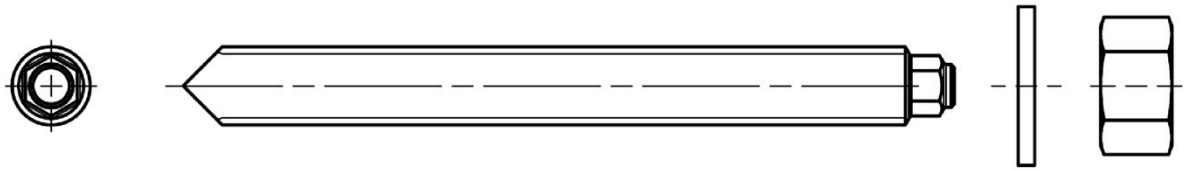
Product description: Injection mortar and steel elements

Injection mortar Hilti HIT-HY 170: hybrid system with aggregate

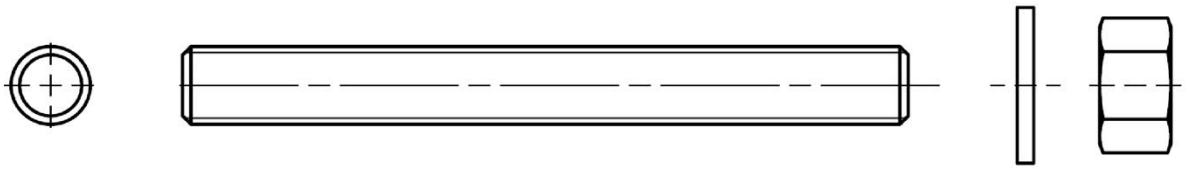
330 ml and 500 ml

Static mixer Hilti HIT-RE-M

Steel elements



HAS-U…: M8 to M24



HAS…: M8 to M24
Threaded rod: M8 to M24
Hilti AM 8.8 meter rod electroplated zinc coated: M8 to M24, 1m to 3m
Hilti AM HDG 8.8 meter rod hot dip galvanized: M8 to M24, 1m to 3m

Commercial standard threaded rod[1)]:

- 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.

1) For hot dip galvanized elements, the requirements of the standard EN ISO 10684 shall be considered, especially with regards to the combination of nuts and rods.

Injection system Hilti HIT-HY 170 with HAS-U	Annex A2
Product description Injection mortar, static mixer, steel elements	

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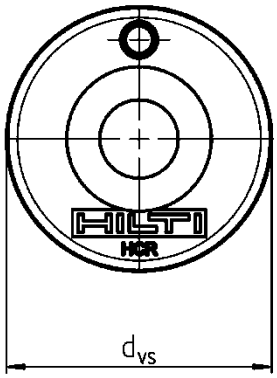
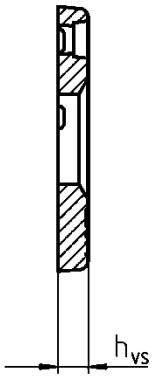
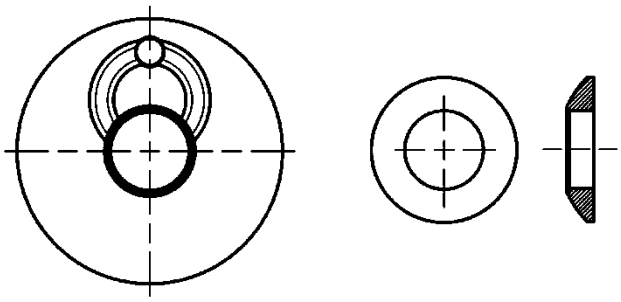
Hilti Filling Set to fill the annular gap between anchor and fixture

Sealing washer





Spherical washer



Hilti Filling Set			**M12**	**M16**
Diameter of sealing washer	d_{VS}	[mm]	**44**	56
Thickness of sealing washer	h_{VS}	[mm]	5	6
Thickness of Hilti Filling Set	h_{fs}	[mm]	10	11

Injection system Hilti HIT-HY 170 with HAS-U

Product description
Steel elements

Annex A3

Table A1: Materials

Designation	Material
Steel elements made of zinc coated steel	
HAS 5.8 (HDG), HAS-U 5.8 (HDG), Threaded rod 5.8	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[1)] ≥ 50 µm
Threaded rod 6.8	Strength class 6.8, f_{uk} = 600 N/mm², f_{yk} = 480 N/mm², Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm or hot dip galvanized[1)] ≥ 50 µm
HAS 8.8 (HDG), HAS-U 8.8 (HDG), AM 8.8 (HDG) Threaded rod 8.8	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[1)] ≥ 50 µm
Washer	Electroplated zinc coated ≥ 5 µm Hot dip galvanized ≥ 50 µm
Nut	Strength class of nut adapted to strength class of threaded rod. Electroplated zinc coated ≥ 5 µm Hot dip galvanized[1)] ≥ 50 µm
Hilti Filling Set (F)	Sealing washer: Electroplated zinc coated ≥ 5 µm, (F) hot dip galvanized ≥ 50 µm Spherical washer: Electroplated zinc coated ≥ 5 µm, (F) Hot dip galvanized ≥ 50 µm Lock nut: Electroplated zinc coated ≥ 5 µm, (F) Electroplated zinc - nickel coated ≥ 6 µm
Metal parts made of stainless steel corrosion resistance classes II according EN 1993-1-4	
Theaded rod	Strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm². Elongation at fracture (l_0 = 5d) > 12% ductile. Stainless steel 1.4301, 1.4307, 1.4311, 1.4541, 1.4306, 1.4567 EN 10088-1.
Washer	Stainless steel EN 10088-1
Nut	Strength class of nut adapted to strength class of threaded rod. Stainless steel EN 10088-1.

[1)] according to EN ISO 10684

Table A1 continued

Designation	Material
Metal parts made of stainless steel corrosion resistance classes III according EN 1993-1-4	
HAS A4, HAS-U A4	Strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Elongation at fracture (l_0=5d) > 12% ductile
Threaded rod	Strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 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
Washer	Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Nut	Strength class 70, f_{uk} = 700 N/mm², f_{yk} = 450 N/mm²; Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1
Hilti Filling Set A4	Sealing washer: Stainless steel according to EN 10088-1 Spherical washer: Stainless steel according to EN 10088-1 Lock nut: Stainless steel according to EN 10088-1
Metal parts made of stainless steel corrosion resistance classes V according EN 1993-1-4	
HAS-U 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

Injection system Hilti HIT-HY 170 with HAS-U	**Annex A5**
Product description Materials	

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loading: M8 to M24.
- Seismic performance category C2: M12 and M16.

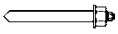
Base material:

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

Temperature in the base material:

- **At installation**
  0 °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)

Table B1: Specifications of intended use

	HIT-HY 170 with …
Elements	Threaded rod (Annex A) 
Hammer drilling with hollow drill bit TE-CD or TE-YD 	✓
Hammer drilling mode	✓
Static and quasi-static loading in uncracked concrete	M8 to M24
Static and quasi-static loading in cracked concrete	M10 to M24
Seismic performance category C2	M12 and M16

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 A (stainless steels).

Design:

- Fastenings 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 and EOTA Technical Report TR 055.

Installation:

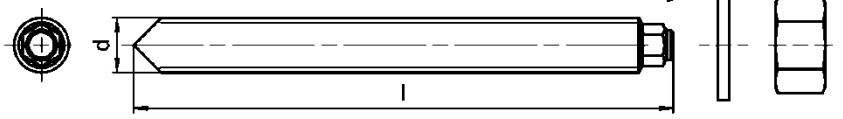
- Use category: dry or wet concrete (not in flooded holes) for all drilling techniques.
- Drilling technique:
  - Hammer drilling,
  - Hammer drilling with Hilti hollow drill bit TE-CD, TE-YD
- Installation direction D3: downward, horizontal and upward (e.g. overhead) installation admissible for all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

Injection system Hilti HIT-HY 170 with HAS-U	**Annex B2**
Intended use Specifications	

Table B2: Installation parameters of threaded rod according to Annex A

Threaded rod according to Annex A			M8	M10	M12	M16	M20	M24
Diameter of element	d	[mm]	8	10	12	16	20	24
Nominal diameter of drill bit	d_0	[mm]	10	12	14	18	22	28
Range of effective embedment depth and depth of drilled hole	$h_{ef} = h_0$	[mm]	60 to 96	60 to 120	70 to 144	80 to 192	90 to 240	96 to 288
Maximum diameter of clearance hole in the fixture	d_f	[mm]	9	12	14	18	22	26
Thickness of Hilti Filling Set	h_{fs}	[mm]	-	-	10	11	-	-
Effective fixture thickness with Hilti Filling Set	$t_{fix,ef}$	[mm]	$t_{fix,ef} = t_{fix} - h_{fs}$					
Minimum thickness of concrete member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2 \cdot d_0$		
Maximum torque moment	T_{max}	[Nm]	10	20	40	80	150	200
Minimum spacing	s_{min}	[mm]	40	50	60	75	90	115
Minimum edge distance	c_{min}	[mm]	40	45	45	50	55	60

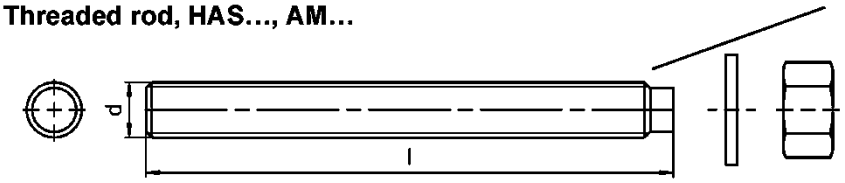
HAS-U…



Marking:

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

Threaded rod, HAS…, AM…



HAS Color code marking:

5.8 = RAL 5010 (blue)
8.8 = RAL 1023 (yellow)
A4 = RAL 3000 (red)

Table B3: Maximum working time and minimum curing time[1)]

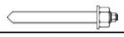
Temperature in the base material T [2)]	Maximum working time t_{work}	Minimum curing time t_{cure}
0°C to 5°C	10 min	5 h
> 5°C to 10°C	8 min	2,5 h
> 10°C to 20°C	5 min	1,5 h
> 20°C to 30°C	3 min	45 min
> 30°C to 40°C	2 min	30 min

1) The curing time data are valid for dry base material only. In wet base material the curing times must be doubled.

2) The minimum temperature of the injection mortar Hilti HIT-HY 170 during installation is + 5°C

Injection system Hilti HIT-HY 170 with HAS-U	**Annex B3**
Intended use Installation parameters of threaded rod, HAS…, HAS-U… and AM 8.8 Maximum working time and minimum curing time	

Table B4: Parameters of cleaning and setting tools

Elements	Drill and clean			Installation
Threaded rod (Annex A)	Hammer drilling	Hollow drill bit [1)]	Brush	Piston plug
				
size	d_0 [mm]	d_0 [mm]	HIT-RB	HIT-SZ
M8	10	-	10	-
M10	12	12	12	12
M12	14	14	14	14
M16	18	18	18	18
M20	22	22	22	22
M24	28	28	28	28

[1)] With vacuum cleaner Hilti VC 10/20/40 (automatic filter cleaning activated, eco mode off) or a vacuum cleaner providing equivalent cleaning performance in combination with the specified Hilti hollow drill bit TE-CD or TE-YD.

Cleaning alternatives

Manual Cleaning (MC):
Hilti hand pump for blowing out drill holes with diameters $d_0 \leq 18$ 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.

Injection system Hilti HIT-HY 170 with HAS-U	Annex B4
Intended use Cleaning and setting tools Cleaning alternatives	

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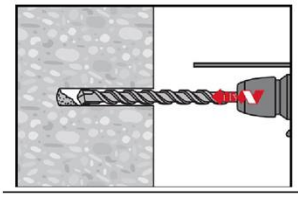
Installation

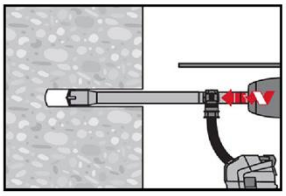
Hole drilling

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



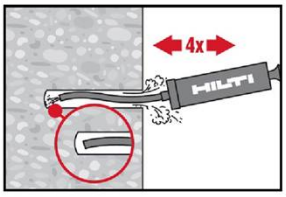
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with vacuum attachment following the requirements given in Table B4. This drilling system removes the dust and cleans the bore hole during drilling when used in accordance with the user's manual. After drilling is completed, proceed to the "injection preparation" step in the installation instruction.

Drill hole cleaning

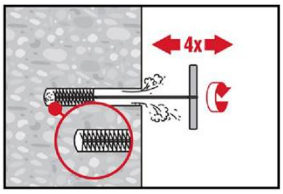
Just before setting an anchor, the drill hole must be free of dust and debris.

Manual Cleaning (MC)

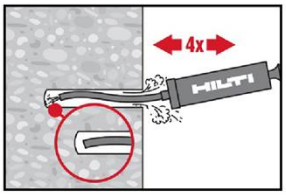
Non-cracked concrete.
For drill hole diameters $d_0 \leq 18$ mm and drill hole depths $h_0 \leq 10 \cdot d$



The Hilti manual pump may be used for blowing out drill holes up to diameters $d_0 \leq 18$ mm and embedment depths up to $h_{ef} \leq 10 \cdot d$.
Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust



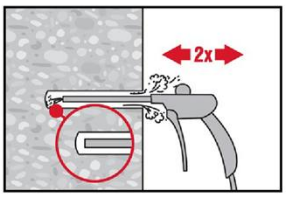
Brush 4 times with the specified brush (see Table B4) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



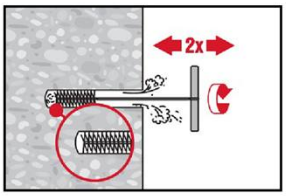
Blow out again with manual pump at least 4 times until return air stream is free of noticeable dust.

Injection system Hilti HIT-HY 170 with HAS-U	Annex B5
Intended use Installation instructions	

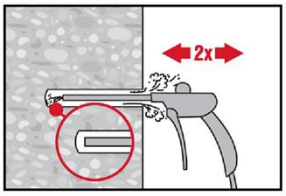
Compressed air cleaning (CAC) for all drill hole diameters d_0 and all drill hole depths h_0



Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

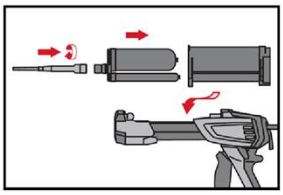


Brush 2 times with the specified brush (see Table B4) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.

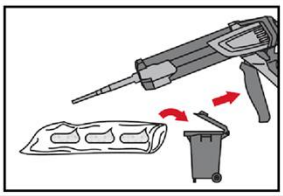


Blow again with compressed air 2 times until return air stream is free of noticeable dust.

Injection preparation



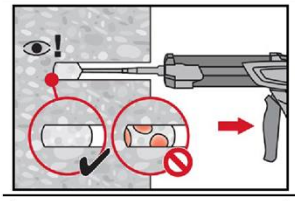
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Do not use damaged foil packs / holders.
Insert foil pack into foil pack holder and put holder into HIT-dispenser.



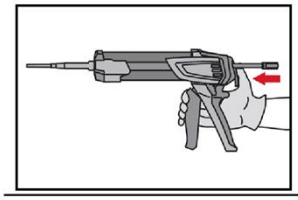
Discard initial adhesive. The foil pack opens automatically as dispensing is initiated.
Depending on the size of the foil pack an initial amount of adhesive has to be discarded.
Discarded quantities are

2 strokes	for 330 ml foil pack,
3 strokes	for 500 ml foil pack

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.

Injection system Hilti HIT-HY 170 with HAS-U	
Intended use Installation instructions	**Annex B6**

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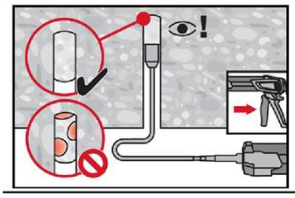
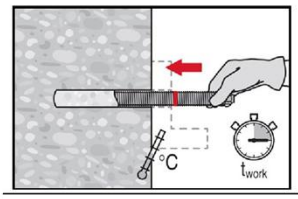
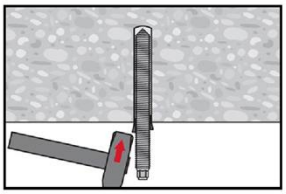


Overhead installation and/or installation with embedment depth h_{ef} > 250mm.
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ (see Table B4). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure

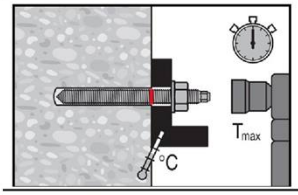
Setting the element



Before use, verify that the element is dry and free of oil and other contaminants.
Mark and set element to the required embedment depth until working time t_{work} (see Table B3) has elapsed.

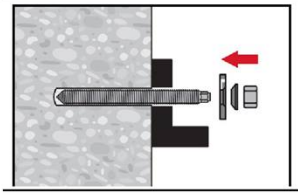


For overhead installation use piston plugs and fix embedded parts with e.g. wedges (HIT-OHW).

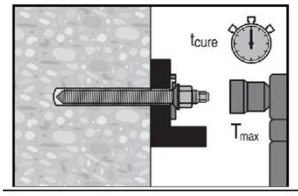


Loading the anchor: After required curing time t_{cure} (see Table B3) the anchor can be loaded.
The applied installation torque shall not exceed the values T_{max} given in Table B2.

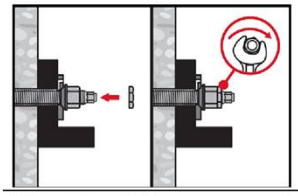
Installation of Hilti Filling Set



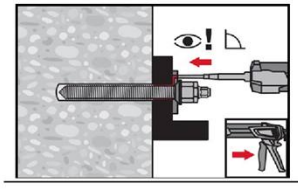
Use Hilti Filling Set with standard nut. Observe the correct orientation of filling washer and spherical washer.



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



Optional:
Installation of lock nut. Tighten with a ¼ to ½ turn.



Fill the annular gap between the anchor rod and fixture with 1-3 strokes of Hilti injection mortar HIT-HY 170.
Follow the installation instructions supplied with the foil pack.
After required curing time t_{cure} the anchor can be loaded.

Injection system Hilti HIT-HY 170 with HAS-U	**Annex B7**
Intended use Installation instructions	

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Table C1: Essential characteristics for threaded rods according to Annex A under tension load in concrete

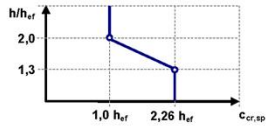
Threaded rod according to Annex A				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Installation factor		γ_{inst}	[-]	1,0					
Steel failure									
Characteristic resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$					
Partial factor grade 5.8, 6.8 and 8.8		$\gamma_{Ms,N}$ [1)]	[-]	1,5					
Partial factor HAS A4, HAS-U A4, Threaded rod: CRC II and III (Table A1)		$\gamma_{Ms,N}$ [1)]	[-]	1,87					
Partial factor HAS-U HCR, Threaded rod: CRC V (Table A1)		$\gamma_{Ms,N}$ [1)]	[-]	1,5					2,1
Combined pullout and concrete cone failure									
Characteristic bond resistance in uncracked concrete C20/25									
Temperature range I:	24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm²]	10,9					
Temperature range II:	50 °C / 80 °C	$\tau_{Rk,ucr}$	[N/mm²]	7,7					
Characteristic bond resistance in cracked concrete C20/25									
Temperature range I:	24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm²]	2)	5,8			6,2	
Temperature range II:	50 °C / 80 °C	$\tau_{Rk,cr}$	[N/mm²]	2)	4,1			4,6	
Influence factors ψ on bond resistance τ_{Rk} in cracked and uncracked concrete									
Influence of concrete strength class: $\tau_{Rk} = \tau_{Rk,(C20/25)} \cdot \psi_c$		ψ_c	C30/37	1,04					
			C40/50	1,07					
			C50/60	1,09					
Sustained load factor		ψ^0_{sus}	24 °C / 40 °C	0,95					
			50 °C / 80 °C	0,79					
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]	$3,0 \cdot h_{ef}$					

Injection system Hilti HIT-HY 170 with HAS-U

Performances
Essential characteristics under tension load in concrete

Annex C1

Table C1 continued

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) In absence of national regulations.

2) No performance assessed

Table C2: Essential characteristics for threaded rods according to Annex A under shear load in concrete

Threaded rod according to Annex A			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
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 6.8, 8.8, CRC II, III, V	k_6	[-]	0,5					
Partial factor grade 5.8, 6.8 and 8.8	$\gamma_{Ms,V}$ 1)	[-]	1,25					
Partial factor HAS A4, HAS-U A4, Threaded rod: CRC II and III (Table A1)	$\gamma_{Ms,V}$ 1)	[-]	1,56					
Partial factor HAS-U 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								
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]	$\min(h_{ef}; 12 \cdot d_{nom})$					
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24

1) In absence of national regulations.

Table C3: Displacement under tension load

Threaded rod according to Annex A			M8	M10	M12	M16	M20	M24
Non-cracked concrete								
Displacement	δ_{N0}	[mm/(N/mm²)]	0,07	0,07	0,07	0,08	0,08	0,09
Displacement	$\delta_{N\infty}$	[mm/(N/mm²)]	0,07	0,07	0,07	0,08	0,08	0,09
Cracked concrete								
Displacement	δ_{N0}	[mm/(N/mm²)]	1)	0,07	0,07	0,06	0,06	0,06
Displacement	$\delta_{N\infty}$	[mm/(N/mm²)]	1)	0,11	0,11	0,11	0,15	0,17

1) No performance assessed

Table C4: Displacement under shear load

Threaded rod according to Annex A			M8	M10	M12	M16	M20	M24
Displacement	δ_{V0}	[mm/(N/mm²)]	0,06	0,06	0,05	0,04	0,04	0,03
Displacement	$\delta_{V\infty}$	[mm/(N/mm²)]	0,09	0,08	0,08	0,06	0,06	0,05

Injection system Hilti HIT-HY 170 with HAS-U

Performances
Displacements

Annex C3

Deutsches Institut für Bautechnik DIBt

Table C5: Essential characteristics for threaded rods according to Annex A under tension loads for seismic performance category C2

Threaded rod according to Annex A			M12	M16
Steel failure				
HAS 8.8 (HDG), HAS-U 8.8 (HDG), AM 8.8 (HDG), Threaded rod 8.8	$N_{Rk,s,C2}$	[kN]	67	126
Combined pullout and concrete cone failure				
Temperature range I: 24 °C / 40 °C	$\tau_{Rk,C2}$	[N/mm²]	2,0	1,9
Temperature range II: 50 °C / 80 °C	$\tau_{Rk,C2}$	[N/mm²]	1,4	1,3

Table C6: Essential characteristics for threaded rods according to Annex A under shear loads for seismic performance category C2

Threaded rod according to Annex A			M12	M16
Steel failure without lever arm with Hilti Filling Set				
HAS 8.8, HAS-U 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	28	46
Steel failure without lever arm without Hilti Filling Set				
HAS 8.8, HAS-U 8.8, AM 8.8	$V_{Rk,s,C2}$	[kN]	24	40
HAS 8.8 HDG, HAS-U 8.8 HDG, AM 8.8 HDG	$V_{Rk,s,C2}$	[kN]	18	30
Threaded rod, electroplated zinc coated 8.8	$V_{Rk,s,C2}$	[kN]	17	28
Threaded rod, hot dip galvanized 8.8	$V_{Rk,s,C2}$	[kN]	13	21

Table C7: Displacements under tension load for seismic performance category C2

Threaded rod according to Annex A			M12	M16
Displacement DLS	$\delta_{N,C2(50\%)}$	[mm]	0,2	0,2
Displacement ULS	$\delta_{N,C2(100\%)}$	[mm]	0,6	0,4

Injection system Hilti HIT-HY 170 with HAS-U

Performances
Essential characteristics for seismic performance category C2 and displacements

Annex C4

Table C8: Displacements under shear load for seismic performance category C2

Threaded rod according to Annex A			**M12**	**M16**
Installation with Hilti Filling Set				
Displacement DLS	$\delta_{V,C2(50\%)}$	[mm]	1,6	1,2
Displacement ULS	$\delta_{V,C2(100\%)}$	[mm]	4,5	3,2
Installation without Hilti Filling Set				
Displacement DLS: HAS 8.8, HAS-U 8.8, AM 8.8, Threaded rods 8.8	$\delta_{V,C2(50\%)}$	[mm]	2,9	3,2
Displacement DLS: HAS 8.8 HDG, HAS-U 8.8 HDG, AM 8.8 HDG, Threaded rods 8.8 hot dip galvanized	$\delta_{V,C2(50\%)}$	[mm]	2,2	2,3
Displacement ULS: HAS 8.8, HAS-U 8.8, AM 8.8, Threaded rods 8.8	$\delta_{V,C2(100\%)}$	[mm]	5,4	9,2
Displacement ULS: HAS 8.8 HDG, HAS-U 8.8 HDG, AM 8.8 HDG, Threaded rods 8.8 hot dip galvanized	$\delta_{V,C2(100\%)}$	[mm]	4,1	4,3

Injection system Hilti HIT-HY 170 with HAS-U

Performances
Essential characteristics for seismic performance category C2 and displacements

Annex C5