Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment ETA-15/0297 of 11 December 2015

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 170
Product family to which the construction product belongs	System for post installed rebar connection with mortar
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	18 pages including 3 annexes
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	European Assessment Document (EAD) 330087-00-0601

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Specific Part

1 Technical description of the product

The subject of this European technical assessment is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the injection mortar Hilti HIT-HY 170 in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter ϕ from 8 to 25 mm according to Annex A. The reinforcing bar is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded element, 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
Amplification factor α_{lb}, Bond resistance f_{bd}	See Annex C1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	See Annex C2

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply..

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

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

In accordance the European Assessment Document (EAD) 330087-00-0601 and according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 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 EAD

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

Issued in Berlin on 11 December 2015 by Deutsches Institut für Bautechnik

Uwe Bender
Head of Department

beglaubigt:
Lange

Deutsches Institut für Bautechnik DIBt

Installed condition

Figure A1:

Overlap joint with existing reinforcement for rebar connections of slabs and beams

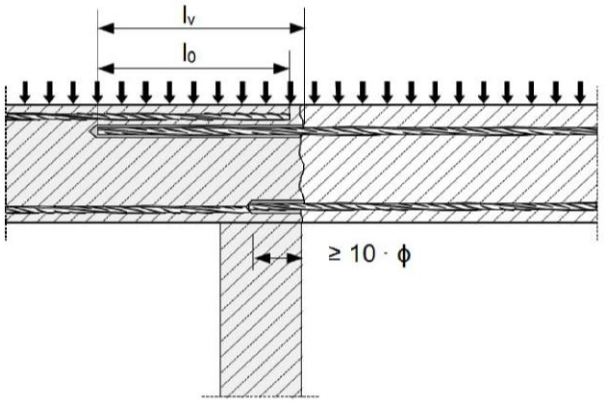


Figure A2:

Overlap joint with existing reinforcement at a foundation of a column or wall where the rebars are stressed in tension

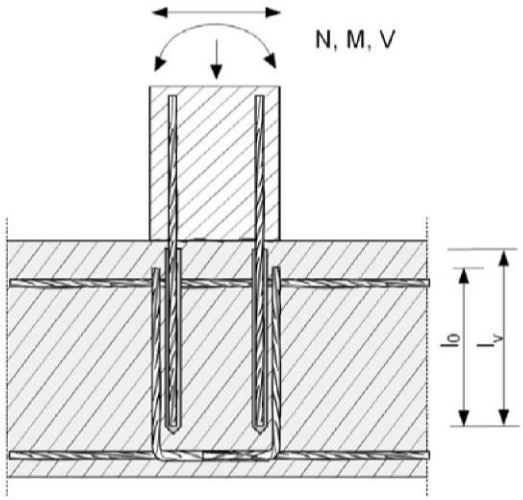
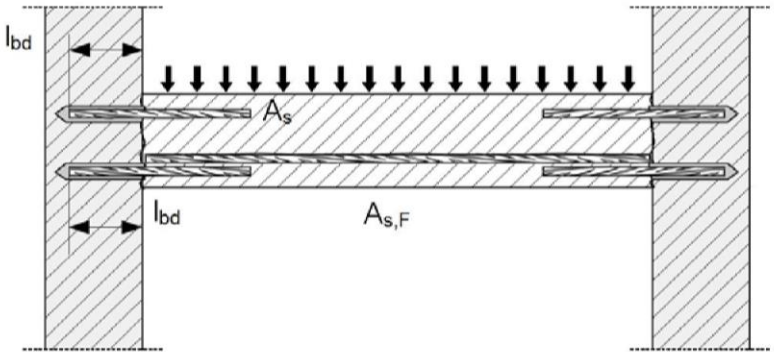


Figure A3:

End anchoring of slabs or beams



Injection system Hilti HIT-HY 170	Annex A1
Product description Installed condition: application examples of post-installed rebars	

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Figure A4:

Rebar connection for components stressed primarily in compression

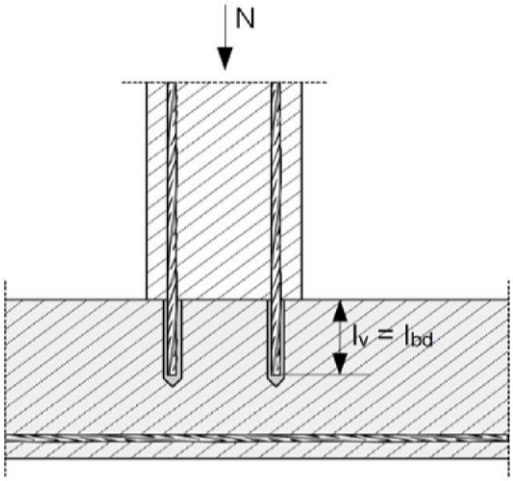
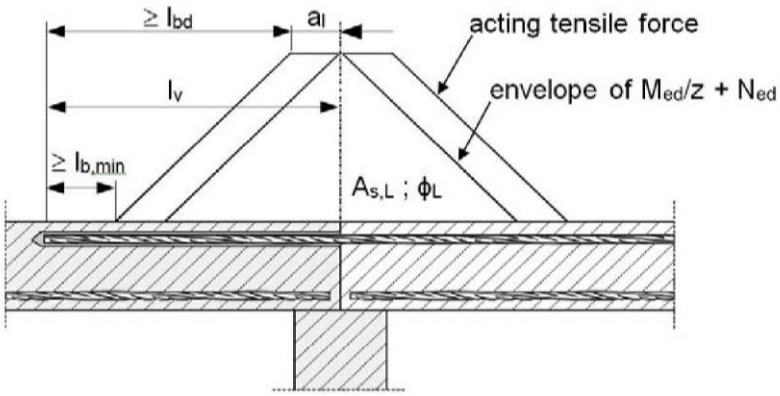


Figure A5:

Anchoring of reinforcement to cover the enveloped line of acting tensile force in the bending member



Note to Figure A1 to Figure A5:

- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1.
- Preparing of joints according to Annex B2.

Injection system Hilti HIT-HY 170	
Product description Installed condition: application examples of post-installed rebars	**Annex A2**

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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

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

Product name: "Hilti HIT-HY 170"

Static mixer Hilti HIT-RE-M

Steel elements

Reinforcing bar (rebar): ϕ 8 to ϕ 25

- Materials and mechanical properties according to Table A1.
- Minimum value of related rib area f_R according to EN 1992-1-1.
- Rib height of the bar h_{rib} shall be in the range:
  $0{,}05 \cdot \phi \le h_{rib} \le 0{,}07 \cdot \phi$
- The maximum outer rebar diameter over the ribs shall be:
  $\phi + 2 \cdot 0{,}07 \cdot \phi = 1{,}14 \cdot \phi$
  (ϕ: Nominal diameter of the bar; h_{rib}: Rib height of the bar)

Table A1: Materials

Designation	Material
Reinforcing bars (rebars)	
Rebar EN 1992-1-1	Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Injection system Hilti HIT-HY 170	
Product description Injection mortar / Static mixer / Steel elements Materials	**Annex A3**

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Specifications of intended use

Anchorages subject to:

- Static and quasi static loading.
- Fire exposure.

Base material:

- Reinforced or unreinforced normal weight concrete according to EN 206.
- Strength classes C12/15 to C50/60 according to EN 206.
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206-1.
- Non-carbonated concrete.
  Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of ϕ + 60 mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond at least to the minimum concrete cover in accordance with EN 1992-1-1. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature in the base material:

- **at installation**
  -5 °C to +40 °C
- **in-service**
  -40 °C to +80 °C (max. long term temperature +50 °C and max. short term temperature +80 °C)

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 forces to be transmitted.
- Design under static or quasi-static loading in accordance with EN 1992-1-1.
- Design under fire exposure in accordance with EN 1992-1-2.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Installation:

- Use category: dry or wet concrete (not in flooded holes).
- Hammer drilling or compressed air drilling.
- Overhead installation is admissible.
- Rebar installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

Injection system Hilti HIT-HY 170	Annex B1
Intended Use Specifications	

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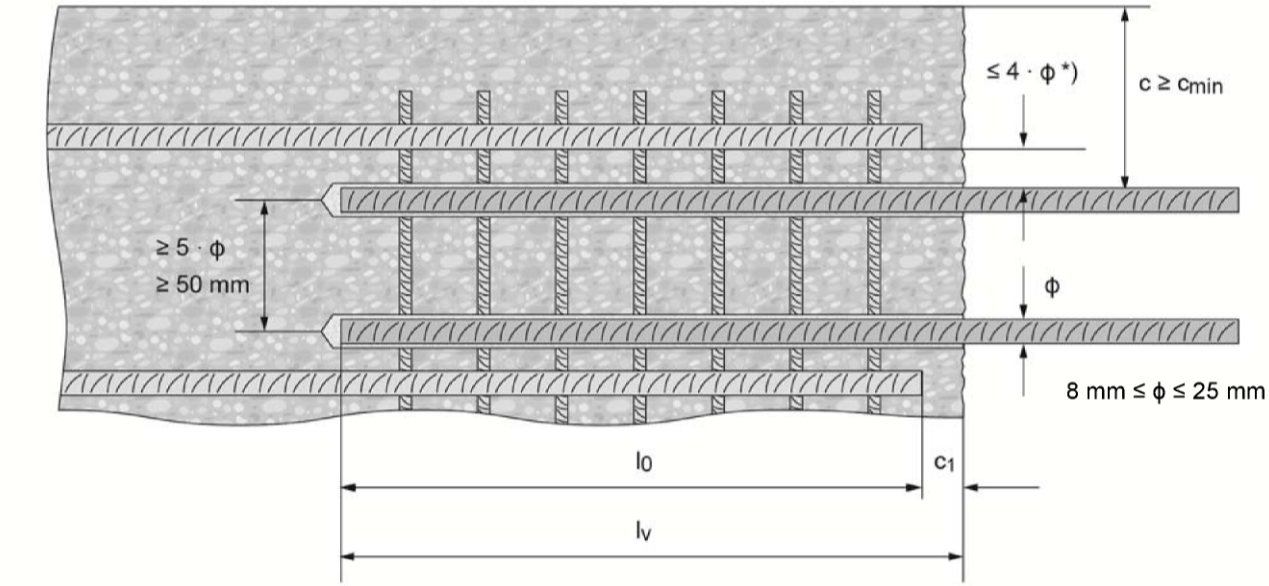
Figure B1: General construction rules for post-installed rebars

- Post-installed rebar may be designed for tension forces only.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.
- The joints for concreting must be roughened to at least such an extent that aggregate protrudes.



*) If the clear distance between lapped bars exceeds 4 · ϕ, then the lap length shall be increased by the difference between the clear bar distance and 4 · ϕ.

c concrete cover of post-installed rebar
c_1 concrete cover at end-face of existing rebar
c_{min} minimum concrete cover according to Table B1 and to EN 1992-1-1
ϕ diameter of reinforcement bar
l_0 lap length, according to EN 1992-1-1
l_v effective embedment depth ≥ $l_0 + c_1$
d_0 nominal drill bit diameter, see Annex B4

Injection system Hilti HIT-HY 170	Annex B2
Intended Use General construction rules for post-installed rebars	

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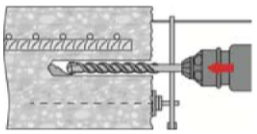
Table B1: Minimum concrete cover c_{min} [1] of the post-installed rebar depending on drilling method and drilling tolerance

Drilling method	Bar diameter [mm]	Minimum concrete cover c_{min} [1] [mm]		
		Without drilling aid	With drilling aid	
Hammer drilling **(HD)**	$\phi < 25$	$30 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
	$\phi \geq 25$	$40 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$	$40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	
Compressed air drilling **(CA)**	$\phi < 25$	$50 + 0{,}08 \cdot l_v$	$50 + 0{,}02 \cdot l_v$	
	$\phi \geq 25$	$60 + 0{,}08 \cdot l_v \geq 2 \cdot \phi$	$60 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$	

[1] See Annex B2, Figure B1.
Comments: The minimum concrete cover acc. EN 1992-1-1.

Table B2: Maximum embedment depth $l_{v,max}$ depending on bar diameter and dispenser

Bar diameter	Dispensers HDE 500, HDM 330, HDM 500
ϕ [mm]	$l_{v,max}$ [mm]
8 to 16	1000
18 to 25	700

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

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
-5°C to 0°C	10 min	12 hours
> 0°C to 5°C	10 min	5 hours
> 5°C to 10°C	8 min	2,5 hours
> 10°C to 20°C	5 min	1,5 hours
> 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.

Injection system Hilti HIT-HY 170	Annex B3
Intended Use Minimum concrete cover / Maximum embedment depth Maximum working time and minimum curing time	

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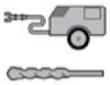
Table B4: Parameters of drilling, cleaning and setting tools

Elements	Drill and clean					Installation		
Rebar	Hammer drilling (HD)	Compressed air drilling (CA)	Brush HIT-RB	Air nozzle HIT-DL	Extension for air nozzle	Piston plug HIT-SZ	Extension for piston plug	Maximum embedment depth
								-
size	d_0 [mm]	d_0 [mm]	size	size	[-]	size	[-]	$l_{v,max}$ [mm]
ϕ 8	10	-	10	10	HIT-DL 10/0,8 or HIT-DL V10/1	-	HIT-VL 9/1,0	250
	12	-	12	12		12		1000
ϕ 10	12	-	12	12		12		250
	14	-	14	14		14	HIT-VL 11/1,0	1000
ϕ 12	14	-	14	14		14		250
	16	-	16	16		16		1000
	-	17	18	16		16		
ϕ 14	18	-	18	18		18		
	-	17	18	16		16		
ϕ 16	20	20	20	20	HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16	20	HIT-VL 16/0,7 and/or HIT-VL 16	700
ϕ 18	22	22	22	22		22		
ϕ 20	25	-	25	25		25		
	-	26	28	25		25		
ϕ 22	28	28	28	28		28		
ϕ 24	32	32	32	32		32		
ϕ 25	32	32	32	32		32		

[1] Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper boreholes.

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.

Injection system Hilti HIT-HY 170

Intended Use
Parameters of cleaning and setting tools
Cleaning alternatives

Annex B4

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Installation instruction

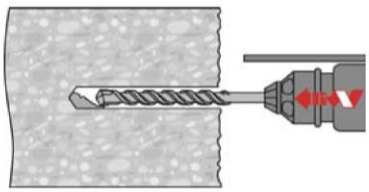
Safety Regulations:

Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!
Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-HY 170.
Important: Observe the installation instruction provided with each foil pack.

Hole drilling

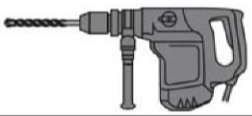
Before drilling remove carbonized concrete and clean contact areas (see Annex B1).
In case of aborted drill hole the drill hole shall be filled with mortar.

Hammer drilling

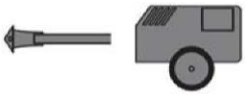


Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit.

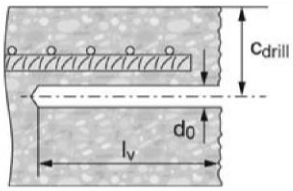
Hammer drill (HD)



Compressed air drill (CA)



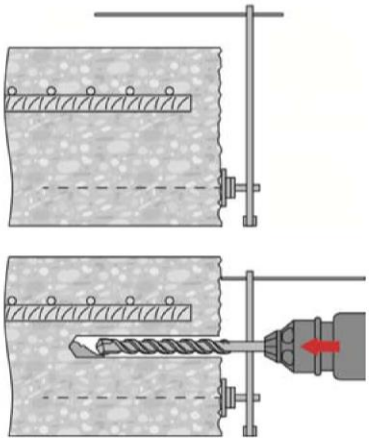
Splicing applications



- Measure and control concrete cover c.
- $c_{drill} = c + d_0/2$.
- Drill parallel to edge and to existing rebar.
- Where applicable use Hilti drilling aid HIT-BH.

Drilling aid

For holes l_v > 20 cm use drilling aid.



Ensure that the drill hole is parallel to the existing rebar.

Three different options can be considered:

- Hilti drilling aid HIT-BH
- Lath or spirit level
- Visual check

Injection system Hilti HIT-HY 170	Annex B5
Intended Use Installation instructions	

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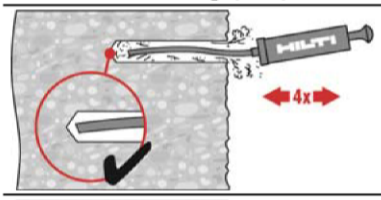
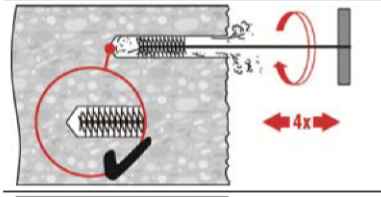
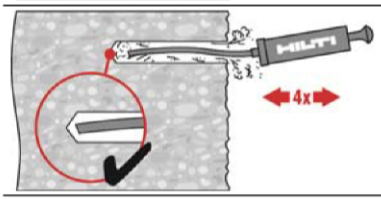
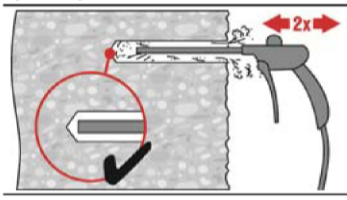
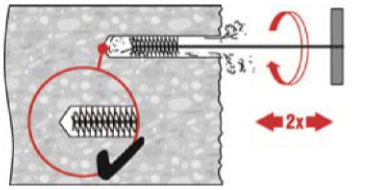
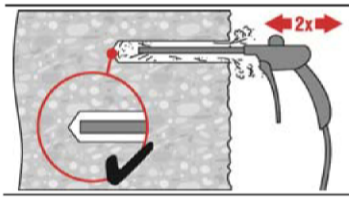
Drill hole cleaning	Just before setting the bar the drill hole must be free of dust and debris. Inadequate hole cleaning = poor load values.
Manual Cleaning (MC)	For drill hole diameters $d_0 \leq 20$ mm and drill hole depths $h_0 \leq 10 \cdot d$.
	The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq 20$ mm and 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 the Hilti hand pump at least 4 times until return air stream is free of noticeable dust.
Compressed Air Cleaning (CAC)	For all drill hole diameters d_0 and all drill hole depths $h_0 \leq 20 \cdot d$.
	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.
	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 system Hilti HIT-HY 170	
Intended Use Installation instructions	**Annex B6**

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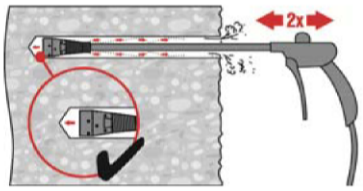
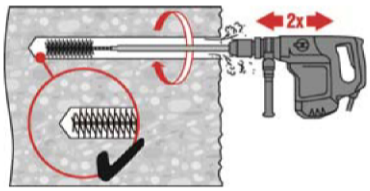
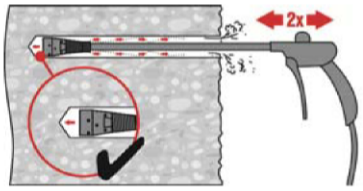
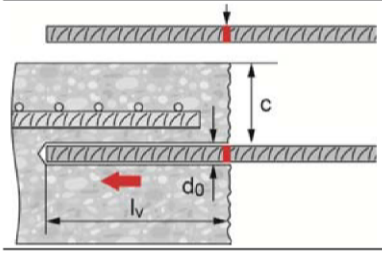
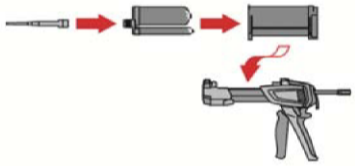
Compressed Air Cleaning (CAC)	For drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20 · ϕ (for ϕ > 12 mm)
	Use the appropriate air nozzle Hilti HIT-DL (see Table B4). Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.
	Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. Attach the other end of the extension to the TE-C/TE-Y chuck. Safety tip: Start machine brushing operation slowly. Start brushing operation once the brush is inserted in the borehole.
	Use the appropriate air nozzle Hilti HIT-DL (see Table B4). Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust. Safety tip: Do not inhale concrete dust. Use of the dust collector Hilti HIT-DRS is recommended.
Rebar preparation	
	Before use, make sure the rebar is dry and free of oil or other residue. Mark the embedment depth on the rebar (e.g. with tape) → l_v. Insert Rebar in borehole to verify hole and setting depth l_v.
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.

Injection system Hilti HIT-HY 170	
Intended Use Installation instructions	**Annex B7**

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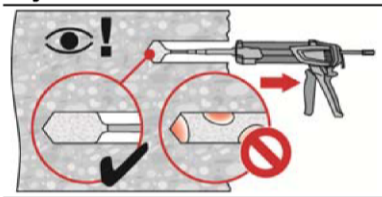
Inject adhesive	Inject adhesive from the back of the drill hole without forming air voids.

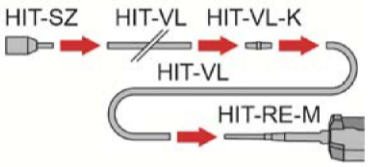
Injection method for drill hole depth ≤ 250 mm (without overhead applications)



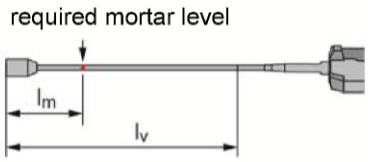
Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill approximately 2/3 of the drill hole to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

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

Injection method for drill hole depth > 250 mm or overhead applications

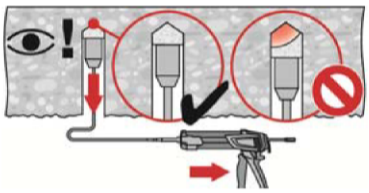


Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ (see Table B4).
For combinations of several injection extensions use coupler HIT-VL-K.
A substitution of the injection extension for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube supports proper injection.



Mark the required mortar level l_m and embedment depth l_v with tape or marker on the injection extension.

- estimation:
  $l_m = 1/3 \cdot l_v$
- precise formula for optimum mortar volume:
  $l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$



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 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.

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	
Intended Use Installation instructions	**Annex B8**

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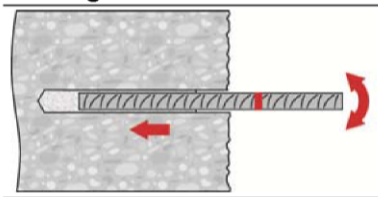
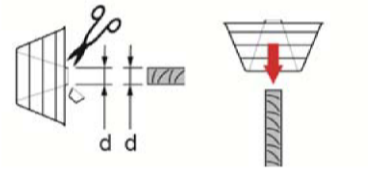
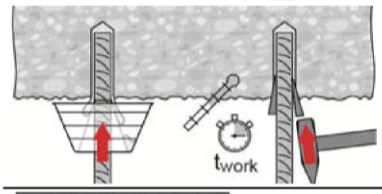
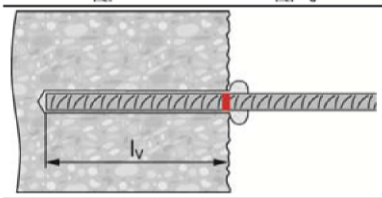
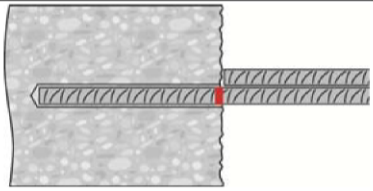
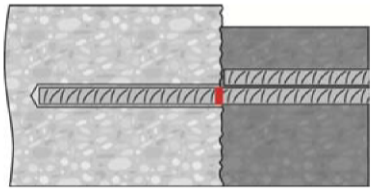
Setting the element	Before use, verify that the element is dry and free of oil and other contaminants.
	For easy installation insert the rebar into the drill hole while slowly twisting until the embedment mark is at the concrete surface level.
 	For overhead application: During insertion of the rebar mortar might flow out of the drill hole. For collection of the flowing mortar HIT-OHC may be used. Support the rebar and secure it from falling until mortar has started to harden, e.g. using wedges HIT-OHW. For overhead installation use piston plugs and fix embedded parts with e.g. wedges.
	After installing the rebar the annular gap must be completely filled with mortar. Proper installation: • desired anchoring embedment l_v is reached: embedment mark at concrete surface. • excess mortar flows out of the borehole after the rebar has been fully inserted until the embedment mark.
	Observe the working time t_{work} (see Table B3), which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time.
	Full load may be applied only after the curing time t_{cure} has elapsed (see Table B3).

Injection system Hilti HIT-HY 170	**Annex B9**
Intended Use Installation instructions	

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Minimum anchorage length and minimum lap length

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} given in Table C1.

Table C1: Amplification factor α_{lb}

Bar diameter	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 25	1,0								

Table C2: Design values of the ultimate bond resistance f_{bd} [1)] in N/mm²

Bar diameter	Concrete class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ 8 to ϕ 12	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7
ϕ 14 to ϕ 25	1,6	2,0	2,3	2,7	3,0	3,4	3,4	3,4	3,4

[1)] According to EN 1992-1-1 for good bond conditions with consideration γ_c=1,5 (recommended value according to EN 1992-1-1). For all other bond conditions multiply the values by 0,7.

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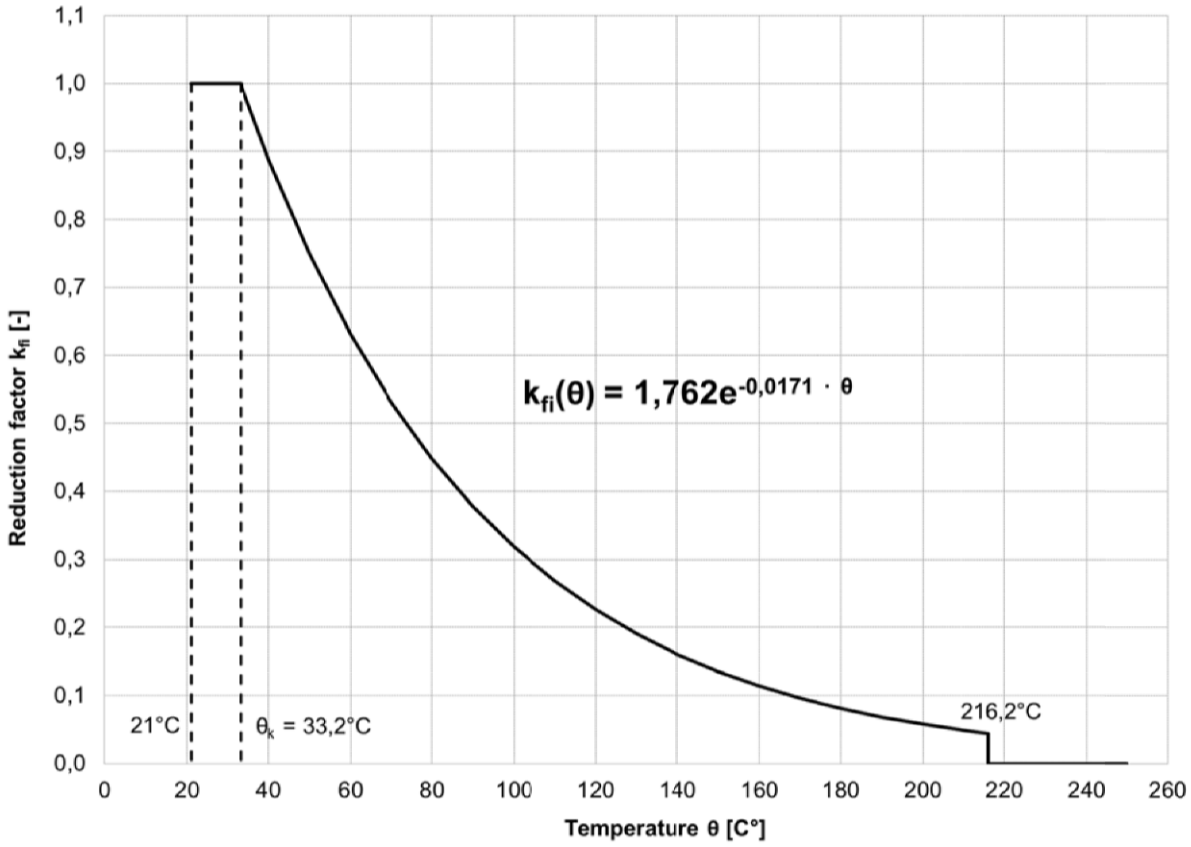
Figure C3: Temperature reduction factor $k_{fi}(\theta)$ under fire exposure



Design value of ultimate bond strength $f_{bd,fi}$ under fire exposure

The design value of ultimate bond strength $f_{bd,fi}$ under fire exposure is calculated according to following equation:

$$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd} \cdot \gamma_c / \gamma_{M,fi}$$

with:

$k_{fi}(\theta)$ … temperature reduction factor under fire exposure, see Figure C3
f_{bd} … design values of the ultimate bond resistance according to Table C2
$\gamma_c = 1{,}5$ … recommended safety factor according to EN 1992-1-1
$\gamma_{M,fi}$ … safety factor according to EN 1992-1-2 under fire exposure

Injection system Hilti HIT-HY 170	Annex C2
Performances Design values of ultimate bond resistance $f_{bd,fi}$ under fire exposure Temperature reduction factor $k_{fi}(\theta)$ under fire exposure	