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-15/0419 of 29 November 2019

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R
Product family to which the construction product belongs	Bonded expansion fastener for use in concrete
Manufacturer	Hilti AG Feldkircherstraße 100 9494 Schaan FÜRSTENTUM LIECHTENSTEIN
Manufacturing plant	Hilti Werke
This European Technical Assessment contains	20 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
This version replaces	ETA-15/0419 issued on 11 April 2019

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Specific Part

1 Technical description of the product

The injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R is a bonded expansion fastener consisting of a foil pack with injection mortar Hilti HIT-HY 200-A or Hilti HIT-HY 200-R and an anchor rod (including nut and washer) in the range of of 3/8 inch to 3/4 inch. The anchor rod (including nut and washer) is made of galvanised steel (HIT-Z) or stainless steel (HIT-Z-R). The anchor rod is placed into a drill hole filled with injection mortar.

The load transfer is realised by mechanical interlock of several cones in the bonding mortar and then via a combination of bonding and friction forces in the base material (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
Characteristic resistance for static and quasi-static shear load	See Annex C2
Displacements (static and quasi-static loading)	See Annex C3
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C4 - C6
Durability	See Annex B1

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 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 29 November 2019 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Lange

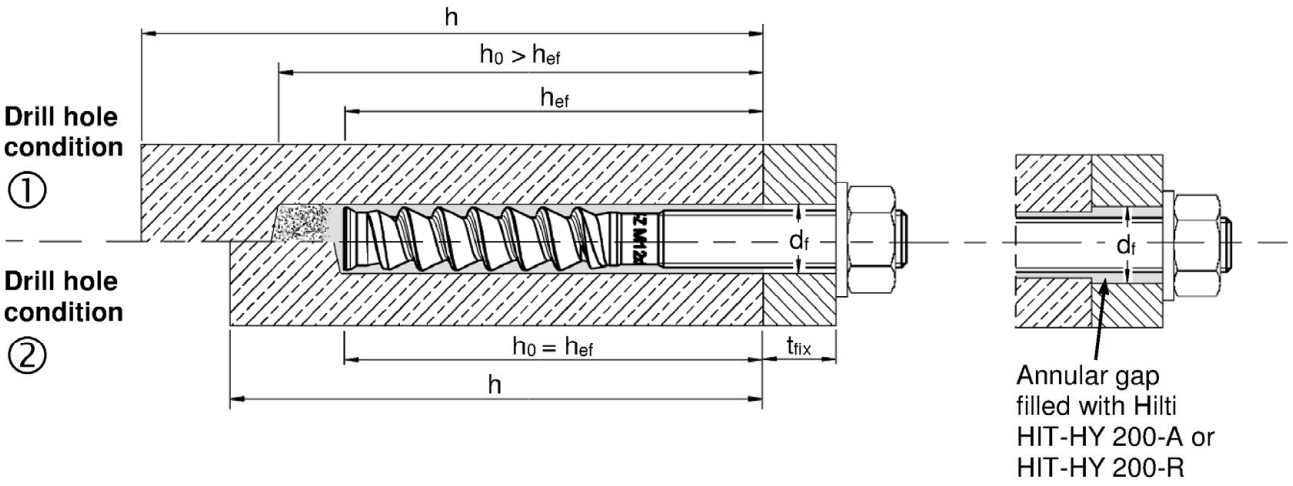
Deutsches Institut für Bautechnik DIBt

Installed condition

Figure A1:
HIT-Z, HIT-Z-R

Pre-setting:
Install fastener before positioning fixture

Through-setting:
Install fastener through positioned fixture



Drill hole condition ① → non-cleaned drill hole

Drill hole condition ② → drilling dust is removed

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex A1**
Product description Installed condition	

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Product description: Injection mortar and fastener

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

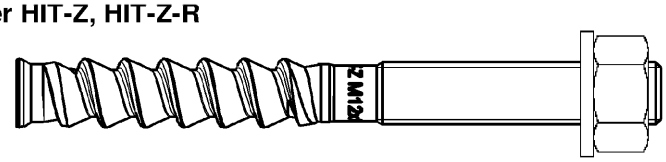
Marking:
HILTI HIT
HY 200-A or HY 200-R
Production number and production line
Expiry date mm/yyyy

Product name: "Hilti HIT-HY 200-A"

Product name: "Hilti HIT-HY 200-R"

Static mixer Hilti HIT-RE-M

Fastener HIT-Z, HIT-Z-R



Hilti fastener: HIT-Z and HIT-Z-R: 3/8 inch (9,5 mm) to 3/4 inch (19,1 mm)

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex A2**
Product description Injection mortar / Static mixer / Fastener	

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Table A1: Materials

Designation	Material
Metal parts made of zinc coated steel	
Fastener HIT-Z	For ≤ 1/2": f_{uk} = 650 N/mm² (94 200 psi), f_{yk} = 520 N/mm² (75 300 psi). For 5/8": f_{uk} = 610 N/mm² (88 400 psi), f_{yk} = 490 N/mm² (71 000 psi), For 3/4": f_{uk} = 595 N/mm² (86 200 psi), f_{yk} = 480 N/mm² (69 600 psi), Elongation at fracture (l_0=5d) > 8% ductile Electroplated zinc coated ≥ 5 µm
Washer	Electroplated zinc coated ≥ 5 µm
Nut	Strength class of nut adapted to strength class of fastener Electroplated zinc coated ≥ 5 µm
Metal parts made of stainless steel corrosion resistance class III according EN 1993-1-4:2006+A1:2015	
Fastener HIT-Z-R	For ≤ 1/2": f_{uk} = 650 N/mm² (94 200 psi), f_{yk} = 520 N/mm² (75 300 psi). For 5/8": f_{uk} = 610 N/mm² (88 400 psi), f_{yk} = 490 N/mm² (71 000 psi), For 3/4": f_{uk} = 595 N/mm² (86 200 psi), f_{yk} = 480 N/mm² (69 600 psi), Elongation at fracture (l_0=5d) > 8% ductile Stainless steel 1.4401, 1.4404 EN 10088-1:2014
Washer	Stainless steel A4 according to EN 10088-1:2014
Nut	Strength class of nut adapted to strength class of fastener Stainless steel 1.4401, 1.4404 EN 10088-1:2014

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Specifications of intended use

Anchorages subject to:

- Static and quasi static loading
  - HIT-Z and HIT-Z-R size 3/8 inch (9,5 mm) to 3/4 inch (19,1 mm).
- Seismic performance category:
  - Seismic C1: HIT-Z, HIT-Z-R sizes 3/8 inch (9,5 mm) to 3/4 inch (19,1 mm) in hammer drilled holes.
  - Seismic C2: HIT-Z, HIT-Z-R sizes 1/2 inch (12,7 mm) and 5/8 inch (15,9 mm) in hammer drilled holes.

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 +80 °C
  (max. long term temperature +50 °C and max. short term temperature +80 °C)
  Temperature range III: -40 °C to +120 °C
  (max. long term temperature +72 °C and max. short term temperature +120 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials)
- For all other conditions according EN 1993-1-4:2006+A1:2015 correspoding to corrosion resistance class 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 fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- The anchorages are designed in accordance with EN 1992-4:2018 and EOTA Technical Report TR 055.

Installation:

- Concrete condition I1: Installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete
- Installation direction D3: downward and horizontal and upward (e.g. overhead).
- Drilling technique: hammer drilling, diamond coring or hammer drilling with hollow drill bit TE-CD, TE-YD
- 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 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B1**
Intended Use Specifications	

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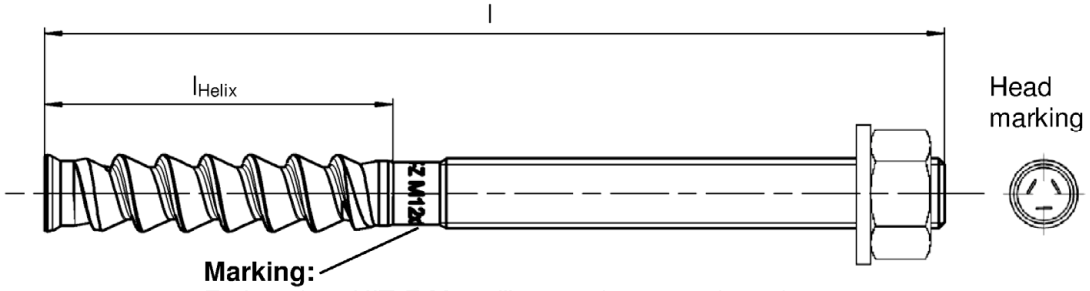
Table B1: Installation parameters HIT-Z, HIT-Z-R

				3/8	1/2	5/8	3/4
Nominal diameter		d	[mm]	9,5	12,7	15,9	19,1
Nominal diameter of drill bit		d_0	[in] ([mm])	7/16 (11,1)	9/16 (14,3)	3/4 (19,1)	7/8 (22,2)
Length of fastener		min l	[mm] ([in])	111 (4 3/8)	114 (4 1/2)	152 (6)	216 (8 1/2)
		max l	[mm] ([in])	162 (6 3/8)	197 (7 3/4)	241 (9 1/2)	248 (9 3/4)
Length of helix		l_{Helix}	[mm] ([in])	57 (2 1/4)	63 (2 1/2)	92 (3 5/8)	102 (4)
Nominal anchorage depth		$h_{ef,min}$	[mm] ([in])	60 (2 3/8)	70 (2 3/4)	95 (3 3/4)	102 (4)
		$h_{ef,max}$	[mm] ([in])	114 (4 1/2)	152 (6)	190 (7 1/2)	216 (8 1/2)
Drill hole condition ① Min. thickness of concrete member		h_{min}	[mm] ([in])	h_{ef} + 57 mm (h_{ef} + 2 1/4 in)		h_{ef} + 102 mm (h_{ef} + 4 in)	
Drill hole condition ② Min. thickness of concrete member		h_{min}	[mm] ([in])	h_{ef} + 32 mm ≥ 102 mm (h_{ef} + 1 1/4 in ≥ 4 in)		h_{ef} + 45 mm (h_{ef} + 1 3/4 in)	
Maximum depth of drill hole		h_0	[mm] ([in])	h – 32 mm (h – 1 1/4 in)		h – 2 d_0	
Pre-setting: Maximum diameter of clearance hole in the fixture		d_f	[in] ([mm])	7/16 (11,1)	9/16 (14,3)	11/16 (17,5)	13/16 (20,6)
Through-setting: Maximum diameter of clearance hole in the fixture		d_f	[in] ([mm])	1/2 (12,7)	5/8 (15,9)	13/16 (20,6)	15/16 (23,8)
Maximum fixture thickness		t_{fix}	[mm] ([in])	89 (3 1/2)	110 (4 1/4)	125 (4 7/8)	121 (4 3/4)
Installation torque moment	HIT-Z	T_{inst}	[Nm] ([ft-lb])	20 (15)	40 (30)	80 (60)	150 (110)
	HIT-Z-R	T_{inst}	[Nm] ([ft-lb])	40 (30)	90 (65)	170 (125)	220 (165)



Marking:
Embossing "HIT-Z M…x l" zinc coated steel
Embossing "HIT-Z-R M…x l“ stainless steel

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Intended Use
Installation parameters

Annex B2

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Minimum edge distance and spacing

For the calculation of minimum spacing and minimum edge distance of fasteners in combination with different embedment depth and thickness of concrete member the following equation shall be fulfilled:

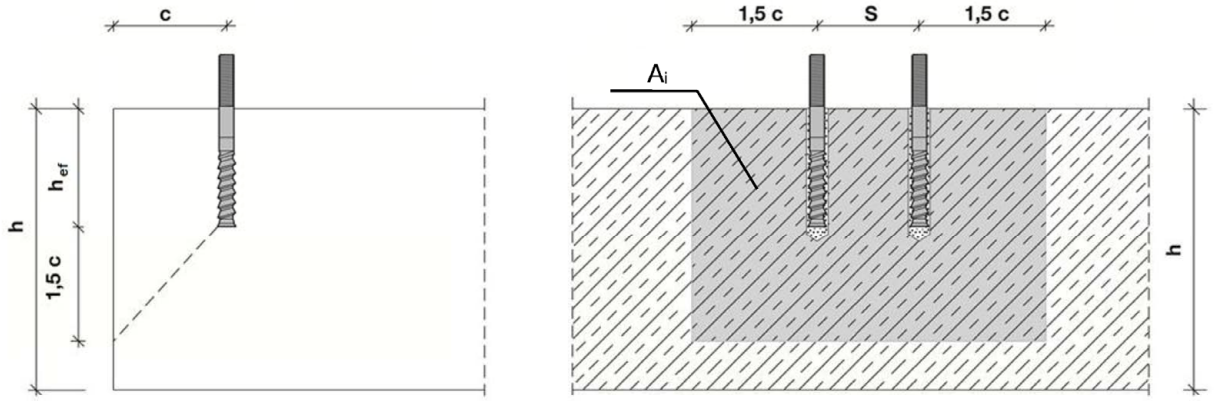
$$A_{i,req} < A_{i,ef}$$

Table B2: Required area $A_{i,req}$

		[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Cracked concrete	$A_{i,req}$	[mm²], ([in²])	32200 (49,9)	54800 (85,0)	95500 (148,1)	157000 (243,4)
Non-cracked concrete	$A_{i,req}$	[mm²], ([in²])	46100 (71,5)	75700 (117,4)	129000 (200,0)	209000 (324,0)

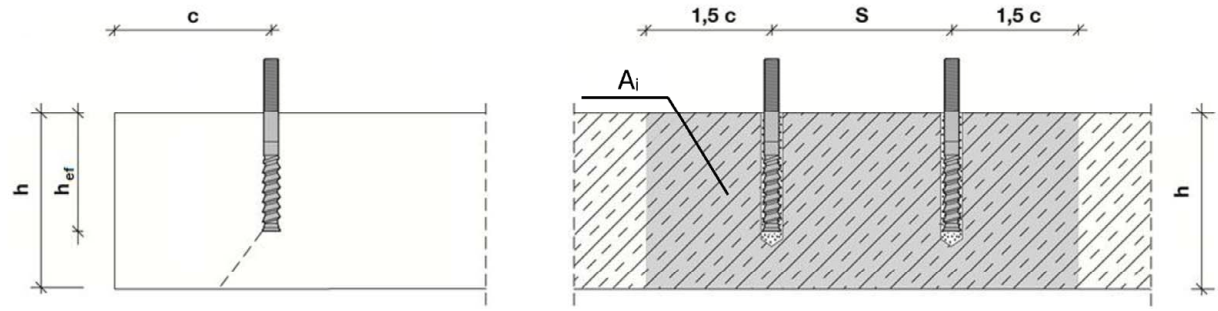
Table B3: Effective area $A_{i,ef}$

Member thickness $h > h_{ef} + 1{,}5 \cdot c$



Single fastener and group of fasteners with $s > 3 \cdot c$	[mm²], ([in²])	$A_{i,ef} = (6 \cdot c) \cdot (h_{ef} + 1{,}5 \cdot c)$	with $c \geq 5 \cdot d$
Group of fasteners with $s \leq 3 \cdot c$	[mm²], ([in²])	$A_{i,ef} = (3 \cdot c + s) \cdot (h_{ef} + 1{,}5 \cdot c)$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

Member thickness $h \leq h_{ef} + 1{,}5 \cdot c$



Single fastener and group of fasteners with $s > 3 \cdot c$	[mm²], ([in²])	$A_{i,ef} = (6 \cdot c) \cdot h$	with $c \geq 5 \cdot d$
Group of fasteners with $s \leq 3 \cdot c$	[mm²], ([in²])	$A_{i,ef} = (3 \cdot c + s) \cdot h$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

c_{min} and s_{min} in 5 mm steps

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Intended Use
Installation parameters: member thickness, spacing and edge distances

Annex B3

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Table B4: Maximum working time and minimum curing time, HIT-HY 200-A

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
5 °C	25 min	2 hours
6 °C to 10 °C	15 min	75 min
11 °C to 20 °C	7 min	45 min
21 °C to 30 °C	4 min	30 min
31 °C to 40 °C	3 min	30 min

Table B5: Maximum working time and minimum curing time, HIT-HY 200-R

Temperature in the base material T	Maximum working time t_{work}	Minimum curing time t_{cure}
5 °C	1 hour	4 hours
6 °C to 10 °C	40 min	2,5 hours
11 °C to 20 °C	15 min	1,5 hours
21 °C to 30 °C	9 min	1 hour
31 °C to 40 °C	6 min	1 hour

Table B6: Parameters of drilling and setting tools

Fastener	Drill			Installation
HIT-Z / HIT-Z-R	Hammer drilling		Diamond coring	Piston plug
	Drill bit	Hollow drill bit TE-CD, TE-YD		
				
Size [in] ([mm])	d_0 [in] ([mm])	d_0 [in] ([mm])	d_0 [in] ([mm])	HIT-SZ
3/8 (9,5)	7/16 (11,1)		7/16 (11,1)	
1/2 (12,7)	9/16 (14,3)	9/16 (14,3)	9/16 (14,3)	9/16 "
5/8 (15,9)	3/4 (19,1)	3/4 (19,1)	3/4 (19,1)	3/4 "
3/4 (19,1)	7/8 (22,2)	7/8 (22,2)	7/8 (22,2)	7/8 "

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B4**
Intended Use Maximum working time and minimum working time Cleaning and setting tools	

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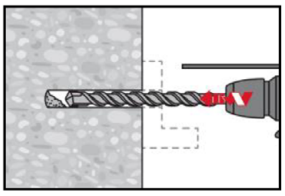
Installation instruction

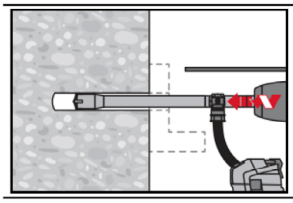
Hole drilling

a) Hammer drilling



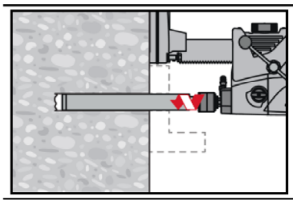
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
Pre-setting: Drill hole to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
After drilling is complete, proceed to the "injection preparation" step in the installation instruction.

b) Hammer drilling with hollow drill bit



Pre- / Through-setting: Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum attachment. This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual (see Annex A1 – Drill hole condition ②).
After drilling is completed, proceed to the "injection preparation" step in the installation instruction.

c) Diamond coring

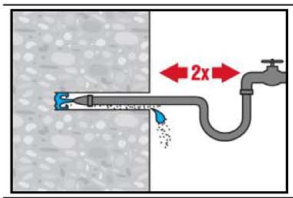


Diamond coring is permissible when suitable diamond core drilling machines and corresponding core bits are used.
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth.
Pre-setting: Drill hole to the required embedment depth.

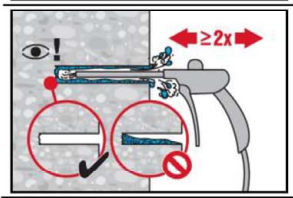
Drill hole cleaning

a) No cleaning required for hammer drilled holes.

b) Hole flushing and evacuation required for wet-drilled diamond cored holes.



Flush 2 times from the back of the hole over the whole length until water runs clear.
Water-line pressure is sufficient.



Blow 2 times from the back of the hole (if needed with nozzle extension) with oil-free compressed air (min. 6 bar at 6 m³/h) to evacuate the water.

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B5**
Intended Use Installation instructions	

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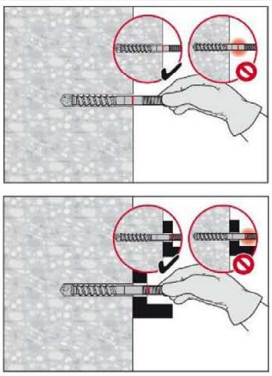
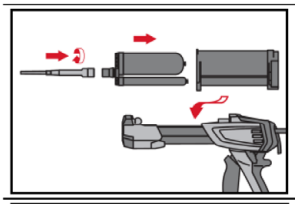
Checking of setting depth

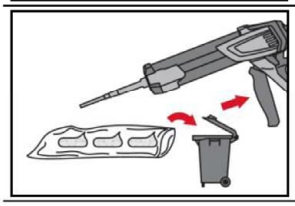


Mark the element and check the setting depth. The element has to fit in the hole until the required embedment depth. If it is not possible to insert the element to the required embedment depth, remove the dust in the drill hole or drill deeper.

Injection preparation



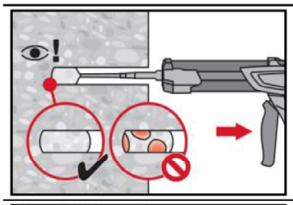
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into the dispenser.



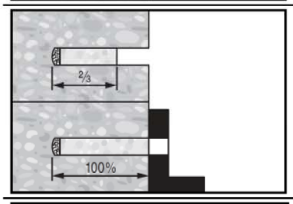
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discarded quantities are:

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

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

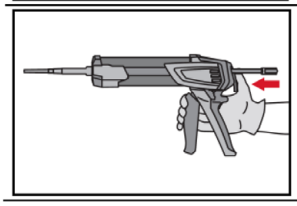


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.



Pre-setting: Fill approximately 2/3 of the drill hole.

Through-setting: Fill 100% of the drill hole



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 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B6**
Intended Use Installation instructions	

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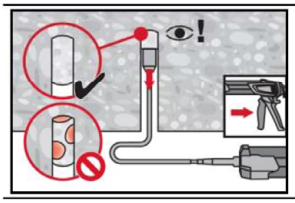
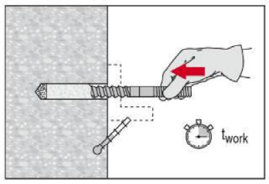
Overhead installation

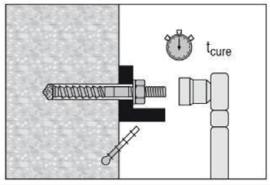


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B6). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally 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.
Set element to the required embedment depth before working time t_{work} has elapsed.
The working time t_{work} is given in Table B4 or Table B5. After setting the element the annular gap between the fastener and the fixture (through-setting) or concrete (pre-setting) has to be filled with mortar.



After required curing time t_{cure} (see Table B4 or Table B5) remove excess mortar.
The required installation torque T_{inst} is given in Table B1. The fastener can be loaded.

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R	**Annex B7**
Intended Use Installation instructions	

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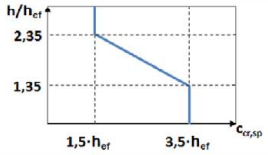
Table C1: Essential characteristics for HIT-Z (-R), under tension load in case of static and quasi static loading

				[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Installation safety factor		γ_{inst}	[-]		1,0			
Steel failure								
HIT-Z		$N_{Rk,s}$	[kN] ([lb])		33 (7305)	60 (13375)	95 (21300)	140 (31470)
HIT-Z-R		$N_{Rk,s}$	[kN] ([lb])		33 (7305)	60 (13375)	95 (21300)	140 (31470)
Pull-out failure								
in uncracked concrete								
Temperature range I:	40 °C / 24 °C	$N_{Rk,p,ucr}$	[kN] ([lb])		40 (8990)	60 (13480)	110 (24720)	145 (32590)
Temperature range II:	80 °C / 50 °C	$N_{Rk,p,ucr}$	[kN] ([lb])		36 (8090)	55 (12360)	100 (22480)	130 (29220)
Temperature range III:	120 °C / 72 °C	$N_{Rk,p,ucr}$	[kN] ([lb])		34 (7640)	50 (11240)	90 (20230)	120 (26970)
in cracked concrete								
Temperature range I:	40 °C / 24 °C	$N_{Rk,p,cr}$	[kN] ([lb])		36 (8090)	55 (12360)	100 (22480)	130 (29220)
Temperature range II:	80 °C / 50 °C	$N_{Rk,p,cr}$	[kN] ([lb])		34 (7640)	50 (11240)	90 (20230)	120 (26970)
Temperature range III:	120 °C / 72 °C	$N_{Rk,p,cr}$	[kN] ([lb])		30 (6740)	45 (10110)	80 (17980)	105 (23600)
Concrete cone failure								
Effective embedment depth		$h_{ef,min}$	[mm] ([in])		60 (2 3/8)	70 (2 3/4)	95 (3 3/4)	102 (4)
		$h_{ef,max}$	[mm] ([in])		114 (4 1/2)	152 (6)	190 (7 1/2)	216 (8 1/2)
Factor for uncracked concrete		$k_{ucr,N}$	[-]		11,0			
Factor for cracked concrete		$k_{cr,N}$	[-]		7,7			
Edge distance		$c_{cr,N}$	[mm] / ([in])		$1,5 \cdot h_{ef}$			
Spacing		$s_{cr,N}$	[mm] / ([in])		$3,0 \cdot h_{ef}$			
Splitting failure								
Edge distance $c_{cr,sp}$ [mm], ([in]) for	$h / h_{ef} \geq 2,35$				$1,5 \cdot h_{ef}$			
	$2,35 > h / h_{ef} > 1,35$				$6,2 \cdot h_{ef} - 2,0 \cdot h$			
	$h / h_{ef} \leq 1,35$				$3,5 \cdot h_{ef}$			
Spacing		$s_{cr,sp}$	[mm] / ([in])		$2 \cdot c_{cr,sp}$			

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Performances
Essential characteristics under tension load in case of static and quasi static loading

Annex C1

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Table C2: Essential characteristics for HIT-Z (-R) under shear load for static and quasi static loading

		[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Installation safety factor	γ_{inst}	[-]	1,0			
Steel failure without lever arm						
HIT-Z	$V_{Rk,s}$	[kN] ([lb])	14 (3215)	26 (5885)	42 (9375)	62 (13850)
HIT-Z-R	$V_{Rk,s}$	[kN] ([lb])	20 (4385)	36 (8025)	57 (12785)	84 (18885)
Ductility factor	k_7	[-]	1,0			
Steel failure with lever arm						
HIT-Z	$M^0_{Rk,s}$	[Nm] ([ft-lb])	39 (29)	96 (71)	194 (143)	349 (257)
HIT-Z-R	$M^0_{Rk,s}$	[Nm] ([ft-lb])	39 (29)	96 (71)	194 (143)	349 (257)
Ductility factor	k_7	[-]	1,0			
Concrete pry-out failure						
Pry-out factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of fastener in shear loading	l_f	[mm] ([in])	h_{ef}			
Diameter of fastener	d_{nom}	[mm] ([in])	9,5 (3/8)	12,7 (1/2)	15,9 (5/8)	19,1 (3/4)

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Table C3: Displacements under tension load for HIT-Z (-R) for static and quasi static loading[1)]

			[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Uncracked concrete, Temperature range I: 40 °C / 24 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,03	0,04	0,05	0,06
	$\delta_{N\infty}$-factor	[mm/kN]		0,08	0,10	0,13	0,16
Uncracked concrete, Temperature range II: 80 °C / 50 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,03	0,05	0,06	0,07
	$\delta_{N\infty}$-factor	[mm/kN]		0,08	0,11	0,14	0,18
Uncracked concrete, Temperature range III: 120 °C / 72 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,04	0,05	0,06	0,08
	$\delta_{N\infty}$-factor	[mm/kN]		0,09	0,12	0,16	0,19
Cracked concrete, Temperature range I: 40 °C / 24 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,07	0,08	0,09	0,10
	$\delta_{N\infty}$-factor	[mm/kN]		0,21	0,21	0,21	0,21
Cracked concrete, Temperature range II: 80 °C / 50 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,07	0,09	0,10	0,11
	$\delta_{N\infty}$-factor	[mm/kN]		0,23	0,23	0,23	0,23
Cracked concrete, Temperature range III: 120 °C / 72 °C							
Displacement	δ_{N0}-factor	[mm/kN]		0,08	0,09	0,11	0,12
	$\delta_{N\infty}$-factor	[mm/kN]		0,25	0,25	0,25	0,25

[1)] Calculation of the displacement

$\delta_{N0} = \delta_{N0}\text{-factor} \cdot N$; $\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot N$; (N: action tension load).

Table C4: Displacements under shear load for HIT-Z (-R) for static and quasi static loading[1)]

			[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Displacement	δ_{V0}-factor	[mm/kN]		0,06	0,05	0,04	0,04
	$\delta_{V\infty}$-factor	[mm/kN]		0,09	0,07	0,07	0,06

[1)] Calculation of the displacement

$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; $\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$; (V: action shear load)

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Table C5: Essential characteristics under tension load for HIT-Z (-R) for seismic performance category C1

				[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Installation safety factor		γ_{inst}	[-]		1,0			
Steel failure								
HIT-Z		$N_{Rk,s,seis}$	[kN] ([lb])		33 (7305)	60 (13375)	95 (21300)	140 (31470)
HIT-Z-R		$N_{Rk,s,seis}$	[kN] ([lb])		33 (7305)	60 (13375)	95 (21300)	140 (31470)
Pull-out failure								
in cracked concrete C20/25								
Temperature range I:	40 °C / 24 °C	$N_{Rk,p,seis}$	[kN] ([lb])		34 (7640)	50 (11240)	95 (21300)	125 (28100)
Temperature range II:	80 °C / 50 °C	$N_{Rk,p,seis}$	[kN] ([lb])		32 (7190)	46 (10340)	85 (19100)	115 (25850)
Temperature range III:	120 °C / 72 °C	$N_{Rk,p,seis}$	[kN] ([lb])		28 (6290)	42 (9440)	75 (16860)	100 (22480)

Table C6: Essential characteristics under shear load for HIT-Z (-R) for seismic performance category C1

			[in] ([mm])	**3/8** (9,5)	**1/2** (12,7)	**5/8** (15,9)	**3/4** (19,1)
Steel failure							
HIT-Z		$V_{Rk,s,seis}$	[kN] ([lb])	14 (3215)	17 (3825)	27 (6185)	43 (9700
HIT-Z-R		$V_{Rk,s,seis}$	[kN] ([lb])	16 (3680)	23 (5215)	31 (7030)	46 (10390)

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Table C7: Essential characteristics for HIT-Z (-R) under tension load for seismic performance category C2

				[in] ([mm])	**1/2** (12,7)	**5/8** (15,9)
Installation safety factor		γ_{inst}	[-]		1,0	
Steel failure						
HIT-Z		$N_{Rk,s,seis}$	[kN] ([lb])		60 (13375)	95 (21300)
HIT-Z-R		$N_{Rk,s,seis}$	[kN] ([lb])		60 (13375)	95 (21300)
Pull-out failure						
in cracked concrete C20/25						
Temperature range I:	40 °C / 24 °C	$N_{Rk,p,seis}$	[kN] ([lb])		26 (5840)	70 (15730)
Temperature range II:	80 °C / 50 °C	$N_{Rk,p,seis}$	[kN] ([lb])		20 (4490)	55 (12360)
Temperature range III:	120 °C / 72 °C	$N_{Rk,p,seis}$	[kN] ([lb])		18 (4040)	48 (10790)

Table C8: Essential characteristics under shear load for HIT-Z (-R) for seismic performance category C2

			[in] ([mm])	**1/2** (12,7)	**5/8** (15,9)
Steel failure					
HIT-Z		$V_{Rk,s,seis}$	[kN] ([lb])	11 (2470)	17 (3850)
HIT-Z-R		$V_{Rk,s,seis}$	[kN] ([lb])	15 (3375)	20 (4600)

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Table C9: Displacements under tension load for HIT-Z (-R) for seismic performance category C2

		[in] ([mm])	**1/2** (12,7)	**5/8** (15,9)
Displacement DLS	$\delta_{N,seis(DLS)}$	[mm]	1,3	1,9
Displacement ULS	$\delta_{N,seis(ULS)}$	[mm]	3,2	3,6

Table C10: Displacements under shear load for HIT-Z (-R) for seismic performance category C2

		[in] ([mm])	**1/2** (12,7)	**5/8** (15,9)
Displacement DLS HIT-Z	$\delta_{V,seis(DLS)}$	[mm]	2,8	3,1
Displacement ULS HIT-Z	$\delta_{V,seis(ULS)}$	[mm]	4,6	6,2
Displacement DLS HIT-Z-R	$\delta_{V,seis(DLS)}$	[mm]	3,0	3,1
Displacement ULS HIT-Z-R	$\delta_{V,seis(ULS)}$	[mm]	6,2	6,2

Injection system Hilti HIT-HY 200-A, Hilti HIT-HY 200-R with HIT-Z / HIT-Z-R

Performances
Displacements for seismic performance category C2

Annex C6