

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-12/0028
of 30 May 2017

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the
European Technical Assessment:

Trade name of the construction product

Product family
to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment
contains

This European Technical Assessment is
issued in accordance with Regulation (EU)
No 305/2011, on the basis of

This version replaces

Deutsches Institut für Bautechnik

Injection system Hilti HIT-HY 200-R

Bonded anchor for use in concrete

Hilti AG
Feldkircherstraße 100
9494 Schaan
FÜRSTENTUM LIECHTENSTEIN

Hilti Werke

21 pages including 3 annexes

Guideline for European technical approval of "Metal
anchors for use in concrete", ETAG 001 Part 5:
"Bonded anchors",
used as European Assessment Document (EAD)
according to Article 66 Paragraph 3 of Regulation (EU)
No 305/2011.

ETA-12/0028 issued on 18 August 2016

**European Technical Assessment
ETA-12/0028**

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English translation prepared by DIBt

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Specific Part**1 Technical description of the product**

The injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R is a bonded anchor consisting of a foil pack with injection mortar Hilti HIT-HY 200-R and an anchor rod (including nut and washer) in the sizes of M8, M10, M12, M16 and M20. The anchor rod (including nut and washer) is made of galvanised steel (HIT-Z), with multilayer coating (HIT-Z-F) 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 action and displacements	See Annex C1 – C4
Characteristic resistance for seismic performance category C1 and displacements	See Annex C5
Characteristic resistance for seismic performance category C2 and displacements	See Annex C6 – C7

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorage satisfy requirements for Class A1
Resistance to fire	No performance assessed

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 with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) 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 30 May 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

beglaubigt:
Lange

Installed condition

Figure A1:

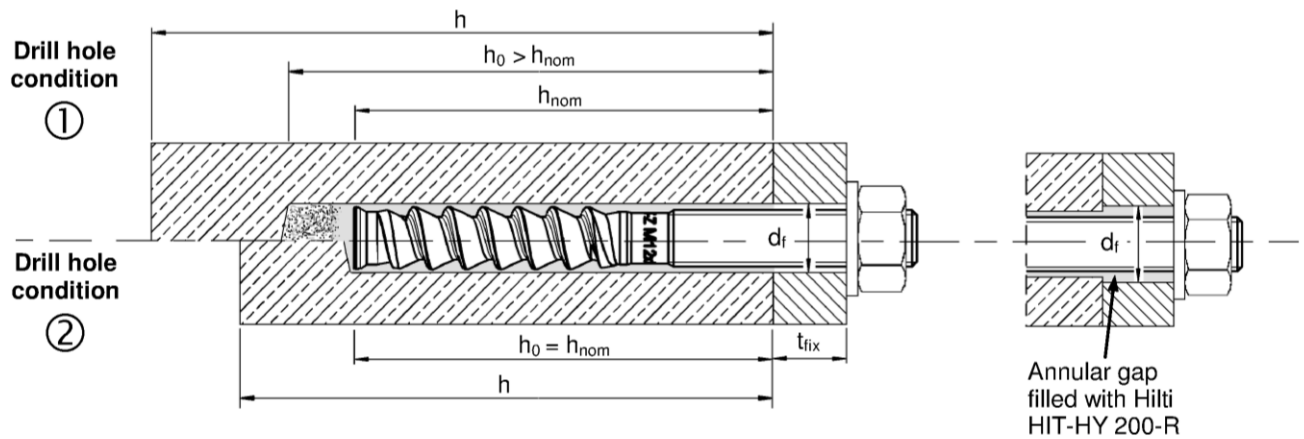
HIT-Z, HIT-Z-F, HIT-Z-R

Pre-setting:

Install anchor before positioning fixture

Through-setting:

Install anchor 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-R with HIT-Z / HIT-Z F / HIT-Z-R

Product description
Installed condition

Annex A1

Product description: Injection mortar and steel elements

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



Static mixer Hilti HIT-RE-M

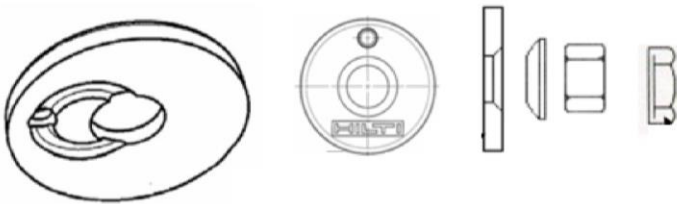


Steel elements



Hilti anchor rod: HIT-Z and HIT-Z-R: M8 to M20
Hilti anchor rod: HIT-Z F: M16 and M20

Steel elements Seismic filling set



Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z F / HIT-Z-R

Product description
Injection mortar / Static mixer / Steel elements

Annex A2

Table A1: Materials

Designation	Material
Metal parts made of zinc coated steel	
Anchor rod HIT-Z	For $\leq M12$: $f_{uk} = 650 \text{ N/mm}^2$, $f_{yk} = 520 \text{ N/mm}^2$, For $M16$: $f_{uk} = 610 \text{ N/mm}^2$, $f_{yk} = 490 \text{ N/mm}^2$, For $M20$: $f_{uk} = 595 \text{ N/mm}^2$, $f_{yk} = 480 \text{ N/mm}^2$, Elongation at fracture ($l_0=5d$) $> 8\%$ ductile; Electroplated zinc coated $\geq 5 \mu\text{m}$
Washer	Electroplated zinc coated $\geq 5 \mu\text{m}$
Nut	Strength class of nut adapted to strength class of anchor rod. Electroplated zinc coated $\geq 5 \mu\text{m}$
Metal parts made of seismic filling set	
Filling washer	Electroplated zinc coated $\geq 5 \mu\text{m}$
Spherical washer	Electroplated zinc coated $\geq 5 \mu\text{m}$
Metal parts made of multilayer coating steel	
Anchor rod HIT-Z-F	For $M16$: $f_{uk} = 610 \text{ N/mm}^2$, $f_{yk} = 490 \text{ N/mm}^2$, For $M20$: $f_{uk} = 595 \text{ N/mm}^2$, $f_{yk} = 480 \text{ N/mm}^2$, Elongation at fracture ($l_0=5d$) $> 8\%$ ductile; Multilayer coating, ZnNi-galvanized according to DIN 50979:2008-07
Washer	Multilayer coating, ZnNi-galvanized according to DIN 50979:2008-07
Nut	Multilayer coating, ZnNi-galvanized according to DIN 50979:2008-07
Metal parts made of stainless steel	
Anchor rod HIT-Z-R	For $\leq M12$: $f_{uk} = 650 \text{ N/mm}^2$, $f_{yk} = 520 \text{ N/mm}^2$, For $M16$: $f_{uk} = 610 \text{ N/mm}^2$, $f_{yk} = 490 \text{ N/mm}^2$, For $M20$: $f_{uk} = 595 \text{ N/mm}^2$, $f_{yk} = 480 \text{ N/mm}^2$, 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 anchor rod. Stainless steel 1.4401, 1.4404 EN 10088-1:2014

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z F / HIT-Z-R

Product description
Materials

Annex A3

Specifications of intended use

Anchorage subject to:

- Static and quasi static loading
 - HIT-Z and HIT-Z-R sizes M8 to M20. HIT-Z-F sizes M16 and M20
- Seismic performance category:
 - Seismic C1: HIT-Z, HIT-Z-R sizes M8 to M20, HIT-Z-F sizes M16 and M20 in hammer drilled holes.
 - Seismic C2: HIT-Z, HIT-Z-R sizes M12 to M20, HIT-Z-F sizes M16 and M20 in hammer drilled holes.

Base material:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000.
- Cracked and non-cracked concrete.

Temperature in the base material:

- **at installation**
+5 °C to +40 °C
- **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 (zinc coated steel, multilayer coated steel and stainless steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal conditions, if no particular aggressive conditions exist (stainless steel).
Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing products are used).

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static loading are designed in accordance with: "EOTA Technical Report TR 029, 09/2010" or "CEN/TS 1992-4:2009, design method A"
- Anchorages under seismic actions (cracked concrete) are designed in accordance with: "EOTA Technical Report TR 045, 02/2013"
Anchorage shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings in stand-off installation or with a grout layer under seismic action are not covered in this European technical assessment (ETA).

Installation:

- Use category: dry or wet concrete (not in flooded holes).
- Drilling technique: hammer drilling, diamond coring or hammer drilling with hollow drill bit TE-CD, TE-YD
- Overhead installation is admissible.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

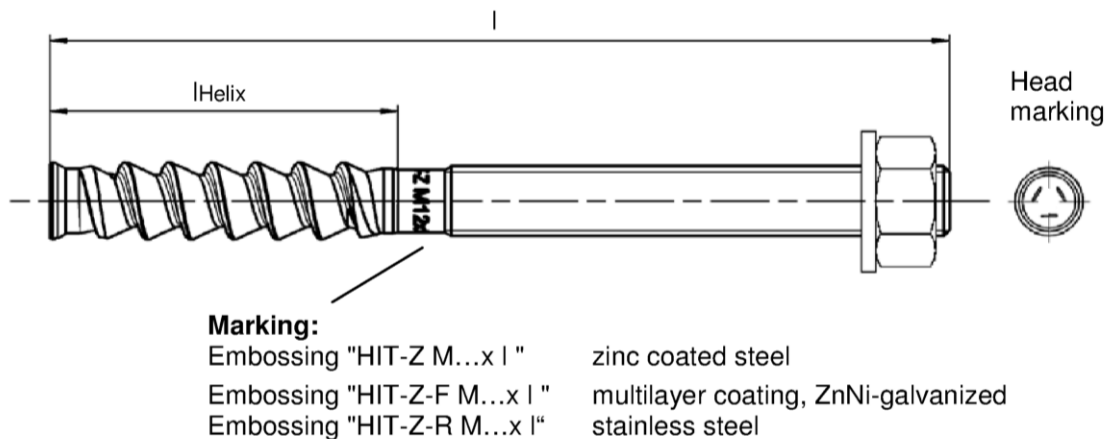
Intended Use
Specifications

Annex B1

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

			M8	M10	M12	M16	M20
Nominal diameter	d	[mm]	8	10	12	16	20
Nominal diameter of drill bit	d ₀	[mm]	10	12	14	18	22
Length of anchor	min l	[mm]	80	95	105	155	215
	max l	[mm]	120	160	196	420	450
Length of helix	l _{Helix}	[mm]	50	60	60	96	100
Nominal anchorage depth	h _{nom,min}	[mm]	60	60	60	96	100
	h _{nom,max}	[mm]	100	120	144	192	220
Drill hole condition ① Minimum thickness of concrete member	h _{min}	[mm]	h _{nom} + 60 mm			h _{nom} + 100 mm	
Drill hole condition ② Minimum thickness of concrete member	h _{min}	[mm]	h _{nom} + 30 mm ≥ 100 mm			h _{nom} + 45 mm	
Maximum depth of drill hole	h ₀	[mm]	h – 30 mm			h – 2 d ₀	
Pre-setting: ¹⁾ Maximum diameter of clearance hole in the fixture	d _f	[mm]	9	12	14	18	22
Through-setting: ¹⁾ Maximum diameter of clearance hole in the fixture	d _f	[mm]	11	14	16	20	24
Maximum fixture thickness	t _{fix}	[mm]	48	87	120	303	326
Maximum fixture thickness with seismic filling set	t _{fix}	[mm]	41	79	111	292	314
Installation torque moment	T _{inst}	[Nm]	10	25	40	80	150

1) for larger clearance hole see "TR 029 section 1.1"



Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use
Installation parameters

Annex B2

Minimum edge distance and spacing

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

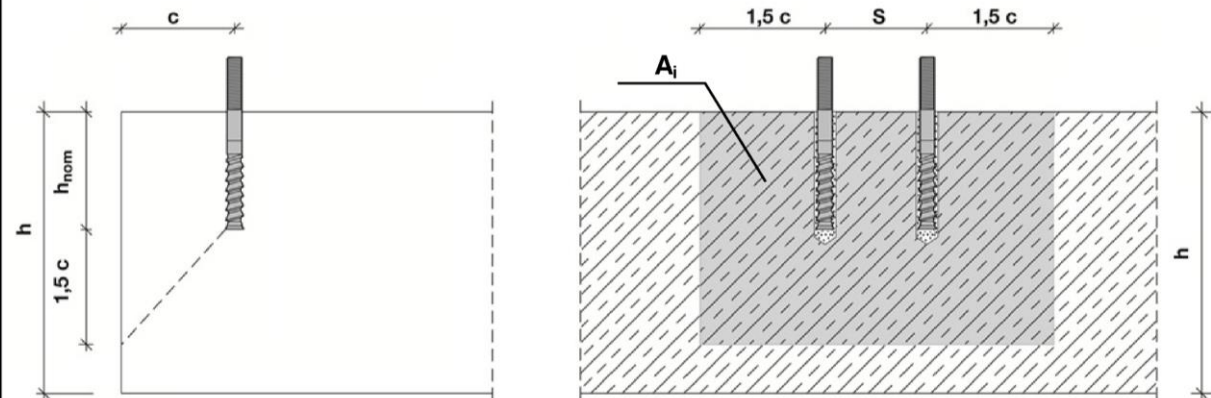
$$A_{i,req} < A_{i,ef}$$

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

HIT-Z, HIT-Z-R, HIT-Z-F			M8	M10	M12	M16	M20
Cracked concrete	$A_{i,req}$	[mm ²]	19200	40800	58800	94700	148000
Non-cracked concrete	$A_{i,req}$	[mm ²]	22200	57400	80800	128000	198000

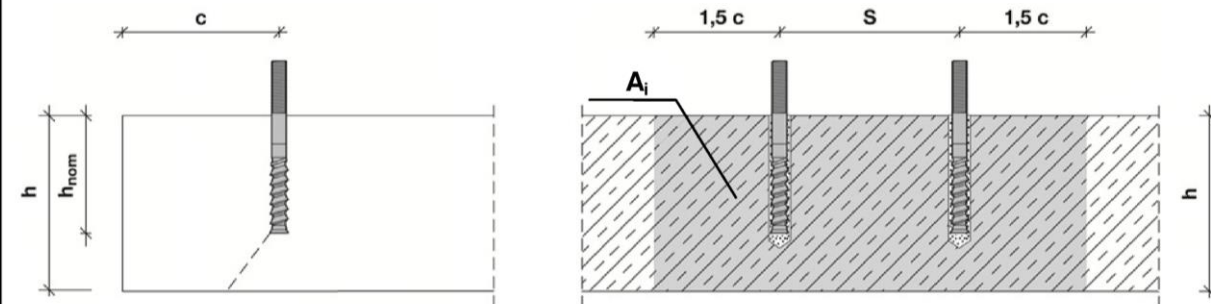
Table B3: Effective area $A_{i,ef}$

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



Single anchor and group of anchors with $s > 3 \cdot c$	[mm ²]	$A_{i,ef} = (6 \cdot c) \cdot (h_{nom} + 1,5 \cdot c)$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm ²]	$A_{i,ef} = (3 \cdot c + s) \cdot (h_{nom} + 1,5 \cdot c)$	with $c \geq 5 \cdot d$ and $s \geq 5 \cdot d$

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



Single anchor and group of anchors with $s > 3 \cdot c$	[mm ²]	$A_{i,ef} = (6 \cdot c) \cdot h$	with $c \geq 5 \cdot d$
Group of anchors with $s \leq 3 \cdot c$	[mm ²]	$A_{i,ef} = (3 \cdot c + s) \cdot h$	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-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use






Installation parameters: member thickness, spacing and edge distances

Annex B3

Table B4: Maximum working time and minimum curing time

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 B5: Parameters of drilling and setting tools

Elements	Drill			Installation
Anchor rod HIT-Z / HIT-Z(-F,-R)	Hammer drilling		Diamond coring	Piston plug
		Hollow drill bit TE-CD, TE-YD		
				
size	d_0 [mm]	d_0 [mm]	d_0 [mm]	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

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use

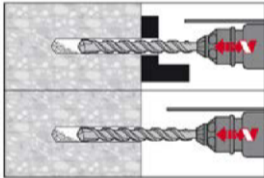
Maximum working time and minimum working time
Cleaning and setting tools

Annex B4

Installation instruction

Hole drilling

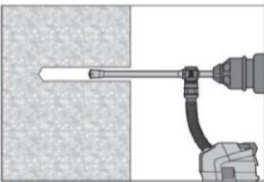
a) Hammer drilling



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.

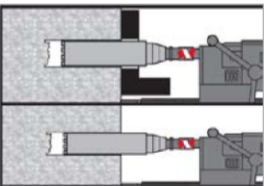
Pre-setting: Drill hole to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
After drilling is complete, proceed to the "injection preparation" step in the installation instruction.

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 - Borehole 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.

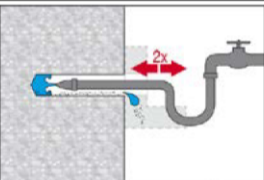
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth.

Pre-setting: Drill hole to the required embedment depth.

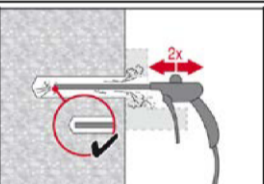
Drill hole cleaning

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.



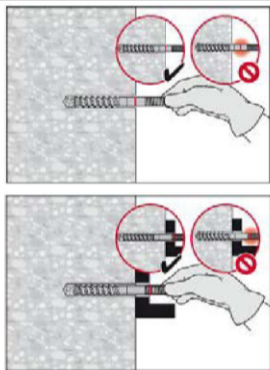
Blow 2 times from the back of the hole (if needed with nozzle extension) with oil-free compressed air (min. 6 bar at 6 m³/h) to evacuate the water.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use
Installation instructions

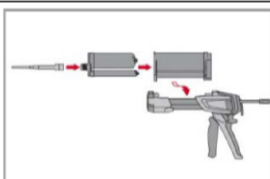
Annex B5

Checking of setting depth

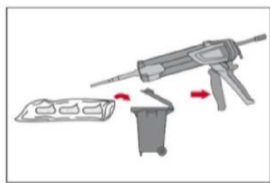


Mark the element and check the setting depth. The element has to fit in the hole until the required embedment depth. If it is not possible to insert the element to the required embedment depth, remove the dust in the drill hole or drill deeper.

Injection preparation



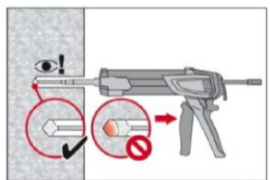
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into the dispenser.



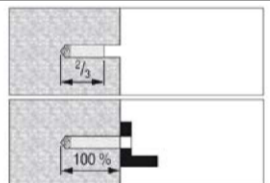
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discarded quantities are:

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.



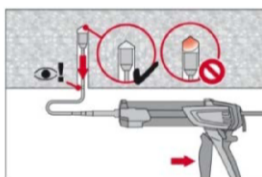
After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use
Installation instructions

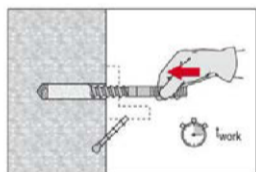
Annex B6

Overhead installation



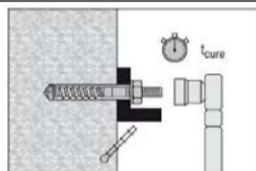
For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B5). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally 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.

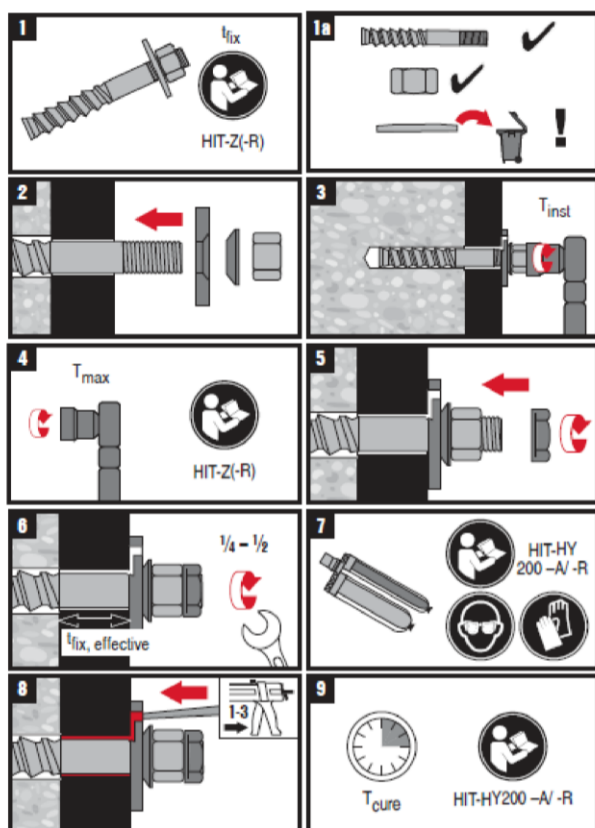
Set element to the required embedment depth before working time t_{work} has elapsed. The working time t_{work} is given in Table B4. After setting the element the annular gap between the anchor and the fixture (through-setting) or



After required curing time t_{cure} (see Table B4) remove excess mortar.

The required installation torque T_{inst} is given in Table B1. The anchor can be loaded.

Installation with Seismic filling set



Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Intended Use
Installation instructions

Annex B7

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

				M8	M10	M12	M16	M20
Installation safety factor		$\gamma_2 = \gamma_{\text{Inst}}$	[-]	1,0				
Steel failure								
Characteristic resistance HIT-Z, HIT-Z-F		$N_{Rk,s}$	[kN]	24	38	55	96	146
Characteristic resistance HIT-Z-R		$N_{Rk,s}$	[kN]	24	38	55	96	146
Combined pull-out and concrete cone failure								
Effective anchorage depth for calculation of $N_{Rk,p}$ (TR 029, 5.2.2.3 respectively CEN/TS 1992-4:2009 part 5, 6.2.2)		$h_{\text{ef}} = l_{\text{Helix}}$	[mm]	50	60	60	96	100
Characteristic bond resistance in non-cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C		$\tau_{Rk,ucr}$	[N/mm ²]	24				
Temperature range II: 80 °C / 50 °C		$\tau_{Rk,ucr}$	[N/mm ²]	22				
Temperature range III: 120 °C / 72 °C		$\tau_{Rk,ucr}$	[N/mm ²]	20				
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5		k_8	[-]	10,1				
Characteristic bond resistance in cracked concrete C20/25								
Temperature range I: 40 °C / 24 °C		$\tau_{Rk,cr}$	[N/mm ²]	22				
Temperature range II: 80 °C / 50 °C		$\tau_{Rk,cr}$	[N/mm ²]	20				
Temperature range III: 120 °C / 72 °C		$\tau_{Rk,cr}$	[N/mm ²]	18				
Factor acc. to section 6.2.2.3 of CEN/TS 1992-4:2009 part 5		k_8	[-]	7,2				
Increasing factor for τ_{Rk} in concrete		Ψ_c	C30/37	1,0				
			C40/50	1,0				
			C50/60	1,0				
Concrete cone failure								
Effective embedment depth for calculation of $N_{Rk,c}$ (TR 029, 5.2.2.4 or CEN/TS 1992-4:2009 part 5, 6.2.3)		h_{ef}	[mm]	h_{nom}				
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5		k_{cr}	[-]	7,2				
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5		k_{ucr}	[-]	10,1				
Edge distance		$c_{\text{cr,N}}$	[mm]	$1,5 \cdot h_{\text{ef}}$				
Spacing		$s_{\text{cr,N}}$	[mm]	$3,0 \cdot h_{\text{ef}}$				

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistance under tension load - static and quasi-static loading
Design according to „EOTA Technical Report TR 029, 09/2010“ or “CEN/TS 1992-4:2009“

Annex C1

Table C1 continued

Splitting failure			
Effective embedment depth for calculation of $N_{Rk,sp}$ (TR 029, 5.2.2.6 respectively CEN/TS 1992-4:2009 part 5, 6.2.4)	h_{ef}	[mm]	h_{nom}
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	k_{cr}	[-]	7,2
Factor according to section 6.2.3 of CEN/TS 1992-4:2009 part 5	k_{ucr}	[-]	10,1
Edge distance $c_{cr,sp}$ [mm] for	$h / h_{nom} \geq 2,35$	$1,5 \cdot h_{nom}$	
	$2,35 > h / h_{nom} > 1,35$	$6,2 \cdot h_{nom} - 2,0 \cdot h$	
	$h / h_{nom} \leq 1,35$	$3,5 \cdot h_{nom}$	
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistance under tension load - static and quasi-static loading
Design according to „EOTA Technical Report TR 029, 09/2010“ or “CEN/TS 1992-4:2009“

Annex C2

Table C2: Characteristic resistance for HIT-Z (-F, -R), under shear load in case of static and quasi static loading

		M8	M10	M12	M16	M20
Steel failure without lever arm						
Factor according to section 6.3.2.1 of CEN/TS 1992-4:2009 part 5	$k_2^{2)}$	1,0				
Characteristic resistance HIT-Z, HIT-Z-F	$V_{Rk,s}$ [kN]	12	19	27	48	73
Characteristic resistance HIT-Z-R	$V_{Rk,s}$ [kN]	14	23	33	57	88
Steel failure with lever arm						
Characteristic resistance HIT-Z, HIT-Z-F	$M_{Rk,s}^0$ [Nm]	24	49	85	203	386
Characteristic resistance HIT-Z-R	$M_{Rk,s}^0$ [Nm]	24	49	85	203	386
Concrete pry-out failure						
Factor acc. to equation (5.7) of TR 029 or acc. to equation (27) of CEN/TS 1992-4:2009 part 5	$k^{1)} = k_3^{2)}$ [-]	2,0				
Concrete edge failure						
Effective length of anchor in shear loading	l_f [mm]	h_{nom}				
Diameter of anchor	$d^{1)} = d_{nom}^{2)}$ [mm]	8	10	12	16	20

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistance under shear load - static and quasi-static loading
Design according to „EOTA Technical Report TR 029, 09/2010“ or “CEN/TS 1992-4:2009“

Annex C3

Table C3: Displacements under tension load for HIT-Z (-F, -R) for static and quasi static loading¹⁾

	M8	M10	M12	M16	M20
Non-cracked concrete					
Temperature range I: 40 °C / 24 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,03	0,03	0,04	0,05	0,07
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,06	0,08	0,10	0,13	0,17
Temperature range I: 80 °C / 50 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,03	0,04	0,04	0,06	0,07
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,07	0,09	0,11	0,15	0,18
Temperature range I: 120 °C / 72 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,03	0,04	0,05	0,06	0,08
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,07	0,10	0,12	0,16	0,20
Cracked concrete					
Temperature range I: 40 °C / 24 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,06	0,07	0,08	0,09	0,10
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,21				
Temperature range I: 80 °C / 50 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,07	0,08	0,08	0,10	0,11
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,23				
Temperature range I: 120 °C / 72 °C					
Displacement δ_{N0} -Factor [mm/(N/mm²)]	0,07	0,08	0,09	0,11	0,12
Displacement $\delta_{N\infty}$ -Factor [mm/(N/mm²)]	0,25				

¹⁾ Calculation of the displacement

$$\delta_{N0} = \delta_{N0\text{-factor}} \cdot \tau; \quad \delta_{N\infty} = \delta_{N\infty\text{-factor}} \cdot \tau; \quad (\tau: \text{action bond strength}).$$

Table C4: Displacements under shear load for HIT-Z (-F, -R) for static and quasi static loading¹⁾

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

¹⁾ Calculation of the displacement

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

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Displacements in case of static and quasi-static loading

Annex C4

Table C5: Characteristic resistance under tension load for HIT-Z (-F, -R) for seismic performance category C1

			M8	M10	M12	M16	M20
Installation safety factor	$\gamma_2 = \gamma_{\text{inst}}$	[-]	1,0				
Steel failure							
Characteristic resistance HIT-Z, HIT-Z-F	$N_{Rk,s,seis}$	[kN]	24	38	55	96	146
Characteristic resistance HIT-Z-R	$N_{Rk,s,seis}$	[kN]	24	38	55	96	146
Combined pull-out and concrete cone failure							
Characteristic bond resistance in cracked concrete C20/25							
Effective anchorage depth for calculation of $N_{Rk,p,seis}$	$h_{ef} = l_{Helix}$	[mm]	50	60	60	96	100
Temperature range I: 40 °C / 24 °C	$\tau_{Rk,seis}$	[N/mm ²]	21				
Temperature range II: 80 °C / 50 °C	$\tau_{Rk,seis}$	[N/mm ²]	19				
Temperature range III: 120 °C / 72 °C	$\tau_{Rk,seis}$	[N/mm ²]	17				

Table C6: Characteristic resistance under shear load for HIT-Z (-F, -R) for seismic performance category C1

	M8	M10	M12	M16	M20
Steel failure					
Characteristic resistance HIT-Z, HIT-Z-F $V_{Rk,s,seis}$ [kN]	7	17	16	28	45
Characteristic resistance HIT-Z-R $V_{Rk,s,seis}$ [kN]	8	19	22	31	48

Table C7: Displacements under tension load for HIT-Z (-F, -R) for seismic performance category C1¹⁾

	M8	M10	M12	M16	M20
Displacement $\delta_{N,seis}$ [mm]	1,2	1,9	1,7	1,3	1,8

¹⁾ Maximum displacement during cycling (seismic event).

Table C8: Displacements under shear load for HIT-Z (-F, -R) for performance category C1¹⁾

	M8	M10	M12	M16	M20
Displacement HIT-Z, HIT-Z-F $\delta_{V,seis}$ [mm]	4,0	5,0	4,9	4,3	5,5
Displacement HIT-Z-R $\delta_{V,seis}$ [mm]	5,0	5,6	5,9	6,0	6,4

¹⁾ Maximum displacement during cycling (seismic event).

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistances and displacements – seismic performance category C1
Design according to „EOTA Technical Report TR 045, Edition February 2013“

Annex C5

Table C9: Characteristic resistance for HIT-Z (-F, -R) under tension load for seismic performance category C2

			M12	M16	M20
Installation safety factor $\gamma_2 = \gamma_{\text{inst}}$ [-]			1,0		
Steel failure					
Characteristic resistance HIT-Z, HIT-Z-F $N_{\text{Rk,s,seis}}$ [kN]			55	96	146
Characteristic resistance HIT-Z-R $N_{\text{Rk,s,seis}}$ [kN]			55	96	146
Combined pull-out and concrete cone failure					
Characteristic bond resistance in cracked concrete C20/25					
Effective anchorage depth for calculation of $N_{\text{Rk,p,seis}}$ $h_{\text{ef}} = l_{\text{Helix}}$ [mm]			60	96	100
Temperature range I: 40 °C / 24 °C	$\tau_{\text{Rk,seis}}$	[N/mm ²]	13	19	20
Temperature range II: 80 °C / 50 °C	$\tau_{\text{Rk,seis}}$	[N/mm ²]	12	17	18
Temperature range III: 120 °C / 72 °C	$\tau_{\text{Rk,seis}}$	[N/mm ²]	10	16	16

*Seismic C2 does not applies for HIT-Z-R.

Table C10: Characteristic resistance under shear load for HIT-Z (-F, -R) for seismic performance category C2

		M12	M16	M20
Steel failure				
Installation without Hilti seismic filling set				
Effective embedment depth	h_{ef} [mm]	$h_{ef} < 96$	$h_{ef} < 125$	$h_{ef} < 150$
Characteristic resistance HIT-Z, HIT-Z-F	$V_{Rk,s,seis}$ [kN]	11	17	35
Characteristic resistance HIT-Z-R	$V_{Rk,s,seis}$ [kN]	16	21	35
Effective embedment depth	h_{ef} [mm]	$h_{ef} \geq 96$	$h_{ef} \geq 125$	$h_{ef} \geq 150$
Characteristic resistance HIT-Z* (-F, -R)	$V_{Rk,s,seis}$ [kN]	21	36	55
Installation with Hilti seismic filling set				
Effective embedment depth	h_{ef} [mm]	$h_{ef} < 96$	$h_{ef} < 125$	$h_{ef} < 150$
Characteristic resistance HIT-Z* (-F, -R)	$V_{Rk,s,seis}$ [kN]	20	34	40
Effective embedment depth	h_{ef} [mm]	$h_{ef} \geq 96$	$h_{ef} \geq 125$	$h_{ef} \geq 150$
Characteristic resistance HIT-Z* (-F, -R)	$V_{Rk,s,seis}$ [kN]	23	41	61

*These values apply only for steel element shorter than HIT-Z M16x280 and HIT-Z M20x300.

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistances and displacements – seismic performance category C2
Design according to „EOTA Technical Report TR 045, 02/2013“

Annex C6

Table C11: Displacements under tension load for HIT-Z (-F, -R) in case of seismic performance category C2

		M12	M16	M20
Displacement DLS	$\delta_{N,seis(DLS)}$ [mm]	1,3	1,9	1,2
Displacement ULS	$\delta_{N,seis(ULS)}$ [mm]	3,2	3,6	2,6

Table C12: Displacements under shear load for HIT-Z (-F, -R) for seismic performance category C2

		M12	M16	M20
Installation without Hilti seismic filling set				
Effective embedment depth	h_{ef} [mm]	$h_{ef} < 96$	$h_{ef} < 125$	$h_{ef} < 150$
Displacement DLS HIT-Z, HIT-Z-F	$\delta_{V,seis(DLS)}$ [mm]	2,8	3,1	4,9
Displacement ULS HIT-Z, HIT-Z-F	$\delta_{V,seis(ULS)}$ [mm]	4,6	6,2	6,8
Displacement DLS HIT-Z-R	$\delta_{V,seis(DLS)}$ [mm]	3,0	3,1	4,9
Displacement ULS HIT-Z-R	$\delta_{V,seis(ULS)}$ [mm]	6,2	6,2	6,8
Effective embedment depth	h_{ef} [mm]	$h_{ef} \geq 96$	$h_{ef} \geq 125$	$h_{ef} \geq 150$
Displacement DLS HIT-Z (-F, -R)	$\delta_{V,seis(DLS)}$ [mm]	3,4	3,6	1,8
Displacement ULS HIT-Z (-F, -R)	$\delta_{V,seis(ULS)}$ [mm]	6,0	5,9	5,8
Installation with Hilti seismic filling set				
Effective embedment depth	h_{ef} [mm]	$h_{ef} < 96$	$h_{ef} < 125$	$h_{ef} < 150$
Displacement DLS HIT-Z (-F, -R)	$\delta_{V,seis(DLS)}$ [mm]	1,4	1,7	1,8
Displacement ULS HIT-Z (-F, -R)	$\delta_{V,seis(ULS)}$ [mm]	4,4	5,1	5,6
Effective embedment depth	h_{ef} [mm]	$h_{ef} \geq 96$	$h_{ef} \geq 125$	$h_{ef} \geq 150$
Displacement DLS HIT-Z (-F, -R)	$\delta_{V,seis(DLS)}$ [mm]	1,4	1,7	4,6
Displacement ULS HIT-Z (-F, -R)	$\delta_{V,seis(ULS)}$ [mm]	5,2	5,1	7,0

Injection system Hilti HIT-HY 200-R with HIT-Z / HIT-Z-F / HIT-Z-R

Performances

Characteristic resistances and displacements – seismic performance category C2
Design according to „EOTA Technical Report TR 045, 02/2013“

Annex C7