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-15/0296 of 13 May 2020

English translation prepared by DIBt - Original version in German language

**General Part**

| | |
|---|---|
| Technical Assessment Body issuing the European Technical Assessment: | Deutsches Institut für Bautechnik |
| Trade name of the construction product | Injection System Hilti HIT-HY 200-A with HIT-Z-D and HIT-Z-R-D |
| Product family to which the construction product belongs | Bonded expansion fastener for use in concrete |
| Manufacturer | Hilti AG Liechtenstein<br>Feldkircherstraße 100<br>9494 Schaan<br>FÜRSTENTUM LIECHTENSTEIN |
| Manufacturing plant | Hilti Corporation |
| This European Technical Assessment contains | 18 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-15/0296 issued on 27 August 2015 |

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## Specific Part

### 1 Technical description of the product

The injection system Hilti HIT-HY 200-A with HIT-Z-D TP M16 or HIT-Z-F / HIT-Z-R-D TP M16 is a bonded expansion fastener consisting of a foil pack with injection mortar Hilti HIT-HY 200-A and an anchor rod. 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 B2, B3, 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 – C5 |

#### 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 on 13 May 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

*beglaubigt:*
Lange

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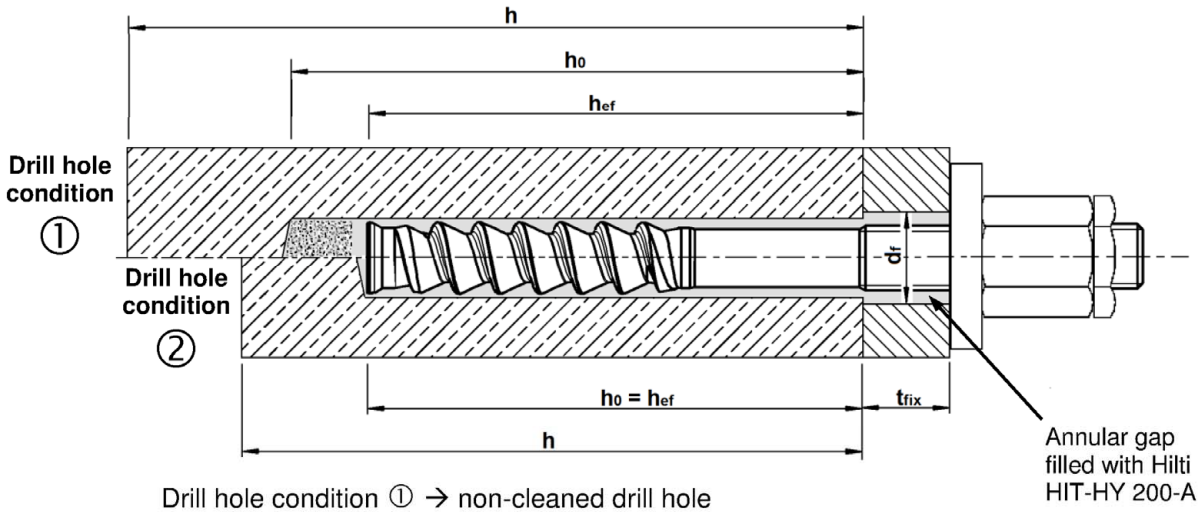
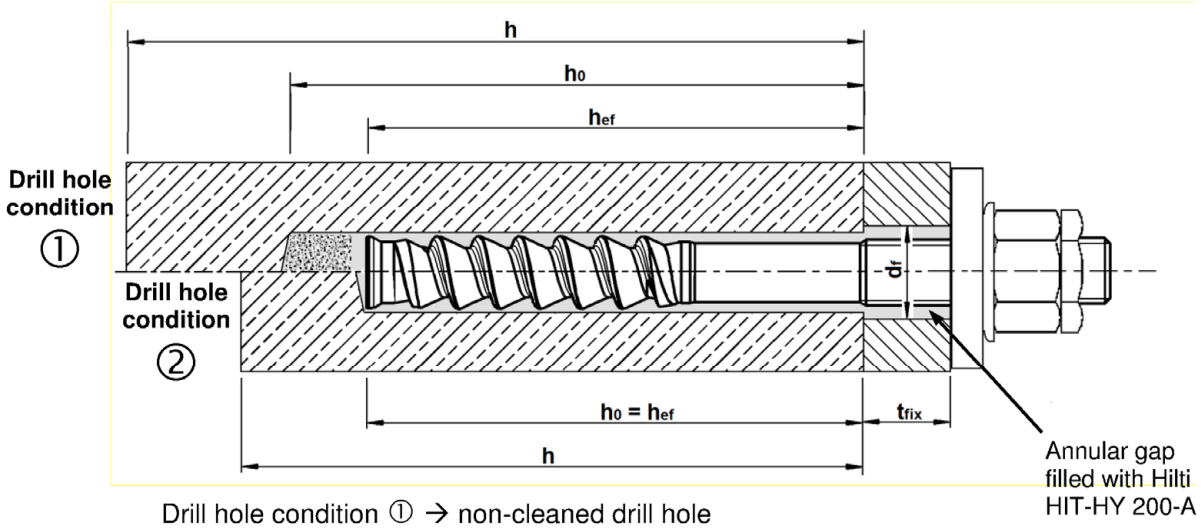
## Installed condition

**Figure A1:**
**HIT-Z-D TP**




Drill hole condition ① → non-cleaned drill hole
Drill hole condition ② → drilling dust is removed

**Figure A2:**
**HIT-Z-R-D TP**




Drill hole condition ① → non-cleaned drill hole
Drill hole condition ② → drilling dust is removed



| Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP | |
|---|---|
| **Product description**<br>Installed condition | **Annex A1** |

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## Product description: Injection mortar and fastener

**Injection mortar Hilti HIT-HY 200-A:** hybrid system with aggregate

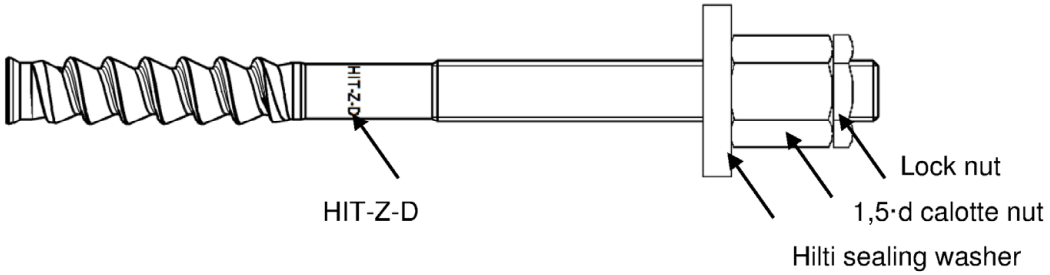
330 ml and 500 ml

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

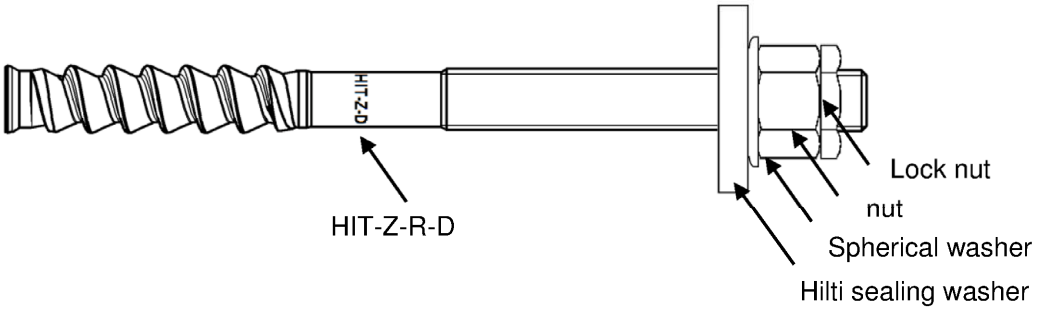

Product name: "Hilti HIT-HY 200-A"

**Static mixer Hilti HIT-RE-M**

**Fastener HIT-Z-D TP M16**




**Fastener HIT-Z-R-D TP M16**






| Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP | Annex A2 |
|---|---|
| **Product description**<br>Injection mortar / Static mixer / Fastener | |

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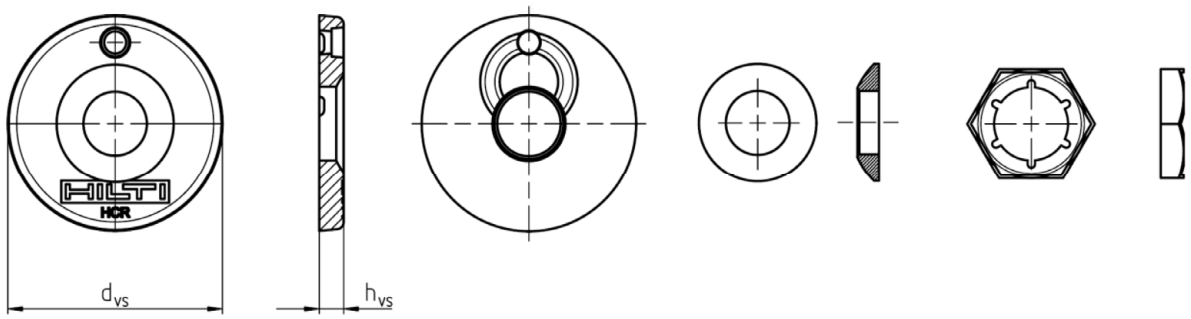
**Hilti Filling Set** to fill the annular gap between fastener and fixture

Sealing washer Spherical washer Lock nut




## Table A1: Geometry of Hilti sealing washer

| Size | | | M16 |
|---|---|---|---|
| Diameter of sealing washer | $d_{vs}$ | [mm] | 52 |
| Thickness of sealing washer | $h_{vs}$ | [mm] | 6 |
| Thickness of Hilti Filling Set | $h_{fS}$ | [mm] | 11 |

## Table A2: Materials

| Designation | Material |
|---|---|
| **Metal parts made of zinc coated steel** | |
| Anchor rod HIT-Z-D TP M16 | $f_{uk}$ = 610 N/mm²; $f_{yk}$ = 490 N/mm²<br>Elongation at fracture ($l_0$=5d) > 8% ductile<br>Electroplated zinc coated ≥ 5 µm |
| Sealing washer | Spherical washer G19 DIN 6319:2001<br>Electroplated zinc coated ≥ 5 µm |
| Calotte nut | Hexagon nut with a height of 1,5 d DIN 6330:2003<br>Electroplated zinc coated ≥ 5 µm |
| Lock nut | Self locking counter nut DIN 7967:1970<br>Electroplated zinc coated ≥ 5 µm |
| **Metal parts made of stainless steel**<br>Corrosion resistance class III according EN 1993-1-4:2006+A1:2015 | |
| Anchor rod HIT-Z-R-D TP M16 | $f_{uk}$ = 610 N/mm²; $f_{yk}$ = 490 N/mm²<br>Elongation at fracture ($l_0$=5d) > 8% ductile<br>Stainless steel 1.4401, 1.4404 EN 10088-1:2014 |
| Sealing washer | Spherical washer G19 DIN 6319:2001<br>Stainless steel A4 EN 10088-1:2014 |
| Spherical washer | Stainless steel 1.4401, 1.4404 EN 10088-1:2014 |
| Hexagon Nut | DIN EN ISO 3506-2:2010, Grade 80,<br>Stainless steel 1.4401, 1.4404 EN 10088-1:2014 |
| Lock nut | Self locking counter nut DIN 7967:1970<br>Stainless steel A4 EN 10088-1:2014 |



**Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP**

**Product description**
Hilti Filling Set, Materials

**Annex A3**

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## Specifications of intended use

**Anchorages subject to:**
- Static and quasi static loading
- Seismic performance category C1 and C2 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 206-1:2010 +A1:2016.
- Cracked and non-cracked 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 corresponding to corrosion resistance class Table A2 Annex A2 (stainless steel)

**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:**
- Use category: dry or wet concrete (not in flooded holes)
- Installation direction: D3: downward and horizontal and upward (e.g. overhead).
- Drilling technique: hammer drilling, hammer drilling with hollow drill bit TE-CD, TE-YD, diamond coring
- 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 with HIT-Z-D TP; HIT-Z-R-D TP | Annex B1 |
|---|---|
| **Intended Use**<br>Specifications | |

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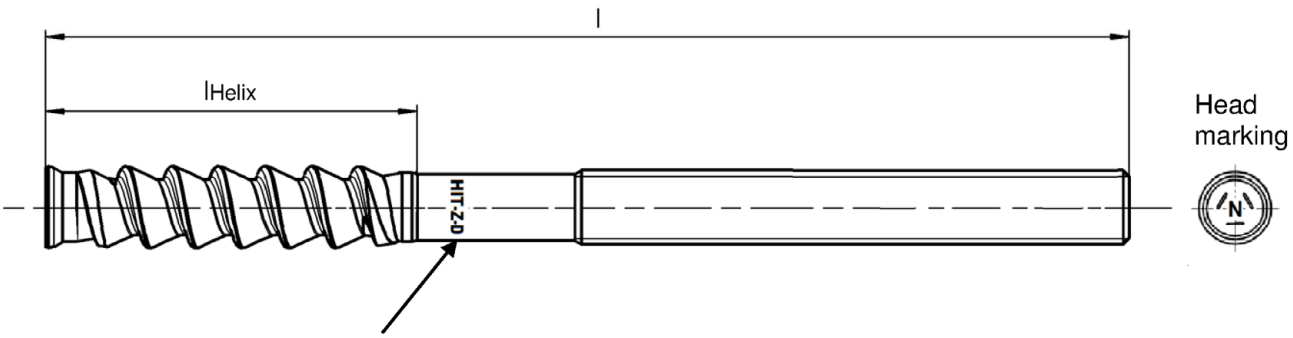
## Table B1: Installation parameters HIT-Z(-R)-D TP

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | | **M16** |
|---|---|---|---|---|
| Nominal diameter | | d | [mm] | 16 |
| Nominal diameter of drill bit | | $d_0$ | [mm] | 18 |
| Length of fastener | | min l | [mm] | 175 |
| | | max l | [mm] | 240 |
| Length of helix | | $l_{Helix}$ | [mm] | 96 |
| Nominal anchorage depth | | $h_{ef}$ | [mm] | 125 |
| Drill hole condition ① Minimum thickness of concrete member | | $h_{min}$ | [mm] | 225 |
| Drill hole condition ② Minimum thickness of concrete member | | $h_{min}$ | [mm] | 160 |
| Maximum depth of drill hole | | $h_0$ | [mm] | $h - 2\ d_0$ |
| Maximum diameter of clearance hole in the fixture | | $d_f$ | [mm] | 20 |
| Maximum fixture thickness | | $t_{fix}$ | [mm] | 80 |
| Installation torque moment | HIT-Z-D TP | $T_{inst}$ | [Nm] | 80 |
| | HIT-Z-D-R TP | $T_{inst}$ | [Nm] | 155 |




**Marking:**
Embossing "HIT-Z-D M 16 x l " zinc coated steel
Embossing "HIT-Z-R-D M 16 x l“ stainless steel
(e.g. HIT-Z-R-D M 16 x 175)



| **Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP** | **Annex B2** |
|---|---|
| **Intended Use**<br>Installation parameters | |

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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 thickness of concrete member the following equation shall be fulfilled:

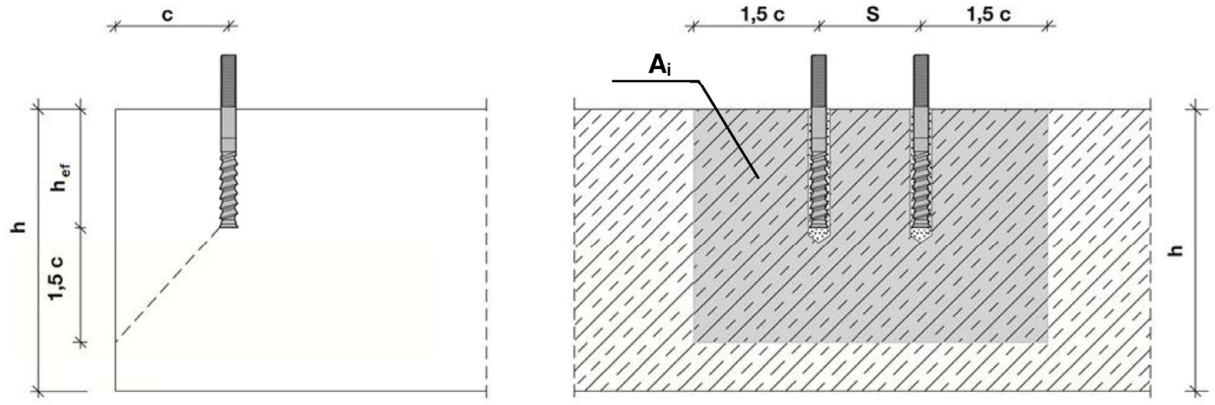
$$A_{i,req} < A_{i,ef}$$

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

| HIT-Z-D TP; HIT-Z-R-D TP | | | M16 |
|---|---|---|---|
| Cracked concrete | $A_{i,req}$ | [mm²] | 94700 |
| Non-cracked concrete | $A_{i,req}$ | [mm²] | 128000 |

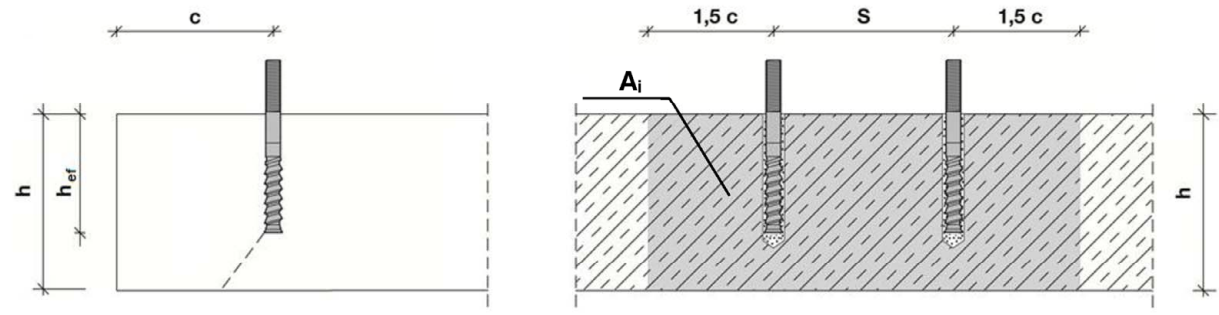
### Table B3: Effective area $A_{i,ef}$

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




| | | | |
|---|---|---|---|
| Single fastener and group of fasteners with $s > 3 \cdot c$ | [mm²] | $A_{i,ef} = (6 \cdot c) \cdot (h_{ef} + 1{,}5 \cdot c)$ | with $c \geq 5 \cdot d$ |
| Group of fasteners with $s \leq 3 \cdot c$ | [mm²] | $A_{i,ef} = (3 \cdot c + s) \cdot (h_{ef} + 1{,}5 \cdot c)$ | 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] | $A_{i,ef} = (6 \cdot c) \cdot h$ | with $c \geq 5 \cdot d$ |
| Group of fasteners with $s \leq 3 \cdot c$ | [mm²] | $A_{i,ef} = (3 \cdot c + s) \cdot h$ | 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 with HIT-Z-D TP; HIT-Z-R-D TP**

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

**Annex B3**

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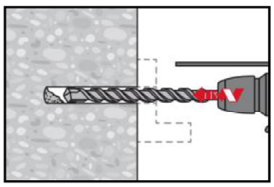
## Table B4: Maximum working time and minimum curing time

| 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 |

## Installation

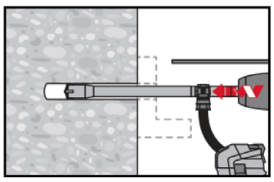
**Hole drilling**

**a) Hammer drilling**



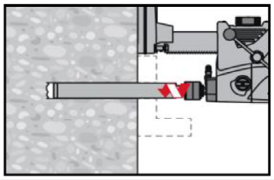
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.
Pre-setting: Drill hole to the required drilling depth with a hammer drill set in rotation-hammer mode using 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**

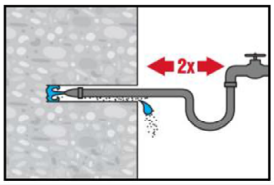


Diamond coring is permissible when suitable diamond core drilling machines and corresponding core bits are used.
Through-setting: Drill hole through the clearance hole in the fixture to the required drilling depth.
Pre-setting: Drill hole to the required embedment depth.

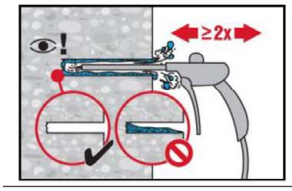
**Drill hole cleaning**

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-A with HIT-Z-D TP; HIT-Z-R-D TP** | **Annex B4** |
|---|---|
| **Intended Use**<br>Maximum working time and minimum curing time<br>Installation instructions | |

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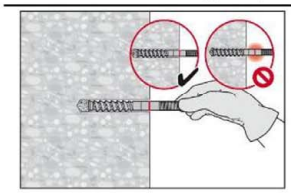
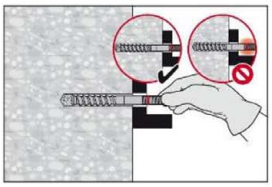
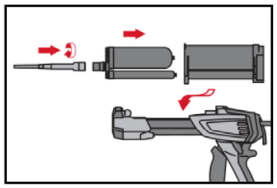
**Check of setting depth**



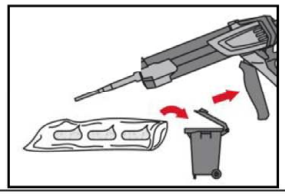


Mark the element and check the setting depth. The element has to fit in the hole until the required embedment depth. If it is not possible to insert the element to the required embedment depth, remove the dust in the drill hole or drill deeper.

**Injection preparation**



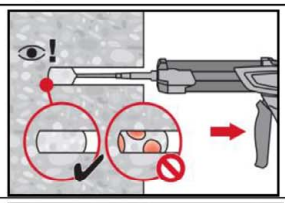
Tightly attach Hilti mixing nozzle HIT-RE-M to foil pack manifold. Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar.
Check foil pack holder for proper function. Insert foil pack into foil pack holder and put holder into dispenser.



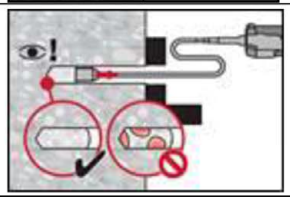
The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discarded quantities are:

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

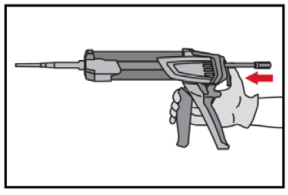
**Inject adhesive from the back of the drill hole without forming air voids**



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
The quantity of mortar should be selected so that the annular gap in the borehole is filled.



Injection is possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ 18. 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. The quantity of mortar should be selected so that the annular gap in the borehole is filled.



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 with HIT-Z-D TP; HIT-Z-R-D TP**

**Intended Use**
Installation instructions

**Annex B5**

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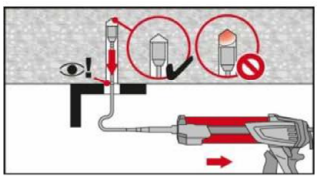
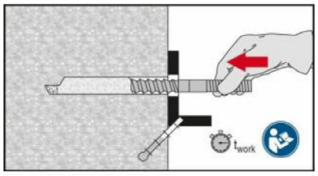
## Overhead installation

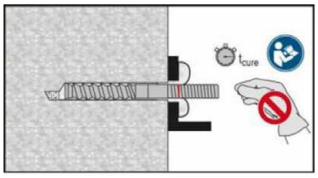


For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug HIT-SZ 18. Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.

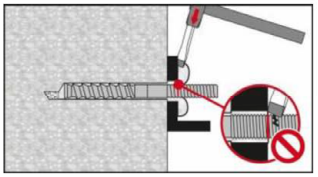
## Setting the element




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.

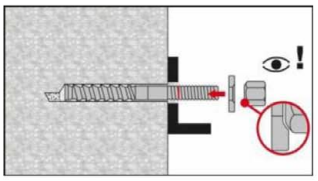



After required curing time $t_{cure}$ (see Table B4) remove excess mortar.

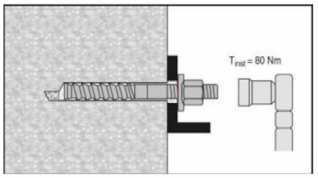


Do not damage thread of HIT-Z(-R)-D TP while removing excess mortar.

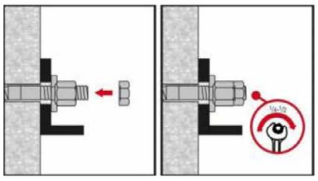
## Final assembly with sealing washer



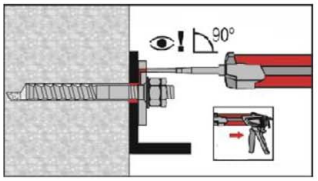
Orient round part of the calotte nut to the sealing washer and install.




The required installation torque moment is given in Table B1.



Apply the lock nut and tighten with a ¼ to ½ turn.




Fill the annular gap between the anchor and fixture completely with Hilti injection mortar HIT-HY 200. The static mixer nozzle must be put orthogonally on the filling hole.
Follow the installation instructions supplied with the HIT-HY 200 foil pack.
After required curing time $t_{cure}$ (see Table B4), the fastener can be loaded.

**Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP**

**Intended Use**
Installation instructions

**Annex B6**

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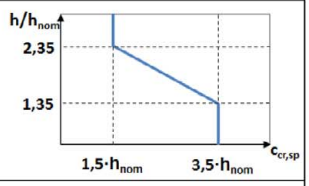
## Table C1: Essential characteristics for HIT-Z(-R)-D TP under tension load in case of static and quasi static loading

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1,0 |
| **Steel failure** | | | |
| HIT-Z-D TP | $N_{Rk,s}$ | [kN] | 96 |
| HIT-Z-R-D TP | $N_{Rk,s}$ | [kN] | 96 |
| **Pull-out failure** | | | |
| in uncracked concrete | | | |
| Temperature range I: 40 °C / 24 °C | $N_{Rk,p,ucr}$ | [kN] | 115 |
| Temperature range II: 80 °C / 50 °C | $N_{Rk,p,ucr}$ | [kN] | 105 |
| Temperature range III: 120 °C / 72 °C | $N_{Rk,p,ucr}$ | [kN] | 95 |
| in cracked concrete | | | |
| Temperature range I: 40 °C / 24 °C | $N_{Rk,p,cr}$ | [kN] | 105 |
| Temperature range II: 80 °C / 50 °C | $N_{Rk,p,cr}$ | [kN] | 95 |
| Temperature range III: 120 °C / 72 °C | $N_{Rk,p,cr}$ | [kN] | 85 |
| **Concrete cone failure** | | | |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 96 |
| | $h_{ef,max}$ | [mm] | 192 |
| Factor for uncracked concrete | $k_{ucr,N}$ | [-] | 11,0 |
| Factor for cracked concrete | $k_{cr,N}$ | [-] | 7,7 |
| Edge distance | $c_{cr,N}$ | [mm] | $1,5 \cdot h_{ef}$ |
| Spacing | $s_{cr,N}$ | [mm] | $3,0 \cdot h_{ef}$ |
| **Splitting failure** | | | |
| Edge distance $c_{cr,sp}$ [mm] for | $h / h_{ef} \geq 2,35$ | | $1,5 \cdot h_{ef}$ |
| | $2,35 > h / h_{ef} > 1,35$ | | $6,2 \cdot h_{ef} - 2,0 \cdot h$ |
| | $h / h_{ef} \leq 1,35$ | | $3,5 \cdot h_{ef}$ |
| Spacing | $s_{cr,sp}$ | [mm] | $2 \cdot c_{cr,sp}$ |






**Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP**

**Performances**
Essential characteristics under tension loads in case of static and quasi-static loading

**Annex C1**

Deutsches Institut für Bautechnik DIBt

## Table C2: Essential characteristics for HIT-Z(-R)-D TP under shear load in case of static and quasi static loading

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1,0 |
| **Steel failure without lever arm** | | | |
| HIT-Z-D TP | $V^0_{Rk,s}$ | [kN] | 48 |
| HIT-Z-R-D TP | $V^0_{Rk,s}$ | [kN] | 57 |
| Ductility factor | $k_7$ | | 1,0 |
| **Steel failure with lever arm** | | | |
| HIT-Z-D TP | $M^0_{Rk,s}$ | [Nm] | 203 |
| HIT-Z-R-D TP | $M^0_{Rk,s}$ | [Nm] | 203 |
| **Concrete pry-out failure** | | | |
| Pry-out factor | $k_8$ | [-] | 2,0 |
| **Concrete edge failure** | | | |
| Effective length of fastener in shear loading | $l_f$ | [mm] | $h_{ef}$ |
| Diameter of fastener | d | [mm] | 16 |

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## Table C3: Displacements under tension load [1] for HIT-Z(-R)-D TP in case of static and quasi static loading

| HIT-Z-D TP; HIT-Z-R-D TP | | | M16 | |
|---|---|---|---|---|
| **Temperature range I : 40°C / 24°C** | | | **Non-cracked concrete** | **Cracked concrete** |
| Displacement | $\delta_{N0}$ – factor | [mm/kN] | 0,05 | 0,09 |
| | $\delta_{N\infty}$ – factor | [mm/kN] | 0,13 | 0,21 |
| **Temperature range II : 80°C / 50°C** | | | | |
| Displacement | $\delta_{N0}$ – factor | [mm/kN] | 0,06 | 0,10 |
| | $\delta_{N\infty}$ – factor | [mm/kN] | 0,15 | 0,23 |
| **Temperature range III : 120°C / 72°C** | | | | |
| Displacement | $\delta_{N0}$ – factor | [mm/kN] | 0,06 | 0,11 |
| | $\delta_{N\infty}$ – factor | [mm/kN] | 0,16 | 0,25 |

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}$ – factor · N
$\delta_{N\infty} = \delta_{N\infty}$ – factor · N (N: action tension load)

## Table C4: Displacements under shear load [1] for HIT-Z(-R)-D TP in case of static and quasi static loading

| HIT-Z-D TP; HIT-Z-R-D TP | | | M16 |
|---|---|---|---|
| Displacement | $\delta_{V0}$ – factor | [mm/kN] | 0,04 |
| | $\delta_{V\infty}$ – factor | [mm/kN] | 0,06 |

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}$ – factor · V
$\delta_{V\infty} = \delta_{V\infty}$ – factor · V (V: action shear load)

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## Table C5: Essential characteristics under tension load for HIT-Z(-R)-D TP in case of seismic performance category C1

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1,0 |
| **Steel failure** | | | |
| HIT-Z-D TP | $N_{Rk,s,C1}$ | [kN] | 96 |
| HIT-Z-R-D TP | $N_{Rk,s,C1}$ | [kN] | 96 |
| **Pullout failure** | | | |
| in cracked concrete C20/25 | | | |
| Temperature range I: 40 °C / 24 °C | $N_{Rk,p,C1}$ | [kN] | 100 |
| Temperature range II: 80 °C / 50 °C | $N_{Rk,p,C1}$ | [kN] | 90 |
| Temperature range III: 120 °C / 72 °C | $N_{Rk,p,C1}$ | [kN] | 80 |

## Table C6: Characteristic resistance under shear load for HIT-Z(-R)-D TP in case of seismic performance category C1

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| **Steel failure without lever arm** | | | |
| HIT-Z-D TP | $V_{Rk,s,C1}$ | [kN] | 28 |
| HIT-Z-R-D TP | $V_{Rk,s,C1}$ | [kN] | 31 |

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

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Installation safety factor | $\gamma_{inst}$ | [-] | 1,0 |
| **Steel failure** | | | |
| HIT-Z-D TP | $N_{Rk,s,C2}$ | [kN] | 96 |
| HIT-Z-R-D TP | $N_{Rk,s,C2}$ | [kN] | 96 |
| **Pullout failure** | | | |
| in cracked concrete C20/25 | | | |
| Temperature range I: 40 °C/24 °C | $N_{Rk,p,C2}$ | [kN] | 70 |
| Temperature range II: 80 °C/50 °C | $N_{Rk,p,C2}$ | [kN] | 60 |
| Temperature range III: 120 °C/72 °C | $N_{Rk,p,C2}$ | [kN] | 50 |

## Table C8: Essential characteristics for HIT-Z(-R)-D TP shear tension load for seismic performance category C2

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| **Steel failure** | | | |
| Characteristic resistance HIT-Z-D TP | $V_{Rk,s,C2}$ | [kN] | 41 |
| Characteristic resistance HIT-Z-R-D TP | $V_{Rk,s,C2}$ | [kN] | 41 |

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

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Displacement DLS | $\delta_{N,C2(DLS)}$ | [mm] | 1,9 |
| Displacement ULS | $\delta_{N,C2(ULS)}$ | [mm] | 3,6 |

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

| **HIT-Z-D TP; HIT-Z-R-D TP** | | | **M16** |
|---|---|---|---|
| Displacement DLS HIT-Z-D TP | $\delta_{V,C2DLS)}$ | [mm] | 3,1 |
| Displacement ULS HIT-Z -D TP | $\delta_{V,C2(ULS)}$ | [mm] | 6,2 |
| Displacement DLS HIT-Z-R-D TP | $\delta_{V,C2(DLS)}$ | [mm] | 3,1 |
| Displacement ULS HIT-Z-R-D TP | $\delta_{V,C2(ULS)}$ | [mm] | 6,2 |



**Injection System Hilti HIT-HY 200-A with HIT-Z-D TP; HIT-Z-R-D TP**

**Performances**
Essential characteristics and displacements for seismic performance category C2

**Annex C5**