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# European Technical Assessment

# ETA-20/0125 du 23/03/2020

*English translation prepared by CSTB - Original version in French language*

**General Part**

| | |
|---|---|
| Nom commercial:<br>*Trade name:* | **Injection system Hilti HIT-RE 500 V3 for rebar connection** |
| Famille de produit:<br>*Product family:* | Scellement d'armatures rapportées, diamètres 8 à 40mm, avec Système d'injection Hilti HIT-RE 500 V3 pour une durée d'utilisation de 100 ans.<br>**Post installed rebar connections diameter 8 to 40 mm made with Hilti HIT-RE 500 V3 injection mortar for a service life of 100 years.** |
| Titulaire:<br>*Manufacturer:* | Hilti Corporation<br>Feldkircherstrasse 100<br>FL-9494 Schaan<br>Principality of Liechtenstein |
| Usine de fabrication:<br>*Manufacturing plants:* | Hilti plants |
| Cette evaluation contient:<br>*This Assessment contains:* | 30 pages incluant 27 pages d'annexes qui font partie intégrante de cette évaluation<br>30 *pages including 27 pages of annexes which form an integral part of this assessment* |
| Base de l'ETE<br>*Basis of ETA:* | DEE 330087-00-0601-v01<br>*EAD 330087-00-0601-v01* |
| Cette évaluation remplace:<br>*This Assessment replaces:* | - |

## Specific Part

## 1 Technical description of the product

The Hilti HIT-RE 500 V3 is used for the connection, by anchoring or overlap joint, of reinforcing bars (rebars) in existing structures made of ordinary non-carbonated concrete C12/15 to C50/60. The design of the post-installed rebar connections is done in accordance with EN 1992-1-1 and EN 1992-1-2 under static loading.

Covered are rebar anchoring systems consisting of Hilti HIT-RE 500 V3 bonding material and the Hilti tension anchor HZA sizes M12 to M27 or HZA-R sizes M12 to M24 or an embedded straight deformed reinforcing bar diameter, d, from 8 to 40 mm with properties according to Annex C of EN 1992-1-1:2004 and EN 10080:2005. The classes B and C of the rebar are recommended. The illustration and the description of the product are given in Annexes A.

## 2 Specification of the intended use

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annexes B.

The provisions made in this European technical assessment are based on an assumed working life of the anchor of 100 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

### 3.1 Mechanical resistance and stability (BWR 1)

| Essential characteristic | Performance |
|---|---|
| Characteristic resistance under static and quasi-static loading | See Annex C1 and C2 |

### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Anchorages satisfy requirements for Class A1 |
| Resistance to fire | See Annex C3 |

### 3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European technical approval, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions).

### 3.4 Safety in use (BWR 4)

For Basic requirement Safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

### 3.5 Protection against noise (BWR 5)

Not relevant.

### 3.6 Energy economy and heat retention (BWR 6)

Not relevant.

### 3.7 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

### 3.8 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

## 4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 96/582/EC of the European Commission[1], as amended, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table apply.

| Product | Intended use | Level or class | System |
|---|---|---|---|
| Metal anchors for use in concrete | For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units | — | 1 |

## 5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

**The original French version is signed by**

Anca Cronopol
Head of the division,

1 Official Journal of the European Communities L 254 of 08.10.1996

## Installed condition

**Figure A1:**

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

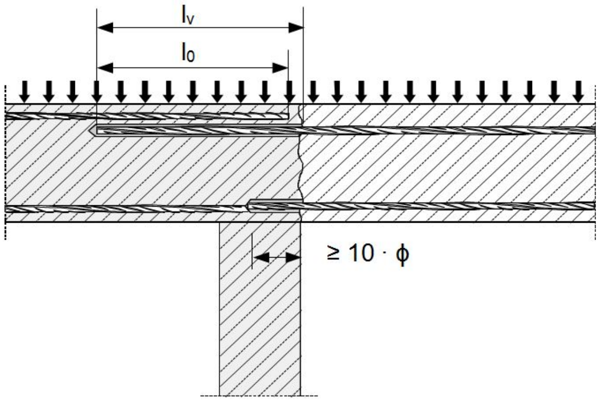



**Figure A2:**

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

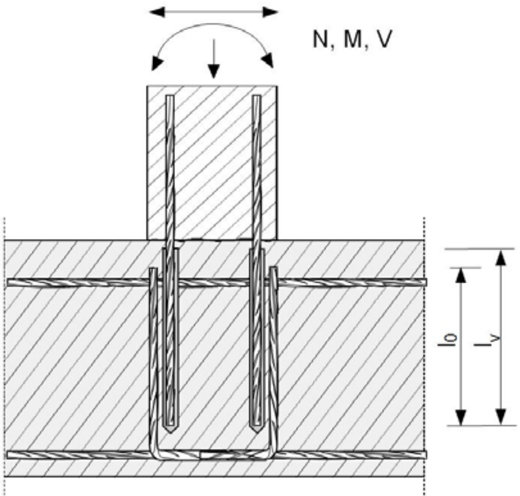
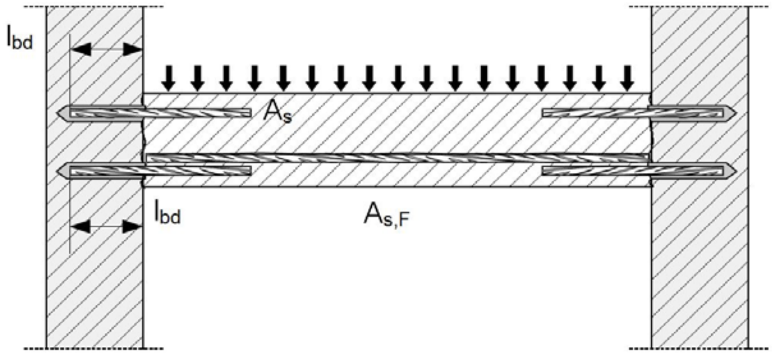



**Figure A3:**

**End anchoring of slabs or beams**




| Injection system Hilti HIT-RE 500 V3 | Annex A1 |
|---|---|
| **Product description**<br>Installed condition: application examples of post-installed rebars | |

**Figure A4:**
**Rebar connection for components stressed primarily in compression**

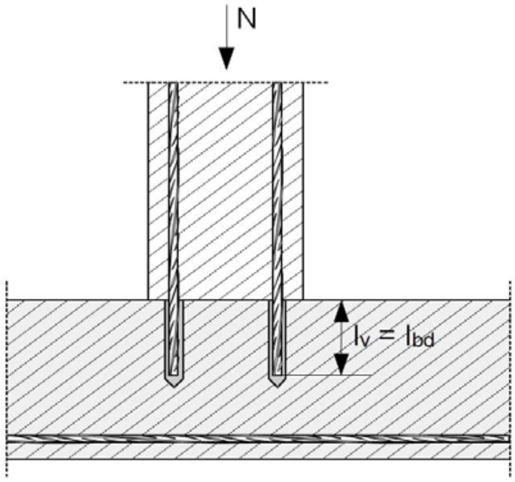
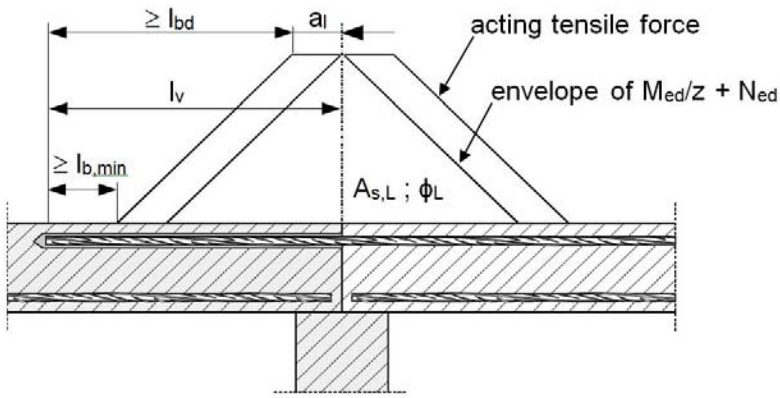



**Figure A5:**
**Anchoring of reinforcement to cover the enveloped line of acting tensile force in the bending member**




**Note to Figure A1 to Figure A5:**

- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1:2004 + AC:2010 shall be present.
- The shear transfer between existing and new concrete shall be designed according to EN 1992-1-1:2004 + AC:2010.
- Preparing of joints according to Annex B2.

The reference to EN 1992-1-1:2004 + AC:2010 is cited in the following as EN 1992-1-1 only.

**Figure A6:**
**Overlap joint of a column stressed in bending to a foundation**

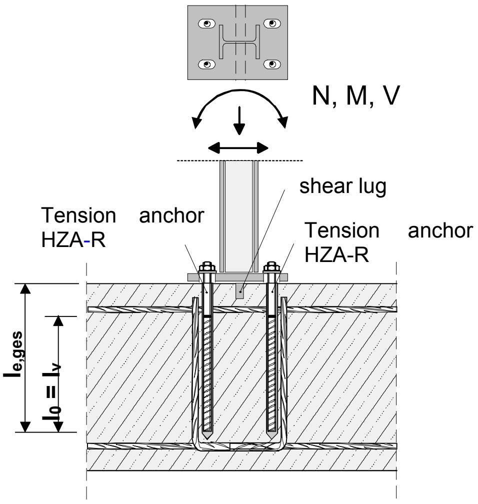



**Figure A7:**
**Overlap joint for the anchorage of barrier posts**

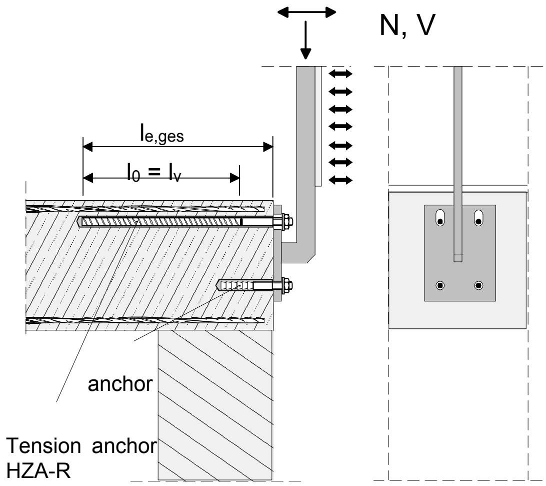
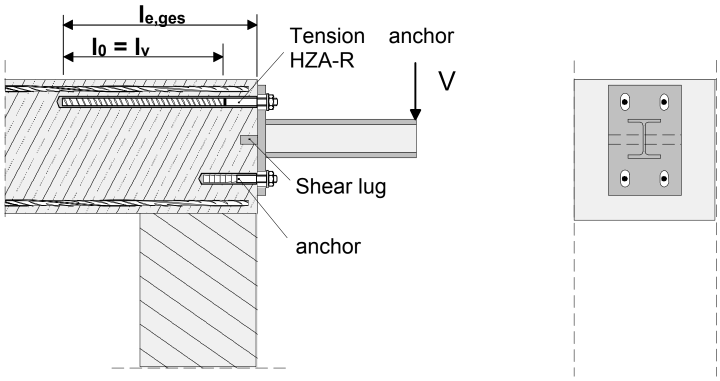


**Figure A8:**
**Overlap joint for the anchorage of cantilever members**




- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.

## Product description: Injection mortar and steel elements

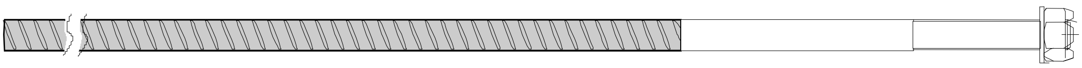
**Injection mortar Hilti HIT-RE 500 V3:** epoxy system with aggregate
330 ml, 500 ml and 1400 ml

Marking:
HILTI HIT
Product name
Production time and line
Expiry date mm/yyyy


Product name: “Hilti HIT-RE 500 V3”

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

**Steel elements**



**Hilti Tension Anchor HZA: M12 to M27 and HZA-R: M12 to M24**

**Reinforcing bar (rebar): ϕ 8 to ϕ 40**

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

| | |
|---|---|
| **Injection system Hilti HIT-RE 500 V3** | **Annex A5** |
| **Product description**<br>Injection mortar / Static mixer / Steel elements.<br>Materials | |

## Table A1: Materials

| Designation | Material |
|---|---|
| **Reinforcing bars (rebars)** | |
| Rebar<br>EN 1992-1-1 | Bars and de-coiled rods class B or C<br>with $f_{yk}$ and k according to NDP or NCL of EN 1992-1-1<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |
| **Metal parts made of zinc coated steel** | |
| Hilti tension anchor HZA | Round steel with threaded part: electroplated zinc coated ≥ 5 µm<br>Rebar: Bars class B according to NDP or NCL of EN 1992-1-1 |
| Washer | Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm |
| Nut | Strength class of nut adapted to strength class of threaded rod.<br>Electroplated zinc coated ≥ 5 µm, hot dip galvanized ≥ 45 µm |
| **Metal parts made of stainless steel** | |
| Hilti tension anchor HZA-R | Round steel with threaded part:<br>Stainless steel 1.4404, 1.4362, 1.4571 EN 10088-1:2014<br>Rebar: Bars class B according to NDP or NCL of EN 1992-1-1 |
| Washer | Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014 |
| Nut | Strength class of nut adapted to strength class of threaded rod.<br>Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1:2014 |

## Specifications of intended use

**Anchorages subject to:**

- Static and quasi static loading: rebar size 8 to 40 mm, HZA M12 to M27 and HZA-R M12 to M24
- Fire exposure

**Base material:**

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013.
- Strength classes C12/15 to C50/60 according to EN 206:2013.
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206:2013.
- Non-carbonated concrete.

  Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of $\phi$ + 60 mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

**Temperature in the base material:**

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

**Design:**

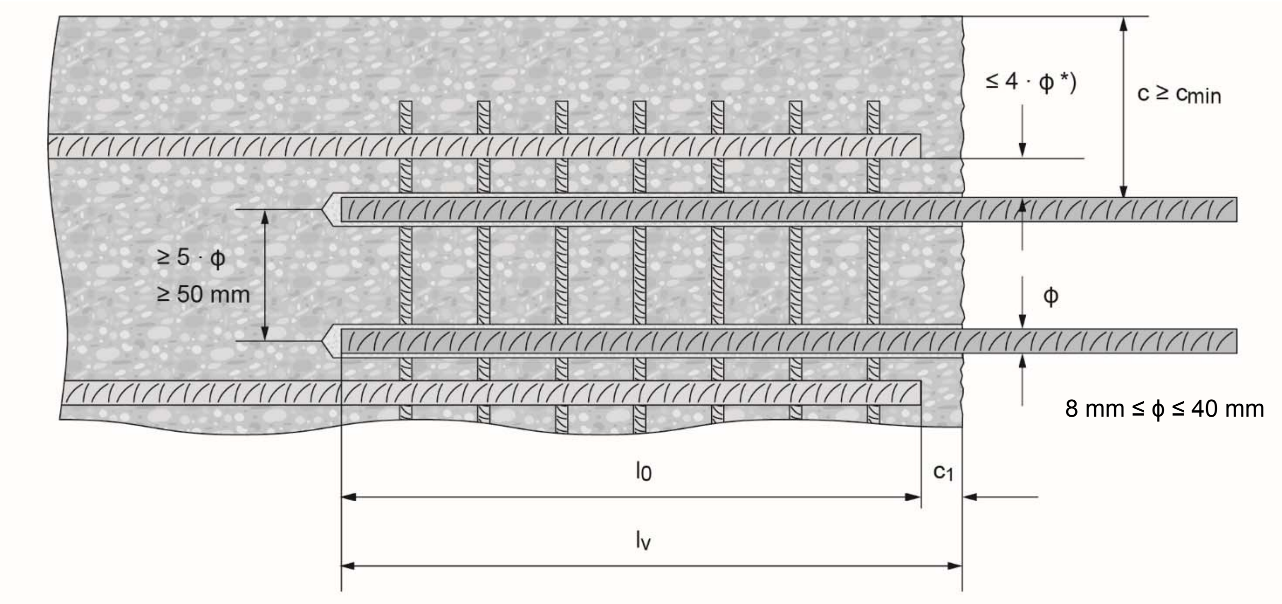
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design under static or quasi-static loading in accordance with EN 1992-1-1. The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

**Installation:**

- Use category: dry or wet concrete (not in flooded holes).
- Drilling technique:
  - hammer drilling (HD),
  - hammer drilling with Hilti hollow drill bit TE-CD, TE-YD (HDB),
  - compressed air drilling (CA)
  - diamond coring, wet (DD),
  - diamond coring, dry (PCC),
  - diamond coring with roughening with Hilti roughening tool TE-YRT (RT).
- Overhead installation is admissible.
- Rebar installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

## Figure B1: General construction rules for post-installed rebars

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

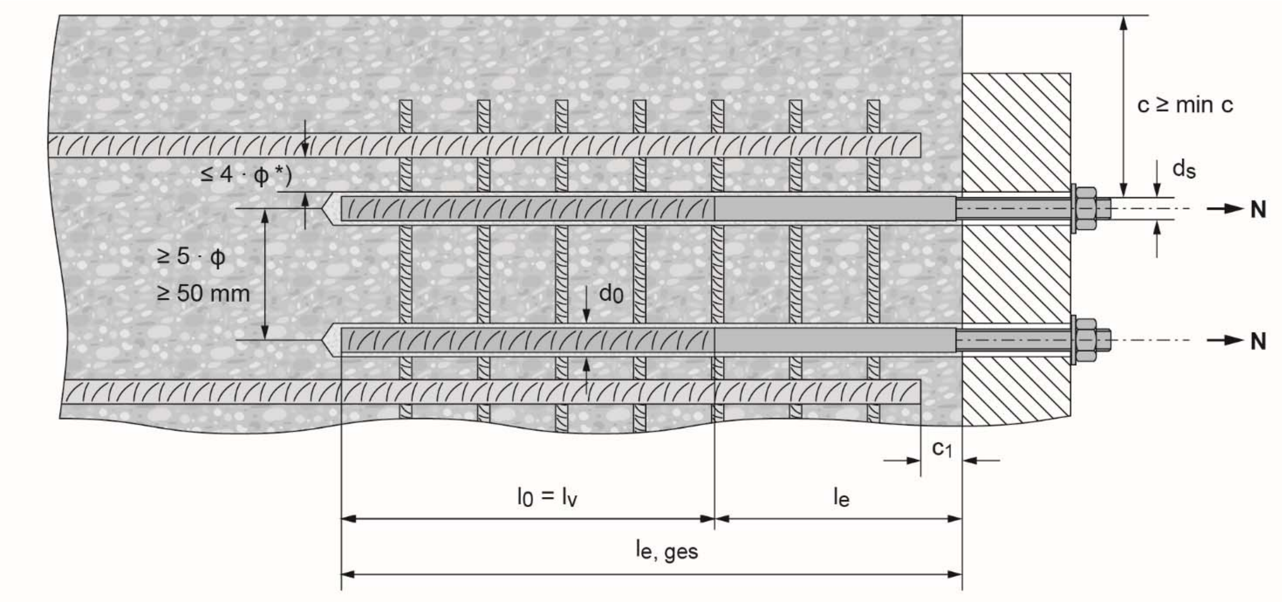



*) If the clear distance between lapped bars exceeds 4 · ϕ, then the lap length shall be increased by the difference between the clear bar distance and 4 · ϕ.

c concrete cover of post-installed rebar
$c_1$ concrete cover at end-face of existing rebar
$c_{min}$ minimum concrete cover according to Table B3 and to EN 1992-1-1
$\phi$ diameter of reinforcement bar
$l_0$ lap length, according to EN 1992-1-1 for static loading
$l_v$ effective embedment depth $\geq l_0 + c_1$
$d_0$ nominal drill bit diameter

## Figure B2: General construction rules for Hilti tension anchor HZA / HZA-R

- Hilti tension anchor HZA / HZA-R may be designed for tension forces only.
- The tension forces must be transferred via an overlap joint to the reinforcement in the existing structure.
- The length of the bonded-in smooth shaft may not be accounted as anchorage.
- The transfer of shear forces shall be ensured by appropriate additional measures, e.g. by shear lugs or by anchors with a European technical assessment (ETA).
- In the anchor plate the holes for the Hilti tension anchor shall be executed as elongated holes with the axis in the direction of the shear force.




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

c concrete cover of Hilti tension anchor HZA / HZA-R
$c_1$ concrete cover at end-face of existing rebar
$c_{min}$ minimum concrete cover according to Table B3 and to EN 1992-1-1
ϕ diameter of reinforcement bar
$l_0$ lap length, according to EN 1992-1-1
$l_v$ effective embedment depth,
$l_e$ length of the smooth shaft or the bonded-in threaded part
$l_{e,ges}$ overall embedment depth
$d_0$ nominal drill bit diameter

## Table B1: Hilti tension anchor HZA-R, dimensions

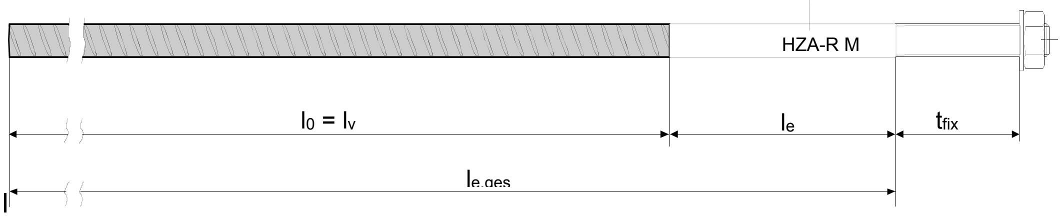
| **Hilti tension anchor HZA-R** | | | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|
| Rebar diameter | $\phi$ | [mm] | 12 | 16 | 20 | 25 |
| Nominal embedment depth and drill hole depth | $l_{e,ges}$ | [mm] | 170 to 800 | 180 to 1300 | 190 to 1300 | 200 to 1300 |
| Effective embedment depth ($l_v = l_{e,ges} - l_e$) | $l_v$ | [mm] | $l_{e,ges} - 100$ | | | |
| Length of smooth shaft | $l_e$ | [mm] | 100 | | | |
| Nominal diameter of drill bit | $d_0$ | [mm] | 16 | 20 | 25 | 32 |
| Maximum diameter of clearance hole in the fixture | $d_f$ | [mm] | 14 | 18 | 22 | 26 |
| Maximum torque moment | $T_{max}$ | [Nm] | 40 | 80 | 150 | 200 |

## Table B2: Hilti tension anchor HZA, dimensions

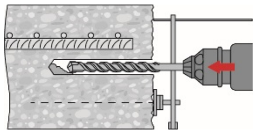
| **Hilti tension anchor HZA** | | | **M12** | **M16** | **M20** | **M24** | **M27** |
|---|---|---|---|---|---|---|---|
| Rebar diameter | $\phi$ | [mm] | 12 | 16 | 20 | 25 | 28 |
| Nominal embedment depth and drill hole depth | $l_{e,ges}$ | [mm] | 90 to 800 | 100 to 1300 | 110 to 1300 | 120 to 1300 | 140 to 1300 |
| Effective embedment depth ($l_v = l_{e,ges} - l_e$) | $l_v$ | [mm] | $l_{e,ges} - 20$ | | | | |
| Length of smooth shaft | $l_e$ | [mm] | 20 | | | | |
| Nominal diameter of drill bit | $d_0$ | [mm] | 16 | 20 | 25 | 32 | 35 |
| Maximum diameter of clearance hole in the fixture | $d_f$ | [mm] | 14 | 18 | 22 | 26 | 30 |
| Maximum torque moment | $T_{max}$ | [Nm] | 40 | 80 | 150 | 200 | 270 |

### Hilti Tension Anchor HZA / HZA-R

**Marking:**
embossing "HZA-R" M .. / $t_{fix}$



## Table B3: Minimum concrete cover $c_{min}$[1)] of the post-installed rebar or tension anchor HZA-(R) depending on drilling method and drilling tolerance

| Drilling method | Bar diameter [mm] | Minimum concrete cover $c_{min}$[1)] [mm] | | |
|---|---|---|---|---|
| | | Without drilling aid | With drilling aid |  |
| Hammer drilling (HD) and hammer drilling with Hilti hollow drill bit TE-CD, TE-YD (HDB) | $\phi < 25$ | $30 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$ | $30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| | $\phi \geq 25$ | $40 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$ | $40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| Compressed air drilling (CA) | $\phi < 25$ | $50 + 0{,}08 \cdot l_v$ | $50 + 0{,}02 \cdot l_v$ | |
| | $\phi \geq 25$ | $60 + 0{,}08 \cdot l_v \geq 2 \cdot \phi$ | $60 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| Diamond coring wet and dry (DD) and (PCC) | $\phi < 25$ | Drill stand works like a drilling aid | $30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| | $\phi \geq 25$ | | $40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| Diamond coring with roughening with Hilti Roughening tool TE-YRT (RT) | $\phi < 25$ | $30 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$ | $30 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |
| | $\phi \geq 25$ | $40 + 0{,}06 \cdot l_v \geq 2 \cdot \phi$ | $40 + 0{,}02 \cdot l_v \geq 2 \cdot \phi$ | |

[1)] See Annexes B2 and B3, Figures B1 and B2.
Comments: The minimum concrete cover acc. EN 1992-1-1.

## Table B4: Maximum embedment depth $l_{v,max}$ depending on bar diameter and dispenser

| Elements | | Dispensers | | |
|---|---|---|---|---|
| Rebar | Hilti Tension Anchor | HDM 330, HDM 500 | HDE 500 | HIT-P8000D |
| Size | Size | $l_{v,max}$ [mm] | $l_{v,max}$ [mm] | $l_{v,max}$ [mm] |
| ϕ 8 | - | 1000 | 1000 | - |
| ϕ 10 | - | | 1000 | - |
| ϕ 12 | HZA(-R) M12 | | 1200 | 1200 |
| ϕ 14 | - | | 1400 | 1400 |
| ϕ 16 | HZA(-R) M16 | | 1600 | 1600 |
| ϕ 18 | - | 700 | 1800 | 1800 |
| ϕ 20 | HZA(-R) M20 | 600 | 2000 | 2000 |
| ϕ 22 | - | 500 | 1800 | 2200 |
| ϕ 24 | - | 300 | 1300 | 2400 |
| ϕ 25 | HZA(-R) M24 | 300 | 1500 | 2500 |
| ϕ 26 | - | 300 | 1000 | 2600 |
| ϕ 28 | HZA M27 | 300 | 1000 | 2800 |
| ϕ 30 | - | - | 1000 | 3000 |
| ϕ 32 | - | | 700 | 3200 |
| ϕ 34 | - | | 600 | |
| ϕ 36 | - | | 600 | |
| ϕ 40 | - | | 400 | |

## Table B5: Parameters for use of the Hilti Roughening Tool TE-YRT

| Associated components | | | | Installation |
|---|---|---|---|---|
| Diamond coring | | Roughening tool TE-YRT | Wear gauge RTG… | Minimum roughening time $t_{roughen}$ |
|  | |  |  | |
| $d_0$ [mm] | | $d_0$ [mm] | Size | $t_{roughen}$ [sec.] = $h_{ef}$ [mm] / 10 |
| Nominal | Measured | | | |
| 18 | 17,9 to 18,2 | 18 | 18 | |
| 20 | 19,9 to 20,2 | 20 | 20 | |
| 22 | 21,9 to 22,2 | 22 | 22 | |
| 25 | 24,9 to 25,2 | 25 | 25 | |
| 28 | 27,9 to 28,2 | 28 | 28 | |
| 30 | 29,9 to 30,2 | 30 | 30 | |
| 32 | 31,9 to 32,2 | 32 | 32 | |
| 35 | 34,9 to 35,2 | 35 | 35 | |

| $h_{ef}$ [mm] | $t_{roughen}$ [sec] |
|---|---|
| 0 to 100 | 10 |
| 101 to 200 | 20 |
| 201 to 300 | 30 |
| 301 to 400 | 40 |
| 401 to 500 | 50 |
| 501 to 600 | 60 |

### Hilti Roughening tool TE-YRT and wear gauge RTG

**TE-YRT**

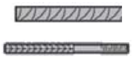
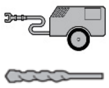
**RTG**
Delivered with each TE-YRT


## Table B6: Maximum working time and minimum curing time[1)]

| Temperature in the base material T | | | Maximum working time $t_{work}$ | Initial curing time $t_{cure,ini}$ | Minimum curing time $t_{cure}$ |
|---|---|---|---|---|---|
| -5 °C | to | -1 °C | 2 hours | 48 hours | 168 hours |
| 0 °C | to | 4 °C | 2 hours | 24 hours | 48 hours |
| 5 °C | to | 9 °C | 2 hours | 16 hours | 24 hours |
| 10 °C | to | 14 °C | 1,5 hours | 12 hours | 16 hours |
| 15 °C | to | 19 °C | 1 hour | 8 hours | 16 hours |
| 20 °C | to | 24 °C | 30 min | 4 hours | 7 hours |
| 25 °C | to | 29 °C | 20 min | 3,5 hours | 6 hours |
| 30 °C | to | 34 °C | 15 min | 3 hours | 5 hours |
| 35 °C | to | 39 °C | 12 min | 2 hours | 4,5 hours |
| 40 °C | | | 10 min | 2 hours | 4 hours |

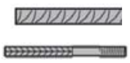
1) The curing time data are valid for dry base material only.
In wet base material the curing times must be doubled.

## Table B7: Parameters of drilling, cleaning and setting tools, hammer drilling and compressed air drilling

| Elements | Drill and clean | | | | | Installation | | |
|---|---|---|---|---|---|---|---|---|
| Rebar / Hilti Tension Anchor | Hammer drilling (HD) | Compressed air drilling (CA) | Brush HIT-RB | Air nozzle HIT-DL | Extension for air nozzle | Piston plug HIT-SZ | Extension for piston plug | Maximum embedment depth |
|  |  |  |  |  |  |  |  1) | - |
| size | $d_0$ [mm] | $d_0$ [mm] | size | size | [-] | size | [-] | $l_{v,max}$ [mm] |
| $\phi$ 8 | 10 | - | 10 | 10 | HIT-DL 10/0,8 or HIT-DL V10/1 | - | HIT-VL 9/1,0 | 250 |
| | 12 | - | 12 | 12 | | 12 | | 1000 |
| $\phi$ 10 | 12 | - | 12 | 12 | | 12 | | 250 |
| | 14 | - | 14 | 14 | | 14 | HIT-VL 11/1,0 | 1000 |
| $\phi$ 12 / HZA(-R) M12 | 14 | - | 14 | 14 | | 14 | | 250 |
| | 16 | - | 16 | 16 | | 16 | | 1200 |
| | - | 17 | 18 | 16 | | 16 | | |
| $\phi$ 14 | 18 | - | 18 | 18 | | 18 | | 1400 |
| | - | 17 | 18 | 16 | | 16 | | |
| $\phi$ 16 / HZA(-R) M16 | 20 | 20 | 20 | 20 | HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16 | 20 | HIT-VL 16/0,7 and/or HIT-VL 16 | 1600 |
| $\phi$ 18 | 22 | 22 | 22 | 22 | | 22 | | 1800 |
| $\phi$ 20 / HZA(-R) M20 | 25 | - | 25 | 25 | | 25 | | 2000 |
| | - | 26 | 28 | 25 | | 25 | | |
| $\phi$ 22 | 28 | 28 | 28 | 28 | | 28 | | 2200 |
| $\phi$ 24 | 30 | 30 | 30 | 30 | | 30 | | 500 |
| | 32 | 32 | 32 | 32 | | 32 | | 2400 |
| $\phi$ 25 / HZA(-R) M24 | 30 | 30 | 30 | 30 | | 30 | | 500 |
| | 32 | 32 | 32 | 32 | | 32 | | 2500 |
| $\phi$ 26 | 35 | 35 | 35 | 32 | | 35 | | 2600 |
| $\phi$ 28 / HZA M27 | 35 | 35 | 35 | 32 | | 35 | | 2800 |
| $\phi$ 30 | - | 35 | 35 | 32 | | 35 | | 3000 |
| | 37 | 37 | 37 | 32 | | 37 | | |
| $\phi$ 32 | 40 | 40 | 40 | 32 | | 40 | | 3200 |
| $\phi$ 34 | - | 42 | 42 | 32 | | 42 | | 3200 |
| | 45 | - | 45 | 32 | | 45 | | |
| $\phi$ 36 | 45 | 45 | 45 | 32 | | 45 | | 3200 |
| $\phi$ 40 | 52 | - | 55 | 32 | | 55 | | 3200 |
| | - | 57 | 55 | 32 | | 55 | | |

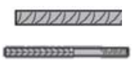
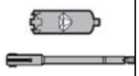
1) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drillholes.

## Table B8: Parameters of drilling, cleaning and setting tools, hammer drilling with hollow drill bit and Diamond coring, dry

| Elements | Drill and clean | | | | | Installation | | |
|---|---|---|---|---|---|---|---|---|
| Rebar / Hilti Tension Anchor | Hammer-drilling with Hollow drill bit (HDB)[3] | Diamond coring, dry (PCC) | Brush HIT-RB | Air nozzle HIT-DL | Extension for air nozzle | Piston plug HIT-SZ | Extension for piston plug | Maximum embedment depth |
|  |  |  |  |  |  [1] |  |  | - |
| Size | $d_0$ [mm] | $d_0$ [mm] | Size | Size | [-] | Size | [-] | $l_{v,max}$ [mm] |
| – | - | - | | | | - | HIT-VL 9/1,0 | - |
| ϕ 10 | 12 | - | | | | 12 | | 250 |
| | 14 | - | | | | 14 | HIT-VL 11/1,0 | 1000 |
| ϕ 12 / HZA(-R) M12 | 14 | - | | | | 14 | | 250 |
| | 16 | - | | | | 16 | | 1000 |
| ϕ 14 | 18 | - | | | | 18 | | 1000 |
| ϕ 16 / HZA(-R) M16 | 20 | - | | | | 20 | HIT-VL 16/0,7 and/or HIT-VL 16 | 1000 |
| ϕ 18 | 22 | - | | | | 22 | | 1000 |
| ϕ 20 / HZA(-R) M20 | 25 | - | | | | 25 | | 1000 |
| ϕ 22 | 28 | - | | | | 28 | | 1000 |
| ϕ 24 | 32 | - | | No cleaning required | | 32 | | 1000 |
| | - | 35 | | | | 35 | | 2400 |
| ϕ 25 / HZA(-R) M24 | 32 | - | | | | 32 | | 1000 |
| | - | 35 | | | | 35 | | 2500 |
| ϕ 26 | 35 | 35 | | | | 32 | | 1000 [2] / 2600 |
| ϕ 28 / HZA M27 | 35 | 35 | | | | 32 | | 1000 [2] / 2800 |
| ϕ 30 | - | 35 | | | | 32 | | 3000 |
| ϕ 32 | - | 47 | | | | 32 | | 3200 |
| ϕ 34 | - | 47 | | | | 32 | | 3200 |
| ϕ 36 | - | 47 | | | | 32 | | 3200 |
| ϕ 40 | - | 52 | | | | 32 | | 3200 |

[1] Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper drilleholes.
[2] Maximum embedment depth for use with Hilti Hollow drill bit TE-CD / TE-YD
[3] To be used in combination with Hilti vacuum cleaner with suction colume >= 57 l/s.

## Table B9: Parameters of drilling, cleaning and setting tools, diamond coring, wet and diamond coring with roughening

| Elements | Drill and clean | | | | | Installation | | |
|---|---|---|---|---|---|---|---|---|
| Rebar / Hilti Tension Anchor | Diamond coring, wet (DD) | Diamond coring with roughening (RT) | Brush HIT-RB | Air nozzle HIT-DL | Extension for air nozzle | Piston plug HIT-SZ | Extension for piston plug | Maximum embedment depth |
|  |  |  |  |  |  |  |  | - |
| Size | $d_0$ [mm] | $d_0$ [mm] | Size | Size | [-] | Size | [-] | $l_{v,max}$ [mm] |
| $\phi$ 8 | 10 | - | 10 | 10 | HIT-DL 10/0,8 or HIT-DL V10/1 | - | HIT-VL 9/1,0 | 250 |
| | 12 | - | 12 | 12 | | 12 | | 1000 |
| $\phi$ 10 | 12 | - | 12 | 12 | | 12 | | 250 |
| | 14 | - | 14 | 14 | | 14 | HIT-VL 11/1,0 | 1000 |
| $\phi$ 12 / HZA(-R) M12 | 14 | - | 14 | 14 | | 14 | | 250 |
| | 16 | - | 16 | 16 | | 16 | | 1200 |
| $\phi$ 14 | 18 | 18 | 18 | 18 | | 18 | | 1400 / 900 [2)] |
| $\phi$ 16 / HZA(-R) M16 | 20 | 20 | 20 | 20 | HIT-DL 16/0,8 or HIT-DL B and/or HIT-VL 16/0,7 and/or HIT-VL 16 | 20 | HIT-VL 16/0,7 and/or HIT-VL 16 | 1600 / 1000 [2)] |
| $\phi$ 18 | 22 | 22 | 22 | 22 | | 22 | | 1800 / 1200 [2)] |
| $\phi$ 20 / HZA(-R) M20 | 25 | 25 | 25 | 25 | | 25 | | 2000 / 1300 [2)] |
| $\phi$ 22 | 28 | 28 | 28 | 28 | | 28 | | 2200 / 1400 [2)] |
| $\phi$ 24 | 30 | 30 | 30 | 30 | | 30 | | 500 |
| | 32 | 32 | 32 | 32 | | 32 | | 2400 / 1600 [2)] |
| $\phi$ 25 / HZA(-R) M24 | 30 | 30 | 30 | 30 | | 30 | | 500 |
| | 32 | 32 | 32 | 32 | | 32 | | 2500 / 1600 [2)] |
| $\phi$ 26 | 35 | 35 | 35 | 32 | | 35 | | 2600 / 1800 [2)] |
| $\phi$ 28 / HZA M27 | 35 | 35 | 35 | 32 | | 35 | | 2800 / 1800 [2)] |
| $\phi$ 30 | 37 | - | 37 | 32 | | 37 | | 3000 |
| $\phi$ 32 | 40 | - | 40 | 32 | | 40 | | 3200 |
| $\phi$ 34 | 42 | - | 42 | 32 | | 42 | | 3200 |
| | 45 | - | 45 | 32 | | 45 | | |
| $\phi$ 36 | 47 | - | 47 | 32 | | 47 | | 3200 |
| $\phi$ 40 | 52 | - | 52 | 32 | | 52 | | 3200 |

1) Assemble extension HIT-VL 16/0,7 with coupler HIT-VL K for deeper boreholes.
2) Maximum embedment depth for use with Hilti Roughening tool TE-YRT

## Cleaning alternatives for hammer drilling

| | |
|---|---|
| **Automatic Cleaning (AC):**<br>Cleaning is performed during drilling with Hilti hollow drill bit TE-CD, TE-YD including vacuum cleaner. |  |
| **Compressed Air Cleaning (CAC):**<br>air nozzle with an orifice opening of minimum 3,5 mm in diameter.<br>+ brush HIT-RB |  |
| **Manual Cleaning (MC):**<br>Hilti hand pump<br>+ brush HIT-RB<br>for cleaning of drill holes with diameters $d_0 \le 20$ mm and drill hole depths $h_0 \le 10 \cdot d$. |  |
| **Compressed Air without brushing (C):**<br>air nozzle with an orifice opening of minimum 3,5 mm in diameter.<br>for cleaning of drill holes with diameters $d_0 \le 32$ mm. |  |

## Installation instruction

**Safety Regulations:**

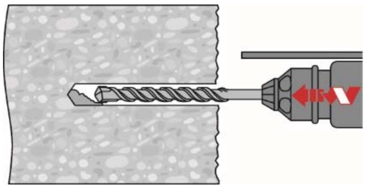
Review the Material Safety Data Sheet (MSDS) before use for proper and safe handling!
Wear well-fitting protective goggles and protective gloves when working with Hilti HIT-RE 500 V3.
Important: Observe the installation instruction provided with each foil pack.

**Hole drilling**

Before drilling remove carbonized concrete and clean contact areas (see Annex B1).

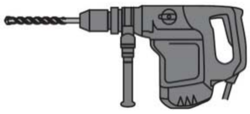
In case of aborted drill hole the drill hole shall be filled with mortar.

**a) Hammer drilling**

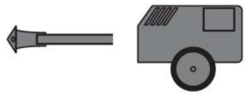


Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode or a compressed air drill using an appropriately sized carbide drill bit.

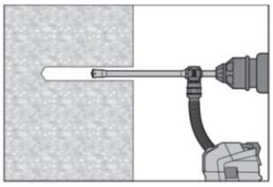
Hammer drill (HD)



Compressed air drill (CA)

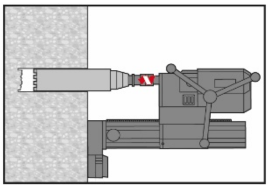


**b) Hammer drilling with Hilti hollow drill bit TE-CD, TE-YD**



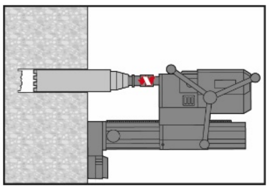
Drill hole to the required embedment depth with an appropriately sized Hilti TE-CD or TE-YD hollow drill bit with Hilti vacuum cleaner VC 20/40 (-Y) (suction volume >= 57 l/s). This drilling system removes the dust and cleans the drill hole during drilling when used in accordance with the user's manual. After drilling is completed, proceed to the "injection preparation" step in the installation instruction.

**c) Diamond coring**

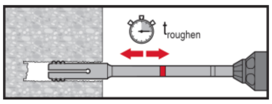


Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.

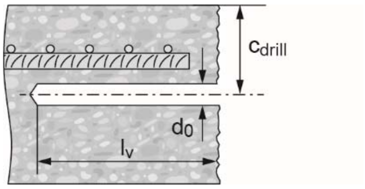
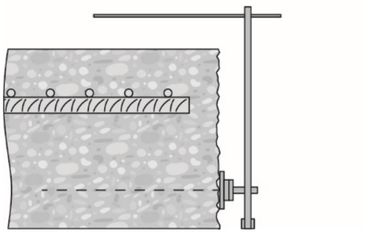
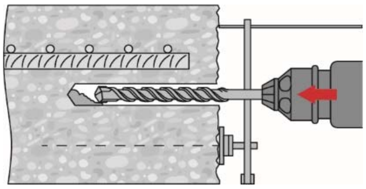
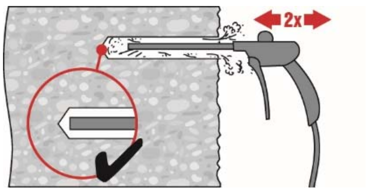
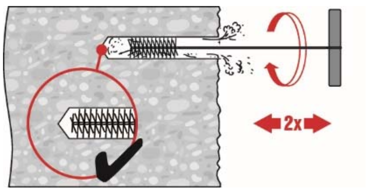
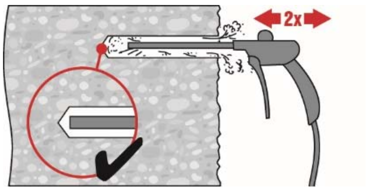
**d) Diamond coring with roughening with Hilti roughening tool TE-YRT**



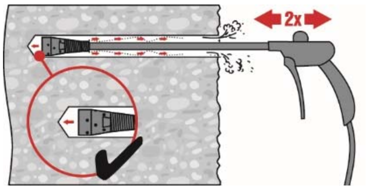
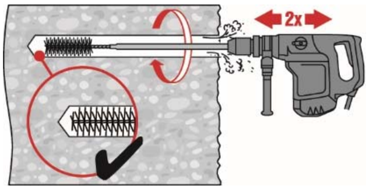
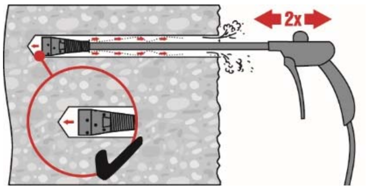
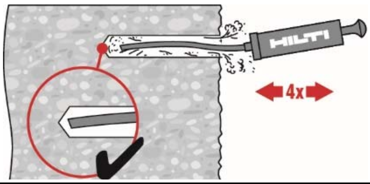
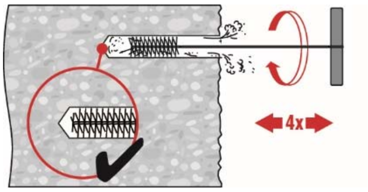
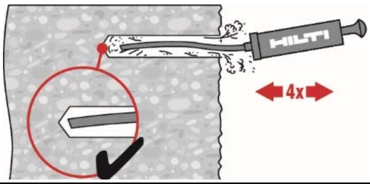
Diamond coring is permissible when suitable diamond core drilling machines and the corresponding core bits are used.




For the use in combination with Hilti roughening tool TE-YRT see parameters in Table B5.
Before roughening water needs to be removed from the drillhole. Check usability of the roughening tool with the wear gauge RTG.
Roughen the drillhole over the whole length to the required $l_v$.

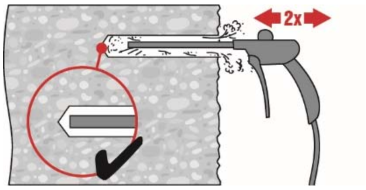
| | |
|---|---|
| **Splicing applications** | |
|  | Measure and control concrete cover c.<br>$c_{drill} = c + d_0/2$.<br>Drill parallel to surface edge and to existing rebar.<br>Where applicable use Hilti drilling aid HIT-BH. |
| **Drilling aid** | For holes $l_v$ > 20 cm use drilling aid. |
| <br> | Ensure that the drill hole is parallel to the existing rebar.<br>Three different options can be considered:<br>• Hilti drilling aid HIT-BH<br>• Lath or spirit level<br>• Visual check |
| **Drill hole cleaning** | Just before setting the bar the drill hole must be free of dust and debris.<br>Inadequate hole cleaning = poor load values. |
| **Compressed Air Cleaning** (CAC) for hammer drilled holes | For all drill hole diameters $d_0$ and all drill hole depths $h_0 \leq 20 \cdot \phi$. |
|  | Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust. |
|  | Brush 2 times with the specified brush (see Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.<br>The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter. |
|  | Blow again with compressed air 2 times until return air stream is free of noticeable dust. |

| | |
|---|---|
| **Injection system Hilti HIT-RE 500 V3** | **Annex B13** |
| **Product description.**<br>Installation instruction | |

| | |
|---|---|
| **Compressed Air Cleaning** (CAC) for hammer drilled holes | For drill holes deeper than 250 mm (for ϕ 8 to ϕ 12) or deeper than 20 · ϕ (for ϕ > 12 mm) |
|  | Use the appropriate air nozzle Hilti HIT-DL (Table B7).<br>Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust.<br><br>Safety tip:<br>Do not inhale concrete dust. |
|  | Screw the round steel brush HIT-RB in one end of the brush extension(s) HIT-RBS, so that the overall length of the brush is sufficient to reach the base of the drill hole. Attach the other end of the extension to the TE-C/TE-Y chuck.<br><br>Safety tip:<br>Start machine brushing operation slowly.<br>Start brushing operation once the brush is inserted in the drillhole. |
|  | Use the appropriate air nozzle Hilti HIT-DL (Table B7).<br>Blow 2 times from the back of the hole over the whole length with oil-free compressed air until return air stream is free of noticeable dust.<br><br>Safety tip:<br>Do not inhale concrete dust.<br>Use of the dust collector Hilti HIT-DRS is recommended. |
| **Manual Cleaning** (MC) for hammer drilled holes | For drill hole diameters $d_0 \leq 20$ mm and all drill hole depths $h_0 \leq 10 \cdot \phi$. |
|  | The Hilti hand pump may be used for blowing out drill holes up to diameters $d_0 \leq$ 20 mm and drill hole depths $h_0 \leq 10 \cdot \phi$.<br>Blow out at least 4 times from the back of the drill hole until return air stream is free of noticeable dust. |
|  | Brush 4 times with the specified brush (Table B7) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.<br>The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter. |
|  | Blow again with the Hilti hand pump at least 4 times until return air stream is free of noticeable dust. |

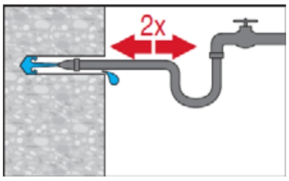
**Compressed Air without brushing** for hammer drilled holes

For drill hole diameters $d_0 \leq 32$ mm

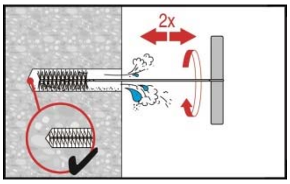



Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

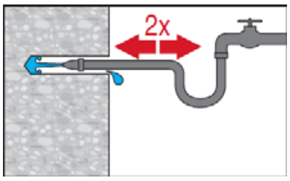
**Cleaning of diamond cored holes:**
For all drill hole diameters $d_0$ and all drill hole depths $h_0$.



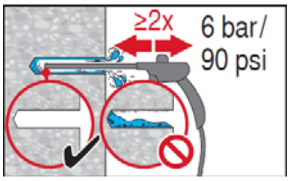

Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.



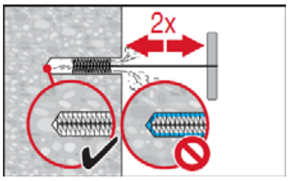

Brush 2 times with the specified brush (Table B9) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



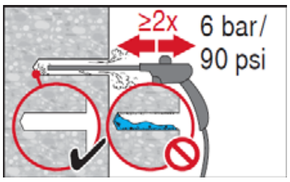

Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.




Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.



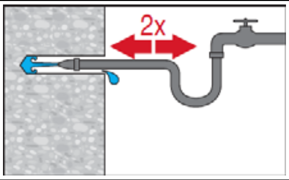

Brush 2 times with the specified brush size (brush Ø ≥ drill hole Ø, see Table B9) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole – if not the brush is too small and must be replaced with the proper brush diameter.



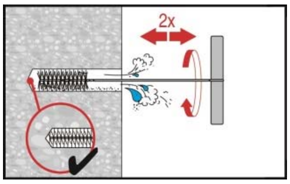

Blow again with compressed air 2 times until return air stream is free of noticeable dust and water.

| | |
|---|---|
| **Injection system Hilti HIT-RE 500 V3** | **Annex B15** |
| **Product description** Installation instruction | |

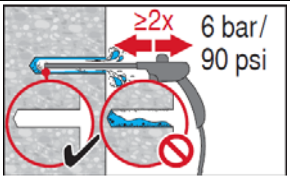
**Cleaning of diamond cored holes with roughening with Hilti roughening tool TE-YRT:**
For all drill hole diameters $d_0$ and all drill hole depths $h_0$.




Flush 2 times by inserting a water hose (water-line pressure) to the back of the hole until water runs clear.

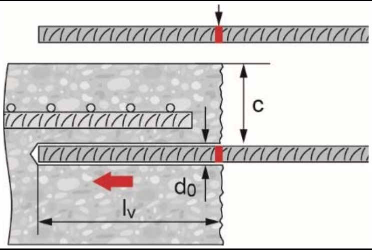



Brush 2 times with the specified brush (Table B9) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.
The brush must produce natural resistance as it enters the drill hole (brush Ø ≥ drill hole Ø) - if not the brush is too small and must be replaced with the proper brush diameter.



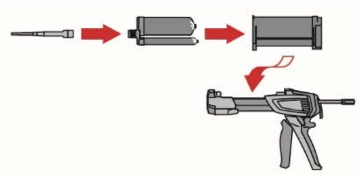

Blow 2 times from the back of the hole (if needed with nozzle extension) over the whole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust and water.
For drill hole diameters ≥ 32 mm the compressor has to supply a minimum air flow of 140 m³/h.

**Rebar preparation**

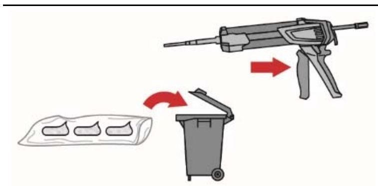



Before use, make sure the rebar is dry and free of oil or other residue.
Mark the embedment depth on the rebar (e.g. with tape) → $l_v$.
Insert rebar in drillhole to verify hole and setting depth $l_v$.

**Injection preparation**



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

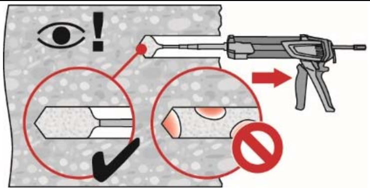


The foil pack opens automatically as dispensing is initiated. Depending on the size of the foil pack an initial amount of adhesive has to be discarded. Discarded quantities are:

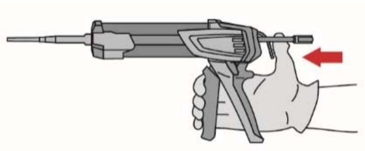
| | |
|---|---|
| 3 strokes | for 330 ml foil pack, |
| 4 strokes | for 500 ml foil pack, |
| 65 ml | for 1400 ml foil pack. |

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

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

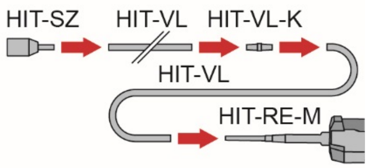


Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill approximately 2/3 of the drill hole to ensure that the annular gap between the anchor and the concrete is completely filled with adhesive along the embedment length.

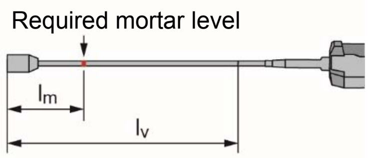


After injection is completed, depressurize the dispenser by pressing the release trigger. This will prevent further adhesive discharge from the mixer.

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



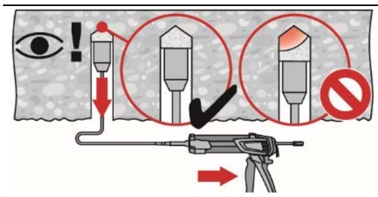

Assemble mixing nozzle HIT-RE-M, extension(s) and piston plug HIT-SZ (see Table B7, B8 or B9).
For combinations of several injection extensions use coupler HIT-VL-K.
A substitution of the injection extension for a plastic hose or a combination of both is permitted.
The combination of HIT-SZ piston plug with HIT-VL 16 pipe and then HIT-VL 16 tube support proper injection.



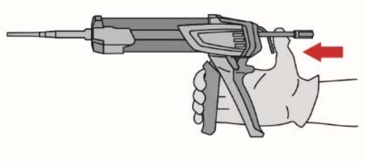

Mark the required mortar level $l_m$ and embedment depth $l_v$ with tape or marker on the injection extension.

Estimation: $l_m = 1/3 \cdot l_v$

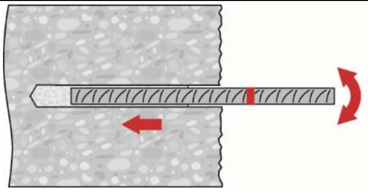
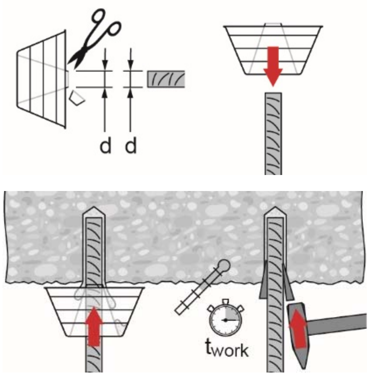
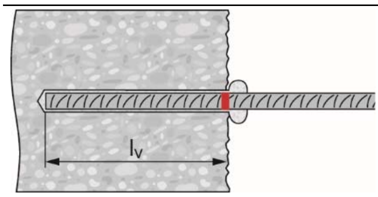
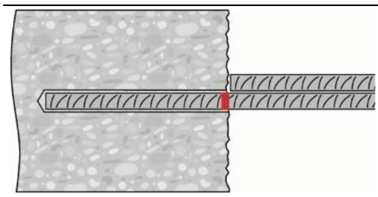
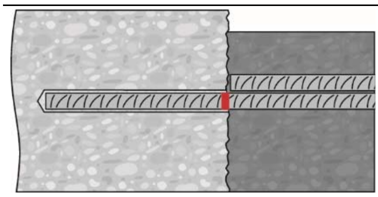
Precise formula for optimum mortar volume: $l_m = l_v \cdot (1{,}2 \cdot (\phi^2 / d_0^2) - 0{,}2)$



For overhead installation the injection is only possible with the aid of extensions and piston plugs. Assemble HIT-RE-M mixer, extension(s) and appropriately sized piston plug (see Table B7, B8 or B9). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure.



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

| **Setting the element** | Before use, verify that the element is dry and free of oil and other contaminants. |
|---|---|
|  | For easy installation insert the rebar into the drill hole while slowly twisting until the embedment mark is at the concrete surface level. |
|  | For overhead application:<br><br>During insertion of the rebar mortar might flow out of the drill hole. For collection of the flowing mortar HIT-OHC may be used.<br>Support the rebar and secure it from falling until mortar has started to harden, e.g. using wedges HIT-OHW. |
|  | After installing the rebar the annular gap must be completely filled with mortar.<br>Proper installation:<br>• desired anchoring embedment $l_v$ is reached: embedment mark at concrete surface.<br>• excess mortar flows out of the drillhole after the rebar has been fully inserted until the embedment mark. |
|  | Observe the working time $t_{work}$ (see Table B6), which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time. |
|  | Full load may be applied only after the curing time $t_{cure}$ has elapsed (see Table B6). |

## Minimum anchorage length and minimum lap length under static and quasi-static loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the amplification factor $\alpha_{lb,100y}$ given in Tables C1 and C2.

The design bond resistance $f_{bd,PIR,100y}$ is given in Tables C4 and C6. It is obtained by multiplying the design bond resistance $f_{bd}$ according to EN 1992-1-1 (Eq. 8.3) by the bond efficiency factor $k_{b,100y}$ according to Tables C3 and C5.

**Table C1: Amplification factor $\alpha_{lb,100y}$ for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, Compressed air drilling, and diamond coring with roughening with Hilti roughening tool TE-YRT with a service life of 100 years.**

| Bar diameter | Amplification factor $\alpha_{lb,100y}$ [-] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 40 | 1,0 | | | | | | | | |

**Table C2: Amplification factor $\alpha_{lb}$ for diamond coring wet with a service life of 100 years.**

| Bar diameter | Amplification factor $\alpha_{lb,100y}$ [-] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 12 | 1,0 | | | | | | | | |
| ϕ 14 to ϕ 36 | Linear interpolation between diameters | | | | | | | | |
| ϕ 40 | 1,0 | | | | 1,2 | 1,3 | 1,4 | | |

**Table C3: Bond efficiency factor $k_{b,100y}$ for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling, diamond coring dry and diamond coring with roughening with Hilti roughening tool TE-YRT with a service life of 100 years.**

| Bar diameter | Bond efficiency factor $k_{b,100y}$ [-] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 40 | 1,00 | | | | | | | | |

**Table C4: Design values of the bond resistance $f_{bd,PIR,100y}$[1)] for hammer drilling, hammer drilling with Hilti hollow drill bit TE-CD, TE-YD, compressed air drilling, diamond coring dry and diamond coring with roughening with Hilti roughening tool TE-YRT with a service life of 100 years.**

| Bar diameter | Bond resistance $f_{bd,PIR,100y}$ [N/mm²] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 32 | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 4,0 | 4,3 |
| ϕ 34 | 1,6 | 2,0 | 2,3 | 2,6 | 2,9 | 3,3 | 3,6 | 3,9 | 4,2 |
| ϕ 36 | 1,6 | 1,9 | 2,2 | 2,6 | 2,9 | 3,2 | 3,5 | 3,8 | 4,1 |
| ϕ 40 | 1,5 | 1,8 | 2,1 | 2,5 | 2,8 | 3,1 | 3,4 | 3,7 | 3,9 |

[1)] According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

**Table C5: Bond efficiency factor $k_{b,100y}$ for diamond coring wet with a service life of 100 years.**

| Bar diameter | Bond efficiency factor $k_{b,100y}$ [-] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 12 | 1,00 | | | | | | | | 0,93 |
| ϕ 14 and ϕ 16 | 1,00 | | | | | | | 0,93 | 0,86 |
| ϕ 18 to ϕ 36 | 1,00 | | | | | | 0,92 | 0,85 | 0,79 |
| ϕ 40 | 1,00 | | | | | 0,90 | 0,82 | 0,76 | 0,71 |

**Table C6: Design values of the bond resistance $f_{bd,PIR,100y}$[1)] for diamond coring wet with a service life of 100 years.**

| Bar diameter | Bond resistance $f_{bd,PIR,100y}$ [N/mm²] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Concrete class | | | | | | | | |
| | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| ϕ 8 to ϕ 12 | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 4,0 | 4,0 |
| ϕ 14 and ϕ 16 | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 3,7 | 3,7 |
| ϕ 18 to ϕ 32 | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,4 | 3,4 | 3,4 |
| ϕ 34 | 1,6 | 2,0 | 2,3 | 2,6 | 2,9 | 3,3 | 3,3 | 3,3 | 3,3 |
| ϕ 36 | 1,6 | 1,9 | 2,2 | 2,6 | 2,9 | 3,2 | 3,2 | 3,2 | 3,2 |
| ϕ 40 | 1,5 | 1,8 | 2,1 | 2,5 | 2,8 | 2,8 | 2,8 | 2,8 | 2,8 |

[1)] According to EN 1992-1-1:2004 for good bond conditions. For all other bond conditions multiply the values by 0,7.

## Design value of the bond resistance $f_{bd,fi,100y}$ under fire exposure for concrete classes C12/15 to C50/60, (all drilling methods) and a service life of 100 years.:

The design value of the bond resistance $f_{bd,fi}$ under fire exposure has to be calculated by the following equation:

$$f_{bd,fi,100y} = k_{b,fi}(\theta) \cdot f_{bd,100y} \cdot \frac{\gamma_C}{\gamma_{M,fi}}$$

If θ > 42°C: $k_{b,fi}(\theta) = \frac{651.24 \cdot \theta^{-1.115}}{f_{bd} \cdot 4{,}3} \leq 1{,}0$

If θ > 305°C: $k_{b,fi}(\theta) = 0.0$

$f_{bd,fi,100y}$ = Design value of the bond resistance in case of fire in N/mm²

$(\theta)$ = Temperature in °C in the mortar layer.

$k_{b,fi}(\theta)$ = Reduction factor under fire exposure.

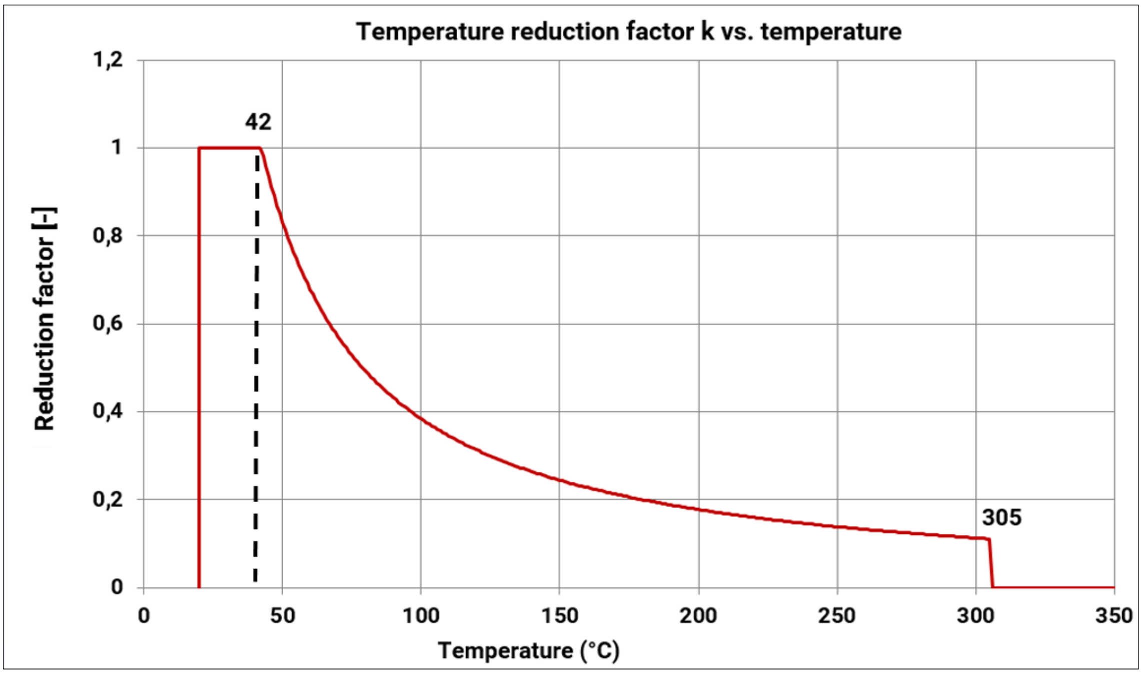
$f_{bd,fi}(\theta)$ = Design value of the bond resistance in N/mm² in cold condition according to Table C2 or C3 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1.

$\gamma_C$ = Partial safety factor according to EN 1992-1-1

$\gamma_{M,fi}$ = Partial safety factor according to EN 1992-1-2

For evidence under fire exposure the anchorage length shall be calculated according to EN 1992-1-1:2004+AC:2010 Equation 8.3 using the temperature-dependent bond resistance $f_{bd,fi,100y}$.

## Figure C1: Example graph of temperature reduction factor $k_{b,fi}(\theta)$ for concrete classes C20/25 for good bond conditions:




| Injection system Hilti HIT-RE 500 V3 | Annex C3 |
|---|---|
| **Performance**<br>Design value of bond resistance $f_{bd,fi,100y}$ under fire exposure with temperature reduction factor $k_{b,fi}(\theta)$ | |