Deutsches Institut für Bautechnik
DIBt

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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-23/0277 of 8 February 2024

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 | Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U |
| Product family to which the construction product belongs | Post-installed fasteners in concrete under fatigue cyclic loading |
| Manufacturer | Hilti Aktiengesellschaft<br>Feldkircherstrasse 100<br>9494 SCHAAN<br>FÜRSTENTUM LIECHTENSTEIN |
| Manufacturing plant | Hilti Plants |
| This European Technical Assessment contains | 15 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 330250-01-0601, Edition 10/2023 |

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## Specific Part

### 1 Technical description of the product

The Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U is a bonded fasteners consisting of a cartridge with injection mortar Hilti HIT 200-A V3 or Hilti HIT 200-R V3 or HIT RE 500 V4 or mortar capsule HVU2 and steel element HAS-U A4 with lock nut, nut, spherical washer and Hilti sealing washer or a steel element HAS-U A4 with lock nut, nut and washer.

The load transfer is achieved by the bond between the steel element, the bonding mortar and the 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 (Assessment method C: Linearized function)** | **Performance** |
|---|---|
| Characteristic fatigue resistance under cyclic tension loading | |
| Characteristic steel fatigue resistance $\Delta N_{Rk,s,0,n}$ ($n$ = 1 to $n$ = ∞) | See Annex C1 and C3 |
| Characteristic concrete cone and splitting fatigue resistance $\Delta N_{Rk,c,0,n}$ $\Delta N_{Rk,sp,0,n}$ ($n$ = 1 to $n$ = ∞) | See Annex C1 and C3 |
| Characteristic combined pull-out /concrete cone fatigue resistance $\Delta \tau_{Rk,p,0,n}$ ($n$ = 1 to $n$ = $10^8$) | See Annex C1 and C3 |
| Characteristic fatigue resistance under cyclic shear loading | |
| Characteristic steel fatigue resistance $\Delta V_{Rk,s,0,n}$ ($n$ = 1 to $n$ = ∞) | See Annex C2 and C3 |
| Characteristic concrete edge fatigue resistance $\Delta V_{Rk,c,0,n}$ ($n$ = 1 to $n$ = ∞) | See Annex C2 and C3 |
| Characteristic concrete pry out fatigue resistance $\Delta V_{Rk,cp,0,n}$ ($n$ = 1 to $n$ = ∞) | See Annex C2 and C3 |

| **Essential characteristic (Assessment method C: Linearized function)** | **Performance** |
|---|---|
| Characteristic fatigue resistance under cyclic combined tension and shear loading | |
| Characteristic steel fatigue resistance $a_s$ ($n$ = 1 to $n$ = ∞) | See Annex C2 and C3 |
| Load transfer factor for cyclic tension and shear loading | |
| Load transfer factor $\psi_{FN}$, $\psi_{FV}$ | See Annex C1 to C3 |

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

In accordance with European Assessment Document No. 330250-01-0601, 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 with Deutsches Institut für Bautechnik.

The following standards and documents are referred to in this European Technical Assessment:

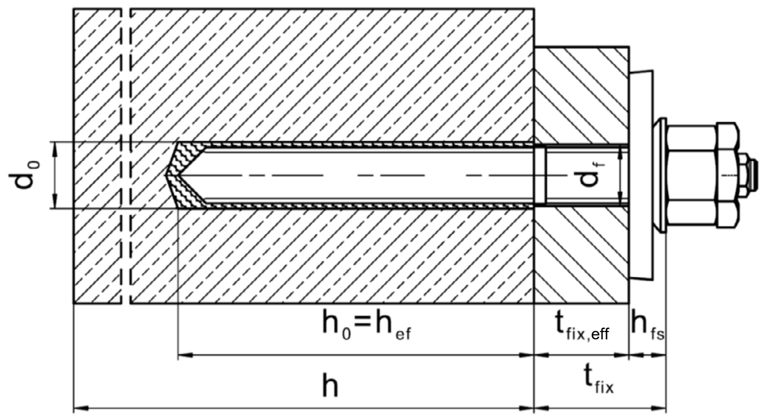
- EN 1993-1-4:2006 + A1:2015 — Eurocode 3: Design of steel structures - Part 1-4: General rules - Supplementary rules for stainless steels
- EN 10088-1:2014 — Stainless steels - Part 1: List of stainless steels
- EN 206:2013 + A2:2021 — Concrete - Specification, performance, production and conformity
- EN 1992-4:2018 — Eurocode 2: Design of concrete structures - Part 4: Design of fastenings for use in concrete
- EOTA TR 061 — Design Method for fasteners in concrete under fatigue cyclic loading, August 2023
- ETA-16/0515 — European Technical Assessment for HVU2, 14 September 2023
- ETA-19/0601 — European Technical Assessment for Injection System Hilti HIT-HY 200-A V3 and HIT-HY 200-R V3, 29 January 2024
- ETA-20/0541 — European Technical Assessment for Injection system Hilti HIT-RE 500 V4, 9 June 2023

Issued in Berlin on 8 February 2024 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Stiller

## Installed condition




**Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U**

**Product description**
Installed condition

**Annex A1**

## Product description: Mortar capsule, injection mortar, fastener, and filling set

**Adhesive anchor capsule HVU2 M8 to M24:** resin and hardener with aggregate

Marking:
HVU2 M …
Expiry date mm/yyyy


Product name: “HVU2”

**Injection mortar Hilti HIT-HY 200-A V3 and Hilti HIT-HY 200-R V3:** hybrid system with aggregate
330 ml and 500 ml

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


Product name: “Hilti HIT-HY 200-A V3”


Product name: “Hilti HIT-HY 200-R V3”

**Injection mortar Hilti HIT-RE 500 V4:** epoxy resin system with aggregate
330 ml, 500 ml and 1400 ml

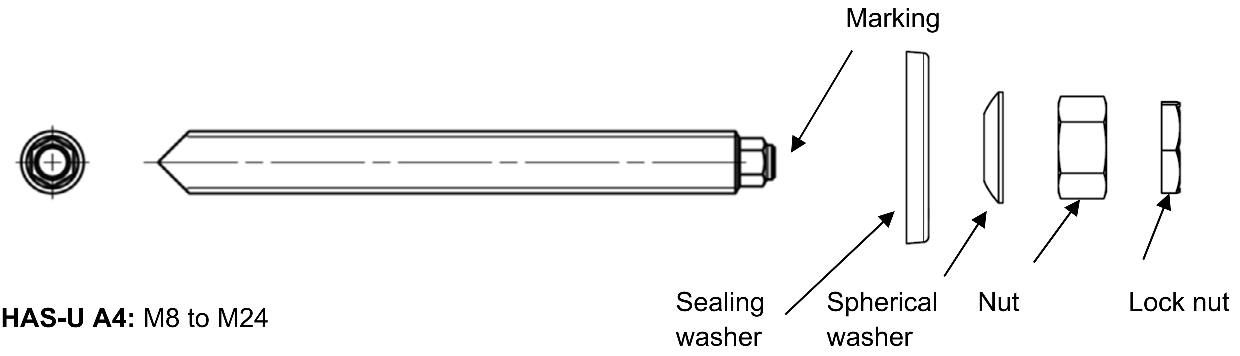
Marking:
HILTI HIT
Production number and
production line
Expiry date mm/yyyy


Product name: “Hilti HIT-RE 500 V4”

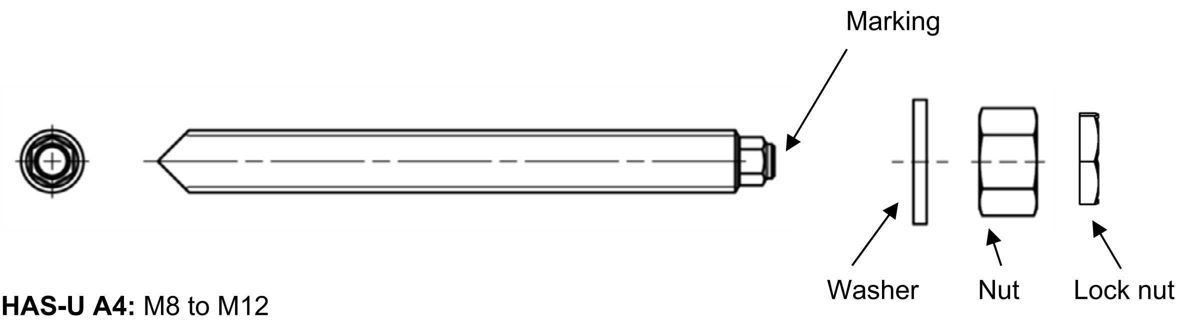
**Static mixer Hilti HIT-RE-M**

| Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U | Annex A2 |
|---|---|
| **Product description**<br>Mortar capsule and injection mortar | |

**Steel element**



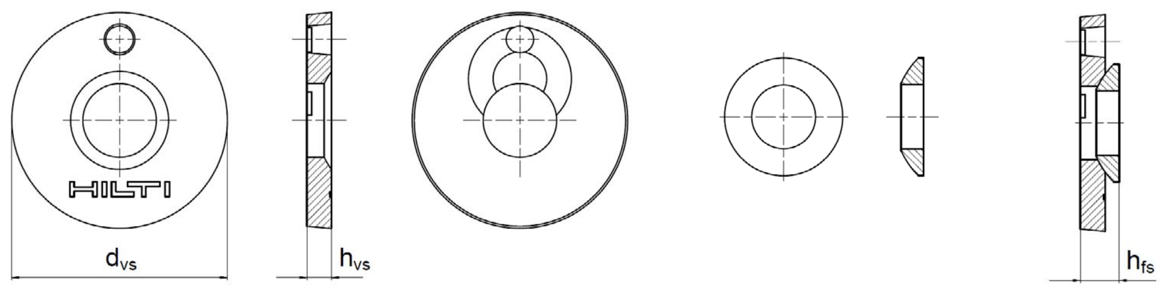

**HAS-U A4:** M8 to M24




**HAS-U A4:** M8 to M12

**Hilti Filling Set to fill the annular gap between steel element and fixture.**

Sealing washer Spherical washer Filling set




| **Hilti Filling Set** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Diameter of sealing washer | $d_{VS}$ | [mm] | 38 | 42 | 44 | 52 | 60 | 70 |
| Thickness of sealing washer | $h_{VS}$ | [mm] | | 5 | | | 6 | |
| Thickness of Hilti Filling Set | $h_{fS}$ | [mm] | 8 | 9 | 10 | 11 | 13 | 15 |

**Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U**

**Product description**
Steel element and Hilti Filling Set

**Annex A3**

## Table A1: Materials

| **Steel elements made of stainless steel<br>corrosion resistance class (CRC) III according EN 1993-1-4** | |
|---|---|
| HAS-U A4 | Strength class 70, $f_{uk}$ = 700 N/mm², $f_{yk}$ = 450 N/mm²,<br>Elongation at fracture ($l_0$=5d) > 12% ductile. |
| Nut | Strength class 70, $f_{uk}$ = 700 N/mm², $f_{yk}$ = 450 N/mm²;<br>Stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439, 1.4362 EN 10088-1 |
| Washer | Stainless steel EN 10088-1 |
| Lock nut | Stainless steel EN 10088-1 |
| Hilti Filling Set A4 | Filling washer: Stainless steel EN 10088-1<br>Spherical washer: Stainless steel EN 10088-1<br>Lock nut: Stainless steel EN 10088-1 |

## Specifications of intended use

**Anchorages subject to:**

- Fatigue cycling load for size M8 to M24.
  Note: static and quasi-static load according to ETA-16/0515 for HVU2, ETA-19/0601 for HIT-HY 200-A V3 and HIT-HY 200-R V3 as well as ETA-20/0541 for HIT-RE 500 V4.

**Base material:**

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206.
- Strength classes C20/25 to C50/60 according to EN 206.
- Cracked and uncracked concrete.

**Temperature in the base material:**

**at installation** and **in-service:**
See Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars.
Note: max. short term temperature +80 °C for Hilti capsule and injection mortars.

**Use conditions (Environmental conditions):**

- For all conditions according EN 1993-1-4
  corresponding to corrosion resistance classes Annex A4 Table A1 (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.).
- Anchorages under fatigue cycling load are designed in accordance with:
  EN 1992-4 or EOTA Technical Report TR 061.

**Installation:**
See Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars.

### Table B1: Specifications of intended use – drilling techniques

| **Mortar capsule and injection mortar** | **HVU2** | **HIT-HY 200-A V3<br>HIT-HY 200-R V3** | **HIT-RE 500 V4** |
|---|---|---|---|
| Hammer drilling | ✓ | ✓ | ✓ |
| Hammer drilling with hollow drill bit TE-CD or TE-YD | ✓<br>≥ M12 | ✓<br>≥ M10 | ✓<br>≥ M10 |
| Diamond coring | ✓ | - | ✓<br>uncracked concrete only |
| Diamond coring with roughening with Hilti Roughening tool TE-YRT | - | ✓<br>≥ M16 | ✓<br>≥ M16 |

## Table B2: Specifications of intended use – installation options

| Installation option | Annular gap filled | Annular gap not filled | |
|---|---|---|---|
| | Hilti filling set[1)] (pre-setting or through-setting) | Hilti filling set | Washer, nut, lock nut |
| all load direction | ✓ M8 to M24 | - | - |
| tension load only | - | ✓ M8 to M24 | ✓ M8 to M12 |

1) Filling the gap between steel element and fixture using Hilti filling set with injection mortar HIT-HY … or HIT-RE ….

## Table B3: Installation parameters[1)]

| **HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4…** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Steel stress cross section | $A_s$ | [mm²] | 36,6 | 58 | 84,3 | 157 | 245 | 353 |
| Pre-setting: Maximum diameter of clearance hole in the fixture | $d_f$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 |
| Through-setting: Maximum diameter of clearance hole in the fixture | $d_f$ | [mm] | 11 | 14 | 16 | 20 | 24 | 30 |
| Minimum fixture thickness | $t_{fix,min}$ 2) | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Thickness of Hilti Filling Set | $h_{fs}$ | [mm] | 8 | 9 | 10 | 11 | 13 | 15 |
| Effective fixture thickness with Hilti Filling Set | $t_{fix,eff}$ | [mm] | $t_{fix,eff} = t_{fix} - h_{fs} \geq t_{fix,min}$ | | | | | |

1) See Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars.

2) The minimum fixture thickness $t_{fix,min}$ can be replaced by a reduced minimum fixture thickness $t_{fix,min,red}$ if a reduced fatigue resistance in transverse direction $\Delta V_{Rk,s,0,red}$ is considered:

$t_{fix,min,red} = (0,5 + 0,5 \cdot \Delta V_{Rk,s,0,(n,\infty),red} / \Delta V_{Rk,s}) \cdot t_{fix,min}$

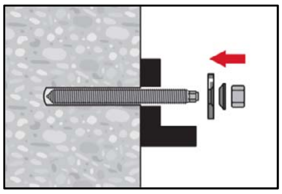
with $\Delta V_{Rk,s} = \Delta V_{Rk,s,0,n}$ for design method I (Table C2)

$\Delta V_{Rk,s} = \Delta V_{Rk,s,0,\infty}$ for design method II (Table C5)

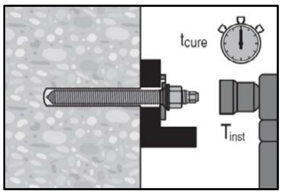
## Installation instruction

See Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars.

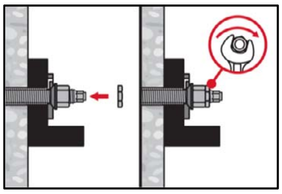
**Installation of Hilti Filling Set** to fill the annular gap between fastener and fixture.
Note: if the fastener is loaded in axial direction the gap does not have to be filled.



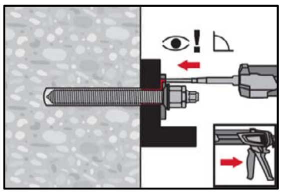
Use Hilti filling set with standard nut. Observe the correct orientation of filling washer and spherical washer.




The applied installation torque shall not exceed the values max. $T_{inst}$ given in Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars.

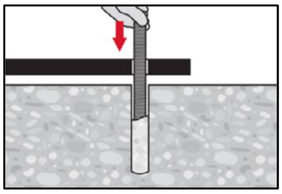


Installation of lock nut. Tighten with a ¼ to ½ turn.

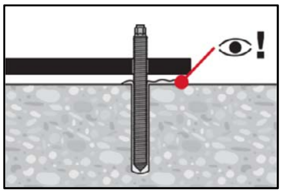


Fill the annular gap between the anchor rod and fixture with 1-3 strokes of a Hilti injection mortar HIT-HY … or HIT-RE … . Follow the installation instructions supplied with the Hilti injection mortar. After required curing time $t_{cure}$ (see Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars) the anchor can be loaded.

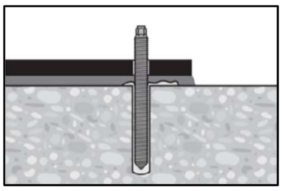
**Setting the fastener with clearance between concrete and anchor plate
(only if the fastener is loaded in axial direction)**



Set the fastener to the required embedment depth before working time $t_{work}$ (see Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars) has elapsed.



Check if mortar excess from the borehole.
The annular gap in the fixture does not have to be filled.



After required curing time $t_{cure}$ (see Annex B of the relevant ETA for the corresponding Hilti capsule and injection mortars) backfill the anchor plate.

| | |
|---|---|
| **Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U** | **Annex B3** |
| **Intended use**<br>Installation instructions | |

## Table C1: Essential characteristics under tension fatigue load in concrete (Design method I acc. to TR 061)

| **HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4…** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | |
| Characteristic steel resistance | [N/mm²] | | $\Delta\sigma_{Rk,s,N,0,n}$ | | | | | |
| Number of cycles | | $n \le 10^4$ | 207,0 | | 253,5 | | | |
| | | $10^4 \le n \le 5\cdot10^6$ | $10^{(-0,194\cdot\log(n)+3,092)}$ | | $10^{(-0,148\cdot\log(n)+2,996)}$ | | | |
| | | $5\cdot10^6 < n \le 10^8$ | $10^{(-0,089\cdot\log(n)+2,387)}$ | | $10^{(-0,069\cdot\log(n)+2,466)}$ | | | |
| | | $n > 10^8$ | 47,3 | | 82,0 | | | |
| Characteristic steel resistance | [kN] | | $\Delta N_{Rk,s,0,n} = A_s \cdot \Delta\sigma_{Rk,s,N,0,n}$ | | | | | |
| Number of cycles | n | $\le 10^4$ | 7,6 | 12,0 | 21,4 | 39,8 | 62,1 | 89,5 |
| | | $2\cdot10^5$ | 4,2 | 6,7 | 13,7 | 25,5 | 39,9 | 57,4 |
| | | $10^6$ | 3,1 | 4,9 | 10,8 | 20,1 | 31,4 | 45,3 |
| | | $2\cdot10^6$ | 2,7 | 4,3 | 9,8 | 18,2 | 28,4 | 40,9 |
| | | $5\cdot10^6$ | 2,3 | 3,6 | 8,5 | 15,9 | 24,8 | 35,7 |
| | | $\ge 10^8$ | 1,7 | 2,7 | 6,9 | 12,9 | 20,1 | 29,0 |
| **Combined pull-out and concrete cone failure in uncracked and cracked concrete** | | | | | | | | |
| Characteristic combined pull-out/concrete cone resistance | [N/mm²] | | $\Delta\tau_{Rk,p(ucr,cr),0,n} = \eta_{k,p,N,fat,n} \cdot \tau_{Rk,(ucr,cr)}$ 1) | | | | | |
| Reduction factor | [-] | | $\eta_{k,p,N,fat,n} = \max(1,2\cdot n^{-0,08}; 0,4)$ with $n \le 10^8$ | | | | | |
| Number of cycles | n | $\le 10^4$ | 0,57 | | | | | |
| | | $2\cdot10^5$ | 0,45 | | | | | |
| | | $10^6$ | 0,40 | | | | | |
| | | $\le 10^8$ | | | | | | |
| **Concrete cone and splitting failure in uncracked and cracked concrete** | | | | | | | | |
| Characteristic concrete cone and splitting resistance | [kN] | | $\Delta N_{Rk,(c,sp),0,n} = \eta_{k,(c,p),N,fat,n} \cdot N_{Rk,(c,sp)}$ 2) | | | | | |
| Reduction factor | [-] | | $\eta_{k,(c,sp),N,fat,n} = \max(1,1\cdot n^{-0,055}; 0,5)$ | | | | | |
| Number of cycles | n | $\le 10^4$ | 0,66 | | | | | |
| | | $2\cdot10^5$ | 0,58 | | | | | |
| | | $10^6$ | 0,51 | | | | | |
| | | $\ge 2\cdot10^6$ | 0,50 | | | | | |
| Load transfer factor for fastener group | $\psi_{FN}$ | [-] | 0,50 | | | | | |

1) $\tau_{Rk,(ucr,cr)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars.
2) $N_{Rk,(c,sp)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars and EN 1992-4.

## Table C2: Essential characteristics under shear fatigue load in concrete (Design method I acc. to TR 061)

| **HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4…** | | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | |
| Characteristic steel resistance | | [N/mm²] | | $\Delta\sigma_{Rk,s,V,0,n}$ | | | | | |
| Number of cycles | | $n \leq 10^4$ | | 135,2 | | | | | |
| | | $10^4 \leq n \leq 5 \cdot 10^6$ | | $10^{(-0,144 \cdot \log(n)+2,707)}$ | | | | | |
| | | $5 \cdot 10^6 < n \leq 10^8$ | | $10^{(-0,067 \cdot \log(n)+2,192)}$ | | | | | |
| | | $n > 10^8$ | | 45,3 | | | | | |
| Characteristic steel resistance | | [kN] | | $\Delta V_{Rk,s,0,n} = A_s \cdot \Delta\sigma_{Rk,s,V,0,n}$ | | | | | |
| Number of cycles | n | $\leq 10^4$ | | 4,9 | 7,8 | 11,4 | 21,2 | 33,1 | 47,7 |
| | | $2 \cdot 10^5$ | | 3,2 | 5,1 | 7,4 | 13,8 | 21,5 | 31,0 |
| | | $10^6$ | | 2,5 | 4,0 | 5,9 | 10,9 | 17,1 | 24,6 |
| | | $2 \cdot 10^6$ | | 2,3 | 3,7 | 5,3 | 9,9 | 15,4 | 22,3 |
| | | $5 \cdot 10^6$ | | 2,0 | 3,2 | 4,7 | 8,7 | 13,5 | 19,5 |
| | | $\geq 10^8$ | | 1,7 | 2,6 | 3,8 | 7,1 | 11,1 | 16,0 |
| **Concrete pry-out failure in uncracked and cracked concrete** | | | | | | | | | |
| Characteristic concrete pry-out resistance | | [kN] | | $\Delta V_{Rk,cp,0,n} = \eta_{k,cp,V,fat,n} \cdot V_{Rk,cp}$ [1)] | | | | | |
| Reduction factor | | [-] | | $\eta_{k,cp,V,fat,n} = \max(1,2 \cdot n^{-0,08}; 0,5)$ | | | | | |
| Number of cycles | n | $\leq 10^4$ | | 0,57 | | | | | |
| | | $\geq 2 \cdot 10^5$ | | 0,50 | | | | | |
| **Concrete edge failure in uncracked and cracked concrete** | | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | |
| Effective outside diameter | $d_{nom}$ | [mm] | | 8 | 10 | 12 | 16 | 20 | 24 |
| Characteristic concrete edge fatigue resistance | | [kN] | | $\Delta V_{Rk,c,0,n} = \eta_{k,c,V,fat,n} \cdot V_{Rk,c}$ [1)] | | | | | |
| Reduction factor | | [-] | | $\eta_{k,c,V,fat,n} = \max(1,2 \cdot n^{-0,08}; 0,5)$ | | | | | |
| Number of cycles | n | $\leq 10^4$ | | 0,57 | | | | | |
| | | $\geq 2 \cdot 10^5$ | | 0,50 | | | | | |
| Load transfer factor for fastener group | $\psi_{FV}$ | [-] | | 0,50 | | | | | |

1) $V_{Rk,(cp,c)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars and EN 1992-4.

## Table C3: Essential characteristics for combined fatigue load in concrete (Design method I acc. to TR 061)

| **HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4…** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|---|---|---|---|
| Exponent for combined fatigue load | $\alpha_s = \alpha_{sn}$ | [-] | 0,50 | | | 0,70 | | |
| | $\alpha_c$ | [-] | 1,5 | | | | | |

| | |
|---|---|
| **Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U** | **Annex C2** |
| **Performances**<br>Essential characteristics under shear and combined fatigue load in concrete<br>(Design method I acc. to TR 061) | |

## Table C4: Essential characteristics under tension fatigue load in concrete (Design method II acc. to TR 061)

| HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4… | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | |
| Characteristic steel resistance | $\Delta N_{Rk,s,0,\infty}$ | [kN] | 1,7 | 2,7 | 6,9 | 12,9 | 20,1 | 29,0 |
| **Combined pull-out and concrete failure in uncracked and cracked concrete** | | | | | | | | |
| Characteristic combined pull-out/concrete cone resistance | | [N/mm²] | $\Delta\tau_{Rk,p(ucr,cr),0,10^8} = 0{,}4 \cdot \tau_{Rk,(ucr,cr)}$ [1)] | | | | | |
| **Concrete cone and splitting failure in uncracked and cracked concrete** | | | | | | | | |
| Characteristic concrete cone and splitting resistance | | [kN] | $\Delta N_{Rk,(c,sp),0,\infty} = 0{,}5 \cdot N_{Rk,(c,sp)}$ [2)] | | | | | |
| Load transfer factor for fastener group | $\psi_{FN}$ | [-] | 0,50 | | | | | |

1) $\tau_{Rk,(ucr,cr)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars.
2) $N_{Rk,(c,sp)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars and EN 1992-4.

## Table C5: Essential characteristics under shear fatigue load in concrete (Design method II acc. to TR 061)

| HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4… | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | |
| Characteristic resistance | $\Delta V_{Rk,s,0,\infty}$ | [kN] | 1,7 | 2,6 | 3,8 | 7,1 | 11,1 | 16,0 |
| **Concrete pry-out failure in uncracked and cracked concrete** | | | | | | | | |
| Characteristic concrete pry-out resistance | | [kN] | $\Delta V_{Rk,cp,0,\infty} = 0{,}5 \cdot V_{Rk,cp}$ [1)] | | | | | |
| **Concrete edge failure in uncracked and cracked concrete** | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | min ($h_{ef}$; $12 \cdot d_{nom}$) | | | | | |
| Effective outside diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 |
| Characteristic concrete edge fatigue resistance | | [kN] | $\Delta V_{Rk,c,0,\infty} = 0{,}5 \cdot V_{Rk,c}$ [1)] | | | | | |
| Load transfer factor for fastener group | $\psi_{FV}$ | [-] | 0,50 | | | | | |

1) $V_{Rk,(cp,c)}$ see Annex C of the relevant ETA for the corresponding Hilti capsule and injection mortars and EN 1992-4.

## Table C6: Essential characteristics for combined fatigue load in concrete (Design method II acc. to TR 061)

| HIT-HY 200-A V3, HIT-HY 200-R V3, HIT-RE 500 V4 and HVU2 with HAS-U A4… | | | M8 | M10 | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| Exponent for combined fatigue load | $\alpha_s = \alpha_{sn}$ | [-] | 0,50 | | | 0,70 | | |
| | $\alpha_c$ | [-] | 1,5 | | | | | |

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|---|---|
| **Hilti injection system HIT-HY 200-A V3, HIT-HY 200-R V3, HIT RE 500 V4 and mortar capsule HVU2 with HAS-U** | **Annex C3** |
| **Performances**<br>Essential characteristics under tension, shear and combined fatigue load in concrete (Design method II acc. to TR 061) | |