**Deutsches Institut für Bautechnik**
**Zulassungsstelle für Bauprodukte und Bauarten**
**Bautechnisches Prüfamt**
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Authorised and notified according to Article 10 of the Council Directive of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products (89/106/EEC)

Deutsches Institut für Bautechnik DIBt

**Mitglied der EOTA**
***Member of EOTA***

# European Technical Approval ETA-07/0260

*English translation prepared by DIBt - Original version in German language*

| | |
|---|---|
| Handelsbezeichnung<br>*Trade name* | Injektionssystem Hilti HIT-RE 500-SD für gerissenen Beton<br>*Injection System Hilti HIT-RE 500-SD for cracked concrete* |
| Zulassungsinhaber<br>*Holder of approval* | Hilti Aktiengesellschaft<br>9494 SCHAAN<br>FÜRSTENTUM LIECHTENSTEIN |
| Zulassungsgegenstand und Verwendungszweck | Verbunddübel in den Größen Ø 8 mm bis Ø 32 mm zur Verankerung im Beton |
| *Generic type and use of construction product* | *Bonded anchor in the size of Ø 8 mm to Ø 32 mm for use in concrete* |
| Geltungsdauer: *Validity:* vom *from* | 26 June 2013 |
| bis *to* | 16 May 2018 |
| Herstellwerk<br>*Manufacturing plant* | Hilti Werke |



| | |
|---|---|
| Diese Zulassung umfasst<br>*This Approval contains* | 42 Seiten einschließlich 33 Anhänge<br>*42 pages including 33 annexes* |
| Diese Zulassung ersetzt<br>*This Approval replaces* | ETA-07/0260 mit Geltungsdauer vom 16.05.2013 bis 16.05.2018<br>*ETA-07/0260 with validity from 16.05.2013 to 16.05.2018* |

# I LEGAL BASES AND GENERAL CONDITIONS

1 This European technical approval is issued by Deutsches Institut für Bautechnik in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1], modified by Council Directive 93/68/EEC[2] and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council[3];
- *Gesetz über das In-Verkehr-Bringen von und den freien Warenverkehr mit Bauprodukten zur Umsetzung der Richtlinie 89/106/EWG des Rates vom 21. Dezember 1988 zur Angleichung der Rechts- und Verwaltungsvorschriften der Mitgliedstaaten über Bauprodukte und anderer Rechtsakte der Europäischen Gemeinschaften (Bauproduktengesetz - BauPG) vom 28. April 1998[4], as amended by Article 2 of the law of 8 November 2011[5];*
- Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex to Commission Decision 94/23/EC[6];
- Guideline for European technical approval of "Metal anchors for use in concrete - Part 5: Bonded anchors", ETAG 001-05.

2 Deutsches Institut für Bautechnik is authorized to check whether the provisions of this European technical approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European technical approval and for their fitness for the intended use remains with the holder of the European technical approval.

3 This European technical approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European technical approval.

4 This European technical approval may be withdrawn by Deutsches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5(1) of Council Directive 89/106/EEC.

5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of Deutsches Institut für Bautechnik. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European technical approval.

6 The European technical approval is issued by the approval body in its official language. This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.



[1] Official Journal of the European Communities L 40, 11 February 1989, p. 12
[2] Official Journal of the European Communities L 220, 30 August 1993, p. 1
[3] Official Journal of the European Union L 284, 31 October 2003, p. 25
[4] *Bundesgesetzblatt Teil I 1998*, p. 812
[5] *Bundesgesetzblatt Teil I 2011*, p. 2178
[6] Official Journal of the European Communities L 17, 20 January 1994, p. 34

# II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

## 1 Definition of product and intended use

### 1.1 Definition of the construction product

The "Injection System Hilti HIT-RE 500-SD for cracked concrete" is a bonded anchor consisting of a foil pack with injection mortar Hilti HIT-RE 500–SD and a steel element. The elements are made of zinc coated steel (threaded rods HIT-V, internal sleeve HIS-N), reinforcing bar, stainless steel (threaded rods HIT-V-R, internal sleeve HIS-RN, tension anchor HZA-R) or high corrosion resistant steel (threaded rods HIT-V-HCR).

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between steel element, injection mortar and concrete.

An illustration of the product and intended use is given in Annex 1 and 2.

### 1.2 Intended use

The anchor is intended to be used for anchorages for which requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive 89/106 EEC shall be fulfilled and failure of anchorages made with these products would cause risk to human life and/or lead to considerable economic consequences. Safety in case of fire (Essential Requirement 2) is not covered in this European technical approval.

The anchor is to be used only for anchorages subject to static or quasi-static loading in reinforced or unreinforced normal weight concrete of strength classes C20/25 at minimum and C50/60 at most according to EN 206:2000-12.

The anchor may be anchored in cracked and non-cracked concrete.

The anchor may be installed in dry or wet concrete; it must not be installed in flooded holes.

The anchor may also be used under seismic action for performance category C1 according to Annex 32.

The anchor may be used in the following temperature ranges:

| | | |
|---|---|---|
| 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 +58 °C | (max long term temperature +35 °C and max short term temperature +58 °C) |
| Temperature range III: | -40 °C to +70 °C | (max long term temperature +43 °C and max short term temperature +70 °C) |

<u>Elements made of zinc coated steel (threaded rods HIT-V, internal sleeve HIS-N):</u>

The element made of electroplated or hot-dipped galvanised steel may only be used in structures subject to dry internal conditions.

<u>Elements made of stainless steel (threaded rods HIT-V-R, internal sleeve HIS-RN, Tension anchor HZA-R):</u>

The element made of stainless steel 1.4401, 1.4404, 1.4578, 1.4571, 1.4439 or 1.4362, may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure (including industrial and marine environment), or exposure to permanently damp internal conditions, if no particular aggressive conditions exist. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Elements made of high corrosion resistant steel (threaded rods HIT-V-HCR):

The element made of high corrosion resistant steel 1.4529 or 1.4565 may be used in structures subject to dry internal conditions and also in structures subject to external atmospheric exposure, in permanently damp internal conditions or in other particular aggressive conditions. Such particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

Elements made of reinforcing bars:

Post-installed reinforcing bars may be used as anchor designed in accordance with the EOTA Technical Reports TR 029 and TR 045 only. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with post-installed reinforcing bars in concrete structures designed in accordance with EN 1992-1-1:2004 are not covered by this European technical approval.

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

## 2 Characteristics of the product and methods of verification

### 2.1 Characteristics of the product

The anchor corresponds to the drawings and provisions given in the Annexes. The characteristic material values, dimensions and tolerances of the anchor not indicated in the Annexes shall correspond to the respective values laid down in the technical documentation[7] of this European technical approval.

The characteristic values for the design of anchorages are given in the Annexes.

The two components of the injection mortar are delivered in unmixed condition in foil packs of sizes 330 ml, 500 ml or 1.400 ml according to Annex 1. Each foil pack is marked with the identifying mark "HILTI HIT-RE 500-SD", with the production date and expiry date.

Each threaded rod HIT-V is marked with the marking of steel grade and length in accordance with Annex 3. Each threaded rod made of stainless steel is marked with the additional letter "R". Each threaded rod made of high corrosion resistant steel is marked with the additional letter "HCR".

Each internal sleeve made of zinc coated steel is marked with "HIS-N" according to Annex 4. Each internal sleeve made of stainless steel is marked with "HIS-RN" according to Annex 4.

Explanations of the markings are given in the Annexes.

Elements made of reinforcing bars shall comply with the specifications given in Annex 5.

Elements made of Tension anchor HZA-R shall comply with the specifications given in Annex 6.

The marking of embedment depth may be done on jobsite.



[7] The technical documentation of this European technical approval is deposited at the Deutsches Institut für Bautechnik and, as far as relevant for the tasks of the approved bodies involved in the attestation of conformity procedure, is handed over to the approved bodies.

## 2.2 Methods of verification

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 has been made in accordance with the "Guideline for European technical approval of Metal Anchors for use in concrete", Part 1 "Anchors in general" and Part 5 "Bonded anchors", on the basis of Option 1 and ETAG 001 Annex E "Assessment of Metal Anchors under Seismic Action".

In addition to the specific clauses relating to dangerous substances contained in this European technical approval, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

# 3 Evaluation and attestation of conformity and CE marking

## 3.1 System of attestation of conformity

According to the Decision 96/582/EG of the European Commission[8] system 2(i) (referred to as System 1) of the attestation of conformity applies.

This system of attestation of conformity is defined as follows:

System 1: Certification of the conformity of the product by an approved certification body on the basis of:

(a) Tasks for the manufacturer:
  - (1) factory production control;
  - (2) further testing of samples taken at the factory by the manufacturer in accordance with a prescribed control plan;

(b) Tasks for the approved body:
  - (3) initial type-testing of the product;
  - (4) initial inspection of factory and of factory production control;
  - (5) continuous surveillance, assessment and approval of factory production control.

Note: Approved bodies are also referred to as "notified bodies".

## 3.2 Responsibilities

### 3.2.1 Tasks for the manufacturer

3.2.1.1 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall insure that the product is in conformity with this European technical approval.

The manufacturer may only use initial/raw/constituent materials stated in the technical documentation of this European technical approval.

8 Official Journal of the European Communities L 254 of 08.10.1996

The factory production control shall be in accordance with the control plan which is part of the technical documentation of this European technical approval. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Deutsches Institut für Bautechnik.[9]

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

3.2.1.2 Other tasks for the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved for the tasks referred to in section 3.1 in the field of anchors in order to undertake the actions laid down in section 3.2.2 For this purpose, the control plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the approved body involved.

The manufacturer shall make a declaration of conformity, stating that the construction product is in conformity with the provisions of this European technical approval.

### 3.2.2 Tasks for the approved bodies

The approved body shall perform the

- initial type-testing of the product,
- initial inspection of factory and of factory production control,
- continuous surveillance, assessment and approval of factory production control,

in accordance with the provisions laid down in the control plan.

The approved body shall retain the essential points of its actions referred to above and state the results obtained and conclusions drawn in a written report.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the product stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its control plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform Deutsches Institut für Bautechnik without delay.

## 3.3 CE marking

The CE marking shall be affixed on each packaging of the anchor. The letters "CE" shall be followed by the identification number of the approved certification body, where relevant, and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate of conformity for the product,
- the number of the European technical approval,
- the number of the guideline for European technical approval,
- use category (ETAG 001-1, Option 1, seismic performance category C1),
- size.



[9] The control plan is a confidential part of the European technical approval and only handed over to the approved body involved in the procedure of attestation of conformity. See section 3.2.2.

## 4 Assumptions under which the fitness of the product for the intended use was favourably assessed

### 4.1 Manufacturing

The European technical approval is issued for the product on the basis of agreed data/information, deposited at Deutsches Institut für Bautechnik, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to Deutsches Institut für Bautechnik before the changes are introduced. Deutsches Institut für Bautechnik will decide whether or not such changes affect the approval and consequently the validity of the CE marking on the basis of the approval and if so whether further assessment or alterations to the approval shall be necessary.

### 4.2 Design of anchorages

The fitness of the anchor for the intended use is given under the following conditions:

The anchorages are designed in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors"[10] and EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action" under the responsibility of an engineer experienced in anchorages and concrete work.

Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastenings in stand-off installation or with a grout layer under seismic action are not covered by this European technical approval.

Post-installed reinforcing bars may be used as anchor designed in accordance with the EOTA Technical Reports TR 029 and TR 045 only. The basic assumptions for the design according to anchor theory shall be observed. This includes the consideration of tension and shear loads and the corresponding failure modes as well as the assumption that the base material (concrete structural element) remains essentially in the serviceability limit state (either non-cracked or cracked) when the connection is loaded to failure. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the reinforcing bars act as dowels to take up shear forces. Connections with reinforcing bars in concrete structures designed in accordance with EN 1992-1-1:2004 (e.g. connection of a wall loaded with tension forces in one layer of the reinforcement with the foundation) are not covered by this European technical approval.

For the internal sleeve HIS-(R)N material and required strength class of the fastening screws or threaded rods shall be specified in accordance with Annex 7. The minimum and maximum thread engagement length $h_s$ of the fastening screw or the threaded rod for installation of the fixture shall be met the requirements according to Annex 4, Table 3. The length of the fastening screw or the threaded rod shall be determined depending on thickness of fixture, admissible tolerances, available thread length and minimum and maximum thread engagement length $h_s$.

Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.

The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).



[10] The Technical Report TR 029 "Design of Bonded Anchors" is published in English on EOTA website www.eota.eu.

## 4.3 Installation of anchors

The fitness for use of the anchor can only be assumed if the anchor is installed as follows:

- anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site,
- anchor installation in accordance with the manufacturer's specifications and drawings using the tools indicated in the technical documentation of this European technical approval,
- use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor,
- commercial standard threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled:
  - material, dimensions and mechanical properties of the metal parts according to the specifications given in Annex 7, Table 6,
  - confirmation of material and mechanical properties of the metal parts by inspection certificate 3.1 according to EN 10204:2004, the documents should be stored,
  - marking of the threaded rod with the envisage embedment depth. This may be done by the manufacturer of the rod or the person on jobsite.
- embedded reinforcing bars shall comply with specifications given in Annex 5,
- checks before placing the anchor to ensure that the strength class of the concrete in which the anchor is to be placed is in the range given and is not lower than that of the concrete to which the characteristic loads apply,
- check of concrete being well compacted, e.g. without significant voids,
- marking and keeping the effective anchorage depth,
- edge distance and spacing not less than the specified values without minus tolerances,
- positioning of the drill holes without damaging the reinforcement,
- drilling by hammer-drilling or Hilti hollow drilling only,
- in case of aborted drill hole: the drill hole shall be filled with mortar,
- the anchor must not be installed in flooded holes,
- cleaning the drill hole in accordance with Annexes 8 to 10,
- for overhead installation piston plugs shall be used, embedded parts shall be fixed during the curing time, e.g. with wedges,
- for injection of the mortar in bore holes ≥ 250 mm piston plugs shall be used,
- the anchor component installation temperature shall be at least +5 °C; during curing of the chemical mortar the temperature of the concrete must not fall below +5 °C; observing the curing time according to Annex 10, Table 7 until the anchor may be loaded,
- fastening screws or threaded rods (including nut and washer) for the internal sleeves HIS-(R)N must be made of appropriate steel grade and property class,
- installation torque moments are not required for functioning of the anchor. However, the torque moments given in Annexes 3, 4 and 6, respectively, must not be exceeded.

## 5 Recommendations concerning packaging, transport and storage

### 5.1 Responsibility of the manufacturer

It is in the responsibility of the manufacturer to ensure that the information on the specific conditions according to 1 and 2 including Annexes referred to as well as sections 4.2 and 4.3 is given to those who are concerned. This information may be made by reproduction of the respective parts of the European technical approval. In addition all installation data shall be shown clearly on the package and/or on an enclosed instruction sheet, preferably using illustration(s).

The minimum data required are:

- drill bit diameter,
- hole depth,
- diameter of anchor rod,
- minimum effective anchorage depth,
- information on the installation procedure, including cleaning of the hole with the cleaning equipments, preferably by means of an illustration,
- anchor component installation temperature,
- ambient temperature of the concrete during installation of the anchor,
- admissible processing time (open time) of the mortar,
- curing time until the anchor may be loaded as a function of the ambient temperature in the concrete during installation,
- maximum torque moment,
- identification of the manufacturing batch,

All data shall be presented in a clear and explicit form.

### 5.2 Packaging, transport and storage

The foil packs shall be protected against sun radiation and shall be stored according to the manufacturer's installation instructions in dry condition at temperatures of at least +5 °C to not more than +25 °C.

Foil packs with expired shelf life must no longer be used.

The anchor shall only be packaged and supplied as a complete unit. Foil packs may be packed separately from steel elements.

Uwe Bender
Head of Department

*beglaubigt:*
Lange

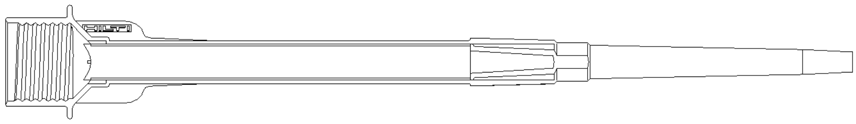
## Injection mortar Hilti HIT-RE 500-SD: Epoxy resin system with aggregate

### Foil pack 330ml, 500ml and 1.400ml

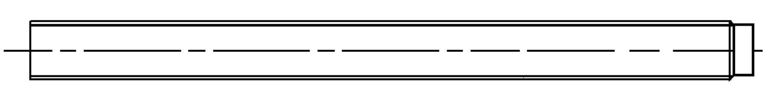
Marking
HILTI HIT
Production date
Production time and line
Expiry date mm/yyyy

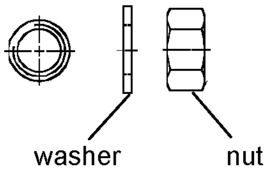
Product name: “Hilti HIT-RE 500-SD”

### Static Mixer HILTI HIT-RE-M

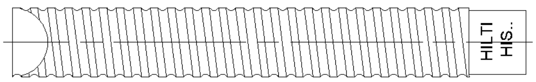


### Steel elements

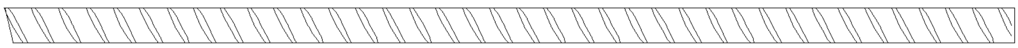




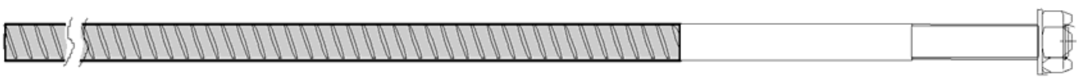

**Threaded rod HIT-V-...**
thread sizes M8, M10, M12, M16, M20, M24, M27 or M30




**Internal sleeve HIS-(R)N...**
thread sizes M8, M10, M12, M16 or M20



**Deformed carbon steel bars for concrete reinforcement (rebar)**
Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø26, Ø28, Ø30 or Ø32



**Hilti Tension anchor HZA-R** M12, M16, M20 or M24

| Injection system Hilti HIT-RE 500-SD | Annex 1 |
|---|---|
| Product | |

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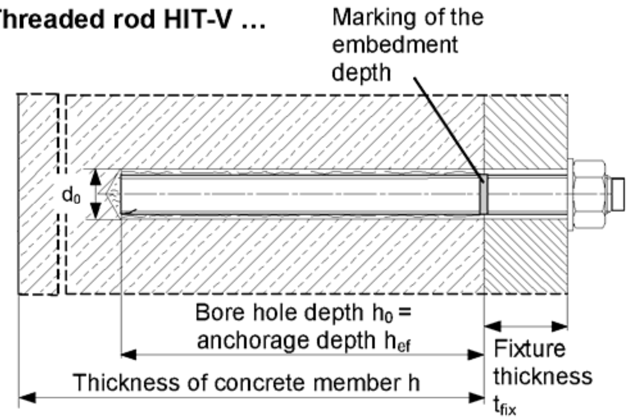
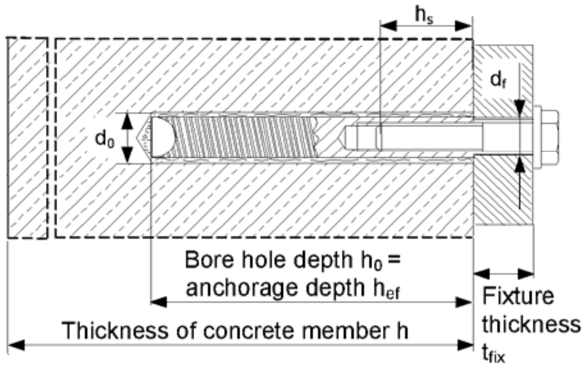
## Installed anchor

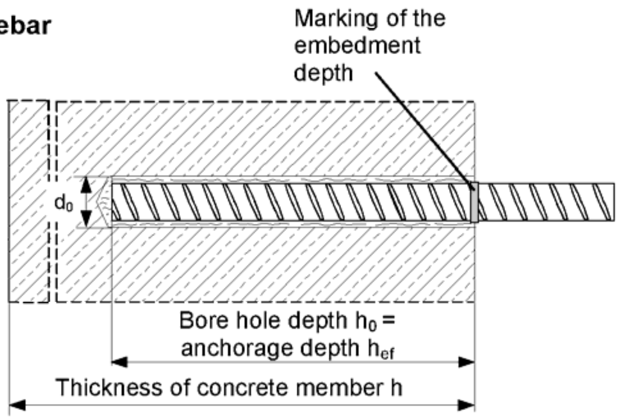
**Threaded rod HIT-V …**




**Internal sleeve HIS-(R)N**




**rebar**




## Table 1: Use category

| | | Drilling method | | HIT-RE 500-SD with … | | | |
|---|---|---|---|---|---|---|---|
| | | Hilti hollow drill bit | Hammer drilling | HIT-V … | Rebar | HIS-(R)N | HZA-R |
| Static and quasi static loading, in cracked and non-cracked concrete | | ✓ | ✓ | Annex 12, 13, 14 | Annex 15, 16, 17 | Annex 18, 19, 20 | Annex 21, 22, 23 |
| Seismic performance category C1 | | ✓ | ✓ | Annex 24, 25 | Annex 26, 27 | Annex 28, 29 | Annex 30, 31 |
| Use category: dry or wet concrete | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Installation temperature | | +5°C to +40°C | | | | | |
| In-service temperature | 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 +58°C | (max long term temperature +35°C and max short term temperature +58°C) | | | | |
| | Temperature range III: | -40°C to +70°C | (max long term temperature +43°C and max short term temperature +70°C) | | | | |

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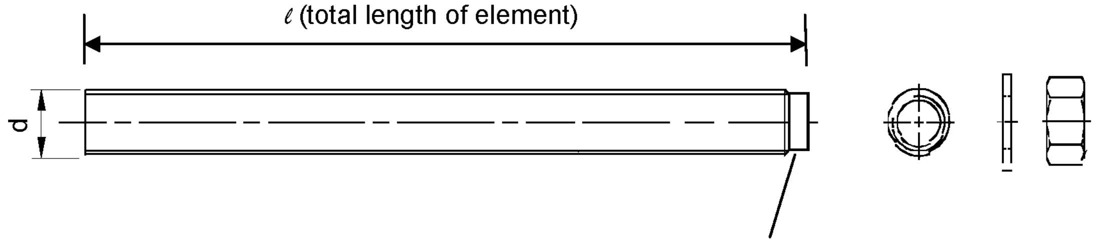
## Table 2: Installation data: threaded rod HIT-V-…

| **HIT-RE 500-SD with HIT-V-…** | | | **M8** | **M10** | **M12** | **M16** | **M20** | **M24** | **M27** | **M30** |
|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of element | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Range of effective anchorage depth $h_{ef}$ and depth of drilled hole $h_0$ | min | [mm] | 40 | 40 | 48 | 64 | 80 | 96 | 108 | 120 |
| | max | [mm] | 160 | 200 | 240 | 320 | 400 | 480 | 540 | 600 |
| Nominal diameter of drill bit | $d_0$ | [mm] | 10 | 12 | 14 | 18 | 24 | 28 | 30 | 35 |
| Diameter of clearance hole in the fixture [1)] | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 | 30 | 33 |
| Maximum torque moment | $T_{max}$ | [Nm] | 10 | 20 | 40 | 80 | 150 | 200 | 270 | 300 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | | $h_{ef} + 2 \times d_0$ | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 80 | 100 | 120 | 135 | 150 |

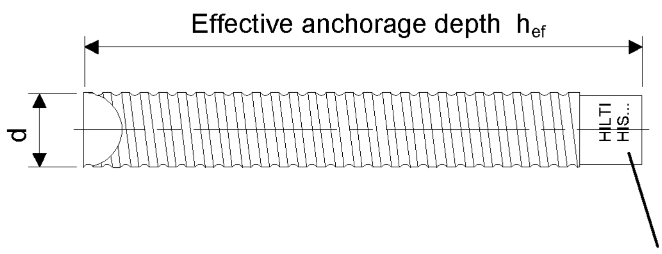
1) for larger clearance hole in the fixture see TR 029 section 1.1




**Head marking:**
5.8 - ℓ = HIT-V-5.8 M…x ℓ
5.8F - ℓ = HIT-V-5.8F M…x ℓ
8.8 - ℓ = HIT-V-8.8 M…x ℓ
8.8F - ℓ = HIT-V-8.8F M…x ℓ
R - ℓ = HIT-V-R M ...x ℓ
HCR - ℓ = HIT-V-HCR M ...x ℓ

## Table 3: Installation data: internal sleeve HIS-(R)N

| HIT-RE 500-SD with HIS-(R)N ... | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Diameter of element | d | [mm] | 12,5 | 16,5 | 20,5 | 25,4 | 27,6 |
| Effective anchorage depth | $h_{ef}$ | [mm] | 90 | 110 | 125 | 170 | 205 |
| Nominal diameter of drill bit | $d_0$ | [mm] | 14 | 18 | 22 | 28 | 32 |
| Depth of drilled hole | $h_0$ | [mm] | 90 | 110 | 125 | 170 | 205 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 |
| Maximum torque moment | $T_{max}$ | [Nm] | 10 | 20 | 40 | 80 | 150 |
| Thread engagement length min-max | $h_s$ | [mm] | 8-20 | 10-25 | 12-30 | 16-40 | 20-50 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | 120 | 150 | 170 | 230 | 270 |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 45 | 55 | 65 | 90 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 45 | 55 | 65 | 90 |




**Marking:**
Identifying mark - HILTI and
embossing "HIS-N" (for C-steel)
embossing "HIS-RN" (for stainless steel)



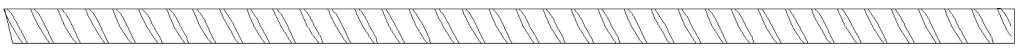
| Injection system Hilti HIT-RE 500-SD | Annex 4 |
|---|---|
| Installation data<br>Internal sleeve HIS-(R)N | |

## Table 4: Installation data: anchor element rebar

| HIT-RE 500-SD with rebar … | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of element | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 25 | 26 | 28 | 30 | 32 |
| Range of effective anchorage depth $h_{ef}$ and depth of drilled hole $h_0$ | min | [mm] | 60 | 60 | 70 | 80 | 80 | 90 | 100 | 104 | 115 | 120 | 130 |
| | max | [mm] | 160 | 200 | 240 | 280 | 320 | 400 | 500 | 520 | 540 | 600 | 660 |
| Nominal diameter of drill bit | $d_0$ | [mm] | 10<br>12[1)] | 12<br>14[1)] | 14<br>16[1)] | 18 | 20 | 25 | 32 | 32 | 35 | 37 | 40 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{ef}$ + 30 mm<br>≥ 100 mm | | | $h_{ef}$ + 2 x $d_0$ | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 125 | 130 | 140 | 150 | 160 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 50 | 60 | 70 | 80 | 100 | 125 | 130 | 140 | 150 | 160 |

1) Each of the two given values can be used

### Rebar



### Refer to EN1992-1-1 Annex C Table C.1 and C.2N Properties of reinforcement:

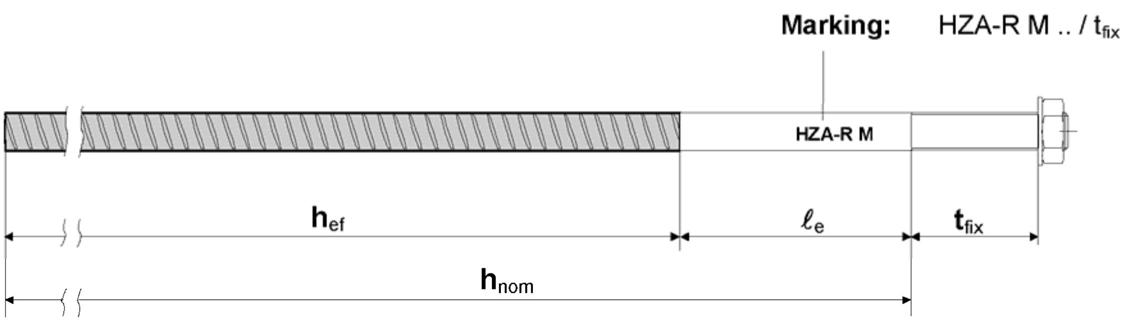
| Product form | | Bars and de-coiled rods | |
|---|---|---|---|
| Class | | B | C |
| Characteristic yield strength $f_{yk}$ or $f_{0,2k}$ (MPa) | | 400 to 600 | |
| Minimum value of $k = (f_t/f_y)k$ | | ≥ 1,08 | ≥ 1,15<br>< 1,35 |
| Characteristic strain at maximum force, $\varepsilon_{uk}$ (%) | | ≥ 5,0 | ≥ 7,5 |
| Bendability | | Bend / Rebend test | |
| Maximum deviation from nominal mass (individual bar) (%) | Nominal bar size (mm)<br>≤ 8<br>> 8 | <br>± 6,0<br>± 4,5 | |
| Bond: Minimum relative rib area, $f_{R,min}$ (determination according to EN 15630) | Nominal bar size (mm)<br>8 to 12<br>> 12 | <br>0,040<br>0,056 | |

### Height of the rebar rib $h_{rib}$:

The height of the rebar rib $h_{rib}$ shall fulfill the following requirement: $0,05 * d \leq h_{rib} \leq 0,07 * d$
with: d = nominal diameter of the rebar element

## Table 5: Installation data: Hilti tension anchor HZA-R

| HIT-RE 500-SD with HZA-R ... | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Diameter of the reinforcement bar | $d$ | [mm] | 12 | 16 | 20 | 25 |
| Range of embedment depth $h_{nom}$ and depth of drilled hole $h_0$ | min | [mm] | 170 | 180 | 190 | 200 |
| | max | [mm] | 240 | 320 | 400 | 500 |
| Effective anchorage depth | $h_{ef}$ | [mm] | $h_{nom}$ – 100 mm | | | |
| Length of smooth shaft | $\ell_e$ | [mm] | 100 | | | |
| Nominal diameter of drill bit | $d_0$ | [mm] | 16 | 20 | 25 | 32 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 14 | 18 | 22 | 26 |
| Maximum torque moment | $T_{max}$ | [Nm] | 40 | 80 | 150 | 200 |
| Minimum thickness of concrete member | $h_{min}$ | [mm] | $h_{nom} + 2 \times d_o$ | | | |
| Minimum spacing | $s_{min}$ | [mm] | 60 | 80 | 100 | 120 |
| Minimum edge distance | $c_{min}$ | [mm] | 60 | 80 | 100 | 120 |






| Injection system Hilti HIT-RE 500-SD | Annex 6 |
|---|---|
| Installation data<br>Hilti tension anchor HZA-R | |

## Table 6: Materials

| Designation | Material |
|---|---|
| **Metal parts made of rebar** | |
| Rebar | See Annex 5 |
| **Metal parts made of zinc coated steel** | |
| Threaded rod HIT-V-5.8(F) | Strength class 5.8 ,$R_m$ = 500 N/mm²; $R_{p\,0,2}$ = 400 N/mm², A5 > 8% Ductile<br>Steel galvanized ≥ 5µm EN ISO 4042<br>(F) hot dipped galvanized ≥ 45µm EN ISO 10684 |
| Threaded rod HIT-V-8.8(F) | Strength class 8.8 ,$R_m$ = 800 N/mm²; $R_{p\,0,2}$ = 640 N/mm², A5 > 8% Ductile<br>Steel galvanized ≥ 5µm EN ISO 4042<br>(F) hot dipped galvanized ≥ 45µm EN ISO 10684 |
| Washer ISO 7089 | Steel galvanized EN ISO 4042; hot dipped galvanized EN ISO 10684 |
| Nut EN ISO 4032 | Strength class 8 ISO 898-2<br>Steel galvanized ≥ 5µm EN ISO 4042; hot dipped galvanized ≥ 45µm EN ISO 10684 |
| Internally threaded Sleeves [1)] HIS-N | Carbon steel 1.0718, EN 10277-3<br>Steel galvanized ≥ 5µm EN ISO 4042 |
| **Metal parts made of stainless steel** | |
| Threaded rod HIT-V-R | For ≤ M24: strength class 70 ,$R_m$ = 700 N/mm²; $R_{p\,0,2}$ = 450 N/mm²; A5 > 8% Ductile<br>For > M24: strength class 50 ,$R_m$ = 500 N/mm²; $R_{p\,0,2}$ = 210 N/mm²; A5 > 8% Ductile<br>Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 |
| Washer ISO 7089 | Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 |
| Nut EN ISO 4032 | Strength class 70 EN ISO 3506-2<br>Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 |
| Internally threaded sleeves [2)] HIS-RN | Stainless steel 1.4401 and 1.4571 EN 10088 |
| Hilti tension anchor HZA-R | Round steel smooth with thread: stainless steel 1.4404, 1.4362 and 1.4571 EN 10088<br>Rebar B500-B acc. DIN 488-1:2009 and DIN 488-2:2009 |
| Washer ISO 7089 | Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 |
| Nut EN ISO 4032 | Strength class 70 EN ISO 3506-2<br>Stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088 |
| **Metal parts made of high corrosion resistant steel** | |
| Threaded rod HIT-V-HCR | For ≤ M20: $R_m$ = 800 N/mm²; $R_{p\,0,2}$ = 640 N/mm², A5 > 8% Ductile<br>For > M20: $R_m$ = 700 N/mm²; $R_{p\,0,2}$ = 400 N/mm², A5 > 8% Ductile<br>High corrosion resistant steel 1.4529, 1.4565 EN 10088 |
| Washer ISO 7089 | High corrosion resistant steel 1.4529, 1.4565 EN 10088 |
| Nut EN ISO 4032 | Strength class 70 EN ISO 3506-2<br>High corrosion resistant steel 1.4529, 1.4565 EN 10088 |

1) related fastening screw: strength class 8.8 EN ISO 898-1, A5 > 8% Ductile, steel galvanized ≥ 5µm EN ISO 4042
2) related fastening screw: strength class 70 EN ISO 3506-1, A5 > 8% Ductile, stainless steel 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088



**Injection system Hilti HIT-RE 500-SD**

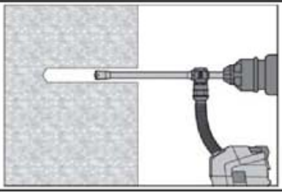
**Materials**

**Annex 7**

## Instruction for use

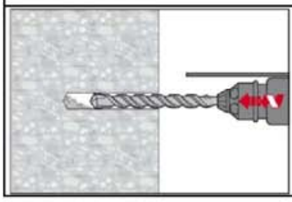
### Bore hole drilling

**a) Hilti Hollow drill bit**



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 bore hole during drilling when used in accordance with the user's manual.
After drilling is complete, proceed to the "injection preparation" step in the instructions for use.

**b) Hammer drilling**

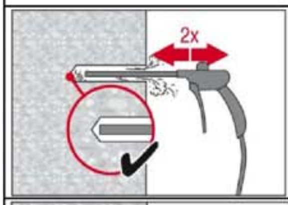


Drill hole to the required embedment depth with a hammer drill set in rotation-hammer mode using an appropriately sized carbide drill bit.

### Bore hole cleaning

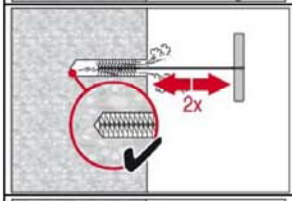
Just before setting an anchor, the bore hole must be free of dust and debris.

**Compressed air cleaning (CAC)** for all bore hole diameters $d_0$ and all bore hole depth $h_0$



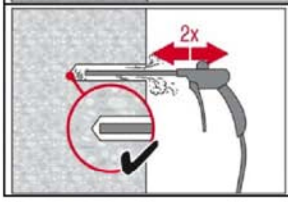

Blow 2 times from the back of the hole (if needed with nozzle extension) over the hole length with oil-free compressed air (min. 6 bar at 6 m³/h) until return air stream is free of noticeable dust.

Borehole diameter ≥ 32 mm the compressor must supply a minimum air flow of 140 m³/hour.



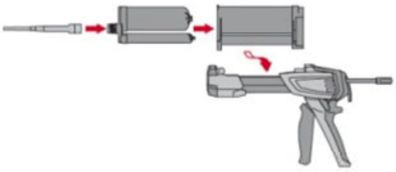

Brush 2 times with the specified brush size (brush Ø ≥ bore hole Ø, see Table 8) by inserting the steel brush Hilti HIT-RB to the back of the hole (if needed with extension) in a twisting motion and removing it.

The brush must produce natural resistance as it enters the bore hole -- if not the brush is too small and must be replaced with the proper brush diameter.

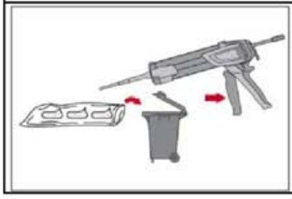



Blow again with compressed air 2 times until return air stream is free of noticeable dust.

## Injection preparation



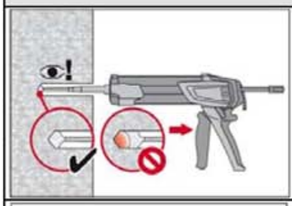
Tightly attach new Hilti mixing nozzle HIT-RE-M to foil pack manifold (snug fit). Do not modify the mixing nozzle.
Observe the instruction for use of the dispenser and the mortar.
Check foil pack holder for proper function. Do not use damaged foil packs / holders.
Insert foil pack into foil pack holder and put holder into HIT-dispenser.



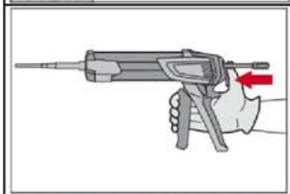
The foil pack opens automatically as dispensing is initiated. Discard initial adhesive. Depending on the size of the foil pack an initial amount of adhesive has to be discarded.

| | | |
|---|---|---|
| Discard quantities are | 3 strokes | for 330 ml foil pack, |
| | 4 strokes | for 500 ml foil pack, |
| | 65 ml | for 1400 ml foil pack |

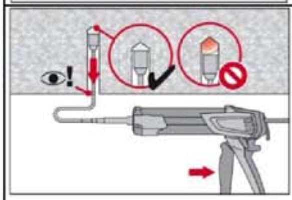
## **Inject adhesive** from the back of the borehole without forming air voids



Inject the adhesive starting at the back of the hole, slowly withdrawing the mixer with each trigger pull.
Fill holes approximately 2/3 full. It is required 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.



Overhead installation and/or installation with embedment depth $h_{ef}$ > 250mm.

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 (see Table 8). Insert piston plug to back of the hole and inject adhesive. During injection the piston plug will be naturally extruded out of the bore hole by the adhesive pressure.

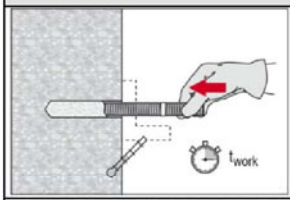
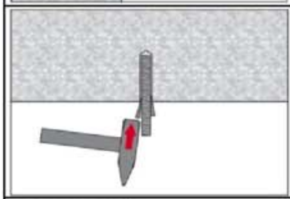
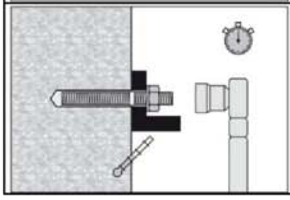
| Setting the element | |
|---|---|
|  | Before use, verify that the element is dry and free of oil and other contaminants.<br>Mark and set element to the required embedment depth until working time $t_{work}$ has elapsed. The working time $t_{work}$ is given in Table 7. |
|  | For overhead installation use piston plugs and fix embedded parts with e.g. wedges HIT-OHW. |
|  | Loading the anchor:<br>After required curing time $t_{cure}$ (see Table 7) the anchor can be loaded.<br>The applied installation torque shall not exceed the values $T_{max}$ given in Tables 2, 3 and 5. |

**Table 7: Working time $t_{work}$ and minimum curing time $t_{cure}$**

| Temperature in the anchorage base | Maximum working time $t_{work}$ | Minimum curing time $t_{cure}$ |
|---|---|---|
| [°C] | [min] | [h] |
| 5 to 9 | 120 | 72 |
| 10 to 14 | 90 | 48 |
| 15 to 19 | 30 | 24 |
| 20 to 29 | 20 | 12 |
| 30 to 39 | 12 | 8 |
| 40 | 12 | 4 |

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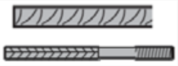
## Table 8: Borehole diameter specific installation tools

| Elements | | | Drill and clean | | | Installation |
|---|---|---|---|---|---|---|
| HIT-V ... | HIS-N | Rebar - HZA(-R) | Hilti hollow drill bit TE-CD TE-YD | Hammer drilling TE-C TE-Y | Brush | Piston plug |
|  |  |  |  |  |  |  |
| [mm] | [mm] | [mm] | $d_0$ [mm] | $d_0$ [mm] | HIT-RB | HIT-SZ |
| 8 | - | 8 | - | 10 | 10 | - |
| 10 | - | 8 / 10 | 12 | 12 | 12 | 12 |
| 12 | 8 | 10 / 12 | 14 | 14 | 14 | 14 |
| - | - | 12 | 16 | 16 | 16 | 16 |
| 16 | 10 | 14 | 18 | 18 | 18 | 18 |
| - | - | 16 | 20 | 20 | 20 | 20 |
| - | 12 | - | 22 | 22 | 22 | 22 |
| 20 | - | - | 24 | 24 | 24 | 24 |
| - | - | 20 | 25 | 25 | 25 | 25 |
| 24 | 16 | - | 28 | 28 | 28 | 28 |
| 27 | - | - | - | 30 | 30 | 30 |
| - | 20 | 25 / 26 | 32 | 32 | 32 | 32 |
| 30 | - | 28 | - | 35 | 35 | 35 |
| - | - | 30 | - | 37 | 37 | 37 |
| - | - | 32 | - | 40 | 40 | 40 |

## Cleaning alternatives

**Automatic cleaning with Hilti hollow drill bit:**
Cleaning is performed during drilling with Hilti TE-CD and TE-YD drilling system including vacuum cleaner.

**Compressed air cleaning (CAC):**
Air nozzle with an orifice opening of minimum 3,5 mm in diameter.



| Injection system Hilti HIT-RE 500-SD | Annex 11 |
|---|---|
| Borehole diameter specific installation tools, Cleaning alternatives | |

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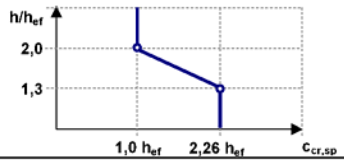
## Table 9: Characteristic tension resistance of threaded rod HIT-V for static and quasi-static loading

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | |
| Char. resistance HIT-V-5.8(F) | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 79 | 123 | 177 | 230 | 281 |
| Char. resistance HIT-V-8.8(F) | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 282 | 367 | 449 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,5 | | | | | | | |
| Char. resistance HIT-V-R | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 | 172 | 247 | 230 | 281 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,87 | | | | | | 2,86 | |
| Char. resistance HIT-V-HCR | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 247 | 321 | 393 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,5 | | | | 2,1 | | | |
| **Combined pullout and concrete cone failure** [4] | | | | | | | | | | |
| Diameter of element | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 16 | 16 | 15 | 15 | 14 | 14 | 13 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,ucr}$ | [N/mm²] | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 11 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,ucr}$ | [N/mm²] | 8 | 8 | 8 | 7,5 | 7 | 7 | 6,5 | 6,5 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,cr}$ | [N/mm²] | 8 | 8 | 7,5 | 7 | 7 | 7 | 6,5 | 6 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,cr}$ | [N/mm²] | 6,5 | 6 | 6 | 6 | 5,5 | 5,5 | 5 | 5 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,cr}$ | [N/mm²] | 4 | 3,5 | 3,5 | 3,5 | 3 | 3 | 3 | 3 |
| Increasing factors for $\tau_{Rk}$ | $\psi_c$ | C30/37 | 1,04 | | | | | | | |
| | | C40/50 | 1,07 | | | | | | | |
| | | C50/60 | 1,09 | | | | | | | |
| **Splitting failure** [4] | | | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | | $h / h_{ef}$ [6] $\geq 2{,}0$ | $1{,}0 \cdot h_{ef}$ | | | | | | | |
| | | $2{,}0 > h / h_{ef}$ [6] $> 1{,}3$ | $4{,}6\, h_{ef} - 1{,}8\, h$ | | | | | | | |
| | | $h / h_{ef}$ [6] $\leq 1{,}3$ | $2{,}26\, h_{ef}$ | | | | | | | |
| Spacing | $s_{cr,sp}$ | [mm] | $2 \times c_{cr,sp}$ | | | | | | | |
| **Partial safety factors for combined pullout, concrete cone and splitting failure** | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] | [-] | 1,8 [2] | | | 2,1 [3] | | | | |




[1] In absence of other national regulations
[2] The partial safety factor $\gamma_2$ = 1,2 is included.
[3] The partial safety factor $\gamma_2$ = 1,4 is included.
[4] Calculation of concrete failure and splitting see chapter 4.2.1
[5] Explanation in chapter 1.2
[6] h = base material thickness; $h_{ef}$ = anchorage depth

## Table 10: Characteristic shear resistance of threaded rod HIT-V for static and quasi-static loading

| HIT-RE 500-SD with HIT-V... | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** [3] | | | | | | | | | | |
| Char. resistance HIT-V-5.8(F) | $V_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 | 61 | 88 | 115 | 140 |
| Char. resistance HIT-V-8.8(F) | $V_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 | 184 | 224 |
| Char. resistance HIT-V-R | $V_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 86 | 124 | 115 | 140 |
| Characteristic resistance HIT-V-HCR | $V_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 124 | 161 | 196 |
| **Steel failure with lever arm** | | | | | | | | | | |
| Char. resistance HIT-V-5.8(F) | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 66 | 167 | 325 | 561 | 832 | 1125 |
| Characteristic resistance HIT-V-8.8(F) | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 266 | 519 | 898 | 1332 | 1799 |
| Characteristic resistance HIT-V-R | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 233 | 454 | 786 | 832 | 1124 |
| Characteristic resistance HIT-V-HCR | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 266 | 520 | 786 | 1165 | 1574 |
| **Partial safety factors for steel failure** | | | | | | | | | | |
| HIT-V-5.8(F) or HIT-V-8.8 (F) | $\gamma_{Ms,V}$ [1] | [-] | 1,25 | | | | | | | |
| HIT-V-R | $\gamma_{Ms,V}$ [1] | [-] | 1,56 | | | | | | 2,38 | |
| HIT-V-HCR | $\gamma_{Ms,V}$ [1] | [-] | 1,25 | | | | | 1,75 | | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Factor in equation (5.7) of Technical Report TR 029 for the design of bonded anchors | k | [-] | 1,0 ($h_{ef}$ < 60mm)<br>2,0 ($h_{ef} \geq$ 60mm) | | | | | | | |
| Partial safety factor | $\gamma_{Mcp,V}$ [1] | [-] | 1,5 [2] | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | |
| See chapter 5.2.3.4 of Technical Report TR 029 for the design of bonded anchors | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ | [-] | 1,5 [2] | | | | | | | |

1) In absence of national regulations
2) The partial safety factor $\gamma_2$ = 1,0 is included.
3) Acc. to chapter 4.2.2 commercial standard rods that fulfill the ductility requirement $A_5$ > 8% (see table 6) can be used only

## Table 11: Displacements under tension load[1)] of anchor rod HIT-V for static and quasi-static loading

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| Non-cracked concrete, temperature range I[2)]: 40°C/24°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,02 | 0,02 | 0,03 | 0,04 | 0,05 | 0,06 | 0,06 | 0,07 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,04 | 0,05 | 0,06 | 0,08 | 0,11 | 0,13 | 0,15 | 0,17 |
| Non-cracked concrete, temperature range II[2)]: 58°C/35°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,04 | 0,05 | 0,07 | 0,09 | 0,11 | 0,13 | 0,14 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,07 | 0,09 | 0,10 | 0,14 | 0,18 | 0,22 | 0,25 | 0,28 |
| Non-cracked concrete, temperature range III[2)]: 70°C/43°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,07 | 0,09 | 0,10 | 0,14 | 0,18 | 0,22 | 0,25 | 0,28 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,09 | 0,12 | 0,15 | 0,20 | 0,26 | 0,31 | 0,35 | 0,40 |
| Cracked concrete, temperature range I[2)]: 40°C/24°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,04 | 0,05 | 0,05 | 0,06 | 0,07 | 0,08 | 0,08 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,23 | | | | | | | |
| Cracked concrete, temperature range II[2)]: 58°C/35°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,07 | 0,08 | 0,09 | 0,11 | 0,13 | 0,14 | 0,15 | 0,17 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,38 | | | | | | | |
| Cracked concrete, temperature range III[2)]: 70°C/43°C | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,14 | 0,16 | 0,18 | 0,22 | 0,25 | 0,28 | 0,31 | 0,33 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,54 | | | | | | | |

1) Calculation of displacement under service load: $\tau_{Sd}$ design value of bond stress
Displacement under short term loading = $\delta_{N0} \times \tau_{Sd} / 1,4$
Displacement under long term loading = $\delta_{N\infty} \times \tau_{Sd} / 1,4$
2) Explanation see chapter 1.2

## Table 12: Displacements under shear load[1)] of anchor rod HIT-V for static and quasi-static loading

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$ | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 |

1) Calculation of displacement under service load: $V_{sd}$ design value of shear load
Displacement under short term loading = $\delta_{V0} \times V_{Sd} / 1,4$
Displacement under long term loading = $\delta_{V\infty} \times V_{Sd} / 1,4$

| Injection system Hilti HIT-RE 500-SD | Annex 14 |
|---|---|
| **Displacements of threaded rod HIT-V for static and quasi-static loading** | |

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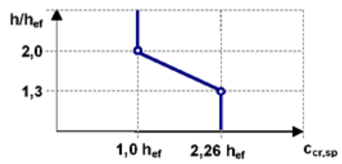
## Table 13: Characteristic tension resistance of rebar for static and quasi-static loading

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | | |
| Characteristic resistance for rebar B500B acc. to DIN 488:2009-08 [7] | $N_{Rk,s}$ | [kN] | 28 | 43 | 62 | 85 | 111 | 173 | 270 | - | 339 | - | 442 |
| Partial safety factor for rebar B500B acc. to DIN 488:2009-08 [8] | $\gamma_{Ms,N}$ [1] | [-] | 1,4 | | | | | | | - | 1,4 | - | 1,4 |
| **Combined pullout and concrete cone failure** [4] | | | | | | | | | | | | | |
| Diameter of element | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 25 | 26 | 28 | 30 | 32 |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 15 | 15 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,ucr}$ | [N/mm²] | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 10 | 10 | 10 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,ucr}$ | [N/mm²] | 7 | 7 | 7 | 7 | 7 | 6,5 | 6,5 | 6,5 | 6 | 6 | 6 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,cr}$ | [N/mm²] | 8 | 8 | 7,5 | 7 | 7 | 7 | 7 | 7 | 6,5 | 6 | 6 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,cr}$ | [N/mm²] | 6,5 | 6,5 | 6 | 6 | 6 | 5,5 | 5,5 | 5,5 | 5 | 5 | 5 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,cr}$ | [N/mm²] | 4 | 3,5 | 3,5 | 3,5 | 3,5 | 3 | 3 | 3 | 3 | 3 | 3 |
| Increasing factors for $\tau_{Rk}$ | $\psi_c$ | C30/37 | 1,04 | | | | | | | | | | |
| | | C40/50 | 1,07 | | | | | | | | | | |
| | | C50/60 | 1,09 | | | | | | | | | | |
| **Splitting failure** [4] | | | | | | | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | | $h / h_{ef}$ [6] $\geq 2,0$ | $1,0 \cdot h_{ef}$ | | | | | | | | | | |
| | | $2,0 > h / h_{ef}$ [6] $> 1,3$ | $4,6\, h_{ef} - 1,8\, h$ | | | | | | | | | | |
| | | $h / h_{ef}$ [6] $\leq 1,3$ | $2,26\, h_{ef}$ | | | | | | | | | | |
| Spacing | $s_{cr,sp}$ | [mm] | $2 \times c_{cr,sp}$ | | | | | | | | | | |
| **Partial safety factors for combined pullout, concrete cone and splitting failure** | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] | [-] | 1,8 [2] | | | | 2,1 [3] | | | | | | |




1) In absence of other national regulations
2) The partial safety factor $\gamma_2 = 1,2$ is included.
3) The partial safety factor $\gamma_2 = 1,4$ is included.
4) Calculation of concrete failure and splitting see chapter 4.2.1
5) Explanation in section 1.2
6) h = base material thickness; $h_{ef}$ = anchorage depth
7) The characteristic tension resistance $N_{Rk,s}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (5.1)
8) The partial safety factor $\gamma_{Ms,N}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (3.3a)



| Injection system Hilti HIT-RE 500-SD | Annex 15 |
|---|---|
| Characteristic tension resistance of rebar for static and quasi-static loading | |

## Table 14: Characteristic shear resistance of rebar for static and quasi-static loading

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | | | | |
| Characteristic resistance for rebar B500B acc. to DIN 488:2009-08 [3] | $V_{Rk,s}$ | [kN] | 14 | 22 | 31 | 42 | 55 | 86 | 135 | - | 169 | - | 221 |
| **Steel failure with lever arm** | | | | | | | | | | | | | |
| Characteristic resistance for rebar B500B acc. to DIN 488:2009-08 [4] | $M^0_{Rk,s}$ | [Nm] | 33 | 65 | 112 | 178 | 265 | 518 | 1012 | - | 1422 | - | 2123 |
| **Partial safety factors for steel failure** | | | | | | | | | | | | | |
| Partial safety factor for rebar B500B acc. to DIN 488:2009-08 [5] | $\gamma_{Ms,V}$ [1] | [-] | 1,5 | | | | | | | - | 1,5 | - | 1,5 |
| **Concrete pry-out failure** | | | | | | | | | | | | | |
| Factor in equation (5.7) of Technical Report TR 029 for the design of bonded anchors | k | [-] | 2,0 | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mcp}$ [1] | [-] | 1,5 [2] | | | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | | | |
| See chapter 5.2.3.4 of Technical Report TR 029 for the design of bonded anchors | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1] | [-] | 1,5 [2] | | | | | | | | | | |

1) In absence of national regulations
2) The partial safety factor $\gamma_2$ = 1,0 is included.
3) The characteristic shear resistance $V_{Rk,s}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (5.5)
4) The characteristic bending resistance $M^0_{Rk,s}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (5.6b)
5) The partial safety factor $\gamma_{Ms,V}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (3.3b) or (3.3c)

## Table 15: Displacements under tension load [1] of rebar for static and quasi-static loading

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Non-cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,02 | 0,02 | 0,03 | 0,03 | 0,04 | 0,05 | 0,06 | 0,07 | 0,07 | 0,08 | 0,08 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,04 | 0,05 | 0,06 | 0,07 | 0,08 | 0,11 | 0,14 | 0,14 | 0,15 | 0,17 | 0,18 |
| Non-cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,04 | 0,05 | 0,06 | 0,07 | 0,09 | 0,12 | 0,12 | 0,13 | 0,14 | 0,15 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,07 | 0,09 | 0,10 | 0,12 | 0,14 | 0,18 | 0,23 | 0,24 | 0,26 | 0,28 | 0,30 |
| Non-cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,07 | 0,09 | 0,10 | 0,12 | 0,14 | 0,18 | 0,23 | 0,24 | 0,26 | 0,28 | 0,30 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,09 | 0,12 | 0,15 | 0,17 | 0,20 | 0,26 | 0,33 | 0,34 | 0,37 | 0,40 | 0,43 |
| Cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,04 | 0,05 | 0,05 | 0,05 | 0,06 | 0,07 | 0,07 | 0,08 | 0,09 | 0,09 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,23 | | | | | | | | | | |
| Cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,07 | 0,08 | 0,09 | 0,10 | 0,11 | 0,13 | 0,15 | 0,15 | 0,16 | 0,17 | 0,17 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,38 | | | | | | | | | | |
| Cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,14 | 0,16 | 0,18 | 0,20 | 0,22 | 0,25 | 0,29 | 0,30 | 0,32 | 0,34 | 0,35 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,54 | | | | | | | | | | |

[1] Calculation of displacement under service load: $\tau_{Sd}$ design value of bond stress
Displacement under short term loading = $\delta_{N0} \times \tau_{Sd} / 1,4$
Displacement under long term loading = $\delta_{N\infty} \times \tau_{Sd} / 1,4$
[2] Explanation see chapter 1.2

## Table 16: Displacements under shear load [1] of rebar for static and quasi-static loading

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,06 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$ | [mm/kN] | 0,09 | 0,08 | 0,07 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 |

[1] Calculation of displacement under service load: $V_{Sd}$ design value of shear load
Displacement under short term loading = $\delta_{V0} \times V_{Sd} / 1,4$
Displacement under long term loading = $\delta_{V\infty} \times V_{Sd} / 1,4$

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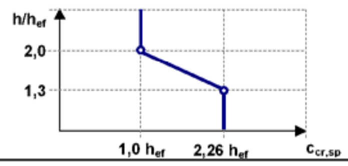
## Table 17: Characteristic tension resistance of internal threaded sleeve HIS-(R)N for static and quasi-static loading

| HIT-RE 500-SD with HIS-(R)N ... | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | |
| Char. resistance HIS-N with screw grade 8.8 | $N_{Rk,s}$ | [kN] | 25 | 46 | 67 | 118 | 109 |
| Partial safety factor | $\gamma_{Ms,N}$ 1) | [-] | 1,43 | 1,5 | | 1,47 | |
| Char. resistance HIS-RN with screw grade 70 | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 | 166 |
| Partial safety factor | $\gamma_{Ms,N}$ 1) | [-] | 1,87 | | | | 2,4 |
| **Combined pullout and concrete cone failure** 4) + 7) | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 90 | 110 | 125 | 170 | 205 |
| Diameter of element | d | [mm] | 12,5 | 16,5 | 20,5 | 25,4 | 27,6 |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | |
| Temp. range I 5): 40°C/24°C | $N_{Rk,ucr}$ 7) | [kN] | 40 | 60 | 95 | 170 | 200 |
| Temp. range II 5): 58°C/35°C | $N_{Rk,ucr}$ 7) | [kN] | 35 | 50 | 75 | 140 | 170 |
| Temp. range III 5): 70°C/43°C | $N_{Rk,ucr}$ 7) | [kN] | 20 | 30 | 40 | 75 | 95 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | |
| Temp. range I 5): 40°C/24°C | $N_{Rk,cr}$ 7) | [kN] | 25 | 40 | 60 | 95 | 115 |
| Temp. range II 5): 58°C/35°C | $N_{Rk,cr}$ 7) | [kN] | 20 | 35 | 40 | 75 | 95 |
| Temp. range III 5): 70°C/43°C | $N_{Rk,cr}$ 7) | [kN] | 12 | 20 | 25 | 40 | 50 |
| Increasing factors for $N_{Rk,p}$ | $\psi_c$ | C30/37 | 1,04 | | | | |
| | | C40/50 | 1,07 | | | | |
| | | C50/60 | 1,09 | | | | |
| **Splitting failure** 4) | | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | | $h / h_{ef}$ 6) $\geq 2{,}0$ | $1{,}0 \cdot h_{ef}$ | | | | |
| | | $2{,}0 > h / h_{ef}$ 6) $> 1{,}3$ | $4{,}6\ h_{ef} - 1{,}8\ h$ | | | | |
| | | $h / h_{ef}$ 6) $\leq 1{,}3$ | $2{,}26\ h_{ef}$ | | | | |
| Spacing | $s_{cr,sp}$ | [mm] | $2 \times c_{cr,sp}$ | | | | |
| **Partial safety factors for combined pullout, concrete cone and splitting failure** | | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ 1) | [-] | 1,8 2) | 2,1 3) | | | |




1) In absence of other national regulations
2) The partial safety factor $\gamma_2 = 1{,}2$ is included.
3) The partial safety factor $\gamma_2 = 1{,}4$ is included.
4) Calculation of concrete failure and splitting see chapter 4.2.1
5) Explanation in section 1.2
6) h = base material thickness; $h_{ef}$ = anchorage depth
7) For design according TR029, the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according to: $\tau_{Rk} = N_{Rk} / (h_{ef} * d * \pi)$

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## Table 18: Characteristic shear resistance of internal threaded sleeve HIS-(R)N for static and quasi-static loading

| HIT-RE 500-SD with HIS-(R)N … | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** [3] | | | | | | | |
| Char. resistance HIS-N with screw grade 8.8 | $V_{Rk,s}$ | [kN] | 13 | 23 | 39 | 59 | 55 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,25 | | 1,5 | | |
| Char. resistance HIS-RN with screw grade 70 | $V_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 83 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,56 | | | | 2,0 |
| **Steel failure with lever arm** | | | | | | | |
| Char. resistance HIS-N with screw grade 8.8 | $M^0_{Rk,s}$ | [Nm] | 30 | 60 | 105 | 266 | 519 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,25 | | | | |
| Char. resistance HIS-RN with screw grade 70 | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 233 | 454 |
| Partial safety factor | $\gamma_{Ms,N}$ [1] | [-] | 1,56 | | | | |
| **Concrete pry-out failure** | | | | | | | |
| Factor in equation (5.7) of Technical Report TR 029 for the design of bonded anchors | k | [-] | 2,0 | | | | |
| Partial safety factor | $\gamma_{Mcp}$ [1] | [-] | 1,5 [2] | | | | |
| **Concrete edge failure** | | | | | | | |
| See chapter 5.2.3.4 of Technical Report TR029 for the design of bonded anchors | | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1] | [-] | 1,5 [2] | | | | |

[1] In absence of national regulations
[2] The partial safety factor $\gamma_2$ = 1,0 is included.
[3] Acc. to chapter 4.2.2 commercial standard screws that fulfill the ductility requirement $A_5$ > 8% (see table 6) can be used only



| Injection system Hilti HIT-RE 500-SD | Annex 19 |
|---|---|
| Characteristic shear resistance of internal threaded sleeve HIS-(R)N for static and quasi-static loading | |

**Table 19: Displacements under tension load [1] of internal threaded sleeve HIS-(R)N for static and quasi-static loading**

| HIT-RE 500-SD with HIS-(R)N ... | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Non-cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,08 | 0,06 | 0,06 | 0,04 | 0,04 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 0,18 | 0,15 | 0,14 | 0,10 | 0,09 |
| Non-cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,15 | 0,13 | 0,12 | 0,09 | 0,07 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 0,31 | 0,26 | 0,23 | 0,17 | 0,15 |
| Non-cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,31 | 0,26 | 0,23 | 0,17 | 0,14 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 0,43 | 0,36 | 0,33 | 0,24 | 0,20 |
| Cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,13 | 0,10 | 0,08 | 0,05 | 0,04 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 0,64 | 0,40 | 0,28 | 0,17 | 0,13 |
| Cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,26 | 0,19 | 0,16 | 0,11 | 0,09 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 1,08 | 0,67 | 0,48 | 0,28 | 0,22 |
| Cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(10kN)] | 0,52 | 0,39 | 0,32 | 0,22 | 0,18 |
| | $\delta_{N\infty}$ | [mm/(10kN)] | 1,53 | 0,95 | 0,67 | 0,40 | 0,30 |

[1] Calculation of displacement under service load: $N_{Sd}$ design value of tension load
Displacement under short term loading = $\delta_{N0} * N_{Sd} / (10 * 1,4)$
Displacement under long term loading = $\delta_{N\infty} * N_{Sd} / (10 * 1,4)$

[2] Explanation see chapter 1.2

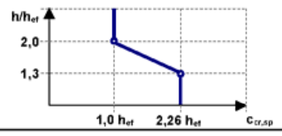
**Table 20: Displacements under shear load [1] of internal threaded sleeve HIS-(R)N for static and quasi-static loading**

| HIT-RE 500-SD with HIS-(R)N ... | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 |
| | $\delta_{V\infty}$ | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 |

[1] Calculation of displacement under service load: $V_{sd}$ design value of shear load
Displacement under short term loading = $\delta_{V0} \times V_{Sd} / 1,4$
Displacement under long term loading = $\delta_{V\infty} \times V_{Sd} / 1,4$

## Table 21: Characteristic tension resistance of tension anchor HZA-R for static and quasi-static loading

| HIT-RE 500-SD with HZA-R ... | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 62 | 111 | 173 | 248 |
| Partial safety factor | $\gamma_{Ms}$ [1] | [-] | 1,4 | | | |
| **Combined pullout and concrete cone failure** [4] | | | | | | |
| Diameter of element | d | [mm] | 12 | 16 | 20 | 25 |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 14 | 13 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,ucr}$ | [N/mm²] | 12 | 11 | 11 | 11 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,ucr}$ | [N/mm²] | 7 | 7 | 6,5 | 6,5 |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,cr}$ | [N/mm²] | 7,5 | 7 | 7 | 7 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,cr}$ | [N/mm²] | 6 | 6 | 6 | 5,5 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,cr}$ | [N/mm²] | 3,5 | 3,5 | 3,5 | 3 |
| Increasing factors for $\tau_{Rk}$ | $\psi_c$ | C30/37 | 1,04 | | | |
| | | C40/50 | 1,07 | | | |
| | | C50/60 | 1,09 | | | |
| Range of effective anchorage depth for calculation of $N^0_{Rk,p}$ acc. Eq. 5.2a (TR 029, 5.2.2.3 Combined pull -out and concrete cone failure) | min $h_{ef}$ | [mm] | 70 | 80 | 90 | 100 |
| | max $h_{ef}$ | [mm] | 140 | 220 | 300 | 400 |
| **Concrete cone failure** [4] | | | | | | |
| Range of effective anchorage depth for calculation of $N^0_{Rk,c}$ acc. Eq. 5.3a (TR 029, 5.2.2.4 Concrete cone failure) | min $h_{ef}$ | [mm] | 170 | 180 | 190 | 200 |
| | max $h_{ef}$ | [mm] | 240 | 320 | 400 | 500 |
| **Splitting failure** [4] | | | | | | |
| Edge distance $c_{cr,sp}$ [mm] for | | $h / h_{ef}$ [6] $\geq 2{,}0$ | $1{,}0 \cdot h_{ef}$ | | | |
| | | $2{,}0 > h / h_{ef}$ [6] $> 1{,}3$ | $4{,}6\, h_{ef} - 1{,}8\, h$ | | | |
| | | $h / h_{ef}$ [6] $\leq 1{,}3$ | $2{,}26\, h_{ef}$ | | | |
| Spacing | $s_{cr,sp}$ | [mm] | $2 \times c_{cr,sp}$ | | | |
| **Partial safety factors for combined pullout, concrete cone and splitting failure** | | | | | | |
| Partial safety factor | $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ [1] | [-] | 1,8 [2] | | 2,1 [3] | |




1) In absence of other national regulations
2) The partial safety factor $\gamma_2$ = 1,2 is included.
3) The partial safety factor $\gamma_2$ = 1,4 is included.
4) Calculation of concrete failure and splitting see chapter 4.2.1
5) Explanation in section 1.2
6) h = base material thickness; $h_{ef}$ = anchorage depth

**Injection system Hilti HIT-RE 500-SD**

**Characteristic tension resistance of tension anchor HZA-R for static and quasi-static loading**

**Annex 21**

### Table 22: Characteristic shear resistance of tension anchor HZA-R for static and quasi-static loading

| HIT-RE 500-SD with HZA-R … | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance | $V_{Rk,s}$ | [kN] | 31 | 55 | 86 | 124 |
| **Steel failure with lever arm** | | | | | | |
| Characteristic resistance | $M^0_{Rk,s}$ | [Nm] | 97 | 235 | 457 | 790 |
| **Partial safety factor for steel failure** | | | | | | |
| Partial safety factor | $\gamma_{Ms}$ [1)] | [-] | 1,25 | | | |
| **Concrete pry-out failure** | | | | | | |
| Factor in equation (5.7) of Technical Report TR 029 for the design of bonded anchors | k | [-] | 2,0 | | | |
| Partial safety factor | $\gamma_{Mcp}$ [1)] | [-] | 1,5 [2)] | | | |
| **Concrete edge failure** | | | | | | |
| See chapter 5.2.3.4 of Technical Report TR 029 for the design of bonded anchors | | | | | | |
| Partial safety factor | $\gamma_{Mc}$ [1)] | [-] | 1,5 [2)] | | | |

1) In absence of national regulations

2) The partial safety factor $\gamma_2$ = 1,0 is included.

## Table 23: Displacements under tension load [1] of tension anchor HZA-R for static and quasi-static loading

| HIT-RE 500-SD with HZA-R ... | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Non-cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,03 | 0,4 | 0,05 | 0,06 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,06 | 0,08 | 0,11 | 0,14 |
| Non-cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,05 | 0,07 | 0,09 | 0,12 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,10 | 0,14 | 0,18 | 0,23 |
| Non-cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,10 | 0,14 | 0,18 | 0,23 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,15 | 0,20 | 0,26 | 0,33 |
| Cracked concrete, temperature range I[2]: 40°C/24°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,05 | 0,05 | 0,06 | 0,07 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,23 | | | |
| Cracked concrete, temperature range II[2]: 58°C/35°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,09 | 0,11 | 0,13 | 0,15 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,38 | | | |
| Cracked concrete, temperature range III[2]: 70°C/43°C | | | | | | |
| Displacement | $\delta_{N0}$ | [mm/(N/mm²)] | 0,18 | 0,22 | 0,25 | 0,29 |
| | $\delta_{N\infty}$ | [mm/(N/mm²)] | 0,54 | | | |

[1] Calculation of displacement under service load: $\tau_{Sd}$ design value of bond stress
Displacement under short term loading = $\delta_{N0} \times \tau_{Sd} / 1,4$
Displacement under long term loading = $\delta_{N\infty} \times \tau_{Sd} / 1,4$

[2] Explanation see chapter 1.2

## Table 24: Displacements under shear load [1] of tension anchor HZA-R for static and quasi-static loading

| HIT-RE 500-SD with HZA-R ... | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Displacement | $\delta_{V0}$ | [mm/kN] | 0,05 | 0,04 | 0,04 | 0,03 |
| | $\delta_{V\infty}$ | [mm/kN] | 0,08 | 0,06 | 0,06 | 0,05 |

[1] Calculation of displacement under service load: $V_{sd}$ design value of shear load
Displacement under short term loading = $\delta_{V0} \times V_{Sd} / 1,4$
Displacement under long term loading = $\delta_{V\infty} \times V_{Sd} / 1,4$

## Table 25: Characteristic tension resistance of threaded rod HIT-V for seismic loading, performance category C1

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | |
| Char. resistanceHIT-V-5.8(F) | $N_{Rk,s,seis}$ | [kN] | 18 | 29 | 42 | 79 | 123 | 177 | 230 | 281 |
| Char. resistanceHIT-V-8.8(F) | $N_{Rk,s,seis}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 282 | 367 | 449 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,5 | | | | | | | |
| Char. resistanceHIT-V-R | $N_{Rk,s,seis}$ | [kN] | 26 | 41 | 59 | 110 | 172 | 247 | 230 | 281 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,87 | | | | | | 2,86 | |
| Char. resistanceHIT-V-HCR | $N_{Rk,s,seis}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 247 | 321 | 393 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,5 | | | | | 2,1 | | |
| **Combined pullout and concrete cone failure** [4)] | | | | | | | | | | |
| Diameter of element | d | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | |
| Temp. range I [5)]: 40°C/24°C | $\tau_{Rk,seis}$ | [N/mm²] | 6,4 | 6,4 | 6 | 5,3 | 5 | 4,6 | 4,1 | 3,6 |
| Temp. range II [5)]: 58°C/35°C | $\tau_{Rk,seis}$ | [N/mm²] | 5,2 | 4,8 | 4,8 | 4,5 | 3,9 | 3,6 | 3,1 | 3 |
| Temp. range III [5)]: 70°C/43°C | $\tau_{Rk,seis}$ | [N/mm²] | 3,2 | 2,8 | 2,8 | 2,6 | 2,1 | 2 | 1,9 | 1,8 |
| Partial safety factor | $\gamma_{Mp,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | | | | | |
| **Concrete cone failure** [4)] | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | | | | | |
| **Splitting failure** [4)] | | | | | | | | | | |
| Partial safety factor | $\gamma_{Msp,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | | | | | |

1) In absence of other national regulations
2) The partial safety factor $\gamma_2$ = 1,2 is included.
3) The partial safety factor $\gamma_2$ = 1,4 is included.
4) for concrete cone failure and splitting failure see Annex 33
5) Explanation in chapter 1.2

The definition of seismic performance category C1 is given in Annex 32.

## Table 26: Characteristic shear resistance of threaded rod HIT-V for seismic loading, performance category C1

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** [3] | | | | | | | | | | |
| Char. Resistance HIT-V-5.8(F) | $V_{Rk,s,seis}$ | [kN] | 6 | 11 | 15 | 27 | 43 | 62 | 81 | 98 |
| Char. Resistance HIT-V-8.8(F) | $V_{Rk,s,seis}$ | [kN] | 11 | 16 | 24 | 44 | 69 | 99 | 129 | 157 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,25 | | | | | | | |
| Char. Resistance HIT-V-R | $V_{Rk,s,seis}$ | [kN] | 9 | 14 | 21 | 39 | 60 | 87 | 81 | 98 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,56 | | | | | | 2,38 | |
| Char. Resistance HIT-V-HCR | $V_{Rk,s,seis}$ | [kN] | 11 | 16 | 24 | 44 | 69 | 87 | 113 | 137 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,25 | | | | | 1,75 | | |
| **Concrete pry-out failure** [3] | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,5 [2] | | | | | | | |
| **Concrete edge failure** [3] | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,5 [2] | | | | | | | |

[1] In absence of national regulations
[2] The partial safety factor $\gamma_2$ = 1,0 is included.
[3] for concrete pry-out failure and concrete edge failure see Annex 33

## Table 27: Displacements under tension load of threaded rod HIT-V for seismic loading, performance category C1

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{N,seis}$ | [mm] | 1,5 | 1,7 | 1,9 | 2,3 | 2,7 | 3,1 | 3,4 | 3,7 |

[1] Maximum displacement during cycling (seismic event)

## Table 28: Displacements under shear load of threaded rod HIT-V for seismic loading, performance category C1

| HIT-RE 500-SD with HIT-V… | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{V,seis}$ | [mm] | 3,2 | 3,5 | 3,8 | 4,4 | 5,0 | 5,6 | 6,1 | 6,5 |

[1] Maximum displacement during cycling (seismic event)

The definition of seismic performance category C1 is given in Annex 32.

## Table 29: Characteristic tension resistance of rebar for seismic loading, performance category C1

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | | |
| Characteristic resistance for rebar B500B acc. to DIN 488:2009-08 [6] | $N_{Rk,s,seis}$ | [kN] | 28 | 43 | 62 | 85 | 111 | 173 | 270 | - | 339 | - | 442 |
| Partial safety factor for rebar B500B acc. to DIN 488:2009-08 [7] | $\gamma_{Ms,seis}$ [1] | [-] | 1,4 | | | | | | | - | 1,4 | - | 1,4 |
| **Combined pullout and concrete cone failure** [4] | | | | | | | | | | | | | |
| Diameter of element | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 25 | 26 | 28 | 30 | 32 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | |
| Temp. range I [5]: 40°C/24°C | $\tau_{Rk,seis}$ | [N/mm²] | 6,4 | 6,4 | 6 | 5,4 | 5,3 | 5 | 4,6 | 4,5 | 4 | 3,6 | 3,4 |
| Temp. range II [5]: 58°C/35°C | $\tau_{Rk,seis}$ | [N/mm²] | 5,2 | 5,2 | 4,8 | 4,7 | 4,5 | 3,9 | 3,6 | 3,5 | 3,1 | 3,0 | 2,9 |
| Temp. range III [5]: 70°C/43°C | $\tau_{Rk,seis}$ | [N/mm²] | 3,2 | 2,8 | 2,8 | 2,7 | 2,6 | 2,1 | 2 | 1,9 | 1,8 | 1,8 | 1,7 |
| Partial safety factor | $\gamma_{Mp,seis}$ [1] | [-] | 1,8 [2] | | | | 2,1 [3] | | | | | | |
| **Concrete cone failure** [4] | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,8 [2] | | | | 2,1 [3] | | | | | | |
| **Splitting failure** [4] | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Msp,seis}$ [1] | [-] | 1,8 [2] | | | | 2,1 [3] | | | | | | |

1) In absence of other national regulations
2) The partial safety factor $\gamma_2$ = 1,2 is included.
3) The partial safety factor $\gamma_2$ = 1,4 is included.
4) for concrete cone failure and splitting failure see Annex 33
5) Explanation in section 1.2
6) The characteristic tension resistance $N_{Rk,s,seis}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (5.1), $N_{Rk,s,seis} = N_{Rk,s}$
7) The partial safety factor $\gamma_{Ms,seis}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (3.3a), $\gamma_{Ms,seis} = \gamma_{Ms}$

The definition of seismic performance category C1 is given in Annex 32.

## Table 30: Characteristic shear resistance of rebar for seismic loading, performance category C1

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | | | | |
| Characteristic resistance for rebar B500B acc. to DIN 488:2009-08 [4] | $V_{Rk,s,seis}$ | [kN] | 10 | 15 | 22 | 29 | 39 | 60 | 95 | - | 118 | - | 155 |
| Partial safety factor for rebar B500B acc. to DIN 488:2009-08 [5] | $\gamma_{Ms,seis}$ [1] | [-] | 1,5 | | | | | | | - | 1,5 | - | 1,5 |
| **Concrete pry-out failure [3]** | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mcp,seis}$ [1] | [-] | 1,5 [2] | | | | | | | | | | |
| **Concrete edge failure [3]** | | | | | | | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,5 [2] | | | | | | | | | | |

1) In absence of national regulations
2) The partial safety factor $\gamma_2 = 1{,}0$ is included.
3) for concrete pry-out failure and concrete edge failure see Annex 33
4) The characteristic shear resistance $V_{Rk,s,seis}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (5.5), $V_{Rk,s,seis} = 0{,}7 \times V_{Rk,s}$
5) The partial safety factor $\gamma_{Ms,seis}$ for rebars that do not fulfill the requirements acc. DIN 488 shall be calculated acc. Technical Report TR 029, Equation (3.3b) or (3.3c), $\gamma_{Ms,seis} = \gamma_{Ms}$

## Table 31: Displacements under tension load of rebar for seismic loading, performance category C1

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{N,seis}$ | [mm] | 1,5 | 1,7 | 1,9 | 2,1 | 2,3 | 2,7 | 3,2 | 3,3 | 3,5 | 3,7 | 3,9 |

1) Maximum displacement during cycling (seismic event)

## Table 32: Displacements under shear load of rebar for seismic loading, performance category C1

| HIT-RE 500-SD with rebar… | | | Ø8 | Ø10 | Ø12 | Ø14 | Ø16 | Ø20 | Ø25 | Ø26 | Ø28 | Ø30 | Ø32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{V,seis}$ | [mm] | 3,2 | 3,5 | 3,8 | 4,1 | 4,4 | 5,0 | 5,8 | 5,9 | 6,2 | 6,5 | 6,8 |

1) Maximum displacement during cycling (seismic event)

The definition of seismic performance category C1 is given in Annex 32.

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**Table 33: Characteristic tension resistance of internal threaded sleeve HIS-(R)N for seismic loading, performance category C1**

| HIT-RE 500-SD with HIS-(R)N … | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | |
| Char. resistanceHIS-N with screw grade 8.8 | $N_{Rk,s,seis}$ | [kN] | 25 | 46 | 67 | 118 | 109 |
| Partial safety factor | $\gamma_{Ms,seis}$ 1) | [-] | 1,43 | 1,5 | | 1,47 | |
| Char. resistanceHIS-RN with screw grade 70 | $N_{Rk,s,seis}$ | [kN] | 26 | 41 | 59 | 110 | 166 |
| Partial safety factor | $\gamma_{Ms,seis}$ 1) | [-] | 1,87 | | | | 2,4 |
| **Combined pullout and concrete cone failure** 4) + 6) | | | | | | | |
| Effective anchorage depth | $h_{ef}$ | [mm] | 90 | 110 | 125 | 170 | 205 |
| Diameter of element | d | [mm] | 12,5 | 16,5 | 20,5 | 25,4 | 27,6 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | |
| Temp. range I 5): 40°C/24°C | $N_{Rk,p,seis}$ 6) | [kN] | 20 | 30 | 42 | 61 | 71 |
| Temp. range II 5): 58°C/35°C | $N_{Rk,p,seis}$ 6) | [kN] | 16 | 26 | 28 | 48 | 59 |
| Temp. range III 5): 70°C/43°C | $N_{Rk,p,seis}$ 6) | [kN] | 9,5 | 15 | 17 | 25 | 31 |
| Partial safety factor | $\gamma_{Mp,seis}$ 1) | [-] | 1,8 2) | 2,1 3) | | | |
| **Concrete cone failure** 4) | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ 1) | [-] | 1,8 2) | 2,1 3) | | | |
| **Splitting failure** 4) | | | | | | | |
| Partial safety factor | $\gamma_{Msp,seis}$ 1) | [-] | 1,8 2) | 2,1 3) | | | |

1) In absence of other national regulations
2) The partial safety factor $\gamma_2$ = 1,2 is included.
3) The partial safety factor $\gamma_2$ = 1,4 is included.
4) for concrete cone failure and splitting failure see Annex 33
5) Explanation in section 1.2
6) For design the characteristic bond resistance may be calculated from the characteristic tension load values for combined pull-out and concrete cone failure according to: $\tau_{Rk,seis} = N_{Rk,seis} / (h_{ef} * d * \pi)$

The definition of seismic performance category C1 is given in Annex 32.

## Table 34: Characteristic shear resistance of internal threaded sleeve HIS-(R)N for seismic loading, performance category C1

| HIT-RE 500-SD with HIS-(R)N … | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | |
| Char. resistance HIS-N with screw grade 8.8 | $V_{Rk,s,seis}$ | [kN] | 9 | 16 | 27 | 41 | 39 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,25 | | 1,5 | | |
| Char. resistance HIS-RN with screw grade 70 | $V_{Rk,s,seis}$ | [kN] | 9 | 14 | 21 | 39 | 58 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,56 | | | | 2,0 |
| **Concrete pry-out failure** [3] | | | | | | | |
| Partial safety factor | $\gamma_{Mcp,seis}$ [1] | [-] | 1,5 [2] | | | | |
| **Concrete edge failure** [3] | | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,5 [2] | | | | |

1) In absence of national regulations
2) The partial safety factor $\gamma_2$ = 1,0 is included.
3) for concrete pry-out failure and concrete edge failure see Annex 33

## Table 35: Displacements under tension load of internal threaded sleeve HIS-(R)N for seismic loading, performance category C1

| HIT-RE 500-SD with HIS-(R)N … | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{N,seis}$ | [mm] | 1,5 | 1,7 | 1,9 | 2,3 | 2,7 |

1) Maximum displacement during cycling (seismic event)

## Table 36: Displacements under shear load of internal threaded sleeve HIS-(R)N for seismic loading, performance category C1

| HIT-RE 500-SD with HIS-(R)N … | | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{V,seis}$ | [mm] | 3,2 | 3,5 | 3,8 | 4,4 | 5,0 |

1) Maximum displacement during cycling (seismic event)

The definition of seismic performance category C1 is given in Annex 32.

**Table 37: Characteristic tension resistance of tension anchor HZA-R for seismic loading, performance category C1**

| HIT-RE 500-SD with HZA-R … | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | |
| Characteristic resistance | $N_{Rk,s,seis}$ | [kN] | 62 | 111 | 173 | 248 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1)] | [-] | 1,4 | | | |
| **Combined pullout and concrete cone failure** [4)] | | | | | | |
| Diameter of element | d | [mm] | 12 | 16 | 20 | 25 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | |
| Temp. range I [5)]: 40°C/24°C | $\tau_{Rk,seis}$ | [N/mm²] | 6 | 5,3 | 5 | 4,6 |
| Temp. range II [5)]: 58°C/35°C | $\tau_{Rk,seis}$ | [N/mm²] | 4,8 | 4,5 | 3,9 | 3,6 |
| Temp. range III [5)]: 70°C/43°C | $\tau_{Rk,seis}$ | [N/mm²] | 2,8 | 2,6 | 2,1 | 2 |
| Partial safety factor | $\gamma_{Mp,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | |
| **Concrete cone failure** [4)] | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | |
| **Splitting failure** [4)] | | | | | | |
| Partial safety factor | $\gamma_{Msp,seis}$ [1)] | [-] | 1,8 [2)] | | 2,1 [3)] | |

1) In absence of other national regulations
2) The partial safety factor $\gamma_2$ = 1,2 is included.
3) The partial safety factor $\gamma_2$ = 1,4 is included.
4) for concrete cone failure and splitting failure see Annex 33
5) Explanation in section 1.2

The definition of seismic performance category C1 is given in Annex 32.

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## Table 38: Characteristic shear resistance of tension anchor HZA-R for seismic loading, performance category C1

| HIT-RE 500-SD with HZA-R … | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | |
| Characteristic resistance | $V_{Rk,s,seis}$ | [kN] | 22 | 39 | 60 | 87 |
| Partial safety factor | $\gamma_{Ms,seis}$ [1] | [-] | 1,25 | | | |
| **Concrete pry-out failure** [3] | | | | | | |
| Partial safety factor | $\gamma_{Mcp,seis}$ [1] | [-] | 1,5 [2] | | | |
| **Concrete edge failure** [3] | | | | | | |
| Partial safety factor | $\gamma_{Mc,seis}$ [1] | [-] | 1,5 [2] | | | |

1) In absence of national regulations
2) The partial safety factor $\gamma_2$ = 1,0 is included.
3) for concrete pry-out failure and concrete edge failure see Annex 33

## Table 39: Displacements under tension load of tension anchor HZA-R for seismic loading, performance category C1

| HIT-RE 500-SD with HZA-R …… | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{N,seis}$ | [mm] | 1,9 | 2,3 | 2,7 | 3,2 |

1) Maximum displacement during cycling (seismic event)

## Table 40: Displacements under shear load of tension anchor HZA-R for seismic loading, performance category C1

| HIT-RE 500-SD with HZA-R … | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Displacement [1] | $\delta_{V,seis}$ | [mm] | 3,8 | 4,4 | 5,0 | 5,8 |

1) Maximum displacement during cycling (seismic event)

The definition of seismic performance category C1 is given in Annex 32.

## Table 41: Recommended seismic performance categories [1)] for metal anchors

| Seismicity level[a] | | Importance Class acc. to EN 1998-1:2004, 4.2.5 | | | |
|---|---|---|---|---|---|
| Class | $a_g \cdot S$ [c] | **I** | **II** | **III** | **IV** |
| Very low [b] | $a_g \cdot S \le 0{,}05\ g$ | No additional requirement | | | |
| Low [b] | $0{,}05\ g < a_g \cdot S \le 0{,}1\ g$ | C1 | C1 [d] or C2 [e] | | C2 |
| > low | $a_g \cdot S > 0{,}1\ g$ | C1 | C2 | | |

[a] The values defining the seismicity levels may be found in the National Annex of EN 1998-1.

[b] Definition according to EN 1998-1: 2004, 3.2.1.

[c] $a_g$ = Design ground acceleration on Type A ground (EN 1998-1: 2004, 3.2.1),
$S$ = Soil factor (see e.g. EN 1998-1: 2004, 3.2.2).

[d] C1 for attachments of non-structural elements

[e] C2 for connections between structural elements of primary and/or secondary seismic members

[1)] The seismic performance of anchors subjected to seismic loading is categorized by performance categories C1 and C2.

Table 41 relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product $a_g \cdot S$, where $a_g$ is the design ground acceleration on Type A ground and $S$ the soil factor, both in accordance with EN 1998-1: 2004.

The value of $a_g$ or that of the product $a_g \cdot S$ used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1 and may be different to the values given in Table 41. Furthermore, the assignment of the seismic performance categories C1 and C2 to the seismicity level and building importance classes is in the responsibility of each individual Member State.

### Table 42: Reduction factor $\alpha_{seis}$

| Loading | Failure mode | Single anchor [1)] | Anchor group |
|---|---|---|---|
| tension | Steel failure | 1,0 | 1,0 |
| | Combined pull-out and concrete cone failure | 1,0 | 0,85 |
| | Concrete cone failure | 0,85 | 0,75 |
| | Splitting failure | 1,0 | 0,85 |
| shear | Steel failure | 1,0 | 0,85 |
| | Concrete edge failure | 1,0 | 0,85 |
| | Concrete pry-out failure | 0,85 | 0,75 |

1) In case of tension loading single anchor also addresses situations where only 1 anchor in a group of anchors is subjected to tension.

## Design information for seismic action:

The seismic design shall be carried out according to the TR 045 „Design of metal anchors for use in concrete under seismic action“. For every failure mode the characteristic seismic resistance $R_{k,seis}$ of a fastening shall be determined as follows:

$$R_{k,seis} = \alpha_{gap} \cdot \alpha_{seis} \cdot R^0_{k,seis}$$

where

$\alpha_{gap}$ reduction factor to take into account inertia effects due to an annular gap between anchor and fixture in case of shear loading;

= 1,0 in case of no hole clearance between anchor and fixture;

= 0,5 in case of connections with standard hole clearance according TR 029, Table 4.1

$\alpha_{seis}$ reduction factor to take into account the influence of large cracks and scatter of load displacement curves, see Table 42;

$R^0_{k,seis}$ basic characteristic seismic resistance for a given failure mode:

For steel failure under tension load and steel failure under shear load $R^0_{k,seis}$ (i.e. $N_{Rk,s,seis}$, $V_{Rk,s,seis}$) shall be taken from Annex 24 to Annex 31

For combined pull-out and concrete cone failure $R^0_{k,seis}$ (i.e. $N_{Rk,p}$) for seismic performance category C1 shall be taken either from Annex 28 or shall be determined as given in TR 029, however the characteristic bond strength $\tau_{Rk}$ needs to be replaced by $\tau_{Rk,seis;}$ for seismic performance category C1 $\tau_{Rk,seis}$ is given in Annex 24, Annex 26 and Annex 30.

For all other failure modes $R^0_{k,seis}$ shall be determined as for the design situation for static and quasi-static loading according to TR 029 (i.e. $N_{Rk,c}$, $N_{Rk,sp}$, $V_{Rk,c}$, $V_{Rk,cp}$).