Deutsches Institut für Bautechnik DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

# European Technical Assessment

# ETA-17/0127 of 13 November 2020

English translation prepared by DIBt - Original version in German language

**General Part**

| | |
|---|---|
| Technical Assessment Body issuing the European Technical Assessment: | Deutsches Institut für Bautechnik |
| Trade name of the construction product | Würth Injection system WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete |
| Product family to which the construction product belongs | Bonded fastener for use in concrete |
| Manufacturer | Adolf Würth GmbH & Co. KG<br>Reinhold-Würth-Straße 12-17<br>74653 Künzelsau<br>DEUTSCHLAND |
| Manufacturing plant | Werk 3 |
| This European Technical Assessment contains | 35 pages including 3 annexes which form an integral part of this assessment |
| This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of | EAD 330499-01-0601, Edition 4/2020 |
| This version replaces | ETA-17/0127 issued on 13 March 2019 |

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## Specific Part

### 1 Technical description of the product

The "Würth Injection system WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete" is a bonded anchor consisting of a cartridge with injection mortar Injection mortar WIT-UH 300 / WIT-VH 300 / WIT-VM 300 and a steel element according to Annex A3 and A5.

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

The product description is given in Annex A.

### 2 Specification of the intended use in accordance with the applicable European Assessment Document

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

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

### 3 Performance of the product and references to the methods used for its assessment

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

| Essential characteristic | Performance |
|---|---|
| Characteristic resistance to tension load (static and quasi-static loading) | See Annex B 3, C 1 to C 4, C 6 to C 7, C 9 to C 10 |
| Characteristic resistance to shear load (static and quasi-static loading) | See Annex C 1, C 5, C 8, C 11 |
| Displacements under short-term and long-term loading | See Annex C 12 to C 14 |
| Characteristic resistance and displacements for seismic performance categories C1 and C2 | See Annex C 15 to C 18 |

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

| Essential characteristic | Performance |
|---|---|
| Content, emission and/or release of dangerous substances | No performance assessed |

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

In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

## 5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 13 November 2020 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Baderschneider

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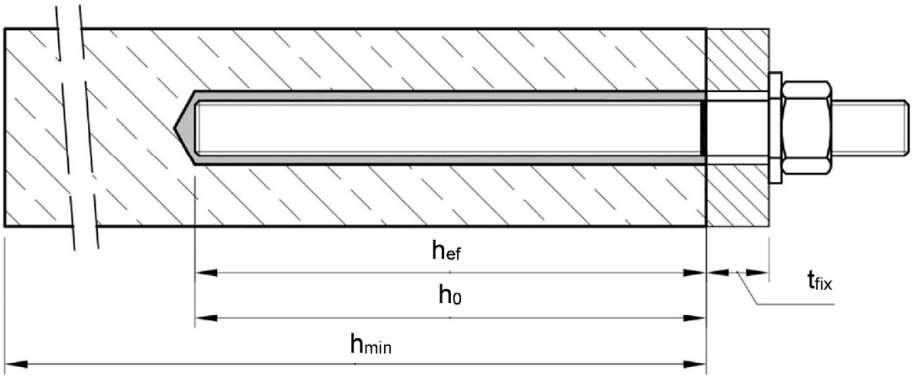
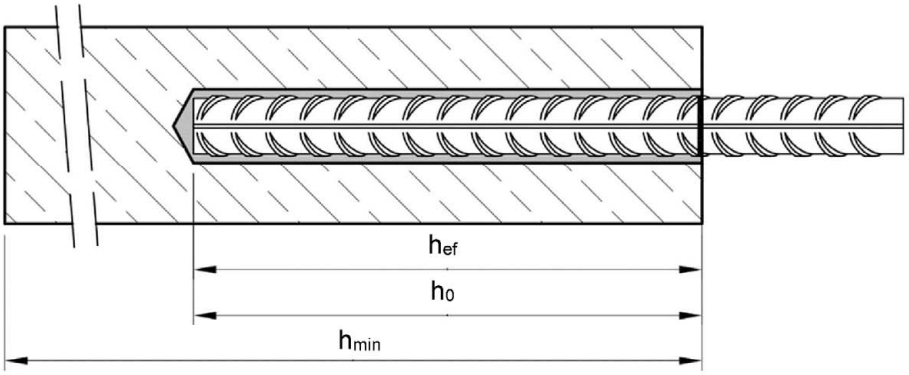
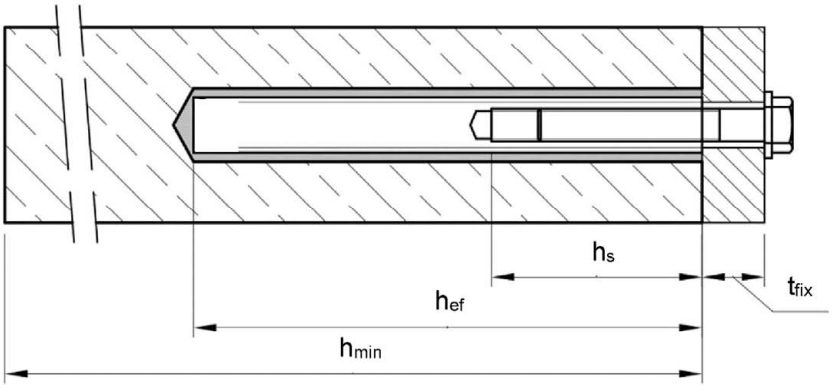
**Installation threaded rod M8 up to M30**
prepositioned installation or
push through installation (annular gap filled with mortar)




**Installation reinforcing bar Ø8 up to Ø32**




**Installation internal threaded anchor rod IG-M6 up to IG-M20**




$t_{fix}$ = thickness of fixture
$h_{ef}$ = effective anchorage depth
$h_0$ = depth of drill hole
$h_{min}$ = minimum thickness of member

| | |
|---|---|
| **Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete** | **Annex A 1** |
| **Product description**<br>Installed condition | |

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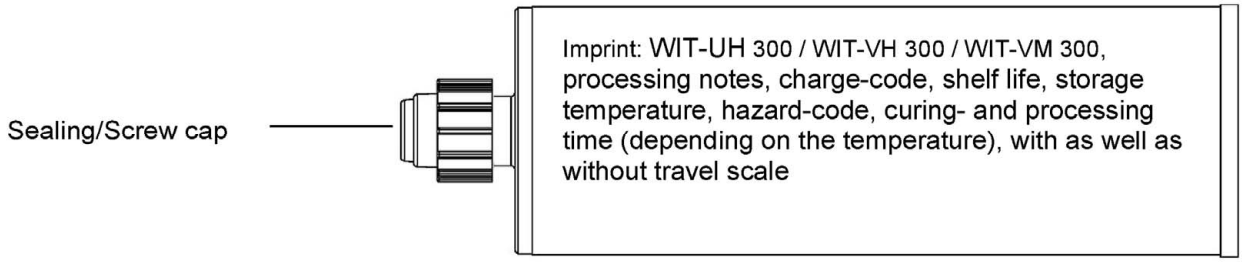
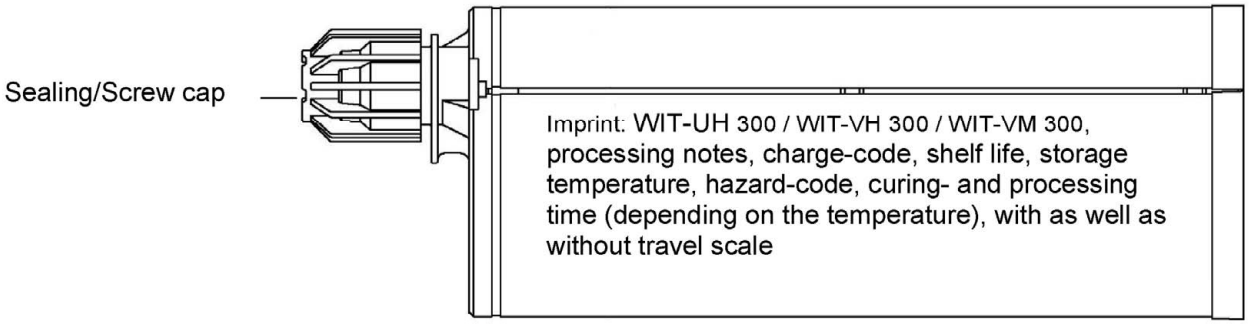
**Cartridge: WIT-UH 300 / WIT-VH 300 / WIT-VM 300**

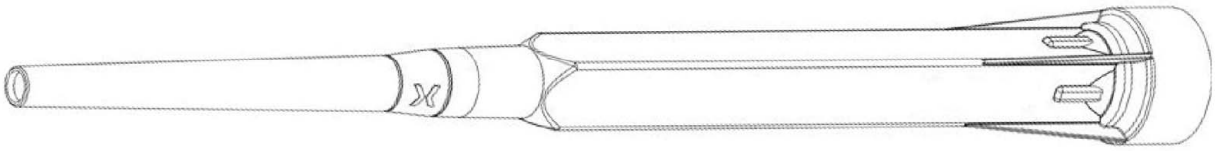
**150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)**




**235 ml, 345 ml up to 360 ml and 825 ml cartridge (Type: “side-by-side”)**




**Static Mixer WIT-UH / WIT-MX**



**Piston plug and mixer extension**

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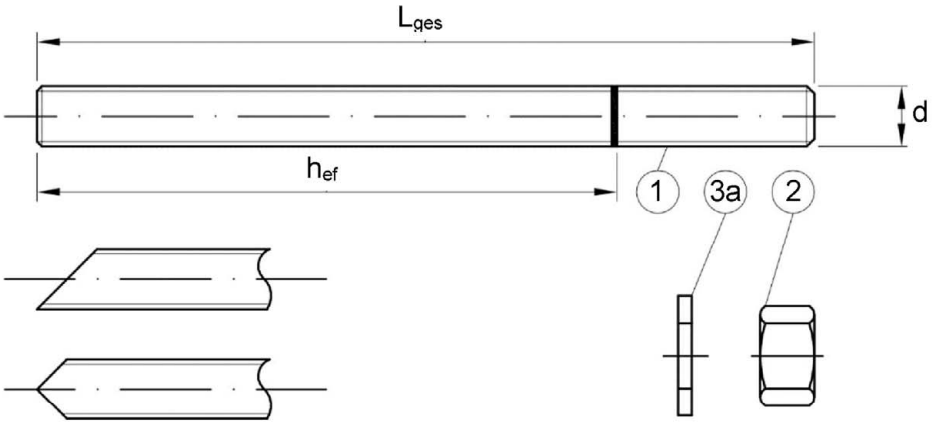
| | |
|---|---|
| **Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete** | **Annex A 2** |
| **Product description**<br>Injection system | |

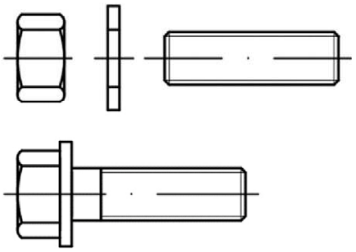
## Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut

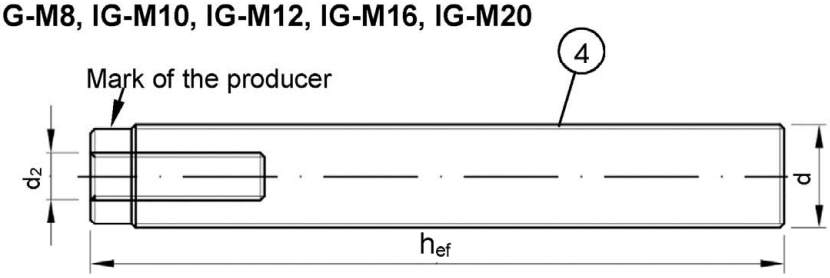



Commercial standard threaded rod with:

- Materials, dimensions and mechanical properties acc. Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

## Internal threaded anchor rod IG-M6, IG-M8, IG-M10, IG-M12, IG-M16, IG-M20




Marking: e.g. M8

| | |
|---|---|
| I | Marking Internal thread |
| ◇ | Mark |
| M8 | Thread size (Internal thread) |
| A4 | additional mark for stainless steel |
| HCR | additional mark for high-corrosion resistance steel |

## Filling washer and mixer reduction nozzle for filling the annular gap between anchor rod and fixture

| | |
|---|---|
| **Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete** | **Annex A 3** |
| **Product description**<br>Threaded rod, internal threaded rod and filling washer | |

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## Table A1: Materials

| Part | Designation | Material | | | | |
|---|---|---|---|---|---|---|
| **Steel, zinc plated** (Steel acc. to EN 10087:1998 or EN 10263:2001)<br>- zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or<br>- hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or<br>- sherardized ≥ 45 µm acc. to EN ISO 17668:2016 | | | | | | |
| 1 | Threaded rod | Property class | | Characteristic steel ultimate tensile strength | Characteristic steel yield strength | Elongation at fracture |
| | | acc. to EN ISO 898-1:2013 | 4.6 | $f_{uk}$ = 400 N/mm² | $f_{yk}$ = 240 N/mm² | $A_5$ > 8% |
| | | | 4.8 | $f_{uk}$ = 400 N/mm² | $f_{yk}$ = 320 N/mm² | $A_5$ > 8% |
| | | | 5.6 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 300 N/mm² | $A_5$ > 8% |
| | | | 5.8 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 400 N/mm² | $A_5$ > 8% |
| | | | 8.8 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 640 N/mm² | $A_5$ ≥ 12% [3] |
| 2 | Hexagon nut | acc. to EN ISO 898-2:2012 | 4 | for threaded rod class 4.6 or 4.8 | | |
| | | | 5 | for threaded rod class 5.6 or 5.8 | | |
| | | | 8 | for threaded rod class 8.8 | | |
| 3a | Washer | Steel, zinc plated, hot-dip galvanised or sherardized<br>(e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000) | | | | |
| 3b | Filling washer | Steel, zinc plated, hot-dip galvanised or sherardized | | | | |
| 4 | Internal threaded anchor rod | Property class | | Characteristic steel ultimate tensile strength | Characteristic steel yield strength | Elongation at fracture |
| | | acc. to EN ISO 898-1:2013 | 5.8 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 400 N/mm² | $A_5$ > 8% |
| | | | 8.8 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 640 N/mm² | $A_5$ > 8% |
| **Stainless steel A2** (Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014)<br>**Stainless steel A4** (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)<br>**High corrosion resistance steel** (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014) | | | | | | |
| 1 | Threaded rod[1)4)] | Property class | | Characteristic steel ultimate tensile strength | Characteristic steel yield strength | Elongation at fracture |
| | | acc. to EN ISO 3506-1:2009 | 50 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 210 N/mm² | $A_5$ ≥ 8% |
| | | | 70 | $f_{uk}$ = 700 N/mm² | $f_{yk}$ = 450 N/mm² | $A_5$ ≥ 12% [3] |
| | | | 80 | $f_{uk}$ = 800 N/mm² | $f_{yk}$ = 600 N/mm² | $A_5$ ≥ 12% [3] |
| 2 | Hexagon nut [1)4)] | acc. to EN ISO 3506-1:2009 | 50 | for threaded rod class 50 | | |
| | | | 70 | for threaded rod class 70 | | |
| | | | 80 | for threaded rod class 80 | | |
| 3a | Washer | A2: Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014<br>A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014<br>HCR: Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014<br>(e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000) | | | | |
| 3b | Filling washer | Stainless steel A4, High corrosion resistance steel | | | | |
| | | Property class | | Characteristic steel ultimate tensile strength | Characteristic steel yield strength | Elongation at fracture |
| 4 | Internal threaded anchor rod[1)2)] | acc. to EN ISO 3506-1:2009 | 50 | $f_{uk}$ = 500 N/mm² | $f_{yk}$ = 210 N/mm² | $A_5$ > 8% |
| | | | 70 | $f_{uk}$ = 700 N/mm² | $f_{yk}$ = 450 N/mm² | $A_5$ > 8% |

[1)] Property class 70 or 80 for threaded rods and hexagon nuts up to M24 and Internal threaded anchor rods up to IG-M16
[2)] for IG-M20 only property class 50
[3)] $A_5$ > 8% fracture elongation if no use for seismic performance category C2
[4)] Property class 80 only for stainless steel A4 and high corrosion resistance steel HCR

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Product description**
Materials threaded rod and internal threaded rod

**Annex A 4**

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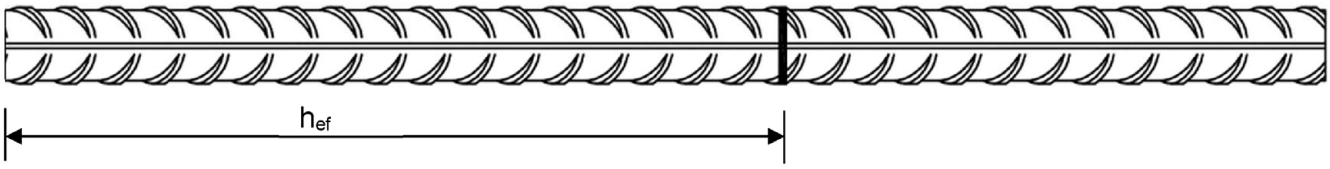
**Reinforcing bar ∅ 8, ∅ 10, ∅ 12, ∅ 14, ∅ 16, ∅ 20, ∅ 24, ∅ 25, ∅ 28, ∅ 32**




- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar shall be in the range 0,05d ≤ h ≤ 0,07d
  (d: Nominal diameter of the bar; h: Rip height of the bar)

## Table A2: Materials

| Part | Designation | Material |
|---|---|---|
| **Reinforcing bars** | | |
| 1 | Rebar<br>EN 1992-1-1:2004+AC:2010, Annex C | Bars and de-coiled rods class B or C<br>$f_{yk}$ and k according to NDP or NCL of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Product description**
Materials reinforcing bar

**Annex A 5**

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**Specifications of intended use**

**Anchorages subject to static and quasi-static loads:**

| | for a working life of 50 years | | for a working life of 100 years | |
|---|---|---|---|---|
| Base material | Non-cracked concrete | cracked concrete | Non-cracked concrete | cracked concrete |
| Hammer drilling (HD),<br>Hammer drilling with hollow drill bit (HDB)<br>or compressed air drilling (CD) | M8 to M30,<br>Ø8 to Ø32,<br>IG-M6 to IG-M20 | | M8 to M30,<br>Ø8 to Ø32,<br>IG-M6 to IG-M20 | |
| Temperature Range: | I: - 40 °C to +40 °C[1)]<br>II: - 40 °C to +80 °C[2)]<br>III: - 40 °C to +120 °C[3)]<br>IV: - 40 °C to +160 °C[4)] | | I: - 40 °C to +40 °C[1)]<br>II: - 40 °C to +80 °C[2)] | |

**Anchorages subject to seismic action:**

| | for Performance Category C1 | for Performance Category C2 |
|---|---|---|
| Base material | Cracked and non-cracked concrete | |
| Hammer drilling (HD),<br>Hammer drilling with hollow drill bit (HDB)<br>or compressed air drilling (CD) | M8 to M30,<br>Ø8 to Ø32 | M12 to M24 |
| Temperature Range: | I: - 40 °C to +40 °C[1)]<br>II: - 40 °C to +80 °C[2)]<br>III: - 40 °C to +120 °C[3)]<br>IV: - 40 °C to +160 °C[4)] | I: - 40 °C to +40 °C[1)]<br>II: - 40 °C to +80 °C[2)]<br>III: - 40 °C to +120 °C[3)]<br>IV: - 40 °C to +160 °C[4)] |

[1)] (max long-term temperature +24 °C and max short-term temperature +40 °C)
[2)] (max long-term temperature +50 °C and max short-term temperature +80 °C)
[3)] (max long-term temperature +72 °C and max short-term temperature +120 °C)
[4)] (max long-term temperature +100 °C and max short-term temperature +160 °C)

**Base materials:**
- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.

**Use conditions (Environmental conditions):**
- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
  - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

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**Design:**

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- The anchorages are designed in accordance to EN 1992-4:2018 and Technical Report TR 055, Edition February 2018

**Installation:**

- Dry, wet concrete or flooded bore holes (not sea-water).
- Hole drilling by hammer (HD), hollow (HDB) or compressed air drill mode (CD).
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

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## Table B1: Installation parameters for threaded rod

| Anchor size | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of element | $d = d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Nominal drill hole diameter | $d_0$ | [mm] | 10 | 12 | 14 | 18 | 22 | 28 | 30 | 35 |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 60 | 60 | 70 | 80 | 90 | 96 | 108 | 120 |
| | $h_{ef,max}$ | [mm] | 160 | 200 | 240 | 320 | 400 | 480 | 540 | 600 |
| Diameter of clearance hole in the fixture[1] | Prepositioned installation $d_f \leq$ | [mm] | 9 | 12 | 14 | 18 | 22 | 26 | 30 | 33 |
| | Push through installation $d_f$ | [mm] | 12 | 14 | 16 | 20 | 24 | 30 | 33 | 40 |
| Maximum torque moment | max $T_{inst} \leq$ | [Nm] | 10 | 20 | 40[2] | 60 | 100 | 170 | 250 | 300 |
| Minimum thickness of member | $h_{min}$ | [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | | $h_{ef} + 2d_0$ | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 75 | 95 | 115 | 125 | 140 |
| Minimum edge distance | $c_{min}$ | [mm] | 35 | 40 | 45 | 50 | 60 | 65 | 75 | 80 |

[1] For application under seismic loading the diameter of clearance hole in the fixture shall be at maximum $d_1$ + 1mm or alternatively the annular gap between fixture and threaded rod shall be filled force-fit with mortar.
[2] Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

## Table B2: Installation parameters for rebar

| Rebar size | | | Ø 8[1] | Ø 10[1] | Ø 12[1] | Ø 14 | Ø 16 | Ø 20 | Ø 24[1] | Ø 25[1] | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diameter of element | $d = d_{nom}$ | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 25 | 28 | 32 |
| Nominal drill hole diameter | $d_0$ | [mm] | 10 \| 12 | 12 \| 14 | 14 \| 16 | 18 | 20 | 25 | 30 \| 32 | 30 \| 32 | 35 | 40 |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 60 | 60 | 70 | 75 | 80 | 90 | 96 | 100 | 112 | 128 |
| | $h_{ef,max}$ | [mm] | 160 | 200 | 240 | 280 | 320 | 400 | 480 | 500 | 560 | 640 |
| Minimum thickness of member | $h_{min}$ | [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | $h_{ef} + 2d_0$ | | | | | | | |
| Minimum spacing | $s_{min}$ | [mm] | 40 | 50 | 60 | 70 | 75 | 95 | 120 | 120 | 130 | 150 |
| Minimum edge distance | $c_{min}$ | [mm] | 35 | 40 | 45 | 50 | 50 | 60 | 70 | 70 | 75 | 85 |

[1] both nominal drill hole diameter can be used

## Table B3: Installation parameters for Internal threaded rod

| Anchor size | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|
| Internal diameter of sleeve | $d_2$ | [mm] | 6 | 8 | 10 | 12 | 16 | 20 |
| Outer diameter of sleeve[1] | $d = d_{nom}$ | [mm] | 10 | 12 | 16 | 20 | 24 | 30 |
| Nominal drill hole diameter | $d_0$ | [mm] | 12 | 14 | 18 | 22 | 28 | 35 |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 60 | 70 | 80 | 90 | 96 | 120 |
| | $h_{ef,max}$ | [mm] | 200 | 240 | 320 | 400 | 480 | 600 |
| Diameter of clearance hole in the fixture | $d_f \leq$ | [mm] | 7 | 9 | 12 | 14 | 18 | 22 |
| Maximum torque moment | max $T_{inst} \leq$ | [Nm] | 10 | 10 | 20 | 40 | 60 | 100 |
| Thread engagement length min/max | $l_{IG}$ | [mm] | 8/20 | 8/20 | 10/25 | 12/30 | 16/32 | 20/40 |
| Minimum thickness of member | $h_{min}$ | [mm] | $h_{ef}$ + 30 mm ≥ 100 mm | | $h_{ef} + 2d_0$ | | | |
| Minimum spacing | $s_{min}$ | [mm] | 50 | 60 | 75 | 95 | 115 | 140 |
| Minimum edge distance | $c_{min}$ | [mm] | 40 | 45 | 50 | 60 | 65 | 80 |

[1] With metric threads according to EN 1993-1-8:2005+AC:2009

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Intended Use**
Installation parameters

**Annex B 3**

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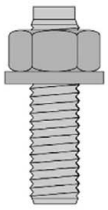
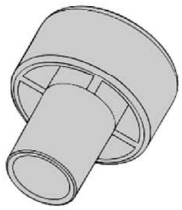
## Table B4: Parameter cleaning and setting tools





| Threaded Rod | Rebar | Internal threaded rod | $d_0$ Drill bit - ∅ HD, HDB, CD | $d_b$ Brush - ∅ | | $d_{b,min}$ min. Brush - ∅ | Piston plug | Installation direction and use of piston plug | | |
|---|---|---|---|---|---|---|---|---|---|---|
| [mm] | [mm] | [mm] | [mm] | WIT- | [mm] | [mm] | WIT- | ↓ | → | ↑ |
| M8 | 8 | | 10 | RB10 | 11,5 | 10,5 | No plug required | | | |
| M10 | 8 / 10 | IG-M6 | 12 | RB12 | 13,5 | 12,5 | | | | |
| M12 | 10 / 12 | IG-M8 | 14 | RB14 | 15,5 | 14,5 | | | | |
| | 12 | | 16 | RB16 | 17,5 | 16,5 | | | | |
| M16 | 14 | IG-M10 | 18 | RB18 | 20,0 | 18,5 | VS18 | $h_{ef}$ > 250 mm | $h_{ef}$ > 250 mm | all |
| | 16 | | 20 | RB20 | 22,0 | 20,5 | VS20 | | | |
| M20 | | IG-M12 | 22 | RB22 | 24,0 | 22,5 | VS22 | | | |
| | 20 | | 25 | RB25 | 27,0 | 25,5 | VS25 | | | |
| M24 | | IG-M16 | 28 | RB28 | 30,0 | 28,5 | VS28 | | | |
| M27 | 24 / 25 | | 30 | RB30 | 31,8 | 30,5 | VS30 | | | |
| | 24 / 25 | | 32 | RB32 | 34,0 | 32,5 | VS32 | | | |
| M30 | 28 | IG-M20 | 35 | RB35 | 37,0 | 35,5 | VS35 | | | |
| | 32 | | 40 | RB40 | 43,5 | 40,5 | VS40 | | | |

**MAC - Hand pump (volume 750 ml)**
Drill bit diameter ($d_0$): 10 mm to 20 mm
Drill hole depth ($h_0$): < 10 $d_s$
Only in non-cracked concrete

**CAC - Rec. compressed air tool (min 6 bar)**
Drill bit diameter ($d_0$): all diameters

**HDB – Hollow drill bit system**
Drill bit diameter ($d_0$): all diameters
The hollow drill bit system contains the Würth Extraction Drill Bit, MKT Extraction Drill Bit, Heller Duster Expert hollow-core drill and a class M vacuum with minimum negative pressure of 253 hPa and flow rate of minimum 150 m³/h (42 l/s).

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Intended Use**
Cleaning and setting tools

**Annex B 4**

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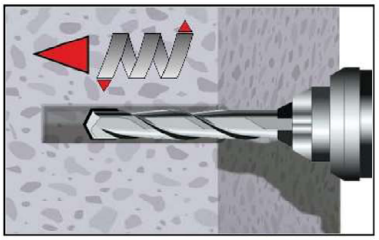
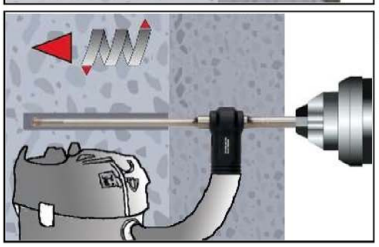
**Installation instructions**

**Drilling of the bore hole**



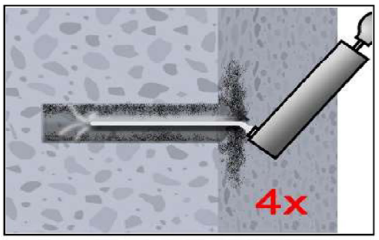
1a. **Hammer (HD) or compressed air drilling (CD)**
Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3).
Proceed with Step 2.
In case of aborted drill hole, the drill hole shall be filled with mortar.



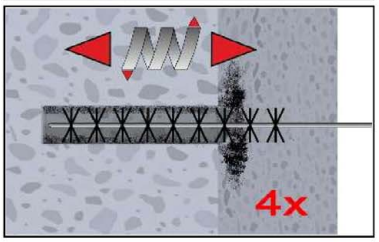
1b. **Hollow drill bit system (HDB) (see Annex B 3)**
Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). This drilling system removes the dust and cleans the bore hole during drilling (all conditions).
Proceed with Step 3.
In case of aborted drill hole, the drill hole shall be filled with mortar.

**Attention! Standing water in the bore hole must be removed before cleaning.**

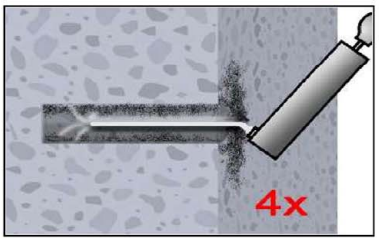
**MAC: Cleaning for dry and wet bore hole with diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10d_{nom}$ (uncracked concrete only!)**




2a. Starting from the bottom or back of the bore hole, blow the hole clean with handpump (Annex B 4) a minimum of four times until return air stream is free of noticeable dust.




2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.




2c. Finally blow the hole clean again with handpump (Annex B 4) a minimum of four times until return air stream is free of noticeable dust.

**After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.**

| | |
|---|---|
| **Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete** | **Annex B 5** |
| **Intended Use**<br>Installation instructions | |

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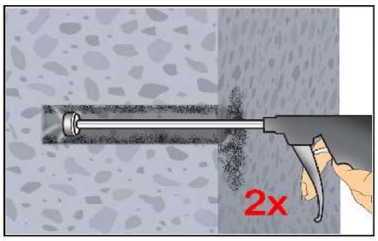
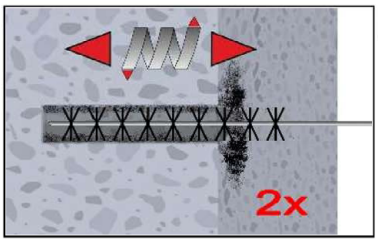
**Installation instructions (continuation)**

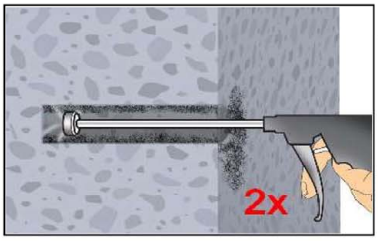
**CAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked and cracked concrete**



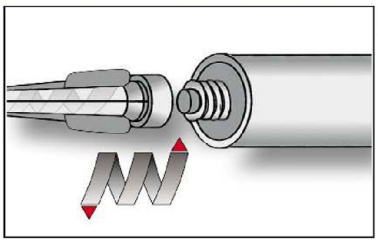

2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.



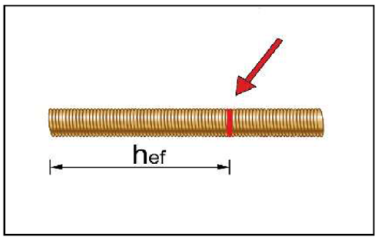

2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times.
If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B5).



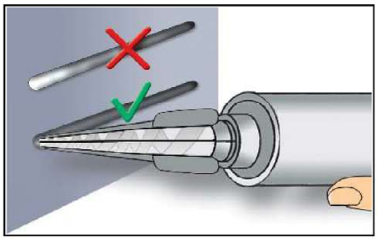

2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.



3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.
For every working interruption longer than the recommended working time (Table B5) as well as for new cartridges, a new static-mixer shall be used.




4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour.

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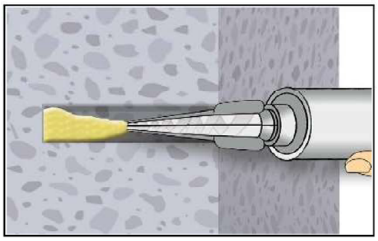
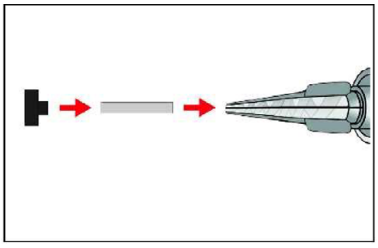
**Installation instructions (continuation)**

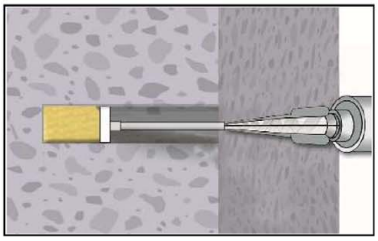


6. Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/ working times given in Table B5.



7. Piston plugs shall be used according to Table B4 for the following applications:
   - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit-Ø $d_0 \geq 18$ mm and embedment depth $h_{ef} > 250$mm
   - Overhead assembly (vertical upwards direction): Drill bit-Ø $d_0 \geq 18$ mm

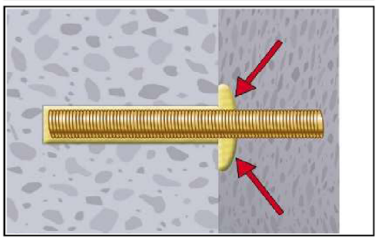
   Assemble mixing nozzle, extension and piston plug before injecting mortar.



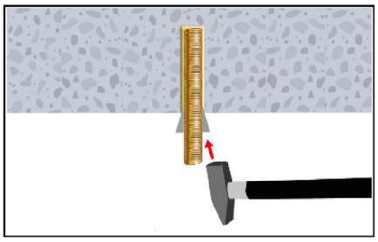
8. Insert piston plug to back of the hole and inject adhesive. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used.
   During injection the piston plug is naturally pushed out of the borehole by the back pressure of the mortar. Observe the gel-/ working times given in Table B5.

9. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment mark has reached the surface level.

   The anchor shall be free of dirt, grease, oil or other foreign material.



10. After inserting the anchor, the annular gab between anchor rod and concrete, in case of a push through installation additionally also the fixture, must be complete filled with mortar. If excess mortar is not visible at the top of the hole, the requirement is not fulfilled and the application has to be renewed.



11. For overhead application the anchor rod shall be fixed (e.g. wedges) until the mortar has started to harden.

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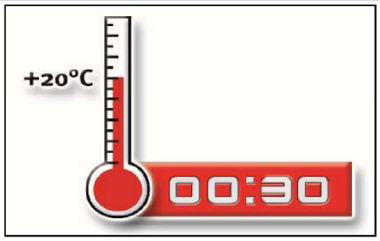
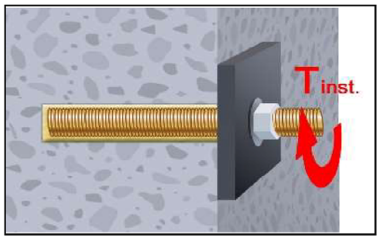
**Installation instructions (continuation)**




12. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B5).




13. After full curing, the add-on part can be installed with up to the max. torque (Table B1 or B3) by using a calibrated torque wrench. In case of prepositioned installation the annular gab between anchor and fixture can be optional filled with mortar. Therefor substitute the washer by the filling washer and connect the mixer reduction nozzle to the tip of the mixer. The annular gap is filled with mortar, when mortar oozes out of the washer.

## Table B5: Maximum working time and minimum curing time

| Concrete temperature | Gelling working time | Minimum curing time in dry concrete | Minimum curing time in wet concrete |
|---|---|---|---|
| - 5 °C to - 1 °C | 50 min | 5 h | 10 h |
| 0 °C to + 4 °C | 25 min | 3,5 h | 7 h |
| + 5 °C to + 9 °C | 15 min | 2 h | 4 h |
| + 10 °C to + 14 °C | 10 min | 1 h | 2 h |
| + 15 °C to + 19 °C | 6 min | 40 min | 80 min |
| + 20 °C to + 29 °C | 3 min | 30 min | 60 min |
| + 30 °C to + 40 °C | 2 min | 30 min | 60 min |
| Cartridge temperature | +5°C to +40°C | | |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Intended Use**
Installation instructions (continuation)
Curing time

**Annex B 8**

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## Table C1: Characteristic values for steel tension resistance and steel shear resistance of threaded rods

| Size | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cross section area | | $A_s$ | [mm²] | 36,6 | 58 | 84,3 | 157 | 245 | 353 | 459 | 561 |
| **Characteristic tension resistance, Steel failure** [1] | | | | | | | | | | | |
| Steel, Property class 4.6 and 4.8 | | $N_{Rk,s}$ | [kN] | 15 (13) | 23 (21) | 34 | 63 | 98 | 141 | 184 | 224 |
| Steel, Property class 5.6 and 5.8 | | $N_{Rk,s}$ | [kN] | 18 (17) | 29 (27) | 42 | 78 | 122 | 176 | 230 | 280 |
| Steel, Property class 8.8 | | $N_{Rk,s}$ | [kN] | 29 (27) | 46 (43) | 67 | 125 | 196 | 282 | 368 | 449 |
| Stainless steel A2, A4 and HCR, class 50 | | $N_{Rk,s}$ | [kN] | 18 | 29 | 42 | 79 | 123 | 177 | 230 | 281 |
| Stainless steel A2, A4 and HCR, class 70 | | $N_{Rk,s}$ | [kN] | 26 | 41 | 59 | 110 | 171 | 247 | -[3] | -[3] |
| Stainless steel A4 and HCR, class 80 | | $N_{Rk,s}$ | [kN] | 29 | 46 | 67 | 126 | 196 | 282 | -[3] | -[3] |
| **Characteristic tension resistance, Partial factor** [2] | | | | | | | | | | | |
| Steel, Property class 4.6 and 5.6 | | $\gamma_{Ms,N}$ | [-] | 2,0 | | | | | | | |
| Steel, Property class 4.8, 5.8 and 8.8 | | $\gamma_{Ms,N}$ | [-] | 1,5 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 50 | | $\gamma_{Ms,N}$ | [-] | 2,86 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 70 | | $\gamma_{Ms,N}$ | [-] | 1,87 | | | | | | | |
| Stainless steel A4 and HCR, class 80 | | $\gamma_{Ms,N}$ | [-] | 1,6 | | | | | | | |
| **Characteristic shear resistance, Steel failure** [1] | | | | | | | | | | | |
| Without lever arm | Steel, Property class 4.6 and 4.8 | $V^0_{Rk,s}$ | [kN] | 9 (8) | 14 (13) | 20 | 38 | 59 | 85 | 110 | 135 |
| | Steel, Property class 5.6 and 5.8 | $V^0_{Rk,s}$ | [kN] | 11 (10) | 17 (16) | 25 | 47 | 74 | 106 | 138 | 168 |
| | Steel, Property class 8.8 | $V^0_{Rk,s}$ | [kN] | 15 (13) | 23 (21) | 34 | 63 | 98 | 141 | 184 | 224 |
| | Stainless steel A2, A4 and HCR, class 50 | $V^0_{Rk,s}$ | [kN] | 9 | 15 | 21 | 39 | 61 | 88 | 115 | 140 |
| | Stainless steel A2, A4 and HCR, class 70 | $V^0_{Rk,s}$ | [kN] | 13 | 20 | 30 | 55 | 86 | 124 | -[3] | -[3] |
| | Stainless steel A4 and HCR, class 80 | $V^0_{Rk,s}$ | [kN] | 15 | 23 | 34 | 63 | 98 | 141 | -[3] | -[3] |
| With lever arm | Steel, Property class 4.6 and 4.8 | $M^0_{Rk,s}$ | [Nm] | 15 (13) | 30 (27) | 52 | 133 | 260 | 449 | 666 | 900 |
| | Steel, Property class 5.6 and 5.8 | $M^0_{Rk,s}$ | [Nm] | 19 (16) | 37 (33) | 65 | 166 | 324 | 560 | 833 | 1123 |
| | Steel, Property class 8.8 | $M^0_{Rk,s}$ | [Nm] | 30 (26) | 60 (53) | 105 | 266 | 519 | 896 | 1333 | 1797 |
| | Stainless steel A2, A4 and HCR, class 50 | $M^0_{Rk,s}$ | [Nm] | 19 | 37 | 66 | 167 | 325 | 561 | 832 | 1125 |
| | Stainless steel A2, A4 and HCR, class 70 | $M^0_{Rk,s}$ | [Nm] | 26 | 52 | 92 | 232 | 454 | 784 | -[3] | -[3] |
| | Stainless steel A4 and HCR, class 80 | $M^0_{Rk,s}$ | [Nm] | 30 | 59 | 105 | 266 | 519 | 896 | -[3] | -[3] |
| **Characteristic shear resistance, Partial factor** [2] | | | | | | | | | | | |
| Steel, Property class 4.6 and 5.6 | | $\gamma_{Ms,V}$ | [-] | 1,67 | | | | | | | |
| Steel, Property class 4.8, 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 50 | | $\gamma_{Ms,V}$ | [-] | 2,38 | | | | | | | |
| Stainless steel A2, A4 and HCR, class 70 | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | | | |
| Stainless steel A4 and HCR, class 80 | | $\gamma_{Ms,V}$ | [-] | 1,33 | | | | | | | |

[1] Values are only valid for the given stress area $A_s$. Values in brackets are valid for undersized threaded rods with smaller stress area $A_s$ for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.
[2] in absence of national regulation
[3] Anchor type not part of the ETA

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values for steel tension resistance and steel shear resistance of threaded rods

**Annex C 1**

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## Table C2: Characteristic values for Concrete cone failure and Splitting with all kind of action

| **Anchor size** | | | | **All Anchor types and sizes** |
|---|---|---|---|---|
| **Concrete cone failure** | | | | |
| Non-cracked concrete | | $k_{ucr,N}$ | [-] | 11,0 |
| Cracked concrete | | $k_{cr,N}$ | [-] | 7,7 |
| Edge distance | | $c_{cr,N}$ | [mm] | 1,5 $h_{ef}$ |
| Axial distance | | $s_{cr,N}$ | [mm] | 2 $c_{cr,N}$ |
| **Splitting** | | | | |
| Edge distance | $h/h_{ef} \geq 2,0$ | $c_{cr,sp}$ | [mm] | 1,0 $h_{ef}$ |
| | $2,0 > h/h_{ef} > 1,3$ | | | $2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$ |
| | $h/h_{ef} \leq 1,3$ | | | 2,4 $h_{ef}$ |
| Axial distance | | $s_{cr,sp}$ | [mm] | 2 $c_{cr,sp}$ |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values for Concrete cone failure and Splitting with all kind of action

**Annex C 2**

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## Table C3: Characteristic values of tension loads under static and quasi-static action for a working life of 50 years

| Anchor size threaded rod | | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steel failure | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | see Table C1 | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 17 | 17 | 16 | 15 | 14 | 13 | 13 | 13 |
| | II: 80°C/50°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 17 | 17 | 16 | 15 | 14 | 13 | 13 | 13 |
| | III: 120°C/72°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 14 | 13 | 12 | 12 | 11 | 11 |
| | IV: 160°C/100°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 12 | 11 | 11 | 10 | 9,5 | 9,0 | 9,0 | 9,0 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 7,0 | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 | 7,0 |
| | II: 80°C/50°C | | $\tau_{Rk,cr}$ | [N/mm²] | 7,0 | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 | 7,0 |
| | III: 120°C/72°C | | $\tau_{Rk,cr}$ | [N/mm²] | 6,0 | 6,5 | 7,0 | 7,5 | 7,0 | 6,0 | 6,0 | 6,0 |
| | IV: 160°C/100°C | | $\tau_{Rk,cr}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,0 | 5,5 | 5,5 | 5,5 |
| Reduktion factor $\psi^0_{sus}$ in cracked and non-cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,90 | | | | | | | |
| | II: 80°C/50°C | | | | 0,87 | | | | | | | |
| | III: 120°C/72°C | | | | 0,75 | | | | | | | |
| | IV: 160°C/100°C | | | | 0,66 | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | | C25/30 | | 1,02 | | | | | | | |
| | | | C30/37 | | 1,04 | | | | | | | |
| | | | C35/45 | | 1,07 | | | | | | | |
| | | | C40/50 | | 1,08 | | | | | | | |
| | | | C45/55 | | 1,09 | | | | | | | |
| | | | C50/60 | | 1,10 | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Splitting** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | MAC | | $\gamma_{inst}$ | [-] | 1,2 | | | | | No Performance assessed | | |
| | CAC | | | | 1,0 | | | | | | | |
| | HDB | | | | 1,2 | | | | | | | |
| for flooded bore hole | CAC | | | | 1,4 | | | | | | | |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 3**

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## Table C4: Characteristic values of tension loads under static and quasi-static action for a working life of 100 years

| Anchor size threaded rod | | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Steel failure | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | see Table C1 | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 17 | 17 | 16 | 15 | 14 | 13 | 13 | 13 |
| Temperature range | II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 17 | 17 | 16 | 15 | 14 | 13 | 13 | 13 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 |
| Temperature range | II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 |
| Increasing factors for concrete $\psi_c$ | | | C25/30 | | 1,02 | | | | | | | |
| | | | C30/37 | | 1,04 | | | | | | | |
| | | | C35/45 | | 1,07 | | | | | | | |
| | | | C40/50 | | 1,08 | | | | | | | |
| | | | C45/55 | | 1,09 | | | | | | | |
| | | | C50/60 | | 1,10 | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Splitting** | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | | MAC | $\gamma_{inst}$ | [-] | 1,2 | | | | | No Performance assessed | | |
| for dry and wet concrete | | CAC | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |
| for dry and wet concrete | | HDB | $\gamma_{inst}$ | [-] | 1,2 | | | | | | | |
| for flooded bore hole | | CAC | $\gamma_{inst}$ | [-] | 1,4 | | | | | | | |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 4**

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## Table C5: Characteristic values of shear loads under static and quasi-static action

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | |
| Characteristic shear resistance Steel, strength class 4.6, 4.8 and 5.6, 5.8 | $V^0_{Rk,s}$ | [kN] | $0{,}6 \cdot A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes | $V^0_{Rk,s}$ | [kN] | $0{,}5 \cdot A_s \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | | |
| Characteristic bending moment | $M^0_{Rk,s}$ | [Nm] | $1{,}2 \cdot W_{el} \cdot f_{uk}$ (or see Table C1) | | | | | | | |
| Elastic section modulus | $W_{el}$ | [mm³] | 31 | 62 | 109 | 277 | 541 | 935 | 1387 | 1874 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | |
| Factor | $k_8$ | [-] | 2,0 | | | | | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | | $\min(h_{ef}; 300mm)$ | |
| Outside diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 16 | 20 | 24 | 27 | 30 |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of shear loads under static and quasi-static action

**Annex C 5**

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## Table C6: Characteristic values of tension loads under static and quasi-static action for a working life of 50 years

| Anchor size internal threaded anchor rods | | | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure**[1] | | | | | | | | | | |
| Characteristic tension resistance, Steel, strength class | | 5.8 | $N_{Rk,s}$ | [kN] | 10 | 17 | 29 | 42 | 76 | 123 |
| | | 8.8 | $N_{Rk,s}$ | [kN] | 16 | 27 | 46 | 67 | 121 | 196 |
| Partial factor, strength class 5.8 and 8.8 | | | $\gamma_{Ms,N}$ | [-] | 1,5 | | | | | |
| Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 [2] | | | $N_{Rk,s}$ | [kN] | 14 | 26 | 41 | 59 | 110 | 124 |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | 1,87 | | | | | 2,86 |
| **Combined pull-out and concrete cone failure** | | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 17 | 16 | 15 | 14 | 13 | 13 |
| | II: 80°C/50°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 17 | 16 | 15 | 14 | 13 | 13 |
| | III: 120°C/72°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 14 | 14 | 13 | 12 | 12 | 11 |
| | IV: 160°C/100°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 11 | 11 | 10 | 9,5 | 9,0 | 9,0 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 |
| | II: 80°C/50°C | | $\tau_{Rk,cr}$ | [N/mm²] | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 |
| | III: 120°C/72°C | | $\tau_{Rk,cr}$ | [N/mm²] | 6,5 | 7,0 | 7,5 | 7,0 | 6,0 | 6,0 |
| | IV: 160°C/100°C | | $\tau_{Rk,cr}$ | [N/mm²] | 5,5 | 6,0 | 6,5 | 6,0 | 5,5 | 5,5 |
| Reduktion factor $\psi^0$sus in cracked and non-cracked concrete C20/25 | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,90 | | | | | |
| | II: 80°C/50°C | | | | 0,87 | | | | | |
| | III: 120°C/72°C | | | | 0,75 | | | | | |
| | IV: 160°C/100°C | | | | 0,66 | | | | | |
| Increasing factors for concrete $\psi_c$ | | | C25/30 | | 1,02 | | | | | |
| | | | C30/37 | | 1,04 | | | | | |
| | | | C35/45 | | 1,07 | | | | | |
| | | | C40/50 | | 1,08 | | | | | |
| | | | C45/55 | | 1,09 | | | | | |
| | | | C50/60 | | 1,10 | | | | | |
| **Concrete cone failure** | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | |
| **Splitting failure** | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | |
| **Installation factor** | | | | | | | | | | |
| for dry and wet concrete | MAC | | $\gamma_{inst}$ | [-] | 1,2 | | | No Performance assessed | | |
| | CAC | | | | 1,0 | | | | | |
| | HDB | | | | 1,2 | | | | | |
| for flooded bore hole | CAC | | | | 1,4 | | | | | |

[1] Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.
[2] For IG-M20 strength class 50 is valid

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 6**

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## Table C7: Characteristic values of tension loads under static and quasi-static action for a working life of 100 years

| Anchor size internal threaded anchor rods | | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure**[1] | | | | | | | | | |
| Characteristic tension resistance, Steel, strength class | 5.8 | $N_{Rk,s}$ | [kN] | 10 | 17 | 29 | 42 | 76 | 123 |
| | 8.8 | $N_{Rk,s}$ | [kN] | 16 | 27 | 46 | 67 | 121 | 196 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,N}$ | [-] | 1,5 | | | | | |
| Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 [2] | | $N_{Rk,s}$ | [kN] | 14 | 26 | 41 | 59 | 110 | 124 |
| Partial factor | | $\gamma_{Ms,N}$ | [-] | 1,87 | | | | | 2,86 |
| **Combined pull-out and concrete cone failure** | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | |
| **Temperature range** I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 17 | 16 | 15 | 14 | 13 | 13 |
| **Temperature range** II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 17 | 16 | 15 | 14 | 13 | 13 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | |
| **Temperature range** I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 |
| **Temperature range** II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 6,5 |
| Increasing factors for concrete $\psi_c$ | | C25/30 | | 1,02 | | | | | |
| | | C30/37 | | 1,04 | | | | | |
| | | C35/45 | | 1,07 | | | | | |
| | | C40/50 | | 1,08 | | | | | |
| | | C45/55 | | 1,09 | | | | | |
| | | C50/60 | | 1,10 | | | | | |
| **Concrete cone failure** | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | |
| **Splitting failure** | | | | | | | | | |
| Relevant parameter | | | | see Table C2 | | | | | |
| **Installation factor** | | | | | | | | | |
| for dry and wet concrete | MAC | $\gamma_{inst}$ | [-] | 1,2 | | | No Performance assessed | | |
| | CAC | $\gamma_{inst}$ | [-] | 1,0 | | | | | |
| | HDB | $\gamma_{inst}$ | [-] | 1,2 | | | | | |
| for flooded bore hole | CAC | $\gamma_{inst}$ | [-] | 1,4 | | | | | |

[1] Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.
[2] For IG-M20 strength class 50 is valid

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 7**

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## Table C8: Characteristic values of shear loads under static and quasi-static action

| Anchor size for internal threaded anchor rods | | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm[1)]** | | | | | | | | | |
| Characteristic shear resistance, Steel, strength class | 5.8 | $V^0_{Rk,s}$ | [kN] | 5 | 9 | 15 | 21 | 38 | 61 |
| | 8.8 | $V^0_{Rk,s}$ | [kN] | 8 | 14 | 23 | 34 | 60 | 98 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | |
| Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70[2)] | | $V^0_{Rk,s}$ | [kN] | 7 | 13 | 20 | 30 | 55 | 40 |
| Partial factor | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | 2,38 |
| Ductility factor | | $k_7$ | [-] | 1,0 | | | | | |
| **Steel failure with lever arm[1)]** | | | | | | | | | |
| Characteristic bending moment, Steel, strength class | 5.8 | $M^0_{Rk,s}$ | [Nm] | 8 | 19 | 37 | 66 | 167 | 325 |
| | 8.8 | $M^0_{Rk,s}$ | [Nm] | 12 | 30 | 60 | 105 | 267 | 519 |
| Partial factor, strength class 5.8 and 8.8 | | $\gamma_{Ms,V}$ | [-] | 1,25 | | | | | |
| Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70[2)] | | $M^0_{Rk,s}$ | [Nm] | 11 | 26 | 52 | 92 | 233 | 456 |
| Partial factor | | $\gamma_{Ms,V}$ | [-] | 1,56 | | | | | 2,38 |
| **Concrete pry-out failure** | | | | | | | | | |
| Factor | | $k_8$ | [-] | 2,0 | | | | | |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | |
| **Concrete edge failure** | | | | | | | | | |
| Effective length of fastener | | $l_f$ | [mm] | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | $\min(h_{ef}; 300mm)$ |
| Outside diameter of fastener | | $d_{nom}$ | [mm] | 10 | 12 | 16 | 20 | 24 | 30 |
| Installation factor | | $\gamma_{inst}$ | [-] | 1,0 | | | | | |

[1)] Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.
[2)] For IG-M20 strength class 50 is valid

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of shear loads under static and quasi-static action

**Annex C 8**

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## Table C9: Characteristic values of tension loads under static and quasi-static action for a working life of 50 years

| Anchor size reinforcing bar | | | | | ∅ 8 | ∅ 10 | ∅ 12 | ∅ 14 | ∅ 16 | ∅ 20 | ∅ 24 | ∅ 25 | ∅ 28 | ∅ 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ [1)] | | | | | | | | | |
| Cross section area | | | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 452 | 491 | 616 | 804 |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | 1,4 [2)] | | | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr}$ | [N/mm²] | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 |
| | II: 80°C/50°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 |
| | III: 120°C/72°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 |
| | IV: 160°C/100°C | | $\tau_{Rk,ucr}$ | [N/mm²] | 9,5 | 9,5 | 9,5 | 9,0 | 9,0 | 9,0 | 9,0 | 9,0 | 8,5 | 8,5 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 7,0 | 7,0 | 7,0 |
| | II: 80°C/50°C | | $\tau_{Rk,cr}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 7,0 | 7,0 | 7,0 |
| | III: 120°C/72°C | | $\tau_{Rk,cr}$ | [N/mm²] | 4,5 | 5,0 | 5,0 | 5,5 | 5,5 | 5,5 | 5,5 | 6,0 | 6,0 | 6,0 |
| | IV: 160°C/100°C | | $\tau_{Rk,cr}$ | [N/mm²] | 4,0 | 4,5 | 4,5 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 |
| Reduktion factor $\psi^0_{sus}$ in cracked and non-cracked concrete C20/25 | | | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\psi^0_{sus}$ | [-] | 0,90 | | | | | | | | | |
| | II: 80°C/50°C | | | | 0,87 | | | | | | | | | |
| | III: 120°C/72°C | | | | 0,75 | | | | | | | | | |
| | IV: 160°C/100°C | | | | 0,66 | | | | | | | | | |
| Increasing factors for concrete $\psi_c$ | | | C25/30 | | 1,02 | | | | | | | | | |
| | | | C30/37 | | 1,04 | | | | | | | | | |
| | | | C35/45 | | 1,07 | | | | | | | | | |
| | | | C40/50 | | 1,08 | | | | | | | | | |
| | | | C45/55 | | 1,09 | | | | | | | | | |
| | | | C50/60 | | 1,10 | | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | | | |
| **Splitting** | | | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | | | |
| **Installation factor** | | | | | | | | | | | | | | |
| for dry and wet concrete | MAC | | $\gamma_{inst}$ | [-] | 1,2 | | | | | No Performance assessed | | | | |
| | CAC | | | | 1,0 | | | | | | | | | |
| | HDB | | | | 1,2 | | | | | | | | | |
| for flooded bore hole | CAC | | | | 1,4 | | | | | | | | | |

1) $f_{uk}$ shall be taken from the specifications of reinforcing bars
2) in absence of national regulation

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 9**

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## Table C10: Characteristic values of tension loads under static and quasi-static action for a working life of 100 years

| Anchor size reinforcing bar | | | | | ∅ 8 | ∅ 10 | ∅ 12 | ∅ 14 | ∅ 16 | ∅ 20 | ∅ 24 | ∅ 25 | ∅ 28 | ∅ 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}$ [1] | | | | | | | | | |
| Cross section area | | | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 452 | 491 | 616 | 804 |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | 1,4 [2] | | | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | | | |
| Characteristic bond resistance in non-cracked concrete C20/25 | | | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 |
| Temperature range | II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,ucr,100}$ | [N/mm²] | 14 | 14 | 14 | 14 | 13 | 13 | 13 | 13 | 13 | 13 |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 4,5 | 4,5 | 4,5 | 4,5 | 4,5 | 4,0 | 4,0 | 4,0 | 4,0 | 4,0 |
| Temperature range | II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,cr,100}$ | [N/mm²] | 4,5 | 4,5 | 4,5 | 4,5 | 4,5 | 4,0 | 4,0 | 4,0 | 4,0 | 4,0 |
| Increasing factors for concrete $\psi_c$ | | | C25/30 | | 1,02 | | | | | | | | | |
| | | | C30/37 | | 1,04 | | | | | | | | | |
| | | | C35/45 | | 1,07 | | | | | | | | | |
| | | | C40/50 | | 1,08 | | | | | | | | | |
| | | | C45/55 | | 1,09 | | | | | | | | | |
| | | | C50/60 | | 1,10 | | | | | | | | | |
| **Concrete cone failure** | | | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | | | |
| **Splitting** | | | | | | | | | | | | | | |
| Relevant parameter | | | | | see Table C2 | | | | | | | | | |
| **Installation factor** | | | | | | | | | | | | | | |
| for dry and wet concrete | MAC | | $\gamma_{inst}$ | [-] | 1,2 | | | | | No Performance assessed | | | | |
| for dry and wet concrete | CAC | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| for dry and wet concrete | HDB | | $\gamma_{inst}$ | [-] | 1,2 | | | | | | | | | |
| for flooded bore hole | CAC | | $\gamma_{inst}$ | [-] | 1,4 | | | | | | | | | |

[1] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation

**Würth Injection System WIT-UH 300 / WIT-VH 300 / WIT-VM 300 for concrete**

**Performances**
Characteristic values of tension loads under static and quasi-static action

**Annex C 10**

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## Table C11: Characteristic values of shear loads under static and quasi-static action

| **Anchor size reinforcing bar** | | | **∅ 8** | **∅ 10** | **∅ 12** | **∅ 14** | **∅ 16** | **∅ 20** | **∅ 24** | **∅ 25** | **∅ 28** | **∅ 32** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure without lever arm** | | | | | | | | | | | | |
| Characteristic shear resistance | $V^0_{Rk,s}$ | [kN] | $0{,}50 \cdot A_s \cdot f_{uk}$ [1)] | | | | | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 452 | 491 | 616 | 804 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 [2)] | | | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | | | |
| **Steel failure with lever arm** | | | | | | | | | | | | |
| Characteristic bending moment | $M^0_{Rk,s}$ | [Nm] | $1.2 \cdot W_{el} \cdot f_{uk}$ [1)] | | | | | | | | | |
| Elastic section modulus | $W_{el}$ | [mm³] | 50 | 98 | 170 | 269 | 402 | 785 | 1357 | 1534 | 2155 | 3217 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 [2)] | | | | | | | | | |
| **Concrete pry-out failure** | | | | | | | | | | | | |
| Factor | $k_8$ | [-] | 2,0 | | | | | | | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| **Concrete edge failure** | | | | | | | | | | | | |
| Effective length of fastener | $l_f$ | [mm] | $\min(h_{ef}; 12 \cdot d_{nom})$ | | | | | | | $\min(h_{ef}; 300mm)$ | | |
| Outside diameter of fastener | $d_{nom}$ | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 24 | 25 | 28 | 32 |
| Installation factor | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |

1) $f_{uk}$ shall be taken from the specifications of reinforcing bars
2) in absence of national regulation

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## Table C12: Displacements under tension load[1)] (threaded rod)

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Non-cracked concrete C20/25 under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,031 | 0,032 | 0,034 | 0,037 | 0,039 | 0,042 | 0,044 | 0,046 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,040 | 0,042 | 0,044 | 0,047 | 0,051 | 0,054 | 0,057 | 0,060 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,032 | 0,034 | 0,035 | 0,038 | 0,041 | 0,044 | 0,046 | 0,048 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,042 | 0,044 | 0,045 | 0,049 | 0,053 | 0,056 | 0,059 | 0,062 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,121 | 0,126 | 0,131 | 0,142 | 0,153 | 0,163 | 0,171 | 0,179 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,124 | 0,129 | 0,135 | 0,146 | 0,157 | 0,168 | 0,176 | 0,184 |
| **Cracked concrete under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,081 | 0,083 | 0,085 | 0,090 | 0,095 | 0,099 | 0,103 | 0,106 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,104 | 0,107 | 0,110 | 0,116 | 0,122 | 0,128 | 0,133 | 0,137 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,084 | 0,086 | 0,088 | 0,093 | 0,098 | 0,103 | 0,107 | 0,110 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,108 | 0,111 | 0,114 | 0,121 | 0,127 | 0,133 | 0,138 | 0,143 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,312 | 0,321 | 0,330 | 0,349 | 0,367 | 0,385 | 0,399 | 0,412 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,321 | 0,330 | 0,340 | 0,358 | 0,377 | 0,396 | 0,410 | 0,424 |

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; $\tau$: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

## Table C13: Displacements under shear load[2)] (threaded rod)

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Non-cracked and cracked concrete under static and quasi-static action** | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 |

[2)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

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## Table C14: Displacements under tension load[1)] (Internal threaded rod)

| Anchor size Internal threaded rod | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|
| **Non-cracked concrete under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,032 | 0,034 | 0,037 | 0,039 | 0,042 | 0,046 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,042 | 0,044 | 0,047 | 0,051 | 0,054 | 0,060 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,034 | 0,035 | 0,038 | 0,041 | 0,044 | 0,048 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,044 | 0,045 | 0,049 | 0,053 | 0,056 | 0,062 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,126 | 0,131 | 0,142 | 0,153 | 0,163 | 0,179 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,129 | 0,135 | 0,146 | 0,157 | 0,168 | 0,184 |
| **Cracked concrete under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,083 | 0,085 | 0,090 | 0,095 | 0,099 | 0,106 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,170 | 0,110 | 0,116 | 0,122 | 0,128 | 0,137 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,086 | 0,088 | 0,093 | 0,098 | 0,103 | 0,110 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,111 | 0,114 | 0,121 | 0,127 | 0,133 | 0,143 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,321 | 0,330 | 0,349 | 0,367 | 0,385 | 0,412 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,330 | 0,340 | 0,358 | 0,377 | 0,396 | 0,424 |

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau;$ $\tau$: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau;$

## Table C15: Displacements under shear load[2)] (Internal threaded rod)

| Anchor size Internal threaded rod | | | IG-M6 | IG-M8 | IG-M10 | IG-M12 | IG-M16 | IG-M20 |
|---|---|---|---|---|---|---|---|---|
| **Non-cracked and cracked concrete under static and quasi-static action** | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,07 | 0,06 | 0,06 | 0,05 | 0,04 | 0,04 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,10 | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 |

[2)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V;$ V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V;$

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## Table C16: Displacements under tension load[1)] (rebar)

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 24 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Non-cracked concrete under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,031 | 0,032 | 0,034 | 0,035 | 0,037 | 0,039 | 0,042 | 0,043 | 0,045 | 0,048 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,040 | 0,042 | 0,044 | 0,045 | 0,047 | 0,051 | 0,054 | 0,055 | 0,058 | 0,063 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,032 | 0,034 | 0,035 | 0,036 | 0,038 | 0,041 | 0,044 | 0,045 | 0,047 | 0,050 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,042 | 0,044 | 0,045 | 0,047 | 0,049 | 0,053 | 0,056 | 0,057 | 0,060 | 0,065 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,121 | 0,126 | 0,131 | 0,137 | 0,142 | 0,153 | 0,163 | 0,164 | 0,172 | 0,186 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,124 | 0,129 | 0,135 | 0,141 | 0,146 | 0,157 | 0,168 | 0,169 | 0,177 | 0,192 |
| **Cracked concrete under static and quasi-static action for a working life of 50 and 100 years** | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C II: 80°C/50°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,081 | 0,083 | 0,085 | 0,087 | 0,090 | 0,095 | 0,099 | 0,099 | 0,103 | 0,108 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,104 | 0,107 | 0,110 | 0,113 | 0,116 | 0,122 | 0,128 | 0,128 | 0,133 | 0,141 |
| Temperature range III: 120°C/72°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,084 | 0,086 | 0,088 | 0,090 | 0,093 | 0,098 | 0,103 | 0,103 | 0,107 | 0,113 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,108 | 0,111 | 0,114 | 0,118 | 0,121 | 0,127 | 0,133 | 0,133 | 0,138 | 0,148 |
| Temperature range IV: 160°C/100°C | $\delta_{N0}$-factor | [mm/(N/mm²)] | 0,312 | 0,321 | 0,330 | 0,340 | 0,349 | 0,367 | 0,385 | 0,385 | 0,399 | 0,425 |
| | $\delta_{N\infty}$-factor | [mm/(N/mm²)] | 0,321 | 0,330 | 0,340 | 0,349 | 0,358 | 0,377 | 0,396 | 0,396 | 0,410 | 0,449 |

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; $\tau$: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

## Table C17: Displacements under shear load[2)] (rebar)

| Anchor size reinforcing bar | | | Ø 8 | Ø 10 | Ø 12 | Ø 14 | Ø 16 | Ø 20 | Ø 24 | Ø 25 | Ø 28 | Ø 32 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Non-cracked and cracked concrete under static and quasi-static action** | | | | | | | | | | | | |
| All temperature ranges | $\delta_{V0}$-factor | [mm/kN] | 0,06 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 | 0,03 | 0,03 | 0,03 | 0,03 |
| | $\delta_{V\infty}$-factor | [mm/kN] | 0,09 | 0,08 | 0,08 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 | 0,04 | 0,04 |

[2)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

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## Table C18: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 and 100 years

| Anchor size threaded rod | | | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | |
| Characteristic tension resistance | | | $N_{Rk,s,eq,C1}$ | [kN] | $1{,}0 \cdot N_{Rk,s}$ | | | | | | | |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | see Table C1 | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | |
| Characteristic bond resistance in cracked and non-cracked concrete C20/25 | | | | | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 7,0 | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 | 7,0 |
| | II: 80°C/50°C | | $\tau_{Rk,eq,C1}$ | [N/mm²] | 7,0 | 7,5 | 8,0 | 9,0 | 8,5 | 7,0 | 7,0 | 7,0 |
| | III: 120°C/72°C | | $\tau_{Rk,eq,C1}$ | [N/mm²] | 6,0 | 6,5 | 7,0 | 7,5 | 7,0 | 6,0 | 6,0 | 6,0 |
| | IV: 160°C/100°C | | $\tau_{Rk,eq,C1}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,0 | 5,5 | 5,5 | 5,5 |
| Increasing factors for concrete $\psi_c$ | | | C25/30 to C50/60 | | 1,0 | | | | | | | |
| **Installation factor** | | | | | | | | | | | | |
| for dry and wet concrete | | CAC | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | |
| | | HDB | | | 1,2 | | | | | | | |
| for flooded bore hole | | CAC | | | 1,4 | | | | | | | |

## Table C19: Characteristic values of shear loads under seismic action (performance category C1)

| Anchor size threaded rod | | | M8 | M10 | M12 | M16 | M20 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | |
| Characteristic shear resistance (Seismic C1) | $V_{Rk,s,eq,C1}$ | [kN] | $0{,}70 \cdot V^0_{Rk,s}$ | | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | | | | | |
| **Factor for annular gap** | $\alpha_{gap}$ | [-] | 0,5 (1,0)[1)] | | | | | | | |

[1)] Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended

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## Table C20: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 and 100 years

| **Anchor size reinforcing bar** | | | | **Ø 8** | **Ø 10** | **Ø 12** | **Ø 14** | **Ø 16** | **Ø 20** | **Ø 24** | **Ø 25** | **Ø 28** | **Ø 32** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | | |
| Characteristic tension resistance | | $N_{Rk,s,eq,C1}$ | [kN] | $1{,}0 \cdot A_s \cdot f_{uk}$ [1] | | | | | | | | | |
| Cross section area | | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 452 | 491 | 616 | 804 |
| Partial factor | | $\gamma_{Ms,N}$ | [-] | 1,4 [2] | | | | | | | | | |
| **Combined pull-out and concrete failure** | | | | | | | | | | | | | |
| Characteristic bond resistance in cracked and non-cracked concrete C20/25 | | | | | | | | | | | | | |
| Temperature range I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 7,0 | 7,0 | 7,0 |
| Temperature range II: 80°C/50°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 5,5 | 5,5 | 6,0 | 6,5 | 6,5 | 6,5 | 6,5 | 7,0 | 7,0 | 7,0 |
| Temperature range III: 120°C/72°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 4,5 | 5,0 | 5,0 | 5,5 | 5,5 | 5,5 | 5,5 | 6,0 | 6,0 | 6,0 |
| Temperature range IV: 160°C/100°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C1}$ | [N/mm²] | 4,0 | 4,5 | 4,5 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 | 5,0 |
| Increasing factors for concrete $\psi_c$ | | C25/30 to C50/60 | | 1,0 | | | | | | | | | |
| **Installation factor** | | | | | | | | | | | | | |
| for dry and wet concrete | CAC | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| for dry and wet concrete | HDB | $\gamma_{inst}$ | [-] | 1,2 | | | | | | | | | |
| for flooded bore hole | CAC | $\gamma_{inst}$ | [-] | 1,4 | | | | | | | | | |

[1] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation

## Table C21: Characteristic values of shear loads under seismic action (performance category C1)

| **Anchor size reinforcing bar** | | | **Ø 8** | **Ø 10** | **Ø 12** | **Ø 14** | **Ø 16** | **Ø 20** | **Ø 24** | **Ø 25** | **Ø 28** | **Ø 32** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | | | | | |
| Characteristic shear resistance | $V_{Rk,s,eq}$ | [kN] | $0{,}35 \cdot A_s \cdot f_{uk}$ [1] | | | | | | | | | |
| Cross section area | $A_s$ | [mm²] | 50 | 79 | 113 | 154 | 201 | 314 | 452 | 491 | 616 | 804 |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 [2] | | | | | | | | | |
| **Factor for annular gap** | $\alpha_{gap}$ | [-] | 0,5 (1,0) [3] | | | | | | | | | |

[1] $f_{uk}$ shall be taken from the specifications of reinforcing bars
[2] in absence of national regulation
[3] Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended

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## Table C22: Characteristic values of tension loads under seismic action (performance category C2) for a working life of 50 and 100 years

| Anchor size threaded rod | | | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | | |
| Characteristic tension resistance, Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70 | | | $N_{Rk,s,eq,C2}$ | [kN] | $1{,}0 \cdot N_{Rk,s}$ | | | |
| Partial factor | | | $\gamma_{Ms,N}$ | [-] | see Table C1 | | | |
| **Combined pull-out and concrete failure** | | | | | | | | |
| Characteristic bond resistance in cracked and non-cracked concrete C20/25 | | | | | | | | |
| Temperature range | I: 40°C/24°C | Dry, wet concrete and flooded bore hole | $\tau_{Rk,eq,C2}$ | [N/mm²] | 3,6 | 3,5 | 3,3 | 2,3 |
| | II: 80°C/50°C | | $\tau_{Rk,eq,C2}$ | [N/mm²] | 3,6 | 3,5 | 3,3 | 2,3 |
| | III: 120°C/72°C | | $\tau_{Rk,eq,C2}$ | [N/mm²] | 3,1 | 3,0 | 2,8 | 2,0 |
| | IV: 160°C/100°C | | $\tau_{Rk,eq,C2}$ | [N/mm²] | 2,5 | 2,7 | 2,5 | 1,8 |
| Increasing factors for concrete $\psi_c$ | | | C25/30 to C50/60 | | 1,0 | | | |
| **Installation factor** | | | | | | | | |
| for dry and wet concrete | CAC | | $\gamma_{inst}$ | [-] | 1,0 | | | |
| | HDB | | | | 1,2 | | | |
| for flooded bore hole | CAC | | | | 1,4 | | | |

## Table C23: Characteristic values of shear loads under seismic action (performance category C2)

| Anchor size threaded rod | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | |
| Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70 | $V_{Rk,s,eq,C2}$ | [kN] | $0{,}70 \cdot V^0_{Rk,s}$ | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | see Table C1 | | | |
| **Factor for annular gap** | $\alpha_{gap}$ | [-] | 0,5 (1,0)[1)] | | | |

[1)] Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended

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## Table C24: Displacements under tension load[1)] (threaded rod)

| Anchor size threaded rod | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Cracked concrete under seismic action (performance category C2)** | | | | | | |
| All temperature ranges | $\delta_{N,eq,C2(DLS)}$ | [mm] | 0,24 | 0,27 | 0,29 | 0,27 |
| | $\delta_{N,eq,C2(ULS)}$ | [mm] | 0,55 | 0,51 | 0,50 | 0,58 |

## Table C25: Displacements under shear load (threaded rod)

| Anchor size threaded rod | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| **Cracked concrete under seismic action (performance category C2)** | | | | | | |
| All temperature ranges | $\delta_{V,eq,C2(DLS)}$ | [mm] | 3,6 | 3,0 | 3,1 | 3,5 |
| | $\delta_{V,eq,C2(ULS)}$ | [mm] | 7,0 | 6,6 | 7,0 | 9,3 |

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