



Approval body for construction products and types of construction

**Bautechnisches Prüfamt** 

An institution established by the Federal and Laender Governments



# **European Technical Assessment**

ETA-19/0542 of 14 April 2022

English translation prepared by DIBt - Original version in German language

#### **General Part**

Technical Assessment Body issuing the European Technical Assessment:

Trade name of the construction product

Product family to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment contains

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

This version replaces

Deutsches Institut für Bautechnik

Würth Injection system WIT-PE 1000 for concrete

Bonded fastener for use in concrete

Adolf Würth GmbH & Co. KG Reinhold-Würth-Straße 12-17 74653 Künzelsau DEUTSCHLAND

Werk 3

46 pages including 3 annexes which form an integral part of this assessment

EAD 330499-01-0601-v01 Edition 11/2020

ETA-19/0542 issued on 6 November 2020



#### European Technical Assessment ETA-19/0542

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#### **Specific Part**

#### 1 Technical description of the product

The "Würth Injection system WIT-PE 1000 for concrete" is a bonded anchor consisting of a mortar cartridge with injection mortar WIT-PE 1000 and a steel element according to Annex A 3.

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 quasistatic loading)	See Annex C 1 to C 6, C 8 to C 11, C 13 to C 16, B 3
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 7, C 12, C 17
Displacements under short-term and long-term loading	See Annex C 18 to C 20
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 21 to C 28

#### 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.

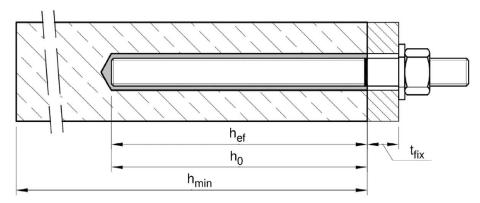
Issued in Berlin on 14 April 2022 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock Head of Section beglaubigt: Baderschneider

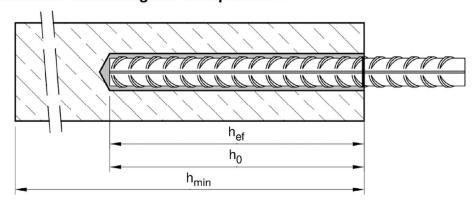


#### Installation threaded rod M8 up to M30

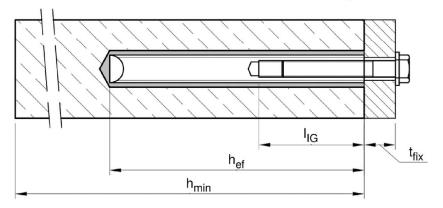
prepositioned installation or push through installation (annular gap filled with mortar)



#### Installation reinforcing bar Ø8 up to Ø32



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



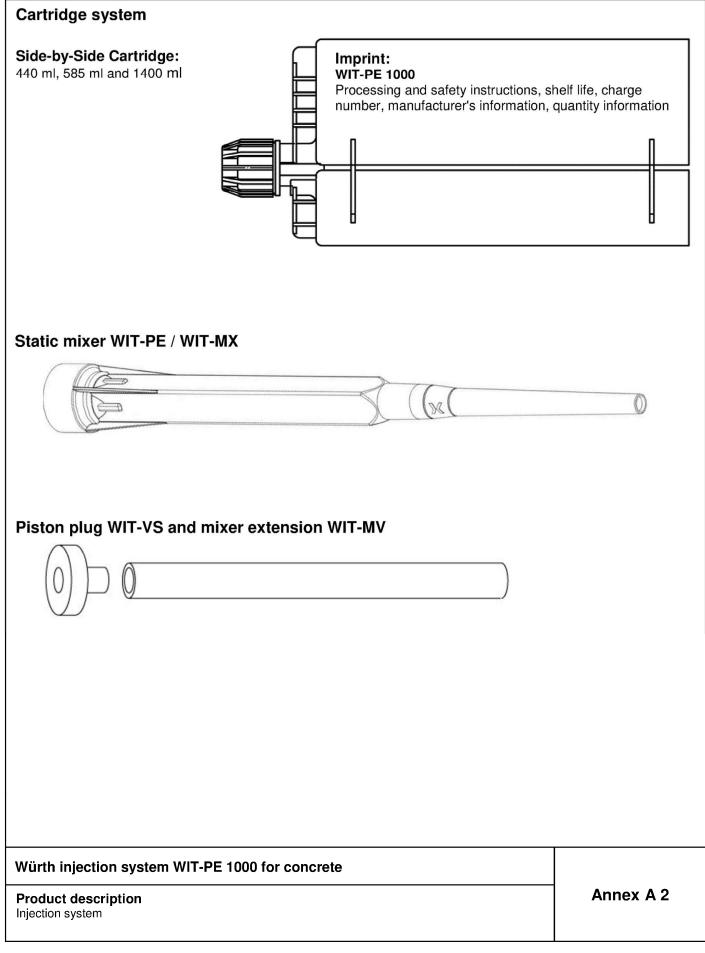
 $t_{fix}$  = thickness of fixture  $h_0$  = nominal drill hole diameter

 $h_{ef}$  = effective embedment depth  $I_{IG}$  = thread engagement length

 $h_{min}$  = minum thickness of member

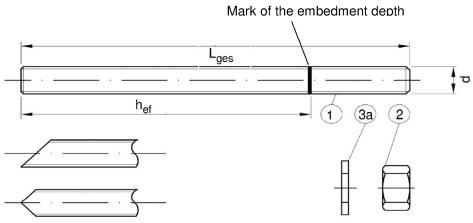
# Würth injection system WIT-PE 1000 for concrete Product description Installed condition Annex A 1







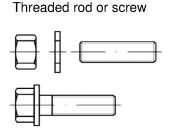
#### Threaded rod M8 up to M30 with washer and hexagon nut

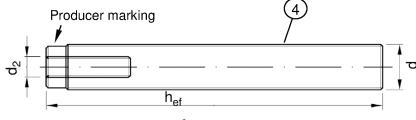


#### Commercial standard rod with:

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

#### Internal threaded rod IG-M6 to IG-M10





Marking Internal thread
Mark

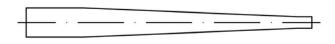
M8 Thread size (Internal thread)
A4 additional mark for stainless steel

HCR additional mark for high-corrosion resistance steel

#### Filling washer WIT-SHB

#### Mixer reduction nozzle WIT-MR-X





#### Würth injection system WIT-PE 1000 for concrete

#### **Product description**

Threaded rod; Internal threaded rod Filling washer; Mixer reduction nozzle

Annex A 3



	ble A1: Mate	eriais					
Pari	Designation	Material					
Ste	el, zinc plated (Steel	acc. to EN ISO 683-4:					
		5 µm acc. to EN ISC		2:2018 or 1:2009 and EN ISO 10684	·2004+AC·2009 or		
		45 μm acc. to EN ISC			.20011710.2000 01		
		Property class		Characteristic steel	Characteristic steel	Elongation at	
		Property class		ultimate tensile strength	yield strength	fracture	
				$f_{uk} = 400 \text{ N/mm}^2$	f <sub>yk</sub> = 240 N/mm <sup>2</sup>	A <sub>5</sub> > 8%	
1	Threaded rod			f <sub>uk</sub> = 400 N/mm <sup>2</sup>	$f_{yk} = 320 \text{ N/mm}^2$	A <sub>5</sub> > 8%	
		acc. to EN ISO 898-1:2013		$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 300 \text{ N/mm}^2$	A <sub>5</sub> > 8%	
		LIN 130 090-1.2013	5.8	f <sub>uk</sub> = 500 N/mm <sup>2</sup>	f <sub>yk</sub> = 400 N/mm <sup>2</sup>	A <sub>5</sub> > 8%	
			8.8	f <sub>uk</sub> = 800 N/mm <sup>2</sup>	f <sub>yk</sub> = 640 N/mm <sup>2</sup>	$A_5 \ge 12\%^{3}$	
			4	for anchor rod class 4.6 o	r 4.8		
2	Hexagon nut	acc. to EN ISO 898-2:2012	5 8	for anchor rod class 5.6 o	r 5.8		
		LIN 130 030-2.2012	8	for anchor rod class 8.8			
За	Washer			galvanised or sherardized EN ISO 7089:2000, EN ISC		7094:2000)	
3b	Filling washer	Steel, zinc plated, ho	ot-dip	galvanised or sherardized			
Pr		I Property clace		Characteristic steel	Characteristic steel	Elongation at fracture	
	Internal threaded	Froperty class		ultimate tensile strength	yield strength	_	
1	Internal threaded anchor rod	. ,	5.8	ultimate tensile strength  f <sub>uk</sub> = 500 N/mm <sup>2</sup>		_	
4	Internal threaded anchor rod	acc. to EN ISO 898-1:2013		f <sub>uk</sub> = 500 N/mm <sup>2</sup>	yield strength	fracture	
Stai Stai	anchor rod nless steel A2 (Mate	acc. to EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1	8.8   .431   .457	f <sub>uk</sub> = 500 N/mm <sup>2</sup>	yield strength f <sub>yk</sub> = 400 N/mm <sup>2</sup> f <sub>yk</sub> = 640 N/mm <sup>2</sup> to EN 10088-1:2014) to EN 10088-1:2014)	fracture A <sub>5</sub> > 8%	
Stai Stai	anchor rod nless steel A2 (Mate	acc. to EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1	8.8   .431   .457	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t r 1.4565, acc. to EN 10088 Characteristic steel	yield strength $f_{yk} = 400 \text{ N/mm}^2$ $f_{yk} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) to EN 10088-1:2014) $f_{xy} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) $f_{xy} = 640 \text{ N/mm}^2$ The first strength of the first o	fracture A <sub>5</sub> > 8%	
Stai Stai Higl	anchor rod  nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45	8.8  .431  .457	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t r 1.4565, acc. to EN 10088	yield strength f <sub>yk</sub> = 400 N/mm <sup>2</sup> f <sub>yk</sub> = 640 N/mm <sup>2</sup> to EN 10088-1:2014) to EN 10088-1:2014) to EN 10188-1:2014)	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at	
Stai Stai Higl	anchor rod nless steel A2 (Mate	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class  acc. to	8.8 1.431 1.457 529 or	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t r 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength	yield strength $f_{yk} = 400 \text{ N/mm}^2$ $f_{yk} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) to EN 10088-1:2014) $f_{xy} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) $f_{xy} = 640 \text{ N/mm}^2$ to EN 10088-1:2014)	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$	
Stai Stai Higi	anchor rod  nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class	8.8 1.431 1.457 529 or	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f <sub>uk</sub> = 500 N/mm <sup>2</sup>	yield strength  f <sub>yk</sub> = 400 N/mm <sup>2</sup> f <sub>yk</sub> = 640 N/mm <sup>2</sup> to EN 10088-1:2014)  to EN 10088-1:2014)  to EN 10088-1:2014)  Characteristic steel  yield strength  f <sub>yk</sub> = 210 N/mm <sup>2</sup>	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture	
Stai Stai Higi	anchor rod  nless steel A2 (Materials and A2 (Ma	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020	8.8 1.431 1.457 529 o	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ \text{r } 1.4565, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \end{aligned}$	yield strength $f_{yk} = 400 \text{ N/mm}^2$ $f_{yk} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) to EN 10088-1:2014) G-1: 2014) Characteristic steel yield strength $f_{yk} = 210 \text{ N/mm}^2$ $f_{yk} = 450 \text{ N/mm}^2$	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$	
Stai Stai Hig	anchor rod  nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  acc. to	8.8 1.431 1.457 529 or 50 70 80 50 70	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4565, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \end{aligned}$	yield strength $f_{yk} = 400 \text{ N/mm}^2$ $f_{yk} = 640 \text{ N/mm}^2$ to EN 10088-1:2014) to EN 10088-1:2014) G-1: 2014) Characteristic steel yield strength $f_{yk} = 210 \text{ N/mm}^2$ $f_{yk} = 450 \text{ N/mm}^2$	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$	
Stai Stai Hig	anchor rod  nless steel A2 (Materials and A2 (Ma	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  acc. to EN ISO 3506-1:2020	8.8 1.431 1.457 529 of 50 70 80 50 70 80	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. } 1 \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. } 1 \\ 1 / 1.4365, \text{ acc. } \text{ to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \\ \text{for anchor rod class } 80 \end{aligned}$	yield strength  f <sub>yk</sub> = 400 N/mm²  f <sub>yk</sub> = 640 N/mm²  to EN 10088-1:2014) to EN 10088-1:2014) G-1: 2014)  Characteristic steel yield strength  f <sub>yk</sub> = 210 N/mm²  f <sub>yk</sub> = 450 N/mm²	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$	
Stai Stai Hig	anchor rod  nless steel A2 (Materials and A2 (Ma	acc. to EN ISO 898-1:2013  erial 1.4301 / 1.4307 / 1  erial 1.4401 / 1.4404 / 1  ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452	8.8 1.431 1.457 529 of 50 70 80 50 70 80 7 1.44 9 or 1	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4565, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \end{aligned}$	yield strength  f <sub>yk</sub> = 400 N/mm²  f <sub>yk</sub> = 640 N/mm²  to EN 10088-1:2014) to EN 10088-1:2014) c-1: 2014)  Characteristic steel yield strength  f <sub>yk</sub> = 210 N/mm²  f <sub>yk</sub> = 450 N/mm²  f <sub>yk</sub> = 600 N/mm²  1541, acc. to EN 10088-1578, acc.	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014  1:2014	
Stai Stai High	anchor rod  nless steel A2 (Material A2 (Mat	acc. to EN ISO 898-1:2013  Prial 1.4301 / 1.4307 / 1  Prial 1.4401 / 1.4404 / 1  Ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20	8.8 1.431 1.457 529 of 50 70 80 71.43 71.44 9 or 1	$\begin{array}{l} f_{uk} = 500 \text{ N/mm}^2 \\ f_{uk} = 800 \text{ N/mm}^2 \\ 1 \ / \ 1.4567 \text{ or } 1.4541, \text{ acc. } 1 \\ 1 \ / \ 1.4362 \text{ or } 1.4578, \text{ acc. } 1 \\ 1 \ / \ 1.4565, \text{ acc. } \text{ to EN } 10088 \\ \hline \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} = 500 \text{ N/mm}^2 \\ f_{uk} = 700 \text{ N/mm}^2 \\ \hline f_{uk} = 800 \text{ N/mm}^2 \\ \hline \text{for anchor rod class } 50 \\ \hline \text{for anchor rod class } 70 \\ \hline \text{for anchor rod class } 80 \\ \hline 807 \ / \ 1.4311 \ / \ 1.4567 \text{ or } 1.4 \\ \hline 1.4565, \text{ acc. to EN } 10088-1 \\ \hline \end{array}$	yield strength  f <sub>yk</sub> = 400 N/mm²  f <sub>yk</sub> = 640 N/mm²  to EN 10088-1:2014) to EN 10088-1:2014) c-1: 2014)  Characteristic steel yield strength  f <sub>yk</sub> = 210 N/mm²  f <sub>yk</sub> = 450 N/mm²  f <sub>yk</sub> = 600 N/mm²  1541, acc. to EN 10088-1578, acc.	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014  1:2014	
Stai High 1 1 2 3a 3b	anchor rod  nless steel A2 (Material A2 (Mat	acc. to EN ISO 898-1:2013  Prial 1.4301 / 1.4307 / 1  Prial 1.4401 / 1.4404 / 1  Ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20	8.8 1.431 1.457 529 of 50 70 80 71.43 71.44 9 or 1	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. to 1.4565, acc. to EN 10088  Characteristic steel ultimate tensile strength  f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 700 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> for anchor rod class 50  for anchor rod class 70  for anchor rod class 80  307 / 1.4311 / 1.4567 or 1.4  1.4565, acc. to EN 10088-1  EN ISO 7089:2000, EN ISC	yield strength  f <sub>yk</sub> = 400 N/mm²  f <sub>yk</sub> = 640 N/mm²  to EN 10088-1:2014) to EN 10088-1:2014) c-1: 2014)  Characteristic steel yield strength  f <sub>yk</sub> = 210 N/mm²  f <sub>yk</sub> = 450 N/mm²  f <sub>yk</sub> = 600 N/mm²  1541, acc. to EN 10088-1578, acc.	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014  1:2014	
Stai Stai High 1	anchor rod  nless steel A2 (Material A2 (Mat	acc. to EN ISO 898-1:2013  Prial 1.4301 / 1.4307 / 1  Prial 1.4401 / 1.4404 / 1  Ce steel (Material 1.45  Property class  acc. to EN ISO 3506-1:2020  A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20  Stainless steel A4, H	8.8 1.431 1.457 529 of 50 70 80 71.43 71.44 9 or 1	f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1 / 1.4565, acc. to EN 10088  Characteristic steel ultimate tensile strength  f <sub>uk</sub> = 500 N/mm <sup>2</sup> f <sub>uk</sub> = 700 N/mm <sup>2</sup> f <sub>uk</sub> = 800 N/mm <sup>2</sup> for anchor rod class 50  for anchor rod class 70  for anchor rod class 80  307 / 1.4311 / 1.4567 or 1.4  1.4565, acc. to EN 10088-1  EN ISO 7089:2000, EN ISO  corrosion resistance steel  Characteristic steel	yield strength    f <sub>yk</sub> = 400 N/mm <sup>2</sup>     f <sub>yk</sub> = 640 N/mm <sup>2</sup>     to EN 10088-1:2014     to	fracture $A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014  1:2014  7094:2000)	

<sup>1)</sup> Property class 70 or 80 for anchor rods and hexagon nuts up to M24 and Internal threaded anchor rods up to IG-M16

<sup>4)</sup> Property class 80 only for stainless steel A4 and HCR

Würth injection system WIT-PE 1000 for concrete	
Product description  Materials threaded rod, Internal threaded anchor rod and filling washer	Annex A 4

<sup>2)</sup> for IG-M20 only property class 50

<sup>3)</sup>  $A_5 > 8\%$  fracture elongation if no use for seismic performance category C2







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  $\leq$   $h_{rib} \leq$  0,07d (d: Nominal diameter of the bar;  $h_{rib}$ : Rib height of the bar)

Table A2: Materials Reinforcing bar

Part	Designation	Material
Reba	ar	
1	Reinforcing steel according to EN 1992 1 1:2004+AC:2010, Annex C	Bars and rebars from ring class B or C $f_{yk}$ and k according to NDP or NCI according to EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

Würth injection system WIT-PE 1000 for concrete	
Product description Materials reinforcing bar	Annex A 5



#### Specification of the intended use

#### Fasteners subject to (Static and quasi-static loads):

	Working life	50 years	Working life	100 years	
Base material	uncracked concrete	cracked concrete	uncracked concrete	cracked concrete	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to M Ø8 to Ø IG-M6 to I	<b>3</b> 32,	M8 to M Ø8 to Ø IG-M6 to I	<b>9</b> 32,	
DD: Diamond drilling	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20	No performance assessed	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20	No performance assessed	
Temperature Range:	I: - 40 C 1		I: - 40 C f	15 15 15 15 15 15 15 15 15 15 15 15 15 1	

#### Fasteners subject to (seismic action):

	Performance Category C1	Performance Category C2								
Base material	Cracked and uncracked concrete	Cracked and uncracked concrete								
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to M30, ∅8 to ∅32	M12 to M30								
DD: Diamond drilling	No performance assessed	No performance assessed								
Temperature Range:	I: - 40 C to +40 C <sup>1)</sup> II: - 40 C to +72 C <sup>2)</sup>	I: - 40 C to +40 C <sup>1)</sup> II: - 40 C to +72 C <sup>2)</sup>								

<sup>1) (</sup>max. long-term temperature +24°C and max. short-term temperature +40°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

Würth injection system WIT-PE 1000 for concrete	
Intended Use Specifications	Annex B 1

<sup>2) (</sup>max. long-term temperature +50°C and max. short-term temperature +72°C)

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English translation prepared by DIBt



#### Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.
   The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- Fasteners are designed under the responsibility of an engineer experienced in fasteners and concrete work.
- The fasteners 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), compressed air (CD) or diamond drill mode (DD).
- Overhead installation allowed.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Würth injection system WIT-PE 1000 for concrete	
Intended Use Specifications (Continued)	Annex B 2



Table B1: Installation parameters for threaded rod											
Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Diameter of element	t	$d = d_{nom}$	[mm]	8	10	12	16	20	24	27	30
Nominal drill hole di	ameter	d <sub>0</sub>	[mm]	10	12	14	18	22	28	30	35
Effective embedmer	at donth	h <sub>ef,min</sub>	[mm]	60	60	70	80	90	96	108	120
Effective embedmer	п аерті	h <sub>ef,max</sub>	[mm]	160	200	240	320	400	480	540	600
Diameter of	Prepositioned ins	stallation d <sub>f</sub> ≤	[mm]	9	12	14	18	22	26	30	33
clearance hole in the fixture	Push through i	nstallation d <sub>f</sub>	[mm]	12	14	16	20	24	30	33	40
Maximum installatio	n torque	max T <sub>inst</sub> ≤	[Nm]	10	20	40 <sup>1)</sup>	60	100	170	250	300
		h <sub>min</sub>	[mm]	_ ~	$h_{ef}$ + 30 mm $h_{ef}$ + 2d <sub>0</sub> ≥ 100 mm			)			
Minimum spacing		s <sub>min</sub>	[mm]	40	50	60	75	95	115	125	140
Minimum edge dista	ınce	c <sub>min</sub>	[mm]	35	40	45	50	60	65	75	80

<sup>1)</sup> Maximum installation torque for M12 with steel Grade 4.6 is 35 Nm

#### Table B2: Installation parameters for reinforcing bar

Reinforcing bar			Ø 8 <sup>1)</sup>	Ø 10 <sup>1)</sup>	Ø 121)	Ø 14	Ø 16	Ø 20	Ø 24 <sup>1)</sup>	Ø 25 <sup>1)</sup>	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 <sub>ef,min</sub>	[mm]	60	60	70	75	80	90	96	100	112	128
Effective embedment depth	h <sub>ef,max</sub>	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h <sub>min</sub>	[mm]		30 mm 00 mm	2			h <sub>e</sub>	<sub>f</sub> + 2d <sub>0</sub>			
Minimum spacing	s <sub>min</sub>	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	C <sub>min</sub>	[mm]	35	40	45	50	50	60	70	70	75	85

<sup>1)</sup> both nominal drill hole diameter can be used

#### Table B3: Installation parameters for Internal threaded anchor rod

Internal threaded anchor rod	IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Internal diameter of anchor rod	d <sub>2</sub>		6	8	10	12	16	20
Outer diameter of anchor rod1)	$d = d_{nom}$	[mm]	10	12	16	20	24	30
Nominal drill hole diameter	d <sub>0</sub>	[mm]	12	14	18	22	28	35
Effective embedment depth	h <sub>ef,min</sub>	[mm]	60	70	80	90	96	120
Effective embedment depth	h <sub>ef,max</sub>		200	240	320	400	480	600
Diameter of clearance hole in the fixture	d <sub>f</sub> ≤		7	9	12	14	18	22
Maximum installation torque	max T <sub>inst</sub> ≤	[Nm]	10	10	20	40	60	100
Thread engagement length min/max	l <sub>IG</sub>	[mm]	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	h <sub>min</sub>	[mm]	h <sub>ef</sub> + 3 ≥ 100			h <sub>ef</sub> -	- 2d <sub>0</sub>	
Minimum spacing	s <sub>min</sub>	[mm]	50	60	75	95	115	140
Minimum edge distance	c <sub>min</sub>	[mm]	40	45	50	60	65	80

<sup>1)</sup> With metric threads according to EN 1993-1-8:2005+AC:2009

Würth injection system WIT-PE 1000 for concrete	
Intended Use Installation parameters	Annex B 3



Table B4: Parameter clear					manil	Reservable.				
hreaded Rod	Re- inforcing bar	Internal threaded anchor rod	d <sub>0</sub> Drill bit - Ø HD, HDB, CD, DD	d <sub>t</sub> Brush	-	d <sub>b,min</sub> min. Brush - Ø	Piston plug	I	on direction piston plu	
[mm]	[mm]	[mm]	[mm]	WIT-	[mm]	[mm]	WIT-	1	$\rightarrow$	1
M8	8		10	RB10	11,5	10,5			7	_
M10	8 / 10	IG-M6	12	RB12	13,5	12,5		No plug required		
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			
	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	h	h.>	
M24		IG-M16	28	RB28	30,0	28,5	VS28	h <sub>ef</sub> >	h <sub>ef</sub> > 250 mm	all
M27	24 / 25		30	RB30	31,8	30,5	VS30	250 11111	250 11111	
	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			

(min 6 bar)



#### **Brush WIT-RB**



#### **Pistole Plug WIT-VS**



#### **Brush extension**



Würth injection system WIT-PE 1000 for concrete	
Intended Use Cleaning and installation tools	Annex B 4



Table B5:	Worki	ng and curing	j time	
Tempera	ture in bas	se material	Maximum working time	Minimum curing time 1)
	Т		t <sub>work</sub>	t <sub>cure</sub>
+ 0 °C	to	+ 4 °C	90 min	144 h
+ 5°C	to	+ 9°C	80 min	48 h
+ 10°C	to	+ 14°C	60 min	28 h
+ 15°C	to	+ 19°C	40 min	18 h
+ 20 °C	to	+ 24 °C	30 min	12 h
+ 25 °C	to	+ 34 °C	12 min	9 h
+ 35 °C	to	+ 39 °C	8 min	6 h
	+ 40 °C		8 min	4 h
Cartr	idge tempe	erature	+5°C to	+40°C

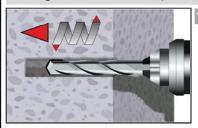
<sup>1)</sup> The minimum curing time is only valid for dry base material. In wet base material the curing time must be doubled.

Würth injection system WIT-PE 1000 for concrete	
Intended Use Working time and curing time	Annex B 5

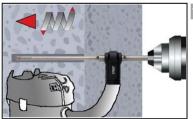


#### Installation instructions

#### Drilling of the bore hole (HD, HDB, CD)



Hammer drilling (HD) / Compressed air drilling (CD) Drill a hole to the required embedment depth. Drill bit diameter according to Table B1, B2 or B3. Aborted drill holes shall be filled with mortar. Proceed with Step 2.Proceed with Step 2.

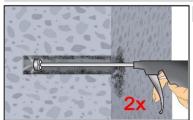


Hollow drill bit system (HDB) (see Annex B 4)
Drill a hole to the required embedment depth.
Drill bit diameter according to Table B1, B2 or B3.
The hollow drilling system removes the dust and cleans the bore hole.
Proceed with Step 3.

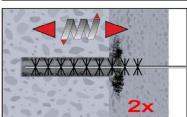
Attention! Standing water in the bore hole must be removed before cleaning.

#### Compressed Air Cleaning (CAC):

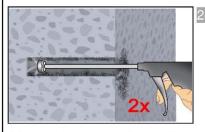
All diameter in cracked and uncracked concrete



Blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)



Brush the bore hole minimum 2x with brush WIT-RB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)



2c. Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

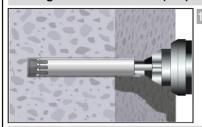
Cleaned bore hole has to be protected against re-contamination in an appropriate way, If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

Würth injection system WIT-PE 1000 for concrete	
Intended Use Installation instructions	Annex B 6



#### Installation instructions (continuation)

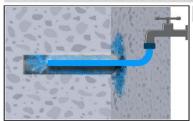
#### Drilling of the bore hole (DD)



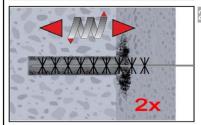
Diamond drilling (DD)
Drill a hole to the required embedment depth required
Drill bit diameter according to Table B1, B2 or B3.
Aborted drill holes shall be filled with mortar.
Proceed with Step 2.

#### Flush & Compressed Air Cleaning (SPCAC):

All diameter in uncracked concrete



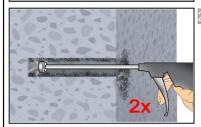
2a. Flushing with water until clear water comes out.



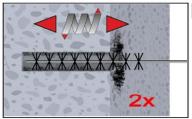
Brush the bore hole minimum 2x with brush WIT-RB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)



Flushing again with water until clear water comes out.



2d. Blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)



Brush the bore hole minimum 2x with brush WIT-RB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)

#### Würth injection system WIT-PE 1000 for concrete

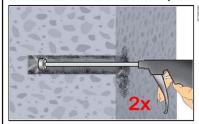
#### **Intended Use**

Installation instructions (continuation)

Annex B 7

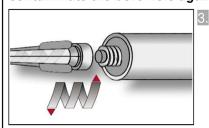


#### Installation instructions (continuation)



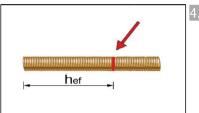
Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

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



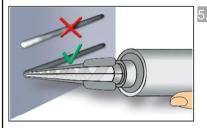
Screw on static-mixing nozzle WIT-PE / WIT-MX, and load the cartridge into an appropriate dispensing tool.

For every working interruption longer than the maximum working time t<sub>work</sub> (Annex B 5) as well as for new cartridges, a new static-mixer shall be used.



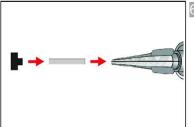
Mark embedment depth on the anchor rod.

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



Not proper mixed mortar is not sufficient for fastening.

Dispense and discard mortar until an uniform grey or red colour is shown (at least 3 full strokes).

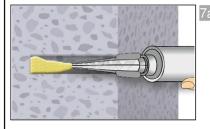


Piston plugs WIT-VS and mixer nozzle extensions WIT-MV shall be used according to

Table B4 for the following applications:

- Horizontal and vertical downwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm and embedment depth h<sub>ef</sub> > 250mm
- Vertical upwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm

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



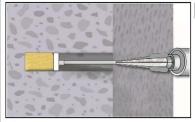
#### Injecting mortar without piston plug WIT-VS:

Starting at bottom of the hole and fill the hole up to approximately two-thirds with adhesive. (If necessary, a mixer nozzle extension shall be used.) Slowly withdraw of the static mixing nozzle avoid creating air pockets Observe the temperature related working time  $t_{work}$  (Annex B 5).

Würth injection system WIT-PE 1000 for concrete	
Intended Use Installation instructions (continuation)	Annex B 8



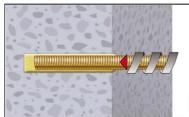
#### Installation instructions (continuation)



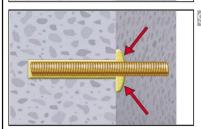
#### 7b. Injecting mortar with piston plug WIT-VS:

Starting at bottom of the hole and fill the hole up to approximately two-thirds with adhesive. (If necessary, a mixer nozzle extension shall be used.) During injection the piston plug is pushed out of the bore hole by the back pressure of the mortar.

Observe the temperature related working time t<sub>work</sub> (Annex B 5).

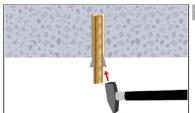


Insert the anchor rod while turning slightly up to the embedment mark.

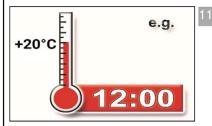


Annular gap between anchor rod and base material must be completely filled with mortar. In case of push through installation the annular gap in the fixture must be filled with mortar also.

Otherwise, the installation must be repeated starting from step 7 before the maximum working time  $t_{work}$  has expired.



For application in vertical upwards direction the anchor rod shall be fixed (e.g. wedges).



Temperature related curing time t<sub>cure</sub> (Annex B 5) must be observed. Do not move or load the fastener during curing time.



Install the fixture by using a calibrated torque wrench. Observe maximum installation torque (Table B1 or B3).

In case of static requirements (e.g. seismic), fill the annular gab in the fixture with mortar according to Annex 2. Therefore replace the washer by the filling washer WIT-SHB and use the mixer reduction nozzle WIT-MR-X.

Würth injection system WIT-PE 1000 for concrete	

#### Intended Use

Installation instructions (continuation)

Annex B 9



T٢	nreaded rod			M8	M10	M12	M16	M20	M24	M27	M30
	ross section area	A <sub>s</sub>	[mm²]	36,6	58	84,3	157	245	353	459	561
	naracteristic tension resistance, Steel failu					,-					
	eel, Property class 4.6 and 4.8	N <sub>Rk,s</sub>	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
St	eel, Property class 5.6 and 5.8	N <sub>Rk,s</sub>	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
St	eel, Property class 8.8	N <sub>Rk,s</sub>	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
St	ainless steel A2, A4 and HCR, class 50	N <sub>Rk,s</sub>	[kN]	18	29	42	79	123	177	230	281
St	ainless steel A2, A4 and HCR, class 70	N <sub>Rk,s</sub>	[kN]	26	41	59	110	171	247	_3)	_3)
St	ainless steel A4 and HCR, class 80	N <sub>Rk,s</sub>	[kN]	29	46	67	126	196	282	_3)	_3)
Cł	naracteristic tension resistance, Partial fac	tor <sup>2)</sup>									
St	eel, Property class 4.6 and 5.6	γ <sub>Ms,N</sub>	[-]				2,0	)			
St	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]				1,5	5			
St	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,N</sub>	[-]				2,8	6			
St	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,N</sub>	[-]		1,87						
	ainless steel A4 and HCR, class 80	γ <sub>Ms,N</sub>	[-]	1,6							
Cł	naracteristic shear resistance, Steel failure	1)	1								
F	Steel, Property class 4.6 and 4.8	V <sup>0</sup> Rk,s	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
rarm	Steel, Property class 5.6 and 5.8	V <sup>0</sup> Rk,s	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
eve	Steel, Property class 8.8	V <sup>0</sup> Rk,s	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
out l	Stainless steel A2, A4 and HCR, class 50	V <sup>0</sup> Rk,s	[kN]	9	15	21	39	61	88	115	140
Without lever	Stainless steel A2, A4 and HCR, class 70	V <sup>0</sup> <sub>Rk,s</sub>	[kN]	13	20	30	55	86	124	_3)	_3)
>	Stainless steel A4 and HCR, class 80	V <sup>0</sup> <sub>Rk,s</sub>	[kN]	15	23	34	63	98	141	_3)	_3)
	Steel, Property class 4.6 and 4.8	M <sup>0</sup> Rk,s	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
arm	Steel, Property class 5.6 and 5.8	M <sup>0</sup> Rk,s	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
era	Steel, Property class 8.8	M <sup>0</sup> Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
1 lever	Stainless steel A2, A4 and HCR, class 50	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	19	37	66	167	325	561	832	1125
=	Stainless steel A2, A4 and HCR, class 70	M <sup>0</sup> Rk,s	[Nm]	26	52	92	232	454	784	_3)	_3)
	Stainless steel A4 and HCR, class 80	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	30	59	105	266	519	896	_3)	_3)
Cł	naracteristic shear resistance, Partial facto								I		
	eel, Property class 4.6 and 5.6	γ <sub>Ms,V</sub>	[-]				1,6	7			
	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,V</sub>	[-]				1,2				
	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,V</sub>	[-]				2,3	35.0			
	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,V</sub>	[-]				1,5	6			
St.	ainless steel A4 and HCR, class 80	γ <sub>Ms,V</sub>	[-]				1,3	3			

<sup>1)</sup> Values are only valid for the given stress area A<sub>s</sub>. Values in brackets are valid for undersized threaded rods with smaller stress area A<sub>s</sub> for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.

<sup>3)</sup> Fastener type not part of the ETA

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods	Annex C 1

<sup>2)</sup> in absence of national regulation



Table C2:	: Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years				
Fastener				All Fastener type and sizes	
Concrete cone fa	ailure		, Ac		
Uncracked concre	ete	k <sub>ucr,N</sub>	[-]	11,0	
Cracked concrete	)	k <sub>cr,N</sub>	[-]	7,7	
Edge distance		c <sub>cr,N</sub>	[mm]	1,5 h <sub>ef</sub>	
Axial distance		s <sub>cr,N</sub>	[mm]	2 c <sub>cr,N</sub>	
Splitting					
	h/h <sub>ef</sub> ≥ 2,0			1,0 h <sub>ef</sub>	
Edge distance	$2.0 > h/h_{ef} > 1.3$	c <sub>cr,sp</sub>	[mm]	$2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$	
	h/h <sub>ef</sub> ≤ 1,3			2,4 h <sub>ef</sub>	
Axial distance	•	s <sub>cr,sp</sub>	[mm]	2 c <sub>cr,sp</sub>	

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years	Annex C 2



	racteristic val a working life			is un	der si	atic	and q	uasi-	statio	e acti	on	
Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure			_									
Characteristic tension res	sistance	N <sub>Rk,s</sub>	[kN]			A <sub>s</sub> •f	uk (or s	see Table C1)				
Partial factor		γ <sub>Ms,N</sub>	[-]				see T	able C1				
Combined pull-out and												
Characteristic bond resis (CD)	tance in uncracked	d concrete C20	)/25 in ham	mer dri	lled hol	es (HC	) and o	compre	ssed a	ir drille	d hole	
II: 40°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr	[N/mm²]	20	20	19	19	18	17	16	16	
E II: 72°C/50°C	flooded bore hole	*HK,ucr	[14/11111]	15	15	15	14	13	13	12	12	
Characteristic bond resis	tance in uncracked	d concrete C20	)/25 in ham	mer dri	lled hol	es with	hollov	v drill bi	t (HDB	3)		
<u>е</u> I: 40°С/24°С	Dry, wet			17	16	16	16	15	14	14	13	
E	concrete	_	[N.L/0]	14	14	14	13	13	12	12	11	
II: 72°C/50°C	flooded bore	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	16	16	16	15	15	14	14	13	
ы П: 72°С/50°С	hole			14	14	14	13	13	12	12	11	
Characteristic bond resis and in hammer drilled ho			5 in hamme	r drille	d holes	(HD) ,	compr	essed a	air drille	ed hole	s (CE	
atrue Be I: 40°C/24°C	Dry, wet concrete and			7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	
Temperature range II: 40°C/24°C	flooded bore hole	<sup>τ</sup> Rk,cr	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	
Reduction factor ψ <sup>0</sup> sus in holes (CD) and in hamme				hamm	er drille	d hole	s (HD),	compr	essed	air drill	ed	
Temperature range II: 40°C/24°C	Dry, wet concrete and	0	r 1	0,80								
ਰ ਜ਼ਿ ਜ਼ਿ: 72°C/50°C	flooded bore hole	Ψ <sup>0</sup> sus	[-]	0,68								
Increasing factors for cor	ncrete	Ψc	[-]				(f <sub>ck</sub> /	20) <sup>0,1</sup>				
Characteristic bond resis	tance depending	τ <sub>Rk,ucr</sub> =	2.90 - 7295			Ψ	(1.0.000000	ucr,(C20	/25)			
on the concrete strength		τ <sub>Rk,cr</sub> =						cr,(C20/				
Concrete cone failure		I III,CI					C III	,01,(020/	23)			
Relevant parameter							see T	able C2	2			
Splitting												
Relevant parameter		<u> </u>					see T	able C2	2			
Installation factor				1			28					
for dry and wet concrete for flooded bore hole (HD		$\gamma_{inst}$	[-]					,0 ,2				
	,							,-				
Würth injection syst  Performances Characteristic values of to a working life of 50 years.	ension loads under			on					Anne	ex C	3	



	racteristic val a working life			ls un	der s	tatic	and q	uasi-	statio	actio	on
Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension res	sistance	N <sub>Rk,s</sub>	[kN]			$A_s \cdot f$	<sub>uk</sub> (or s	ee Tab	ole C1)		
Partial factor		γ <sub>Ms,N</sub>	[-]	see Table C1							
Combined pull-out and	concrete failure										
Characteristic bond resis (CD)	tance in uncracked	d concrete C20	/25 in ham	mer dri	lled hol	es (HD	) and o	compre	ssed a	ir drilled	d holes
II: 40°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm²]	20	20	19	19	18	17	16	16
ਰ ਇ E II: 72°C/50°C	flooded bore hole	TAK,ucr, 100	[14//////	15	15	15	14	13	13	12	12
Characteristic bond resis	tance in uncracked	d concrete C20	/25 in ham	mer dri	lled hol	es with	hollow	drill bi	it (HDB	3)	
<u>≅</u> I: 40°C/24°C	Dry, wet			17	16	16	16	15	14	14	13
1: 40°C/24°C     1: 72°C/50°C     1: 40°C/24°C     1: 4	concrete		[N1/207	14	14	14	13	13	12	12	11
I: 40°C/24°C	flooded bore	<sup>τ</sup> Rk,ucr,100	[N/mm <sup>2</sup> ]	16	16	16	15	15	14	14	13
Б П: 72°С/50°С	hole			14	14	14	13	13	12	12	11
Characteristic bond resis and in hammer drilled ho			in hamme								
II: 72°C/50°C	Dry, wet concrete and		[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5
8 E	flooded bore hole	<sup>τ</sup> Rk,cr,100	[	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5
Reduction factor ψ <sup>0</sup> sus,10 holes (CD) and in hamme				5 in ha	mmer c	drilled h	oles (F	ID), co	mpress	sed air	drilled
II: 72°C/50°C	Dry, wet concrete and	0	r 1	0,80							
II: 72°C/50°C	flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,68							
Increasing factors for cor	ncrete	Ψc	[-]				(f <sub>ck</sub> /	20) <sup>0,1</sup>			
Characteristic bond resis		τ <sub>Rk,ucr,100</sub> =				Ψ <sub>c</sub> •		r,100,(C	20/25)		
on the concrete strength	class	τ <sub>Rk,cr,100</sub> =				Ψс	<sup>τ</sup> Rk,cr	,100,(C2	20/25)		
Concrete cone failure				I							
Relevant parameter							see 1	able C2	<u>-</u>		
Splitting							200 T	able C2	)		
Relevant parameter Installation factor							566 L	abie UZ			
for dry and wet concrete	(HD: HDB_CD)						1	,0			
for flooded bore hole (HD		γinst	[-]					,2			
Würth injection syst									Anne	ex C 4	ı
Characteristic values of t for a working life of 100 y			i-static actic	on							



Table C5: Characteristic val for a working life			ls un	der s	tatic a	and q	uasi-	statio	actio	on
Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure										
Characteristic tension resistance	N <sub>Rk,s</sub>	[kN]			A <sub>s</sub> •f	<sub>uk</sub> (or s	ee Tab	le C1)		
Partial factor	γ <sub>Ms,N</sub>	[-]				see Ta	able C1			
Combined pull-out and concrete failure										
Characteristic bond resistance in uncracked	concrete C20	25 in diam	ond dri	lled ho	les (DE	))	,			
II: 40°C/24°C Dry, wet concrete and flooded bore hole	<b>T</b>		15	14	14	13	12	12	11	11
ਸ਼ਿਲਾ ਹੈ ਜ਼ਿਲ੍ਹਾ ਸ਼ਿਲ੍ਹਾ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਰ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ ਸ਼ਿਲ੍ਹ	<sup>₹</sup> Rk,ucr	[N/mm²]	12	12	11	10	9,5	9,5	9,0	9,0
Reduction factor $\psi^0_{ { t Sus}}$ in uncracked concre	te C20/25 in di	amond drill	ed hole	es (DD	)					
II: 72°C/50°C Dry, wet concrete and flooded bore hole	ψ <sup>0</sup> sus [-]									
ြင့် II: 72°C/50°C hole			0,72							
Increasing factors for concrete	Ψc	[-]				(f <sub>ck</sub> /	20) <sup>0,2</sup>			
Characteristic bond resistance depending on the concrete strength class	τ <sub>Rk,ucr</sub> =		Ψc • <sup>τ</sup> Rk,ucr,(C20/25)							
Concrete cone failure										
Relevant parameter						see Ta	able C2			
Splitting										
Relevant parameter						see Ta	able C2			
Installation factor										
for dry and wet concrete (DD) for flooded bore hole (DD)	γ <sub>inst</sub>	[-]		1,2		1	,0	1,4		

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 years (threaded rod)	Annex C 5



Table C6: Characteristic value for a working life			ds un	der s	tatic	and q	uasi-	statio	c acti	on
Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure	_	_								
Characteristic tension resistance	N <sub>Rk,s</sub>	[kN]			<b>A</b> <sub>s</sub> • 1	uk (or s	ee Tab	le C1)		
Partial factor	γ <sub>Ms,N</sub>	[-]				see Ta	able C1			
Combined pull-out and concrete failure	<del>)</del>									
Characteristic bond resistance in uncrack	ed concrete C20	)/25 in diam	ond dr	illed ho	les (DI	))				
Dry, wet concrete and flooded bore		[N]/na na 2]	15	14	14	13	12	12	11	11
II: 72°C/50°C Dry, wet concrete and flooded bore hole	,	[N/mm <sup>2</sup> ]	11	11	10	10	9,5	9,0	8,5	8,5
Reduction factor $\psi^0_{sus,100}$ in uncracked of	oncrete C20/25	in diamond	drilled	holes	(DD)					
II: 40°C/24°C Dry, wet concrete and flooded bore hole	Ju0	F 1	0,73							
flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,70							
Increasing factors for concrete	Ψ <sub>C</sub>	[-]		(f <sub>ck</sub> / 20) <sup>0,2</sup>						
Characteristic bond resistance depending on the concrete strength class	τ <sub>Rk,ucr,100</sub> =		Ψ <sub>c</sub> • <sup>τ</sup> Rk,ucr,100,(C20/25)							
Concrete cone failure										
Relevant parameter						see Ta	able C2	<u> </u>		
Splitting			1							
Relevant parameter						see Ta	able C2	<u> </u>		
Installation factor	Ī									
for dry and wet concrete (DD) for flooded bore hole (DD)	γ <sub>inst</sub>	[-]	1,0							

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 100 years (threaded rod)	Annex C 6



Table C7: Characteristic for a working I					nder s	tatic a	nd qu	asi-sta	atic acti	on	
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 <sup>0</sup> <sub>Rk,s</sub>	[kN]			0,6 •	A <sub>s</sub> ·f <sub>uk</sub>	(or see	Table C	1)		
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	V <sup>0</sup> <sub>Rk,s</sub>	[kN]			0,5 •	A <sub>s</sub> ∙f <sub>uk</sub>	(or see	Table C	1)		
Partial factor	γ <sub>Ms,V</sub>	[-]	see Table C1								
Ductility factor	k <sub>7</sub>	[-]	1,0								
Steel failure with lever arm											
Characteristic bending moment	M <sup>0</sup> Rk,s	[Nm]			1,2 • \	W <sub>el</sub> ∙ f <sub>uk</sub>	(or see	Table C	(1)		
Elastic section modulus	W <sub>el</sub>	[mm³]	31	62	109	277	541	935	1387	1874	
Partial factor	γ <sub>Ms,V</sub>	[-]				see	Table C	:1			
Concrete pry-out failure											
Factor	k <sub>8</sub>	[-]					2,0				
Installation factor	γ <sub>inst</sub>	[-]					1,0				
Concrete edge failure	· ·										
Effective length of fastener	If	[mm]	$\min(h_{ef}; 12 \cdot d_{nom})$ $\min(h_{ef}; 300mm)$						300mm)		
Outside diameter of fastener	d <sub>nom</sub>	[mm]	] 8 10 12 16 20 24 27 30						30		
Installation factor	γ <sub>inst</sub>	[-]		1,0							

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (threaded rod)	Annex C 7



-c	eristic value rking life of			ads un	ider sta	tic and	quasi-s	tatic ac	tion	
Internal threaded anchor rod	s			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel failure <sup>1)</sup>										
Characteristic tension resistant	ce, 5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123	
Steel, strength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196	
Partial factor, strength class 5.8	3 and 8.8	γMs,N	[-]	State 1	W. Control of	1	,5	C24-10 C3	2. 9049391	
Characteristic tension resistance										
Steel A4 and HCR, Strength cla	, <u>-</u> ,	N <sub>Rk,s</sub>	[kN]	14 26 41			59	110	124	
Partial factor		γMs,N	[-]			1,87			2,86	
Combined pull-out and conc	rete cone failui									
Characteristic bond resistance (CD)			20/25 in h	ammer dr	illed holes	(HD) and	compres	sed air dri	led holes	
I: 40°C/24°C	Dry, wet			20	19	19	18	17	16	
Temperature range II: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	15	15	14	13	13	12	
Characteristic bond resistance	in uncracked co	oncrete C	20/25 in h	ammer dr	illed holes	with hollo	w drill bit	(HDB)		
I: 40°C/24°C	Dry, wet			16	16	16	15	14	13	
Temperature II: 72°C/50°C	concrete	τρι	[N/mm <sup>2</sup> ]	14	14	13	13	12	11	
range I: 40°C/24°C	flooded bore	<sup>τ</sup> Rk,ucr	[[14/11111]	16	16	15	15	14	13	
II: 72°C/50°C	hole		(05: 1	14	14	13	13	12	11	
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)										
Temperature I: 40°C/24°C	Dry, wet concrete and flooded bore	<sup>τ</sup> Rk,ucr	[N/mm²]	7,0	8,5	8,5	8,5	8,5	8,5	
range II: 72°C/50°C	hole			6,0	7,0	7,0	7,0	7,0	7,0	
Reduction factor ψ <sup>0</sup> <sub>SuS</sub> in crac holes (CD) and in hammer drill				25 in hami	mer drilled	holes (HI	D), compre	essed air d	drilled	
	Dry, wet			0,80						
Temperature II: 72°C/50°C	concrete and flooded bore	$\Psi^0$ sus	[-]							
Increasing factors for concrete	hole	Ψc	[-]		0,68 (f <sub>ck</sub> / 20) <sup>0,1</sup>					
Characteristic bond resistance	depending on		<sup>τ</sup> Rk,ucr =			(6-	ıcr,(C20/25)			
the concrete strength class			τ <sub>Rk,cr</sub> =			Ψc • τ <sub>Rk</sub> ,	cr,(C20/25)			
Concrete cone failure							11 00			
Relevant parameter						see 12	able C2			
Splitting failure Relevant parameter						soo Ts	able C2			
Installation factor						300 10	IDIC OZ			
for dry and wet concrete (HD; H	HDB. CD)					1	,0			
for flooded bore hole (HD; HDE	A AUGUST SPECIES AND PROPERTY.	γinst	[-]				,2			
Fastenings (incl. nut and was     The characteristic tension res     For IG-M20 strength class 50	sistance for steel								ed rod.	
Würth injection system W	/IT-PE 1000 f	or concr	ete							
Performances Characteristic values of tension for a working life of 50 years (Ir				action			7	Annex (	8 3	



Table C9: Characteristic values of tension loads under static and quasi-static action for a working life of 100 years										
Internal threaded anchor rod	s			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel failure <sup>1)</sup>										
Characteristic tension resistant	ce, 5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123	
Steel, strength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196	
Partial factor, strength class 5.8	8 and 8.8	γMs,N	[-]				-]			
Characteristic tension resistant			[kN]	[kN]	26	41	59	110	124	
Steel A4 and HCR, Strength cla	ass 70 <sup>2)</sup>	N <sub>Rk,s</sub>	[KIN]	[KIN]	20	41	39	110	124	
Partial factor		γMs,N	[-]			[-]			2,86	
Combined pull-out and conc										
Characteristic bond resistance (CD)		oncrete C20	0/25 in ha	mmer drill	led holes	(HD) and	compress	sed air dri	led holes	
Temperature I: 40°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm²]	20	19	19	18	17	16	
range II: 72°C/50°C	flooded bore hole	*HK,UCF, TOO		15	15	14	13	13	12	
Characteristic bond resistance	1	oncrete C20	)/25 in hai					<u> </u>		
I: 40°C/24°C	Dry, wet			16	16	16	15	14	13	
Temperature II: 72°C/50°C	concrete	τ <sub>Rk,ucr,100</sub>	[N/mm²]	14	14	13	13	12	11	
range <u>I: 40°C/24°C</u>	flooded bore hole	TIN, doi, 100		16	16	15	15	14	13	
II: 72°C/50°C Characteristic bond resistance		rote C20/2	5 in hamn	14	14 holes (H	13	13	drilled ho	11 les (CD)	
and in hammer drilled holes wit	th hollow drill bi			ner drined	Tibles (FI	D), compi	esseu an	drilled 110	les (GD)	
Temperature I: 40°C/24°C	Dry, wet concrete and	τ <sub>Rk,ucr,100</sub> [ <b>f</b>	[N/mm²]	6,5	7,5	7,5	7,5	7,5	7,5	
range II: 72°C/50°C	flooded bore hole	Tik,uci, 100		5,5	6,5	6,5	6,5	6,5	6,5	
Reduction factor $\psi^0_{SUS,100}$ in drilled holes (CD) and in hamm					ammer dri	illed holes	(HD), co	mpressed	air	
, ,	Dry, wet	With Hollow	ווו טונ (ר	(סטר						
TemperatureI: 40°C/24°C	concrete and	\ <sub>w0</sub>		0,80						
range II: 72°C/50°C	flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,68						
Increasing factors for concrete		Ψc	[-]	(f <sub>ck</sub> / 20) <sup>0,1</sup>						
Characteristic bond resistance	depending on	τ <sub>Rk.</sub>	ucr,100 =		Ψ	<sup>/</sup> c <sup>• τ</sup> Rk,ucr	.100.(C20/2	25)		
the concrete strength class	acpointing on		c,cr,100 =			<sup>l/</sup> c • <sup>τ</sup> Rk,cr,				
Concrete cone failure		1	1,01,100			,,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			
Relevant parameter						see Ta	able C2			
Splitting failure										
Relevant parameter						see Ta	able C2			
Installation factor										
for dry and wet concrete (HD; I		γ <sub>inst</sub>	[-]				,0			
for flooded bore hole (HD; HDE	· ,						,2			
Fastenings (incl. nut and was The characteristic tension res     For IG-M20 strength class 50	sistance for stee								d rod.	
Würth injection system V	/IT-PE 1000 f	or concre	te							
Performances Characteristic values of tension for a working life of 100 years (				tion			<i>A</i>	Annex C	9	



Table C10:	Characteristic values of tension loads under static and quasi-static action
	for a working life of 50 years

						I . <b>.</b>					
Internal threaded anchor rod	IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20					
Steel failure <sup>1)</sup>											
Characteristic tension resistance, 5.8		N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123		
Steel, strength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196		
Partial factor, strength class 5.	8 and 8.8	γ <sub>Ms,N</sub>	[-]			1	,5				
Characteristic tension resistand Steel A4 and HCR, Strength cl		N <sub>Rk,s</sub>	[kN]	14	26	41	59	110	124		
Partial factor		γ <sub>Ms,N</sub>	[-]			1,87			2,86		
Combined pull-out and conc	rete cone failu	re									
Characteristic bond resistance	in uncracked c	oncrete C20	0/25 in dia	mond dril	led holes	(DD)					
Temperature I: 40°C/24°C	Dry, wet concrete and	τ	[N]/mm2]	14	14	13	12	12	11		
range II: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,ucr	[N/mm²]	12	11	10	9,5	9,5	9,0		
Reduction factor $\psi^0_{ t sus}$ in uncr	acked concrete	C20/25 in	diamond c	rilled hole	es (DD)						
Temperature I: 40°C/24°C	Dry, wet concrete and	\(\text{0}\)	[]	0,77							
range II: 72°C/50°C	flooded bore hole	$\Psi^0$ sus [-]		0,72							
Increasing factors for concrete		Ψc	[-]			(f <sub>ck</sub> /	20) <sup>0,2</sup>				
Characteristic bond resistance the concrete strength class	depending on		τ <sub>Rk,ucr</sub> =	Ψ <b>c</b> * <sup>τ</sup> Rk,ucr,(C20/25)							
Concrete cone failure											
Relevant parameter						see Ta	able C2				
Splitting failure											
Relevant parameter						see Ta	able C2				
Installation factor											
for dry and wet concrete (DD)		· ·	[ ]			1	,0				
for flooded bore hole (DD)		γinst	[-]	1,	,2		1,	,4			
4\ -							anne de la management de la companyone d				

<sup>1)</sup> 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.

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 years (Internal threaded anchor rod)	Annex C 10

<sup>2)</sup> For IG-M20 strength class 50 is valid



Table C11:	Characteristic values of tension loads under static and quasi-static action
	for a working life of 100 years

Internal threaded anchor rods Steel failure <sup>1)</sup> Characteristic tension resistance Steel, strength class Partial factor, strength class 5.8 Characteristic tension resistance	e, <u>5.8</u> 8.8 3 and 8.8	$N_{Rk,s}$ $N_{Rk,s}$ $\gamma_{Ms,N}$	[kN]	10	17	IG-M10	IG-M12	IG-M16	IG-M20		
Characteristic tension resistand Steel, strength class Partial factor, strength class 5.8	8.8 3 and 8.8	N <sub>Rk,s</sub>			17	V=020					
Steel, strength class Partial factor, strength class 5.8	8.8 3 and 8.8	N <sub>Rk,s</sub>			17						
Partial factor, strength class 5.8	3 and 8.8		[kN]			29	42	76	123		
				16	27	46	67	121	196		
Characteristic tension resistance	e, Stainless		[-]			1	,5				
Steel A4 and HCR, Strength cla	ass 70 <sup>2)</sup>	N <sub>Rk,s</sub>	[kN]	14	26	41	59	110	124		
Partial factor		γ <sub>Ms,N</sub>	[-]			1,87			2,86		
Combined pull-out and concr	ete cone failu	re		34							
Characteristic bond resistance	in uncracked co	oncrete C20	)/25 in dia	mond dril	led holes	(DD)					
TemperatureI: 40°C/24°C	Dry, wet concrete and	TD: 400	[N/mm²]	14	14	13	12	12	11		
range II: 72°C/50°C	flooded bore hole	*Rk,ucr,100		11	10	10	9,5	9,0	8,5		
Reduction factor $\psi^0_{ t sus,100}$ in $\iota$	uncracked conc	rete C20/25	5 in diamo	nd drilled	holes (D	D)					
Temperature I: 40°C/24°C	Dry, wet concrete and	,,,O	[]	0,73							
range II: 72°C/50°C	flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,70							
ncreasing factors for concrete		Ψс	[-]			(f <sub>ck</sub> / 2	20) <sup>0,2</sup>				
Characteristic bond resistance on the concrete strength class	depending on	<sup>τ</sup> Rk,	ucr,100 =	Ψc • <sup>τ</sup> Rk,ucr,100,(C20/25)							
Concrete cone failure											
Relevant parameter						see Ta	able C2				
Splitting failure											
Relevant parameter						see Ta	able C2				
nstallation factor											
or dry and wet concrete (DD)		γ <sub>inst</sub>	[-]	1,0							
or flooded bore hole (DD)		rinst	[ ]	1,	2		1,	4			

<sup>1)</sup> 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.

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 100 years (Internal threaded anchor rod)	Annex C 11

<sup>2)</sup> For IG-M20 strength class 50 is valid



1,0

20

1,0

24

min(h<sub>ef</sub>; 300mm)

30

min(h<sub>ef</sub>; 12 • d<sub>nom</sub>)

16

Table C12: Character for a work						static a	nd qua	si-stati	c action
Internal threaded anchor rods	nternal threaded anchor rods						IG-M12	IG-M16	IG-M20
Steel failure without lever arm <sup>1</sup>	)								
Characteristic shear resistance,	5.8	V <sup>0</sup> Rk,s	[kN]	5	9	15	21	38	61
Steel, strength class	8.8	V <sup>0</sup> Rk,s	[kN]	8	14	23	34	60	98
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]			•	1,25		
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		V <sup>0</sup> <sub>Rk,s</sub>	[kN]	7	13	20	30	55	40
Partial factor   YMs,V   [-]   1,56						2,38			
Ductility factor		k <sub>7</sub>	[-]	1,0					
Steel failure with lever arm <sup>1)</sup>									
Characteristic bending moment,	5.8	M <sup>0</sup> Rk,s	[Nm]	8	19	37	66	167	325
Steel, strength class	8.8	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	12	30	60	105	267	519
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]	1,25					
Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	n] 11 26 52 92 233				456	
Partial factor		γ <sub>Ms,V</sub>	[-]			1,56			2,38
Concrete pry-out failure		•	•						
Factor		k <sub>8</sub>	[-]	2,0					

1) Fastenings (incl. nut and washer) must comply	with th	he appropriate material and property class of the internal threaded rod.
The characteristic tension resistance for steel to	failure i	is valid for the internal threaded rod and the fastening element.

10

12

[-]

[mm]

[mm]

[-]

 $\gamma_{\text{inst}}$ 

 $I_f$ 

d<sub>nom</sub>

 $\gamma_{\text{inst}}$ 

Installation factor

Installation factor

Concrete edge failure

Effective length of fastener

Outside diameter of fastener

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (Internal threaded anchor rod)	Annex C 12

<sup>2)</sup> For IG-M20 strength class 50 is valid



Table C13: Characteristic values of tension loads under static and quasi-static action for a working life of 50 years													
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure		l N							. 1\				
Characteristic tension	resistance	N <sub>Rk,s</sub>	[kN]						f <sub>uk</sub> 1)				
Cross section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	[-]					1,	42)						
Combined pull-out ar Characteristic bond res			to C20/25	in ham	mer d	rillad k	noles (	HD) ai	nd com	nrace	od air	drillad	holes
(CD)	sistance in uncra	cked concre	16 020/23	III IIaII	iiiiei u	iiilea i	10163 (	i iD) ai	id con	ipiess	eu aii	armea	110163
II: 72°C/50°C	Dry, wet concrete and flooded bore hole	<sup>₹</sup> Rk,ucr	[N/mm²]	16 12	16 12	16 12	16 12	16 12	16 12	15 12	15 12	15 11	15 11
Characteristic bond res	 sistance in uncra	ked concre	te C20/25	in ham	ımer d	rilled h	l noles v	vith ho	llow dr	ill bit (	L HDB)		
13 C 5 S C 11 C 1 C 5 C 1 C 1 C 1 C 1 C 1 C 1 C	Dry, wet	2000	223,23	14	14	13	13	13	13	13	13	13	13
	concrete			12	12	12	11	11	11	11	11	11	11
II: 72°C/50°C	flooded bore	<sup>τ</sup> Rk,ucr	Rk,ucr [N/mm²]	13	13	13	13	13	13	13	13	13	13
ਜ਼ਿ ਹੈ: 72°C/50°C	hole			11	11	11	11	11	11	11	11	11	11
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD)													
and in hammer drilled	holes with hollow	drill bit (HD	B)								ľ		I
II: 72°C/50°C	Dry, wet concrete and	τ <sub>Rk,cr</sub> [[	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
G E II: 72°C/50°C	flooded bore hole	TK,CI	[	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor $\psi^0_{sus}$ holes (CD) and in han					n ham	ımer d	rilled h	oles (	HD), co	ompre	ssed a	ir drille	∍d
II: 72°C/50°C	Dry, wet concrete and flooded bore	Ψ <sup>0</sup> sus	0,80										
長 II: 72°C/50°C	hole								68				
Increasing factors for c		Ψc	[-]					(f <sub>ck</sub> / :	20) <sup>0,1</sup>				
Characteristic bond residepending on the cond			$\tau_{Rk,ucr}$ =				Ψс	• τ <sub>Rk,ι</sub>	ıcr,(C20	/25)			
class	rete strengtri		$\tau_{Rk,cr} =$				$\Psi_{C}$	• τ <sub>Rk,ι</sub>	ıcr,(C20	/25)			
Concrete cone failure	•			r									
Relevant parameter								see Ta	able C2	2			
Splitting									.L. 01				
Relevant parameter							-	see la	able C2				
Installation factor	te (HD: HDR								. 829				
for dry and wet concrete (HD; HDB, CD) $\gamma_{inst}$ [-]								,0					
for flooded bore hole (I		N290 20,20,018	9262 34					1	,2				
1) f <sub>uk</sub> shall be taken fro		ons of reinford	cing bars										
<sup>2)</sup> in absence of nation	al regulation												
Würth injection sy	stem WIT-PE	1000 for co	oncrete										
Performances Characteristic values of for a working life of 50			nd quasi-sta	atic act	ion					A	nnex	C 13	3



Table C14: Characteristic values of tension loads under static and quasi-static action for a working life of 100 years													
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													74)
Characteristic tension	resistance	N <sub>Rk,s</sub>	[kN]					A <sub>s</sub> ·	f <sub>uk</sub> 1)				
Cross section area		A <sub>s</sub>	[mm²]	50 79 113 154 201 314 452 491 616 80								804	
Partial factor		γ <sub>Ms,N</sub>	[-]					1,	42)				
Combined pull-out ar													
Characteristic bond res	sistance in uncra	cked concre	te C20/25	in han	nmer d	Irilled h	noles (	HD) ar	nd con	npress	ed air	drilled	holes
Temperature range II: 40°C/24°C	Dry, wet concrete and flooded bore	τ <sub>Rk,ucr,100</sub>	[N/mm²]	16	16	16	16	16	16	15	15	15	15
	hole			12	12	12	12	12	12	12	12	11	11
Characteristic bond res	sistance in uncra	cked concre	te C20/25	in han	nmer d					<del>, ,</del>			
<u>E</u> <u>I: 40°C/24°C</u>	Dry, wet			14	14	13	13	13	13	13	13	13	13
E: 40°C/24°C  II: 72°C/50°C  II: 72°C/50°C	concrete	τ <sub>Rk,ucr,100</sub>	[N/mm²]	12	12	12	11	11	11	11	11	11	11
हुँ हुँ <u>।: 40°C/24°C</u>	flooded bore	nk,uci, 100	[]	13	13	13	13	13	13	13	13	13	13
1 = 0.00 0	hole			11	11	11	11	11	11	11	11	11	11
and in hammer drilled	Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)												
Temperature range II: 40°C/24°C O°C/20°C	Dry, wet concrete and	<sup>T</sup> Rk,ucr,100	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
G E II: 72°C/50°C	flooded bore hole	Thk,uci, 100	[]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
Reduction factor $\psi^0_{sus,100}$ in cracked and uncracked concrete C20/25 in hammer drilled holes (HD), compressed air													
drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)													
Temperature range II: 40°C/24°C	Dry, wet concrete and flooded bore	Ψ <sup>0</sup> sus,100	[-]	0,80									
हिं II: 72°C/50°C	hole			0,68									
Increasing factors for o	concrete	Ψc	[-]					$(f_{ck} / 2$	20) <sup>0,1</sup>				
Characteristic bond res		τ <sub>Rk</sub>	,ucr,100 =				Ψ <sub>C</sub> •	τ <sub>Rk,ucr</sub>	,100,(C	20/25)			
depending on the cond class	rete strength		,ucr,100 =					<sup>T</sup> Rk,ucr		,			
Concrete cone failure	•	1 110	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,				- 0	7 111,001	, , , , , , ,	_0,_0)			
Relevant parameter							) 1	see Ta	able C	2			
Splitting													
Relevant parameter							3	see Ta	able C	2			
Installation factor													
for dry and wet concret CD)		γ <sub>inst</sub>	[-]						,0				
for flooded bore hole (I	HD; HDB, CD)							1	,2				
<sup>1)</sup> f <sub>uk</sub> shall be taken fro	m the specification	ons of reinford	cing bars										
<sup>2)</sup> in absence of nation	al regulation												
Würth injection sy	stem WIT-PE	1000 for co	ncrete										
Performances Characteristic values of for a working life of 100			d quasi-sta	atic act	ion					A	nnex	C 14	! 



	Table C15: Characteristic values of tension loads under static and quasi-static action for a working life of 50 years												
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													
Characteristic tension	resistance	N <sub>Rk,s</sub>	[kN]					A <sub>s</sub> ·	$f_{uk}^{1)}$				
Cross section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ <sub>Ms,N</sub>	[-]					1,	42)				
Combined pull-out ar	d concrete fail							-					
Characteristic bond res	istance in uncra	cked concre	te C20/25	in dia	mond o	drilled	holes (	DD)					
II: 40°C/24°C	Dry, wet concrete and	_	[N]/ma ma 2]	14	13	13	13	12	12	11	11	11	11
80 mg   H: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,ucr	[N/mm²]	11	11	10	10	10	9,5	9,5	9,5	9,0	9,0
Reduction factor ψ <sup>0</sup> <sub>SUS</sub> in uncracked concrete C20/25 in diamond drilled holes (DD)													
I: 40°C/24°C Dry, wet concrete and flooded bore hole		ψ <sup>0</sup> sus	[-]	0,77									
II: 72°C/50°C	flooded bore hole	Ψ sus [-]		0,72									
Increasing factors for c	oncrete	Ψc	[-]	(f <sub>ck</sub> / 20) <sup>0,2</sup>									
Characteristic bond residepending on the conclass			τ <sub>Rk,ucr</sub> =				Ψc	• τ <sub>Rk,ι</sub>	ıcr,(C20	)/25)			
Concrete cone failure	,												
Relevant parameter							,	see Ta	able C2	2			
Splitting													
Relevant parameter	Relevant parameter see Table C2												
Installation factor													
for dry and wet concret	<u> </u>	$\gamma_{inst}$	[-]					1	,0				
for flooded bore hole ([					1	,2				1	,4		
1) f <sub>uk</sub> shall be taken fro	m the specification	ons of reinford	cing bars										

<sup>2)</sup> in absence of national regulation

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 years (reinforcing bar)	Annex C 15



1	naracteristic r a working l			n Ioa	ds u	nder	stati	c and	d qua	asi-si	tatic	actio	n
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure								2	51				
Characteristic tension	resistance	N <sub>Rk,s</sub>	[kN]	$A_s \cdot f_{uk}^{1)}$									
Cross section area		As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ <sub>Ms,N</sub>	[-]					1,	42)					
Combined pull-out an	nd concrete failu												
Characteristic bond resistance in uncracked concrete C20/					mond c	drilled	holes	(DD)			20.5	26	
II: 40°C/24°C	Dry, wet concrete and		[N]/mama 2]	14	13	13	13	12	12	11	11	11	11
8	flooded bore hole	<sup>τ</sup> Rk,ucr,100	[N/mm <sup>2</sup> ]	11	10	10	10	9,5	9,0	9,0	9,0	8,5	8,5
Reduction factor $\psi^0_{sus.100}$ in uncracked concrete C20/25 in					nd drill	ed ho	les (DI	))					
range I: 40°C/24°C	Dry, wet concrete and	0	F.1	0,73									
II: 72°C/50°C	flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,70									
Increasing factors for c	oncrete	Ψс	[-]					(f <sub>ck</sub> / 2	20) <sup>0,2</sup>	\$2 85			
Characteristic bond res depending on the conc class		<sup>τ</sup> Rk	ucr,100 =				ψ <b>c</b> • τ	Rk,ucı	r,100,(	C20/25)	)		
Concrete cone failure	)												
Relevant parameter								see Ta	able C	2			
Splitting													
Relevant parameter				see Table C2									
Installation factor													
for dry and wet concret	te (DD)	γ:	[-]	1,0									
for flooded bore hole (I	γinst	[-]		1	,2				1	,4			
1) f <sub>IJk</sub> shall be taken from the specifications of reinforcing bars													

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 100 years (reinforcing bar)	Annex C 16

<sup>2)</sup> in absence of national regulation



Table C17: Characteris					unde	r sta	itic a	nd q	uasi-	static	action	n for
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure without lever arm												
Characteristic shear resistance	V <sup>0</sup> Rk,s	[kN]					0,5	·As·	f <sub>uk</sub> 1)			
Cross section area	Ασ	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ <sub>Ms,V</sub>	[-]	1,52)									
Ductility factor	k <sub>7</sub>	[-]	1,0									
Steel failure with lever arm												
Characteristic bending moment	M <sup>0</sup> Rk,s	[Nm]	1,2 • W <sub>el</sub> • f <sub>uk</sub> 1)									
Elastic section modulus	W <sub>el</sub>	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	γ <sub>Ms,V</sub>	[-]						1,52	)			
Concrete pry-out failure	'											
Factor	k <sub>8</sub>	[-]						2,0				
Installation factor	γ <sub>inst</sub>	[-]						1,0				
Concrete edge failure	'											
Effective length of fastener	I <sub>f</sub>	[mm]			min(h	n <sub>ef</sub> ; 12	• d <sub>nor</sub>	<sub>n</sub> )		min(	h <sub>ef</sub> ; 300	mm)
Outside diameter of fastener	d <sub>nom</sub>	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γ <sub>inst</sub>	[-]						1,0				

<sup>1)</sup> f<sub>uk</sub> shall be taken from the specifications of reinforcing bars

Würth injection system WIT-PE 1000 for concrete	
Performances	Annex C 17
Characteristic values of shear loads under static and quasi-static action	
for a working life of 50 and 100 years (reinforcing bar)	

<sup>2)</sup> in absence of national regulation



Table C18: Displacements under tension load<sup>1)</sup>

> in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)

Threaded rod				M10	M12	M16	M20	M24	M27	M30
Uncracked concrete un	der static and	d quasi-static act	ion for a	workin	g life of	50 and	100 year	'S		
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
Temperature range II:	$\delta_{\text{N0}}$ -factor	[mm/(N/mm²)]	0,038	0,039	0,040	0,044	0,047	0,051	0,052	0,055
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,047	0,049	0,051	0,055	0,059	0,064	0,067	0,070
Cracked concrete unde	r static and q	uasi-static actior	n for a w	orking l	ife of 50	and 100	) years			
Temperature range I:	$\delta_{\text{N0}}$ -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,100	0,115	0,122	0,128	0,135	0,142	0,155	0,171
Temperature range II:	$\delta_{\text{N0}}$ -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,134	0,154	0,163	0,172	0,181	0,189	0,207	0,229

<sup>1)</sup> Calculation of the displacement

 $\delta_{N0} = \delta_{N0}$ -factor  $\cdot \tau$ ;

τ: action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty} \text{-factor } \cdot \tau;$ 

Table C19: Displacements under tension load<sup>1)</sup> in diamond drilled holes (DD)

Threaded rod				M10	M12	M16	M20	M24	M27	M30
Uncracked concrete under static and quasi-static action for a working life of 50 years										
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,018	0,019	0,019	0,020	0,022	0,023	0,024	0,025
Temperature range II:	$\delta_{\text{N0}}$ -factor	[mm/(N/mm²)]	0,013	0,014	0,014	0,015	0,016	0,016	0,018	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,052	0,053	0,055	0,058	0,062	0,065	0,068	0,070
Uncracked concrete un	der static and	d quasi-static act	ion for a	workin	g life of	100 yea	rs			
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,020	0,021	0,021	0,023	0,024	0,025	0,026	0,027
Temperature range II:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,013	0,014	0,014	0,015	0,016	0,016	0,018	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,038	0,039	0,040	0,043	0,045	0,047	0,049	0,051

<sup>1)</sup> Calculation of the displacement

 $\delta_{N0} = \delta_{N0}$ -factor  $\cdot \tau$ ;

τ: action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty}$ -factor  $\cdot \tau$ ;

#### Table C20: Displacements under shear load<sup>1)</sup> for all drilling methods

Threaded rod	М8	M10	M12	M16	M20	M24	M27	M30		
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years										
All temperature	$\delta_{V0}$ -factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

<sup>1)</sup> Calculation of the displacement

 $\delta v_0 = \delta v_0$ -factor · V;

V: action shear load

 $\delta_{V\infty} = \delta_{V\infty}$ -factor  $\cdot V$ ;

#### Würth injection system WIT-PE 1000 for concrete

#### **Performances**

Displacements under static and quasi-static action for a working life of 50 and 100 years (threaded rod) Annex C 18



Table C21:	Displacements under tension load <sup>1)</sup>
	in hammer drilled holes (HD), compressed air drilled holes (CD) and
	in hammer drilled holes with hollow drill bit (HDB)

Internal threaded anchor	ternal threaded anchor rods			IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Uncracked concrete under static and quasi-static action for a working life of 50 and 100 years								
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,029	0,030	0,033	0,035	0,038	0,041
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,029	0,030	0,033	0,035	0,038	0,041
Temperature range II:	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,039	0,040	0,044	0,047	0,051	0,055
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,049	0,051	0,055	0,059	0,064	0,070
Cracked concrete under	static and qua	si-static action	for a work	ing life of	50 and 100	years		
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,071	0,072	0,074	0,076	0,079	0,082
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,115	0,122	0,128	0,135	0,142	0,171
Temperature range II:	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,095	0,096	0,099	0,102	0,106	0,110
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,154	0,163	0,172	0,181	0,189	0,229

<sup>1)</sup> Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \ \cdot \tau;$ 

 $\tau$ : action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty}\text{-factor }\cdot\tau;$ 

Table C22: Displacements under tension load<sup>1)</sup> in diamond drilled holes (DD)

nternal threaded anchor rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Uncracked concrete und	Uncracked concrete under static and quasi-static action for a working life of 50 years							
Temperature range I:	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,012	0,012	0,013	0,014	0,014	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,019	0,019	0,020	0,022	0,023	0,025
Temperature range II:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,014	0,014	0,015	0,016	0,016	0,018
72°C/50°C $\delta_{N\infty}$ -factor		[mm/(N/mm²)]	0,053	0,055	0,058	0,062	0,065	0,070
Uncracked concrete und	ler static and q	uasi-static actio	n for a wo	rking life o	of 100 year	'S		
Temperature range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,012	0,012	0,013	0,014	0,014	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,021	0,021	0,023	0,024	0,025	0,027
Temperature range II:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,014	0,014	0,015	0,016	0,016	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,039	0,040	0,043	0,045	0,047	0,051

<sup>1)</sup> Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \cdot \tau;$ 

 $\tau$ : action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty} \text{-factor } \cdot \tau;$ 

# Table C23: Displacements under shear load<sup>1)</sup> for all drilling methods

Internal threaded	l anchor rods	nchor rods IG-M6 IG-M8 IG-M10 IG-M12 IG-M16						IG-M20	
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years									
All temperature	δ <sub>V0</sub> -factor	[mm/kN]	0,07	0,06	0,06	0,05	0,04	0,04	
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,10	0,09	0,08	0,08	0,06	0,06	

<sup>1)</sup> Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor  $\cdot V$ ;

V: action shear load

 $\delta_{V\infty} = \delta_{V\infty}\text{-factor }\cdot V;$ 

#### Würth injection system WIT-PE 1000 for concrete

#### **Performances**

Annex C 19

Displacements under static and quasi-static action for a working life of 50 and 100 years (Internal threaded anchor rod)



Table C24:	Displacements under tension load <sup>1)</sup>
	in hammer drilled holes (HD), compressed air drilled holes (CD) and in
	hammer drilled holes with hollow drill bit (HDB)

Reinforcing bar		Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Uncracked concrete under static and quasi-static action for a working life of 50 and 100 years												
Temp range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
Temp range II:	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,038	0,039	0,040	0,042	0,044	0,047	0,051	0,051	0,054	0,058
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,047	0,049	0,051	0,053	0,055	0,059	0,065	0,065	0,068	0,072
Cracked concrete	under statio	and quasi-stat	ic actio	n for a	workin	g life of	50 and	100 ye	ears			
Temp range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temp range II:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260

<sup>1)</sup> Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \ \cdot \tau;$ 

 $\tau$ : action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty}$ -factor  $\cdot \tau$ ;

# Table C25: Displacements under tension load<sup>1)</sup> in diamond drilled holes (DD)

Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked concre	Uncracked concrete under static and quasi-static action for a working life of 50 years											
Temp range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,008	0,009	0,009	0,01	0,011	0,012	0,013	0,013	0,014	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,018	0,018	0,019	0,020	0,021	0,024	0,027	0,027	0,028	0,031
Temp range II:	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,048	0,051	0,054	0,058	0,061	0,068	0,076	0,076	0,081	0,088
Uncracked concre	ete under sta	tic and quasi-st	atic ac	tion for	a work	ing life	of 100	years				
Temp range I:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,008	0,009	0,009	0,010	0,011	0,012	0,013	0,013	0,014	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,018	0,020	0,021	0,022	0,024	0,026	0,029	0,029	0,031	0,034
Temp range II:	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,035	0,037	0,040	0,042	0,045	0,049	0,055	0,055	0,059	0,064

<sup>1)</sup> Calculation of the displacement

 $\delta_{N0} = \delta_{N0}$ -factor  $\cdot \tau$ ;

τ: action bond stress for tension

 $\delta_{\mathsf{N}\infty} = \delta_{\mathsf{N}\infty}\text{-factor }\cdot\tau;$ 

# Table C26: Displacements under shear load<sup>1)</sup> for all drilling methods

Reinforcing bar	Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32		
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years												
All temperature	$\delta_{V0}$ -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
ranges	$\delta_{V_{\infty}}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04

<sup>1)</sup> Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor · V;

V: action shear load

 $\delta_{V^{\infty}} = \delta_{V^{\infty}}\text{-factor }\cdot V;$ 

#### Würth injection system WIT-PE 1000 for concrete

#### **Performances**

Displacements under static and quasi-static action for a working life of 50 and 100 years (reinforcing bar)

Annex C 20



Table C27:	(performance category C1) for a working life of 50 years													
Threaded rod					M8	M10	M12	M16	M20	M24	M27	M30		
Steel failure			,											
Characteristic ter	nsion resist	tance	N <sub>Rk,s,eq,C1</sub>	[kN]	1,0 • N <sub>Rk,s</sub>									
Partial factor			γ <sub>Ms,N</sub>	[-]				see Ta	ıble C1					
Combined pull-out and concrete failure														
Characteristic bo drilled holes (CD						hamm	er drille	ed hole	s (HD)	, compi	ressed	air		
Temperature range II: 72°C/2	24°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5		
He II: 72°C/	50°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0		
Increasing factor	s for concr	ete	Ψς	[-]		1,0								
Characteristic bo			τ	Rk,eq,C1 =			Ψ <sub>C</sub>	<sup>τ</sup> Rk,eq	,C1,(C20	0/25)				
Installation fact	or													
for dry and wet concrete (HD; HDB, CD)			ν:	[-]				1	,0					
for flooded bore	hole (HD; H	HDB, CD)	γinst	[-]	1,2									

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years (threaded rod)	Annex C 21



Table	Table C28: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years												
Thread	ed rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel fa	ailure												
Charac	teristic tension resi	stance	N <sub>Rk,s,eq,C1</sub>	[kN]				1,0 •	$N_{Rk,s}$				
Partial f	factor		γ <sub>Ms,N</sub>	[-]				see Ta	ıble C1				
Combined pull-out and concrete failure													
Characteristic bond resistance in cracked and uncracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)													
Temperature range	I: 40°C/24°C	Dry, wet concrete and	<sup>T</sup> Rk,eq,C1	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	
Tempe	II: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5	
Increas	ing factors for cond	rete	Ψς	[-]				1	,0				
	teristic bond resista concrete strength c	τ	Rk,eq,C1 =	Ψc • τRk,eq,C1,(C20/25)									
Installa	ition factor												
	and wet concrete (H ded bore hole (HD;	Vinet					,0 ,2	_					

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years (threaded rod)	Annex C 22



Table C29:	Table C29: Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years												
Threaded rod				М8	M10	M12	M16	M20	M24	M27	M30		
Steel failure													
Characteristic shea (Seismic C1)	ar resistance	V <sub>Rk,s,eq,C1</sub>	[kN]				0,70	) • V <sup>0</sup> Rk	,s				
Partial factor		γ <sub>Ms,V</sub>	[-]	[-] see Table C1									
Factor for annular gap $\alpha_{gap}$ [-] $0.5 (1.0)^{1)}$													

<sup>1)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years (threaded rod)	Annex C 23



Table C	Table C30: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years													
Reinforcing	g bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure	е						•				•			
Characterist	tic tension res	sistance	N <sub>Rk,s,eq,C1</sub>	[kN]	$1.0 \cdot A_s \cdot f_{uk}^{1)}$									
Cross section area			A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial facto	r		γ <sub>Ms,N</sub>	[-]					1,	<b>4</b> <sup>2)</sup>				
Combined pull-out and concrete failure														
Characteristic bond resistance in cracked and uncracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)														
nperature range	0°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
Temperature range 2 : II	'2°C/50°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Increasing fa	actors for cor	ncrete	Ψс	[-]					1	,0				
Characteristic bond resistance depending on the concrete strength class			<sup>τ</sup> R	k,eq,C1 =	Ψc • <sup>τ</sup> Rk,eq,C1,(C20/25)									
Installation	•													
for dry and wet concrete (HD; HDB, CD)			γinst	[-]					1	,0				
for flooded b	oore hole (HD	); HDB, CD)		1,2										

 $<sup>^{1)}</sup>$   $f_{uk}$  shall be taken from the specifications of reinforcing bars

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years (reinforcing bar)	Annex C 24

<sup>2)</sup> in absence of national regulation



Tabl	Table C31: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years													
Reinfo	rcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure														
Charac	teristic tension re	[kN]	1,0 • A <sub>s</sub> • f <sub>uk</sub> <sup>1)</sup>											
Cross	racteristic tension resistance $N_{Rk,s,eq,C1}$ [kN] as section area $A_s$ [mm²]					79	113	154	201	314	452	491	616	804
Partial	factor		γMs,N	[-]					1,	42)				
Comb	ned pull-out and	d concrete failu	re											
1	teristic bond resi holes (CD) and ir						in har	nmer c	drilled	holes (	(HD), c	compre	essed a	air
, , ,			<sup>τ</sup> Rk,eq,C1	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Tempe ran	Dry, wet concrete and flooded bore hole		<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5

nperat range	I: 40°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
	II: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
Increas	Increasing factors for concrete			[-]		1,0								
	Characteristic bond resistance depending on the concrete strength class		τ <sub>F</sub>	Rk,eq,C1 =	Ψc <sup>• τ</sup> Rk,eq,C1,(C20/25)									
Install	ation factor													
for dry CD)	for dry and wet concrete (HD; HDB, CD)		γ <sub>inst</sub>	[-]	1,0									
for flooded bore hole (HD; HDB, CD)			1,2											
1) f	1) f.,, shall be taken from the specifications of reinforcing bars													

<sup>1)</sup> f<sub>uk</sub> shall be taken from the specifications of reinforcing bars

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years (reinforcing bar)	Annex C 25

<sup>2)</sup> in absence of national regulation



Table C32: Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years													
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Steel failure													
Characteristic shear resistance V <sub>Rk,s,eq,C1</sub> [kN]				0,35 • A <sub>s</sub> • f <sub>uk</sub> <sup>1)</sup>									
Cross section area	A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804	
Partial factor	γ <sub>Ms,V</sub>	[-]	1,5 <sup>2)</sup>										
Factor for annular gap	$\alpha_{\sf gap}$	[-]	0,5 (1,0) <sup>3)</sup>										

 $<sup>^{1)}</sup>$   $f_{uk}$  shall be taken from the specifications of reinforcing bars

Würth injection system WIT-PE 1000 for concrete	
Performances	Annex C 26
Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years (reinforcing bar)	

<sup>2)</sup> in absence of national regulation

<sup>3)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.

for flooded bore hole (HD; HDB, CD)



1,2

Table		ncteristic va ormance ca							s			
Threade	ed rod				M12	M16	M20	M24	M27	M30		
Steel fai	lure											
Characteristic tension resistance, Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70			N <sub>Rk,s,eq,C2</sub>	[kN]	1,0 • N <sub>Rk,s</sub>							
Partial factor $\gamma_{Ms,N}$ [-]					see Table C1							
Combine	ed pull-out and co	oncrete failure										
	eristic bond resistateles (CD) and in ha					hammer o	drilled hol	es (HD), d	compress	ed air		
Temperature range	I: 40°C/24°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C2	[N/mm²]	5,8	4,8	5,0	5,1	4,8	5,0		
Tempe ran -	II: 72°C/50°C	flooded bore hole	<sup>τ</sup> Rk,eq,C2	[N/mm²]	5,0	4,1	4,3	4,4	4,1	4,3		
Increasir	ng factors for concr	ete	Ψς	[-]	1,0							
Characteristic bond resistance depending on the concrete strength class			$\tau_{Rk,eq,C2} = \qquad \qquad \psi_{c} \cdot \tau_{Rk,eq,C2,(C20/25)}$			5)						
Installat	ion factor											
for dry and wet concrete (HD; HDB, CD)			Vinot	[-]	1,0							

# Table C34: Characteristic values of shear loads under seismic action (performance category C2) for a working life of 50 and 100 years

1000											
Threaded rod	M12	M16	M20	M24	M27	M30					
Steel failure					ů.						
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70  V <sub>Rk,s,eq,C2</sub> [kN]				0,70 • V <sup>0</sup> <sub>Rk,s</sub>							
Partial factor	γ <sub>Ms,V</sub>	[-]	see Table C1								
Factor for annular gap	$\alpha_{\sf gap}$	[-]									

[-]

Würth injection system WIT-PE 1000 for concrete	
Performances Characteristic values of tension and shear loads under seismic action (performance category C2) for a working life of 50 and 100 years (threaded rod)	Annex C 27

<sup>1)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.



Table C35: Displacements under tension load (threaded rod)													
Threaded rod			M12	M16	M20	M24	M27	M30					
Uncracked and cracked concrete under seismic action (performance category C2) for a working life of 50 and 100 years													
All tomproveture vanges	δ <sub>N,eq,C2(DLS)</sub>	[mm]	0,21	0,24	0,27	0,36	0,92	0,70					
All temperature ranges	$\delta_{N,eq,C2(ULS)}$	[mm]	0,54	0,51	0,54	0,63	1,70	0,92					

### Table C36: Displacements under shear load (threaded rod)

Threaded rod	M12	M16	M20	M24	M27	M30						
Uncracked and cracked concrete under seismic action (performance category C2) for a working life of 50 and 100 years												
All temperature ranges	$\delta_{V,eq,C2(DLS)}$	[mm]	3,1	3,4	3,5	4,2	4,0	3,8				
All temperature ranges	$\delta_{V,eq,C2(ULS)}$	[mm]	6,0	7,6	7,3	10,9	11,1	11,2				

Würth injection system WIT-PE 1000 for concrete

Performances
Displacements under seismic action (performance category C2)
for a working life of 50 and 100 years (threaded rod)

Annex C 28