

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 28 April 2020

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

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

EAD 330499-01-0601

ETA-19/0542 issued on 13 September 2019

European Technical Assessment

ETA-19/0542

English translation prepared by DIBt

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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 cartridge with injection WIT-PE 1000 and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30 or reinforcing bar in the range of Ø 8 to Ø 32 mm or an internal threaded anchor rod IG-M6 to IG-M20.

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 years and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex B2, C 1 to C 5, C 7 to C 9, C 11 to C 13
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 6, C 10, C 14
Displacements under short-term and long-term loading	See Annex C 15 to C 17
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 18 to C 23

3.2 Hygiene, health and the environment (BWR 3)

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

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.

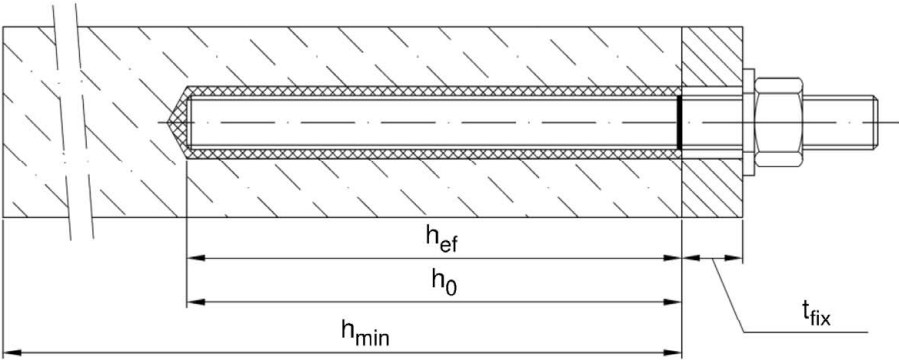
Issued in Berlin on 28 April 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

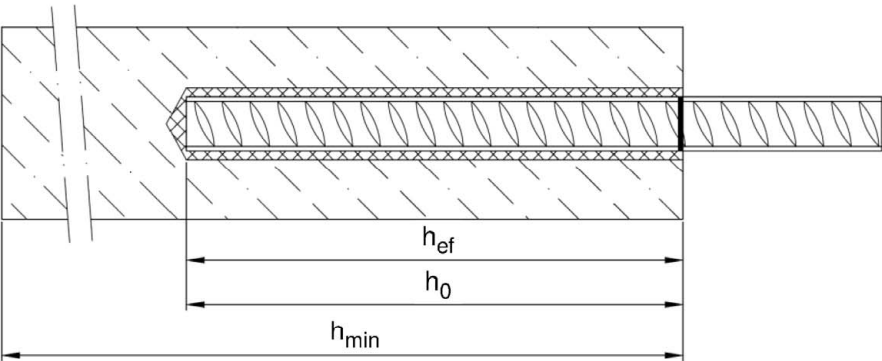
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Baderschneider

Installation threaded rod M8 up to M30

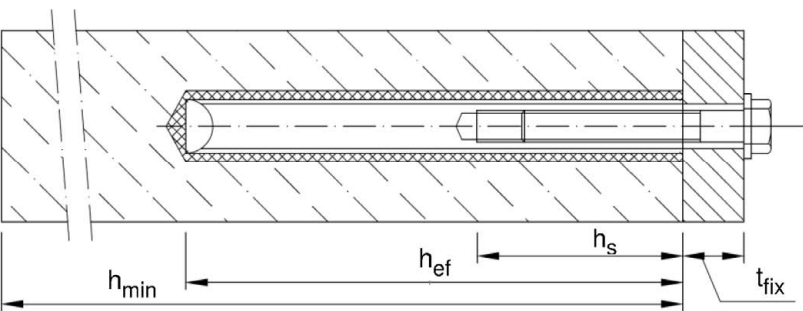
prepositioned installation or
push through installation (annular gap filled with mortar)



Installation reinforcing bar $\varnothing 8$ up to $\varnothing 32$



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



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

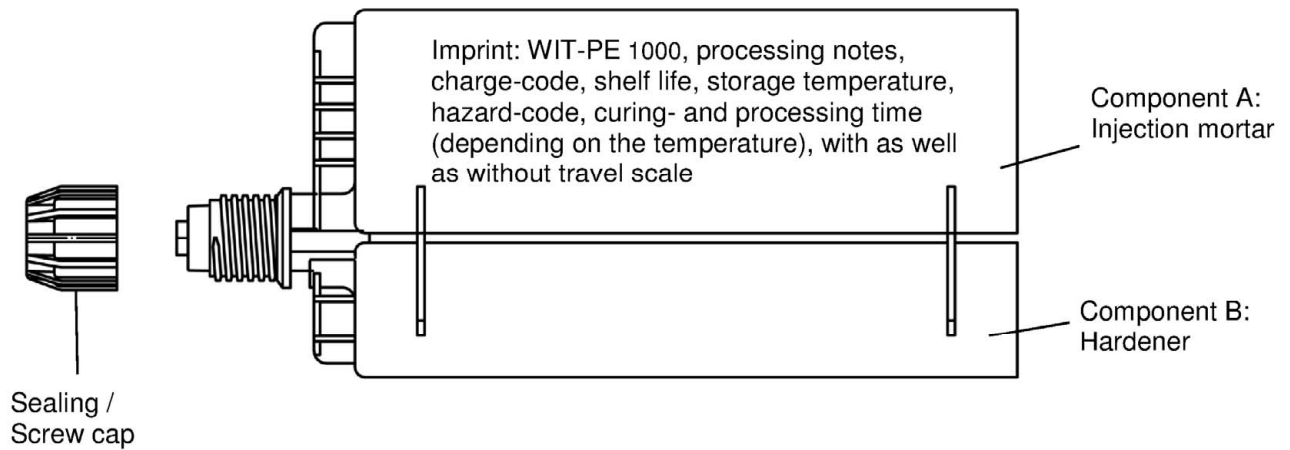
Würth Injection System WIT-PE 1000 for concrete

Product description
Installed condition

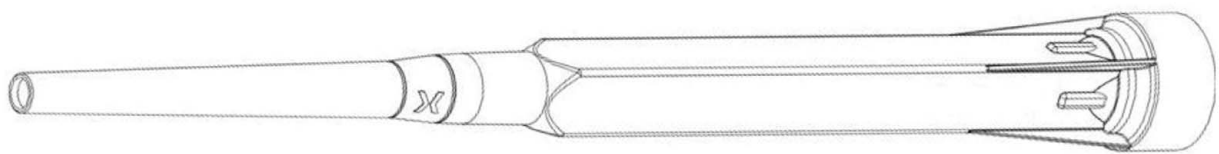
Annex A 1

Cartridge: WIT-PE 1000

440ml, 585ml and 1400ml cartridge (Type: "side-by-side")



Static Mixer WIT-PE



Piston Plug and Mixer Extension

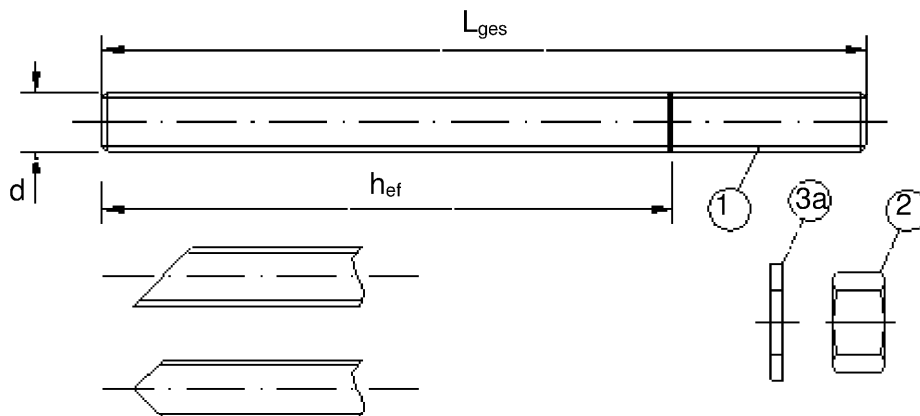


Würth Injection System WIT-PE 1000 for concrete

Product description
Injection system

Annex A 2

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

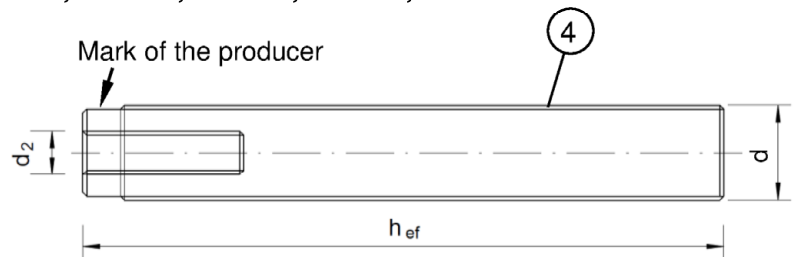
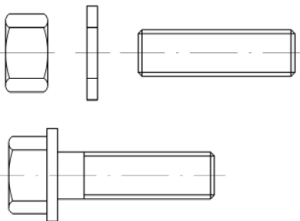


Commercial standard threaded rod with:

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

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

Threaded rod or screw



Marking: e.g.



M8

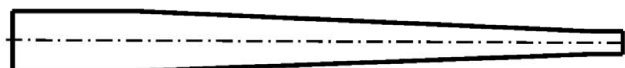
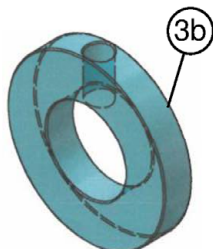


Marking Internal thread

Mark

- M8 Thread size (Internal thread)
- A4 additional mark for stainless steel
- HCR additional mark for high-corrosion resistance steel

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



Würth Injection System WIT-PE 1000 for concrete

Product description

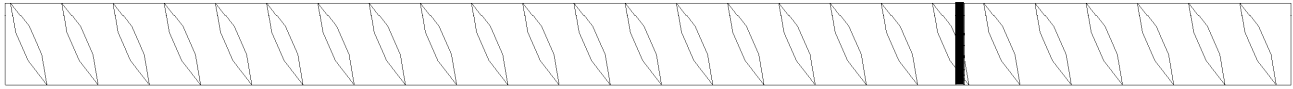
Threaded rod, internal threaded rod and filling washer

Annex A 3

Table A1: Materials

Part	Designation	Material				
Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001)						
- zinc plated $\geq 5 \mu\text{m}$ acc. to EN ISO 4042:1999 or						
- hot-dip galvanised $\geq 40 \mu\text{m}$ acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or						
- sherardized $\geq 45 \mu\text{m}$ acc. to EN ISO 17668:2016						
1	Threaded rod	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 898-1:2013	4.6	$f_{uk} = 400 \text{ N/mm}^2$	$f_{yk} = 240 \text{ N/mm}^2$	$A_5 > 8\%$
			4.8	$f_{uk} = 400 \text{ N/mm}^2$	$f_{yk} = 320 \text{ N/mm}^2$	$A_5 > 8\%$
			5.6	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 300 \text{ N/mm}^2$	$A_5 > 8\%$
			5.8	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 400 \text{ N/mm}^2$	$A_5 > 8\%$
			8.8	$f_{uk} = 800 \text{ N/mm}^2$	$f_{yk} = 640 \text{ N/mm}^2$	$A_5 \geq 12\%$ ³⁾
2	Hexagon nut	acc. to EN ISO 898-2:2012	4	for anchor rod class 4.6 or 4.8		
		5	for anchor rod class 5.6 or 5.8			
		8	for anchor rod class 8.8			
3a	Washer	Steel, zinc plated, hot-dip galvanised or sherardized (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)				
3b	Filling washer	Steel, zinc plated, hot-dip galvanised or sherardized				
4	Internal threaded anchor rod	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 898-1:2013	5.8	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 400 \text{ N/mm}^2$	$A_5 > 8\%$
			8.8	$f_{uk} = 800 \text{ N/mm}^2$	$f_{yk} = 640 \text{ N/mm}^2$	$A_5 > 8\%$
Stainless steel A2 (Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014)						
Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)						
High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)						
1	Threaded rod ¹⁾⁴⁾	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 3506-1:2009	50	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 210 \text{ N/mm}^2$	$A_5 \geq 8\%$
			70	$f_{uk} = 700 \text{ N/mm}^2$	$f_{yk} = 450 \text{ N/mm}^2$	$A_5 \geq 12\%$ ³⁾
			80	$f_{uk} = 800 \text{ N/mm}^2$	$f_{yk} = 600 \text{ N/mm}^2$	$A_5 \geq 12\%$ ³⁾
2	Hexagon nut ¹⁾⁴⁾	acc. to EN ISO 3506-1:2009	50	for anchor rod class 50		
		70	for anchor rod class 70			
		80	for anchor rod class 80			
3a	Washer	A2: Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014 A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014 HCR: Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014 (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)				
3b	Filling washer	Stainless steel A4, High corrosion resistance steel				
4	Internal threaded anchor rod ¹⁾²⁾	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 3506-1:2009	50	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 210 \text{ N/mm}^2$	$A_5 > 8\%$
			70	$f_{uk} = 700 \text{ N/mm}^2$	$f_{yk} = 450 \text{ N/mm}^2$	$A_5 > 8\%$
¹⁾ Property class 70 or 80 for anchor rods up to M24 and Internal threaded anchor rods up to IG-M16,						
²⁾ for IG-M20 only property class 50						
³⁾ $A_5 > 8\%$ fracture elongation if <u>no</u> requirement for performance category C2 exists						
⁴⁾ Property class 80 only for stainless steel A4 and HCR						
Würth Injection System WIT-PE 1000 for concrete					Annex A 4	
Product description Materials threaded rod and internal threaded rod						

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



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

Table A2: Materials

Part	Designation	Material
Reinforcing bars		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$
Würth Injection System WIT-PE 1000 for concrete		Annex A 5
Product description Materials reinforcing bar		

Specifications of intended use				
Anchorage subject to (for a service life of 50 years):				
	Static and quasi-static loads		Seismic action for Performance Category C1	Seismic action for Performance Category C2
Base material	Non-cracked concrete	cracked concrete	Cracked and non-cracked concrete	
Hammer drilling (HD), Hammer drilling with hollow drill bit (HDB) or compressed air drilling (CD)	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20		M8 to M30, Ø8 to Ø32	M12 to M24
Diamond drilling (DD)	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20	No performance assessed	No performance assessed	No performance assessed
Temperature Range:	I: - 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C) II: - 40 °C to +72 °C (max long term temperature +50 °C and max short term temperature +72 °C)			
Anchorage subject to (for a service life of 100 years):				
	Static and quasi-static loads		Seismic action for Performance Category C1	Seismic action for Performance Category C2
Base material	Non-cracked concrete	cracked concrete	Cracked and non-cracked concrete	
Hammer drilling (HD), Hammer drilling with hollow drill bit (HDB) or compressed air drilling (CD)	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20		M8 to M30, Ø8 to Ø32	M12 to M24
Diamond drilling (DD)	No performance assessed	No performance assessed	No performance assessed	No performance assessed
Temperature Range:	I: - 40 °C to +40 °C (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				Annex B 1
Intended Use Specifications				

Design:

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

Installation:

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

Würth Injection System WIT-PE 1000 for concrete

Intended Use
Specifications

Annex B 2

Table B1: Installation parameters for threaded rod

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

¹⁾ Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

Table B2: Installation parameters for rebar

Anchor size			Ø 8 ¹⁾	Ø 10 ¹⁾	Ø 12 ¹⁾	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	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	32
Effective embedment depth	$h_{ef,min}$	[mm]	60	60	70	75	80	90	96	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h_{min}	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$						
Minimum spacing	s_{min}	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	c_{min}	[mm]	35	40	45	50	50	60	70	70	75	85

¹⁾ both nominal drill hole diameter can be used

Table B3: Installation parameters for Internal threaded anchor rod

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

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

Würth Injection System WIT-PE 1000 for concrete

Intended Use
Installation parameters

Annex B 3

Table B4: Parameter cleaning and setting tools

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

CAC - Rec. compressed air tool (min 6 bar)

Drill bit diameter (d_0): all diameters



HDB – Hollow drill bit system

Drill bit diameter (d_0): all diameters

The hollow drill bit system contains the Würth Saugbohrer, MKT Saugbohrer hollow drill bit and a class M vacuum with minimum negative pressure of 253 hPa and flow rate of minimum 150 m³/h (42 l/s).

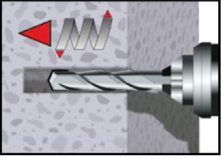
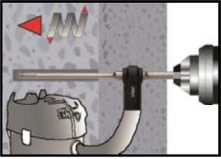
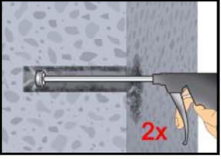
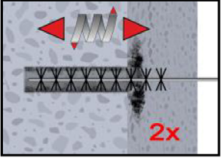
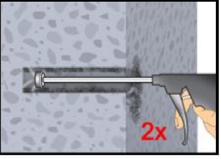


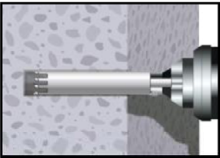
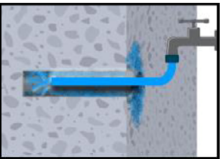
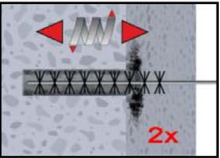
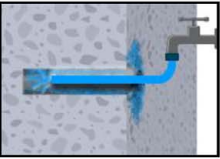
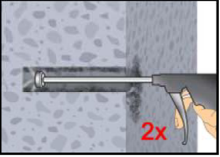
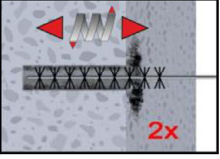
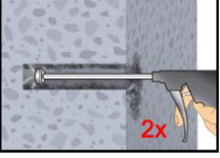
Würth Injection System WIT-PE 1000 for concrete

Intended Use

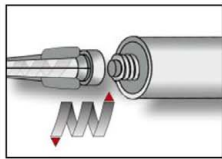
Cleaning and setting tools

Annex B 4

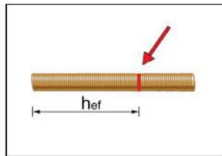
Installation instructions	
Drilling of the bore hole (HD, HDB, CD)	
 	1a. Hammer (HD) or compressed air drilling (CD) Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). Proceed with Step 2. In case of aborted drill hole, the drill hole shall be filled with mortar. 1b. Hollow drill bit system (HDB) (see Annex B 3) Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). This drilling system removes the dust and cleans the bore hole during drilling (all conditions). Proceed with Step 3. In case of aborted drill hole, the drill hole shall be filled with mortar.
	Attention! Standing water in the bore hole must be removed before cleaning.
CAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked and cracked concrete	
  	2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used. 2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush $> d_{b,min}$ (Table B4) a minimum of two times in a twisting motion. If the bore hole ground is not reached with the brush, a brush extension must be used. 2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.
	After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.
Würth Injection System WIT-PE 1000 for concrete	
Intended Use Installation instructions	Annex B 5

Installation instructions	
Drilling of the bore hole (DD)	
	1a. Diamond drilling (DD) Drill with diamond drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). Proceed with Step 2. In case of aborted drill hole, the drill hole shall be filled with mortar.
SPCAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked concrete	
     	Attention! Standing water in the bore hole must be removed before cleaning. 2a. Rinsing with water until clear water comes out. 2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush $> d_{b,min}$ (Table B4) a minimum of two times in a twisting motion. If the bore hole ground is not reached with the brush, a brush extension must be used. 2c. Rinsing again with water until clear water comes out. 2d. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used. 2e. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush $> d_{b,min}$ (Table B4) a minimum of two times in a twisting motion. If the bore hole ground is not reached with the brush, a brush extension must be used. 2f. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.
	After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.
Würth Injection System WIT-PE 1000 for concrete	
Intended Use Installation instructions	
Annex B 6	

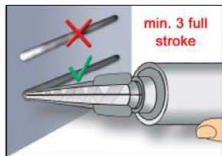
Installation instructions (continuation)



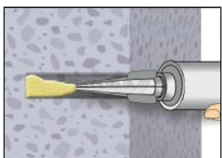
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.
For every working interruption longer than the recommended working time (Table B5) as well as for new cartridges, a new static-mixer shall be used.



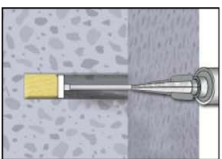
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



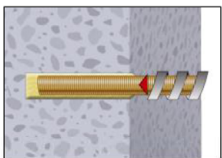
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey or red colour.



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

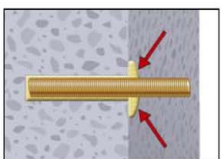


7. Piston plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
- Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit- $\varnothing d_0 \geq 18$ mm and embedment depth $h_{ef} > 250$ mm
 - Overhead assembly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

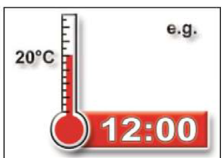


8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

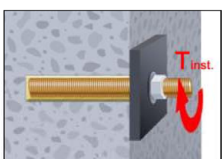
The anchor shall be free of dirt, grease, oil or other foreign material.



9. After inserting the anchor, the annular gap between anchor rod and concrete, in case of a push through installation additionally also the fixture, must be complete filled with mortar. If excess mortar is not visible at the top of the hole, the requirement is not fulfilled and the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).



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



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

Würth Injection System WIT-PE 1000 for concrete

Intended Use

Installation instructions (continuation)

Annex B 7

Table B5: Maximum working time and minimum curing time

Concrete temperature	Gelling working time	Minimum curing time in dry concrete	Minimum curing time in wet concrete
+ 5 °C to + 9 °C	80 min	48 h	96 h
+ 10 °C to + 14 °C	60 min	28 h	56 h
+ 15 °C to + 19 °C	40 min	18 h	36 h
+ 20 °C to + 24 °C	30 min	12 h	24 h
+ 25 °C to + 34 °C	12 min	9 h	18 h
+ 35 °C to + 39 °C	8 min	6 h	12 h
+40 °C	8 min	4 h	8 h
Cartridge temperature	+5°C to +40°C		
Würth Injection System WIT-PE 1000 for concrete			Annex B 8
Intended Use Curing time			

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

Size			M8	M10	M12	M16	M20	M24	M27	M30	
Cross section area		A _s	[mm²]	36,6	58	84,3	157	245	353	459	561
Characteristic tension resistance, Steel failure ¹⁾											
Steel, Property class 4.6 and 4.8		N _{Rk,s}	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
Steel, Property class 5.6 and 5.8		N _{Rk,s}	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
Steel, Property class 8.8		N _{Rk,s}	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
Stainless steel A2, A4 and HCR, class 50		N _{Rk,s}	[kN]	18	29	42	79	123	177	230	281
Stainless steel A2, A4 and HCR, class 70		N _{Rk,s}	[kN]	26	41	59	110	171	247	-	-
Stainless steel A4 and HCR, class 80		N _{Rk,s}	[kN]	29	46	67	126	196	282	-	-
Characteristic tension resistance, Partial factor ²⁾											
Steel, Property class 4.6 and 5.6		γ _{Ms,N}	[-]	2,0							
Steel, Property class 4.8, 5.8 and 8.8		γ _{Ms,N}	[-]	1,5							
Stainless steel A2, A4 and HCR, class 50		γ _{Ms,N}	[-]	2,86							
Stainless steel A2, A4 and HCR, class 70		γ _{Ms,N}	[-]	1,87							
Stainless steel A4 and HCR, class 80		γ _{Ms,N}	[-]	1,6							
Characteristic shear resistance, Steel failure ¹⁾											
Without lever arm	Steel, Property class 4.6 and 4.8	V ⁰ _{Rk,s}	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
	Steel, Property class 5.6 and 5.8	V ⁰ _{Rk,s}	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
	Steel, Property class 8.8	V ⁰ _{Rk,s}	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
	Stainless steel A2, A4 and HCR, class 50	V ⁰ _{Rk,s}	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A2, A4 and HCR, class 70	V ⁰ _{Rk,s}	[kN]	13	20	30	55	86	124	-	-
	Stainless steel A4 and HCR, class 80	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	-	-
With lever arm	Steel, Property class 4.6 and 4.8	M ⁰ _{Rk,s}	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	M ⁰ _{Rk,s}	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
	Steel, Property class 8.8	M ⁰ _{Rk,s}	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
	Stainless steel A2, A4 and HCR, class 50	M ⁰ _{Rk,s}	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, class 70	M ⁰ _{Rk,s}	[Nm]	26	52	92	232	454	784	-	-
	Stainless steel A4 and HCR, class 80	M ⁰ _{Rk,s}	[Nm]	30	59	105	266	519	896	-	-
Characteristic shear resistance, Partial factor ²⁾											
Steel, Property class 4.6 and 5.6		γ _{Ms,V}	[-]	1,67							
Steel, Property class 4.8, 5.8 and 8.8		γ _{Ms,V}	[-]	1,25							
Stainless steel A2, A4 and HCR, class 50		γ _{Ms,V}	[-]	2,38							
Stainless steel A2, A4 and HCR, class 70		γ _{Ms,V}	[-]	1,56							
Stainless steel A4 and HCR, class 80		γ _{Ms,V}	[-]	1,33							
¹⁾ Values are only valid for the given stress area A_s. Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009. ²⁾ in absence of national regulation											
Würth Injection System WIT-PE 1000 for concrete								Annex C 1			
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods											

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

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

Annex C 2

Table C3: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years												
Anchor size threaded rod					M8	M10	M12	M16	M20	M24	M27	M30
Steel failure												
Characteristic tension resistance			$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ (or see Table C1)							
Partial factor			$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure												
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	20	20	19	19	18	17	16	16
	II: 72°C/50°C				15	15	15	14	13	13	12	12
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)												
Temperature range	I: 40°C/24°C	Dry, wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	17	16	16	16	15	14	14	13
	II: 72°C/50°C				14	14	14	13	13	12	12	11
	I: 40°C/24°C	flooded bore hole			16	16	16	15	15	14	14	13
	II: 72°C/50°C				14	14	14	13	13	12	12	11
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD) , compressed air drilled holes (CD) and with hollow drill bit (HDB)												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5
	II: 72°C/50°C				6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ^0_{sus} in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ^0_{sus}	[-]	0,80							
	II: 72°C/50°C				0,68							
Increasing factors for concrete ψ_c			C25/30		1,02							
			C30/37		1,04							
			C35/45		1,07							
			C40/50		1,08							
			C45/55		1,09							
			C50/60		1,10							
Concrete cone failure												
Relevant parameter					see Table C2							
Splitting												
Relevant parameter					see Table C2							
Installation factor												
for dry and wet concrete (HD; HDB, CD)			γ_{inst}	[-]	1,0							
for flooded bore hole (HD; HDB, CD)					1,2							
Würth Injection System WIT-PE 1000 for concrete									Annex C 3			
Performances Characteristic values of tension loads under static and quasi-static action												

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

Anchor size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ (or see Table C1)							
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)											
Temperature range I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,ucr,100}$	[N/mm²]	20	20	19	19	18	17	16	16
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)											
Temperature range I: 40°C/24°C	Dry, wet concrete	$\tau_{Rk,ucr,100}$	[N/mm²]	17	16	16	16	15	14	14	13
	I: 40°C/24°C flooded bore hole			16	16	16	15	15	14	14	13
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD) , compressed air drilled holes (CD) and with hollow drill bit (HDB)											
Temperature range I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,cr,100}$	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5
Increasing factors for concrete ψ_c		C25/30		1,02							
		C30/37		1,04							
		C35/45		1,07							
		C40/50		1,08							
		C45/55		1,09							
		C50/60		1,10							
Concrete cone failure											
Relevant parameter				see Table C2							
Splitting											
Relevant parameter				see Table C2							
Installation factor											
for dry and wet concrete (HD; HDB, CD)		γ_{inst}	[-]	1,0							
for flooded bore hole (HD; HDB, CD)				1,2							

Table C5: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years

Anchor size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure												
Characteristic tension resistance		N _{Rk,s}	[kN]	A _s · f _{uk} (or see Table C1)								
Partial factor		γ _{Ms,N}	[-]	see Table C1								
Combined pull-out and concrete failure												
Characteristic bond resistance in non-cracked concrete C20/25 in diamond drilled holes (DD)												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr}	[N/mm²]	15	14	14	13	12	12	11	11
	II: 72°C/50°C				12	12	11	10	9,5	9,5	9,0	9,0
Reduction factor ψ ⁰ _{sus} in non-cracked concrete C20/25 in diamond drilled holes (DD)												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,77							
	II: 72°C/50°C				0,72							
Increasing factors for concrete ψ _c			C25/30		1,04							
			C30/37		1,08							
			C35/45		1,12							
			C40/50		1,15							
			C45/55		1,17							
			C50/60		1,19							
Concrete cone failure												
Relevant parameter				see Table C2								
Splitting												
Relevant parameter				see Table C2								
Installation factor												
for dry and wet concrete (DD)		γ _{inst}	[-]	1,0								
for flooded bore hole (DD)				1,2		1,4						

Table C6: Characteristic values of shear loads under static and quasi-static action

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure without lever arm											
Characteristic shear resistance Steel, strength class 4.6, 4.8 and 5.6, 5.8	$V_{Rk,s}^0$	[kN]	$0,6 \cdot A_s \cdot f_{uk}$ (or see Table C1)								
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	$V_{Rk,s}^0$	[kN]	$0,5 \cdot A_s \cdot f_{uk}$ (or see Table C1)								
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1								
Ductility factor	k_7	[-]	1,0								
Steel failure with lever arm											
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}$ (or see Table C1)								
Elastic section modulus	W_{el}	[mm³]	31	62	109	277	541	935	1387	1874	
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1								
Concrete pry-out failure											
Factor	k_8	[-]	2,0								
Installation factor	γ_{inst}	[-]	1,0								
Concrete edge failure											
Effective length of fastener	l_f	[mm]	$\min(h_{ef}; 12 \cdot d_{nom})$						$\min(h_{ef}; 300\text{mm})$		
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30	
Installation factor	γ_{inst}	[-]	1,0								
Würth Injection System WIT-PE 1000 for concrete								Annex C 6			
Performances Characteristic values of shear loads under static and quasi-static action											

Table C7: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years

Anchor size internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel failure ¹⁾										
Characteristic tension resistance,	5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123	
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196	
Partial factor, strength class 5.8 and 8.8		γ _{Ms,N}	[-]	1,5						
Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		N _{Rk,s}	[kN]	14	26	41	59	110	124	
Partial factor		γ _{Ms,N}	[-]	1,87					2,86	
Combined pull-out and concrete cone failure										
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)										
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr}	[N/mm²]	20	19	19	18	17	16
	II: 72°C/50°C				15	15	14	13	13	12
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)										
Temperature range	I: 40°C/24°C	Dry, wet concrete	τ _{Rk,ucr}	[N/mm²]	16	16	16	15	14	13
	II: 72°C/50°C				14	14	13	13	12	11
	I: 40°C/24°C	flooded bore hole			16	16	15	15	14	13
	II: 72°C/50°C				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 with hollow drill bit (HDB)										
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,cr}	[N/mm²]	7,0	8,5	8,5	8,5	8,5	8,5
	II: 72°C/50°C				6,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ ⁰ _{sus} in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)										
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,80					
	II: 72°C/50°C				0,68					
Increasing factors for concrete ψ _c			C25/30		1,02					
			C30/37		1,04					
			C35/45		1,07					
			C40/50		1,08					
			C45/55		1,09					
			C50/60		1,10					
Concrete cone failure										
Relevant parameter				see Table C2						
Splitting failure										
Relevant parameter				see Table C2						
Installation factor										
for dry and wet concrete (HD; HDB, CD)		γ _{inst}	[-]	1,0						
for flooded bore hole (HD; HDB, CD)				1,2						
¹⁾ Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.										
²⁾ For IG-M20 strength class 50 is valid										
Würth Injection System WIT-PE 1000 for concrete								Annex C 7		
Performances Characteristic values of tension loads under static and quasi-static action										

Table C8: Characteristic values of tension loads under static and quasi-static action for a service life of 100 years										
Anchor size internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel failure ¹⁾										
Characteristic tension resistance,	5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123	
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196	
Partial factor, strength class 5.8 and 8.8		γ _{Ms,N}	[-]	1,5						
Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		N _{Rk,s}	[kN]	14	26	41	59	110	124	
Partial factor		γ _{Ms,N}	[-]	1,87						2,86
Combined pull-out and concrete cone failure										
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)										
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr,100}	[N/mm²]	20	19	19	18	17	16
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)										
Temperature range	I: 40°C/24°C	Dry, wet concrete	τ _{Rk,ucr,100}	[N/mm²]	16	16	16	15	14	13
	I: 40°C/24°C	flooded bore hole			16	16	15	15	14	13
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)										
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,cr,100}	[N/mm²]	6,5	7,5	7,5	7,5	7,5	7,5
Increasing factors for concrete ψ _c			C25/30		1,02					
			C30/37		1,04					
			C35/45		1,07					
			C40/50		1,08					
			C45/55		1,09					
			C50/60		1,10					
Concrete cone failure										
Relevant parameter				see Table C2						
Splitting failure										
Relevant parameter				see Table C2						
Installation factor										
for dry and wet concrete (HD; HDB, CD)		γ _{inst}	[-]	1,0						
for flooded bore hole (HD; HDB, CD)				1,2						
1) Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element. 2) For IG-M20 strength class 50 is valid										
Würth Injection System WIT-PE 1000 for concrete								Annex C 8		
Performances Characteristic values of tension loads under static and quasi-static action										

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

Anchor size internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel failure ¹⁾									
Characteristic tension resistance,	5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196
Partial factor, strength class 5.8 and 8.8		γ _{Ms,N}	[-]	1,5					
Characteristic tension resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		N _{Rk,s}	[kN]	14	26	41	59	110	124
Partial factor		γ _{Ms,N}	[-]	1,87					
Combined pull-out and concrete cone failure									
Characteristic bond resistance in non-cracked concrete C20/25 in diamond drilled holes (DD)									
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr}	[N/mm²]	14	14	13	12	11
	II: 72°C/50°C				12	11	10	9,5	9,5
Reduction factor ψ ⁰ _{sus} in non-cracked concrete C20/25 in diamond drilled holes (DD)									
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,77				
	II: 72°C/50°C				0,72				
Increasing factors for concrete ψ _c			C25/30		1,04				
			C30/37		1,08				
			C35/45		1,12				
			C40/50		1,15				
			C45/55		1,17				
			C50/60		1,19				
Concrete cone failure									
Relevant parameter				see Table C2					
Splitting failure									
Relevant parameter				see Table C2					
Installation factor									
for dry and wet concrete (DD)		γ _{inst}	[-]	1,0					
for flooded bore hole (DD)				1,2	1,4				
¹⁾ Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element. ²⁾ For IG-M20 strength class 50 is valid									
Würth Injection System WIT-PE 1000 for concrete							Annex C 9		
Performances Characteristic values of tension loads under static and quasi-static action									

Table C10: Characteristic values of shear loads under static and quasi-static action

Anchor size for internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel failure without lever arm ¹⁾									
Characteristic shear resistance, Steel, strength class	5.8	V ⁰ _{Rk,s}	[kN]	5	9	15	21	38	61
	8.8	V ⁰ _{Rk,s}	[kN]	8	14	23	34	60	98
Partial factor, strength class 5.8 and 8.8		γ _{Ms,V}	[-]	1,25					
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		V ⁰ _{Rk,s}	[kN]	7	13	20	30	55	40
Partial factor		γ _{Ms,V}	[-]	1,56					2,38
Ductility factor		k ₇	[-]	1,0					
Steel failure with lever arm ¹⁾									
Characteristic bending moment, Steel, strength class	5.8	M ⁰ _{Rk,s}	[Nm]	8	19	37	66	167	325
	8.8	M ⁰ _{Rk,s}	[Nm]	12	30	60	105	267	519
Partial factor, strength class 5.8 and 8.8		γ _{Ms,V}	[-]	1,25					
Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 ²⁾		M ⁰ _{Rk,s}	[Nm]	11	26	52	92	233	456
Partial factor		γ _{Ms,V}	[-]	1,56					2,38
Concrete pry-out failure									
Factor		k ₈	[-]	2,0					
Installation factor		γ _{inst}	[-]	1,0					
Concrete edge failure									
Effective length of fastener		l _f	[mm]	min(h _{ef} ; 12 • d _{nom})					min(h _{ef} ; 300mm)
Outside diameter of fastener		d _{nom}	[mm]	10	12	16	20	24	30
Installation factor		γ _{inst}	[-]	1,0					
¹⁾ Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element. ²⁾ For IG-M20 strength class 50 is valid									
Würth Injection System WIT-PE 1000 for concrete								Annex C 10	
Performances Characteristic values of shear loads under static and quasi-static action									

Table C11: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years														
Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Steel failure														
Characteristic tension resistance		N _{Rk,s}	[kN]	A _s · f _{uk} ¹⁾										
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804	
Partial factor		γ _{Ms,N}	[-]	1,4 ²⁾										
Combined pull-out and concrete failure														
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr}	[N/mm²]	16	16	16	16	16	16	15	15	15	15
	II: 72°C/50°C				12	12	12	12	12	12	12	12	11	11
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)														
Temperature range	I: 40°C/24°C	Dry, wet concrete	τ _{Rk,ucr}	[N/mm²]	14	14	13	13	13	13	13	13	13	13
	II: 72°C/50°C				12	12	12	11	11	11	11	11	11	11
	I: 40°C/24°C	flooded bore hole			13	13	13	13	13	13	13	13	13	13
	II: 72°C/50°C				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 with hollow drill bit (HDB)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,cr}	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
	II: 72°C/50°C				6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ ⁰ _{sus} in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,80									
	II: 72°C/50°C				0,68									
Increasing factors for concrete ψ _c			C25/30		1,02									
			C30/37		1,04									
			C35/45		1,07									
			C40/50		1,08									
			C45/55		1,09									
			C50/60		1,10									
Concrete cone failure														
Relevant parameter				see Table C2										
Splitting														
Relevant parameter				see Table C2										
Installation factor														
for dry and wet concrete (HD; HDB, CD)		γ _{inst}	[-]	1,0										
for flooded bore hole (HD; HDB, CD)				1,2										
1) f _{uk} shall be taken from the specifications of reinforcing bars														
2) in absence of national regulation														
Würth Injection System WIT-PE 1000 for concrete											Annex C 11			
Performances														
Characteristic values of tension loads under static and quasi-static action														

Table C12: Characteristic values of tension loads under static and quasi-static action for a service life of 100 years														
Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Steel failure														
Characteristic tension resistance		N _{Rk,s}	[kN]	A _s · f _{uk} ¹⁾										
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804	
Partial factor		γ _{Ms,N}	[-]	1,4 ²⁾										
Combined pull-out and concrete failure														
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes (HD) and compressed air drilled holes (CD)														
Temperature range I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr,100}	[N/mm²]	16	16	16	16	16	16	15	15	15	15	
Characteristic bond resistance in non-cracked concrete C20/25 in hammer drilled holes with hollow drill bit (HDB)														
Temperature range I: 40°C/24°C	Dry, wet concrete	τ _{Rk,ucr,100}	[N/mm²]	14	14	13	13	13	13	13	13	13	13	
	I: 40°C/24°C flooded bore hole			13	13	13	13	13	13	13	13	13	13	
Characteristic bond resistance in cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)														
Temperature range I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,cr,100}	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	
Increasing factors for concrete ψ _c		C25/30		1,02										
		C30/37		1,04										
		C35/45		1,07										
		C40/50		1,08										
		C45/55		1,09										
		C50/60		1,10										
Concrete cone failure														
Relevant parameter				see Table C2										
Splitting														
Relevant parameter				see Table C2										
Installation factor														
for dry and wet concrete (HD; HDB, CD)		γ _{inst}	[-]	1,0										
for flooded bore hole (HD; HDB, CD)				1,2										
1) f _{uk} shall be taken from the specifications of reinforcing bars 2) in absence of national regulation														
Würth Injection System WIT-PE 1000 for concrete											Annex C 12			
Performances Characteristic values of tension loads under static and quasi-static action														

Table C13: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years

Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Steel failure														
Characteristic tension resistance		N _{Rk,s}	[kN]	A _s · f _{uk} ¹⁾										
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804	
Partial factor		γ _{Ms,N}	[-]	1,4 ²⁾										
Combined pull-out and concrete failure														
Characteristic bond resistance in non-cracked concrete C20/25 in diamond drilled holes (DD)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	τ _{Rk,ucr}	[N/mm²]	14	13	13	13	12	12	11	11	11	11
	II: 72°C/50°C				11	11	10	10	10	9,5	9,5	9,5	9,0	9,0
Reduction factor ψ ⁰ _{sus} in non-cracked concrete C20/25 in diamond drilled holes (DD)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,77									
	II: 72°C/50°C				0,72									
Increasing factors for concrete ψ _c			C25/30		1,04									
			C30/37		1,08									
			C35/45		1,12									
			C40/50		1,15									
			C45/55		1,17									
			C50/60		1,19									
Concrete cone failure														
Relevant parameter				see Table C2										
Splitting														
Relevant parameter				see Table C2										
Installation factor														
for dry and wet concrete (DD)		γ _{inst}	[-]	1,0										
for flooded bore hole (DD)				1,2				1,4						
1) f _{uk} shall be taken from the specifications of reinforcing bars 2) in absence of national regulation														
Würth Injection System WIT-PE 1000 for concrete										Annex C 13				
Performances Characteristic values of tension loads under static and quasi-static action														

Table C14: Characteristic values of shear loads under static and quasi-static action

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure without lever arm												
Characteristic shear resistance	$V_{Rk,s}^0$	[kN]	$0,5 \cdot A_s \cdot f_{uk}^{1)}$									
Cross section area	A_s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	$\gamma_{Ms,V}$	[-]	$1,5^{2)}$									
Ductility factor	k_7	[-]	1,0									
Steel failure with lever arm												
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}^{1)}$									
Elastic section modulus	W_{el}	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	$\gamma_{Ms,V}$	[-]	$1,5^{2)}$									
Concrete pry-out failure												
Factor	k_8	[-]	2,0									
Installation factor	γ_{inst}	[-]	1,0									
Concrete edge failure												
Effective length of fastener	l_f	[mm]	$\min(h_{ef}; 12 \cdot d_{nom})$							$\min(h_{ef}; 300mm)$		
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γ_{inst}	[-]	1,0									
¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation												
Würth Injection System WIT-PE 1000 for concrete										Annex C 14		
Performances Characteristic values of shear loads under static and quasi-static action												

Table C15: Displacements under tension load¹⁾ in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete under static and quasi-static action for a service life of 50 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,038	0,039	0,040	0,044	0,047	0,051	0,052	0,055
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,047	0,049	0,051	0,055	0,059	0,064	0,067	0,070
Cracked concrete under static and quasi-static action for a service life of 50 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,259	0,154	0,163	0,172	0,181	0,189	0,207	0,229
Non-cracked concrete under static and quasi-static action for a service life of 100 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,028	0,030	0,031	0,033	0,036	0,038	0,040	0,042
Cracked concrete under static and quasi-static action for a service life of 100 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171

¹⁾ Calculation of the displacement

$$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau; \quad \tau: \text{action bond stress for tension}$$

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

Table C16: Displacements under tension load¹⁾ in diamond drilled holes (DD)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete under static and quasi-static action for a service life of 50 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,015
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,018	0,019	0,019	0,020	0,022	0,023	0,024	0,025
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,013	0,014	0,014	0,015	0,016	0,016	0,018	0,018
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,052	0,053	0,055	0,058	0,062	0,065	0,068	0,070

¹⁾ Calculation of the displacement

$$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau; \quad \tau: \text{action bond stress for tension}$$

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

Table C17: Displacements under shear load²⁾ for all drilling methods

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

²⁾ Calculation of the displacement

$$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V; \quad V: \text{action shear load}$$

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

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Displacements under static and quasi-static action (threaded rods)

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Table C18: Displacements under tension load¹⁾ in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)

Anchor size Internal threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years								
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,029	0,030	0,033	0,035	0,038	0,041
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,029	0,030	0,033	0,035	0,038	0,041
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,039	0,040	0,044	0,047	0,051	0,055
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,049	0,051	0,055	0,059	0,064	0,070
Cracked concrete C20/25 under static and quasi-static action for a service life of 50 years								
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,071	0,072	0,074	0,076	0,079	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,171
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,095	0,096	0,099	0,102	0,106	0,110
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,154	0,163	0,172	0,181	0,189	0,229
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 100 years								
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,029	0,030	0,033	0,035	0,038	0,041
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,030	0,031	0,033	0,036	0,038	0,042
Cracked concrete C20/25 under static and quasi-static action for a service life of 100 years								
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,071	0,072	0,074	0,076	0,079	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,171

¹⁾ Calculation of the displacement

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

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

τ : action bond stress for tension

Table C19: Displacements under tension load¹⁾ in diamond drilled holes (DD)

Anchor size Internal threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years								
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,012	0,012	0,013	0,014	0,014	0,015
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,019	0,019	0,020	0,022	0,023	0,025
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,014	0,014	0,015	0,016	0,016	0,018
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,053	0,055	0,058	0,062	0,065	0,070

¹⁾ Calculation of the displacement

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

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

τ : action bond stress for tension

Table C20: Displacements under shear load²⁾ for all drilling methods

Anchor size Internal threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Non-cracked and cracked concrete C20/25 under static and quasi-static action								
All temperature ranges	δ_{V0} -factor	[mm/kN]	0,07	0,06	0,06	0,05	0,04	0,04
	$\delta_{V\infty}$ -factor	[mm/kN]	0,10	0,09	0,08	0,08	0,06	0,06

²⁾ Calculation of the displacement

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

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

V : action shear load

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Performances

Displacements under static and quasi-static action (Internal threaded anchor rod)

Annex C 16

Table C21: Displacements under tension load¹⁾ in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temp.- range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
Temp.- range II: 72°C/50°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,038	0,039	0,040	0,042	0,044	0,047	0,051	0,051	0,054	0,058
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,047	0,049	0,051	0,053	0,055	0,059	0,065	0,065	0,068	0,072
Cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temp.- range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temp.- range II: 72°C/50°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 100 years												
Temp.- range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,028	0,030	0,031	0,032	0,033	0,036	0,039	0,039	0,041	0,043
Cracked concrete C20/25 under static and quasi-static action for a service life of 100 years												
Temp.- range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194

¹⁾ Calculation of the displacement

$$\delta_{N0} = \delta_{N0\text{-factor}} \cdot \tau; \quad \tau: \text{action bond stress for tension}$$

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

Table C22: Displacements under tension load¹⁾ in diamond drilled holes (DD)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temp.- range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,008	0,009	0,009	0,01	0,011	0,012	0,013	0,013	0,014	0,015
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,018	0,018	0,019	0,020	0,021	0,024	0,027	0,027	0,028	0,031
Temp.- range II: 72°C/50°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,048	0,051	0,054	0,058	0,061	0,068	0,076	0,076	0,081	0,088

¹⁾ Calculation of the displacement

$$\delta_{N0} = \delta_{N0\text{-factor}} \cdot \tau; \quad \tau: \text{action bond stress for tension}$$

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

Table C23: Displacements under shear load²⁾ for all drilling methods

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
For concrete C20/25 under static and quasi-static action												
All temperature ranges	δ _{V0} -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
	δ _{V∞} -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04

²⁾ Calculation of the displacement

$$\delta_{V0} = \delta_{V0\text{-factor}} \cdot V; \quad V: \text{action shear load}$$

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

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Performances

Displacements under static and quasi-static action (rebar)

Annex C 17

**Table C24: Characteristic values of tension loads under seismic action
(performance category C1+C2)**

Anchor size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension resistance (Seismic C1)		N _{Rk,s,eq,C1}	[kN]	1,0 • N _{Rk,s}							
Characteristic tension resistance, (Seismic C2) Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70		N _{Rk,s,eq,C2}	[kN]	No performance assased		1,0 • N _{Rk,s}				No performance assased	
Partial factor		γ _{Ms,N}	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)											
Temperature range I: 40°C/24°C II: 72°C/50°C	Dry, wet concrete and flooded bore hole	τ _{Rk,eq,C1}	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5
		τ _{Rk,eq,C2}	[N/mm²]	NPA ¹⁾		5,8	4,8	5,0	5,1	NPA ¹⁾	
		τ _{Rk,eq,C1}	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0
		τ _{Rk,eq,C2}	[N/mm²]	NPA ¹⁾		5,0	4,1	4,3	4,4	NPA ¹⁾	
Reduction factor ψ ⁰ _{sus} in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)											
Temperature range I: 40°C/24°C II: 72°C/50°C	Dry, wet concrete and flooded bore hole	ψ ⁰ _{sus}	[-]	0,80							
				0,68							
Increasing factors for concrete ψ _C		C25/30 to C50/60		1,0							
Concrete cone failure											
Relevant parameter				see Table C2							
Splitting											
Relevant parameter				see Table C2							
Installation factor											
for dry and wet concrete (HD; HDB, CD)		γ _{inst}	[-]	1,0							
for flooded bore hole (HD; HDB, CD)				1,2							
1) No performance assased											
Würth Injection System WIT-PE 1000 for concrete								Annex C 18			
Performances Characteristic values of tension loads under seismic action (performance category C1+C2)											

**Table C25: Characteristic values of shear loads under seismic action
(performance category C1+C2)**

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure										
Characteristic shear resistance (Seismic C1)	$V_{Rk,s,eq,C1}$	[kN]	$0,70 \cdot V^0_{Rk,s}$							
Characteristic shear resistance (Seismic C2), Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥ 70	$V_{Rk,s,eq,C2}$	[kN]	No performance assassed		$0,70 \cdot V^0_{Rk,s}$				No performance assassed	
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Ductility factor	k_7	[-]	1,0							
Concrete pry-out failure										
Factor	k_8	[-]	2,0							
Installation factor	γ_{inst}	[-]	1,0							
Concrete edge failure										
Effective length of fastener	l_f	[mm]	$\min(h_{ef}; 12 \cdot d_{nom})$						$\min(h_{ef}; 300\text{mm})$	
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ_{inst}	[-]	1,0							
Factor for annular gap	α_{gap}	[-]	$0,5 (1,0)^{1)}$							
¹⁾ Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.										
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Performances Characteristic values of shear loads under seismic action (performance category C1+C2)										

**Table C26: Characteristic values of tension loads under seismic action
(performance category C1)**

Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32	
Steel failure														
Characteristic tension resistance		$N_{Rk,s,eq,C1}$	[kN]	$1,0 \cdot A_s \cdot f_{uk}^{1)}$										
Cross section area		A_s	[mm²]	50	79	113	154	201	314	452	491	616	804	
Partial factor		$\gamma_{Ms,N}$	[-]	$1,4^{2)}$										
Combined pull-out and concrete failure														
Characteristic bond resistance in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,eq,C1}$	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
	II: 72°C/50°C		$\tau_{Rk,eq,C1}$	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ_{sus}^0 in cracked and non-cracked concrete C20/25 in hammer drilled holes (HD), compressed air drilled holes (CD) and with hollow drill bit (HDB)														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ_{sus}^0	[-]	0,80									
	II: 72°C/50°C				0,68									
Increasing factors for concrete ψ_C		C25/30 to C50/60		1,0										
Concrete cone failure														
Relevant parameter				see Table C2										
Splitting														
Relevant parameter				see Table C2										
Installation factor														
for dry and wet concrete (HD; HDB, CD)		γ_{inst}	[-]	1,0										
for flooded bore hole (HD; HDB, CD)				1,2										
¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation														
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Performances Characteristic values of tension loads under seismic action (performance category C1)														

**Table C27: Characteristic values of shear loads under seismic action
(performance category C1)**

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure												
Characteristic shear resistance	V _{Rk,s,eq,C1}	[kN]	0,35 · A _s · f _{uk} ¹⁾									
Cross section area	A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ _{Ms,V}	[-]	1,5 ²⁾									
Ductility factor	k ₇	[-]	1,0									
Concrete pry-out failure												
Factor	k ₈	[-]	2,0									
Installation factor	γ _{inst}	[-]	1,0									
Concrete edge failure												
Effective length of fastener	l _f	[mm]	min(h _{ef} ; 12 · d _{nom})							min(h _{ef} ; 300mm)		
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γ _{inst}	[-]	1,0									
Factor for annular gap	α _{gap}	[-]	0,5 (1,0) ³⁾									

¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars

²⁾ in absence of national regulation

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

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Performances

Characteristic values of shear loads under seismic action (performance category C1)

Annex C 21

Table C28: Displacement under tension load¹⁾ (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic C1 action										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,259	0,154	0,163	0,172	0,181	0,189	0,207	0,229

Table C29: Displacements under tension load¹⁾ (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked and cracked concrete under seismic C1 action												
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260

¹⁾ Calculation of the displacement

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

$$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau; (\tau: \text{action bond stress for tension})$$

Table C30: Displacements under shear load²⁾ (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic C1 action										
All temperature ranges	δ_{V0} -factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

Table C31: Displacements under shear load²⁾ (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked and cracked concrete under seismic C1 action												
All temperature ranges	δ_{V0} -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04

²⁾ Calculation of the displacement

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

$$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V; (V: \text{action shear load})$$

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Performances

Displacements under seismic C1 action (threaded rods and rebar)

Annex C 22

Table C32: Displacements under tension load (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic C2 action										
All temperature ranges	$\delta_{N,C2(DLS)}$	[mm]	No performance assessed		0,21	0,24	0,27	0,36	No performance assessed	
	$\delta_{N,C2(ULS)}$	[mm]			0,54	0,51	0,54	0,63		

Table C33: Displacements under shear load (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete under seismic C2 action										
All temperature ranges	$\delta_{V,C2(DLS)}$	[mm]	No performance assessed		3,1	3,4	3,5	4,2	No performance assessed	
	$\delta_{V,C2(ULS)}$	[mm]			6,0	7,6	7,3	10,9		

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Performances

Displacements under seismic C2 action (threaded rods)

Annex C 23