Deutsches Institut für Bautechnik
DIBt

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Approval body for construction products and types of construction
Bautechnisches Prüfamt
An institution established by the Federal and Laender Governments

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

European Technical Assessment

ETA-11/0352 of 23 April 2015

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	POWERS PURE 150-PRO injection resin with anchor rod for concrete
Product family to which the construction product belongs	Bonded anchor for diamond coring for use in uncracked concrete
Manufacturer	Powers Fasteners Europe Stanley Black&Decker Deutschland GmbH Black-&-Decker Str. 40 65510 Idstein DEUTSCHLAND
Manufacturing plant	Powers Fasteners Europe BV Factory 2, Germany
This European Technical Assessment contains	27 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.

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Specific Part

1 Technical description of the product

The "POWERS PURE150-PRO Injection resin with anchor rod for concrete" is a bonded anchor consisting of a cartridge with injection mortar POWERS PURE150-PRO and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M10 to M24 or reinforcing bar in the range of diameter 10 to 25 mm or threaded sleeves with internal thread of sizes M8 to M16.

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. 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 for design according to TR 029	See Annex C 1 to C 6
Characteristic resistance for design according to CEN/TS 1992-4:2009	See Annex C 7 to C 12
Displacements under tension and shear loads	See Annex C 13 to C 15

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance determined (NPD)

3.3 Hygiene, health and the environment (BWR 3)

Not applicable.

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

3.5 Protection against noise (BWR 5)

Not applicable.

3.6 Energy economy and heat retention (BWR 6)

Not applicable.

3.7 Sustainable use of natural resources (BWR 7)

The sustainable use of natural resources was not investigated.

3.8 General aspects

The verification of durability is part of testing the essential characteristics. Durability is only ensured if the specifications of intended use according to Annex B are taken into account.

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

According to Decision of the Commission of 24 June 1996 (96/582/EC) (OJ L 254 of 08.10.96 p. 62-65), the system of assessment and verification of constancy of performance (see Annex V and Article 65 Paragraph 2 to Regulation (EU) No 305/2011) given in the following table applies.

Product	Intended use	Level or class	System
Metal anchors for use in concrete (heavy-duty type)	For fixing and/or supporting concrete structural elements or heavy units such as cladding and suspended ceilings	—	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 23 April 2015 by Deutsches Institut für Bautechnik

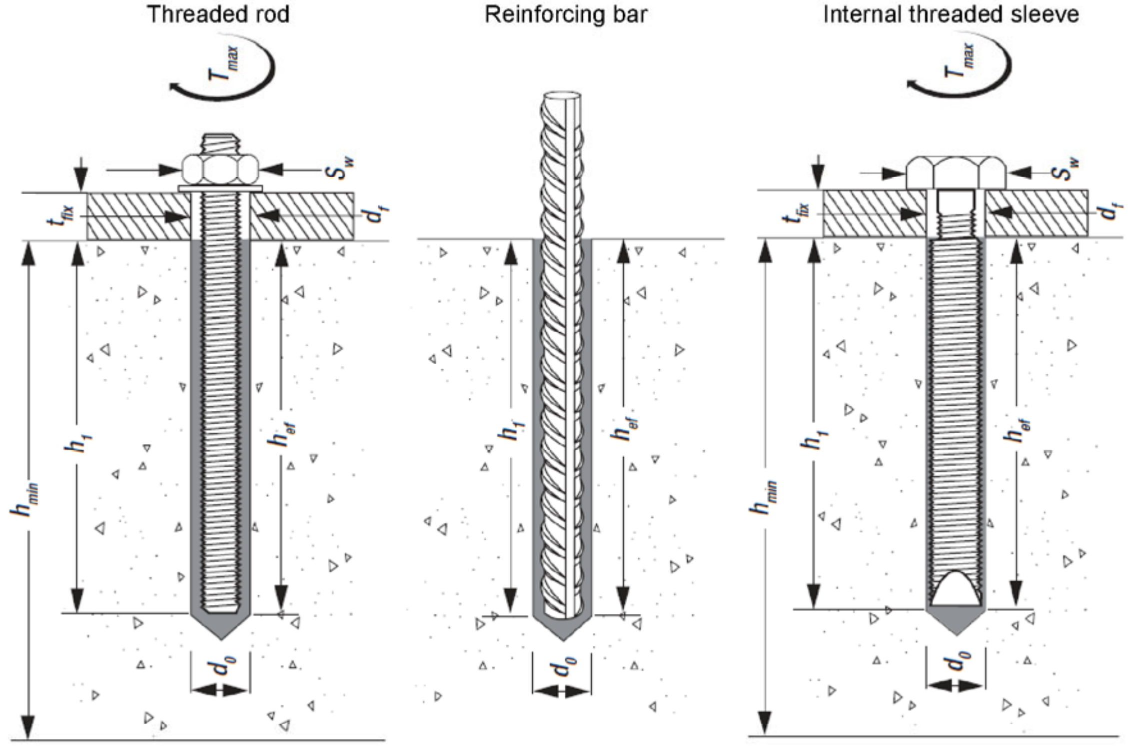
Andreas Kummerow
p.p. Head of Department

beglaubigt:
Baderschneider

Threaded rod M10, M12, M16, M20 and M24 with washer and nut

Reinforcing bar ∅ 10, ∅ 12, ∅ 14, ∅ 16 and ∅ 20, ∅ 24, ∅ 25

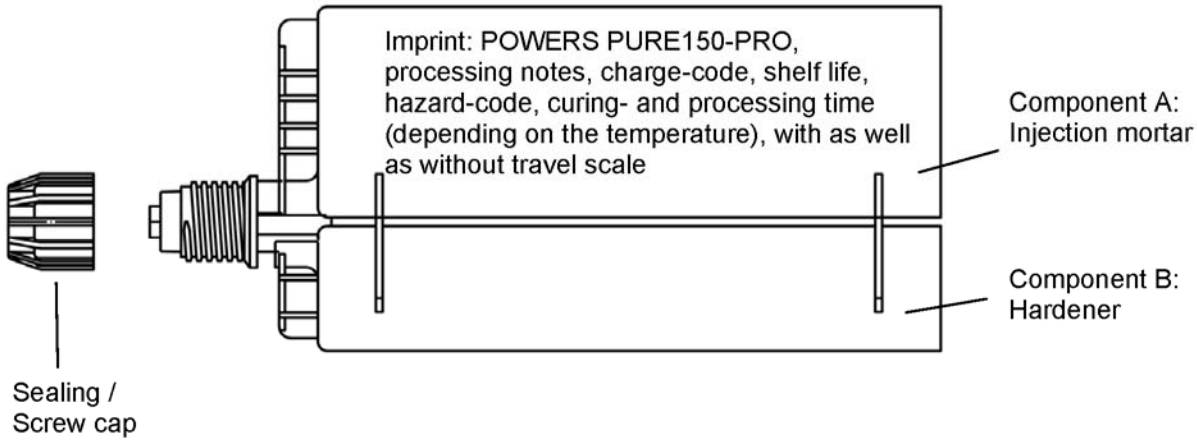
Internal threaded sleeve M8, M10, M12 and M16



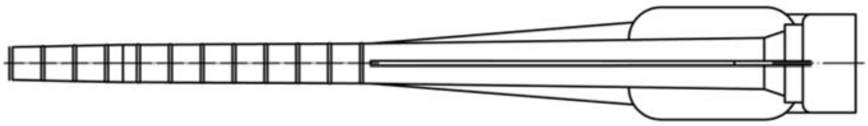
POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex A1**
Product description Product (Steel) and Installation	

Cartridge: PURE150-PRO

385 ml, 585 ml and 1400 ml injection mortar cartridge (Type: “side-by-side”)

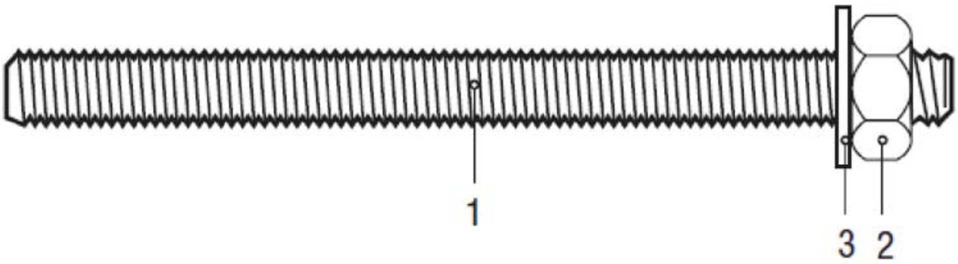


Static mixing nozzle



POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex A2**
Product description Product (Injection mortar)	

Table A1: Materials (Threaded rod)

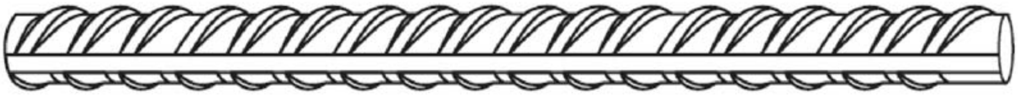


Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. EN ISO 4042:1999 or Steel, hot-dip galvanised ≥ 40 µm acc. EN ISO 1461:2009		
1	Threaded rod	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4.6, 5.8, 8.8 acc. EN 1993-1-8:2005+AC:2009 A_5 > 8% fracture elongation, $f_{uk} = f_{ub}$ $f_{yk} = f_{yb}$
2	Hexagon Nut EN ISO 4032:2012	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 rod) Property class 5 (for class 5.8 rod) Property class 8 (for class 8.8 rod) EN ISO 898-2:2012
3	Washer EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated
Stainless steel		
1	Threaded rod	Material 1.4401 / 1.4571, EN 10088-1:2005, Property class 70 EN ISO 3506-1:2009 A_5 > 8% fracture elongation, $f_{uk} = R_{m.min}$ $f_{yk} = R_{p0,2,min}$
2	Hexagon Nut EN ISO 4032:2012	Material 1.4401 / 1.4571 EN 10088-1:2005, Property class 70 EN ISO 3506-2:2009
3	Washer EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401 or 1.4571, EN 10088-1:2005
High corrosion resistance steel		
1	Threaded rod	Material 1.4529 / 1.4565, EN 10088-1:2005, Property class 70 EN ISO 3506-1:2009 A_5 > 8% fracture elongation, $f_{uk} = R_{m.min}$ $f_{yk} = R_{p0,2,min}$
2	Hexagon Nut EN ISO 4032:2012	Material 1.4529 / 1.4565 EN 10088-1:2005, Property class 70 EN ISO 3506-2:2009
3	Washer EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565 acc. EN 10088-1:2005

Commercial standard rod with:
- Materials, dimensions and mechanical properties (Table A1)
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex A3**
Product description Material (Threaded rod)	

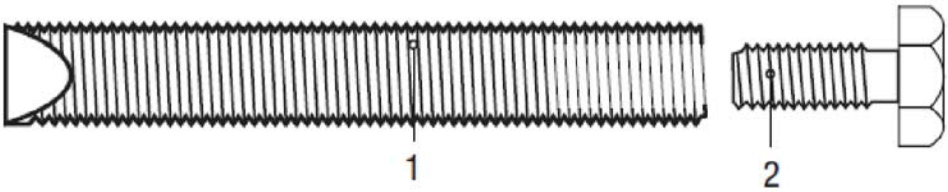
Table A2: Material (Reinforcing bar)



- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2009+AC:2010
- Rip hight of the bar shall be in the range 0,05d≤h≤0,07d
  (d: Nominal diameter oft he rebar, h: Rip hight of the bar)

Reinforcing bar		
1	Rebar according EN 1992-1-1:2009+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:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Table A3: Material (Internal threaded sleeve)



Part	**Designation**	**Material**
Steel, zinc plated ≥ 5 µm acc. EN ISO 4042:1999		
1	Internal threaded sleeve	Steel, EN 10087:2001 or EN 10263:2001 Property class 5.8, EN 1993-1-8:2005+AC:2009
2	Corresponding steel screw	Steel screws property class 5.8 or 8.8, EN ISO 898-1:2013 Zinc plated ≥ 5 µm acc. EN ISO 4042:1999
Stainless steel A4		
1	Internal threaded sleeve	Material 1.4401 / 1.4404 / 1.4571, EN 10088-1: 2005, Property class 70, EN ISO 3506-1:2009
2	Corresponding steel screw	Steel screws property class 50 or 70 EN ISO 3506-1:2009 Stainless steel 1.4401, 1.4404, 1.4571 EN 10088-1:2005
High corrosion resistance steel HCR		
1	Internal threaded sleeve	Material 1.4529 / 1.4565, EN 10088-1:2005, Property class 70, EN ISO 3506-1:2009
2	Corresponding steel screw	Steel screws property class 50 or 70 EN ISO 3506-1:2009 High corrosion resistance steel 1.4529, 1.4565 EN 10088-1:2005

POWERS PURE150-PRO Injection resin with anchor rod for concrete

Annex A4

Product description
Material (Reinforcing bar)
Werkstoffe (Internal threaded sleeve)

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads: Threaded rod M10 to M24, Rebar Ø10 to Ø25, Internal threaded rod M8 to M16.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000.
- Non-cracked concrete

Temperature Range:

- I: - 40 °C to +40 °C (max. long term temperature +24 °C und max. short term temperature +40 °C)
- II: - 40 °C to +60 °C (max. long term temperature +43 °C und max. short term temperature +60 °C)
- III: - 40 °C to +72 °C (max. long term temperature +43 °C und max. short term temperature +72 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions
  (zinc coated steel, stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist
  (stainless steel or high corrosion resistant steel).
- Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions exist

  (high corrosion resistant steel).
  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution
  (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

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.
- Anchorages under static or quasi-static actions are designed in accordance with:
  - EOTA Technical Report TR 029 "Design of bonded anchors", Edition September 2010 or
  - CEN/TS 1992-4:2009

Installation:

- Dry or wet concrete
- Flooded holes (not sea water)
- Hole drilling by diamond drilling
- 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.

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex B1**
Intended Use Specifications	

Table B1: Installation parameters for threaded rod

Anchor size		M 10	M 12	M 16	M 20	M 24
Nominal drill hole diameter	d_0 [mm] =	12	14	18	24	28
Embedment depth and bore hole depth	$h_{ef,min}$ [mm] =	60	70	80	90	96
	$h_{ef,max}$ [mm] =	200	240	320	400	480
Diameter of clearance hole in the fixture	d_f [mm] ≤	12	14	18	22	26
Diameter of steel brush	d_b [mm] ≥	14	16	20	26	30
Torque moment	T_{inst} [Nm]	20	40	80	120	160
Thickness of fixture	$t_{fix,min}$ [mm] >	0				
	$t_{fix,max}$ [mm] <	1500				
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm	$h_{ef} + 2d_0$			
Minimum spacing	s_{min} [mm]	50	60	80	100	120
Minimum edge distance	c_{min} [mm]	50	60	80	100	120

Table B2: Installation parameters for reinforcing bar

Rebar size		∅ 10	∅ 12	∅ 14	∅ 16	∅ 20	∅ 24	∅ 25
Nominal drill hole diameter	d_0 [mm] =	14	16	18	20	24	28	32
Embedment depth and bore hole depth	$h_{ef,min}$ [mm] =	60	70	75	80	90	96	100
	$h_{ef,max}$ [mm] =	200	240	280	320	400	480	500
Diameter of steel brush	d_b [mm] ≥	16	18	20	22	26	30	34
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm	$h_{ef} + 2d_0$					
Minimum spacing	s_{min} [mm]	50	60	70	80	100	120	125
Minimum edge distance	c_{min} [mm]	50	60	70	80	100	120	125

Table B3: Installation parameters for internal threaded sleeves

Internal thread size		M 8	M 10	M 12	M 16
External diameter size	[mm]	12	16	20	24
Nominal drill hole diameter	d_0 [mm]	14	18	24	28
Embedment depth and bore hole depth	h_{ef} [mm]	80	90	110	150
Diameter of clearance hole in the fixture	d_f [mm]	9	12	14	18
Diameter of steel brush	d_b [mm]	16	20	26	30
Torque moment	T_{inst} [Nm]	10	20	40	80
Minimum thickness of member	h_{min} [mm]	110	130	160	210
Minimum spacing	s_{min} [mm]	60	80	100	120
Minimum edge distance	c_{min} [mm]	60	80	100	120

POWERS PURE150-PRO Injection resin with anchor rod for concrete

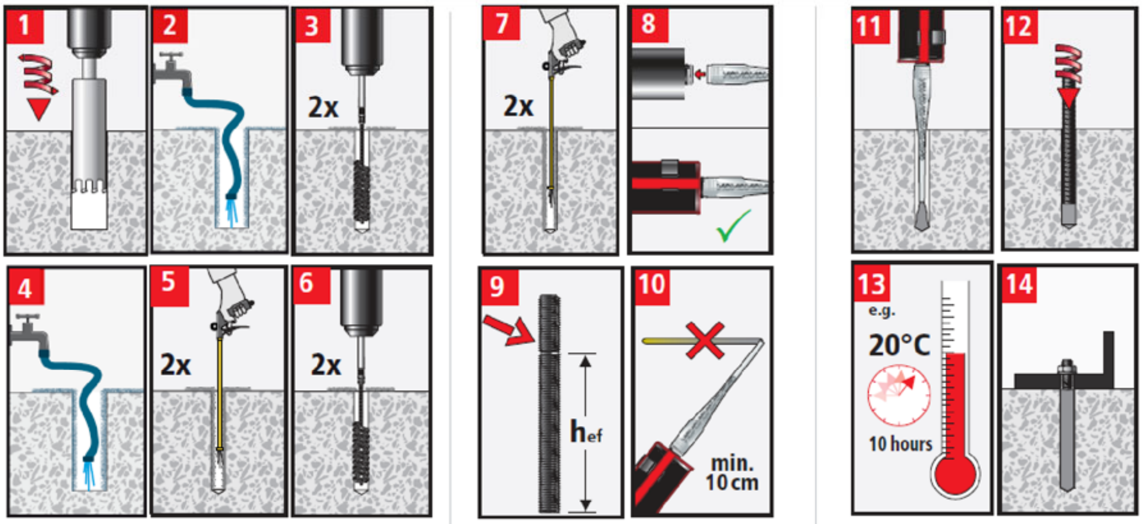
Annex B2

Intended Use
Installation parameters

Installation Instructions

Installation

Solid Material diamond drilling



1. Drill a hole to the size and embedment required.
2. Rinse the drill hole until clear water comes out of the drill hole.
3. Brush the hole with an appropriate sized wirebrush a minimum of two times. Start at the rear of the drill hole. If the rear of the drill hole cannot be reached by brush an extension must be used.
4. Please repeat step 2.
5. Starting from the rear of the hole, blow the hole clean with compressed air a minimum of two times. If the rear of the drill hole cannot be reached an extension must be used.
6. Brush the hole again with an appropriate sized wirebrush a minimum of two times. If the rear of the drill hole cannot be reached by brush an extension must be used.
7. Please repeat step 5.
8. Attach a supplied static mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working interruption longer than the recommended gel time (as seen on table setting time) as well as for new cartridges, a new static mixer must be used.
9. Prior to inserting the threaded rod into the filled hole, the position of the embedment depth must be marked on the anchor rods or rebar. Insert marked rebar/rod into unfilled hole to check if embedment is reached.
10. Prior to dispensing into the anchor hole, squeeze out a minimum of 10cm until the mortar shows a consistent colour.
11. Fill the cleaned hole approximately two-thirds with adhesive starting from the rear of the hole. For all diameters use a piston plug and extension nozzle. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedments larger than 190 mm an extension nozzle must be used. Observe gelworking times.
12. Push the threaded rod or reinforcing bar into the hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The rod or rebar should be free of dirt, grease, oil or other foreign material.
13. 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.
14. After full curing, the fixture can be installed. Make sure the max. torque is not exceeded. Ensure that the anchor is fully seated at the bottom of the hole (in case the threaded rod is not marked) and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed.

Table B4: Minimum curing time

Concrete Temperatur	Gelling working time	Minimum curing time in dry concrete	Minimum curing time in wet concrete
≥ + 5 °C	120 min	50 h	100 h
≥ + 10 °C	90 min	30 h	60 h
≥ + 20 °C	30 min	10 h	20 h
≥ + 30 °C	20 min	6 h	12 h
≥ + 40 °C	12 min	4 h	8 h

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex B3**
Intended Use Installation instructions Minimum curing time	

Steel brush and extension

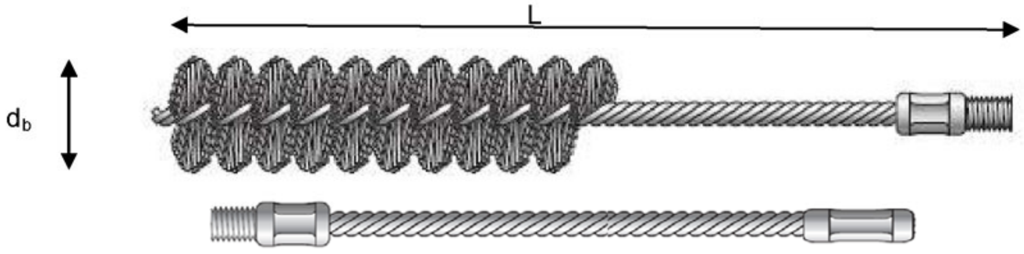
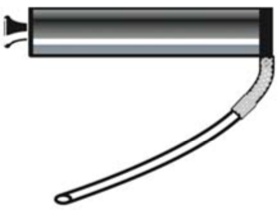


Table B5: Parameter cleaning and setting tools

Threaded rod [mm]	Internal threaded sleeve [mm]	Rebar	Drill bit ∅ d_0 [mm]	Brush diameters nominal d_b [mm]	minimum $d_{b,min}$ [mm]	Piston plug denom. (∅) [mm]
M10		8	12	14	12,5	-
M12	M8	10	14	16	14,5	-
-		12	16	18	16,5	-
M16	M10	14	18	20	18,5	-
-		16	20	22	20,5	-
M20	M12	20	24	26	24,5	#24 (22)
M24	M16	-	28	30	28,5	#28 (27)
		25	32	34	32,5	#28 (29)



Hand pump (volume 750 ml)
Drill bit diameter (d_0): 12 mm to 20 mm

Rec. compressed air tool (min 6 bar)
Drill bit diameter (d_0): 12 mm to 32 mm

Piston plug for overhead or horizontal installation
Drill bit diameter (d_0): 24 mm to 32 mm

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex B4**
Intended Use Cleaning and setting tools	

Table C1: Characteristic values for tension loads in uncracked concrete (Design method according to TR 029)

Anchor size threaded rod				M 10	M 12	M 16	M 20	M24
Steel failure								
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See TR029, Chapter 5.2.2.2., Eq. (5.1), $N_{Rk,s} = A_s \cdot f_{uk}$				
Stressed cross section		A_s	[mm²]	58,0	84,3	156,7	244,8	352,5
Combined pullout and concrete cone failure								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range I: 40°C/24°C	Dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11,0	10,0	10,0	9,5	9,0
	Flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13,0	12,0	11,0	11,0	10,0
Temperature range II: 60°C/43°C	Dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,0	6,0	5,5
	Flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,0	7,5	7,0	7,0	6,5
Temperature range III: 72°C/43°C	Dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	6,0	5,5	5,0	5,0
	Flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	7,0	6,5	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04				
		C40/50		1,08				
		C50/60		1,10				
Splitting failure								
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0h_{ef}$				
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$				
		$h \leq 1{,}3h_{ef}$		$2{,}4h_{ef}$				
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Installation safety factor (dry and wet concrete)		γ_2		1,0	1,2			
Installation safety factor (flooded bore hole)		γ_2		1,4				

Table C2: Characteristic values for shear loads in uncracked concrete (Design method according to TR 029)

Anchor size threaded rod			**M 10**	**M 12**	**M 16**	**M 20**	**M24**
Steel failure without lever arm							
Characteristic shear resistance	$V_{Rk,s}$	[kN]	See TR029, Chapter 5.2.3.2., Eq. (5.5), $V_{Rk,s}=0,5 \cdot A_s \cdot f_{uk}$				
Stressed cross section	A_s	[mm²]	58,0	84,3	156,7	244,8	352,5
Steel failure with lever arm							
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	See TR029, Chapter 5.2.3.2., Eq. (5.6 b), $M^0_{Rk,s}=1,2 \cdot W_{el} \cdot f_{uk}$				
Elastic section modulus	W_{el}	[mm³]	62,3	109,1	276,6	540,3	933,4
Concrete pryout failure							
Factor k in equation (5.7) of Technical Report TR 029 for the design of Bonded Anchors			2,0				
Installation safety factor	γ_2		1,0				
Concrete edge failure							
See chapter 5.2.3.4 of Technical Report TR 029 for the design of Bonded Anchors							
Installation safety factor	γ_2		1,0				

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Table C3: Characteristic values for tension loads in uncracked concrete (Design method according to TR 029)

Anchor size reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Steel failure										
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See TR029, Chapter 5.2.2.2. Eq. (5.1), $N_{Rk,s} = A_s \cdot f_{uk}$						
Stressed cross section		A_s	[mm²]	78,5	113,1	153,9	201,1	314,2	452,4	490,9
Combined pullout and concrete cone failure										
Characteristic bond resistance in uncracked concrete C20/25										
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11,0	10,0	10,0	10,0	9,5	9,0	9,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13,0	12,0	12,0	11,0	11,0	10,0	10,0
Temperature range II: 60°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,5	6,0	6,0	5,5	5,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,0	7,5	7,5	7,0	7,0	6,5	6,5
Temperature range III: 72°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	6,0	5,5	5,5	5,0	5,0	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	7,0	6,5	6,5	6,0	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04						
		C40/50		1,08						
		C50/60		1,10						
Splitting failure										
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0h_{ef}$						
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$						
		$h \leq 1{,}3h_{ef}$		$2{,}4h_{ef}$						
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$						
Installation safety factor (dry and wet concrete)		γ_2		1,0	1,2					
Installation safety factor (flooded bore hole)		γ_2		1,4						

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex C3**
Performances Characteristic values for tension loads in uncracked concrete (Design method according to TR 029)	

Table C4: Characteristic values for shear loads in uncracked concrete (Design method according to TR 029)

Anchor size reinforcing bar			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Steel failure without lever arm									
Characteristic shear resistance	$V_{Rk,s}$	[kN]	Siehe TR029, Abs. 5.2.3.2., Gleichung (5.5), $V_{Rk,s}=0,5 \cdot A_s \cdot f_{uk}$						
Stressed cross section	A_s	[mm²]	78,5	113,1	153,9	201,1	314,2	452,4	490,9
Steel failure with lever arm									
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	Siehe TR029, Abs. 5.2.3.2., Gleichung (5.6 b), $M^0_{Rk,s}=1,2 \cdot W_{el} \cdot f_{uk}$						
Elastic section modulus	W_{el}	[mm³]	98,2	169,6	269,4	402,1	785,4	1357	1534
Concrete pry out failure									
Factor k in Equation (5.7) of Technical Report TR 029 for the design of Bonded Anchors			2,0						
Installation safety factor	γ_2		1,0						
Concrete edge failure									
See chapter 5.2.3.4 of Technical Report TR 029 for the design of bonded anchors									
Installation safety factor	γ_2		1,0						

Table C5: Characteristic values for tension loads in uncracked concrete (Design method according to TR 029)

Anchor size internal threaded sleeve				**M 8**	**M 10**	**M 12**	**M 16**
External diameter		d	[mm]	12	16	20	24
Embedment depth		h_{ef}	[mm]	80	90	110	150
Steel failure (internal threaded sleeve)							
Characteristic tension resistance, zinc plated		$N_{Rk,s}$	[kN]	19,5	42,8	71,1	83,7
Characteristic tension resistance, stainless steel A4		$N_{Rk,s}$	[kN]	24,2	53,1	88,1	103,8
Steel failure (threaded rod)							
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See TR029, Chapter 5.2.2.2., Eq. (5.1), $N_{Rk,s} = A_s \cdot f_{uk}$			
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156,7
Combined pullout and concrete cone failure							
Characteristic bond resistace in uncracked concrete C20/25							
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10,0	10,0	9,5	9,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	12,0	11,0	11,0	10,0
Temperature range II: 60°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,5	6,0	6,0	5,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,0	7,0	6,5
Temperature range III: 72°C/43°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	5,5	5,0	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04			
		C40/50		1,08			
		C50/60		1,10			
Splitting failure							
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0h_{ef}$			
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$			
		$h \leq 1{,}3h_{ef}$		$2{,}4h_{ef}$			
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$			
Installation safety factor (dry and wet concrete)		γ_2		1,2			
Installation safety factor (flooded bore hole)		γ_2		1,4			

Table C6: Characteristic values for shear loads in uncracked concrete (Design method according to TR 029)

Anchor size internal threaded sleeve			M 8	M 10	M 12	M 16
External diameter	d	[mm]	12	16	20	24
Embedment depth	h_{ef}	[mm]	80	90	110	150
Steel failure without lever arm (internal threaded sleeve)						
Characteristic shear resistance, zinc plated	$V_{Rk,s}$	[kN]	9,7	21,4	35,5	41,9
Characteristic shear resistance, A4 steel	$V_{Rk,s}$	[kN]	12,1	26,5	44,1	51,9
Steel failure without lever arm (threaded rod)						
Characteristic shear resistance	$V_{Rk,s}$	[kN]	See TR029, Chapter 5.2.3.2., Eq. (5.5), $V_{Rk,s}=0,5 \cdot A_s \cdot f_{uk}$			
Stressed cross section	A_s	[mm²]	36,6	58,0	84,3	156,7
Steel failure with lever arm (internal threaded sleeve)						
Characteristic bending moment, zinc plated	$M^0_{Rk,s}$	[Nm]	46,5	131,8	267,2	405,7
Characteristic bending moment, A4 steel	$M^0_{Rk,s}$	[Nm]	57,7	163,4	331,3	503,0
Steel failure with lever arm (threaded rod)						
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	See TR029, Chapter 5.2.3.2., Eq. (5.6 b), $M^0_{Rk,s}=1,2 \cdot W_{el} \cdot f_{uk}$			
Elastic section modulus	W_{el}	[mm³]	31,2	62,3	109,1	276,6
Concrete pryout failure						
Factor k in Equation (5.7) of Technical Report TR 029 for the design of Bonded Anchors			2,0			
Installation safety factor	γ_2		1,0			
Concrete edge failure						
See chapter 5.2.3.4 of Technical Report TR 029 for the design of Bonded Anchors						
Installation safety factor	γ_2		1,0			

Table C7: Characteristic values for tension loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size threaded rod				M 10	M 12	M 16	M 20	M24
Steel failure								
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.2.2, $N_{Rk,s} = A_s \cdot f_{uk}$				
Stressed cross section		A_s	[mm²]	58,0	84,3	156,7	244,8	352,5
Combined pullout and concrete cone failure								
Characteristic bond resistance in uncracked concrete C20/25								
Temperature range I: 40°C/24°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11,0	10,0	10,0	9,5	9,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13,0	12,0	11,0	11,0	10,0
Temperature range II: 60°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,0	6,0	5,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,0	7,5	7,0	7,0	6,5
Temperature range III: 72°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	6,0	5,5	5,0	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	7,0	6,5	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04				
		C40/50		1,08				
		C50/60		1,10				
Factor acc. CEN/TS 1992-4-5, chapter 6.2.2.3		k_8		10,1				
Concrete cone failure								
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$				
Characteristic spacing		$s_{cr,N}$	[mm]	$2 \cdot c_{cr,sp}$				
Factor acc. CEN/TS 1992-4-5, chapter 6.2.3.1		k_{ucr}		10,1				
Splitting failure								
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0 h_{ef}$				
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$				
		$h \leq 1{,}3h_{ef}$		$2{,}4 h_{ef}$				
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Installation safety factor (dry and wet concrete)		γ_{inst}		1,0	1,2			
Installation safety factor (flooded bore hole)		γ_{inst}		1,4				

Table C8: Characteristic values for shear loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size threaded rod			M 10	M 12	M 16	M 20	M24
Steel failure without lever arm							
Characteristic shear resistance	$V_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.3.2.1, $V_{Rk,s}=0{,}5 \cdot A_s \cdot f_{uk}$				
Stressed cross section	A_s	[mm²]	58,0	84,3	156,7	244,8	352,5
Steel failure with lever arm							
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	See CEN/TS 1992-4-5, Chapter 6.3.2.2, $M^0_{Rk,s}=1{,}2 \cdot W_{el} \cdot f_{uk}$				
Elastic section modulus	W_{el}	[mm³]	62,3	109,1	276,6	540,3	933,4
Ductility factor	k_2		0,80				
Concrete pryout failure							
Factor acc. Eq. (27) CEN/TS 1992-4-5, chapter 6.3.3	k_3		2,0				
Installation safety factor	γ_{inst}		1,0				
Concrete edge failure							
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8d_{nom})$				
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24
Installation safety factor	γ_{inst}		1,0				

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Table C9: Characteristic values for tension loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Steel failure										
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.2.2, $N_{Rk,s} = A_s \cdot f_{uk}$						
Stressed cross section		A_s	[mm²]	78,5	113,1	153,9	201,1	314,2	452,4	490,9
Combined pullout and concrete cone failure										
Characteristic bond resistance in uncracked concrete C20/25										
Temperature range I: 40°C/24°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	11,0	10,0	10,0	10,0	9,5	9,0	9,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	13,0	12,0	12,0	11,0	11,0	10,0	10,0
Temperature range II: 60°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,5	6,0	6,0	5,5	5,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	8,0	7,5	7,5	7,0	7,0	6,5	6,5
Temperature range III: 72°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	6,0	5,5	5,5	5,0	5,0	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	7,0	6,5	6,5	6,0	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04						
		C40/50		1,08						
		C50/60		1,10						
Factor acc. CEN/TS 1992-4-5 chapter 6.2.3.3		k_8		10,1						
Concrete cone failure										
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$						
Characteristic spacing		$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$						
Factor acc. CEN/TS 1992-4-5 chapter 6.2.3.1		k_{ucr}		10,1						
Splitting failure										
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0 h_{ef}$						
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$						
		$h \leq 1{,}3h_{ef}$		$2{,}4h_{ef}$						
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$						
Installation safety factor (dry and wet concrete)		γ_{inst}		1,0	1,2					
Installation safety factor (flooded bore hole)		γ_{inst}		1,4						

POWERS PURE150-PRO Injection resin with anchor rod for concrete

Annex C9

Performances
Characteristic values for tension loads in uncracked concrete
(Design method according to CEN/TS 1992-4)

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Table C10: Characteristic values for shear loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size reinforcing bar			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Steel failure without lever arm									
Characteristic shear resistance	$V_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.3.2.1, $V_{Rk,s}=0{,}5 \cdot A_s \cdot f_{uk}$						
Stressed cross section	A_s	[mm²]	78,5	113,1	153,9	201,1	314,2	452,4	490,9
Steel failure with lever arm									
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	Siehe CEN/TS 1992-4-5, Abs. 6.3.2.2, $M^0_{Rk,s}=1{,}2 \cdot W_{el} \cdot f_{uk}$						
Elastic section modulus	W_{el}	[mm³]	98,2	169,6	269,4	402,1	785,4	1357	1534
Ductility factor	k_2		0,80						
Concrete pry out failure									
Factor acc. Eq. (27) CEN/TS 1992-4-5 chapter 6.3.3	k_3		2,0						
Installation safety factor	γ_{inst}		1,0						
Concrete edge failure									
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8d_{nom})$						
Outside diameter of anchor	d_{nom}	[mm]	10	12	14	16	20	24	25
Installation safety factor	γ_{inst}		1,0						

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Table C11: Characteristic values for tension loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size internal threaded sleeve				M 8	M 10	M 12	M 16
External diameter		d	[mm]	12	16	20	24
Embedment depth		h_{ef}	[mm]	80	90	110	150
Steel failure (internal threaded sleeve)							
Characteristic tension resistance, Zinc plated		$N_{Rk,s}$	[kN]	19,5	42,8	71,1	83,7
Characteristic tension resistance, Stainless steel A4		$N_{Rk,s}$	[kN]	24,2	53,1	88,1	103,8
Steel failure (threaded rod)							
Characteristic tension resistance		$N_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.2.2, $N_{Rk,s} = A_s \cdot f_{uk}$			
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156,7
Combined pullout and concrete cone failure							
Characteristic bond resistance in uncracked concrete C20/25							
Temperature range I: 40°C/24°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10,0	10,0	9,5	9,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	12,0	11,0	11,0	10,0
Temperature range II: 60°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,5	6,0	6,0	5,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	7,0	7,0	6,5
Temperature range III: 72°C/43°C	dry or wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	6,0	5,5	5,0	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,0	6,5	6,0	6,0
Increasing factor ψ_c for characteristic bond resistance $\tau_{Rk,ucr}$		C30/37		1,04			
		C40/50		1,08			
		C50/60		1,10			
Factor acc. CEN/TS 1992-4-5 chapter 6.2.2.3		k_8		10,1			
Concrete cone failure							
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$			
Characteristic spacing		$s_{cr,N}$	[mm]	$2 \cdot c_{cr,N}$			
Factor acc. CEN/TS 1992-4-5 chapter 6.2.3.1		k_{ucr}		10,1			
Splitting failure							
Characteristic edge distance $c_{cr,sp}$ [mm]		$h \geq 2h_{ef}$		$1{,}0h_{ef}$			
		$2{,}0h_{ef} > h > 1{,}3h_{ef}$		$5h_{ef} - 2h$			
		$h \leq 1{,}3h_{ef}$		$2{,}4h_{ef}$			
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$			
Installation safety factor (dry and wet concrete)		γ_{inst}		1,2			
Installation safety factor (flooded bore hole)		γ_{inst}		1,4			

POWERS PURE150-PRO Injection resin with anchor rod for concrete	**Annex C11**
Performances Characteristic values for tension loads in uncracked concrete (Design method according to CEN/TS 1992-4)	

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Table C12: Characteristic values for shear loads in uncracked concrete (Design method according to CEN/TS 1992-4)

Anchor size internal threaded sleeve			M 8	M 10	M 12	M 16
External diameter	d	[mm]	12	16	20	24
Embedment depth	h_{ef}	[mm]	80	90	110	150
Steel failure without lever arm (internal threaded sleeve)						
Characteristic shear resistance, zinc plated	$V_{Rk,s}$	[kN]	9,7	21,4	35,5	41,9
Characteristic shear resistance, A4 steel	$V_{Rk,s}$	[kN]	12,1	26,5	44,1	51,9
Steel failure without lever arm (threaded rod)						
Characteristic shear resistance	$V_{Rk,s}$	[kN]	See CEN/TS 1992-4-5, Chapter 6.3.2.1, $V_{Rk,s}=0{,}5 \cdot A_s \cdot f_{uk}$			
Stressed cross section	A_s	[mm²]	36,6	58,0	84,3	156,7
Steel failure with lever arm (internal threaded sleeve)						
Characteristic bending moment, Zinc plated	$M^0_{Rk,s}$	[Nm]	46,5	131,8	267,2	405,7
Characteristic bending moment, A4 steel	$M^0_{Rk,s}$	[Nm]	57,7	163,4	331,3	503,0
Ductility factor	k_2		0,80			
Steel failure with lever arm (threaded rod)						
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	See CEN/TS 1992-4-5, Chapter 6.3.2.2, $M^0_{Rk,s}=1{,}2 \cdot W_{el} \cdot f_{uk}$			
Elastic section modulus	W_{el}	[mm³]	31,2	62,3	109,1	276,6
Ductility factor	k_2		0,80			
Concrete pryout failure						
Factor acc. CEN/TS 1992-4-5, chapter 6.2.3	k_3		2,0			
Installation safety factor	γ_{inst}		1,0			
Concrete edge failure						
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 8d_{nom})$			
Outside diameter of anchor	d_{nom}	[mm]	12	16	20	24
Installation safety factor	γ_{inst}		1,0			

Table C13: Displacements under tension loads [1)] (threaded rod)

Anchor size threaded rod			M 10	M 12	M 16	M 20	M24
Temperature range 40°C/24°C							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,013	0,015	0,020	0,024	0,029
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,052	0,061	0,079	0,096	0,114
Temperature range 72°C/43°C and 60°C/43°C							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,015	0,018	0,023	0,028	0,033
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,060	0,070	0,091	0,111	0,131

[1)] Calculation of the displacement
$\delta_{N0} = \delta_{N0}$ - Factor$\cdot \tau$
$\delta_{N\infty} = \delta_{N\infty}$ - Factor$\cdot \tau$

Table C14: Displacements under shear loads [1)] (threaded rod)

Anchor size threaded rod			M 10	M 12	M 16	M 20	M24
Displacement	δ_{V0} - Factor	[mm/(kN)]	0,06	0,05	0,04	0,04	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/(kN)]	0,08	0,08	0,06	0,06	0,05

[1)] Calculation of the displacement
$\delta_{V0} = \delta_{V0}$ - Factor$\cdot \tau$
$\delta_{V\infty} = \delta_{V\infty}$ - Factor$\cdot \tau$

Table C15: Displacements under tension loads [1)] (Reinforcing bar)

Reinforcing bar			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Temperature range 40°C/24°C									
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,024	0,029	0,030
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,052	0,061	0,070	0,079	0,096	0,114	0,118
Temperature range 72°C/43°C and 60°C/43°C									
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,015	0,018	0,020	0,023	0,028	0,032	0,034
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,060	0,070	0,081	0,091	0,111	0,131	0,136

1) Calculation of the displacement
$\delta_{N0} = \delta_{N0}$ - Factor$\cdot\tau$
$\delta_{N\infty} = \delta_{N\infty}$ - Factor$\cdot\tau$

Table C16: Displacements under shear loads [1)] (Reinforcing bar)

Reinforcing bar			Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25
Displacement	δ_{V0} - Factor	[mm/kN]	0,05	0,05	0,04	0,04	0,04	0,04	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/kN]	0,08	0,07	0,06	0,06	0,05	0,05	0,05

1) Calculation of the displacement
$\delta_{V0} = \delta_{V0}$ - Factor$\cdot\tau$
$\delta_{V\infty} = \delta_{V\infty}$ - Factor$\cdot\tau$

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Table C17: Displacements under tension loads [1] (internal threaded sleeve)

Anchor size internal threaded sleeve			**M 8**	**M 10**	**M 12**	**M 16**
Temperature range 40°C/24°C						
Displacement	δ_{N0} - Factor	[mm/ (N/mm²)]	0,015	0,020	0,024	0,029
Displacement	$\delta_{N\infty}$ - Factor	[mm/ (N/mm²)]	0,061	0,079	0,096	0,114
Temperature range 72°C/43°C and 60°C/43°C						
Displacement	δ_{N0} - Factor	[mm/ (N/mm²)]	0,018	0,023	0,028	0,033
Displacement	$\delta_{N\infty}$ - Factor	[mm/ (N/mm²)]	0,070	0,091	0,111	0,131

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}$ - Factor $\cdot \tau$
$\delta_{N\infty} = \delta_{N\infty}$ - Factor $\cdot \tau$

Table C18: Displacements under tension loads [1] (internal threaded sleeve)

Anchor size internal threaded sleeve			**M 8**	**M 10**	**M 12**	**M 16**
Displacement	δ_{V0} - Factor	[mm/ kN]	0,05	0,04	0,04	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/ kN]	0,08	0,06	0,06	0,05

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}$ - Factor$\cdot \tau$
$\delta_{V\infty} = \delta_{V\infty}$ - Factor$\cdot \tau$