Deutsches Institut für Bautechnik

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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-08/0376 of 15 February 2021

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	PURE150-PRO
Product family to which the construction product belongs	Bonded fastener for use in concrete
Manufacturer	Stanley Black & Decker Deutschland GmbH Black & Decker Straße 40 65510 Idstein DEUTSCHLAND
Manufacturing plant	Herstellwerk 1
This European Technical Assessment contains	41 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 330499-01-0601, Edition 04/2020
This version replaces	ETA-08/0376 issued on 4 May 2015

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Specific Part

1 Technical description of the product

The "PURE150-PRO" is a bonded anchor consisting of a cartridge with injection mortar PURE150-PRO 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 a reinforcing bar in the range of diameter 8 to 32 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 to tension load (static and quasi-static loading)	See Annex B2, C1 to C3, C6 to C8, C11 to C13
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C4, C5, C9, C10, C14 and C15
Displacements (static and quasi-static loading)	See Annex C16 to C21
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C22 to C27

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 15 February 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

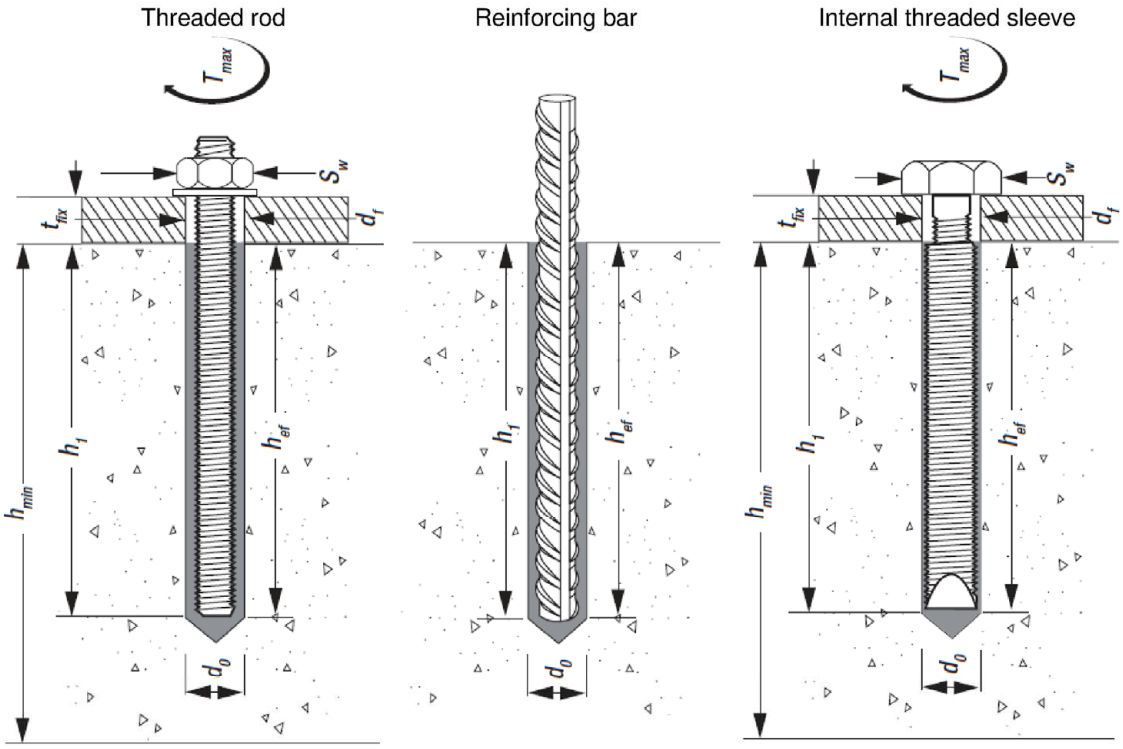
beglaubigt:
Baderschneider

Deutsches Institut für Bautechnik DIBt

Threaded rod
Hammer drilling: M8, M10, M12, M16, M20, M24, M27 and M30 with washer and nut
Diamond coring: M10, M12, M16, M20 and M24 with washer and nut

Reinforcing bar
Hammer drilling: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø24, Ø25, Ø28 and Ø32
Diamond coring: Ø10, Ø12, Ø14, Ø16, Ø20, Ø24 and Ø25

Internal threaded sleeve (metric external thread)
Hammer drilling: Internal threaded sleeve M8, M10, M12, M16 and M20
Diamond coring: Internal threaded sleeve M8, M10, M12 and M16



PURE150-PRO	**Annex A1**
Product description Product and Installation	

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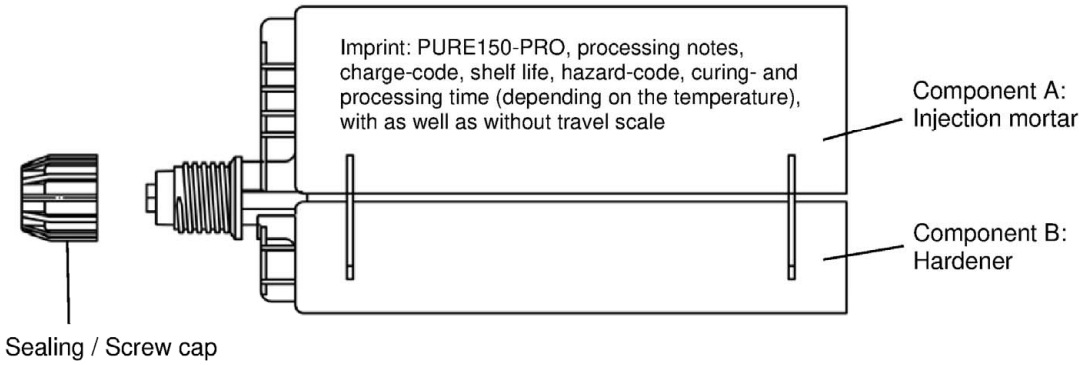
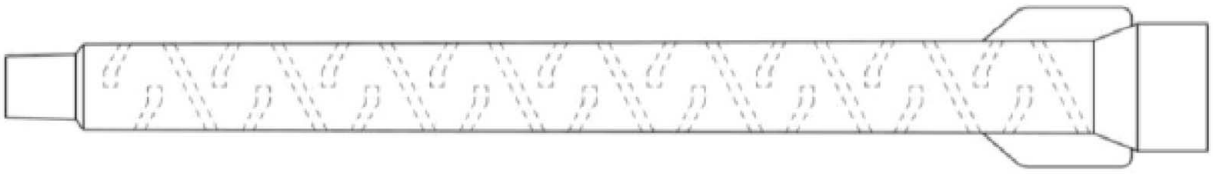
Cartridge: PURE150-PRO
385 ml, 585 ml and 1400 ml injection mortar cartridge (Type: "side-by-side")



Static mixing nozzle:



PURE150-PRO	**Annex A2**
Product description Material (Injection mortar)	

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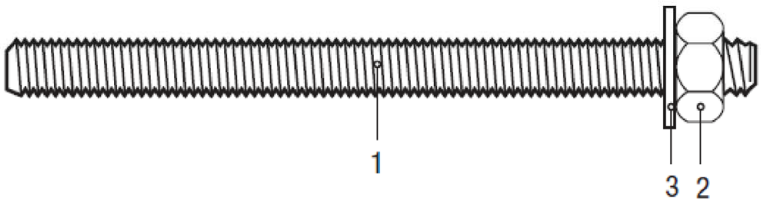
Table A1: Material: Treaded rod



Part	Designation	Material
Steel acc. to EN 10087:1998 or EN 10263:2001, zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or Steel, hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009, EN ISO 10684:2004+AC:2009 or sherardised ≥ 40 µm acc. to DIN EN 17668:2016-06		
1	Threaded rod	acc. to EN ISO 898-1:2013 Property class 4.6, 4.8, 5.6, 5.8, 8.8 A_5 > 8% fracture elongation[1)]
2	Hexagon nut	acc. to EN ISO 898-2:2012 Property class 4 (for class 4.6 or 4.8 rod); f_{uk} = 400 MPa Property class 5 (for class 5.6 or 5.8 rod) ; f_{uk} = 500 MPa Property class 8 (for class 8.8 rod) ; f_{uk} = 800 MPa
3	Washer (EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)	Steel, zinc plated, hot dipped galvanised, or sheradised
Stainless steel A2 (Material 1.4301 / 1.4311 / 1.4307 / 1.4541 / 1.4567) and A4 (Material 1.4362 / 1.4401 / 1.4404 / 1.4571 / 1.4578) acc. to EN 10088-1:2014		
1	Threaded rod	acc. to EN ISO 3506-1:2009 Property class 50, 70 (≤ M24), 80 (only A4) A_5 > 8% fracture elongation[1]
2	Hexagon nut	acc. to EN ISO 3506-1:2009 Property class 50 (for class 50 rod), 70 (≤ M24, for class 70 rod), 80 (only A4, for class 80 rod)
3	Washer (EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)	acc. to EN 10088-1:2014 A2: Material 1.4301 / 1.4311 / 1.4307 / 1.4541 / 1.4567 A4: Material 1.4362 / 1.4401 / 1.4404 / 1.4571 / 1.4578
High corrosion resistance steel (Material 1.4529 / 1.4565 acc. to EN 10088-1:2014)		
1	Threaded rod	acc. to EN ISO 3506-1:2009 Property class 50, 70 (≤ M24), 80 A_5 > 8% fracture elongation[1]
2	Hexagon nut	acc. to EN ISO 3506-1:2009 Property class 50 (for class 50 rod), 70 (≤ M24, for class 70 rod), 80 (for class 80 rod)
3	Washer (EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)	Material 1.4529 or 1.4565, acc. to EN 10088-1:2014

1) A_5 > 12% if requirement for performance category C2 exists

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

PURE150-PRO	**Annex A3**
Product description Material (Threaded rod)	

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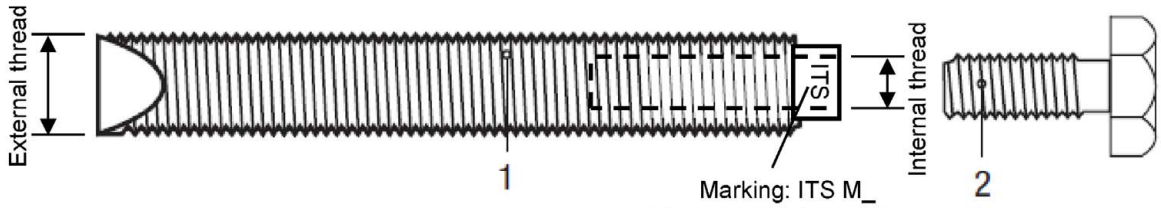
Table A2: Material: Reinforcing bar

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

Reinforcing bar		
1	Rebar according 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 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Table A3: Material: Internal threaded sleeve (metric external thread)



Part	Designation	Material
Steel acc. to EN 10087:1998 or EN 10263:2001, zinc plated ≥ 5 µm acc. to EN ISO 4042:1999		
1	Internal threaded sleeve	Property class 5.8, EN 1993-1-8:2005+AC:2009
2	Corresponding steel screw	acc. to EN ISO 898-1:2013 Property class 5.8 or 8.8 (zinc plated)
Stainless steel A4 (Material 1.4362 / 1.4401 / 1.4404 / 1.4571 / 1.4578) acc. to EN 10088-1:2014		
1	Internal threaded sleeve	acc. to EN ISO 3506-1:2009 Property class 50, 70 (≤ M16)
2	Corresponding steel screw	acc. to EN ISO 3506-1:2009 Property class 50 or 70 (≤ M16)
High corrosion resistance steel HCR (Material 1.4529 / 1.4565 acc. to EN 10088-1:2014)		
1	Internal threaded sleeve	acc. to EN ISO 3506-1:2009 Property class 50, 70 (≤ M16)
2	Corresponding steel screw	acc. to EN ISO 3506-1:2009 Property class 50, 70 (≤ M16)

PURE150-PRO	**Annex A4**
Product description Material (Reinforcing bar) Material (Internal threaded sleeve)	

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Specifications of intended use

Anchorages subject to:
- Static and quasi-static loads: Threaded rod M8 to M30, Reinforcing bar Ø8 to Ø32, Internal threaded sleeve M8 to M20 for hammer drilling and Threaded rod M10 to M24, Reinforcing bar Ø10 to Ø25, Internal threaded sleeve M8 to M16for diamond coring.
- Seismic action for Performance Category C1: Threaded rod M8 to M30, Rebar Ø8 to Ø32, for hammer drilling only.
- Seismic action for Performance Category C2: Threaded rod M12 and M16, for hammer drilling only.

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.
- Uncracked concrete: Threaded rod M8 to M30, Reinforcing bar Ø8 to Ø32, Internal threaded sleeve M8 to M20.
- Cracked concrete: Threaded rod M8 to M30, Reinforcing bar Ø8 to Ø32, Internal threaded sleeve M8 to M20.

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 +60 °C (max. long term temperature +43 °C and max. short term temperature +60 °C)
- III: - 40 °C to +72 °C (max. long term temperature +43 °C and max. short term temperature +72 °C)

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 corrosion resistance class:
  - Stainless steel A2 according to Annex A3, Table A1: CRC II
  - Stainless steel A4 according to Annex A3, Table A1 and Annex A4, Table A3: CRC III
  - High corrosion resistance steel HCR according to Annex A3, Table A1 and Annex A4, Table A3: CRC V

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 are designed according to EN 1992-4:2018 and Technical Report TR 055, Edition February 2018.

Installation:
- Dry or wet concrete.
- Flooded holes (not sea water).
- Hole drilling by hammer drill mode (standard or hollow drill bit), and 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.
- Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded sleeve.
- The injection mortar is assessed for installation at minimum concrete temperature of +5°C, where subsequently the temperature in the concrete does not rise at a rapid rate, i.e. from the minimum installation temperature to 24°C within a 12-hour period.

PURE150-PRO	**Annex B1**
Intended use Specifications	

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Table B1: Installation parameters for threaded rod

Threaded rod size		**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal diameter	d_{nom} [mm]	8	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0 [mm]	10	12	14	18	24	28	32	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	d_f [mm]	9	12	14	18	22	26	30	33
Torque moment	max T_{inst} [Nm]	10	20	40	80	120	160	180	200
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]	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min} [mm]	40	50	60	80	100	120	135	150

Table B2: Installation parameters for reinforcing bar

Reinforcing bar size		**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Nominal diameter	d_{nom} [mm]	8	10	12	14	16	20	24	25	28	32
Nominal drill hole diameter	d_0 [mm]	12	14	16	18	20	24	28	32	35	40
Effective embedment depth	$h_{ef,min}$ [mm]	60	60	70	75	80	90	96	100	112	128
	$h_{ef,max}$ [mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm		h_{ef} + 2d_0							
Minimum spacing	s_{min} [mm]	40	50	60	70	80	100	120	125	140	160
Minimum edge distance	c_{min} [mm]	40	50	60	70	80	100	120	125	140	160

Table B3: Installation parameters for internal threaded sleeve (metric external thread)

Internal thread size		**M8**	**M10**	**M12**	**M16**	**M20**
Thread = internal diameter	[mm]	8	10	12	16	20
Nominal = external diameter	d_{nom} [mm]	12	16	20	24	30
Nominal drill hole diameter	d_0 [mm]	14	18	24	28	35
Effective embedment depth	h_{ef} [mm]	80	90	110	150	200
Diameter of clearance hole in the fixture	d_f [mm]	9	12	14	18	22
Torque moment	maxT_{inst} [Nm]	10	20	40	80	120
Thread engagement length min-max	l_1 [mm]	8-20	10-25	12-30	16-32	20-40
Minimum thickness of member	h_{min} [mm]	110	130	160	210	270
Minimum spacing	s_{min} [mm]	60	80	100	120	150
Minimum edge distance	c_{min} [mm]	60	80	100	120	150

PURE150-PRO

Annex B2

Intended Use
Installation parameters

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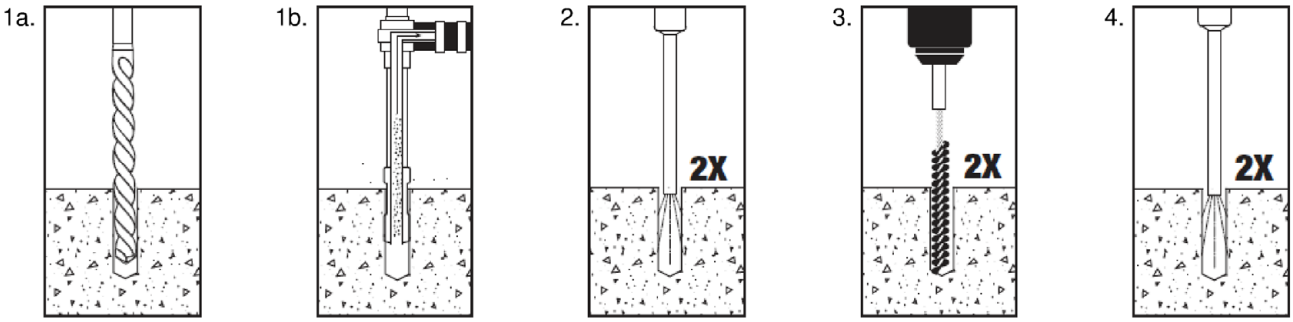
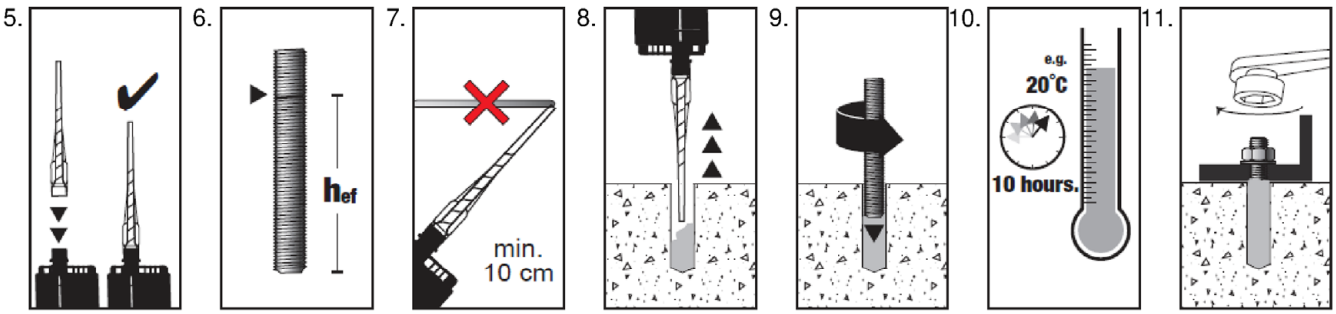
Installation instructions for hammer drilling

Standard Drill Bit **Hollow Drill Bit**



1a.) Using the proper drill bit size, drill a hole into the base material to the required depth.
1b.) Connect the hollow drill bit of proper size to the vacuum and drill a hole into the base material to the required depth while the vac is running. The dust is removed during the drilling process.
2.) Before cleaning, remove any standing water out of the drilled hole. Starting from the bottom of the hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump minimum of 2 times. A hand pump can be used for anchor sizes up to a borehole of 20 mm diameter. For boreholes larger than 20 mm or deeper than 240 mm, compressed air (min. 6 bar) **must** be used. If the hole ground cannot be reached, an extension must be used.
3.) Select a brush of the correct diameter and attach the brush to a drill or battery screwdriver. Starting from the hole ground, brush the hole a minimum of 2 times. If the hole ground is not reached, a brush extension must be used.
4.) Finally, blow the hole clean again with compressed air (min. 6 bar) or a hand pump minimum of 2 times. A hand pump can be used for anchor sizes up to a hole of 20 mm diameter. For holes larger than 20 mm or deeper than 240 mm, compressed air (min. 6 bar) **must** be used. If the hole ground cannot be reached, an extension must be used.



5.) Attach a supplied static mixing nozzle to the cartridge and load the cartidge into the correct dispensing tool. For foil tube type cartridges, cut off the foil clip before use. For every working interruption longer than the recommneded working time as well as for new cartridges, a new mixer nozzle must be used.
6.) Mark the required embedment depth on the anchor rod.
7.) Squeeze out a minimum of 3 full strokes and discard non-balanced adhesive until the adhesive shows a consistent colour.
8.) Starting from the back of the cleaned hole, fill the hole approximately two thirds with adhesive. Slowly withdraw the nozzle as the hole fills to avoid air voids. For holes with embedment depths greater than 190 mm, an extension nozzle must be used. For overhead and horizontal installation in holes larger than 20 mm diameter, a piston plug and extension nozzle must be used. Obeserve the gel / working times provided. Injecting the adhesive in water filled holes is allowed for drill diameters less than 18 mm.
9.) Push the rod or rebar into the hole while turning slightly to properly distribute the adhesive. The anchor should be clean and free of dirt, grease or oil. Be sure that the anchor is fully seated at the hole ground and that the gap is completedly filled with adhesive. Excess adhesive should be visible at the top of the hole.
10.) Allow the adhesive to cure for the specified time prior to applying any load. Do not load the anchor before.
11.) After full curing, the fixture can be installed. Make sure the maximum torque is not exceeded.

PURE150-PRO	**Annex B3**
Intended use Installation instructions	

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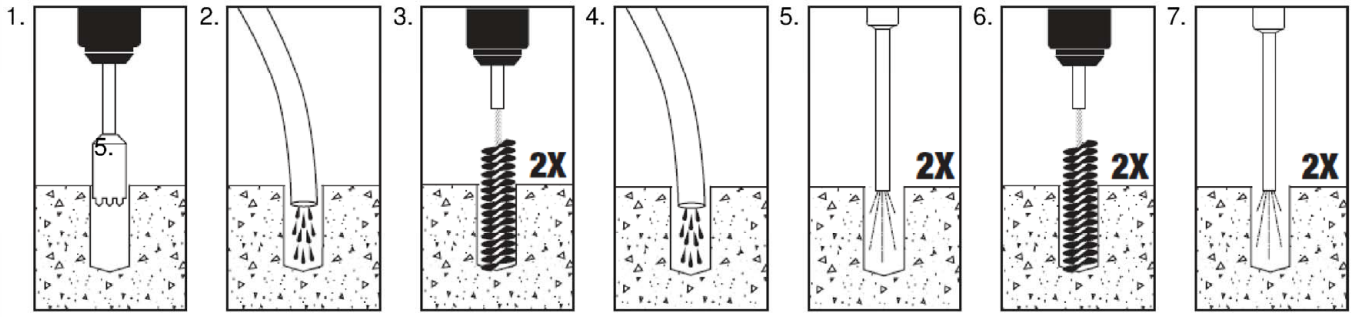
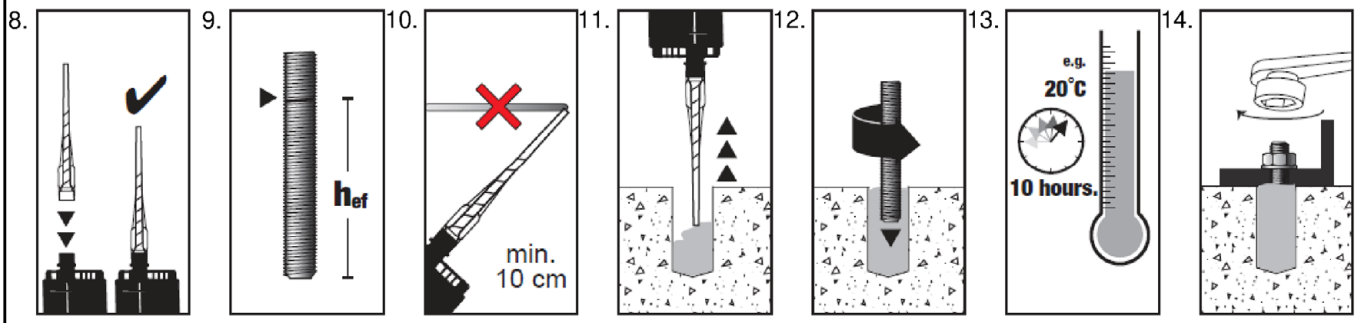
Installation instructions for diamond coring



1.) Using the proper core bit size, drill a hole into the base material to the required depth.
2.) Rinse the hole until access water is clear.
3.) Brush the hole with the proper wire brush 2 times minimum.
4.) Rinse the hole until access water is clear.
5.) Blow the hole clean using a hand pump or compressed air 2 times minimum.
6.) Brush the hole with the proper wire brush 2 times minimum.
7.) Blow the hole clean using a hand pump or compressed air 2 times minimum.



8.) Attach a supplied static mixing nozzle to the cartridge and load the cartidge into the correct dispensing tool. For foil tube type cartridges, cut off the foil clip before use. For every working interruption longer than the recommneded working time as well as for new cartridges, a new mixer nozzle must be used.
9.) Mark the required embedment depth on the anchor rod.
10.) Squeeze out a minimum of 3 full strokes and discard non-balanced adhesive until the adhesive shows a consistent colour.
11.) Starting from the back of the cleaned hole, fill the hole approximately two thirds with adhesive. Slowly withdraw the nozzle as the hole fills to avoid air voids. For holes with embedment depths greater than 190 mm, an extension nozzle must be used. For overhead and horizontal installation in holes larger than 20 mm diameter, a piston plug and extension nozzle must be used. Obeserve the gel / working times provided. Injecting the adhesive in water filled holes is allowed for drill diameters less than 18 mm.
12.) Push the rod or rebar into the hole while turning slightly to properly distribute the adhesive. The anchor should be clean and free of dirt, grease or oil. Be sure that the anchor is fully seated at the hole ground and that the gap is completedly filled with adhesive. Excess adhesive should be visible at the top of the hole.
13.) Allow the adhesive to cure for the specified time prior to applying any load. Do not load the anchor before.
14.) After full curing, the fixture can be installed. Make sure the maximum torque is not exceeded.

PURE150-PRO	**Annex B4**
Intended use Installation instructions	

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Table B4: 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	120 min	50 h	100 h
+10°C to +19°C	90 min	30 h	60 h
+20°C to +29°C	30 min	10 h	20 h
+30°C to +39°C	20 min	6 h	12 h
≥ + 40°C	12 min	4 h	8 h
Cartridge temperature	-5°C to +40°C		

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Steel brush and extension

Table B5 Parameter cleaning and setting tools

Threaded rod [mm]	Internal threaded sleeve [mm]	Reinforcing bar [mm]	Drill bit d_0 [mm]	Brush diameters nominal d_b [mm]	Brush diameters minimum $d_{b,min}$ [mm]	Piston plug denom. [mm]	
M8			10	12	10,5	-	
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	#18	Required for h_{ef} > 250 mm; always required for overhead installations
		16	20	22	20,5	#20	
M20	M12	20	24	26	24,5	#24	
M24	M16	24	28	30	28,5	#28	
M27		25	32	34	32,5	#32	
M30	M20	28	35	37	35,5	#35	
		32	40	42	40,5	#40	

Hand pump (volume 750 ml)
Drill bit diameter (d_0): 10 mm to 20 mm
Drill hole depth (h_0): < 10 d_{nom}
Only in uncracked concrete

Recommended compressed air tool (min 6 bar)
Drill bit diameter (d_0): all diameters

Piston plug for overhead or horizontal installation
Drill bit diameter (d_0): 18 mm to 40 mm

PURE150-PRO	**Annex B6**
Intended use Cleaning and setting tools	

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Table C1: Threaded rod
Characteristic resistance values under tension load in uncracked concrete for hammer drilling

Anchor size threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure $N_{Rk,s} = A_s f_{uk}$ (valid for the given A_s)[1)]											
Property class 4.6, 4.8		$N_{Rk,s}$	[kN]	15(13)	23(21)	34	63	98	141	184	224
Property class 5.6, 5.8		$N_{Rk,s}$	[kN]	18(17)	29(27)	42	78	122	176	230	280
Property class 8.8		$N_{Rk,s}$	[kN]	29(27)	46(43)	67	125	196	282	368	449
A2, A4, HCR, Property class 50		$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
A2, A4, HCR, Property class 70		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	-[2)]	-[2)]
A4, HCR, Property class 80		$N_{Rk,s}$	[kN]	29	46	67	126	196	282	-[2)]	-[2)]
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156	244	352	459	560
Partial factor											
Property class 4.6, 5.6		$\gamma_{Ms,N}$	[-]	2,0							
Property class 4.8, 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5							
A2, A4, HCR, Property class 50		$\gamma_{Ms,N}$	[-]	2,86							
A2, A4, HCR, Property class 70		$\gamma_{Ms,N}$	[-]	1,87							
A4, HCR, Property class 80		$\gamma_{Ms,N}$	[-]	1,6							
Combined pull-out and concrete cone failure											
Characteristic bond resistance $\tau_{Rk,ucr}$ [N/mm²] in uncracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		15 12	15 13	15 14	14 14	13 13	12 12	12 12	12 12
	flooded bore hole	$h_{ef} \le 12d$		15	14	13	10	9,5	8,5	7,5	7,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		9,5 7,5	9,5 8,0	9,0 8,0	8,5 8,5	8,0 8,0	7,5 7,5	7,5 7,5	7,5 7,5
	flooded bore hole	$h_{ef} \le 12d$		9,5	9,5	9,0	8,5	7,5	7,0	6,5	6,0
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		8,5 7,0	8,5 7,0	8,0 7,0	7,5 7,5	7,0 7,0	7,0 7,0	6,5 6,5	6,5 6,5
	flooded bore hole	$h_{ef} \le 12d$		8,5	8,5	8,0	7,5	7,0	6,0	5,5	5,5
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed							
		Temperature range II		No Performance Assessed							
		Temperature range III		No Performance Assessed							
Increasing factors for concrete ψ_c		C30/37		1,04							
		C40/50		1,08							
		C50/60		1,10							
Concrete cone failure											
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$							
Characteristic spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$							
Factor in uncracked concrete		$k_{ucr,N}$	[-]	11,0							
Splitting failure											
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$							
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2					1,4		
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4							

[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)] Anchor type not part of the ETA

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Annex C1

Performances
Threaded rod: Characteristic resistance values under tension load in uncracked concrete for hammer drilling

Deutsches Institut für Bautechnik DIBt

Table C2: Threaded rod | Characteristic resistance values under tension load in cracked concrete for hammer drilling

Anchor size threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure $N_{Rk,s} = A_s f_{uk}$ (valid for the given A_s)[1)]											
Property class 4.6, 4.8		$N_{Rk,s}$	[kN]	15(13)	23(21)	34	63	98	141	184	224
Property class 5.6, 5.8		$N_{Rk,s}$	[kN]	18(17)	29(27)	42	78	122	176	230	280
Property class 8.8		$N_{Rk,s}$	[kN]	29(27)	46(43)	67	125	196	282	368	449
A2, A4, HCR, Property class 50		$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
A2, A4, HCR, Property class 70		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	-[2)]	-[2)]
A4, HCR, Property class 80		$N_{Rk,s}$	[kN]	29	46	67	126	196	282	-[2)]	-[2)]
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156	244	352	459	560
Partial factor											
Property class 4.6, 5.6		$\gamma_{Ms,N}$	[-]	2,0							
Property class 4.8, 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5							
A2, A4, HCR, Property class 50		$\gamma_{Ms,N}$	[-]	2,86							
A2, A4, HCR, Property class 70		$\gamma_{Ms,N}$	[-]	1,87							
A4, HCR, Property class 80		$\gamma_{Ms,N}$	[-]	1,6							
Combined pull-out and concrete cone failure											
Characteristic bond resistance $\tau_{Rk,cr}$ [N/mm²] in cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		7,0 -[3)]	7,0 -[3)]	7,5 7,0	6,5 6,5	6,0 6,0	5,5 5,5	5,5 5,5	5,5 5,5
	flooded bore hole	$h_{ef} \le 12d$		7,0	7,0	7,5	6,0	5,0	4,5	4,0	4,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		4,5 -[3)]	4,5 -[3)]	4,5 4,0	4,0 4,0	3,5 3,5	3,5 3,5	3,5 3,5	3,5 3,5
	flooded bore hole	$h_{ef} \le 12d$		4,5	4,5	4,5	4,0	3,5	3,5	3,5	3,5
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		4,0 -[3)]	4,0 -[3)]	4,0 3,5	3,5 3,5	3,0 3,0	3,0 3,0	3,0 3,0	3,0 3,0
	flooded bore hole	$h_{ef} \le 12d$		4,0	4,0	4,0	3,5	3,0	3,0	3,0	3,0
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed							
		Temperature range II		No Performance Assessed							
		Temperature range III		No Performance Assessed							
Increasing factors for concrete ψ_c		C30/37		1,04							
		C40/50		1,08							
		C50/60		1,10							
Concrete cone failure											
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$							
Characteristic spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$							
Factor in cracked concrete		$k_{cr,N}$	[-]	7,7							
Splitting failure											
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$							
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2				1,4			
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4							

[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)] Anchor type not part of the ETA
[3)] No performance assessed

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Annex C2

Performances
Threaded rod: Characteristic resistance values under tension load in cracked concrete for hammer drilling

Deutsches Institut für Bautechnik DIBt

Table C3: Threaded rod
Characteristic resistance values under tension load in uncracked concrete for diamond coring

Anchor size threaded rod				**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure $N_{Rk,s} = A_s f_{uk}$ (valid for the given A_s)[1)]								
Property class 4.6, 4.8		$N_{Rk,s}$	[kN]	23(21)	34	63	98	141
Property class 5.6, 5.8		$N_{Rk,s}$	[kN]	29(27)	42	78	122	176
Property class 8.8		$N_{Rk,s}$	[kN]	46(43)	67	125	196	282
A2, A4, HCR, Property class 50		$N_{Rk,s}$	[kN]	28	42	79	123	177
A2, A4, HCR, Property class 70		$N_{Rk,s}$	[kN]	41	59	110	171	247
A2, A4, HCR, Property class 80		$N_{Rk,s}$	[kN]	46	67	126	196	282
Stressed cross section		A_s	[mm²]	58,0	84,3	156	244	352
Partial factor								
Property class 4.6, 5.6		$\gamma_{Ms,N}$	[-]	2,0				
Property class 4.8, 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5				
A2, A4, HCR, Property class 50		$\gamma_{Ms,N}$	[-]	2,86				
A2, A4, HCR, Property class 70		$\gamma_{Ms,N}$	[-]	1,87				
A4, HCR, Property class 80		$\gamma_{Ms,N}$	[-]	1,6				
Combined pull-out 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
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed				
		Temperature range II		No Performance Assessed				
		Temperature range III		No Performance Assessed				
Increasing factor for concrete ψ_c		C30/37		1,04				
		C40/50		1,08				
		C50/60		1,10				
Concrete cone failure								
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{cf}$				
Characteristic spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$				
Factor in uncracked concrete		$k_{ucr,N}$	[-]	11,0				
Splitting failure								
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$				
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,0	1,2			
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4				

[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.

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Annex C3

Performances
Threaded rod: Characteristic resistance values under tension load in uncracked concrete for diamond coring

Deutsches Institut für Bautechnik DIBt

Table C4: Threaded rod
Characteristic resistance values under shear load in cracked and uncracked concrete for hammer drilling

Anchor size threaded rod			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure without lever arm $V_{Rk,s} = 0{,}5\ A_s\ f_{uk}$ (valid for the given A_s)[1)]										
Property class 4.6, 4.8	$V^0_{Rk,s}$	[kN]	9(8)	14(13)	20	38	59	85	110	135
Property class 5.6, 5.8	$V^0_{Rk,s}$	[kN]	11(10)	15(13)	21	39	31	88	115	140
Property class 8.8	$V^0_{Rk,s}$	[kN]	15(13)	23(21)	34	63	98	141	184	224
A2, A4, HCR, Property class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
A2, A4, HCR, Property class 70	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124	-[2)]	-[2)]
A4, HCR, Property class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	-[2)]	-[2)]
Stressed cross section	A_s	[mm²]	36,6	58,0	84,3	156	244	352	459	560
Partial factor										
Property class 4.6, 5.6	$\gamma_{Ms,V}$	[-]	1,67							
Property class 4.8, 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25							
A2, A4, HCR, Property class 50	$\gamma_{Ms,V}$	[-]	2,38							
A2, A4, HCR, Property class 70	$\gamma_{Ms,V}$	[-]	1,56							
A4, HCR, Property class 80	$\gamma_{Ms,V}$	[-]	1,33							
Ductility factor	k_7		1,0							
Steel failure with lever arm $M^0_{Rk,s} = 1{,}2\ W_{el}\ f_{uk}$ (valid for the given W_{el})[1)]										
Property class 4.6, 4.8	$M^0_{Rk,s}$	[Nm]	15(13)	30(27)	52	133	260	449	666	900
Property class 5.6, 5.8	$M^0_{Rk,s}$	[Nm]	19(16)	37(33)	65	166	324	560	833	1123
Property class 8.8	$M^0_{Rk,s}$	[Nm]	30(26)	60(53)	105	266	519	896	1333	1797
A2, A4, HCR, Property class 50	$M^0_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	1125
A2, A4, HCR, Property class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	232	454	784	-[2)]	-[2)]
A4, HCR, Property class 80	$M^0_{Rk,s}$	[Nm]	30	59	105	266	519	896	-[2)]	-[2)]
Elastic section modulus	W_{el}	[mm³]	31,2	62,3	109	276	540	933	1388	1872
Partial factor										
Property class 4.6, 5.6	$\gamma_{Ms,V}$	[-]	1,67							
Property class 4.8, 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25							
A2, A4, HCR, Property class 50	$\gamma_{Ms,V}$	[-]	2,38							
A2, A4, HCR, Property class 70	$\gamma_{Ms,V}$	[-]	1,56							
A4, HCR, Property class 80	$\gamma_{Ms,V}$	[-]	1,33							
Ductility factor	k_7	[-]	1,0							
Concrete pryout failure										
Pryout factor	k_8	[-]	2,0							
Concrete edge failure										
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 12\ d_{nom})$						$l_f = \min(h_{ef};$ 300 mm)	
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ_{inst}	[-]	1,0							

[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)] Anchor type not part of the ETA

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Table C5: Threaded rod
Characteristic resistance values under shear load in uncracked concrete for diamond coring

Anchor size threaded rod			**M10**	**M12**	**M16**	**M20**	**M24**
Steel failure without lever arm $V_{Rk,s} = 0{,}5\ A_s\ f_{uk}$ (valid for the given A_s)[1)]							
Property class 4.6, 4.8	$V^0_{Rk,s}$	[kN]	14(13)	17	31	49	71
Property class 5.6, 5.8	$V^0_{Rk,s}$	[kN]	15(13)	21	39	61	88
Property class 8.8	$V^0_{Rk,s}$	[kN]	23(21)	34	63	98	141
A2, A4, HCR, Property class 50	$V^0_{Rk,s}$	[kN]	15	21	39	61	88
A2, A4, HCR, Property class 70	$V^0_{Rk,s}$	[kN]	20	30	55	86	124
A2, A4, HCR, Property class 80	$V^0_{Rk,s}$	[kN]	23	34	63	98	141
Stressed cross section	A_s	[mm²]	58,0	84,3	156	244	352
Partial factor							
Property class 4.6, 5.6	$\gamma_{Ms,V}$	[-]	1,67				
Property class 4.8, 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25				
A2, A4, HCR, Property class 50	$\gamma_{Ms,V}$	[-]	2,38				
A2, A4, HCR, Property class 70	$\gamma_{Ms,V}$	[-]	1,56				
A4, HCR, Property class 80	$\gamma_{Ms,V}$	[-]	1,33				
Ductility factor	k_7	[-]	1,0				
Steel failure with lever arm $M^0_{Rk,s} = 1{,}2\ W_{el}\ f_{uk}$ (valid for the given W_{el})[1)]							
Property class 4.6	$M^0_{Rk,s}$	[Nm]	30	52	133	260	499
Property class 5.8	$M^0_{Rk,s}$	[Nm]	37	65	166	324	560
Property class 8.8	$M^0_{Rk,s}$	[Nm]	60	105	266	519	896
A4, HCR, Property class 50	$M^0_{Rk,s}$	[Nm]	37	66	167	325	561
A4, HCR, Property class 70	$M^0_{Rk,s}$	[Nm]	52	92	232	454	784
A4, HCR, Property class 80	$M^0_{Rk,s}$	[Nm]	59	105	266	519	896
Elastic section modulus	W_{el}	[mm³]	62,3	109	276	540	933
Partial factor							
Property class 4.6, 5.6	$\gamma_{Ms,V}$	[-]	1,67				
Property class 4.8, 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25				
A2, A4, HCR, Property class 50	$\gamma_{Ms,V}$	[-]	2,38				
A2, A4, HCR, Property class 70	$\gamma_{Ms,V}$	[-]	1,56				
A4, HCR, Property class 80	$\gamma_{Ms,V}$	[-]	1,33				
Ductility factor	k_7	[-]	1,0				
Concrete pryout failure							
Pryout factor	k_8	[-]	2,0				
Concrete edge failure							
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 12\ d_{nom})$				
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24
Installation factor	γ_{inst}	[-]	1,0				

[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.

Deutsches Institut für Bautechnik DIBt

Table C6: Reinforcing bar
Characteristic resistance values under tension load in uncracked concrete for hammer drilling

Anchor size reinforcing bar				**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Steel failure													
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s f_{uk}$ [1]									
Stressed cross section		A_s	[mm²]	50,3	78,5	113	153	201	314	452	490	615	804
Partial factor		$\gamma_{Ms,N}$	[-]	1,4 [2]									
Combined pullout and concrete cone failure													
Characteristic bond resistance $\tau_{Rk,ucr}$ [N/mm²] in uncracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		14 11	14 12	13 12	13 12	12 12	12 12	11 11	11 11	11 11	11 11
	flooded bore hole	$h_{ef} \le 12d$		14	13	11	10	9,5	8,5	7,5	7,5	7,0	6,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		8,5 6,5	8,5 7,0	8,0 7,0	8,0 7,0	7,5 7,0	7,0 7,0	7,0 6,5	7,0 6,5	6,5 6,5	6,5 6,5
	flooded bore hole	$h_{ef} \le 12d$		8,5	8,5	8,0	8,0	7,5	7,0	6,0	6,0	5,5	5,0
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		7,5 6,0	7,5 6,0	7,5 6,0	7,0 6,5	7,0 6,5	6,5 6,0	6,0 6,0	6,0 6,0	6,0 5,5	6,0 5,5
	flooded bore hole	$h_{ef} \le 12d$		7,5	7,5	7,5	7,0	7,0	6,0	5,5	5,5	5,0	4,5
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed									
		Temperature range II		No Performance Assessed									
		Temperature range III		No Performance Assessed									
Increasing factor for concrete ψ_c		C30/37		1,04									
		C40/50		1,08									
		C50/60		1,10									
Concrete cone failure													
Characteristic edge distance		$c_{cr,N}$	[mm]	$1{,}5 \cdot h_{ef}$									
Characteristic spacing		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$									
Factor in uncracked concrete		$k_{ucr,N}$	[-]	11,0									
Splitting failure													
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$									
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$									
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2					1,4				
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4									

[1] f_{uk} shall be taken from the specifications of the reinforcing bar
[2] In absence of national regulations

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Table C7: Reinforcing bar
Characteristic resistance values under tension load in cracked concrete for hammer drilling

Anchor size reinforcing bar				**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Steel failure													
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s f_{uk}$ [1]									
Stressed cross section		A_s	[mm²]	50,3	78,5	113	153	201	314	452	490	615	804
Partial factor		$\gamma_{Ms,N}$	[-]	1,4 [2]									
Combined pullout and concrete cone failure													
Characteristic bond resistance $\tau_{Rk,cr}$ [N/mm²] in cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$		7,0 -[3]	7,0 -[3]	7,5	7,0	6,5	6,0	5,5	5,5	5,5	5,5
		$h_{ef} > 12d$				7,0	6,5	6,5	6,0	5,5	5,5	5,5	5,5
	flooded bore hole	$h_{ef} \le 12d$		7,0	7,0	7,5	6,5	6,0	5,0	4,5	4,5	4,0	4,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		4,5 -[3]	4,5 -[3]	4,5	4,0	4,0	3,5	3,5	3,5	3,5	3,5
		$h_{ef} > 12d$				4,0	4,0	4,0	3,5	3,5	3,5	3,5	3,5
	flooded bore hole	$h_{ef} \le 12d$		4,5	4,5	4,5	4,0	4,0	3,5	3,5	3,5	3,5	3,0
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		4,0 -[3]	4,0 -[3]	4,0	3,5	3,5	3,0	3,0	3,0	3,0	3,0
		$h_{ef} > 12d$				3,5	3,5	3,5	3,0	3,0	3,0	3,0	3,0
	flooded bore hole	$h_{ef} \le 12d$		4,0	4,0	4,0	3,5	3,5	3,0	3,0	3,0	3,0	3,0
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed									
		Temperature range II		No Performance Assessed									
		Temperature range III		No Performance Assessed									
Increasing factor for concrete ψ_c		C30/37		1,04									
		C40/50		1,08									
		C50/60		1,10									
Concrete cone failure													
Characteristic edge distance		$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$									
Characteristic spacing		$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$									
Factor in cracked concrete		$k_{ucr,N}$	[-]	7,7									
Splitting failure													
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1,0 \cdot h_{ef} \le 2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}}\right) \le 2,4 \cdot h_{ef}$									
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$									
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2					1,4				
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4									

[1] f_{uk} shall be taken from the specifications of the reinforcing bar
[2] In absence of national regulations
[3] No Performance Assessed

PURE150-PRO

Annex C7

Performances
Reinforcing bar: Characteristic resistance values under tension load in cracked concrete for hammer drilling

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Table C8: Reinforcing bar
Characteristic resistance values under tension load in uncracked concrete for diamond coring

Anchor size reinforcing bar				**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**
Steel failure										
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s f_{uk}$ [1]						
Stressed cross section		A_s	[mm²]	78,5	113	153	201	314	452	490
Partial factor		$\gamma_{Ms,N}$	[-]	1,4 [2]						
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
Reduction factors for Sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed						
		Temperature range II		No Performance Assessed						
		Temperature range III		No Performance Assessed						
Increasing factor for concrete ψ_c		C30/37		1,04						
		C40/50		1,08						
		C50/60		1,10						
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 in uncracked concrete		$k_{ucr,N}$	[-]	11,0						
Splitting failure										
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$						
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$						
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,0	1,2					
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4						

[1] f_{uk} shall be taken from the specifications of the reinforcing bar
[2] In absence of national regulations

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Table C9: Reinforcing bar
Characteristic resistance values under shear load in cracked and uncracked concrete for hammer drilling

Anchor size reinforcing bar			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Steel failure without lever arm (valid for the given A_s)												
Characteristic shear resistance	$V^0_{Rk,s}$	[kN]	$0{,}5\ A_s\ f_{uk}$ [1)]									
Stressed cross section	A_s	[mm²]	50,3	78,5	113	153	201	314	452	490	615	804
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2)]									
Ductility factor	k_7	[-]	1,0									
Steel failure with lever arm (valid for the given W_{el})												
Characteristic bending resist.	$M^0_{Rk,s}$	[Nm]	$1{,}2\ W_{el}\ f_{uk}$ [1)]									
Elastic section modulus	W_{el}	[mm³]	50,3	98,2	169	2694	402	785	1357	1534	2155	3217
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2)]									
Ductility factor	k_7	[-]	1,0									
Concrete pry out failure												
Pryout factor	k_8	[-]	2,0									
Concrete edge failure												
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 12\ d_{nom})$							$l_f = \min(h_{ef};$ 300 mm)		
Outside diameter of anchor	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 the reinforcing bar
[2)] In absence of national regulations

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Table C10: Reinforcing bar
Characteristic resistance values under shear load in uncracked concrete for diamond coring

Anchor size reinforcing bar			**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**
Steel failure without lever arm (valid for the given A_s)									
Characteristic shear resistance	$V^0_{Rk,s}$	[kN]	$0{,}5\ A_s\ f_{uk}$ [1]						
Stressed cross section	A_s	[mm²]	78,5	113	153	201	314	452	490
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2]						
Ductility factor	k_7	[-]	1,0						
Steel failure with lever arm (valid for the given W_{el})									
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2\ W_{el}\ f_{uk}$ [1]						
Elastic section modulus	W_{el}	[mm³]	98,2	169	269	402	785	1357	1534
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 [2]						
Ductility factor	k_7	[-]	1,0						
Concrete pry out failure									
Pryout factor	k_8	[-]	2,0						
Concrete edge failure									
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 12\ d_{nom})$						$l_f = \min(h_{ef};\ 300\ mm)$
Outside diameter of anchor	d_{nom}	[mm]	10	12	14	16	20	24	25
Installation factor	γ_{inst}	[-]	1,0						

[1] f_{uk} shall be taken from the specifications of the reinforcing bar
[2] In absence of national regulations

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Table C11: Internal threaded sleeve
Characteristic resistance values under tension load in uncracked concrete for hammer drilling

Anchor size internal threaded sleeve				**M8**	**M10**	**M12**	**M16**	**M20**
External diameter		d	[mm]	12	16	20	24	30
Effective anchorage depth		h_{ef}	[mm]	80	90	110	150	200
Steel failure (internal threaded sleeve)								
Property class 5.8		$N_{Rk,s}$	[kN]	17	29	42	76	123
Property class 8.8		$N_{Rk,s}$	[kN]	27	46	67	121	196
A4, HCR, Property class 70[2)]		$N_{Rk,s}$	[kN]	26	41	59	110	124
Partial factor								
Property class 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5				
A4, HCR, Property class 70[2)]		$\gamma_{Ms,N}$	[-]	1,87				2,86
Steel failure (threaded rod)								
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s f_{uk}$[1)]				
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156	244
Combined pullout and concrete cone failure								
Characteristic bond resistance $\tau_{Rk,ucr}$ [N/mm²] in uncracked concrete C20/25								
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$		15,0	14,0	13,0	12,0	12,0
	flooded bore hole	$h_{ef} \le 12d$		13,0	10,0	9,5	8,5	7,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		9,0	8,5	8,0	7,5	7,5
	flooded bore hole	$h_{ef} \le 12d$		9,0	8,5	7,5	7,0	6,0
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		8,0	7,5	7,0	7,0	6,5
	flooded bore hole	$h_{ef} \le 12d$		8,0	7,5	7,0	6,0	5,5
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed				
		Temperature range II		No Performance Assessed				
		Temperature range III		No Performance Assessed				
Increasing factor for concrete ψ_c		C30/37		1,04				
		C40/50		1,08				
		C50/60		1,10				
Concrete cone failure								
Characteristic edge distance		$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$				
Characteristic spacing		$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$				
Factor for uncracked concrete		$k_{ucr,N}$	[-]	11,0				
Splitting failure								
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1,0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2,5 - \frac{h}{h_{ef}}\right) \le 2,4 \cdot h_{ef}$				
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2		1,4		
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4				

[1)] f_{uk} shall be taken from the specifications of the threaded rod
[2)] For M20 property class 50

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Table C12: Internal threaded sleeve
Characteristic resistance values under tension load in cracked concrete for hammer drilling

Anchor size internal threaded sleeve				**M8**	**M10**	**M12**	**M16**	**M20**
External diameter		d	[mm]	12	16	20	24	30
Effective anchorage depth		h_{ef}	[mm]	80	90	110	150	200
Steel failure (internal threaded sleeve)								
Property class 5.8		$N_{Rk,s}$	[kN]	17	29	42	76	123
Property class 8.8		$N_{Rk,s}$	[kN]	27	46	67	121	196
A4, HCR, Property class 70[2)]		$N_{Rk,s}$	[kN]	26	41	59	110	124
Partial factor								
Property class 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5				
A4, HCR, Property class 70[2)]		$\gamma_{Ms,N}$	[-]	1,87				2,86
Steel failure (threaded rod)								
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s f_{uk}$[1)]				
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156	244
Combined pullout and concrete cone failure								
Characteristic bond resistance $\tau_{Rk,cr}$ [N/mm²] in cracked concrete C20/25								
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \leq 12d$		7,5	6,5	6,0	5,5	5,5
	flooded bore hole	$h_{ef} \leq 12d$		7,5	6,0	5,0	4,5	4,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \leq 12d$		4,5	4,0	3,5	3,5	3,5
	flooded bore hole	$h_{ef} \leq 12d$		4,5	4,0	3,5	3,5	3,5
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \leq 12d$		4,0	3,5	3,0	3,0	3,0
	flooded bore hole	$h_{ef} \leq 12d$		4,0	3,5	3,0	3,0	3,0
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed				
		Temperature range II		No Performance Assessed				
		Temperature range III		No Performance Assessed				
Increasing factor for concrete ψ_c		C30/37		1,04				
		C40/50		1,08				
		C50/60		1,10				
Concrete cone failure								
Characteristic edge distance		$c_{cr,N}$	[mm]	$1,5\ h_{ef}$				
Characteristic spacing		$s_{cr,N}$	[mm]	$3,0\ h_{ef}$				
Factor for cracked concrete		$k_{cr,N}$	[-]	7,7				
Splitting failure								
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \leq 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \leq 2{,}4 \cdot h_{ef}$				
Characteristic spacing		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$				
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2		1,4		
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4				

[1)] f_{uk} shall be taken from the specifications of the threaded rod
[2)] For M20 property class 50

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Table C13: Internal threaded sleeve
Characteristic resistance values under tension load in uncracked concrete for diamond coring

Anchor size internal threaded sleeve				**M8**	**M10**	**M12**	**M16**
External diameter		d	[mm]	12	16	20	24
Embedment depth		h_{ef}	[mm]	80	90	110	150
Steel failure (internal threaded sleeve)							
Property class 5.8		$N_{Rk,s}$	[kN]	17	29	42	76
Property class 8.8		$N_{Rk,s}$	[kN]	27	46	67	121
A4, HCR, Property class 70[2)]		$N_{Rk,s}$	[kN]	26	41	59	110
Partial factor							
Property class 5.8, 8.8		$\gamma_{Ms,N}$	[-]	1,5			
A4, HCR, Property class 70[2)]		$\gamma_{Ms,N}$	[-]	1,87			
Steel failure (threaded rod)							
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s\ f_{uk}$[1)]			
Stressed cross section		A_s	[mm²]	36,6	58,0	84,3	156
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
Reduction factors for sustained loads ψ^0_{sus}		Temperature range I		No Performance Assessed			
		Temperature range II		No Performance Assessed			
		Temperature range III		No Performance Assessed			
Increasing factor for concrete ψ_c		C30/37		1,04			
		C40/50		1,08			
		C50/60		1,10			
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 for uncracked concrete		$k_{ucr,N}$	[-]	11,0			
Splitting failure							
Characteristic edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$			
Characteristic spacing		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$			
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2			
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4			

[1)] f_{uk} shall be taken from the specifications of the threaded rod
[2)] For M20 property class 50

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Table C14: Internal threaded sleeve
Characteristic resistance values under shear load in cracked and uncracked concrete for hammer drilling

Anchor size internal threaded sleeve			**M8**	**M10**	**M12**	**M16**	**M20**
External diameter	d	[mm]	12	16	20	24	30
Effective anchorage depth [mm]	h_{ef}	[mm]	80	90	110	150	200
Steel failure without lever arm (internal threaded sleeve)							
Property class 5.8	$V^0_{Rk,s}$	[kN]	9	15	21	38	61
Property class 8.8	$V^0_{Rk,s}$	[kN]	14	23	34	60	98
A4 and HCR, Property class 70[2)]	$V^0_{Rk,s}$	[kN]	13	20	30	55	40
Partial factor							
Property class 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25				
A4, HCR, Property class 70[2)]	$\gamma_{Ms,V}$	[-]	1,0				2,38
Ductility factor	k_7	[-]	1,0				
Steel failure with lever arm (internal threaded sleeve)							
Property class 5.8	$M^0_{Rk,s}$	[Nm]	19	37	66	167	325
Property class 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	267	519
A4 and HCR, Property class 70[2)]	$M^0_{Rk,s}$	[Nm]	26	52	92	233	456
Partial factor							
Property class 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25				
A4, HCR, Property class 70[2)]	$\gamma_{Ms,V}$	[-]	1,0				2,38
Ductility factor	k_7	[-]	1,0				
Concrete pryout failure							
Pryout factor	k_8	[-]	2,0				
Concrete edge failure							
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 12\ d_{nom})$				$l_f = \min(h_{ef}; 300\ mm)$
Outside diameter of anchor	d_{nom}	[mm]	12	16	20	24	30
Installation factor	γ_{inst}	[-]	1,0				

[1)] f_{uk} shall be taken from the specifications of the threaded rod
[2)] For M20 property class 50

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Table C15: Internal threaded sleeve
Characteristic resistance values under shear load in uncracked concrete for diamond coring

Anchor size internal threaded sleeve			**M8**	**M10**	**M12**	**M16**
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)						
Property class 5.8	$V^0_{Rk,s}$	[kN]	9	15	21	38
Property class 8.8	$V^0_{Rk,s}$	[kN]	14	23	34	60
A4 and HCR, Property class 70[2)]	$V^0_{Rk,s}$	[kN]	13	20	30	55
Partial factor						
Property class 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25			
A4, HCR, Property class 70[2)]	$\gamma_{Ms,V}$	[-]	1,56			
Ductility factor	k_7		1,0			
Steel failure with lever arm (internal threaded sleeve)						
Property class 5.8	$M^0_{Rk,s}$	[Nm]	19	37	66	167
Property class 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	267
A4 and HCR, Property class 70[2)]	$M^0_{Rk,s}$	[Nm]	26	52	92	233
Partial factor						
Property class 5.8, 8.8	$\gamma_{Ms,V}$	[-]	1,25			
A4, HCR, Property class 70[2)]	$\gamma_{Ms,V}$	[-]	1,56			
Ductility factor	k_7	[-]	1,0			
Concrete pryout failure						
Pryout factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 12\ d_{nom})$			
Outside diameter of anchor	d_{nom}	[mm]	12	16	20	24
Installation factor	γ_{inst}	[-]	1,0			

[1)] f_{uk} shall be taken from the specifications of the threaded rod
[2)] For M20 property class 50

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Table C16: Threaded rod
Displacements under tension load for hammer drilling[1)]

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Temperature range 40°C/24°C for uncracked concrete C20/25										
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,020	0,024	0,029	0,032	0,035
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,079	0,096	0,114	0,127	0,140
Temperature range 72°C/43°C and 60°C/43°C for uncracked concrete C20/25										
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,023	0,028	0,033	0,037	0,043
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,091	0,111	0,131	0,146	0,161
Temperature range 40°C/24°C for cracked concrete C20/25										
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,032	0,032	0,032	0,037	0,042	0,048	0,054	0,062
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,21	0,21[)]	0,21	0,21	0,21	0,21	0,21	0,21
Temperature range 72°C/43°C and 60°C/43°C for cracked concrete C20/25										
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,043	0,049	0,055	0,063	0,071
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24

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

Table C17: Threaded rod
Displacements under shear load for hammer drilling[1)]

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Displacement	δ_{V0} - Factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

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

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Annex C16

Performances
Threaded rod. Displacements under tension and shear load for hammer drilling

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Table C18: Threaded rod
Displacements under tension load for diamond coring[1)]

Anchor size threaded rod			M10	M12	M16	M20	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$\cdot \tau$ with τ = action bond stress
$\delta_{N\infty} = \delta_{N\infty}$ - Factor$\cdot \tau$ with τ = action bond stress

Table C19: Threaded rod
Displacements under shear load for diamond coring[1)]

Anchor size threaded rod			M10	M12	M16	M20	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$\cdot$ V with V = action shear load
$\delta_{V\infty} = \delta_{V\infty}$ - Factor$\cdot$ V with V = action shear load

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Annex C17

Performances
Threaded rod. Displacements under tension and shear load for diamond coring

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Table C20: Reinforcing bar
Displacements under tension load for hammer drilling[1)]

Anchor size reinforcing bar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32
Temperature range 40°C/24°C for uncracked concrete C20/25												
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,011	0,013	0,015	0,018	0,020	0,024	0,029	0,030	0,033	0,037
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,044	0,052	0,061	0,070	0,079	0,096	0,114	0,118	0,132	0,149
Temperature range 72°C/43°C and 60°C/43°C for uncracked concrete C20/25												
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,013	0,015	0,018	0,020	0,023	0,028	0,033	0,034	0,038	0,043
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,050	0,060	0,070	0,081	0,091	0,111	0,131	0,136	0,151	0,172
Temperature range 40°C/24°C for cracked concrete C20/25												
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,032	0,032	0,032	0,035	0,037	0,042	0,048	0,049	0,056	0,064
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,21	0,21	0,21	0,21	0,21	0,21	0,21	0,21	0,21	0,21
Temperature range 72°C/43°C and 60°C/43°C for cracked concrete C20/25												
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,032	0,032	0,037	0,040	0,043	0,049	0,055	0,056	0,064	0,073
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24	0,24

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

Table C21: Reinforcing bar
Displacements under shear load under static and quasi-static action for hammer drilling[1)]

Anchor size reinforcing bar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32
Displacement	δ_{V0} - Factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,04	0,03	0,03	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/kN]	0,09	0,08	0,07	0,06	0,06	0,05	0,05	0,05	0,04	0,04

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

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Table C22: Reinforcing bar
Displacements under tension load for diamond coring[1)]

Reinforcing bar			Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25
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$\cdot \tau$ with τ = action bond stress
$\delta_{N\infty} = \delta_{N\infty}$ - Factor$\cdot \tau$ with τ = action bond stress

Table C23: Reinforcing bar
Displacements under shear load for diamond coring[1)]

Reinforcing bar			Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25
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$\cdot$ V with V = action shear load
$\delta_{V\infty} = \delta_{V\infty}$ - Factor$\cdot$ V with V = action shear load

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Table C24: Internal threaded sleeve
Displacements under tension load for hammer drilling[1)]

Anchor size internal threaded sleeve			M8	M10	M12	M16	M20
Temperature range 40°C/24°C for uncracked concrete C20/25							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,015	0,020	0,024	0,029	0,035
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,061	0,079	0,096	0,114	0,140
Temperature range 72°C/43°C and 60°C/43°C for uncracked concrete C20/25							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,018	0,023	0,028	0,033	0,043
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,070	0,091	0,111	0,131	0,161
Temperature range 40°C/24°C for cracked concrete C20/25							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,032	0,037	0,042	0,048	0,055
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,210	0,210	0,210	0,210	0,210
Temperature range 72°C/43°C and 60°C/43°C for cracked concrete C20/25							
Displacement	δ_{N0} - Factor	[mm/(N/mm²)]	0,037	0,043	0,049	0,055	0,063
Displacement	$\delta_{N\infty}$ - Factor	[mm/(N/mm²)]	0,240	0,240	0,240	0,240	0,240

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

Table C25: Internal threaded sleeve
Displacements under shear load for hammer drilling[1)]

Anchor size internal threaded sleeve			M8	M10	M12	M16	M20
Displacement	δ_{V0} - Factor	[mm/kN]	0,05	0,04	0,04	0,03	0,03
Displacement	$\delta_{V\infty}$ - Factor	[mm/kN]	0,08	0,06	0,06	0,05	0,05

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

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Table C26: Internal threaded sleeve
Displacements under tension load for diamond coring[1)]

Anchor size internal threaded sleeve			M8	M10	M12	M16
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· τ with τ = action bond stress
$\delta_{N\infty} = \delta_{N\infty}$ - Factor· τ with τ = action bond stress

Table C27: Internal threaded sleeve
Displacements under shear load for diamond coring[1)]

Anchor size internal threaded sleeve			M8	M10	M12	M16
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· V with V = action shear load
$\delta_{V\infty} = \delta_{V\infty}$ - Factor· V with V = action shear load

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Annex C21

Performances
Reinforcing bar: Displacements under tension and shear load for diamond coring

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Table C28: Threaded rod
Characteristic resistance values under tension load under seismic action (performance category C1)

Anchor size threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Characteristic tension resistance, steel failure[1)]											
Steel, property class 4.6, 4.8		$N_{Rk,s,eq,C1}$	[kN]	15(13)	23(21)	34	63	98	141	184	224
Steel, property class 5.6, 5.8		$N_{Rk,s,eq,C1}$	[kN]	18(17)	29(27)	42	78	122	176	230	280
Steel, property class 8.8		$N_{Rk,s,eq,C1}$	[kN]	29(27)	46(43)	67	125	196	282	368	449
A2, A4, HCR, property class 50		$N_{Rk,s,eq,C1}$	[kN]	18	29	42	79	123	177	230	281
A2, A4, HCR, property class 70		$N_{Rk,s,eq,C1}$	[kN]	26	41	59	110	171	247	-[2)]	-[2)]
A4, HCR, property class 80		$N_{Rk,s,eq,C1}$	[kN]	29	46	67	126	196	282	-[2)]	-[2)]
Partial factor		$\gamma_{Ms,N}$	[kN]	See Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance $\tau_{Rk,eq,C1}$ [N/mm²] in cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		5,9 -[3)]	7,0 -[3)]	7,1 6,5	6,2 6,2	5,7 5,7	5,5 5,5	5,5 5,5	5,5 5,5
	flooded bore hole	$h_{ef} \le 12d$		5,9	7,0	7,1	5,8	4,8	4,5	4,0	4,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		3,7 -[3)]	4,5 -[3)]	4,3 3,8	3,8 3,8	3,4 3,3	3,5 3,5	3,5 3,5	3,5 3,5
	flooded bore hole	$h_{ef} \le 12d$		3,7	4,5	4,3	3,8	3,4	3,5	3,5	3,5
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		3,2 -[3)]	4,0 -[3)]	3,9 3,3	3,4 3,3	3,0 2,9	3,0 3,0	3,0 3,0	3,0 3,0
	flooded bore hole	$h_{ef} \le 12d$		3,2	4,0	3,9	3,4	3,0	3,0	3,0	3,0
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2				1,4			
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4							

[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)] Anchor type not part of the ETA
[3)] No performance assessed

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Table C30: Threaded rod
Characteristic resistance values under shear load under seismic action (performance category C1)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic shear resistance, steel failure without lever arm[1)]										
Steel, property class 4.6, 4.8	$V^0_{Rk,s,eq,C1}$	[kN]	7,2(7,0)	12,3(11,4)	17,6	33,4	51,9	68,0	88,0	108
Steel, property class 5.6, 5.8	$V^0_{Rk,s,eq,C1}$	[kN]	9,7(8,8)	13,2(11,4)	18,5	34,3	53,7	70,4	92,0	112
Steel, property class 8.8	$V^0_{Rk,s,eq,C1}$	[kN]	13,2(11,4)	20,2(18,3)	30,0	55,4	86,2	112	147	179
A2, A4 and HCR, property class 50	$V^0_{Rk,s,eq,C1}$	[kN]	7,2	13,2	18,5	34,3	53,7	70,4	92,0	112
A2, A4 and HCR, property class 70	$V^0_{Rk,s,eq,C1}$	[kN]	11,4	17,6	26,4	48,4	75,7	99,2	-[2)]	-[2)]
A4 and HCR, property class 80	$V^0_{Rk,s,eq,C1}$	[kN]	13,2	20,2	29,9	55,4	86,2	112	-[2)]	-[2)]
Factor for annular gap	α_{gap}	[-]	0,5							
Partial factor	$\gamma_{Ms,V}$	[kN]	See Table C4							
Installation factor	γ_{inst}	[-]	1,0							

[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)] Anchor type not part of the ETA

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Table C32: Reinforcing bar
Characteristic resistance values under tension load under seismic action (performance category C1)

Anchor size reinforcing bar				**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Steel failure													
All reinforcing bars		$N_{Rk,s,eq,C1}$	[kN]	1,0 A_s f_{uk} [1]									
Cross section area		A_s	[mm]	50	79	113	154	201	314	452	491	616	804
Partial factor		$\gamma_{Ms,N}$	[kN]	1.4 [2]									
Combined pull-out and concrete failure													
Characteristic bond resistance $\tau_{Rk,eq,C1}$ [N/mm²] in cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$		5,9	7,0	7,1	6,4	6,2	5,7	5,5	5,5	5,5	5,5
		$h_{ef} > 12d$		-[3]	-[3]	6,4	5,9	6,2	5,7	5,5	5,5	5,5	5,5
	flooded bore hole	$h_{ef} \le 12d$		5,9	7,0	7,1	6,0	5,7	4,8	4,5	4,5	4,0	4,0
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		3.7	4,5	4,3	3,7	3,8	3,3	3,3	3,5	3,5	3,5
		$h_{ef} > 12d$		-[3]	-[3]	3,6	3,7	3,8	3,3	3,3	3,5	3,5	3,5
	flooded bore hole	$h_{ef} \le 12d$		3.7	4,5	4,3	3,7	3,8	3,3	3,5	3,5	3,5	3,0
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$		3,2	4,0	3,9	3,2	3,3	2,9	2,9	3,0	3,0	3,0
		$h_{ef} > 12d$		-[3]	-[3]	3,2	3,2	3,3	2,9	2,9	3,0	3,0	3,0
	flooded bore hole	$h_{ef} \le 12d$		3,2	4,0	3,9	3,2	3,3	2,9	2,9	3,0	3,0	3,0
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,2					1,4				
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4									

[1] f_{uk} shall be taken from the specifications of the reinforcing bar
[2] In absence of national regulations
[3] No performance assessed

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Table C34: Reinforcing bar
Characteristic resistance values under shear load under seismic action (performance category C1)

Anchor size reinforcing bar			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Characteristic shear resistance, steel failure without lever arm												
All reinforcing bars	$V_{Rk,s,eq,C1}$	[kN]	0,4 A_s f_{uk} [1)]		0,44 A_s f_{uk} [1)]							
Cross section area	A_s	[mm]	50	79	113	154	201	314	452	491	616	804
Factor for annular gap	α_{gap}	[-]	0,5									
Partial factor	$\gamma_{Ms,V}$	[kN]	1.5 [2)]									
Installation factor	γ_{inst}	[-]	1,0									

[1)] f_{uk} shall be taken from the specifications of the reinforcing bar
[2)] In absence of national regulations

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Table C36: Threaded rod
Characteristic resistance values under tension load under seismic action (performance category C2)

Anchor size threaded rod				**M12**	**M16**
Steel failure					
Characteristic tension resistance, Steel, property class 4.6, 4.8		$N_{Rk,s,eq,C2}$	[kN]	34	63
Characteristic tension resistance, Steel, property class 5.6, 5.8		$N_{Rk,s,eq,C2}$	[kN]	42	78
Characteristic tension resistance, Steel, property class 8.8		$N_{Rk,s,eq,C2}$	[kN]	62	125
Characteristic tension resistance, Stainless steel A2, A4 and HCR, property class 50		$N_{Rk,s,eq,C2}$	[kN]	42	79
Characteristic tension resistance, Stainless steel A2, A4 and HCR, property class 70		$N_{Rk,s,eq,C2}$	[kN]	59	110
Characteristic tension resistance, Stainless steel A4 and HCR, property class 80		$N_{Rk,s,eq,C2}$	[kN]	67	126
Partial factor		$\gamma_{Ms,N}$	[kN]	See Table C1	
Combined pull-out and concrete failure					
Characteristic bond resistance $\tau_{Rk,eq,C2}$ [N/mm²] in cracked concrete C20/25					
Temperature range I: 40°C/24°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		2,4 2,2	2,2 2,2
	flooded bore hole	$h_{ef} \le 12d$		2,4	2,1
Temperature range II: 60°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		1,4 1,3	1,4 1,3
	flooded bore hole	$h_{ef} \le 12d$		1,4	1,4
Temperature range III: 72°C/43°C	dry and wet concrete	$h_{ef} \le 12d$ $h_{ef} > 12d$		1,3 1,1	1,2 1,1
	flooded bore hole	$h_{ef} \le 12d$		1,3	1,2
Installation factor (dry and wet concrete)			γ_{inst} [-]	1,2	
Installation factor (flooded bore hole)			γ_{inst} [-]	1,4	

Table C37: Threaded rods
Displacements under tension load under seismic action (performance category C2)[1)]

Anchor size threaded rod			**M12**	**M16**
Temperature range I: 40°C/24°C	$\delta_{N,eq,C2(DLS)}$-Factor	[mm/(N/mm²)]	0,03	0,05
	$\delta_{N,eq,C2(ULS)}$-Factor	[mm/(N/mm²)]	0,06	0,09
Temperature range II: 60°C/43°C	$\delta_{N,eq,C2(DLS)}$-Factor	[mm/(N/mm²)]	0,03	0,05
	$\delta_{N,eq,C2(ULS)}$-Factor	[mm/(N/mm²)]	0,06	0,09
Temperature range III: 72°C/43°C	$\delta_{N,eq,C2(DLS)}$-Factor	[mm/(N/mm²)]	0,03	0,05
	$\delta_{N,eq,C2(ULS)}$-Factor	[mm/(N/mm²)]	0,06	0,09

[1)] Calculation of the displacement
$\delta_{N,eq,C2(DLS)} = \delta_{N,eq,C2(DLS)}$-Factor $\cdot \tau$ with τ = action bond stress
$\delta_{N,eq,C2(ULS)} = \delta_{N,eq,C2(ULS)}$-Factor $\cdot \tau$ with τ = action bond stress

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Annex C26

Performances
Threaded rod: Characteristic resistance values and displacements under tension load (seismic actions, performance category C2)

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Table C38: Threaded rod
Characteristic resistance values under shear load under seismic action (performance category C2)

Anchor size threaded rod			**M12**	**M16**
Steel failure without lever arm				
Characteristic tension resistance, Steel, property class 4.6, 4.8	$V_{Rk,s,eq,C2}$	[kN]	16,0	30,4
Characteristic tension resistance, Steel, property class 5.6, 5.8	$V_{Rk,s,eq,C2}$	[kN]	16,8	31,2
Characteristic tension resistance, Steel, property class 8.8	$V_{Rk,s,eq,C2}$	[kN]	27,2	50,4
Characteristic tension resistance, Stainless steel A2, A4 and HCR, property class 50	$V_{Rk,s,eq,C2}$	[kN]	16,8	31,2
Characteristic tension resistance, Stainless steel A2, A4 and HCR, property class 70	$V_{Rk,s,eq,C2}$	[kN]	24,0	44,0
Characteristic tension resistance, Stainless steel A4 and HCR, property class 80	$V_{Rk,s,eq,C2}$	[kN]	27,2	50,4
Factor for annular gap	α_{gap}	[-]	0,5	
Partial factor	$\gamma_{Ms,V}$	[kN]	See Table C4	
Installation factor	γ_{inst}	[-]	1,0	

Table C39: Threaded rod
Displacements under shear load under seismic action (performance category C2)[1)]

Anchor size threaded rod			**M12**	**M16**
All temperatures	$\delta_{V,eq,C2(DLS)}$ -Factor	[mm/(N/mm²)]	0,2	0,1
	$\delta_{V,eq,C2(ULS)}$ -Factor	[mm/(N/mm²)]	0,2	0,1

[1)] Calculation of the displacement
$\delta_{V,eq,C2(DLS)} = \delta_{V,eq,C2(DLS)}$-Factor · V with V = action shear load
$\delta_{V,eq,C2(ULS)} = \delta_{V,eq,C2(ULS)}$-Factor · V with V = action shear load

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Annex C27

Performances
Threaded rod: Characteristic resistance values and displacements under shear load (seismic actions, performance category C2)