Deutsches Institut für Bautechnik
DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

European Technical Assessment

ETA-16/0905 of 20 February 2017

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	Injection system AC200+ for concrete
Product family to which the construction product belongs	Bonded anchor for use in concrete
Manufacturer	Stanley Black & Decker Deutschland GmbH Richard-Klinger-Straße 11 65510 Idstein DEUTSCHLAND
Manufacturing plant	Plant 1
This European Technical Assessment contains	20 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 "Injection stem AC200+ for concrete" is a bonded anchor consisting of a cartridge with injection mortar AC200+ and a steel element. The steel element consist 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.

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 static and quasi-static action and seismic performance categories C1, C2	See Annex C 1 to C 4
Displacements	See Annex C 5 to C 6

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 assessed

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

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.

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

In accordance with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 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 EAD

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

Issued in Berlin on 20 February 2017 by Deutsches Institut für Bautechnik

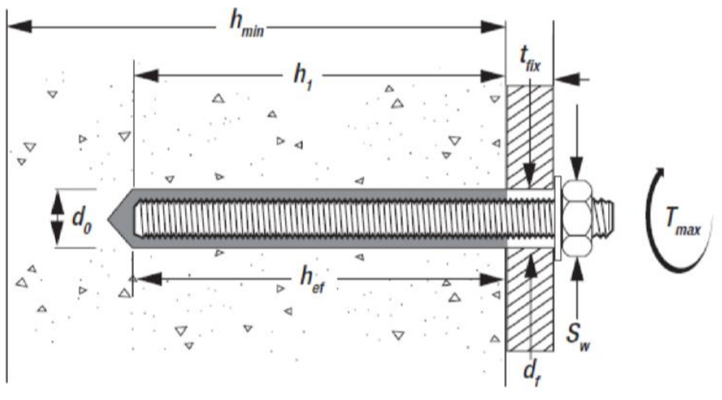
Andreas Kummerow
p.p. Head of Department

beglaubigt:
Baderschneider

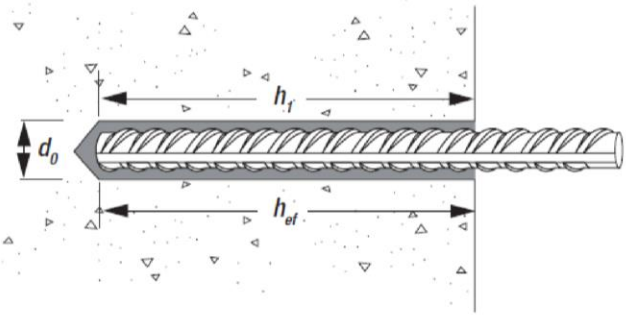
Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut

Reinforcing bar Ø8, Ø10, Ø2, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32

Installation threaded rod M8 to M30



Installation reinforcing bar Ø8 to Ø32



t_{fix} = thickness of fixture
h_{ef} = effective anchorage depth
h_1 = depth of drill hole
h_{min} = minimum thickness of member

Injection System AC200+ for concrete

Product description
Installed condition

Annex A1

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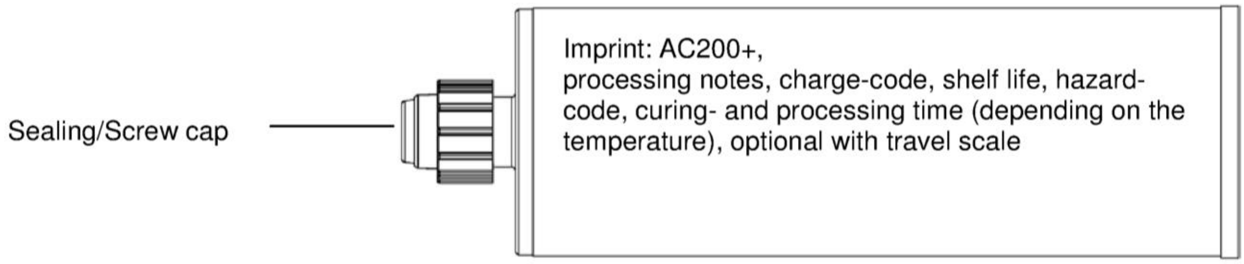
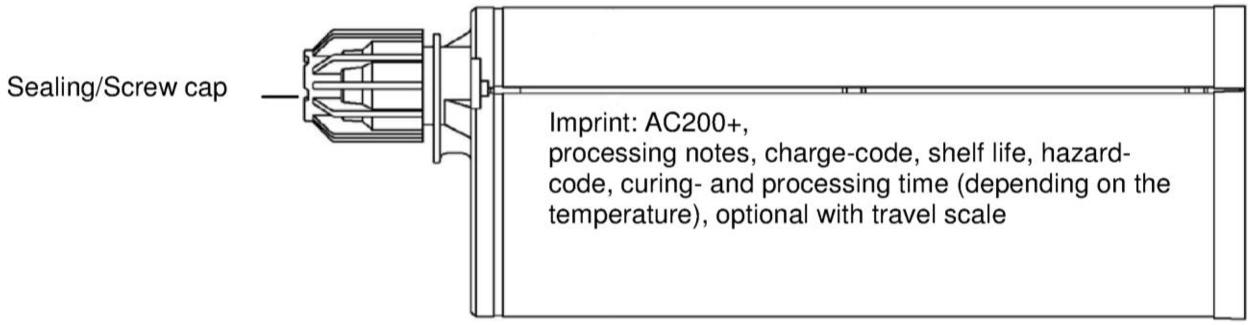
Cartridge: AC200+

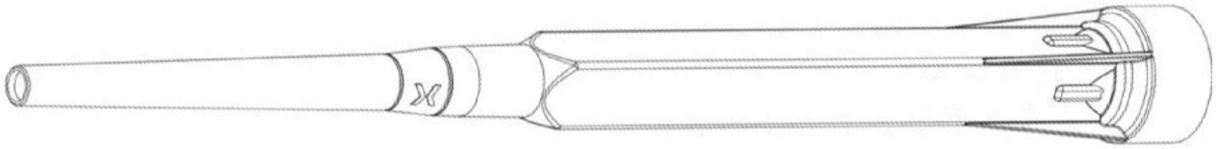
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)



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

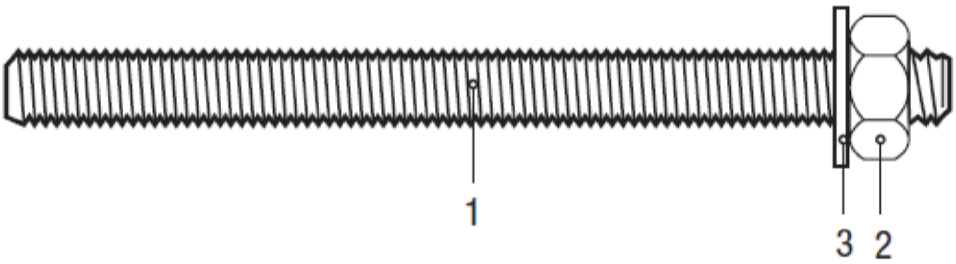


Static mixer



Injection System AC200+ for concrete	Annex A2
Product description Injection system	

Table A1: Materials (Threaded rod)



Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or **Steel, hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009**		
1	Anchor rod	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4.6, 4.8, 5.6, 5.8, 8.8 acc. to EN 1993-1-8:2005+AC:2009 A_5 > 12% fracture elongation
2	Hexagon nut EN ISO 4032:2012	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 rod and 4.8 rod) Property class 5 (for class 5.6 rod and 5.8 rod) Property class 8 (for class 8.8 rod) EN ISO 898-2:2012
3	Washer EN ISO 887:2006; EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated or hot-dip galvanised
Stainless steel A4		
1	Anchor rod	Material 1.4401 / 1.4404 / 1.4571, EN 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A_5 > 12% fracture elongation
2	Hexagon nut EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571 EN 10088-1:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
3	Washer EN ISO 887:2006; EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401, 1.4404 or 1.4571, EN 10088-1:2005
High corrosion resistance steel HCR		
1	Anchor rod	Material 1.4529 / 1.4565, EN 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A_5 > 12% fracture elongation
2	Hexagon nut EN ISO 4032 :2012	Material 1.4529 / 1.4565 EN 10088-1:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
3	Washer EN ISO 887:2006; EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565, EN 10088-1:2005

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

Injection System AC200+ for concrete

Product description
Materials (Threaded rod)

Annex A3

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Table A1: Materials (Rebar)

Part	Designation	Material
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 $f_{uk} = f_{tk} = k \cdot f_{yk}$

- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2009+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)

Specifications of intended use

Anchorages subject to:
- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C1: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C2: M12

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: M8 to M30, Rebar Ø8 to Ø32.
- Cracked concrete: M8 to M30, Rebar Ø8 to Ø32.

Temperature Range:
- I: - 40 °C to +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- II: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °C)
- III: - 40 °C to +160 °C (max long term temperature +100 °C and max short term temperature +160 °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
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  - EOTA Technical Report TR 045 "Design of metal anchors under seismic action", Edition February 2013
  - Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure.
  - Fastenings in stand-off installation or with a grout layer are not allowed.

Installation:
- Dry or wet concrete.
- Hole drilling by hammer or compressed air drill mode.
- 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.

Table B1: Installation parameters for threaded rod

Threaded rod size		M8	M10	M12	M16	M20	M24	M27	M30
Diameter of threaded rod	$d_1 = d_{nom}$ [mm]	8	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0 [mm]	10	12	14	18	22	28	32	35
Effective anchorage depth	$h_{ef,min}$ [mm]	60	60	70	80	90	96	108	120
	$h_{ef,max}$ [mm]	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture[1)]	d_f [mm]	9	12	14	18	22	26	30	33
Installation torque (max.)	T_{inst} [Nm]	10	20	40[2)]	60	100	170	250	300
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2d_0$				
Minimum spacing	s_{min} [mm]	40	50	60	75	95	115	125	140
Minimum edge distance	c_{min} [mm]	35	40	45	50	60	65	75	80

1) For larger clearance hole see TR029 section 1.1; for application under seismic loading the diameter of clearance hole in the fixture shall be at maximum d_1 + 1mm or alternatively the annular gap between fixture and anchor rod shall be filled force-fit with mortar.

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

Table B2: Installation parameters for rebar

Rebar size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Diameter of element	$d = d_{nom}$ [mm]	8	10	12	14	16	20	25	28	32
Nominal drill hole diameter	d_0 [mm]	12	14	16	18	20	25	32	35	40
Effective anchorage depth	$h_{ef,min}$ [mm]	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$ [mm]	160	200	240	280	320	400	500	560	640
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2d_0$						
Minimum spacing	s_{min} [mm]	40	50	60	70	75	95	120	130	150
Minimum edge distance	c_{min} [mm]	35	40	45	50	50	60	70	75	85

Table B3: Parameter cleaning and setting tools

								
Threaded Rod	Rebar	Drill bit diameter d_0	Brush diameter nominal d_b	Brush diameter minimum $d_{b,min}$	Piston plug Ø	Installation direction and use of piston plug		
[mm]	[mm]	[mm]	[mm]	[mm]	[No.]	down	horizont	overhead
M8	-	10	11,5	10,5	-	-	-	-
M10	Ø8	12	13,5	12,5	-	-	-	-
M12	Ø10	14	15,5	14,5	-	-	-	-
-	Ø12	16	17,5	16,5	-	-	-	-
M16	Ø14	18	20,0	18,5	#18	h_{ef} > 250 mm	h_{ef} > 250 mm	all
-	Ø16	20	22,0	20,5	#20			
M20	-	22	24,0	22,5	#22			
-	Ø20	25	27,0	25,5	#25			
M24	-	28	30,0	28,5	#28			
M27	-	30	31,8	30,5	#30			
-	Ø25	32	34,0	32,5	#32			
M30	Ø28	35	37,0	35,5	#35			
-	Ø32	40	43,5	40,5	#40			

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

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

Piston plug
Drill bit diameter (d_0): 18 mm to 40 mm

Steel brush
Drill bit diameter (d_0): all diameters

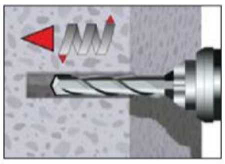
Injection System AC200+ for concrete

Intended use
Cleaning and setting tools

Annex B3

Installation instructions

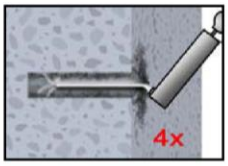
Drilling of the bore hole



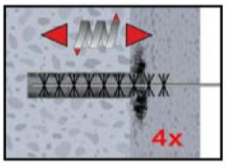
1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2). In case of aborted drill hole: the drill hole shall be filled with mortar

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

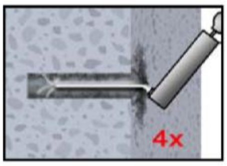
MAC: Cleaning for bore hole diameter $d_0 \le$ 20mm and bore hole depth $h_0 \le 10d_s$ (uncracked concrete only!)



2a. Starting from the bottom or back of the bore hole, blow the hole clean by a hand pump (Annex B3) a minimum of four times. If the bore hole ground is not reached an extension must be used.

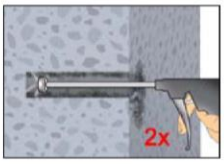


2b. Check brush diameter (Table B3). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B3) a minimum of four times in a twisting motion. If the bore hole ground is not reached with the brush, a brush extension must be used.

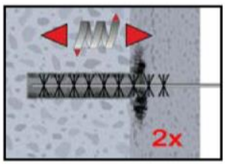


2c. Finally blow the hole clean again with a hand pump (Annex B3) a minimum of four times. If the bore hole ground is not reached an extension must be used.

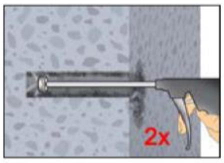
CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete



2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.



2b. Check brush diameter (Table B3). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B3) a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension must be used.

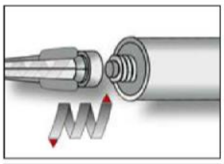


2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

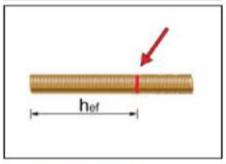
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar.
In-flowing water must not contaminate the bore hole again.

Injection System AC200+ for concrete	**Annex B4**
Intended use Installation instructions	

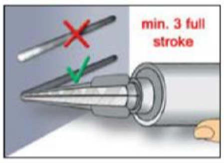
Preparing



3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. For every working interruption longer than the recommended working time (Table B4) as well as for new cartridges, a new static-mixer shall be used.

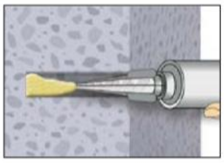


4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.

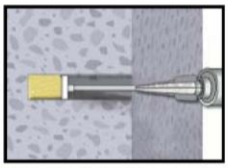


5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour.

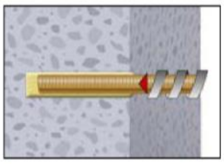
Installation



6. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used. Observe the gel-/ working times given in Table B4.

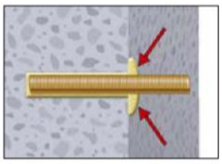


7. Piston plugs and mixer nozzle extensions shall be used according to Table B3 for the following applications:
   - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): For drill bit diameter ≥ 18 mm and embedment depth h_{ef} > 250mm
   - Overhead assembly (vertical upwards direction): For drill bit diameter ≥ 18 mm



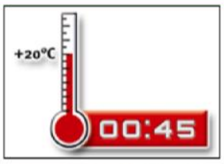
8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

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

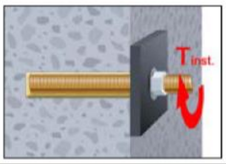


9. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).

Curing and fixture



10. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B4).



11. After full curing, the add-on part can be installed with up to the max. torque (Table B1) by using a calibrated torque wrench.

Injection System AC200+ for concrete	**Annex B5**
Intended use Installation instructions (continuation)	

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Table B4: Maximum working time and minimum curing time

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

Injection System AC200+ for concrete

Intended use
Curing time

Annex B6

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Table C1: Characteristic values of tension loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Anchor size threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure											
Characteristic tension resistance		$N_{Rk,s} = N_{Rk,s,C1} = N_{Rk,s,C2}$	[kN]	$A_s \cdot f_{uk}$							
		$N_{Rk,s,C2}$	[kN]	NPD		$A_s \cdot f_{uk}$	NPD				
Combined pull-out and concrete cone failure											
Characteristic bond resistance in non-cracked concrete C20/25											
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	17	17	16	15	14	13	13	13
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	14	14	13	12	12	11	11
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	12	12	11	10	9,5	9,0	9,0	9,0
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	6,5	7,0	7,5	8,5	8,5	8,5	8,5	8,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		3,6	NPD				
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,5	6,0	6,5	7,5	7,5	7,5	7,5	7,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		3,1	NPD				
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,0	5,5	6,0	6,5	6,5	6,5	6,5	6,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		2,5	NPD				
Increasing factors for concrete (only static or quasi-static action) ψ_c		C25/30		1,02							
		C30/37		1,04							
		C35/45		1,07							
		C40/50		1,08							
		C45/55		1,09							
		C50/60		1,10							
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_3	[-]	10,1							
	Cracked concrete			7,2							
Concrete cone failure											
Factor according to CEN/TS 1992-4-5 Section 6.2.3.1	Non-cracked concrete	k_{ucr}	[-]	10,1							
	Cracked concrete	k_{cr}	[-]	7,2							
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}							
Axial distance		$s_{cr,N}$	[mm]	3,0 h_{ef}							
Splitting failure											
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}							
	$2,0 > h/h_{ef} > 1,3$			2 h_{ef} (2,5-h/h_{ef})							
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}							
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Installation safety factor **(CAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0 (1,2)[1]				1,2			
Installation safety factor **(MAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2				-			

[1] Value in brackets for cracked concrete

Injection System AC200+ for concrete

Performances
Characteristic values of tension loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Annex C1

Table C2: Characteristic values of shear loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm										
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0{,}50 \cdot A_s \cdot f_{uk}$							
	$V_{Rk,s,C1}$	[kN]	$0{,}35 \cdot A_s \cdot f_{uk}$							
	$V_{Rk,s,C2}$	[kN]	NPD		$0{,}40 \cdot A_s \cdot f_{uk}$	NPD				
Steel failure with lever arm										
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$							
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)							
	$M^0_{Rk,s,C2}$	[Nm]	No Performance Determined (NPD)							
Concrete pry-out failure										
Factor according to EN 1992-4 Section 7.2.2.4	k_8	[-]	2,0							
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							
Concrete edge failure										
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$							
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							

Injection System AC200+ for concrete

Performances
Characteristic values of shear loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Annex C2

Table C3: Characteristic values of tension loads for rebar under static, quasi-static action and seismic action (performance category C1)

Anchor size rebar				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure												
Characteristic tension resistance		$N_{Rk,s}$ = $N_{Rk,s,C1}$	[kN]	$A_s \cdot f_{uk}$								
Combined pull-out and concrete cone failure												
Characteristic bond resistance in non-cracked concrete C20/25												
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	14	14	14	14	13	13	13	13	13
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	13	12	12	12	12	11	11	11	11
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10	10	9,5	9,5	9,5	9,0	9,0	9,0	9,0
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,0	5,5	6,0	6,0	7,5	7,5	7,5	7,5	8,0
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	4,5	5,0	5,0	5,5	6,5	6,5	6,5	6,5	7,0
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	4,0	4,5	4,5	5,0	5,5	6,0	6,0	5,5	6,5
Increasing factors for concrete (only static or quasi-static action) ψ_c		C25/30		1,02								
		C30/37		1,04								
		C35/45		1,07								
		C40/50		1,08								
		C45/55		1,09								
		C50/60		1,10								
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_3	[-]	10,1								
	Cracked concrete	k_3	[-]	7,2								
Concrete cone failure												
Factor according to CEN/TS 1992-4-5 Section 6.2.3.1	Non-cracked concrete	k_{ucr}	[-]	10,1								
	Cracked concrete	k_{cr}	[-]	7,2								
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}								
Axial distance		$s_{cr,N}$	[mm]	3,0 h_{ef}								
Splitting failure												
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}								
	$2,0 > h/h_{ef} > 1,3$	$c_{cr,sp}$	[mm]	2 h_{ef} $(2,5-h/h_{ef})$								
	$h/h_{ef} \leq 1,3$	$c_{cr,sp}$	[mm]	2,4 h_{ef}								
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$								
Installation safety factor **(CAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0 (1,2)[1]					1,2			
Installation safety factor **(MAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2					-			

[1] Value in brackets for cracked concrete

Injection System AC200+ for concrete

Performances
Characteristic values of tension loads for rebar under static, quasi-static action and seismic action (performace category C1)

Annex C3

Table C4: Characteristic values of shear loads for rebar under static, quasi-static action and seismic action (performance category C1)

Anchor size rebar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure without lever arm											
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0{,}50 \cdot A_s \cdot f_{uk}$								
	$V_{Rk,s,C1}$	[kN]	$0{,}37 \cdot A_s \cdot f_{uk}$								
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1	k_2	[-]	0,8								
Steel failure with lever arm											
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$								
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)								
Concrete pry-out failure											
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$	[-]	2,0								
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								
Concrete edge failure											
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 8\ d_{nom})$								
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								

Injection System AC200+ for concrete

Performances
Characteristic values of shear loads for rebar under static, quasi-static action and seismic action (performance category C1)

Annex C4

Table C5: Displacements under tension load[1)] (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete C20/25 under static and quasi-static action										
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,037	0,039	0,042	0,044	0,046
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,047	0,051	0,054	0,057	0,060
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,038	0,041	0,044	0,046	0,048
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,049	0,053	0,056	0,059	0,062
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,121	0,126	0,131	0,142	0,153	0,163	0,171	0,179
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,146	0,157	0,168	0,176	0,184
Cracked concrete C20/25 under static, quasi-static and seismic action (performance category C1)										
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,090	0,095	0,099	0,103	0,106
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,116	0,122	0,128	0,133	0,137
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,093	0,098	0,103	0,107	0,110
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,121	0,127	0,133	0,138	0,143
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,349	0,367	0,385	0,399	0,412
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,321	0,330	0,340	0,358	0,377	0,396	0,410	0,424
Cracked concrete C20/25 under seismic action (performance category C2)										
Temperature range I: 80°C/50°C	$\delta_{N,seis(DLS)}$	[mm/(N/mm²)]	No Parameter Determined (NPD)		0,120	No Parameter Determined (NPD)				
	$\delta_{N,seis(ULS)}$	[mm/(N/mm²)]			0,140					
Temperature range II: 120°C/72°C	$\delta_{N,seis(DLS)}$	[mm/(N/mm²)]			0,120					
	$\delta_{N,seis(ULS)}$	[mm/(N/mm²)]			0,140					
Temperature range III: 160°C/100°C	$\delta_{N,seis(DLS)}$	[mm/(N/mm²)]			0,120					
	$\delta_{N,seis(ULS)}$	[mm/(N/mm²)]			0,140					

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

Table C6: Displacements under shear load[1)] (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete C20/25 under static, quasi-static and seismic action (performance category C1)										
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Cracked concrete C20/25 under seismic action (performance category C2)										
All temperature ranges	$\delta_{V,seis(DLS)}$	[mm/(kN)]	No Parameter Determined (NPD)		0,27	No Parameter Determined (NPD)				
	$\delta_{V,seis(ULS)}$	[mm/(kN)]			0,27					

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

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Performances
Displacements (threaded rods)

Annex C5

Table C7: Displacements under tension load[1] (rebar)

Anchor size rebar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non-cracked concrete C20/25 under static and quasi-static action											
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,035	0,037	0,039	0,043	0,045	0,048
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,045	0,047	0,051	0,055	0,058	0,063
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,036	0,038	0,041	0,045	0,047	0,050
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,047	0,049	0,053	0,057	0,060	0,065
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,121	0,126	0,131	0,137	0,142	0,153	0,164	0,172	0,186
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,141	0,146	0,157	0,169	0,177	0,192
Cracked concrete C20/25 under static, quasi-static and seismic action (performance category C1)											
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,087	0,090	0,095	0,099	0,103	0,108
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,113	0,116	0,122	0,128	0,133	0,141
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,090	0,093	0,098	0,103	0,107	0,113
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,118	0,121	0,127	0,133	0,138	0,148
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,340	0,349	0,367	0,385	0,399	0,425
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,321	0,330	0,340	0,349	0,358	0,377	0,396	0,410	0,449

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

Table C8: Displacement under shear load[1] (rebar)

Anchor size rebar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Non-cracked and cracked concrete C20/25 under static, quasi-static and seismic action (performance category C1)											
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04

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