Deutsches Institut für Bautechnik

DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment

ETA-13/0258 of 10 May 2016

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 AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice
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	Herstellwerk 1 Herstellwerk 2
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.
This version replaces	ETA-13/0258 issued on 11 May 2015

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Specific Part

1 Technical description of the product

The "Injection system AC100-PRO, AC100-PRO Nordic or AC100-Pro Ice" is a bonded anchor consisting of a cartridge with injection mortar AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice 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 tension and shear loads	See Annex C 1 to C 4
Displacements under tension and shear loads	See Annex C 5 / 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 10 May 2016 by Deutsches Institut für Bautechnik

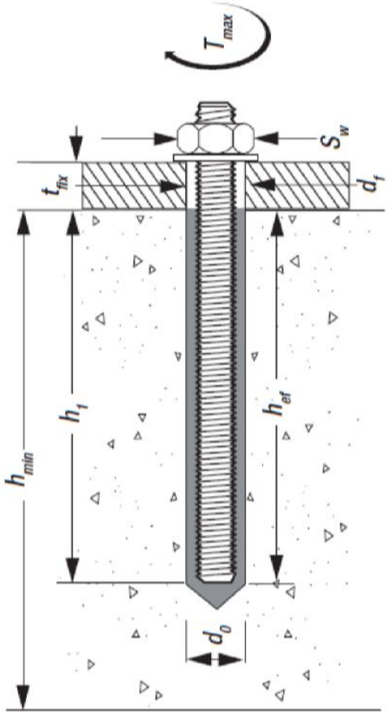
Uwe Bender
Head of Department

beglaubigt:
Baderschneider

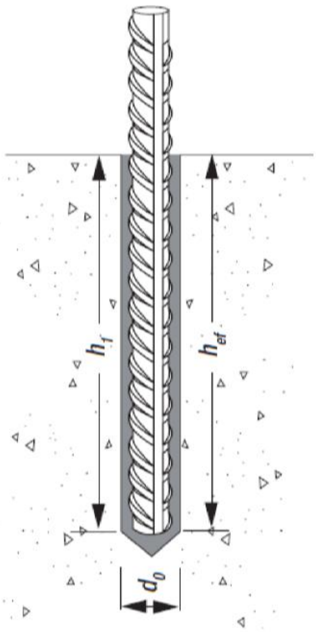
Threaded rod M8, M10, M12, M16, M20, M24, M27 and M30 with washer and nut

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

Threaded rod

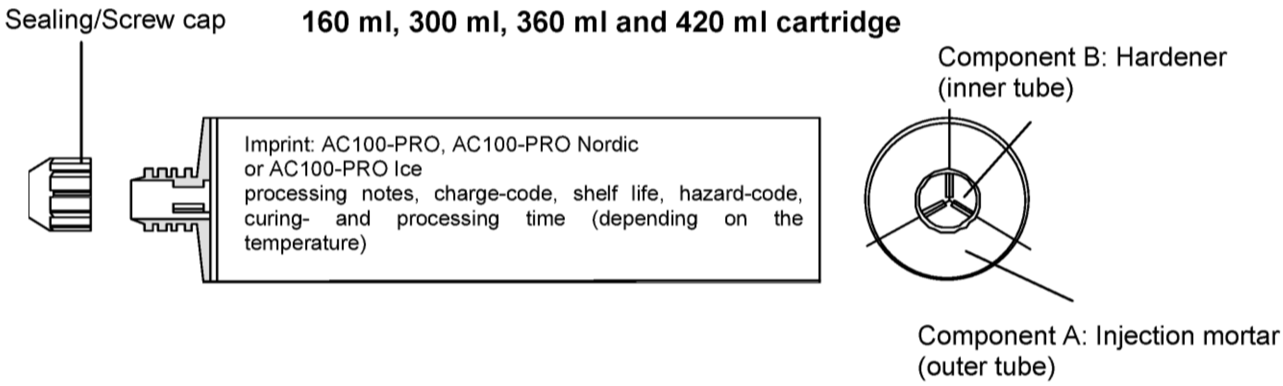


Reinforcing bar

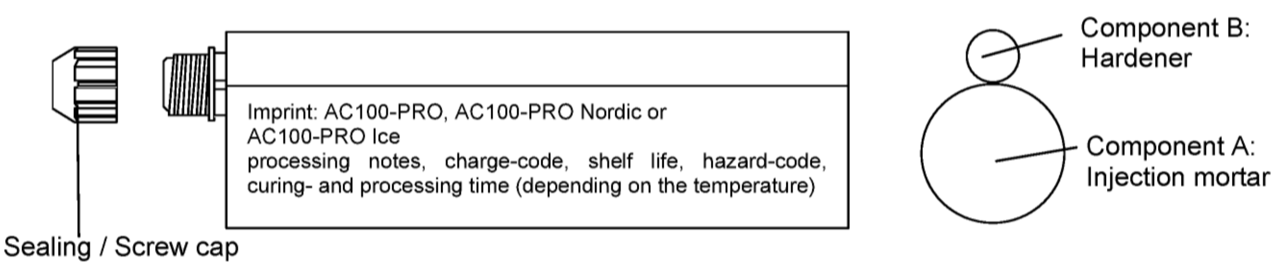


Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex A1**
Product description Product and Installation	

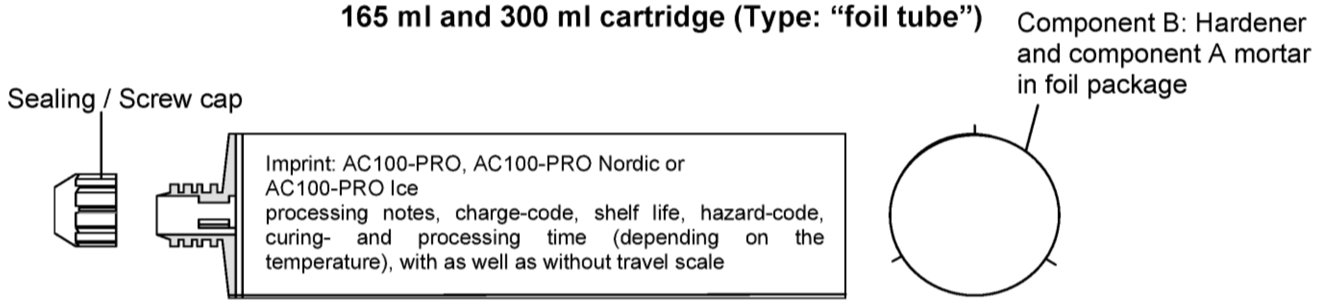
160 ml, 300 ml, 360 ml and 420 ml cartridge



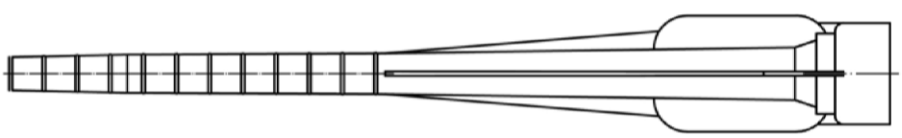
235 ml, 360 ml and 825 ml cartridge (Type: "side-by-side")



165 ml and 300 ml cartridge (Type: "foil tube")

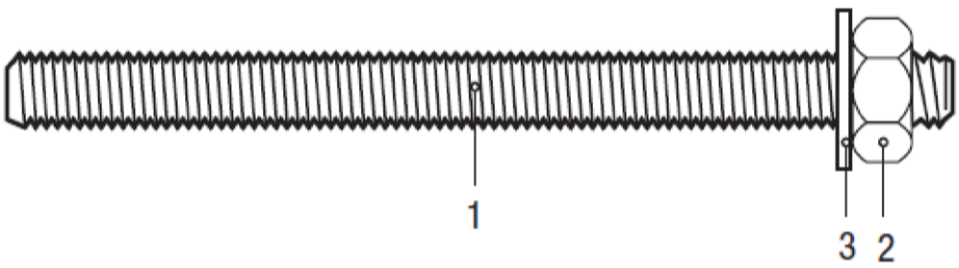


Static Mixer



Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex A2**
Product description Product (Injection mortar)	

Table A1: Material (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		
1	Anchor rod	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4.6, 5.8, 8.8 acc. EN 1993-1-8:2005+AC:2009 A_5 > 8% fracture elongation, $f_{uk} = f_{ub}$ $f_{yk} = f_{yb}$
2	Hexagon nut EN ISO 4032 :2012	Steel acc. EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 rod) Property class 5 (for class 5.8 rod) Property class 8 (for class 8.8 rod) EN ISO 898-2:2012
3	Washer EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated 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 > 8% fracture elongation, $f_{uk} = R_{m,min}$ $f_{yk} = R_{p0.2,min}$
2	Hexagon nut EN ISO 4032:2012	Material 1.4401 / 1.4404 / 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, EN ISO 7089, EN ISO 7093, or EN ISO 7094	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 > 8% fracture elongation, $f_{uk} = R_{m,min}$ $f_{yk} = R_{p0.2,min}$
2	Hexagon nut EN ISO 4032 :2012	Material 1.4529 / 1.4565 EN 10088-1:2005, > 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 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 AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex A3**
Product description Materials (Threaded rod)	

Table A2: Material (Rebar)

- 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)

Reinforcing bar		
1	Rebar according EN 1992-1-1:2009+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Specifications of intended use

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

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

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 +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- III: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °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.
- Flooded holes (not sea water) for drill diameters $d_0 \leq 18$ mm.
- Hole drilling by hammer 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.

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex B1**
Intended use Specifications	

Table B1: Installation parameters for threaded rod

Anchor size		**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**	**M 27**	**M 30**
Nominal drill hole diameter	d_0 [mm]	10	12	14	18	24	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	d_f [mm]	9	12	14	18	22	26	30	33
Diameter of steel brush	d_b [mm]	12	14	16	20	26	30	34	37
Torque moment	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			$h_{ef} + 2 \cdot d_0$				
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

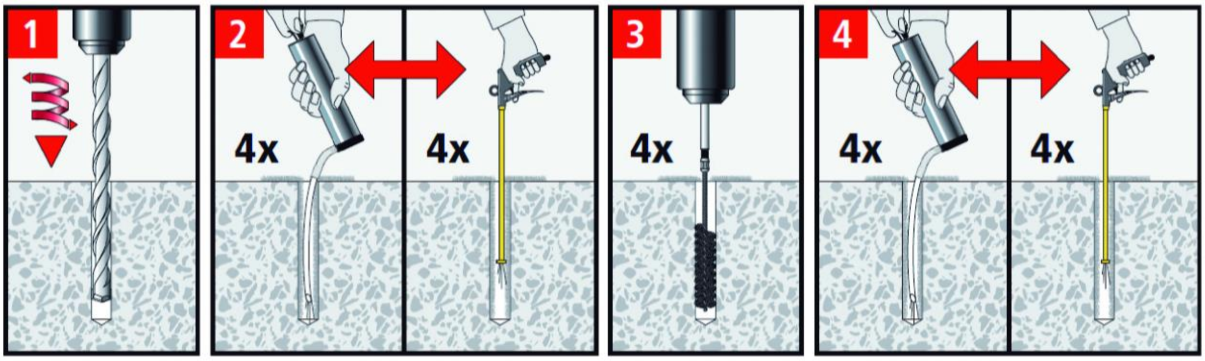
Table B2: Installation parameters for rebar

Rebar size		**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 24**	**Ø 25**	**Ø 28**	**Ø 32**
Nominal drill hole diameter	d_0 [mm]	12	14	16	18	20	24	28	32	35	37
Effective anchorage 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	480	540	640
Diameter of steel brush	d_b [mm]	14	16	18	20	22	26	30	34	37	40
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2 \cdot d_0$							
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

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice

Annex B2

Intended use
Installation parameters



1 Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1 or Table B2).

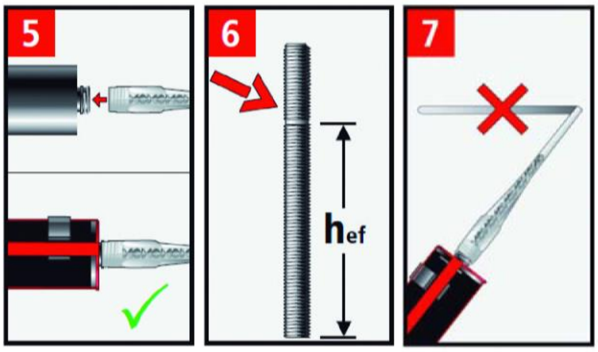
2 Before cleaning remove standing water out of the drill hole. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump (Annex B5) a minimum of four times. If the bore hole ground is not reached an extension shall be used.

The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm.
For bore holes larger than 20 mm or deeper than 240 mm, compressed air (min. 6 bar) **must** be used.

3. Check brush diameter (Table B6) and attach the brush to a drilling machine or a battery screwdriver. Starting from the bottom or back of the bore hole, brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B6) a minimum of four times.
If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B6).

4. Finally blow the hole clean again with compressed air (min. 6 bar) or a hand pump (Annex B6) a minimum of four times. If the bore hole ground is not reached an extension shall be used.

The hand-pump can be used for anchor sizes up to bore hole diameter 20 mm.
For bore holes larger than 20 mm or deeper than 240 mm, compressed air (min. 6 bar) **must** be used.

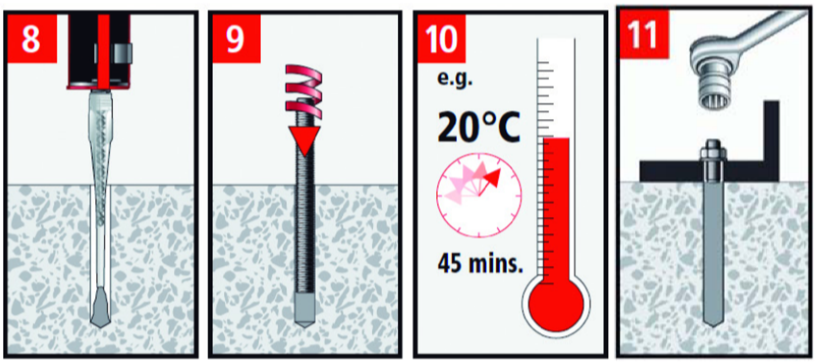


5. Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use.
For every working interruption longer than the recommended working time (Table B3 or B4) as well as for new cartridges, a new static-mixer shall be used.

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

7. 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.

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex B3**
Intended use Installation instructions	



8. 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. For overhead and horizontal installation in bore holes larger than ∅ 20 mm a piston plug and extension nozzle (Annex B6) shall be used. Observe the gel-/ working times given in Table B5. Injecting the mortar in with water filled drill holes is allowed for drill diameters smaller than 18 mm.

9. 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.

   Be sure that the anchor is fully seated at the bottom of the hole that the annular gap is completely filled with mortar and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application shall not be loaded and has to be renewed.

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 or B5).

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

Table B3: Minimum curing time AC100-PRO

Concrete temperature[1)]			Gelling- / working time	Minimum curing time in dry concrete[3)]
-10 °C	to	-6°C	90 min[2)]	24 h[2)]
-5 °C	to	-1°C	90 min	14 h
0 °C	to	+4°C	45 min	7 h
+5 °C	to	+9°C	25 min	2 h
+ 10 °C	to	+19°C	15 min	80 min
+ 20 °C	to	+29°C	6 min	45 min
+ 30 °C	to	+34°C	4 min	25 min
+ 35 °C	to	+39°C	2 min	20 min
≥ + 40 °C			1,5 min	15 min

1) Cartridge temperature **must** be between +5°C to +40°C
2) Cartridge temperature **must** be at min. +15°C
3) In wet concrete the curing time **must** be doubled

Table B4: Minimum curing time AC100-PRO Nordic or Ice

Concrete temperature[1)]			Gelling- / working time	Minimum curing time in dry concrete[2)]
-20 °C	to	-16°C	75 min	24 h
-15 °C	to	-11°C	55 min	16 h
-10 °C	to	-6°C	35 min	10 h
-5 °C	to	-1°C	20 min	5 h
0 °C	to	+4°C	10 min	2,5 h
+5 °C	to	+9°C	6 min	80 min
≥ + 10 °C			6 min	60 min

1) Cartridge temperature **must** be between -20°C to +10°C
2) In wet concrete the curing time **must** be doubled

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice
Intended use
Curing time

Annex B5

Steel brush and extension

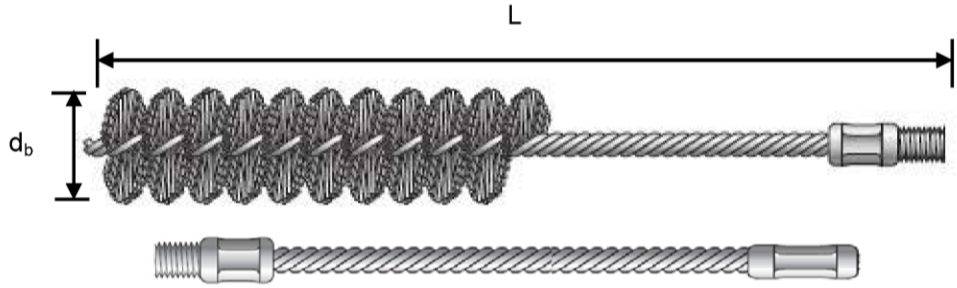


Table B5: Parameter cleaning and setting tools

Threaded rod [mm]	Rebar [mm]	Drill bit Ø d_0 [mm]	Brush diameters nominal d_b [mm]	Brush diameters minimum $d_{b,min}$ [mm]	Piston plug denom. (Ø) [mm]
M8		10	12	10,5	-
M10	8	12	14	12,5	-
M12	10	14	16	14,5	-
	12	16	18	16,5	-
M16	14	18	20	18,5	-
	16	20	22	20,5	-
M20	20	24	26	24,5	#24 (22)
M24	24	28	30	28,5	#28 (27)
M27	25	32	34	32,5	#28 (29)
M30	28	35	37	35,5	#35 (34)
	32	37	40	37,5	#35 (36)

Hand pump (volume 750 ml)
Drill bit diameter (d_0): 10 mm to 20 mm

Recommended compressed air tool (min 6 bar)
Drill bit diameter (d_0): 10 mm to 37 mm

Piston plug for overhead or horizontal installation
Drill bit diameter (d_0): 24 mm to 37 mm

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice

Annex B6

Intended use
Cleaning and setting tools

Table C1: Characteristic resistance values for threaded rods under tension loads

Anchor size threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$							
		$N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}$							
Combined pullout and concrete cone failure											
Characteristic bond resistance in non-cracked concrete C20/25											
dry and wet concrete	Temp. range I: 40°C/24°C	$\tau_{Rk,uncr}$	[N/mm²]	11	13	13	13	13	12	11	9,5
	Temp. range II: 80°C/50°C	$\tau_{Rk,uncr}$	[N/mm²]	8,0	9,5	9,5	9,5	9,5	9,0	8,0	7,0
	Temp. range III: 120°C/72°C	$\tau_{Rk,uncr}$	[N/mm²]	5,5	6,5	6,5	6,5	6,5	6,0	5,5	5,0
flooded bore hole	Temp. range I: 40°C/24°C	$\tau_{Rk,uncr}$	[N/mm²]	8,0	9,5	9,5	9,5	Not admissible			
	Temp. range II: 80°C/50°C	$\tau_{Rk,uncr}$	[N/mm²]	6,0	7,0	7,0	7,0				
	Temp. range III: 120°C/72°C	$\tau_{Rk,uncr}$	[N/mm²]	4,5	5,5	5,5	5,5				
Characteristic bond resistance in cracked concrete C20/25											
dry and wet concrete	Temp. range I: 40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	4,0	5,0	5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,seis}$	[N/mm²]	2,5	3,1	3,7	3,7	3,7	3,8	4,5	4,5
	Temp. range II: 80°C/50°C	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,5	4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,seis}$	[N/mm²]	1,6	2,2	2,7	2,7	2,7	2,8	3,1	3,1
	Temp. range III: 120°C/72°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,seis}$	[N/mm²]	1,3	1,6	2,0	2,0	2,0	2,1	2,4	2,4
flooded bore hole	Temp. range I: 40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	6,0	6,0	Not admissible			
		$\tau_{Rk,seis}$	[N/mm²]	2,5	2,5	3,7	3,7				
	Temp. range II: 80°C/50°C	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,0	4,5	4,5				
		$\tau_{Rk,seis}$	[N/mm²]	1,6	1,9	2,7	2,7				
	Temp. range III: 120°C/72°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,5	3,5				
		$\tau_{Rk,seis}$	[N/mm²]	1,3	1,6	2,0	2,0				
Increasing factors for non-cracked concrete ψ_c		C30/37		1,04							
		C40/50		1,08							
		C50/60		1,10							
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_8	[-]	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]	$1{,}5 \cdot h_{ef}$							
Axial distance		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$							
Splitting failure											
Edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$							
Installation safety factor	dry and wet concrete	$\gamma_2 = \gamma_{inst}$		1,0	1,2						
	flooded bore hole	$\gamma_2 = \gamma_{inst}$		1,4				Not admissible			

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice

Annex C1

Performances
Application with threaded rod
Characteristic values for tension loads

Table C2: Characteristic resistance values for threaded rods under shear loads

Anchor size threaded rod			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Steel failure without lever arm										
Characteristic tension resistance	$V_{Rk,s}$	[kN]	$0{,}5 \cdot A_s \cdot f_{uk}$							
	$V_{Rk,s,seis}$	[kN]	$0{,}35 \cdot A_s \cdot f_{uk}$							
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 resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$							
	$M^0_{Rk,s,seis}$	[Nm]	No Performance Determined (NPD)							
Concrete pryout 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	16	20	24	27	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0							

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice

Annex C2

Performances
Application with threaded rod
Characteristic values for shear loads

Table C3: Characteristic resistance values for reinforcing bars under tension loads

Anchor size reinforcing bar				Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32
Steel failure													
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$									
		$N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}$									
Combined pullout and concrete cone failure													
Characteristic bond resistance in non-cracked concrete C20/25													
dry and wet concrete	Temp. range I: 40°C/24°C	$\tau_{Rk,uncr}$	[N/mm²]	11	13	13	13	13	13	11,5	11,5	10,5	9,0
	Temp. range II: 80°C/50°C	$\tau_{Rk,uncr}$	[N/mm²]	8,0	9,5	9,5	9,5	9,5	9,5	8,5	8,5	7,5	6,5
	Temp. range III: 120°C/72°C	$\tau_{Rk,uncr}$	[N/mm²]	5,5	6,5	6,5	6,5	6,5	6,5	6,0	6,0	5,0	4,5
flooded bore hole	Temp. range I: 40°C/24°C	$\tau_{Rk,uncr}$	[N/mm²]	8,0	9,5	9,5	9,5	9,5	Not admissible				
	Temp. range II: 80°C/50°C	$\tau_{Rk,uncr}$	[N/mm²]	6,0	7,0	7,0	7,0	7,0					
	Temp. range III: 120°C/72°C	$\tau_{Rk,uncr}$	[N/mm²]	4,5	5,5	5,5	5,5	5,5					
Characteristic bond resistance in cracked concrete C20/25													
dry and wet concrete	Temp. range I: 40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	4,0	5,0	5,5	5,5	5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,seis}$	[N/mm²]	2,5	3,1	3,7	3,7	3,7	3,7	3,7	3,8	4,5	4,5
	Temp. range II: 80°C/50°C	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,5	4,0	4,0	4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,seis}$	[N/mm²]	1,6	2,2	2,7	2,7	2,7	2,7	2,7	2,8	3,1	3,1
	Temp. range III: 120°C/72°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,0	3,0	3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,seis}$	[N/mm²]	1,3	1,6	2,0	2,0	2,0	2,0	2,0	2,1	2,4	2,4
flooded bore hole	Temp. range I: 40°C/24°C	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	6,0	6,0	6,0	Not admissible				
		$\tau_{Rk,seis}$	[N/mm²]	2,5	2,5	3,7	3,7	3,7					
	Temp. range II: 80°C/50°C	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,0	4,5	4,5	4,5					
		$\tau_{Rk,seis}$	[N/mm²]	1,6	1,9	2,7	2,7	2,7					
	Temp. range III: 120°C/72°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,5	3,5	3,5					
		$\tau_{Rk,seis}$	[N/mm²]	1,3	1,6	2,0	2,0	2,0					
Increasing factors for non-cracked concrete ψ_c		C30/37		1,04									
		C40/50		1,08									
		C50/60		1,10									
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_8	[-]	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]	$1{,}5 \cdot h_{ef}$									
Axial distance		$s_{cr,N}$	[mm]	$3{,}0 \cdot h_{ef}$									
Splitting failure													
Edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$									
Axial distance		$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$									
Installation safety factor	dry and wet concrete	$\gamma_2 = \gamma_{inst}$		1,0	1,2								
	flooded bore hole	$\gamma_2 = \gamma_{inst}$		1,4					Not admissible				

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice

Annex C3

Performances
Application with reinforcing bar
Characteristic values for tension loads

Table C4: Characteristic resistance values for reinforcing bars under shear loads

Anchor size reinforcing bar			**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
Steel failure without lever arm												
Characteristic tension resistance	$V_{Rk,s}$	[kN]	$0{,}5 \cdot A_s \cdot f_{uk}$									
	$V_{Rk,s,seis}$	[kN]	$0{,}35 \cdot A_s \cdot f_{uk}$									
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 resistance	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$									
	$M^0_{Rk,s,seis}$	[Nm]	No Performance Determined (NPD)									
Concrete pryout 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	24	25	28	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0									

Table C5: Displacements for tension loads[1] (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete										
Temperature range I 40°C/24°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,034	0,033	0,037	0,045	0,052	0,060	0,065	0,071
Temperature range II 80°C/50°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
Temperature range III 120°C/72°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
Cracked concrete										
Temperature range I 40°C/24°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,090	0,090	0,070	0,070	0,070	0,070	0,070	0,070
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,105	0,105	0,105	0,105	0,105	0,105	0,105	0,105
Temperature range II 80°C/50°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,219	0,219	0,170	0,170	0,170	0,170	0,170	0,170
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,255	0,255	0,245	0,245	0,245	0,245	0,245	0,245
Temperature range III 120°C/72°C										
Displacement	δ_{N0} - factor	[mm/ (N/mm²)]	0,219	0,219	0,170	0,170	0,170	0,170	0,170	0,170
Displacement	$\delta_{N\infty}$ - factor	[mm/ (N/mm²)]	0,255	0,255	0,245	0,245	0,245	0,245	0,245	0,245

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

Table C6: Displacement for shear load[1] (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete										
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	0,04
Cracked concrete										
Displacement	δ_{V0} - factor	[mm/ kN]	0,120	0,120	0,112	0,103	0,093	0,084	0,076	0,069
Displacement	$\delta_{V\infty}$ - factor	[mm/ kN]	0,180	0,180	0,169	0,154	0,140	0,125	0,115	0,104

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

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex C5**
Performances Displacements (Threaded rods)	

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Table C7: Displacements for tension loads[1] (reinforcing bar)

Anchor size reinforcing bar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32
Uncracked concrete												
Temperature range I 40°C/24°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,021	0,023	0,026	0,028	0,031	0,036	0,042	0,043	0,047	0,052
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,034	0,033	0,037	0,041	0,045	0,052	0,057	0,061	0,071	0,075
Temperature range II 80°C/50°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,069	0,075	0,088	0,103	0,104	0,113	0,126
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,144	0,149	0,163	0,181
Temperature range III 120°C/72°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,069	0,075	0,088	0,103	0,104	0,113	0,126
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,144	0,149	0,163	0,181
Cracked concrete												
Temperature range I 40°C/24°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,090	0,090	0,07	0,070	0,070	0,070	0,070	0,070	0,070	0,070
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,105	0,105	0,105	0,105	0,105	0,105	0,105	0,105	0,105	0,105
Temperature range II 80°C/50°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,219	0,219	0,170	0,170	0,170	0,170	0,170	0,170	0,170	0,170
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,255	0,255	0,245	0,245	0,245	0,245	0,245	0,245	0,245	0,245
Temperature range III 120°C/72°C												
Displacement	δ_{N0} - factor	[mm/(N/mm²)]	0,219	0,219	0,170	0,170	0,170	0,170	0,170	0,170	0,170	0,170
Displacement	$\delta_{N\infty}$ - factor	[mm/(N/mm²)]	0,255	0,255	0,245	0,245	0,245	0,245	0,245	0,245	0,245	0,245

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

Table C8: Displacement for shear load[1] (reinforcing bar)

Anchor size reinforcing bar			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø24	Ø25	Ø28	Ø32
Uncracked concrete												
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	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04
Uncracked concrete												
Displacement	δ_{V0} - factor	[mm/(kN)]	0,120	0,120	0,112	0,108	0,103	0,093	0,083	0,081	0,074	0,064
Displacement	$\delta_{V\infty}$ - factor	[mm/(kN)]	0,180	0,180	0,169	0,161	0,154	0,140	0,126	0,122	0,111	0,097

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

Injection system AC100-PRO, AC100-PRO Nordic or AC100-PRO Ice	**Annex C6**
Performances Displacements (Reinforcing bar)	