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Authorised and notified according
to Article 29 of the Regulation (EU)
No 305/2011 of the European
Parliament and of the Council of 9
March 2011

MEMBER OF EOTA



European Technical Assessment ETA-18/0950 of 2018/11/06

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

**Trade name of the
construction product:**

Meccanocar 155 00 11540-F420

**Product family to which the
above construction product
belongs:**

Bonded injection type anchor for use in concrete

Manufacturer:

Meccanocar Italia S.r.l.
Via San Francesco, 22
IT - 56033 Capannoli (PI)
web www.meccanocar.com

Manufacturing plant:

Meccanocar Italia S.r.l.

**This European Technical
Assessment contains:**

23 pages including 18 annexes which form an
integral part of the document

**This European Technical
Assessment is issued in
accordance with Regulation
(EU) No 305/2011, on the basis
of:**

EAD 330499-00-0601, "Bonded fasteners for use in
concrete"

This version replaces:

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full (except the confidential Annexes referred to above). However, partial reproduction may be made, with the written consent of the issuing Technical Assessment Body. Any partial reproduction has to be identified as such.

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product and intended use

Technical description of the product

The Injection System VSM for concrete is a bonded anchor consisting of a cartridge with VSM injection mortar 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.

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.

The characteristic material values, dimensions and tolerances of the anchors not indicated in Annexes shall correspond to the respective values laid down in the technical documentation¹ of this European Technical Assessment.

2 Specification of the intended use in accordance with the applicable EAD

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 provisions made in this European Technical Assessment are based on an assumed intended working life of the anchor of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body, 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.

¹ The technical documentation of this European Technical Assessment is deposited at ETA-Danmark and, as far as relevant for the tasks of the Notified bodies involved in the attestation of conformity procedure, is handed over to the notified bodies.

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

3.1 Characteristics of product

Mechanical resistance and stability (BWR 1):

The essential characteristics are detailed in the Annex C.

Safety in case of fire (BWR 2):

Anchorage satisfy requirements for Class A1.

No performance is assessed for resistance to fire.

Hygiene, health and the environment (BWR3):

No performance assessed

Safety in use (BWR4):

For basic requirement Safety in use the same criteria are valid for Basic Requirement Mechanical resistance and stability (BWR1).

Sustainable use of natural resources (BWR7)

No performance assessed

Other Basic Requirements are not relevant.

3.2 Methods of assessment

The assessment of fitness of the anchor for the intended use in relation to the requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements 1 and 4 has been made in accordance with EAD 330499-00-0601, "Bonded fasteners for use in concrete" and EOTA TR 049, "Post-installed fasteners in concrete under seismic action".

4 Assessment and verification of constancy of performance (AVCP)

4.1 AVCP system

According to the decision 96/582/EC of the European Commission, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 1.

5 Technical details necessary for the implementation of the AVCP system, as foreseen in the applicable EAD

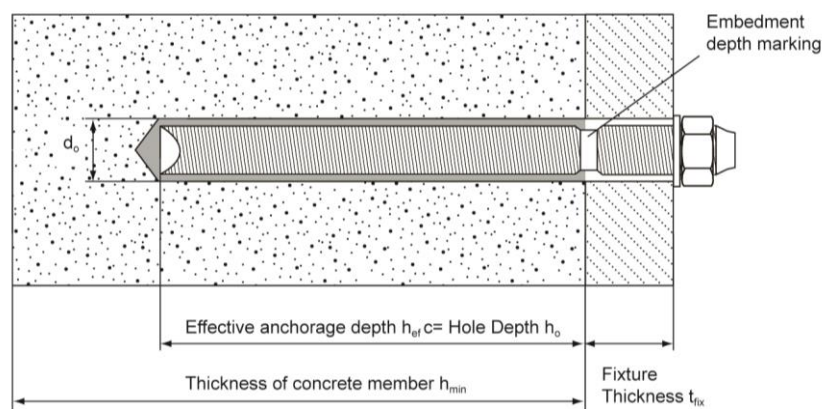
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking

Issued in Copenhagen on 2018-11-06 by

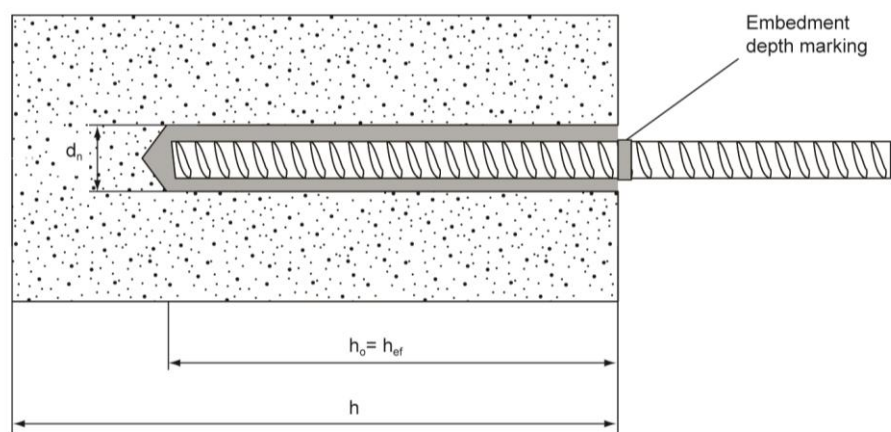


Thomas Bruun
Managing Director, ETA-Danmark

Installation threaded rod M8 up to M30



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



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

Injection System VSM for concrete	Annex A1
Product description Installed condition	

Cartridge: VSM

- A) Foil Bag Cartridge 165ml, 300ml.**
- B) Coaxial Cartridge 380ml / 400 ml / 410 ml / 420ml**
- C) Side by Side Cartridge 345ml, 825ml**

Cartridge Print : VSM
Including - Installation procedure, Production Batch code, Expiry Date,
Storage conditions, Health & Safety warning, Gel & Cure time according
to temperatures.

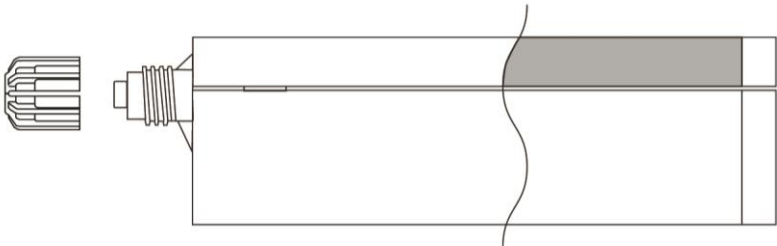
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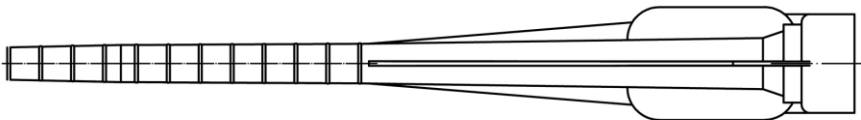
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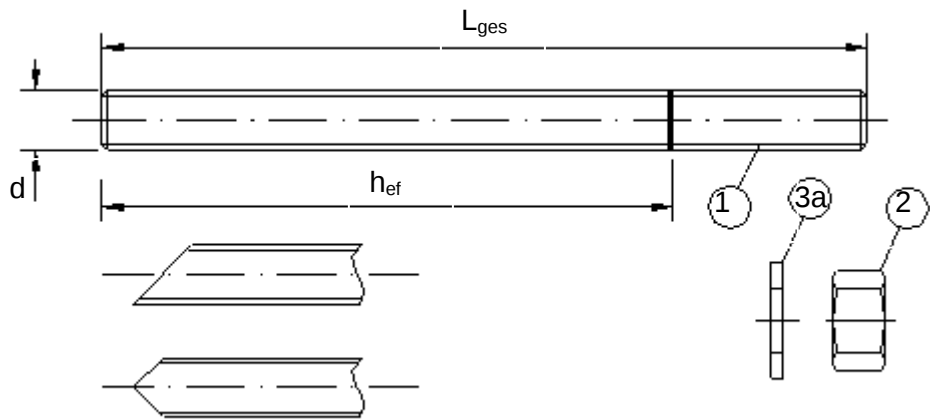


Mixer



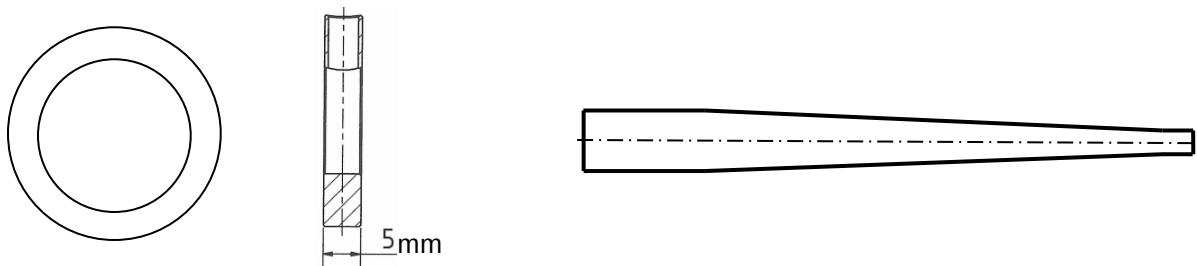
Injection System VSM for concrete	Annex A2
Product description Injection system	

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



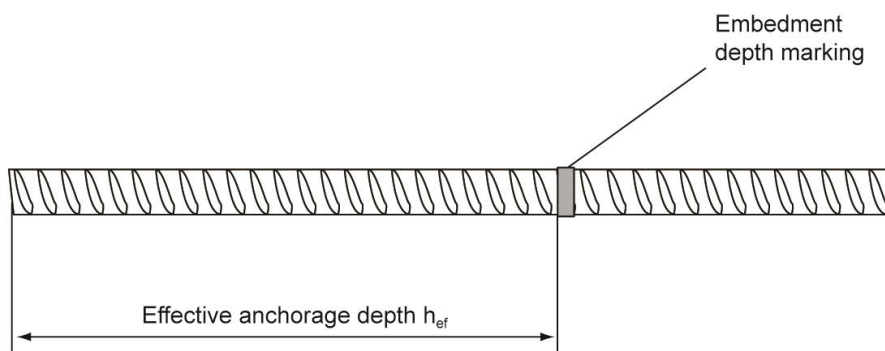
- Commercial standard threaded rod with:
- Materials, dimensions and mechanical properties acc. Table A1
 - Inspection certificate 3.1 acc. to EN 10204:2004
 - Marking of embedment depth

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



Injection System VSM for concrete	Annex A3
Product description Threaded rod and filling washer	

Table A1: Materials				
	Designation	Material		
Steel, zinc plated (Steel acc. to EN 10087:1998 or EN 10263:2001)				
zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 odr hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or sherardized ≥ 40 µm acc. to DIN EN 17668:2016-06				
1	Anchor rod	Property class acc. to EN ISO 898-1:2013	4.6	f _{uk} =400 N/mm ² ; f _{yk} =240 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			4.8	f _{uk} =400 N/mm ² ; f _{yk} =320 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			5.6	f _{uk} =500 N/mm ² ; f _{yk} =300 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			5.8	f _{uk} =500 N/mm ² ; f _{yk} =400 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			8.8	f _{uk} =800 N/mm ² ; f _{yk} =640 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			10.9	f _{uk} =1000 N/mm ² ; f _{yk} =900 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
2	Hexagon nut	Property class acc. to EN ISO 898-2:2012	4	for anchor rod class 4.6 or 4.8
			5	for anchor rod class 5.6 or 5.8
			8	for anchor rod class 8.8
			10	for anchor rod class 10.9
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Steel, zinc plated, hot-dip galvanised or sherardized		
3b	Filling washer			
Stainless steel A2 (Material 1.4301 / 1.4303 / 1.4307 / 1.4567 oder 1.4541, acc. to EN 10088-1:2014) and Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)				
1	Anchor rod ¹⁾²⁾	Property class acc. to EN ISO 3506-1:2009	50	f _{uk} =500 N/mm ² ; f _{yk} =210 N/mm ² ; A ₅ >8% ⁴⁾ fracture elongation
			70	f _{uk} =700 N/mm ² ; f _{yk} =450 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
			80	f _{uk} =800 N/mm ² ; f _{yk} =600 N/mm ² ; A ₅ > 8% ⁴⁾ fracture elongation
2	Hexagon nut ¹⁾²⁾	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	A2: Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, EN 10088-1:2014 A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, EN 10088-1:2014		
3b	Filling washer ³⁾			
High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)				
1	Anchor rod ¹⁾	Property class acc. to EN ISO 3506-1:2009	50	f _{uk} =500 N/mm ² ; f _{yk} =210 N/mm ² ; A ₅ >8% ⁴⁾ fracture elongation
			70	f _{uk} =700 N/mm ² ; f _{yk} =450 N/mm ² ; A ₅ >8% ⁴⁾ fracture elongation
			80	f _{uk} =800 N/mm ² ; f _{yk} =600 N/mm ² ; A ₅ >8% ⁴⁾ fracture elongation
2	Hexagon nut ¹⁾	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014		
3b	Filling washer			
¹⁾ Property class 70 for anchor rods up to M24 and ²⁾ Property class 70 only for stainless steel A4 ³⁾ Filling washer only with stainless steel A4 ⁴⁾ For seismic performance category C2, A₅ > 19% fracture elongation				
Injection System VSM for concrete				Annex A4
Product description Materials threaded rod				

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

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

Table A2: Materials

Part	Designation	Material
Reinforcing bars		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Rebar class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Injection System VSM for concrete

Product description
Materials reinforcing bar

Annex A5

Specifications of intended use

Anchorage subject to:

- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C1: M8 to M30 (except hot-dip galvanised rods), Rebar Ø8 to Ø32.
- Seismic action for Performance Category C2: M12, M16 and M20

Base materials:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- 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 +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 A2 resp. A4 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 A4 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.
- The Anchorages are designed in accordance to:
 - FprEN 1992-4:2017 and Technical Report TR055
 - Anchorages under seismic load are designed in accordance with EOTA Technical Report TR045

Installation:

- Dry or wet concrete: M8 to M30, Rebar Ø8 to Ø32.
- Flooded holes (not sea water): M8 to M16, Rebar Ø8 to Ø16.
- Hole drilling by hammer (HD), hollow (HDB) or compressed air drill mode (CD).
- 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 VSM for concrete	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
Outer diameter of anchor	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 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
Maximum torque moment	T_{inst} [Nm] ≤	10	20	40	80	120	160	180	200
Minimum thickness of member	h_{min} [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$				
Minimum spacing	s_{min} [mm]	40	50	60	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 25	Ø 28	Ø 32
Outer diameter of anchor	d _{nom} [mm] =	8	10	12	14	16	20	25	28	32
Nominal drill hole diameter	d ₀ [mm] =	12	14	16	18	20	24	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	580	640
Diameter of steel brush	d _b [mm] ≥	14	16	18	20	22	26	34	37	41,5
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	125	140	160
Minimum edge distance	c _{min} [mm]	40	50	60	70	80	100	125	140	160

Injection System VSM for concrete**Annex B2**

Intended Use
Installation parameters

Table B3: Parameter cleaning and setting tools

									
Threaded Rod	Rebar	d_0 Drill bit - Ø HD, HDB, CA	d_b Brush - Ø		$d_{b,min}$ min. Brush - Ø	Piston plug	Installation direction and use of piston plug		
(mm)	(mm)	(mm)		(mm)	(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	PL18	$h_{ef} > 250 \text{ mm}$	$h_{ef} > 250 \text{ mm}$	all
	16	20		22	20,5	PL20			
M20	20	24		26	24,5	PL24			
M24		28		30	28,5	PL28			
M27	25	32		34	32,5	PL32			
M30	28	35		37	35,5	PL35			
	32	40		41,5	40,5	PL40			

**Push Pump**

Drill bit diameter (d_0): 10 mm to 20 mm
 Drill hole depth (h_0): $< 10 d_{nom}$
 Only in non-cracked concrete

**CAC - Compressed air tool (min 6 bar)**

Drill bit diameter (d_0): all diameters

**Piston plug for overhead or horizontal installation PL**

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

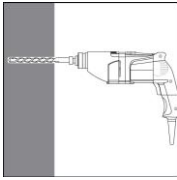
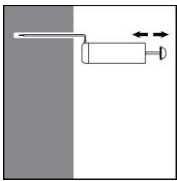
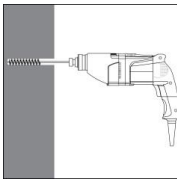
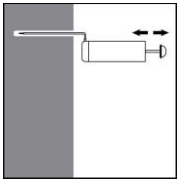
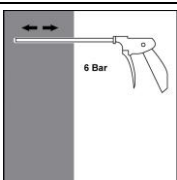
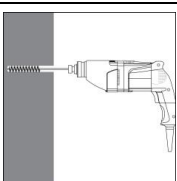
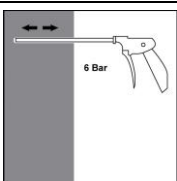
**Steel Brush**

Drill bit diameter (d_0): all diameters

Injection System VSM for concrete

Intended Use
 Cleaning and setting tools

Annex B3

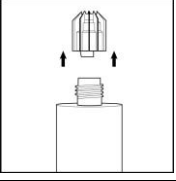
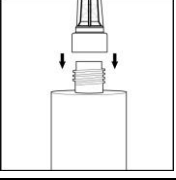
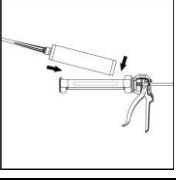
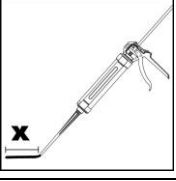
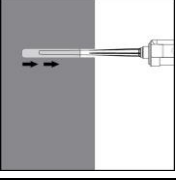
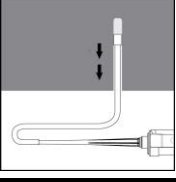
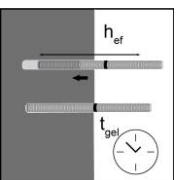
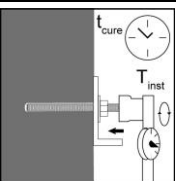
Instructions for use		
Bore hole drilling		
		Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1 or B2.), with hammer (HD), hollow (HDB) or compressed air (CD) drilling. The use of a hollow drill bit is only in combination with a sufficient vacuum permitted. 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.
Bore hole cleaning Just before setting an anchor, the bore hole must be free of dust and debris.		
MAC: Cleaning for bore hole diameter $d_0 \leq 20\text{mm}$ and bore hole depth $h_0 \leq 10d_{\text{nom}}$ (uncracked concrete only!)		
	X 4	Starting from the bottom or back of the bore hole, blow the hole clean by a hand pump ¹⁾ (Annex B3) a minimum of four times.
	X 4	Check brush diameter (Table B3). Brush the hole with an appropriate sized wire brush $> d_{b,\text{min}}$ (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.
	X 4	Finally blow the hole clean again with a hand pump (Annex B3) a minimum of four times. ¹⁾It is permitted to blow bore holes with diameter between 14 mm and 20 mm and an embedment depth up to $10d_{\text{nom}}$ also in cracked concrete with hand-pump
CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete		
	X 4	Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 3) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.
	X 4	Check brush diameter (Table B3). Brush the hole with an appropriate sized wire brush $> d_{b,\text{min}}$ (Table B3) a minimum of four times. If the bore hole ground is not reached with the brush, a brush extension must be used.
	X 4	Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B3) a minimum of four 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 VSM for concrete

Annex B4

Intended Use

Installation instructions

Instructions for use	
	Remove the threaded cap from the cartridge.
	Attach the supplied mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use if necessary. For every working interruption longer than the recommended working time (Table B4) as well as for new cartridges, a new mixer shall be used.
	Insert the cartridge into the dispenser. Press the release trigger to retract the plunger and insert the cartridge neatly into the cradle without any distortion. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.
	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. For foil tube cartridges it must be discarded a minimum of six full strokes.
	Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the 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.
	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): Drill bit-Ø d0 ≥ 18 mm and embedment depth h_{ef} > 250mm • Overhead assembly (vertical upwards direction): Drill bit-Ø d0 ≥ 18 mm
	Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor shall be free of dirt, grease, oil or other foreign material.
	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). 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). After full curing, the add-on part can be installed with up to the max. torque (Table B1) by using a calibrated torque wrench. It can be optional filled the annular gap between anchor and fixture with mortar. Therefor substitute the washer by the filling washer and connect the mixer reduction nozzle to the tip of the mixer. The annular gap is filled with mortar, when mortar oozes out of the washer.

Injection System VSM for concrete**Annex B5****Intended Use**

Installation instructions (continuation)

**Table B4: Maximum Working time and minimum curing time
VSM**

Concrete temperature	Gelling- / working time	Minimum curing time in dry concrete ¹⁾
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
Cartridge temperature	+5°C to +40°C	

¹⁾ In wet concrete the curing time must be doubled.

Resin injection pump details

Image	Size Cartridge / Code	Type
	165 / 300ml 165/300 ml 10:1	Manual
	345 / 380 / 400 / 410 / 420ml 420 ml 10:1 345 ml 10:1	Manual
	165 / 300 / 380 / 400 / 410 / 420ml 165/300 ml 380 / 400 / 410 / 420 ml 345 ml 7.4v Tool	Battery
	380 / 400 / 410 / 825ml 380 / 400 / 410 / 420 ml 825ml	Pneumatic

Injection System VSM for concrete**Annex B6**

Intended Use
Curing time

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

Size				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Characteristic tension resistance, Steel failure											
Steel, Property class 4.6 and 4.8		N _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
Steel, Property class 5.6 and 5.8		N _{Rk,s}	[kN]	18	29	42	78	122	176	230	280
Steel, Property class 8.8		N _{Rk,s}	[kN]	29	46	67	125	196	282	368	449
Steel, Property class 10.9		N _{Rk,s}	[kN]	38	60	87	163	255	367	477	583
Stainless steel A2, A4 and HCR, Property class 50		N _{Rk,s}	[kN]	18	29	42	79	123	177	230	281
Stainless steel A2, A4 and HCR, Property class 70		N _{Rk,s}	[kN]	26	41	59	110	171	247	-	-
Stainless steel A4 and HCR, Property class 80		N _{Rk,s}	[kN]	29	46	67	126	196	282	-	-
Characteristic tension resistance, Partial factor											
Steel, Property class 4.6		γ _{Ms,N} ¹⁾	[-]	2,0							
Steel, Property class 4.8		γ _{Ms,N} ¹⁾	[-]	1,5							
Steel, Property class 5.6		γ _{Ms,N} ¹⁾	[-]	2,0							
Steel, Property class 5.8, 8.8 and 10.9		γ _{Ms,N} ¹⁾	[-]	1,5							
Stainless steel A2, A4 and HCR, Property class 50		γ _{Ms,N} ¹⁾	[-]	2,86							
Stainless steel A2, A4 and HCR, Property class 70		γ _{Ms,N} ¹⁾	[-]	1,87							
Stainless steel A4 and HCR, Property class 80		γ _{Ms,N} ¹⁾	[-]	1,6							
Characteristic shear resistance, Steel failure											
Without lever arm	Steel, Property class 4.6 and 4.8	V ⁰ _{Rk,s}	[kN]	9	14	20	38	59	85	110	135
	Steel, Property class 5.6 and 5.8	V ⁰ _{Rk,s}	[kN]	9	15	21	39	61	88	115	140
	Steel, Property class 8.8	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	184	224
	Steel, Property class 10.9	V ⁰ _{Rk,s}	[kN]	19	30	43	81	127	183	238	224
	Stainless steel A2, A4 and HCR, Property class 50	V ⁰ _{Rk,s}	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A2, A4 and HCR, Property class 70	V ⁰ _{Rk,s}	[kN]	13	20	30	55	86	124	-	-
	Stainless steel A4 and HCR, Property class 80	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	-	-
With lever arm	Steel, Property class 4.6 and 4.8	M ⁰ _{Rk,s}	[Nm]	15	30	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	M ⁰ _{Rk,s}	[Nm]	19	37	65	166	324	560	833	1123
	Steel, Property class 8.8	M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	896	1333	1797
	Steel, Property class 10.9	M ⁰ _{Rk,s}	[Nm]	37	75	131	333	649	1123	1664	2249
	Stainless steel A2, A4 and HCR, Property class 50	M ⁰ _{Rk,s}	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, Property class 70	M ⁰ _{Rk,s}	[Nm]	26	52	92	232	454	784	-	-
	Stainless steel A4 and HCR, Property class 80	M ⁰ _{Rk,s}	[Nm]	30	59	105	266	519	896	-	-
Characteristic shear resistance, Partial factor											
Steel, Property class 4.6		γ _{Ms,V} ¹⁾	[-]	1,67							
Steel, Property class 4.8		γ _{Ms,V} ¹⁾	[-]	1,25							
Steel, Property class 5.6		γ _{Ms,V} ¹⁾	[-]	1,67							
Steel, Property class 5.8		γ _{Ms,V} ¹⁾	[-]	1,25							
Steel, Property class 8.8		γ _{Ms,V} ¹⁾	[-]	1,25							
Steel, Property class 10.9		γ _{Ms,V} ¹⁾	[-]	1,50							
Stainless steel A2, A4 and HCR, Property class 50		γ _{Ms,V} ¹⁾	[-]	2,38							
Stainless steel A2, A4 and HCR, Property class 70		γ _{Ms,V} ¹⁾	[-]	1,56							
Stainless steel A4 and HCR, Property class 80		γ _{Ms,V} ¹⁾	[-]	1,33							
1) in absence of national regulation											
Injection System VSM for concrete								Annex C1			
Performances											
Characteristic values for steel tension resistance and steel shear resistance of threaded rods											

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

Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	see Table C1							
		$N_{Rk,s, C1} = N_{Rk,s, C2}$	[kN]	$1,0 \cdot N_{Rk,s}$							
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete failure											
Characteristic bond resistance in non-cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10	12	12	12	12	11	10	9
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	8,5	8,5	8,5	No Performance assessed			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,5	9	9	9	9	8,5	7,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	5,5	6,5	6,5	6,5	No Performance assessed			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	5,5	6,5	6,5	6,5	6,5	6,5	5,5	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	4,0	5,0	5,0	5,0	No Performance assessed			
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	4,0	5,0	5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,C1}$	[N/mm²]	2,5	3,1	3,7	3,7	3,7	3,8	4,5	4,5
		$\tau_{Rk,C2}$	[N/mm²]	-	-	2	2	2	-	-	-
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	4,0	4,0	5,5	5,5	No Performance assessed			
		$\tau_{Rk,C1}$	[N/mm²]	2,5	2,5	3,7	3,7	No Performance assessed			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,5	4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,C1}$	[N/mm²]	1,6	2,2	2,7	2,7	2,7	2,8	3,1	3,1
		$\tau_{Rk,C2}$	[N/mm²]	-	-	1,4	1,4	1,4	-	-	-
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	2,5	3,0	4,0	4,0	No Performance assessed			
		$\tau_{Rk,C1}$	[N/mm²]	1,6	1,9	2,7	2,7	No Performance assessed			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]	1,3	1,6	2,0	2,0	2,0	2,1	2,4	2,4
		$\tau_{Rk,C2}$	[N/mm²]	-	-	1,1	1,1	1,1	-	-	-
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,5	3,0	3,0	No Performance assessed			
		$\tau_{Rk,C1}$	[N/mm²]	1,3	1,6	2,0	2,0	No Performance assessed			
Increasing factors for concrete (only static or quasi-static actions) ψ_c		C25/30		1,02							
		C30/37		1,04							
		C35/45		1,07							
		C40/50		1,08							
		C45/55		1,09							
		C50/60		1,10							
Concrete cone failure											
Non-cracked concrete		$k_{ucr,N}$	[-]	11,0							
Cracked concrete		$k_{cr,N}$	[-]	7,7							
Edge distance		$c_{cr,N}$	[mm]	$1,5 h_{ef}$							
Axial distance		$s_{cr,N}$	[mm]	$2 c_{cr,N}$							
Splitting											
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	$1,0 h_{ef}$							
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}} \right)$							
	$h/h_{ef} \leq 1,3$			$2,4 h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	$2 c_{cr,sp}$							
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,0	1,2						
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4				No Performance assessed			
Injection System VSM for concrete								Annex C2			
Performances Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1 and C2)											

Table C3: Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1 and C2)

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Steel failure without lever arm										
Characteristic shear resistance	$V_{Rk,s}^0$	[kN]	see Table C1							
	$V_{Rk,s,C1}$	[kN]	$0,70 \cdot V_{Rk,s}^0$							
	$V_{Rk,s,C2}$	[kN]	-	-	$0,60 \cdot V_{Rk,s}^0$	$0,70 \cdot V_{Rk,s}^0$	$0,75 \cdot V_{Rk,s}^0$	-	-	-
Characteristic shear resistance for hot-dip galvanized commercial rods	$V_{Rk,s,C2}$	[kN]	-	-	$0,35 \cdot V_{Rk,s}^0$			-	-	-
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Ductility factor	k_7	[-]	1,0							
Steel failure with lever arm										
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	see Table C1							
	$M_{Rk,s,eq}^0$	[Nm]	No Performance Determined (NPD)							
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Concrete pry-out failure										
Factor	k_8	[-]	2,0							
Installation factor	γ_{inst}	[-]	1,0							
Concrete edge failure										
Effective length of fastener	l_f	[mm]	$l_f = \min(h_{ef}, 8 d_{nom})$							
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ_{inst}	[-]	1,0							
Factor for annular gap	α_{gap}	[-]	$0,5 (1,0)^{1)}$							

¹⁾ Value in brackets valid for filled annular gap between anchor and clearance hole in the fixture. Use of special filling washer Annex A3 is required

Injection System VSM for concrete

Performances

Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1 and C2)

Annex C3

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

Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
Steel failure													
Characteristic tension resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$										
	$N_{Rk,s,eq}$	[kN]	$1,0 \cdot A_s \cdot f_{uk}^{1)}$										
Cross section area	A_s	[mm ²]	50	79	113	154	201	314	491	616	804		
Partial factor	$\gamma_{Ms,N}$	[-]	1,4 ²⁾										
Combined pull-out and concrete failure													
Characteristic bond resistance in non-cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm ²]	10	12	12	12	12	12	11	10	8,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	7,5	8,5	8,5	8,5	8,5	No Performance Assessed				
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm ²]	7,5	9	9	9	9	9	8,0	7,0	6,0	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	5,5	6,5	6,5	6,5	6,5	No Performance Assessed				
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm ²]	5,5	6,5	6,5	6,5	6,5	6,5	6,0	5,0	4,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	4,0	5,0	5,0	5,0	5,0	No Performance Assessed				
Characteristic bond resistance in cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm ²]	4,0	5,0	5,5	5,5	5,5	5,5	5,5	6,5	6,5	
		$\tau_{Rk,eq}$	[N/mm ²]	2,5	3,1	3,7	3,7	3,7	3,7	3,8	4,5	4,5	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm ²]	4,0	4,0	5,5	5,5	5,5	No Performance Assessed				
		$\tau_{Rk,eq}$	[N/mm ²]	2,5	2,5	3,7	3,7	3,7	No Performance Assessed				
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm ²]	2,5	3,5	4,0	4,0	4,0	4,0	4,0	4,5	4,5	
		$\tau_{Rk,eq}$	[N/mm ²]	1,6	2,2	2,7	2,7	2,7	2,7	2,8	3,1	3,1	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm ²]	2,5	3,0	4,0	4,0	4,0	No Performance Determined (NPD)				
		$\tau_{Rk,eq}$	[N/mm ²]	1,6	1,9	2,7	2,7	2,7	No Performance Determined (NPD)				
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm ²]	2,0	2,5	3,0	3,0	3,0	3,0	3,0	3,5	3,5	
		$\tau_{Rk,eq}$	[N/mm ²]	1,3	1,6	2,0	2,0	2,0	2,0	2,1	2,4	2,4	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm ²]	2,0	2,5	3,0	3,0	3,0	No Performance Determined (NPD)				
		$\tau_{Rk,eq}$	[N/mm ²]	1,3	1,6	2,0	2,0	2,0	No Performance Determined (NPD)				
Increasing factors for concrete (only static or quasi-static actions) ψ_c		C25/30		1,02									
		C30/37		1,04									
		C35/45		1,07									
		C40/50		1,08									
		C45/55		1,09									
		C50/60		1,10									
Concrete cone failure													
Non-cracked concrete		$k_{ucr,N}$	[-]	11,0									
Cracked concrete		$k_{cr,N}$	[-]	7,7									
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}									
Axial distance		$s_{cr,N}$	[mm]	2 $c_{cr,N}$									
Splitting													
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	$1,0 h_{ef}$									
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}} \right)$									
	$h/h_{ef} \leq 1,3$			$2,4 h_{ef}$									
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$									
Installation factor (dry and wet concrete)		γ_{inst}	[-]	1,0	1,2								
Installation factor (flooded bore hole)		γ_{inst}	[-]	1,4					No Performance Determined (NPD)				
¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation													
Injection System VSM for concrete									Annex C4				
Performances Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)													

Table C6: Displacements under tension load¹⁾ (threaded rod)

Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Non-cracked concrete C20/25											
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049	
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,030	0,033	0,037	0,045	0,052	0,060	0,065	0,071	
Temperature range II: 80°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119	
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172	
Temperature range III: 120°C/72°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119	
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172	
Cracked concrete C20/25											
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,090		0,070						
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,105		0,105						
Temperature range II: 80°C/50°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,219		0,170						
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,255		0,245						
Temperature range III: 120°C/72°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,219		0,170						
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,255		0,245						
Seismic Category C2											
All temperature ranges	$\delta_{N,eq}$ (DLS)	[mm]	-	-	0,11	0,19	0,62	-	-	-	
	$\delta_{N,eq}$ (ULS)	[mm]	-	-	0,29	0,62	0,94	-	-	-	
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 C7: Displacements under shear load ¹⁾ (threaded rod)											
Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
For non-cracked concrete C20/25											
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	
For cracked concrete C20/25											
All temperature ranges	δ_{V0} -factor	[mm/(kN)]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07	
	$\delta_{V\infty}$ -factor	[mm/(kN)]	0,18	0,18	0,17	0,15	0,14	0,13	0,12	0,10	
Seismic Category C2											
All temperature ranges	$\delta_{V,eq}$ (DLS)	[mm]	-	-	2,99	3,76	5,19	-	-	-	
	$\delta_{V,eq}$ (ULS)	[mm]	-	-	5,17	6,32	10,26	-	-	-	
¹⁾ Calculation of the displacement $\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load $\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;											
Injection System VSM for concrete								Annex C6			
Performances Displacements (threaded rods)											

Table C8: Displacements under tension load¹⁾ (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25											
Temperature range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm²)]	0,021	0,023	0,026	0,028	0,031	0,036	0,043	0,047	0,052
	δ _{N∞} -factor	[mm/(N/mm²)]	0,030	0,033	0,037	0,041	0,045	0,052	0,061	0,071	0,075
Temperature range II: 80°C/50°C	δ _{N0} -factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ _{N∞} -factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Temperature range III: 120°C/72°C	δ _{N0} -factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ _{N∞} -factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Cracked concrete C20/25											
Temperature range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm²)]	0,090			0,070					
	δ _{N∞} -factor	[mm/(N/mm²)]	0,105			0,105					
Temperature range II: 80°C/50°C	δ _{N0} -factor	[mm/(N/mm²)]	0,219			0,170					
	δ _{N∞} -factor	[mm/(N/mm²)]	0,255			0,245					
Temperature range III: 120°C/72°C	δ _{N0} -factor	[mm/(N/mm²)]	0,219			0,170					
	δ _{N∞} -factor	[mm/(N/mm²)]	0,255			0,245					

1) Calculation of the displacement

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

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

Table C9: Displacement under shear load¹⁾ (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25											
All temperature ranges	δv ₀ -factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	δv _∞ -factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04
Cracked concrete C20/25											
All temperature ranges	δv ₀ -factor	[mm/(kN)]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,06
	δv _∞ -factor	[mm/(kN)]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,10

1) Calculation of the displacement

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

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

Injection System VSM for concrete Performances Displacements (rebar)	Annex C7