

Approval body for construction products
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and
Laender Governments



European Technical Assessment

ETA-21/0585
of 3 September 2021

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the
European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Mapei injection system Mapefix EP 50 for concrete

Product family
to which the construction product belongs

Bonded fastener for use in concrete

Manufacturer

Mapei S.p.A.
Via Cafiero, 22
20158 MILANO (Italy)
ITALIEN

Manufacturing plant

Mapei s.p.a., plant 1, Germany

This European Technical Assessment
contains

24 pages including 3 annexes which form an integral part
of this assessment

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

EAD 330499-01-0601, Edition 04/2020

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Specific Part

1 Technical description of the product

The "Mapei Injection System Mapefix EP 50 for concrete" is a bonded anchor consisting of a cartridge with injection Mapefix EP 50 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 reinforcing bar in the range of Ø 8 to Ø 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 to tension load (static and quasi-static loading)	See Annex B 2, C 1, C 2, C 3 and C 5
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 4 and C 6
Displacements under short-term and long-term loading	See Annex C 7 and C 8
Characteristic resistance and displacements for seismic performance categories C1 and C2	No performance assessed

3.2 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed

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

In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

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

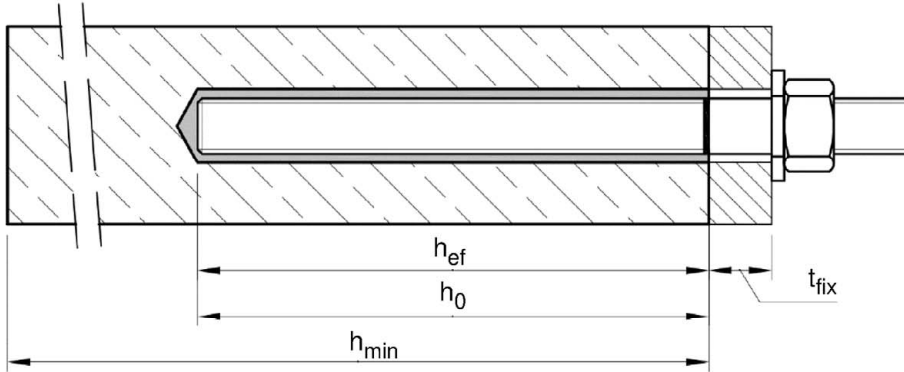
Issued in Berlin on 3 September 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

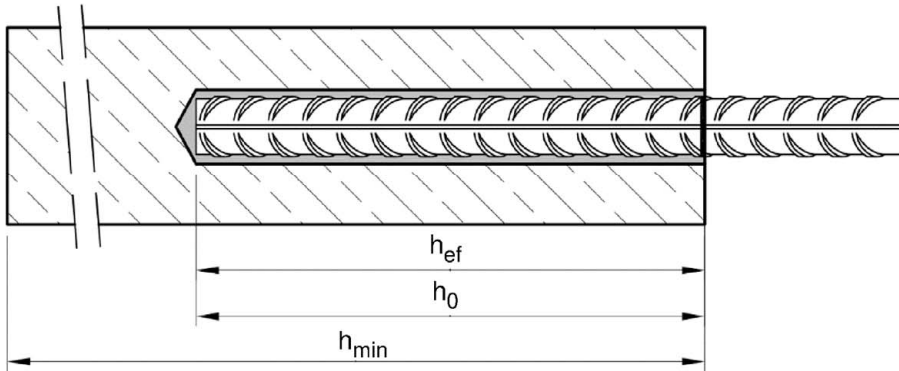
beglaubigt:
Baderschneider

Installation threaded rod M8 up to M30

prepositioned installation or
push through installation (annular gap filled with mortar)



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



- t_{fix} = thickness of fixture
 h_{ef} = effective anchorage depth
 h_0 = depth of drill hole
 h_{min} = minimum thickness of member

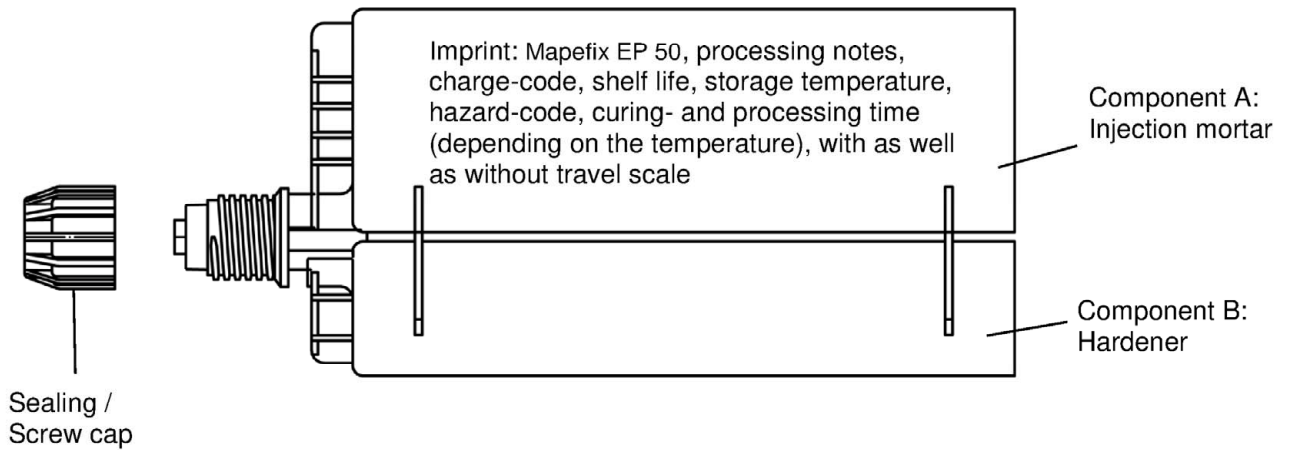
Mapei injection system Mapefix EP 50 for concrete

Product description
Installed condition

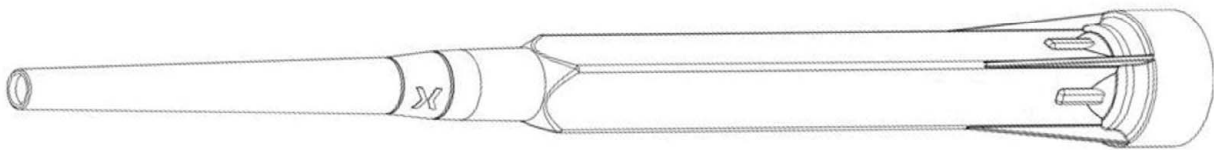
Annex A 1

Cartridge: Mapefix EP 50

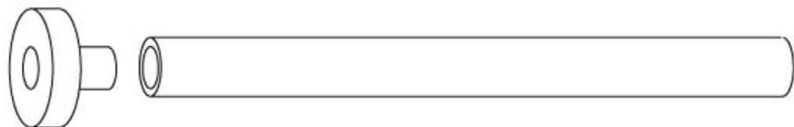
440ml, 585ml and 1400ml cartridge (Type: "side-by-side")



Static Mixer



Piston Plug and Mixer Extension

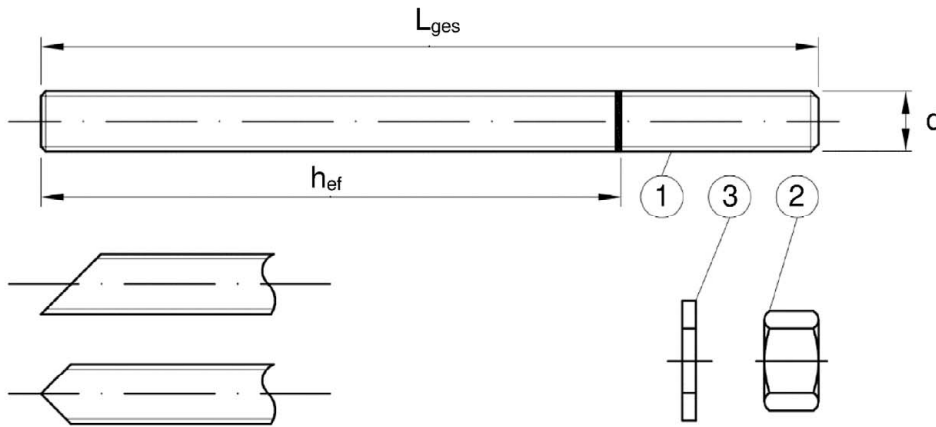


Mapei injection system Mapefix EP 50 for concrete

Product description
Injection system

Annex A 2

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

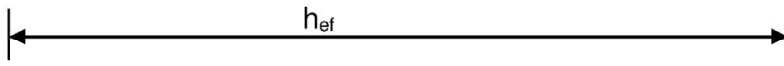
Mapei injection system Mapefix EP 50 for concrete

Product description
Threaded rod

Annex A 3

Table A1: Materials						
Part	Designation	Material				
Steel, zinc plated (Steel acc. to EN ISO 683-4:2018 or EN 10263:2001)						
- zinc plated $\geq 5 \mu\text{m}$ acc. to EN ISO 4042:2018 or						
- hot-dip galvanised $\geq 40 \mu\text{m}$ acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or						
- sherardized $\geq 45 \mu\text{m}$ acc. to EN ISO 17668:2016						
1	Threaded rod	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 898-1:2013	4.6	$f_{uk} = 400 \text{ N/mm}^2$	$f_{yk} = 240 \text{ N/mm}^2$	$A_5 > 8\%$
			4.8	$f_{uk} = 400 \text{ N/mm}^2$	$f_{yk} = 320 \text{ N/mm}^2$	$A_5 > 8\%$
			5.6	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 300 \text{ N/mm}^2$	$A_5 > 8\%$
			5.8	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 400 \text{ N/mm}^2$	$A_5 > 8\%$
8.8	$f_{uk} = 800 \text{ N/mm}^2$	$f_{yk} = 640 \text{ N/mm}^2$	$A_5 > 8\%$			
2	Hexagon nut	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		
3	Washer	Steel, zinc plated, hot-dip galvanised or sherardized (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)				
Stainless steel A2 (Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014)						
Stainless steel A4 (Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)						
High corrosion resistance steel (Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)						
1	Threaded rod ¹⁾²⁾	Property class	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture	
		acc. to EN ISO 3506-1:2020	50	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 210 \text{ N/mm}^2$	$A_5 \geq 8\%$
			70	$f_{uk} = 700 \text{ N/mm}^2$	$f_{yk} = 450 \text{ N/mm}^2$	$A_5 > 8\%$
80	$f_{uk} = 800 \text{ N/mm}^2$	$f_{yk} = 600 \text{ N/mm}^2$	$A_5 > 8\%$			
2	Hexagon nut ¹⁾²⁾	acc. to EN ISO 3506-1:2020	50	for anchor rod class 50		
			70	for anchor rod class 70		
			80	for anchor rod class 80		
3	Washer	A2: Material 1.4301 / 1.4307 / 1.4311 / 1.4567 or 1.4541, acc. to EN 10088-1:2014 A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014 HCR: Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014 (e.g.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000)				
¹⁾ Property class 70 or 80 for anchor s and hexagon nuts up to M24 ²⁾ Property class 80 only for stainless steel A4 and HCR						
Mapei injection system Mapefix EP 50 for concrete					Annex A 4	
Product description Materials threaded rod						

Reinforcing bar $\varnothing 8, \varnothing 10, \varnothing 12, \varnothing 14, \varnothing 16, \varnothing 20, \varnothing 24, \varnothing 25, \varnothing 28, \varnothing 32$



- 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: Rip height of the bar)

Table A2: Materials

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

Mapei injection system Mapefix EP 50 for concrete

Product description
Materials reinforcing bar

Annex A 5

Specifications of intended use

Anchorage subject to:

- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32.

Base materials:

- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.
- Uncracked concrete: 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 +60 °C (max long term temperature +35 °C and max short term temperature +60 °C)
- III: - 40 °C to +70 °C (max long term temperature +43 °C and max short term temperature +70 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
 - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
 - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
 - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- The anchorages are designed in accordance to EN 1992-4:2018 and Technical Report TR 055, Edition February 2018

Installation:

- Dry, wet concrete or flooded bore holes (not sea-water).
- 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.

Mapel injection system Mapefix EP 50 for concrete

Intended Use
Specifications

Annex B 1

Table B1: Installation parameters for threaded rod

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Diameter of element	$d = d_{nom}$	[mm]	8	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0	[mm]	10	12	14	18	22	28	30	35
Effective embedment depth	$h_{ef,min}$	[mm]	60	60	70	80	90	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture	Prepositioned installation d_f	[mm]	9	12	14	18	22	26	30	33
	Push through installation d_f	[mm]	12	14	16	20	24	30	33	40
Maximum torque moment	$\max T_{inst} \leq$	[Nm]	10	20	40 ¹⁾	60	100	170	250	300
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	75	95	115	125	140
Minimum edge distance	c_{min}	[mm]	35	40	45	50	60	65	75	80

¹⁾ Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

Table B2: Installation parameters for rebar

Anchor size			$\emptyset 8^1)$	$\emptyset 10^1)$	$\emptyset 12^1)$	$\emptyset 14$	$\emptyset 16$	$\emptyset 20$	$\emptyset 24$	$\emptyset 25$	$\emptyset 28$	$\emptyset 32$
Diameter of element	$d = d_{nom}$	[mm]	8	10	12	14	16	20	24	25	28	32
Nominal drill hole diameter	d_0	[mm]	10 12	12 14	14 16	18	20	25	32	32	35	40
Effective embedment depth	$h_{ef,min}$	[mm]	60	60	70	75	80	90	96	100	112	128
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h_{min}	[mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$						
Minimum spacing	s_{min}	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	c_{min}	[mm]	35	40	45	50	50	60	70	70	75	85

¹⁾ both nominal drill hole diameter can be used

Mapex injection system Mapex EP 50 for concrete

Intended Use
Installation parameters

Annex B 2

Table B3: Parameter cleaning and setting tools

Threaded Rod	Rebar	d_0 Drill bit - Ø HD, HDB, CD	Brush - Ø		$d_{b,min}$ min. Brush - Ø	Piston plug	Installation direction and use of piston plug					
				[mm]				↓	→	↑		
[mm]	[mm]	[mm]		[mm]	[mm]							
M8	8	10	RB10	11,5	10,5	No plug required						
M10	8 / 10	12	RB12	13,5	12,5							
M12	10 / 12	14	RB14	15,5	14,5							
	12	16	RB16	17,5	16,5							
M16	14	18	RB18	20,0	18,5	VS18	$h_{ef} > 250$ mm	$h_{ef} > 250$ mm	all			
		16	20	RB20	22,0	20,5				VS20		
M20		22	RB22	24,0	22,5	VS22						
	20	25	RB25	27,0	25,5	VS25						
M24		28	RB28	30,0	28,5	VS28						
M27		30	RB30	31,8	30,5	VS30						
M30	24 / 25	32	RB32	34,0	32,5	VS32						
	28	35	RB35	37,0	35,5	VS35						
	32	40	RB40	43,5	40,5	VS40						



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



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



HDB – Hollow drill bit system
Drill bit diameter (d_0): all diameters

The hollow drill bit system contains the Heller Duster Expert hollow drill bit and a class M vacuum with minimum negative pressure of 253 hPa and flow rate of minimum 150 m³/h (42 l/s).

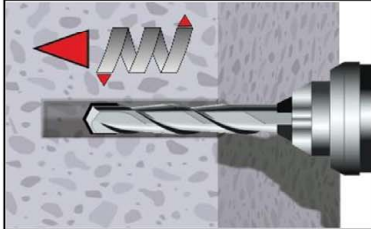
Mapai injection system Mapefix EP 50 for concrete

Intended Use
Cleaning and setting tools

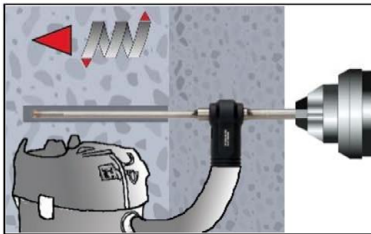
Annex B 3

Installation instructions

Drilling of the bore hole



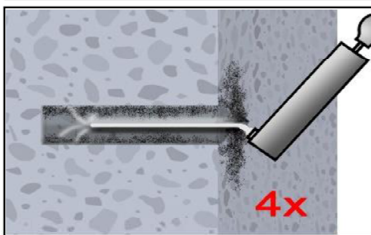
- 1a. Hammer (HD) or compressed air drilling (CD)**
Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1 or B2).
Proceed with Step 2.
In case of aborted drill hole, the drill hole shall be filled with mortar.



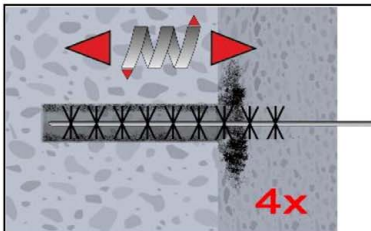
- 1b. Hollow drill bit system (HDB) (see Annex B 3)**
Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1 or B2). This drilling system removes the dust and cleans the bore hole during drilling (all conditions).
Proceed with Step 3.
In case of aborted drill hole, the drill hole shall be filled with mortar.

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

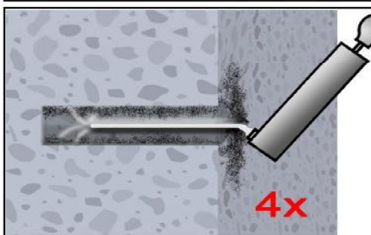
MAC: Cleaning for dry and wet bore hole with diameter $d_0 \leq 20\text{mm}$ and bore hole depth $h_0 \leq 10d_{\text{nom}}$ (uncracked concrete only!)



- 2a.** Starting from the bottom or back of the bore hole, blow the hole clean with handpump (Annex B 3) a minimum of four times until return air stream is free of noticeable dust.



- 2b.** 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.



- 2c.** Finally blow the hole clean again with handpump (Annex B 3) a minimum of four times until return air stream is free of noticeable dust.

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.

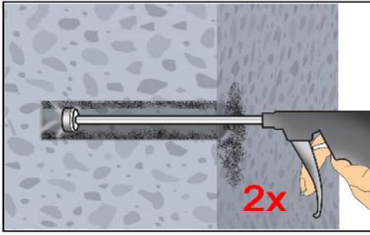
Mapei injection system Mapefix EP 50 for concrete

Intended Use
Installation instructions

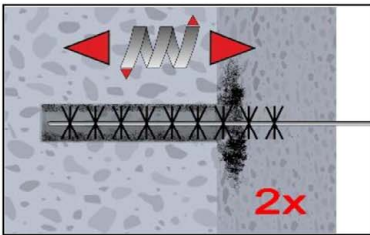
Annex B 4

Installation instructions (continuation)

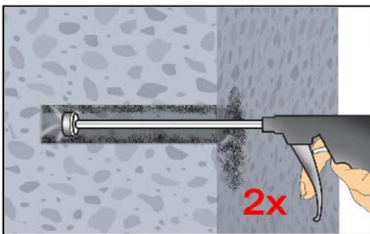
CAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked and cracked concrete



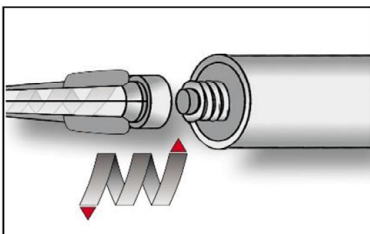
2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.



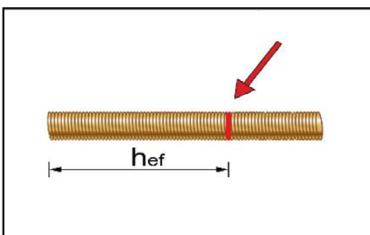
2b. Check brush diameter (Table B3). Brush the hole with an appropriate sized wire brush $> d_{b,min}$ (Table B3) a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B5).



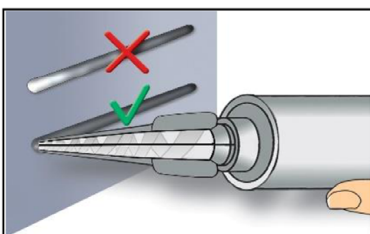
2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.



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.



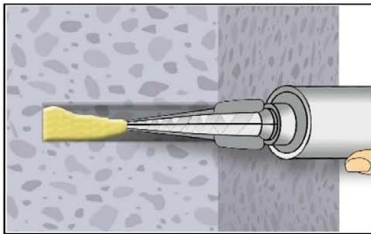
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey or red colour.

Mapex injection system Mapefix EP 50 for concrete

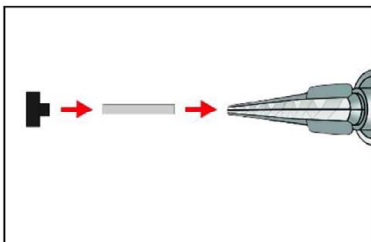
Intended Use
Installation instructions (continuation)

Annex B 5

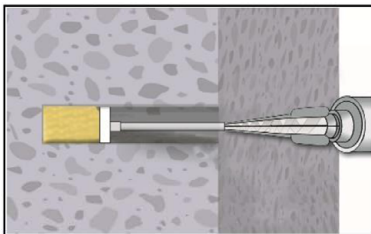
Installation instructions (continuation)



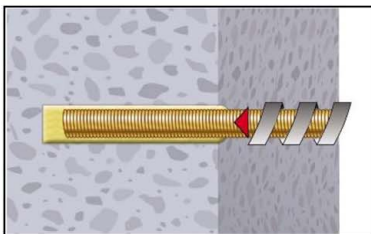
6. Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/ working times given in Table B4.



7. Piston plugs shall be used according to Table B3 for the following applications:
 - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit- $\varnothing d_0 \geq 18$ mm and embedment depth $h_{ef} > 250$ mm
 - Overhead assembly (vertical upwards direction): Drill bit- $\varnothing d_0 \geq 18$ mm
 Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.

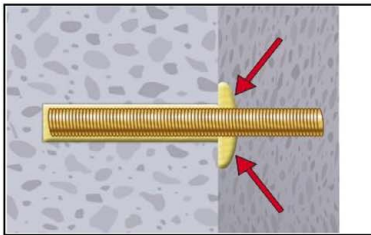


8. Insert piston plug to back of the hole and inject adhesive. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. During injection the piston plug is naturally pushed out of the borehole by the back pressure of the mortar. Observe the gel-/ working times given in Table B4.

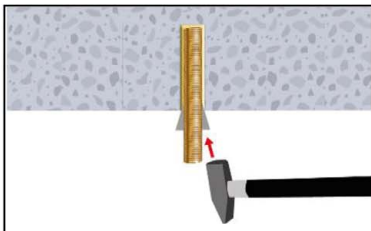


9. Push the fixing element into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment mark has reached the surface level.

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



10. After inserting the anchor, the annular gap between anchor rod and concrete, in case of a push through installation additionally also the fixture, must be complete filled with mortar. If excess mortar is not visible at the top of the hole, the requirement is not fulfilled and the application has to be renewed.



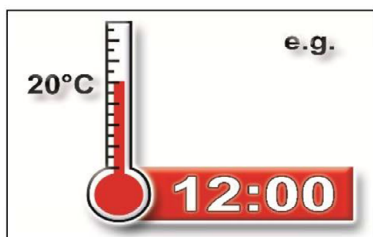
11. For overhead application the anchor rod shall be fixed (e.g. wedges) until the mortar has started to harden.

Mapei injection system Mapefix EP 50 for concrete

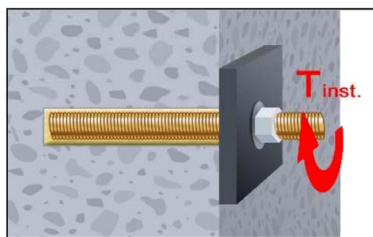
Intended Use
Installation instructions (continuation)

Annex B 6

Installation instructions (continuation)



12. 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).



13. After full curing, the add-on part can be installed with up to the max. torque (Table B1) by using a calibrated torque wrench. In case of prepositioned installation the annular gap between anchor and fixture can be optional filled 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.

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 + 9 °C	80 min	60 h	120 h
+ 10 °C to + 14 °C	60 min	48 h	96 h
+ 15 °C to + 19 °C	40 min	24 h	48 h
+ 20 °C to + 24 °C	30 min	12 h	24 h
+ 25 °C to + 34 °C	12 min	10 h	20 h
+ 35 °C to + 39 °C	8 min	7 h	14 h
+40 °C	8 min	4 h	8 h
Cartridge temperature	+5°C to +40°C		

Mapei injection system Mapefix EP 50 for concrete

Intended Use
Installation instructions (continuation)
Curing time

Annex B 7

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

Size			M8	M10	M12	M16	M20	M24	M27	M30	
Cross section area	A_s	[mm ²]	36,6	58	84,3	157	245	353	459	561	
Characteristic tension resistance, Steel failure ¹⁾											
Steel, Property class 4.6 and 4.8	$N_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63	98	141	184	224	
Steel, Property class 5.6 and 5.8	$N_{Rk,s}$	[kN]	18 (17)	29 (27)	42	78	122	176	230	280	
Steel, Property class 8.8	$N_{Rk,s}$	[kN]	29 (27)	46 (43)	67	125	196	282	368	449	
Stainless steel A2, A4 and HCR, class 50	$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281	
Stainless steel A2, A4 and HCR, class 70	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	.. ³⁾	.. ³⁾	
Stainless steel A4 and HCR, class 80	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	.. ³⁾	.. ³⁾	
Characteristic tension resistance, Partial factor ²⁾											
Steel, Property class 4.6 and 5.6	$\gamma_{Ms,N}$	[-]	2,0								
Steel, Property class 4.8, 5.8 and 8.8	$\gamma_{Ms,N}$	[-]	1,5								
Stainless steel A2, A4 and HCR, class 50	$\gamma_{Ms,N}$	[-]	2,86								
Stainless steel A2, A4 and HCR, class 70	$\gamma_{Ms,N}$	[-]	1,87								
Stainless steel A4 and HCR, class 80	$\gamma_{Ms,N}$	[-]	1,6								
Characteristic shear resistance, Steel failure ¹⁾											
Without lever arm	Steel, Property class 4.6 and 4.8	$V^0_{Rk,s}$	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
	Steel, Property class 5.6 and 5.8	$V^0_{Rk,s}$	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
	Steel, Property class 8.8	$V^0_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
	Stainless steel A2, A4 and HCR, class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A2, A4 and HCR, class 70	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124	.. ³⁾	.. ³⁾
	Stainless steel A4 and HCR, class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	.. ³⁾	.. ³⁾
With lever arm	Steel, Property class 4.6 and 4.8	$M^0_{Rk,s}$	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	$M^0_{Rk,s}$	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
	Steel, Property class 8.8	$M^0_{Rk,s}$	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
	Stainless steel A2, A4 and HCR, class 50	$M^0_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	232	454	784	.. ³⁾	.. ³⁾
	Stainless steel A4 and HCR, class 80	$M^0_{Rk,s}$	[Nm]	30	59	105	266	519	896	.. ³⁾	.. ³⁾
Characteristic shear resistance, Partial factor ²⁾											
Steel, Property class 4.6 and 5.6	$\gamma_{Ms,V}$	[-]	1,67								
Steel, Property class 4.8, 5.8 and 8.8	$\gamma_{Ms,V}$	[-]	1,25								
Stainless steel A2, A4 and HCR, class 50	$\gamma_{Ms,V}$	[-]	2,38								
Stainless steel A2, A4 and HCR, class 70	$\gamma_{Ms,V}$	[-]	1,56								
Stainless steel A4 and HCR, class 80	$\gamma_{Ms,V}$	[-]	1,33								
¹⁾ Values are only valid for the given stress area A_s . Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009. ²⁾ in absence of national regulation ³⁾ Anchor type not part of the ETA											
Mapei injection system Mapefix EP 50 for concrete									Annex C 1		
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods											

Table C2: Characteristic values for Concrete cone failure and Splitting with all kind of action

Anchor		All Anchor type and sizes		
Concrete cone failure				
Uncracked 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]		$2 c_{cr,sp}$

Mapei injection system Mapifix EP 50 for concrete

Performances

Characteristic values for Concrete cone failure and Splitting with all kind of action

Annex C 2

Table C3: Characteristic values of tension loads under static and quasi-static action				M8	M10	M12	M16	M20	M24	M27	M30	
Anchor size threaded rod												
Steel failure												
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ (or see Table C1)								
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1								
Combined pull-out and concrete failure												
Characteristic bond resistance in uncracked concrete C20/25												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	15	15	15	14	14	13	13	13
	II: 60°C/35°C				10	10	10	9,5	9,5	9,0	9,0	9,0
	III: 70°C/43°C				7,0	7,0	7,0	6,5	6,5	6,0	6,0	6,0
Characteristic bond resistance in cracked concrete C20/25												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	7,0	7,0	7,0	6,0	6,0	6,0
	II: 60°C/35°C				5,0	5,0	5,0	5,0	5,0	4,5	4,5	4,5
	III: 70°C/43°C				3,5	3,5	3,5	3,5	3,5	3,0	3,0	3,0
Reduction factor ψ_{sus}^0 in cracked and uncracked concrete C20/25												
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ_{sus}^0	[-]	0,60							
	II: 60°C/35°C				0,60							
	III: 70°C/43°C				0,60							
Increasing factors for concrete 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												
Relevant parameter				see Table C2								
Splitting												
Relevant parameter				see Table C2								
Installation factor												
for dry and wet concrete or flooded bore hole		γ_{inst}	[-]	1,4								
Mapei injection system Mapefix EP 50 for concrete										Annex C 3		
Performances Characteristic values of tension loads under static and quasi-static action												

Table C4: Characteristic values of shear loads under static and quasi-static action											
Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure without lever arm											
Characteristic shear resistance Steel, strength class 4.6, 4.8 and 5.6, 5.8	$V_{Rk,s}^0$	[kN]	0,6 · A _s · f _{uk} (or see Table C1)								
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	$V_{Rk,s}^0$	[kN]	0,5 · A _s · f _{uk} (or see Table C1)								
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]	1,2 · W _{el} · f _{uk} (or see Table C1)								
Elastic section modulus	W _{el}	[mm ³]	31	62	109	277	541	935	1387	1874	
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]	min(h _{ef} ; 12 · d _{nom})						min(h _{ef} ; 300mm)		
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	16	20	24	27	30	
Installation factor	γ_{inst}	[-]	1,0								
Mapei injection system Mapefix EP 50 for concrete									Annex C 4		
Performances Characteristic values of shear loads under static and quasi-static action											

Table C5: Characteristic values of tension loads under static and quasi-static action														
Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32		
Steel failure														
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$										
Cross section area		A_s	[mm ²]	50	79	113	154	201	314	452	491	616	804	
Partial factor		$\gamma_{Ms,N}$	[-]	1,4 ²⁾										
Combined pull-out and concrete failure														
Characteristic bond resistance in uncracked concrete C20/25														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,ucr}$	[N/mm ²]	14	14	14	12	12	12	12	11	11	11
	II: 60°C/35°C				9,5	9,5	9,5	8,5	8,5	8,5	7,5	7,5	7,5	7,5
	III: 70°C/43°C				6,0	6,0	6,0	6,0	6,0	5,5	5,5	5,5	5,0	5,0
Characteristic bond resistance in cracked concrete C20/25														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,cr}$	[N/mm ²]	6,0	7,0	7,0	6,5	6,5	6,0	6,0	6,0	5,5	5,5
	II: 60°C/35°C				4,0	4,5	4,5	4,5	4,0	4,0	4,0	4,0	3,5	3,5
	III: 70°C/43°C				2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5	2,5
Reduction factor ψ_{sus}^0 in cracked and uncracked concrete C20/25														
Temperature range	I: 40°C/24°C	Dry, wet concrete and flooded bore hole	ψ_{sus}^0	[-]	0,60									
	II: 60°C/35°C				0,60									
	III: 70°C/43°C				0,60									
Increasing factors for concrete 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														
Relevant parameter			see Table C2											
Splitting														
Relevant parameter			see Table C2											
Installation factor														
for dry and wet concrete or flooded bore hole		γ_{inst}	[-]	1,4										
¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation														
Mapei injection system Mapefix EP 50 for concrete											Annex C 5			
Performances		Characteristic values of tension loads under static and quasi-static action												

Table C6: Characteristic values of shear loads under static and quasi-static action														
Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32		
Steel failure without lever arm														
Characteristic shear resistance	$V_{Rk,s}^0$	[kN]	$0,5 \cdot A_s \cdot f_{uk}^{1)}$											
Cross section area	A_s	[mm ²]	50	79	113	154	201	314	452	491	616	804		
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 ²⁾											
Ductility factor	k_7	[-]	1,0											
Steel failure with lever arm														
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{1)}$											
Elastic section modulus	W_{el}	[mm ³]	50	98	170	269	402	785	1357	1534	2155	3217		
Partial factor	$\gamma_{Ms,V}$	[-]	1,5 ²⁾											
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]	$\min(h_{ef}; 12 \cdot d_{nom})$						$\min(h_{ef}; 300\text{mm})$					
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	14	16	20	24	25	28	32		
Installation factor	γ_{inst}	[-]	1,0											
¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation														
Mapei injection system Mapefix EP 50 for concrete										Annex C 6				
Performances			Characteristic values of shear loads under static and quasi-static action											

Table C7: Displacements under tension load¹⁾ (threaded rod)										
Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete under static and quasi-static action										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
Temperature range II: 60°C/35°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,038	0,039	0,040	0,044	0,047	0,051	0,052	0,055
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,047	0,049	0,051	0,055	0,059	0,064	0,067	0,070
Temperature range III: 70°C/43°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,042	0,043	0,044	0,048	0,052	0,056	0,057	0,061
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,052	0,054	0,056	0,061	0,065	0,070	0,074	0,077
Cracked concrete under static and quasi-static action										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171
Temperature range II: 60°C/35°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,259	0,154	0,163	0,172	0,181	0,189	0,207	0,229
Temperature range III: 70°C/43°C	δ_{N0} -factor	[mm/(N/mm ²)]	0,101	0,105	0,106	0,109	0,112	0,117	0,120	0,121
	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,285	0,169	0,179	0,189	0,199	0,208	0,228	0,252
<p>¹⁾ Calculation of the displacement $\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension $\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;</p>										
Table C8: Displacements under shear load²⁾ (threaded rod)										
Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked and cracked concrete under static and quasi-static action										
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
<p>²⁾ Calculation of the displacement $\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load $\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;</p>										
Mapei injection system Mapefix EP 50 for concrete								Annex C 7		
Performances Displacements under static and quasi-static action (threaded rods)										

Table C9: Displacements under tension load¹⁾ (rebar)												
Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked concrete under static and quasi-static action												
Temperature range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,015	0,015	0,016	0,017	0,017	0,019	0,020	0,020	0,021	0,023
Temperature range II: 60°C/35°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,038	0,039	0,040	0,042	0,044	0,047	0,051	0,051	0,054	0,058
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,047	0,049	0,051	0,053	0,055	0,059	0,065	0,065	0,068	0,072
Temperature range III: 70°C/43°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,042	0,043	0,044	0,046	0,048	0,052	0,056	0,056	0,059	0,064
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,052	0,054	0,056	0,058	0,061	0,065	0,072	0,072	0,075	0,079
Cracked concrete under static and quasi-static action												
Temperature range I: 40°C/24°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temperature range II: 60°C/35°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260
Temperature range III: 70°C/43°C	δ _{N0} -factor	[mm/(N/mm ²)]	0,101	0,105	0,106	0,108	0,109	0,112	0,117	0,117	0,120	0,124
	δ _{N∞} -factor	[mm/(N/mm ²)]	0,169	0,179	0,189	0,199	0,208	0,228	0,252	0,252	0,266	0,286
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 C10: Displacements under shear load²⁾ (rebar)												
Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked and cracked concrete under static and quasi-static action												
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	0,03
	δ _{V∞} -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04
²⁾ Calculation of the displacement $\delta_{V0} = \delta_{V0\text{-factor}} \cdot V;$ V: action shear load $\delta_{V\infty} = \delta_{V\infty\text{-factor}} \cdot V;$												
Mapei injection system Mapefix EP 50 for concrete										Annex C 8		
Performances Displacements under static and quasi-static action (rebar)												