Declaration of Performance

2873-CPR-M 530-5

1. Unique identification code of the product-type: Mungo Injection system MIT-SE Plus or MIT-COOL Plus for concrete

2. Manufacturer: Mungo Befestigungstechnik AG, Bornfeldstrasse 2, CH-4600 Olten/Switzerland

3. System/s of AVCP: System 1

4. Intended use or use/es:

Product	Intended use
Bonded anchor for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units, see appendix, especially Annexes B1 to B6

5. European Assessment Document: ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD)
European Technical Assessment: ETA-10/0130 of 13 December 2016
Technical Assessment Body: DIBt – Deutsches Institut für Bautechnik
Notified body/ies: 2873 – IFSW

6. Declared performance:
Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance tension and shear loads	See appendix, especially Annexes C1 to C4
Displacements under tension and shear loads	See appendix, especially Annexes C5 / C6

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

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Singed for and on behalf of the manufacturer by:

Robert Klemencic
Dipl.-Ing., MBA
Head of Engineering
Olten, 29.04.2021

This DoP Has been prepared in different languages. In case there is a dispute on the interpretation the English version shall always prevail. The Appendix includes voluntary and complementary information in English language exceeding the (language as neutrally specified) legal requirements.

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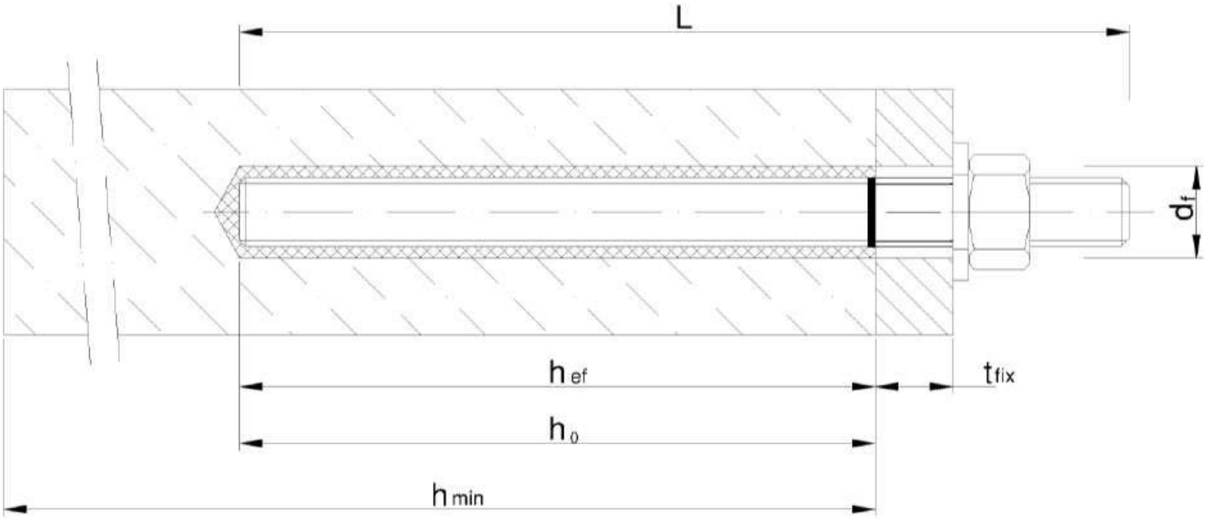
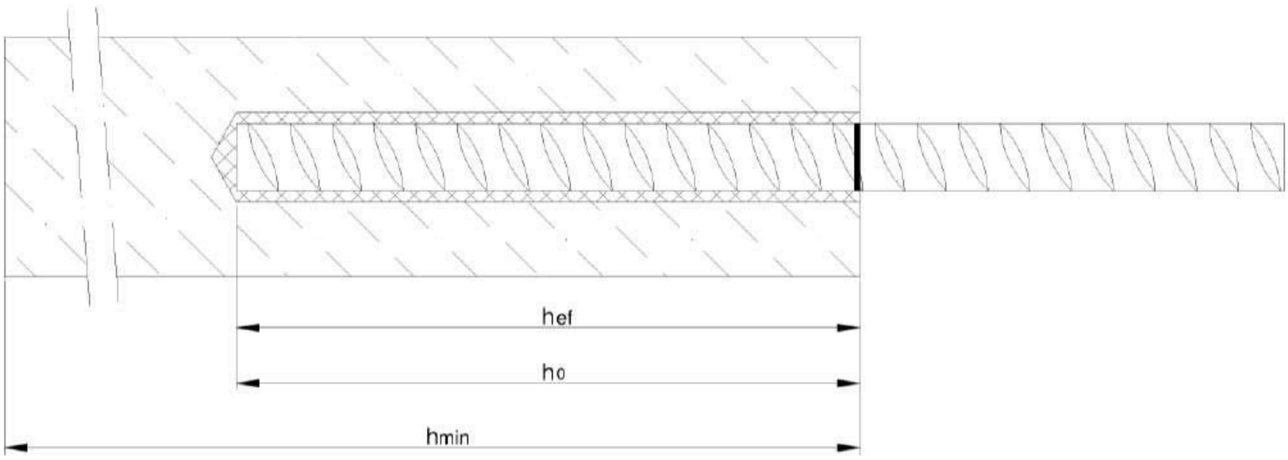
EXCERPT 1/16

Installation threaded rod



Installation reinforcing bar



d_f = diameter of clearance hole in the fixture

t_{fix} = thickness of fixture

h_{ef} = effective anchorage depth

h_0 = depth of drill hole

h_{min} = minimum thickness of member

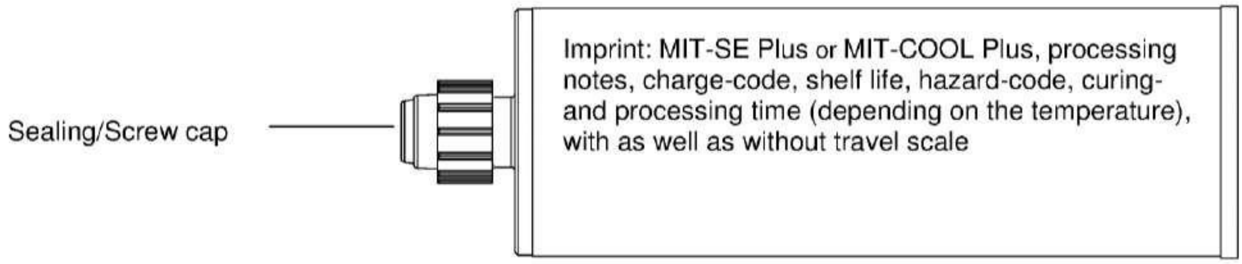
Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete

Product description
Installed condition

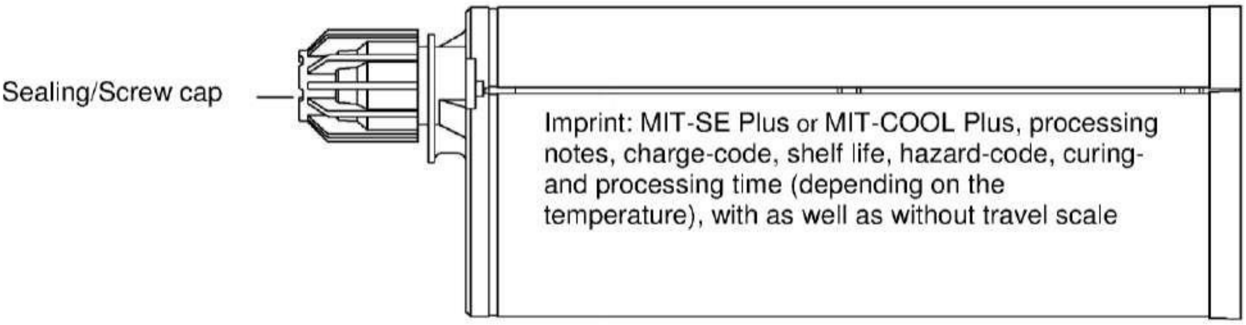
Annex A 1

Cartridge: MIT-SE Plus or MIT-COOL Plus

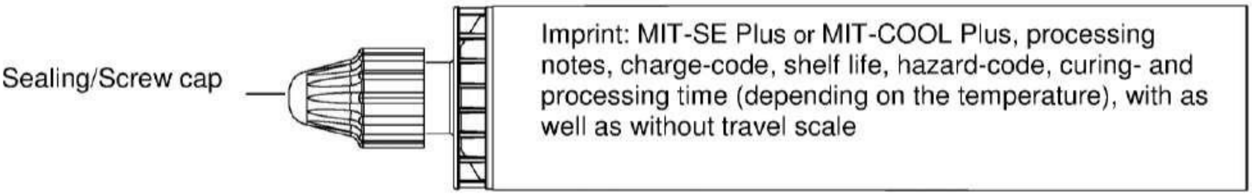
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)



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



165 ml and 300 ml cartridge (Type: “foil tube”)

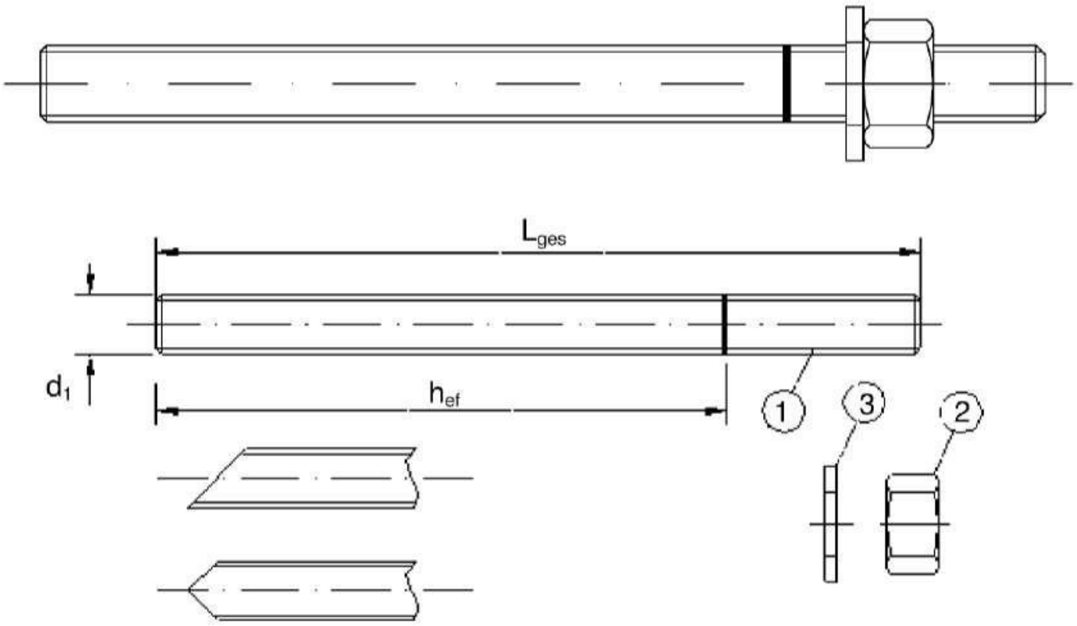


Static Mixer

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	**Annex A 2**
Product description Injection system	

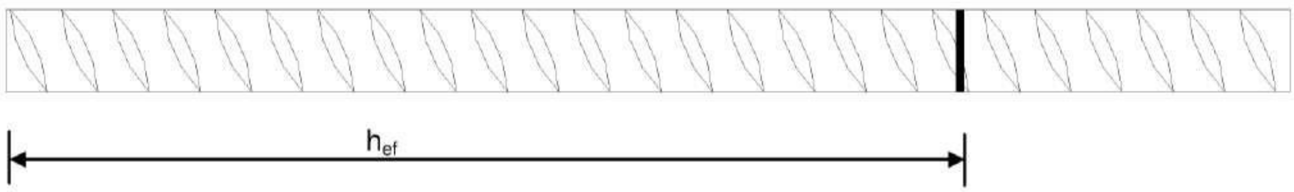
EXCERPT 3/16

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

Reinforcing bar ∅ 8, ∅ 10, ∅ 12, ∅ 14, ∅ 16, ∅ 20, ∅ 25, ∅ 28, ∅ 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 ≤ h ≤ 0,07d
  (d: Nominal diameter of the bar; h: Rip height of the bar)

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	Annex A 3
Product description Threaded rod and reinforcing bar	

EXCERPT 4/16

Table A1: Materials

Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or Steel, hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009		
1	Anchor rod	Steel, EN 10087:1998 or EN 10263:2001 Property class 4.6, 4.8, 5.8, 8.8, EN 1993-1-8:2005+AC:2009 A_5 > 8% fracture elongation
2	Hexagon nut, EN ISO 4032:2012	Steel acc. to EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 or 4.8 rod) EN ISO 898-2:2012, Property class 5 (for class 5.8 rod) EN ISO 898-2:2012, Property class 8 (for class 8.8 rod) EN ISO 898-2:2012
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated or hot-dip galvanised
Stainless steel		
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
2	Hexagon nut, EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571 EN 10088:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401, 1.4404 or 1.4571, EN 10088-1:2005
High corrosion resistance steel		
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
2	Hexagon nut, EN ISO 4032:2012	Material 1.4529 / 1.4565 EN 10088-1:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565, EN 10088-1:2005
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:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete

Product description
Materials

Annex A 4

EXCERPT 5/16

Specifications of intended use

Anchorages subject to:
- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C1: M12 to M30, Rebar Ø12 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.
- Non-cracked concrete: M8 to M30, Rebar Ø8 to Ø32.
- Cracked concrete: M12 to M30, Rebar Ø12 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 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: M8 to M30, Rebar Ø8 to Ø32.
- Flooded holes (not sea water): M8 to M16, Rebar Ø8 to Ø16.
- Hole drilling by hammer or compressed air drill mode.
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	**Annex B 1**
Intended Use Specifications	

Electronic copy of the ETA by DIBt: ETA-10/0130

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			$h_{ef} + 2d_0$				
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		**∅ 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	480	540	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

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete

Intended Use
Installation parameters

Annex B 2

Steel brush

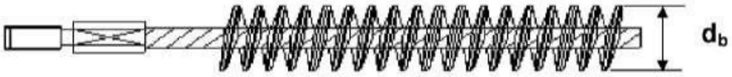


Table B3: Parameter cleaning and setting tools

Threaded Rod	Rebar	d_0 Drill bit - Ø	d_b Brush - Ø	$d_{b,min}$ min. Brush - Ø	Piston plug
(mm)	(mm)	(mm)	(mm)	(mm)	(No.)
M8		10	12	10,5	No piston plug required
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
M24		28	30	28,5	# 28
M27	25	32	34	32,5	# 32
M30	28	35	37	35,5	# 35
	32	40	41,5	40,5	# 38

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

Recommended compressed air tool (min 6 bar)
Drill bit diameter (d_0): 10 mm to 40 mm

Piston plug for overhead or horizontal installation
Drill bit diameter (d_0): 24 mm to 40 mm

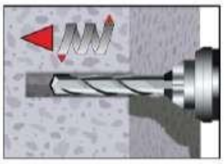
Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete

Intended Use
Cleaning and setting tools

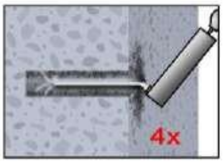
Annex B 3

EXCERPT 8/16

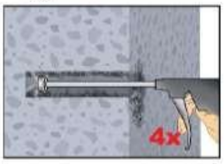
Installation instructions



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). In case of aborted drill hole: the drill hole shall be filled with mortar



or

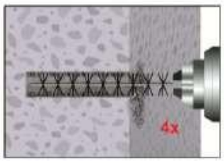


Attention! Standing water in the bore hole must be removed before cleaning.

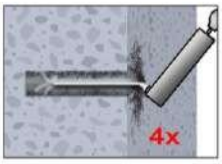
2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump (Annex B 3) a minimum of four times. If the bore hole ground is not reached an extension shall be used.

The hand-pump can **only** be used for anchor sizes in uncracked concrete up to bore hole diameter 20mm or embedment depth up to 240mm.

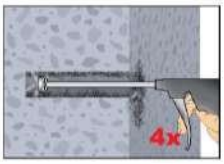
Compressed air (min. 6 bar) can be used for all sizes in cracked and uncracked concrete.



2b. Check brush diameter (Table B3) and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B3) a minimum of four times.
If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B3).

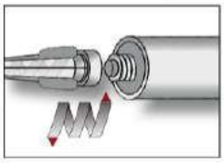


or

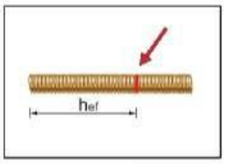


2c. Finally blow the hole clean again with compressed air (min. 6 bar) or a hand pump (Annex B 3) a minimum of four times. If the bore hole ground is not reached an extension shall be used. The hand-pump can **only** be used for anchor sizes in uncracked concrete up to bore hole diameter 20mm or embedment depth up to 240mm. Compressed air (min. 6 bar) can be used for all sizes in cracked and uncracked concrete.

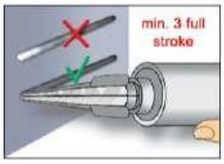
After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.



3. 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 B4 or B5) as well as for new cartridges, a new static-mixer shall be used.



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



5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour. For foil tube cartridges is must be discarded a minimum of six full strokes.

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	**Annex B 4**
Intended Use Installation instructions	

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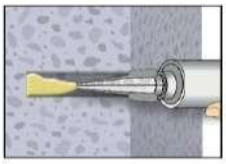
EXCERPT 9/16

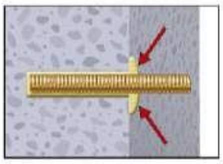
Installation instructions (continuation)



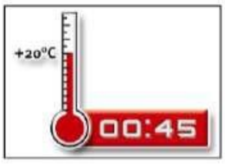
6. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used. For overhead and horizontal installation a piston plug (Annex B 3) and extension nozzle shall be used. Observe the gel-/ working times given in Table B4 or B5.

7. 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.

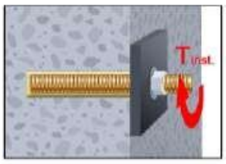
   The anchor should be free of dirt, grease, oil or other foreign material.



8. 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 should be fixed (e.g. wedges).



9. 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).



10. After full curing, the add-on part can be installed with the max. torque (Table B2) by using a calibrated torque wrench.

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	**Annex B 5**
Intended Use Installation instructions (continuation)	

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Table B4: Maximum Working time and minimum curing time MIT-SE Plus

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

1) In wet concrete the curing time must be doubled.
2) Cartridge temperature must be at min. +15°C.

Table B5: Maximum Working time and minimum curing time MIT-COOL Plus

Concrete temperature	Gelling- / working time	Minimum curing time in dry concrete [1)]
-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
Cartridge temperature	-20°C to +10°C	

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

Mungo Injection System MIT-SE Plus or MIT-COOL Plus for concrete	Annex B 6
Intended Use Curing time	

EXCERPT 11/16

Deutsches Institut für Bautechnik DIBt

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

Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M24	M27	M30
Steel failure											
Characteristic tension resistance		$N_{Rk,s} = N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}$							
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	not admissible			
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	not admissible			
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	not admissible			
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,C1}$	[N/mm²]			3,7	3,7	3,7	3,8	4,5	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			5,5	5,5	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			3,7	3,7	not admissible			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,C1}$	[N/mm²]			2,7	2,7	2,7	2,8	3,1	3,1
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			4,0	4,0	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			2,7	2,7	not admissible			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]			2,0	2,0	2,0	2,1	2,4	2,4
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			3,0	3,0	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			2,0	2,0	not admissible			
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							
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]	$1{,}5\ h_{ef}$							
Axial distance		$s_{cr,N}$	[mm]	$3{,}0\ h_{ef}$							
Splitting											
Edge distance		$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \leq 2 \cdot h_{ef}\left(2{,}5 - \frac{h}{h_{ef}}\right) \leq 2{,}4 \cdot h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$							
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$		1,0	1,2						
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$		1,4				not admissible			

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

Annex C 1

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

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	$V_{Rk,s}$	[kN]	$0,50 \cdot A_s \cdot f_{uk}$							
	$V_{Rk,s,C1}$	[kN]	not admissible		$0,35 \cdot A_s \cdot f_{uk}$					
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 moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$							
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)							
Concrete pry-out failure										
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$		2,0							
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0							
Concrete edge failure										
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$							
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0							

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Table C3: 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		$N_{Rk,s} = N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}$								
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	12	11	10	8,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	7,5	8,5	8,5	8,5	8,5	not admissible			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	7,5	9	9	9	9	9	8,0	7,0	6,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	5,5	6,5	6,5	6,5	6,5	not admissible			
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	6,0	5,0	4,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm²]	4,0	5,0	5,0	5,0	5,0	not admissible			
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		5,5	5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,C1}$	[N/mm²]			3,7	3,7	3,7	3,7	3,8	4,5	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			5,5	5,5	5,5	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			3,7	3,7	3,7	not admissible			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		4,0	4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,C1}$	[N/mm²]			2,7	2,7	2,7	2,7	2,8	3,1	3,1
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			4,0	4,0	4,0	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			2,7	2,7	2,7	not admissible			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	not admissible		3,0	3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,C1}$	[N/mm²]			2,0	2,0	2,0	2,0	2,1	2,4	2,4
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm²]			3,0	3,0	3,0	not admissible			
		$\tau_{Rk,C1}$	[N/mm²]			2,0	2,0	2,0	not admissible			
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								
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]	$1{,}5\ h_{ef}$								
Axial distance		$s_{cr,N}$	[mm]	$3{,}0\ h_{ef}$								
Splitting												
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]	$2\ c_{cr,sp}$								
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$		1,0	1,2							
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$		1,4					not admissible			

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

Annex C 3

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Table C4: Characteristic values of shear 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 without lever arm											
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0{,}50 \cdot A_s \cdot f_{uk}$								
	$V^0_{Rk,s,C1}$	[kN]	not admissible		$0{,}35 \cdot A_s \cdot f_{uk}$						
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 moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$								
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)								
Concrete pry-out failure											
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$		2,0								
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0								
Concrete edge failure											
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef};\ 8\ d_{nom})$								
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation safety factor	$\gamma_2 = \gamma_{inst}$		1,0								

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

Annex C 4

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Table C5: Displacements under tension load[1] (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/mm²)]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	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/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	$\delta_{N\infty}$-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	δ_{N0}-factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
Cracked concrete C20/25										
Temperature range I: 40°C/24°C	δ_{N0}-factor	[mm/(N/mm²)]	-		0,070					
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,105					
Temperature range II: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]			0,170					
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,245					
Temperature range III: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]			0,170					
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,245					

[1] Calculation of the displacement

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

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

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

Anchor size threaded rod			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)]	-		0,11	0,10	0,09	0,08	0,08	0,07
	$\delta_{V\infty}$-factor	[mm/(kN)]			0,17	0,15	0,14	0,13	0,12	0,10

[1] Calculation of the displacement

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

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

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Performances Displacements (threaded rods)	

Table C7: Displacements under tension load[1] (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
	$\delta_{N\infty}$-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
	$\delta_{N\infty}$-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
	$\delta_{N\infty}$-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)]	-		0,070						
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,105						
Temperature range II: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]			0,170						
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,245						
Temperature range III: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]			0,170						
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]			0,245						

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

Table C8: Displacement under shear load[1] (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	δ_{V0}-factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04
Cracked concrete C20/25											
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	-		0,11	0,11	0,10	0,09	0,08	0,07	0,06
	$\delta_{V\infty}$-factor	[mm/(kN)]			0,17	0,16	0,15	0,14	0,12	0,11	0,10

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

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Performances Displacements (rebar)	