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European Technical Assessment

ETA 20/0104 of 30/01/2020

(English language translation, the original version in Czech language)

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague	
Trade name of the construction product	Friulsider Injection System KEM HR KEM HR Blue KEM HR Express KEM HR Tropical
Product family to which the construction product belongs	Product area code: 33 Post-installed rebar connections of the sizes Ø8 to Ø25 with injection mortar
Manufacturer	Friulsider S.p.A. Via Trieste, 1 33048 san Giovanni al Natisone (Ud) Italy
Manufacturing plant(s)	Friulsider S.p.A., Plant 1 Germany
This European Technical Assessment contains	15 pages including 12 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 330087-00-0601

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1. Technical description of the product

The Friulsider Injection System KEM HR, KEM HR Blue, KEM HR Express and KEM HR Tropical is used for the connection, by anchoring or overlap joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete. The design of the post-installed rebar connections is done in accordance with the regulations for reinforced concrete constructions.

Reinforcing bars made of steel with a diameter from 8 to 25 mm and Friulsider KEM HR, KEM HR Blue, KEM HR Express, KEM HR Tropical chemical mortar are used for rebar connections. The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded element, injection mortar and concrete.

The illustration and the description of the product are given in Annex A.

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 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, but are to be regarded only as a means for choosing the 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
Bond strength of post-installed rebar	See Annex C 1
Reduction factor	See Annex C 1
Amplification factor for minimum anchorage length	See Annex C 1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class (A1) according to EN 13501-1
Resistance to fire	No performance assessed

3.3 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B 1 are kept.

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

According to the Decision 96/582/EC of the European Commission[1] the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the following table applies.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the construction works) or heavy units	-	1

[1] Official Journal of the European Communities L 254 of 08.10.1996

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

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technický a zkušební ústav stavební Praha, s.p.[2] The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

Issued in Prague on 30.01.2020

By

Ing. Mária Schaan
Head of the Technical Assessment Body

[2] The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

Installation post installed rebar

Figure A1: Overlapping joint for rebar connections of slabs and beams

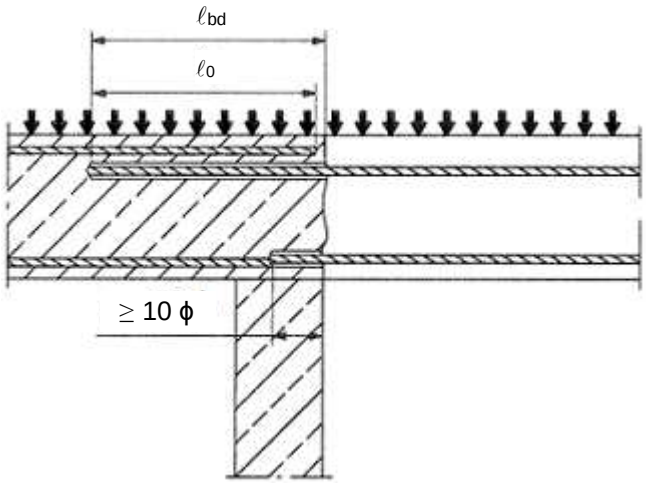


Figure A2: Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

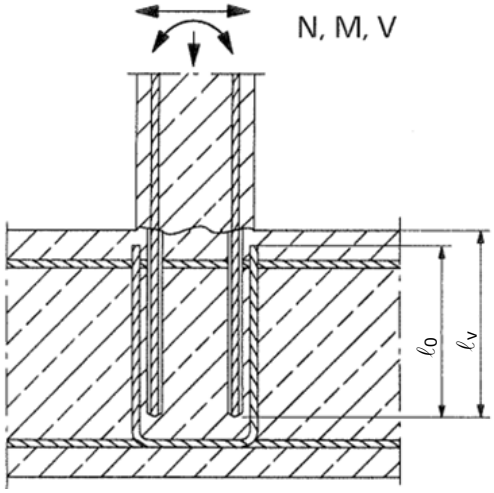


Figure A3: End anchoring of slabs or beams, designed as simply supported

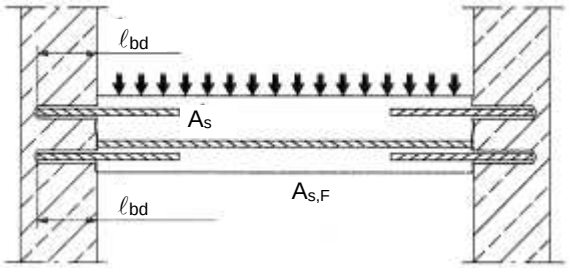


Figure A4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression.

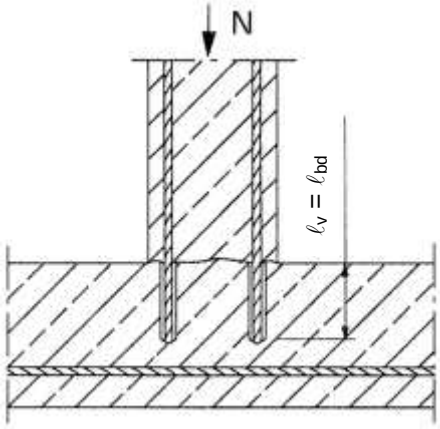
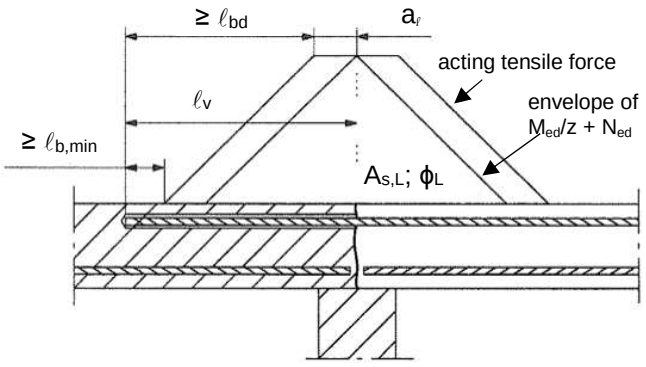


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force



Note to Figure A1 to A5:

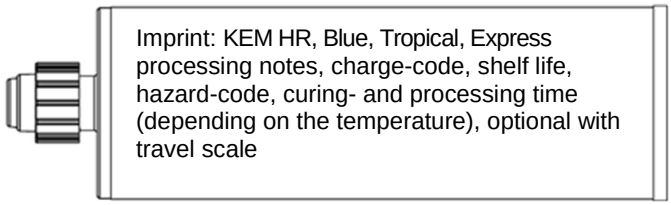
In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2004+AC:2010.

Preparing of joints according to Annex B 2

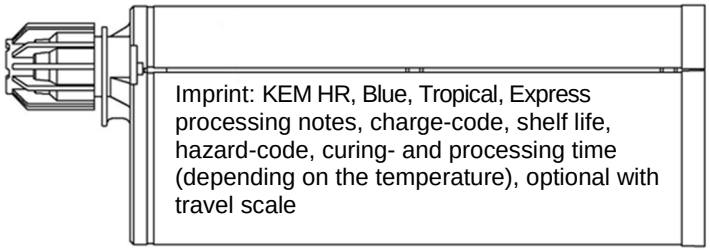
Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex A 1**
Product description Installed condition and examples of use for rebars	

Cartridge:

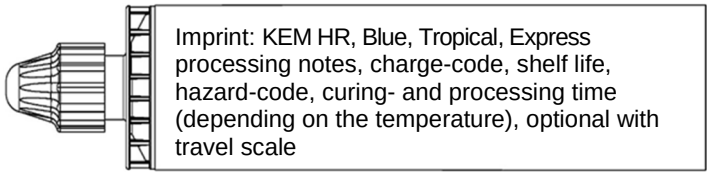
Type "coaxial": 150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge



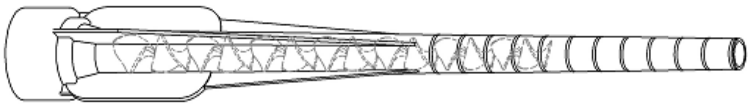
Type "side-by-side": 235 ml, 345 ml up to 360 ml and 825 ml cartridge



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



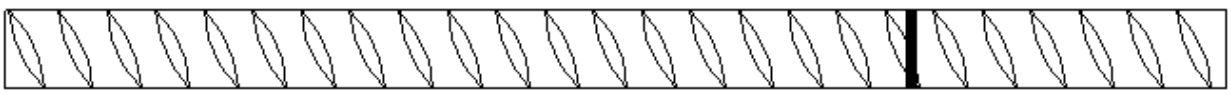
Static mixer
SM 14W



CM 8W

Piston plug and mixer extension

Reinforcing bar (rebar): ø8 to ø25

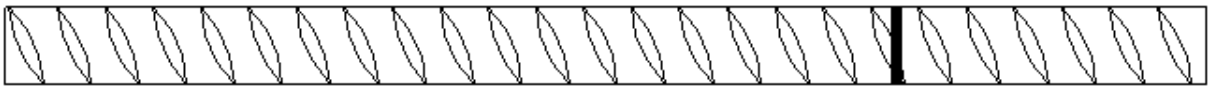


Friulsider Injection System for rebar connection
KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express

Product description
Injection mortar / Static mixer / Rebar

Annex A 2

Reinforcing bar (rebar): ø8, ø10, ø12, ø14, ø16, ø20, ø25



- 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 $0{,}05\phi \le h \le 0{,}07\phi$
  (ϕ: Nominal diameter of the bar; h: Rip height of the bar)

Table A1: Materials

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

Friulsider Injection System for rebar connection **KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express**	**Annex A 3**
Product description Specifications Rebar	

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads.

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2013 + A1:2016.
- Strength classes C12/15 to C50/60 according to EN 206-1:2013 + A1:2016.
- Maximum chloride concrete of 0,40% (CL 0.40) related to the cement content according to EN 206-1:2013 + A1:2016.
- Non-carbonated concrete.

Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of ϕ + 60 mm prior to the installation of the new rebar.

The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1:2004+AC:2010.

The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Temperature Range:

- - 40°C to +80°C (max. short term temperature +80°C and max long term temperature +50°C).

Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design according to EN 1992-1-1:2004+AC:2010, EN 1992-1-2:2004+AC:2008 and Annex B 2.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

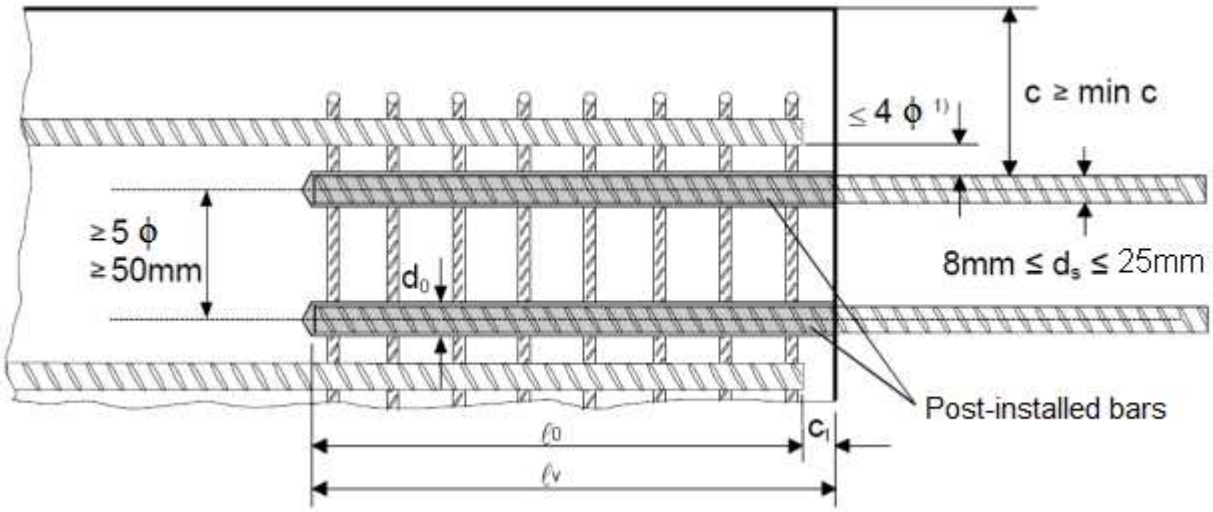
Installation:

- Dry or wet concrete.
- It must not be installed in flooded holes.
- Overhead installation allowed.
- Hole drilling by hammer drill (HD) or compressed air drill mode (CD).
- The installation of post-installed rebar resp. tension anchors shall be done only by suitable trained installer and under supervision on site; the conditions under which an installer may be considered as suitable trained and the conditions for supervision on site are up to the Member States in which the installation is done.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).

Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex B 1**
Intended use Specifications	

Figure B1: General construction rules for post-installed rebars

- Only tension forces in the axis of the rebar may be transmitted
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1:2004+AC:2010.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.



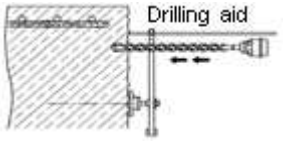
1) If the clear distance between lapped bars exceeds 4ϕ, then the lap length shall be increased by the difference between the clear bar distance and 4ϕ.

The following applies to Figure B1:

c	concrete cover of post-installed rebar
c_1	concrete cover at end-face of existing rebar
min c	minimum concrete cover according to Table B1 and to EN 1992-1-1:2004+AC:2010, Section 4.4.1.2
ϕ	diameter of post-installed rebar
ℓ_0	lap length, according to EN 1992-1-1:2004+AC:2010, Section 8.7.3
ℓ_v	effective embedment depth, ≥ $\ell_0 + c_1$
d_0	nominal drill bit diameter, see Annex B 6

Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex B 2**
Intended use General construction rules for post-installed rebars	

Table B1: Minimum concrete cover min c[1] of post-installed rebar and tension anchor ZA depending of drilling method



Drilling method	Rebar diameter	Without drilling aid	With drilling aid
Hammer drilling (HD)	< 25 mm	30 mm + 0,06 · ℓ_v ≥ 2 ϕ	30 mm + 0,02 · ℓ_v ≥ 2 ϕ
	≥ 25 mm	40 mm + 0,06 · ℓ_v ≥ 2 ϕ	40 mm + 0,02 · ℓ_v ≥ 2 ϕ
Compressed air drilling (CD)	< 25 mm	50 mm + 0,08 · ℓ_v	50 mm + 0,02 · ℓ_v
	≥ 25 mm	60 mm + 0,08 · ℓ_v ≥ 2 ϕ	60 mm + 0,02 · ℓ_v ≥ 2 ϕ

[1] see Annex B2, Figures B1 and Annex B3, Figure B2
Comments: The minimum concrete cover acc. EN 1992-1-1:2004+AC:2010 must be observed

Table B2: Maximum embedment depth $\ell_{v,max}$

Rebar ϕ	$\ell_{v,max}$ [mm]
8 mm	800
10 mm	1000
12 mm	1000
14 mm	1000
16 mm	1000
20 mm	1000
25 mm	1000

Table B3: Base material temperature, gelling time and curing time

Concrete temperature	KEM HR Express		KEM HR, KEM HR Blue[1]		KEM HR Tropical	
	Max. working time	Min. curing time	Max. working time	Min. curing time	Max. working time	Min. curing time
-10 to -6 °C					60 min	4 h
-5 to -1 °C			90 min	6 h	45 min	2 h
0 to +4 °C			45 min	3 h	25 min	80 min
+5 to +9 °C			25 min	2 h	10 min	45 min
+10 to +14 °C	30 min	5 h	20 min	100 min	4 min	25 min
+15 to +19 °C	20 min	210 min	15 min	80 min	3 min	20 min
+20 to +29 °C	15 min	145 min	6 min	45 min	2 min	15 min
+30 to +34 °C	10 min	80 min	4 min	25 min		
+35 to +39 °C	6 min	45 min	2 min	20 min		
+40 to +44 °C	4 min	25 min				
+45 °C	2 min	20 min				
Cartridge temperature	**+5°C to +45°C**		**+5°C to +40°C**		**+5°C to +30°C**	

[1] The KEM HR Blue injection mortar has a curing time proof by changing the color from blue to gray after curing minimum time. The curing time proof is only valid for the standard version of the mortar.

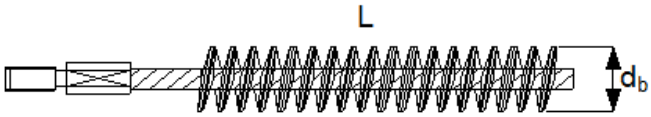
Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex B 3**
Intended use Minimum concrete cover, maximum embedment depth, working time and curing time	

Table B4: Dispensing tools			
Cartridge type/size	**Hand tool**		**Pneumatic tool**
Coaxial cartridges 150, 165, 280, 300 up to 333 ml	 e.g. Type H 297 or H244C		 e.g. Type TS 492 X
Coaxial cartridges 380 up to 420 ml	 e.g. Type CCM 380/10	 e.g. Type H 285 or H244C	 e.g. Type TS 485 LX
Side-by-side cartridges 235, 345 up to 360 ml	 e.g. Type CBM 330A	 e.g. Type H 260	 e.g. Type TS 477 LX
Side-by-side cartridge 825 ml	-	-	 e.g. Type TS 498X

All cartridges could also be extruded by a battery tool.

Cleaning and installation tools

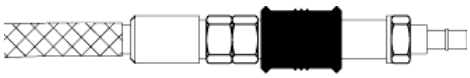
Brush RBT:



SDS Plus Adapter:

Brush extension:

Hand pump (volume 750 ml)



Rec. compressed air tool hand slide valve (min 6 bar)

Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex B 4**
Intended use Dispensing, cleaning and installation tools	

Table B5: Brushes, piston plugs, max anchorage depth and mixer extension, hammer (HD) and compressed air (CD) drilling

Bar size ϕ	Drill bit - ∅		d_b Brush - ∅		$d_{b,min}$ min. Brush - ∅	Piston plug	Cartridge: All sizes				Cartridge: side-by-side (825 ml)	
							Hand or battery tool		Pneumatic tool		Pneumatic tool	
	HD	CD					$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension
[mm]	[mm]			[mm]	[mm]		[mm]		[mm]		[mm]	
8	12	-	RBT12	13,5	12,5	-	700	VL10/0,75	800	VL10/0,75	800	VL10/0,75
10	14	-	RBT14	15,5	14,5	VS14			1000		1000	
12	16		RBT16	17,5	16,5	VS16						
14	18		RBT18	20,0	18,5	VS18						
16	20		RBT20	22,0	20,5	VS20						
20	25	-	RBT25	27,0	25,5	VS25	500		700			
	-	26	RBT26	28,0	26,5	VS25						
25	32		RBT32	34,0	32,5	VS32						

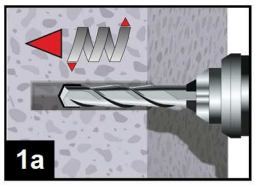
Friulsider Injection System for rebar connection
KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express

Intended use
Parameter brushes, piston plugs, max anchorage depth and mixer extension

Annex B 5

A) Bore hole drilling

Note: Before drilling, remove carbonated concrete and clean contact areas (see Annex B1)
In case of aborted drill hole: the drill hole shall be filled with mortar.



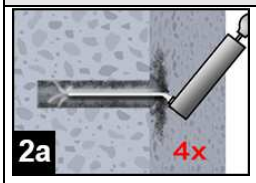
1a. Hammer (HD) or compressed air drilling (CD)
Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar with carbide hammer drill (HD) or a compressed air drill (CD). Proceed with Step 2.

Hammer drill (HD)

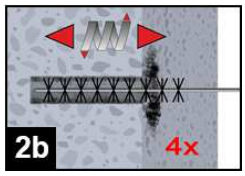
Compressed air drill (CD)

B) Bore hole cleaning

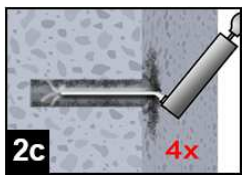
MAC: Cleaning for bore hole diameter $d_0 \leq 20mm$ and bore hole depth $h_0 \leq 10d_s$



2a. Starting from the bottom or back of the bore hole, blow the hole clean a hand pump (Annex B 7) a minimum of four times.

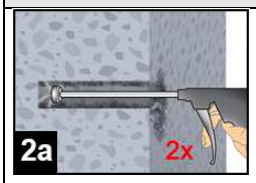


2b. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension shall be used.

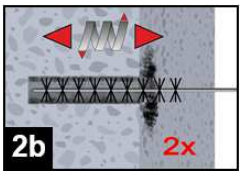


2c. Finally blow the hole clean again with a hand pump (Annex B 7) a minimum of four times.

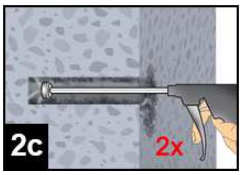
CAC: Cleaning for all bore hole diameter and bore hole depth



2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 7) 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.



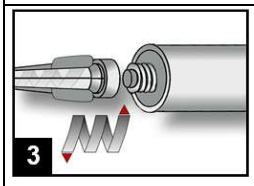
2b. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times.
If the bore hole ground is not reached with the brush, a brush extension shall be used (Table B5).



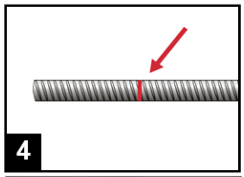
2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 7) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.

Friulsider Injection System for rebar connection **KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express**	**Annex B 6**
Intended use Installation instruction	

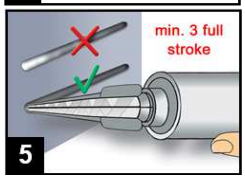
C) Preparation of bar and cartridge



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 B3) as well as for every new cartridges, a new static-mixer shall be used.

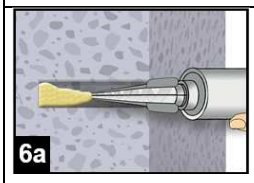


4. Prior to inserting the reinforcing bar into the filled bore hole, the position of the embedment depth shall be marked (e.g. with tape) on the reinforcing bar and insert bar in empty hole to verify hole and depth ℓ_v.
The reinforcing bar should be free of dirt, grease, oil or other foreign material.

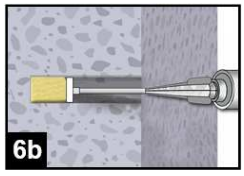


5. Prior to dispensing into the anchor hole, squeeze out separately the mortar until it shows a consistent grey or blue (KEM HR Blue) colour, but a minimum of three full strokes, and discard non-uniformly mixed adhesive components.

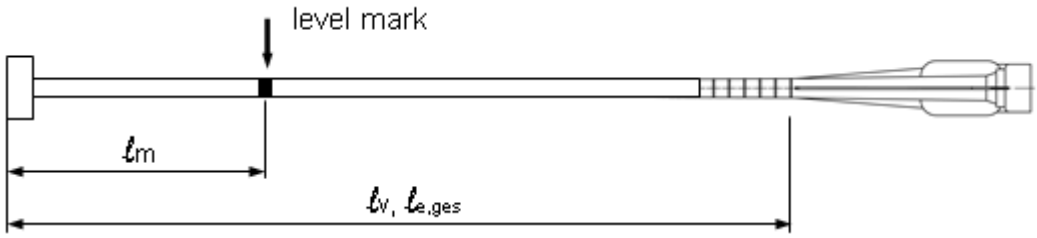
D) Filling the bore hole



6a. 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.



6b. For overhead and horizontal installation and bore holes deeper than 240 mm a piston plug and the appropriate mixer extension must be used.
Observe the gel-/ working times given in Table B3.



Injection tool must be marked by mortar level mark ℓ_m and anchorage depth ℓ_v resp. $\ell_{e,ges}$ with tape or marker.

Quick estimation: $\ell_m = 1/3 \cdot \ell_v$ Continue injection until the mortar level mark ℓ_m becomes visible.

Optimum mortar volume: $\ell_m = \ell_v$ resp. $\ell_{e,ges} \cdot \left(1{,}2 \cdot \frac{d_s^2}{d_0^2} - 0{,}2\right)$ [mm]

Friulsider Injection System for rebar connection **KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express**	**Annex B 7**
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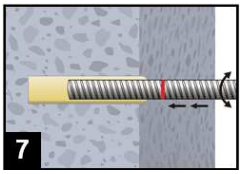
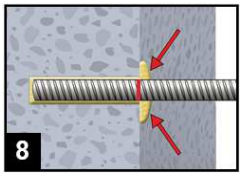
E) Inserting the rebar

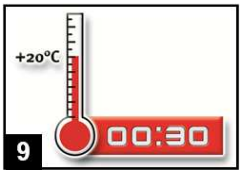


3. Push the reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

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



4. Be sure that the bar is inserted in the bore hole until the embedment mark is at the concrete surface 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 installation fix embedded part (e.g. wedges).



5. Observe gelling time t_{gel}. Attend that the gelling time can vary according to the base material temperature (see Table B3). It is not allowed to move the bar after geling time t_{gel} has elapsed.

   Allow the adhesive to cure to the specified time prior to applying any load. Do not move or load the bar until it is fully cured (attend Table B3). After full curing time $\mathbf{t_{cure}}$ has elapsed, the add-on part can be installed.

Friulsider Injection System for rebar connection KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express	**Annex B 8**
Intended use Installation instruction	

Minimum anchorage length and minimum lap length

The minimum anchorage length $\ell_{b,min}$ and the minimum lap length $\ell_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($\ell_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $\ell_{0,min}$ acc. to Eq. 8.11) shall be multiply by the amplification factor α_{lb} according to Table C1.

Table C1: Amplification factor α_{lb} related to concrete class and drilling method

Concrete class	Drilling method	Bar size	Amplification factor α_{lb}
C12/15 to C50/60	All drilling method	8 mm to 25 mm	1,5

Table C2: Reduction factor k_b for all drilling methods

Rebar - ϕ	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 mm to 20 mm	1,0								
25 mm	1,0								0,93

Table C3: Design values of the ultimate bond strength $f_{bd,PIR}$ in N/mm² for all drilling methods and for good conditions

$f_{bd,PIR} = k_b \cdot f_{bd}$

with

f_{bd}: Design value of the ultimate bond strength in N/mm² considering the concrete classes and the rebar diameter according to EN 1992-1-1:2004+AC:2010.
(for all other bond conditions multiply the values by 0.7)

k_b: Reduction factor according to Table C2

Rebar - ϕ	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 mm to 20 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
25 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,0

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KEM HR, KEM HR Blue, KEM HR Tropical, KEM HR Express

Intended use
Amplification factor α_{lb}
Design values of ultimate bond strength $f_{bd,PIR}$

Annex C 1