Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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European Technical Assessment ETA-14/0203 of 8 May 2017

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	Ripple injection system R-Fix for rebar connection
Product family to which the construction product belongs	System for post installed rebar connection with mortar
Manufacturer	RIPPLE CONSTRUCTION PRODUCTS PVT LTD+ Corp. Office: 303 & 403, ROYAL ARCADIA Above SBI Bank, Balkampet Main Road S R NAGAR, HYDERABAD - 500 038 INDIA PinCode - INDIEN
Manufacturing plant	RIPPLE CONSTRUCTION PRODUCTS PVT LTD+ Plant 1
This European Technical Assessment contains	17 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	European Assessment Document (EAD) 330087-00-0601
This version replaces	ETA-14/0203 issued on 26 June 2014

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Specific Part

1 Technical description of the product

The subject of this European Technical Assessment is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the "Ripple Injection system R-Fix for rebar connection" in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter ϕ from 8 to 40 mm according to Annex A and injection mortar Ripple R-Fix are used for rebar connections. The rebar is placed into a drilled hole filled with injection mortar and is anchored via the bond between rebar, 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
Amplification factor α_{lb}, Bond resistance f_{bd}	See Annex C1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	The products satisfy requirements for Class A1
Resistance to fire	See Annex C2

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

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

In accordance with European Assessment Document EAD No. 330087-00-0601, the applicable European legal act is: [96/582/EC].

The system(s) to be applied is (are): 1

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

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

Issued in Berlin on 8 May 2017 by Deutsches Institut für Bautechnik

Andreas Kummerow
Head of Department

beglaubigt:
Baderschneider

Deutsches Institut für Bautechnik DIBt

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

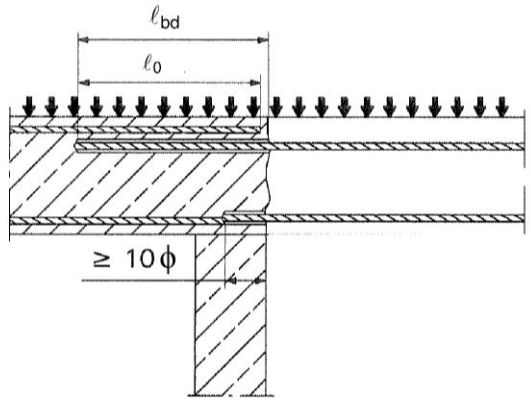


Figure A2: Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

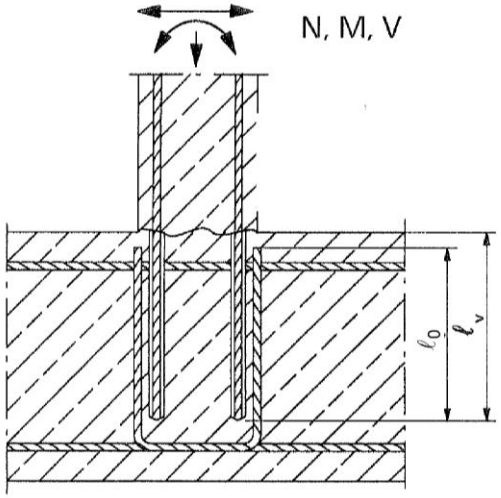


Figure A3: End anchoring of slabs or beams (e.g. designed as simply supported)

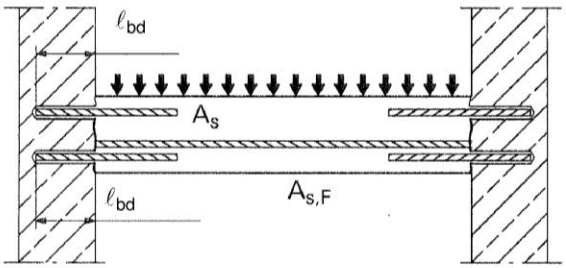


Figure A4: Rebar connection for components stressed primarily in compression. The rebars sre stressed in compression

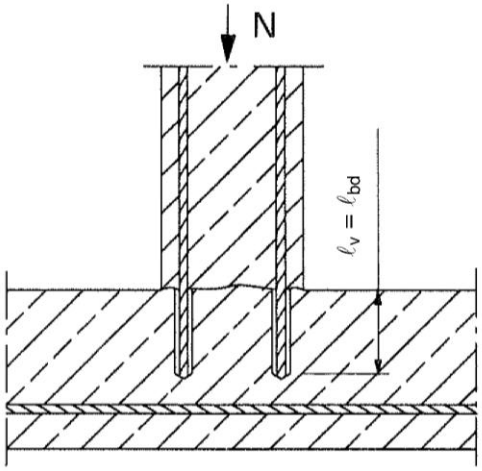
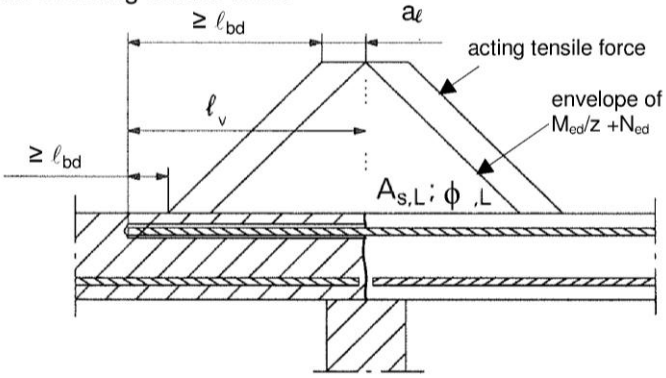


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force



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

Ripple Injection System R-Fix for rebar connection	**Annex A 1**
Product description Installed condition and examples of use for rebars	

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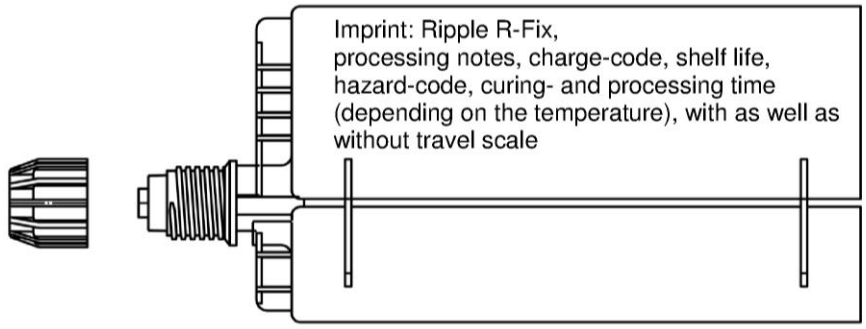
Ripple Injection System R-Fix:

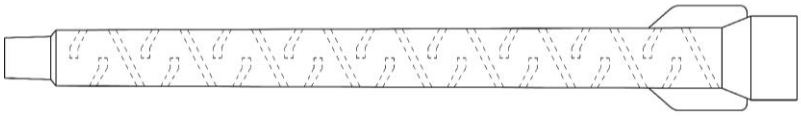
Injection mortar: Ripple R-Fix

Type "side-by-side":
385 ml, 444ml, 585 ml, 999 ml and 1400 ml

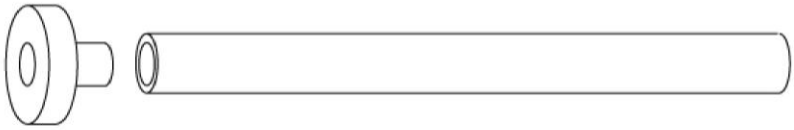


Static Mixer

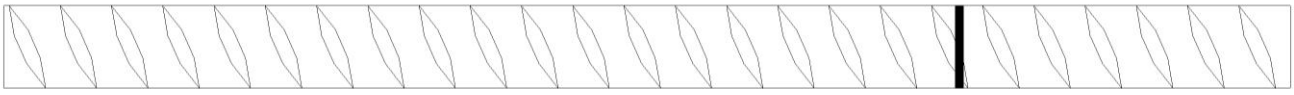
TAH 18W



Piston plug and mixer extension



Reinforcing bar (rebar): ø8, ø10, ø12, ø14, ø16, ø20, ø22, ø24, ø25, ø28, ø32, ø34, ø36, ø40



- 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:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Ripple Injection System R-Fix for rebar connection	Annex A 2
Product description Injection mortar / Static mixer / Rebar Materials	

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Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads.
- Fire exposure

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C12/15 to C50/60 according to EN 206-1:2000.
- Maximum chloride concrete of 0,40% (CL 0.40) related to the cement content according to EN 206-1:2000.
- 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.
- 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.
- Anchorages under static or quasi-static actions are designed in accordance with EN 1992-1-1:2004+AC:2010 and Annex B2.
- Anchorages under fire exposure are designed in accordance with EN 1992-1-2:2004+AC:2008.

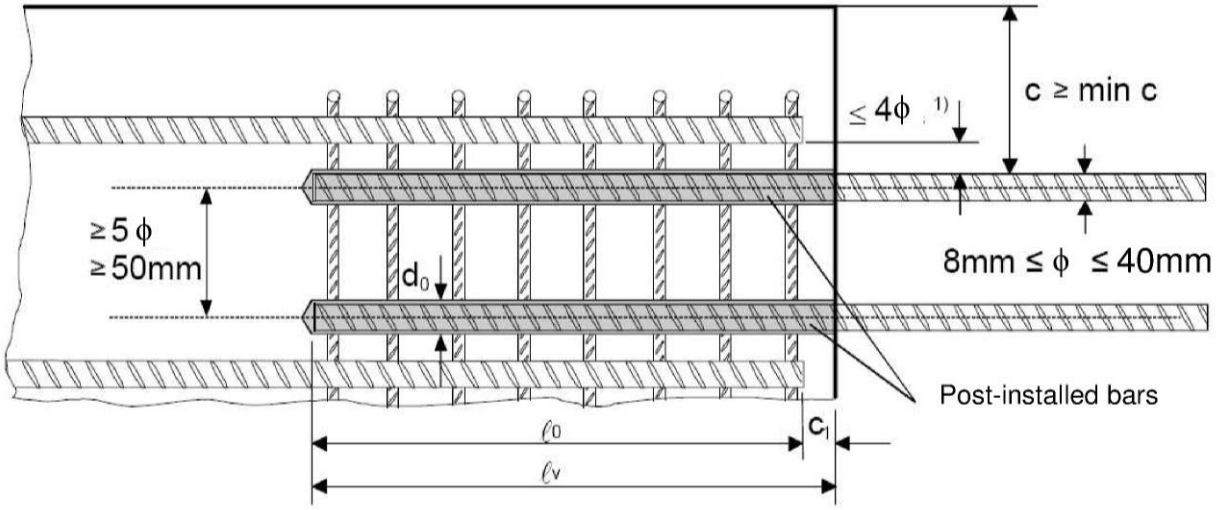
Installation:

- Dry or wet concrete.
- It must not be installed in flooded holes.
- Hole drilling by hammer drill, compressed air drill or diamond drill mode.
- The installation of post-installed rebar 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).

Ripple Injection System R-Fix for rebar connection	**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 3

Ripple Injection System R-Fix for rebar connection	**Annex B 2**
Intended use General construction rules for post-installed rebars	

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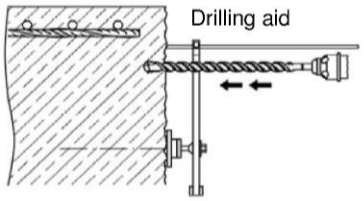
Table B1: Minimum concrete cover min c[1)] of post-installed rebar depending of drilling method



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	60 mm + 0,02 · ℓ_v
Diamond coring (DD)	< 25 mm	Drill stand used as drilling aid	30 mm + 0,02 · ℓ_v ≥ 2 ϕ
	≥ 25 mm		40 mm + 0,02 · ℓ_v ≥ 2 ϕ

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

Table B2: Bore hole diameter and maximum embedment depth $\ell_{v,max}$

Bar size ϕ	Drill bit - ∅			Cartridge: side-by-side (385, 444, 585, 999, 1400 ml)	Cartridge: side-by-side (385, 444, 585 ml)	Cartridge: side-by-side (999, 1400 ml)
				Hand or battery tool	Pneumatic tool	Pneumatic tool
	HD	CD	DD	$l_{v,max}$	$l_{v,max}$	$l_{v,max}$
(mm)	(mm)			(mm)	(mm)	(mm)
8	12	-	12	700	800	800
10	14	-	14		1000	1000
12	16				1200	1200
14	18					1400
16	20				1500	1600
20	25	26	25	500	1000	2000
22	28					
24	32				700	
25	32					
28	35					
32	40			-		
34	40				500	
36	45					
40	55	55	52			

Ripple Injection System R-Fix for rebar connection

Intended use
Minimum concrete cover
Maximum embedment depth

Annex B 3

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

Concrete temperature	Gelling- / working time[1)]	Minimum curing time in dry concrete	Minimum curing time in wet concrete
	t_{gel}	$t_{cure,dry}$	$t_{cure,wet}$
≥ 5 °C	120 min	50 h	100 h
≥ + 10 °C	90 min	30 h	60 h
≥ + 20 °C	30 min	10 h	20 h
≥ + 30 °C	20 min	6 h	12 h
≥ + 40 °C	12 min	4 h	8 h

[1)] t_{gel}: maximum time from starting of mortar injection to completing of rebar setting.

Table B4: Dispensing tools

Cartridge type/size	Hand tool		Pneumatic tool
Side-by-side cartridges 385, 444, 585 ml	e.g. SA 296C585	e.g. Type H 244 C	e.g. Type TS 444 KX
Side-by-side cartridge 999 ml	-	-	e.g. Type TS 4104
Side-by-side cartridge 1400 ml	-	-	e.g. Type TS 471

All cartridges could also be extruded by a battery tool.

Ripple Injection System R-Fix for rebar connection

Intended use
Working time and curing times
Dispensing tools

Annex B 4

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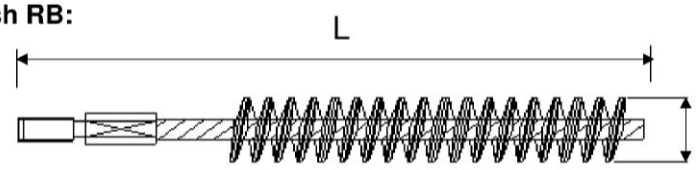
Table B5: Installation tools

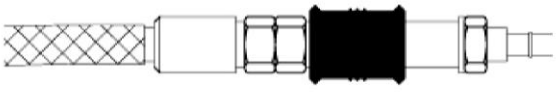
Bar size ϕ	Drill and clean						Installation		
	Drill bit - ∅			Brush	min Brush - ∅	Air Nozzle	Piston plug	Mixer extension	Max embedment depth
	HD	CD	DD		$d_{b,min}$				l_v or $l_{e,ges}$
[mm]	[mm]			RB	[mm]	AN	VS	VL	[mm]
8	12	-	12	14	12,5	10	-	VL 10/0,75 or VL 16/1,8	800
10	14	-	14	16	14,5		14		1000
12	16			18	16,5	14	16		1200
14	18			20	18,5		18		1400
16	20			22	20,5	17	20		1600
20	25	-	25	27	25,5		25		2000
	-	26	-	27	26,5		25		2000
22	28			30	28,5	27	28		2000
24	32			34	32,5		32		2000
25	32			34	32,5		32		2000
28	35			37	35,5		35		2000
32	40			42	40,5		40		2000
34	40			42	40,5		40		2000
36	45			47	45,5	40	45		2000
40	-	-	52	54	52,5		52		2000
	55	55	-	58	55,5		55		2000

Brush RB:



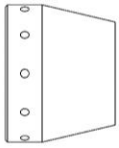
SDS Plus Adapter:

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



Hand pump (volume 750 ml)

Air nozzle AN:



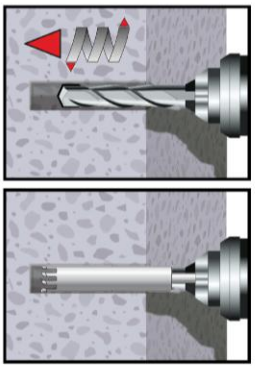
Brush extension:

Ripple Injection System R-Fix for rebar connection

Intended use
Installation tools

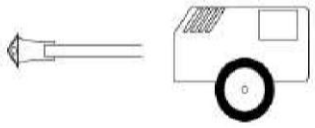
Annex B 5

1) Bore hole drilling

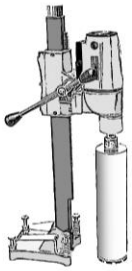


1. Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar with carbide hammer drill (HD), a compressed air drill (CD) or diamond core (DD). In case of aborted drill hole: the drill hole shall be filled with mortar. Drill bit sizes see Table B5.

Hammer drilling (HD)



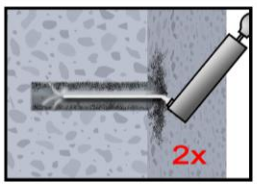
Compressed air drilling (CD)



Diamond coring (DD)

2a) Bore hole cleaning (HD and CD)

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



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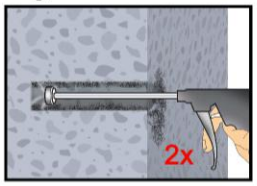

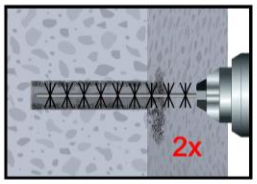

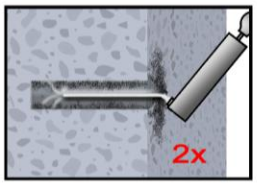

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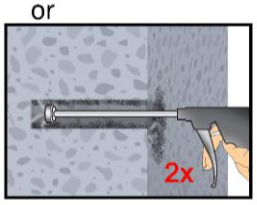

2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) or a hand pump a minimum of two times. If the bore hole ground is not reached an extension shall be used.

For bore holes deeper than 240 mm, compressed air (min. 6 bar **must** be used. For bore holes larger than 32 mm, compressed air (min. 6 bar) and the appropriate air nozzle (see Table B5) **must** be used.

2b. Check brush diameter (Table B5) 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 B5) a minimum of two times.
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 compressed air (min. 6 bar) or a hand pump a minimum of two times. If the bore hole ground is not reached an extension shall be used.

For bore holes deeper than 240 mm, compressed air (min. 6 bar **must** be used. For bore holes larger than 32 mm, compressed air (min. 6 bar) and the appropriate air nozzle (see Table B5) **must** be used.

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

Ripple Injection System R-Fix for rebar connection	**Annex B 6**
Intended use Installation instruction: Bore hole drilling and cleaning (HD and CD)	

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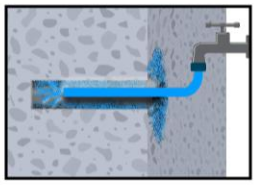
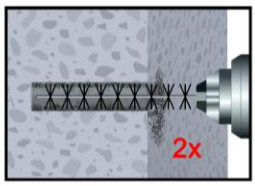
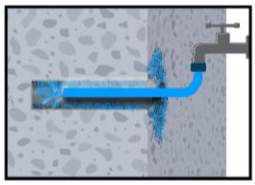
2b) Bore hole cleaning (DD)



2a. Rinsing with water until clear water comes out.

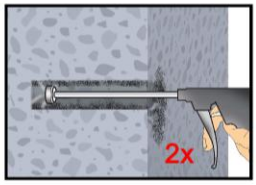


2b. Check brush diameter acc. Table B5 and attach the brush to a drilling machine or a battery screwdriver. Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times. If the bore hole ground is not reached with the brush, a brush extension shall be used (Table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

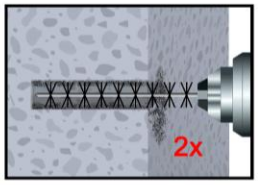


2c. Rinsing again with water until clear water comes out.

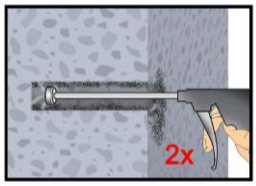
Attention! Standing water in the bore hole must be removed before cleaning.



2d. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) with the appropriate air nozzle (see Table B5) a minimum of two times. If the bore hole ground is not reached an extension shall be used.



2e. Check brush diameter (Table B5) 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 B5) a minimum of two times.
If the bore hole ground is not reached with the brush, a brush extension shall be used.



2f. Finally blow the hole clean again with compressed air (min. 6 bar) with the appropriate air nozzle (see Table B5) a minimum of two times. If the bore hole ground is not reached an extension shall be used.

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

Ripple Injection System R-Fix for rebar connection	**Annex B 7**
Intended Use Installation instruction: Bore hole cleaning (DD)	

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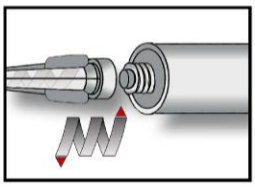
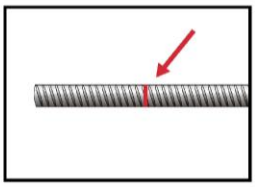
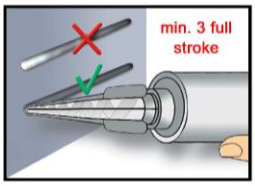
3) Preparation of bar and cartridge



3a. 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.

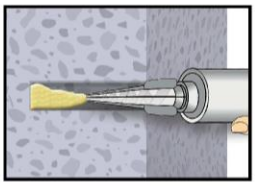


3b. Prior to inserting the reinforcing bar into the filled bore hole, the position of the embedment depth shall be marked (e.g. with tape) on the reinforcing bar and insert bar in empty hole to verify hole and depth ℓ_v.
The anchor should be free of dirt, grease, oil or other foreign material.

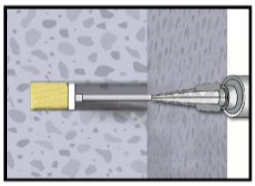


3c. Prior to dipensing into the anchor hole, squeeze out separately the mortar until it shows a consistent grey or red colour, but a minimum of three full strokes, and discard non-uniformly mixed adhesive components.

4) Filling the bore hole

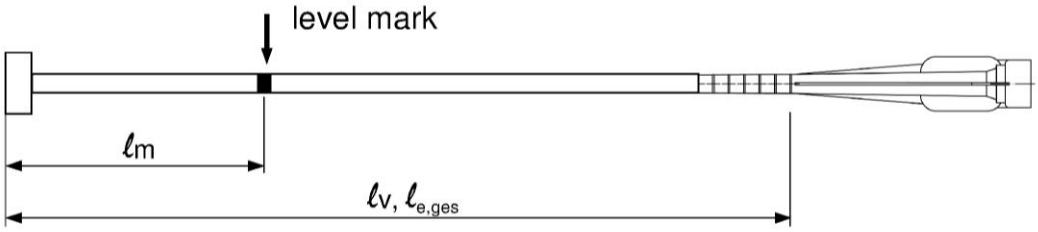


4. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used.



For overhead and horizontal installation 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. $\ell_{e,ges} \cdot \left(1{,}2 \cdot \frac{\phi^2}{d_0^2} - 0{,}2\right)$ [mm]

Ripple Injection System R-Fix for rebar connection	**Annex B 8**
Intended Use Installation instruction: Preparation of bar and cartridge Filling the bore hole	

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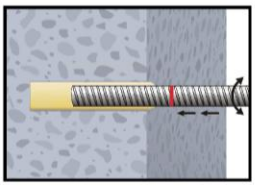
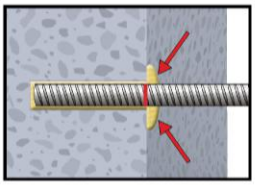
5) Setting the rebar

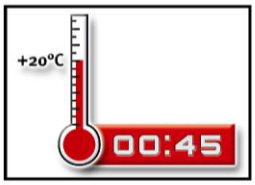


5a. Push the reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

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



5b. 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 horizontal and overhead installation fix embedded part (e.g. with wedges).



5c. 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.

Ripple Injection System R-Fix for rebar connection	**Annex B 9**
Intended Use Installation instruction: Inserting rebar	

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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 related to concrete class and drilling method

Concrete class	Drilling method	Bar size	Amplification factor α_{lb}
C12/15 to C50/60	Hammer drilling (HD) and compressed air drilling (CD)	8 mm to 32 mm	1,0
C12/15 to C50/60	Hammer drilling (HD) and compressed air drilling (CD)	> 32 mm	1,5
C12/15 to C50/60	Diamond coring (DD)	8 mm to 40 mm	1,5

Table C2: Design values of the ultimate bond resistance f_{bd} in N/mm² for hammer (HD) and compressed air drilling (CD) methods for good conditions
according to EN 1992-1-1:2004+AC:2010 for good bond conditions
(for all other bond conditions multiply the values by 0.7)

Rebar - ∅	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 32 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
34 mm	1,6	2,0	2,3	2,6	2,9	3,3	3,6	3,9	4,2
36 mm	1,5	1,9	2,2	2,6	2,9	3,3	3,6	3,8	4,1
40 mm	1,5	1,8	2,1	2,5	2,8	3,1	3,4	3,7	4,0

Table C3: Design values of the ultimate bond resistance f_{bd} in N/mm² for Diamond coring (DD) method for good conditions
according to EN 1992-1-1:2004+AC:2010 for good bond conditions
(for all other bond conditions multiply the values by 0.7)

Rebar - ∅	Concrete class								
ϕ	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 28 mm	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
32 mm	1,6	2,0	2,3	2,7					
34 mm	1,6	2,0	2,3	2,6					
36 mm	1,5	1,9	2,2	2,6					
40 mm	1,5	1,8	2,1	2,5					

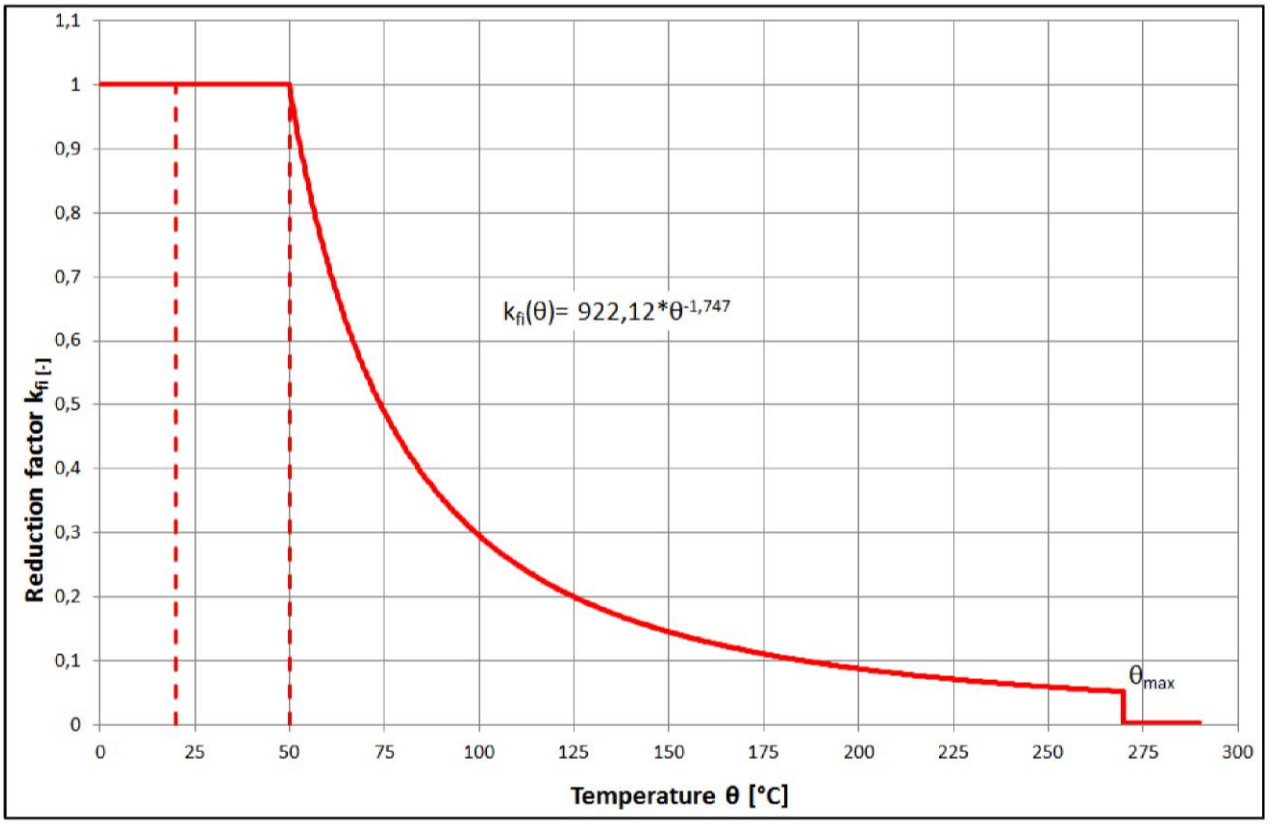
Ripple Injection System R-Fix for rebar connection

Performances
Amplification factor
Design values of ultimate bond resistance f_{bd}

Annex C 1

Reduction factor $k_{fi}(\theta)$ for design in case of fire (all drilling methods)

according to EN 1992-1-2:2004 + AC:2008



$k_{fi}(\theta) = a * \theta^b$ with a = 922,12 and b = -1,747

$k_{fi}(\theta) < 1$ for 50°C ≤ θ ≤ 270°C

$k_{fi}(\theta) = 0$ for θ > 270°C

Design value of the bond strength $f_{bd,fi}$ under fire exposure

The design value of the bond strength $f_{bd,fi}$ under fire exposure will calculated by the following equation:

$$f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd} \cdot \gamma_c / \gamma_{M,fi}$$

with:

$k_{fi}(\theta)$ … Reduction factor under fire exposure, see Figure C4

f_{db} … Design value of the bond strength according to Table C2 or C3

γ_c = 1,5 … recommended safety factor according to EN 1992-1-1

$\gamma_{M,fi}$ … safety factor according to EN 1992-1-2 under fire exposure

Ripple Injection System R-Fix for rebar connection	**Annex C 2**
Performances Reduction factor $k_{fi}(\theta)$ for design in case of fire	