Deutsches Institut für Bautechnik

Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products

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European Technical Assessment ETA-24/0076 of 26 April 2024

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	VJ Technology Injection system V420+
Product family to which the construction product belongs	Post-installed reinforcing bar (rebar) connection with improved bond-splitting behaviour under static loading
Manufacturer	VJ Technology Ltd. Brunswick Road ASHFORD, KENT, TN23 1EN GROSSBRITANNIEN
Manufacturing plant	Plant 1 Germany
This European Technical Assessment contains	16 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 332402-00-0601, Edition 09/2023

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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 VJ Technology Injection system V420+ in accordance with the regulations for reinforced concrete construction.
Reinforcing bars with a diameter ϕ from 8 to 32 mm according to Annex A and the injection mortar V420+ or V420+ V3 are used for the post-installed rebar connection. The rebar is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded reinforcing bar, 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 rebar connection 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 rebar connections of at least 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	
Resistance to combined pull-out and concrete failure in uncracked concrete	See Annex C 1
Resistance to concrete cone failure	See Annex C 1
Robustness	See Annex C 1
Resistance to bond-splitting failure	See Annex C 1
Influence of cracked concrete on resistance to combined pull-out and concrete failure	See Annex C 1
Characteristic resistance to tension load (seismic loading)	No performance assessed

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. 332402-00-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

Issued in Berlin on 26 April 2024 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

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Installation condition and application example

Figure A1: Column / wall to foundation / slab

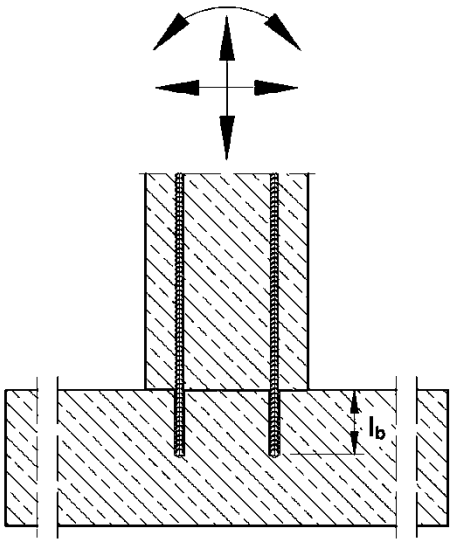
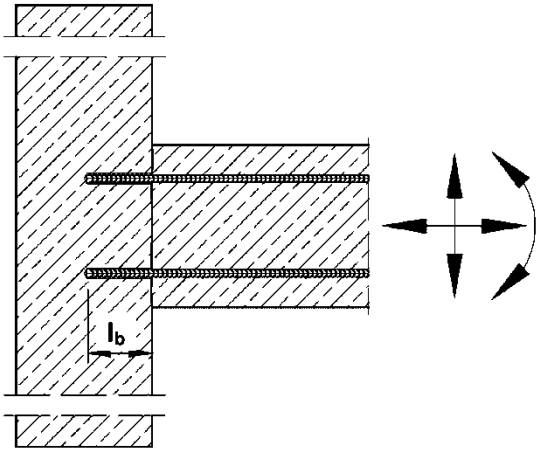


Figure A2: Slab / beam to wall or beam to column



l_b = Embedment length

The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1:2004+AC:2010.

VJ Technology Injection system V420+	**Annex A 1**
Product description Installed condition and examples of use for rebars	

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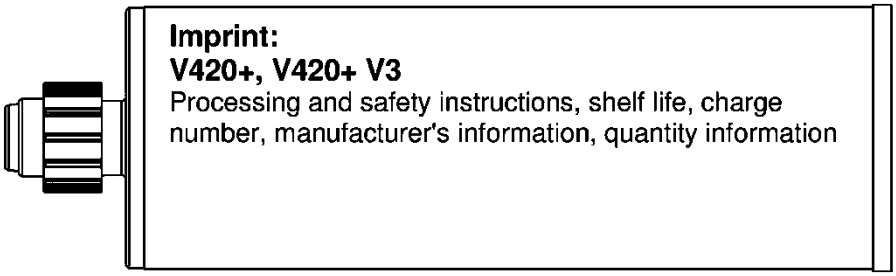
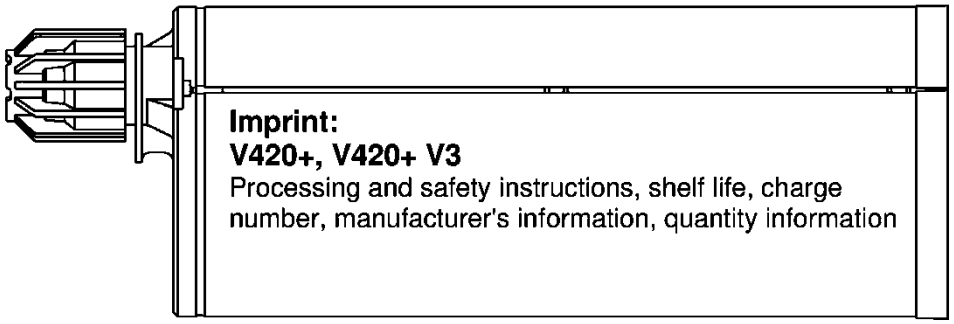
Cartridge system

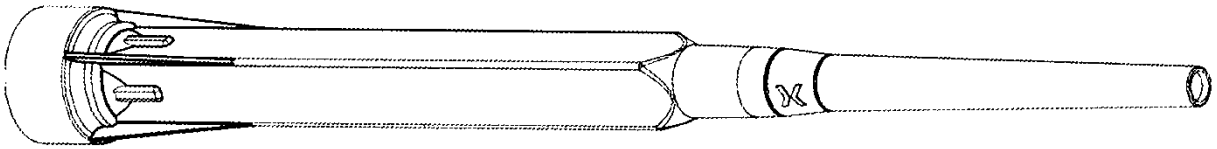
Coaxial Cartridge:
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml



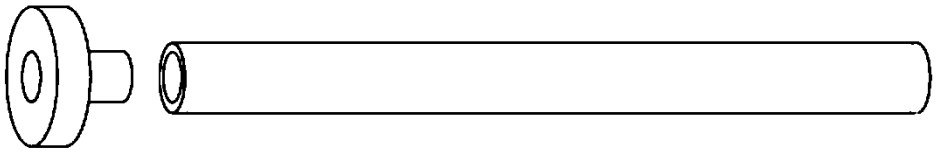
Side-by-Side Cartridge:
235 ml, 345 ml up to 360 ml and 825 ml



Static mixer PM-19E



Piston plug PP und mixer extension



VJ Technology Injection system V420+	**Annex A 2**
Product description Injection system	

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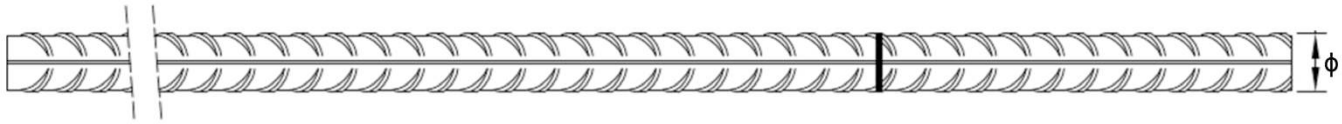
Reinforcing bar (rebar): ø8 up to ø32



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

Table A1: Materials Rebar

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 NCI of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

VJ Technology Injection system V420+	**Annex A 3**
Product description Specifications Rebar	

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Specification of the intended use

Anchorages subject to:		working life 50 years	working life 100 years
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	Static and quasi-static loads	Ø8 to Ø32	Ø8 to Ø32
Temperature Range:		I: - 40 °C to +40 °C[1)] II: - 40 °C to +80 °C[2)] III: - 40 °C to +120 °C[3)] IV: - 40 °C to +160 °C[4)]	I: - 40 °C to +40 °C[1)] II: - 40 °C to +80 °C[2)]

1) (max. long-term temperature +24°C and max. short-term temperature +40°C)
2) (max. long-term temperature +50°C and max. short-term temperature +80°C)
3) (max. long-term temperature +72°C and max. short-term temperature +120°C)
4) (max. long-term temperature +100°C and max. short-term temperature +160°C)

Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.
- Maximum chloride content of 0,40% (CL 0.40) related to the cement content according to EN 206:2013 + 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.

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 EOTA Technical Report TR 069, Edition June 2021.
- 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, as well as in flooded holes.
- Overhead installation allowed.
- Hole drilling by hammer drill (HD), hollow drill (HDB) or compressed air drill mode (CD).
- Rebar installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- 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).

VJ Technology Injection system V420+	**Annex B 1**
Intended use Specifications	

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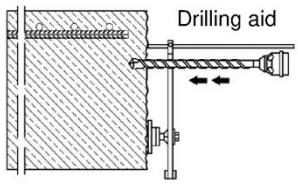
Table B1: Minimum concrete cover c_{min} of post-installed rebar depending of drilling method

Drilling method	Rebar diameter	Without drilling aid	With drilling aid	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit	< 25 mm	30 mm + 0,06 · l_b ≥ 2 ϕ	30 mm + 0,02 · l_b ≥ 2 ϕ	
	≥ 25 mm	40 mm + 0,06 · l_b ≥ 2 ϕ	40 mm + 0,02 · l_b ≥ 2 ϕ	
CD: Compressed air drilling	< 25 mm	50 mm + 0,08 · l_b	50 mm + 0,02 · l_b	
	≥ 25 mm	60 mm + 0,08 · l_b ≥ 2 ϕ	60 mm + 0,02 · l_b ≥ 2 ϕ	

The minimum concrete cover acc. EN 1992-1-1:2004+AC:2010 must be observed.
The minimum clear spacing is a = max (40mm; 4 ϕ)

Table B2: Dispensing tools

Cartridge type/size	Hand tool		Pneumatic tool
Coaxial cartridges 150, 280, 300 up to 333 ml	 e.g. Type H297 / 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 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.

VJ Technology Injection system V420+

Intended use
Minimum concrete cover
Dispensing tools

Annex B 2

Deutsches Institut für Bautechnik DIBt

Table B3: Brushes, piston plugs, max embedment length and mixer extension, hammer (HD) and compressed air (CD) drilling

Bar size ϕ	Drill bit - Ø		d_b Brush - Ø		$d_{b,min}$ min. Brush - Ø	Piston plug	Cartridge: All sizes				Cartridge: 825 ml	
							Hand or battery tool		Pneumatic tool		Pneumatic tool	
	HD	CD					$l_{b,max}$	Mixer extension	$l_{b,max}$	Mixer extension	$l_{b,max}$	Mixer extension
[mm]	[mm]			[mm]	[mm]		[mm]		[mm]		[mm]	
8	10	-	BR10	11,5	10,5	-	250	10/0,75 or 16/1,8	250	10/0,75 or 16/1,8	250	10/0,75 or 16/1,8
	12	-	BR12	13,5	12,5	-	700		800		800	
10							250		250		250	
	14	-	BR14	15,5	14,5	PP14	700		1000		1000	
12							250		250		250	
	16		BR16	17,5	16,5	PP16	700		1000		1200	16/1,8
14	18		BR18	20,0	18,5	PP18					1400	
16	20		BR20	22,0	20,5	PP20					1600	
20	25	-	BR25	27,0	25,5	PP25	500		700		2000	
	-	26	BR26	28,0	26,5	PP25						
22	28		BR28	30,0	28,5	PP28						
24/25	30		BR30	32,0	30,5	PP30			500			
	32		BR32	34,0	32,5	PP32						
28	35		BR35	37,0	35,5	PP35						
32	40		BR40	43,5	40,5	PP40						

Table B4: Brushes, piston plugs, max embedment length and mixer extension, hammer drilling with hollow drill bit system (HDB)

Bar size ϕ	Drill bit - Ø	d_b Brush - Ø	$d_{b,min}$ min. Brush - Ø	Piston plug	Cartridge: All sizes				Cartridge: 825 ml	
					Hand or battery tool		Pneumatic tool		Pneumatic tool	
	HDB				$l_{b,max}$	Mixer extension	$l_{b,max}$	Mixer extension	$l_{b,max}$	Mixer extension
[mm]	[mm]				[mm]		[mm]		[mm]	
8	10	No cleaning required		-	250	10/0,75 or 16/1,8	250	10/0,75 or 16/1,8	250	10/0,75 or 16/1,8
	12				700		800		800	
10					250		250		250	
	14			PP14	700		1000		1000	
12					250		250		250	
	16			PP16	700		1000		1000	16/1,8
14	18			PP18						
16	20			PP20						
20	25			PP25	500		700			
22	28			PP28						
24/25	30			PP30			500			
	32			PP32						
28	35			PP35						
32	40			PP40						

VJ Technology Injection system V420+

Intended use
Parameter brushes, piston plugs, max embedment length and mixer extension

Annex B 3

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Cleaning and installation tools

HDB – Hollow drill bit system

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

Hand pump

(Volume 750 ml, $h_0 \leq 10\ d_s$, $d_0 \leq 20$mm)

Compressed air tool

(min 6 bar)

Brush BR

Piston Plug PP

Brush extension

Table B5: Working time and curing time

Temperature in base material			Maximum working time	Minimum curing time[1)]
T			t_{work}	t_{cure}
- 5 °C	up to	- 1 °C	50 min	5 h
0 °C	up to	+ 4 °C	25 min	3,5 h
+ 5 °C	up to	+ 9 °C	15 min	2 h
+ 10 °C	up to	+ 14 °C	10 min	1 h
+ 15 °C	up to	+ 19 °C	6 min	40 min
+ 20 °C	up to	+ 29 °C	3 min	30 min
+ 30 °C	up to	+ 40 °C	2 min	30 min
Cartridge temperature			+5°C up to +40°C	

[1)] The minimum curing time is only valid for dry base material.
In wet base material the curing time must be doubled.

VJ Technology Injection system V420+	**Annex B 4**
Intended use Cleaning and installation tools Working time and curing time	

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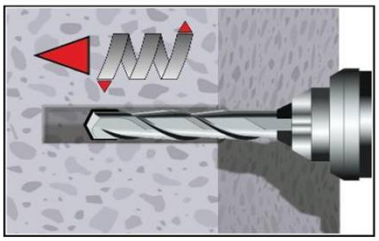
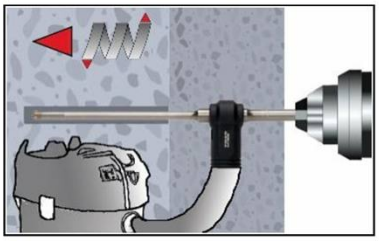
Installation instructions

Attention: Before drilling, remove carbonated concrete and clean contact areas (see Annex B 1)
Aborted drill holes shall be filled with mortar.

Drilling of the bore hole



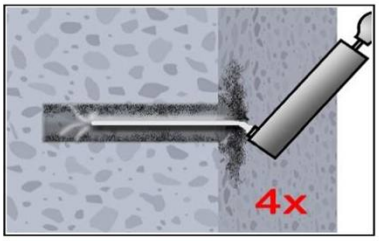
1a. **Hammer drilling (HD) / Compressed air drilling (CD)**
Drill a hole to the required embedment length.
Drill bit diameter according to Table B3.
Proceed with Step 2 (MAC or CAC).



1b. **Hollow drill bit system (HDB) (see Annex B 4)**
Drill a hole to the required embedment length .
Drill bit diameter according to Table B4.
Proceed with Step 3.

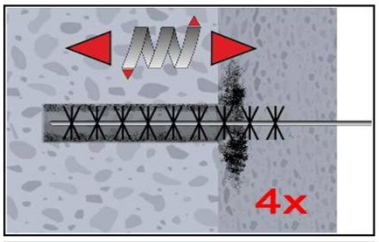
Manual Air Cleaning (MAC)

for bore hole diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10\phi$, with drilling method HD and CD

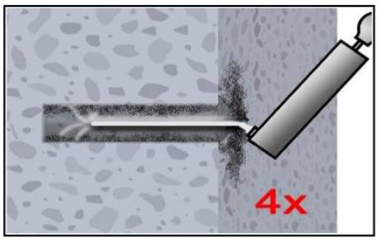


Attention! Standing water in the bore hole must be removed before cleaning.

2a. Blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).



2b. Brush the bore hole minimum 4x with brush BR according to Table B3 over the entire embedment depth in a twisting motion (if necessary, use a brush extension).



2c. Finally blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).

VJ Technology Injection system V420+	**Annex B 5**
Intended use Installation instruction	

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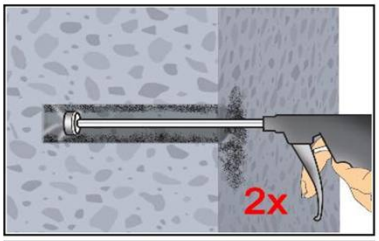
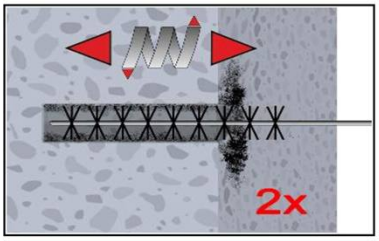
Installation instructions (continuation)

Compressed Air Cleaning (CAC):
All diameter with drilling method HD and CD

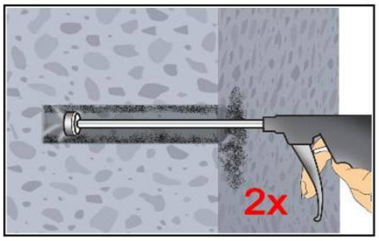


Attention! Standing water in the bore hole must be removed before cleaning.

2a. Blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

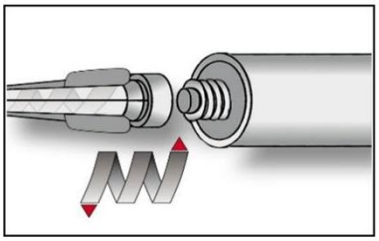


2b. Brush the bore hole minimum 2x with brush BR according to Table B3 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used.)

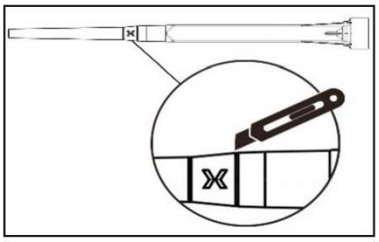


2c. Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar, oil-free) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

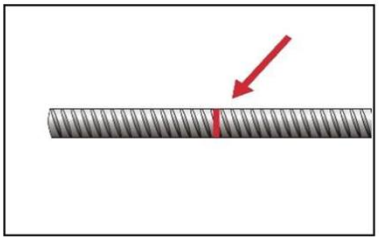
Cleaned bore hole has to be protected against re-contamination in an appropriate way, If necessary, repeat cleaning process directly before dispensing the mortar.



3. Screw on static-mixing nozzle PM-19E and load the cartridge into an appropriate dispensing tool.
For every working interruption longer than the maximum working time t_{work} (Annex B 4) as well as for new cartridges, a new static-mixer shall be used.



3a. In case of using the mixer extension 16/1,8, the tip of the mixer nozzle has to be cut off at position „X“.



4. Mark embedment length l_b on the reinforcing bar.
The anchor rod shall be free of dirt, grease, oil or other foreign material.

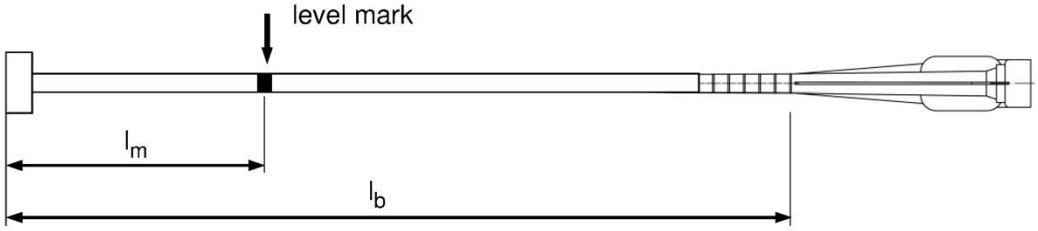
VJ Technology Injection system V420+	**Annex B 6**
Intended use Installation instructions (continuation)	

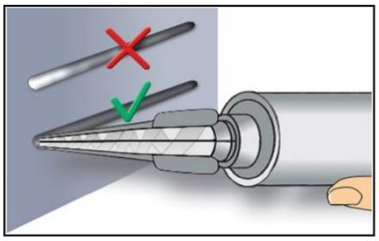
Deutsches Institut für Bautechnik DIBt

Installation instructions (continuation)

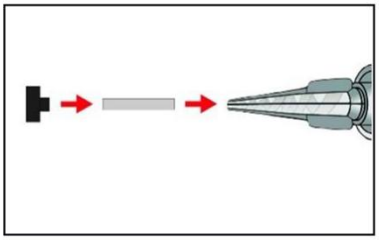
5. Injection tool must be marked by mortar level mark l_m and embedment length l_b with tape or marker.
Quick estimation: $l_m = 1/3 \cdot l_b$
Optimum mortar volume:

$$l_m = l_b \cdot \left(1{,}2 \cdot \frac{\phi^2}{d_0^2} - 0{,}2 \right)$$

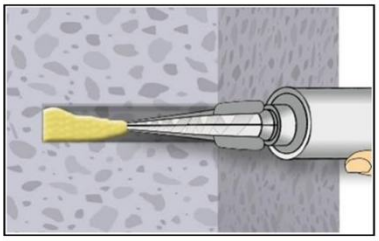




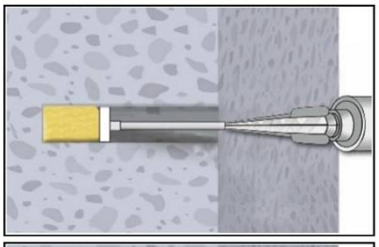
6. Not proper mixed mortar is not sufficient for fastening.
Dispense and discard mortar until an uniform grey colour is shown (at least 3 full strokes).



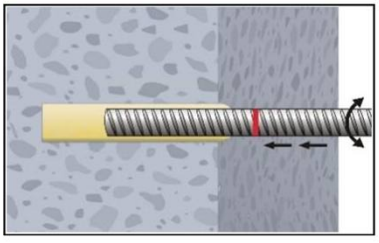
7. Piston plugs PP and mixer nozzle extensions shall be used according to Table B3 or B4
Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.



8a. **Injecting mortar without piston plug PP**
Starting at bottom of the hole and fill the hole up with mortar until the mortar level mark l_m is visible. (If necessary, a mixer nozzle extension shall be used.)
Slowly withdraw of the static mixing nozzle avoid creating air pockets
Observe the temperature related working time t_{work} (Annex B 4).



8b. **Injecting mortar with piston plug PP**
Insert piston plug to bottom of the hole and fill the hole with mortar until mortar level mark l_m is visible. (If necessary, a mixer nozzle extension shall be used.)
During injection the piston plug is pushed out of the bore hole by the back pressure of the mortar.
Observe the temperature related working time t_{work} (Annex B 4).



9. Insert the reinforcing bar while turning slightly up to the embedment mark.

VJ Technology Injection system V420+	**Annex B 7**
Intended use Installation instructions (continuation)	

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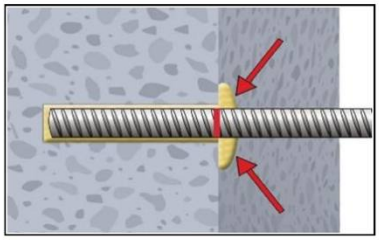
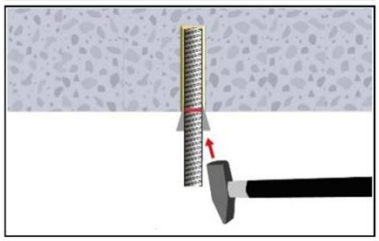
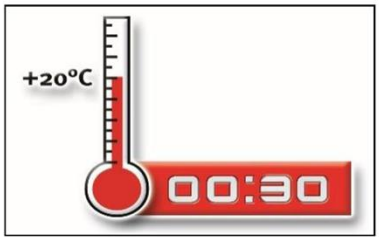
Installation instructions (continuation)



10. Annular gap between reinforcing bar and base material must be completely filled with mortar. Otherwise, the installation must be repeated starting from step 8 before the maximum working time t_{work} has expired.



11. For application in vertical upwards direction the reinforcing bar shall be fixed (e.g. wedges).



12. Temperature related curing time t_{cure} (Annex B 4) must be observed.
Do not move or load the reinforcing bar during curing time.

VJ Technology Injection system V420+	**Annex B 8**
Intended use Installation instructions (continuation)	

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Table C1: Characteristic resistance to tension load under static and quasi-static loading in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB); working life 50 and 100 years

Reinforcing bar					**Ø 8**	**Ø 10**	**Ø 12**	**Ø 14**	**Ø 16**	**Ø 20**	**Ø 24**	**Ø 25**	**Ø 28**	**Ø 32**
Combined pull-out and concrete failure[1]														
Characteristic bond resistance in uncracked concrete C20/25														
Temperature range[1]	I: 24°C/40°C	Dry, wet concrete and flooded bore hole	$\tau_{Rk,ucr,50}$ = $\tau_{Rk,ucr,100}$	[N/mm²]	14	14	14	14	13	13	13	13	13	13
	II: 50°C/80°C				14	14	14	14	13	13	13	13	13	13
	III: 72°C/120°C		$\tau_{Rk,ucr,50}$		13	12	12	12	12	11	11	11	11	11
	IV: 100°C/160°C				9,5	9,5	9,5	9,0	9,0	9,0	9,0	9,0	8,5	8,5
Reduction factor $\psi^0_{sus,50}$ or $\psi^0_{sus,100}$ in cracked and uncracked concrete C20/25														
Temperature range[1]	I: 24°C/40°C	Dry, wet concrete and flooded bore hole	$\psi^0_{sus,50}$ = $\psi^0_{sus,100}$	[-]	0,90									
	II: 50°C/80°C				0,87									
	III: 72°C/120°C		$\psi^0_{sus,50}$		0,75									
	IV: 100°C/160°C				0,66									
Increasing factors for concrete			ψ_c	[-]	$(f_{ck} / 20)^{0,1}$									
Characteristic bond resistance depending on the concrete strength class			$\tau_{Rk,ucr,50}$ =		$\psi_c \cdot \tau_{Rk,ucr,50,(C20/25)}$									
			$\tau_{Rk,ucr,100}$ =		$\psi_c \cdot \tau_{Rk,ucr,100,(C20/25)}$									
Influence of cracked concrete on combined pullout and concrete cone failure														
Factor for influence of cracked concrete			Ω_{cr}	[-]	0,77	0,78	0,79	0,81	0,81	0,82	0,83	0,83	0,83	0,83
Bond-splitting failure														
Product basic factor			A_k	[-]	6,7									
Exponent for influence of…														
- concrete compressive strength			sp1	[-]	0,27									
- rebar diameter ϕ			sp2	[-]	0,36									
- concrete cover c_d			sp3	[-]	0,37									
- side concrete cover (c_{max} / c_d)			sp4	[-]	0,16									
- embedment length l_b			lb1	[-]	0,49									
Concrete cone failure														
Uncracked concrete			$k_{ucr,N}$	[-]	11,0									
Cracked concrete			$k_{cr,N}$	[-]	7,7									
Edge distance			$c_{cr,N}$	[mm]	$1,5\ l_b$[3]									
Axial distance			$s_{cr,N}$	[mm]	$3,0\ l_b$[3]									
Installation factor														
for dry and wet concrete	MAC		γ_{inst}	[-]	1,2						[2]			
	CAC				1,0									
	HDB				1,2									
for flooded bore hole	CAC				1,4									

1) Performance in Temperature Range III and IV assessed for working life 50 years only
2) no performance assessed
3) see Annex A 1

VJ Technology Injection system V420+

Performances
Characteristic resistance to tension load under static and quasi-static loading; working life 50 and 100 years (HD, CD and HDB)

Annex C 1