Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-16/0904 of 1 October 2021

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Injection system AC200+ for rebar connection
Product family to which the construction product belongs	Systems for post-installed rebar connections with mortar
Manufacturer	Stanley Black & Decker Deutschland GmbH Richard-Klinger-Straße 11 65510 Idstein DEUTSCHLAND
Manufacturing plant	Plant 1
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 330087-01-0601, Edition 06/2021
This version replaces	ETA-16/0904 issued on 11 January 2018

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may only be made with the written consent of the issuing Technical Assessment Body. Any partial reproduction shall be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

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 "Injection system AC2000+ for rebar connection" in accordance with the regulations for reinforced concrete construction.

Reinforcing bars made of steel with a diameter ϕ from 8 to 32 mm according to Annex A and injection mortar AC200+ 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 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 under static and quasi-static loading	See Annex C 1
Characteristic resistance under seismic loading	See Annex B 3 and C 2

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 3

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. 330087-01-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

Issued in Berlin on 1 October 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

Installation post installed rebar connection

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

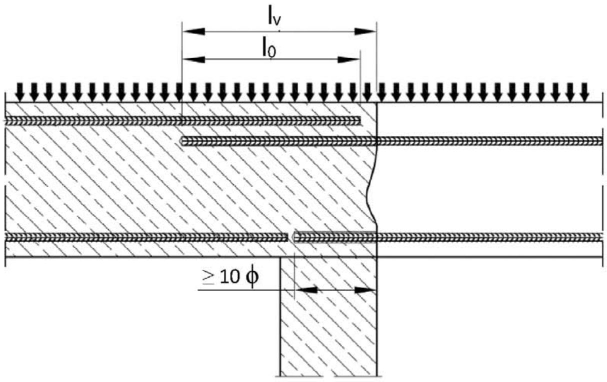


Figure A2: Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

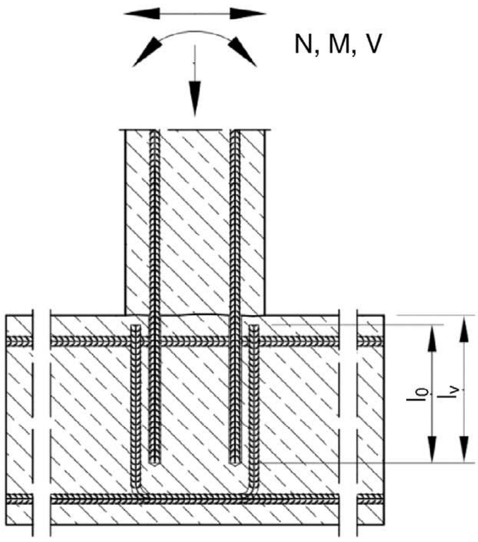


Figure A3: End anchoring of slabs or beams (e.g. designed as simply supported)

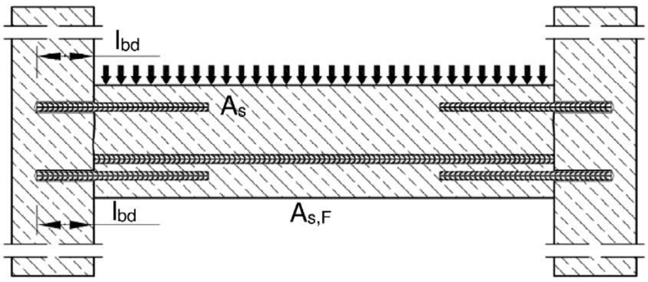


Figure A4: Rebar connection for components stressed primarily in compression. The rebars sre stressed in compression

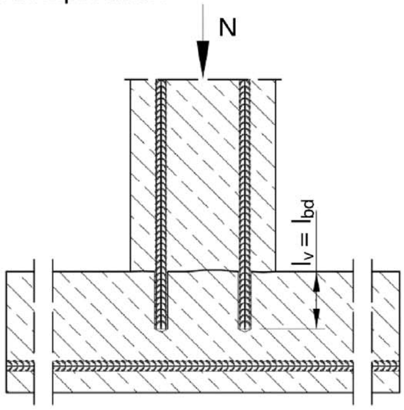
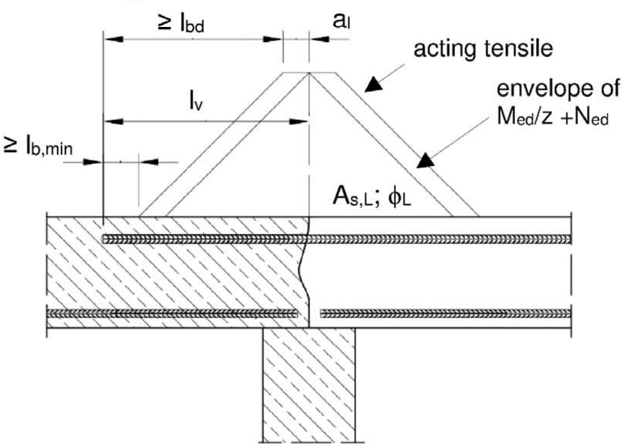


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force



Note to Figure A1 to A5:

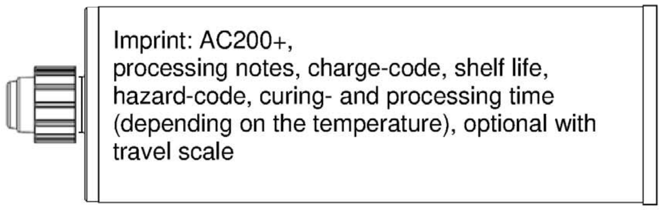
In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2004+AC:2010.

Preparing of joints according to Annex B2

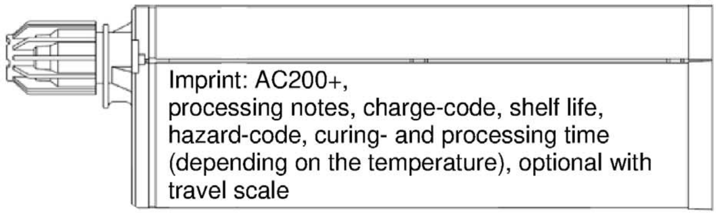
«Systemname_En»Injection System AC200+:

Cartridge: AC200+

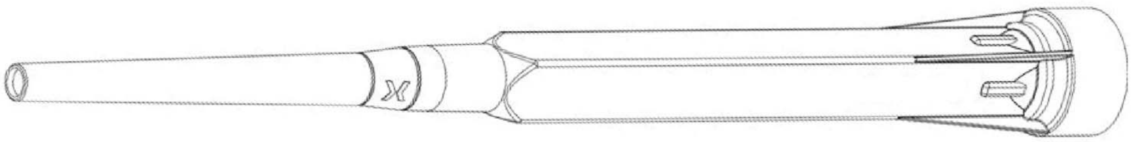
Type 'coaxial':
150 ml, 280 ml,
300 ml up to 333 ml and
380 ml up to 420 ml cartridge



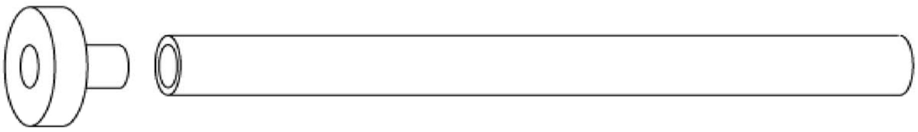
Type 'side-by-side':
235 ml,
345 ml up to 360 ml and
825 ml cartridge



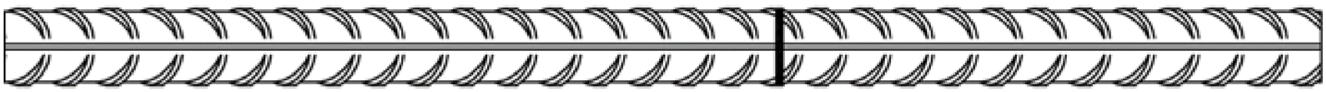
Static Mixer



Piston Plug and Mixer Extension



Reinforcing bar (rebar): ⌀8, ⌀10, ⌀12, ⌀14, ⌀16, ⌀20, ⌀22, ⌀24, ⌀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 0,05Ø ≤ h_{rib} ≤ 0,07Ø
  (Ø: Nominal diameter of the bar; h_{rib}: Rib 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 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Injection system AC200+ for rebar connections

Product description
Injection system and reinforcing bar

Annex A2

Deutsches Institut für Bautechnik DIBt

Specifications of intended use

Anchorages subject to:		Static and quasi-static loads	Seismic action
Hammer drilling (HD), Hammer drilling with hollow drill bit (HDB) or compressed air drilling (CD)	for a working life of 50 years	Ø8 to Ø32	Ø10 to Ø32
	for a working life of 100 years	Ø8 to Ø32	Ø10 to Ø32
	Fire exposure	Ø8 to Ø32	No performance assessed
Temperature Range:	- 40 °C to +80 °C (max long-term temperature +50 °C and max short-term temperature +80 °C)		

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206:2013 + A1:2016.
- Strength classes C12/15 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 Ø + 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:

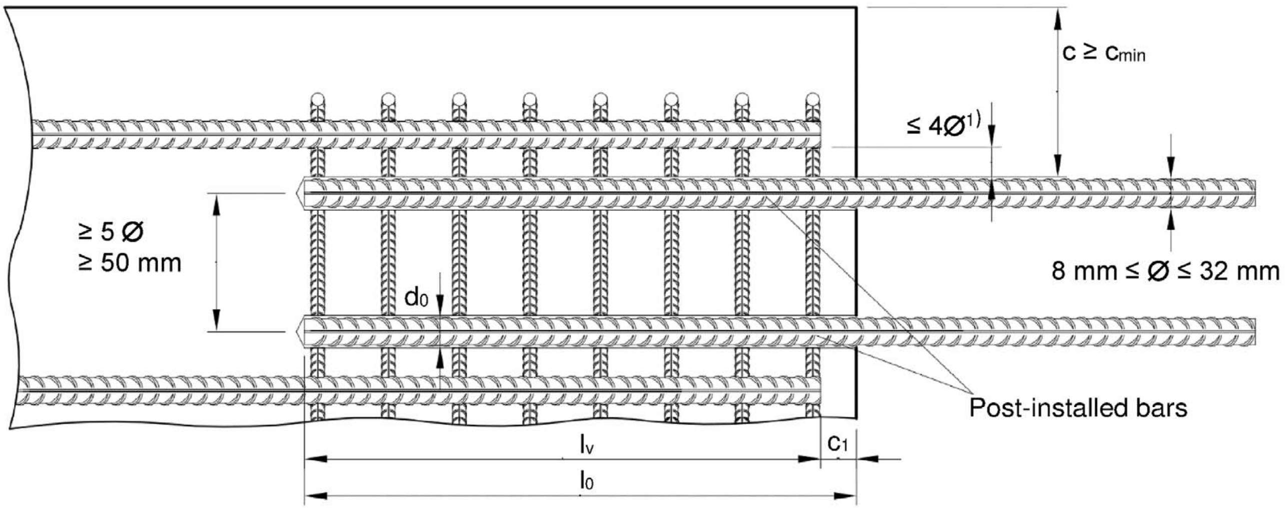
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design according to EN 1992-1-1:2004+AC:2010, EN 1992-1-2:2004+AC:2008 and Annex B2.
- 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 in hammer drill mode with standard bit (HD) or with hollow drill bit (HDB), or in compressed air drill mode (CD).
- 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).

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 4Ø, then the lap length shall be increased by the difference between the clear bar distance and 4Ø.

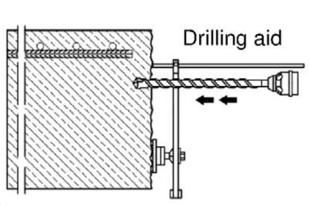
The following applies to Figure B1:

c	concrete cover of post-installed rebar
c_1	concrete cover at end-face of existing rebar
c_{min}	minimum concrete cover according to Table B1 and to EN 1992-1-1:2004+AC:2010, Section 4.4.1.2
Ø	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, $\geq l_0 + c_1$
d_0	nominal drill bit diameter, see Table B5 and B6

Deutsches Institut für Bautechnik DIBt

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

Drilling method	Rebar diameter	Without drilling aid	With drilling aid
Hammer drilling (HD) Hammer drilling with hollow drill (HDB)	< 25 mm	30 mm + 0,06 · l_v ≥ 2 ∅	30 mm + 0,02 · l_v ≥ 2 ∅
	≥ 25 mm	40 mm + 0,06 · l_v ≥ 2 ∅	40 mm + 0,02 · l_v ≥ 2 ∅
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 ∅	60 mm + 0,02 · l_v ≥ 2 ∅



[1)] See Annex B2, Figure B1
Comments: The minimum concrete cover acc. EN 1992-1-1:2004+AC:2010 must be observed.
For minimum concrete cover $c_{min,seis}$ in case of seismic action see Table B2.

Table B2: Minimum concrete cover min $c_{min,seis}$

Drilling method	Design condition	Distance of 1st edge	Distance of 2nd edge
Hammer drilling (HD); Hammer drilling with hollow drill (HDB); Compressed air drilling (CD)	Edge	≥ 2 ∅	≥ 2 ∅
	Corner	≥ 2 ∅	≥ 2 ∅

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

Concrete temperature	Maximum working time t_{gel}[1)]	Minimum curing time t_{cure} in dry concrete	Minimum curing time t_{cure} in wet concrete
- 5 °C to - 1 °C	50 min	5 h	10 h
0 °C to + 4 °C	25 min	3,5 h	7 h
+ 5 °C to + 9 °C	15 min	2 h	4 h
+ 10 °C to + 14 °C	10 min	1 h	2 h
+ 15 °C to + 19 °C	6 min	40 min	80 min
+ 20 °C to + 29 °C	3 min	30 min	60 min
+ 30 °C to + 40 °C	2 min	30 min	60 min
Cartridge temperature	+5 °C to +40 °C		

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

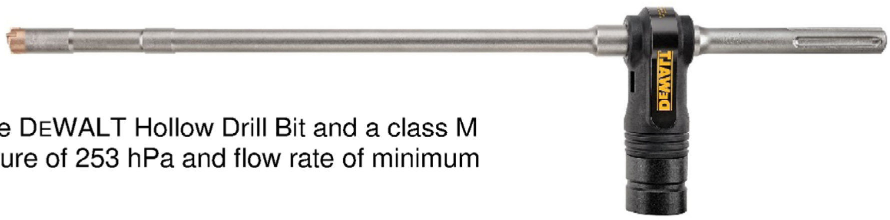
Injection system AC200+ for rebar connections	**Annex B3**
Intended use Minimum concrete cover; gelling and curing time	

Table B4: Dispensing tools

Cartridge type/size	Hand tools		Pneumatic tools
Coaxial cartridges 150, 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 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 battery tools.

Cleaning and installation accessories



HDB – Hollow drill bit system
The hollow drill bit system contains the DEWALT Hollow Drill Bit and a class M vacuum with minimum negative pressure of 253 hPa and flow rate of minimum 150 m³/h (42 l/s).

Brush«Produktzusatz

SDS Plus Adapter

Brush extension

Piston Plug

Hand pump (volume 750 ml)

Compressed air nozzle (min 6 bar)

Injection system AC200+ for rebar connections	**Annex B4**
Intended use Dispensing, cleaning and installation accessories	

Deutsches Institut für Bautechnik DIBt

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

Rebar size	Drill bit diameter d_0		Brush diameter		Piston plug	Cartridge: All sizes				Cartridge: 825 ml	
			nominal	minimum		Hand or battery tool		Pneumatic tool		Pneumatic tool	
Ø	HD	CD	d_b	$d_{b,min}$		$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension
[mm]	[mm]		[mm]	[mm]	[No]	[mm]		[mm]		[mm]	
8	10	-	11,5	10,5	-	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8
	12	-	13,5	12,5	-	700		800		800	
10						250		250		250	
	14	-	15,5	14,5	#14	700		1000		1000	
12						250		250		250	
	16		17,5	16,5	#16	700		1000		1200	VL16/1,8
14	18		20,0	18,5	#18					1400	
16	20		22,0	20,5	#20					1600	
20	25	-	27,0	25,5	#25	500		700		2000	
	-	26	28,0	26,5	#25						
22	28		30,0	28,5	#28						
24/25	30		32,0	30,5	#30			500			
	32		34,0	32,5	#32						
28	35		37,0	35,5	#35						
32	40		43,5	40,5	#40						

Table B6: Brushes, piston plugs, max anchorage depth and mixer extension, hammer drilling with hollow drill bit (HDB)

Rebar size	Drill bit diameter d_0	Brush diameter		Piston plug	Cartridge: All sizes				Cartridge: 825 ml	
		nominal	minimal		Hand or battery tool		Pneumatic tool		Pneumatic tool	
Ø	HDB	d_b	d_b		$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension	$l_{v,max}$	Mixer extension
[mm]	[mm]	[mm]	[mm]	[No]	[mm]		[mm]		[mm]	
8	10	No cleaning required		-	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8	250	VL10/0,75 or VL16/1,8
	12				700		800		800	
10					250		250		250	
	14			#14	700		1000		1000	
12					250		250		250	
	16			#16	700		1000		1000	VL16/1,8
14	18			#18						
16	20			#20						
20	25			#25	500		700			
22	28			#28						
24/25	30			#30			500			
	32			#32						
28	35			#35						
32	40			#40						

Injection system AC200+ for rebar connections

Intended use
Brushes, piston plugs, max anchorage depth and mixer extension

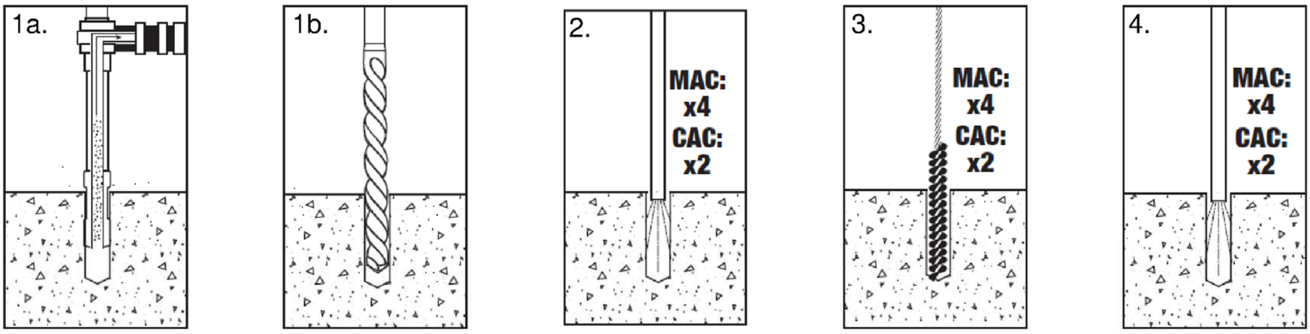
Annex B5

Installation instructions

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

Compressed Air Cleaning (CAC)
Cleaning for dry, wet and water filled bore hole with all diameter and hole depth, uncracked and cracked concrete

Hollow Drill Bit (HDB) **Standard Drill Bit, hammer drill mode (HD) or compressed air drill mode (CD)**

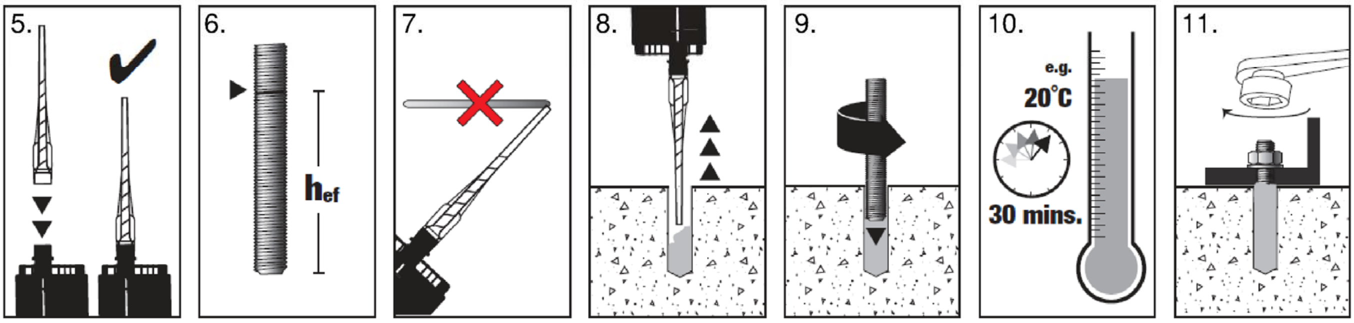


1a.) Connect the hollow drill bit of proper size to the vacuum and drill a hole into the base material to the required depth while the vac is running. The drill dust is removed during the drilling process. Proceed with Step 5.
1b.) Using the proper drill bit size, drill a hole into the base material to the required depth. Proceed with Step 2.
2.) Before cleaning, remove any standing water out of the drilled hole. Starting from the bottom of the hole, blow the hole clean with a hand pump minimum of 4 times (MAC) or with compressed air (min. 6 bar) minimum of 2 times (CAC). If the hole ground cannot be reached, an extension must be used.
3.) Select a brush of the correct diameter. Starting from the hole ground, brush the hole a minimum of 4 times (MAC) or 2 times (CAC), respectively. If the hole ground is not reached, a brush extension must be used.
4.) Finally, blow the hole clean again with a hand pump minimum of 4 times (MAC) or with compressed air (min. 6 bar) minimum of 2 times (CAC). If the hole ground cannot be reached, an extension must be used.

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

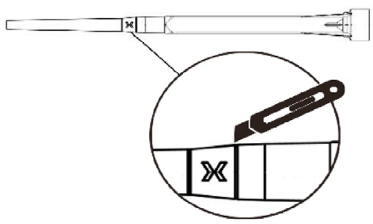
Injection system AC200+ for rebar connections	**Annex B6**
Intended use Installation instructions	

Installation instructions (continued)

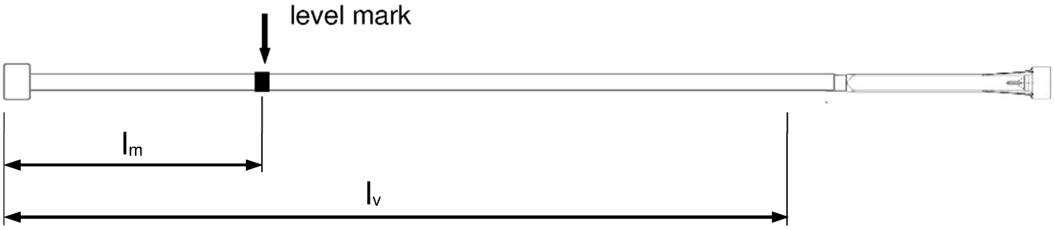


5.) Attach a supplied static mixing nozzle to the cartridge and load the cartidge into the correct dispensing tool. For foil tube type cartridges, cut off the foil clip before use. For every working interruption longer than the recommneded working time as well as for new cartridges, a new mixer nozzle must be used.
6.) Mark the required embedment depth on the anchor rod.
7.) Squeeze out a minimum of 3 full strokes and discard non-balanced adhesive until the adhesive shows a consistent colour.
8.) Starting from the back of the cleaned hole, fill the hole approximately two thirds with adhesive. Slowly withdraw the nozzle as the hole fills to avoid creating air pockets. For holes with embedment depths greater than 190 mm, a proper extension nozzle must be used. For vertical down installations and horizontal installations in holes deeper than 250 mm, and for overhead installation always, use a piston plug if the hole is 18 mm or larger.
9.) Push the threaded rod or reinforcing bar into the hole while turning slightly to properly distribute the adhesive. The anchor should be clean and free of dirt, grease or oil. Be sure that the gap is completedly filled with adhesive. Excess adhesive must be visible at the top of the hole. For overhead application, the threaded rod or reinforcing bar must be fixed (e.g. wedges) until the mortar has started to harden.
10.) Allow the adhesive to cure for the specified time prior to applying any load. Do not load the anchor until it is fully cured.
11.) After full curing, the fixture can be installed. Make sure the maximum torque is not exceeded.

In case of using the mixer extension VL16/1,8,
the tip of the mixer nozzle has to be cut off at position ‘X’:



Piston plugs shall be used according to Table B5 or B6 for overhead and horizontal applications, and for vertical downward installation in case of bore holes deeper than 250 mm



Injection tool must be marked by mortar level mark l_m and anchorage depth l_v with tape or marker:
For estimation of mortar volume: $l_m = 1/3 \cdot l_v$
For optimum mortar volume: $l_m = l_v \cdot (1{,}2\ \varnothing^2/d_0^2 - 0{,}2)$
Continue injection until the mortar level mark l_m becomes visible

Injection system AC200+ for rebar connections	**Annex B7**
Intended use Installation instructions	

Minimum anchorage length and minimum lap length under static or quasi-static loading

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiplied by the amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ according to Table C1.

Table C1: Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ related to concrete class and drilling method; working life 50 and 100 years

Concrete class	Drilling method	Rebar size	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$
C12/15 to C50/60	all drilling methods	8 mm to 32 mm	1,0

Table C2: Reduction factor $k_b = k_{b,100y}$ for all drilling methods; working life 50 and 100 years

Rebar	Concrete class								
∅	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
8 to 32 mm	1,0								

Table C3: Design values of the ultimate bond stress $f_{bd,PIR}$ and $f_{bd,PIR,100y}$ in N/mm² for all drilling methods and for good conditions; working life 50 and 100 years

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

$$f_{bd,PIR,100y} = k_{b,100y} \cdot f_{bd}$$

with

f_{bd}: Design value of the ultimate bond stress in N/mm² considering the concrete classes, the rebar diameter, the drilling method for good bond condition (for all other bond conditions multiply the values by $\eta_1 = 0.7$) and recommended partial factor $\gamma_c = 1{,}5$ according to EN 1992-1-1:2004+AC:2010.

k_b, $k_{b,100y}$: Reduction factor according to Table C2

Rebar	Concrete class								
∅	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

Injection system AC200+ for rebar connections

Performances Minimum anchorage length and minimum lap length, Amplification factor, Reduction factor and Design values of ultimate bond resistance

Annex C1

English translation prepared by DIBt

Minimum anchorage length and minimum lap length under seismic action

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1:2004+AC:2010 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiplied by the amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ according to Table C4.

Table C4: Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ related to concrete class and drilling method; working life 50 and 100 years

Concrete class	Drilling method	Rear size	Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$
C16/20 to C50/60	all drilling methods	10 mm to 32 mm	1,0

Table C5: Reduction factor $k_{b,seis} = k_{b,seis,100y}$ for all drilling methods; working life 50 and 100 years

Rebar	Concrete class								
∅	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 to 32 mm	No performance assessed	1,0							

Table C7: Design values of the ultimate bond stress $f_{bd,PIR,seis}$ and $f_{bd,PIR,seis,100y}$ in N/mm² for all drilling methods and for good conditions; working life 50 and 100 years

$$f_{bd,PIR,seis} = k_{b,seis} \cdot f_{bd}$$

$$f_{bd,PIR,seis,100y} = k_{b,seis,100y} \cdot f_{bd}$$

with

f_{bd}: Design value of the ultimate bond stress in N/mm² considering the concrete classes, the rebar diameter, the drilling method for good bond condition (for all other bond conditions multiply the values by $\eta_1 = 0.7$) and recommended partial factor $\gamma_c = 1{,}5$ according to EN 1992-1-1:2004+AC:2010.

$k_{b,seis}$, $k_{b,seis,100y}$: Reduction factor according to Table C5

Rebar	Concrete class								
∅	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
10 to 32 mm	No performance assessed	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Injection system AC200+ for rebar connections

Performances Minimum anchorage length and minimum lap length, Amplification factor, Reduction factor and Design values of ultimate bond stress under seismic action

Annex C2

Design value of the ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$ at increased temperature for concrete classes C12/15 to C50/60, (all drilling methods); working life 50 and 100 years:

The design value of the bond stress $f_{bd,fi}$ at increased temperature has to be calculated by the following equation:

For working life 50 years: $\mathbf{f_{bd,fi} = k_{fi}(\theta) \cdot f_{bd,PIR} \cdot \gamma_c / \gamma_{M,fi}}$

with: $\theta \leq 364°C$: $k_{fi}(\theta) = 30{,}34 \cdot e^{(\theta \cdot -0{,}011)} / (f_{bd,PIR} \cdot 4{,}3) \leq 1{,}0$

$\theta > 364°C$: $k_{fi}(\theta) = 0$

For working life 100 years: $\mathbf{f_{bd,fi,100y} = k_{fi,100y}(\theta) \cdot f_{bd,PIR,100y} \cdot \gamma_c / \gamma_{M,fi}}$

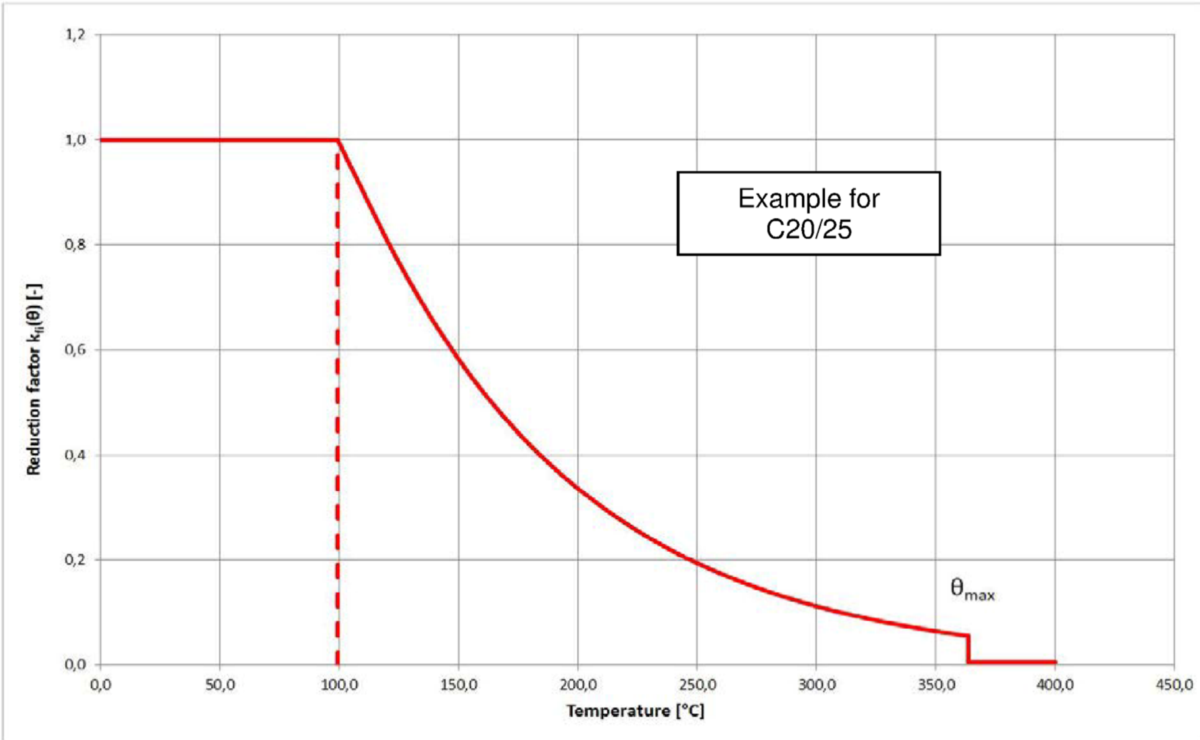
with: $\theta \leq 364°C$: $k_{fi,100y}(\theta) = 30{,}34 \cdot e^{(\theta \cdot -0{,}011)} / (f_{bd,PIR,100y} \cdot 4{,}3) \leq 1{,}0$

$\theta > 364°C$: $k_{fi,100y}(\theta) = 0$

$f_{bd,fi}$, $f_{bd,fi,100y}$	Design value of the ultimate bond stress at increased temperature in N/mm²
θ	Temperature in °C in the mortar layer
$k_{fi}(\theta)$, $k_{fi,100y}(\theta)$	Reduction factor at increased temperature
$f_{bd,PIR}$, $f_{bd,PIR,100y}$	Design value of the bond stress $f_{bd,PIR} = f_{bd,PIR,100y}$ in N/mm² in cold condition according to Table C3 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2004+AC:2010
γ_c	= 1,5, recommended partially safety factor according to EN 1992-1-1:2004+AC:2010
$\gamma_{M,fi}$	= 1,0, recommended partially safety factor according to EN 1992-1-2:2004+AC:2008

For evidence at increased temperature the anchorage length shall be designed according to EN 1992-1-1:2004+AC:2010 Equation 8.3 using the temperature-dependent design value of ultimate bond stress $f_{bd,fi}$.

Example graph of Reduction factor $k_{fi}(\theta)$ for concrete classes C20/25 for good bond conditions:



Injection system AC200+ for rebar connections

Performances
Design value of ultimate bond stress at increased temperature

Annex C3