Deutsches Institut für Bautechnik DIBt

Member of EOTA
www.eota.eu

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-17/0513 of 27 October 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	SPIT VIPER XTREM / SPIT VIPER XTREM TR
Product family to which the construction product belongs	Injection system for post-installed rebar connections
Manufacturer	SPIT Route de Lyon 26500 BOURG-LÉS-VALENCE FRANKREICH
Manufacturing plant	
This European Technical Assessment contains	20 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 330087-00-0601

Deutsches Institut für Bautechnik
Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +49 30 78730-0 | Fax: +49 30 78730-320 | Email: dibt@dibt.de | www.dibt.de

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This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No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 mortar "SPIT VIPER XTREM" or "SPIT VIPER XTREM TR" in accordance with the regulations for reinforced concrete construction.

Ribbed reinforcing bars made of steel with a diameter ϕ from 8 to 32 mm according to Annex A and the injection mortar "SPIT VIPER XTREM" or "SPIT VIPER XTREM TR" 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 post-installed rebar connection 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
Characteristic resistance under static and quasi-static loading	See Annex C1 – C3

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	The post-installed rebar connection satisfies requirements for Class A1
Resistance to fire	See Annex C4

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 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 27 October 2017 by Deutsches Institut für Bautechnik

Dr.-Ing. Lars Eckfeldt	*beglaubigt:*
p. p. Head of Department	Lange

Injection mortar

Injection mortar SPIT VIPER XTREM 280 ml, 410 ml and 825 ml:
Vinylester adhesive two components

Marking

Trade name
VIPER XTREM – Regular version
VIPER XTREM TR – Tropical version
Identifying mark of the producer **SPIT**

Expire date
Curing and processing time
Charge code number

Static mixer

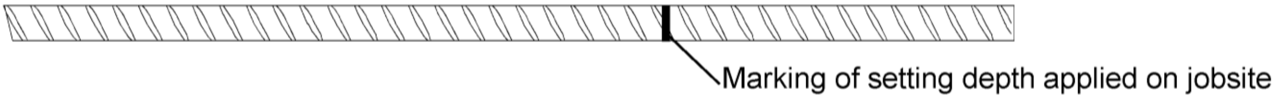
Turbo mixing nozzle

Standard Quadro mixing nozzle

High flow mixing nozzle

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	**Annex A1**
Product description Injection system SPIT VIPER XTREM	

Figure A6: Ribbed reinforcing bar (rebar):



Properties of the ribbed reinforcing bar (rebar):

- Rebar according to EN 1992-1-1:2004 Annex C
- Bars or de-coiled rods class B or C
- Nominal diameter ϕ: 8 to 32 mm
- Rib height h in the range of $0{,}05\ \phi \leq h \leq 0{,}07\ \phi$
- Yield strength f_{yk} according to NDP or NCL of EN 1992-1-1/NA
- Ultimate strength $f_{uk} = f_{tk} = k \cdot f_{yk}$

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	**Annex A2**
Product description Specification rebar	

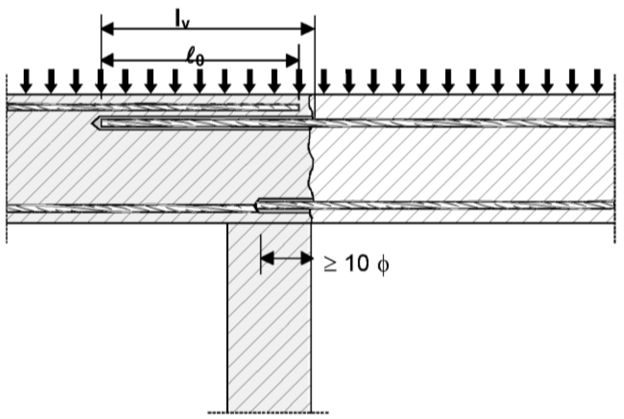


Figure A1: Overlap joint for rebar connections of slabs and beams

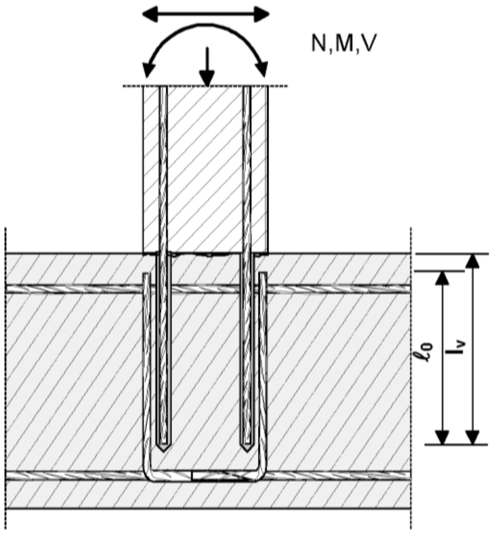


Figure A2: Overlap joint at a foundation of a column or wall where the rebars are stressed in tension

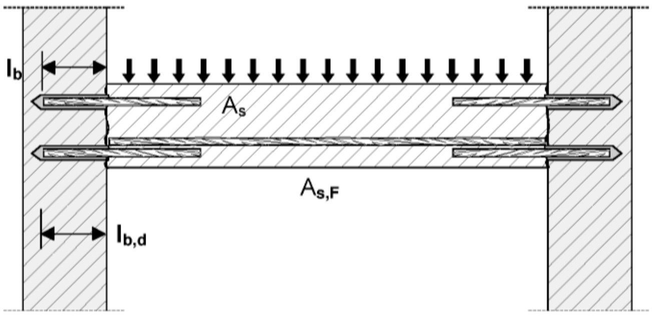


Figure A3: End anchoring of slabs or beams, designed as simply supported

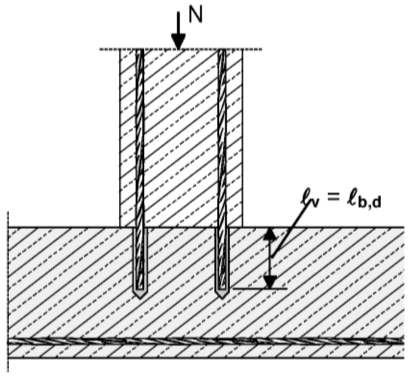


Figure A4: Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

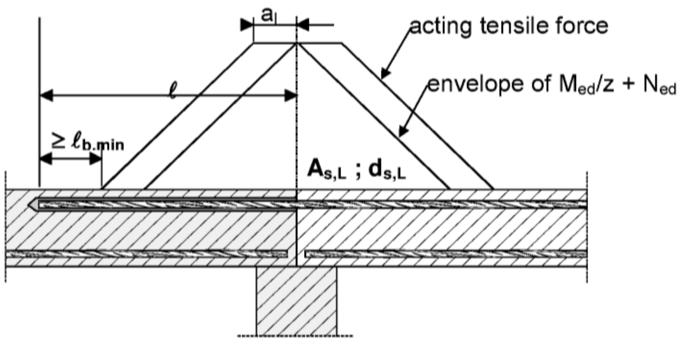


Figure A5: Anchoring of reinforcement to cover the line of acting tensile force

Note to Figure A1 to A5:

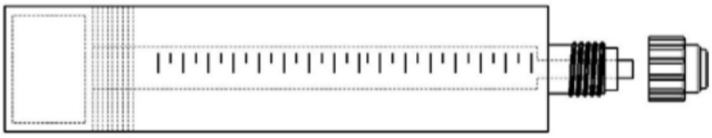
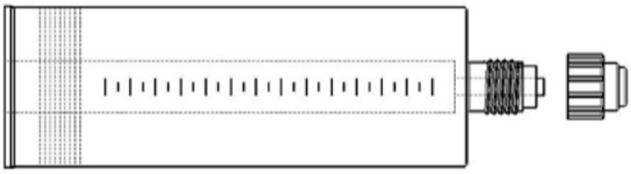
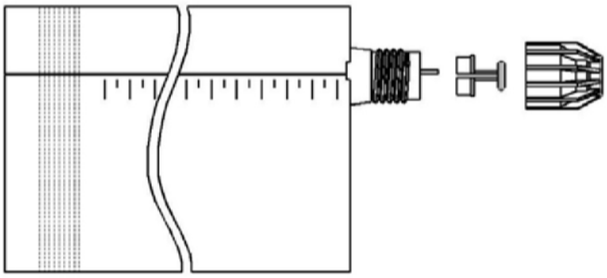
- In the Figures no transverse reinforcement is plotted, the transverse reinforcement as required by EN 1992-1-1 shall be present.
- Preparing of joints according to Annex B2

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

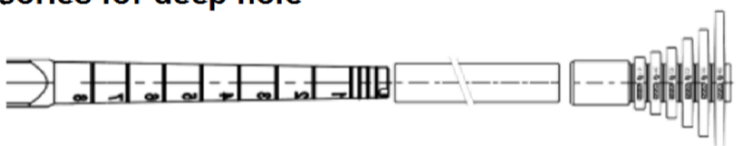
Product description
Specification rebar

Annex A3

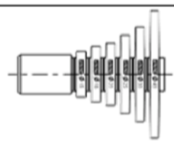
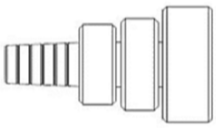
Cartridges

280 ml coaxiale cartridge	
410 ml coaxiale cartridge	
825 ml side by side cartridge	

Injection accessories for deep hole



Plastic extension must be use for hole deeper h_0 > 250 mm
Piston plug for hole deeper must be use for hole deeper h_0 > 350 mm

Cartridge volume	Mixing Nozzle	Extension for piston plug	Piston plug
All cartridges	Turbo or Standard Quadro	Ø13x1000	
Cartridge 825 ml	High flow	Ø20x1000	

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Product description
Cartridges
Injection accessories for deep hole

Annex A4

Specifications of intended use

Anchorages subject to:

- Static and quasi static loading
- Fire exposure

Base material:

- Reinforced or unreinforced normal weight concrete of strength classes C 20/25 to C50/60 according to EN 206-1:2000
- Maximum chloride content 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.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, 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 under static or quasi-static loading in accordance with EN 1992-1-1 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.

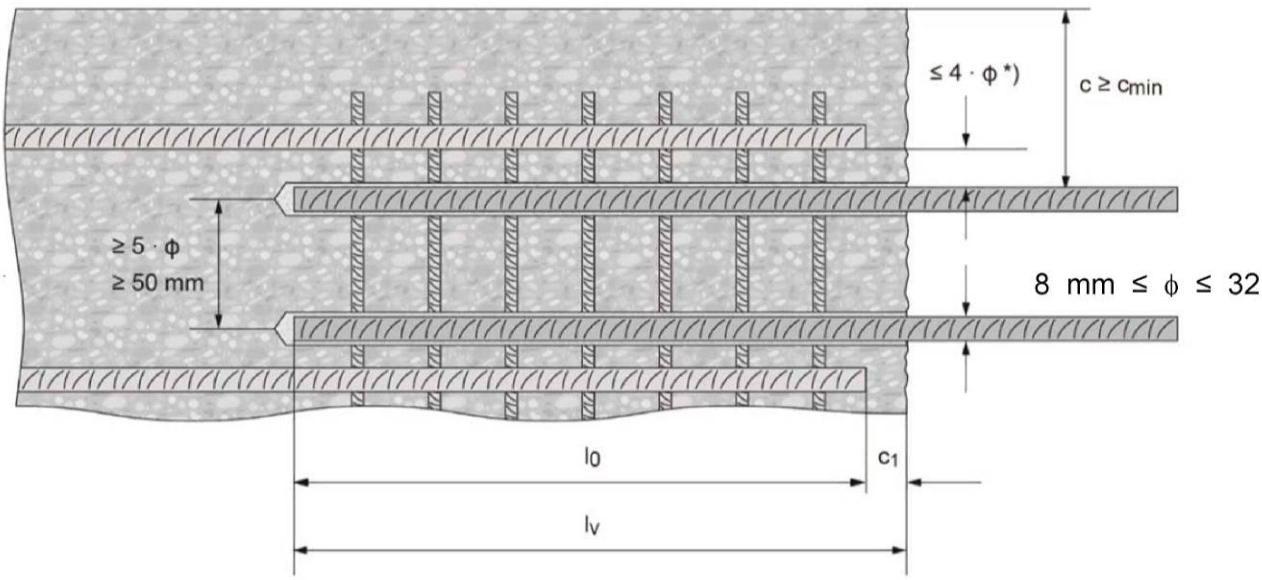
Installation:

- Drilling technique:
  - Hammer drilling technique
  - Hammer drilling with hollow drill bit XTD
  - Compressed air drilling
  - Diamond drilling technique with roughening tool
- Use category:
  - dry or wet concrete (not in flooded holes) for Hammer drilling technique, compressed air drilling and diamond drilling technique with roughening tool
  - Only dry concrete for hammer drilling with hollow drill bit XTD
  - Installation direction downwards, horizontal and overhead
- 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).

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	Annex B1
Intended Use Specifications	

Figure B1: Construction rules for post-installed rebars

- Post-installed rebar may be designed for tension forces only.
- The transfer of shear forces between new concrete and existing structure shall be designed additionally according to EN 1992-1-1.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.



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

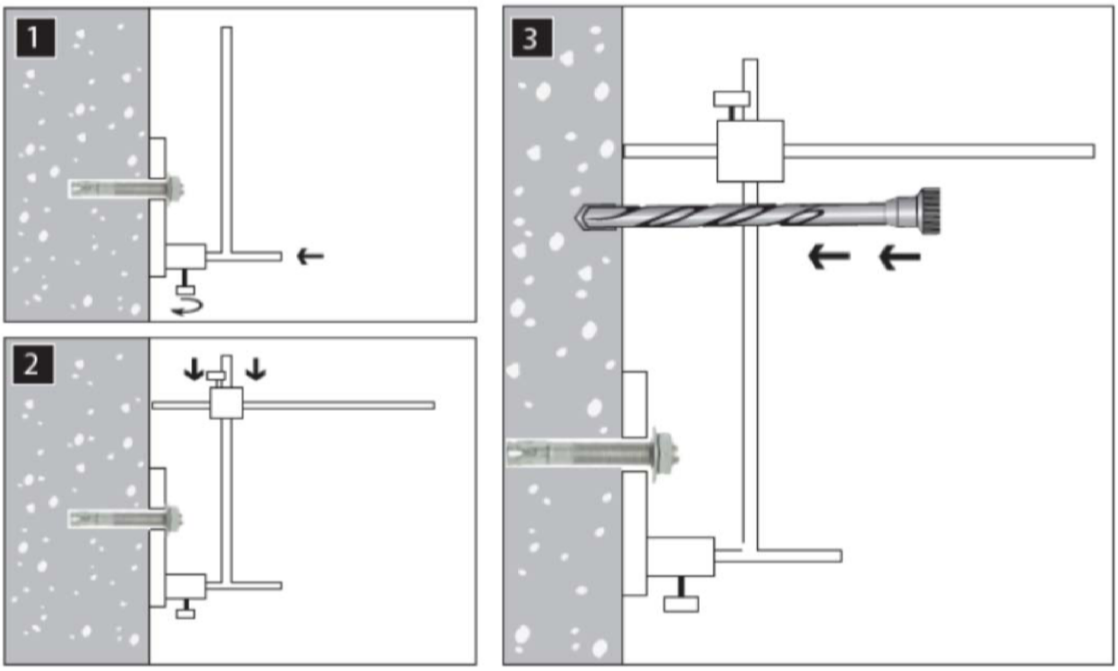
- c: concrete cover of post-installed rebar
- c_1: concrete cover at end-face of existing rebar
- c_{min}: minimum concrete cover according to Table B1 and to EN 1992-1-1:2004 AC:2010, Section 4.4.1.2
- ϕ: diameter of post-installed rebar
- l_0: lap length, according to EN 1992-1-1:2004/AC:2010, Section 8.7.3
- l_v: effective embedment depth $\geq l_0 + c_1$
- d_0 nominal drill bit diameter, see Annex B3
- Minimum spacing between two post-installed bars a = 50 mm $\geq 5\phi$

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	Annex B2
Intended used General construction rules for post-installed rebars	

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

Drilling method	Bar diameter ϕ	Without drilling aid	With drilling aid
Hammer drilling	< 25 mm	$30 + 0{,}06\ l_v \geq 2\phi$	$30 + 0{,}02\ l_v \geq 2\phi$
	≥ 25 mm	$40 + 0{,}06\ l_v \geq 2\phi$	$40 + 0{,}02\ l_v \geq 2\phi$
Hammer drilling with hollow drill bit XTD	< 25 mm	$30 + 0{,}06\ l_v \geq 2\phi$	$30 + 0{,}02\ l_v \geq 2\phi$
	≥ 25 mm	$40 + 0{,}06\ l_v \geq 2\phi$	$40 + 0{,}02\ l_v \geq 2\phi$
Compressed air drilling	< 25 mm	$50 + 0{,}08\ l_v \geq 2\phi$	$50 + 0{,}02\ l_v \geq 2\phi$
	≥ 25 mm	$60 + 0{,}08\ l_v \geq 2\phi$	$60 + 0{,}02\ l_v \geq 2\phi$
Diamond core drilling	< 25 mm	Drill stand is used as drilling aid	$30 + 0{,}02\ l_v \geq 2\phi$
	≥ 25 mm		$40 + 0{,}02\ l_v \geq 2\phi$

Figure B2: Drilling aid system



Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	Annex B3
Intended used Minimum concrete cover c_{min}	

Table B2: Maximum embedment depth $l_{v,max}$ depending on bar diameter and dispenser

Rebar diameter ϕ	Maximum embedment length $l_{v,max}$ [mm]		
	Manuel Dispenser	Pneumatic Dispenser	
[mm]	280 ml 410 ml 825 ml	410 ml	825 ml
8	500	600	900
10			
12			
16			
20			
25			
28			
32			

Table B3: Installation parameters

Rebar diameter ϕ	Nominal drilling diameter d_{cut} [mm]			
[mm]	Hammer drilling	Hammer drilling with hollow drill bit XTD [1)]	Diamond core	Diamond core and roughening drill bit
8	10	-	-	-
10	12	-	-	-
12	15	16	16	-
16	20	20	-	20
20	25	25	-	25
25	30	30	-	30
28	35	-	-	35
32	40	-	-	40

1) Maximum working length: 600 mm

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Intended used
Maximum embedment depth lv_{max}
Installation parameters

Annex B4

Table B4: Parameters for use of Roughening tool

Diamond coring d_{cut} [mm]	Roughtening tool [1)] d_{cut} [mm]
20	20
25	25
30	30
35	35
40	40

1) For checking the wear of roughening drill bit, a wear gauge is delivered with each roughtening tool

Table B5: Dimensions of the cleaning tools for reinforcing bars (rebars)

	Nominal diameter of the reinforcing bars (rebars)								
Dimensions	ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ20	ϕ25	ϕ28	ϕ32
Ø Brush [mm] [1)] 	11	13	16	20	22	26	32	37	42
Ø Plastic extension for compress air	6	9	9	13	13	13	13/20	13/20	13/20

1) The diameter of the round steel brush shall be checked before use. The minimum brush diameter has to be at least equal to the borehole diameter d_0. The round steel brush shall produce natural resistance as it enters the drill hole. If this is not the case, please use a new brush or a brush with a larger diameter.

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Intended used
Parameters for using of roughening drill bit
Dimensions of cleaning tools

Annex B5

Table B6: Gel time and curing time for Regular Version

Temperature of base material	Working time	Curing time
-10°C to -5°C	90 min	24 h
-4°C to 0°C	50 min	240 min
1°C to 5°C	25 min	120 min
6°C to 10°C	15 min	90 min
11°C to 20°C	7 min	60 min
21°C to 30°C	4 min	45 min
31°C to 40°C	2 min	30 min

Table B7: Gel time and curing time for Tropical Version:

Temperature of base material	Working time	Curing time
+ 5°C	60 min	240 min
6°C to 10°C	40 min	180 min
11°C to 20°C	15 min	120 min
21°C to 30°C	8 min	60 min
31°C to 40°C	4 min	60 min

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Product description
Minimum curing time and maximum working time

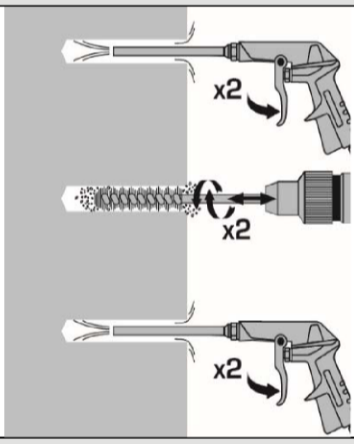
Annex B6

Drilling the hole:

	Rotary hammer drilling or compressed air drilling
	Electrical hammer drilling with XTD hollow drill bit used in relation with the SPIT AC 1625 vacuum or the type. This drilling technique allows for cleaning the hole from the dust debris while operating drilling. No further cleaning is then required before injecting resin.
	Diamond core drilling The roughening tool must be used for core diameter higher than 20 mm.

Cleaning the hole:

Hammer drilling technique



1. Using compress air cleaning (min 6 bars), use the appropriate extension, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing).
2. Using the relevant brush and extension fitted on a Spit drilling machine, starting from the top of the hole, move downward to the bottom of the hole then move upward to the top of the hole. Repeat this operation.
3. Using compress air cleaning (min 6 bars), use the appropriate extension, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing).

Hammer drilling technique

Electrical hammer drilling with XTD hollow drill bit used in relation with the SPIT AC 1625 vacuum or the type. This drilling technique allows for cleaning the hole from the dust debris while operating drilling. No further cleaning is then required before injecting resin.

Diamond core drilling technique

1. For core diameter higher than 20 mm, remove water in the hole and use the roughening drill bit before applying cleaning procedure
2. Clean the hole with tap water.
3. Using the relevant brush and extension fitted on a Spit drilling machine, starting from the top of the hole, move downward to the bottom of the hole then move upward to the top of the hole. Repeat this operation.
4. Clean the hole with tap water
5. Using compress air cleaning (mini 6 bars), use the appropriate extension, starting from the top of the hole blow out at least 2 times by moving downward to the bottom of the hole then moving upward to the top of the hole and until no dust is evacuated. (not less than 10s per each blowing).

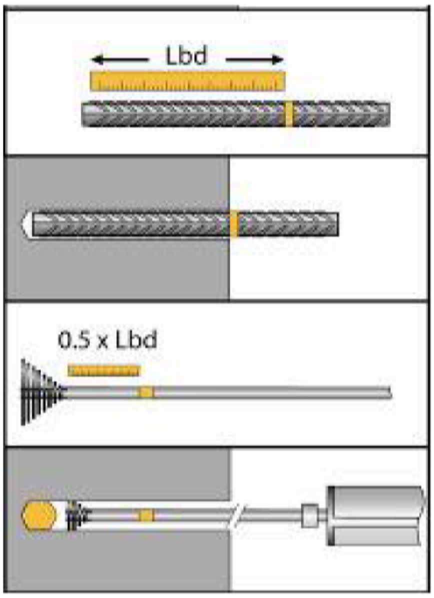
Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	**Annex B7**
Product description Installation instruction	

Safety precaution:

The safety data sheet must be read before using the product and the safety instructions followed.

- Storage temperature of cartridge +0°C à +35°C
- Cartridge temperature at time of installation: Must be ≥ +5°C
- Base material temperature at time of installation: Must be between -10°C and +40°C
- Check the date of expiry of the cartridge

Dispensing into the hole:



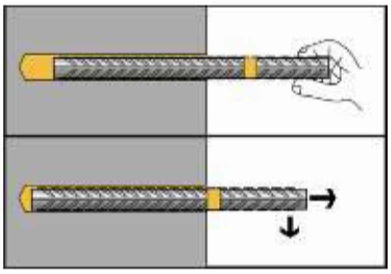
1. Put the anchorage depth mark on the rebar

2. Check the anchorage depth

3. Cut the piston plug at the relevant diameter. The volume of resin that need to be injected in the hole must be indicated on the mixing nozzle or its extension. The marking must be placed at 0.5 time the anchorage depth.

4. Dispense the first part to waste until an even colour is achieved (≈ 20cm). Insert the nozzle to the far end of the hole, and inject the resin, withdrawing the nozzle as the hole fills in order to avoid trapping air bubbles. Fill the hole until the mark appear. For pneumatic dispenser with 410 ml cartridge, the maximum pressure is 6 bars.

Inserting the rebar:



1. Immediately insert the rebar, slowly and with a slight twisting motion. Remove excess resin from around the mouth of the hole before it sets. Control the embedment depth during the working time (See Annex B6 Table B6 or B7) which varies according to temperature of base material.

2. Leave the rebar undisturbed until the curing time has elapse. (See Annex B6 Table B6 or B7).

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	**Annex B8**
Product description Installation instruction	

Table C1: Amplification factor α_{lb} for Hammer drilling and compressed air drilling

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} given in Table C1.

<table>
<tr><th rowspan="2">Bar diameter</th><th colspan="9">Concrete strength class</th></tr>
<tr><th>C12/15</th><th>C16/20</th><th>C20/25</th><th>C25/30</th><th>C30/37</th><th>C35/45</th><th>C40/50</th><th>C45/55</th><th>C50/60</th></tr>
<tr><td>ϕ8</td><td colspan="8">1,0</td><td>1,1</td></tr>
<tr><td>ϕ10</td><td colspan="7">1,0</td><td>1,1</td><td>1,2</td></tr>
<tr><td>ϕ12</td><td colspan="7">1,0</td><td>1,1</td><td>1,2</td></tr>
<tr><td>ϕ14</td><td colspan="3">1,0</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,2</td></tr>
<tr><td>ϕ16</td><td colspan="2">1,0</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,1</td><td>1,2</td><td>1,3</td></tr>
<tr><td>ϕ20</td><td>1,0</td><td>1,1</td><td>1,2</td><td>1,2</td><td>1,2</td><td>1,2</td><td>1,2</td><td>1,3</td><td>1,3</td></tr>
<tr><td>ϕ25</td><td>1,1</td><td>1,1</td><td>1,3</td><td>1,3</td><td>1,3</td><td>1,3</td><td>1,3</td><td>1,4</td><td>1,4</td></tr>
<tr><td>ϕ28</td><td>1,1</td><td>1,2</td><td>1,3</td><td>1,4</td><td>1,4</td><td>1,4</td><td>1,4</td><td>1,4</td><td>1,4</td></tr>
<tr><td>ϕ32</td><td>1,1</td><td>1,2</td><td>1,4</td><td>1,5</td><td>1,5</td><td>1,5</td><td>1,5</td><td>1,5</td><td>1,5</td></tr>
</table>

Table C2: Bond efficiency value k_b for Hammer drilling and compressed air drilling

Bar diameter	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ8-ϕ32	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0	1,0

Table C3: Design values of the ultimate bond stress f_{bd}[1)] in N/mm²
for Hammer drilling and compressed air drilling

Bar diameter	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ8-ϕ32	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

[1)] According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR	Annex C1
Performance Minimum anchorage length and minimum lap length, Bond efficiency value k_b and Design values of ultimate bond resistance f_{bd}	

Table C4: Amplification factor α_{lb} for Hammer drilling with XTD hollow drill bit

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} given in Table C1.

Bar diameter	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ12-ϕ25	1,5								

Table C5: Bond efficiency value k_b for Hammer drilling with XTD hollow drill bit

Bar diameter	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ12-ϕ25	1,0								

Table C6: Design values of the ultimate bond stress f_{bd}[1)] in N/mm² for Hammer drilling with XTD hollow drill bit

Bar diameter	Concrete strength class								
	C12/15	C16/20	C20/25	C25/30	C30/37	C35/45	C40/50	C45/55	C50/60
ϕ12-ϕ25	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

1) According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

Table C7: Amplification factor α_{lb} for Diamond drilling

The minimum anchorage length $l_{b,min}$ and the minimum lap length $l_{0,min}$ according to EN 1992-1-1 shall be multiplied by the relevant amplification factor α_{lb} given in Table C1.

<table>
<tr><th rowspan="2">Bar diameter</th><th colspan="9">Concrete strength class</th></tr>
<tr><th>C12/15</th><th>C16/20</th><th>C20/25</th><th>C25/30</th><th>C30/37</th><th>C35/45</th><th>C40/50</th><th>C45/55</th><th>C50/60</th></tr>
<tr><td>ϕ12</td><td colspan="7" rowspan="7">1,0</td><td rowspan="4">1,1</td><td rowspan="3">1,2</td></tr>
<tr><td>ϕ14</td></tr>
<tr><td>ϕ16</td></tr>
<tr><td>ϕ20</td><td rowspan="2">1,1</td></tr>
<tr><td>ϕ25</td><td rowspan="3">1,0</td></tr>
<tr><td>ϕ28</td><td rowspan="2">1,0</td></tr>
<tr><td>ϕ32</td></tr>
</table>

Table C7: Bond efficiency value k_b for Diamond drilling

<table>
<tr><th rowspan="2">Bar diameter</th><th colspan="9">Concrete strength class</th></tr>
<tr><th>C12/15</th><th>C16/20</th><th>C20/25</th><th>C25/30</th><th>C30/37</th><th>C35/45</th><th>C40/50</th><th>C45/55</th><th>C50/60</th></tr>
<tr><td>ϕ12-ϕ20</td><td colspan="9">1,0</td></tr>
<tr><td>ϕ25</td><td colspan="8">1,0</td><td>0,9</td></tr>
<tr><td>ϕ28</td><td colspan="7">1,0</td><td>0,9</td><td>0,9</td></tr>
<tr><td>ϕ32</td><td colspan="6">1,0</td><td>0,9</td><td>0,8</td><td>0,9</td></tr>
</table>

Table C8: Design values of the ultimate bond stress f_{bd}[1)] in N/mm² for Diamond drilling

<table>
<tr><th rowspan="2">Bar diameter</th><th colspan="9">Concrete strength class</th></tr>
<tr><th>C12/15</th><th>C16/20</th><th>C20/25</th><th>C25/30</th><th>C30/37</th><th>C35/45</th><th>C40/50</th><th>C45/55</th><th>C50/60</th></tr>
<tr><td>ϕ12-ϕ20</td><td rowspan="4">1,6</td><td rowspan="4">2,0</td><td rowspan="4">2,3</td><td rowspan="4">2,7</td><td rowspan="4">3,0</td><td rowspan="4">3,4</td><td rowspan="3">3,7</td><td rowspan="2">4,0</td><td>4,3</td></tr>
<tr><td>ϕ25</td><td>4,0</td></tr>
<tr><td>ϕ28</td><td>3,7</td><td>4,0</td></tr>
<tr><td>ϕ32</td><td>3,4</td><td>3,4</td><td>3,7</td></tr>
</table>

1) According to EN 1992-1-1 for good bond conditions. For all other bond conditions multiply the values by 0,7.

Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Performance
Minimum anchorage length and minimum lap length
Bond efficiency value k_b and Design values of ultimate bond resistance f_{bd}

Annex C3

Design value of ultimate bond stress in case of fire $f_{b,fi}$ [N/mm²] for concrete strength classes C12/15 to C50/60

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

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

where

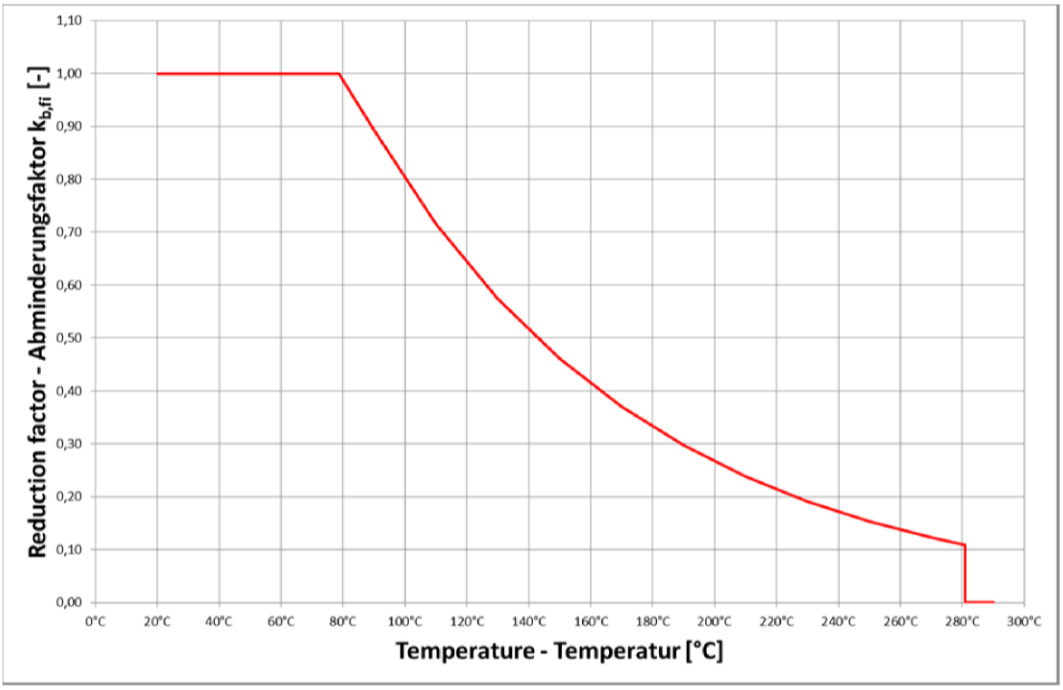
$\theta < 281$ °C: $k_{b,fi}(\theta) = \min\{1{,}0;\ 23{,}755\ e^{-0{,}011 \bullet \theta} / (f_{bd} \bullet 4{,}3)\}$

$\theta > 281$ °C: $k_{b,fi} = 0$

$f_{bd,fi}$	Design value of ultimate bond stress in case of fire
$k_{b,fi}(\theta)$	Reduction factor according to Figure C1
f_{bd}	Design values of the ultimate bond stress in cold state according to Annexes C1 to C3 depending on concrete strength class, size of rebar, drilling method and bond condition according to EN 1992-1-1
γ_c	safety factor according to EN 1992-1-1
$\gamma_{M,fi}$	safety factor according to EN 1992-1-2

For evidence under fire exposure the anchorage length shall be calculated according to EN 1992-1-1, Equation 8.3 using the temperature-dependent bond strength $f_{bd,fi}$.

Example curve for the reduction factor $k_{b,fi}$ for concrete strength class C20/25, good bond conditions



Injection system SPIT VIPER XTREM / SPIT VIPER XTREM TR

Performance
Bond strength in case of fire for concrete C20/25 to C50/60

Annex C4