European Technical Assessment

ETA-25/0846
of 6 January 2026

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 Smart Hybrid SIT-HY for rebar connection
Product family to which the construction product belongs	Systems for post-installed rebar connections with mortar
Manufacturer	pgb - Polska Sp. z o.o. ul. Fryderyka Wilhelma Redena 3 41-807 ZABRZE POLEN
Manufacturing plant	Plant 12
This European Technical Assessment contains	23 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

DIBt | Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +493078730-0 | FAX: +493078730-320 | Email: dibt@dibt.de | www.dibt.de

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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 "Injection System Smart Hybrid SIT-HY 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 or the tension anchor ZA from sizes M12 to M24 according to Annex A and injection mortar SIT-Hybrid 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 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 under static and quasi-static loading	See Annex C 1
Characteristic resistance under seismic loading	See Annex B 4 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 and C 4

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 6 January 2026 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock   *beglaubigt:*
Head of Section   Baderschneider

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Installation post installed rebar

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

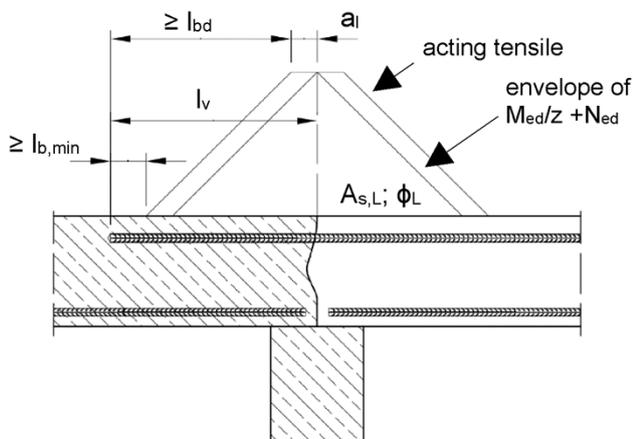**Figure A2:** Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

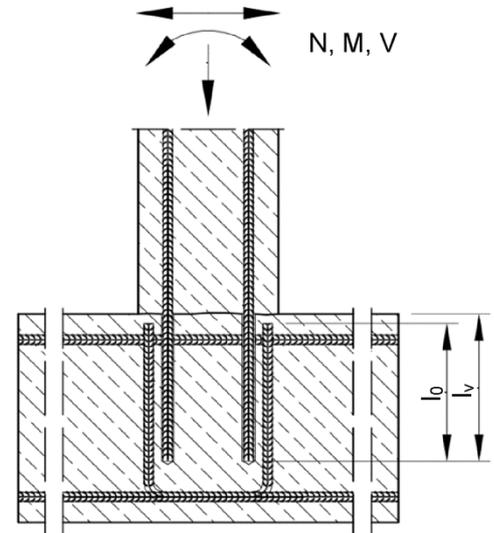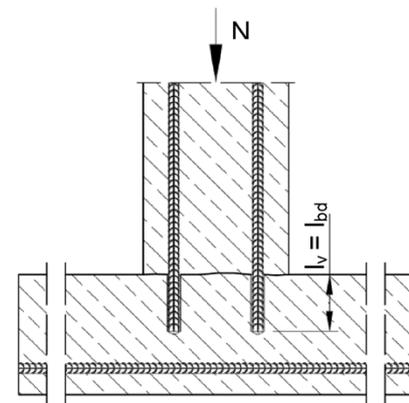**Figure A3:** End anchoring of slabs or beams (e.g. designed as simply supported)

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

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

Note to Figure A1 to A5:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2011.

Preparing of joints according to Annex B 2

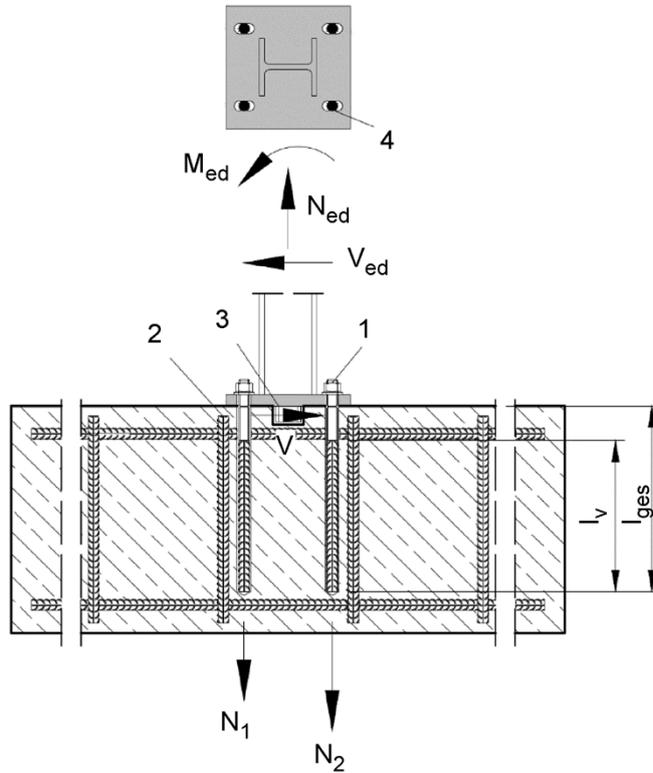---

Injection System Smart Hybrid SIT-HY for rebar connection

Product description
Installed condition and examples of use for rebars

Annex A 1

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Installation tension anchor ZA

Figure A6: Anchorage of column to foundation with tension anchor ZA.

1. Tension anchor ZA (tension only)
2. Existing stirrup / reinforcement for overlap (lap splice)
3. Shear lug (or fastener loaded in shear)
4. Slotted hole with axial direction to the shear force

Figure A7: Anchorage of guardrail posts or cantilevered building components with tension anchor ZA and fastener.
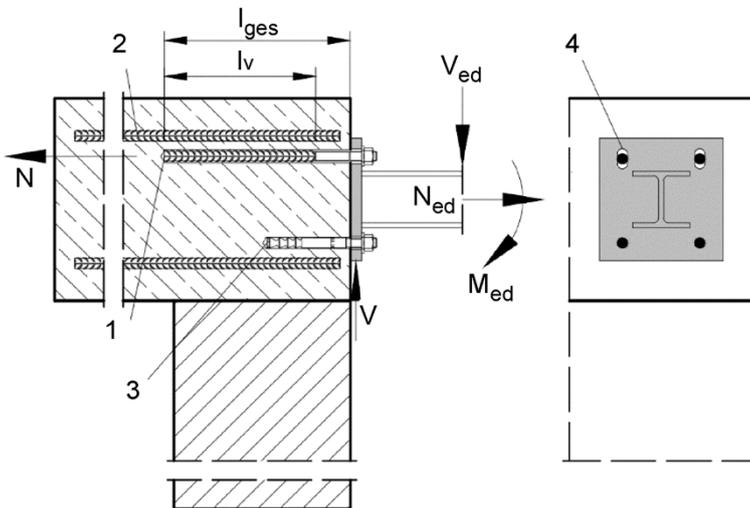
1. Tension anchor ZA (tension only)
2. Existing stirrup / reinforcement for overlap (lap splice)
3. Fastener (or shear lug loaded in shear)
4. Slotted hole with axial direction to the shear force

Note to Figure A6 and A7: In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2011. The tension anchor may be only used for axial tensile force. The tensile force must be transferred by lab to the existing reinforcement of the building. The transfer of the shear force has to be ensured by suitable measures, e.g. by means of shear lugs or anchors with European Technical Assessment (ETA). Generals construction rules see Annex B 3

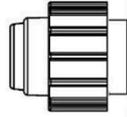| **Injection System Smart Hybrid SIT-HY for rebar connection**	
Product description Installed condition and examples of use for tension anchors ZA	**Annex A 2**

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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

**Imprint:
SIT-Hybrid**
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

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

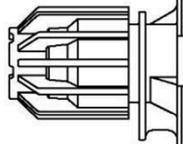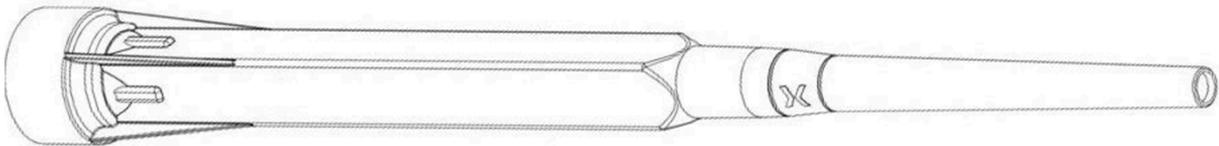**Imprint:
SIT-Hybrid**
Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Static mixer SIT-PM

Piston plug PP und mixer extension ME

Injection System Smart Hybrid SIT-HY for rebar connection	
Product description Injection system	**Annex A 3**

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Reinforcing bar (rebar): ø8 up to ø32
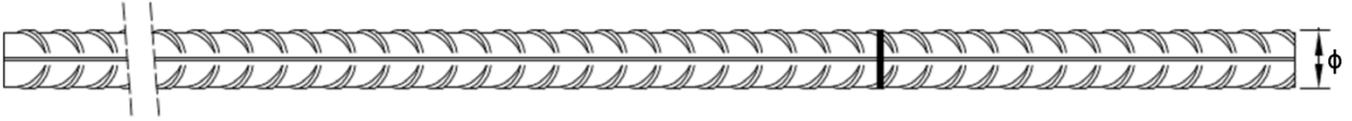
- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2011

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

Table A1: Materials Rebar

Designation	Material
Rebar EN 1992-1-1:2011, 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 Smart Hybrid SIT-HY for rebar connection

Product description Specifications Rebar	**Annex A 4**

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Tension Anchor: ZA-M12 up to ZA-M24

Marking: e.g. ◇ ZA ◇ 12 A4

◇   Mark of the producer

ZA   Trade name

12   Rod diameter/thread

A4   for stainless steel A4
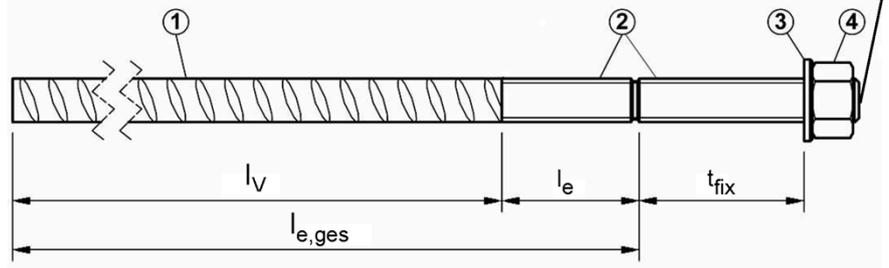
HCR   for high corrosion resistance steel

Table A2: Materials Tension Anchor ZA

Part	Designation	Material											
		ZA vz				ZA A4				ZA HCR			
		M12	M16	M20	M24	M12	M16	M20	M24	M12	M16	M20	M24
1	Reinforcement bar	Class B according to NDP or NCL of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$											
	f_{yk} [N/mm²]	500				500				500			
2	Threaded rod	Steel, zinc plated according to EN ISO 683-4:2018 or EN 10263:2021				Stainless steel, 1.4362, 1.4401, 1.4404, 1.4571, EN 10088-1:2014				High corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014			
3	Washer	Steel, zinc plated according to EN ISO 683-4:2018 or EN 10263:2021				Stainless steel, 1.4362, 1.4401, 1.4404, 1.4571, EN 10088-1:2014				High corrosion resistant steel, 1.4529, 1.4565, EN 10088-1:2014			
4	Nut												

Table A3: Dimensions and installation parameters

| Size			ZA-M12	ZA-M16	ZA-M20	ZA-M24
Diameter of threaded rod	d_s	[mm]	12	16	20	24
Diameter of reinforcement bar	φ	[mm]	12	16	20	25
Drill hole diameter	d_o	[mm]	16	20	25	32
Diameter of clearance hole in fixture	d_f	[mm]	14	18	22	26
With across nut flats	SW	[mm]	19	24	30	36
Stress area	A_s	[mm²]	84	157	245	353
Effective embedment depth	l_v	[mm]	according to static calculation			
Length of bonded thread — plated	l_e	[mm]	≥ 20	≥ 20	≥ 20	≥ 20
Length of bonded thread — A4/HCR			≥ 100	≥ 100	≥ 100	≥ 100
Minimum thickness of fixture	min t_{fix}	[mm]	5	5	5	5
Maximum thickness of fixture	max t_{fix}	[mm]	3000	3000	3000	3000
Maximum installation torque	max T_{inst}	[Nm]	50	100	150	150

Injection System Smart Hybrid SIT-HY for rebar connection	
Product description Specifications Tension Anchor ZA	**Annex A 5**

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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 ZA-M12 to ZA-M24	Ø8 to Ø32 ZA-M12 to ZA-M24
	Seismic action	Ø10 to Ø32	Ø10 to Ø32
	Fire exposure	Ø8 to Ø32 ZA-M12 to ZA-M24	Ø8 to Ø32 ZA-M12 to ZA-M24
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 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 1992-1-1:2011. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

Use conditions (Environmental conditions) with tension anchor ZA:

- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006 + A1:2015 corresponding to corrosion resistance class:
  - Stainless steel class A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

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 1992-1-1:2011, EN 1992-1-2:2011 and Annex B 2 and B 3.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.

Installation:

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

Injection System Smart Hybrid SIT-HY for rebar connection	
Intended use Specifications	**Annex B 1**

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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 1992-1-1:2011.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.
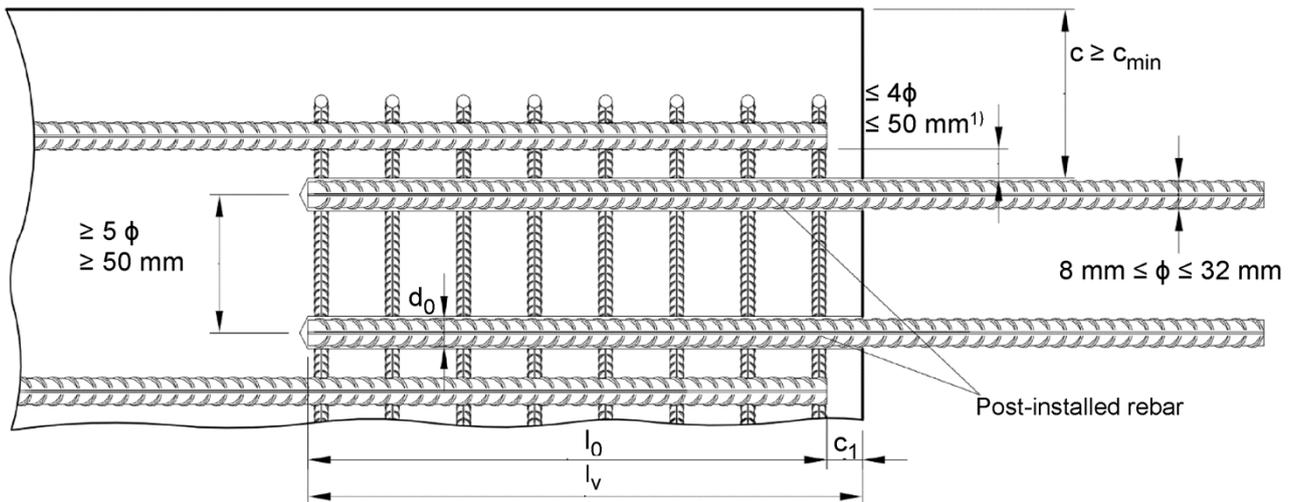
$c \geq c_{min}$

$\leq 4\phi$
≤ 50 mm[1]

$\geq 5\ \phi$
≥ 50 mm

8 mm $\leq \phi \leq 32$ mm

d_0

Post-installed rebar

l_0 c_1

l_v

[1] If the clear distance between lapped bars exceeds 4ϕ or 50 mm, then the lap length shall be increased by the difference between the clear bar distance and the smaller of 4ϕ or 50 mm.

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 1992-1-1:2011, Section 4.4.1.2
ϕ	diameter of post-installed rebar
l_0	Lap length, according to EN 1992-1-1:2011, section 8.7.3 for static loading and according to EN 1998- 1:2004+AC:2009, section 5.6.3 for seismic action
l_v	effective embedment depth, $\geq l_0 + c_1$
d_0	nominal drill bit diameter, see Annex B 5

Injection System Smart Hybrid SIT-HY for rebar connection

Intended use
General construction rules for post-installed rebars

Annex B 2

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Figure B2:   General construction rules for tension anchors ZA

- The length of the bonded-in thread may be not be accounted as anchorage.
- Only tension forces in the direction of the bar axis may be transmitted by the tension anchor ZA.
- The tension force must be transferred via an overlap joint to the reinforcement in the building part.
- The transfer of shear forces shall be ensured by appropriate additional measures, e.g shear lugs or by anchors with an European technical assessment.
- In the anchor plate, the holes for the tension anchors shall be executed as elongated holes with axis in the direction of the shear force.
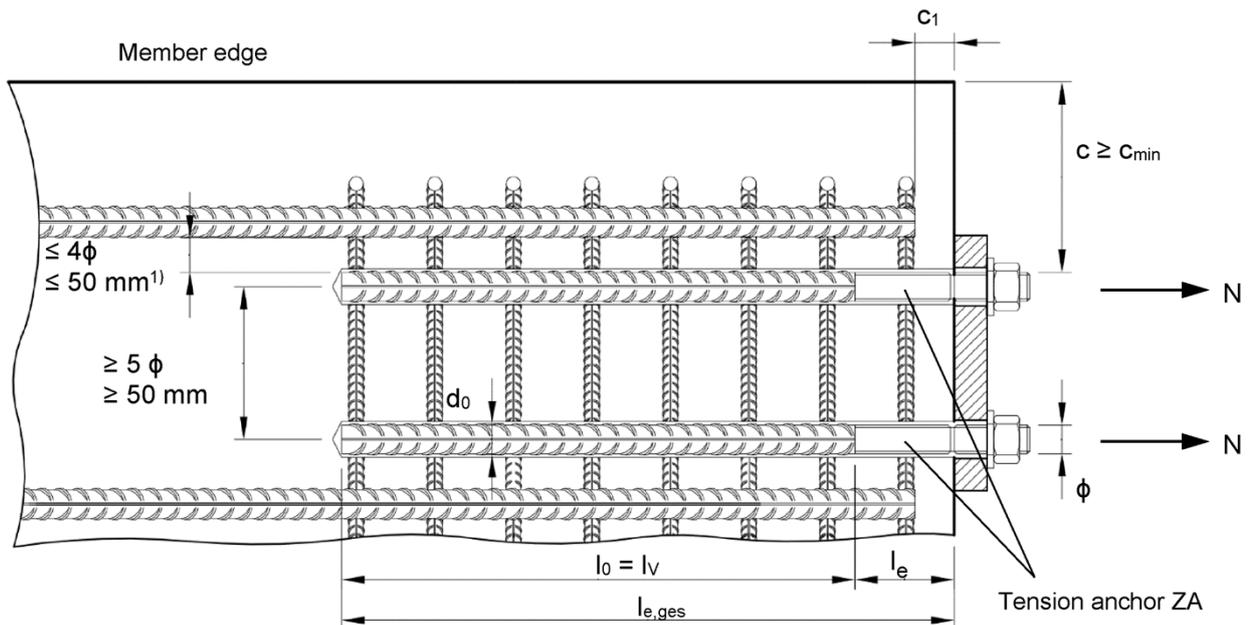
[1] If the clear distance between lapped bars exceeds 4ϕ or 50 mm, then the lap length shall be increased by the difference between the clear bar distance and the smaller of 4ϕ or 50 mm.
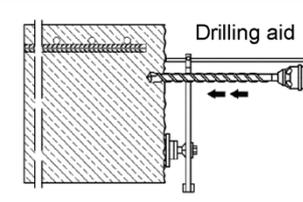
The following applies to Figure B2:

c	concrete cover of tension anchor ZA
c_1	concrete cover at end-face of existing rebar
c_{min}	minimum concrete cover according to Table B1 and to EN 1992-1-1:2011, Section 4.4.1.2
ϕ	diameter of tension anchor
l_0	lap length, according to EN 1992-1-1:2011, Section 8.7.3
l_v	effective embedment depth
l_e	length of bonded thread
$l_{e,ges}$	overall embedment depth, $\geq l_0 + c_2$
d_0	nominal drill bit diameter, see Annex B 5

Injection System Smart Hybrid SIT-HY for rebar connection

Intended use
General construction rules for tension anchors

Annex B 3

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Table B1: Minimum concrete cover c_{min}[1] of post-installed rebar and tie rod ZA 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	$30\ mm + 0{,}06 \cdot l_v \geq 2\ \phi$	$30\ mm + 0{,}02 \cdot l_v \geq 2\ \phi$	Drilling aid
	≥ 25 mm	$40\ mm + 0{,}06 \cdot l_v \geq 2\ \phi$	$40\ mm + 0{,}02 \cdot l_v \geq 2\ \phi$	
CD: Compressed air drilling	< 25 mm	$50\ mm + 0{,}08 \cdot l_v$	$50\ mm + 0{,}02 \cdot l_v$	
	≥ 25 mm	$60\ mm + 0{,}08 \cdot l_v \geq 2\ \phi$	$60\ mm + 0{,}02 \cdot l_v \geq 2\ \phi$	

[1] see Annex B 2, Figure B1 and Annex B 3, Figure B2
Comments: The minimum concrete cover acc. EN 1992-1-1:2011 must be observed.
For the minimum concrete cover $c_{min,seis}$ in case of a seismic action, see Table B2.

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

Drilling method	Design conditions	Distance to 1st edge	Distance to 2nd edge
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	Edge	$\geq 2\ \phi$	$\geq 2\ \phi$
	Corner	$\geq 2\ \phi$	$\geq 2\ \phi$

Table B3: 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.

Injection System Smart Hybrid SIT-HY for rebar connection	
Intended use Minimum concrete cover Dispensing, cleaning and installation tools	**Annex B 4**

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Table B4: Brushes, piston plugs, max anchorage depth and mixer extension, hammer (HD) and compressed air (CD) drilling

Bar size φ [mm]	Tension anchor φ [mm]	Drill bit - Ø HD [mm]	Drill bit - Ø CD [mm]	Brush - Ø	d_b [mm]	$d_{b,min}$ min. Brush - Ø [mm]	Piston plug	Cartridge: All sizes — Hand or battery tool $l_{v,max}$ [mm]	Hand or battery tool Mixer extension	Cartridge: All sizes — Pneumatic tool $l_{v,max}$ [mm]	Pneumatic tool Mixer extension	Cartridge: 825 ml — Pneumatic tool $l_{v,max}$ [mm]	Pneumatic tool Mixer extension
8	-	10	-	SB10	11,5	10,5	-	250	ME10/0,75 or ME16/1,8	250	ME10/0,75 or ME16/1,8	250	ME10/0,75 or ME16/1,8
	-							700		800		800	
10	-	12	-	SB12	13,5	12,5	-	250		250		250	
	-							700		1000		1000	
12	ZA-M12	14	-	SB14	15,5	14,5	PP14	250		250		250	
14	-	16		SB16	17,5	16,5	PP16	700		1000		1200	ME16/1,8
		18		SB18	20,0	18,5	PP18	700		1000		1400	
16	ZA-M16	20		SB20	22,0	20,5	PP20	700		1000		1600	
20	ZA-M20	25	-	SB25	27,0	25,5	PP25	500		700		2000	
		-	26	SB26	28,0	26,5	PP25	500		700		2000	
22	-	28		SB28	30,0	28,5	PP28	500		700		2000	
24/25	ZA-M24	30		SB30	32,0	30,5	PP30	500		500		2000	
		32		SB32	34,0	32,5	PP32	500		500		2000	
28	-	35		SB35	37,0	35,5	PP35	500		500		2000	
32	-	40		SB40	43,5	40,5	PP40	500		500		2000	

Table B5: Brushes, piston plugs, max anchorage depth and mixer extension, hammer drilling with hollow drill bit system (HDB)

Bar size φ [mm]	Tension anchor φ [mm]	Drill bit - Ø HDB [mm]	Brush - Ø d_b / $d_{b,min}$ min. Brush - Ø	Piston plug	Cartridge: All sizes — Hand or battery tool $l_{v,max}$ [mm]	Hand or battery tool Mixer extension	Cartridge: All sizes — Pneumatic tool $l_{v,max}$ [mm]	Pneumatic tool Mixer extension	Cartridge: 825 ml — Pneumatic tool $l_{v,max}$ [mm]	Pneumatic tool Mixer extension
8	-	10	No cleaning required	-	250	ME10/0,75 or ME16/1,8	250	ME10/0,75 or ME16/1,8	250	ME10/0,75 or ME16/1,8
	-	12			700		800		800	
10	-			-	250		250		250	
	-	14		PP14	700		1000		1000	
12	ZA-M12	16		PP16	250		250		250	
14	-	18		PP18	700		1000		1000	ME16/1,8
16	ZA-M16	20		PP20	700		1000		1000	
20	ZA-M20	25		PP25	500		700		1000	
22	-	28		PP28	500		700		1000	
24/25	ZA-M24	30		PP30	500		500		1000	
		32		PP32						
28	-	35		PP35	500		500		1000	
32	-	40		PP40	500		500		1000	

Injection System Smart Hybrid SIT-HY for rebar connection

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

Annex B 5

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Cleaning and installation tools

HDB – Hollow drill bit system

The hollow drill system consists of Heller Duster Expert hollow drill bit or a hollow drill bit with equivalent performance 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, $h_0 \leq 10\ d_s$, $d_0 \leq 20mm$)

Manual slide valve

(min 6 bar)

Brush SB

Piston Plug PP

Brush extension SBE

Table B6:   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.

Injection System Smart Hybrid SIT-HY for rebar connection	
Intended Use Cleaning and installation tools Working time and curing time	**Annex B 6**

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Installation instructions

Attention: Before drilling, remove carbonated concrete and clean contact areas (see Annex B1)
Aborted drill holes shall be filled with mortar.

Drilling of the bore hole
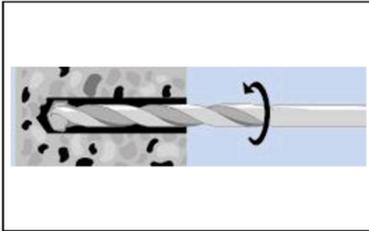
|	
	1a. **Hammer drilling (HD) / Compressed air drilling (CD)** Drill a hole to the required embedment depth. Drill bit diameter according to Table B4. Proceed with Step 2 (MAC or CAC).
	1b. **Hollow drill bit system (HDB) (see Annex B 6)** Drill a hole to the required embedment depth. Drill bit diameter according to Table B5. Proceed with Step 3.
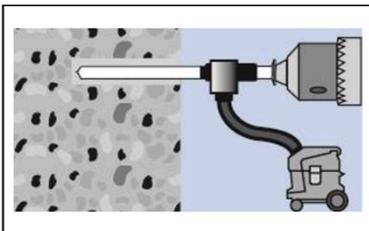
Manual Air Cleaning (MAC)

for bore hole diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10d\phi$, with drilling method HD and CD
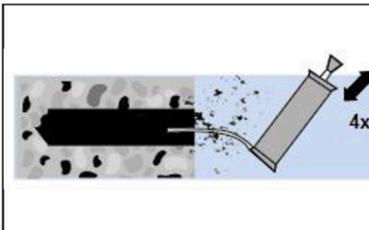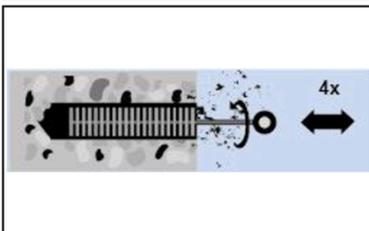
	Attention! Standing water in the bore hole must be removed before cleaning. **2a.** Blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 6).
	2b. Brush the bore hole minimum 4x with brush SB according to Table B4 over the entire embedment depth in a twisting motion (if necessary, use a brush extension SBE).
	2c. Finally blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 6).
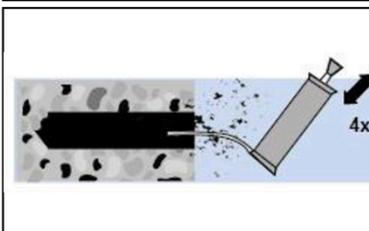
Injection System Smart Hybrid SIT-HY for rebar connection	
Intended Use Installation instruction	**Annex B 7**

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### Installation instructions (continuation)

Compressed Air Cleaning (CAC):
All diameter in cracked and uncracked concrete, with drilling method HD and CD
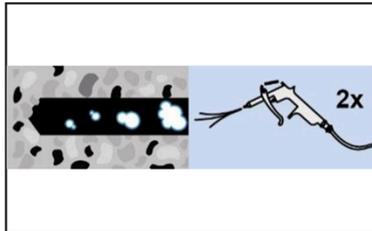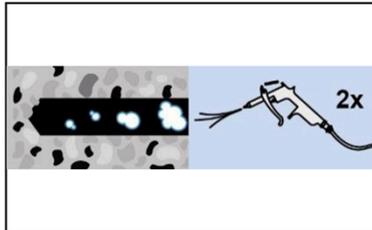
Attention! Standing water in the bore hole must be removed before cleaning.

2a. Blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 6) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)
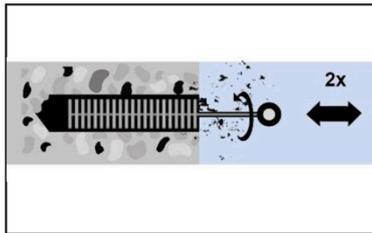
2b. Brush the bore hole minimum 2x with brush SB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension SBE shall be used.)

2c. Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 6) 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.
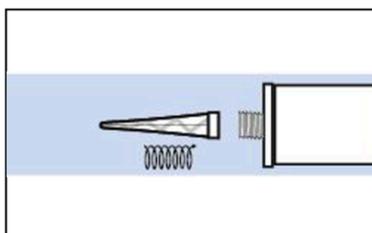
3. Screw on static-mixing nozzle SIT-PM and load the cartridge into an appropriate dispensing tool.
For every working interruption longer than the maximum working time t_{work} (Annex B 6) as well as for new cartridges, a new static-mixer shall be used.
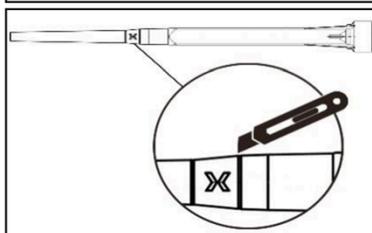
3a. In case of using the mixer extension ME16/1,8, the tip of the mixer nozzle has to be cut off at position „X".
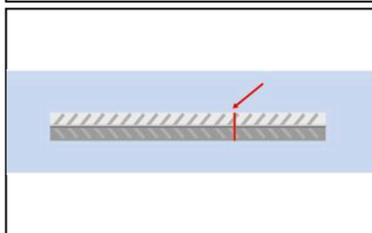
4. Mark embedment depth on the reinforcing bar.
The anchor rod shall be free of dirt, grease, oil or other foreign material.

Injection System Smart Hybrid SIT-HY for rebar connection

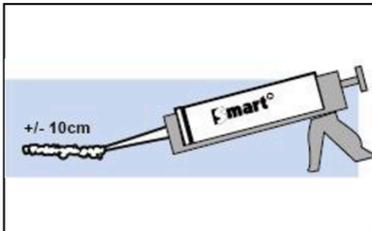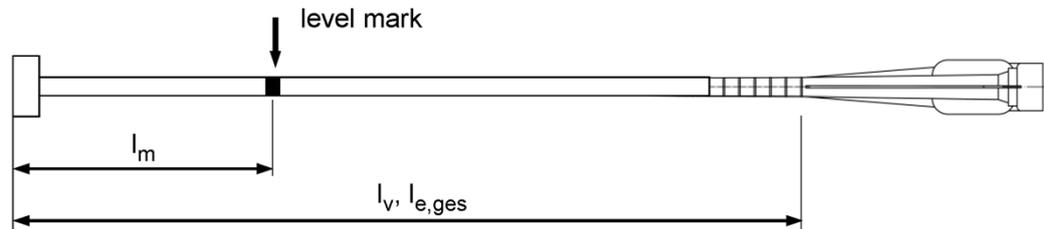| **Intended Use** Installation instructions (continuation)	**Annex B 8**

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Installation instructions (continuation)

5. Injection tool must be marked by mortar level mark l_m and anchorage depth l_v resp. $l_{e,ges}$ with tape or marker.
Quick estimation: $l_m = 1/3 \cdot l_v$
Optimum mortar volume:

$$l_m = l_v \text{ resp. } l_{e,ges} \cdot \left(1{,}2 \cdot \frac{\phi^2}{d_0^2} - 0{,}2 \right)$$
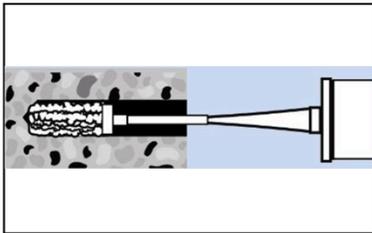
level mark

l_m

$l_v, l_{e,ges}$

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).
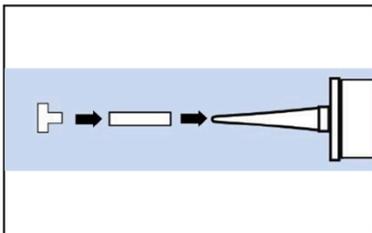
7. Piston plugs PP and mixer nozzle extensions ME shall be used according to Table B4 or B5
Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.
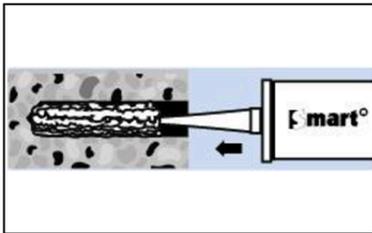
8a. **Injecting mortar without piston plug PP**
Starting at bottom of the hole and fill the hole up with mortar until the mortar level mark l_m is visible. (If necessary, a mixer nozzle extension shall be used.)
Slowly withdraw of the static mixing nozzle avoid creating air pockets
Observe the temperature related working time t_{work} (Annex B 6).

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 6).
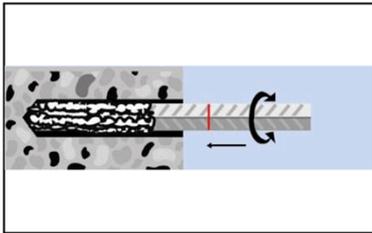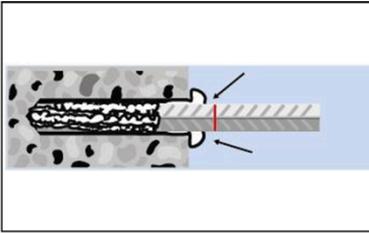
9. Insert the reinforcing bar while turning slightly up to the embedment mark.

Injection System Smart Hybrid SIT-HY for rebar connection

Intended Use
Installation instructions (continuation)

Annex B 9

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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.
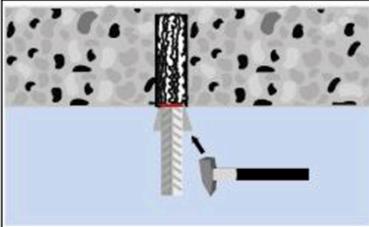
11. For application in vertical upwards direction the reinforcing bar shall be fixed (e.g. wedges).
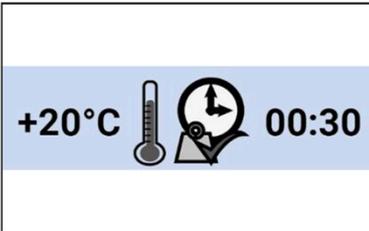
12. Temperature related curing time t_{cure} (Annex B 6) must be observed.
Do not move or load the reinforcing bar during curing time.

+20°C 00:30

Injection System Smart Hybrid SIT-HY for rebar connection

Intended Use
Installation instructions (continuation)

Annex B 10

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Table C1: Characteristic tension resistance for tension anchor ZA

| Tension Anchor			M12	M16	M20	M24
Steel, zinc plated (ZA vz)						
Characteristic tension resistance	$N_{Rk,s}$	[kN]	67	125	196	282
Partial factor	$\gamma_{Ms,N}$	[-]	1,4			
Stainless Steel (ZA A4 or ZA HCR)						
Characteristic tension resistance	$N_{Rk,s}$	[kN]	67	125	171	247
Partial factor	$\gamma_{Ms,N}$	[-]	1,4		1,3	1,4

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 1992-1-1:2011 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiply by the amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ according to Table C2.

Table C2: Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$ related to concrete class and drilling method; working life 50 and 100 years

Concrete class	Drilling method	Bar size	Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$
C12/15 to C50/60	all drilling methods	8 mm to 32 mm ZA-M12 to ZA-M24	1,0

Table C3: Reduction factor $k_b = k_{b,100y}$ for all drilling methods; working life 50 and 100 years

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 ZA-M12 to ZA-M24	1,0								

Table C4: 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 1992-1-1:2011.

k_b, $k_{b,100y}$: Reduction factor according to Table C3

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 ZA-M12 to ZA-M24	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3

Injection System Smart Hybrid SIT-HY for rebar connection	**Annex C 1**
Performances Characteristic tension resistance for tension anchor, Minimum anchorage length and minimum lap length, Amplification factor, Reduction factor and Design values of ultimate bond resistance	

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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 1992-1-1:2011 ($l_{b,min}$ acc. to Eq. 8.6 and Eq. 8.7 and $l_{0,min}$ acc. to Eq. 8.11) shall be multiply by the amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$ according to Table C5.

Table C5: **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	Bar 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 C6: **Reduction factor $k_{b,seis} = k_{b,seis,100y}$ for all drilling methods; working life 50 and 100 years**

Rebar	Concrete classes								
ϕ	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 1992-1-1:2011.

$k_{b,seis}$, $k_{b,seis,100y}$: Reduction factor according to Table C6

Rebar	Concrete classes								
ϕ	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 Smart Hybrid SIT-HY for rebar connection

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

Annex C 2

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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:
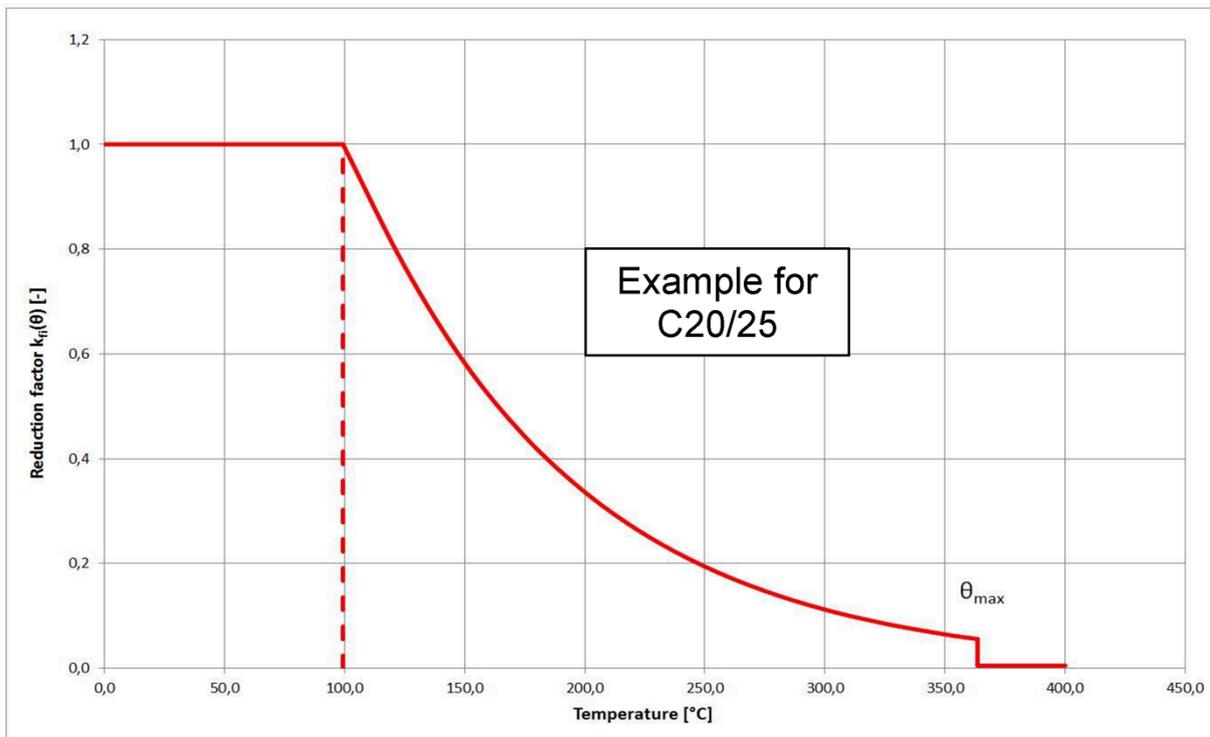
The design value of the ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$ at increased temperature has to be calculated by the following equation:

For working life 50 years:

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

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:

$$f_{bd,fi,100y} = k_{fi,100y}(\theta) \cdot f_{bd,PIR,100y} \cdot \gamma_c / \gamma_{M,fi}$$

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 in N/mm² in cold condition according to Table C4 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2011.
γ_c	= 1,5, recommended partial factor according to EN 1992-1-1:2011
$\gamma_{M,fi}$	= 1,0, recommended partial factor according to EN 1992-1-2:2011

For evidence at increased temperature the anchorage length shall be calculated according to EN 1992-1-1:2011 Equation 8.3 using the temperature-dependent design value of ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$.

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

Injection System Smart Hybrid SIT-HY for rebar connection

Performances
Design value of ultimate bond stress at increased temperature

Annex C 3

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Table C8:	Characteristic tension resistance for tension anchor ZA under fire exposure

Tension Anchor				M12	M16	M20	M24
Steel, zinc plated (ZA vz)							
Characteristic tension resistance	R30	$N_{Rk,s,fi}$	[kN]	2,3	4,0	6,3	9,0
	R60			1,7	3,0	4,7	6,8
	R90			1,5	2,6	4,1	5,9
	R120			1,1	2,0	3,1	4,5
Stainless Steel (ZA A4 or ZA HCR)							
Characteristic tension resistance	R30	$N_{Rk,s,fi}$	[kN]	3,4	6,0	9,4	13,6
	R60			2,8	5,0	7,9	11,3
	R90			2,3	4,0	6,3	9,0
	R120			1,8	3,2	5,0	7,2

Injection System Smart Hybrid SIT-HY for rebar connection	
Performances Characteristic tension resistance for tension anchor ZA under fire exposure	**Annex C 4**