Deutsches Institut für Bautechnik

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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-19/0200 of 2 September 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 | Chemofast Injection System EP 1000 for rebar connection |
| Product family to which the construction product belongs | Systems for post-installed rebar connections with mortar |
| Manufacturer | CHEMOFAST Anchoring GmbH<br>Hanns-Martin-Schleyer-Straße 23<br>47877 Willich<br>DEUTSCHLAND |
| Manufacturing plant | CHEMOFAST Anchoring GmbH<br>Hanns-Martin-Schleyer-Straße 23<br>47877 Willich<br>DEUTSCHLAND |
| This European Technical Assessment contains | 24 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-19/0200 issued on 29 January 2020 |



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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 "Chemofast Injection system EP 1000 for rebar connection" in accordance with the regulations for reinforced concrete construction.
Reinforcing bars made of steel with a diameter $\phi$ from 8 to 40 mm or the tension anchor ZA of sizes M12 to M24 according to Annex A and injection mortar Chemofast EP 1000 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 B4 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 to 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 2 September 2021 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock
Head of Section

*beglaubigt:*
Baderschneider

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## Installation post installed rebar

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

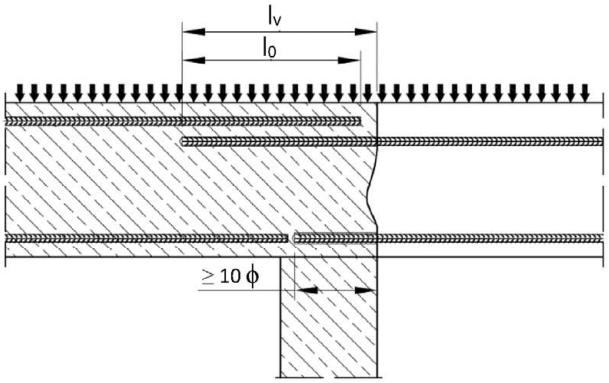



**Figure A2:** Overlapping joint at a foundation of a wall or column where the rebars are stressed in tension

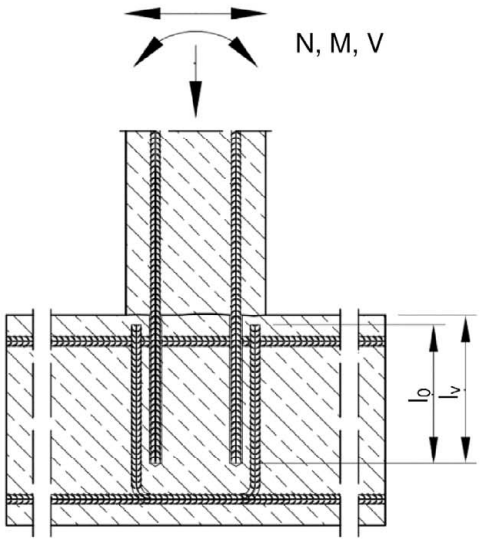



**Figure A3:** End anchoring of slabs or beams (e.g. designed as simply supported)

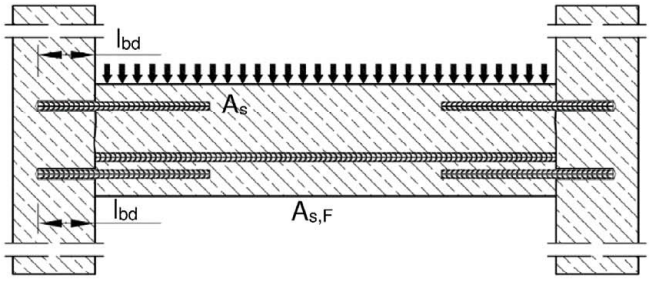



**Figure A4:** Rebar connection for components stressed primarily in compression. The rebars are stressed in compression

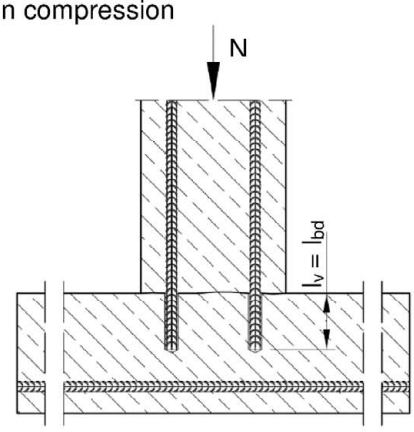
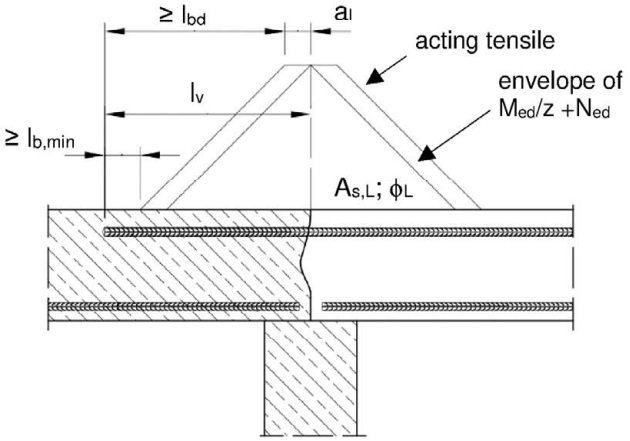



**Figure A5:** Anchoring of reinforcement to cover the line of acting tensile force




**Note to Figure A1 to A5:**

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

Preparing of joints according to Annex B 2

| | |
|---|---|
| **Chemofast Injection System EP 1000 for rebar connection** | **Annex A 1** |
| **Product description**<br>Installed condition and examples of use for rebars | |

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## Installation tension anchor ZA

**Figure A6:** Overlapping joint of a column stressed in bending to a foundation

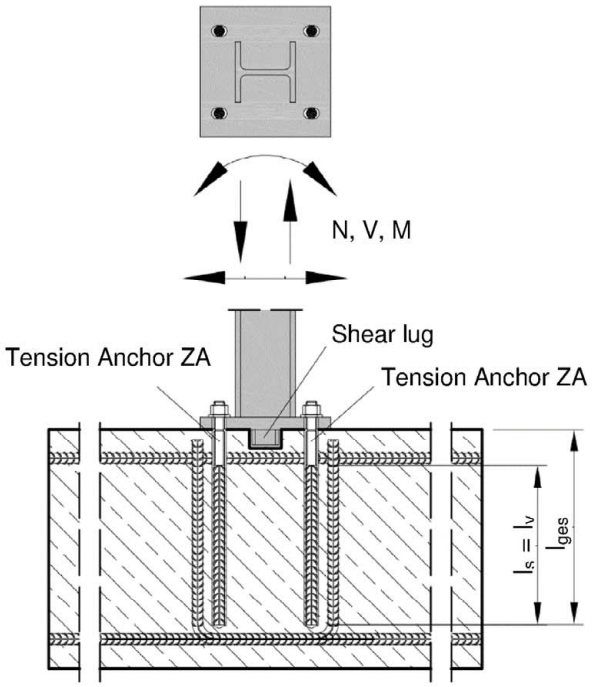



**Figure A7:** Overlap joint for the anchorage of barrier posts

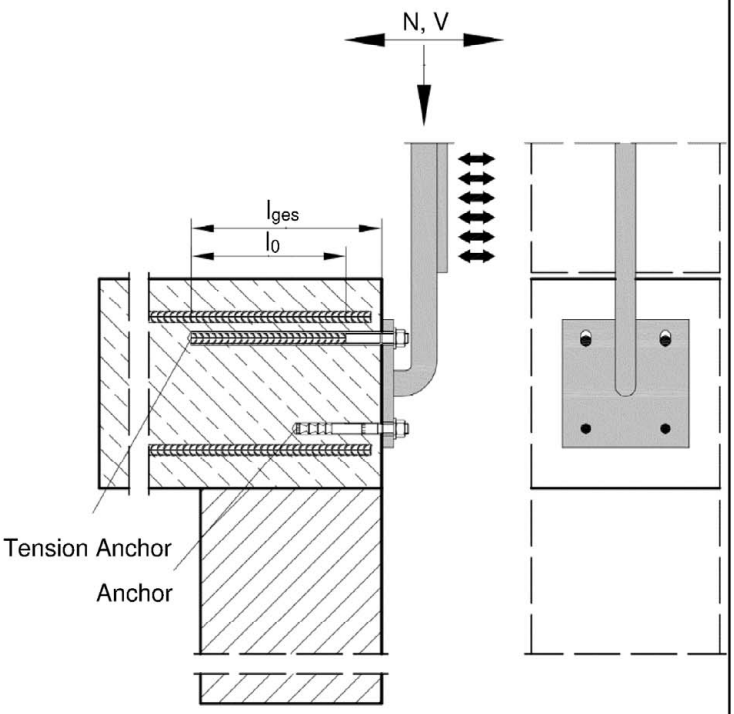
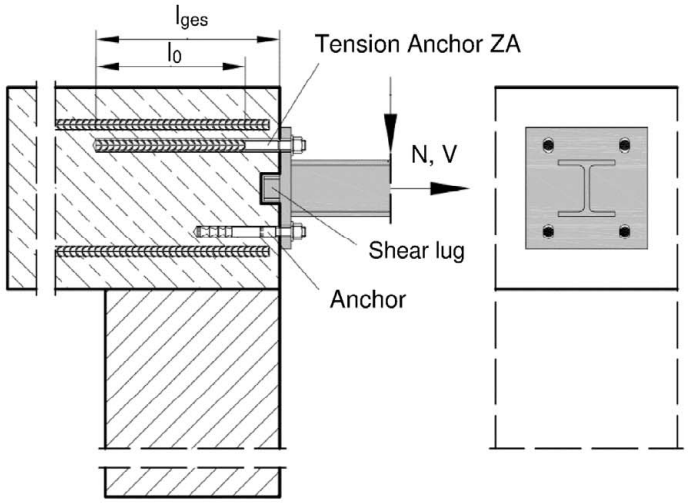



**Figure A8:** Overlap joint for the anchorage to centilever members




## Note to Figure A6 to A8:

In the Figures no transverse reinforcement is plotted, the transverse reinforcement shall comply with EN 1992-1-1:2002+AC:2010



| | |
|---|---|
| **Chemofast Injection System EP 1000 for rebar connection** | |
| **Product description**<br>Installed condition and examples of use for tension anchors ZA | **Annex A 2** |

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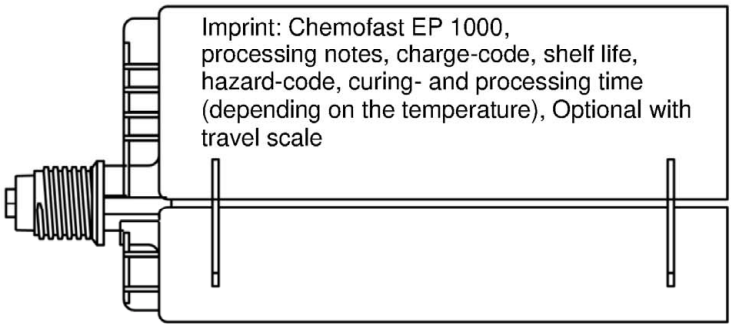
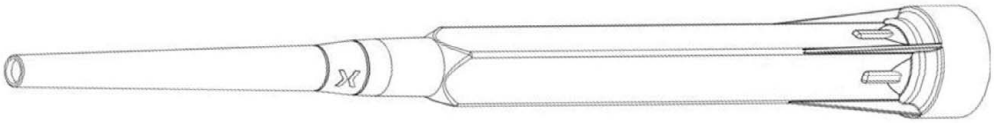
## Chemofast Injection System EP 1000:

**Injection mortar: Chemofast EP 1000**

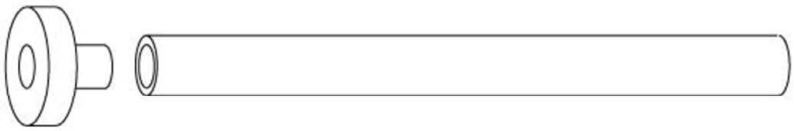
**Type "side-by-side":**
440ml, 585 ml and 1400 ml cartridge




**Static Mixer:**

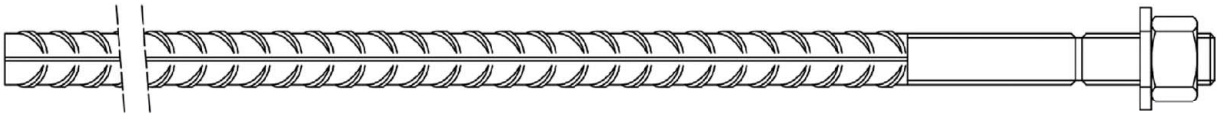


**Piston plug and mixer extension**



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

**Tension Anchor ZA: M12 to M24**





| **Chemofast Injection System EP 1000 for rebar connection** | **Annex A 3** |
|---|---|
| **Product description**<br>Injection mortar / Static mixer / Rebar / Tension Anchor ZA | |

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

- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar shall be in the range $0{,}05\phi \le h_{rib} \le 0{,}07\phi$
  ($\phi$: 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<br>$f_{yk}$ and k according to NDP or NCL of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |



**Chemofast Injection System EP 1000 for rebar connection**

**Product description**
Materials Rebar

**Annex A 4**

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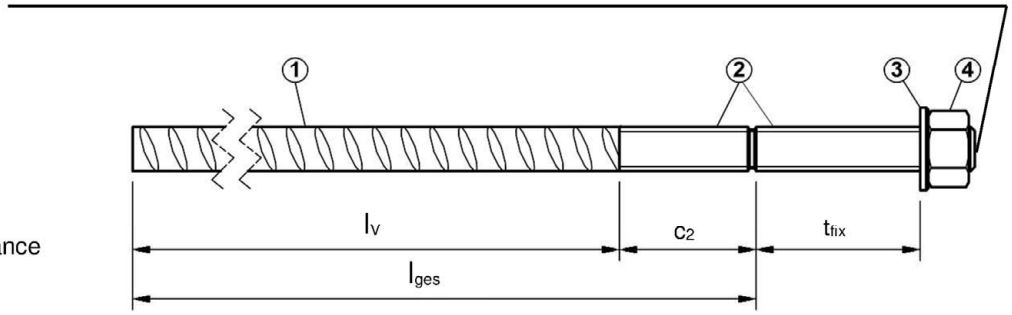
## Tension Anchor ZA: M12, M16, M20, M24

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

| 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<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ | | | | | | | | | | | |
| | $f_{yk}$ [N/mm²] | 500 | | | | 500 | | | | 500 | | | |
| 2 | Threaded rod | Steel, zinc plated according to EN ISO 683-4:2018 or EN 10263:2001 | | | | 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 10263:2001 | | | | 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 parameter

| Size | | | | ZA-M12 | ZA-M16 | ZA-M20 | ZA-M24 |
|---|---|---|---|---|---|---|---|
| Diameter of threaded rod | | $d_s$ | [mm] | 12 | 16 | 20 | 24 |
| Diameter of reinforcement bar | | $\phi$ | [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 | $c_2$ | [mm] | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 |
| | A4/HCR | | | ≥ 100 | ≥ 100 | ≥ 100 | ≥ 100 |
| Minimum thickness of fixture | | $t_{fix}$ | [mm] | 5 | 5 | 5 | 5 |
| Maximum thickness of fixture | | $t_{fix}$ | [mm] | 3000 | 3000 | 3000 | 3000 |
| Maximum installation torque | | $T_{max}$ | [Nm] | 50 | 100 | 150 | 150 |

**Chemofast Injection System EP 1000 for rebar connection**

**Product description**
Specifications Tension Anchor ZA

**Annex A 5**

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## Specifications of intended use

| **Anchorages subject to:** | | static and quasi-static loads | seismic action |
|---|---|---|---|
| Hammer drilling (HD),<br>Hammer drilling with hollow drill bit (HDB),<br>Compressed air drilling (CD),<br>Or Diamond drilling (DD) | for a working life of 50 years | Ø8 to Ø40<br>ZA-M12 to ZA-M24 | Ø10 to Ø40 |
| | for a working life of 100 years | Ø8 to Ø40<br>ZA-M12 to ZA-M24 | Ø10 to Ø40 |
| | Fire exposure | Ø8 to Ø40<br>ZA-M12 to ZA-M24 | No performance assessed |
| Temperature Range: | - 40°C to +80°C<br>(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 $\phi$ + 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.

**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 Stahl 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 1992-1-1:2004+AC:2010, EN 1992-1-2:2004+AC:2008 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), hammer drill with hollow drill bit (HDB), diamond drill (DD) or compressed air drill (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).



| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 1** |
|---|---|
| **Intended use**<br>Specifications | |

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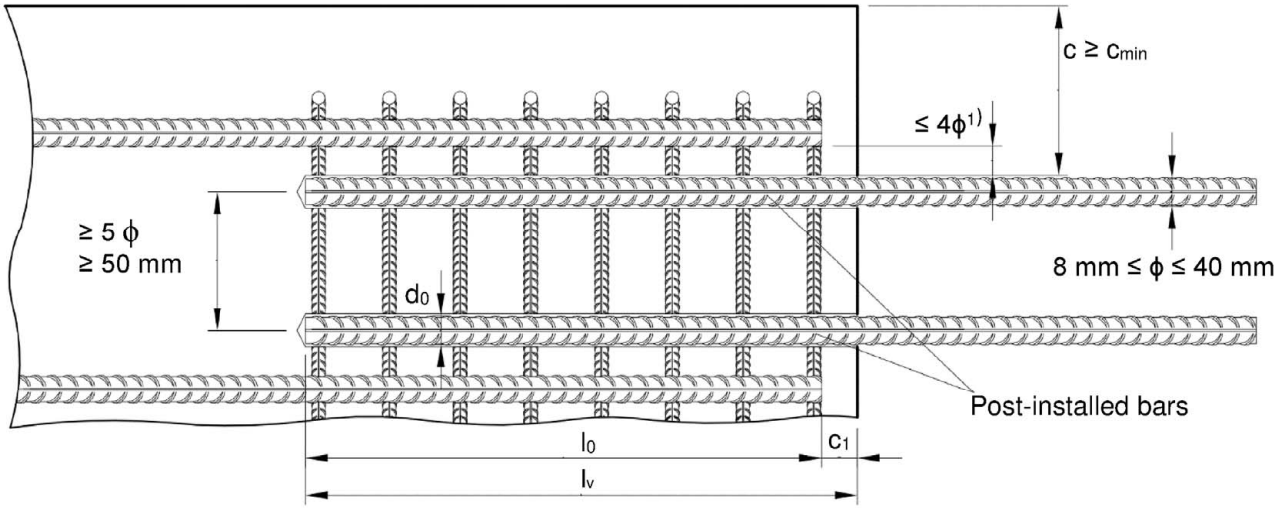
## Figure B1: General construction rules for post-installed rebars

- 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 1992-1-1:2004+AC:2010.
- The joints for concreting must be roughened to at least such an extent that aggregate protrude.




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

The following applies to Figure B1:

| | |
|---|---|
| $c$ | concrete cover of post-installed rebar |
| $c_1$ | concrete cover at end-face of existing rebar |
| $c_{min}$ | minimum concrete cover according to Table B1 and to EN 1992-1-1:2004+AC:2010, Section 4.4.1.2 |
| $\phi$ | 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 B 5 |



| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 2** |
|---|---|
| **Intended use**<br>General construction rules for post-installed rebars | |

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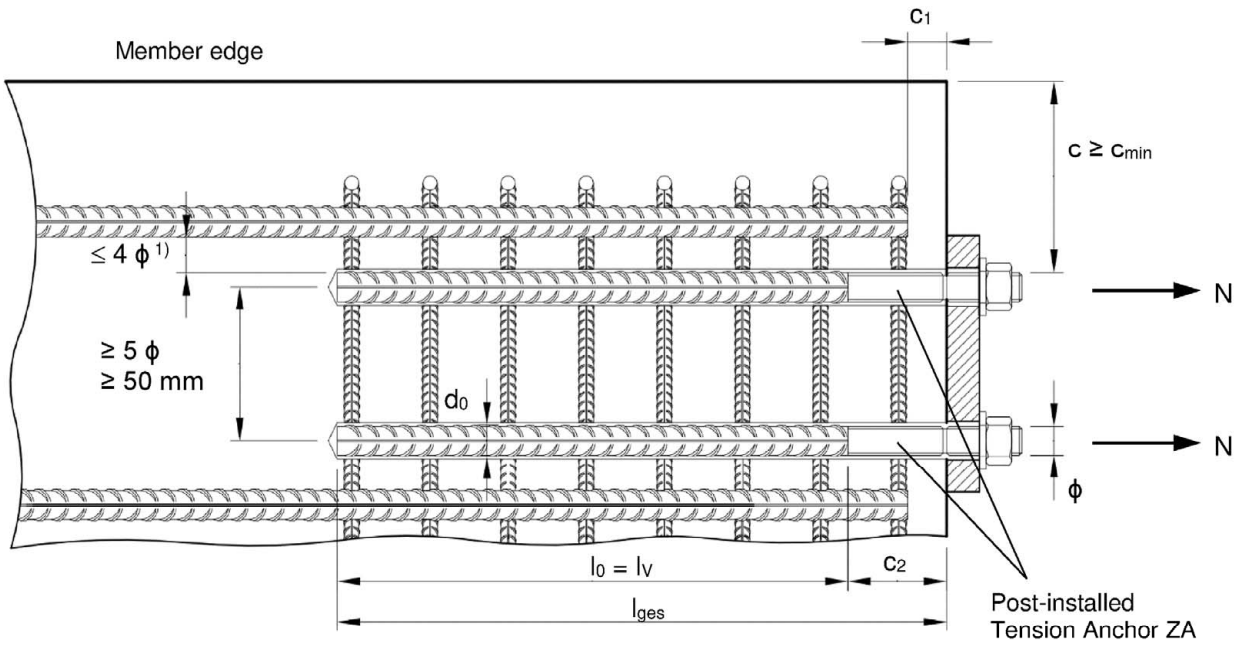
## Figure B2: General construction rules for tension anchors ZA

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

The following applies to Figure B2:

| | |
|---|---|
| $c$ | concrete cover of tension anchor ZA |
| $c_1$ | concrete cover at end-face of existing rebar |
| $c_2$ | Length of bonded thread |
| $c_{min}$ | minimum concrete cover according to Table B1 and to EN 1992-1-1:2004+AC:2010, Section 4.4.1.2 |
| $\phi$ | diameter of tension anchor |
| $l_0$ | lap length, according to EN 1992-1-1:2004+AC:2010, Section 8.7.3 |
| $l_v$ | effective embedment depth, $\geq l_0 + c_1$ |
| $l_{ges}$ | overall embedment depth, $\geq l_0+c_2$ |
| $d_0$ | nominal drill bit diameter, see Annex B 4 |



| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 3** |
|---|---|
| **Intended use**<br>General construction rules for tension anchors | |

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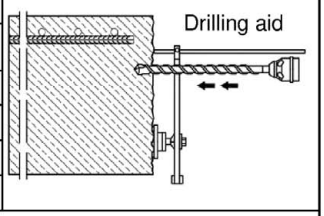
## Table B1: Minimum concrete cover min c[1] of post-installed rebar depending of drilling method

| Drilling method | Rebar diameter | Without drilling aid | With drilling aid | |
|---|---|---|---|---|
| Hammer drilling (HD), Hammer drilling with hollow drill (HDB) | < 25 mm | 30 mm + 0,06 · $l_v$ ≥ 2 ϕ | 30 mm + 0,02 · $l_v$ ≥ 2 ϕ |   |
| | ≥ 25 mm | 40 mm + 0,06 · $l_v$ ≥ 2 ϕ | 40 mm + 0,02 · $l_v$ ≥ 2 ϕ | |
| Diamond drilling (DD) | < 25 mm | Drill rig used as drilling aid | 30 mm + 0,02 · $l_v$ ≥ 2 ϕ | |
| | ≥ 25 mm | | 40 mm + 0,02 · $l_v$ ≥ 2 ϕ | |
| Compressed air drilling (CD) | < 25 mm | 50 mm + 0,08 · $l_v$ | 50 mm + 0,02 · $l_v$ | |
| | ≥ 25 mm | 60 mm + 0,08 · $l_v$ ≥ 2 ϕ | 60 mm + 0,02 · $l_v$ ≥ 2 ϕ | |

[1] see Annex B 2, Figure B1 and Annex B 3, Figure B2
Comments: The minimum concrete cover acc. EN 1992-1-1:2004+AC:2010 must be observed
For minimum concrete cover in case of seismic action $c_{min,seis}$ 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 ϕ | ≥ 2 ϕ |
| | Corner | ≥ 2 ϕ | ≥ 2 ϕ |
| Diamond drilling (DD) | Edge | ≥ 4 ϕ | ≥ 8 ϕ |
| | Corner | ≥ 6 ϕ | ≥ 6 ϕ |

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

| Temperature in base material | Maximum Gelling- / working time[1] | Initial curing time in dry concrete[2] | Minimum curing time in dry concrete[3] |
|---|---|---|---|
| | $t_{gel}$ | $t_{cure,ini}$ | $t_{cure}$ |
| 0 °C to + 4°C | 80 min | 30 h | 144 h |
| + 5 °C to + 9°C | 80 min | 20 h | 48 h |
| + 10 °C to + 14°C | 60 min | 15 h | 28 h |
| + 15 °C to + 19°C | 40 min | 9 h | 18 h |
| + 20 °C to + 24°C | 30 min | 6 h | 12 h |
| + 25 °C to + 34°C | 12 min | 4 h | 9 h |
| + 35 °C to + 39°C | 8 min | 3 h | 6 h |
| +40 °C | 8 min | 1,5 h | 4 h |
| Cartridge temperature | +5°C to +40°C | | |

[1] $t_{gel}$: maximum time from starting of mortar injection to completing of rebar setting.
[2] After $t_{cure,ini}$ has elapsed, the installation of the connecting reinforcement and the construction of the formwork can be continued
[3] In wet concrete the curing times must be doubled.

**Chemofast Injection System EP 1000 for rebar connection**

**Intended use**
Minimum concrete cover
Gelling and curing time

**Annex B 4**

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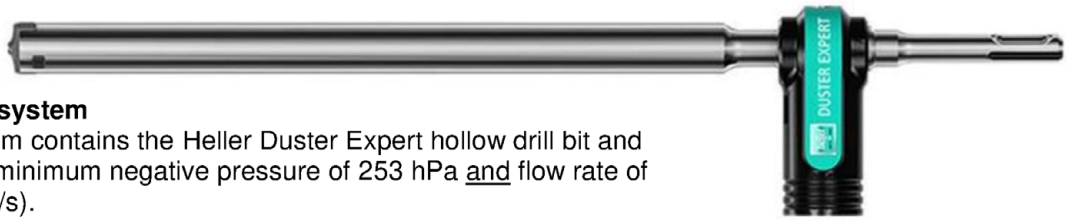
## Table B4: Dispensing tools

| Cartridge type/size | Hand tool | | Pneumatic tool |
|---|---|---|---|
| Side-by-side cartridges 440, 585 ml |  e.g. SA 296C585 |  e.g. Typ H 244 C |  e.g. Typ TS 444 KX |
| Side-by-side cartridges 1400 ml | - | - |  e.g. Typ TS 471 |

Ale cartridges can be used with battery tool as well.

### Cleaning and installation tools

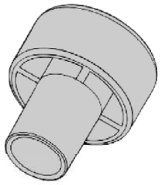



**HDB – Hollow drill bit system**
The hollow drill bit system contains the Heller Duster Expert hollow drill bit and a class M vacuum with minimum negative pressure of 253 hPa and flow rate of minimum 150 m³/h (42 l/s).

**Brush RB:**


**SDS Plus Adapter:**

**Brush extension:**



**Piston Plug**

**Hand pump (volume 750 ml)**

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

| Chemofast Injection System EP 1000 for rebar connection | Annex B 5 |
|---|---|
| **Intended Use**<br>Dispensing, cleaning and installation tools | |

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## Table B5: Brushes, piston plugs, max anchorage depth and mixer extension, hammer (HD), diamond (DD) and compressed air (CD) drilling

| Bar size ϕ | Tension anchor ϕ | Drill bit - Ø | | | $d_b$ Brush - Ø | | $d_{b,min}$ min. Brush - Ø | Piston plug | Cartridge: 440 ml or 585 ml | | | | Cartridge: 1400 ml | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Hand or battery tool | | Pneumatic tool | | Pneumatic tool | |
| | | HD | DD | CD | | | | | $l_{v,max}$ | Mixer extension | $l_{v,max}$ | Mixer extension | $l_{v,max}$ | Mixer extension |
| [mm] | [mm] | [mm] | | | | [mm] | [mm] | | [mm] | | [mm] | | [mm] | |
| 8 | - | 10 | | - | RB10 | 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 | | - | RB12 | 13,5 | 12,5 | - | 700 | | 800 | | 800 | |
| 10 | - | | | | | | | | 250 | | 250 | | 250 | |
| | - | 14 | | - | RB14 | 15,5 | 14,5 | VS14 | 700 | | 1000 | | 1000 | |
| 12 | ZA-M12 | | | | | | | | 250 | | 250 | | 250 | |
| | | 16 | | | RB16 | 17,5 | 16,5 | VS16 | 700 | | 1300 | | 1200 | VL16/1,8 |
| 14 | - | 18 | | | RB18 | 20,0 | 18,5 | VS18 | | | | | 1400 | |
| 16 | ZA-M16 | 20 | | | RB20 | 22,0 | 20,5 | VS20 | | | | | 1600 | |
| 20 | ZA-M20 | 25 | | - | RB25 | 27,0 | 25,5 | VS25 | 500 | | 1000 | | 2000 | |
| | | - | | 26 | RB26 | 28,0 | 26,5 | VS25 | | | | | | |
| 22 | - | 28 | | | RB28 | 30,0 | 28,5 | VS28 | | | | | | |
| 24/25 | ZA-M24 | 30 | | | RB30 | 32,0 | 30,5 | VS30 | | | | | | |
| | | 32 | | | RB32 | 34,0 | 32,5 | VS32 | | | | | | |
| 28 | - | 35 | | | RB35 | 37,0 | 35,5 | VS35 | | | | | | |
| 32/34 | - | 40 | | | RB40 | 43,5 | 40,5 | VS40 | | | | | | |
| 36 | - | 45 | | | RB45 | 47,0 | 45,5 | VS45 | - | - | | | | |
| 40 | - | - | 52 | - | RB52 | 54,0 | 52,5 | VS52 | | | | | | |
| | - | 55 | - | 55 | RB55 | 58,0 | 55,5 | VS55 | | | | | | |

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

| Bar size ϕ | Tension anchor ϕ | Drill bit - Ø | $d_b$ Brush - Ø | $d_{b,min}$ min. Brush - Ø | Piston plug | Cartridge: 440 ml or 585 ml | | | | Cartridge: 1400 ml | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hand or battery tool | | Pneumatic tool | | Pneumatic tool | |
| | | HDB | | | | $l_{v,max}$ | Mixer extension | $l_{v,max}$ | Mixer extension | $l_{v,max}$ | Mixer extension |
| [mm] | [mm] | [mm] | | | | [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 | | | VS14 | 700 | | 1000 | | 1000 | |
| 12 | ZA-M12 | | | | | 250 | | 250 | | 250 | |
| | | 16 | | | VS16 | 700 | | 1000 | | 1000 | |
| 14 | - | 18 | | | VS18 | | | | | | |
| 16 | ZA-M16 | 20 | | | VS20 | | | | | | |
| 20 | ZA-M20 | 25 | | | VS25 | 500 | | | | | |
| 22 | | 28 | | | VS28 | | | | | | |
| 24/25 | ZA-M24 | 30 | | | VS30 | | | | | | |
| | | 32 | | | VS32 | | | | | | |
| 28 | | 35 | | | VS35 | | | | | | |
| 32/34 | | 40 | | | VS40 | | | | | | |

**Chemofast Injection System EP 1000 for rebar connection**

**Intended use**
Installation tools

**Annex B 6**

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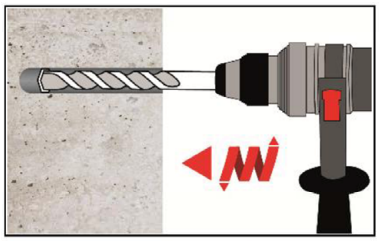
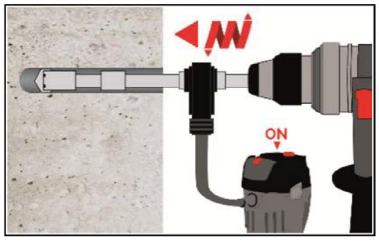
## A) Bore hole drilling

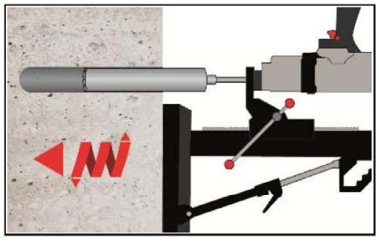
Note: Before drilling, remove carbonated concrete and clean contact areas (see Annex B1)
In case of aborted drill hole: the drill hole shall be filled with mortar.



1a. **Hammer (HD) or compressed air drilling (CD)**
Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. Proceed with Step B1 (MAC or CAC).




1b. **Hollow drill bit system (HDB)** (see Annex B 5)
Drill a hole into the base material to the size and embedment depth required by the selected reinforcing bar. This drilling system removes the dust and cleans the bore hole during drilling.
Proceed with Step C.



1c. **Diamond drilling (DD)**
Drill with diamond drill a hole into the base material to the size and embedment depth required by the selected anchor
Proceed with Step B2.



| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 7** |
|---|---|
| **Intended use**<br>Installation instruction: Bore hole drilling (HD, CD, HDB and DD) | |

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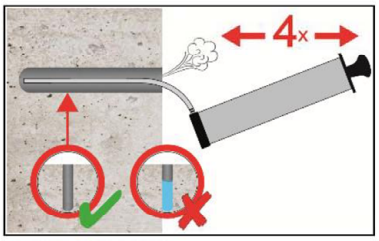
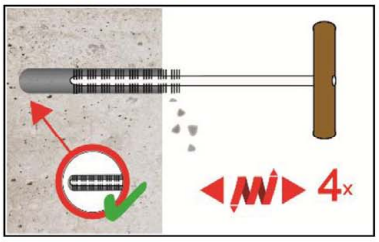
## B1) Bore hole cleaning (HD and CD)

**MAC: Cleaning for bore hole diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10d_s$**

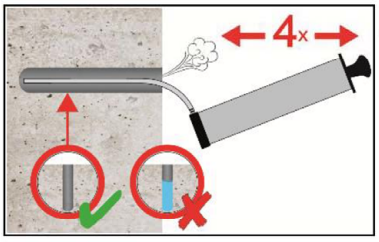



**Attention! Standing water in the bore hole must be removed before cleaning.**

2a. Starting from the bottom or back of the bore hole, blow the hole clean with a hand pump (Annex B 5) a minimum of four times. If the bore hole ground is not reached an extension shall be used.

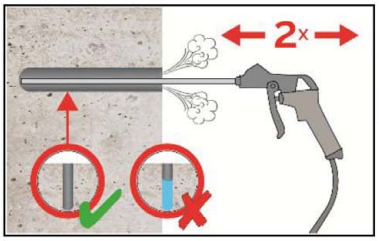



2b. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension shall be used.



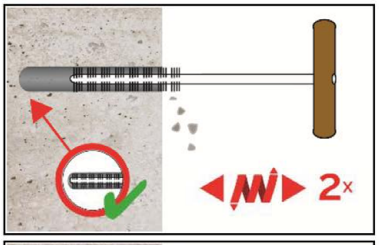

2c. Finally blow the hole clean again with a hand pump (Annex B 5) a minimum of four times. If the bore hole ground is not reached an extension shall be used

**CAC: Cleaning for all bore hole diameter and bore hole depth with drilling method HD and CD**

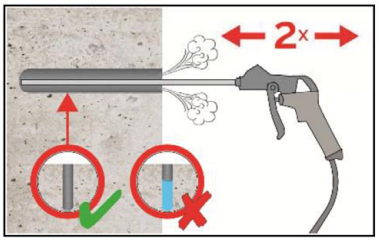



**Attention! Standing water in the bore hole must be removed before cleaning.**

2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 5) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used




2b. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension shall be used.




2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 5) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.

**After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar.**

| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 8** |
|---|---|
| **Intended use**<br>Installation instruction: Bore hole cleaning (HD and CD) | |

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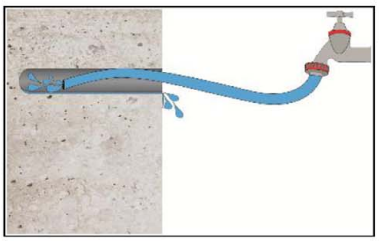
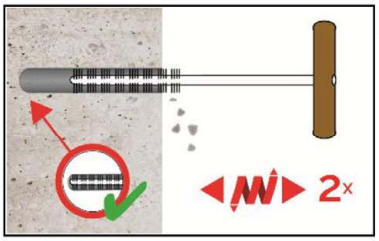
## B2) Bore hole cleaning (DD)

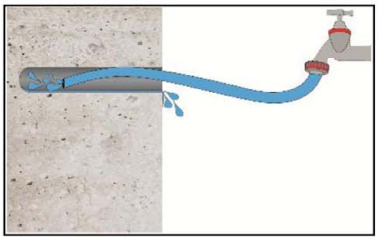
**SPCAC: Cleaning for all bore hole diameter and bore hole depth with drilling method DD**



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

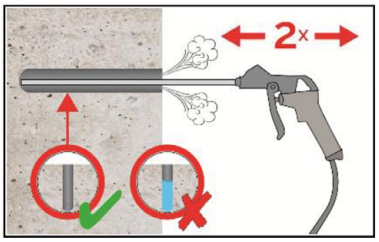



2b. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.

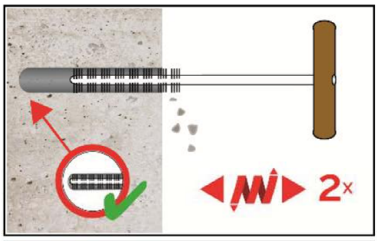


2c. Rinsing again with water until clear water comes out.

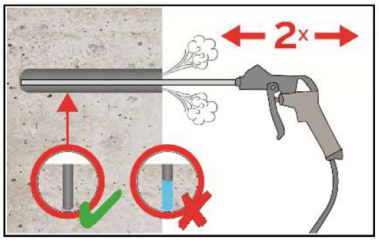
**Attention! Standing water in the bore hole must be removed before cleaning.**




2d. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 5) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used




2e. Check brush diameter (Table B5). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B5) a minimum of two times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension shall be used.




2f. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 5) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension shall be used.

**After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar.**

| **Chemofast Injection System EP 1000 for rebar connection** | **Annex B 9** |
|---|---|
| **Intended use**<br>Installation instruction: Bore hole cleaning (DD) | |

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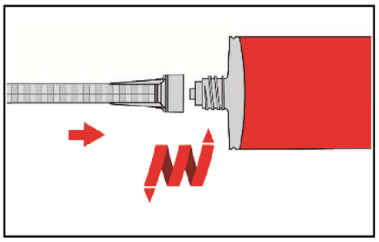
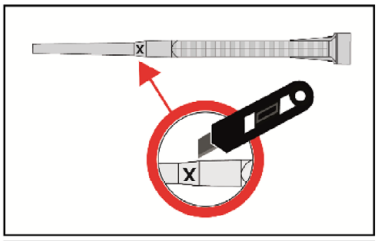
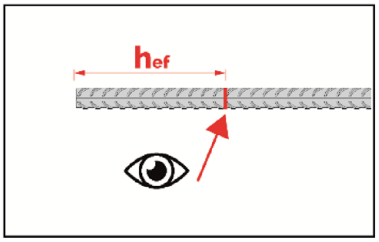
## C) Preparation of bar and cartridge



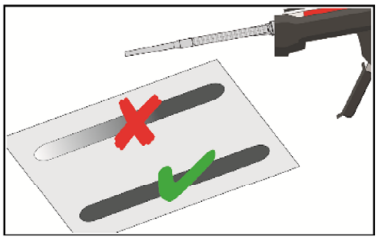
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.
For every working interruption longer than the recommended working time (Table B3) as well as for every new cartridges, a new static-mixer shall be used.




3a. In case of using the mixer extension VL16/1,8, the tip of the mixer nozzle has to be cut off at position „X".

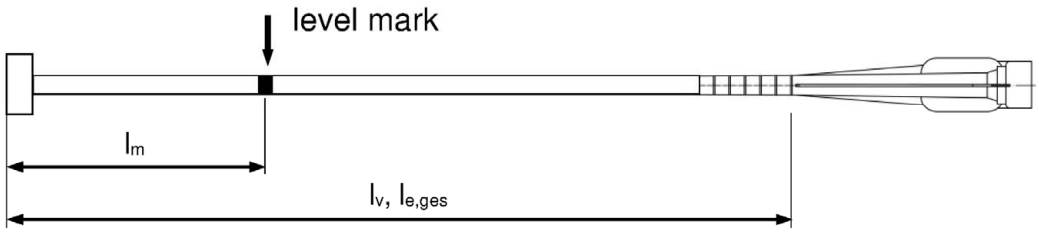



4. Prior to inserting the reinforcing bar into the filled bore hole, the position of the embedment depth shall be marked (e.g. with tape) on the reinforcing bar and insert bar in empty hole to verify hole and depth $l_v$.
The reinforcing bar should be free of dirt, grease, oil or other foreign material.



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

## D) Filling the bore hole




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: $l_m = 1/3 \cdot l_v$
Continue injection until the mortar level mark $l_m$ becomes visible.
Optimum mortar volume:

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

**Chemofast Injection System EP 1000 for rebar connection**

**Intended Use**
Installation instruction: Preparation of bar and cartridge
Filling the bore hole

**Annex B 10**

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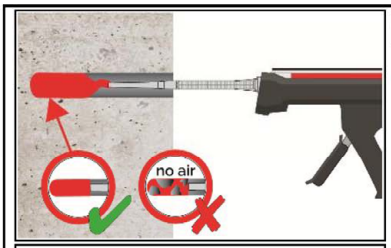
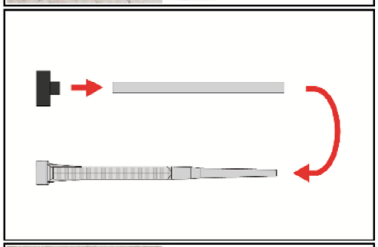
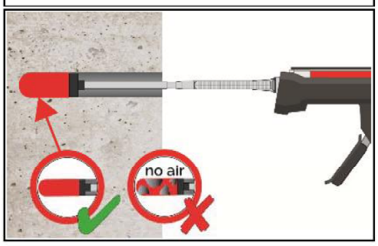



6a. Starting from the bottom or back of the cleaned bore hole fill the hole with adhesive, until the level mark at the mixer extension is visible at the top of the hole. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Slowly withdraw the static mixing nozzle and using a piston plugs during injection of the mortar, helps to avoid creating air pockets. Observe the gel-/ working times given in Table B3.



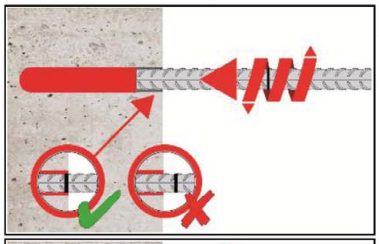
6b. Piston plugs shall be used according to Table B5 or B6 for the following applications:
- For overhead and horizontal installation
- In vertical downwards direction with bore holes deeper than 250 mm

Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.



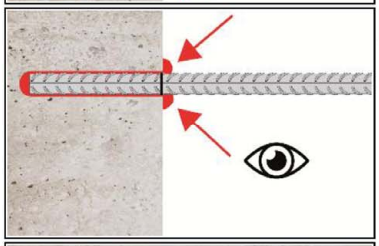

6c. Insert piston plug to back of the hole and inject adhesive. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used.
During injection the piston plug will be naturally extruded out of the drill hole by the adhesive pressure. Observe the gel-/ working times given in Table B3.

## E) Setting the rebar

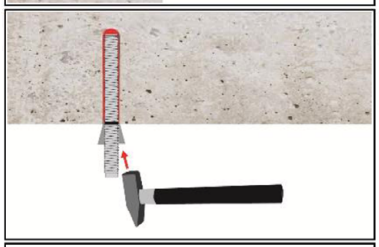


7. Push the reinforcing bar into the bore hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

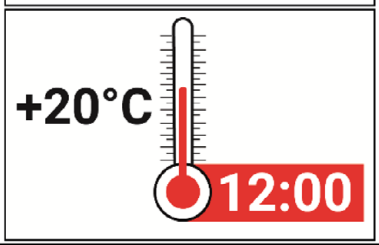
The reinforcing bar should be free of dirt, grease, oil or other foreign material.



8. Be sure that the bar is inserted in the bore hole until the embedment mark is at the concrete surface and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed.



8a. For horizontal and overhead installation fix embedded part (e.g. with wedges) until the mortar has started to harden.




9. Observe gelling and curing time in Table B3.
Slightly adjustment of the reinforcing bar within the gelling time $t_{gel}$ is possible. After the time $t_{cure,ini}$ has elapsed, the installation of the connecting reinforcement and the formwork can be continued. The full load to the reinforcing bar may be applied after the full curing time $t_{cure}$ has elapsed. Attend that the gelling and curing time can vary according to the base material temperature.

**Chemofast Injection System EP 1000 for rebar connection**

**Intended Use**
Installation instruction: Inserting rebar

**Annex B 11**

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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 1992-1-1:2004+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 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 40 mm<br>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 40 mm<br>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 1992-1-1:2004+AC:2010.

$k_b$, $k_{b,100y}$: 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<br>ZA-M12 to ZA-M24 | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 4,0 | 4,3 |
| 34 mm | 1,6 | 2,0 | 2,3 | 2,6 | 2,9 | 3,3 | 3,6 | 3,9 | 4,2 |
| 36 mm | 1,5 | 1,9 | 2,2 | 2,6 | 2,9 | 3,3 | 3,6 | 3,8 | 4,1 |
| 40 mm | 1,5 | 1,8 | 2,1 | 2,5 | 2,8 | 3,1 | 3,4 | 3,7 | 4,0 |

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**Performances**

Amplification factor $\alpha_{lb} = \alpha_{lb,100y}$, Reduction factor $k_b = k_{b,100y}$,
Design values of ultimate bond resistance $f_{bd,PIR} = f_{bd,PIR,100y}$

**Annex C 1**

Deutsches Institut für Bautechnik 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 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 40 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 class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ϕ | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| 10 to 40 mm | No parameter 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 C6

| Rebar | Concrete class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ϕ | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| 10 to 32 mm | No parameter assessed | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 4,0 | 4,3 |
| 34 mm | | 2,0 | 2,3 | 2,6 | 2,9 | 3,3 | 3,6 | 3,9 | 4,2 |
| 36 mm | | 1,9 | 2,2 | 2,6 | 2,9 | 3,3 | 3,6 | 3,8 | 4,1 |
| 40 mm | | 1,8 | 2,1 | 2,5 | 2,8 | 3,1 | 3,4 | 3,7 | 4,0 |

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**Performances**

Amplification factor $\alpha_{lb,seis} = \alpha_{lb,seis,100y}$, Reduction factor $k_{b,seis} = k_{b,seis,100y}$, Design values of ultimate bond resistance $f_{bd,PIR,seis} = f_{bd,PIR,seis,100y}$

**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 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: $\theta \le 278°C$: $k_{fi}(\theta) = 4673{,}8 \cdot \theta^{-1{,}598} / (f_{bd,PIR} \cdot 4{,}3) \le 1{,}0$

$\theta > 278°C$: $k_{fi}(\theta) = 0$

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

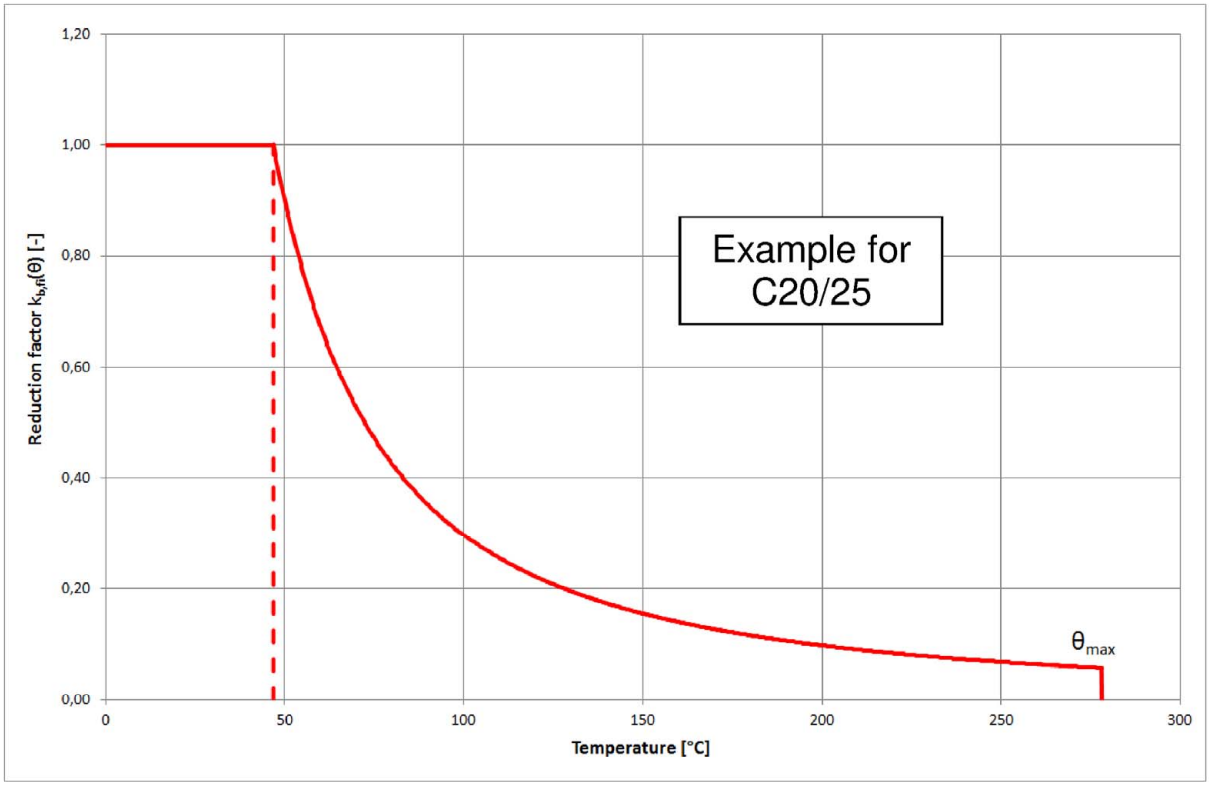
with: $\theta \le 278°C$: $k_{fi,100y}(\theta) = 4673{,}8 \cdot \theta^{-1{,}598} / (f_{bd,PIR,100y} \cdot 4{,}3) \le 1{,}0$

$\theta > 278°C$: $k_{fi,100y}(\theta) = 0$

| | |
|---|---|
| $f_{bd,fi}$, $f_{bd,fi,100y}$ | Design value of the ultimate bond stress at increased temperature in N/mm² |
| $\theta$ | 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 C4 considering the concrete classes, the rebar diameter, the drilling method and the bond conditions according to EN 1992-1-1:2004+AC:2010. |
| $\gamma_c$ | = 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 calculated 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 $k_{fi}(\theta)$, $k_{fi,100y}(\theta)$ for concrete classes C20/25 for good bond conditions:




**Chemofast Injection System EP 1000 for rebar connection**

**Performances**
Design value of ultimate bond stress $f_{bd,fi}$, $f_{bd,fi,100y}$ at increased temperature

**Annex C 3**

Deutsches Institut für Bautechnik DIBt

**Table C8: Characteristic tension resistance for tension anchor ZA under fire exposure,** concrete classes C12/15 to C50/60, according to EN 1992-4:2018

| **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 |