...eine starke Verbindung

# PRESTANDADEKLARATION

DoP Nr: **MKT-540** - sv

✧ **Produkttypens unika identifikationskod:** **Insprutningssystem VMH för efterföljande rebar anslutning**

✧ **Avsedd användning/avsedda användningar:** System för efterföljande rebar anslutning, se bilaga/Annex B

✧ **Tillverkare:** MKT Metall-Kunststoff-Technik GmbH & Co.KG
Auf dem Immel 2
67685 Weilerbach

✧ **System för bedömning och fortlöpande kontroll av prestanda:** 1

✧ **Europeiskt bedömningsdokument:** **EAD 330087-00-0601**
Europeisk teknisk bedömning: **ETA-17/0715, 18.07.2018**
Tekniskt bedömningsorgan: DIBt, Berlin
Anmält/anmälda organ: NB 1343 – MPA, Darmstadt

✧ **Angiven prestanda:**

| Väsentliga egenskaper | Prestanda |
|---|---|
| **Bärförmåga, stadga och beständighet (BWR1)** | |
| Karakteristiska resistanser för statiska och kvasi-statiska belastningar | Bilaga/Annex C1 |
| **Säkerhet vid brand (BWR2)** | |
| Brandegenskaper | Klass A1 |
| Brandmotstånd | Bilaga/Annex C2 – C3 |

Prestandan för ovanstående produkt överensstämmer med den angivna prestandan. Denna prestandadeklaration har utfärdats i enlighet med förordning (EU) nr 305/2011 på eget ansvar av den tillverkare som anges ovan.

Undertecknad på tillverkarens vägnar av:

**Stefan Weustenhagen**
(Verkställande direktör)
**Weilerbach, 18.07.2018**

p.p.
**Dipl.-Ing. Detlef Bigalke**
(Produktutveckling direktör)

Originalen av denna deklarationsförklaring skrevs på tyska. Vid avvikelser i översättningen gäller den tyska versionen.

## Specifications of intended use

**Anchorages subject to:**

| **Rebar** | **∅8** | **∅10** | **∅12** | **∅14** | **∅16** | **∅20** | **∅22** | **∅24** | **∅25** | **∅28** | **∅32** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Static or quasi static action | ✓ | | | | | | | | | | |
| Fire exposure | ✓ | | | | | | | | | | |

| **Tension anchor ZA** | **M12** | **M16** | **M20** | **M24** |
|---|---|---|---|---|
| Static or quasi static action | ✓ | | | |
| Fire exposure | ✓ | | | |

**Base material:**

- Reinforced or unreinforced normal weight concrete acc. to EN 206-1:2000
- Strength classes C12/15 to C50/60 acc. to EN 206-1:2000
- Maximum chloride concrete of 0,40 % (CL 0,40) related to the cement content acc. to EN 206-1:2000
- Non-carbonated concrete

  Note: In case of a carbonated surface of the existing concrete structure the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of ∅ + 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.

**Temperature range:**

- \- 40 °C to +80 °C (max. short term temperature +80 °C and max. long term temperature +50 °C)

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions (zinc plated steel, stainless steel or high corrosion resistant steel)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel or high corrosion resistant steel)
- Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions exist (high corrosion resistant steel)

  Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used)

## Specifications of intended use

**Design:**

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work
- Anchorages are designed in accordance with EN 1992-1-1:2004+AC:2010, EN1992-1-2:2004+AC:2008 and Annex B3 and B4
- 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

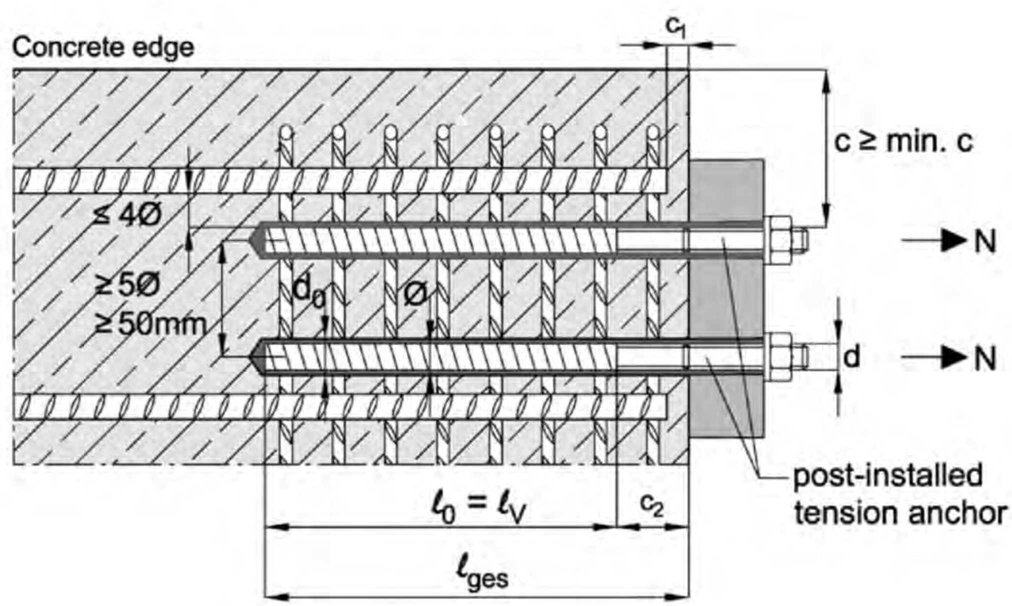
**Installation:**

- Dry or wet concrete
- Installation in water filled bore holes is not admissible
- Overhead installation admissible
- Hole drilling by hammer drill, vacuum drill or compressed air drill
- 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)
- The joints for concreting must be roughened to at least such an extent that aggregate protrude
- The installation of post-installed rebar or tension anchor ZA 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
- Minimum concrete cover acc. to EN 1992-1-1:2004+AC:2010 must be observed

## General construction rules for tension anchor ZA

- The length for the post-installed thread must not be added to the anchoring length
- The tension anchor ZA can only transfer forces towards the bar axis
- Tension forces must be transferred by an overlap joint into the present reinforcement of the member
- The transmission of shear forces must be ensured by additional measures, e.g. by shear cleats or anchors with an European Technical Assessment (ETA)
- In the anchor plate the holes for the tension anchors must be executed as elongated holes with axis in the direction of the shear force
- If the clear distance of overlapping bars is greater than 4Ø, the lap length must be increased by a length equal to the clear space where it exceeds 4Ø

**Figure B1: Tension Anchor ZA**

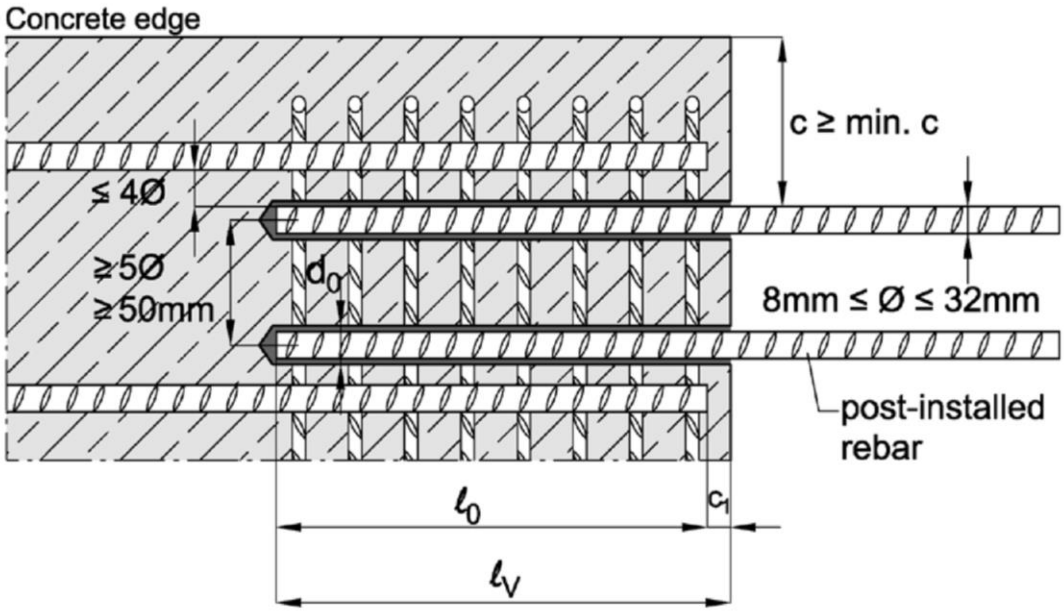



| | |
|---|---|
| c | concrete cover of tension anchor ZA |
| $c_1$ | concrete cover at front end of cast-in-place rebar |
| $c_2$ | Length of bonded thread |
| min c | minimum concrete cover according Table B1 and EN 1992-1-1:2004+AC:2010 |
| Ø | diameter of tension anchor (rebar part) |
| d | diameter of tension anchor (threaded part) |
| $\ell_0$ | lap length acc. to EN 1992-1-1:2004+AC:2010 |
| $\ell_v$ | embedment depth $\ell_v \geq \ell_0 + c_1$ |
| $\ell_{ges}$ | overall embedment depth $\ell_{ges} \geq \ell_0 + c_2$ |
| $d_0$ | nominal drill bit diameter according Annex B6, to Table B4 |

## General construction rules for post-installed rebars

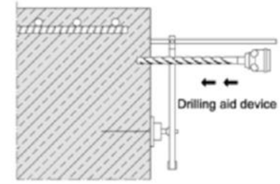
- The shear transfer between old and new concrete shall be designed acc. to EN 1992-1-1:2004+AC:2010
- Only tension forces in the axis of the rebar may be transmitted
- If the clear distance of overlapping bars is greater than 4Ø, the lap length must be increased by a length equal to the clear space where it exceeds 4Ø

**Figure B2: Post-installed rebars**




| | |
|---|---|
| c | concrete cover of post-installed rebar |
| $c_1$ | concrete cover at front end of cast-in-place rebar |
| min c | minimum concrete cover according Table B1 and EN 1992-1-1:2004+AC:2010 |
| Ø | diameter of tension anchor (rebar) |
| $\ell_0$ | lap length acc. to EN 1992-1-1:2004+AC:2010 |
| $\ell_v$ | embedment depth $\ell_v \geq \ell_0 + c_1$ |
| $d_0$ | nominal drill bit diameter according to Annex B6, Table B4 |

## Table B1: Minimum concrete cover min c[1)] of post-installed rebar and tension anchor ZA depending on drilling method




| Drilling method | Rod diameter | min c (without drilling aid device) | min c (with drilling aid device) |
|---|---|---|---|
| **Hammer drilling Vacuum drilling** | < 25 mm | 30 mm + 0,06 $\ell_v$ ≥ 2 Ø | 30 mm + 0,02 $\ell_v$ ≥ 2 Ø |
| | ≥ 25 mm | 40 mm + 0,06 $\ell_v$ ≥ 2 Ø | 40 mm + 0,02 $\ell_v$ ≥ 2 Ø |
| **Compressed air drilling** | < 25 mm | 50 mm + 0,08 $\ell_v$ | 50 mm + 0,02 $\ell_v$ |
| | ≥ 25 mm | 60 mm + 0,08 $\ell_v$ | 60 mm + 0,02 $\ell_v$ |

[1)] See Annex B3 and B4; Minimum concrete cover acc. to EN 1992-1-1:2004+AC:2010 must be observed

## Table B2: Dimensions and installation parameters of tension anchor ZA

| Anchor size | | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|
| Thread diameter | | d | [mm] | 12 | 16 | 20 | 24 |
| Rebar diameter | | ∅ | [mm] | 12 | 16 | 20 | 25 |
| Cross section area (threaded part) | | $A_s$ | [$mm^2$] | 84 | 157 | 245 | 353 |
| Width across nut flats | | SW | [mm] | 19 | 24 | 30 | 36 |
| Effective embedment depth | | $\ell_v$ | [mm] | according to static calculation | | | |
| Length of bonded thread | steel, zinc plated | $c_2$ | [mm] | ≥ 20 | ≥ 20 | ≥ 20 | ≥ 20 |
| | A4/HCR | | | ≥ 100 | ≥ 100 | ≥ 100 | ≥ 100 |
| Maximum installation torque | | $T_{inst}$ | [Nm] | 50 | 100 | 150 | 150 |

## Table B3: Working and curing time

| Bore hole temperature | | | Working time | Minimum curing time | |
|---|---|---|---|---|---|
| | | | | dry concrete | wet concrete |
| - 5 °C | to | - 1 °C | 50 min | 5 h | 10 h |
| 0 °C | to | + 4 °C | 25 min | 3,5 h | 7 h |
| + 5 °C | to | + 9 °C | 15 min | 2 h | 4 h |
| + 10 °C | to | + 14 °C | 10 min | 1 h | 2 h |
| + 15 °C | to | + 19 °C | 6 min | 40 min | 80 min |
| + 20 °C | to | + 29 °C | 3 min | 30 min | 60 min |
| + 30 °C | to | + 40 °C | 2 min | 30 min | 60 min |
| Cartridge temperature | | | +5°C to +40°C | | |

## Table B4: Drilling and cleaning

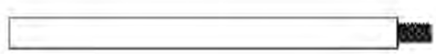
| Rebar Ø | Tension anchor ZA | Drill bit diameter | Brush diameter | |
|---|---|---|---|---|
| | | | Brush- Ø | min. Brush- Ø |
| | | $d_0$ | $d_b$ | $d_{b,min}$ |
| [mm] | [-] | [mm] | [mm] | [mm] |
| 8 | | 12 | 14 | 12,5 |
| 10 | | 14 | 16 | 14,5 |
| 12 | M12 | 16 | 18 | 16,5 |
| 14 | | 18 | 20 | 18,5 |
| 16 | M16 | 20 | 22 | 20,5 |
| 20 | M20 | 25 | 27 | 25,5 |
| 22 | | 28 | 30 | 28,5 |
| 24 | | 32 | 34 | 32,5 |
| 25 | M24 | 32 | 34 | 32,5 |
| 28 | | 35 | 37 | 35,5 |
| 32 | | 40 | 43 | 40,5 |

**Compressed air hose (min. 6 bar) with air valve**

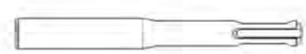
**Recommended compressed air tool (min. 6 bar)**

**Brush RB**

**Brush extension**



**SDS Plus Adapter**



**Retaining washer VM-IA**

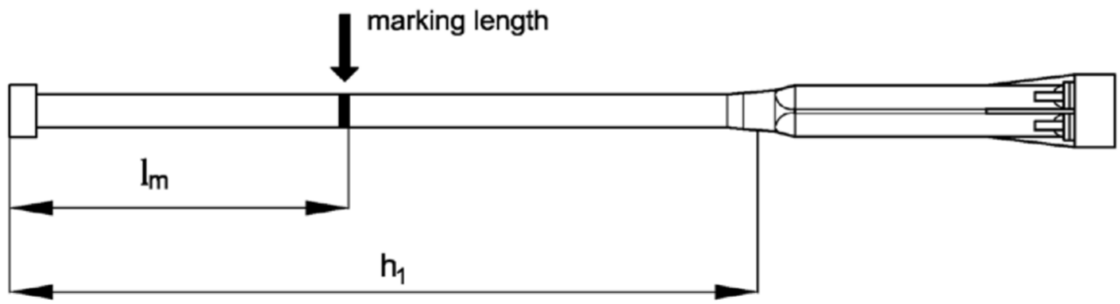
**Extension pipe**

**Static mixer**

**Table B5: Installation tools and max. embedment depth**

<table>
<tr><th rowspan="2">Rebar Ø</th><th rowspan="2">Tension anchor ZA</th><th rowspan="2">Drill bit diameter $d_0$</th><th rowspan="4">Retaining washer[1)]</th><th colspan="4">Cartridges: all formats</th><th colspan="2">Cartridge: side-by-side (825 ml)</th></tr>
<tr><th colspan="2">Hand- or akku-tool</th><th colspan="2">Compressed air tool</th><th colspan="2">Compressed air tool</th></tr>
<tr><th rowspan="2">[mm]</th><th rowspan="2">[-]</th><th rowspan="2">[mm]</th><th>$\ell_{v,max}$</th><th rowspan="2">Extension pipe</th><th>$\ell_{v,max}$</th><th rowspan="2">Extension pipe</th><th>$\ell_{v,max}$</th><th rowspan="2">Extension pipe</th></tr>
<tr><th>[cm]</th><th>[cm]</th><th>[cm]</th></tr>
<tr><td>8</td><td></td><td>12</td><td>-</td><td rowspan="5">70</td><td rowspan="3">VM-XE 10</td><td>80</td><td rowspan="3">VM-XE 10</td><td>80</td><td rowspan="3">VM-XE 10</td></tr>
<tr><td>10</td><td></td><td>14</td><td>VM-IA 14</td><td rowspan="4">100</td><td>100</td></tr>
<tr><td>12</td><td>M12</td><td>16</td><td>VM-IA 16</td><td>120</td></tr>
<tr><td>14</td><td></td><td>18</td><td>VM-IA 18</td><td rowspan="8">VM-XE 10<br>VM-XLE 16</td><td rowspan="8">VM-XE 10<br>VM-XLE 16</td><td>140</td><td rowspan="8">VM-XLE 16</td></tr>
<tr><td>16</td><td>M16</td><td>20</td><td>VM-IA 20</td><td>160</td></tr>
<tr><td>20</td><td>M20</td><td>25</td><td>VM-IA 25</td><td rowspan="6">50</td><td rowspan="2">70</td><td rowspan="4">200</td></tr>
<tr><td>22</td><td></td><td>28</td><td>VM-IA 28</td></tr>
<tr><td>24</td><td></td><td>32</td><td>VM-IA 32</td><td rowspan="4">50</td></tr>
<tr><td>25</td><td>M24</td><td>32</td><td>VM-IA 32</td></tr>
<tr><td>28</td><td></td><td>35</td><td>VM-IA 35</td><td rowspan="2">200</td></tr>
<tr><td>32</td><td></td><td>40</td><td>VM-IA 40</td></tr>
</table>

1) For horizontal or overhead installation as well as for drill holes deeper than 240mm




On the static mixer and the extension pipe the mortar filling mark $l_m$ and the drill hole depth $h_1$ must be marked with an adhesive tape or text marker. Rough estimate: $l_m = \frac{1}{3} \cdot h_1$

Fill in the mortar as long until the filling mark $l_m$ will be visible.

Optimal mortar volume: $l_m = h_1 * (1{,}2 * \frac{\varnothing^2}{d_0^2} - 0{,}2)$ [mm]

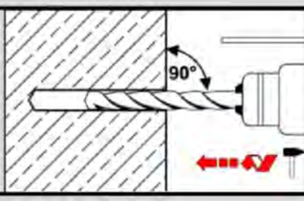
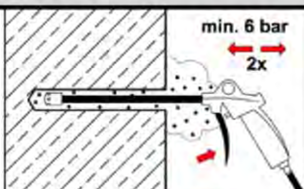
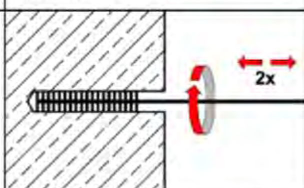
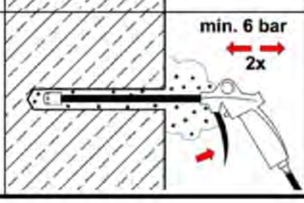
$l_m$ Length from the end of the retaining washer to the mark on the mixer extension
$h_1$ drill hole depth = embedment depth $\ell_v$ resp. $\ell_{ges}$)
Ø rebar diameter
$d_o$ nominal drill bit diameter

**Table B6: Dispensing tools**

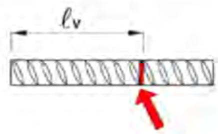
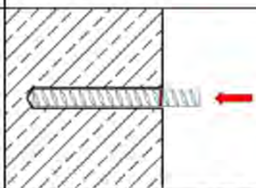
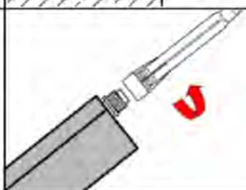
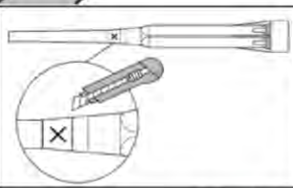
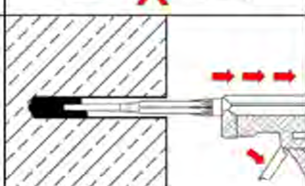
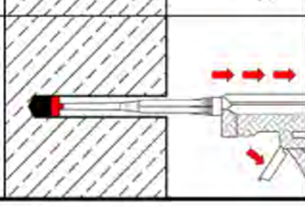
| Cartridge Type | Cartridge Size | Hand tool | | Pneumatic tool |
|---|---|---|---|---|
| coaxial | 150, 280, 333 ml | e.g.: VM-P 330 | | e.g.: VM-P 345 Pneumatic |
| coaxial | 380 to 420 ml | e.g.: VM-P 380 Standard | e.g.: VM-P 380 Profi | e.g.: VM-P 380 Pneumatic |
| side-by-side | 235, 345 ml | e.g.: VM-P 345 Standard | e.g.: VM-P 345 Profi | e.g.: VM-P 345 Pneumatic |
| side-by-side | 825 ml | - | - | e.g.: VM-P 825 Pneumatic |

All cartridges can also be extruded by battery tool (e.g. VM-P Akku)

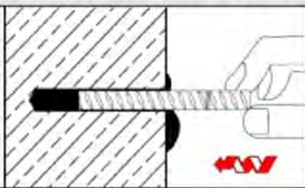
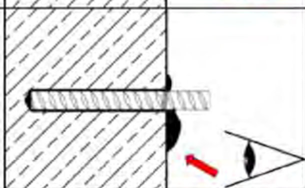
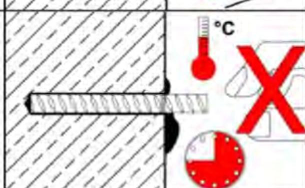
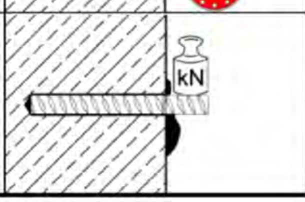
## Installation instructions

| | | | |
|---|---|---|---|
| **Bore hole drilling** | | | |
| **1.** | |  | Drill hole by hammer drilling, vacuum drilling or compressed air drilling (with drill bit diameter according to Annex B7 and selected embedment depth).<br>In case of aborted holes, the bore holes must be filled with mortar. |
| **Cleaning** | | | |
| **2.** | 2a. |  | Starting from the bottom or back of the bore hole, blow out the hole with compressed air (min. 6 bar) (Annex B6) a minimum of **two** times until return air stream is free of noticeable dust.<br>If the bore hole ground is not reached, an extension must be used. |
| | 2b. |  | Brush the hole with an appropriate sized wire brush $\geq d_{b,min}$ (Table B4, check minimum brush diameter $d_{b,min}$) a minimum of **two** times with rotary motion.<br>If the bore hole ground is not reached, a brush extension must be used. |
| | 2c. |  | Starting from the bottom or back of the bore hole, blow out the hole with compressed air (min. 6 bar) again a minimum of **two** times until return air stream is free of noticeable dust.<br>If the bore hole ground is not reached, an extension must be used. |

## Installation instruction (continuation)

| Preparing and injection into borehole | | |
|---|---|---|
| 5 |  | Mark the position of the embedment depth $\ell_v$ on the rebar. |
| 6 |  | Check drill hole depth by inserting rebar or anchor rod into the empty hole. |
| 7 |  | Prepare cartridge with static mixer (if necessary with extension pipe and retaining washer). Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool (Table B6).<br>For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used. |
| 7a |  | When extension pipe VM-XLE 16 is used, the tip of the mixer has to be cut off at position „X“. |
| 8 |  | Prior to applying, discard mortar (forerun) until the mortar shows a consistent grey colour, but at least three full strokes. Never use this mortar! |
| 9 |  | Fill in injection mortar from the bottom of the clean borehole approx 2/3 air bubble free. Slowly moving the static mixer out of the borehole prevents the formation of air inclusions. For embedment larger than 190mm an extension pipe (Annex B6) must be used.<br>Observe the working- and curing time given in table B3. |
| 10 |  | For overhead and horizontal installation and embedment larger than 240mm a retaining washer shall be used.<br>Observe the working- and curing time given in table B3. |

## Installation instruction (continuation)

| Installation of rebar or tension anchor | | |
|---|---|---|
| 11 |  | Immediately insert the rebar or tension anchor into the hole while turning slightly until the embedment depth is reached.<br>The bar shall be free of dirt, grease and oil. |
| 12 |  | Excess injection mortar must exceed from the borehole, the annular gap shall be filled completely with mortar. If no mortar exceeds, these requirements are not maintained and the application has to be renewed.<br>For overhead installation fix embedment part (e.g. wedges). |
| 13 |  | Ensure the curing time of the injection mortar according to table B3.<br>Attention: the working time may vary due to different underground temperatures (Table B3).<br>Do not move or load the anchor or rebar until curing time. |
| 14 |  | After the curing time (Table B3) the threaded rod or reinforcing bar can be load. |

## Minimum anchorage length and minimum lap length

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

**Table C1: Amplification factor $a_{lb}$ depending on concrete strength class and drilling method**

| Concrete strength class | Drilling method | Rod diameter | Amplification factor $\alpha_{lb}$ [-] |
|---|---|---|---|
| C12/15 to C50/60 | hammer drilling<br>vacuum drilling<br>compressed air drilling | Ø8 to Ø32<br>ZA-M12 to ZA-M24 | 1,0 |

**Table C2: Reduction factor $k_b$ for all drilling methods**

| Rod diameter | | Concrete strength class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| Ø8 to Ø32<br>ZA-M12 to ZA-M24 | $k_b$<br>[-] | 1,0 | | | | | | | | |

**Table C3: Design values of the ultimate bond stress $f_{bd,PIR}$ in N/mm² for all drilling methods and for good bond conditions**

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

with

$f_{bd}$: Design value of the ultimate bond stress in N/mm² considering the concrete strength classes and the rebar diameter according to EN 1992-1-1:2004+AC:2010
(for all other bond conditions multiply the values by 0,7)

$k_b$: Reduction factor according to Table C2

| Rod diameter | | Concrete strength class | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | C12/15 | C16/20 | C20/25 | C25/30 | C30/37 | C35/45 | C40/50 | C45/55 | C50/60 |
| Ø8 to Ø32<br>ZA-M12 to ZA-M24 | $f_{bd,PIR}$<br>[N/mm²] | 1,6 | 2,0 | 2,3 | 2,7 | 3,0 | 3,4 | 3,7 | 4,0 | 4,3 |

## Design value of ultimate bond stress $f_{bd,fi}$ under fire exposure for concrete classes C12/15 to C50/60 (all drilling methods):

The design value of ultimate bond stress $f_{bd,fi}$ under fire exposure will be calculated by the following equation:

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

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

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

| | |
|---|---|
| $f_{bd,fi}$ | design value of ultimate bond stress in case of fire in N/mm² |
| $\theta$ | Temperature in °C in the mortar layer |
| $k_{fi}(\theta)$ | Reduction factor under fire exposure |
| $f_{bd,PIR}$ | Design value of the ultimate bond stress in N/mm² in cold condition according to Table C2 considering concrete class, rebar diameter, drilling method and the bond conditions according to EN 1992-1-1:2004+AC:2010. |
| $\gamma_c$ | partial factor acc. to EN 1992-1-1:2004+AC:2010 |
| $\gamma_{M,fi}$ | partial factor acc. to EN 1992-1-2:2004+AC:2008 |

For evidence under fire exposure the anchorage length shall be calculated according to EN 1992-1-1:2004+AC:2010 Equation 8.3 using the temperature-dependent ultimate bond stress $f_{bd,fi}$.

**Figure C1: Example graph of reduction factor $k_{fi}(\theta)$**
Concrete strength class C20/25 for good bond conditions

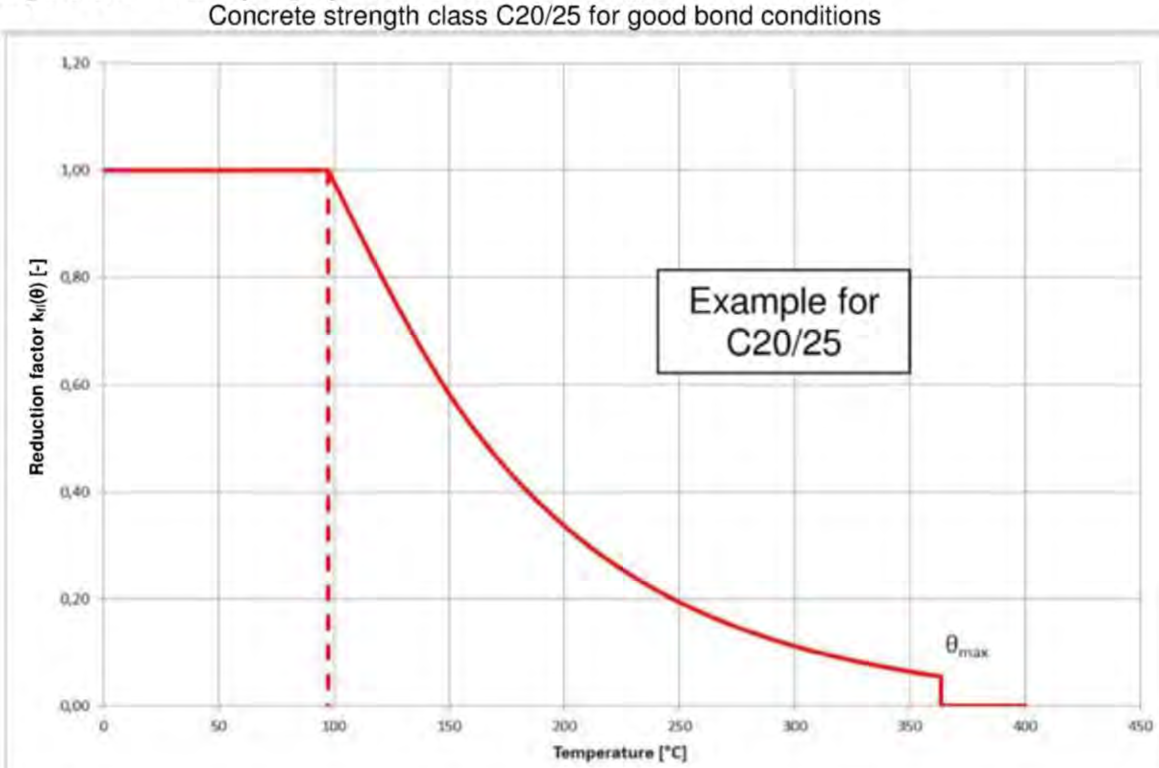


**Table C4: Characteristic tension strength in case of fire for tension anchor ZA,**
concrete strength class C12/15 to C50/60, acc. to Technical Report TR 020

| Tension anchor ZA | | | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|---|---|
| **Steel failure** | | | | | | | |
| **Steel, zinc plated** | | | | | | | |
| Characteristic tension strength | R30 | $\sigma_{Rk,s,fi}$ | [N/mm²] | 20 | | | |
| | R60 | | | 15 | | | |
| | R90 | | | 13 | | | |
| | R120 | | | 10 | | | |
| **Stainless steel A4, HCR** | | | | | | | |
| Characteristic tension strength | R30 | $\sigma_{Rk,s,fi}$ | [N/mm²] | 30 | | | |
| | R60 | | | 25 | | | |
| | R90 | | | 20 | | | |
| | R120 | | | 16 | | | |

**Design value of the tension strength $\sigma_{Rd,s,fi}$ under fire exposure for tension anchor ZA**

The design value of the steel strength $\sigma_{Rd,s,fi}$ under fire exposure will be calculated by the following equation:

$$\sigma_{Rd,s,fi} = \sigma_{Rk,s,fi} / \gamma_{M,fi}$$

with:

$\sigma_{Rk,s,fi}$ characteristic steel strength acc. to Table C4
$\gamma_{M,fi}$ partial factor under fire exposure acc. to EN 1992-1-2:2004+AC:2008