...eine starke Verbindung

DÉCLARATION DES PERFORMANCES

DoP No **MKT-2.3-200_fr**

✧ **Code d'identification unique du produit type:** **Système à injection VMU plus pour liaison de ferraillage ultérieure**

✧ **Usage(s) prévu(s):** Systèmes pour les connexions de barres d'armature post-installées, voir l'annexe/Annex B

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

✧ **Système(s) d'évaluation et de vérification de la constance des performances:** 1

✧ **Document d'évaluation européen:** **EAD 330087-00-0601**
Évaluation technique européenne: **ETA-11/0514, 17.05.2018**
Organisme d'évaluation technique: DIBt, Berlin
Organisme(s) notifié(s): NB 2873 – Technische Universität Darmstadt

✧ **Performance(s) déclarée(s):**

Caractéristiques essentielles	Performances
Résistance mécanique et stabilité (BWR 1)	
Résistances caractéristiques pour les charges statiques et quasi-statiques	Annexe/Annex C1
Sécurité en cas d'incendie (BWR 2)	
Le comportement du feu	Classe A1
Résistance au feu	Annexe/Annex C2 – C3

Les performances du produit identifié ci-dessus sont conformes aux performances déclarées. Conformément au règlement (UE) no 305/2011, la présente déclaration des performances est établie sous la seule responsabilité du fabricant mentionné ci-dessus.

Signé pour le fabricant et en son nom par:

Stefan Weustenhagen
(Directeur général)
Weilerbach, 01.01.2021

p.p.
Dipl.-Ing. Detlef Bigalke
(Directeur du développement de produits)

L'original de cette déclaration d'exécution a été rédigé en allemand. En cas de divergences dans la traduction, la version allemande fait foi.

Specifications of intended use

Anchorages subject to:

Rebar	**Ø8**	**Ø10**	**Ø12**	**Ø14**	**Ø16**	**Ø20**	**Ø22**	**Ø24**	**Ø25**	**Ø28**	**Ø32**
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, EN 1992-1-2:2004+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

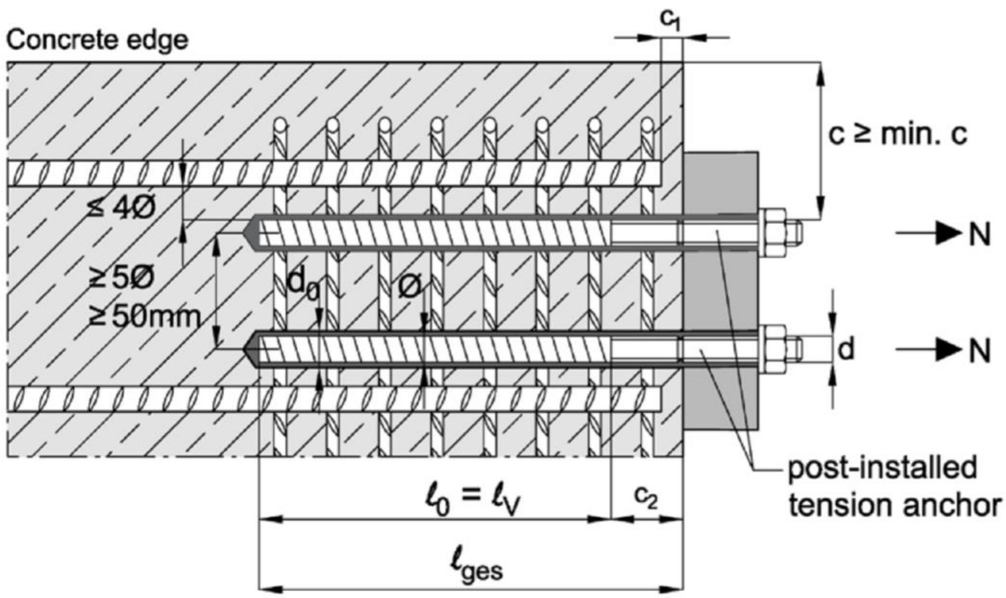
Installation:

- 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

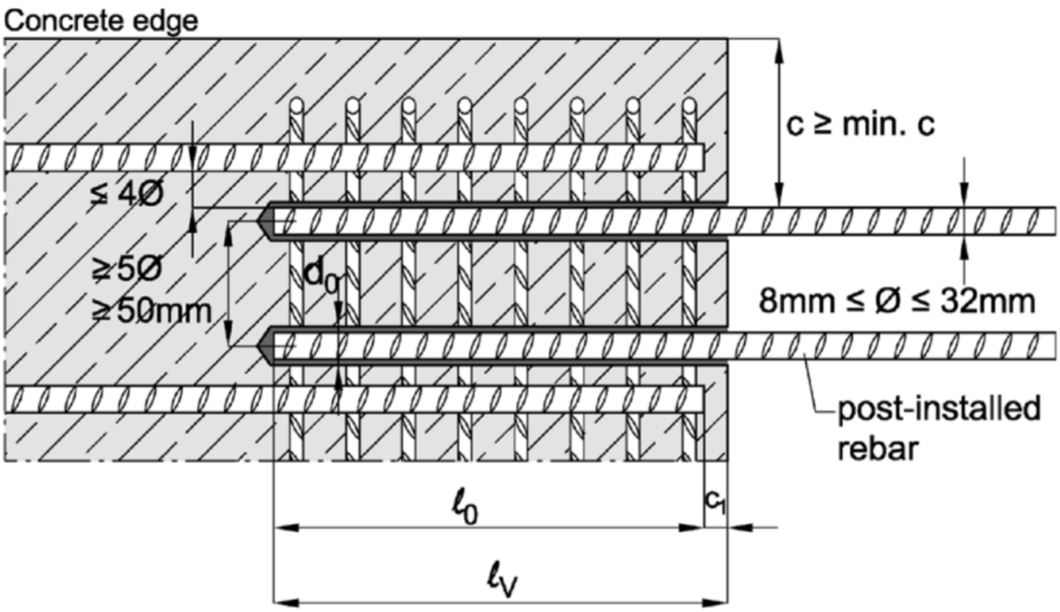


c	concrete cover of tension anchor ZA
c_1	concrete cover at front end of cast-in-place rebar
c_2	Length of bonded thread
min c	minimum concrete cover according Table B1 and EN 1992-1-1:2004+AC:2010
Ø	diameter of tension anchor (rebar part)
d	diameter of tension anchor (threaded part)
ℓ_0	lap length acc. to EN 1992-1-1:2004+AC:2010
ℓ_v	embedment depth $\ell_v \geq \ell_0 + c_1$
ℓ_{ges}	overall embedment depth $\ell_{ges} \geq \ell_0 + c_2$
d_0	nominal drill bit diameter according to Table B6

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)
ℓ_0	lap length acc. to EN 1992-1-1:2004+AC:2010
ℓ_v	embedment depth $\ell_v \geq \ell_0 + c_1$
d_0	nominal drill bit diameter according to Table B6

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 • $\ell_v \geq 2$ Ø	30 mm+ 0,02 • $\ell_v \geq 2$ Ø
	≥ 25 mm	40 mm+ 0,06 • $\ell_v \geq 2$ Ø	40 mm+ 0,02 • $\ell_v \geq 2$ Ø
Compressed air drilling	< 25 mm	50 mm+ 0,08 • ℓ_v	50 mm+ 0,02 • ℓ_v
	≥ 25 mm	60 mm+ 0,08 • ℓ_v	60 mm+ 0,02 • ℓ_v

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

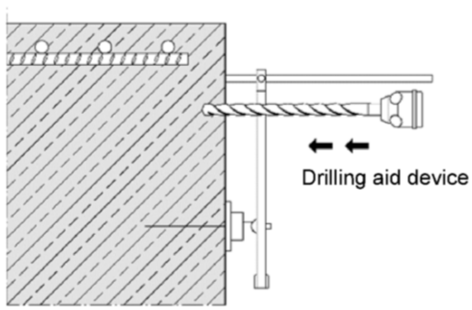


Table B2: Dimensions and installation parameters of tension anchor ZA

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	[mm²]	84	157	245	353
Width across nut flats		SW	[mm]	19	24	30	36
Effective embedment depth		ℓ_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	Cartridge temperature	Working time	Minimum curing time	
			dry concrete	wet concrete
-10°C to - 6°C	≥ +15°C	90 min	24 h	48 h
- 5°C to - 1°C	+5°C to +25°C	90 min	14 h	28 h
0°C to + 4°C		45 min	7 h	14 h
+ 5°C to + 9°C		25 min	2 h	4 h
+ 10°C to + 19°C		15 min	80 min	160 min
+ 20°C to + 24°C		6 min	45 min	90 min
+ 25°C to + 29°C		4 min	25 min	50 min
+ 30°C to + 40°C	≤ +20°C	2,5 min	15 min	30 min

Table B4: 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	e.g.: VM-P 380 Profi	e.g.: VM-P 380 Pneumatic
side-by-side	235, 345 ml	e.g.: VM-P 345	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)

Table B5: Drilling and cleaning

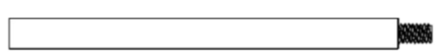
Rebar Ø	Tension anchor ZA	Drill bit diameter	Brush diameter	
			Brush- Ø	min. Brush- Ø
		d_0	d_b	$d_{b,min}$
[mm]	[-]	[mm]	[mm]	[mm]
8		12	14	12,5
10		14	16	14,5
12	M12	16	18	16,5
14		18	20	18,5
16	M16	20	22	20,5
20	M20	25	27	25,5
22		28	30	28,5
24		32	34	32,5
25	M24	32	34	32,5
28		35	37	35,5
32		40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

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

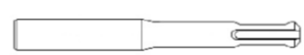
Recommended compressed air tool (min. 6 bar)

Brush RB

Brush extension

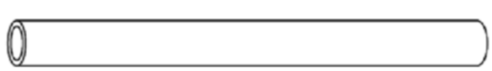


SDS Plus Adapter



Retaining washer VM-IA

Extension pipe



Static mixer

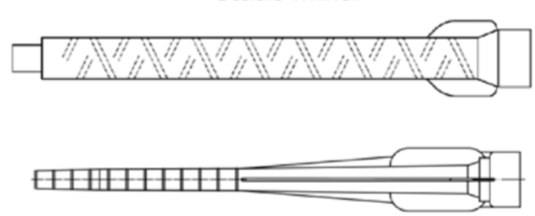
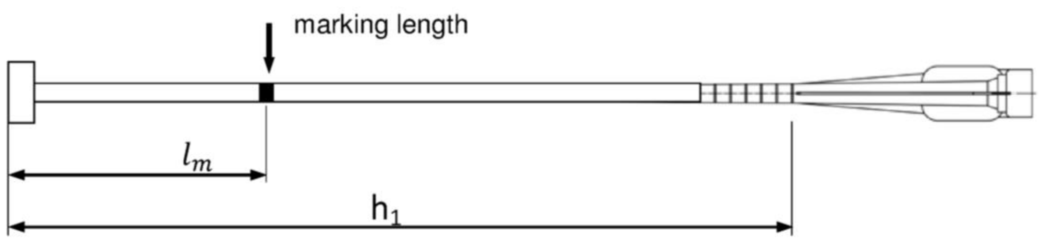


Table B6: Installation tools and max. embedment depth

<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="3">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>[mm]</th><th>[-]</th><th>[mm]</th><th>$\ell_{v,max}$ [cm]</th><th>Extension pipe</th><th>$\ell_{v,max}$ [cm]</th><th>Extension pipe</th><th>$\ell_{v,max}$ [cm]</th><th>Extension pipe</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
VM-XLE 16</td><td rowspan="8">VM-XE 10
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

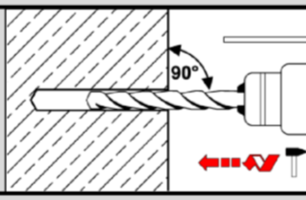
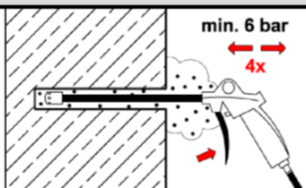
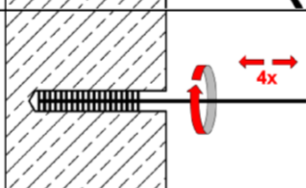
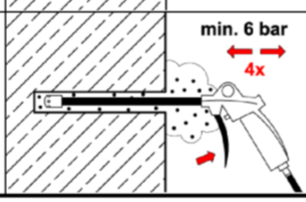


On the static mixer and the extension pipe the mortar filling mark l_m and the drill hole depth h_1 must be marked with an adhesive tape or text marker. Rough estimate: $l_m = \frac{1}{3} \cdot h_1$
Fill in the mortar as long until the filling mark l_m will be visible.

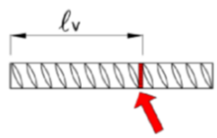
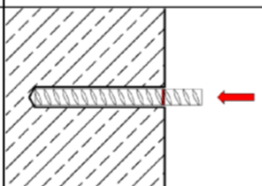
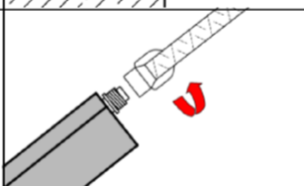
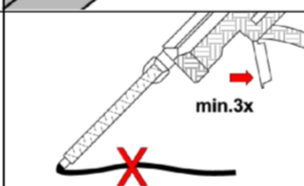
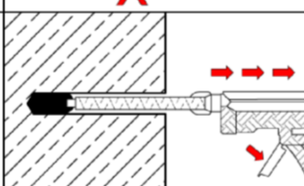
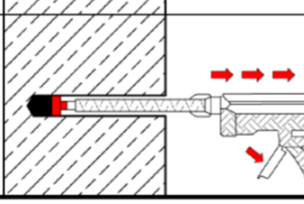
Optimal mortar volume: $l_m = h_1 * (1{,}2 * \frac{Ø^2}{d_0^2} - 0{,}2)$ [mm]

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

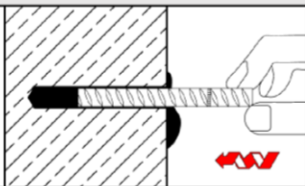
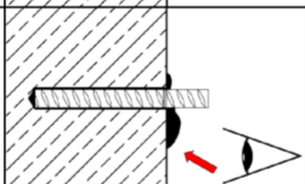
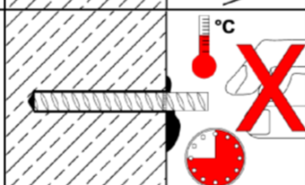
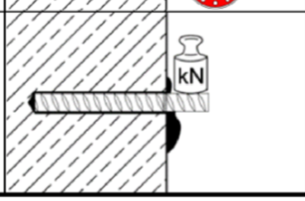
Installation instructions

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). 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 B7) a minimum of **four** times until return air stream is free of noticeable dust. If bore hole ground is not reached, an extension must be used.
	2b.		Brush the hole with an appropriate sized wire brush ≥ $d_{b,min}$ (Table B5, check minimum brush diameter $d_{b,min}$) a minimum of **four** times with rotary motion. If 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 **four** times until return air stream is free of noticeable dust. If bore hole ground is not reached, an extension must be used.

Installation instruction (continuation)

Preparing and injection into borehole		
3		Mark the position of the embedment depth on the rebar (e.g. with tape)
4		Check drill hole depth by inserting rebar or anchor rod into the empty hole.
5		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. 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.
6		Prior to applying, discard mortar (forerun) until the mortar shows a consistent grey colour, but at least three full strokes. Never use this mortar!
7		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 (Table B6) must be used.
8		For overhead and horizontal installation and embedment larger than 240mm a retaining washer shall be used.

Installation instruction (continuation)

Installation of rebar or tension anchor		
7		Immediately insert the rebar or tension anchor into the hole while turning slightly until the embedment depth is reached. The bar shall be free of dirt, grease and oil.
8		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. For overhead installation fix embedment part (e.g. wedges).
9		Ensure the curing time of the injection mortar according to table B3. Attention: the working time may vary due to different underground temperatures. Do not move or load the anchor or rebar until curing time.
10		After the curing time 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 α_{lb} acc. to Table C1.

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

Concrete strength class	Drilling method	Rod diameter	Amplification factor α_{lb} [-]
C12/15 to C50/60	hammer drilling vacuum drilling compressed air drilling	Ø8 to Ø32 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
∅8 to ∅25 ZA-M12 to ZA-M24	k_b [-]	1,0								
∅28 to ∅32	k_b [-]	1,0							0,92	0,86

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
∅8 to ∅25 ZA-M12 to ZA-M24	$f_{bd,PIR}$ [N/mm²]	1,6	2,0	2,3	2,7	3,0	3,4	3,7	4,0	4,3
∅28 to ∅32	$f_{bd,PIR}$ [N/mm²]	1,6	2,0	2,3	2,7	3,0	3,4	3,7	3,7	3,7

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: $\theta \leq 243°C$: $k_{fi}(\theta) = 18{,}88 * \theta^{(\theta * -0{,}016)} / (f_{bd,PIR} * 4{,}3) \leq 1{,}0$

$\theta > 243°C$: $k_{fi}(\theta) = 0$

$f_{bd,fi}$	design value of ultimate bond stress in case of fire in N/mm²
θ	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
γ_c	Partial factor EN 1992-1-1:2004+AC:2010
$\gamma_{M,fi}$	Partial factor 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

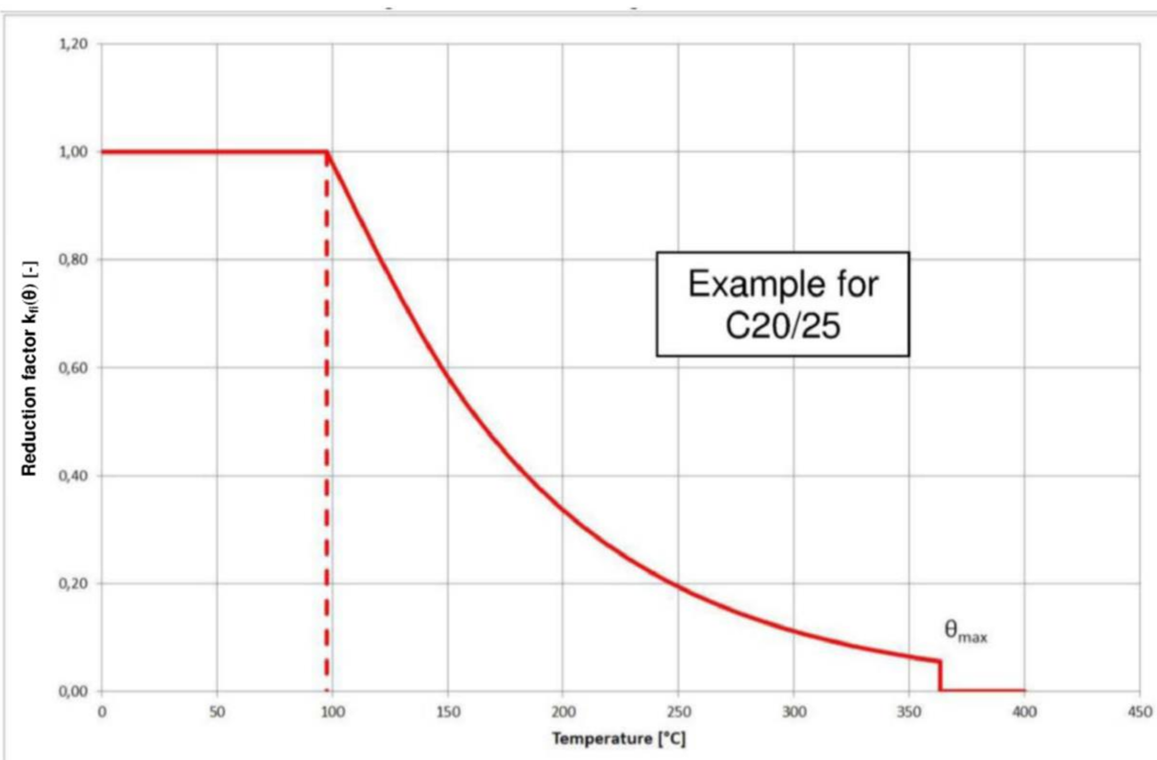


Table C4: Characteristic tension strength in case of fire for tension anchor ZA, concrete strength class C12/15 to C50/60, acc. to Technical Report TR 020

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