

DÉCLARATION DES PERFORMANCES
DoP Nr. MKT-312 - fr

- Code d'identification unique du produit type: **MKT Système à injection VMZ et VMZ-IG**
- Numéro de type, de lot ou de série ou tout autre élément permettant l'identification du produit de construction, conformément à l'article 11, paragraphe 4:

ETA-04/0092, Annex A3, A5
Numéro de lot : voir emballage

- Usage ou usages prévus du produit de construction, conformément à la spécification technique harmonisée applicable, comme prévu par le fabricant:

Type de produit	Ancrage d'assemblage à couple de serrage contrôlé
Pour utilisation dans	Béton fissuré et non fissuré C20/25 - C50/60 (EN 206)
Option	1
Charge	Statique, quasi-statique ou sismique catégorie de performance C1+C2 (Dimensions VMZ: M10, M12, M16, M20, M24)
Matériau	<p><u>Acier galvanisé à chaud ou diffusion galvanisé:</u> Dans des locaux intérieurs secs uniquement Dimensions comprises: VMZ: M8, M10, M12, M16, M20, M24</p> <p><u>Acier diffusion galvanisé:</u> Dans des locaux intérieurs secs uniquement Dimensions comprises: VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u>Acier galvanisé:</u> Dans des locaux intérieurs secs uniquement Dimensions comprises: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u>Acier inoxydable (marquage A4):</u> A l'intérieur et à l'extérieur sans conditions particulièrement agressives Dimensions comprises: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u>Acier hautement résistant à la corrosion (marquage HCR):</u> A l'intérieur et à l'extérieur dans des conditions particulièrement agressives Dimensions comprises: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p>
Plage de température (éventuellement)	Plage de température I: -40 °C à +80 °C Plage de température II: -40 °C à +120 °C

- Nom, raison sociale ou marque déposée et adresse de contact du fabricant, conformément à l'article 11, paragraphe 5:

MKT Metall-Kunststoff-Technik GmbH & Co. KG
Auf dem Immel 2
D - 67685 Weilerbach

- Le cas échéant, nom et adresse de contact du mandataire dont le mandat couvre les tâches visées à l'article 12, paragraphe 2: --

6. Le ou les systèmes d'évaluation et de vérification de la constance des performances du produit de construction, conformément à l'annexe V: **System 1**
7. Dans le cas de la déclaration des performances concernant un produit de construction couvert par une norme harmonisée:
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8. Dans le cas de la déclaration des performances concernant un produit de construction pour lequel une évaluation technique européenne a été délivrée:

Deutsches Institut für Bautechnik, Berlin

a délivré:

ETA-04/0092

sur la base de

ETAG 001-5

a réalisé 1343-CPR selon le système 1:

- i) La détermination du produit type sur la base d'essais de type (y compris l'échantillonnage), de calculs relatifs au type, de valeurs issues de tableaux ou de la documentation descriptive du produit ;
- ii) Une inspection notifié de certification du contrôle de la production;
- iii) Une surveillance, une évaluation et une appréciation permanentes du contrôle de la production en usine.

a délivré: le certificat de constance des performances 1343-CPR-M 550-4/08.14

9. Performances déclarées:

Caractéristiques essentielles	Méthode d'évaluation	Performances		Spécifications techniques harmonisées
		VMZ-A	VMZ-IG	
Résistance caractéristiques en charge de traction	ETAG 001, Annex C CEN/TS 1992-4	Annex C1-C3	Annex C10, C11	ETAG 001
Résistance caractéristiques en charge transversale	ETAG 001, Annex C CEN/TS 1992-4	Annex C4, C5	Annex C12	
Résistance caractéristique en cas de séisme	TR 045	Annex C6, C7	--	
Décalage à l'état d'utilisation	ETAG 001, Annex C CEN/TS 1992-4	Annex C8, C9	Annex C12	

Lorsque, conformément à l'article 37 ou 38, la documentation technique spécifique a été utilisée, les exigences remplies par le produit: --

10. Les performances du produit identifié aux points 1 et 2 sont conformes aux performances déclarées indiquées au point 9.

La présente déclaration des performances est établie sous la seule responsabilité du fabricant identifié au point 4.

Signée pour le fabricant et en son nom par:



Stefan Weustenhagen
(Directrice Générale)
Weilerbach, 13.04.2017

i.V.



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



Table C1: Characteristic values for tension loads, VMZ-A M8 – M12, cracked concrete, static and quasi-static action

Anchor size VMZ-A			40 M8	50 M8	60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0										
Steel failure													
Characteristic tension resistance $N_{RK,s}$	Steel, zinc plated	[kN]	15	18	25	35	49	54	57				
	A4, HCR	[kN]	15	18	25	35	49	54	57				
Partial safety factor	γ_{Ms}	[-]	1,5										
Pull-out													
Characteristic resistance $N_{RK,p}$ in concrete C20/25	50°C / 80°C ²⁾	[kN]	1)										
	72°C / 120°C ²⁾	[kN]	5	7,5	12	12	12	16	20	20	30	30	30
Increasing factor	ψ_C	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
Concrete cone failure													
Effective anchorage depth	$h_{ef} \geq$	[mm]	40	50	60	75	75	70	80	95	100	110	125
Factor acc. to CEN/TS 1992-4	k_{cr}	[-]	7,2										

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Table C2: Characteristic values for tension loads, VMZ-A M16 – M24, cracked concrete, static and quasi-static action

Anchor size VMZ-A			90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0										
Steel failure													
Characteristic tension resistance $N_{RK,s}$	Steel, zinc plated	[kN]	88	95	111	97	96	188		222			
	A4, HCR	[kN]	88	95	111	97	114	165		194			
Partial safety factor	γ_{Ms}	[-]	1,5				1,68	1,5		1,5			
Pull-out													
Characteristic resistance $N_{RK,p}$ in concrete C20/25	50°C / 80°C ²⁾	[kN]	1)										
	72°C / 120°C ²⁾	[kN]	25	30	50	51	30	60		75			
Increasing factor	ψ_C	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
Concrete cone failure													
Effective anchorage depth	$h_{ef} \geq$	[mm]	90	105	125	145	160	115	170	190	170	200	225
Factor acc. to CEN/TS 1992-4	k_{cr}	[-]	7,2										

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ	Annex C1
Performance Characteristic values for tension loads, VMZ-A in cracked concrete, static and quasi-static action	

Table C3: Characteristic values for tension loads, VMZ-A M8 – M12 in uncracked concrete, static and quasi-static action

Anchor size VMZ-A			40 M8	50 M8	60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0										
Steel failure													
Characteristic tension resistance $N_{Rk,s}$	Steel, zinc plated	[kN]	15	18	25	35	49	54	57				
	A4, HCR	[kN]	15	18	25	35	49	54	57				
Partial safety factor	γ_{Ms}	[-]	1,5										
Pull-out													
Characteristic resistance $N_{Rk,p}$ in uncracked concrete C20/25	50°C / 80°C ²⁾	[kN]	9	1)	1)	1)			40	1)	50	50	
	72°C / 120°C ²⁾	[kN]	6	9	16	16	16	25	25	30	30	30	
Splitting													
Splitting for standard thickness of concrete member (The higher resistance of Case 1 and Case 2 may be applied.)													
Standard thickness of concrete	$h_{std} \geq 2 h_{ef}$	[mm]	100	120	150	150	140	160	190	200	220	250	
Case 1 ($N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$)													
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,sp}^0$	[kN]	7,5	9	16	20	20	20	1)	30	40	40	40
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	3 h_{ef}										
Case 2													
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	6 h_{ef}	5 h_{ef}	7 h_{ef}	7 h_{ef}	5 h_{ef}	3 h_{ef}	5 h_{ef}	4 h_{ef}	6 h_{ef}	5 h_{ef}	
Splitting for minimum thickness of concrete member (The higher resistance of Case 1 and Case 2 may be applied.)													
Minimum thickness of concrete	$h_{min} \geq$	[mm]	80	100	110	110	110	125	130	140	160		
Case 1 ($N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$)													
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,sp}^0$	[kN]	7,5	-	16	16	20	25	25	30	30	30	
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	3 h_{ef}	-	3 h_{ef}	3 h_{ef}							
Case 2													
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	6 h_{ef}	7 h_{ef}	6 h_{ef}	7 h_{ef}	7 h_{ef}	7 h_{ef}	6 h_{ef}	7 h_{ef}	6 h_{ef}	6 h_{ef}	6 h_{ef}
Increasing factor for $N_{Rk,p}$ and $N_{Rk,sp}^0$	ψ_C	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
Concrete cone failure													
Effective anchorage depth	$h_{ef} \geq$	[mm]	40	50	60	75	75	70	80	95	100	110	125
Factor acc. to CEN/TS 1992-4	k_{ucr}	[-]	10,1										

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ

Performance

Characteristic values for **tension loads, VMZ-A M8 – M12, uncracked concrete**, static and quasi-static action

Annex C2

Table C4: Characteristic values for tension loads, VMZ-A M16 – M24, uncracked concrete, static and quasi-static action

Anchor size VMZ-A		90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)	
Installation safety factor	$\gamma_2 = \gamma_{inst}$ [-]	1,0											
Steel failure													
Characteristic tension resistance $N_{Rk,s}$	Steel, zinc plated	[kN]	88	95	111	111	97	96	188	188	222	222	222
	A4, HCR	[kN]	88	95	111	111	97	114	165	165	194	194	194
Partial safety factor	γ_{Ms} [-]	1,5					1,68	1,5		1,5			
Pull-out													
Characteristic resistance $N_{Rk,p}$ in uncracked concrete C20/25	50°C / 80°C ²⁾	[kN]	1)			75	90	1)			1)		
	72°C / 120°C ²⁾	[kN]	25	35	50	50	53	40	75	75	95	95	95
Splitting													
Splitting for standard thickness of concrete (The higher resistance of Case 1 and Case 2 may be applied.)													
Standard thickness of concrete	$h_{std} \geq 2 h_{ef}$ [mm]	180	200	250	290	320	230	340	380	340	400	450	
Case 1 ($N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$)													
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,sp}^0$ [kN]	40	50	50	60	80	1)		115	1)		140	
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$ [mm]	3 h_{ef}											
Case 2													
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$ [mm]	4 h_{ef}	4 h_{ef}	4 h_{ef}	4 h_{ef}	4 h_{ef}	3 h_{ef}	3 h_{ef}	4 h_{ef}	3 h_{ef}	3 h_{ef}	3,6 h_{ef}	
Splitting for minimum thickness of concrete (The higher resistance of Case 1 and Case 2 may be applied.)													
Minimum thickness of concrete	$h_{min} \geq$ [mm]	130	150	160	180	200	160	220	240	220	260	290	
Case 1 ($N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$)													
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,sp}^0$ [kN]	35	50	40	50	71	-	75	75	1)		115	115
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$ [mm]	3 h_{ef}											
Case 2													
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$ [mm]	5 h_{ef}	5 h_{ef}	6 h_{ef}	5 h_{ef}	5 h_{ef}	5 h_{ef}	5,2 h_{ef}	4,4 h_{ef}	5,2 h_{ef}	4,4 h_{ef}	4,4 h_{ef}	
Increasing factor for $N_{Rk,p}$ and $N_{Rk,sp}^0$	ψ_C [-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$											
Concrete cone failure													
Effective anchorage depth	$h_{ef} \geq$ [mm]	90	105	125	145	160	115	170	190	170	200	225	
Factor acc. to CEN/TS 1992-4	k_{ucr} [-]	10,1											

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ

Performance

Characteristic values for **tension loads, VMZ-A M16 – M24, uncracked concrete**, static and quasi-static action

Annex C3

Table C5: Characteristic values for shear load, VMZ-A M8 – M12, cracked and uncracked concrete, static and quasi-static action

Anchor size VMZ-A			40 M8	50 M8	60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0										
Steel failure without lever arm													
Characteristic shear resistance $V_{Rk,s}$	Steel, zinc plated	[kN]	14	21	34								
	A4, HCR	[kN]	15	23	34								
Partial safety factor	γ_{Ms}	[-]	1,25										
Factor for ductility	k_2	[-]	1,0										
Steel failure with lever arm													
Characteristic bending moments $M^0_{Rk,s}$	Steel, zinc plated	[Nm]	30	60	105								
	A4, HCR	[Nm]	30	60	105								
Partial safety factor	γ_{Ms}	[-]	1,25										
Concrete pry-out failure													
Factor k acc. ETAG 001, Annex C or k_3 acc. CEN/TS 1992-4	$k_{(3)}$	[-]	2										
Concrete edge failure													
Effective length of anchor in shear load	l_f	[mm]	40	50	60	75	75	70	80	95	100	110	125
Diameter of anchor	d_{nom}	[mm]	10		12		12	14					

Injection System VMZ

Performance

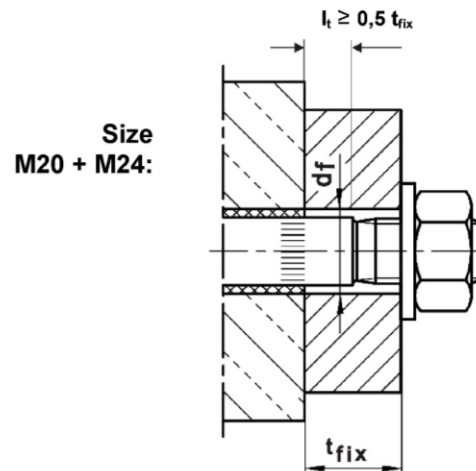
Characteristic values for **shear load, VMZ-A M8 – M12, cracked and uncracked concrete**, static and quasi-static action

Annex C4

Table C6: Characteristic values for shear load, VMZ-A M16 – M24, cracked and uncracked concrete, static and quasi-static action

Anchor size VMZ-A		90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)	
Installation safety factor	$\gamma_2 = \gamma_{inst}$ [-]	1,0											
Steel failure without lever arm													
Characteristic shear resistance	Steel, zinc plated [kN]	63					70	149 ¹⁾ (98)	178 ¹⁾ (141)				
$V_{Rk,s}$	A4, HCR [kN]	63					86	131 ¹⁾ (86)	156 ¹⁾ (123)				
Partial safety factor	γ_{Ms} [-]	1,25					1,4	1,25	1,25				
Factor for ductility	k_2 [-]	1,0											
Steel failure with lever arm													
Characteristic bending moments	Steel, zinc plated [Nm]	266					392	519	896				
$M^0_{Rk,s}$	A4, HCR [Nm]	266					454		784				
Partial safety factor	γ_{Ms} [-]	1,25					1,4	1,25	1,25				
Concrete pry-out failure													
Factor k acc. ETAG 001, Annex C or k_3 acc. CEN/TS 1992-4	$k_{(3)}$ [-]	2											
Concrete edge failure													
Effective length of anchor in shear load	l_f [mm]	90	105	125	145	160	115	170	190	170	200	225	
Diameter of anchor	d_{nom} [mm]	18					22	24	26				

¹⁾ This value may only be applied if $l_t \geq 0,5 t_{fix}$



Injection System VMZ

Performance

Characteristic values for **shear load, VMZ-A M16 – M24, cracked and uncracked concrete, static and quasi-static action**

Annex C5

**Table C7: Characteristic resistances for seismic loading
VMZ-A M10 – M12 performance category C1 and C2**

Anchor size VMZ-A			60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Tension loads											
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								
Steel failure, steel zinc plated											
Characteristic resistance C1	$N_{Rk,s,seis,C1}$	[kN]	25	35	49	54	57				
Characteristic resistance C2	$N_{Rk,s,seis,C2}$	[kN]	25	35	49	54	57				
Steel failure, stainless steel A4, HCR											
Characteristic resistance C1	$N_{Rk,s,seis,C1}$	[kN]	25	35	49	54	57				
Characteristic resistance C2	$N_{Rk,s,seis,C2}$	[kN]	25	35	49	54	57				
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5								
Pull-out											
Characteristic resistance C1	$N_{Rk,p,seis,C1}$	50°C / 80°C ¹⁾	[kN]	14,5	14,5	30,6	36,0	41,5	42,8		
		72°C / 120°C ¹⁾	[kN]	10,9	10,9	20,0	30,0				
Characteristic resistance C2	$N_{Rk,p,seis,C2}$	50°C / 80°C ¹⁾	[kN]	7,4	7,4	8,7	17,6				
		72°C / 120°C ¹⁾	[kN]	5,1	5,1	6,5	12,3				

Shear loads											
Steel failure without lever arm, steel zinc plated											
Characteristic resistance C1	$V_{Rk,s,seis,C1}$	[kN]	11,8	27,2							
Characteristic resistance C2	$V_{Rk,s,seis,C2}$	[kN]	12,6	27,2							
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25								
Steel failure without lever arm, stainless steel A4, HCR											
Characteristic resistance C1	$V_{Rk,s,seis,C1}$	[kN]	12,9	27,2							
Characteristic resistance C2	$V_{Rk,s,seis,C2}$	[kN]	13,8	27,2							
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,25								
Steel failure with lever arm											
Characteristic bending moment C1	$M_{Rk,s,seis,C1}^0$	[Nm]	no performance determined								
Characteristic bending moment C2	$M_{Rk,s,seis,C2}^0$	[Nm]	no performance determined								

¹⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ	Annex C6
Performance Characteristic resistances for seismic loading, VMZ-A M10 – M12, performance category C1 and C2	

**Table C8: Characteristic resistances for seismic loading
VMZ-A M16 – M24 performance category C1 and C2**

Anchor size VMZ-A		90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)	
Tension loads													
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]											
Steel failure, steel zinc plated													
Characteristic resistance C1	$N_{Rk,s,seis,C1}$	[kN]	88	95	111	97	96	188	222				
Characteristic resistance C2	$N_{Rk,s,seis,C2}$	[kN]	88	95	111	97	96	188	222				
Steel failure, stainless steel A4, HCR													
Characteristic resistance C1	$N_{Rk,s,seis,C1}$	[kN]	88	95	111	97	114	165	194				
Characteristic resistance C2	$N_{Rk,s,seis,C2}$	[kN]	88	95	111	97	114	165	194				
Partial safety factor	$\gamma_{Ms,seis}$	[-]					1,5	1,68	1,5	1,5			
Pull-out													
Characteristic resistance C1	$N_{Rk,p,seis,C1}$	50°C / 80°C ¹⁾	[kN]	30,7	38,7	43,7		44,4	88,2	90,7			
		72°C / 120°C ¹⁾	[kN]	25,0	30,0	38,5		29,4	55,8	59,3			
Characteristic resistance C2	$N_{Rk,p,seis,C2}$	50°C / 80°C ¹⁾	[kN]	16,3	22,1	26,1		30,9	59,7	59,7			
		72°C / 120°C ¹⁾	[kN]	10,5	14,4	19,5		16,2	44,4	44,4			

Shear loads													
Steel failure without lever arm, steel zinc plated													
Characteristic resistance C1	$V_{Rk,s,seis,C1}$	[kN]	39,1				39,1	82,3	107				
Characteristic resistance C2	$V_{Rk,s,seis,C2}$	[kN]	50,4				51,0	108,8 ¹⁾ (71,5)	154,9 ¹⁾ (122,7)				
Partial safety factor	$\gamma_{Ms,seis}$	[-]					1,25	1,4	1,25	1,25			
Steel failure without lever arm, stainless steel A4, HCR													
Characteristic resistance C1	$V_{Rk,s,seis,C1}$	[kN]	39,1				39,1	72,2	93				
Characteristic resistance C2	$V_{Rk,s,seis,C2}$	[kN]	50,4				62,6	95,6 ¹⁾ (62,8)	135,7 ¹⁾ (107)				
Partial safety factor	$\gamma_{Ms,seis}$	[-]					1,25	1,4	1,25	1,25			
Steel failure with lever arm													
Characteristic bending moment C1	$M^0_{Rk,s,seis,C1}$	[Nm]	no performance determined										
Characteristic bending moment C2	$M^0_{Rk,s,seis,C2}$	[Nm]	no performance determined										

¹⁾ This value may only be applied if $l_t \geq 0,5 t_{fix}$, (see Annex C5)

Injection System VMZ	Annex C7
Performance Characteristic resistances for seismic loading, VMZ-A M16 – M24, performance category C1 and C2	

Table C9: Displacements under tension loads, VMZ-A M8 – M12

Anchor size VMZ-A			40 M8	50 M8	60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Tension load in cracked concrete	N	[kN]	4,3	6,1	8,0	11,1	11,1	10,0	12,3	15,9	17,1	19,8	24,0
Displacement	δ_{N0}	[mm]	0,5	0,5	0,5	0,6	0,6	0,6	0,6	0,6	0,6	0,7	0,7
	$\delta_{N\infty}$	[mm]	1,3										
Tension load in uncracked concrete	N	[kN]	4,3	8,5	11,1	15,6	15,6	14,1	17,2	19,0	24,0	23,8	23,8
Displacement	δ_{N0}	[mm]	0,2	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,4	0,6	0,6
	$\delta_{N\infty}$	[mm]	1,3										
Displacements under seismic tension loads C2													
Displacements for DLS	$\delta_{N,seis,C2(DLS)}$	[mm]	-	-	1,0		1,0		1,3		1,1		
Displacements for ULS	$\delta_{N,seis,C2(ULS)}$	[mm]	-	-	3,0		3,0		3,9		3,0		

Table C10: Displacements under tension loads, VMZ-A M16 – M24

Anchor size VMZ-A			90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)
Tension load in cracked concrete	N	[kN]	14,6	18,4	24,0	30,0	34,7	21,1	38,0	44,9	38,0	48,5	57,9
Displacement	δ_{N0}	[mm]	0,7	0,7	0,7	0,8	1,2	0,7	0,8	0,8	0,8	0,9	0,9
	$\delta_{N\infty}$	[mm]	1,3				1,6	1,1	1,3		1,3		
Tension load in uncracked concrete	N	[kN]	20,5	25,9	33,0	35,7	48,1	29,6	53,3	63,0	53,3	67,9	81,1
Displacement	δ_{N0}	[mm]	0,6	0,6	0,6	0,6	0,8	0,5	0,6	0,6	0,6	0,6	0,6
	$\delta_{N\infty}$	[mm]	1,3				1,6	1,1	1,3		1,3		
Displacements under seismic tension loads C2													
Displacements for DLS	$\delta_{N,seis,C2(DLS)}$	[mm]	1,6		1,5			1,7	1,9		1,9		
Displacements for ULS	$\delta_{N,seis,C2(ULS)}$	[mm]	3,7		4,4			4,0	4,5		4,5		

Injection System VMZ

Performance
Displacements under tension loads, **VMZ-A**

Annex C8

Table C11: Displacements under shear loads VMZ-A M8 – M12

Anchor size VMZ-A			40 M8	50 M8	60 M10	75 M10	75 M12	70 M12	80 M12	95 M12	100 M12	110 M12	125 M12
Shear load	V	[kN]	8,3		13,3		19,3						
Displacements	δ_{V0}	[mm]	2,4	2,5	2,9		3,3						
	$\delta_{V\infty}$	[mm]	3,6	3,8	4,4		5,0						
Displacements under seismic shear loads C2													
Displacements for DLS	$\delta_{V,seis,C2(DLS)}$	[mm]	-	-	2,1		2,5						
Displacements for ULS	$\delta_{V,seis,C2(ULS)}$	[mm]	-	-	3,7		5,1						

Table C12: Displacements under shear loads VMZ-A M16 – M24

Anchor size VMZ-A			90 M16	105 M16	125 M16	145 M16	160 M16	115 M20	170 M20 (LG)	190 M20 (LG)	170 M24 (LG)	200 M24 (LG)	225 M24 (LG)
Shear load	V	[kN]	36				44	75 (49)		89 (71)			
Displacements	δ_{V0}	[mm]	3,8				3,0	4,3 (3,0)		4,6 (3,5)			
	$\delta_{V\infty}$	[mm]	5,7				4,5	6,5 (4,5)		6,9 (5,3)			
Displacements under seismic shear loads C2													
Displacements for DLS	$\delta_{V,seis,C2(DLS)}$	[mm]	2,9				3,5		3,7				
Displacements for ULS	$\delta_{V,seis,C2(ULS)}$	[mm]	6,8				9,3		9,3				

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Performance
Displacements under shear loads, **VMZ-A**

Annex C9

Table C13: Characteristic values for tension load, VMZ-IG , cracked concrete

Anchor size VMZ-IG			40 M6	50 M6	60 M8	75 M8	70 M10	80 M10	90 M12	105 M12	125 M12	115 M16	170 M16	170 M20	
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0												
Steel failure															
Characteristic tension resistance $N_{RK,S}$	Steel, zinc plated	[kN]	15	16	19	29	35			67			52	125	108
	A4, HCR	[kN]	11		19	21	33			47			65	88	94
Partial safety factor	γ_{Ms}	[-]	1,5												
Pull-out															
Characteristic resistance $N_{RK,p}$ in cracked concrete C20/25	50°C / 80°C ²⁾	[kN]	1)												
	72°C / 120°C ²⁾	[kN]	5	7,5	12		16	20	20	30	50	30	60	75	
Increasing factor	ψ_c	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$												
Concrete cone failure															
Effective anchorage depth	h_{ef}	[mm]	40	50	60	75	70	80	90	105	125	115	170	170	
Factor according to CEN/TS 1992-4	k_{cr}	[-]	7,2												

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ

Performance
Characteristic values for tension load, VMZ-IG, cracked concrete

Annex C10

Table C14: Characteristic values for tension load, VMZ-IG, uncracked concrete

Anchor size VMZ-IG			40 M6	50 M6	60 M8	75 M8	70 M10	80 M10	90 M12	105 M12	125 M12	115 M16	170 M16	170 M20	
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0												
Steel failure															
Characteristic tension resistance $N_{RK,s}$	Steel, zinc plated	[kN]	15	16	19	29	35			67			52	125	108
	A4, HCR	[kN]	11		19	21	33			47			65	88	94
Partial safety factor	γ_{Ms}	[-]	1,5												
Pull-out															
Characteristic resistance $N_{RK,p}$ in uncracked concrete C20/25	50°C / 80°C ²⁾	[kN]	9	1)	1)										
	72°C / 120°C ²⁾	[kN]	6	9	16	16	25	25	35	50	40	75	95		
Splitting															
Splitting for standard thickness of concrete (The higher resistance of Case 1 and Case 2 may be applied.)															
Standard thickness of concrete	$h_{std} \geq 2h_{ef}$	[mm]	100	120	150	140	160	180	200	250	230	340	340		
Case 1 ($N_{RK,c}$ has to be replaced by $N_{RK,sp}^0$)															
Characteristic resistance in concrete C20/25	$N_{RK,sp}^0$	[kN]	7,5	9	16	20	20	1)	40	50	50	1)	1)		
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	3 h_{ef}												
Case 2															
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	6 h_{ef}	6 h_{ef}	5 h_{ef}	7 h_{ef}	5 h_{ef}	3 h_{ef}	4 h_{ef}	4 h_{ef}	4 h_{ef}	4 h_{ef}	3 h_{ef}	3 h_{ef}	3 h_{ef}
Splitting for minimum thickness of concrete (The higher resistance of Case 1 and Case 2 may be applied.)															
Minimum thickness of concrete	$h_{min} \geq$	[mm]	80	100	110	110		130	150	160	160	220	220		
Case 1 ($N_{RK,c}$ has to be replaced by $N_{RK,sp}^0$)															
Characteristic resistance in concrete C20/25	$N_{RK,sp}^0$	[kN]	7,5	-	16	20	25	35	50	40	-	75	1)		
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	3 h_{ef}												
Case 2															
Spacing (edge distance)	$s_{cr,sp} (= 2 c_{cr,sp})$	[mm]	6 h_{ef}	7 h_{ef}	6 h_{ef}	7 h_{ef}	7 h_{ef}	6 h_{ef}	5 h_{ef}	5 h_{ef}	6 h_{ef}	5 h_{ef}	5,2 h_{ef}	5,2 h_{ef}	
Increasing factor for $N_{RK,p}$ and $N_{RK,sp}^0$	ψ_c	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$												
Concrete cone failure															
Effective anchorage depth	h_{ef}	[mm]	40	50	60	75	70	80	90	105	125	115	170	170	
Factor according to CEN/TS 1992-4	k_{ucr}	[-]	10,1												

¹⁾ Pull-out failure is not decisive

²⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ

Performance

Characteristic values for tension loads, **VMZ-IG**, uncracked concrete

Annex C11

Table C15: Characteristic values for shear load, VMZ-IG, cracked and uncracked concrete

Anchor size VMZ-IG			40 M6	50 M6	60 M8	75 M8	70 M10	80 M10	90 M12	105 M12	125 M12	115 M16	170 M16	170 M20
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0											
Steel failure without lever arm														
Characteristic shear resistance $V_{Rk,s}$	Steel, zinc plated	[kN]	8,0	9,5	15	18			34			26	63	54
	A4, HCR	[kN]	5,5	9,5	10	16			24			32	44	47
Partial safety factor	γ_{Ms}	[-]	1,25											
Factor for ductility	k_2	[-]	1,0											
Steel failure with lever arm														
Characteristic bending moments $M_{Rk,s}^0$	Steel, zinc plated	[kN]	12		30		60			105		212	266	519
	A4, HCR	[kN]	8,5		21		42			74		187	187	365
Partial safety factor	γ_{Ms}	[-]	1,25											
Concrete pry-out failure														
Factor k acc. ETAG 001, Annex C or k_3 acc. CEN/TS 1992-4	$k_{(3)}$	[-]	2											
Concrete edge failure														
Effective length of anchor in shear load	l_f	[mm]	40	50	60	75	70	80	90	105	125	115	170	170
Diameter of anchor	d_{nom}	[mm]	10		12		14			18		22	24	26

Table C16: Displacements under tension loads, VMZ-IG

Anchor size VMZ-IG			40 M6	50 M6	60 M8	75 M8	70 M10	80 M10	90 M12	105 M12	125 M12	115 M16	170 M16	170 M20
Tension load in cracked concrete	N	[kN]	4,3	6,1	8,0	11,1	10,0	12,3	14,6	18,4	24,0	21,1	38,0	38,0
Displacement	δ_{N0}	[mm]	0,5		0,5	0,6	0,6		0,7			0,7	0,8	0,8
	$\delta_{N\infty}$	[mm]					1,3					1,1	1,3	1,3
Tension load in uncracked concrete	N	[kN]	4,3	8,5	11,1	15,6	14,1	17,2	20,5	25,9	33,0	29,6	53,3	53,3
Displacement	δ_{N0}	[mm]	0,2	0,4		0,4	0,4		0,6			0,5	0,6	0,6
	$\delta_{N\infty}$	[mm]					1,3					1,1	1,3	1,3

Table C17: Displacements under shear loads, VMZ-IG

Anchor size VMZ-IG			40 M6	50 M6	60 M8	75 M8	70 M10	80 M10	90 M12	105 M12	125 M12	115 M16	170 M16	170 M20
Shear load	V	[kN]	4,6		5,4	8,4	10,1			19,3		14,8	35,8	30,7
Displacement	δ_{V0}	[mm]	0,4		0,5	0,4	0,5			1,2		0,8	1,9	1,2
	$\delta_{V\infty}$	[mm]	0,7		0,8	0,7	0,8			1,9		1,2	2,8	1,9
Shear load	V	[kN]	3,2		5,4	5,9	9,3			13,5		18,5	25,2	26,9
Displacement	δ_{V0}	[mm]	0,3		0,5	0,3	0,5			0,9		1,0	1,4	1,1
	$\delta_{V\infty}$	[mm]	0,4		0,7	0,5	0,7			1,4		1,5	2,1	1,6

Injection System VMZ

Performance

Characteristic values for **shear load, VMZ-IG, cracked and uncracked concrete, Displacements**

Annex C12