

**DÉCLARATION DES PERFORMANCES  
DoP Nr. MKT-311 - 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:

<b>Type de produit</b>	Ancrage d'assemblage à couple de serrage contrôlé
<b>Pour utilisation dans</b>	Béton fissuré et non fissuré C20/25 - C50/60 (EN 206)
<b>Option</b>	1
<b>Charge</b>	Statique, quasi-statique ou sismique catégorie de performance C1+C2 (Dimensions VMZ: M10, M12, M16, M20, M24)
<b>Matériau</b>	<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>
<b>Plage de température (éventuellement)</b>	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

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.

Signé pour le fabricant et en son nom par:



**Lore Weustenhagen**  
(Directrice Générale)  
Weilerbach, 22.04.2015

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**  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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										
<b>Steel failure</b>													
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	$\gamma_{Ms}$	[-]	1,5										
<b>Pull-out</b>													
Characteristic resistance $N_{Rk,p}$ in concrete C20/25	50 °C / 80 °C <sup>2)</sup>	[kN]	1)										
	72 °C / 120 °C <sup>2)</sup>	[kN]	5	7,5	12	12	12	16	20	20	30	30	30
Increasing factor	$\psi_c$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
<b>Concrete cone failure</b>													
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										

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> 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**  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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											
<b>Steel failure</b>														
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	$\gamma_{Ms}$	[-]	1,5					1,68	1,5		1,5			
<b>Pull-out</b>														
Characteristic resistance $N_{Rk,p}$ in concrete C20/25	50 °C / 80 °C <sup>2)</sup>	[kN]	1)											
	72 °C / 120 °C <sup>2)</sup>	[kN]	25	30	50	51	30	60		75				
Increasing factor	$\psi_c$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$											
<b>Concrete cone failure</b>														
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											

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> Maximum long term temperature / Maximum short term temperature

### Injection System VMZ

#### Performance

Characteristic values for **tension loads, VMZ-A in cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C1**

**Table C3: Characteristic values for tension loads, VMZ-A M8 – M12 in non-cracked concrete, static and quasi-static action**  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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										
<b>Steel failure</b>													
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	$\gamma_{Ms}$	[-]	1,5										
<b>Pull-out</b>													
Characteristic resistance $N_{Rk,p}$ in non-cracked concrete C20/25	50 °C / 80 °C <sup>2)</sup>	[kN]	9	1 <sup>1)</sup>	1 <sup>1)</sup>	1 <sup>1)</sup>			40	1 <sup>1)</sup>	50	50	
	72 °C / 120 °C <sup>2)</sup>	[kN]	6	9	16	16	16	25	25	30	30	30	
<b>Splitting</b>													
Splitting for <b>standard thickness of concrete member</b> (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	
<b>Case 1</b> ( $N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$ )													
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,sp}^0$	[kN]	7,5	9	16	20	20	20	1 <sup>1)</sup>	30	40	40	40
Spacing (edge distance)	$S_{cr,sp} (= 2 C_{cr,sp})$	[mm]	3 $h_{ef}$										
<b>Case 2</b>													
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 <b>minimum thickness of concrete member</b> (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		
<b>Case 1</b> ( $N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$ )													
Characteristic resistance in non-cracked 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 $h_{ef}$							
<b>Case 2</b>													
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 $N_{Rk,sp}^0$	$\psi_C$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
<b>Concrete cone failure</b>													
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										

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> Maximum long term temperature / Maximum short term temperature

### Injection System VMZ

#### Performance

Characteristic values for **tension loads, VMZ-A M8 – M12, non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C2**

**Table C4: Characteristic values for tension loads, VMZ-A M16 – M24, non-cracked concrete, static and quasi-static action, (Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)**

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											
<b>Steel failure</b>													
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	$\gamma_{Ms}$ [-]	1,5					1,68	1,5		1,5			
<b>Pull-out</b>													
Characteristic resistance $N_{Rk,p}$ in non-cracked concrete C20/25	50 °C / 80 °C <sup>2)</sup>	[kN]	1)			75	90	1)			1)		
	72 °C / 120 °C <sup>2)</sup>	[kN]	25	35	50	50	53	40	75	75	95	95	95
<b>Splitting</b>													
Splitting for <b>standard thickness of concrete</b> (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
<b>Case 1</b> ( $N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$ )													
Characteristic resistance in non-cracked 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 $h_{ef}$										
<b>Case 2</b>													
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 <b>minimum thickness of concrete</b> (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
<b>Case 1</b> ( $N_{Rk,c}^0$ has to be replaced by $N_{Rk,sp}^0$ )													
Characteristic resistance in non-cracked concrete C20/25	$N_{Rk,sp}^0$	[kN]	35	50	40	50	71	-	75	75	1)		115
Spacing (edge distance)	$s_{cr,sp} (= 2 C_{cr,sp})$	[mm]	3 $h_{ef}$										
<b>Case 2</b>													
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 $N_{Rk,sp}^0$	$\psi_C$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$										
<b>Concrete cone failure</b>													
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										

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> Maximum long term temperature / Maximum short term temperature

### Injection System VMZ

#### Performance

Characteristic values for **tension loads, VMZ-A M16 – M24, non-cracked concrete, static and quasi-static action, (Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)**

**Annex C3**

**Table C5:** Characteristic values for **shear load, VMZ-A M8 – M12, cracked and non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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										
<b>Steel failure without lever arm</b>													
Characteristic shear resistance $V_{Rk,s}$	Steel, zinc plated	[kN]	14	21	34								
	A4, HCR	[kN]	15	23	34								
Partial safety factor	$\gamma_{Ms}$	[-]	1,25										
Factor for ductility	$k_2$	[-]	1,0										
<b>Steel failure with lever arm</b>													
Characteristic bending moments $M^0_{Rk,s}$	Steel, zinc plated	[Nm]	30	60	105								
	A4, HCR	[Nm]	30	60	105								
Partial safety factor	$\gamma_{Ms}$	[-]	1,25										
<b>Concrete pry-out failure</b>													
Factor k acc ETAG 001, Annex C or $k_3$ acc. CEN/TS 1992-4	$k_{(3)}$	[-]	2										
<b>Concrete edge failure</b>													
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**

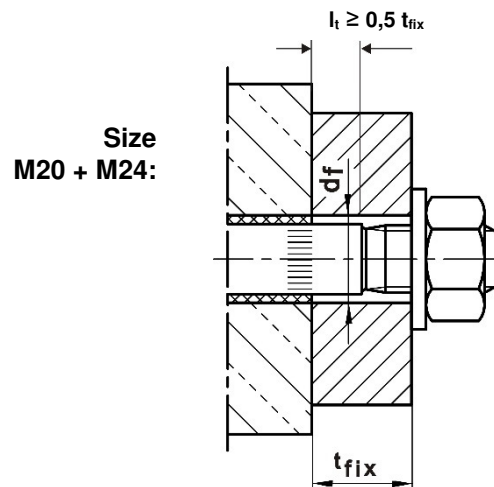
Characteristic values for **shear load, VMZ-A M8 – M12, cracked and non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C4**

**Table C6:** Characteristic values for **shear load, VMZ-A M16 – M24, cracked and non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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										
<b>Steel failure without lever arm</b>												
Characteristic shear resistance	Steel, zinc plated [kN]	63					70	149 <sup>1)</sup> (98)		178 <sup>1)</sup> (141)		
$V_{Rk,s}$	A4, HCR [kN]	63					86	131 <sup>1)</sup> (86)		156 <sup>1)</sup> (123)		
Partial safety factor	$\gamma_{Ms}$ [-]	1,25					1,4	1,25		1,25		
Factor for ductility	$k_2$ [-]	1,0										
<b>Steel failure with lever arm</b>												
Characteristic bending moments	Steel, zinc plated [Nm]	266					392	519		896		
$M^0_{Rk,s}$	A4, HCR [Nm]	266					454		784			
Partial safety factor	$\gamma_{Ms}$ [-]	1,25					1,4	1,25		1,25		
<b>Concrete pry-out failure</b>												
Factor k acc ETAG 001, Annex C or $k_3$ acc. CEN/TS 1992-4	$k_{(3)}$ [-]	2										
<b>Concrete edge failure</b>												
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		

<sup>1)</sup> This value may only be applied if  $l_f \geq 0,5 t_{fix}$



### Injection System VMZ

#### Performance

Characteristic values for **shear load, VMZ-A M16 – M24, cracked and non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C5**

**Table C7:** Characteristic resistances for **seismic tension loading**  
**VMZ-A M10 – M12** performance category **C1** and **C2**  
(Design according to EOTA Technical Report TR045)

Anchor size VMZ-A			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								
<b>Steel failure, steel zinc plated</b>											
Characteristic resistance <b>C1</b>	$N_{Rk,s,seis,C1}$	[kN]	25	35	49		54			57	
Characteristic resistance <b>C2</b>	$N_{Rk,s,seis,C2}$	[kN]	25	35	49		54			57	
<b>Steel failure, stainless steel A4, HCR</b>											
Characteristic resistance <b>C1</b>	$N_{Rk,s,seis,C1}$	[kN]	25	35	49		54			57	
Characteristic resistance <b>C2</b>	$N_{Rk,s,seis,C2}$	[kN]	25	35	49		54			57	
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5								
<b>Pull-out</b>											
Characteristic resistance <b>C1</b>	$N_{Rk,p,seis,C1}$	50 °C / 80 °C <sup>1)</sup>	[kN]	14,5		14,5				30,6	
		72 °C / 120 °C <sup>1)</sup>	[kN]	10,9		10,9				20,0	
Characteristic resistance <b>C2</b>	$N_{Rk,p,seis,C2}$	50 °C / 80 °C <sup>1)</sup>	[kN]	7,4		7,4				8,7	
		72 °C / 120 °C <sup>1)</sup>	[kN]	5,1		5,1				6,5	

**Table C8:** Characteristic resistances for **seismic tension loading**  
**VMZ-A M16 – M24** performance category **C1** and **C2**  
(Design according to EOTA Technical Report TR045)

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										
<b>Steel failure, steel zinc plated</b>													
Characteristic resistance <b>C1</b>	$N_{Rk,s,seis,C1}$	[kN]	88	95	111		97	96	188			222	
Characteristic resistance <b>C2</b>	$N_{Rk,s,seis,C2}$	[kN]	88	95	111		97	96	188			222	
<b>Steel failure, stainless steel A4, HCR</b>													
Characteristic resistance <b>C1</b>	$N_{Rk,s,seis,C1}$	[kN]	88	95	111		97	114	165			194	
Characteristic resistance <b>C2</b>	$N_{Rk,s,seis,C2}$	[kN]	88	95	111		97	114	165			194	
Partial safety factor	$\gamma_{Ms,seis}$	[-]	1,5					1,68	1,5			1,5	
<b>Pull-out</b>													
Characteristic resistance <b>C1</b>	$N_{Rk,p,seis,C1}$	50 °C / 80 °C <sup>1)</sup>	[kN]	30,6		43,7		30,6	88,2			90,7	
		72 °C / 120 °C <sup>1)</sup>	[kN]	20,0		38,5		20,0	55,8			59,3	
Characteristic resistance <b>C2</b>	$N_{Rk,p,seis,C2}$	50 °C / 80 °C <sup>1)</sup>	[kN]	13,5	16,1	26,1		16,1	59,7			59,7	
		72 °C / 120 °C <sup>1)</sup>	[kN]	10,0	12,0	19,5		11,0	44,4			44,4	

<sup>1)</sup> Maximum long term temperature / Maximum short term temperature

<b>Injection System VMZ</b>	<b>Annex C6</b>
<b>Performance</b> Characteristic resistances for <b>seismic tension loading, VMZ-A</b> , performance category <b>C1</b> and <b>C2</b> (Design according to TR045)	



**Table C9:** Characteristic resistances for **seismic shear loading**  
**VMZ-A M10 – M12** performance category **C1** and **C2**  
(Design according to EOTA Technical Report TR045)

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

**Table C10:** Characteristic resistances for **seismic shear loading**  
**VMZ-A M16 – M24** performance category **C1** and **C2**  
(Design according to EOTA Technical Report TR045)

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

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

**Injection System VMZ**

**Performance**

Characteristic resistances for **seismic shear loading, VMZ-A**, performance category **C1** and **C2** (Design according to TR045)

**Annex C7**

**Table C11: 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	$\delta_{N0}$	[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 non-cracked 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	$\delta_{N0}$	[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 <b>C2</b>													
Displacements for DLS	$\delta_{N,seis,C2(DLS)}$	[mm]	-	-	1,0		1,0				1,3		
Displacements for ULS	$\delta_{N,seis,C2(ULS)}$	[mm]	-	-	3,0		3,0				3,9		

**Table C12: 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	$\delta_{N0}$	[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 non-cracked 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	$\delta_{N0}$	[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 <b>C2</b>														
Displacements for DLS	$\delta_{N,seis,C2(DLS)}$	[mm]	1,5						1,9		1,9			
Displacements for ULS	$\delta_{N,seis,C2(ULS)}$	[mm]	4,4						4,5		4,5			

**Injection System VMZ**

**Performance**

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

**Annex C8**

**Table C13: 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	$\delta_{v0}$	[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 <b>C2</b>													
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 C14: 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	$\delta_{v0}$	[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 <b>C2</b>													
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				

**Injection System VMZ**

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

**Annex C9**

**Table C15: Characteristic values for tension load, VMZ-IG, cracked concrete**  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

Anchor size <b>VMZ-IG</b>			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												
<b>Steel failure</b>															
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	$\gamma_{Ms}$	[-]	1,5												
<b>Pull-out</b>															
Characteristic resistance $N_{Rk,p}$ in cracked concrete C20/25	50 °C / 80 °C <sup>2)</sup>	[kN]	1)												
	72 °C / 120 °C <sup>2)</sup>	[kN]	5	7,5	12		16	20	20	30	50	30	60	75	
Increasing factor	$\psi_c$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$												
<b>Concrete cone failure</b>															
Effective anchorage depth	$h_{ef}$	[mm]	40	50	60	75	70	80	90	105	125	115	170	170	
Factor acc. to CEN/TS 1992-4	$k_{cr}$	[-]	7,2												

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> Maximum long term temperature / Maximum short term temperature

**Injection System VMZ**

**Performance**

Characteristic values for tension load, **VMZ-IG**, cracked concrete  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C10**

**Table C16:** Characteristic values for **tension load, VMZ-IG**, non-cracked concrete  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

Anchor size <b>VMZ-IG</b>			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												
<b>Steel failure</b>															
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	$\gamma_{Ms}$	[-]	1,5												
<b>Pull-out</b>															
Characteristic resistance $N_{Rk,p}$ in non-cracked concrete C20/25	50°C / 80°C <sup>2)</sup>	[kN]	9	1)	1)										
	72°C / 120°C <sup>2)</sup>	[kN]	6	9	16		16	25	25	35	50	40	75	95	
<b>Splitting</b>															
<b>Splitting for standard thickness of concrete</b> (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		
<b>Case 1</b> ( $N_{Rk,c}^0$ 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 $h_{ef}$												
<b>Case 2</b>															
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 $h_{ef}$	3 $h_{ef}$	3 $h_{ef}$	3 $h_{ef}$	
<b>Splitting for minimum thickness of concrete</b> (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			
<b>Case 1</b> ( $N_{Rk,c}^0$ 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 $h_{ef}$												
<b>Case 2</b>															
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 $N_{Rk,sp}^0$	$\psi_c$	[-]	$\left(\frac{f_{ck,cube}}{25}\right)^{0,5}$												
<b>Concrete cone failure</b>															
Effective anchorage depth	$h_{ef}$	[mm]	40	50	60	75	70	80	90	105	125	115	170	170	
Factor acc. to CEN/TS 1992-4	$k_{ucr}$	[-]	10,1												

<sup>1)</sup> Pull-out failure is not decisive

<sup>2)</sup> Maximum long term temperature / Maximum short term temperature

### Injection System VMZ

#### Performance

Characteristic values for tension loads, **VMZ-IG**, non-cracked concrete  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**Annex C11**

**Table C17: Characteristic values for shear load, VMZ-IG , cracked and non-cracked concrete**

(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

Anchor size <b>VMZ-IG</b>			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												
<b>Steel failure without lever arm</b>															
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	$\gamma_{Ms}$	[-]	1,25												
Factor for ductility	$k_2$	[-]	1,0												
<b>Steel failure with lever arm</b>															
Characteristic bending moments $M^0_{Rk,s}$	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	$\gamma_{Ms}$	[-]	1,25												
<b>Concrete pry-out failure</b>															
Factor k acc ETAG 001, Annex C or $k_3$ acc. CEN/TS 1992-4	$k_{(3)}$	[-]	2												
<b>Concrete edge failure</b>															
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 C18: Displacements under tension loads, VMZ-IG**

Anchor size <b>VMZ-IG</b>			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 <b>cracked</b> 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	$\delta_{N0}$	[mm]	0,5		0,5	0,6	0,6			0,7			0,7	0,8	0,8
	$\delta_{N\infty}$	[mm]	1,3												
Tension load in <b>non-cracked</b> 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	$\delta_{N0}$	[mm]	0,2	0,4	0,4		0,4			0,6			0,5	0,6	0,6
	$\delta_{N\infty}$	[mm]	1,3												

**Table C19: Displacements under shear loads, VMZ-IG**

Anchor size <b>VMZ-IG</b>			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 <b>Steel, zinc plated</b>	V	[kN]	4,6		5,4	8,4	10,1			19,3			14,8	35,8	30,7
Displacement	$\delta_{V0}$	[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 <b>Stainless steel A4 / HCR</b>	V	[kN]	3,2		5,4	5,9	9,3			13,5			18,5	25,2	26,9
Displacement	$\delta_{V0}$	[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 non-cracked concrete (Design method A according to ETAG 001, Annex C or CEN/TS 1992-4), **Displacements**

**Annex C12**