

**DECLARAÇÃO DE DESEMPENHO**  
**DoP Nr. MKT-311 - pt**

- Código de identificação único do produto-tipo: **MKT sistema de injeção VMZ e VMZ-IG**
- Número do tipo, do lote ou da série, ou quaisquer outros elementos que permitam a identificação do produto de construção, nos termos do n.º 4 do artigo 11:  
**ETA-04/0092, Anexos A3, A5**  
**número do lote: ver embalagem**
- Utilização ou utilizações previstas do produto de construção, de acordo com a especificação técnica harmonizada aplicável, tal como previsto pelo fabricante:

<b>Tipo de produto</b>	conector de cisalhamento de binário controlado
<b>Para utilização em</b>	betão fissurado e não-fissurado C20/25 - C50/60 (EN 206)
<b>Opção</b>	1
<b>Carga</b>	estática ou quase estática, terremoto Categoria C1+C2 (tamanhos VMZ: M10, M12, M16, M20, M24)
<b>Material</b>	<p><u> aço galvanizado a quente ou difusão galvanizado:</u> somente em locais secos tamanhos incluídos: VMZ: M8, M10, M12, M16, M20, M24</p> <p><u> aço difusão galvanizado:</u> somente em locais secos tamanhos incluídos: VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u> aço galvanizado:</u> somente em locais secos tamanhos incluídos: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u> aço inoxidável (gravação em relevo A4):</u> em áreas internas e externas sem condições particularmente agressivas tamanhos incluídos: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p> <p><u> aço de alta resistência à corrosão (gravação em relevo HCR):</u> em áreas interiores e exteriores com condições particularmente agressivas tamanhos incluídos: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20</p>
<b>Faixa de temperatura (possivelmente)</b>	Faixa de temperatura I: -40 °C para +80 °C Faixa de temperatura II: -40 °C para +120 °C

- Nome, designação comercial ou marca comercial registada e endereço de contacto do fabricante, nos termos do n.º 5 do artigo 11:

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

- Se aplicável, nome e endereço de contacto do mandatário cujo mandato abrange os actos especificados no n.º 2 do artigo 12: --

6. Sistema ou sistemas de avaliação e verificação da regularidade do desempenho do produto de construção tal como previsto no anexo V: **Sistema 1**
7. No caso de uma declaração de desempenho relativa a um produto de construção abrangido por uma norma harmonizada:

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8. No caso de uma declaração de desempenho relativa a um produto de construção para o qual tenha sido emitida uma Avaliação Técnica Europeia:

**Deutsches Institut für Bautechnik, Berlin**

emitiu:

**ETA-04/0092**

com base em:

**ETAG 001-5**

O organismo de certificação de produtos notificado 1343-CPR foi realizada de acordo com o sistema 1:

- i) na determinação do produto-tipo com base nos ensaios de tipo (incluindo a amostragem), nos cálculos de tipo, nos valores tabelados ou em documentação descritiva do produto;
- ii) na inspeção inicial da unidade fabril e no controlo da produção em fábrica;
- iii) no acompanhamento, apreciação e aprovação contínuos do controlo da produção em fábrica

e emitiu: certificado de regularidade do desempenho 1343-CPR-M 550-4

9. Desempenho declarado:

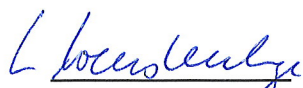
Características essenciais	Método de projeto	Desempenho		Especificações técnicas harmonizadas
		VMZ-A	VMZ-IG	
Resistência característica para cargas de tensão	ETAG 001, Anexo C CEN/TS 1992-4	Anexo C1-C3	Anexo C10, C11	ETAG 001
Resistência Característica a cargas de cisalhamento	ETAG 001, Anexo C CEN/TS 1992-4	Anexo C4, C5	Anexo C12	
Resistência característica de ocorrências sísmicas	TR 045	Anexo C6, C7	--	
Mudança na utilização	ETAG 001, Anexo C CEN/TS 1992-4	Anexo C8, C9	Anexo C12	

Quando, nos termos do artigo 37.o ou do artigo 38.o, tenha sido utilizada documentação técnica específica, os requisitos a que o produto obedece: --

10. O desempenho do produto identificado nos pontos 1 e 2 é conforme com o desempenho declarado no ponto 9.

A presente declaração de desempenho é emitida sob a exclusiva responsabilidade do fabricante identificado no ponto 4.

Assinado por e em nome do fabricante por:



**Lore Weustenhagen**  
(Administradora)  
**Weilerbach, 22.04.2015**

i.V. 

**Dipl.-Ing. Detlef Bigalke**  
(Director de Desenvolvimento de Produto)



**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 $h_{ef}$	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

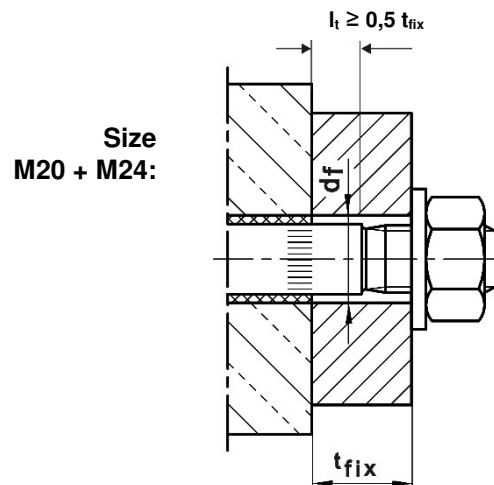
Characteristic values for **shear load, VMZ-A M8 – M12, cracked and non-cracked concrete**, static and quasi-static action  
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

**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	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	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**