

DECLARATION OF PERFORMANCE
DoP No. MKT-311 - en

1. Unique identification code of the product-type: **MKT Injection System VMZ and VMZ-IG**
2. Type, batch or serial number or any other element allowing identification of the construction product as required pursuant to Article 11(4):

ETA-04/0092, Annex A3 and A5
Batch number: see packaging of the product.

3. Intended use or uses of the construction product, in accordance with the applicable harmonised technical specification, as foreseen by the manufacturer:

generic type	torque controlled bonded anchor
for use in	cracked and non-cracked concrete C20/25 - C50/60 (EN 206)
option	1
loading	static or quasi-static, seismic category C1+C2 (sizes VMZ: M10, M12, M16, M20, M24)
material	<u>hot-dip galvanized and sherardized:</u> dry internal conditions covered sizes: VMZ: M8, M10, M12, M16, M20, M24 <u>sherardized steel:</u> dry internal conditions covered sizes: VMZ-IG: M6, M8, M10, M12, M16, M20 <u>galvanized steel:</u> dry internal conditions covered sizes: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20 <u>stainless steel (marking A4):</u> internal and external use without particular aggressive conditions covered sizes: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20 <u>high corrosion resistant steel (marking HCR):</u> internal and external use with particular aggressive conditions covered sizes: VMZ: M8, M10, M12, M16, M20, M24 VMZ-IG: M6, M8, M10, M12, M16, M20
temperature range (if applicable)	Range I: -40 °C to +80 °C Range II: -40 °C to +120 °C

4. Name, registered trade name or registered trade mark and contact address of the manufacturer as required pursuant to Article 11(5):

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

5. Where applicable, name and contact address of the authorised representative whose mandate covers the tasks specified in Article 12(2): --

6. System or systems of assessment and verification of constancy of performance of the construction product as set out in Annex V: **System 1**
7. In case of the declaration of performance concerning a construction product covered by a harmonised standard: --

8. In case of the declaration of performance concerning a construction product for which a European Technical Assessment has been issued:

issued **Deutsches Institut für Bautechnik, Berlin**
ETA-04/0092
on the basis of **ETAG 001-5**

The notified body 1343-CPR performed under system 1:

- (i) determination of the product type on the basis of type testing (including sampling), type calculation, tabulated values or descriptive documentation of the product;
 - (ii) initial inspection of the manufacturing plant and of factory production control;
 - (iii) continuous surveillance, assessment and evaluation of factory production control.
- and issued: **Certificate of constancy of performance 1343-CPR-M 550-4**

9. Declared performance:

Essential Characteristics	Design Method	Performance		Harmonized Technical Specification
		VMZ-A	VMZ-IG	
characteristic resistance for tension	ETAG 001, Annex C CEN/TS 1992-4	Annex C1-C3	Annex C10, C11	ETAG 001
characteristic resistance for shear (static or quasi-static)	ETAG 001, Annex C CEN/TS 1992-4	Annex C4, C5	Annex C12	
characteristic resistance for seismic action	TR 045	Annex C6, C7	--	
displacement for serviceability limit state	ETAG 001, Annex C CEN/TS 1992-4	Annex C8, C9	Annex C12	

Where pursuant to Article 37 or 38 in the Specific Technical Documentation has been used, the requirements with which the product complies: --

10. The performance of the product identified in points 1 and 2 is in conformity with the declared performance in point 9.

This declaration of performance is issued under the sole responsibility of the manufacturer identified in point 4.

Signed for and on behalf of the manufacturer by:

L. Weustenhagen
Lore Weustenhagen
 (General Manager)
Weilerbach, 22.04.2015

i.V. *Detlef Bigalke*
Dipl.-Ing. Detlef Bigalke
 (Head of product development)



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										
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
(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											
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

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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										
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 non-cracked concrete C20/25	50 °C / 80 °C ²⁾	[kN]	9	1) ¹⁾	1) ¹⁾	1) ¹⁾			40	1) 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 non-cracked concrete C20/25	$N_{Rk,sp}^0$	[kN]	7,5	9	16	20	20	20	1) 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 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}							
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

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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											
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 non-cracked 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 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}										
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 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}										
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

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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										
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							

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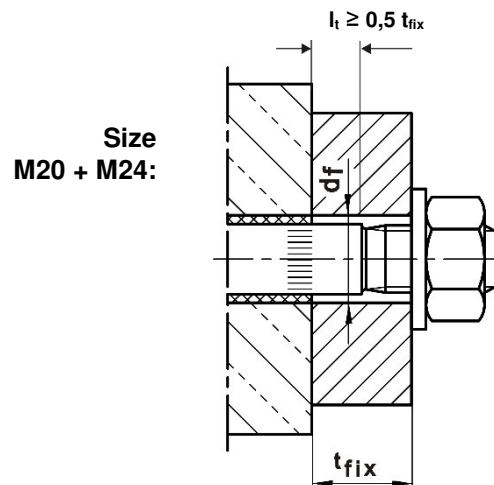
Characteristic values for **shear load, VMZ-A M8 – M12, cracked and non-cracked concrete**, static and quasi-static action
(Design method A according to ETAG 001, Annex C or CEN/TS 1992-4)

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										
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 $l_f \geq 0,5 t_{fix}$



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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								
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	
		72 °C / 120 °C ¹⁾	[kN]	10,9		10,9				20,0	
Characteristic resistance C2	$N_{Rk,p,seis,C2}$	50 °C / 80 °C ¹⁾	[kN]	7,4		7,4				8,7	
		72 °C / 120 °C ¹⁾	[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										
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]	30,6		43,7		30,6		88,2			90,7
		72 °C / 120 °C ¹⁾	[kN]	20,0		38,5		20,0		55,8			59,3
Characteristic resistance C2	$N_{Rk,p,seis,C2}$	50 °C / 80 °C ¹⁾	[kN]	13,5	16,1	26,1		16,1		59,7			59,7
		72 °C / 120 °C ¹⁾	[kN]	10,0	12,0	19,5		11,0		44,4			44,4

¹⁾ Maximum long term temperature / Maximum short term temperature

Injection System VMZ	Annex C6
Performance Characteristic resistances for seismic tension loading, VMZ-A , performance category C1 and C2 (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								
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	$M^0_{Rk,s,seis,C1}$	[Nm]	no performance determined								
Characteristic bending moment C2	$M^0_{Rk,s,seis,C2}$	[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										
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

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	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 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	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		
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	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 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	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]	1,5						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	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 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	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 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 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 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

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 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 non-cracked 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 ($N_{Rk,c}^0$ 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}												
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}	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 ($N_{Rk,c}^0$ 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}												
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 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

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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 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 $M^0_{Rk,s}$	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	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 C18: 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												
Tension load in non-cracked 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												

Table C19: 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

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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