



... eine starke Verbindung

DECLARAÇÃO DE DESEMPENHO  
DoP N.o MKT-321 - pt

1. Código de identificação único do produto-tipo: **MKT sistema de injeção VMU plus**
2. 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-11/0415, Anexos A2, A3**  
**Número do lote: ver embalagem**

3. 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>	âncoras alfundegados
<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
<b>Material</b>	<p><u> aço galvanizado a quente:</u> somente em locais secos tamanhos incluídos: M8, M10, M12, M16, M20, M24, M27, M30</p> <p><u> aço galvanizado:</u> somente em locais secos tamanhos incluídos: M8, M10, M12, M16, M20, M24, M27, M30</p> <p><u> aço inoxidável (gravação em relevo A4):</u> em áreas internas e externas sem condições tamanhos incluídos: M8, M10, M12, M16, M20, M24, M27, M30</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: M8, M10, M12, M16, M20, M24, M27, M30</p> <p><u> aço de reforço (B500 B):</u> tamanhos incluídos: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32</p>
<b>Faixa de temperatura (possivelmente)</b>	Faixa de temperatura I: -40 °C para +40 °C Faixa de temperatura II: -40 °C para +80 °C Faixa de temperatura III: -40 °C para +120 °C

4. 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**

5. 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-11/0415**

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 550-10

9. Desempenho declarado:

Características essenciais	Método de projeto	Desempenho		Especificações técnicas harmonizadas
		Varão roscado	Vergalhão	
Resistência característica para cargas de tensão	TR 029, CEN/TS 1992-4	Anexo C1, C2	Anexo C5, C6	ETAG 001
Resistência Característica a cargas de cisalhamento	TR 029, CEN/TS 1992-4	Anexo C3	Anexo C7	
Resistência característica a terremotos C1	TR 045	Anexo C4	Anexo C8	
Mudança na utilização	TR 029, CEN/TS 1992-4	Anexo C9	Anexo C10	

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:

*S. Weustenhagen*

**Stefan Weustenhagen**  
(Diretor)  
Weilerbach, 13.11.2015

i.V. *Detlef Bigalke*

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



**Table C1:** Characteristic values for **threaded rods** under **tension loads** in **cracked concrete**

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
<b>Steel failure</b>											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$							
<b>Combined pull-out and concrete cone failure</b>											
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 40 °C/24 °C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,5	5,5	5,5	5,5	6,5	6,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	4,0	5,5	5,5	not admissible			
Temperature range II: 80 °C/50 °C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,5	4,0	4,0	4,0	4,0	4,5	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	4,0	4,0	not admissible			
Temperature range III: 120 °C/72 °C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	3,0	3,5	3,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	not admissible			
Increasing factor for $\tau_{Rk,cr}$		$\psi_c$	C25/30	1,02							
			C30/37	1,04							
			C35/45	1,07							
			C40/50	1,08							
			C45/55	1,09							
			C50/60	1,10							
Factor according to CEN/TS 1992-4-5		$k_8$	[-]	7,2							
<b>Concrete cone failure</b>											
Factor according to CEN/TS 1992-4-5		$k_{cr}$	[-]	7,2							
Edge distance		$c_{cr,N}$	[mm]	1,5 $h_{ef}$							
Axial distance		$s_{cr,N}$	[mm]	3,0 $h_{ef}$							
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2						
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4				not admissible			

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for **threaded rods** under **tension loads** in **cracked concrete**

**Annex C1**

**Table C2: Characteristic values for threaded rods under tension loads in non-cracked concrete**

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
<b>Steel failure</b>											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$							
<b>Combined pull-out and concrete cone failure</b>											
Characteristic bond resistance in non-cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	10	12	12	12	12	11	10	9
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	8,5	8,5	8,5	not admissible			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	9	9	9	9	8,5	7,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	not admissible			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	6,5	5,5	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,0	5,0	not admissible			
Increasing factor for $\tau_{Rk,ucr}$		$\psi_c$	C25/30	1,02							
			C30/37	1,04							
			C35/45	1,07							
			C40/50	1,08							
			C45/55	1,09							
			C50/60	1,10							
Factor according to CEN/TS 1992-4-5		$k_8$	[-]	10,1							
<b>Concrete cone failure</b>											
Factor according to CEN/TS 1992-4-5		$k_{ucr}$	[-]	10,1							
Edge distance		$c_{cr,N}$	[mm]	1,5 $h_{ef}$							
Axial distance		$s_{cr,N}$	[mm]	3,0 $h_{ef}$							
<b>Splitting failure</b>											
Edge distance for		$c_{cr,sp}$	[mm]	$1,0 \cdot h_{ef} \leq 2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right) \leq 2,4 \cdot h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2						
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4					not admissible		

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for **threaded rods** under **tension loads** in **non-cracked concrete**

**Annex C2**

**Table C3:** Characteristic values for **threaded rods** under **shear loads** in **cracked and non-cracked concrete**

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
<b>Steel failure without lever arm</b>										
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0,5 \cdot A_s \cdot f_{uk}$							
Ductility factor according to CEN/TS 1992-4-5	$k_2$	[-]	0,8							
<b>Steel failure with lever arm</b>										
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}$							
<b>Concrete pry-out failure</b>										
Factor k acc. to TR 029 or $k_3$ acc. to CEN/TS 1992-4-5	$k_{(3)}$	[-]	2,0							
<b>Concrete edge failure</b>										
Effective length of anchor	$l_f$	[mm]	$l_f = \min(h_{ef}; 8 d_{nom})$							
Outside diameter of anchor	$d_{nom}$	[mm]	8	10	12	16	20	24	27	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							

**Injection sytem VMU plus for concrete**

**Performance**  
Characteristic value for **threaded rods** under **shear loads**

**Annex C3**

**Table C4:** Characteristic values for **threaded rods** under **seismic action**, category **C1**

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
<b>Tension load</b>												
<b>Steel failure</b>												
Characteristic tension resistance	$N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}$									
<b>Combined pull-out and concrete cone failure</b>												
Characteristic bond resistance in concrete C20/25 to C50/60												
Temperature range I: 40 °C/24 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	2,5	3,1	3,7	3,7	3,7	3,8	4,5	4,5	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	2,5	2,5	3,7	3,7	not admissible				
Temperature range II: 80 °C/50 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,6	2,2	2,7	2,7	2,7	2,8	3,1	3,1	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,6	1,9	2,7	2,7	not admissible				
Temperature range III: 120 °C/72 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	2,1	2,4	2,4	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	not admissible				
Increasing factor for $\tau_{Rk,seis}$	$\psi_c$	[-]	1,0									
Installation safety factor (dry and wet concrete)	$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2								
Installation safety factor (flooded bore hole)	$\gamma_2 = \gamma_{inst}$	[-]	1,4						not admissible			
<b>Shear load</b>												
<b>Steel failure without lever arm</b>												
Characteristic shear resistance	$V_{Rk,s,seis}$	[kN]	$0,35 \cdot A_s \cdot f_{uk}$									
<b>Steel failure with lever arm</b>												
Characteristic bending moment	$M^0_{Rk,s,seis}$	[Nm]	No Performance Determined (NPD)									

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for **threaded rods** under **seismic action**, category **C1**

**Annex C4**

**Table C5: Characteristic values for rebar under tension loads in cracked concrete**

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
<b>Steel failure</b>												
Characteristic tension resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$									
<b>Combined pull-out and concrete cone failure</b>												
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,5	5,5	5,5	5,5	5,5	6,5	6,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	4,0	5,5	5,5	5,5	not admissible			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,5	4,0	4,0	4,0	4,0	4,0	4,5	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	4,0	4,0	4,0	not admissible			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	3,0	3,0	3,5	3,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	not admissible			
Increasing factors for $\tau_{Rk,cr}$		$\psi_c$	C25/30	1,02								
			C30/37	1,04								
			C35/45	1,07								
			C40/50	1,08								
			C45/55	1,09								
			C50/60	1,10								
Factor acc. to CEN/TS 1992-4-5		$k_8$	[-]	7,2								
<b>Concrete cone failure</b>												
Factor acc. to CEN/TS 1992-4-5		$k_{cr}$	[-]	7,2								
Edge distance		$c_{cr,N}$	[mm]	1,5 $h_{ef}$								
Axial distance		$s_{cr,N}$	[mm]	3,0 $h_{ef}$								
Installation safety factor (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2							
Installation safety factor (flooded bore hole)		$\gamma_2 = \gamma_{inst}$	[-]	1,4					not admissible			

<sup>1)</sup>  $f_{uk} = f_{tk} = k \cdot f_{yk}$

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for rebar under tension loads in cracked concrete

**Annex C5**

**Table C6: Characteristic values for rebar under tension loads in non-cracked concrete**

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32		
<b>Steel failure</b>													
Characteristic tension resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$										
<b>Combined pull-out and concrete cone failure</b>													
Characteristic bond resistance in non-cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	10	12	12	12	12	12	11	10	8,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	8,5	8,5	8,5	8,5	not admissible				
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	9	9	9	9	9	8,0	7,0	6,0	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	not admissible				
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	6,5	6,0	5,0	4,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,0	5,0	5,0	not admissible				
Increasing factors for $\tau_{Rk,ucr}$	$\psi_c$	C25/30		1,02									
		C30/37		1,04									
		C35/45		1,07									
		C40/50		1,08									
		C45/55		1,09									
		C50/60		1,10									
Factor acc. to CEN/TS 1992-4-5	$k_8$	[-]	10,1										
<b>Concrete cone failure</b>													
Factor acc. to CEN/TS 1992-4-5	$k_{ucr}$	[-]	10,1										
Edge distance	$c_{cr,N}$	[mm]	1,5 $h_{ef}$										
Axial distance	$s_{cr,N}$	[mm]	3,0 $h_{ef}$										
<b>Splitting failure</b>													
Edge distance for	$c_{cr,sp}$	[mm]	$1,0 \cdot h_{ef} \leq 2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right) \leq 2,4 \cdot h_{ef}$										
Axial distance	$s_{cr,sp}$	[mm]	$2 c_{cr,sp}$										
Installation safety factor (dry and wet concrete)	$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2									
Installation safety factor (flooded bore hole)	$\gamma_2 = \gamma_{inst}$	[-]	1,4						not admissible				

<sup>1)</sup>  $f_{uk} = f_{tk} = k \cdot f_{yk}$

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for rebar under tension loads in non-cracked concrete

**Annex C6**



**Table C7:** Characteristic values for **rebar** under **shear loads** in **cracked and non-cracked concrete**

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
<b>Steel failure without lever arm</b>											
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0,50 \cdot A_s \cdot f_{uk}^{1)}$								
Ductility factor according to CEN/TS 1992-4-5	$k_2$	[-]	0,8								
<b>Steel failure with lever arm</b>											
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{1)}$								
<b>Concrete pry-out failure</b>											
Factor k acc. to TR 029 or $k_3$ acc. to CEN/TS 1992-4-5	$k_{(3)}$	[-]	2,0								
<b>Concrete edge failure</b>											
Effective length of anchor	$l_f$	[mm]	$l_f = \min(h_{ef}; 8 d_{nom})$								
Outside diameter of anchor	$d_{nom}$	[mm]	8	10	12	14	16	20	25	28	32
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								

<sup>1)</sup>  $f_{uk} = f_{tk} = k \cdot f_{yk}$

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for **rebar** under **shear loads** in **cracked and non-cracked concrete**

**Annex C7**

**Table C8:** Characteristic values for **rebar** under **seismic action**, category **C1**

Rebar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
<b>Tension load</b>													
<b>Steel failure</b>													
Characteristic tension resistance	$N_{Rk,s,seis}$	[kN]	$A_s \cdot f_{uk}^{1)}$										
<b>Combined pull-out and concrete cone failure</b>													
Characteristic bond resistance in concrete C20/25 to C50/60													
Temperature range I: 40 °C/24 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	2,5	3,1	3,7	3,7	3,7	3,7	3,8	4,5	4,5	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	2,5	2,5	3,7	3,7	3,7	not admissible				
Temperature range II: 80 °C/50 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,6	2,2	2,7	2,7	2,7	2,7	2,8	3,1	3,1	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,6	1,9	2,7	2,7	2,7	not admissible				
Temperature range III: 120 °C/72 °C	dry and wet concrete	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	2,0	2,1	2,4	2,4	
	flooded bore hole	$\tau_{Rk,seis}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	not admissible				
Increasing factor for $\tau_{Rk,seis}$	$\psi_c$	[-]	1,0										
Installation safety factor (dry and wet concrete)	$\gamma_2 = \gamma_{inst}$	[-]	1,0	1,2									
Installation safety factor (flooded bore hole)	$\gamma_2 = \gamma_{inst}$	[-]	1,4						not admissible				
<b>Shear load</b>													
<b>Steel failure without lever arm</b>													
Characteristic shear resistance	$V_{Rk,s,seis}$	[kN]	$0,35 \cdot A_s \cdot f_{uk}^{1)}$										
<b>Steel failure with lever arm</b>													
Characteristic bending moment	$M^0_{Rk,s,seis}$	[Nm]	No Performance Determined (NPD)										

<sup>1)</sup>  $f_{uk} = f_{tk} = k \cdot f_{yk}$

**Injection sytem VMU plus for concrete**

**Performance**

Characteristic values for **rebar** under **seismic action**, category **C1**

**Annex C8**

**Table C9: Displacements under tension loads<sup>1)</sup> (threaded rod)**

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
<b>Non-cracked concrete C20/25</b>										
Temperature range I: 40 °C/24 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,030	0,033	0,037	0,045	0,052	0,060	0,065	0,071
Temperature range II: 80 °C/50 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
Temperature range III: 120 °C/72 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
<b>Cracked concrete C20/25</b>										
Temperature range I: 40 °C/24 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,090			0,070				
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,105			0,105				
Temperature range II: 80 °C/50 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170				
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245				
Temperature range III: 120 °C/72 °C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170				
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245				

<sup>1)</sup> Calculation of the displacement

$$\delta_{N0} = \delta_{N0}\text{-Faktor} \cdot \tau; \quad \tau: \text{acting bond stress for tension load}$$

$$\delta_{N\infty} = \delta_{N\infty}\text{-Faktor} \cdot \tau;$$

**Table C10: Displacements under shear load<sup>1)</sup> (threaded rod)**

Threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
<b>Non-cracked concrete C20/25</b>										
All temperature ranges	$\delta_{V0}$ -factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$ -factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
<b>Cracked concrete C20/25</b>										
All temperature ranges	$\delta_{V0}$ -factor	[mm/(kN)]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07
	$\delta_{V\infty}$ -factor	[mm/(kN)]	0,18	0,18	0,17	0,15	0,14	0,13	0,12	0,10

<sup>1)</sup> Calculation of the displacement

$$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V; \quad V: \text{acting shear load}$$

$$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V;$$

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**Performance**  
Displacements (threaded rod)

**Annex C9**

**Table C11: Displacements under tension load<sup>1)</sup> (rebar)**

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
<b>Non-cracked concrete C20/25</b>											
Temperature range I: 40 °C/24 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,021	0,023	0,026	0,028	0,031	0,036	0,043	0,047	0,052
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,030	0,033	0,037	0,041	0,045	0,052	0,061	0,071	0,075
Temperature range II: 80 °C/50 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Temperature range III: 120 °C/72 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
<b>Cracked concrete C20/25</b>											
Temperature range I: 40 °C/24 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,090				0,070				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,105				0,105				
Temperature range II: 80 °C/50 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219				0,170				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255				0,245				
Temperature range III: 120 °C/72 °C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219				0,170				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255				0,245				

<sup>1)</sup> Calculation of the displacement

$$\delta_{N0} = \delta_{N0}\text{-Faktor} \cdot \tau; \quad \tau: \text{acting bond stress for tension load}$$

$$\delta_{N\infty} = \delta_{N\infty}\text{-Faktor} \cdot \tau;$$

**Table C12: Displacements under shear load<sup>1)</sup> (rebar)**

Rebar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
<b>Non-cracked concrete C20/25</b>											
All temperature ranges	δ <sub>v0</sub> -factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	δ <sub>v∞</sub> -factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04
<b>Cracked concrete C20/25</b>											
All temperature ranges	δ <sub>v0</sub> -factor	[mm/(kN)]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,06
	δ <sub>v∞</sub> -factor	[mm/(kN)]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,10

<sup>1)</sup> Calculation of the displacement

$$\delta_{v0} = \delta_{v0}\text{-factor} \cdot V; \quad V: \text{acting shear load}$$

$$\delta_{v\infty} = \delta_{v\infty}\text{-factor} \cdot V;$$

**Injection sytem VMU plus for concrete**

**Performance**  
Displacements (rebar)

**Annex C10**