

## PRESTATIEVERKLARING

MKT Injectiesysteem VMU Plus  
voor beton

geldig voor  
**Injectieanker XV Plus**

Dit document MÜPRO is alleen informatie en is niet onderworpen aan het bijwerken.  
De volledige inhoud mag alleen worden gebruikt voor reclame of andere doeleinden na goedkeuring door de MÜPRO.  
Alle rechten en wijzigingen.

PRESTATIEVERKLARING  
DoP Nr. MKT-321 - nl

1. Unieke identificatiecode van het producttyp: **MKT Injectiesysteem VMU plus**
2. Type-, partij- of serienummer, dan wel een ander identificatiemiddel voor het bouwproduct, zoals voorgeschreven in artikel 11, lid 4:  
**ETA-11/0415, Bijlage A2, A3**  
**Chargennummer: zie verpakking**
3. Beoogde gebruiken van het bouwproduct, overeenkomstig de toepasselijke geharmoniseerde technische specificatie, zoals door de fabrikant bepaald:

<b>Producttype</b>	verlijmd anker
<b>Voor toepassing in</b>	gescheurd en ongescheurd beton C20/25 - C50/60 (EN 206)
<b>Optie</b>	1
<b>Belasting</b>	Statisch, quasi-statisch of seismisch (prestatiecategorie C1)
<b>Materiaal</b>	<u>thermisch verzinkt staal:</u> alleen in droge binnenruimtes inbegrepen maten: M8, M10, M12, M16, M20, M24, M27, M30  <u>staal verzinkt:</u> alleen in droge binnenruimtes inbegrepen maten: M8, M10, M12, M16, M20, M24, M27, M30  <u>roestvrij staal (markering A4):</u> voor binnen- en buitenbereiken zonder bijzonder agressieve omstandigheden inbegrepen maten: M8, M10, M12, M16, M20, M24, M27, M30  <u>hoogcorrosiebestendig staal (markering HCR):</u> voor binnen- en buitenbereiken onder bijzonder agressieve omstandigheden inbegrepen maten: M8, M10, M12, M16, M20, M24, M27, M30  <u>wapeningsstaal (B500 B):</u> inbegrepen maten: Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32
<b>Temperatuurbereik</b> (in voorkomende gevallen)	Bereik I: -40 °C tot +40 °C Bereik II: -40 °C tot +80 °C Bereik III: -40 °C tot +120 °C

4. Naam, geregistreerde handelsnaam of geregistreerd handelsmerk en contactadres van de fabrikant, zoals voorgeschreven in artikel 11, lid 5:

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

5. Indien van toepassing, naam en contactadres van de gemachtigde wiens mandaat de in artikel 12, lid 2, vermelde taken bestrijkt: --

6. Het systeem of de systemen voor de beoordeling en verificatie van de prestatiebestendigheid van het bouwproduct, vermeld in bijlage V: **System 1**
7. Indien de prestatieverklaring betrekking heeft op een bouwproduct dat onder een geharmoniseerde norm valt:  
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8. Indien de prestatieverklaring betrekking heeft op een bouwproduct waarvoor een Europese technische beoordeling is afgegeven:

**Deutsches Institut für Bautechnik, Berlin**

heeft het volgende afgegeven:

**ETA-11/0415**

op basis van

**ETAG 001-5**

De aangemelde instantie voor productcertificering 1343-CPR heeft het volgende uitgevoerd volgens systeem 1:

- i) de bepaling van het producttype op grond van typeonderzoek (inclusief bemonstering), typeberekening, getabelleerde waarden of een beschrijvende documentatie van het product;
- ii) de initiële inspectie van de productie-installatie en van de productiecontrole in de fabriek;
- iii) permanente bewaking, beoordeling en evaluatie van de productiecontrole in de fabriek

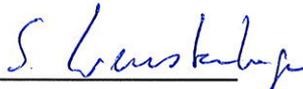
en heeft het volgende afgegeven: het certificaat van prestatiebestendigheid 1343-CPR-M 550-10

9. Aangegeven prestatie:

Essentiële kenmerken	Beoordelingsmethode	Prestaties		Geharmoniseerde technische specificaties
		Draadstang	Wapeningsstaal	
Karakteristieke trekweerstand	TR 029, CEN/TS 1992-4	bijlage C1, C2	bijlage C5, C6	ETAG 001
Karakteristieke afschuifweerstand	TR 029, CEN/TS 1992-4	bijlage C3	bijlage C7	
Karakteristieke weerstand bij seismische inwerking C1	TR 045	bijlage C4	bijlage C8	
Verschuiving in gebruikstoestand	TR 029, CEN/TS 1992-4	bijlage C9	bijlage C10	

Indien overeenkomstig artikel 37 of 38 een specifieke technische documentatie is gebruikt, de eisen waaraan het product voldoet: --

10. De prestaties van het in de punten 1 en 2 omschreven product zijn conform de in punt 9 aangegeven prestaties. Deze prestatieverklaring wordt verstrekt onder de exclusieve verantwoordelijkheid van de in punt 4 vermelde fabrikant: Ondertekend voor en namens de fabrikant door:

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

i.V.   
**Dipl.-Ing. Detlef Bigalke**  
 (Director of Product Development)



**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	$M_{Rk,s}^0$	[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**