

... eine starke Verbindung

DECLARAÇÃO DE DESEMPENHO

DoP número: MKT-2.1-701_pt

♦ Código de identificação único do produto-tipo: Sistema de injeção VME plus

- ♦ Utilização(ões) prevista(s):
- ♦ Fabricante:

 Sistemas de avaliação e verificação da regularidade:

Documento de Avaliação Europeu
 Avaliação Técnica Europeia :
 Organismo de Avaliação Técnica:
 Organismo(s) notificado (s):

Sistema de injeção para ancoragem em concreto, ver Anexo B / Annex B

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

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EAD 330499-01-0601 ETA-19/0483, 12.05.2021 DIBt, Berlin NB 2873 – Technische Universität Darmstadt

♦ Desempenho(s) declarado(s):

Características essenciais	Desempenho
Resistência mecânica e estabilidade (BWR 1)	
Resistências características sob carga de tração (efeitos estáticos e quase-estáticos)	Anexo / Annex B3, C1, C3-C6, C9-C11, C13-C15
Resistências características sob tensão transversal (efeitos estáticos e quase-estáticos)	Anexo / Annex C2, C7, C12, C16
Deslocamentos	Anexo / Annex C18 – C21
Resistência característica e deslocamentos para a categoria de desempenho sísmico C1 + C2	Anexo / Annex C8, C17-C19
Higiene, saúde e ambiente (BWR 3)	
Conteúdo, emissão e / ou liberação de substâncias perigosas	Desempenho não determinado

O desempenho do produto identificado acima está em conformidade com o conjunto de desempenhos declarados. A presente declaração de desempenho é emitida, em conformidade com o Regulamento (EU) n.o 305/2011, sob a exclusiva responsabilidade do fabricante identificado acima.

Assinado por e em nome do fabricante por:

Stefan Weustenhagen (Diretor-gerente) Weilerbach, 12.05.2021

p.p.



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

O original desta declaração de desempenho foi escrito em alemão. Em caso de desvios na tradução, a versão alemã é válida.

Specification of intended use								
Static and quasi-static action	working life 50 years working life 100 years							
Threaded rod Internally threaded anchor rod Rebar	VMU-IG M6 -	- M30 - VMU-IG M20 - Ø32						
	cracked or unc	racked concrete						
Base material	compacted, reinforced or unrei	C20/25 to C50/60 inforced normal weight concrete EN 206:2013+A1:2016						
		concrete: d air drilling / vaccum drilling						
Hole drilling	hammer drilling / compressed	d concrete: d air drilling / vaccum drilling / d drilling						
Temperature range ¹⁾	I: -40°C to +40°C II: -40°C to +72°C	I: -40°C to +40°C II: -40°C to +72°C						
Seismic action	performance category C1	performance category C2						
Threaded rod Internally threaded anchor rod Rebar	M8 - M30 Ø8 - Ø32	M12 - M24 						
	cracked or unc	cracked concrete						
Base material	strength classes C20/25 to C50/60 compacted, reinforced or unreinforced normal weight concrete (without fibers) acc. to EN 206:2013+A1:2016							
	hammer drilling / compressed air drilling / vaccum drilling							
Hole drilling	hammer drilling / compresse	ed air drilling / vaccum drilling						
Hole drilling Temperature range ¹⁾	hammer drilling / compresse I: -40°C to +40°C II: -40°C to +72°C	ed air drilling / vaccum drilling I: -40°C to +40°C II: -40°C to +72°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						
Temperature range ¹⁾ ¹⁾ Temperature Range I: max. Temperature Range II: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						
Temperature range ¹) ¹) Temperature Range I: max.	I: -40°C to +40°C II: -40°C to +72°C long term temperature +24°C and	I: -40°C to +40°C II: -40°C to +72°C max. short term temperature +40°C						

Specification of intended use

Use conditions (Environmental conditions):

- · Structures subject to dry internal conditions: all materials
- For all other conditions: Intended use of Materials according to Annex A4, Table A1 corresponding corrosion resistance classes CRC according to EN 1993-1-4:2006+A1:2015

Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete
 work
- Anchorages are designed in accordance with EN 1992-4:2018 or Technical Report TR 055, February 2018

Installation:

- Dry or wet concrete or waterfilled drillholes (not seawater)
- Hole drilling by hammer drill, compressed air drill, vacuum drill or diamond drill mode
- Overhead installation allowed
- Anchor installation carried out by appropriately qualified personnel and under the responsibility of the person responsible for technical matters of the site
- Internally threaded anchor rod: Screws and threaded rods (incl. nut and washer) must at least correspond to the material and strength class of the internally threaded anchor rod used

Injection System VME plus

Intended use Specifications

Table B1: Installation parameters for threaded rods

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Diameter of threaded	rod	d=dnom	[mm]	8	10	12	16	20	24	27	30
Nominal drill hole diar	neter	d ₀	[mm]	10	12	14	18	22	28	30	35
Effective encharage d	anth	h _{ef,min}	[mm]	60	60	70	80	90	96	108	120
Effective anchorage depth -		h _{ef,max}	[mm]	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture	Pre-setting installation	d _f ≤	[mm]	9	12	14	18	22	26	30	33
	Through setti installation	^{ing} d _f ≤	[mm]	12	14	16	20	24	30	33	40
Maximum installation torque max.T _{inst} ≤		[Nm]	10	20	40 (35) ¹⁾	60	100	170	250	300	
Minimum thickness of	member	h _{min}	[mm]	h _{ef} + 3	0mm ≥1	00mm			h _{ef} + 2d ₀	I	
Minimum spacing		Smin	[mm]	40	50	60	75	95	115	125	140
Minimum edge distan	ce	Cmin	[mm]	35	40	45	50	60	65	75	80

¹⁾ max. installation torque for property class 4.6

Table B2: Installation parameters for internally threaded anchor rods

Internally threaded anchor rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20	
Inner diameter of threaded rod	d ₂	[mm]	6	8	10	12	16	20	
Outer diameter of threaded rod ¹⁾	$d = d_{nom}$	[mm]	10	12	16	20	24	30	
Nominal drill hole diameter	d 0	[mm]	12	14	18	22	28	35	
Effective encharges depth	h _{ef,min}	[mm]	60	70	80	90	96	120	
Effective anchorage depth	h _{ef,max}	[mm]	200	240	320	400	480	600	
Diameter of clearance hole in the fixture	d _f ≤	[mm]	7	9	12	14	18	22	
Maximum installation torque n	nax.T _{inst} ≤	[Nm]	10	10	20	40	60	100	
Minimum screw-in depth	lıg	[mm]	8	8	10	12	16	20	
Minimum thickness of member h _{min}		[mm]		30mm 0mm	h _{ef} + 2d ₀				
Minimum spacing	Smin	[mm]	50	60	75	95	115	140	
Minimum edge distance	Cmin	[mm]	40	45	50	60	65	80	

¹⁾ with metric thread acc. to EN 1993-1-8:2005+AC:2009

Table B3: Installation parameters for rebar

Rebar			Ø 8	Ø 10	Ø 12	2 Ø 14	Ø 16	Ø 20	Ø 24	Ø2	5 Ø 28	Ø 32
Diameter of rebar	$d = d_{nom}$	[mm]	8	10	12	14	16	20	24	25	28	32
Nominal drill hole diameter 1)	do	[mm]	10 12	12 14	14 1	6 18	20	25	30 32	30 3	2 35	40
Effective anchorage	h _{ef,min}	[mm]	60	60	70	75	80	90	96	100	112	128
	h _{ef,max}	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h _{min}	[mm]		- 30 mm 00 mm		h _{ef} + 2d ₀						
Minimum spacing	Smin	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	e Cmin	[mm]	35	40	45	50	50	60	70	70	75	85
¹⁾ for Ø8, Ø10,Ø12, Ø24 ar	nd Ø25 b	oth non	ninal drill	hole dia	meter	can be us	əd					

Injection System VME plus

Intended use

Installation parameters

Annex B3

	[
Threaded rod	Internally threaded anchor rod	Rebar	Drill bit Ø	Brush Ø	min. Brush Ø
		(11111111111111)		d _b ;	WW
[-]	[-]	Ø [mm]	d ₀ [mm]	d ⊾ [mm]	d _{b,min} [mm]
M8		8	10	11,5	10,5
M10	VMU-IG M6	8 / 10	12	13,5	12,5
M12	VMU-IG M8	10 / 12	14	15,5	14,5
		12	16	17,5	16,5
M16	VMU-IG M10	14	18	20,0	18,5
		16	20	22,0	20,5
M20	VMU-IG M12		22	24,0	22,5
		20	25	27,0	25,5
M24	VMU-IG M16		28	30,0	28,5
M27		24 / 25	30	31,8	30,5
		24 / 25	32	34,0	32,5
M30	VMU-IG M20	28	35	37,0	35,5
		32	40	43,5	40,5

Table B5: Retaining washer

Drill bit Ø		Installation direction and use							
d ₀ [mm]	[-]	₽	+	1					
10									
12	No roto			uirod					
14	no reta	ining wa	sner requ	lirea					
16									
18	VM-IA 18								
20	VM-IA 20								
22	VM-IA 22								
25	VM-IA 25								
28	VM-IA 28	h _{ef} > 250mm	h _{ef} > 250mm	all					
30	VM-IA 30		2001111						
32	VM-IA 32								
35	VM-IA 35								
40	VM-IA 40								

Vacuum drill bit

Vacuum drill bit (MKT Hollow drill bit SB, Würth Hammer drill bit with suction or Heller Duster Expert hollow drill bit system) and a vacuum cleaner with minimum negative pressure of 253 hPa and flow rate of minimum 42 l/s (150 m³/h)



Recommended compressed air tool (min 6 bar) Drill bit diameter (d₀): all diameters

Injection System VME plus

Intended use

Cleaning and setting tools

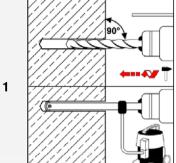
Annex B4

Table B6: Working time and curing time

Comer	ata tamar		Morking time	Minimum curing time					
Concr	ete temp	berature	Working time	dry concrete	wet concrete				
0°C	to	+4°C	90 min	144 h	288 h				
+5°C	to	+9°C	80 min	48 h	96 h				
+10°C	to	+14°C	60 min	28 h	56 h				
+15°C	to	+19°C	40 min 18 h		36 h				
+20°C	to +24°C		to +24°C		C to +24°C		30 min	12 h	24 h
+25°C	to	+34°C	12 min	9 h	18 h				
+35°C	to	+39°C	8 min	6 h	12 h				
	+40°C		8 min	4 h	8 h				
Cartrio	dge temp	perature	+5°C to +40°C						

Installation instructions

Drilling of the drill hole and cleaning: Hammer drilling, compressed air drilling and vacuum drilling



Hammer drilling or compressed air drilling:

Drill with hammer drill or compressed air drill a hole into the base material with prescribed nominal drill hole diameter (Table B1, B2 or B3) and selected drillhole depth. Continue with step 2.

In case of aborted drill hole, the drill hole shall be filled with mortar.

Vacuum drilling: see Annex B4 Drill drillhole with prescribed nominal drill hole diameter (Table B1, B2 or B3) and selected drillhole depth. This drilling method removes dust and cleans the drillhole during drilling. Continue with step 3. In case of aborted drill hole, the drill hole shall be filled with mortar.

Attention! Standing water in the drill hole must be removed before cleaning!

Cleaning: dry, wet and water-filled drill holes with all diameter in uncracked and cracked concrete (Cleaning not applicable when using vacuum drilling)

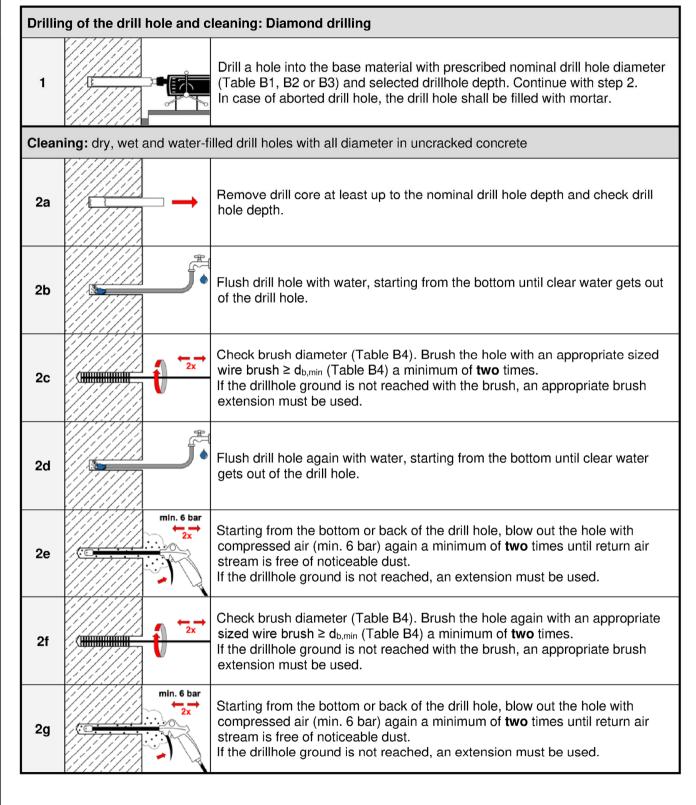
2a	min. 6 bar 2x	Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) a minimum of two times until return air stream is free of noticeable dust. If the drillhole ground is not reached, an extension must be used.
2b		Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush $\geq d_{b,min}$ (Table B4) a minimum of two times. If the drillhole ground is not reached with the brush, an appropriate brush extension must be used.
2c	min. 6 bar 2x	Starting from the bottom or back of the drill hole, blow out the hole with compressed air (min. 6 bar) again a minimum of two times until return air stream is free of noticeable dust. If the drillhole ground is not reached, an extension must be used.

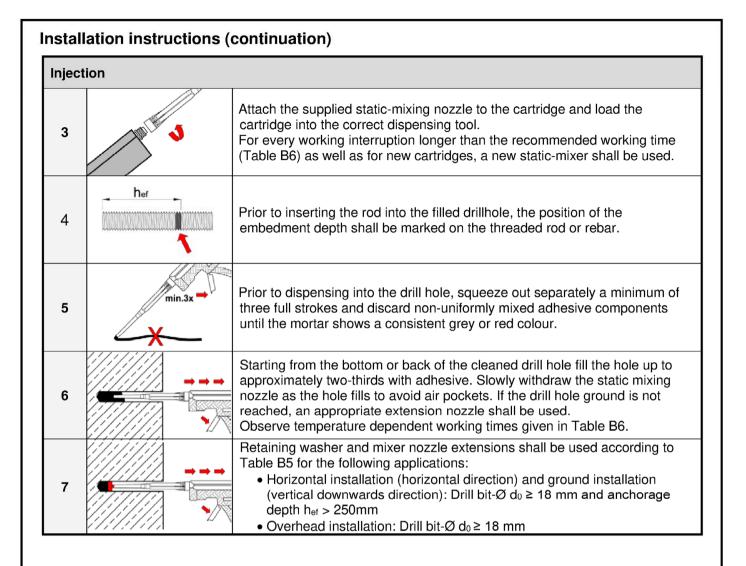
After cleaning, the drillhole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the drillhole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the drillhole again.

Injection System VME plus

Intended use Installation instructions – Drilling and cleaning: Hammer drilling, compressed air drilling and vacuum drilling Annex B6







Intended use Installation instructions – Injection Annex B8

L	ing the fastening elem	ent
8		Push the threaded rod or reinforcing bar into the hole while turning slightly to ensure proper distribution of the adhesive until the embedment depth is reached. The anchor shall be free of dirt, grease, oil or other foreign material.
9		Make sure that excess mortar is visible at the top of the hole and in case of through-setting installation also in the fixture. If these requirements are not maintained, repeat application before end of working time! For overhead installation, the anchor should be fixed (e.g. by wedges).
10		Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B6).
1		Remove excess mortar.
2	T _{inst}	The fixture can be mounted after curing time. Apply installation torque T _{inst} according to Table B1 or B2.
13		In case of pre-setting installation the annular gap between anchor rod and fixture can optionally be filled with mortar. Therefore, replace regular washer by washer with drill and plug on reducing adapter on static mixer. Annular gap is completely filled, when excess mortar seeps out.

area resistance under tens / class 4.6 and 4.8 / class 5.6 and 5.8 / class 8.8 and HCR / class 50 and HCR / class 70 HCR / class 80	As sion load Nrk,s Nrk,s Nrk,s Nrk,s	[mm ²] ¹⁾ [kN] [kN] [kN]	36,6 15 (13) 18 (17) 29 (27) 18	58,0 23 (21) 29 (27) 46 (43) 29	84,3 34 42 67 42	157 63 78 125	245 98 122 196	353 141 176 282	459 184 230	561 224 280	
resistance under tens / class 4.6 and 4.8 / class 5.6 and 5.8 / class 8.8 and HCR / class 50 and HCR / class 70 HCR	sion load N _{Rk,s} N _{Rk,s} N _{Rk,s}	1) [kN] [kN] [kN] [kN]	15 (13) 18 (17) 29 (27)	23 (21) 29 (27) 46 (43)	34 42 67	63 78 125	98 122	141 176	184 230	224 280	
/ class 4.6 and 4.8 / class 5.6 and 5.8 / class 8.8 and HCR / class 50 and HCR / class 70 HCR	N _{Rk,s} N _{Rk,s} N _{Rk,s}	[kN] [kN] [kN] [kN]	(13) 18 (17) 29 (27)	(21) 29 (27) 46 (43)	42 67	78 125	122	176	230	280	
/ class 5.6 and 5.8 / class 8.8 and HCR / class 50 and HCR / class 70 HCR	Nrk,s Nrk,s Nrk,s	[kN] [kN] [kN]	(13) 18 (17) 29 (27)	(21) 29 (27) 46 (43)	42 67	78 125	122	176	230	280	
/ class 8.8 and HCR / class 50 and HCR / class 70 HCR	Nrk,s Nrk,s	[kN]	(17) 29 (27)	(27) 46 (43)	67	125					
and HCR / class 50 and HCR / class 70 HCR	N _{Rk,s}	[kN]	(27)	(43)			196	282			
/ class 50 and HCR / class 70 HCR			18	29	12				368	449	
/ class 70 HCR	N _{Rk,s}	[kN]			42	79	123	177	230	281	
		[]	26	41	59	110	171	247	_3)	_3)	
01233 00	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	_3)	_3)	
:)			1					I	1		
/ class 4.6	γMs,N	[-]	2,0								
/ class 4.8	γMs,N	[-]	1,5								
/ class 5.6	γMs,N	[-]	2,0								
/ class 5.8	γMs,N	[-]	1,5								
/ class 8.8	γMs,N	[-]				1	,5				
	γMs,N	[-]				2,	86				
	γMs,N	[-]			1	,87			_3)	_3)	
	γMs,N	[-]			1	,6			_3)	_3)	
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regulation$\gamma_{Ms,N}$$\gamma_{Ms,N}$</td> <td>y class 4.6$\gamma_{MS,N}$[-]2,0y class 4.8$\gamma_{MS,N}$[-]1,5y class 5.6$\gamma_{MS,N}$[-]2,0y class 5.8$\gamma_{MS,N}$[-]1,5y class 5.8$\gamma_{MS,N}$[-]1,5y class 8.8$\gamma_{MS,N}$[-]1,5y class 5.0$\gamma_{MS,N}$[-]1,5and HCR$\gamma_{MS,N}$[-]1,6y class 50$\gamma_{MS,N}$[-]1,87HCR$\gamma_{MS,N}$[-]1,6y class 80$\gamma_{MS,N}$[-]1,6stic resistances apply for all anchor rods with the cross sectional area As specified heral standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulationHeral standard threaded rodsHeral standard threaded rods</td> <td>y class 4.6$\gamma_{Ms,N}$[-]2,0y class 4.8$\gamma_{Ms,N}$[-]1,5y class 5.6$\gamma_{Ms,N}$[-]2,0y class 5.8$\gamma_{Ms,N}$[-]1,5y class 5.8$\gamma_{Ms,N}$[-]1,5y class 8.8$\gamma_{Ms,N}$[-]1,5y class 50$\gamma_{Ms,N}$[-]1,5and HCR$\gamma_{Ms,N}$[-]1,87y class 70$\gamma_{Ms,N}$[-]1,87HCR$\gamma_{Ms,N}$[-]1,6y class 80$\gamma_{Ms,N}$[-]1,6stic resistances apply for all anchor rods with the cross sectional area As specified here: VMUal standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized threaded N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulation$\gamma_{Ms,N}$$\gamma_{Ms,N}$</td> <td>y class 4.6$\gamma_{Ms,N}$[-]2,0y class 4.8$\gamma_{Ms,N}$[-]1,5y class 5.6$\gamma_{Ms,N}$[-]2,0y class 5.8$\gamma_{Ms,N}$[-]1,5y class 8.8$\gamma_{Ms,N}$[-]1,5y class 5.0$\gamma_{Ms,N}$[-]1,5y class 50$\gamma_{Ms,N}$[-]1,6and HCR$\gamma_{Ms,N}$[-]1,87y class 70$\gamma_{Ms,N}$[-]1,6HCR$\gamma_{Ms,N}$[-]1,6y class 80$\gamma_{Ms,N}$[-]1,6Joint cresistances apply for all anchor rods with the cross sectional area As specified here: VMU-A, V-A, al standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized threaded rods M N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulationHereHere</td>	y class 4.6 $\gamma_{Ms,N}$ [-]y class 4.8 $\gamma_{Ms,N}$ [-]y class 5.6 $\gamma_{Ms,N}$ [-]y class 5.8 $\gamma_{Ms,N}$ [-]y class 8.8 $\gamma_{Ms,N}$ [-]and HCR $\gamma_{Ms,N}$ [-]y class 50 $\gamma_{Ms,N}$ [-]and HCR $\gamma_{Ms,N}$ [-]y class 70 $\gamma_{Ms,N}$ [-]11HCR $\gamma_{Ms,N}$ [-]y class 80 $\gamma_{Ms,N}$ [-]11stic resistances apply for all anchor rods with the cross sectional areaal standard threaded rods with a smaller cross sectional area (e.g. hold)N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulation	y class 4.6 $\gamma_{Ms,N}$ [-]2y class 4.8 $\gamma_{Ms,N}$ [-]1y class 5.6 $\gamma_{Ms,N}$ [-]2y class 5.8 $\gamma_{Ms,N}$ [-]1y class 8.8 $\gamma_{Ms,N}$ [-]1y class 5.0 $\gamma_{Ms,N}$ [-]1and HCR $\gamma_{Ms,N}$ [-]2,and HCR $\gamma_{Ms,N}$ [-]1,87y class 50 $\gamma_{Ms,N}$ [-]1,87HCR $\gamma_{Ms,N}$ [-]1,6stic resistances apply for all anchor rods with the cross sectional area As specal standard threaded rods with a smaller cross sectional area (e.g. hot-dip gate N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulation $\gamma_{Ms,N}$ $\gamma_{Ms,N}$	y class 4.6 $\gamma_{MS,N}$ [-]2,0y class 4.8 $\gamma_{MS,N}$ [-]1,5y class 5.6 $\gamma_{MS,N}$ [-]2,0y class 5.8 $\gamma_{MS,N}$ [-]1,5y class 5.8 $\gamma_{MS,N}$ [-]1,5y class 8.8 $\gamma_{MS,N}$ [-]1,5y class 5.0 $\gamma_{MS,N}$ [-]1,5and HCR $\gamma_{MS,N}$ [-]1,6y class 50 $\gamma_{MS,N}$ [-]1,87HCR $\gamma_{MS,N}$ [-]1,6y class 80 $\gamma_{MS,N}$ [-]1,6stic resistances apply for all anchor rods with the cross sectional area As specified heral standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulationHeral standard threaded rodsHeral standard threaded rods	y class 4.6 $\gamma_{Ms,N}$ [-]2,0y class 4.8 $\gamma_{Ms,N}$ [-]1,5y class 5.6 $\gamma_{Ms,N}$ [-]2,0y class 5.8 $\gamma_{Ms,N}$ [-]1,5y class 5.8 $\gamma_{Ms,N}$ [-]1,5y class 8.8 $\gamma_{Ms,N}$ [-]1,5y class 50 $\gamma_{Ms,N}$ [-]1,5and HCR $\gamma_{Ms,N}$ [-]1,87y class 70 $\gamma_{Ms,N}$ [-]1,87HCR $\gamma_{Ms,N}$ [-]1,6y class 80 $\gamma_{Ms,N}$ [-]1,6stic resistances apply for all anchor rods with the cross sectional area As specified here: VMUal standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized threaded N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulation $\gamma_{Ms,N}$ $\gamma_{Ms,N}$	y class 4.6 $\gamma_{Ms,N}$ [-]2,0y class 4.8 $\gamma_{Ms,N}$ [-]1,5y class 5.6 $\gamma_{Ms,N}$ [-]2,0y class 5.8 $\gamma_{Ms,N}$ [-]1,5y class 8.8 $\gamma_{Ms,N}$ [-]1,5y class 5.0 $\gamma_{Ms,N}$ [-]1,5y class 50 $\gamma_{Ms,N}$ [-]1,6and HCR $\gamma_{Ms,N}$ [-]1,87y class 70 $\gamma_{Ms,N}$ [-]1,6HCR $\gamma_{Ms,N}$ [-]1,6y class 80 $\gamma_{Ms,N}$ [-]1,6Joint cresistances apply for all anchor rods with the cross sectional area As specified here: VMU-A, V-A, al standard threaded rods with a smaller cross sectional area (e.g. hot-dip galvanized threaded rods M N ISO 10684:2004 + AC:2009), the values in brackets are valid.national regulationHereHere	

Performance Characteristic steel resistance for **threaded rods** under **tension load** Annex C1

Threa	ded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel	failure				1			1	1	1	I
Cross	sectional area	As	[mm ²]	36,6	58,0	84,3	157	245	353	459	561
Chara	acteristic resistance under shear load	1)							1		1
Steel	failure <u>without</u> lever arm										
pe	Property class 4.6 and 4.8	$V^0{}_{\text{Rk},\text{s}}$	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
Steel, zinc plated	Property class 5.6 and 5.8	$V^0_{Rk,s}$	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
zin	Property class 8.8	$V^0_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
SS	A2, A4 and HCR, property class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
Stainless steel	A2, A4 and HCR, property class 70	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124	-	-
S	A4 and HCR, property class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	-	-
Steel	failure <u>with</u> lever arm								-		
Steel, zinc plated	Property class 4.6 and 4.8	M^0 Rk,s	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
	Property class 5.6 and 5.8	M ⁰ Rk,s	[Nm]	19 (16)	37 (33)	65	166	324	560	833	112
	Property class 8.8	$M^0_{Rk,s}$	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	179
SS	A2, A4 and HCR, property class 50	$M^0{}_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	112
Stainless steel	A2, A4 and HCR, property class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	232	454	784	_3)	_3)
Ω Ω	A4 and HCR, property class 80	$M^0_{Rk,s}$	[Nm]	30	59	105	266	519	896	_3)	_3)
Partia	al factor ²⁾										
	Property class 4.6	γMs,V	[-]				1,6	57			
Steel, zinc plated	Property class 4.8	γMs,V	[-]				1,2	25			
Steel, ic plate	Property class 5.6	γMs,V	[-]				1,6	67			
zino	Property class 5.8	γMs,V	[-]				1,2	25			
	Property class 8.8	γMs,V	[-]				1,2	25			
SS	A2, A4 and HCR, property class 50	γMs,V	[-]				2,3	8			
Stainless steel	A2, A4 and HCR, property class 70	γMs,V	[-]			1,5	6			_3)	_3)
Ś	A4 and HCR, property class 80	γMs,V	[-]			1,3	33			_3)	_3)
For acc in a	e characteristic resistances apply for all and r commercial standard threaded rods with a cording to EN ISO 10684:2004 + AC:2009) absence of national regulation chor type not part of the ETA	a smaller cr	oss sec	ctional a	rea (e.g.						

Characteristic steel resistance for threaded rods under shear load

Threaded rods / Interna	lly threaded anchor ro	ods / Rel	bars	all sizes						
Concrete cone failure										
Factor k	uncracked concrete	k _{ucr,N}	[-]	11,0						
Factor k1 cracked concrete kcr,N [-] 7,7										
Edge distance C _{cr,N} [mm] 1,5 • h _{ef}										
Spacing		S _{cr,N}	[mm]	2 · c _{cr,N}						
Splitting failure										
Characteristic resistance		N ⁰ Rk,sp	[kN]	min(N _{Rk,p} ;N ⁰ _{Rk,c})						
	h/h _{ef} ≥ 2,0			1,0 • h _{ef}						
Edge distance	$2,0 > h/h_{ef} > 1,3$	Ccr,sp	[mm]	2 • h _{ef} (2,5 - h / h _{ef})						
$\frac{h}{h_{ef}} \le 1,3$										
Spacing		Scr,sp	[mm]	2 • C _{cr,sp}						

Table C4: Characteristic values of tension load for threaded rods,static and quasi-static action, working life 50 years

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure										1		
Characteristic resistance	9	N _{Rk,s}	[kN]			A _s • f	uk (or se	ee Tabl	e C1)			
Partial factor		γMs,N	[-]				see Ta	ble C1				
Combined pull-out and	concrete failure											
Characteristic bond res	sistance in <u>uncrac</u>	<u>cked</u> col	ncrete C2	0/25								
Temperature range I: 40°C / 24°C	hammer- or compressed air	τRk,ucr	[N/mm ²]	20	20	19	19	18	17	16	16	
Temperature range II: 72°C / 50°C	drilling	€TRk,ucr	[N/mm ²]	15	15	15	14	13	13	12	12	
Temperature range I: 40°C / 24°C	vacuum drilling	τRk,ucr	[N/mm ²]	17 (16) ¹⁾	16	16	16 (15) ¹⁾	15	14	14	13	
Temperature range II: 72°C / 50°C	vacuum uniing	$ au_{Rk,ucr}$	[N/mm ²]	14	14	14	13	13	12	12	11	
Characteristic bond res	sistance in <u>cracke</u>	ed concr	rete C20/2	5								
Temperature range I: 40°C / 24°C	hammer-, compressed air	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5			
Temperature range II: 72°C / 50°C	[N/mm ²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0			
Reduction factor ψ^{0}_{sus} in	n concrete C20/25											
Temperature range I: 40°C / 24°C	hammer-, compressed air	ψ^0 sus	[-]	0,80								
Temperature range II: 72°C / 50°C	or vacuum drilling	ψ^0 sus	[-]				0,	68				
	C25/30		[-]	1,02								
	C30/37		[-]					04				
Increasing factors for	C35/45	Ψc	[-]					07				
concrete	C40/50		[-]					08				
	C45/55 C50/60		[-]					09 10				
Concrete cone failure							ι,	10				
Relevant parameter							see Ta	ble C3				
Splitting failure							500 10					
Relevant parameter							see Ta	ble C3				
Installation factor							555 10					
			1 1					0				
dry or wet concrete		γinst	[-]				1	,0				
waterfilled drill hole	1. J. 1. 1. 1	γinst	[-]				1	,2				
¹⁾ value in brackets: charac	teristic bond resista	nce for w	vaterfilled d	irill hole:	S							
Injection System V	ME plus											
Performance Characteristic values o									Ar	nnex (24	

Table C5: Characteristic values of tension load for threaded rods,static and quasi-static action, working life 100 years

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure												
Characteristic resistance)	N _{Rk,s}	[kN]			A₅ • f	_{uk} (or s	ee Tabl	e C1)			
Partial factor		γMs,N	[-]				see Ta	ble C1				
Combined pull-out and	concrete failure											
Characteristic bond res	sistance in <u>uncra</u>	<u>cked</u> cor	ncrete C2	0/25								
Temperature range I: 40°C / 24°C	Hammer- or compressed air	τ _{Rk,ucr,100}	[N/mm ²]	20	20	19	19	18	17	16	16	
Temperature range II: 72°C / 50°C	drilling	τ _{Rk,ucr,100}	[N/mm ²]	15	15	15	14	13	13	12	12	
Temperature range I: 40°C / 24°C	Vacuum drilling	τ _{Rk,ucr,} 100	[N/mm ²]	17 (16) ¹⁾	16	16	16 (15) ¹⁾	15	14	14	13	
Temperature range II: 72°C / 50°C	Vacuum unning	τRk,ucr,100	[N/mm ²]	14	14	14	13	13	12	12	11	
Characteristic bond res	sistance in <u>crack</u>	ed concr	ete C20/2	5								
Temperature range I: 40°C / 24°C	Hammer-, compressed air	[N/mm ²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5		
Temperature range II: 72°C / 50°C	or vacuum drilling	[N/mm ²]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5		
	C25/30		[-]				1,	02				
	C30/37		[-]	.,								
Increasing factors for	C35/45		[-]	1,07								
concrete	C40/50	Ψο	[-]	1,08								
	C45/55		[-]				1,	09				
	C50/60		[-]				1,	10				
Concrete cone failure												
Relevant parameter							see Ta	ble C3				
Splitting failure												
Relevant parameter							see Ta	ble C3				
Installation factor			Γ									
dry or wet concrete		γinst	[-]				1	,0				
waterfilled drill hole		γinst	[-]				1	,2				
¹⁾ Value in brackets: characteristic bond resistance for waterfilled drill holes												
Injection System V	/ME plus											
Performance Characteristic values of tension loads for threaded rods, working life 100 years								Ar	nnex (25		

Table C6: Characteristic values of tension load for threaded rods,static and quasi-static action, working life 50 and 100 years,diamond drilling in uncracked concrete

Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure						1				I		
Characteristic resistance	9	N _{Rk,s}	[kN]			As • f	uk (or s	ee Tabl	le C1)			
Partial factor		γMs,N	[-]				see Ta	able C1				
Combined pull-out and	l concrete failure											
Characteristic bond re	sistance in <u>uncra</u>	<u>cked</u> cor	ncrete C2	0/25					Workin	g life 50	years	
Temperature range I: 40°C / 24°C	diamond drilling	TRk,ucr	[N/mm ²]	15	14	14	13	12	12	11	11	
Temperature range II: 72°C / 50°C	diamond diming	€7Rk,ucr	[N/mm²]	12	12	11	10	9,5	9,5	9,0	9,0	
Reduction factor ψ^{0}_{sus}	in <u>uncracked</u> con	crete C2	0/25									
Temperature range I: 40°C / 24°C	diamond drilling	ψ^0 sus	[-]	0,77								
Temperature range II: 72°C / 50°C	[-]				0,	72						
Characteristic bond re	sistance in <u>uncra</u>	ncrete C20	0/25				۷	Vorking	life 100	years		
Temperature range I: 40°C / 24°C	diamond drilling	[N/mm²]	15	14	14	13	12	12	11	11		
Temperature range II: 72°C / 50°C	diamond dining	τ _{Rk,ucr,} 100	[N/mm²]	11	11	10	10	9,5	9,0	8,5	8,5	
	C25/30		[-]	1,04								
	C30/37		[-]	1,08								
Increasing factors for	C35/45		[-]	1,12								
concrete	C40/50	Ψο	[-]				1,	15				
	C45/55		[-]				1,	17				
	C50/60		[-]				1,	19				
Concrete cone failure												
Relevant parameter							see Ta	able C3				
Splitting failure												
Relevant parameter							see Ta	able C3				
Installation factor												
dry or wet concrete		γinst	[-]				1	,0				
waterfilled drill hole	[-]		1,2				1,4					
Injection System V	/ME plus											
Performance Characteristic values o working life 50 and 100								Ar	nnex (26		

Table C7: Characteristic values of shear loads for threaded rods,static and quasi-static action

Threaded rod		M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure <u>without</u> lever arm				1	1		1			
Characteristic shear resistance Steel, property class 4.6, 4.8, 5.6 and 5.8	V ⁰ Rk,s	[kN]					A _s ∙ f _{uk} Γable C	2		
Characteristic shear resistance Steel, property class 8.8 Stainless steel A2, A4 and HCR (all property classes)	$V^0_{Rk,s}$	[kN]				,	A _s ∙ f _{uk} Γable C	2		
Ductility factor	k 7	[-]				1	,0			
Partial factor	γMs,V	[-]				see Ta	ble C2			
Steel failure <u>with</u> lever arm										
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]			c		V _{el} • f _{uk} āble C	2		
Elastic section modulus	W_{el}	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	γMs,V	[-]				see Ta	uble C2		•	
Concrete pry-out failure										
Pry-out factor	k ₈	[-]				2	,0			
Concrete edge failure									-	
Effective length of anchor	lf	[mm]	m] min (h _{ef} ;12 d _{nom}) min (h _{ef} ;300mn							
Outside diameter of anchor	[mm]	8	10	12	16	20	24	27	30	
Installation factor	actor γ_{inst} [-] 1,0									

Table C8: Characteristic values of tension load for threaded rods,seismic action (performance category C1 + C2), working life 50 and 100 years

				M8	M10	M12	M16	M20	M24	M27	M30
Tension loads											
Steel failure											
Characteristic resistance	e C1	N _{Rk,s,C1}	[kN]				1,0 •	$N_{Rk,s}$			
Characteristic resistance steel, zinc plated, proper stainless steel A4 and H property class ≥ 70	ty class 8.8	NRk,s,C2	[kN]	-	1)		1,0 •	N _{Rk,s}			1)
Partial factor		γMs,N	[-]			•	see Ta	ble C1			
Combined pull-out and	l concrete failure										
Characteristic bond rea	sistance in conci	rete C20/2	5 to C50	/60							
Temperature range I:	hammer-,	$ au_{Rk,C1}$	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5
40°C / 24°C	compressed	$ au_{Rk,C2}$	[N/mm²]	-	1)	5,8	4,8	5,0	5,1	-	1)
Temperature range II:	air or – vacuum	$ au_{Rk,C1}$	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0
72°C / 50°C	drilling	$ au_{Rk,C2}$	[N/mm²]	-	1)	5,0	4,1	4,3	4,4	-	1)
Installation factor											
Dry or wet concrete γinst [-] 1,0											
Waterfilled drill hole		γinst	[-]				1	,2			
Table C9: Characteristic values of shear loads for threaded rods, seismic action (performance category C1 + C2)											
Seismic a						M12	M16	M20	M24	M27	M30
				/ C1 +	• C2)			M20	M24	M27	M30
Threaded rod	action (perform			/ C1 +	• C2)			M20	M24	M27	M30
Threaded rod Shear loads	action (perform			/ C1 +	• C2)		M16	М20 V ⁰ _{Rk,s}	M24	M27	M30
Threaded rod Shear loads Steel failure <u>without</u> le	ver arm C1 C2 ty class 8.8	mance ca	ategory	/ C1 +	• C2) M10	M12	M16	V ⁰ Rk,s	M24	M27	M30
Threaded rod Shear loads Steel failure <u>without</u> ler Characteristic resistance steel, zinc plated, proper stainless steel A4 and H	ver arm C1 C2 ty class 8.8	V _{Rk,s,C1}	[kN]	/ C1 + M8	• C2) M10	M12	M16 0,7 •),7 • V ⁰ F	V ⁰ Rk,s	M24		M30
Threaded rod Shear loads Steel failure without less Characteristic resistance Characteristic resistance steel, zinc plated, proper stainless steel A4 and H property class ≥ 70 Partial factor Factor for anchorages	ver arm C1 C2 ty class 8.8	VRk,s,C1 VRk,s,C2	[kN]	/ C1 + M8	• C2) M10	M12	M16 0,7 ⋅ 0,7 ⋅ V ⁰ F see Ta 1	V ⁰ Rk,s Rk,s	M24		M30
Threaded rod Shear loads Steel failure without less Characteristic resistance Characteristic resistance steel, zinc plated, proper stainless steel A4 and H property class ≥ 70 Partial factor Factor for anchorages	ection (perform ver arm C1 C2 ty class 8.8 CR, chout annular gap ular gap between ed rod and fixture ssed	Mance ca V _{Rk,s,C1} V _{Rk,s,C2} γ _{Ms,N}	[kN]	/ C1 + M8	• C2) M10	M12	M16 0,7 ⋅ 0,7 ⋅ V ⁰ F see Ta 1	V ⁰ Rk,s Ik,s Ible C2 ,0	M24		M30

Table C10: Characteristic values of tension loads for internally threaded anchor rod,static and quasi-static action, working life 50 years

Internally threaded ar	nchor rod				VMU-IG M 6	VMU-IG M 8	VMU-IG M 10	VMU-IG M 12	VMU-IG M 16	VMU-IG M 20
Steel failure 1)										
Characteristic resistand	ce,	5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123
steel, zinc plated, prop	erty class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196
Partial factor 5.8 and 8			γMs,N	[-]			1	,5		
Characteristic resistand								= 0		
Stainless steel A4 / HC property class 70	;R,		$N_{Rk,s}$	[kN]	14	26	41	59	110	124 ²⁾
Partial factor			γMs,N	[-]			1,87			2,86
Combined pull-out an	d concrete	failure		LJ			.,			,00
Characteristic bond r				oncrete	C20/25					
Temperature range I: 40°C / 24°C	hammer-	or		[N/mm²]	20	19	19	18	17	16
Temperature range II: 72°C / 50°C	compresse drilling		€7Rk,ucr	[N/mm²]	15	15	14	13	13	12
Temperature range I: 40°C / 24°C	vacuum dri	illina	€7Rk,ucr	[N/mm²]	16	16	16 (15) ³⁾	15	14	13
Temperature range II: 72°C / 50°C	vacuum un	lining i	τ̃Rk,ucr	[N/mm²]	14	14	13	13	12	11
Characteristic bond r	1		<u>ked</u> con	crete C2	0/25					
Temperature range I: 40°C / 24°C	hammer compresse	d air	€7, TRk, cr	[N/mm²]	7,0	8,5	8,5	8,5	8,5	8,5
Temperature range II: 72°C / 50°C	or vacuu drilling		τ _{Rk,cr}	[N/mm²]	6,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ^{0}_{sus}										
Temperature range I: 40°C / 24°C	hammer compresse	d air	$\psi^0{}_{\text{sus}}$	[-]			0,	80		
Temperature range II: 72°C / 50°C	or vacuu drilling		$\psi^0{}_{\text{sus}}$	[-]				68		
				C25/30 C30/37				02		
				C30/37			,	04 07		
Increasing factor for co	ncrete		Ψc	C40/50				08		
				C45/55				09		
				C50/60				10		
Concrete cone failure)									
Relevant parameter							see Ta	ıble C3		
Splitting failure										
Relevant parameter							see Ta	uble C3		
Installation factor										
dry or wet concrete			γinst	[-]				,0		
waterfilled drill hole γinst [-] 1,2 1) ^{IF} Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element. 2) 2) for VMU-IG M20: property class 50 3) value in bracket is valid for waterfilled drill hole										
Injection System	VME plus	;								
Performance Characteristic values of tension loads for internally threaded anchor rod, working life 50 years Annex C9										

Table C11: Characteristic values of tension loads for internally threaded anchor rod static and quasi-static action, working life 100 years

Internally threaded ar	nchor rod			VMU-IG M 6	VMU-IG M 8	VMU-IG M 10	VMU-IG M 12	VMU-IG M 16	VMU-IG M 20		
Steel failure 1)							L		I		
Characteristic resistand	ce, 5.	8 N _{Rk,s}	[kN]	10	17	29	42	76	123		
steel, zinc plated, prop		8 N _{Rk,s}	[kN]	16	27	46	67	121	196		
Partial factor 5.8 and 8	.8	γMs,N	[-]		•	1	,5	•			
Characteristic resistand Stainless steel A4 / HC property class 70		N _{Rk,s}	[kN]	14	26	41	59	110	124 ²⁾		
Partial factor		γMs,N	[-]			1,87			2,86		
Combined pull-out an	d concrete failu	ire	<u> </u>						1		
Characteristic bond r	esistance in un	cracked c	oncrete	C20/25							
Temperature range I: 40°C / 24°C	hammer- or compressed ai		[N/mm ²]	20	19	19	18	17	16		
$\begin{array}{ c c c c c c c c c c c c c c c c c c c$											
Temperature range I: 40°C / 24°C	vacuum drilling	τ _{Rk,ucr} ,100	[N/mm ²]	16	16	16 (15) ³⁾	15	14	13		
Temperature range II: 72°C / 50°C			[N/mm ²]	14	14	13	13	12	11		
Characteristic bond r	esistance in <u>cra</u>	icked con	crete C2	0/25							
Temperature range I: 40°C / 24°C	hammer-, compressed ai	TRk,cr,100	[N/mm ²]	6,5	7,5	7,5	7,5	7,5	7,5		
Temperature range II: 72°C / 50°C	or vacuum drilling	TRk,cr,100	[N/mm²]	5,5	6,5	6,5	6,5	6,5	6,5		
			C25/30			,	02				
			C30/37			,	04				
Increasing factor for co	ncrete	Ψc	C35/45			,	07				
0		1-	C40/50			,	08				
			C45/55			,	09				
-			C50/60			1,	10				
Concrete cone failure							h la 00				
Relevant parameter						see la	ble C3				
Splitting failure											
Relevant parameter						see Ta	ible C3				
Installation factor							•				
dry or wet concrete		γinst	[-]				,0				
waterfilled drill hole γinst [-] 1,2 ¹⁾ fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element. ²⁾ for VMU-IG M20: property class 50 3) value in bracket is valid for waterfilled drill hole											
njection System VME plus Performance Characteristic values of tension loads for internally threaded anchor rod, working life 100 years Annex C10											

Table C12: Characteristic values of tension loads for internally threaded anchor rod,
static and quasi-static action, working life 50 and 100 years,
diamond drilling

Internally threaded ar	nchor rod			VMU-IG M 6	VMU-IG M 8	VMU-IG M 10	VMU-IG M 12	VMU-IG M 16	VMU-IG M 20
Steel failure 1)									
Characteristic resistance	ce, 5.	8 NRk,s	[kN]	10	17	29	42	76	123
steel, zinc plated, prop	erty class 8	8 N _{Rk,s}	[kN]	16	27	46	67	121	196
Partial factor 5.8 and 8		γMs,N	[-]		-	1	,5	-	
Characteristic resistand stainless steel A4 / HC property class 70		N _{Rk,s}	[kN]	14	26	41	59	110	124 ²⁾
Partial factor		γMs,N	[-]			1,87		•	2,86
Combined pull-out an	d concrete fail	ure							
Characteristic bond r	esistance in <u>un</u>	<u>cracked</u> c	oncrete	C20/25			W	orking life	50 years
Temperature range I: 40°C / 24°C	diamond drillin		[N/mm²]	14	14	13	12	12	11
Temperature range II: 72°C / 50°C			[N/mm ²]	12	11	10	9,5	9,5	9,0
Reduktionsfaktor ψ^0_{st}	IS								
Temperature range I: 40°C / 24°C	diamond drillin	ψ ⁰ sus	[-]			0,	77		
Temperature range II: 72°C / 50°C		ψ ⁰ sus	[-]			0,	72		
Characteristic bond r	esistance in <u>un</u>	cracked c	oncrete	C20/25			Wo	rking life ·	00 years
Temperature range I: 40°C / 24°C	diamond drillin		[N/mm²]	14	14	13	12	12	11
Temperature range II: 72°C / 50°C			[N/mm²]	11	10	10	9,5	9,0	8,5
			C25/30			,	04		
			C30/37				08		
Increasing factor for τ_{RI}	<,ucr	Ψc	C35/45 C40/50			,	12 15		
			C45/55				17		
			C50/60				19		
Concrete cone failure	•								
Relevant parameter						see Ta	ble C3		
Splitting failure									
Relevant parameter						see Ta	ble C3		
Installation factor									
dry or wet concrete		γinst	[-]			1	,0		
waterfilled drill hole		γinst	[-]	1,	2		1,	4	
 ¹⁾ fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod. The characteristic tension resistance for steel failure of the given strength class are valid for th internally threaded anchor rod and the fastening element. ²⁾ for VMU-IG M20: property class 50 ³⁾ value in bracket is valid for waterfilled drill hole 									
Injection System	VME plus								
Performance Characteristic values of tension loads for internally threaded anchor rod, working life 50 and 100 years, diamond drilling									c C11

Table C13: Characteristic values of shear loads for internally threaded anchor rod, static and quasi-static action

Internally threaded anchor rod VMU-IG VMU-IG												
Steel fa	ailure <u>without</u> lever arm ¹⁾											
ed	Characteristic resistance,	5.8	$V^0_{Rk,s}$	[kN]	6	10	17	25	45	74		
Steel, zinc plated	property class	8.8	V ⁰ Rk,s	[kN]	8	14	23	34	60	98		
zin	Partial factor 5.8 and 8.8		γMs,V	[-]			1,	25				
Stainless steel	Characteristic resistance, A4 / HCR, property class 70		V ⁰ Rk,s	[kN]	7	13	20	30	55	62 ²⁾		
Sta	Partial factor		γMs,V	[-]			1,56			2,38		
Ductility	/ factor		k7	[-]			1	,0				
Steel fa	ailure <u>with</u> lever arm ¹⁾			1	1	1		1	1	1		
eq	Characteristic bending	5.8	M ⁰ Rk,s	[Nm]	8	19	37	66	167	325		
Steel, zinc plated	resistance, - property class	8.8	M ⁰ Rk,s	[Nm]	12	30	60	105				
zin	Partial factor 5.8 and 8.8		γMs,V	[-]			1,	25				
Stainless steel	Characteristic bending resista A4 / HCR, property class 70	nce	M ⁰ Rk,s	[Nm]	11	26	53	92	234	643 ²⁾		
Sta	Partial factor		γMs,V	[-]			1,56			2,38		
Concre	ete pry-out failure			1								
Pry-out	factor		k ₈	[-]			2	,0				
Concre	ete edge failure			1						1		
Effectiv	e length of anchor		lf	[mm]		mir	n (h _{ef} ;12 d _r	nom)	1	min (h _{ef} 300mm		
Outside	e diameter of anchor		d _{nom}	[mm]	10	12	16	20	24	30		
Installat	tion factor		γinst	[-]			1	,0				
 ¹⁾ fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internally threaded anchor rod (exception: VMU-IG M20). The characteristic shear resistance for steel failure of the given strength class are valid for the internally threaded anchor rod and the fastening element. ²⁾ for VMU-IG M20: Internally threaded rod: property class 50; Fastening screws or threaded rods (incl. nut and washer): property class 70 												
Injecti	ion System VME plus											
Perform	nance	_		_					Anne	x C12		

Characteristic values of shear loads for internally threaded anchor rod

Table C14: Characteristic values of tension loads for rebar,static and quasi-static action, working life 50 years

Steel failure Characteristic tension resistance Nex.s [KN] A. 5 La ⁽¹⁾ Cross sectional area A. 1mm ²] 50 79 113 154 201 314 452 491 616 80 Partial factor $y_{06.N}$ [-] 1,4 $\frac{2}{2}$ 1,4 $\frac{2}{2}$ 1,4 $\frac{2}{2}$ 1,4 $\frac{2}{2}$ 1,4 $\frac{2}{2}$ 1,2 $\frac{12}{2}$ 12 12	einforcing bar $\ensuremath{\varnothing}\ 8\ensuremath{\left }\ensuremath{\varnothing}\ 10\ensuremath{\left }\ensuremath{\varnothing}\ 12\ensuremath{\left }\ensuremath{\varnothing}\ 14\ensuremath{\left }\ensuremath{\otimes}\ 20\ensuremath{\left }\ensuremath{\varnothing}\ 24\ensuremath{\left }\ensuremath{\otimes}\ 28\ensuremath{\left }\ensuremath{\otimes}\ 32\ensuremath{\right }\ensuremath{\otimes}\ 32\ensuremath{\left }\ensuremath{\otimes}\ 10\ensuremath{\left }\ensuremath{\otimes}\ 12\ensuremath{\left }\ 9\ensuremath{\left }\ 16\ensuremath{\left }\ensuremath{\otimes}\ 24\ensuremath{\left }\ensuremath{\otimes}\ 28\ensuremath{\left }\ 8\ensuremath{\left }\ 32\ensuremath{\left }\ 32\ens$													
	Reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Cross sectional area As. Imm ³ 50 79 113 154 201 314 452 491 616 60 Partial factor Max [-] 1.4 ²¹ 1.4 ²¹ Combined pull-out and concrete failure Characteristic bond resistance in uncracked concrete C20/25 Temperature range I: hammer- and ord c2/4*C Temperature range II: hammer- and crilling Temperature range II: hammer- and crilling Temperature range II: to assume for the colspan="4">Compressed air trauser (N/mm ²) 12 13<	Steel failure													
Partial factor YME.N [-] 1,4 ^{2/2} Combined pull-out and concrete failure Characteristic bond resistance in <u>uncracked</u> concrete C20/25 Temperature range II: OCC / 24*C mammer- and compressed air drilling trekur Temperature range II: d0*C / 24*C 16 16 16 16 16 16 16 15<	Characteristic tension r	esistance	N _{Rk,s}	[kN]					A _s •	f _{uk} 1)				
Combined pull-out and concrete failure Characteristic bond resistance in <u>uncracked</u> concrete C20/25 Temperature range I: dorG / 24°C hammer- and compressed air drilling TRkorr [N/mm?] 16 16 16 16 15	Cross sectional area		As	[mm²]	50	79	113	154	201	314	452	491	616	804
	Partial factor		γMs,N	[-]					1,4	4 ²⁾				
Temperature range I: d0°C / 24°C hammer- and compressed air d1000 Tmkuur (N/mm²) 16 16 16 16 16 15 15 15 15 Temperature range II: d0°C / 24°C vacuum drilling Tmkuur Temperature range II: d0°C / 24°C vacuum drilling Tmkuur Temperature range II: rescur 2°C / 50°C 12	Combined pull-out an	d concrete failure	e											
Apr:C / 24*C Ammmer and ornigressed air Compressed air Compressed air Cor / 24*C Tell war and the drilling Tell war Tell war and the compressed air Cor / 24*C Tell war Tell war Tell war and the tremperature range II: Cor / 24*C Tell war tell war auum drilling Tell war Tell	Characteristic bond r	esistance in <u>uncr</u> a	acked co	oncrete C	20/25									
Temperature range I: drilling trac.or [N/mm2] 12 13 13 13 13 13 13 13 13 13 13 13 <th13< th=""> 13 13</th13<>	Temperature range I: 40°C / 24°C		τ _{Rk,ucr}	[N/mm²]	16	16	16	16	16	16	15	15	15	15
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	Temperature range II: 72°C / 50°C		τ _{Rk,ucr}	[N/mm²]	12	12	12	12	12	12	12	12	11	11
Temperature range II: 72°C / 50°C Takuor [N/mm²] 12 (11) ³¹ 12 (11) ³¹ 11 (11) ³¹ 11 11 11	Temperature range I: 40°C / 24°C	voouum drilling	τ _{Rk,ucr}	[N/mm²]		14 (13) ³⁾	13	13	13	13	13	13	13	13
$\begin{array}{ c c c c c c } \hline Temperature range I: \\ d0^{\circ}C / 24^{\circ}C \\ for vacuum drilling \\ \hline Tenk.er \\ d^{\circ}C / 50^{\circ}C \\ \hline Tenk.er \\ \hline Tenk.er \\ for vacuum drilling \\ \hline Tenk.er \\$	Temperature range II: 72°C / 50°C	vacuum dniing	τRk,ucr	[N/mm²]				11	11	11	11	11	11	11
40°C / 24°C compressed air or vacuum drilling inverting inverton inverton inverting inverting inverton inverting i	Characteristic bond r	esistance in <u>crac</u> l	ked con	crete C20	/25									•
Introduction and or large frinting trilling	Temperature range I: 40°C / 24°C		τ _{Rk,cr}	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
Temperature range I: $40^{\circ}C / 24^{\circ}C$ hammer, compressed air or vacuum drilling ψ^{0}_{sus} [-]0,80 $10^{\circ}C / 24^{\circ}C$ or vacuum drilling ψ^{0}_{sus} [-]0,68 $10^{\circ}C / 24^{\circ}C$ or vacuum drilling ψ^{0}_{sus} [-]0,68 $10^{\circ}C / 24^{\circ}C$ 0.681,02 $10^{\circ}C / 20^{\circ}C$ 1,040.68 $10^{\circ}C / 20^{\circ}C$ 1,040.68Increasing factor for concrete ψ^{0}_{eu} $10^{\circ}C / 20^{\circ}C$ $10^{\circ}C / 20^{\circ}C$ 1,040.68Concrete cone failure0.680.68Relevant parametersee Table C3Splitting failuresee Table C3Relevant parametersee Table C3Installation factor1.0dry or wet concrete γ_{rest} [-] 10° waterfilled drill hole γ_{rest} 10° subscription 10° 10° subscripti	Temperature range II: 72°C / 50°C		τ _{Rk,cr}	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
40°C / 24°C compressed air or vacuum drilling \psi subscription (-] 0.80 Temperature range II: 72°C / 50°C or vacuum drilling \psi subscription (-] 0.68 Vec C25/30 1.02 C30/37 1.04 C35/45 1.07 Increasing factor for concrete Vec C35/45 1.07 C40/50 1.08 C45/55 1.09 C50/60 1.10 C50/60 1.10 Concrete cone failure See Table C3 See Table C3 See Table C3 Splitting failure see Table C3 See Table C3 See Table C3 Installation factor	Reductionfactor ψ^0_{sus}													
T2°C / 50°C drilling U ^r sus [-] 0,68 Increasing factor for concrete	Temperature range I: 40°C / 24°C		ψ^0 sus	[-]					0,	80				
Increasing factor for concrete $ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Temperature range II: 72°C / 50°C		ψ^0 sus											
Increasing factor for concrete $ \begin{array}{c c c c c c c c c c c c c c c c c c c $														
Increasing factor for concrete														
C45/55 1,09 C50/60 1,10 Concrete cone failure Relevant parameter see Table C3 Splitting failure Relevant parameter see Table C3 Installation factor dry or wet concrete	Increasing factor for co	ncrete	ψc											
C50/60 1,10 C50/60 1,10 Concrete cone failure Relevant parameter see Table C3 Splitting failure Relevant parameter see Table C3 Installation factor dry or wet concrete γ_{inst} [-] 1,0 waterfilled drill hole γ_{inst} [-] 1,2 0 fuk shall be taken from the specifications of reinforcing bars 1 1,2 0 fuk shall be taken from the specifications of reinforcing bars 1 1,2 0 value in brackets: characteristic bond resistance for waterfilled drill holes Annex C13														
Relevant parameter see Table C3 Splitting failure Relevant parameter see Table C3 Installation factor Installation factor Installation factor dry or wet concrete γinst [-] 1,0 waterfilled drill hole γinst [-] 1,2 0 fuk shall be taken from the specifications of reinforcing bars 1 1 0 value in brackets: characteristic bond resistance for waterfilled drill holes Injection System VME plus Performance Annex C13														
Splitting failure Relevant parameter see Table C3 Installation factor dry or wet concrete γinst yinst [-] 1,0 waterfilled drill hole γinst yinst [-] 1,2 fuk shall be taken from the specifications of reinforcing bars in absence of national regulation value in brackets: characteristic bond resistance for waterfilled drill holes Injection System VME plus Performance	Concrete cone failure				1									
Relevant parameter see Table C3 Installation factor Installation factor dry or wet concrete γinst [-] 1,0 waterfilled drill hole γinst [-] 1,2 fuk shall be taken from the specifications of reinforcing bars 1 1,2 fuk shall be taken from the specifications of reinforcing bars 1 1 value in brackets: characteristic bond resistance for waterfilled drill holes 1 1 Injection System VME plus Annex C13	Relevant parameter							5	see Ta	able C	3			
Installation factor dry or wet concrete γinst [-] 1,0 waterfilled drill hole γinst [-] 1,2 transform the specifications of reinforcing bars 1,2 1,2 transform the specifications of reinforcing bars 1,2 1,2 transform the specifications of reinforcing bars 1,2 1,2 transform the specification of reinforcing bars 1,2 1,2 value in brackets: characteristic bond resistance for waterfilled drill holes 1,2 1,2 injection System VME plus Annex C13 Annex C13										bla Of	2			
dry or wet concrete γinst [-] 1,0 waterfilled drill hole γinst [-] 1,2 fuk shall be taken from the specifications of reinforcing bars 1,2 1,2 in absence of national regulation value in brackets: characteristic bond resistance for waterfilled drill holes 1,0 njection System VME plus Annex C13	•								see ra	ible C.	3			
waterfilled drill hole γinst [-] 1,2 fuk shall be taken from the specifications of reinforcing bars in absence of national regulation in absence of national regulation value in brackets: characteristic bond resistance for waterfilled drill holes Injection System VME plus Annex C13				[]						0				
fuk shall be taken from the specifications of reinforcing bars in absence of national regulation value in brackets: characteristic bond resistance for waterfilled drill holes njection System VME plus Performance	-													
) in absence of national regulation) value in brackets: characteristic bond resistance for waterfilled drill holes Injection System VME plus Performance Annex C13		he specifications of							- 1	, ∠				
Performance Annex C13	²⁾ in absence of national I	regulation		-	drill h	oles								
Performance Annex C13	Injection System	VME plus									Τ			
	Performance	-	for reb a	r, working	g life 5	i0 vea	rs					Anne	ex C1	3

Table C15: Characteristic values of tension loads for rebar,static and quasi-static action, working life 100 years

Reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													
Characteristic tension r	resistance	N _{Rk,s}	[kN]					A _s •	f _{uk} 1)				
Cross sectional area		As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γMs,N	[-]			•	•	1,4	4 ²⁾	•	•		
Combined pull-out an	nd concrete failu	re											
Characteristic bond r	esistance in <u>unc</u>	cracked co	oncrete C	20/25									
Temperature range I: 40°C / 24°C	hammer- and compressed	τ _{Rk,ucr,100}	[N/mm²]	16	16	16	16	16	16	15	15	15	15
Temperature range II: 72°C / 50°C	air drilling	τ _{Rk,ucr,} 100	[N/mm²]	12	12	12	12	12	12	12	12	11	11
Temperature range I: 40°C / 24°C	vacuum drilling	τ _{Rk,ucr,100}	[N/mm²]	14 (13) ³⁾	14 (13) ³⁾	13	13	13	13	13	13	13	13
Temperature range II: 72°C / 50°C	Temperature range II:					12 (11) ³⁾	11	11	11	11	11	11	11
Characteristic bond r	esistance in <u>cra</u>	<u>cked</u> con	crete C20	/25						-			
Temperature range I: 40°C / 24°C	hammer-, compressed	τRk,cr,100	[N/mm ²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
Temperature range II: 72°C / 50°C	air or vacuum drilling	τRk,cr,100	[N/mm²]	5,5	5,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5	6,5
			C25/30						02				
			C30/37	1,04									
Increasing factor for co	oncrete	Ψc	C35/45	1,07									
			C40/50 C45/55					,	08 09				
			C50/60					,	10				
Concrete cone failure	•			I				,					
Relevant parameter							:	see Ta	able C	3			
Splitting failure													
Relevant parameter							:	see Ta	able C	3			
Installation factor				1									
dry or wet concrete		γinst	[-]					1	,0				
waterfilled drill hole		γinst	[-]					1	,2				
 ¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation ³⁾ value in brackets: characteristic bond resistance for waterfilled drill holes 													
Injection System VME plus													
Performance Characteristic values						ars					Anne	ex C1	4

Table C16: Characteristic values of tension loads for rebar. static and guasi-static action, working life 50 and 100 years, diamond drilling Ø 10 Ø 12 Ø 14 Ø 16 Ø 20 Ø 24 Ø 25 Ø 28 Ø 32 **Reinforcing bar** Ø8 Steel failure [kN] $A_s \cdot f_{uk}^{1)}$ Characteristic tension resistance N_{Rk.s} 452 As [mm²] 50 79 113 154 201 314 491 616 804 Cross sectional area 1,4²⁾ [-] Partial factor γMs,N Combined pull-out and concrete failure Characteristic bond resistance in uncracked concrete C20/25 Working life 50 years Temperature range I: 14 13 13 13 12 12 [N/mm²] 11 11 11 11 τRk.ucr 40°C / 24°C diamond drilling Temperature range II: 10 10 9.5 9.0 9.0 $\tau_{\rm Rk,ucr}$ [N/mm²] 11 11 10 9.5 9.5 72°C / 50°C Reduction factor w⁰sus Temperature range I: Ψ⁰sus 0.77 [-] 40°C / 24°C diamond drilling Temperature range II: 0.72 Ψ^0 sus [-] 72°C / 50°C Characteristic bond resistance in uncracked concrete C20/25 Working life 100 years Temperature range I: 13 12 12 11 [N/mm²] 14 13 13 11 11 11 TRk,ucr,100 40°C / 24°C diamond drilling Temperature range II: 11 10 10 10 9.5 9.0 9.0 9.0 8.5 [N/mm²] 8.5 TRk,ucr,100 72°C / 50°C C25/30 1.04 C30/37 1.08 C35/45 1,12 Increasing factor for concrete Ψc C40/50 1.15 C45/55 1.17 C50/60 1,19 Concrete cone failure Relevant parameter see Table C3 Splitting failure Relevant parameter see Table C3 Installation factor dry or wet concrete [-] 1.0 γinst waterfilled drill hole [-] 1.2 1.4 Yinst ¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars ²⁾ in absence of national regulation Injection System VME plus Performance Annex C15 Characteristic values of tension loads for rebar, working life 50 and 100 years, diamond drilling

Table C17: Characteristic val	ues	of sh	ear lo	oads f	or reb	ar, s	tatic a	and q ı	uasi-s	static	actio	n
Reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure <u>without</u> lever arm												
Characteristic shear V resistance	/ ⁰ Rk,s	[kN]					0,50 • /	A s ∙ f _{uk} ¹)				
Cross sectional area	As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γMs,V	[-]					1,	5 ²⁾				
Ductility factor	k 7	[-]					1	,0				
Steel failure <u>with</u> lever arm												
Characteristic bending N resistance	1 ⁰ Rk,s	[Nm]					1,2 • W	$I_{el} \cdot f_{uk}^{1)}$				
Elastic section modulus	Wel	[mm ³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	γMs,V	[-]					1,	5 ²⁾	•			
Concrete pry-out failure												
Pry-out factor	k ₈	[-]					2	,0				
Concrete edge failure												
Effective length of rebar	lf	[mm]			min	(h _{ef} ;12 (d _{nom})			min (h _{ef} ; 300)mm)
Outside diameter of rebar	d _{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γinst	[-]		-	-		1	,0				-

f_{uk} shall be taken from the specifications of reinforcing bars
 in absence of national regulation

Table C18: Characteristic values of tension load for rebar, seismic action (performance category C1), working life 50 and 100 years

Reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													
Characteristic resistance	[kN]	As • fuk ¹⁾											
Cross sectional area As			[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γMs,N	[-]					1,4	l ²⁾				
Combined pull-out and concrete failure													
Characteristic bond re	esistance in conci	rete C20	/25 to C5	0/60									
Temperature range I: 40°C / 24°C	hammer-, compressed air	τ _{Rk,C1}	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
Temperature range II: 72°C / 50°C	or vacuum drilling	τRk,C1	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Installation factor													
dry or wet concrete γ _{inst} [-]				1,0									
waterfilled drill hole		γinst	[-]					1,	2				

f_{uk} shall be taken from the specifications of reinforcing bars
 in absence of national regulation

Table C19: Characteristic values of shear loads for rebar, seismic action (performance category C1)

Reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure without lever an	m											
Characteristic resistance	$V_{Rk,s,C1}$	[kN]	0,35 • A _s • f _{uk} ¹⁾									
Cross sectional area	As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γMs,V	[-]	1,5 ²)									
Ductility factor	k 7	[-]					1	,0				

¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars

2) in absence of national regulation

Injection System VME plus

Characteristic values for rebar under seismic action

Annex C17

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30	
Hammer-, compresse	ed air or vac	uum drilling		•	•				•		
Displacement factor ¹⁾ Uncracked concrete, s	static and qu	asi-static actio	on. work	ina life s	50 and 1	00 vears	6				
Temperature range I:	δ _{N0} - factor		0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041	
40°C / 24°C	δ _{N∞} - factor	_ mm _	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041	
Temperature range II:	δ _{N0} - factor	$\left[\frac{\text{mm}}{N/mm^2}\right]$	0,038	0,039	0,040	0,044	0,047	0,051	0,052	0,055	
72°C / 50°C	δ _{N∞} - factor		0,047	0,049	0,051	0,055	0,059	0,064	0,067	0,070	
Displacement factor ¹⁾					and 100						
Cracked concrete, sta	δ _{N0} - factor	-static action,	0,069	0,071	0,072	0,074	0,076	0,079	0.081	0,082	
Temperature range I <i>:</i> 40°C / 24°C		mm	0,100	0,115	0,122	0,128	0,135	0,142		0,171	
	δ _{N0} - factor	$\left[\frac{\text{mm}}{N/mm^2}\right]$	0,092	0,095	0,096	0,099	0,102	0,106	-	0,110	
Temperature range II: 72°C / 50°C	δ _{N∞} - factor		0,134	0,154	0,163	0,172	0,181	0,189		0,229	
Displacement	UN∞ ⁻ Iacioi		0,104	0,104	0,100	0,172	0,101	0,100	0,207	0,220	
Uncracked and cracke		seismic actior	ו (C2)						1		
All temperature	δN,C2 (DLS)	[mm]	-	2)	0,21	0,24	0,27	0,36		2)	
-	$\delta_{\text{N,C2}}(\text{ULS})$				0,54	0,51	0,54	0,63			
Diamond drilling Displacement factor ¹⁾											
Uncracked concrete, s	static and qu	asi-static actio	on, work	ing life s	50 years				1		
Temperature range I:	δ _{N0} - factor		0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,01	
40°C / 24°C	$\delta_{N\infty}$ - factor		0,018	0,019	0,019	0,020	0,022	0,023	0,024	0,02	
Temperature range	δ_{N0} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,013	0,014	0,014	0,015	0,016	0,016	38 0,039 38 0,039 38 0,039 51 0,052 64 0,067 64 0,067 79 0,081 42 0,155 06 0,109 89 0,207 36 2 33 2 14 0,015 23 0,024 16 0,018 65 0,068 14 0,015 23 0,024 16 0,018 65 0,068	0,018	
II: 72°C / 50°C	δ _{N∞} - factor		0,052	0,053	0,055	0,058	0,062	0,065	0,068	0,070	
Displacement factor ¹⁾ Uncracked concrete, s	static and qu	asi-static activ	on work	ing life '	100 vear	<u> </u>					
Temperature range I:	δ _{N0} - factor		0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,015	
40°C / 24°C	δ _{N∞} - factor	_ mm _	0,020	0,021	0,021	0,023	0,024	0,025	0,026	0,02	
Temperature range	δ _{N0} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,013	0,014	0,014	0,015	0,016	0,016		0,018	
II: 72°C / 50°C	δ _{N∞} - factor		0,038	0,039	0,040	0,043	0,045	0,047	0,049	0,05	
¹⁾ Calculation of the disp $\delta_{N0} = \delta_{N0}$ -factor $\cdot \tau$; $\delta_{N\infty} = \delta_{N\infty}$ -factor $\cdot \tau$; ²⁾ No Performance ass	τ: αα	ting bond stres	s under te	ension loa	ad				<u> </u>		

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
All drilling metho	ds		I	1				1		
Displacement fact Uncracked and cra	or ¹⁾ acked concrete	e. static and qua	si-static	action						
All temperature	δ _{vo} - factor		0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
ranges	δv∞- factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Displacement Uncracked and cracked concrete, seismic action (C2)										
All temperature	δv,c2 (DLS)			0	3,1	3,4	3,5	4,2		
anges	δv,c2 (ULS)	[mm]	-	2)	6,0	7,6	7,3	10,9	·	2)

Performance Displacements (threaded rod under shear load)

Internally threaded anch	nor rod		VMU-IG M 6	VMU-IG M 8	VMU-IG M 10	VMU-IG M 12	VMU-IG M 16	VMU-IO M 20
Hammer-, compressed	air or vaccu	m drilling	·					
Uncracked concrete, sta	atic and quasi	-static action,	working li	fe 50 and 1	100 years			
Temperature range I:	δ _{N0} - factor		0,029	0,030	0,033	0,035	0,038	0,041
40°C / 24°C	δ _{N∞} - factor	$\left[\frac{\text{mm}}{\text{N/mm}^2}\right]$	0,029	0,030	0,033	0,035	0,038	0,041
Temperature range II:	δ _{N0} - factor	^L N/mm ²	0,039	0,040	0,044	0,047	0,051	0,055
72°C / 50°C	δ _{N∞} - factor		0,049	0,051	0,055	0,059	0,064	0,070
Cracked concrete, station	c and quasi-st	atic action, w	orking life	50 and 100) years			
Temperature range I:	δ _{N0} - factor		0,071	0,072	0,074	0,076	0,079	0,082
40°C / 24°C	δ _{N∞} - factor	$\left[\frac{\text{mm}}{\text{N/mm}^2}\right]$	0,115	0,122	0,128	0,135	0,142	0,171
Temperature range II:	δ _{N0} - factor	^L N/mm ^{2J}	0,095	0,096	0,099	0,102	0,106	0,110
72°C / 50°C	δ _{N∞} - factor		0,154	0,163	0,172	0,181	0,189	0,229
Diamond drilling								
Uncracked concrete, sta	atic and quasi	-static action,	working li	fe 50 years	3			
Temperature range I:	δ _{N0} - factor		0,012	0,012	0,013	0,014	0,014	0,015
40°C / 24°C	δ _{N∞} - factor	$\left[\frac{\text{mm}}{\text{N/mm}^2}\right]$	0,019	0,019	0,020	0,022	0,023	0,025
Temperature range II:	δ _{N0} - factor	^L N/mm ^{2J}	0,014	0,014	0,015	0,016	0,016	0,018
72°C / 50°C	δ _{N∞} - factor		0,053	0,055	0,058	0,062	0,065	0,070
Cracked concrete, static	c and quasi-st	atic action, w	orking life	100 years				
Temperature range I:	δ_{N0} - factor		0,012	0,012	0,013	0,014	0,014	0,015
40°C / 24°C	δ _{N∞} - factor	$\left[\frac{\text{mm}}{\text{N/mm}^2}\right]$	0,021	0,021	0,023	0,024	0,025	0,027
Temperature range II:	δ_{N0} - factor	^L N/mm ^{2J}	0,014	0,014	0,015	0,016	0,016	0,018
72°C / 50°C	δ _{N∞} - factor		0,039	0,040	0,043	0,045	0,047	0,051

Table C23: Displacement factors¹⁾ under shear load, internally threaded anchor rod

Internally threaded anch	or rod		VMU-IG M 6	VMU-IG M 8	VMU-IG M 10	VMU-IG M 12	VMU-IG M 16	VMU-IG M 20	
Uncracked and cracked	concrete, sta	tic and quasi-	static actio	on					
	δ _{vo} - factor	[mm/(kN)]	0,07	0,06	0,06	0,05	0,04	0,04	
All temperature ranges	δv∞- factor	[mm/(kN)]	0,10	0,09	0,08	0,08	0,06	0,06	
$\begin{array}{c c c c c c c c c c c c c c c c c c c $									
Injection System VI	/IE plus								
Performance							Anne	x C20	

Performance Displacements (internally threaded anchor rod)

Table C24: Displa	acement f	actors ¹⁾ u	nder t	ensio	n load	d (reba	ar)					
Reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Hammer-, compress	ed air or va	ccum drilli	ng			1			I	I	1	
Uncracked concrete,	static and q	uasi-static a	ction,	working	g life 50) and 1	00 year	ſS				
Temperature range I:	$\delta_{\text{N0}}\text{-}$ factor		0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
40°C / 24°C	δ _{N∞} - factor	r mm	0,015	0,015	0,016	0,017	0,017	0,019	0,020	0,020	0,021	0,023
Temperature range II:	δ_{N0} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,038	0,039	0,040	0,042	0,044	0,047	0,051	0,051	0,054	0,058
72°C / 50°C	δ _{N∞} - factor		0,047	0,049	0,051	0,053	0,055	0,059	0,065	0,065	0,068	0,072
Cracked concrete, sta	si-static act	ion, wo	orking	life 50 a	and 100	years						
Temperature range I:	δ_{NO^-} factor		0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
40°C / 24°C	$\delta_{N\infty^{-}} \text{ factor }$		0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temperature range II:	δ_{N0} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
72°C / 50°C	δ _{N∞} - factor		0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260
Diamond drilling												
Uncracked concrete,	static and o	uasi-static a	ction,	working	g life 50) years		•				
Temperature range I:	$\delta_{\text{N0}^{-}}$ factor		0,008	0,009	0,009	0,010	0,011	0,012	0,013	0,013	0,014	0,015
40°C / 24°C	$\delta_{N\infty}$ - factor		0,018	0,018	0,019	0,020	0,021	0,024	0,027	0,027	0,028	0,031
Temperature range II:	δ_{N0} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
72°C / 50°C	δ _{N∞} - factor		0,048	0,051	0,054	0,058	0,061	0,068	0,076	0,076	0,081	0,088
Uncracked concrete,	static and q	uasi-static a	ction,	working	g life 10	00 year	s					
Temperature range I:	δ_{N0^-} factor		0,008	0,009	0,009	0,010	0,011	0,012	0,013	0,013	0,014	0,015
40°C / 24°C	$\delta_{N\infty^-} \text{ factor}$	mm	0,018	0,020	0,021	0,022	0,024	0,026	0,029	0,029	0,031	0,034
Temperature range II:	δ_{NO} - factor	$\left[\frac{1}{N/mm^2}\right]$	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
72°C / 50°C	$δ_{N∞}$ - factor		0,035	0,037	0,040	0,042	0,045	0,049	0,055	0,055	0,059	0,064
¹⁾ Calculation of the dis $\delta_{N0} = \delta_{N0}$ - factor $\cdot \tau$; $\delta_{N\infty} = \delta_{N\infty}$ - factor $\cdot \tau$; Table C25: Displa	τ:	acting bond s actors ¹⁾ U)					
Reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked and crack	ed concrete	, static and	quasi-s	tatic ad	ction							
All temperature	δ _{vo} - factor		0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
ranges	δ _{v∞} - factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04
¹⁾ Calculation of the dis $\delta_{V0} = \delta_{V0}$ - factor \cdot V; $\delta_{V\infty} = \delta_{V\infty}$ - factor \cdot V;		: acting shear	r load									
Injection System	VME plus	;										
Performance Displacements (reba	r)									An	nex C	21