



Approval body for construction products and types of construction

**Bautechnisches Prüfamt** 

An institution established by the Federal and Laender Governments



# **European Technical Assessment**

ETA-16/0018 of 28 September 2023

English translation prepared by DIBt - Original version in German language

#### **General Part**

Technical Assessment Body issuing the European Technical Assessment:

Trade name of the construction product

Product family to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment contains

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

This version replaces

Deutsches Institut für Bautechnik

Chemofast Injection system UM-H for concrete

Bonded fasteners and bonded expansion fasteners for use in concrete

CHEMOFAST Anchoring GmbH Hanns-Martin-Schleyer-Straße 23 47877 Willich DEUTSCHLAND

**CHEMOFAST Anchoring GmbH** 

43 pages including 3 annexes which form an integral part of this assessment

330499-02-0601, Edition 07/2023

ETA-16/0018 issued on 6 October 2020



# European Technical Assessment ETA-16/0018

Page 2 of 43 | 28 September 2023

English translation prepared by DIBt

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# **European Technical Assessment ETA-16/0018**

Page 3 of 43 | 28 September 2023

English translation prepared by DIBt

#### **Specific Part**

#### 1 Technical description of the product

The "Chemofast Injection system UM-H+ for concrete" is a bonded anchor consisting of a cartridge with Chemofast injection mortar UM-H and a steel element according to Annex A 3 and A 5.

The steel element is placed into a drilled hole filled with injection mortar and is anchored via the bond between metal part, injection mortar and concrete.

The product description is given in Annex A.

# 2 Specification of the intended use in accordance with the applicable European Assessment Document

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

#### 3 Performance of the product and references to the methods used for its assessment

#### 3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance				
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 to C 4, C 6 to C 7, C 9 to C 10, B 3				
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 5, C 8, C 11				
Displacements under short-term and long-term loading	See Annex C 12 to C 14				
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 15 to C 23				

#### 3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 24 to C 26

#### 3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed



# European Technical Assessment ETA-16/0018

Page 4 of 43 | 28 September 2023

English translation prepared by DIBt

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD 330499-02-0601 the applicable European legal act is: [96/582/EC]. The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

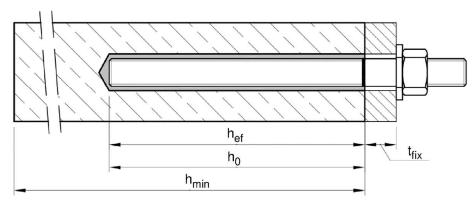
Issued in Berlin on 28 September 2023 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock Head of Section beglaubigt: Stiller

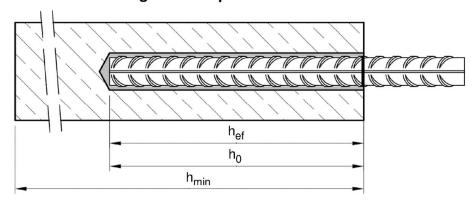


# Installation threaded rod M8 up to M30

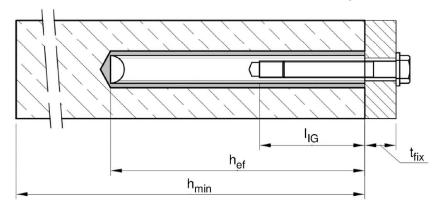
prepositioned installation or push through installation (annular gap filled with mortar)



## Installation reinforcing bar Ø8 up to Ø32



# Installation internal threaded anchor rod IG-M6 up to IG-M20



 $t_{fix}$  = thickness of fixture

 $h_0$  = drill hole depth

h<sub>ef</sub> = effective embedment depth

= thread engagement length

h<sub>min</sub> = minum thickness of member

# Chemofast Injection system UM-H for concrete

## **Product description**

Installed condition

Annex A 1

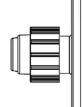
 $I_{IG}$ 



#### Cartridge system

#### **Coaxial Cartridge:**

150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml



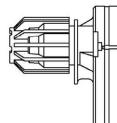
#### Imprint:

#### UM-H

Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

# Side-by-Side Cartridge:

235 ml, 345 ml up to 360 ml and 825 ml

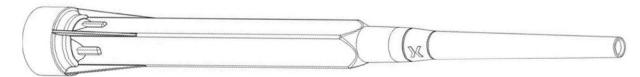


#### Imprint:

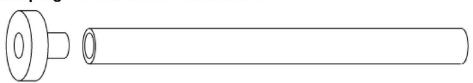
#### UM-H

Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

#### Static mixer PM-19E



# Piston plug VS and mixer extension VL



Chemofast Injection system UM-H for concrete

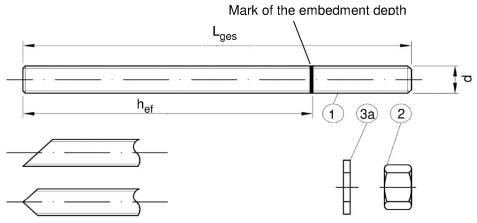
#### **Product description**

Injection system

Annex A 2



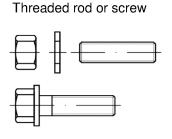
#### Threaded rod M8 up to M30 with washer and hexagon nut

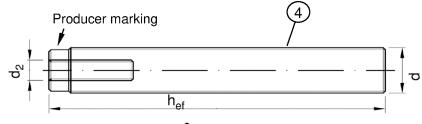


#### Commercial standard rod with:

- Materials, dimensions and mechanical properties acc. to Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004. The document shall be stored.
- Marking of embedment depth

#### Internal threaded rod IG-M6 to IG-M20





Marking Internal thread

Mark

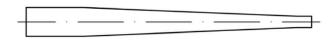
M8 Thread size (Internal thread)
A4 additional mark for stainless steel

HCR additional mark for high-corrosion resistance steel

#### Filling washer VFS



#### Mixer reduction nozzle MR



#### Chemofast Injection system UM-H for concrete

#### **Product description**

Threaded rod; Internal threaded rod Filling washer; Mixer reduction nozzle

Annex A 3



Part	Designation	Material				
		acc. to EN ISO 683-4:	2018	or EN 10263:2017)		
- zi	nc plated ≥ 5	μm acc. to EN ISO	4042	2:2022 or		
				1:2022 and EN ISO 10684:	2004+AC:2009 or	
· S	herardized ≥ 4	l5 μm acc. to EN ISO	1/66	Characteristic steel	Characteristic steel	Elengation at
		Property class		ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
1			4.6	$f_{uk} = 400 \text{ N/mm}^2$	$f_{vk} = 240 \text{ N/mm}^2$	A <sub>5</sub> > 8%
				f <sub>uk</sub> = 400 N/mm <sup>2</sup>	f <sub>yk</sub> = 320 N/mm <sup>2</sup>	A <sub>5</sub> > 8%
	Threaded rod	acc. to		f <sub>uk</sub> = 500 N/mm <sup>2</sup>	$f_{yk} = 300 \text{ N/mm}^2$	A <sub>5</sub> > 8%
		EN ISO 898-1:2013		f <sub>uk</sub> = 500 N/mm <sup>2</sup>	$f_{yk} = 400 \text{ N/mm}^2$	A <sub>5</sub> > 8%
				f <sub>uk</sub> = 800 N/mm <sup>2</sup>	$f_{yk} = 640 \text{ N/mm}^2$	$A_5 \ge 12\%^{(3)}$
			4	for anchor rod class 4.6 o		7.5 = 1270
2	Hexagon nut	acc. to	5	for anchor rod class 5.6 o		
-	Ticxagon nat	EN ISO 898-2:2022	8	for anchor rod class 8.8	1 3.0	
	144.0004.0000	Steel, zinc plated, ho		galvanised or sherardized		
3a	Washer			N ISO 7089:2000, EN ISC	7093:2000 or EN ISO	7094:2000)
3b	Filling washer	Steel, zinc plated, ho	t-dip	galvanised or sherardized		
	Internal threaded anchor rod	Property class		Characteristic steel ultimate tensile strength	Characteristic steel	Elongation at fracture
4		acc. to EN ISO 898-1:2013	5.0	f <sub>uk</sub> = 500 N/mm <sup>2</sup>	yield strength $f_{vk} = 400 \text{ N/mm}^2$	A <sub>5</sub> > 8%
				f <sub>uk</sub> = 800 N/mm <sup>2</sup>	$f_{vk} = 640 \text{ N/mm}^2$	$A_5 > 8\%$
O 1 - 1	-1			1800	1.0	A <sub>5</sub> > 0 / 0
Stai	nless steel A4 (Mate	rial 1.4401 / 1.4404 / 1	.457	1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t · 1.4565, acc. to EN 10088	o EN 10088-1:2014)	
		Property class		Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
1	Threaded rod <sup>1)4)</sup>		50	$f_{uk} = 500 \text{ N/mm}^2$	$f_{yk} = 210 \text{ N/mm}^2$	A <sub>5</sub> ≥ 8%
	Tilleaded fod 77	acc. to EN ISO 3506-1:2020		f <sub>uk</sub> = 700 N/mm <sup>2</sup>	f <sub>yk</sub> = 450 N/mm <sup>2</sup>	$A_5 \ge 12\%^{3}$
				f <sub>uk</sub> = 800 N/mm <sup>2</sup>	f <sub>vk</sub> = 600 N/mm <sup>2</sup>	$A_5 \ge 12\%^{(3)}$
			50	for anchor rod class 50	1 *	-
2	Hexagon nut 1)4)	acc. to EN ISO 3506-1:2020	70	for anchor rod class 70		
		The administration of the second seco	80	for anchor rod class 80		
3a	Washer	A4: Material 1.4401 / HCR: Material 1.452	1.44 9 or 1	07 / 1.4311 / 1.4567 or 1.4 04 / 1.4571 / 1.4362 or 1.4 .4565, acc. to EN 10088-1 :N ISO 7089:2000, EN ISC	578, acc. to EN 10088- : 2014	1:2014
3b	Filling washer	Stainless steel A4, H	ligh c	orrosion resistance steel		
	Internal threaded	Property class		Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
4	anchor rod <sup>1)2)</sup>	acc. to	50	f <sub>uk</sub> = 500 N/mm <sup>2</sup>	f <sub>vk</sub> = 210 N/mm <sup>2</sup>	A <sub>5</sub> > 8%
	anonor rou	EN ISO 3506-1:2020		f <sub>uk</sub> = 700 N/mm <sup>2</sup>	f <sub>vk</sub> = 450 N/mm <sup>2</sup>	A <sub>5</sub> > 8%

<sup>4)</sup> Property class 80 only for stainless steel A4 and HCR

Chemofast Injection system UM-H for concrete	
Product description  Materials threaded rod and internal threaded rod	Annex A 4







Minimum value of related rip area  $f_{R,min}$  according to EN 1992-1-1:2004+AC:2010 Rib height of the bar shall be in the range  $0.05d \le h_{rib} \le 0.07d$  (d: Nominal diameter of the bar;  $h_{rib}$ : Rib height of the bar)

Table A2: Materials Reinforcing bar

Part	Designation	Material
Reba	ar	
1	Reinforcing steel according to EN 1992 1 1:2004+AC:2010, Annex C	Bars and rebars from ring class B or C $f_{yk}$ and k according to NDP or NCI according to EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

Chemofast Injection system UM-H for concrete	
Product description Materials reinforcing bar	Annex A 5



Specification of the intendent		:				
	Working life	e 50 years	Worki	ng life 100 years		
Base material	uncracked concrete	cracked concrete	uncracked concrete	cracked concrete		
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	Ø8 to	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20				
Temperature Range:	I: - 40 °C II: - 40 °C III: - 40 °C IV: - 40 °C		0 °C to +40 °C¹) 0 °C to +80 °C²)			
Fasteners subject to (seismic ac	tion):					
	Perform	nance Category C2				
Base material		cracked concret	e			
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to Ø8 to	ı	M12 to M24			
Temperature Range:	II: - 40 °C III: - 40 °C	to +40 °C¹) to +80 °C²) to +120 °C³) 5) to +160 °C⁴) 5)	II: - 4 III: - 4	0°C to +40°C <sup>1</sup> ) 0°C to +80°C <sup>2</sup> ) 0°C to +120°C <sup>3</sup> ) 0°C to +160°C <sup>4</sup> ) 5)		
Fasteners subject to (Fire expos	ure):					
Base material		uncracked and c	racked concret	е		
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling		M8 to Ø8 to IG-M6 to	Ø32,			
Temperature Range:		II: - 40 °C III: - 40 °C	to $+40  ^{\circ}C^{1)}$ to $+80  ^{\circ}C^{2)}$ to $+120  ^{\circ}C^{3)}$ to $+160  ^{\circ}C^{4)}$			
1) (max. long-term temperature +24°C 2) (max. long-term temperature +50°C 3) (max. long-term temperature +72°C 4) (max. long-term temperature +100°C 5) Only for working life of 50 years	and max. short-term te and max. short-term te	mperature +80°C) mperature +120°C)				
Chemofast Injection system UN	Л-H for concrete					
Intended use Specifications				Annex B 1		



#### Base materials:

- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A2:2021.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A2:2021.

#### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+ A2:2020 corresponding to corrosion resistance class:
  - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

#### Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored.
   The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- Fasteners are designed under the responsibility of an engineer experienced in fasteners and concrete work.
- The fasteners are designed in accordance to EN 1992-4:2018 and Technical Report TR 055, Edition February 2018
- The fasteners under fire exposure are designed in accordance to Technical Report TR 082, Edition June 2023.

#### Installation:

- Dry, wet concrete or flooded bore holes (not sea-water).
- Hole drilling by hammer (HD), hollow (HDB) or compressed air (CD).
- Overhead installation allowed.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Installationtemperature in concrete:
  - -5°C up to +40°C for the standard variation of temperature after installation.

Chemofast Injection system UM-H for concrete	
Intended use Specifications (Continued)	Annex B 2



Table B1: Installation parameters for threaded rod											
Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30	
Diameter of elemen	t	$d = d_{nom}$	[mm]	8	10	12	16	20	24	27	30
Nominal drill hole di	ameter	d <sub>0</sub>	[mm]	10	12	14	18	22	28	30	35
Effective embedmen			[mm]	60	60	70	80	90	96	108	120
Effective embedmer	п аерті	h <sub>ef,max</sub>	[mm]	160	200	240	320	400	480	540	600
Diameter of	Prepositioned ins	tallation d <sub>f</sub> ≤	[mm]	9	12	14	18	22	26	30	33
clearance hole in the fixture <sup>1)</sup>	Push through i		[mm]	12	14	16	20	24	30	33	40
Maximum installatio	n torque	max T <sub>inst</sub>	[Nm]	10	20	40 <sup>2)</sup>	60	100	170	250	300
Minimum thickness of member		h <sub>min</sub>	[mm]		h <sub>ef</sub> + 30 mm ≥ 100 mm		h <sub>ef</sub> + 2d <sub>0</sub>				
Minimum spacing	Minimum spacing		[mm]	40	50	60	75	95	115	125	140
Minimum edge dista	ance	c <sub>min</sub>	[mm]	35	40	45	50	60	65	75	80

<sup>1)</sup> For application under seismic loading the diameter of clearance hole in the fixture shall be at maximum d<sub>1</sub> + 1mm or alternatively the annular gap between fixture and threaded rod shall be filled force-fit with mortar.

# Table B2: Installation parameters for reinforcing bar

P. Comments of the Comments of												
Reinforcing bar		Ø 81)	Ø 10 <sup>1)</sup>	Ø 121)	Ø 14	Ø 16	Ø 20	Ø 24 <sup>1)</sup>	Ø 25 <sup>1)</sup>	Ø 28	Ø 32	
Diameter of element	$d = d_{nom}$	[mm]	8	10	12	14	16	20	24	25	28	32
Nominal drill hole diameter	d <sub>0</sub>	[mm]	10 12	12 14	14 16	18	20	25	30 32	30 32	35	40
Effective embedment depth	h <sub>ef,min</sub>	[mm]	60	60	70	75	80	90	96	100	112	128
	h <sub>ef,max</sub>	[mm]	160	200	240	280	320	400	480	500	560	640
Minimum thickness of member	h <sub>min</sub>	[mm]		30 mm 00 mm	≥			h <sub>e</sub>	<sub>f</sub> + 2d <sub>0</sub>			
Minimum spacing	S <sub>min</sub>	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	c <sub>min</sub>	[mm]	35	40	45	50	50	60	70	70	75	85

<sup>1)</sup> both nominal drill hole diameter can be used

# Table B3: Installation parameters for Internal threaded anchor rod

Internal threaded anchor rod		6	IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Internal diameter of anchor rod	d <sub>2</sub>	[mm]	6	8	10	12	16	20
Outer diameter of anchor rod1)	$d = d_{nom}$	[mm]	10	12	16	20	24	30
Nominal drill hole diameter	d <sub>0</sub>	[mm]	12	14	18	22	28	35
Effective embedment depth	h <sub>ef,min</sub>	[mm]	60	70	80	90	96	120
Effective embedment depth	h <sub>ef,max</sub>		200	240	320	400	480	600
Diameter of clearance hole in the fixture	d <sub>f</sub> ≤	[mm]	7	9	12	14	18	22
Maximum installation torque	max T <sub>inst</sub>	[Nm]	10	10	20	40	60	100
Thread engagement length min/max	l <sub>IG</sub>	[mm]	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	h <sub>min</sub>	[mm]	$h_{ef}$ + 30 mm ≥ 100 mm $h_{ef}$ + 2d <sub>0</sub>			- 2d <sub>0</sub>		
Minimum spacing	s <sub>min</sub>	[mm]	50	60	75	95	115	140
Minimum edge distance	c <sub>min</sub>	[mm]	40	45	50	60	65	80
1) 140.1								

1) With metric threads

#### Chemofast Injection system UM-H for concrete

#### Intended use

Installation parameters

Annex B 3

<sup>2)</sup> Maximum installation torque for M12 with steel Grade 4.6 is 35 Nm



					aman	Mark Mark					
hreaded Rod	Re- inforcing bar	Internal threaded anchor rod	d <sub>0</sub> Drill bit - Ø HD, HDB, CD	d <sub>l</sub> Brusl	~ 0	d <sub>b,min</sub> min. Brush - Ø	Piston plug		n direction piston plu		
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		1	<b>→</b>	1	
M8	8		10	RB10	11,5	10,5					
M10	8 / 10	IG-M6	12	RB12	13,5	12,5	]	NI	اد دیانیه می		
M12	10 / 12	IG-M8	14	RB14	15,5	14,5	]	No plug	required		
	12		16	RB16	17,5	16,5					
M16	14	IG-M10	18	RB18	20,0	18,5	VS18				
	16		20	RB20	22,0	20,5	VS20				
M20		IG-M12	22	RB22	24,0	22,5	VS22				
	20		25	RB25	27,0	25,5	VS25	] h.\	] h .	h . >	
M24		IG-M16	28	RB28	30,0	28,5	VS28	h <sub>ef</sub> >	h <sub>ef</sub> >	all	
M27	24 / 25		30	RB30	31,8	30,5	VS30	250 mm	250 11111		
	24 / 25		32	RB32	34,0	32,5	VS32	_			
							1/005	1	1 1		
M30	28	IG-M20	35	RB35	37,0	35,5	VS35				
Cleaning	28 32 g and insta	allation to	40	RB35 RB40	37,0 43,5	35,5 40,5	VS35 VS40				
Cleaning	28 32	allation to	40		43,5		VS40 I system cod a class Nure of 253	I vacuum cle	eaner with a	minimu	
Cleaning HDB – Ho	28 32 g and installow drill bit	allation to	40 ols		43,5	40,5  The hollow drill Hohlbohrer and negative press	VS40 I system cod a class Nure of 253 s).	I vacuum cle	eaner with a	minimu	
Cleaning HDB – Ho	28 32 g and installow drill bit	allation to	40 ols		43,5	40,5  The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/	VS40 I system cod a class Nure of 253 s).	I vacuum cle	eaner with a	minimu	
Cleaning HDB – Ho	28 32 g and installow drill bit	allation to	40 ols		43,5	40,5  The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/	VS40 I system or d a class Nure of 253 s).	I vacuum cle	eaner with a	minimu	
Cleaning HDB – Ho Hand pun Volume 75	28 32 g and installow drill bit	allation to	40 ols		43,5	The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/s)	VS40 I system or d a class Nure of 253 s).	I vacuum cle	eaner with a	minimu	
Cleaning HDB - Ho Hand pun Volume 75 Brush RB	28 32 g and installow drill bit inp 0 ml, h <sub>0</sub> ≤ 10 c	allation to system d <sub>s</sub> , d <sub>0</sub> ≤ 20mm)	40 ols	RB40	43,5	The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/s)	VS40 I system cod a class Mure of 253 s). I air tool	I vacuum cle hPa and a f	eaner with a	minimu	



Table B5:	Workin	g time and cu	ring time	
Tempera	ature in bas	se material	Maximum working time	Minimum curing time 1)
	Т		t <sub>work</sub>	t <sub>cure</sub>
- 5°C	to	- 1 °C	50 min	5 h
0°C	to	+ 4 °C	25 min	3,5 h
+ 5 °C	to	+ 9 °C	15 min	2 h
+ 10°C	to	+ 14 °C	10 min	1 h
+ 15°C	to	+ 19°C	6 min	40 min
+ 20 °C	to	+ 29 °C	3 min	30 min
+ 30 °C	to	+ 40 °C	2 min	30 min
Cart	ridge tempe	erature	+5°C to	+40°C

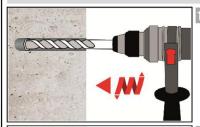
<sup>1)</sup> The minimum curing time is only valid for dry base material. In wet base material the curing time must be doubled.

Chemofast Injection system UM-H for concrete	
Intended use Working time and curing time	Annex B 5



#### Installation instructions

#### Drilling of the bore hole



#### Hammer drilling (HD) / Compressed air drilling (CD)

Drill a hole to the required embedment depth.

Drill bit diameter according to Table B1, B2 or B3.

Aborted drill holes shall be filled with mortar.

Proceed with Step 2 (MAC or CAC).



#### Hollow drill bit system (HDB) (see Annex B 4)

Drill a hole to the required embedment depth.

Drill bit diameter according to Table B1, B2 or B3.

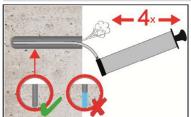
The hollow drilling system removes the dust and cleans the bore hole.

Proceed with Step 3.

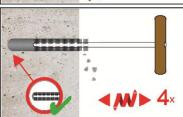
Attention! Standing water in the bore hole must be removed before cleaning.

#### Manual Air Cleaning (MAC)

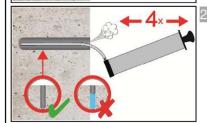
for bore hole diameter  $d_0 \le 20$ mm and bore hole depth  $h_0 \le 10d_{nom}$  (uncracked concrete only)



Blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).



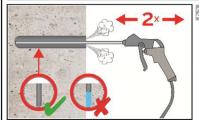
Brush the bore hole minimum 4x with brush RB according to Table B4 over the entire embedment depth in a twisting motion (if necessary, use a brush extension RBL).



Finally blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).

#### Compressed Air Cleaning (CAC):

All diameter in cracked and uncracked concrete, all drilling methods



Blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

#### Chemofast Injection system UM-H for concrete

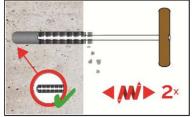
#### Intended use

Installation instructions

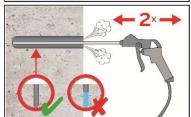
Annex B 6



#### Installation instructions (continuation)

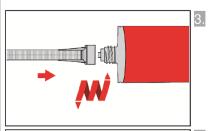


Brush the bore hole minimum 2x with brush RB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used .RBL)



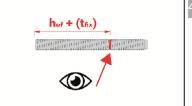
Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

Cleaned bore hole has to be protected against re-contamination in an appropriate way, If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.



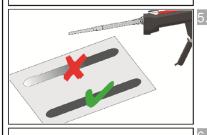
Screw on static-mixing nozzle PM-19E and load the cartridge into an appropriate dispensing tool.

For every working interruption longer than the maximum working time t<sub>work</sub> (Annex B 5) as well as for new cartridges, a new static-mixer shall be used.

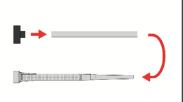


Mark embedment depth on the anchor rod. Consider  $t_{\mbox{\scriptsize fix}}$  in case of push through installations.

The anchor rod shall be free of dirt, grease, oil or other foreign material.



Not proper mixed mortar is not sufficient for fastening. Dispense and discard mortar until an uniform grey colour is shown (at least 3 full strokes).



Piston plugs VS and mixer nozzle extensions VL shall be used according to Table B4 for the following applications:

- Horizontal and vertical downwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm and embedment depth h<sub>ef</sub> > 250mm
- Vertical upwards direction: Drill bit-Ø d<sub>0</sub> ≥ 18 mm

Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.

# Chemofast Injection system UM-H for concrete Intended use Installation instructions (continuation) Annex B 7

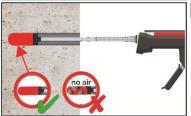


#### Installation instructions (continuation)



#### 7a. Injecting mortar without piston plug VS

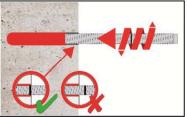
Starting at bottom of the hole and fill the hole up to approximately two-thirds with mortar. (If necessary, a mixer nozzle extension shall be used.) Slowly withdraw of the static mixing nozzle avoid creating air pockets Observe the temperature related working time  $t_{work}$  (Annex B 5).



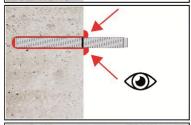
#### Injecting mortar with piston plug VS

Starting at bottom of the hole and fill the hole up to approximately two-thirds with mortar. (If necessary, a mixer nozzle extension shall be used.) During injection the piston plug is pushed out of the bore hole by the back pressure of the mortar.

Observe the temperature related working time t<sub>work</sub> (Annex B 5).



Insert the anchor rod while turning slightly up to the embedment mark.

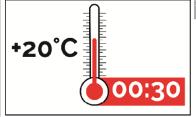


Annular gap between anchor rod and base material must be completely filled with mortar. In case of push through installation the annular gap in the fixture must be filled with mortar also.

Otherwise, the installation must be repeated starting from step 7 before the maximum working time  $t_{work}$  has expired.



 For application in vertical upwards direction the anchor rod shall be fixed (e.g. wedges).



Temperature related curing time t<sub>cure</sub> (Annex B 5) must be observed. Do not move or load the fastener during curing time.



Install the fixture by using a calibrated torque wrench. Observe maximum installation torque (Table B1 or B3).

In case of static requirements (e.g. seismic), fill the annular gab in the fixture with mortar (Annex A 2). Therefore replace the washer by the filling washer VFS and use the mixer reduction nozzle MR.

#### Chemofast Injection system UM-H for concrete

#### Intended use

Installation instructions (continuation)

Annex B 8



T	able C1: Characteristic values resistance of threade			ension	resist	ance	and s	teel s	hear		
Th	readed rod			M8	M10	M12	M16	M20	M24	M27	M30
Cr	oss section area	A <sub>s</sub>	[mm <sup>2</sup> ]	36,6	58	84,3	157	245	353	459	561
Ch	naracteristic tension resistance, Steel failu	re <sup>1)</sup>									
The state of	eel, Property class 4.6 and 4.8	N <sub>Rk,s</sub>	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
Ste	eel, Property class 5.6 and 5.8	N <sub>Rk,s</sub>	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
Ste	eel, Property class 8.8	N <sub>Rk,s</sub>	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
Sta	ainless steel A2, A4 and HCR, class 50	N <sub>Rk,s</sub>	[kN]	18	29	42	79	123	177	230	281
Sta	ainless steel A2, A4 and HCR, class 70	N <sub>Rk,s</sub>	[kN]	26	41	59	110	171	247	_3)	_3)
	ainless steel A4 and HCR, class 80	N <sub>Rk,s</sub>	[kN]	29	46	67	126	196	282	_3)	_3)
Cł	naracteristic tension resistance, Partial fac	tor <sup>2)</sup>									
Ste	eel, Property class 4.6 and 5.6	γ <sub>Ms,N</sub>	[-]				2,0	0			
Ste	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]				1,	5			
Sta	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,N</sub>	[-]				2,8	86			
Sta	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,N</sub>	[-]				1,8	37			
	ainless steel A4 and HCR, class 80	γ <sub>Ms,N</sub>	[-]				1,6	6			
Cł	naracteristic shear resistance, Steel failure	1)	1								
두	Steel, Property class 4.6 and 4.8	V <sup>0</sup> <sub>Rk,s</sub>	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
arm	Steel, Property class 5.6 and 5.8	V <sup>0</sup> Rk,s	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
eve	Steel, Property class 8.8	V <sup>0</sup> Rk,s	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
out l	Stainless steel A2, A4 and HCR, class 50	V <sup>0</sup> Rk,s	[kN]	9	15	21	39	61	88	115	140
Without lever	Stainless steel A2, A4 and HCR, class 70	V <sup>0</sup> <sub>Rk,s</sub>	[kN]	13	20	30	55	86	124	_3)	_3)
>	Stainless steel A4 and HCR, class 80	V <sup>0</sup> Rk,s	[kN]	15	23	34	63	98	141	_3)	_3)
	Steel, Property class 4.6 and 4.8	M <sup>0</sup> Rk,s	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
arm	Steel, Property class 5.6 and 5.8	M <sup>0</sup> Rk,s	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
	Steel, Property class 8.8	M <sup>0</sup> Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
th lever	Stainless steel A2, A4 and HCR, class 50	М <sup>0</sup> <sub>Rk,s</sub>	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, class 70	M <sup>0</sup> Rk,s	[Nm]	26	52	92	232	454	784	_3)	_3)
	Stainless steel A4 and HCR, class 80	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]	30	59	105	266	519	896	_3)	_3)
Cł	naracteristic shear resistance, Partial facto										
Ste	eel, Property class 4.6 and 5.6	γ <sub>Ms,V</sub>	[-]				1,6	57			
Ste	eel, Property class 4.8, 5.8 and 8.8	γ <sub>Ms,V</sub>	[-]				1,2	25			
Sta	ainless steel A2, A4 and HCR, class 50	γ <sub>Ms,V</sub>	[-]				2,3	18			
Sta	ainless steel A2, A4 and HCR, class 70	γ <sub>Ms,V</sub>	[-]				1,5	6			
Sta	ainless steel A4 and HCR, class 80	γ <sub>Ms,V</sub>	[-]				1,3	33			

<sup>1)</sup> Values are only valid for the given stress area A<sub>s</sub>. Values in brackets are valid for undersized threaded rods with smaller stress area A<sub>s</sub> for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.
2) in absence of national regulation

<sup>3)</sup> Fastener type not part of the ETA

Chemofast Injection system UM-H for concrete	
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods	Annex C 1



Table C2:		ic values of te g life of 50 and		s under static and quasi-static action
Fastener				All Anchor types and sizes
Concrete cone	failure			
Uncracked conc	rete	k <sub>ucr,N</sub>	[-]	11,0
Cracked concret	е	k <sub>cr,N</sub>	[-]	7,7
Edge distance		c <sub>cr,N</sub>	[mm]	1,5 h <sub>ef</sub>
Axial distance		s <sub>cr,N</sub>	[mm]	2 c <sub>cr,N</sub>
Splitting				

Axial distance		s <sub>cr,N</sub>	[mm]	2 c <sub>cr,N</sub>
Splitting		·	•	
	h/h <sub>ef</sub> ≥ 2,0			1,0 h <sub>ef</sub>
Edge distance	$2.0 > h/h_{ef} > 1.3$	C <sub>cr,sp</sub>	[mm]	$2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$
	h/h <sub>ef</sub> ≤ 1,3			2,4 h <sub>ef</sub>
Axial distance		s <sub>cr,sp</sub>	[mm]	2 c <sub>cr,sp</sub>
		*		

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years	Annex C 2



13 13 13 13 12 11 9,0 9,0 9,0 7,0 7,0 7,0 5,0 6,0	14 13 14 13 12 12 9,5 9,0 8,5 7,0 8,5 7,0	15 15 13 10 S	47.5	17	17	[kN] [-]	N <sub>Rk,s</sub> γ <sub>Ms,N</sub>		teristic tension resi		
13 13 13 13 12 11 9,0 9,0 9,0 7,0 7,0 7,0 5,0 6,0	14 13 14 13 12 12 9,5 9,0 8,5 7,0	15 15 13 10 S	16	22.00-	17	[-]	γ <sub>Ms,N</sub>				
13 13 13 12 11 9,0 9,0 9,0 7,0 7,0 7,0 6,0 6,0	14 13 14 13 12 12 9,5 9,0 8,5 7,0	15 15 13 10 S	16 16	22.00-	17		1	anarata failura	Partial factor		
13 13 13 12 11 9,0 9,0 9,0 7,0 7,0 7,0 6,0 6,0	14     13       12     12       9,5     9,0       8,5     7,0	15 13 10 S	16	22.00-	17	0/25		Combined pull-out and concrete failure			
13 13 13 12 11 9,0 9,0 9,0 7,0 7,0 7,0 6,0 6,0	14     13       12     12       9,5     9,0       8,5     7,0	15 13 10 S	16	22.00-	17		d concrete C2		teristic bond resist		
7,0 7,0 7,0 7,0 6,0 6,0	12     12       9,5     9,0       8,5     7,0	13		17		[N/mm²]	<sup>τ</sup> Rk,ucr		I: 24°C/40°C		
7,0 7,0 7,0 7,0 6,0 6,0	9,5 9,0	10 9	14		17	[N/mm <sup>2</sup> ]	<sup>τ</sup> Rk,ucr	Dry, wet concrete and	II: 50°C/80°C	ure r	
7,0 7,0 7,0 7,0 6,0 6,0	8,5 7,0			14	15	[N/mm <sup>2</sup> ]	<sup>τ</sup> Rk,ucr	flooded bore hole	III: 72°C/120°C	Femperature range	
7,0 7,0 5,0 6,0		90 9	11	11	12	[N/mm²]	<sup>τ</sup> Rk,ucr		IV: 100°C/160°C		
7,0 7,0 5,0 6,0		an				25	concrete C20/2	ance in cracked	teristic bond resist	Charac	
6,0 6,0	8,5 7,0	9,0	8,0	7,5	7,0	[N/mm <sup>2</sup> ]	τ <sub>Rk,cr</sub>		I: 24°C/40°C	ange	
		9,0	8,0	7,5	7,0	[N/mm <sup>2</sup> ]	<sup>τ</sup> Rk,cr	Dry, wet concrete and	II: 50°C/80°C	ure ra	
5,5 5,5	7,0 6,0	7,5 7	7,0	6,5	6,0	[N/mm²]	<sup>τ</sup> Rk,cr	flooded bore hole	III: 72°C/120°C	Temperature range	
	6,0 5,5	6,5	6,0	5,5	5,5	[N/mm²]	<sup>τ</sup> Rk,cr		IV: 100°C/160°C	Tem	
	10					e C20/25	racked concre	cracked and unc	tion factor $\psi^0_{ { m sus}}$ in (	Redukt	
	00	0,90							I: 24°C/40°C	9 I: 24°C/4	
	37	0,87				F1	Ψ <sup>0</sup> sus	Dry, wet concrete and	II: 50°C/80°C	remperature range	
0,75						[-]	Ψ sus	flooded bore hole	III: 72°C/120°C	oeratı	
0,66									□ IV: 100°C/160°C		
(f <sub>ck</sub> / 20) <sup>0,1</sup>						[-]	Ψc	crete	sing factors for cond	Increas	
(		$_{\rm r} = \qquad \qquad \psi_{\rm c} \cdot \tau_{\rm Rk,ucr,(C20/25)}$			τ <sub>Rk,ucr</sub> =			teristic bond resist			
	r,(C20/25)	• <sup>τ</sup> Rk,cr,(	Ψο			τ <sub>Rk,cr</sub> =			ASSESSMENT OF THE PROPERTY OF	400 S MINGNO	
	ole C2	see Table	9								
		000 14010								Splittir	
	ole C2	see Table							nt parameter	Releva	
_								I	ation factor	Installa	
Performanc assessed			1,2	•				MAC	l l		
		1,0 1,2				[-]	γinst	CAC HDB	and wel concrete	ioi ury	
		1,4						CAC	ded bore hole	for floo	
) Pe	r,(C20/25)  ple C2  No Pe ass	see Table see Table 1,0 1,2	Ψο			τ <sub>Rk,cr</sub> =	Yinst	MAC CAC HDB	concrete strength of the cone failure of the c	on the Concre Releva Splittir Releva Installa	



Characteristic tension resistance   N <sub>Rik,s</sub>   [kN]   A <sub>s</sub> · f <sub>luk</sub> (or see Table C1)	hreaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Partial factor   Y <sub>Ms,N</sub>   [-]   see Table C1			M	FI N 17			Λ . f	/or o	oo Tob	lo C1)		
Combined pull-out and concrete failure		sistance	7.00		5 5.1							
Characteristic bond resistance in uncracked concrete C20/25	POSSELVE CAMBINE DELINE GALLES GALLES		γ <sub>Ms,N</sub>	[-]				see la	able C1			
I: 24°C/40°C   Dry, wet concrete and flooded bore hole   TRk,ucr,100   [N/mm²]   17   17   16   15   14   13   13   13   13   13   15   15   15			d concrete CO	0/05								
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$		Included a contracted		0/25								
Characteristic bond resistance in cracked concrete C20/25	I: 24°C/40°C	concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm <sup>2</sup> ]	17	17	16	15	14	13	13	13
I: 24°C/40°C   Dry, wet concrete and flooded bore hole   τ <sub>Rk,cr,100</sub>   [N/mm²]   5,5   6,0   6,5					17	17	16	15	14	13	13	13
Reduktion factor $\psi^0_{sus,100}$ in cracked and uncracked concrete C20/25 $\frac{\psi^0_{sus,100}}{U} = \frac{U}{U} = \frac{U}{U}$	X 25 Act 1/2 1/2 1/2 1/2 2 2 2 2 2 2 2 2 2 2 2 2	tance in cracked o	concrete C20/2	25	ı							î
$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	erature Oge I: 24°C/40°C	concrete and	<sup>τ</sup> Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
$\frac{0}{1} = \frac{0}{1} = \frac{0}$	ਜੂ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ ਗੁਲਾ	The state of the s	<sup>τ</sup> Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
Increasing factors for concrete $ \psi_{\text{C}} \qquad [-] \qquad \qquad (f_{\text{ck}}  /  20)^{ 0,1} $ Characteristic bond resistance depending on the concrete strength class $ \tau_{\text{Rk,cr,100}} = \qquad \psi_{\text{C}} \cdot \tau_{\text{Rk,cr,100,(C20/25)}} $ Concrete cone failure $ \text{Relevant parameter} \qquad \qquad \text{see Table C2} $ Splitting $ \text{Relevant parameter} \qquad \qquad \text{see Table C2} $ Installation factor	leduktion factor ψ <sup>0</sup> sus,10	ο in cracked and ι	uncracked con	crete C20/2	5							
Increasing factors for concrete $ \psi_{\text{C}} \qquad [-] \qquad \qquad (f_{\text{ck}}  /  20)^{ 0,1} $ Characteristic bond resistance depending on the concrete strength class $ \tau_{\text{Rk,cr,100}} = \qquad \psi_{\text{C}} \cdot \tau_{\text{Rk,cr,100,(C20/25)}} $ Concrete cone failure $ \text{Relevant parameter} \qquad \qquad \text{see Table C2} $ Splitting $ \text{Relevant parameter} \qquad \qquad \text{see Table C2} $ Installation factor	erature ge I: 24°C/40°C		W <sup>0</sup>	[-]	0,90							
Characteristic bond resistance depending on the concrete strength class $\tau_{Rk,cr,100} = \frac{\psi_c \cdot \tau_{Rk,cr,100,(C20/25)}}{\psi_c \cdot \tau_{Rk,cr,100,(C20/25)}}$ Concrete cone failure  Relevant parameter see Table C2  Splitting  Relevant parameter see Table C2  Installation factor	II: 20°C/80°C	ा: 50°C/80°C   flooded bore hole		1.1								
on the concrete strength class $\tau_{Rk,cr,100} = \psi_c \cdot \tau_{Rk,cr,100,(C20/25)}$ Concrete cone failure Relevant parameter See Table C2 Splitting Relevant parameter see Table C2 Installation factor	ncreasing factors for cor	ocrete	Ψc	[-]				$(f_{ck} / 1)$	20) <sup>0,1</sup>			
on the concrete strength class $\tau_{Rk,cr,100} = \psi_c \cdot \tau_{Rk,cr,100,(C20/25)}$ $\textbf{Concrete cone failure}$ $\textbf{Relevant parameter} \qquad \qquad \textbf{see Table C2}$ $\textbf{Splitting}$ $\textbf{Relevant parameter} \qquad \qquad \textbf{see Table C2}$ $\textbf{Installation factor}$	haracteristic bond resis	tance depending	τ	Rk,ucr,100 =			Ψ <sub>c</sub> •	<sup>τ</sup> Rk,ucr	,100,(C	20/25)		
Concrete cone failure  Relevant parameter see Table C2  Splitting  Relevant parameter see Table C2  Installation factor			1	r <sub>Rk.cr.100</sub> =			Ψc	• τ <sub>Rk.cr.</sub>	.100.(C2	20/25)		
Splitting Relevant parameter see Table C2 Installation factor	oncrete cone failure				l s)					,		
Relevant parameter see Table C2  Installation factor								see Ta	able C2	2		
Installation factor					1							
No Porform	(*)							see 18	able C2	<u>'</u>		
	istaliation factor	T								No Per	rformar	nce
for dry and wet concrete	HDB				assess							
γ (-)			γ <sub>inst</sub> [-]		1,0							
for flooded bore hole CAC 1,4			-		1,2							
1,4	i nooded bore noie	CAC							,4			

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Annex C 4

Chemofast Injection system UM-H for concrete

for a working life of 100 years (threaded rod)

Characteristic values of tension loads under static and quasi-static action

Performances

Installation factor



1,0

Table C5: Characteristic for a working					nder s	tatic a	nd qu	asi-sta	atic acti	on
Threaded rod			М8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm					•					
Characteristic shear resistance Steel, strength class 4.6, 4.8 and 5.6, 5.8	V <sup>0</sup> <sub>Rk,s</sub>	[kN]			0,6 •	A <sub>s</sub> ·f <sub>uk</sub>	(or see	Table C	1)	
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	V <sup>0</sup> Rk,s	[kN]			0,5 •	A <sub>s</sub> ·f <sub>uk</sub>	(or see	Table C	1)	
Partial factor	$\gamma_{Ms,V}$	[-]				see	Table C	:1		
Ductility factor	k <sub>7</sub>	[-]	1,0							
Steel failure with lever arm	'									
Characteristic bending moment	M <sup>0</sup> Rk,s	[Nm]	1,2 • W <sub>el</sub> • f <sub>uk</sub> (or see Table C1)							
Elastic section modulus	W <sub>el</sub>	[mm³]	31 62 109 277 541 935 1387 187					1874		
Partial factor	γ <sub>Ms,V</sub>	[-]	see Table C1							
Concrete pry-out failure										
Factor	k <sub>8</sub>	[-]	2,0							
Installation factor	γinst	[-]					1,0			
Concrete edge failure										
Effective length of fastener	I <sub>f</sub>	[mm]		m	nin(h <sub>ef</sub> ; 1	12 · d <sub>nor</sub>	m)		min(h <sub>ef</sub> ;	300mm)
Outside diameter of fastener	d <sub>nom</sub>	[mm]	8	10	12	16	20	24	27	30
·										

[-]

γinst

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (threaded rod)	Annex C 5



Tabl		acteristic valu working life o			oads un	ider sta	tic and	quasi-s	static ac	tion		
	al threaded ancho	r rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Steel f	ailure <sup>1)</sup>									,		
Charac	teristic tension resi	stance, 5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123		
Steel, s	strength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196		
Partial	factor, strength cla	ss 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]		1,5						
	teristic tension resi 4 and HCR, Streng		N <sub>Rk,s</sub>	[kN]	14	14 26 41 59 110						
Partial	factor		γ <sub>Ms,N</sub>	[-]	1,87 2,86							
Combi	ned pull-out and o	concrete cone failu	ire	e								
Charac	teristic bond resista	ance in uncracked o	oncrete C	20/25								
<u>re</u>	I: 24°C/40°C		τ <sub>Rk,ucr</sub>	[N/mm <sup>2</sup> ]	17	16	15	14	13	13		
iperatu range	II: 50°C/80°C	Dry, wet concrete	τ <sub>Rk,ucr</sub>	[N/mm <sup>2</sup> ]	17	16	15	14	13	13		
Temperature range	and flooded bore ho		<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	13	12	12	11		
Ter	IV: 100°C/160°C		τ <sub>Rk,ucr</sub>	[N/mm <sup>2</sup> ]	11	11	10	9,5	9,0	9,0		
Charac	teristic bond resista	ance in cracked cor		111,001								
<u>e</u>	I: 24°C/40°C		τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	7,5	8,0	9,0	8,5	7,0	7,0		
eratu nge	II: 50°C/80°C	Dry, wet concrete	τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	7,5	8,0	9,0	8,5	7,0	7,0		
	III: 72°C/120°C	and flooded bore hole	τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	6,5	7,0	7,5	7,0	6,0	6,0		
Ter	IV: 100°C/160°C		τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	5,5	6,0	6,5	6,0	5,5	5,5		
Redukt	ion factor ψ <sup>0</sup> sus in α	cracked and uncrac		rete C20/2	5							
<u>e</u>	I: 24°C/40°C				0,90							
Temperature range	II: 50°C/80°C	Dry, wet concrete			0,87							
nperat range	III: 72°C/120°C	and flooded bore hole	$\Psi^0$ sus	[-]		0,75						
Leu	IV: 100°C/160°C	nooded bore note					0.	66				
Increas	sing factors for cond	crete	Ψς	[-]				20) <sup>0,1</sup>				
		ance depending on	1.0	τ <sub>Rk,ucr</sub> =				ucr,(C20/25)	(			
	crete strength clas			τ <sub>Rk,cr</sub> =				cr,(C20/25)				
Concre	ete cone failure			1111,01			· C TIK,	01,(020/20)				
Releva	nt parameter						see Ta	able C2				
Splittir	ng failure											
	nt parameter						see Ta	able C2				
Installa	ation factor	I						T				
		MAC	4			1,2		527	ormance a	issessec		
for dry and wet concrete	CAC	$\gamma_{inst}$	[-]	1,0								
for floo	flooded bore hole CAC	Person Diff.					<u>,2</u> ,4					
1) Fastenings (incl. nut and washer) must comply with the								,- <b>T</b>				

<sup>2)</sup> For IG-M20 strength class 50 is valid

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 50 years (internal threaded anchor rod)	Annex C 6



1.4

Table		acteristic valu working life o			oads ur	nder sta	atic and	quasi-	static ad	ction	
Interna	I threaded ancho	r rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel fa	ailure <sup>1)</sup>										
Charac	teristic tension resi	istance, 5.8	N <sub>Rk,s</sub>	[kN]	10	17	29	42	76	123	
Steel, s	trength class	8.8	N <sub>Rk,s</sub>	[kN]	16	27	46	67	121	196	
Partial 1	factor, strength cla	ss 5.8 and 8.8	γ <sub>Ms,N</sub>	[-]	1,5						
	teristic tension resi 4 and HCR, Streng		N <sub>Rk,s</sub>	[kN]	14 26 41 59 110					124	
Partial f	factor		γMs,N	[-]			1,87		=2	2,86	
Combi	ned pull-out and	concrete cone fail	ure							•	
	teristic bond resist	ance in uncracked	concrete C2	20/25							
Temperature range	Dry, wet concrete		<sup>τ</sup> Rk,ucr,100	[N/mm²]	17	16	15	14	13	13	
Tempe			<sup>T</sup> Rk,ucr,100	[N/mm²]	17	16	15	14	13	13	
Charac	teristic bond resist	ance in cracked cor	ncrete C20/	25							
Temperature range	I: 24°C/40°C	Dry, wet concrete	<sup>T</sup> Rk,cr,100	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5	
Tempe	II: 50°C/80°C	flooded bore hole	<sup>T</sup> Rk,cr,100	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5	
Redukt	ion factor ψ <sup>0</sup> sus,100	in cracked and un	cracked co	ncrete C2	20/25						
Temperature range	I: 24°C/40°C	Dry, wet concrete	Ψ <sup>0</sup> sus,100	[-]			0	,90			
Tempe	II: 50°C/80°C	flooded bore hole	Ψ sus,100	ניז	0,87						
Increas	ing factors for cond	crete	Ψc	[-]			(f <sub>ck</sub> /	20) 0,1			
Charac	teristic bond resist	ance depending	τ <sub>Bk</sub> ι	ıcr,100 =		Ų	ν <sub>c</sub> • τ <sub>Rk,uc</sub>	r 100 (C20/2	25)		
	concrete strength of			,cr,100 =			Ψc • τ <sub>Rk,cr</sub>				
Concre	ete cone failure		1 110	,01,100			. o iin,ci	, 100,(020/2	,		
	nt parameter					see Ta	able C2				
Splittin	g failure										
	nt parameter				see Ta	able C2					
Installa	ation factor				(42 - 147-144)						
**************************************		MAC				1,2			ormance a	assessed	
for dry a	for dry and wet concrete CAC			[-]				,0 ,2			

<sup>1)</sup> Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

for flooded bore hole

CAC

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under static and quasi-static action for a working life of 100 years (internal threaded anchor rod)	Annex C 7

<sup>2)</sup> For IG-M20 strength class 50 is valid



1,0

Table C8: Character for a work						static	and qua	si-stat	ic action		
Internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Steel failure without lever arm <sup>1</sup>	)				ı		I		1		
Characteristic shear resistance,	5.8	V <sup>0</sup> Rk,s	[kN]	5	9	15	21	38	61		
Steel, strength class	8.8	V <sup>0</sup> Rk,s	[kN]	8	14	23	34	60	98		
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]				1,25				
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		V <sup>0</sup> <sub>Rk,s</sub>	[kN]	7	13	20	30	55	40		
Partial factor		γ <sub>Ms,V</sub>	[-]			1,56	•		2,38		
Ductility factor k <sub>7</sub>				1,0							
Steel failure with lever arm1)											
Characteristic bending moment,	5.8	M <sup>0</sup> Rk,s	[Nm]	8	19	37	66	167	325		
Steel, strength class	8.8	M <sup>0</sup> Rk,s	[Nm]	12	30	60	105	267	519		
Partial factor, strength class 5.8 a	and 8.8	γ <sub>Ms,V</sub>	[-]	1,25							
Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 <sup>2)</sup>		м <sup>0</sup> <sub>Rk,s</sub>	[Nm]	11	26	52	92	233	456		
Partial factor		γ <sub>Ms,V</sub>	[-]			1,56			2,38		
Concrete pry-out failure											
Factor		k <sub>8</sub>	[-]				2,0				
Installation factor		γinst	[-]				1,0				
Concrete edge failure											
ective length of fastener			[mm]		min	(h <sub>ef</sub> ; 12 • c	i <sub>nom</sub> )		min(h <sub>ef</sub> ; 300m		
Outside diameter of fastener		d <sub>nom</sub>	[mm]	10	12	16	20	24	30		

<sup>1)</sup> Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

[-]

 $\gamma_{\text{inst}}$ 

Installation factor

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (internal threaded anchor rod)	Annex C 8

<sup>2)</sup> For IG-M20 strength class 50 is valid



Table		acteristic working I			n loa	ds u	nder	stati	c and	d qua	asi-s	tatic	actio	n
Reinfo	rcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 3
Steel fa	ailure							'						
Charac	teristic tension resi	stance	N <sub>Rk,s</sub>	[kN]					A <sub>s</sub> •	f <sub>uk</sub> 1)		35		
Cross s	section area		A <sub>s</sub>	[mm <sup>2</sup> ]	50	79	113	154	201	314	452	491	616	804
Partial t	factor		γ <sub>Ms,N</sub>	[-]			•		1,	<b>4</b> <sup>2)</sup>				
Combi	ned pull-out and o	oncrete failu												
Charac	teristic bond resista	ance in uncra	cked concret	te C20/25										
<u>re</u>	I: 24°C/40°C	Dry, wet	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	14	14	13	13	13	13	13	13
nperatı range	II: 50°C/80°C	concrete	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	14	14	14	14	13	13	13	13	13	13
Temperature range	III: 72°C/120°C	flooded	<sup>τ</sup> Rk,ucr	[N/mm²]	13	12	12	12	12	11	11	11	11	11
Tel	IV: 100°C/160°C	bore hole	<sup>τ</sup> Rk,ucr	[N/mm <sup>2</sup> ]	9,5	9,5	9,5	9,0	9,0	9,0	9,0	9,0	8,5	8,5
Charac	teristic bond resista	ance in crack		C20/25										
<u>e</u>	I: 24°C/40°C	Dry, wet	τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
ratu ge	II: 50°C/80°C	concrete	τ <sub>Rk,cr</sub>	[N/mm²]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
Temperature range	III: 72°C/120°C	and flooded	τ <sub>Rk,cr</sub>	[N/mm²]	4,5	5,0	5,0	5,5	5,5	5,5	5,5	6,0	6,0	6,0
Ter	IV: 100°C/160°C	bore hole	τ <sub>Rk,cr</sub>	[N/mm <sup>2</sup> ]	4,0	4,5	4,5	5,0	5,0	5,0	5,0	5,0	5,0	5,0
Redukt	ion factor ψ <sup>0</sup> sus in α	racked and ι				1	, , -	- / -				- 2-5	-3.4.50	-
	I: 24°C/40°C	Dry, wet		[-]	0,90									
nperatur range	II: 50°C/80°C	concrete and flooded	Ψ <sup>0</sup> sus						0,	87				
Temperature range	III: 72°C/120°C								0,	75				
- <u>-</u>	IV: 100°C/160°C	bore hole							0,	66				
Increas	ing factors for cond	crete	Ψς	[-]	(f <sub>ck</sub> / 20) <sup>0,1</sup>									
	teristic bond resista			τ <sub>Rk,ucr</sub> =	Ψc * <sup>†</sup> Rk,ucr,(C20/25)									
class	ing on the concrete	outongui		$\tau_{Rk,cr} =$	Ψc * <sup>τ</sup> Rk,cr,(C20/2					20/25)				
Concre	ete cone failure													
	nt parameter								see Ta	ble C2	2			
Splittin										8 18 17 1				
	nt parameter								see Ta	ble C2	2			
Installa	ation factor	1440	1				٠, ٠			N.F.	D. /			
for day	and wat concrete	CAC	-				1,2		- 1	,0 ,0	Perfor	mance	asses	sed
ioi diy a	and wet concrete	HDB	γinst	[-]						,0 ,2				
for floor	ded bore hole	CAC	-							<u>,2</u> ,4				
CIT C	shall be taken from t bsence of national re		ns of reinford	cing bars										
Perfor Charac	mofast Injection s mances cteristic values of ter vorking life of 50 yea	nsion loads ur			ıtic act	ion					Δ	ınnex	c C 9	



Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø3	
Steel failure		T.	1					_	r 1\					
Characteristic tension resi	stance	N <sub>Rk,s</sub>	[kN]						f <sub>uk</sub> 1)	Dellario				
Cross section area		A <sub>s</sub>	[mm <sup>2</sup> ]	50	79	113	154	201	314	452	491	616	80	
Partial factor		γMs,N	[-]					1,	<b>4</b> <sup>2)</sup>					
Combined pull-out and c														
Characteristic bond resista		cked concre	te C20/25											
Temperature range range II: 20°C/80°C	Dry, wet concrete and	<sup>τ</sup> Rk,ucr,100	[N/mm²]	14	14	14	14	13	13	13	13	13	1:	
II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,ucr,100	[N/mm²]	14	14	14	14	13	13	13	13	13	13	
Characteristic bond resista	ance in crack	ed concrete	C20/25											
Temperature range II: 24°C/40°C C	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0			
ен дел п: 20°С/80°С	and flooded bore hole	<sup>τ</sup> Rk,cr,100	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0	
Reduktion factor ψ <sup>0</sup> sus,100	in cracked a	nd uncracke	d concrete	C20/2	25									
	Dry, wet concrete			0,90										
Temperature range II: 24°C/40°C	and flooded bore hole	Ψ <sup>0</sup> sus,100	[-]	0,87										
Increasing factors for cond	crete	Ψς	[-]					(f <sub>ck</sub> /	20) <sup>0,1</sup>					
Characteristic bond resista		τ <sub>Rk</sub>	,ucr,100 =	Ψc • <sup>τ</sup> Rk,ucr,100,(C20/25)										
depending on the concrete class	e strength		Rk,cr,100 =											
Concrete cone failure				see Table C2										
Relevant parameter							;	see Ta	able C	2				
Splitting								T.	-1-1- 0					
Relevant parameter								see 18	able C					
Installation factor	MAC					1,2			No	Dorfor	mance			
for dry and wet concrete	CAC	-				1,2		1	,0	renoi	mance	asse	,500	
for any and wet concrete		γinst	[-]											
for flooded bore hole		1												
	HDB CAC he specification							1	,2 ,4					
			crete											



Table C11: Characterist for a working					ndei	r stat	ic aı	nd qı	uasi-	static	actio	า
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure without lever arm			•	•		•		I.	•		•	
Characteristic shear resistance	V <sup>0</sup> Rk,s	[kN]					0,50	· A <sub>s</sub> ·	f <sub>uk</sub> 1)			
Cross section area	A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	[-]		•		•	•	1,5 <sup>2)</sup>	•		•		
Ductility factor	k <sub>7</sub>	[-]						1,0				
Steel failure with lever arm		•	•									
Characteristic bending moment	M <sup>0</sup> <sub>Rk,s</sub>	[Nm]					1.2	w <sub>el</sub> •	f <sub>uk</sub> 1)			
Elastic section modulus	W <sub>el</sub>	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	γ <sub>Ms,V</sub>	[-]	1,52)									
Concrete pry-out failure		•	•									
Factor	k <sub>8</sub>	[-]						2,0				
Installation factor	γinst	[-]						1,0				
Concrete edge failure	1											
Effective length of fastener	If	[mm]	$\min(h_{ef}; 12 \cdot d_{nom}) \qquad \min(h_{ef}; 300 mm)$							mm)		
Outside diameter of fastener	d <sub>nom</sub>	[mm]	8 10 12 14 16 20 24 25 28 32						32			
Installation factor	γinst	[-]	1,0									

 $<sup>^{1)}\,</sup>f_{\mbox{\scriptsize uk}}$  shall be taken from the specifications of reinforcing bars

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of shear loads under static and quasi-static action for a working life of 50 and 100 years (rebar)	Annex C 11

<sup>2)</sup> in absence of national regulation



Table C12: Disp	olacement	s under tensi	on load	<b>1</b> 1)						
Threaded rod			М8	M10	M12	M16	M20	M24	M27	M30
Uncracked concrete C2	20/25 under s	tatic and quasi-s	tatic acti	on for a	working	g life of	50 and 1	100 year	s	
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,037	0,039	0,042	0,044	0,046
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,047	0,051	0,054	0,057	0,060
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,038	0,041	0,044	0,046	0,048
III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,049	0,053	0,056	0,059	0,062
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,121	0,126	0,131	0,142	0,153	0,163	0,171	0,179
IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,124	0,129	0,135	0,146	0,157	0,168	0,176	0,184
Cracked concrete unde	er static and c	quasi-static actio	n for a w	orking l	ife of 50	and 10	) years			
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,090	0,095	0,099	0,103	0,106
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,116	0,122	0,128	0,133	0,137
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,093	0,098	0,103	0,107	0,110
III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,121	0,127	0,133	0,138	0,143
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,312	0,321	0,330	0,349	0,367	0,385	0,399	0,412
IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,321	0,330	0,340	0,358	0,377	0,396	0,410	0,424

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

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \ \cdot \tau; \qquad \qquad \tau\text{: action bond stress for tension}$ 

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

# Table C13: Displacements under shear load<sup>1)</sup>

Threaded rod	М8	M10	M12	M16	M20	M24	M27	M30			
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years											
All temperature	$\delta_{V0}$ -factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03	
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	

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

 $\delta_{V0} = \delta_{V0}$ -factor  $\cdot$  V; V: action shear load

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

Chemofast Injection system UM-H for concre	te
Devleymen	

#### Performances

Displacements under static and quasi-static action for a working life of 50 and 100 years (threaded rod)

Annex C 12



Table C14: Displacements under tension load <sup>1)</sup>											
Internal threaded ancho	or rods		IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20			
Uncracked concrete under static and quasi-static action for a working life of 50 and 100 years											
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,032	0,034	0,037	0,039	0,042	0,046			
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,042	0,044	0,047	0,051	0,054	0,060			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,034	0,035	0,038	0,041	0,044	0,048			
III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,044	0,045	0,049	0,053	0,056	0,062			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,126	0,131	0,142	0,153	0,163	0,179			
IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,129	0,135	0,146	0,157	0,168	0,184			
Cracked concrete unde	r static and qu	asi-static action	for a work	ing life of	50 and 100	years		,			
Temperature range I: 24°C/40°C	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,083	0,085	0,090	0,095	0,099	0,106			
II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,170	0,110	0,116	0,122	0,128	0,137			
Temperature range	δ <sub>N0</sub> -factor	[mm/(N/mm²)]	0,086	0,088	0,093	0,098	0,103	0,110			
III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,111	0,114	0,121	0,127	0,133	0,143			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,321	0,330	0,349	0,367	0,385	0,412			
IV: 100°C/160°Č	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,330	0,340	0,358	0,377	0,396	0,424			

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

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \cdot \tau;$   $\tau$ : action bond stress for tension

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

# Table C15: Displacements under shear load<sup>1)</sup>

Internal threaded	l anchor rods		IG-M6	16 IG-M8 IG-M10		IG-M12	IG-M16	IG-M20	
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years									
All temperature	δ <sub>V0</sub> -factor	[mm/kN]	0,07	0,06	0,06	0,05	0,04	0,04	
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,10	0,09	0,08	0,08	0,06	0,06	

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

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

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

Chemofast Injection system UM-H for concrete	
Performances Displacements under static and quasi-static action for a working life of 50 and 100 years (internal threaded anchor rod)	Annex C 13



Table C16:	Displace	ments under	tensi	on loa	ad <sup>1)</sup>							
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked concre	ete under sta	atic and quasi-s	tatic ac	tion for	a work	ing life	of 50 a	ınd 100	years			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,035	0,037	0,039	0,042	0,043	0,045	0,048
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,045	0,047	0,051	0,054	0,055	0,058	0,063
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,032	0,034	0,035	0,036	0,038	0,041	0,044	0,045	0,047	0,050
range III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,047	0,049	0,053	0,056	0,057	0,060	0,065
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,121	0,126	0,131	0,137	0,142	0,153	0,163	0,164	0,172	0,186
range IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,141	0,146	0,157	0,168	0,169	0,177	0,192
Cracked concrete	under statio	and quasi-stat	ic actio	n for a	workin	g life of	f 50 and	l 100 ye	ears			
Temperature range	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,087	0,090	0,095	0,099	0,099	0,103	0,108
I: 24°C/40°C II: 50°C/80°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,113	0,116	0,122	0,128	0,128	0,133	0,141
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,090	0,093	0,098	0,103	0,103	0,107	0,113
range III: 72°C/120°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,118	0,121	0,127	0,133	0,133	0,138	0,148
Temperature	$\delta_{N0}$ -factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,340	0,349	0,367	0,385	0,385	0,399	0,425
range IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,321	0,330	0,340	0,349	0,358	0,377	0,396	0,396	0,410	0,449

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

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \ \cdot \tau;$ 

τ: action bond stress for tension

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

# Table C17: Displacements under shear load<sup>1)</sup>

Reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked and	tic and	quasi-s	static ac	tion fo	r a work	cing life	of 50 a	nd 100	years			
All temperature ranges	$\delta_{V0}$ -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	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	0,04	0,04

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

 $\delta_{V0} = \delta_{V0}\text{-factor} \cdot V;$ 

V: action shear load

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

Chemofast Injection system UM-H for concrete	
Performances Displacements under static and quasi-static action for a working life of 50 and 100 years (rebar)	Annex C 14



Tabl	Table C18: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years											
Thread	ded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel fa	ailure											
Charac	cteristic tension resist	ance	N <sub>Rk,s,eq,C1</sub>	[kN]				1,0 •	$N_{Rk,s}$			
Partial	factor		γ <sub>Ms,N</sub>	[-]				see Ta	able C1			
Combi	ined pull-out and co	ncrete failure										
Characteristic bond resistance in cracked and uncracked concrete C20/25												
<u>e</u>	I: 24°C/40°C	Dry Wot	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
Temperature range	II: 50°C/80°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
mpe	III: 72°C/120°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	6,0	6,5	7,0	7,5	7,0	6,0	6,0	6,0
Le Le	IV: 100°C/160°C	Tiole	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	5,5	5,5	6,0	6,5	6,0	5,5	5,5	5,5
Increas	sing factors for concre	ete	Ψc	[-]				1	,0			
Characteristic bond resistance depending on the concrete strength class			τ	Ψ <sub>C</sub> • τ <sub>Rk,eq,C1,(C20/25)</sub>								
Installa	ation factor											
for dry	or dry and wet concrete								,0			
		HDB	γinst	[-]					,2			
for floo	ded bore hole	CAC						1	,4			

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years (threaded rod)	Annex C 15



Tabl	Table C19: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years											
Thread	led rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel fa	ailure											
Charac	Characteristic tension resistance N <sub>Rk,s,eq,C1</sub> [kN]							1,0 •	$N_{Rk,s}$			
Partial t	factor		γ <sub>Ms,N</sub>	[-]				see Ta	able C1			
Combi	ned pull-out and co	ncrete failure										
Characteristic bond resistance in cracked and uncracked concrete C20/25												
Temperature range	I: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	6	6,5	6,5	6,5	6,5	6,5	6,5
Tempe	II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	6	6,5	6,5	6,5	6,5	6,5	6,5
Increas	ing factors for concr	ete	Ψc	[-]				1	,0			
	teristic bond resistar concrete strength cla	τ	$\tau_{Rk,eq,C1} = \psi_{c} \cdot \tau_{Rk,eq,C1,(C20/25)}$									
Installa	ation factor	,	,									
for dry	or dry and wet concrete				1,0							
-		HDB	γ <sub>inst</sub>	[-]					,2			
for floor	ded bore hole	CAC						1	,4			

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years (threaded rod)	Annex C 16



Table C20:	Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years											
Threaded rod				М8	M10	M12	M16	M20	M24	M27	M30	
Steel failure												
Characteristic shear resistance (Seismic C1) $V_{Rk,s,eq,C1}  [kN] \qquad \qquad 0.70 \cdot V^0_{Rk,s}$						,s						
							Table C	:1				
Factor for annular gap $\alpha_{ m gap}$				0,5 (1,0)1)								

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of shear loads under seismic action (performance category C1) (threaded rod)	Annex C 17

<sup>1)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended



# Table C21: Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years

						202						<u> </u>		
Reinfo	rcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel f	Steel failure							77						
Charac	cteristic tension resi	stance	N <sub>Rk,s,eq,C1</sub>	[kN]					1,0 • A	s · fuk	1)			
Cross	section area		As	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial	factor		γ <sub>Ms,N</sub>	[-]					1,	42)				
Combi	ined pull-out and o	concrete failu	ire											
Charac	cteristic bond resista	ance in crack	ed and uncra	cked cond	crete C	20/25								
ange	I: 24°C/40°C	Dry wot	<sup>τ</sup> Rk,eq,C1	[N/mm²]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
ure ra	II: 50°C/80°C	concrete	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
perat	III: 72°C/120°C	flooded	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	4,5	5,0	5,0	5,5	5,5	5,5	5,5	6,0	6,0	6,0
Tem	IV: 100°C/160°C	bore note	<sup>τ</sup> Rk,eq,C1	[N/mm <sup>2</sup> ]	4,0	4,5	4,5	5,0	5,0	5,0	5,0	5,0	5,0	5,0
Increas	sing factors for cond	crete	Ψc	[-]	1,0									
Characteristic bond resistance depending on the concrete strength class			k,eq,C1 =	Ψc * <sup>τ</sup> Rk,eq,C1,(C20/25)										
Installa	ation factor													
for dry and wat caparate								1	,0					
HDB γ		γinst	[-]					1	,2					
for floo	ded bore hole	CAC							1	,4				
Charace and England Charace Charace Class Installation for dry	I: 24°C/40°C II: 50°C/80°C III: 72°C/120°C IV: 100°C/160°C sing factors for conducteristic bond resisteding on the concrete	Dry, wet concrete and flooded bore hole crete ance e strength	rRk,eq,C1  τRk,eq,C1  τRk,eq,C1  τRk,eq,C1  τRk,eq,C1  νc  τR	[N/mm²] [N/mm²] [N/mm²] [N/mm²] [-] k,eq,C1 =	5,5 5,5 4,5	5,5 5,5 5,0	6,0 6,0 5,0	6,5 5,5 5,0	6,5 5,5 5,0 1 <sup>†</sup> Rk,ec	6,5 5,5 5,0 ,0 ,0 ,0 ,0	6,5 5,5 5,0	7,0 6,0	7,0 6,0	7

 $<sup>^{1)}</sup>$   $f_{uk}$  shall be taken from the specifications of reinforcing bars

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 50 years (rebar)	Annex C 18

<sup>2)</sup> in absence of national regulation



Table C22:	Characteristic values of tension loads under seismic action
	(performance category C1) for a working life of 100 years

Reinforcing bar						Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel f	ailure													
Charac	cteristic tension resi	stance	N <sub>Rk,s,eq,C1</sub>	[kN]	1,0 • A <sub>s</sub> • f <sub>uk</sub> <sup>1)</sup>									
Cross	section area		A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial	factor		$\gamma_{Ms,N}$	[-]					1,	<b>4</b> <sup>2)</sup>				
Comb	ined pull-out and o	concrete fail	ure											
Charac	cteristic bond resista	ance in crack	ed and uncra	acked cond	crete C	20/25								
Temperature range	I: 24°C/40°C	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C1	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0
Tempe	II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,eq,C1	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,0	4,0	4,0	4,0	4,0
Increas	sing factors for cond	crete	Ψс	[-]	1,0									
Characteristic bond resistance depending on the concrete strength class τ <sub>Rk,eq,C1</sub> =					Ψc • <sup>τ</sup> Rk,eq,C1,(C20/25)									
Installation factor														
for dry	for dry and wet concrete CAC HDB								1	,0				
lor dry			$\gamma_{inst}$	[-]					1	,2				
for flooded bore hole CAC			17.00					1	,4					

 $<sup>^{1)}\</sup> f_{\mbox{\scriptsize uk}}$  shall be taken from the specifications of reinforcing bars

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1) for a working life of 100 years (rebar)	Annex C 19

<sup>2)</sup> in absence of national regulation



Table C23: Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years													
Reinforcing bar				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure	Steel failure												
Characteristic shea	ar resistance	V <sub>Rk,s,eq</sub>	[kN]					0,35	· A <sub>s</sub> ·	f <sub>uk</sub> 1)			
Cross section area	Į.	A <sub>s</sub>	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ <sub>Ms,V</sub>	[-] 1,5 <sup>2</sup>										
Factor for annular	r gap	$\alpha_{\sf gap}$	[-]					0,	5 (1,0	)3)			

 $<sup>^{1)}</sup>$   $f_{uk}$  shall be taken from the specifications of reinforcing bars

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of shear loads under seismic action (performance category C1) for a working life of 50 and 100 years (rebar)	Annex C 20

<sup>2)</sup> in absence of national regulation

<sup>3)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended



Table		cteristic va rmance cat					on				
Thread	ed rod				M12	M16	M20	M24			
Steel fa	ailure										
Steel, s Stainles	teristic tension resist trength class 8.8 ss Steel A4 and HCF h class ≥70	oberedo contragarendo de Pre	N <sub>Rk,s,eq,C2</sub>	[kN]		1,0 •	$N_{Rk,s}$				
Partial f	actor		γ <sub>Ms,N</sub>	γ <sub>Ms,N</sub> [-] see Table C1							
Combin	ned pull-out and co	ncrete failure	•								
Charact	teristic bond resistar	ice in cracked a	nd uncracked	concrete C20	0/25						
<u>e</u>	I: 24°C/40°C	Dry, wet	τ <sub>Rk,eq,C2</sub>	[N/mm <sup>2</sup> ]	3,6 3,5 3,3						
nperatu range	II: 50°C/80°C	concrete and	<sup>τ</sup> Rk,eq,C2	[N/mm <sup>2</sup> ]	3,6	3,5	3,3	2,3			
Temperature range	III: 72°C/120°C	flooded bore	τ <sub>Rk,eq,C2</sub>	[N/mm <sup>2</sup> ]	3,1	3,0	2,8	2,0			
Tel	IV: 160°C/100°C	hole	τ <sub>Rk,eq,C2</sub>	[N/mm <sup>2</sup> ]	2,5	2,7	2,5	1,8			
Increas	ing factors for concre	ete	Ψс	[-]		1	,0				
	Characteristic bond resistance depending on the concrete strength class $\tau_{Rk,eq,C2} = \psi_c \cdot \tau_{Rk,eq,C2,(C20/25)}$										
Installa	tion factor										
for dry and wet concrete CAC			γinst	[-]	1,0 1,2						
for flooded bore hole CAC 1,4											

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C2) for a working life of 50 years (threaded rod)	Annex C 21



	aracteristic va rformance cat								
Threaded rod				M12	M16	M20	M24		
Steel failure									
Characteristic tension re Steel, strength class 8.8 Stainless Steel A4 and H Strength class ≥70		N <sub>Rk,s,eq,C2</sub>	[kN]		1,0 •	$N_{Rk,s}$			
Partial factor		$\gamma_{Ms,N}$	[-]		see Ta	ıble C1			
Combined pull-out and	concrete failure								
Characteristic bond resis	stance in cracked a	and uncracked	concrete C2	0/25					
nperature range :I :C,000/ C)	Dry, wet concrete and	<sup>τ</sup> Rk,eq,C2	[N/mm²]	3,6 3,5 3,3 2,					
II: 24°C/40°C  II: 50°C/80°C	flooded bore hole	<sup>τ</sup> Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3		
Increasing factors for co	ncrete	Ψc	[-]		1	,0			
Characteristic bond resist on the concrete strength			τ <sub>Rk,eq,C2</sub> =		Ψ <sub>c</sub> • τ <sub>Rk,eq</sub>	,C2,(C20/25)			
Installation factor									
for dry and wet concrete	HDR	γ <sub>inst</sub>	[-]	1,0 1,2					
for flooded bore hole	CAC			1,4					

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C2) for a working life of 100 years (threaded rod)	Annex C 22



# Table C26: Characteristic values of shear loads under seismic action (performance category C2) for a working life of 50 and 100 years

Threaded rod			M12	M16	M20 M24				
Steel failure									
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70	V <sub>Rk,s,eq,C2</sub>	[kN]	0,70 • V <sup>0</sup> <sub>Rk,s</sub>						
Partial factor	γ <sub>Ms,V</sub>	[-]		see Table C1					
Factor for annular gap	$\alpha_{\sf gap}$	[-]		0,5 (1,0)1)					

<sup>1)</sup> Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended

# Table C27: Displacements under tension load

Threaded rod		M12	M16	M20	M24						
Cracked concrete under seismic action (performance category C2) for a working life of 50 and 100 years											
All temperature	$\delta_{N,eq,C2(50\%)} = \delta_{N,eq,C2(DLS)}$	[mm]	0,24	0,27	0,29	0,27					
ranges	$\delta_{N,eq,C2(100\%)} = \delta_{N,eq,C2(ULS)}$	[mm]	0,55	0,51	0,50	0,58					

## Table C28: Displacements under shear load

Threaded rod		M12	M16	M20	M24	
	under seismic action of 50 and 100 years	(performance	category C2)			
All temperature	$\delta_{V,eq,C2(50\%)} = \delta_{V,eq,C2(DLS)}$	[mm]	3,6	3,0	3,1	3,5
ranges	$\delta_{V \text{ eq C2}(100\%)} =$	[mm]	7,0	6,6	7,0	9,3

ı		
	Chemofast Injection system UM-H for concrete	
	Performances Characteristic values of shear loads Displacements under seismic action (performance category C2) for a working life of 50 and 100 years (threaded rod)	Annex C 23



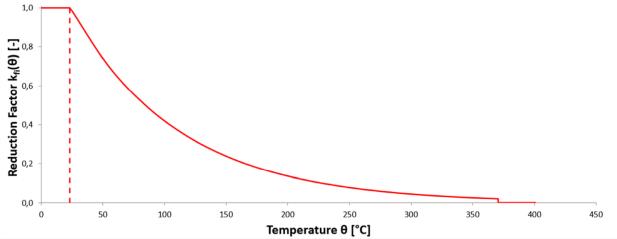
Fire sposure time [min] $\frac{36}{60}$ $\frac{66}{12}$ $\frac{12}{12}$ $12$	0,9 0,7 0,5 0,5 concrete (	1,7 1,4 1,0 0,8 C20/25		5,7 4,2 3,0 2,2 50/60 u	,0 ),011·θ≤		16,5 12,4 8,7 6,4 litions	15,1 10,7 7,9
Fire sposure time [min] $\theta$ 12 $\theta$ 4°C $\theta$ $\theta$ 379	0,9 0,7 0,5 0,5 concrete (	1,4 1,0 0,8	2,3 1,6 1,2 up to C	4,2 3,0 2,2 50/60 u	6,6 4,7 3,4 nder fi	9,5 6,7 4,9 re cond	12,4 8,7 6,4	20,2 15,1 10,7 7,9 <b>for a</b>
Fire sposure time [min] $\theta$ 12 $\theta$ 4°C $\theta$ $\theta$ 379	0,9 0,7 0,5 0,5 concrete (	1,4 1,0 0,8	2,3 1,6 1,2 up to C	4,2 3,0 2,2 50/60 u	6,6 4,7 3,4 nder fi	9,5 6,7 4,9 re cond	12,4 8,7 6,4	15,1 10,7 7,9
time [min] $\theta$ d uncracked $\theta < 24^{\circ}C$ $\theta < 379$	0,7 0,5 concrete (	1,0	1,6 1,2 up to C	3,0 2,2 <b>50/60 u</b> 1,01 · e -0	$4,7$ $3,4$ $0$ $0$ $0,011 \cdot \theta \le 0$	6,7 4,9 re cond	8,7 6,4	10,7 7,9
[min] $\frac{12}{12}$ d uncracked $\theta < 24^{\circ}$ C $\frac{4^{\circ}}{12}$ C $\frac{12}{12}$ C $\frac{12}{12$	0 0,5 concrete (	0,8	1,2 up to C	2,2 <b>50/60 u</b> 1,01 • e -0	3,4 nder fi	4,9 re cond	6,4	7,9
d uncracked $\theta < 24^{\circ}C$ $4^{\circ}C \le \theta \le 379$	concrete (		ip to C	<b>50/60 u</b> 1, 01 • e <sup>-0</sup>	nder fi	re cond		
θ < 24°C 4°C ≤ θ ≤ 379		520/25 (		1, 01 • e <sup>-0</sup>	,0 ),011·θ≤		litions	Tor a
4°C ≤ θ ≤ 379	°C		1,36	01 • e <sup>-0</sup>	),011∙⊕≤	1,0		
	°C		1,30			1,0		
θ > 379°C				0,	0,			
0 200 Tempe	250		00	350	4	00	450	
[N/mm²]		·1	k <sub>fi,p</sub> (	θ) • τ <sub>Rk</sub>	,cr,(C20/25) <sup>1)</sup>			
		Т						
Fire —		_	- 12	- 2	8,8	- 2	-	20,2
								15,1
[min]		_						10,7
12	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9
30	1.1	2.2	4.7	12.0	23.4	40.4	59.9	81,0
Fire		***	- 0	9,0	17,5	30,3	44,9	60,7
time 9		1,3	2,5	6,3	12,3	21,3	31,6	42,7
[min]		1,0	1,8	4,7	9,1	15,7	23,3	31,5
cracked conc	ete for con	crete stre	ength cla	ass C20	/25 for	the relev	/ant	
\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Temper   30   60   120     1	Temperature θ [°C [N/mm²]]  Fire posure time [min]	Temperature θ [°C]  [N/mm²]  Fire posure time [min]  30 1,1 1,7 60 0,9 1,4 90 0,7 1,0 120 0,5 0,8  Fire posure time [min]  30 1,1 2,2 60 0,9 1,8 90 0,7 1,3 120 0,5 1,0					



Table C30: Characteristic values of tension and shear loads under fire exposure in
hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer
drilled holes with hollow drill bit (HDB)

Internal threaded anchor rods					IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
		Fire	30	0,3	1,1	1,7	3,0	5,7	8,8
N <sub>Rk,s,fi</sub>	[kN]	2 20 30	60	0,2	0,9	1,4	2,3	4,2	6,6
		time	90	0,2	0,7	1,0	1,6	3,0	4,7
		[min]	120	0,1	0,5	0,8	1,2	2,2	3,4
			Fire exposure	N <sub>Rk,s,fi</sub> [kN]  Fire exposure time [min]  90	N <sub>Rk,s,fi</sub> [kN]  Fire exposure time [min]  90 0,2	N <sub>Rk,s,fi</sub> [kN] Fire exposure time [min] 30 0,3 1,1 60 0,2 0,9 90 0,2 0,7	N <sub>Rk,s,fi</sub> [kN]  Fire exposure time [min]    Signature   10	N <sub>Rk,s,fi</sub> [kN]  Fire exposure time [min]  90 0,2 0,7 1,0 1,6	N <sub>Rk,s,fi</sub> [kN]  Fire exposure time [min]  90 0,2 0,7 1,0 1,6 3,0

Characteristic bond resistance in cracked and uncracked concrete C20/25 up to C50/60 under fire conditions for a given temperature θ



			'	emperatu	ופטן כן							
Characteristic bond resistance for a given temperature $(\theta)$	$\tau_{Rk,fi}(\theta)$	[N/mm²]				k <sub>f</sub>	,p(θ) • τ <sub>Rk,cr,(C20/25)</sub> 1)					
Steel failure without lever arm												
Characteristic shear resistance; Steel, Stainless Steel A4 and HCR, strength class 5.8 and 8.8 resp. 70			Fire	30	0,3	1,1	1,7	3,0	5,7	8,8		
	V <sub>Rk,s,fi</sub>	[LANI]	ovnocuro	60	0,2	0,9	1,4	2,3	4,2	6,6		
		[kN]		90	0,2	0,7	1,0	1,6	3,0	4,7		
				120	0,1	0,5	0,8	1,2	2,2	3,4		
Steel failure with lever arm												
Characteristic bending			Fire	30	0,2	1,1	2,2	4,7	12,0	23,4		
Characteristic bending moment; Steel, Stainless	M0	[Nm]	ovnocuro	60	0,2	0,9	1,8	3,5	9,0	17,5		
l cross series series in the series s	M <sup>0</sup> Rk,s,fi	ן נואווו <u>ן</u>	time	90	0,1	0,7	1,3	2,5	6,3	12,3		
class 5.8 and 8.8 resp. 70			[min]	120	0,1	0,5	1,0	1,8	4,7	9,1		

<sup>1)</sup>  $au_{Rk,cr,(C20/25)}$  characteristic bond resistance for cracked concrete for concrete strength class C20/25 for the relevant temperature range

Chemofast Injection system UM-H for concrete	
Performances Characteristic values of tension and shear loads under fire exposure (internal threaded anchor rod)	Annex C 25



	drilled	hole	es of tenses (HD), o	compre	esse									er
	ioles wi	ui iic	ollow ari	וו טונ (ר		Appare to the	SUBSECT OF WASH	8108D1 × 180	BACKET OF AGE	with the second of	775.2473000.000		TO 1000 TO 1000 TO 1000	name Parka
Reinforcing bar					Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure				20.000		0		20.00	220 200	400 700	25.72	100-100	W 000 100	12000 0
			F:	30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	
Characteristic tension	N <sub>Rk,s,fi</sub>	[kN]	Fire exposure	60	0,5	1,0	1,7	2,3	3,0	4,7	6,8	7,4	9,2	12,1
resistance; BSt 500	,		time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
Ob	<u> </u>			120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Characteristic bond resistiven temperature $\theta$	tance in c	гаске	a ana unc	гаскеа с	oncre	te C2	0/25 u	p to C	50/60	unae	r tire (	conait	ions i	or a
g			θ < 2	2°C					1	,0				
Temperature reduction	$k_{fi,p}(\theta)$	[-]	22°C ≤ θ :	≤ 370°C				1,26	8 · е -	0,011•θ	≤ 1,0			
factor	,p		$\theta > 37$				20.	0	,0	92				
Reduction Factor k <sub>ff</sub> (θ) [-]	10	0	150	200 Tempera		250 <b>)</b> [°C]	30	0	350		400		450	
Characteristic bond	(0)		FN.1/ 07		ν (Δ) ο σ						(,1)			
resistance for a given temperature $(\theta)$	$\tau_{Rk,fi}(\theta)$		[N/mm²]	a.	$k_{fi,p}(\theta) \cdot \tau_{Rk,cr,(0)}$						20/25) '			
Steel failure without lever	arm	l			l									
				30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	16,1
Characteristic shear	$V_{Rk,s,fi}$	[kN]	Fire exposure	60	0,5	1,0	1,7	2,3	3,0	4,7	6,8	7,4	9,2	12,1
resistance; BSt 500	TK,5,II	[13,4]	time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
Table 19 By St.				120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Steel failure with lever arr	n			- 00	0.0	1.0	4.4	0.5	0.7	400	00.0	00.0	<b>-4</b> -7	77.0
			Fire	30	0,6	1,8	4,1	6,5	9,7	18,8	32,6		51,7	
Characteristic bending moment; BSt 500	M <sup>0</sup> Rk,s,fi	[Nm]	exposure	60	0,5	1,5	3,1	4,8	7,2	14,1		27,6	38,8	
moment, Dot 500			time [min]	90	0,4	1,2	2,6	4,2	6,3	12,3		23,9	33,6	55.0
1) $\tau_{\text{Rk,cr,(C20/25)}}$ characteris	tic bond re	 sistan	ce for crack	120 ed concre	0,3 ete for	0,9 concre	2,0 ete stre	3,2 ngth cl	4,8 lass C	9,4 20/25 t		18,4 releva		38,6