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European Technical Assessment Body for construction products



European Technical Assessment

ETA-16/0018 of 16 May 2025

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

EAD 330499-02-0601, Edition 12/2023

ETA-16/0018 issued on 28 September 2023

European Technical Assessment ETA-16/0018

English translation prepared by DIBt



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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 to 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

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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 16 May 2025 by Deutsches Institut für Bautechnik

Dipl.-Ing. Beatrix Wittstock Head of Section

beglaubigt: Stiller

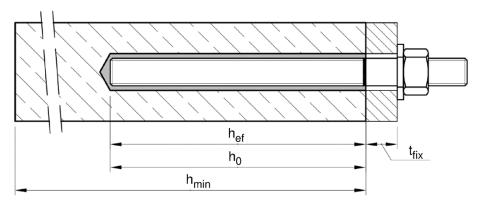
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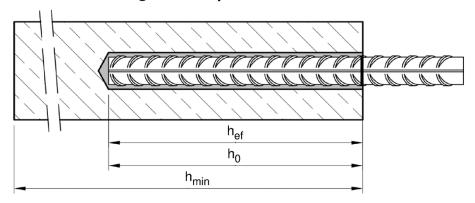
drill hole depth

Installation threaded rod M8 up to M30

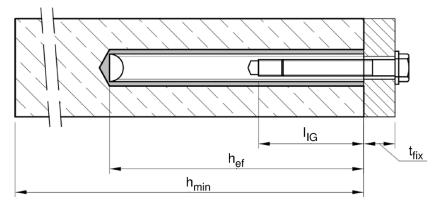
prepositioned installation or push through installation (annular gap filled with mortar)



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

 h_{ef} = effective embedment depth I_{IG} = thread engagement length

 h_{min} = minum thickness of member

Chemofast Injection system UM-H for concrete

Product description
Installed condition

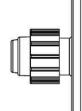
Annex A 1



Cartridge system

Coaxial Cartridge:

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



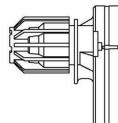
Imprint:

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

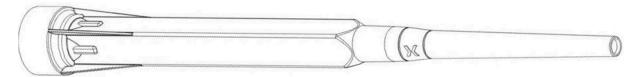


Imprint:

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

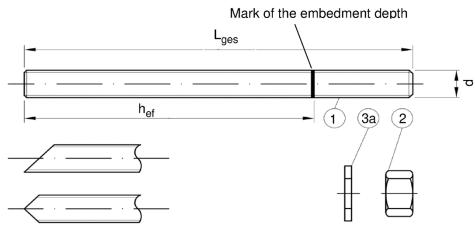
Product description

Injection system

Annex A 2



Threaded rod M8 up to M30 with washer and hexagon nut

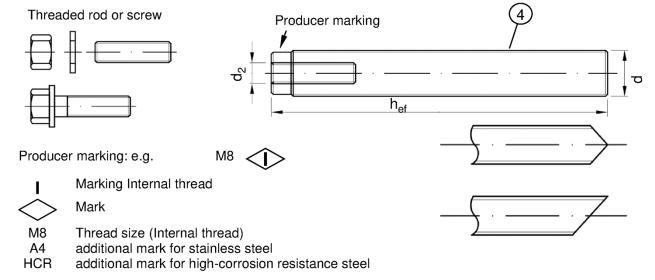


Commercial standard rod with:

- 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

For hot dip galvanized elements, the requirements with regards to the combination of nuts and rods according to EN ISO 10684:2004+AC:2009 Annex F shall be considered.

Internal threaded rod IG-M6 to IG-M20



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



	ible A1: Mate	rials				
Par	Designation	Material				
- z - h	inc plated ≥ 5 ot-dip galvanised ≥ 4	acc. to EN ISO 683-4:2 µm acc. to EN ISO 0 µm acc. to EN ISO 5 µm acc. to EN ISO	4042 146	2:2022 or 1:2022 and EN ISO 10684:	2004+AC:2009 or	
		Property class		Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
			4.6	f _{UK} = 400 N/mm ²	f _{VK} = 240 N/mm ²	A ₅ > 8%
1	Threaded rod		4.8	f _{uk} = 400 N/mm ²	f _{VK} = 320 N/mm ²	A ₅ > 8%
1	Tilleaded fod	acc. to	5.6	f _{uk} = 500 N/mm ²	f _{yk} = 300 N/mm ²	A ₅ > 8%
		EN ISO 898-1:2013	5.8	f _{uk} = 500 N/mm ²	f _{yk} = 400 N/mm ²	A ₅ > 8%
			8.8	f _{uk} = 800 N/mm ²	f _{yk} = 640 N/mm ²	A ₅ ≥ 12% ³⁾
		acc. to	4	for anchor rod class 4.6 or		
2	Hexagon nut	EN ISO 898-2:2022	<u>5</u> 8	for anchor rod class 5.6 or	r 5.8	
 3a	Washer		t-dip	for anchor rod class 8.8 galvanised or sherardized	7000 0000 - 51100 7	204 2022)
3b	Filling washer	1 2		N ISO 7089:2000, EN ISO galvanised or sherardized	7093:2000 or EN ISO 7	094:2000)
<u> </u>		Property class	it-dip	Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
4	Internal threaded anchor rod	acc to				
4	anchor rod	lacc to	5.8	$f_{uk} = 500 \text{ N/mm}^2$	$f_{vk} = 400 \text{ N/mm}^2$	$A_5 > 8\%$
	anchor rod	acc. to EN ISO 898-1:2013		un.	$f_{yk} = 400 \text{ N/mm}^2$ $f_{yk} = 640 \text{ N/mm}^2$	A ₅ > 8% A ₅ > 8%
Sta	inless steel A2 (Mate	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1	8.8 .431 .457	un.	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023)	
Sta	inless steel A2 (Mate	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1	8.8 .431 .457	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023)	
Stai Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistance	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45	8.8 .431 .457 .29 oi	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088 Characteristic steel	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel	$A_5 > 8\%$
Stai Hig	inless steel A2 (Mate	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to	8.8 .431 .457 .29 oi	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength	A ₅ > 8% Elongation at fracture
Stai Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistance	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class	8.8 .431 .457 29 or	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ²	f _{yk} = 640 N/mm ² to EN 10088-1:2023) to EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ²	$A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$
Stai Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistant) Threaded rod 1)4)	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020	8.8 .431 .457 29 or	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088. Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ²	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ²	A ₅ > 8% Elongation at fracture A ₅ \geq 8% A ₅ \geq 12% 3)
Sta Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistance	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 acc. to	8.8 .431 .457 .29 or 50 70 80 50 70	$f_{uk} = 800 \text{ N/mm}^2$ 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088. Characteristic steel ultimate tensile strength $f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 700 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ for anchor rod class 50 for anchor rod class 70	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ²	A ₅ > 8% Elongation at fracture A ₅ \geq 8% A ₅ \geq 12% 3)
Sta Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistant) Threaded rod 1)4)	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 acc. to EN ISO 3506-1:2020	50 70 80 80	$f_{uk} = 800 \text{ N/mm}^2$ $1 / 1.4567 \text{ or } 1.4541, \text{ acc. to}$ $1 / 1.4362 \text{ or } 1.4578, \text{ acc. to}$ $1 / 1.4365, \text{ acc. to EN } 10088.$ $Characteristic steel$ $ultimate tensile strength$ $f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 700 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ $f_{or anchor rod class 50}$ $f_{or anchor rod class 70}$ $f_{or anchor rod class 80}$	f _{yk} = 640 N/mm ² to EN 10088-1:2023) to EN 10088-1:2023) to EN 10088-1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ²	Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 12\% \ ^3$ $A_5 \ge 12\% \ ^3$
Sta Hig	inless steel A2 (Mate inless steel A4 (Mate h corrosion resistant) Threaded rod 1)4)	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 re steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529	8.8 .431'.457'29 or 100'.00'.00'.00'.00'.00'.00'.00'.00'.00'	$f_{uk} = 800 \text{ N/mm}^2$ 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088. Characteristic steel ultimate tensile strength $f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 700 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ for anchor rod class 50 for anchor rod class 70	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ² 541, acc. to EN 10088-1578, acc. to EN 10088-1:2023	Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$
Sta Hig 1	Threaded rod 1)4) Hexagon nut 1)4)	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 re steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529 (e.g.: EN ISO 887:20	8.8 .431'.457'29 or 1 80 70 80 1.433'1.44 9 or 1 006, E	$f_{uk} = 800 \text{ N/mm}^2$ $1 / 1.4567 \text{ or } 1.4541, \text{ acc. to}$ $1 / 1.4362 \text{ or } 1.4578, \text{ acc. to}$ $1 / 1.4365, \text{ acc. to EN } 10088$ $Characteristic steel$ $ultimate tensile strength$ $f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 700 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ $for anchor rod class 50$ $for anchor rod class 70$ $for anchor rod class 80$ $07 / 1.4311 / 1.4567 \text{ or } 1.4$ $04 / 1.4571 / 1.4362 \text{ or } 1.4$ $.4565, \text{ acc. to EN } 10088-1$	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ² 541, acc. to EN 10088-1:2023 77093:2000 or EN ISO 7	Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 12\%^{3}$ $A_5 \ge 12\%^{3}$:2023 :2023
Sta Hig 1 1 2 3a	Threaded rod 1)4) Hexagon nut 1)4) Washer Filling washer	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 re steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529 (e.g.: EN ISO 887:20	8.8 .431'.457'29 or 1 80 70 80 1.433'1.44 9 or 1 006, E	f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1 / 1.4362 or 1.4578, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ² f _{uk} = 800 N/mm ² for anchor rod class 50 for anchor rod class 70 for anchor rod class 80 07 / 1.4311 / 1.4567 or 1.4 04 / 1.4571 / 1.4362 or 1.4 .4565, acc. to EN 10088-1 EN ISO 7089:2000, EN ISO	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ² 541, acc. to EN 10088-1578, acc. to EN 10088-1:2023	Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 12\%^{3}$ $A_5 \ge 12\%^{3}$:2023 :2023
Sta	Threaded rod ¹⁾⁴⁾ Hexagon nut ¹⁾⁴⁾ Washer	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 re steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452! (e.g.: EN ISO 887:20 Stainless steel A4, H	8.8 .431'.457'29 or 1 80 70 80 1.433'1.44 9 or 1 006, E	$\begin{array}{l} f_{uk} = 800 \text{ N/mm}^2 \\ 1/1.4567 \text{ or } 1.4541, \text{ acc. to} \\ 1/1.4362 \text{ or } 1.4578, \text{ acc. to} \\ 1/1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} = 500 \text{ N/mm}^2 \\ f_{uk} = 700 \text{ N/mm}^2 \\ f_{uk} = 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 80 \\ 07/1.4311/1.4567 \text{ or } 1.4 \\ 04/1.4571/1.4362 \text{ or } 1.4 \\ 04/565, \text{ acc. to EN } 10088-1 \\ \text{EN ISO } 7089:2000, \text{ EN ISO} \\ \text{orrosion resistance steel} \\ \text{Characteristic steel} \end{array}$	f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ² 541, acc. to EN 10088-1 :2023 7093:2000 or EN ISO 7	A ₅ > 8% Elongation at fracture A ₅ \geq 8% A ₅ \geq 12% 3) A ₅ \geq 12% 3) A ₅ \geq 12% 3) :2023 :2023 :2023 :2023 :2023 Elongation at

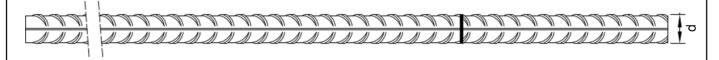
⁴⁾ Property class 80 only for stainless steel A4 and HCR

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

 ²⁾ for IG-M20 only property class 50
 3) A₅ > 8% fracture elongation if no use for seismic performance category C2







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		- material
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



Fasteners subject to (Static and	quasi-static loads)	<u>:</u>		
	Working life in concrete C20	•		ng life 100 years e C20/25 to C90/105
Base material	uncracked concrete	cracked concrete	uncracked concrete	cracked concrete
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to Ø8 to IG-M6 to	Ø32,	S	M8 to M30, Ø8 to Ø32, M6 to IG-M20
Temperature Range:	II: - 40 °C III: - 40 °C	to +40 °C¹) to +80 °C²) to +120 °C³) to +160 °C⁴)		0 °C to +40 °C¹) 0 °C to +80 °C²)
Fasteners subject to (seismic ac	tion):			
	Performance	Category C1	Perform	ance Category C2
Base material	Crack	ked and uncracked c	oncrete C20/25	to C50/60
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to Ø8 to		N	И12 to M24
Temperature Range:			II: - 4: III: - 4:	0 °C to +40 °C ¹⁾ 0 °C to +80 °C ²⁾ 0 °C to +120 °C ^{3) 5)} 0 °C to +160 °C ^{4) 5)}
Fasteners subject to (Fire exposu	ıre):			
Base material	uncra	acked and cracked co	oncrete C20/25	to C50/60
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 °C¹) to +80 °C²) to +120 °C³) to +160 °C⁴)	
1) (max. long-term temperature +24°C a 2) (max. long-term temperature +50°C a 3) (max. long-term temperature +72°C a 4) (max. long-term temperature +100°C	and max. short-term te and max. short-term te	mperature +80°C) mperature +120°C)		
5) Only for working life of 50 years				
	I-H for concrete			



Base materials:

- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A2:2021.
- Strength classes C20/25 to C90/105 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 + A1:2015 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 pa	arameters	for thre	eaded	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 ₀	[mm]	10	12	14	18	22	28	30	35
Effective embedme	at donth	h _{ef,min}	[mm]	60	60	70	80	90	96	108	120
Effective embedmer	н аертп	h _{ef,max}	[mm]	160	200	240	320	400	480	540	600
Diameter of	Prepositioned ins	stallation d _f ≤	[mm]	9	12	14	18	22	26	30	33
clearance hole in the fixture ¹⁾	Push through i		[mm]	12	14	16	20	24	30	33	40
Maximum installatio	n torque	max T _{inst}	[Nm]	10	20	40 ²⁾	60	100	170	250	300
Minimum thickness	of member	h _{min}	[mm]	1	f + 30 m : 100 mr			ľ	n _{ef} + 2do)	
Minimum spacing		s _{min}	[mm]	40	50	60	75	95	115	125	140
Minimum edge dista	ınce	c _{min}	[mm]	35	40	45	50	60	65	75	80

 $^{^{1)}}$ For application under seismic loading the diameter of clearance hole in the fixture shall be at maximum $d_1 + 1mm$ or alternatively the annular gap between fixture and threaded rod shall be filled force-fit with mortar.

Table B2: Installation parameters for reinforcing bar

Reinforcing bar			Ø 8 ¹⁾	Ø 10 ¹⁾	Ø 12 ¹⁾	Ø 14	Ø 16	Ø 20	Ø 24 ¹⁾	Ø 25 ¹⁾	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_0	[mm]	10 12	12 14	14 16	18	20	25	30 32	30 32	35	40
Effective embedment depth	h _{ef,min}	[mm]	60	60	70	75	80	90	96	100	112	128
Effective embedment depth	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 _e	_f + 2d ₀			
Minimum spacing	s _{min}	[mm]	40	50	60	70	75	95	120	120	130	150
Minimum edge distance	c _{min}	[mm]	35	40	45	50	50	60	70	70	75	85

¹⁾ both nominal drill hole diameter can be used

Table B3: Installation parameters for Internal threaded anchor rod

Internal threaded anchor rod			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Internal diameter of anchor rod	d ₂		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 ₀	[mm]	12	14	18	22	28	35
Effective embedment depth	h _{ef,min}	[mm]	60	70	80	90	96	120
Effective embedment 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	max T _{inst}	[Nm]	10	10	20	40	60	100
Thread engagement length min/max	l _{IG}	[mm]	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	h _{min}	[mm]	١ .	30 mm 0 mm		h _{ef} -	- 2d ₀	
Minimum spacing	s _{min}	[mm]	50	60	75	95	115	140
Minimum edge distance	c _{min}	[mm]	40	45	50	60	65	80
min/max Minimum thickness of member Minimum spacing	l _{IG} h _{min} s _{min}	[mm] [mm]	h _{ef} + 3 ≥ 100 50	30 mm 0 mm 60	75	h _{ef} -	- 2d ₀	140

¹⁾ With metric threads

Chemofast Injection system UM-H for concrete

Intended use

Installation parameters

Annex B 3

²⁾ Maximum installation torque for M12 with steel Grade 4.6 is 35 Nm



					mmil	A PROPERTY.				
hreaded Rod	Re- inforcing bar	Internal threaded anchor rod	d ₀ Drill bit - Ø HD, HDB, CD	d _t Brush	٠ ا	d _{b,min} min. Brush - Ø	Piston plug	1	n direction piston plu	
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		↓	\rightarrow	1
M8	8		10	RB10	11,5	10,5			ı	
M10	8 / 10	IG-M6	12	RB12	13,5	12,5		No plug	required	
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 _{ef} >	h _{ef} >	
M24		IG-M16	28	RB28	30,0	28,5	VS28	250 mm	250 mm	al
M27	24 / 25		30	RB30	31,8	30,5	VS30	200 111111	200 111111	
		1	32	RB32	34,0	32,5	VS32			
	24 / 25				_			-	1 1	
`	28 32	IG-M20 allation too	35 40	RB35 RB40	37,0 43,5	35,5 40,5	VS35 VS40			
Cleaninç HDB – Ho	28 32 g and installow drill bit	allation too	35 40 ols	RB35	37,0 43,5	35,5 40,5 The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/	VS35 VS40 I system cod a class Nure of 253 s).	I vacuum cle	eaner with a	minim
Cleaninç HDB – Ho	28 32 g and installow drill bit	allation to	35 40 ols	RB35	37,0 43,5	35,5 40,5 The hollow dril Hohlbohrer and negative press 150 m³/h (42 l/	VS35 VS40 I system cod a class Nure of 253 s).	I vacuum cle	eaner with a	minim
Cleaning HDB – Ho Hand pun Volume 75 Brush RB	28 32 g and installow drill bit	allation too	35 40 ols	RB35	37,0 43,5	35,5 40,5 The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/	VS35 VS40 system cod a class Nure of 253 s).	I vacuum cle	eaner with a	minim
Cleaning HDB - Ho Hand pun Volume 75 Brush RB	28 32 g and installow drill bit inp io ml, h₀ ≤ 10 of tension RBL	allation too t system d _s , d _o ≤ 20mm)	35 40 ols	RB35 RB40	37,0 43,5	35,5 40,5 The hollow drill Hohlbohrer and negative press 150 m³/h (42 l/s) Compressed (min 6 bar) Piston Plug	VS35 VS40 system or d a class Nure of 253 s).	I vacuum cle hPa and a f	eaner with a	minim



Table B5:	Workin	g time and cu	ring time	
Tempera	ature in bas	se material	Maximum working time	Minimum curing time 1)
	Т		t _{work}	t _{cure}
- 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

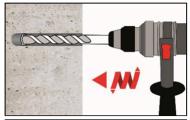
¹⁾ The minimum curing time is only valid for dry base material. In wet base material the curing time must be doubled.

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



Installation instructions

Drilling of the bore hole



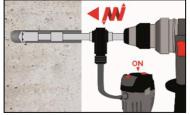
1a. Hammer drilling (HD) / Compressed air drilling (CD)

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).



1b. 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.

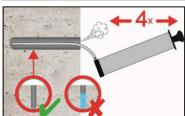
The hollow drilling system removes the dust and cleans the bore hole.

Proceed with Step 3.

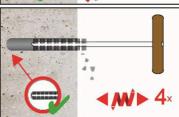
Attention! Standing water in the bore hole must be removed before cleaning.

Manual Air Cleaning (MAC)

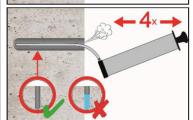
for bore hole diameter $d_0 \le 20$ mm and bore hole depth $h_0 \le 10d_{nom}$ (uncracked concrete only)



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



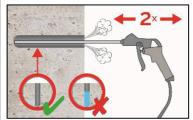
Brush the bore hole minimum 4x with brush RB according to Table B4 over the entire embedment depth in a twisting motion (if necessary, use a brush extension RBL).



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

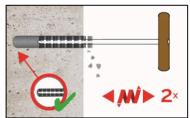
Intended use

Installation instructions

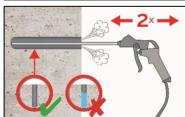
Annex B 6



Installation instructions (continuation)

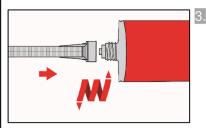


Brush the bore hole minimum 2x with brush RB according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension shall be used .RBL)



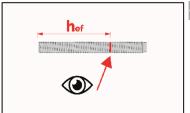
Finally blow the bore hole clean minimum 2x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

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.



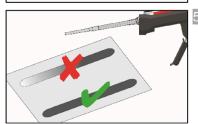
Screw on static-mixing nozzle PM-19E and load the cartridge into an appropriate dispensing tool.

For every working interruption longer than the maximum working time t_{work} (Annex B 5) as well as for new cartridges, a new static-mixer shall be used.

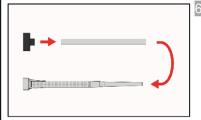


Mark embedment depth on the anchor rod. Consider t_{fix} in case of push through installations.

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:

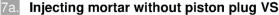
- Horizontal and vertical downwards direction: Drill bit-Ø d₀ ≥ 18 mm and embedment depth h_{ef} > 250mm
- Vertical upwards direction: Drill bit-Ø d₀ ≥ 18 mm
 Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.

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

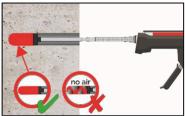


Installation instructions (continuation)





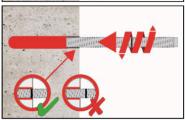
Starting at bottom of the hole and fill the hole up to approximately two-thirds with mortar. (If necessary, a mixer nozzle extension shall be used.) Slowly withdraw of the static mixing nozzle avoid creating air pockets Observe the temperature related working time t_{work} (Annex B 5).



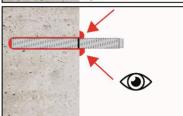
Injecting mortar with piston plug VS

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 twork (Annex B 5).



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

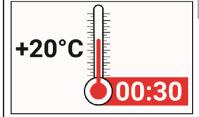


Annular gap between anchor rod and base material must be completely filled with mortar. In case of push through installation the annular gap in the fixture must be filled with mortar also.

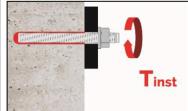
Otherwise, the installation must be repeated starting from step 7 before the maximum working time $t_{\rm work}$ has expired.



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



Temperature related curing time t_{cure} (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



Т	able C1: Characteristic values resistance of thread			ension	resist	ance	and s	teel s	hear		
Th	readed rod			M8	M10	M12	M16	M20	M24	M27	M30
Cr	oss section area	A _s	[mm²]	36,6	58	84,3	157	245	353	459	561
Ch	aracteristic tension resistance, Steel failu	re ¹⁾									
Ste	eel, Property class 4.6 and 4.8	N _{Rk,s}	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
Ste	eel, Property class 5.6 and 5.8	N _{Rk,s}	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
Ste	eel, Property class 8.8	N _{Rk,s}	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
Sta	ainless steel A2, A4 and HCR, class 50	N _{Rk,s}	[kN]	18	29	42	79	123	177	230	281
Sta	ainless steel A2, A4 and HCR, class 70	N _{Rk,s}	[kN]	26	41	59	110	171	247	_3)	_3)
Sta	ainless steel A4 and HCR, class 80	N _{Rk,s}	[kN]	29	46	67	126	196	282	_3)	_3)
Cr	naracteristic tension resistance, Partial fac	tor ²⁾									
Ste	eel, Property class 4.6 and 5.6	γ _{Ms,N}	[-]				2,0	0			
Ste	eel, Property class 4.8, 5.8 and 8.8	γMs,N	[-]				1,	5			
Sta	ainless steel A2, A4 and HCR, class 50	γ _{Ms,N}	[-]				2,8	86			
Sta	ainless steel A2, A4 and HCR, class 70	γ _{Ms,N}	[-]	1,87							
Sta	ainless steel A4 and HCR, class 80	γ _{Ms,N}	[-]				1,0	6			
Cr	naracteristic shear resistance, Steel failure	1)									
	Steel, Property class 4.6 and 4.8	V ⁰ _{Rk,s}	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
r arm	Steel, Property class 5.6 and 5.8	V ⁰ Rk,s	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
lever	Steel, Property class 8.8	V ⁰ Rk,s	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
Ĭ	Stainless steel A2, A4 and HCR, class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
Without	Stainless steel A2, A4 and HCR, class 70	V ⁰ Rk,s	[kN]	13	20	30	55	86	124	_3)	_3)
>	Stainless steel A4 and HCR, class 80	V ⁰ _{Rk,s}	[kN]	15	23	34	63	98	141	_3)	_3)
	Steel, Property class 4.6 and 4.8	M ⁰ Rk,s	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
arm	Steel, Property class 5.6 and 5.8	M ⁰ Rk,s	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
	Steel, Property class 8.8	M ⁰ Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
th lever	Stainless steel A2, A4 and HCR, class 50	M ⁰ Rk,s	[Nm]	19	37	66	167	325	561	832	1125
×	Stainless steel A2, A4 and HCR, class 70	M ⁰ Rk,s	[Nm]	26	52	92	232	454	784	_3)	_3)
	Stainless steel A4 and HCR, class 80	M ⁰ Rk,s	[Nm]	30	59	105	266	519	896	_3)	_3)
Cr	naracteristic shear resistance, Partial facto	or ²⁾									
Ste	eel, Property class 4.6 and 5.6	γ _{Ms,V}	[-]				1,6	57			
Ste	eel, Property class 4.8, 5.8 and 8.8	γ _{Ms,V}	[-]				1,2	25			
Sta	ainless steel A2, A4 and HCR, class 50	γ _{Ms,V}	[-]				2,3	88			
Sta	ainless steel A2, A4 and HCR, class 70	γ _{Ms,V}	[-]				1,5	6			
Sta	ainless steel A4 and HCR, class 80	γ _{Ms,V}	[-]				1,3	3			

 $^{^{1)}}$ Values are only valid for the given stress area A_s . Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot-dip galvanised threaded rods according to EN ISO 10684:2004+AC:2009.

³⁾ 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

²⁾ in absence of national regulation



Table C2: Characteristic values of tension loads under static and quasi-static action for a working life of 50 and 100 years											
Fastener				All Anchor types and sizes							
Concrete cone fa	ailure										
Uncracked concre	ete	k _{ucr,N}	[-]	11,0							
Cracked concrete)	k _{cr,N}	[-]	7,7							
Edge distance		c _{cr,N}	[mm]	1,5 h _{ef}							
Axial distance $s_{cr,N}$ [mm] $2 c_{cr,N}$											
Splitting											

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

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



	ded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel f		-1	N	FL-N IZ		A _s ⋅ f _{UK} (or see Table C1)							
	cteristic tension resi	stance	N _{Rk,s}	[kN]						le CT)			
Partial	ined pull-out and o	concrete failure	γ _{Ms,N}	[-]				see Ta	ble C i				
	cteristic bond resista		d concrete C20)/25									
	I: 24°C/40°C		^τ Rk,ucr	[N/mm ²]	17	17	16	15	14	13	13	13	
Femperature range	II: 50°C/80°C	Dry, wet concrete and	^τ Rk,ucr	[N/mm²]	17	17	16	15	14	13	13	13	
perat	III: 72°C/120°C	flooded bore hole	^τ Rk,ucr	[N/mm²]	15	14	14	13	12	12	11	11	
<u>'</u>	IV: 100°C/160°C		^τ Rk,ucr	[N/mm²]	12	11	11	10	9,5	9,0	9,0	9,0	
	cteristic bond resista	ance in cracked c	oncrete C20/2	5									
ange	I: 24°C/40°C		^τ Rk,cr	[N/mm²]	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	^τ Rk,cr	[N/mm ²]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0	
pera	III: 72°C/120°C	flooded bore hole	^τ Rk,cr	[N/mm ²]	6,0	6,5	7,0	7,5	7,0	6,0	6,0	6,0	
	IV: 100°C/160°C		^τ Rk,cr	[N/mm ²]	5,5	5,5	6,0	6,5	6,0	5,5	5,5	5,5	
	tion factor ψ ⁰ sus in α	cracked and uncr	acked concrete	e C20/25									
Temperature range	I: 24°C/40°C				0,90								
e II: 50°C/80°C		Dry, wet concrete and	Ψ ⁰ sus	[-]	0,87								
рега	III: 72°C/120°C	flooded bore hole	Ψ sus	"	0,75								
Теп	IV: 100°C/160°C							0,					
Increas	sing factors	≤ C50/60 > C50/60	Ψς	[-]	(f _{ck} / 20) ^{0,1}								
	cteristic bond resista concrete strength o			$\tau_{Rk,ucr} = $ $\tau_{Rk,cr} = $	Ψc * τRk,ucr,(C20/25) Ψc * τRk,cr,(C20/25)								
Concre	ete cone failure			7 11 1,01	l			, , , , ,	J.,(U_U/I				
	ınt parameter							see Ta	ble C2				
Splittir													
	ant parameter ation factor							see Ta	ble C2				
IIIStalia	ation factor	MAC					1,2			No Per		ice	
for dry	and wet concrete	CAC	γinst	[-]					,0	ass	essed		
HDB						1,2							
101 1100	ded bore note	CAC						<u> </u>	,4				
Chen	nofast Injection	system UM-H f	or concrete										
	rmances acteristic values of te									Anne	x C 3	;	



There	la di wa d				B.CO	B#40	B440	B44.0	B400	B 40 4	8407	BEOG
Thread Steel fa	led rod				M8	M10	M12	M16	M20	M24	M27	M30
Characteristic tension resistance N _{Rk,s} [kN]							A _c • f	uk (or s	ee Tab	le C1)		
	ned pull-out and	concrete failure	γ _{Ms,N}	[]				000 10	2010 01			
	teristic bond resist		d concrete C2	0/25								
Temperature range	I: 24°C/40°C	Dry, wet concrete and	^τ Rk,ucr,100	[N/mm²]	17	17	16	15	14	13	13	13
Temp ra	II: 50°C/80°C	flooded bore hole	^τ Rk,ucr,100	[N/mm ²]	17	17	16	15	14	13	13	13
	teristic bond resist	ance in cracked o	concrete C20/2	:5								
rature ge	I: 24°C/40°C	Dry, wet concrete and	^τ Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
Temperature range	II: 50°C/80°C	flooded bore hole	^τ Rk,cr,100	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5	6,5	6,5
	ion factor ψ ⁰ sus,100	່ ງ in cracked and ເ	uncracked con-	crete C20/25	5							
	I: 24°C/40°C	Dry, wet concrete and		0,90								
Temperature range	II: 50°C/80°C	flooded bore hole	Ψ ⁰ sus,100	[-]	0,87							
Increas	sing factors for	≤ C50/60		.,	(f _{ck} / 20) ^{0,1}							
concre	-	> C50/60	Ψc	[-]	1,1							
Charac	teristic bond resist	ance depending	τρ	Rk,ucr,100 =			Ψ _c •	τ _{Rk.uc}	r.100.(C	20/25)		
	concrete strength			Rk,cr,100 =	Ψc * ^τ Rk,ucr,100,(C20/25) Ψc * ^τ Rk,cr,100,(C20/25)							
Concre	ete cone failure			1111,01,100				1 (11,01	,100,(02	.0,20)		
Releva	nt parameter							see Ta	able C2	2		
Splittir	ng											
	nt parameter							see Ta	able C2	<u> </u>		
Installa	ation factor											
for dry and wet concrete				1,2 No Performance assessed				nce				
ioi uiy	and wet concrete	CAC	γ _{inst}	[-]					,0			
fo , fl	ded bess !!-	HDB	-						,2			
for flooded bore hole CAC 1,4												

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 (threaded rod)	Annex C 4



Table C5: Characteristic for a working					nder s	tatic a	ınd qu	asi-sta	atic acti	on
Threaded rod			M8	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 ⁰ Rk,s	[kN]			0,6 •	A _s ·f _{uk}	(or see	Table C	1)	
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all strength classes	V ⁰ Rk,s	[kN]			0,5 •	A _s ·f _{uk}	(or see	Table C	1)	
Partial factor	γ _{Ms,V}	[-]				see	Table C	;1		
Ductility factor	k ₇	[-]	1,0							
Steel failure with lever arm										
Characteristic bending moment	M ⁰ Rk,s	[Nm]	1,2 • W _{el} • f _{uk} (or see Table C1)							
Elastic section modulus	W _{el}	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	γ _{Ms,V}	[-]				see	Table C	:1		
Concrete pry-out failure										
Factor	k ₈	[-]					2,0			
Installation factor	γ _{inst}	[-]	1,0							
Concrete edge failure										
Effective length of fastener	If	[mm]		n	nin(h _{ef} ; 1	12 · d _{noi}	m)		min(h _{ef} ;	300mm)
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ _{inst}	[-]	1,0							

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 value working life of			oads ur	ider sta	tic and	quasi-s	static ac	tion	
Interna	al threaded ancho	r rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20	
Steel f	ailure ¹⁾										
Charac	teristic tension resi	stance, 5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123	
Steel, s	strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196	
Partial	factor, strength clas	ss 5.8 and 8.8	γ _{Ms,N}	[-]			1	,5			
	teristic tension resi 4 and HCR, Streng		N _{Rk,s}	[kN]	14	26	41	59	110	124	
Partial	factor		γ _{Ms,N}	[-]			1,87			2,86	
	<u> </u>	concrete cone failu									
		ance in uncracked co	oncrete C	20/25			1	1	1		
ure	I: 24°C/40°C		^τ Rk,ucr	[N/mm ²]	17	16	15	14	13	13	
iperat range	II: 50°C/80°C	Dry, wet concrete and	τ _{Rk,ucr}	[N/mm ²]	17	16	15	14	13	13	
Temperature range	III: 72°C/120°C	flooded bore hole	τ _{Rk,ucr}	[N/mm ²]	14	14	13	12	12	11	
Tel				[N/mm ²]	11	11	10	9,5	9,0	9,0	
Charac	teristic bond resista	ance in cracked cond	crete C20)/25							
<u>re</u>	I: 24°C/40°C		τ _{Rk,cr}	[N/mm ²]	7,5	8,0	9,0	8,5	7,0	7,0	
Temperature range	II: 50°C/80°C	⊣and ⊢	τ _{Rk,cr}	[N/mm ²]	7,5	8,0	9,0	8,5	7,0	7,0	
nperat range	III: 72°C/120°C		τ _{Rk,cr}	[N/mm²]	6,5	7,0	7,5	7,0	6,0	6,0	
Ten	IV: 100°C/160°C	noodod boro noio	τ _{Rk,cr}	[N/mm ²]	5,5	6,0	6,5	6,0	5,5	5,5	
Redukt	tion factor ψ^0_{sus} in (racked and uncrack	<u> </u>	rete C20/2	5						
	I: 24°C/40°C						0.	90			
atu Je	II: 50°C/80°C	Dry, wet concrete			0,87						
Temperature range	III: 72°C/120°C	and	Ψ^0_{sus}	[-]	0,75						
em _	IV: 100°C/160°C	flooded bore hole			0,75						
		≤ C50/60						20) ^{0,1}			
Increas concre	sing factors for		Ψς	[-]							
		> C50/60		_				,1			
	steristic bond resista acrete strength clas	ance depending on		τ _{Rk,ucr} =			Ψc • τ _{Rk,ι}	ucr,(C20/25))		
		S 		$\tau_{Rk,cr} =$			Ψc • τ _{Rk,}	cr,(C20/25)			
	ete cone failure						T	-1-1- 00			
	nt parameter ng failure						see 18	able C2			
	nt parameter						see Ta	able C2			
	ation factor						000 10				
		MAC				1,2		No Perf	ormance a	ıssessec	
for dry	and wet concrete	CAC	Vinct	[-]	1,0						
		HDB	γinst	[-]	1,2						
for floo	ded bore hole	CAC					1	,4			

The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

²⁾ 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



	racteristic valu working life o			oads ur	nder sta	itic and	quasi-	static ad	ction		
Internal threaded ancho	r rods			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Steel failure1)											
Characteristic tension res	istance, 5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123		
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196		
Partial factor, strength cla	ss 5.8 and 8.8	γ _{Ms,N}	[-]			1	,5				
Characteristic tension res Steel A4 and HCR, Stren		N _{Rk,s}	[kN]	14	26	41	59	110	124		
Partial factor		γ _{Ms,N}	[-]			1,87			2,86		
Combined pull-out and	concrete cone fail	ure							•		
Characteristic bond resist	ance in uncracked	concrete C	20/25								
range I: 24°C/40°C	Dry, wet concrete	τRk,ucr,100	[N/mm²]	17	16	15	14	13	13		
Temperature range II: 24°C/40°C	and flooded bore hole	τRk,ucr,100	[N/mm²]	17	16	15	14	13	13		
Characteristic bond resist	ance in cracked co	ncrete C20/	'25								
range I: 24°C/40°C	Dry, wet concrete	τ _{Rk,cr,100}	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5		
Temperature range II: 24°C/40°C	and flooded bore hole	τ _{Rk,cr,100}	[N/mm²]	6,0	6,5	6,5	6,5	6,5	6,5		
Reduktion factor ψ ⁰ sus,10	o in cracked and un	cracked co	ncrete C2	20/25							
	Dry, wet concrete					0,	,90				
Temperature range II: 24°C/40°C	flooded bore hole	Ψ ⁰ sus,100	[-]	0,87							
Increasing factors for	≤ C50/60					(f _{ck} /	20) ^{0,1}				
concrete	> C50/60	Ψc	[-]				,1				
Characteristic bond resist	ance depending	τ _{Rk ι}	ucr,100 =		V	^γ c • τ _{Rk,uc}	r 100 (C20/	25)			
on the concrete strength			,cr,100 =			Ψc • τ _{Rk,cr}					
Concrete cone failure] THK	,01,100			+C -nk,ci	,100,(020/2	.5)			
Relevant parameter						see Ta	able C2				
Splitting failure											
Relevant parameter						see Ta	able C2				
Installation factor											
	MAC				1,2			ormance a	assesseo		
for dry and wet concrete	CAC	γ _{inst}	[-]				,0				
fou floodod boss to to	HDB		',	1,2							
for flooded bore hole	CAC					1	,4				

The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

²⁾ 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 100 years (internal threaded anchor rod)	Annex C 7



1,0

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

¹⁾ 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.

[-]

 γ_{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

²⁾ For IG-M20 strength class 50 is valid



Table		acteristic working l			n Ioa	ds uı	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 32
Steel fa														
Charac	teristic tension resi	stance	N _{Rk,s}	[kN]					A_s •	$f_{uk}^{1)}$				
Cross s	section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial t	factor		γ _{Ms,N}	[-]					1,	4 ²⁾				
	ned pull-out and o													
Charac	teristic bond resista	ance in uncra	cked concre	te C20/25										
nre	I: 24°C/40°C	Dry, wet	^τ Rk,ucr	[N/mm ²]	14	14	14	14	13	13	13	13	13	13
nperat	II: 50°C/80°C	concrete	^τ Rk,ucr	[N/mm ²]	14	14	14	14	13	13	13	13	13	13
Temperature range	III: 72°C/120°C	flooded	^τ Rk,ucr	[N/mm ²]	13	12	12	12	12	11	11	11	11	11
<u>–</u>	IV: 100°C/160°C	bore hole	τ _{Rk,ucr}	[N/mm ²]	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 cracke		C20/25										
Ire	I: 24°C/40°C	Dry, wet	τ _{Rk,cr}	[N/mm ²]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
Temperature range	II: 50°C/80°C	concrete	τ _{Rk,cr}	[N/mm ²]	5,5	5,5	6,0	6,5	6,5	6,5	6,5	7,0	7,0	7,0
nperat range	III: 72°C/120°C	and flooded	τ _{Rk,cr}	[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 _{Rk,cr}	[N/mm²]	4,0	4,5	4,5	5,0	5,0	5,0	5,0	5,0	5,0	5,0
Redukt	ion factor ψ^0_{sus} in ϕ^0_{sus}	racked and ι					-	-		· ·			· ·	
	I: 24°C/40°C			[-]	0,90									
ratur ge	II: 50°C/80°C	Dry, wet concrete	Ψ^0 sus						0,	87				
Temperature range	III: 72°C/120°C	and flooded							0,	75				
Te	IV: 100°C/160°C	bore hole							0,	66				
	ing factors for	≤ C50/60	Ψς	0,66 (f _{ck} / 20) ⁰				20) 0,1						
concret		> C50/60	*C	[[]					1	,1				
	teristic bond resista ling on the concrete			$\tau_{Rk,ucr} = $ $\tau_{Rk,cr} = $	Ψ _c • τ _{Rk,ucr,(C20/25)} Ψ _c • τ _{Rk,cr,(C20/25)}									
	ete cone failure			7 11 1,01	1.6 HK,GI,(O20/23)									
	nt parameter							;	see Ta	ble C	2			
Splittin	ıg													
Releva	nt parameter								see Ta	ıble C	2			
Installa	ntion factor													
		MAC					1,2				Perfor	mance	asses	ssed
for dry a	and wet concrete	CAC	γ _{inst}	[-]						,0				
for floor	ded bore hole	HDB CAC								,2 ,4				
									ı	, +				
	shall be taken from t bsence of national re		ns of reinford	oing bars										
Perfor	nofast Injection s										A	nnex	c C 9	
Chara	cteristic values of ter orking life of 50 yea		der static an	d quasi-sta	itic acti	ion								



Reinforcing bar Steel failure Characteristic tension resista Cross section area Partial factor				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 3	
Cross section area														
	ance	N _{Rk,s}	[kN]					A _s •	f _{uk} 1)					
Partial factor		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804	
r artiar ractor		γ _{Ms,N}	[-]					1,	4 ²⁾					
Combined pull-out and cor	ncrete failu													
Characteristic bond resistan	ce in uncra	cked concre	te C20/25											
g ag 1: 24°C/40°C c	ry, wet oncrete nd	^τ Rk,ucr,100	[N/mm ²]	14	14	14	14	13	13	13	13	13	13	
<u>'</u>	ooded ore hole	^τ Rk,ucr,100	[N/mm²]	14	14	14	14	13	13	13	13	13	13	
Characteristic bond resistant	ce in crack	ed concrete	C20/25											
g gg 1: 24°C/40°C c	ry, wet oncrete nd	^τ 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	
·	ooded ore hole	^τ 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 $\psi^0_{sus,100}$ in	cracked a	nd uncracke	d concrete	C20/	25									
at 24°C/40°C	ry, wet oncrete nd	Ψ ⁰ sus,100	[-]	0,90										
P II: 50°C/80°C	ooded ore hole	Y SUS,100	1,	0,87										
Increasing factors for ≤	C50/60	N/	[_]					(f _{ck} / 2	20) ^{0,1}					
concrete >	C50/60 Ψ _C [-] 1,1													
Characteristic bond resistan		τ _{Rk}	,ucr,100 =				Ψ _C • 1	Rk,ucr	,100,(C	20/25)				
depending on the concrete s class	trength		k,cr,100 =				Ψς•	τ _{Bk cr}	100,(C2	20/25)				
Concrete cone failure			,01,100					,,	.00,(01	20,20)				
Relevant parameter								see Ta	ble C2	2				
Splitting														
Relevant parameter							(see Ta	ıble C2	2				
Installation factor								_			_			
	MAC					1,2				Perfor	mance	asses	ssed	
for dry and wet concrete	CAC	γ _{inst}	[-]						,0					
for flooded bore bala	HDB	-	'						,2					
for flooded bore hole 1) f _{uk} shall be taken from the	CAC							1	,4					



Table C11: Characterist for a workin					nde	r sta	tic aı	nd qı	uasi-	static	actio	n
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			•	•		•	•		•	•	•	
Characteristic shear resistance	V ⁰ _{Rk,s}	[kN]					0,50	·As·	f _{uk} 1)			
Cross section area	A _s	[mm²]	50 79 113 154 201 314 452 491 616 80							804		
Partial factor	γ _{Ms,V}	[-]						1,5 ²⁾				
Ductility factor	k ₇	[-]						1,0				
Steel failure with lever arm												
Characteristic bending moment	М ⁰ _{Rk,s}	[Nm]					1.2	w _{el} •	f _{uk} 1)			
Elastic section modulus	W _{el}	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	γ _{Ms,V}	[-]						1,5 ²⁾				
Concrete pry-out failure	·	•										
Factor	k ₈	[-]						2,0				
Installation factor	γinst	[-]						1,0				
Concrete edge failure		-										
Effective length of fastener	If	[mm]		ı	min(h _e	_{ef} ; 12 ·	d _{nom})		min(h _{ef} ; 300	mm)
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γinst	[-]						1,0				

 $^{^{\}rm 1)}\,f_{\rm uk}$ 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

²⁾ in absence of national regulation



Table C12: Disp	olacement	s under tensi	on load	J 1)						
Threaded rod			M8	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	00 year	s	
Temperature range	δ _{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 _{N0} -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/mm ²)]	0,042	0,044	0,045	0,049	0,053	0,056	0,059	0,062
Temperature range	δ_{N0} -factor	[mm/(N/mm²)]	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 ²)]	0,124	0,129	0,135	0,146	0,157	0,168	0,176	0,184
Cracked concrete unde	er static and o	uasi-static actio	n for a w	orking l	ife of 50	and 100	0 years			
Temperature range	δ _{N0} -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	δ _{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	δ_{N0} -factor	[mm/(N/mm ²)]	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/mm²)]	0,321	0,330	0,340	0,358	0,377	0,396	0,410	0,424

¹⁾ Calculation of the displacement

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

τ: action bond stress for tension

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

Table C13: Displacements under shear load¹⁾

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	δ_{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	

¹⁾ Calculation of the displacement

 $\delta v_0 = \delta v_0$ -factor $\cdot V$;

V: action shear load

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

Chemofast Injection system UM-H for concrete
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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 ¹⁾											
Internal threaded ancho	or rods		IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20			
Uncracked concrete un	der static and	quasi-static actio	n for a wo	rking life	of 50 and 1	00 years					
Temperature range	δ _{N0} -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	δ_{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/mm ²)]	0,044	0,045	0,049	0,053	0,056	0,062			
Temperature range	δ_{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/mm ²)]	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	δ_{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_{N0} -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/mm²)]	0,111	0,114	0,121	0,127	0,133	0,143			
Temperature range	δ_{N0} -factor	[mm/(N/mm²)]	0,321	0,330	0,349	0,367	0,385	0,412			
IV: 100°C/160°C	$\delta_{N\infty}$ -factor	[mm/(N/mm ²)]	0,330	0,340	0,358	0,377	0,396	0,424			

¹⁾ 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 C15: Displacements under shear load¹⁾

Internal threaded	IG-M6 IG-M8 IG-M10		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_{V0} -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		

¹⁾ Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -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 (internal threaded anchor rod)	Annex C 13



Table C16:	Displace	ments under	tensi	on loa	ad ¹⁾							
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	nd 100	years			
Temperature range	δ_{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	δ_{N0} -factor	[mm/(N/mm²)]	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	δ_{N0} -factor	[mm/(N/mm²)]	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	50 and	l 100 ye	ears			
Temperature range	δ_{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	δ_{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	δ_{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/mm²)]	0,321	0,330	0,340	0,349	0,358	0,377	0,396	0,396	0,410	0,449

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor } \cdot \tau; \hspace{1cm} \tau\text{: action bond stress for tension}$

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

Table C17: Displacements under shear load¹⁾

Reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Uncracked and cracked concrete under static and quasi-static action for a working life of 50 and 100 years												
All temperature	δ_{V0} -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	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	0,04	0,04

1) Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor · 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											
Threac	led rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel failure												
Characteristic tension resistance N _{Rk,s,eq,C1} [kN]								1,0 •	$N_{Rk,s}$			
Partial	factor		$\gamma_{Ms,N}$	[-]				see Ta	able C1			
Combi	Combined pull-out and concrete failure											
Charac	teristic bond resistar	nce in cracked a	ind uncracked	concrete C2	20/25							
<u>e</u>	I: 24°C/40°C	Dry wet	^τ Rk,eq,C1	[N/mm ²]	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	^τ Rk,eq,C1	[N/mm ²]	7,0	7,5	8,0	9,0	8,5	7,0	7,0	7,0
mpe ran	III: 72°C/120°C	flooded bore hole	^τ Rk,eq,C1	[N/mm ²]	6,0	6,5	7,0	7,5	7,0	6,0	6,0	6,0
	IV: 100°C/160°C	Tible	^τ Rk,eq,C1	[N/mm²]	5,5	5,5	6,0	6,5	6,0	5,5	5,5	5,5
Increas	sing factors for concr	ete	Ψс	[-]				1	,0			
	teristic bond resistar concrete strength cla		τ	Ψ _C • τ _{Rk,eq,C1,(C20/25)}								
Installa	ation factor											
for dry	and wet concrete	CAC						1	,0			
	and wet concrete	HDB	γ inst	[-]				1	,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



	(performance category C1) for a working life of 100 years											
Threaded rod				M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure												
Characteristic tension resistance N _{Rk,s,eq,C1} [kN							1,0 •	$N_{Rk,s}$				
Partial factor		γ _{Ms,N}	[-]				see Ta	able C1				
Combined pull-out an	Combined pull-out and concrete failure											
Characteristic bond res	istance in cracked a	nd uncracked	concrete C2	20/25								
range C/40°C	Dry, wet concrete and	^τ Rk,eq,C1	[N/mm²]	5,5	6	6,5	6,5	6,5	6,5	6,5	6,5	
Temperature range range II: 24°C/40°C	flooded bore hole	^τ Rk,eq,C1	[N/mm²]	5,5	6	6,5	6,5	6,5	6,5	6,5	6,5	
Increasing factors for co	oncrete	Ψс	[-]				1	,0				
	Characteristic bond resistance depending on the concrete strength class			Ψc • ^τ Rk,eq,C1,(C20/25)								
Installation factor												
for dry and wet concrete	CAC			1,0								
	HDR	γ _{inst}	[-]					,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 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	М30			
Steel failure													
Characteristic she (Seismic C1)	ear resistance	V _{Rk,s,eq,C1}	[kN]				0,70)·V ⁰ Rk	,s				
Partial factor $\gamma_{Ms,V}$ [-] see Table C1						:1							
Factor for annular gap α_{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

¹⁾ 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

Reinforcing bar						Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel f	Ø8	10 10	,	,,,		, ·	,	<i>1</i> -0	, C _ C					
Charac	teristic tension resi	stance	N _{Rk,s,eq,C1}	[kN]					1,0 • A	s • f _{uk}	1)			
Cross	section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial	factor		γ _{Ms,N}	[-]					1,	4 ²⁾				
Combi	ned pull-out and o	concrete fail	,											
Charac	teristic bond resista	ance in crack	ed and uncra	acked cond	crete (20/25								
ange	I: 24°C/40°C	Dry, wet	^τ Rk,eq,C1	[N/mm ²]	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 and flooded	^τ 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
Temperature range	III: 72°C/120°C		^τ Rk,eq,C1	[N/mm²]	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 hole	^τ Rk,eq,C1	[N/mm²]	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			Rk,eq,C1 =	Ψ _C * ^τ Rk,eq,C1,(C20/25)										
Installa	Installation factor													
for dry and wet concrete								1	,0					
	HDB		γ _{inst}	[-]						,2				
for floo	for flooded bore hole CAC			1,4										

 $^{^{1)}\,}f_{\mbox{\scriptsize uk}}$ 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 50 years (rebar)	Annex C 18

²⁾ in absence of national regulation



1,2

1,4

Table C22: Characteris									n			
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure												
Characteristic tension resistance	N _{Rk,s,eq,C1}	[kN]					1,0 • A	s • f _{uk}	1)			
Cross section area	A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ _{Ms,N}	[-]					1,	4 ²⁾				
Combined pull-out and concrete t	ailure											
Characteristic bond resistance in cra	cked and uncr	acked con	crete (220/25								
II: 50°C/80°C Dry, wet concrete and flooded bore hole	^τ 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
and flooded bore hole	^τ 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
Increasing factors for concrete	Ψс	[-]	1,0									
Characteristic bond resistance depending on the concrete strength class			Ψc * ^τ Rk,eq,C1,(C20/25)									
Installation factor												
for dry and wet concrete CAC	V:	[-]						,0				

[-]

HDB

CAC

 γ_{inst}

for flooded bore hole

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

 $^{^{\}rm 1)}~{\rm f}_{\rm uk}$ shall be taken from the specifications of reinforcing bars

²⁾ 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	Reinforcing bar Ø 8 Ø 10 Ø 12 Ø 14 Ø 16 Ø 20 Ø 24 Ø 25 Ø 28 Ø 3										Ø 32		
Steel failure													
Characteristic shea	ar resistance	V _{Rk,s,eq}	[kN]					0,35	·As·	f _{uk} 1)			
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ _{Ms,V}	[-]	1,52)									
Factor for annula	r gap	$\alpha_{\sf gap}$	[-]	0,5 (1,0)3)									

 $^{^{1)}}$ 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

²⁾ in absence of national regulation

³⁾ 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



Tabl		ecteristic va ormance cat					on					
Thread	led rod				M12	M16	M20	M24				
Steel fa	ailure											
Steel, s Stainle	eteristic tension resist strength class 8.8 ss Steel A4 and HCF th class ≥70		N _{Rk,s,eq,C2}	[kN]		1,0 • N _{Rk,s}						
Partial	factor		γ _{Ms,N}	[-]		see Ta	able C1					
Combi	ned pull-out and co	ncrete failure										
Charac	teristic bond resistar	nce in cracked a	nd uncracked	concrete C20	0/25							
<u>l</u> e	I: 24°C/40°C	Dry wot	τ _{Rk,eq,C2}	[N/mm ²]	3,6	3,5	3,3	2,3				
Temperature range	II: 50°C/80°C	Dry, wet concrete and	• '	τ _{Rk,eq,C2}	[N/mm ²]	3,6	3,5	3,3	2,3			
mpe	III: 72°C/120°C	flooded bore	τ _{Rk,eq,C2}	[N/mm ²]	3,1	3,0	2,8	2,0				
Tel	IV: 160°C/100°C	hole	τ _{Rk,eq,C2}	[N/mm²]	2,5	2,7	2,5	1,8				
Increas	sing factors for concre	ete	Ψс	[-]		1,0						
Characteristic bond resistance depending on the concrete strength class				τ _{Rk,eq,C2} =	$\Psi_{c} \cdot \tau_{Rk,eq,C2,(C20/25)}$							
Installa	ation factor		•	·								
for dry and wat congrete CAC						1	,0					
for dry and wet concrete HDB		γinst	[-]	1,2								
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 C2) for a working life of 50 years (threaded rod)	Annex C 21



	naracteristic va erformance cat									
Threaded rod				M12	M16	M20	M24			
Steel failure										
Characteristic tension r Steel, strength class 8. Stainless Steel A4 and Strength class ≥70	[kN]	1,0 • N _{Rk,s}								
Partial factor		γ _{Ms,N}	[-]		see Ta	able C1				
Combined pull-out ar	d concrete failure									
Characteristic bond res	sistance in cracked a	nd uncracked	concrete C2	0/25						
Temperature range	Dry, wet concrete and	^τ Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3			
Hemore II: 50°C\80°C	flooded bore hole	^τ Rk,eq,C2	[N/mm²]	3,6	3,5	3,3	2,3			
Increasing factors for c	oncrete	Ψс	[-]		1,0					
Characteristic bond res		τ _{Rk,eq,C2} =		Ψc • ^τ Rk,eq,C2,(C20/25)						
Installation factor										
for dry and wet concrete CAC				1,0						
for flooded bore hole	jγinst	[-]	1,2							

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 _{Rk,s,eq,C2}	[kN]		0,70 •	V ⁰ Rk,s		
Partial factor	γ _{Ms,V}	[-]	see Table C1				
Factor for annular gap	$\alpha_{\sf gap}$	[-]		0,5 (1,0)1)		

¹⁾ 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 ranges	$\delta_{N,eq,C2(50\%)} = \delta_{N,eq,C2(DLS)}$	[mm]	0,24	0,27	0,29	0,27					
	$\delta_{N,eq,C2(100\%)} = \delta_{N,eq,C2(ULS)}$	[mm]	0,55	0,51	0,50	0,58					

Table C28: Displacements under shear load

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

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



hammer drilled ho		oles	(HD), co	mpres	sed ai							ner
Threaded rod					М8	M10	M12	M16	M20	M24	M27	M30
Steel failure												
Characteristic tension			Fire	30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2
resistance; Steel, Stainless Steel A2, A4 and HCR,	N _{Rk,s,fi}	 [kN]	exposure	60	0,9	1,4	2,3	4,2	6,6	9,5	12,4	15,1
strength class 5.8 resp. 50	Int,o,ii	[[((time [min]	90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7
and higher		-1		120	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9
Characteristic bond resistagiven temperature θ	ince in cra	скеа а	and uncrac	скеа соп	crete C	20/25 t	ib to C	50/60 u	naer 111	re cond	litions	tor a
T			θ < 2	4°C				1,				
Temperature reduction factor	$k_{fi,p}(\theta)$	[-]	24°C ≤ θ ≤ 379°C				1,30	01 • e ⁻⁰),011∙⊕≤	1,0		
			$\theta > 37$	79°C				0	,0			
Reduction Factor k _{ff} (θ) [-] 0,0 0 0,0 0 50	100		150	200	250		00	350	4	00	450	
Characteristic bond			IE	emperatu	re o [C	<u> </u>						
resistance for a given temperature (θ)	$\tau_{Rk,fi}(\theta)$		[N/mm²]			k _{fi,p} (θ) • τ _{Rk}	,cr,(C20/	(25) ¹⁾		
Steel failure without lever a	arm 			30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2
Characteristic shear			Fire	60	0,9	1,7	2,3	4,2	6,6	9,5	12,4	15,1
	W	[kN]	exposure time	90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7
resistance; Steel, Stainless Steel A2, A4 and HCR,	V _{Rk,s,fi}				_ ,,		_	2,2	3,4	4,9	6,4	7,9
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50	▼ Rk,s,fi		[min]	120	0,5	0,8	1,2	2,2				
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher			[min]	120	0,5	0,8	1,2	2,2	0, 1	,		
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher Steel failure with lever arm Characteristic bending				30	0,5	2,2	4,7	12,0	23,4	40,4	59,9	81,0
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher Steel failure with lever arm Characteristic bending moment; Steel, Stainless		[Nm1	Fire exposure			,	· · ·	-		-	59,9 44,9	81,0 60,7
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher Steel failure with lever arm Characteristic bending moment; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50		[Nm]	Fire exposure time	30 60 90	1,1 0,9 0,7	2,2 1,8 1,3	4,7 3,5 2,5	12,0 9,0 6,3	23,4 17,5 12,3	40,4 30,3 21,3	44,9 31,6	60,7 42,7
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher Steel failure with lever arm Characteristic bending moment; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher 1) \(\tau_{Rk,cr,(C20/25)} \) characteristic	M ⁰ Rk,s,fi		Fire exposure time [min]	30 60 90 120	1,1 0,9 0,7 0,5	2,2 1,8 1,3 1,0	4,7 3,5 2,5 1,8	12,0 9,0 6,3 4,7	23,4 17,5 12,3 9,1	40,4 30,3 21,3 15,7	44,9 31,6 23,3	60,7
resistance; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher Steel failure with lever arm Characteristic bending moment; Steel, Stainless Steel A2, A4 and HCR, strength class 5.8 resp. 50 and higher	M ⁰ Rk,s,fi		Fire exposure time [min]	30 60 90 120	1,1 0,9 0,7 0,5	2,2 1,8 1,3 1,0	4,7 3,5 2,5 1,8	12,0 9,0 6,3 4,7	23,4 17,5 12,3 9,1	40,4 30,3 21,3 15,7	44,9 31,6 23,3	60,7 42,7

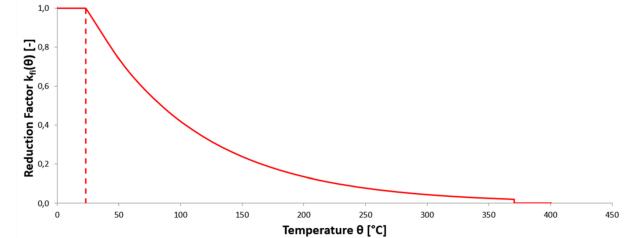


Table C30: Characteristic values of tension and shear loads under fire exposure in
hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer
drilled holes with hollow drill bit (HDB)

Internal threaded anchor ro	ternal threaded anchor rods						IG-M10	IG-M12	IG-M16	IG-M20	
Steel failure											
Characteristic tension			Fire	30	0,3	1,1	1,7	3,0	5,7	8,8	
resistance; Steel, Stainless	N	[kN]	exposure time [min]	60	0,2	0,9	1,4	2,3	4,2	6,6	
Steel A4 and HCR, strength class 5.8 and 8.8 resp. 70	N _{Rk,s,fi}			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	

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

			θ < 24°C	1,0
Temperature reduction	$k_{fi,p}(\theta)$	[-]	24°C ≤ θ ≤ 379°C	1,301 • e ^{-0,011 • θ} ≤ 1,0
ladioi	'		θ > 379°C	0.0



,												
Characteristic bond resistance for a given temperature (θ)	$\tau_{Rk,fi}(\theta)$	[N/mm²]				$k_{fi,p}(\theta) \cdot \tau_{Rk,cr,(C20/25)}^{1)}$						
Steel failure without lever arm												
Characteristic shear			Fire	30	0,3	1,1	1,7	3,0	5,7	8,8		
registance: Steel Steinless	V _{Rk,s,fi}	[kN]	exposure time [min]	60	0,2	0,9	1,4	2,3	4,2	6,6		
				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		
	NAO	 [Nm]	exposure	60	0,2	0,9	1,8	3,5	9,0	17,5		
Steel A4 and HCR, strength class 5.8 and 8.8 resp. 70	M ⁰ Rk,s,fi	ן נואוזו <u>ן</u> 	time	90	0,1	0,7	1,3	2,5	6,3	12,3		
			[min]	120	0,1	0,5	1,0	1,8	4,7	9,1		

τ_{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



	teristic v er drilled holes wi	hole	es (HD), d	compre	esse	d air					-			er
Reinforcing bar					Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure														
				30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	16,1
Characteristic tension	No. "	[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	$N_{Rk,s,fi}$	ן נייואן	time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
				120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Characteristic bond resis given temperature θ	stance in c	racke	d and unci	acked c	oncre	te C20	0/25 u	p to C	50/60	unde	r fire (condit	ions 1	for a
given temperature o			θ < 22	 2°C					1	,0				
Temperature reduction	$k_{fi,p}(\theta)$	[-]	22°C ≤ θ :					1,26	8 · e -	0,011•θ	≤ 1,0			
factor	,p		θ > 37					0	,0					
Reduction Factor k _{ff} (θ) [-]	0 10	0	150	200 Tempera		250 A [°C]	30	0	350		400		450	
Characteristic bond resistance for a given temperature (θ)	$\tau_{Rk,fi}(\theta)$		[N/mm²]		$k_{fi,p}(\theta) \cdot \tau_{Rk,cr,(C20/25)}^{1)}$									
Steel failure without leve	r arm													
			F :	30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	
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	, . ,		time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
Steel failure with lever ar	m			120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Oteci idiidie with level di	···			30	0,6	1,8	4,1	6,5	9,7	18,8	32.6	36,8	51,7	77,2
Characteristic bending			Fire	60	0,5	1,5	3,1	4,8	7,2	14,1		27,6	38,8	
moment; BSt 500	M ⁰ Rk,s,fi	[Nm] 	exposure time [min]	90	0,4	1,2	2,6	4,2	6,3	12,3	21,2	23,9		
				120	0,3	0,9	2,0	3,2	4,8	9,4	16,3	18,4	25,9	38,6
1) $ au_{ ext{Rk,cr,(C20/25)}}$ characteri temperature range	istic bond re	sistan	ce for crack	ed concre	ete for	concre	ete stre	ngth c	lass C	20/25	for the	releva	nt	