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European Technical Assessment Body
for construction products



European Technical Assessment

ETA-11/0033
of 16 December 2025

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:

Deutsches Institut für Bautechnik

Trade name of the construction product

Berner multicomponent system MCS Diamond

Product family to which the construction product belongs

Bonded fasteners and bonded expansion fasteners for use in concrete

Manufacturer

Berner Omnichannel Trading
Holding SE
Bernerstraße 6
74653 Künzelsau
DEUTSCHLAND

Manufacturing plant

Berner Herstellwerk 6

This European Technical Assessment contains

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

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

EAD 330499-02-0601, Edition 12/2023

This version replaces

ETA-11/0033 issued on 30 September 2016

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Specific Part

1 Technical description of the product

The "BERNER multicomponent system MCS Diamond" is a bonded fastener consisting of a cartridge with injection mortar MCS Diamond and a steel element according to Annex A5.

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 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 B3 to B12, C1 to C16, C19, C21, C23, C24, C25 to C34
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C1 to C4, C20, C22, C23, C24
Displacements under short-term and long-term loading	See Annex C17, C18, C35, C36
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C37 to C47

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C48 to C51

3.3 Hygiene, health and the environment (BWR 3)

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

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

In accordance with the European Assessment Document 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 December 2025 by Deutsches Institut für Bautechnik

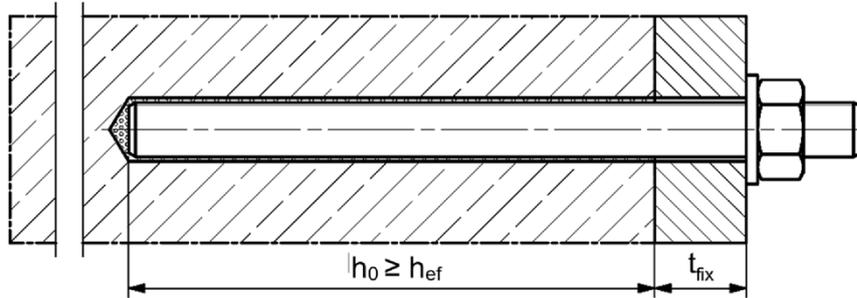
Dipl.-Ing. Beatrix Wittstock
Head of Section

beglaubigt:
Baderschneider

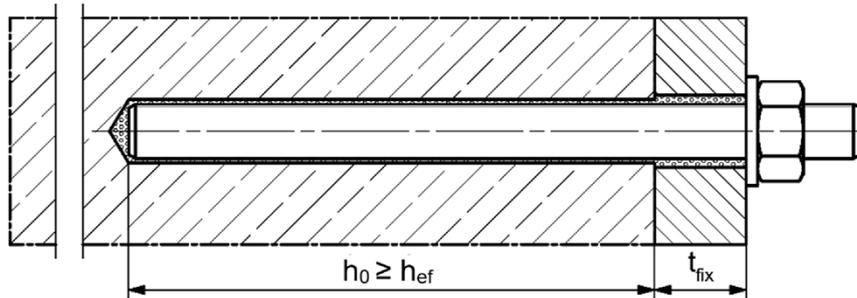
Installation conditions part 1

BERNER Anchor rod MCS PLUS A / BCA M (Anchor rod) and commercial standard threaded rod (Threaded rod)

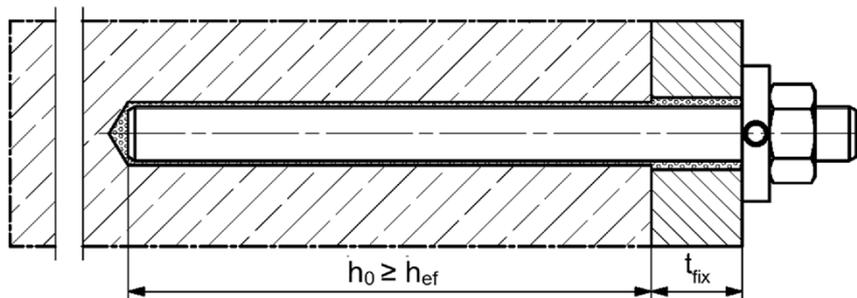
Pre-positioned installation



Push through installation (annular gap filled with mortar)



Pre-positioned or push through installation with subsequently BERNER injected filling disc BFD (annular gap filled with mortar)



h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

Figures not to scale

BERNER multicomponent system MCS Diamond

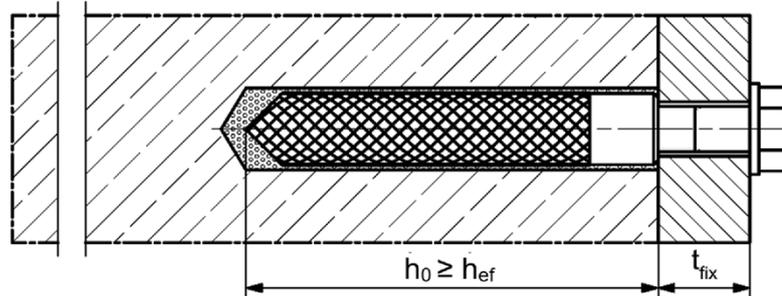
Product description
Installation conditions part 1

Annex A1

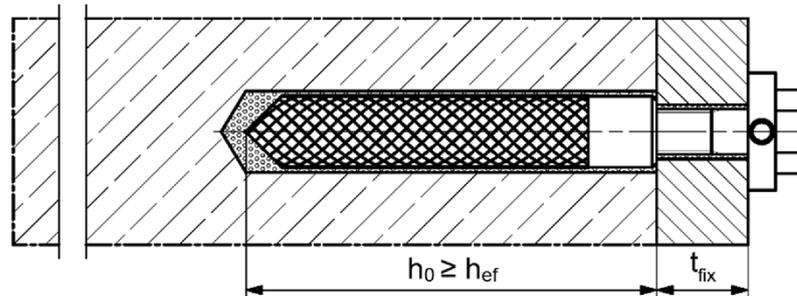
Installation conditions part 2

BERNER internal threaded anchor MCS Plus I (BERNER MCS Plus I)

Pre-positioned installation



Pre-positioned installation with subsequently injected filling disc (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

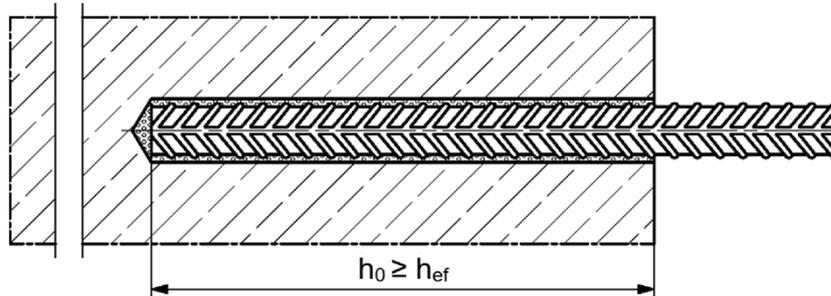
BERNER multicomponent system MCS Diamond

Product description
Installation conditions part 2

Annex A2

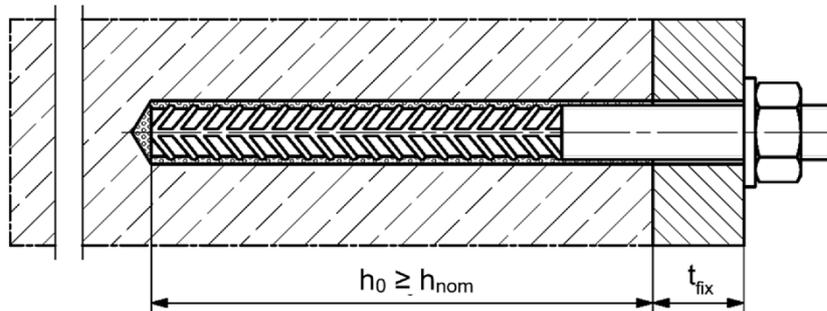
Installation conditions part 3

Reinforcing bar

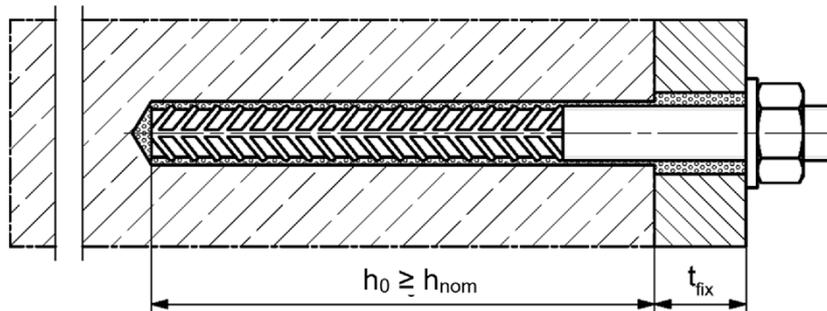


BERNER rebar anchor BRA (BERNER BRA)

Pre-positioned installation



Push through installation (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

h_{nom} = overall fastener embedment depth in the concrete

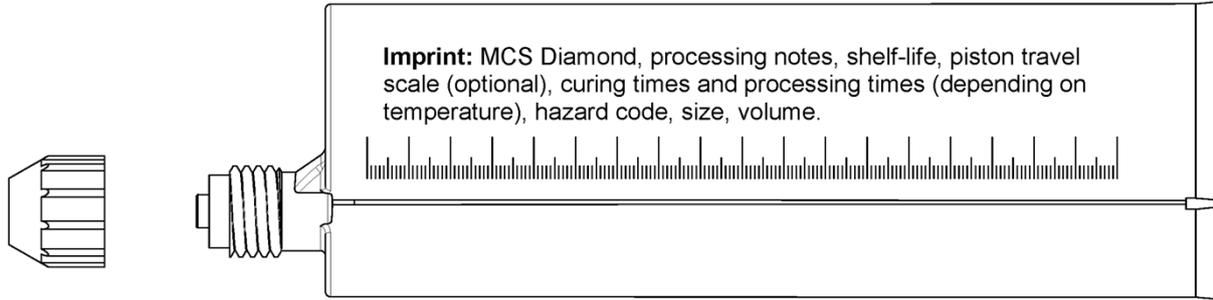
BERNER multicomponent system MCS Diamond

Product description
Installation conditions part 3

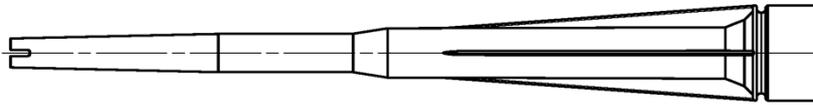
Annex A3

Overview system components part 1

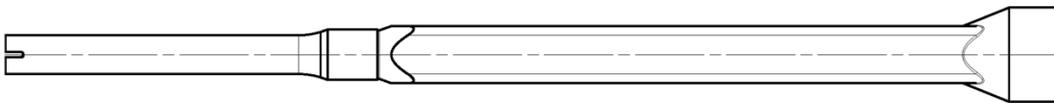
Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1500 ml



Static mixer MCS Diamond for injection cartridges 390 ml



Static mixer MCS Diamond for injection cartridges > 390 ml



**Injection adapter and extension tube Ø 9 for static mixer MCS Diamond for injection cartridges 390 ml;
Injection adapter and extension tube Ø 9 or Ø 15 for static mixer MCS Diamond for injection cartridges > 390 ml**



Cleaning brush



Compressed-air cleaning tool



Figures not to scale

BERNER multicomponent system MCS Diamond

Product description
Overview system components part 1;
cartridges / static mixer / accessories

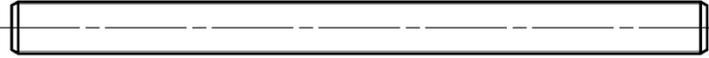
Annex A4

Overview system components part 2

Anchor rod / Threaded rod

Metric size: M8, M10, M12, M14, M16, M20, M22, M24, M27, M30

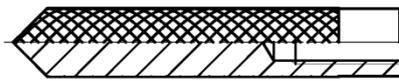
Fractional size: 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1 1/8"



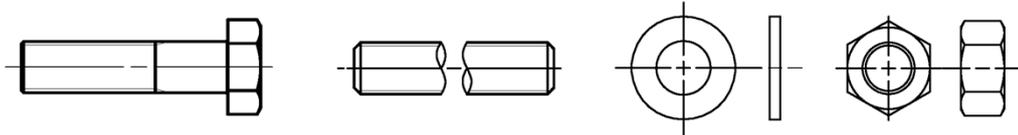
BERNER MCS Plus I

Metric size: M8, M10, M12, M16, M20

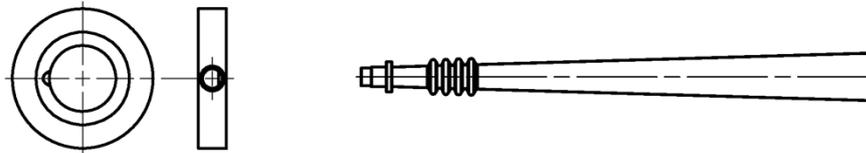
Fractional size: 3/8", 1/2", 5/8", 3/4"



Screw / Anchor rod / Threaded rod / washer / hexagon nut



filling disc BFD with injection adapter



Reinforcing bar

Nominal diameter,

Metric size: $\phi 8$, $\phi 10$, $\phi 12$, $\phi 14$, $\phi 16$, $\phi 18$, $\phi 20$, $\phi 22$, $\phi 24$, $\phi 25$, $\phi 26$, $\phi 28$, $\phi 30$, $\phi 32$, $\phi 34$, $\phi 36$, $\phi 40$

Fractional size: #3 (3/8"), #4 (1/2"), #5 (5/8"), #6 (3/4"), #7 (7/8"), #8 (1"), #9 (1,128"), #10 (1,270")



BERNER BRA

Metric size: M12, M16, M20, M24



Figures not to scale

BERNER multicomponent system MCS Diamond

Product description

Overview system components part 2;
steel components

Annex A5

Table A6.1: Materials, metric sizes

Part	Designation	Material		
1	Injection cartridge	Mortar, hardener, filler		
	Steel grade	Steel zinc plated (zp, hdg)	Stainless steel R acc. to EN 10088-1: 2023 Corrosion resistance class CRC III acc. to EN 1993-1-4: 2006+A1:2015	High corrosion resistant steel HCR acc. to EN 10088-1: 2023 Corrosion resistance class CRC V acc. to EN 1993-1-4: 2006+ A1:2015
2	Anchor rod / Threaded rod	Property class 4.8, 5.8 or 8.8; EN ISO 898-1:2013 zp ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation ¹⁾	Property class 50, 70 or 80; EN ISO 3506-1:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; 1.4062; 1.4662; 1.4462; EN 10088-1: 2023 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation ¹⁾	Property class 50, 70 or 80; EN ISO 3506-1:2020 or property class HCR 70 with $f_{yk} = 560 \text{ N/mm}^2$; 1.4565; 1.4529; EN 10088-1: 2023 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation ¹⁾
3	Washer ISO 7089:2000	zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023	1.4565; 1.4529; EN 10088-1: 2023
4	Hexagon nut	Property class 5 or 8 acc. EN ISO 898-2:2022 zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4565; 1.4529; EN 10088-1: 2023
5	BERNER MCS Plus I	Property class 5.8 EN ISO 898-1:2013 zinc plated ≥ 5 µm, EN ISO 4042:2022	Property class 70 EN ISO 3506-1:2020; 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023	Property class 70 EN ISO 3506-1:2020 1.4565; 1.4529; EN 10088-1: 2023
6	Commercial standard screw or Anchor rod / Threaded rod for BERNER MCS Plus I	Property class 5.8 or 8.8; EN ISO 898-1:2013 zinc plated ≥ 5 µm, EN ISO 4042:2022 $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023 $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2020 1.4565; 1.4529; EN 10088-1: 2023 $A_5 > 8 \%$ fracture elongation
7	filling disc similar to DIN 6319-G	zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023	1.4565; 1.4529; EN 10088-1: 2023
8	Rebar	EN 1992-1-1:2004 and AC:2010, Annex C Bars and de-coiled rods, class B or C with f_{yk} and k according to NDP or NCI according to EN 1992-1-1/NA; $f_{uk} = f_{tk} = k \cdot f_{yk}$ ($A_5 > 12 \%$) ¹⁾		
9	BERNER BRA	Rebar part: Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCI of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$ ($A_5 > 8 \%$) Threaded part: Property class 80 EN ISO 3506-1:2020	1.4401, 1.4404, 1.4571, 1.4578, 1.4439, 1.4362, 1.4062 acc. to EN 10088-1:2023 Corrosion resistance class CRC III acc. to EN 1993-1-4:2006+A1:2015 1.4565; 1.4529 acc. to EN 10088-1: 2023 Corrosion resistance class CRC V acc. to EN 1993-1-4: 2006+A1:2015 $f_{uk} \leq 1000 \text{ N/mm}^2$; fracture elongation $A_5 > 8 \%$	
¹⁾ Fracture elongation $A_5 > 8 \%$, for applications without requirements for seismic performance category C1 or C2.				
BERNER multicomponent system MCS Diamond				Annex A6
Product description part 1 Materials, metric sizes				

Table A7.1: Materials, fractional sizes

Part	Designation	Material	
1	Injection cartridge	Mortar, hardener, filler	
	Steel grade	Steel zinc plated (zp, hdg)	Stainless steel R Corrosion resistance class CRC III acc. to EN 1993-1-4: 2006+A1:2015
2	Fractional Threaded rod	ASTM F568M-07, Class 5.8 $f_{uk} = 500 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022 ASTM F1554-20, Grade 36 $f_{uk} = 400 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022 ASTM F1554-20, Grade 55 $f_{uk} = 517 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$; EN ISO 4042:2022 ASTM F1554-20, Grade 105 $f_{uk} = 862 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022 ASTM A193/A193M-23, Grade B7 $f_{uk} = 862 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022	ASTM F593M-13ae1, Alloy Group 2 $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} \leq 5/8 \text{ in. (CW1)}$ $f_{uk} = 586 \text{ N/mm}^2$, $f_{yk} \geq 3/4 \text{ in. (CW2)}$ $A_5 > 12 \%$ fracture elongation ¹⁾ ; ASTM A193/A193M-23, Grade B8M, Class 1 $f_{uk} = 517 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; ASTM A193/A193M-23, Grade B8M, Class 2B $f_{uk} = 655 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾
3	Washer	ASTM F436/F436M-19 zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004+AC:2009	ASTM A240/A240M-23a Type 316
4	Hexagon nut	ASTM A563/A563M-23, Grade DH or ASTM A194/A194M-23, Grade 2H for Threaded rod material ASTM F568M-07, Class 5.8 or ASTM F1554-20, Grade 36, 55, 105 ASTM A194/A194M-23, Grade 2H / 4 / 7 for Threaded rod material ASTM A193/A193M-23, B7 zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022	ASTM F593M-13ae1, Alloy Group 2 for Threaded rod material: ASTM F593M-13ae1, Alloy Group 2 / ASTM A193/A193M-23, Grade 8M for Threaded rod material: ASTM A193/A193M-23, Grade B8M, Class 1 or ASTM A193/A193M-23, Grade B8M, Class 2B
5	BERNER MCS Plus I	Property class 5.8 EN ISO 898-1:2013 zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2022	Property class 70; EN ISO 3506-1:2020; 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1: 2023
6	Commercial standard screw or Threaded rod for BERNER MCS Plus I	See Table A7.1, line 2, steel zinc plated, EN ISO 4042:2022	See Table A7.1, line 2, stainless steel R
7	filling disc similar to DIN 6319-G	zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2023
8	Reinforcing bar	ASTM A615/A615M-22 (ASTM A767/A767M-19) Grade 40, $f_{uk} = 414 \text{ N/mm}^2$, $f_{yk} = 276 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 60, $f_{uk} = 621 \text{ N/mm}^2$, $f_{yk} = 414 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 75, $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} = 517 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 80, $f_{uk} = 552 \text{ N/mm}^2$, $f_{yk} = 414 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 80, $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} = 552 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾	

¹⁾ Fracture elongation $A_5 > 8 \%$, for applications without requirements for seismic performance category C1 or C2.

BERNER multicomponent system MCS Diamond

Product description
Materials, fractional sizes

Annex A7

Specifications of intended use part 1											
Table B1.1: Overview use and performance categories											
Anchorages subject to		MCS Diamond with ...									
		Anchor rod / Threaded rod 	BERNER MCS Plus I 		Reinforcing bar 		BERNER BRA 				
Hammer drilling with standard drill bit 	all sizes										
Hammer drilling with hollow drill bit 	Nominal drill bit diameter (d_0) 12 mm to 35 mm; 7/16" to 1 3/8" (BERNER Cleandril dustless, fischer "FHD", Heller "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD", DreBo „D-Plus“, DreBo „D-Max“)										
Diamond drilling 	all sizes										
Static and quasi static load, in uncracked / cracked concrete	Metric sizes	M8 to M30	Annexes: C1, C4 – C6, C17		M8 to M20	Annexes: C2, C4, C7, C8, C17		ϕ 8 to ϕ 40	Annexes: C3, C4, C9 – C13 C18	M12 to M24	Annexes: C3, C4, C14 – C16, C18
	Fractional sizes	3/8" to 1 1/8"	Annexes: C19, C20, C24 – C28, C35		3/8" to 3/4"	Annexes: C21, C22, C24, C29 – C31, C35		#3 to #10	Annexes: C23, C24, C32 – C34, C36	- ¹⁾	
Seismic performance category (only hammer drilling with standard / hollow drill bits)	C1	M10 to M30	Annexes: C37, C39, C40		- ¹⁾	- ¹⁾		ϕ 10 to ϕ 32	Annexes: C38, C39, C41	- ¹⁾	
		3/8" to 1 1/8"	Annexes: C43, C45, C46					#3 to #10	Annexes: C44, C45, C47		
	C2	M12 M16 M20 M24	Annexes: C38, C39, C42					- ¹⁾			
Use category	11	dry or wet concrete	all sizes								
	12	water filled hole	all sizes (not permitted for diamond drilling in combination with cracked concrete and working life 100 years)								
Installation direction	D3 (downward and horizontal and upwards (e.g. overhead) installation)										
Installation temperature	$T_{i,min} = -5\text{ °C}$ to $T_{i,max} = +40\text{ °C}$ for the standard variation of temperature after installation										
Resistance to fire	Annexes: C48 – C51		- ¹⁾		- ¹⁾		- ¹⁾				
In-service temperature	Temperature range I	-40 °C to +40 °C		(max. short term temperature +40 °C; max. long term temperature +24 °C)							
	Temperature range II	-40 °C to +60 °C		(max. short term temperature +60 °C; max. long term temperature +35 °C)							
	Temperature range III	-40 °C to +72 °C		(max. short term temperature +72 °C; max. long term temperature +50 °C)							
¹⁾ no performance assessed.											
BERNER multicomponent system MCS Diamond									Annex B1		
Intended use Specifications part 1											

Specifications of intended use part 2

Base materials:

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

Use conditions (Environmental conditions):

- Fastener intended for use in 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 classes to Annex A6 table A6.1 (metric sizes) or Annex A7 Table A7.1 (fractional sizes).

Design:

- Fastenings are designed under the responsibility of an engineer experienced in fastenings and concrete work.
- Verifiable calculation notes and drawings are to be 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.).
- Fastenings are designed in accordance with:
EN 1992-4:2018 and TR 082 from June 2023.

Installation:

- Fastener installation is to be carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Fastening depth should be marked and adhered to installation.
- Overhead installation is allowed (necessary equipment see installation instruction).

BERNER multicomponent system MCS Diamond

Intended use
Specifications part 2

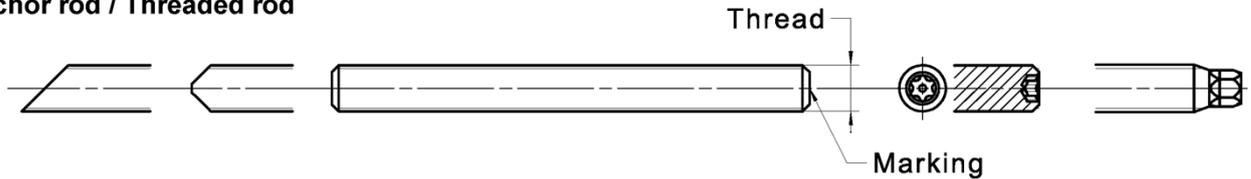
Annex B2

Table B3.1: Installation parameters for metric Anchor rods / Threaded rods

Anchor rods / Threaded rods		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30	
Nominal drill hole diameter	d_0	10	12	14	16	18	22 24 ¹⁾	25	28	30	35	
Drill hole depth	h_0	$h_0 \geq h_{ef}$										
Effective embedment depth	$h_{ef, min}$	60	60	70	75	80	90	93	96	108	120	
	$h_{ef, max}$	160	200	240	280	320	400	440	480	540	600	
Diameter of the clearance hole of the fixture	pre-positioned installation d_f	9	12	14	16	18	22	24	26	30	33	
	push through installation d_f	12	14	16	18	20	26	28	30	33	40	
Minimum thickness of concrete member	h_{min}	$h_{ef} + 30$				$h_{ef} + 2d_0$						
Maximum installation torque	$\max T_{inst}$	[Nm]	10	20	40	50	60	120	135	150	200	300

¹⁾ Both drill hole diameters can be used.

Anchor rod / Threaded rod



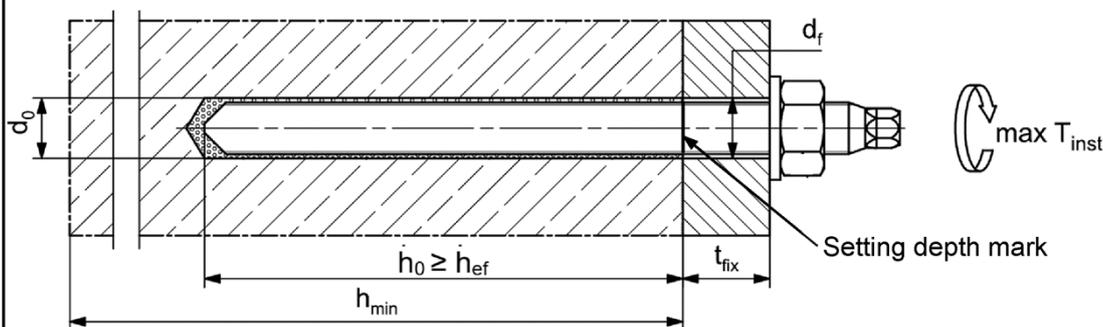
Marking (on random place) BERNER anchor rod:

Steel zinc plated PC ¹⁾ 8.8	• or +	Steel hot-dip PC ¹⁾ 8.8	•
High corrosion resistant steel HCR PC ¹⁾ 50	•	High corrosion resistant steel HCR PC ¹⁾ 70	-
High corrosion resistant steel HCR PC ¹⁾ 80	(Stainless steel R property class 50	~
Stainless steel R property class 80	*		

Alternatively: Colour coding according to DIN 976-1:2016

¹⁾ PC = property class

Installation conditions:



Threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled:

- Materials, dimensions and mechanical properties according to **Annex A6, Table A6.1**.
- Inspection certificate 3.1 according to EN 10204:2004, the documents have to be stored.
- Setting depth is marked.
- Steel load-bearing capacities for hot-dip galvanised parts are only valid if the threaded rod and nut are correctly paired. The strength class of the nut must be one strength class higher than that of the threaded rod ($\geq M12$ in combination with tolerance class 6AX in accordance with EN ISO 10684:2004+AC:2009 two strength classes higher). The pairing of undersized threaded rods (additional designation U according to EN ISO 10684) with oversized nuts (additional designation Z or X according to EN ISO 10684) is not permitted under any circumstances

Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters Anchor rods / Threaded rods (metric size)

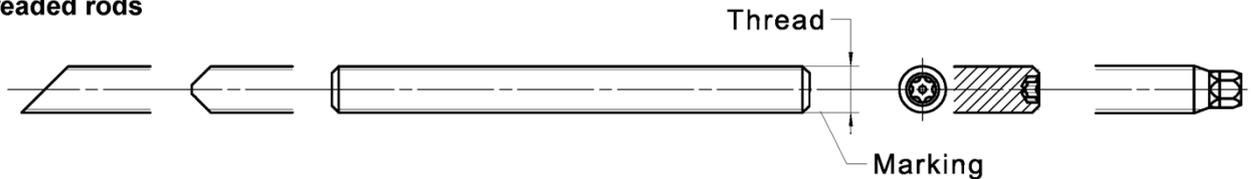
Annex B3

Table B4.1: Installation parameters for fractional Threaded rods

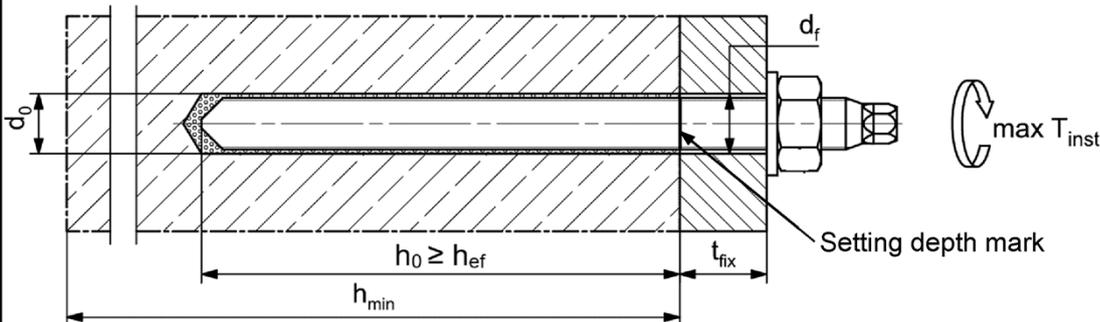
Threaded rods		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
Nominal drill hole diameter	d_0	[mm]	11,1	14,3	19,1	22,2	25,4	31,8		
		[inch]	7/16	9/16	3/4	7/8	1	1 1/8		
Drill hole depth	h_0	$h_0 \geq h_{ef}$								
Effective embedment depth	$h_{ef, min}$	60,0	70,0	79,0	89,0	89,0	102,0	178,0		
	$h_{ef, max}$	191,0	254,0	318,0	381,0	445,0	508,0	572,0		
Diameter of the clearance hole of the fixture	pre-positioned installation	d_f	[mm]	8,9	11,9	14,0	16,0	18,0	22,1	23,9
	push through installation			11,9	14,0	16,0	18,0	20,1	25,9	27,9
Minimum thickness of concrete member	h_{min}	$h_{ef} + 30$		$h_{ef} + 2d_0$						
Maximum installation torque	$\max T_{inst}$	[Nm]	18	41	60	107	136	173	180	

1) Both drill hole diameters can be used.

Threaded rods



Installation conditions:



Additional requirements for Threaded rods, washers and hexagon nuts:

- Materials, dimensions, and mechanical properties according to **Annex A7, Table A7.1**.
- Inspection certificate 3.1 according to EN 10204:2004, the documents shall be stored.
- Setting depth is marked.
- Steel load-bearing capacities for hot-dip galvanised parts are only valid if the threaded rod and nut are correctly paired. The strength class of the nut must be one strength class higher than that of the threaded rod ($\geq M12$ in combination with tolerance class 6AX in accordance with EN ISO 10684:2004+AC:2009 two strength classes higher). The pairing of undersized threaded rods (additional designation U according to EN ISO 10684) with oversized nuts (additional designation Z or X according to EN ISO 10684) is not permitted under any circumstances

Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters Threaded rods (fractional size)

Annex B4

Table B5.1: Minimum spacing and minimum edge distance for metric Anchor rods and metric reinforcing bars											
Metric Anchor rods			M8	M10	M12	M14	M16	-	M20	M22	M24
Metric Reinforcing bars (nominal diameter)		ϕ	8	10	12	14	16	18	20	22	24
Minimum edge distance											
Uncracked / cracked concrete	C_{min}	[mm]	40	45	45	45	50	55	55	55	60
Minimum spacing	S_{min}		according to Annex B7								
Minimum spacing											
Uncracked / cracked concrete	S_{min}	[mm]	40	45	55	60	65	85	85	95	105
Minimum edge distance	C_{min}		according to Annex B7								
Required projecting area											
Uncracked concrete	$A_{sp,req}$	[1000	8,0	13,0	21,5	23,0	24,0	38,5	38,5	39,5	40,0
Cracked concrete		mm ²]	6,5	10,0	16,5	17,5	18,5	29,5	29,5	30,0	30,5
Anchor rods											
Reinforcing bars (nominal diameter)		ϕ	25	26	-	28	30	32	34	36	40
Minimum edge distance											
Uncracked / cracked concrete	C_{min}	[mm]	75	75	75	80	80	120	120	135	175
Minimum spacing	S_{min}		according to Annex B7								
Minimum spacing											
Uncracked / cracked concrete	S_{min}	[mm]	120	120	120	140	140	160	160	160	160
Minimum edge distance	C_{min}		according to Annex B7								
Required projecting area											
Uncracked concrete	$A_{sp,req}$	[1000	47,5	47,5	47,5	64,0	64,0	64,0	64,0	64,0	64,0
Cracked concrete		mm ²]	36,5	36,5	36,5	49,0	49,0	49,0	49,0	49,0	49,0
<p>Splitting failure for minimum edge distance and spacing in dependence of the effective embedment depth h_{ef}.</p> <p>For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:</p> $A_{sp,req} < A_{sp,t}$ <p>$A_{sp,req}$ = required projecting area, $A_{sp,t}$ = effective projecting area (according to Annex B7).</p>											
BERNER multicomponent system MCS Diamond									Annex B5		
Intended use Minimum spacing and edge distance for Anchor rods and reinforcing bars											

Table B6.1: Minimum spacing and minimum edge distance for fractional Threaded rods and reinforcing bars

Fractional Threaded rods		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	-	
Fractional Reinforcing bars		#3	#4	#5	#6	#7	#8	#9	#10	
Minimum edge distance										
Uncracked / cracked concrete	c_{min}	[mm]	45	45	50	55	60	75	80	120
Minimum spacing	s_{min}		according to Annex B7							
Minimum spacing										
Uncracked / cracked concrete	s_{min}	[mm]	45	60	65	85	105	120	140	160
Minimum edge distance	c_{min}		according to Annex B7							
Required projecting area										
Uncracked concrete	$A_{sp,req}$	[1000	12,5	21,0	24,5	36,0	39,5	43,5	40,5	64,5
Cracked concrete		mm ²]	9,5	16,0	18,5	27,5	30,0	33,5	31,0	49,5

Splitting failure for minimum edge distance and spacing in dependence of the effective embedment depth h_{ef} .

For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

$$A_{sp,req} < A_{sp,t}$$

$A_{sp,req}$ = required projecting area,

$A_{sp,t}$ = effective projecting area (according to **Annex B7**).

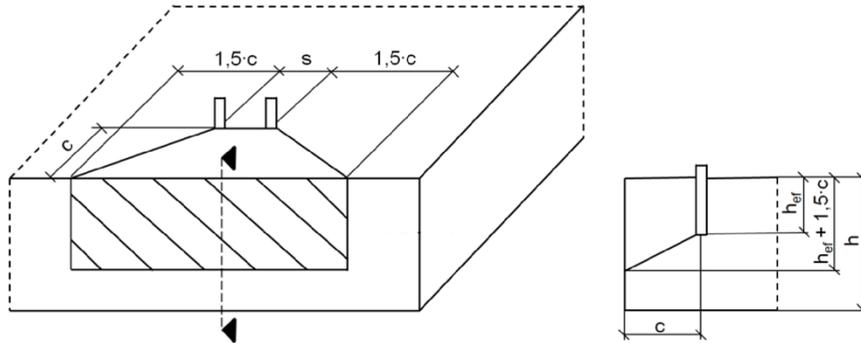
BERNER multicomponent system MCS Diamond

Intended use

Minimum spacing and edge distance for Anchor rods and reinforcing bars

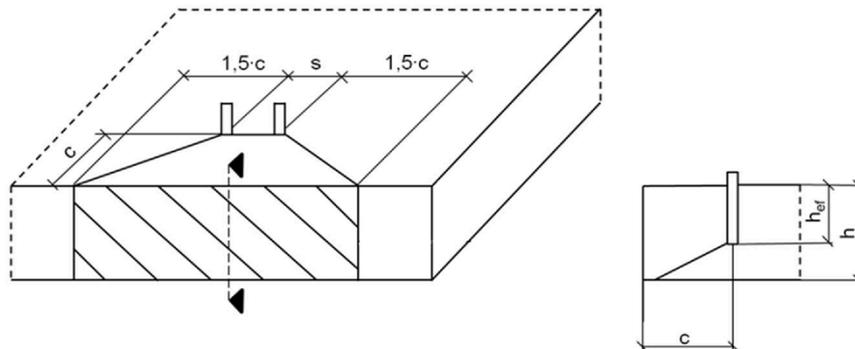
Annex B6

Table B7.1: Projecting area $A_{sp,t}$ with concrete member thickness
 $h > h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single fastener	$A_{sp,t} = (3 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	with $c \geq c_{min}$
Group of fastener with $s > 3 \cdot c$	$A_{sp,t} = (6 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	
Group of fastener with $s \leq 3 \cdot c$	$A_{sp,t} = (3 \cdot c + s) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B7.2: Projecting area $A_{sp,t}$ with concrete member thickness
 $h \leq h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single anchor	$A_{sp,t} = 3 \cdot c \cdot \text{existing } h$	[mm ²]	with $c \geq c_{min}$
Group of fastener with $s > 3 \cdot c$	$A_{sp,t} = 6 \cdot c \cdot \text{existing } h$	[mm ²]	
Group of fastener with $s \leq 3 \cdot c$	$A_{sp,t} = (3 \cdot c + s) \cdot \text{existing } h$	[mm ²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Edge distance and axial spacing shall be rounded up to at least 5 mm.

Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use

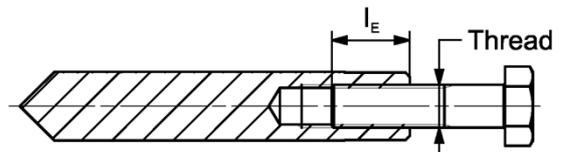
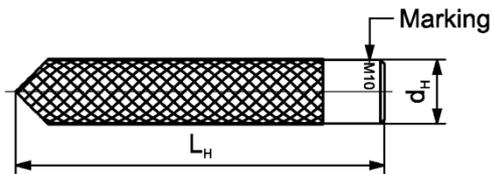
Minimum thickness of concrete member for Anchor rods / Threaded rods,
minimum spacing and edge distance

Annex B7

Table B8.1: Installation parameters for metric BERNER MCS Plus I

BERNER MCS Plus I		Thread	M8	M10	M12	M16	M20
Diameter of anchor	$d_{nom} = d_H$	[mm]	12,0	15,7	18,0	22,0	28,0
Nominal drill hole diameter	d_0		14	18	20	24	32
Drill hole depth	h_0		$h_0 \geq h_{ef} = L_H$				
Effective embedment depth ($h_{ef} = L_H$)	h_{ef}		90	90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		55	65	75	95	125
Diameter of clearance hole in the fixture	d_f		9	12	14	18	22
Minimum thickness of concrete member	h_{min}		120	125	165	205	260
Maximum screw-in depth	$l_{E,max}$		18	23	26	35	45
Minimum screw-in depth	$l_{E,min}$		8	10	12	16	20
Maximum installation torque	$\max T_{inst}$		[Nm]	10	20	40	80

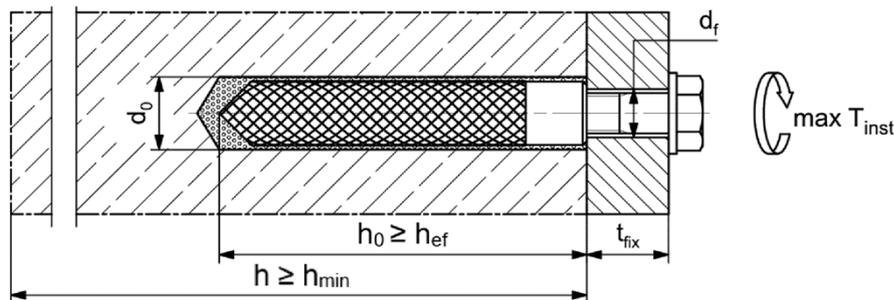
BERNER MCS Plus I



Marking: Anchor size e. g.: **M10**
Stainless steel → additional **R**; e.g.: **M10 R**
High corrosion resistant steel → additional **HCR**; e.g.: **M10 HCR**

Retaining screw or threaded rods (including nut and washer) must comply with the appropriate material and strength class of **Annex A6, Table A6.1**.

Installation conditions:



Figures not to scale

BERNER multicomponent system MCS Diamond

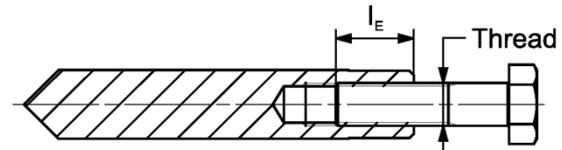
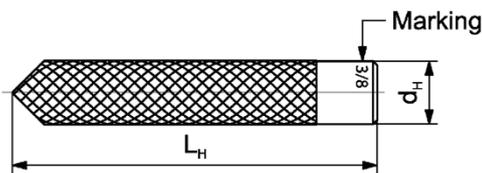
Intended use
Installation parameters internal threaded BERNER MCS Plus I (metric size)

Annex B8

Table B9.1: Installation parameters for fractional BERNER MCS Plus I

BERNER MCS Plus I		Thread	3/8"	1/2"	5/8"	3/4"
Diameter of anchor	$d_{nom} = d_H$	[mm]	15,7	18	22	28
Nominal drill hole diameter	d_0	[mm]	18	20	24	32
		[inch]	3/4	13/16	1	1 1/4
Drill hole depth	h_0		$h_0 \geq h_{ef} = L_H$			
Effective embedment depth ($h_{ef} = L_H$)	h_{ef}		90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	65	75	95	125
Diameter of clearance hole in the fixture	d_f		12	14	18	22
Minimum thickness of concrete member	h_{min}		125	165	205	260
Maximum screw-in depth	$l_{E,max}$		23	26	35	45
Minimum screw-in depth	$l_{E,min}$		10	12	16	20
Maximum installation torque	$\max T_{inst}$	[Nm]	20	40	80	120

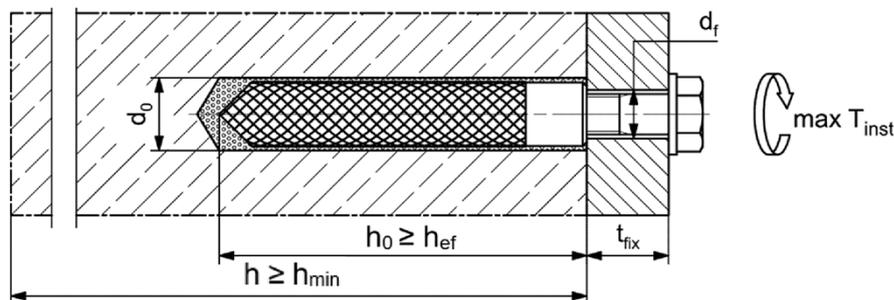
BERNER MCS Plus I



Marking: Anchor size e. g.: **M 3/8**
Stainless steel → additional **R**; e.g.: **M 3/8 R**

Retaining screw or threaded rods (including nut and washer) must comply with the appropriate material and strength class of **Annex A7, Table A7.1**.

Installation conditions:



Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters internal threaded anchors BERNER MCS Plus I (fractional size)

Annex B9

Table B10.1: Installation parameters for metric reinforcing bars ¹⁾

Nominal diameter of the bar		ϕ	8 ²⁾	10 ²⁾	12 ²⁾	14	16	18	20	22	24				
Nominal drill hole diameter	d_0	[mm]	10	12	12	14	14	16	18	20	25	25	30	30	
Drill hole depth	h_0		$h_0 \geq h_{ef}$												
Effective embedment depth	$h_{ef,min}$		60	60	70	75	80	85	90	94	98				
	$h_{ef,max}$		160	200	240	280	320	360	400	440	480				
Minimum thickness of concrete member	h_{min}	$h_{ef} + 30$					$h_{ef} + 2d_0$								

Nominal diameter of the bar		ϕ	25	26	28	30	32	34	36	40	-	
Nominal drill hole diameter	d_0	[mm]	30	35	35	40	40	40	45	55	-	
Drill hole depth	h_0		$h_0 \geq h_{ef}$									
Effective embedment depth	$h_{ef,min}$		100	104	112	120	128	136	144	160	-	
	$h_{ef,max}$		500	520	560	600	640	680	720	800	-	
Minimum thickness of concrete member	h_{min}	$h_{ef} + 2d_0$										

¹⁾ Detailed calculation according to **Annex B7**.

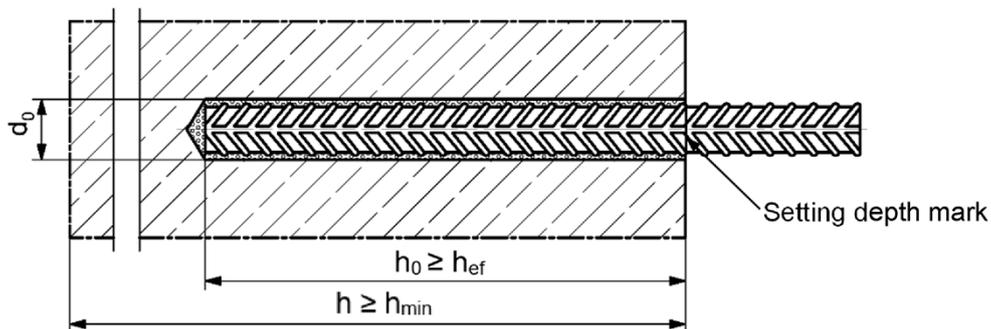
²⁾ Both drill hole diameters can be used.

Reinforcing bar



- The minimum value of related rib area $f_{R,min}$ must fulfil the requirements of EN 1992-1-1:2004+AC:2010.
- The rib height must be within the range: $0,05 \cdot \phi \leq h_{rib} \leq 0,07 \cdot \phi$
(ϕ = Nominal diameter of the bar, h_{rib} = rib height).

Installation conditions:



Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters reinforcing bars (metric size)

Annex B10

Table B11.1: Installation parameters for fractional reinforcing bars ¹⁾

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10	
Nominal drill hole diameter	d_0	[mm]	12,7	15,9	19,1	22,2	28,6	31,8	34,9	38,1
		[inch]	1/2	5/8	3/4	7/8	1 1/8	1 1/4	1 3/8	1 1/2
Drill hole depth	h_0	$h_0 \geq h_{ef}$								
Effective embedment depth	$h_{ef,min}$	60	70	79	89	89	102	114	127	
	$h_{ef,max}$	[mm]	191	254	318	381	445	508	572	635
Minimum thickness of concrete member	h_{min}	$h_{ef} + 30$		$h_{ef} + 2d_0$						

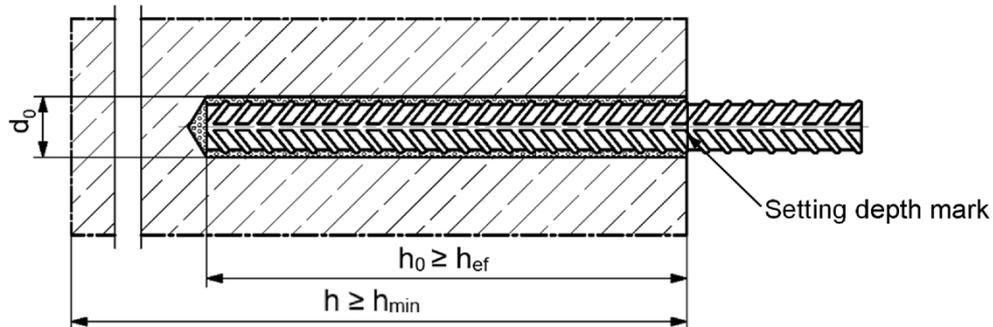
¹⁾ Detailed calculation according to **Annex B7**.

Reinforcing bar



- Reinforcing bars, acc. to ASTM A615/A615M-22 (ASTM A767/A767M-19).
Materials, dimensions, and mechanical properties according to **Annex A7, Table A7.1**.

Installation conditions:



Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters reinforcing bars (fractional size)

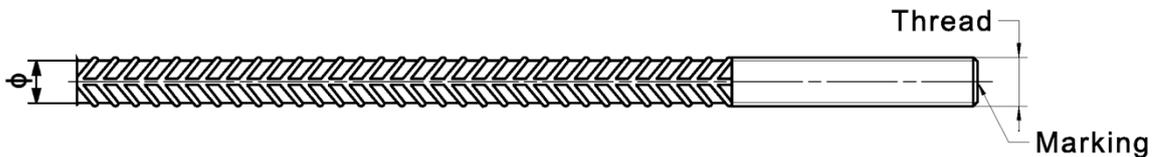
Annex B11

Table B12.1: Installation parameters for metric BERNER BRA

BERNER BRA		Thread	M12 ¹⁾	M16	M20	M24	
Nominal diameter of the bar	ϕ	[mm]	12	16	20	25	
Nominal drill hole diameter	d_0		14	16	20	25	30
Drill hole depth	h_0		$h_{ef} + l_e = h_{nom}$				
Effective embedment depth	$h_{ef,min}$		70	80	90	96	
	$h_{ef,max}$		140	220	300	380	
Distance concrete surface to welded joint	l_e		100				
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		55	65	85	105	
Diameter of clearance hole in the fixture	pre-positioned anchorage $\leq d_f$		14	18	22	26	
	push through anchorage $\leq d_f$		18	22	26	32	
Minimum thickness of concrete member	h_{min}		$h_0 + 30$	$h_0 + 2d_0$			
Maximum installation torque	$\max T_{inst}$	[Nm]	40	60	120	150	

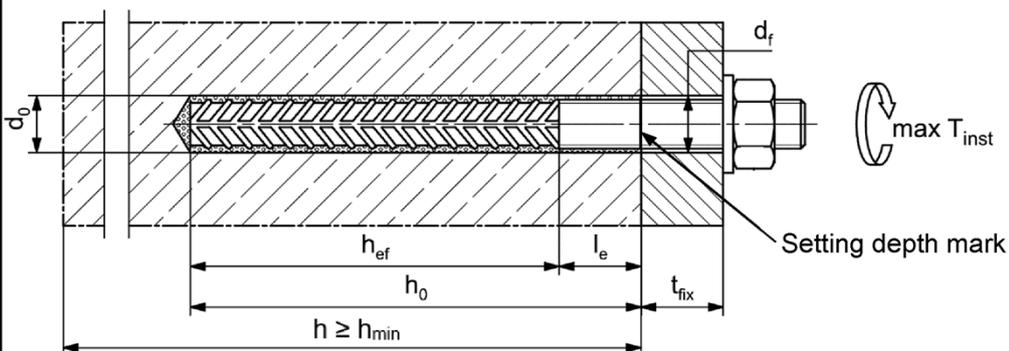
¹⁾ Both drill hole diameters can be used.

BERNER BRA



Marking frontal e.g.:
BRA (for stainless steel R)
BRA HCR (for high corrosion resistant steel HCR)

Installation conditions:



Figures not to scale

BERNER multicomponent system MCS Diamond

Intended use
Installation parameters BERNER BRA (metric size)

Annex B12

Table B13.1: Parameters of the cleaning brush (steel brush with steel bristles)

The size of the cleaning brush refers to the drill hole diameter.

Nominal drill hole diameter d_0	[mm]	10	12	14	16	18	20	22	24	25	28	30	32	35	40	45	55
	[inch]	-	7/16	1/2	5/8	3/4	13/16		1		1 1/8	1 1/4	1 3/8	1 1/2	-	-	-
Steel brush diameter d_b	[mm]	11	14	16	20		25		26	27	30	40			-	-	-
Steel brush diameter d_b	[mm]	-	-	-	-	-	-	-	-	-	-	-	-	-	42	47	58

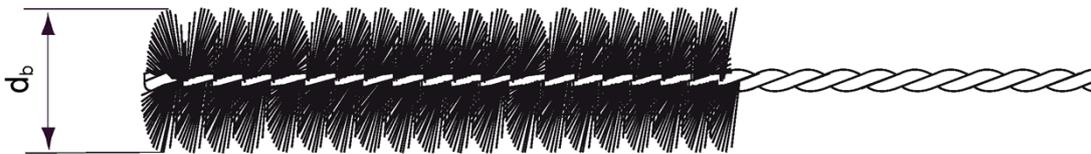


Table B13.2: Conditions for use static mixer without an extension tube

Nominal drill hole diameter d_0	[mm]	10	12	14	16	18	20	22	24	25	28	30	32	35	40	45	55
	[inch]	-	7/16	1/2	5/8	3/4	13/16	-	1	-	1 1/8	1 1/4		1 3/8	1 1/2	-	-
Drill hole depth h_0 by using	MCS Diamond 390 ml [mm]	≤90	≤120	≤140	≤150	≤160	≤170	≤190	≤210								
	MCS Diamond 585 ml to 1500 ml [mm]	-	≤90			≤260			≤280								

Table B13.3: Maximum processing time of the mortar and minimum curing time
(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

Temperature at anchoring base [°C]	Maximum processing time t_{work}	Minimum curing time t_{cure} ¹⁾
-5 to 0 ²⁾	240 min	200 h
> 0 to 5 ²⁾	150 min	90 h
> 5 to 10	120 min	40 h
> 10 to 20	30 min	18 h
> 20 to 30	14 min	10 h
> 30 to 40	7 min	5 h

¹⁾ In wet concrete or water filled holes the curing times must be doubled.

²⁾ Minimal cartridge temperature +5 °C.

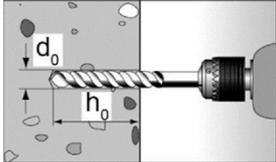
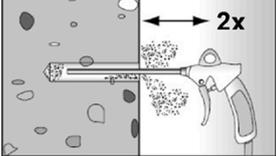
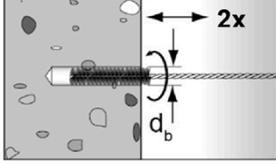
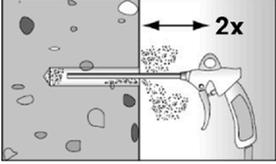
BERNER multicomponent system MCS Diamond

Intended use
Cleaning brush (steel brush)
Processing time and curing time

Annex B13

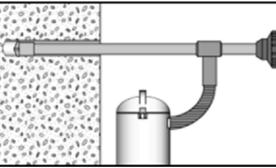
Installation instructions part 1

Drilling and cleaning the hole (hammer drilling with standard drill bit)

1		<p>Drill the hole. Nominal drill hole diameter d_0 and drill hole depth h_0 see Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</p>
2		<p>Cleaning the drill hole: Blow out the drill hole twice, with oil-free compressed air ($p \geq 6$ bar).</p> 
3		<p>Brush the drill hole twice. For drill hole diameter ≥ 30 mm use a power drill. For deep holes use an extension. Corresponding brushes see Table B13.1.</p>
4		<p>Cleaning the drill hole: Blow out the drill hole twice, with oil-free compressed air ($p \geq 6$ bar).</p> 

Go to step 6

Drilling and cleaning the hole (hammer drilling with hollow drill bit)

1		<p>Check a suitable hollow drill (see Table B1.1) for correct operation of the dust extraction.</p>
2		<p>Use a suitable dust extraction system, e. g. Bosch GAS 35 M AFC or a comparable dust extraction system with equivalent performance data.</p> <p>Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Nominal drill hole diameter d_0 and drill hole depth h_0 see Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</p>

Go to step 6

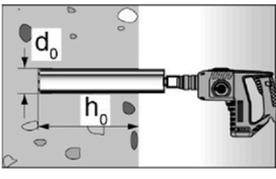
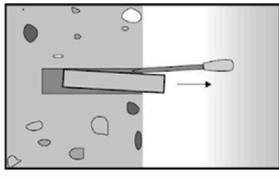
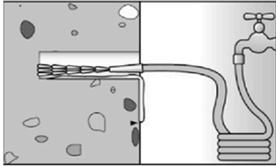
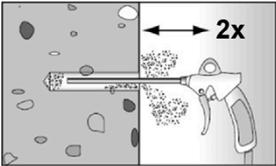
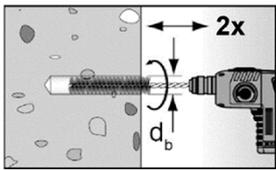
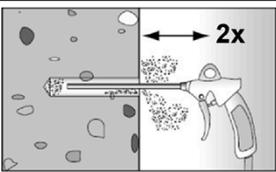
BERNER multicomponent system MCS Diamond

Intended use
Installation instructions part 1

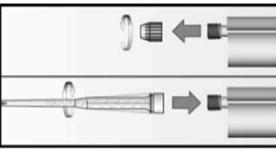
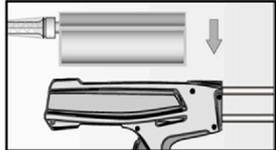
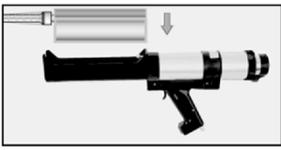
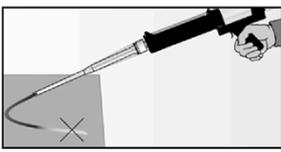
Annex B14

Installation instructions part 2

Drilling and cleaning the hole (wet drilling with diamond drill bit)

1		<p>Drill the hole. Drill hole diameter d_0 and nominal drill hole depth h_0 see Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</p>	 <p>Break the drill core and remove it.</p>
2		<p>Flush the drill hole with clean water until it flows clear.</p>	
3		<p>Blow out the drill hole twice, using oil-free compressed air ($p > 6$ bar).</p>	
4		<p>Brush the drill hole twice using a power drill. Corresponding brushes see Table B13.1.</p>	
5		<p>Blow out the drill hole twice, using oil-free compressed air ($p > 6$ bar).</p>	

Preparing the cartridge

6		<p>Remove the sealing cap. Screw on the static mixer (the spiral in the static mixer must be clearly visible).</p>	
7			<p>Place the cartridge into the dispenser.</p>
8			<p>Extrude approximately 10 cm of material out until the resin is evenly grey in colour. Do not use mortar that is not uniformly grey.</p>

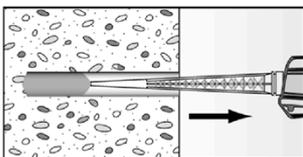
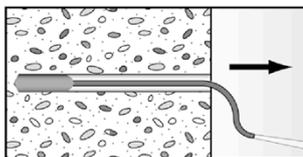
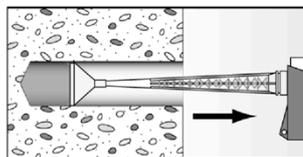
BERNER multicomponent system MCS Diamond

Intended use
Installation instructions part 2

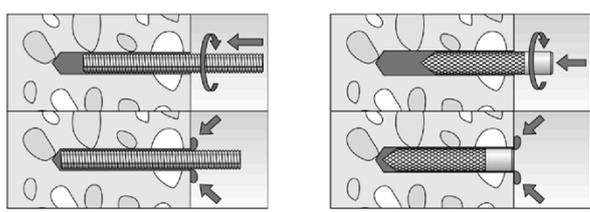
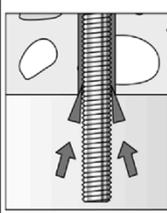
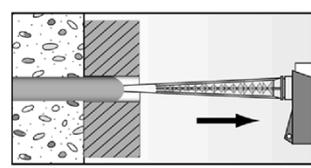
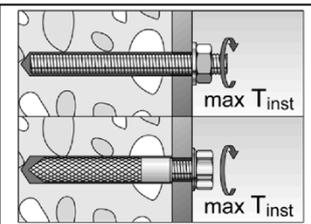
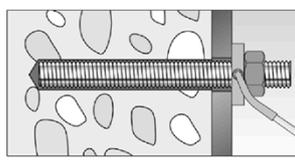
Annex B15

Installation instructions part 3

Injection of the mortar

<p>9</p>	 <p>Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles.</p>	 <p>The conditions for mortar injection without extension tube can be found in Table B13.2. For deeper drill holes, than those mentioned in Table B13.2, use a suitable extension tube.</p>	 <p>For overhead installation, deep holes ($h_0 > 250$ mm) or drill hole diameter ($d_0 \geq 30$ mm / 1 1/8") use an injection-adapter.</p>
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Installation of Anchor rods, Threaded rods or BERNER MCS Plus I

<p>10</p>		<p>Only use clean and oil-free metal parts. Mark the setting depth of the metal parts. Push the Anchor rod, Threaded rod or BERNER MCS Plus I down to the bottom of the hole, turning it slightly while doing so. After inserting the metal part, excess mortar must be emerged around the anchor element. If not, pull out the metal part immediately and reinject mortar.</p>
	<p>For overhead installations support the metal part with wedges (e.g. centering wedges) or overhead clips.</p>	 <p>For push through installation fill the annular gap with mortar.</p>
<p>11</p> 	<p>Wait for the specified curing time t_{cure} see Table B13.3.</p>	<p>12</p>  <p>Mounting the fixture $\max T_{inst}$ see Tables B3.1, B4.1, B8.1 and B9.1.</p>
<p>Option</p>	 <p>After the minimum curing time is reached, the gap between metal part and fixture (annular clearance) may be filled with mortar via the filling disc. Compressive strength ≥ 50 N/mm² (e.g., BERNER injection mortars MCS Diamond, MCS Uni Plus). ATTENTION: Using filling disc reduces t_{fix} (usable length of the anchor).</p>	

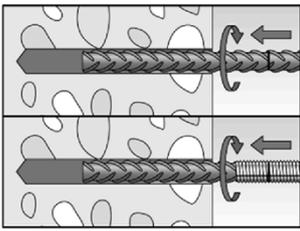
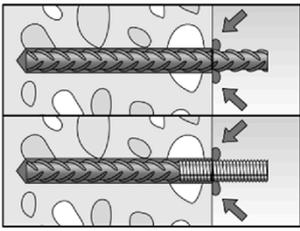
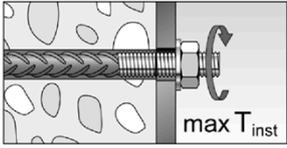
BERNER multicomponent system MCS Diamond

Intended use
Installation instructions part 3

Annex B16

Installation instructions part 4

Installation reinforcing bars and BERNER BRA

10		Only use clean and oil-free reinforcing bars or BERNER BRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the BERNER BRA into the filled hole up to the setting depth mark.			
		When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole. If not, pull out the anchor element immediately and reinject mortar.			
11		Wait for the specified curing time t_{cure} see Table B13.3 .	12		Mounting the fixture $max T_{inst}$ see Table B12.1 .

BERNER multicomponent system MCS Diamond

Intended use
Installation instructions part 4

Annex B17

Table C1.1: Characteristic resistance to steel failure under tension / shear loading of metric Anchor rods / Threaded rods													
Anchor rod / Threaded rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30		
Characteristic resistance to steel failure under tension loading ¹⁾													
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	Property class	4.8	14,6(13,2)	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
			5.8	18,3(16,6)	29,0(26,8)	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			8.8	29,2(26,5)	46,4(42,8)	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	18,3	29,0	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			70	25,6	40,6	59,0	80,5	109,9	171,5	212,1	247,1	321,3	392,7
			80	29,2	46,4	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
Partial factors ²⁾													
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	4.8	1,50									
			5.8	1,50									
			8.8	1,50									
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	2,86									
			70	1,87 / BERNER HCR: 1,50 ³⁾									
			80	1,60									
Characteristic resistance to steel failure under shear loading ¹⁾													
without lever arm													
Characteristic resistance $V_{Rk,s}^0$	Steel zinc plated	Property class	4.8	8,7(7,9)	13,9(12,8)	20,2	27,6	37,6	58,8	72,7	84,7	110,1	134,6
			5.8	10,9(9,9)	17,4(16,0)	25,2	34,5	47,1	73,5	90,9	105,9	137,7	168,3
			8.8	14,6(13,2)	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	9,1	14,5	21,0	28,7	39,2	61,2	75,7	88,2	114,7	140,2
			70	12,8	20,3	29,5	40,2	54,9	85,7	106,0	123,5	160,6	196,3
			80	14,6	23,2	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
Ductility factor	k_7	[-]	1,0										
with lever arm													
Charact. resistance $M_{Rk,s}^0$	Steel zinc plated	Property class	4.8	14,9(12,9)	29,9(26,5)	52,3	83,5	132,9	259,6	357,1	448,8	665,7	899,5
			5.8	18,7(16,1)	37,3(33,2)	65,4	104,4	166,2	324,6	446,4	561,0	832,2	1124,4
			8.8	29,9(25,9)	59,8(53,1)	104,6	167,0	265,9	519,3	714,2	897,6	1331,5	1799,0
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	18,7	37,3	65,4	104,4	166,2	324,6	446,4	561,0	832,2	1124,4
			70	26,2	52,3	91,5	146,1	232,6	454,4	624,9	785,4	1165,0	1574,1
			80	29,9	59,8	104,6	167,0	265,9	519,3	714,2	897,6	1331,5	1799,0
Partial factors ²⁾													
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	4.8	1,25									
			5.8	1,25									
			8.8	1,25									
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	2,38									
			70	1,56 / BERNER HCR: 1,25 ³⁾									
			80	1,33									
¹⁾ 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. ²⁾ In absence of other national regulations. ³⁾ Only admissible for high corrosion resist. steel HCR, acc. to Table A6.1 .													
BERNER multicomponent system MCS Diamond										Annex C1			
Performance Characteristic resistance to steel failure under tension / shear loading of metric Anchor rods / Threaded rods													

Table C2.1: Characteristic resistance to steel failure under tension / shear loading of metric BERNER MCS Plus I									
BERNER MCS Plus I			M8	M10	M12	M16	M20		
Characteristic resistance to steel failure under tension loading									
Characteristic resistance with Screw or Threaded / Anchor rod $N_{Rk,s}$	Steel zinc plated	Property class of Screw or Threaded / Anchor rod	5.8	[kN]	18,3	29,0	42,1	78,3	122,4
			8.8		29,2	46,4	67,4	106,7	180,2
	Stainless steel R and High corrosion resistant steel HCR		70		25,6	40,6	59,0	109,6	171,3
Partial factors ¹⁾									
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class of Screw or Threaded / Anchor rod	5.8	[-]	1,50				
			8.8		1,50				
	Stainless steel R and High corrosion resistant steel HCR		70		1,87 / BERNER HCR: 1,50 ²⁾				
Characteristic resistance to steel failure under shear loading									
Without lever arm									
Characteristic resistance with Screw or Threaded / Anchor rod $V^0_{Rk,s}$	Steel zinc plated	Property class of Screw or Threaded / Anchor rod	5.8	[kN]	10,9	17,4	25,2	47,1	73,5
			8.8		14,6	23,2	33,7	62,8	98,0
	Stainless steel R and High corrosion resistant steel HCR		70		12,8	20,3	29,5	54,9	85,7
Ductility factor			k_7	[-]	1,0				
With lever arm									
Characteristic resistance with Screw or Threaded / Anchor rod $M^0_{Rk,s}$	Steel zinc plated	Property class of Screw or Threaded / Anchor rod	5.8	[Nm]	18,7	37,3	65,4	166,2	324,6
			8.8		29,9	59,8	104,6	265,9	519,3
	Stainless steel R and High corrosion resistant steel HCR		70		26,2	52,3	91,5	232,6	454,4
Partial factors ¹⁾									
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class of Screw or Threaded / Anchor rod	5.8	[-]	1,25				
			8.8		1,25				
	Stainless steel R and High corrosion resistant steel HCR		70		1,56 / BERNER HCR: 1,25 ²⁾				
¹⁾ In absence of other national regulations. ²⁾ Only admissible for high corrosion resistant steel HCR, acc. to Table A6.1.									
BERNER multicomponent system MCS Diamond						Annex C2			
Performance Characteristic resistance to steel failure under tension / shear loading of metric BERNER MCS Plus I									

Table C3.1: Characteristic resistance to steel failure under tension / shear loading of metric reinforcing bars

Nominal diameter of the bar		ϕ	8 to 40
Characteristic resistance to steel failure under tension loading			
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$
Characteristic resistance to steel failure under shear loading			
Without lever arm			
Characteristic resistance	$V_{Rk,s}^0$	[kN]	$k_6^{2)}) \cdot A_s \cdot f_{uk}^{1)}$
Ductility factor	k_7	[-]	1,0
With lever arm			
Characteristic resistance	$M_{Rk,s}^0$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{1)}$
<p>1) f_{uk} respectively shall be taken from the specifications of the reinforcing bar. 2) In accordance with EN 1992-4:2018 section 7.2.2.3.1: $k_6 = 0,6$ for fasteners made of carbon steel with $f_{uk} \leq 500 \text{ N/mm}^2$, $= 0,5$ for fasteners made of carbon steel with $500 \text{ N/mm}^2 < f_{uk} \leq 1000 \text{ N/mm}^2$, $= 0,5$ for fasteners made of stainless steel.</p>			

Table C3.2: Characteristic resistance to steel failure under tension / shear loading of metric BERNER BRA

BERNER BRA		M12	M16	M20	M24	
Characteristic resistance to steel failure under tension loading						
Characteristic resistance	$N_{Rk,s}$	[kN]	62,0	110,0	173,0	236,5
Partial factor ¹⁾						
Partial factor	$\gamma_{Ms,N}$	[-]	1,40			
Characteristic resistance to steel failure under shear loading						
Without lever arm						
Characteristic resistance	$V_{Rk,s}^0$	[kN]	34,5	64,3	100,4	144,7
Ductility factor	k_7	[-]	1,0			
With lever arm						
Characteristic resistance	$M_{Rk,s}^0$	[Nm]	107,4	273,0	532,2	920,4
Partial factor¹⁾						
Partial factor	$\gamma_{Ms,V}$	[-]	1,5			

¹⁾ In absence of other national regulations.

BERNER multicomponent system MCS Diamond

Performance

Characteristic resistance to steel failure under tension / shear loading of metric reinforcing bars and metric BERNER BRA

Annex C3

Table C4.1: Characteristic resistance for concrete failure under tension / shear loading (metric size)																					
Size			All sizes																		
Tension loading																					
Installation factor		γ_{inst}	[-]		See Annex C5 to C16, C40 and C41																
Factors for the compressive strength of concrete > C20/25																					
Increasing factor ψ_c for cracked or uncracked concrete $\tau_{Rk(X,Y)} = \psi_c \cdot \tau_{Rk(C20/25)}$	C25/30		ψ_c	[-]	1,02																
	C30/37				1,04																
	C35/45				1,06																
	C40/50				1,07																
	C45/55				1,08																
C50/60		1,09																			
Splitting failure																					
Edge distance	$h / h_{ef} \geq 2,0$		$C_{cr,sp}$	[mm]	1,0 h_{ef}																
	$2,0 > h / h_{ef} > 1,3$				4,6 h_{ef} - 1,8 h																
	$h / h_{ef} \leq 1,3$				2,26 h_{ef}																
Spacing		$S_{cr,sp}$			2 $C_{cr,sp}$																
Concrete cone failure																					
Uncracked concrete		$k_{ucr,N}$	[-]	11,0																	
Cracked concrete		$k_{cr,N}$		7,7																	
Edge distance		$C_{cr,N}$	[mm]	1,5 h_{ef}																	
Spacing		$S_{cr,N}$		2 $C_{cr,N}$																	
Factors for sustained tension loading																					
Temperature range			24 °C / 40 °C			35 °C / 60 °C			50 °C / 72 °C												
Factor		ψ_{sus}^0	[-]		0,77			0,60			0,48										
Factor		$\psi_{sus,100}^0$	[-]		0,77			0,60			0,71										
Shear loading																					
Installation factor		γ_{inst}	[-]		1,0																
Concrete pry-out failure																					
Factor for pry-out failure		k_8	[-]		2,0																
Concrete edge failure																					
Effective length of fastener for shear loading		l_f	[mm]		for $d_{nom} \leq 24$ mm: min (h_{ef} ; 12 d_{nom}) for $d_{nom} > 24$ mm: min (h_{ef} ; max (8 d_{nom} ; 300 mm))																
Effective diameter of the fastener d_{nom}																					
Size			M8	M10	M12	M14	M16	M20	M22	M24	M27	M30									
Anchor rods and Threaded rods		d_{nom}	[mm]		8,0	10,0	12,0	14,0	16,0	20,0	22,0	24,0	27,0	30,0							
BERNER MCS Plus I		d_{nom}	[mm]		12,0	15,7	18,0	- ¹⁾	22,0	28,0	- ¹⁾	- ¹⁾	- ¹⁾	- ¹⁾							
BERNER BRA		d_{nom}	[mm]		- ¹⁾	- ¹⁾	12,0	- ¹⁾	16,0	20,0	- ¹⁾	25,0	- ¹⁾	- ¹⁾							
Size (nominal diameter of the bar)			ϕ	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40	
Reinforcing bar		d_{nom}	[mm]		8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
¹⁾ Anchor type not part of the assessment.																					
BERNER multicomponent system MCS Diamond											Annex C4										
Performance Characteristic resistance for concrete failure under tension / shear loading (metric size)																					

Table C5.1: Characteristic resistance to combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer or diamond drilled holes; uncracked or cracked concrete; working life 50 years

Anchor rod / Threaded rod		M8 ¹⁾	M10	M12	M14	M16	M20	M22	M24	M27	M30		
Combined pull-out and concrete cone failure													
Calculation diameter	d [mm]	8	10	12	14	16	20	22	24	27	30		
Uncracked concrete													
Characteristic bond resistance in uncracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	20,8	19,7	18,8	18,1	17,6	16,7	16,3	16,0	15,5	15,1	
	II: 35 °C / 60 °C		18,0	18,0	18,0	17,0	17,0	16,0	15,0	15,0	15,0	14,0	14,0
	III: 50 °C / 72 °C		18,0	17,0	17,0	16,0	16,0	15,0	14,0	14,0	14,0	14,0	13,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	20,8	19,7	18,8	17,9	16,9	15,3	14,4	13,8	13,2	12,3	
	II: 35 °C / 60 °C		16,0	16,0	15,0	13,0	13,0	11,0	11,0	10,0	10,0	9,0	
	III: 50 °C / 72 °C		15,0	14,0	14,0	13,0	12,0	11,0	10,0	10,0	10,0	9,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole			1,4										
Diamond-drilling (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	16,0	15,0	13,5	12,8	12,4	11,6	11,3	10,9	10,5	10,3	
	II: 35 °C / 60 °C		16,0	15,0	13,0	12,0	12,0	10,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C		15,0	14,0	12,0	11,0	11,0	10,0	9,0	9,0	8,0	8,0	
Diamond-drilling (water filled hole)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	16,0	16,8	15,5	14,3	13,6	12,0	11,5	10,9	10,3	9,9	
	II: 35 °C / 60 °C		16,0	15,0	13,0	12,0	12,0	10,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C		15,0	14,0	12,0	11,0	11,0	10,0	9,0	9,0	8,0	8,0	
Installation factors; Diamond-drilling													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole			1,4										
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,7	9,0	10,1	9,8	9,5	8,5	8,5	8,5	8,5	8,5	
	II: 35 °C / 60 °C		7,7	9,0	10,1	9,8	9,5	8,5	8,5	8,5	8,5	8,5	
	III: 50 °C / 72 °C		7,2	8,5	9,5	9,2	8,9	8,5	8,5	8,5	8,5	8,5	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,6	7,7	8,7	8,3	7,7	6,0	6,0	6,0	6,0	6,0	
	II: 35 °C / 60 °C		6,6	7,7	8,7	8,3	7,7	6,0	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C		6,2	7,3	8,1	7,9	7,3	6,0	6,0	6,0	6,0	6,0	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole			1,2					1,4					
Diamond-drilling (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
	II: 35 °C / 60 °C		7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
	III: 50 °C / 72 °C		7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
Diamond-drilling (water filled hole)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,0	7,5	7,5	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
	II: 35 °C / 60 °C		6,0	7,5	7,5	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C		6,0	7,0	7,0	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
Installation factors; Diamond-drilling													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole			1,2					1,4					

¹⁾ Not allowed for hollow drill bit.

BERNER multicomponent system MCS Diamond

Performance

Characteristic resistance to combined pull-out and concrete failure for metric Anchor rods and Threaded rods; working life 50 years

Annex C5

Table C6.1: Characteristic resistance to combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years

Anchor rod / Threaded rod		M8 ¹⁾	M10	M12	M14	M16	M20	M22	M24	M27	M30		
Combined pull-out and concrete cone failure													
Calculation diameter	d [mm]	8	10	12	14	16	20	22	24	27	30		
Uncracked concrete													
Characteristic bond resistance in uncracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	17,1	16,1	15,4	14,9	14,4	13,7	13,4	13,1	12,7	12,4	
	II: 35 °C / 60 °C		13,5	13,5	13,5	12,8	12,8	12,0	11,3	11,3	11,3	11,3	10,5
	III: 50 °C / 72 °C		9,9	10,2	10,2	10,4	10,4	9,8	9,1	9,1	9,1	9,1	8,5
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	17,1	16,2	15,4	14,7	13,9	12,5	11,8	11,3	10,8	10,1	
	II: 35 °C / 60 °C		12,0	12,0	11,3	9,8	9,8	8,3	8,3	7,5	7,5	6,8	
	III: 50 °C / 72 °C		8,3	8,4	8,4	8,5	7,8	7,2	6,5	6,5	5,9	5,9	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole	γ_{inst}	[-]	1,4										
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	12,0	12,3	11,6	11,1	10,5	10,1	9,5	9,3	8,9	8,8	
	II: 35 °C / 60 °C		12,0	11,3	9,8	9,0	9,0	7,5	7,5	7,5	6,8	6,8	
	III: 50 °C / 72 °C		8,3	8,4	7,2	7,2	7,2	6,5	5,9	5,9	5,2	5,2	
Diamond-drilling (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	12,0	13,8	12,7	11,7	11,2	10,0	9,4	8,9	8,4	8,1	
	II: 35 °C / 60 °C		12,0	11,3	9,8	9,0	9,0	7,5	7,5	7,5	6,8	6,8	
	III: 50 °C / 72 °C		8,3	8,4	7,2	7,2	7,2	6,5	5,9	5,9	5,2	5,2	
Installation factors													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole	γ_{inst}	[-]	1,4										
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	5,7	7,0	7,6	7,4	7,2	6,9	6,8	6,7	6,5	6,3	
	II: 35 °C / 60 °C		5,7	7,0	7,6	7,4	7,2	6,9	6,8	6,7	6,5	6,3	
	III: 50 °C / 72 °C		5,4	6,6	7,2	7,0	6,8	6,4	6,4	6,3	6,1	6,0	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	4,9	6,0	6,5	6,1	5,9	4,9	4,8	4,7	4,6	4,4	
	II: 35 °C / 60 °C		4,9	6,0	6,5	6,1	5,9	4,9	4,8	4,7	4,6	4,4	
	III: 50 °C / 72 °C		4,6	5,7	6,1	5,7	5,5	4,5	4,5	4,4	4,3	4,3	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete	γ_{inst}	[-]	1,0										
Water filled hole	γ_{inst}	[-]	1,2				1,4						
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	
	II: 35 °C / 60 °C		4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	
	III: 50 °C / 72 °C		4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	
Installation factors													
Dry or wet concrete	γ_{inst}	[-]	1,0										

¹⁾ Not allowed for hollow drill bit.

BERNER multicomponent system MCS Diamond

Performance

Characteristic resistance to combined pull-out and concrete failure for Anchor rods and Threaded rods in hammer or diamond drilled holes; working life 100 years

Annex C6

Table C7.1: Characteristic resistance to combined pull-out and concrete failure for metric BERNER MCS Plus I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 50 years							
BERNER MCS Plus I		M8	M10	M12	M16	M20	
Combined pull-out and concrete cone failure							
Calculation diameter	d [mm]	12	15,7	18	22	28	
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,ucr}$ [N/mm ²]	18,8	17,6	17,0	16,2	15,3
			15,0	14,0	14,0	13,0	12,0
			14,0	13,0	13,0	12,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,ucr}$ [N/mm ²]	18,8	16,9	15,8	14,3	12,8
			14,0	12,0	12,0	11,0	10,0
			13,0	12,0	11,0	10,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Diamond-drilling (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,ucr}$ [N/mm ²]	13,3	12,3	11,9	11,2	10,4
			13,0	12,0	11,0	10,0	9,0
			12,0	11,0	10,0	9,0	8,0
Diamond-drilling (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,ucr}$ [N/mm ²]	15,1	13,6	12,6	11,4	10,2
			13,0	12,0	11,0	10,0	9,0
			12,0	11,0	10,0	9,0	8,0
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	6,5	6,0	6,0	6,0
			7,0	6,5	6,0	6,0	6,0
			7,0	6,0	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
Diamond-drilling (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
Diamond-drilling (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	6,5	6,0	6,0	6,0
			7,0	6,5	6,0	6,0	6,0
			7,0	6,0	6,0	6,0	6,0
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
BERNER multicomponent system MCS Diamond						Annex C7	
Performance Characteristic resistance to combined pull-out and concrete failure for BERNER MCS Plus I; working life 50 years							

Table C8.1: Characteristic resistance to combined pull-out and concrete failure for metric BERNER MCS Plus I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years							
BERNER MCS Plus I		M8	M10	M12	M16	M20	
Combined pull-out and concrete cone failure							
Calculation diameter	d [mm]	12	15,7	18	22	28	
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	15,4	14,4	14,0	13,3	12,6
			11,3	10,5	10,5	9,8	9,0
			7,7	7,8	7,8	7,8	7,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	15,4	13,9	13,0	11,7	10,5
			10,5	9,0	9,0	8,3	7,5
			7,2	7,2	6,6	6,5	5,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Diamond-drilling (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	10,9	10,1	9,8	9,2	8,6
			9,8	9,0	8,3	7,5	6,8
			6,6	6,6	6,0	5,9	5,2
Diamond-drilling (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	12,5	11,2	10,3	9,3	8,4
			9,8	9,0	8,3	7,5	6,8
			6,6	6,6	6,0	5,9	5,2
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,cr}$ [N/mm ²]	4,2	5,1	4,8	4,6	4,6
			4,2	5,1	4,8	4,6	4,6
			4,2	5,1	4,8	4,6	4,6
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,cr}$ [N/mm ²]	4,2	5,5	4,8	3,9	3,9
			4,2	5,5	4,8	3,9	3,9
			4,2	5,1	4,8	3,9	3,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
Diamond-drilling (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,100,cr}$ [N/mm ²]	4,2	5,1	4,8	4,6	4,6
			4,2	5,1	4,8	4,6	4,6
			4,2	5,1	4,8	4,6	4,6
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
BERNER multicomponent system MCS Diamond					Annex C8		
Performance Characteristic resistance to combined pull-out and concrete failure for BERNER MCS Plus I; working life 100 years							

Table C9.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; uncracked concrete; working life 50 years													
Nominal diameter of the bar		ϕ	8 ¹⁾	10	12	14	16	18	20	22	24		
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
Uncracked concrete													
Characteristic bond resistance in uncracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	16,0	16,8	16,1	15,5	15,0	14,6	14,2	14,0	13,6	
	II: 35 °C / 60 °C			16,0	15,0	15,0	14,0	14,0	13,0	13,0	13,0	13,0	12,0
	III: 50 °C / 72 °C			15,0	14,0	14,0	13,0	13,0	12,0	12,0	12,0	12,0	12,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	16,0	16,8	16,1	14,9	14,4	13,4	13,0	12,1	11,8	
	II: 35 °C / 60 °C			16,0	16,0	14,0	13,0	12,0	12,0	11,0	11,0	10,0	
	III: 50 °C / 72 °C			15,0	14,0	13,0	12,0	12,0	11,0	11,0	10,0	10,0	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Diamond-drilling (dry or wet concrete as well as water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	16,0	15,0	13,0	12,0	12,0	11,0	10,0	10,0	10,0	
	II: 35 °C / 60 °C			16,0	15,0	13,0	12,0	12,0	11,0	10,0	10,0	10,0	
	III: 50 °C / 72 °C			15,0	14,0	12,0	11,0	11,0	10,0	10,0	9,0	9,0	
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Nominal diameter of the bar		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾			
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
Uncracked concrete													
Characteristic bond resistance in uncracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	13,5	13,3	13,1	12,9	12,7	12,5	12,4	12,1		
	II: 35 °C / 60 °C			12,0	12,0	12,0	12,0	12,0	11,0	11,0	11,0		
	III: 50 °C / 72 °C			11,0	11,0	11,0	11,0	11,0	11,0	10,0	10,0		
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	11,5	11,4	10,6	10,5	10,3	9,0	8,0	8,0		
	II: 35 °C / 60 °C			10,0	10,0	10,0	9,0	9,0	9,0	8,0	8,0		
	III: 50 °C / 72 °C			9,0	9,0	9,0	9,0	8,0	8,0	8,0	8,0		
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Diamond-drilling (dry or wet concrete as well as water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	9,0	9,0	9,0	9,0	8,0	8,0	8,0	7,0		
	II: 35 °C / 60 °C			9,0	9,0	9,0	9,0	8,0	8,0	8,0	8,0		
	III: 50 °C / 72 °C			9,0	8,0	8,0	8,0	8,0	7,0	7,0	7,0		
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
1) Not allowed for hollow drill bit.													
BERNER multicomponent system MCS Diamond										Annex C9			
Performance Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 50 years													

Table C10.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years part 1													
Nominal diameter of the bar ϕ		8 ¹⁾	10	12	14	16	18	20	22	24			
Combined pull-out and concrete cone failure													
Calculation diameter d		[mm]	8	10	12	14	16	18	20	22	24		
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C				7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C				7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	
	II: 35 °C / 60 °C				6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				6,0	6,5	6,5	6,0	6,0	6,0	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,2				1,4					
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	
	II: 35 °C / 60 °C				7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C				7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	7,0
Diamond-drilling (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	
	II: 35 °C / 60 °C				6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				6,0	6,5	6,5	6,0	6,0	6,0	6,0	6,0	6,0
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,2				1,4					
1) Not allowed for hollow drill bit.													
BERNER multicomponent system MCS Diamond										Annex C10			
Performance Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 50 years part 1													

Table C11.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years part 2													
Nominal diameter of the bar		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾			
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C				8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C				8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
	III: 50 °C / 72 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	7,0	7,0	5,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				7,0	7,0	7,0	7,0	5,0	5,0	5,0	5,0	
	III: 50 °C / 72 °C				7,0	7,0	7,0	7,0	5,0	5,0	5,0	5,0	
Diamond-drilling (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
	III: 50 °C / 72 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0	
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
¹⁾ Not allowed for hollow drill bit.													
BERNER multicomponent system MCS Diamond										Annex C11			
Performance Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 50 years part 2													

Table C12.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; uncracked concrete; working life 100 years												
Nominal diameter of the bar		ϕ	8 ¹⁾	10	12	14	16	18	20	22	24	
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	12,0	13,8	13,2	12,7	12,3	12,0	11,6	11,5	11,2
	II: 35 °C / 60 °C			12,0	11,3	11,3	10,5	10,5	9,8	9,8	9,8	9,0
	III: 50 °C / 72 °C			8,3	8,4	8,4	8,5	8,5	7,8	7,8	7,8	7,8
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	12,0	13,8	13,2	12,2	11,8	11,0	10,7	9,9	9,7
	II: 35 °C / 60 °C			12,0	12,0	10,5	9,8	9,0	9,0	8,3	8,3	7,5
	III: 50 °C / 72 °C			8,3	8,4	7,8	7,8	7,8	7,2	7,2	6,5	6,5
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	12,0	11,3	9,8	9,0	9,0	8,3	7,5	7,5	7,5
	II: 35 °C / 60 °C			12,0	11,3	9,8	9,0	9,0	8,3	7,5	7,5	7,5
	III: 50 °C / 72 °C			8,3	8,4	7,2	7,2	7,2	6,5	6,5	5,9	5,9
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Nominal diameter of the bar		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾		
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40	
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	11,1	10,9	10,8	10,6	10,5	10,3	10,1	9,9	
	II: 35 °C / 60 °C			9,0	9,0	9,0	9,0	9,0	8,3	8,3	8,3	
	III: 50 °C / 72 °C			7,2	7,2	7,2	7,2	7,2	7,2	6,5	6,5	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	9,4	9,3	8,7	8,6	8,5	6,8	6,0	6,0	
	II: 35 °C / 60 °C			7,5	7,5	7,5	6,8	6,8	6,8	6,0	6,0	
	III: 50 °C / 72 °C			5,9	5,9	5,9	5,9	5,2	5,2	5,2	5,2	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	6,8	6,8	6,8	6,8	6,0	6,0	6,0	5,3	
	II: 35 °C / 60 °C			6,8	6,8	6,8	6,8	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C			5,9	5,2	5,2	5,2	5,2	4,6	4,6	4,6	
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
1) Not allowed for hollow drill bit.												
BERNER multicomponent system MCS Diamond										Annex C12		
Performance Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 100 years												

Table C13.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 100 years													
Nominal diameter of the bar		ϕ	8 ¹⁾	10	12	14	16	18	20	22	24		
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	
	II: 35 °C / 60 °C			4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	5,2
	III: 50 °C / 72 °C			4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	5,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	3,6	6,4	5,2	4,2	4,2	3,9	3,9	3,9	3,9	
	II: 35 °C / 60 °C			3,6	6,4	5,2	4,2	4,2	3,9	3,9	3,9	3,9	
	III: 50 °C / 72 °C			3,6	5,5	5,2	3,9	3,9	3,9	3,9	3,9	3,9	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,2				1,4					
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
	II: 35 °C / 60 °C			4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
	III: 50 °C / 72 °C			4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
Installation factor; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Nominal diameter of the bar		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾			
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
	II: 35 °C / 60 °C			5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
	III: 50 °C / 72 °C			5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	3,9	3,9	3,9	3,9	3,3	3,8	3,8	3,8		
	II: 35 °C / 60 °C			3,9	3,9	3,9	3,9	3,3	3,8	3,8	3,8		
	III: 50 °C / 72 °C			3,9	3,9	3,9	3,9	3,3	3,3	3,3	3,3		
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Diamond-drilling (dry or wet concrete)													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
	II: 35 °C / 60 °C			4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
	III: 50 °C / 72 °C			4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
Installation factor; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
1) Not allowed for hollow drill bit.													
BERNER multicomponent system MCS Diamond										Annex C13			
Performance Characteristic resistance for combined pull-out and concrete failure for reinforcing bars; working life 100 years													

Table C14.1: Characteristic resistance to combined pull-out and concrete failure for metric BERNER BRA in hammer or diamond drilled holes; uncracked concrete; working life 50 years

BERNER BRA		M12	M16	M20	M24	
Combined pull-out and concrete cone failure						
Calculation diameter	d [mm]	12	16	20	25	
Uncracked concrete						
Characteristic bond resistance in uncracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	16,1	15,0	14,2	13,5
	II: 35 °C / 60 °C		15,0	14,0	13,0	12,0
	III: 50 °C / 72 °C		14,0	13,0	12,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	16,1	14,4	13,0	11,5
	II: 35 °C / 60 °C		14,0	12,0	11,0	10,0
	III: 50 °C / 72 °C		13,0	12,0	11,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete		γ_{inst} [-]	1,0			
Water filled hole			1,4			
Diamond-drilling (dry or wet concrete as well as water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm ²]	13,0	12,0	10,0	9,0
	II: 35 °C / 60 °C		13,0	12,0	10,0	9,0
	III: 50 °C / 72 °C		12,0	11,0	10,0	9,0
Installation factors; Diamond-drilling						
Dry or wet concrete		γ_{inst} [-]	1,0			
Water filled hole			1,4			
BERNER multicomponent system MCS Diamond					Annex C14	
Performance Characteristic resistance to combined pull-out and concrete failure for BERNER BRA; working life 50 years						

Table C15.1: Characteristic resistance to combined pull-out and concrete failure for metric BERNER BRA in hammer or diamond drilled holes; cracked concrete; working life 50 years						
BERNER BRA		M12	M16	M20	M24	
Combined pull-out and concrete cone failure						
Calculation diameter	d [mm]	12	16	20	25	
Cracked concrete						
Characteristic bond resistance in cracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	8,0	8,0	8,0	8,0
	II: 35 °C / 60 °C		8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C		8,0	8,0	8,0	8,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,5	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,5	6,0	6,0
	III: 50 °C / 72 °C		6,5	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,2	1,4		
Diamond-drilling (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	7,0	6,0	6,0	7,0
	II: 35 °C / 60 °C		7,0	6,0	6,0	7,0
	III: 50 °C / 72 °C		7,0	6,0	6,0	7,0
Diamond-drilling (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,5	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,5	6,0	6,0
	III: 50 °C / 72 °C		6,5	6,0	6,0	6,0
Installation factors; Diamond-drilling						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,2	1,4		
BERNER multicomponent system MCS Diamond					Annex C15	
Performance Characteristic resistance to combined pull-out and concrete failure for BERNER BRA; working life 50 years						

Table C16.1: Characteristic resistance to combined pull-out and concrete failure for metric BERNER BRA in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years

BERNER BRA		M12	M16	M20	M24	
Combined pull-out and concrete cone failure						
Calculation diameter	d [mm]	12	16	20	25	
Uncracked concrete						
Characteristic bond resistance in uncracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	13,2	12,3	11,6	11,1
	II: 35 °C / 60 °C		11,3	10,5	9,8	9,0
	III: 50 °C / 72 °C		8,4	8,5	7,8	7,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	13,2	11,8	10,7	9,4
	II: 35 °C / 60 °C		10,5	9,0	8,3	7,5
	III: 50 °C / 72 °C		7,8	7,8	7,2	5,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,4			
Diamond-drilling (dry or wet concrete as well as water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm ²]	9,8	9,0	7,5	6,8
	II: 35 °C / 60 °C		9,8	9,0	7,5	6,8
	III: 50 °C / 72 °C		7,2	7,2	6,5	5,9
Installation factors; Diamond-drilling						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,4			
BERNER BRA		M12	M16	M20	M24	
Combined pull-out and concrete cone failure						
Calculation diameter	d [mm]	12	16	20	25	
Cracked concrete						
Characteristic bond resistance in cracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	6,4	5,2	5,2	5,2
	II: 35 °C / 60 °C		6,4	5,2	5,2	5,2
	III: 50 °C / 72 °C		6,4	5,2	5,2	5,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	5,2	4,2	3,9	3,9
	II: 35 °C / 60 °C		5,2	4,2	3,9	3,9
	III: 50 °C / 72 °C		5,2	3,9	3,9	3,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,2	1,4		
Diamond-drilling (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	5,6	3,9	3,9	4,6
	II: 35 °C / 60 °C		5,6	3,9	3,9	4,6
	III: 50 °C / 72 °C		5,6	3,9	3,9	4,6
Installation factors; Diamond-drilling						
Dry or wet concrete	γ_{inst}	[-]	1,0			
BERNER multicomponent system MCS Diamond					Annex C16	
Performance Characteristic resistance to combined pull-out and concrete failure for BERNER BRA; working life 100 years						

Table C17.1: Displacements for metric Anchor rods / Threaded rods

Anchor rod / Threaded rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Displacement-Factors for tension loading ¹⁾											
Uncracked or cracked concrete; Temperature range I, II, III											
δ_{N0} -Factor	[mm/(N/mm ²)]	0,07	0,08	0,09	0,09	0,10	0,11	0,11	0,12	0,12	0,13
$\delta_{N\infty}$ -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,19
Displacement-Factors for shear loading ²⁾											
Uncracked or cracked concrete; Temperature range I, II, III											
δ_{V0} -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V\infty}$ -Factor		0,27	0,22	0,18	0,16	0,14	0,11	0,10	0,09	0,08	0,07
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading						²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading					

Table C17.2: Displacements for metric BERNER MCS Plus I

BERNER MCS Plus I		M8	M10	M12	M16	M20
Displacement-Factors for tension loading ¹⁾						
Uncracked or cracked concrete; Temperature range I, II, III						
δ_{N0} -Factor	[mm/(N/mm ²)]	0,09	0,10	0,10	0,11	0,13
$\delta_{N\infty}$ -Factor		0,13	0,15	0,16	0,17	0,19
Displacement-Factors for shear loading ²⁾						
Uncracked or cracked concrete; Temperature range I, II, III						
δ_{V0} -Factor	[mm/kN]	0,12	0,09	0,08	0,07	0,05
$\delta_{V\infty}$ -Factor		0,18	0,14	0,12	0,10	0,08
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading				²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading		

BERNER multicomponent system MCS Diamond

Performance

Displacements for metric Anchor rods / Threaded rods and BERNER MCS Plus I

Annex C17

Table C18.1: Displacements for metric reinforcing bars

Nominal diameter of the bar ϕ		8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40	
Displacement-Factors for tension loading ¹⁾																			
Uncracked or cracked concrete; Temperature range I, II, III																			
δ_{N0} -Factor	[mm/(N/mm ²)]	0,07	0,08	0,09	0,09	0,10	0,10	0,11	0,11	0,12	0,12	0,12	0,13	0,13	0,13	0,14	0,14	0,15	
$\delta_{N\infty}$ -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,16	0,17	0,18	0,18	0,18	0,19	0,19	0,20	0,20	0,21	0,22	
Displacement-Factors for shear loading ²⁾																			
Uncracked or cracked concrete; Temperature range I, II, III																			
δ_{V0} -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,08	0,07	0,07	0,06	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,04	
$\delta_{V\infty}$ -Factor		0,27	0,22	0,18	0,16	0,14	0,12	0,11	0,10	0,09	0,09	0,08	0,08	0,07	0,07	0,06	0,06	0,05	
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading										²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading									

Table C18.2: Displacements for metric BERNER BRA

BERNER BRA	M12	M16	M20	M24
Displacement-Factors for tension loading ¹⁾				
Uncracked or cracked concrete; Temperature range I, II, III				
δ_{N0} -Factor	0,09		0,10	0,12
$\delta_{N\infty}$ -Factor	0,13		0,15	0,18
Displacement-Factors for shear loading ²⁾				
Uncracked or cracked concrete; Temperature range I, II, III				
δ_{V0} -Factor	0,12		0,09	0,06
$\delta_{V\infty}$ -Factor	0,18		0,14	0,09
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading			²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading	

BERNER multicomponent system MCS Diamond

Performance
Displacements for reinforcing bars and BERNER BRA

Annex C18

Table C19.1: Characteristic resistance to steel failure under tension loading for fractional Threaded rods part 1											
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"			
Characteristic resistance to steel failure under tension loading											
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	Property class	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9	148,9	195,4	246,0
			F1554, Grade 36		19,9	36,5	58,3	86,2	119,1	156,2	196,7
			F1554, Grade 55		25,8	47,3	75,3	111,5	154,0	202,0	254,4
			F1554, Grade 105		43,0	78,8	125,6	185,9	256,7	336,8	424,0
	Stainless steel R		A193, Grade B7		43,0	78,8	125,6	185,9	256,7	336,8	424,0
			F593, Alloy Group 2		34,4	63,0	100,5	126,4	174,5	229,0	288,3
			A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5	154,0	202,0	254,4
			A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3	195,1	255,9	322,2
Partial factors ¹⁾											
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	F568M, Class 5.8	[-]	1,50						
			F1554, Grade 36		1,94						
			F1554, Grade 55		1,64						
			F1554, Grade 105		1,43						
	Stainless steel R		A193, Grade B7		1,43						
			F593, Alloy Group 2		1,85	2,27					
			A193, Grade B8M, Class 1		3,00						
			A193, Grade B8M, Class 2B		1,52						
¹⁾ In absence of other national regulations.											
BERNER multicomponent system MCS Diamond									Annex C19		
Performance Characteristic resistance to steel failure under tension / shear loading for fractional Threaded rods part 1											

Table C20.1: Characteristic resistance to steel failure under shear loading for fractional Threaded rods part 2											
Threaded rod		3/8	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"			
Characteristic resistance to steel failure under shear loading											
without lever arm											
Characteristic resistance $V_{Rk,s}^0$	Steel zinc plated	Property class	F568M, Class 5.8	[kN]	15,0	27,4	43,7	64,7	89,3	117,2	147,6
			F1554, Grade 36		11,9	21,9	34,9	51,7	71,4	93,7	118,0
			F1554, Grade 55		12,9	23,6	37,6	55,7	77,0	101,0	127,2
			F1554, Grade 105		21,5	39,4	62,8	92,9	128,3	168,4	212,0
			A193, Grade B7		21,5	39,4	62,8	92,9	128,3	168,4	212,0
	Stainless steel R		F593, Alloy Group 2		17,2	31,5	50,2	63,2	87,2	114,5	144,1
			A193, Grade B8M, Class 1		12,9	23,6	37,6	55,7	77,0	101,0	127,2
			A193, Grade B8M, Class 2B		16,3	29,9	47,7	70,6	97,5	127,9	161,1
			Ductility factor k_6		[-]		1,0				
with lever arm											
Charact. resistance $M_{Rk,s}^0$	Steel zinc plated	Property class	F568M, Class 5.8	[Nm]	29,9	74,0	148,9	268,2	435,1	653,8	923,5
			F1554, Grade 36		23,9	59,2	119,1	214,5	348,0	522,9	738,6
			F1554, Grade 55		30,9	76,6	154,0	277,4	450,0	676,1	955,1
			F1554, Grade 105		51,5	127,6	256,8	462,4	750,0	1126,9	1591,9
			A193, Grade B7		51,5	127,6	256,8	462,4	750,0	1126,9	1591,9
	Stainless steel R		F593, Alloy Group 2		41,2	102,1	205,4	314,4	510,0	766,3	1082,5
			A193, Grade B8M, Class 1		30,9	76,6	154,0	277,4	450,0	676,1	955,1
			A193, Grade B8M, Class 2B		39,1	97,0	195,1	351,4	570,0	856,4	1209,8
			Partial factors ¹⁾								
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	F568M, Class 5.8	[-]	1,25						
			F1554, Grade 36		1,61						
			F1554, Grade 55		1,36						
			F1554, Grade 105		1,50						
			A193, Grade B7		1,50						
	Stainless steel R		F593, Alloy Group 2		1,54	1,89					
			A193, Grade B8M, Class 1		2,50						
			A193, Grade B8M, Class 2B		1,27						
			¹⁾ In absence of other national regulations.								
BERNER multicomponent system MCS Diamond									Annex C20		
Performance Characteristic resistance to steel failure under tension / shear loading for fractional Anchor rods / Threaded rods part 2											

Table C21.1: Characteristic resistance to steel failure under tension loading for fractional BERNER MCS Plus I part 1								
BERNER MCS Plus I	MCS Plus I	Screw		3/8"	1/2"	5/8"	3/4"	
Characteristic resistance to steel failure under tension loading								
Characteristic resistance with screw $N_{Rk,s}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9
			F1554, Grade 36		20,0	36,6	58,3	86,3
			F1554, Grade 55		25,8	47,3	75,3	111,5
			F1554, Grade 105		43,1	76,4	110,8	186,0
			A193, Grade B7		43,1	76,4	110,8	186,0
	Property class, Stainless steel R	70	F593, Alloy Group 2		34,4	63,0	100,4	126,4
			A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5
			A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3
	Partial factors ¹⁾							
Partial factors $\gamma_{Ms,N}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[-]	1,50			
			F1554, Grade 36		1,94			
			F1554, Grade 55		1,64			
			F1554, Grade 105		1,43	1,50		
			A193, Grade B7		1,43	1,50		
	Property class, Stainless steel R	70	F593, Alloy Group 2		1,85		2,27	
			A193, Grade B8M, Class 1		3,00			
			A193, Grade B8M, Class 2B		1,52			
	¹⁾ In absence of other national regulations.							
BERNER multicomponent system MCS Diamond						Annex C21		
Performance Characteristic resistance to steel failure under tension loading for fractional BERNER MCS Plus I part 1								

Table C22.1: Characteristic resistance to steel failure under shear loading for fractional BERNER MCS Plus I part 2								
BERNER MCS Plus I	MCS Plus I	Screw		3/8"	1/2"	5/8"	3/4"	
Characteristic resistance to steel failure under shear loading								
Without lever arm								
Characteristic resistance with $V^{0}_{Rk,s}$ screw	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[kN]	15,0	27,4	43,7	64,7
			F1554, Grade 36		11,9	21,9	34,9	51,7
			F1554, Grade 55		12,9	23,6	37,6	55,7
			F1554, Grade 105		21,5	39,4	62,8	92,9
			A193, Grade B7		21,5	39,4	62,8	92,9
	Property class, Stainless steel R	70	F593, Alloy Group 2		17,2	31,5	50,2	63,2
			A193, Grade B8M, Class 1		12,9	23,6	37,6	55,7
			A193, Grade B8M, Class 2B		16,3	29,9	47,7	70,6
	With lever arm							
Characteristic resistance with $M^{0}_{Rk,s}$ screw	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[Nm]	29,9	74,0	148,9	268,2
			F1554, Grade 36		23,9	59,2	119,1	214,5
			F1554, Grade 55		30,9	76,6	154,0	277,4
			F1554, Grade 105		51,5	127,6	256,8	462,4
			A193, Grade B7		51,5	127,6	256,8	462,4
	Property class, Stainless steel R	70	F593, Alloy Group 2		41,2	102,1	205,4	314,4
			A193, Grade B8M, Class 1		30,9	76,6	154,0	277,4
			A193, Grade B8M, Class 2B		39,1	97,0	195,1	351,4
	Partial factors ¹⁾							
Partial factors $\gamma_{Ms,V}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[-]	1,25			
			F1554, Grade 36		1,61			
			F1554, Grade 55		1,36			
			F1554, Grade 105		1,50			
			A193, Grade B7		1,50			
	Property class, Stainless steel R	70	F593, Alloy Group 2		1,54		1,89	
			A193, Grade B8M, Class 1		2,50			
			A193, Grade B8M, Class 2B		1,27			
	¹⁾ In absence of other national regulations.							
BERNER multicomponent system MCS Diamond							Annex C22	
Performance Characteristic resistance to steel failure under shear loading for fractional BERNER MCS Plus I part 2								

Table C23.1: Characteristic resistance to steel failure under tension / shear loading for fractional reinforcing bars

Rebar size	#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾
Characteristic resistance to steel failure under tension loading								
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{2)}$					
Characteristic resistance to steel failure under shear loading								
Without lever arm								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$k_6^{3)} \cdot A_s \cdot f_{uk}^{2)}$					
Ductility factor	k_7	[-]	1,0					
With lever arm								
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{2)}$					

1) Not allowed for hollow drill bit.

2) f_{uk} respectively shall be taken from the specifications of the reinforcing bar.

3) In accordance with EN 1992-4:2018 section 7.2.2.3.1:

$k_6 = 0,6$ for fasteners made of carbon steel with $f_{uk} \leq 500 \text{ N/mm}^2$,

$= 0,5$ for fasteners made of carbon steel with $500 \text{ N/mm}^2 < f_{uk} \leq 1000 \text{ N/mm}^2$,

$= 0,5$ for fasteners made of stainless steel.

BERNER multicomponent system MCS Diamond

Performance

Characteristic resistance to steel failure under tension / shear loading for reinforcing bars

Annex C23

Table C24.1: Characteristic resistance for concrete failure under tension / shear loading for fractional sizes																					
Size		All sizes																			
Characteristic resistance to concrete failure under tension loading																					
Installation factor		γ_{inst}	[-]		See Annex C25 to C34, C46 and C47																
Factors for the compressive strength of concrete > C20/25																					
Increasing factor ψ_c for cracked or uncracked concrete $\tau_{RK(X,Y)} = \psi_c \cdot \tau_{RK(C20/25)}$	C25/30		ψ_c	[-]	1,02																
	C30/37				1,04																
	C35/45				1,06																
	C40/50				1,07																
	C45/55				1,08																
	C50/60				1,09																
Splitting failure																					
Edge distance	$h / h_{ef} \geq 2,0$		$C_{cr,sp}$	[mm]	1,0 h_{ef}																
	$2,0 > h / h_{ef} > 1,3$				4,6 h_{ef} - 1,8 h																
	$h / h_{ef} \leq 1,3$				2,26 h_{ef}																
Spacing		$S_{cr,sp}$		2 $C_{cr,sp}$																	
Concrete cone failure																					
Uncracked concrete		$k_{ucr,N}$		[-]	11,0 ¹⁾																
Cracked concrete		$k_{cr,N}$			7,7 ¹⁾																
Edge distance		$C_{cr,N}$		[mm]	1,5 h_{ef}																
Spacing		$S_{cr,N}$			2 $C_{cr,N}$																
Factors for sustained tension loading																					
Temperature range			24 °C / 40 °C		35 °C / 60 °C		50 °C / 72 °C														
Factor		ψ_{sus}^0		[-]		0,77		0,60		0,48											
Factor		$\psi_{sus,100}^0$		[-]		0,77		0,60		0,71											
Characteristic resistance to concrete failure under shear loading																					
Installation factor		γ_{inst}		[-]		1,0															
Concrete pry-out failure																					
Factor for pry-out failure		k_8		[-]		2,0															
Concrete edge failure																					
Effective length of fastener in shear loading		l_f		[mm]		for $d_{nom} \leq 24$ mm: min (h_{ef} ; 12 d_{nom}) for $d_{nom} > 24$ mm: min (h_{ef} ; max (8 d_{nom} ; 300 mm))															
Calculation diameters																					
Size				3/8"		1/2"		5/8"		3/4"		7/8"		1"		1 1/8"					
Anchor rods and Threaded rods		d_{nom}		[mm]		9,5		12,7		15,9		19,1		22,2		25,4		28,6			
BERNER MCS Plus I		d_{nom}		[mm]		15,7		18,0		22,0		28,0		- ²⁾		- ²⁾		- ²⁾			
Rebar size						#3		#4		#5		#6		#7		#8		#9		#10	
Reinforcing bar		d_{nom}		[mm]		9,5		12,7		15,9		19,1		22,2		25,4		28,7		32,3	
¹⁾ Values only valid when using SI units. ²⁾ Anchor type not part of the assessment.																					
BERNER multicomponent system MCS Diamond										Annex C24											
Performance Characteristic resistance for concrete failure under tension / shear loading for fractional sizes																					

Table C25.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; uncracked concrete; working life 50 years												
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"				
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6		
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	20,0	18,6	17,7	16,8	16,2	15,8	15,3	
	II: 35 °C / 60 °C				18,0	18,0	17,0	16,0	15,0	15,0	14,0	
	III: 50 °C / 72 °C				17,0	17,0	16,0	15,0	14,0	14,0	13,0	
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	20,0	18,6	17,0	15,4	14,3	13,7	12,8	
	II: 35 °C / 60 °C				16,0	15,0	13,0	11,0	11,0	10,0	10,0	9,0
	III: 50 °C / 72 °C				14,0	14,0	12,0	11,0	10,0	9,0	9,0	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
<u>Diamond-drilling (dry or wet concrete)</u>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	14,4	13,3	12,3	11,8	11,3	10,8	10,3	
	II: 35 °C / 60 °C				15,0	13,0	12,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C				14,0	12,0	11,0	10,0	9,0	8,0	8,0	
<u>Diamond-drilling (water filled hole)</u>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	17,3	15,0	13,6	12,4	11,5	10,8	10,1	
	II: 35 °C / 60 °C				15,0	13,0	12,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C				14,0	12,0	11,0	10,0	9,0	8,0	8,0	
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
BERNER multicomponent system MCS Diamond									Annex C25			
Performance Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods; working life 50 years												

Table C26.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; cracked concrete; working life 50 years											
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"			
Combined pull-out and concrete cone failure											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6		
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,cr}$	[N/mm ²]	8,7	9,9	9,5	8,5	8,5	8,5	8,5
	II: 35 °C / 60 °C				8,7	9,9	9,5	8,5	8,5	8,5	8,5
	III: 50 °C / 72 °C				8,2	9,3	8,9	8,5	8,5	8,5	8,5
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,cr}$	[N/mm ²]	7,5	8,5	7,8	6,0	6,0	6,0	6,0
	II: 35 °C / 60 °C				7,5	8,5	7,8	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				7,0	8,0	7,3	6,0	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,2		1,4					
Diamond-drilling (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,cr}$	[N/mm ²]	7,0	7,0	6,0	6,0	7,0	7,0	7,0
	II: 35 °C / 60 °C				7,0	7,0	6,0	6,0	7,0	7,0	7,0
	III: 50 °C / 72 °C				7,0	7,0	6,0	6,0	7,0	7,0	7,0
Diamond-drilling (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,cr}$	[N/mm ²]	7,5	7,5	6,0	6,0	6,0	6,0	6,0
	II: 35 °C / 60 °C				7,5	7,5	6,0	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				7,0	7,0	6,0	6,0	6,0	6,0	6,0
Installation factors; Diamond-drilling											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,2		1,4					
BERNER multicomponent system MCS Diamond								Annex C26			
Performance Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods; working life 50 years											

Table C27.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; uncracked concrete; working life 100 years										
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
Combined pull-out and concrete cone failure										
Calculation diameter d		[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
Uncracked concrete										
Characteristic bond resistance in uncracked concrete C20/25										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	16,4	15,3	14,5	13,8	13,3	12,9	12,6
	II: 35 °C / 60 °C			13,5	13,5	12,8	12,0	11,3	11,3	10,5
	III: 50 °C / 72 °C			10,2	10,2	10,4	9,8	9,1	9,1	8,5
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)										
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	16,4	15,3	13,9	12,6	11,7	11,2	10,5
	II: 35 °C / 60 °C			12,0	11,3	9,8	8,3	8,3	7,5	6,8
	III: 50 °C / 72 °C			8,4	8,4	7,8	7,2	6,5	5,9	5,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit										
Dry or wet concrete		γ_{inst}	[-]	1,0						
Water filled hole				1,4						
Diamond-drilling (dry or wet concrete)										
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	11,8	10,8	10,1	9,7	9,3	8,8	8,5
	II: 35 °C / 60 °C			11,3	9,8	9,0	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C			8,4	7,2	7,2	6,5	5,9	5,2	5,2
Diamond-drilling (water filled hole)										
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	14,2	12,3	11,2	10,2	9,4	8,9	8,3
	II: 35 °C / 60 °C			11,3	9,8	9,0	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C			8,4	7,2	7,2	6,5	5,9	5,2	5,2
Installation factors; Diamond-drilling										
Dry or wet concrete		γ_{inst}	[-]	1,0						
Water filled hole				1,4						
BERNER multicomponent system MCS Diamond								Annex C27		
Performance Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; working life 100 years										

Table C28.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; cracked concrete; working life 100 years									
Threaded rod			3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
Combined pull-out and concrete cone failure									
Calculation diameter		d [mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6
Cracked concrete									
Characteristic bond resistance in cracked concrete C20/25									
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	7,0	7,5	7,2	6,9	6,8	6,5	6,3
	II: 35 °C / 60 °C		7,0	7,5	7,2	6,9	6,8	6,5	6,3
	III: 50 °C / 72 °C		6,6	7,1	6,8	6,4	6,4	6,1	6,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	6,0	6,5	5,9	4,9	4,8	4,6	4,4
	II: 35 °C / 60 °C		6,0	6,5	5,9	4,9	4,8	4,6	4,4
	III: 50 °C / 72 °C		5,6	6,1	5,5	4,5	4,5	4,3	4,3
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit									
Dry or wet concrete		γ_{inst} [-]	1,0						
Water filled hole			1,2			1,4			
Diamond-drilling (dry or wet concrete)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm ²]	6,0	5,6	3,9	3,9	4,6	4,6	4,6
	II: 35 °C / 60 °C		6,0	5,6	3,9	3,9	4,6	4,6	4,6
	III: 50 °C / 72 °C		6,0	5,6	3,9	3,9	4,6	4,6	4,6
Installation factors; Diamond-drilling									
Dry or wet concrete		γ_{inst} [-]	1,0						
BERNER multicomponent system MCS Diamond								Annex C28	
Performance Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; working life 100 years									

Table C29.1: Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I in hammer or diamond drilled holes; uncracked concrete; working life 50 years							
BERNER MCS Plus I		3/8"	1/2"	5/8"	3/4"		
Combined pull-out and concrete cone failure							
Calculation diameter	d	[mm]	15,7	18,0	22,0	28,0	
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$ [N/mm ²]	17,6	17,0	16,2	15,3
	II: 35 °C / 60 °C			14,0	14,0	13,0	12,0
	III: 50 °C / 72 °C			13,0	13,0	12,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$ [N/mm ²]	16,9	15,8	14,3	12,8
	II: 35 °C / 60 °C			12,0	12,0	11,0	10,0
	III: 50 °C / 72 °C			12,0	11,0	10,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete		γ_{inst}	[-]	1,0			
Water filled hole				1,4			
Diamond-drilling (dry or wet concrete)							
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$ [N/mm ²]	12,3	11,9	11,2	10,4
	II: 35 °C / 60 °C			12,0	11,0	10,0	9,0
	III: 50 °C / 72 °C			11,0	10,0	9,0	8,0
Diamond-drilling (water filled hole)							
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$ [N/mm ²]	13,6	12,6	11,4	10,2
	II: 35 °C / 60 °C			12,0	11,0	10,0	9,0
	III: 50 °C / 72 °C			11,0	10,0	9,0	8,0
Installation factors; Diamond-drilling							
Dry or wet concrete		γ_{inst}	[-]	1,0			
Water filled hole				1,4			
BERNER multicomponent system MCS Diamond					Annex C29		
Performance Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I; working life 50 years							

Table C30.1: Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I in hammer or diamond drilled holes; cracked concrete; working life 50 years							
BERNER MCS Plus I		3/8"	1/2"	5/8"	3/4"		
Combined pull-out and concrete cone failure							
Calculation diameter	d	[mm]	15,7	18,0	22,0	28,0	
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	6,0	6,0	7,0	7,0
	II: 35 °C / 60 °C			6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C			6,0	6,0	7,0	7,0
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	6,5	6,0	6,0	6,0
	II: 35 °C / 60 °C			6,5	6,0	6,0	6,0
	III: 50 °C / 72 °C			6,0	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2	1,4			
<u>Diamond-drilling (dry or wet concrete)</u>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	6,0	6,0	7,0	7,0
	II: 35 °C / 60 °C			6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C			6,0	6,0	7,0	7,0
<u>Diamond-drilling (water filled hole)</u>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	6,5	6,0	6,0	6,0
	II: 35 °C / 60 °C			6,5	6,0	6,0	6,0
	III: 50 °C / 72 °C			6,0	6,0	6,0	6,0
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2	1,4			
BERNER multicomponent system MCS Diamond						Annex C30	
Performance Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I; working life 50 years							

Table C31.1: Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years

BERNER MCS Plus I		3/8"	1/2"	5/8"	3/4"	
Combined pull-out and concrete cone failure						
Calculation diameter	d [mm]	15,7	18,0	22,0	28,0	
Uncracked concrete						
Characteristic bond resistance in uncracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	14,4	14,0	13,3	12,6
	II: 35 °C / 60 °C		10,5	10,5	9,8	9,0
	III: 50 °C / 72 °C		7,8	7,8	7,8	7,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	13,9	13,0	11,7	10,5
	II: 35 °C / 60 °C		9,0	9,0	8,3	7,5
	III: 50 °C / 72 °C		7,2	6,6	6,5	5,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,4			
Diamond-drilling (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	10,1	9,8	9,2	8,6
	II: 35 °C / 60 °C		9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,0	5,9	5,2
Diamond-drilling (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm ²]	11,2	10,3	9,3	8,4
	II: 35 °C / 60 °C		9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,0	5,9	5,2
Installation factors; Diamond-drilling						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,4			
Cracked concrete						
Characteristic bond resistance in cracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm ²]	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		5,1	4,8	4,6	4,6
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm ²]	5,5	4,8	3,9	3,9
	II: 35 °C / 60 °C		5,5	4,8	3,9	3,9
	III: 50 °C / 72 °C		5,1	4,8	3,9	3,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,2		1,4	
Diamond-drilling (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm ²]	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		5,1	4,8	4,6	4,6
Installation factors; Diamond-drilling						
Dry or wet concrete	γ_{inst}	[-]	1,0			
BERNER multicomponent system MCS Diamond					Annex C31	
Performance Characteristic resistance to combined pull-out and concrete failure for fractional BERNER MCS Plus I; working life 100 years						

Table C32.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; uncracked concrete; working life 50 years											
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾		
Combined pull-out and concrete cone failure											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
Uncracked concrete											
Characteristic bond resistance in uncracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$	[N/mm ²]	17,0	15,9	15,1	14,4	13,9	13,4	13,1	12,7
	II: 35 °C / 60 °C			15,0	15,0	14,0	13,0	13,0	12,0	12,0	12,0
	III 50 °C / 72 °C			14,0	14,0	13,0	12,0	12,0	11,0	11,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$	[N/mm ²]	17,0	15,9	14,5	13,2	12,3	11,6	10,5	10,2
	II: 35 °C / 60 °C			16,0	14,0	12,0	11,0	11,0	10,0	10,0	9,0
	III 50 °C / 72 °C			14,0	13,0	12,0	11,0	10,0	9,0	9,0	8,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete	γ_{inst}	[-]	1,0								
Water filled hole			1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$	[N/mm ²]	15,0	13,0	12,0	10,0	10,0	9,0	9,0	8,0
	II: 35 °C / 60 °C			15,0	13,0	12,0	10,0	10,0	9,0	9,0	8,0
	III 50 °C / 72 °C			14,0	12,0	11,0	10,0	9,0	9,0	8,0	8,0
Installation factors; Diamond-drilling											
Dry or wet concrete	γ_{inst}	[-]	1,0								
Water filled hole			1,4								
¹⁾ Not allowed for drilling with hollow drill bit.											
BERNER multicomponent system MCS Diamond									Annex C32		
Performance Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; working life 50 years											

Table C33.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years											
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾		
Combined pull-out and concrete cone failure											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	7,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C			7,0	8,0	8,0	8,0	8,0	8,0	8,0	
	III 50 °C / 72 °C			7,0	8,0	8,0	8,0	8,0	8,0	8,0	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	7,5	6,5	6,5	6,0	6,0	6,0	5,0	
	II: 35 °C / 60 °C			7,5	6,5	6,5	6,0	6,0	6,0	6,0	5,0
	III 50 °C / 72 °C			6,5	6,5	6,0	6,0	6,0	6,0	6,0	5,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete	γ_{inst}	[-]	1,0								
Water filled hole			1,2				1,4				
Diamond-drilling (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	6,0	6,0	7,0	7,0	5,0	
	II: 35 °C / 60 °C			7,0	7,0	6,0	6,0	7,0	7,0	7,0	5,0
	III 50 °C / 72 °C			7,0	7,0	6,0	6,0	7,0	7,0	7,0	5,0
Diamond-drilling (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	7,5	6,5	6,5	6,0	6,0	6,0	5,0	
	II: 35 °C / 60 °C			7,5	6,5	6,5	6,0	6,0	6,0	6,0	5,0
	III 50 °C / 72 °C			6,5	6,5	6,0	6,0	6,0	6,0	6,0	5,0
Installation factors; Diamond-drilling											
Dry or wet concrete	γ_{inst}	[-]	1,0								
Water filled hole			1,2				1,4				
¹⁾ Not allowed for drilling with hollow drill bit.											
BERNER multicomponent system MCS Diamond									Annex C33		
Performance Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; working life 50 years											

Table C34.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; uncracked and cracked concrete; working life 100 years												
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾			
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	14,0	13,0	12,4	11,9	11,4	11,0	10,8	10,5
	II:	35 °C / 60 °C			11,3	11,3	10,5	9,8	9,8	9,0	9,0	9,0
	III:	50 °C / 72 °C			8,4	8,4	8,5	7,8	7,8	7,2	7,2	7,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	13,9	13,0	11,9	11,0	10,1	9,5	8,6	8,5
	II:	35 °C / 60 °C			12,0	10,5	9,0	8,3	8,3	7,5	7,5	6,8
	III:	50 °C / 72 °C			8,4	7,8	7,8	7,2	6,5	5,9	5,9	5,2
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}		[-]		1,0						
Water filled hole		γ_{inst}		[-]		1,4						
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,ucr}$ [N/mm ²]	11,3	9,8	9,0	7,5	7,5	6,8	6,8	6,0
	II:	35 °C / 60 °C			11,3	9,8	9,0	7,5	7,5	6,8	6,8	6,0
	III:	50 °C / 72 °C			8,4	7,2	7,2	6,5	5,9	5,9	5,2	5,2
Installation factors												
Dry or wet concrete		γ_{inst}		[-]		1,0						
Water filled hole		γ_{inst}		[-]		1,4						
Cracked concrete												
Characteristic bond resistance in cracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,cr}$ [N/mm ²]	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
	II:	35 °C / 60 °C			6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
	III:	50 °C / 72 °C			6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,cr}$ [N/mm ²]	6,4	5,2	4,2	3,9	3,9	3,9	3,9	3,3
	II:	35 °C / 60 °C			6,4	5,2	4,2	3,9	3,9	3,9	3,9	3,3
	III:	50 °C / 72 °C			5,5	5,2	3,9	3,9	3,9	3,9	3,9	3,3
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}		[-]		1,0						
Water filled hole		γ_{inst}		[-]		1,2		1,4				
Diamond-drilling (dry or wet concrete)												
Temperature range	I:	24 °C / 40 °C		$\tau_{RK,100,cr}$ [N/mm ²]	6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
	II:	35 °C / 60 °C			6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
	III:	50 °C / 72 °C			6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
Installation factors												
Dry or wet concrete		γ_{inst}		[-]		1,0						
1) Not allowed for drilling with hollow drill bit.												
BERNER multicomponent system MCS Diamond										Annex C34		
Performance Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; uncracked and cracked concrete; working life 100 years												

Table C35.1: Displacements for fraction Threaded rods								
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
Displacement-Factors for tension loading ¹⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ_{N0} -Factor	[mm/(N/mm ²)]	0,08	0,09	0,10	0,11	0,11	0,12	0,13
$\delta_{N\infty}$ -Factor		0,12	0,13	0,15	0,16	0,17	0,19	0,19
Displacement-Factors for shear loading ²⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ_{V0} -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,05	0,05
$\delta_{V\infty}$ -Factor		0,22	0,18	0,14	0,11	0,10	0,08	0,07
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading				²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading				
Table C35.2: Displacements for fractional BERNER MCS Plus I								
BERNER MCS Plus I		3/8"	1/2"	5/8"	3/4"			
Displacement-Factors for tension loading ¹⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ_{N0} -Factor	[mm/(N/mm ²)]	0,10	0,10	0,11	0,13			
$\delta_{N\infty}$ -Factor		0,15	0,16	0,17	0,19			
Displacement-Factors for shear loading ²⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ_{V0} -Factor	[mm/kN]	0,09	0,08	0,07	0,05			
$\delta_{V\infty}$ -Factor		0,14	0,12	0,10	0,08			
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading				²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading				
BERNER multicomponent system MCS Diamond							Annex C35	
Performance Displacements for fractional Threaded rods and fractional BERNER MCS Plus I								

Table C36.1: Displacements for fractional reinforcing bars									
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10
Displacement-Factors for tension loading ¹⁾									
Uncracked or cracked concrete; Temperature range I, II, III									
δ_{N0} -Factor	[mm/(N/mm ²)]	0,08	0,09	0,10	0,11	0,11	0,12	0,13	0,13
$\delta_{N\infty}$ -Factor		0,12	0,13	0,15	0,16	0,17	0,18	0,19	0,20
Displacement-Factors for shear loading ²⁾									
Uncracked or cracked concrete; Temperature range I, II, III									
δ_{V0} -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V\infty}$ -Factor		0,22	0,18	0,14	0,11	0,10	0,09	0,08	0,07
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading					²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading				
BERNER multicomponent system MCS Diamond								Annex C36	
Performance Displacements for fractional reinforcing bars									

Table C37.1: Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods and Threaded rods under seismic action performance category C1

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30		
Characteristic resistance to steel failure under tension loading ¹⁾												
Anchor rods and Threaded rods, performance category C1 ²⁾												
Characteristic resistance $N_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
			5.8	29,0(26,8)	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			8.8	46,4(42,8)	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	29,0	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			70	40,6	59,0	80,5	109,9	171,5	212,1	247,1	321,3	392,7
			80	46,4	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
Characteristic resistance to steel failure under shear loading without lever arm ¹⁾												
Anchor rods, performance category C1 ²⁾												
Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	13,9(12,8)	20,2	27,6	37,6	58,8	72,7	84,7	110,1	134,6
			5.8	17,4(16,0)	25,2	34,5	47,1	73,5	90,9	105,9	137,7	168,3
			8.8	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	14,5	21,0	28,7	39,2	61,2	75,7	88,2	114,7	140,2
			70	20,3	29,5	40,2	54,9	85,7	106,0	123,5	160,6	196,3
			80	23,2	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
Threaded rods, performance category C1 ²⁾												
Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	9,7(9,0)	14,1	19,3	26,3	41,1	50,9	59,3	77,1	97,2
			5.8	12,1(11,2)	17,7	24,1	32,9	51,4	63,6	74,1	96,3	117,8
			8.8	16,2(15,0)	23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	10,1	14,7	20,1	27,4	42,8	53,0	61,7	80,3	98,1
			70	14,2	20,6	28,1	38,4	60,0	74,2	86,4	112,4	137,4
			80	16,2	23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0
¹⁾ 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. ²⁾ Partial factors for performance category C1 or C2 see table C39.1; for Anchor rods the factor for steel ductility is 1,0.												
BERNER multicomponent system MCS Diamond										Annex C37		
Performance Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods / Threaded rods under seismic action performance category C1												

Table C38.1: Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods and Threaded rods under seismic action performance category C2														
Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30				
Characteristic resistance to steel failure under tension loading														
Anchor rods and Threaded rods, performance category C2 ¹⁾														
Characteristic resistance $N_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	- ²⁾	30,3	- ²⁾	56,5	88,2	- ²⁾	141,2	- ²⁾	- ²⁾		
			5.8	- ²⁾	37,9	- ²⁾	70,6	110,2	- ²⁾	176,5	- ²⁾	- ²⁾		
			8.8	- ²⁾	60,6	- ²⁾	113,0	176,4	- ²⁾	282,4	- ²⁾	- ²⁾		
	Stainless steel R and high corrosion resistant steel HCR		50	- ²⁾	37,9	- ²⁾	70,6	110,2	- ²⁾	176,5	- ²⁾	- ²⁾		
			70	- ²⁾	53,1	- ²⁾	98,9	154,3	- ²⁾	247,1	- ²⁾	- ²⁾		
			80	- ²⁾	60,6	- ²⁾	113,0	176,4	- ²⁾	282,4	- ²⁾	- ²⁾		
Characteristic resistance to steel failure under shear loading without lever arm														
Anchor rods, performance category C2 ¹⁾														
Characteristic resistance $V_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	- ²⁾	13,3	- ²⁾	28,2	45,2	- ²⁾	77,0	- ²⁾	- ²⁾		
			5.8	- ²⁾	16,6	- ²⁾	35,3	56,5	- ²⁾	96,3	- ²⁾	- ²⁾		
			8.8	- ²⁾	22,2	- ²⁾	47,1	75,4	- ²⁾	128,4	- ²⁾	- ²⁾		
	Stainless steel R and high corrosion resistant steel HCR		50	- ²⁾	13,9	- ²⁾	29,4	47,1	- ²⁾	80,3	- ²⁾	- ²⁾		
			70	- ²⁾	19,4	- ²⁾	41,2	66,0	- ²⁾	112,4	- ²⁾	- ²⁾		
			80	- ²⁾	22,2	- ²⁾	47,1	75,4	- ²⁾	128,4	- ²⁾	- ²⁾		
Threaded rods, performance category C2 ¹⁾														
Characteristic resistance $V_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	- ²⁾	13,3	- ²⁾	26,3	41,1	- ²⁾	59,3	- ²⁾	- ²⁾		
			5.8	- ²⁾	16,6	- ²⁾	32,9	51,4	- ²⁾	74,1	- ²⁾	- ²⁾		
			8.8	- ²⁾	22,2	- ²⁾	43,9	68,6	- ²⁾	98,8	- ²⁾	- ²⁾		
	Stainless steel R and high corrosion resistant steel HCR		50	- ²⁾	13,9	- ²⁾	27,4	42,8	- ²⁾	61,7	- ²⁾	- ²⁾		
			70	- ²⁾	19,4	- ²⁾	38,4	60,0	- ²⁾	86,4	- ²⁾	- ²⁾		
			80	- ²⁾	22,2	- ²⁾	43,9	68,6	- ²⁾	98,8	- ²⁾	- ²⁾		
¹⁾ Partial factors for performance category C2 see table C39.1; for Anchor rods the factor for steel ductility is 1,0. ²⁾ No performance assessed.														
Table C38.2: Characteristic resistance to steel failure under tension / shear loading for metric reinforcing bars (B500B) under seismic action performance category C1														
Nominal diameter of the bar ϕ		10	12	14	16	18	20	22	24	25	26	28	30	32
Characteristic resistance to steel failure under tension loading														
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1 ¹⁾														
Characteristic resistance	$N_{Rk,s,C1}$ [kN]	42,3	61,0	83,1	108,5	137,1	169,5	205,2	244,0	265,1	286,2	332,6	381,2	434,1
Characteristic resistance to steel failure under shear loading, without lever arm														
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1 ¹⁾														
Characteristic resistance	$V_{Rk,s,C1}$ [kN]	14,8	21,3	29,1	37,9	48,0	59,3	71,8	85,4	92,7	100,1	116,4	133,4	151,9
¹⁾ Partial factors for performance category C1 see table C39.1.														
BERNER multicomponent system MCS Diamond												Annex C38		
Performance Characteristic resistance to steel failure for metric Anchor rods / Threaded rods and reinforcing bars under seismic action performance category C2 and C1 respectively														

Table C39.1: Partial factors for metric Anchor rods, Threaded rods and reinforcing bars (B500B) under seismic action performance category C1 or C2

Anchor rod / Threaded rod		M10 to M30	
Nominal diameter of the bar ϕ		10 to 32	
Tension loading, steel failure ¹⁾			
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class 4.8	1,50
		5.8	1,50
Partial factor $\gamma_{Ms,N}$	Stainless steel R and high corrosion resistant steel HCR	Property class 8.8	1,50
		50	2,86
		70	1,87 / Anchor rod HCR: 1,50 ²⁾
		80	1,60
	Reinforcing bar	B500B	1,40
Shear loading, steel failure ¹⁾			
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class 4.8	1,25
		5.8	1,25
Partial factor $\gamma_{Ms,V}$	Stainless steel R and high corrosion resistant steel HCR	Property class 8.8	1,25
		50	2,38
		70	1,56 / Anchor rod HCR: 1,25 ²⁾
		80	1,33
	Reinforcing bar	B500B	1,50
<p>¹⁾ In absence of other national regulations.</p> <p>²⁾ Only admissible for high corrosion resistant steel HCR, according to Table A6.1.</p>			
BERNER multicomponent system MCS Diamond			Annex C39
Performance Partial factors for metric Anchor rods, Threaded rods, and reinforcing bars (B500B) under seismic action performance category C1 or C2			

Table C40.1: Characteristic resistance for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C1; working life 50 years

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30	
Characteristic bond resistance, combined pull-out and concrete cone failure											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	7,0	7,0	6,7	6,0	5,7	6,7	6,7	6,7	
	II: 35 °C / 60 °C		7,0	7,0	6,7	6,0	5,7	6,7	6,7	6,7	6,7
	III: 50 °C / 72 °C		7,0	7,0	6,7	5,7	5,7	6,7	6,7	6,7	6,7
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	7,5	7,5	6,5	5,7	5,7	5,7	5,7	5,7	
	II: 35 °C / 60 °C		7,5	7,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7
	III: 50 °C / 72 °C		6,8	6,8	6,5	5,7	5,7	5,7	5,7	5,7	5,7
Installation factors											
Tension loading											
Dry or wet concrete		γ_{inst}	[-]		1,0						
Water filled hole			1,2			1,4					

Table C40.2: Characteristic resistance for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C1; working life 100 years

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30	
Characteristic bond resistance, combined pull-out and concrete cone failure											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	5,5	5,3	5,8	4,6	4,6	5,4	5,3	5,1	5,0
	II: 35 °C / 60 °C		5,5	5,3	5,8	4,6	4,6	5,4	5,3	5,1	5,0
	III: 50 °C / 72 °C		5,5	5,3	5,5	4,3	4,3	5,0	5,0	4,8	4,8
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	5,9	5,6	5,7	4,3	4,6	4,6	4,5	4,3	4,2
	II: 35 °C / 60 °C		5,9	5,6	5,7	4,3	4,6	4,6	4,5	4,3	4,2
	III: 50 °C / 72 °C		5,3	5,1	5,3	4,3	4,3	4,3	4,2	4,1	4,0
Installation factors											
Tension loading											
Dry or wet concrete		γ_{inst}	[-]		1,0						
Water filled hole			1,2			1,4					

BERNER multicomponent system MCS Diamond		Annex C40
Performance Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for Anchor rods / Threaded rods; working life 50 and 100 years		

Table C41.1: Characteristic resistance for combined pull-out and concrete failure for metric reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 50 years

Nominal diameter of the bar		ϕ	10	12	14	16	18	20	22	24	25	26	28	30	32	
Characteristic bond resistance, combined pull-out and concrete cone failure																
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8	
	II: 35 °C / 60 °C		7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8
	III: 50 °C / 72 °C		7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8	
	II: 35 °C / 60 °C		7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8	
	III: 50 °C / 72 °C		6,5	6,5	5,8	5,8	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8	
Installation factors																
Tension loading																
Dry or wet concrete		γ_{inst}	[-]		1,0											
Water filled hole		γ_{inst}	[-]		1,2					1,4						

Table C41.2: Characteristic resistance for combined pull-out and concrete failure for metric reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 100 years

Nominal diameter of the bar		ϕ	10	12	14	16	18	20	22	24	25	26	28	30	32	
Characteristic bond resistance, combined pull-out and concrete cone failure																
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	4,4	3,1	
	II: 35 °C / 60 °C		6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	4,4	4,4	3,1
	III: 50 °C / 72 °C		6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	4,4	4,4	3,1
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm ²]	6,4	5,2	4,2	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	
	II: 35 °C / 60 °C		6,4	5,2	4,2	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	
	III: 50 °C / 72 °C		5,5	5,2	3,8	3,8	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	
Installation factors																
Tension loading																
Dry or wet concrete		γ_{inst}	[-]		1,0											
Water filled hole		γ_{inst}	[-]		1,2					1,4						

BERNER multicomponent system MCS Diamond		Annex C41
Performance Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for and reinforcing bars; working life 50 and 100 years		

Table C42.1: Characteristic resistance and displacements for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C2; working life 50 and 100 years

Anchor rod / Threaded rod		M12	M16	M20	M24	
Characteristic bond resistance, combined pull-out and concrete cone failure						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Tem- per- a- ture range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$ [N/mm ²]	3,5	5,8	5,0	3,1
	II: 35 °C / 60 °C		3,5	5,8	5,0	3,1
	III: 50 °C / 72 °C		3,3	5,5	4,7	2,9
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Tem- per- a- ture range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$ [N/mm ²]	3,5	5,8	5,0	3,1
	II: 35 °C / 60 °C		3,5	5,8	5,0	3,1
	III: 50 °C / 72 °C		3,3	5,5	4,7	2,9
Installation factors						
Tension loading						
Dry or wet concrete		γ_{inst}	[-]	1,0		
Water filled hole				1,2	1,4	
Displacement-Factors for tension loading ¹⁾						
$\delta_{N,C2(50\%)-Factor}$		[mm/(N/mm ²)]	0,09	0,10	0,11	0,12
$\delta_{N,C2(100\%)-Factor}$			0,15	0,17	0,17	0,18
Displacement-Factors for shear loading ²⁾						
$\delta_{V,C2(50\%)-Factor}$		[mm/kN]	0,18	0,10	0,07	0,06
$\delta_{V,C2(100\%)-Factor}$			0,25	0,14	0,11	0,09
1) Calculation of effective displacement: $\delta_{N,C2(50\%)} = \delta_{N,C2(50\%)-Factor} \cdot \tau$ $\delta_{N,C2(100\%)} = \delta_{N,C2(100\%)-Factor} \cdot \tau$ τ = acting bond strength under tension loading			2) Calculation of effective displacement: $\delta_{V,C2(50\%)} = \delta_{V,C2(50\%)-Factor} \cdot V$ $\delta_{V,C2(100\%)} = \delta_{V,C2(100\%)-Factor} \cdot V$ V = acting shear loading			
BERNER multicomponent system MCS Diamond					Annex C42	
Performance Characteristic resistance for combined pull-out and concrete failure under seismic action (C2) for Anchor rods and Threaded rods; working life 50 and 100 years						

Table C43.1: Characteristic resistance to steel failure under tension or shear loading for fractional Threaded rods under seismic action performance category C1

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
Characteristic resistance to steel failure under tension loading										
Threaded rods, performance category C1 ¹⁾										
Characteristic resistance $N_{Rk,s,C1}$	Steel zinc plated	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9	148,9	195,4	246,0
		F1554, Grade 36		19,9	36,5	58,3	86,2	119,1	156,2	196,7
		F1554, Grade 55		25,8	47,3	75,3	111,5	154,0	202,0	254,4
		F1554, Grade 105		43,0	78,8	125,6	185,9	256,7	336,8	424,0
	Stainless steel R	A193, B7		43,0	78,8	125,6	185,9	256,7	336,8	424,0
		F593, Alloy Group 2		34,4	63,0	100,5	126,4	174,5	229,0	288,3
		A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5	154,0	202,0	254,4
		A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3	195,1	255,9	322,2
Characteristic resistance to steel failure under shear loading without lever arm										
Threaded rods, performance category C1 ¹⁾										
Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	F568M, Class 5.8	[kN]	12,0	21,9	34,9	51,7	53,6	70,3	88,5
		F1554, Grade 36		8,3	15,3	24,4	36,2	50,0	65,6	82,6
		F1554, Grade 55		10,3	18,9	30,1	44,6	46,2	60,6	76,3
		F1554, Grade 105		15,0	27,6	43,9	65,0	89,8	117,8	148,4
	Stainless steel R	A193, B7		17,2	31,5	50,2	74,3	77,0	101,0	127,2
		F593, Alloy Group 2		13,7	25,2	40,2	50,5	52,3	68,7	86,5
		A193, Grade B8M, Class 1		10,3	18,9	30,1	44,6	46,2	60,6	76,3
		A193, Grade B8M, Class 2B		13,1	23,9	38,1	56,5	58,5	76,7	96,6
¹⁾ Partial factors for performance category C1 or see table C45.1										
BERNER multicomponent system MCS Diamond								Annex C43		
Performance Characteristic resistance to steel failure under tension or shear loading for Anchor rods and Threaded rods under seismic action (performance category C1)										

Table C44.1: Characteristic resistance to **steel failure** under tension / shear loading for **fractional reinforcing bars** under seismic action performance category **C1**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10	
Characteristic resistance to steel failure under tension loading										
Reinforcing bar materials, performance category C1 ¹⁾										
Characteristic resistance $N_{Rk,s,C1}$	A615 (A767), Grade 40	[kN]	29,3	53,3	82,3	117,4	160,0	210,9	266,8	338,8
	A615 (A767), Grade 60		44,0	80,0	123,4	176,2	240,1	316,4	400,2	508,2
	A615 (A767), Grade 75		48,9	88,9	137,2	195,8	266,8	351,6	444,7	564,6
	A706 (A767), Grade 60		39,1	71,1	109,7	156,6	213,4	281,3	355,7	451,7
Characteristic resistance to steel failure under shear loading, without lever arm										
Reinforcing bar materials, performance category C1 ¹⁾										
Characteristic Resistance $V_{Rk,s,C1}$	A615 (A767), Grade 40	[kN]	13,0	23,6	36,5	52,1	71,0	93,6	118,4	150,4
	A615 (A767), Grade 60		16,3	29,6	45,6	65,2	88,8	117,0	148,0	188,0
	A615 (A767), Grade 75		18,1	32,9	50,7	72,4	98,7	130,1	164,5	208,9
	A706 (A767), Grade 60		14,4	26,3	40,6	57,9	78,9	104,0	131,6	167,1
<p>¹⁾ Partial factors for performance category C1 see table C45.1.</p>										
BERNER multicomponent system MCS Diamond								Annex C44		
Performance		Characteristic resistance to steel failure under tension/shear loading for fractional reinforcing bars under seismic action (performance category C1)								

Table C45.1: Partial factors for fractional Threaded rods and reinforcing bars under seismic action performance category C1

Threaded rod		3/8" to 5/8"	3/4" to 1 1/8"	
Rebar size		#3 to #10		
Tension loading, steel failure ¹⁾				
Partial factor $\gamma_{Ms,N}$	Threaded rod, zinc plated	F568M, Class 5.8	1,50	
		F1554, Grade 36	1,94	
		F1554, Grade 55	1,64	
		F1554, Grade 105	1,43	
		A193, B7	1,43	
	Threaded rod, stainless steel R	F593, Alloy Group 2	1,85	2,27
		A193, Grade B8M, Class 1	[-]	
		A193, Grade B8M, Class 2B	3,00	
	Reinforcing bar	A615 (A767), Grade 40	1,52	
		A615 (A767), Grade 60	1,80	
		A615 (A767), Grade 75	1,80	
		A706 (A767), Grade 60	1,60	
	Shear loading, steel failure ¹⁾			
	Partial factor $\gamma_{Ms,V}$	Threaded rod, zinc plated	F568M, Class 5.8	1,25
F1554, Grade 36			1,61	
F1554, Grade 55			1,36	
F1554, Grade 105			1,50	
A193, B7			1,50	
Threaded rod, stainless steel R		F593, Alloy Group 2	1,54	1,89
		A193, Grade B8M, Class 1	[-]	
		A193, Grade B8M, Class 2B	2,50	
Reinforcing bar		A615 (A767), Grade 40	1,27	
		A615 (A767), Grade 60	1,50	
		A615 (A767), Grade 75	1,50	
		A706 (A767), Grade 60	1,33	
¹⁾ In absence of other national regulations.				
BERNER multicomponent system MCS Diamond			Annex C45	
Performance Partial factors for Threaded rods and reinforcing bars under seismic action performance category C1 (fractional size)				

Table C46.1: Characteristic resistance for combined pull-out and concrete failure for fractional Threaded rods in hammer drilled holes under seismic action performance category C1; working life 50 years

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
Characteristic bond resistance, combined pull-out and concrete cone failure									
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	8,5	9,0	9,1	8,5	8,5	8,2	7,1
	II: 35 °C / 60 °C		8,5	9,0	9,1	8,5	8,5	8,2	7,1
	III: 50 °C / 72 °C		8,0	8,5	8,5	8,5	8,5	8,2	7,1
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	7,4	7,7	7,5	6,0	6,0	5,8	5,0
	II: 35 °C / 60 °C		7,4	7,7	7,5	6,0	6,0	5,8	5,0
	III: 50 °C / 72 °C		6,9	7,3	7,0	6,0	6,0	5,8	5,0
Installation factors									
Tension loading									
Dry or wet concrete		γ_{inst}	[-]	1,0					
Water filled hole				1,2		1,4			

Table C46.2: Characteristic resistance for combined pull-out and concrete failure for fractional Threaded rods in hammer drilled holes under seismic action performance category C1; working life 100 years

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
Characteristic bond resistance, combined pull-out and concrete cone failure									
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	6,8	6,8	6,9	6,9	6,8	6,3	5,3
	II: 35 °C / 60 °C		6,8	6,8	6,9	6,9	6,8	6,3	5,3
	III: 50 °C / 72 °C		6,4	6,4	6,5	6,4	6,4	5,9	5,1
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	5,9	5,9	5,7	4,9	4,8	4,4	3,7
	II: 35 °C / 60 °C		5,9	5,9	5,7	4,9	4,8	4,4	3,7
	III: 50 °C / 72 °C		5,5	5,5	5,3	4,5	4,5	4,2	3,6
Installation factors									
Tension loading									
Dry or wet concrete		γ_{inst}	[-]	1,0					
Water filled hole				1,2		1,4			

BERNER multicomponent system MCS Diamond

Performance

Characteristic resist. for combined pull-out and concrete failure under seismic action (C1) for Anchor rods / Threaded rods; working life 50 and 100 years (fractional size)

Annex C46

Table C47.1: Characteristic resistance for combined pull-out and concrete failure for fractional reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 50 years

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾	
Characteristic bond resistance, combined pull-out and concrete cone failure										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
	II: 35 °C / 60 °C		6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
	III: 50 °C / 72 °C		6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)										
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	6,6	5,7	5,7	5,3	5,3	5,3	5,3	4,4
	II: 35 °C / 60 °C		6,6	5,7	5,7	5,3	5,3	5,3	5,3	4,4
	III: 50 °C / 72 °C		5,7	5,7	5,3	5,3	5,3	5,3	5,3	4,4
Installation factors										
Tension loading										
Dry or wet concrete		γ_{inst} [-]	1,0							
Water filled hole			1,2			1,4				

¹⁾ Not allowed for drilling with hollow drill bit.

Table C47.2: Characteristic resistance for combined pull-out and concrete failure for fractional reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 100 years

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾	
Characteristic bond resistance, combined pull-out and concrete cone failure										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
	II: 35 °C / 60 °C		5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
	III: 50 °C / 72 °C		5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)										
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm ²]	5,6	4,6	3,7	3,4	3,4	3,4	3,4	2,9
	II: 35 °C / 60 °C		5,6	4,6	3,7	3,4	3,4	3,4	3,4	2,9
	III: 50 °C / 72 °C		4,9	4,6	3,4	3,4	3,4	3,4	3,4	2,9
Installation factors										
Tension loading										
Dry or wet concrete		γ_{inst} [-]	1,0							
Water filled hole			1,2			1,4				

¹⁾ Not allowed for drilling with hollow drill bit.

BERNER multicomponent system MCS Diamond

Performance

Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for and reinforcing bars; working life 50 and 100 years (fractional size)

Annex C47

Table C48.1: Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 1

Fire resistance to steel failure under tension and shear loading

Anchor rod / Threaded rod ISO 898-1 Class 5.8 and higher	R30			R60		
	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	1,6	1,6	1,7	1,2	1,2	1,2
M10	3,3	3,3	4,2	2,3	2,3	3,0
M12	5,8	5,8	9,1	4,0	4,0	6,2
M14	6,6	6,6	12,0	4,6	4,6	8,4
M16	10,9	10,9	15,1	7,5	7,5	11,2
M20	11,1	11,1	29,4	8,2	8,2	21,8
M22	13,7	13,7	40,5	10,1	10,1	30,0
M24	16,0	16,0	50,9	11,8	11,8	37,7
M27	20,8	20,8	75,5	15,4	15,4	56,0
M30	25,4	25,4	102,0	18,8	18,8	75,6

Anchor rod / Threaded rod ISO 898-1 Class 5.8 and higher	R90			R120		
	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,8	0,8	0,8	0,6	0,6	0,6
M10	1,4	1,4	1,8	0,9	0,9	1,1
M12	2,1	2,1	3,3	1,2	1,2	1,9
M14	2,7	2,7	4,9	1,7	1,7	3,2
M16	4,0	4,0	7,3	2,3	2,3	5,3
M20	5,3	5,3	14,2	3,9	3,9	10,4
M22	6,6	6,6	19,5	4,8	4,8	14,3
M24	7,7	7,7	24,6	5,6	5,6	18,0
M27	10,0	10,0	36,4	7,3	7,3	26,7
M30	12,3	12,3	49,3	9,0	9,0	36,1

BERNER multicomponent system MCS Diamond

Performance

Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 1

Annex C48

Table C49.1: Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 2

Anchor rods R and HCR and Threaded rod, EN ISO 3506-1 Class A4-50 and higher	R30			R60		
	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	0,7	0,7	0,7	0,5	0,5	0,6
M10	1,4	1,4	1,8	1,1	1,1	1,5
M12	2,5	2,5	3,9	2,1	2,1	3,9
M14	3,4	3,4	6,2	2,8	2,8	6,2
M16	4,7	4,7	9,9	3,9	3,9	9,9
M20	7,3	7,3	19,4	6,1	6,1	19,4
M22	9,0	9,0	26,7	7,5	7,5	26,7
M24	10,5	10,5	33,6	8,8	8,8	28,0
M27	13,7	13,7	49,9	11,4	11,4	41,6
M30	16,8	16,8	67,4	14,0	14,0	56,2
Anchor rods R and HCR and Threaded rod, EN ISO 3506-1 Class A4-50 and higher	R90			R120		
	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,4	0,4	0,4	0,3	0,3	0,3
M10	0,9	0,9	1,2	0,8	0,8	1,0
M12	1,6	1,6	3,9	1,3	1,3	3,9
M14	2,3	2,3	6,2	1,8	1,8	6,2
M16	3,1	3,1	9,9	2,5	2,5	9,9
M20	4,9	4,9	19,4	3,9	3,9	19,4
M22	6,0	6,0	26,7	4,8	4,8	26,7
M24	7,0	7,0	22,4	5,6	5,6	17,9
M27	9,1	9,1	33,2	7,3	7,3	26,6
M30	11,2	11,2	44,9	8,9	8,9	35,9
BERNER multicomponent system MCS Diamond						Annex C49
Performance Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 2						

Table C50.1: Fire resistance to steel failure under tension and shear loading for fractional Threaded rods						
Fire resistance to steel failure under tension and shear loading						
Threaded rod	R30			R60		
Steel zinc plated; detailed materials see Table A7.1, part No 2 ¹⁾	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
3/8"	2,7	2,7	3,2	1,9	1,9	2,3
1/2"	5,9	5,9	9,6	4,1	4,1	6,7
5/8"	6,7	6,7	13,7	4,9	4,9	10,1
3/4"	9,7	9,7	24,3	7,2	7,2	18,0
7/8"	13,5	13,5	39,4	10,0	10,0	29,2
1"	17,7	17,7	59,3	13,1	13,1	43,9
1 1/8"	22,3	22,3	83,8	16,5	16,5	62,2
Threaded rod	R90			R120		
Steel zinc plated; detailed materials see Table A7.1, part No 2 ¹⁾	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
3/8"	1,1	1,1	1,4	0,8	0,8	0,9
1/2"	2,3	2,3	3,7	1,3	1,3	2,2
5/8"	3,6	3,6	7,5	2,2	2,2	4,5
3/4"	4,7	4,7	11,7	3,4	3,4	8,6
7/8"	6,5	6,5	19,0	4,7	4,7	13,9
1"	8,5	8,5	28,6	6,2	6,2	20,9
1 1/8"	10,7	10,7	40,5	7,9	7,9	29,6
Threaded rod	R30			R60		
Stainless steel R; detailed materials see Table A7.1, part No 2	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
3/8"	1,1	1,1	1,4	0,9	0,9	1,1
1/2"	2,7	2,7	4,4	2,2	2,2	3,7
5/8"	4,3	4,3	8,9	3,6	3,6	7,4
3/4"	6,4	6,4	16,1	5,4	5,4	13,4
7/8"	8,9	8,9	26,1	7,4	7,4	21,7
1"	11,7	11,7	39,2	9,7	9,7	32,6
1 1/8"	14,7	14,7	55,4	12,3	12,3	46,2
Threaded rod	R90			R120		
Stainless steel R; detailed materials see Table A7.1, part No 2	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
3/8"	0,7	0,7	0,9	0,6	0,6	0,7
1/2"	1,8	1,8	2,9	1,4	1,4	2,3
5/8"	2,9	2,9	5,9	2,3	2,3	4,7
3/4"	4,3	4,3	10,7	3,4	3,4	8,5
7/8"	5,9	5,9	17,4	4,7	4,7	13,9
1"	7,8	7,8	26,1	6,2	6,2	20,9
1 1/8"	9,8	9,8	36,9	7,8	7,8	29,5
¹⁾ No performance assessed for ASTM F1554 Grade 36.						
BERNER multicomponent system MCS Diamond					Annex C50	
Performance Fire resistance to steel failure under tension and shear loading for fractional Threaded rods						

Characteristic bond resistance for cracked concrete under fire conditions for metric and fractional Anchor rods and Threaded rods in hammer drilled holes with standard drill bit or hollow drill bit

The characteristic bond resistance for cracked concrete under fire conditions for a given temperature.

$\tau_{RK,fi}(\theta)$ has to be calculated by the following equation:

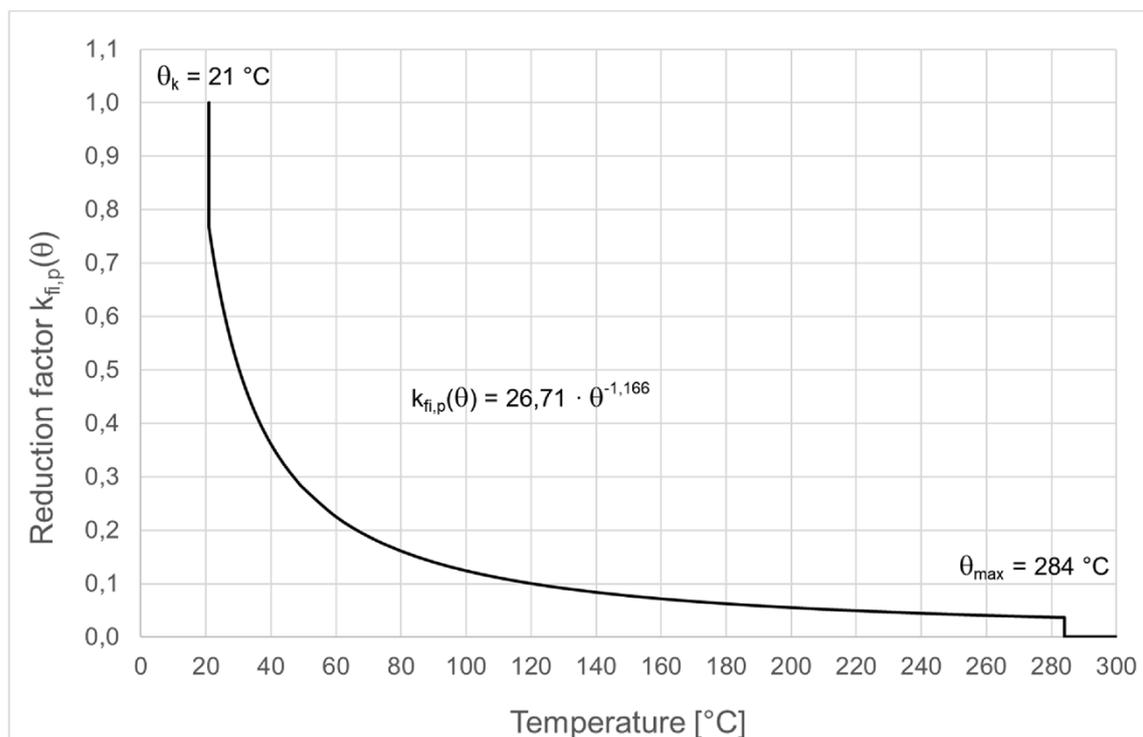
$$\tau_{RK,fi}(\theta) = k_{fi,p}(\theta) \cdot \tau_{RK,cr,C20/25}$$

- θ = Temperature in °C in the mortar layer,
- $\tau_{RK,fi}(\theta)$ = Characteristic bond resistance for cracked concrete under fire exposure for a given temperature in N/mm² for concrete classes C20/25 to C50/60.
- $k_{fi,p}(\theta)$ = Reduction factor under fire conditions.
- $\tau_{RK,cr,C20/25}$ = Characteristic bond resistance for cracked concrete C20/25 in N/mm², given in Table C5.1, Table C6.1, Table C26.1 or Table C28.1, respectively.

Anchor rods or Threaded rods
 If: $\theta > 21 \text{ °C}$ $k_{fi,p}(\theta) = 26,71 \cdot \theta^{-1,166} \leq 1,0$
 If: $\theta > \theta_{max} = 284 \text{ °C}$ $k_{fi,p}(\theta) = 0$

see Figure C51.1

Figure C51.1: Graph of reduction factor $k_{fi,p}(\theta)$ for Anchor rods or Threaded rods.



BERNER multicomponent system MCS Diamond

Performance

Characteristic bond resistance under fire conditions for anchor rods and threaded rods

Annex C51