Deutsches Institut für Bautechnik
Approval body for construction products and types of construction
Bautechnisches Prüfamt
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European Technical Assessment — ETA-10/0473 of 4 September 2018

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 High-Performance Anchor BHA, BHA-I
Product family to which the construction product belongs	Mechanical fasteners for use in concrete
Manufacturer	Berner Trading Holding GmbH Bernerstraße 6 74653 Künzelsau DEUTSCHLAND
Manufacturing plant	Berner Herstellwerk 6 Berner manufacturing plant 6
This European Technical Assessment contains	23 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 330232-00-0601

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Specific Part

1 Technical description of the product

The Berner High-Performance Anchor BHA, BHA-I is an anchor made of galvanised steel (sizes with external diameter 10, 12, 15, 18, 24, 28 and 32, sizes with internal thread 12/M6 I, 12/M8 I, 15/M10 I and 15/M12 I) or stainless steel (sizes with external diameter 10, 12, 15, 18 and 24, sizes with internal thread 12/M6 I, 12/M8 I, 15/M10 I and 15/M12 I) which is placed into a drilled hole and anchored by torque-controlled expansion.

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 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 and C 2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 3 and C 4
Displacements (static and quasi-static loading)	See Annex C 9 and C 10
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 7, C 8 and C 10

3.2 Safety in case of fire (BWR 2)

Essential characteristics	**Performance**
Reaction to fire	Class A1
Resistance to fire	See Annex C 5 and C 6

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 330232-00-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

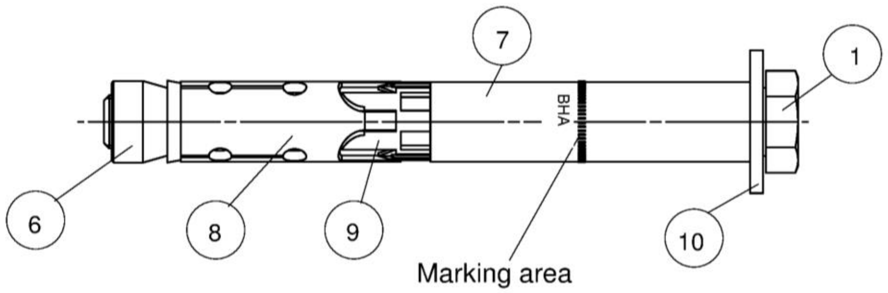
5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

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 4 September 2018 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

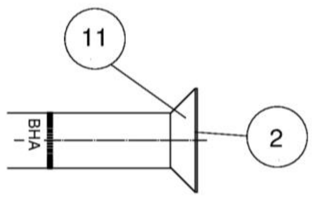
beglaubigt:
Baderschneider



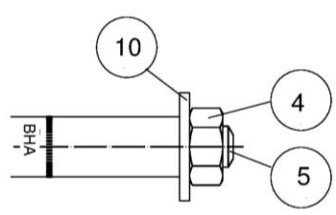
Type hexagon screw **S**
BHA 10 - 32 S
BHA 10 - 24 S A4

Product label, example: BHA 15/25 A4

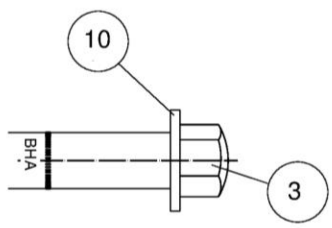
- BHA — Type of fastener
- 15/25 — Nominal drill hole diameter/max. thickness of fixture (t_{fix})
- A4 — Identification A4



Type countersunk screw **SK**
BHA 10 - 18 SK
BHA 10 - 18 SK A4

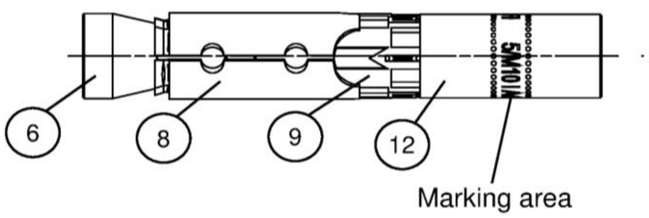


Type hexagon nut **B**
BHA 10 - 32 B
BHA 10 - 24 B A4



Type cap nut **H**
BHA 10 - 24 H
BHA 10 - 24 H A4

1	Hexagon screw	5	Threaded rod	9	Plastic sleeve
2	Countersunk screw	6	Cone nut	10	Washer
3	Cap nut	7	Distance sleeve	11	Conical washer
4	Hexagon nut	8	Expansion sleeve	12	Internal thread socket



Type internal threaded anchor I
BHA 12 M6-I or M8-I
BHA 15 M10-I or M12-I

Product label, example: BHA 12/M8-I A4

- BHA — Type of fastener
- 12/M8-I — Nominal drill hole diameter / size of internal thread
- A4 — Identification A4

(Fig. not to scaled)

Berner High-Performance Anchor BHA, BHA-I	**Annex A 1**
Product description Anchor types BHA, BHA A4, BHA-I, BHA-I A4	

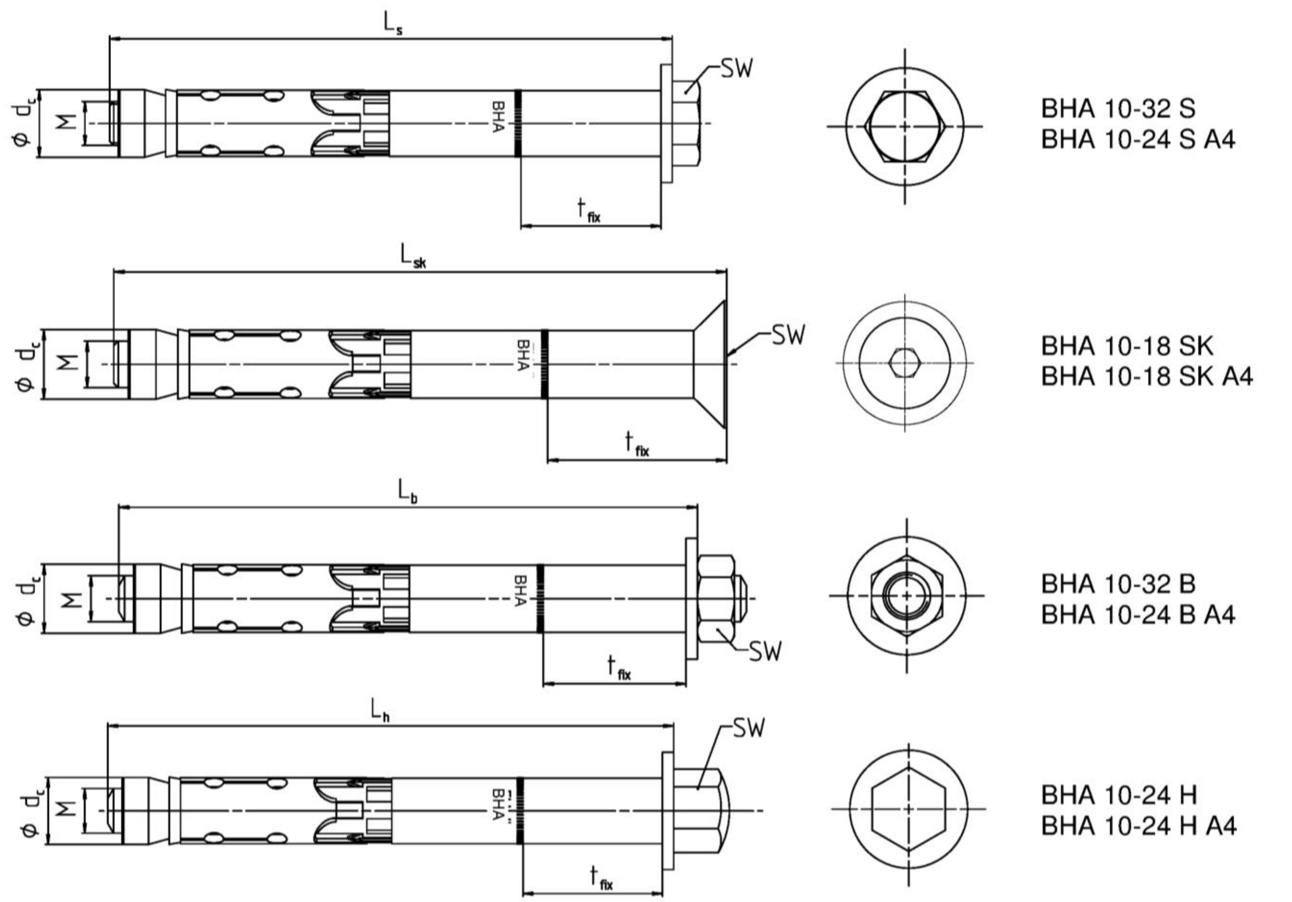


Table A2.1: Dimensions [mm] BHA and BHA A4

Anchor type			BHA 10	BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Thread		M	6	8	10	12	16	20	24
Diameter cone nut		d_c	10	12	14,8	17,8	23,7	27,5	31,5
Wrench size SW	BHA-S, -B		10	13	17	19	24	30	36
	BHA-SK[1)]		4	5	6	8	-		
	BHA-S, -B		13	17	17	19	24	-	
	BHA-S A4, -B A4, -H A4		10	13	17	19	24	-	
	BHA-SK A4[1)]		4	5	6	8	-		
t_{fix} BHA-S, -B, -H + BHA-S A4, -B A4, -H A4		min	0	0	0	0	0	0	0
t_{fix} BHA-SK + BHA-SK A4 [2)]		min	5	6	6	8	-	-	-
Length of screw / bolt	L_s, L_h, L_b (- t_{fix})	≥	49	74	89	99	124	149	174
Length of countersunk screw	L_{sk} (- t_{fix})	≥	54	79	95	107	-		

1) Internal hexagon
2) The influence of the thickness of fixture to the characteristic resistance for shear loads, steel failure without lever arm is taken into account, see tables C3.1, C7.1 and C7.2

(Fig. not to scaled)

Berner High-Performance Anchor BHA, BHA-I

Product description
Anchor types and dimensions BHA, BHA A4

Annex A 2

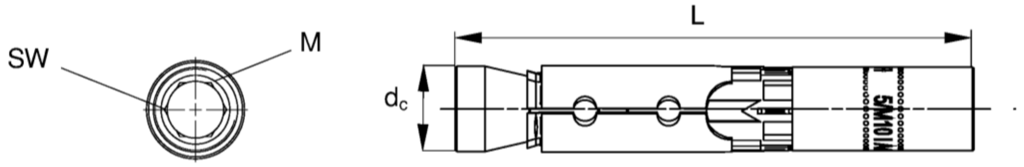


Table A3.1: Anchor Dimensions [mm] BHA-I and BHA-I A4

Anchor type BHA-I, BHA-I A4		**BHA 12/M6 I**	**BHA 12/M8 I**	**BHA 15/M10 I**	**BHA 15/M12 I**
Thread	M	6	8	10	12
Diameter cone nut	d_c	12	12	14,8	14,8
Wrench size internal hexagon	SW	6	8	6	8
Anchor length	L	77,5	77,5	90	90

Table A3.2: Material BHA and BHA A4

No.	Designation	BHA	BHA A4
1	Hexagon screw	Steel class 8.8; EN ISO 898-1:2013 [1)]	Class 80 EN ISO 3506:2010
2	Countersunk screw	Steel class 8.8; EN ISO 898-1:2013 [1)]	
3	Cap nut	Steel class 8 [1)]	
4	Hexagon nut	Steel class 8 [1)]	
5	Threaded rod	Steel $f_{uk} \geq 800$ N/mm²; $f_{yk} \geq 640$ N/mm² [1)]	Steel $f_{uk} \geq 800$ N/mm²; $f_{yk} \geq 640$ N/mm²
6	Cone nut	Steel EN 10277:2008 [1)]	Class 80, EN ISO 3506:2010
7	Distance sleeve	Steel EN 10305:2016 [1)]	EN 10088:2014
8	Expansion sleeve	Steel EN 10139:2016/ EN 10277:2008 [1)]	EN 10088:2014
9	Plastic sleeve	ABS (plastic)	
10	Washer	Steel EN 10139:2016 [1)]	EN 10088:2014
11	Conical washer	Steel EN 10277:2008 [1)]	EN 10088:2014

[1)] Galvanised according to EN ISO 4042:2001, ≥ 5 µm

Table A3.3: Material BHA-I and BHA-I A4

No.	Designation	BHA-I	BHA-I A4
6	Cone nut	Steel EN 10277:2008 [1)]	Strength class ≥ 70 EN ISO 3506:2010
8	Expansion sleeve	Steel EN 10139:2016 / EN 10277:2008 [1)]	EN 10088:2014
9	Plastic sleeve	ABS (plastic)	
12	Internal thread bolt	Steel EN 10277:2008 [1)] $f_{uk} \geq 750$ N/mm², $f_{yk} \geq 600$ N/mm²	EN 10088:2014 $f_{uk} \geq 750$ N/mm², $f_{yk} \geq 600$ N/mm²
Requirements for fixing elements		Steel strength class 5.8, 6.8 or 8.8 EN ISO 898-1:2013 [1)]	Steel strength class A50, A70 or A80 EN ISO 3506:2010 1.4362, 1.4401, 1.4404, 1.4571, 1.4529

[1)] Galvanised according to EN ISO 4042:2001, ≥ 5 µm

Berner High-Performance Anchor BHA, BHA-I

Product description
Anchor types and dimensions BHA-I, BHA I-A4
Materials

Annex A 3

Specifications of intended use

Anchorages subject to:

Size		10	12	15	18	24	28	32
High Performance Anchor	BHA	✓	✓	✓	✓	✓	✓	✓
	BHA A4	✓	✓	✓	✓	✓	-	-
High Performance Anchor BHA-I, BHA-I A4		-	✓	✓	-	-	-	-
Static and quasi-static loads		✓	✓	✓	✓	✓	✓	✓
Cracked and uncracked concrete		✓	✓	✓	✓	✓	✓	✓
Fire exposure		✓	✓	✓	✓	✓	✓	✓
Seismic performance category	C1 BHA	-	✓	✓	✓	✓	✓	✓
	C1 BHA A4	-	✓	✓	✓	✓	-	-
	C2 BHA	-	✓	✓	✓	✓	✓	✓
	C2 BHA A4	-	✓	✓	✓	✓	-	-

Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres (cracked or uncracked) according to EN 206:2013
- Strength classes C20/25 to C50/60 according to EN 206:2013

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (BHA, BHA A4, BHA-I, BHA-I A4)
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal conditions, if no particular aggressive conditions exist (BHA A4, BHA-I A4)

Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used)

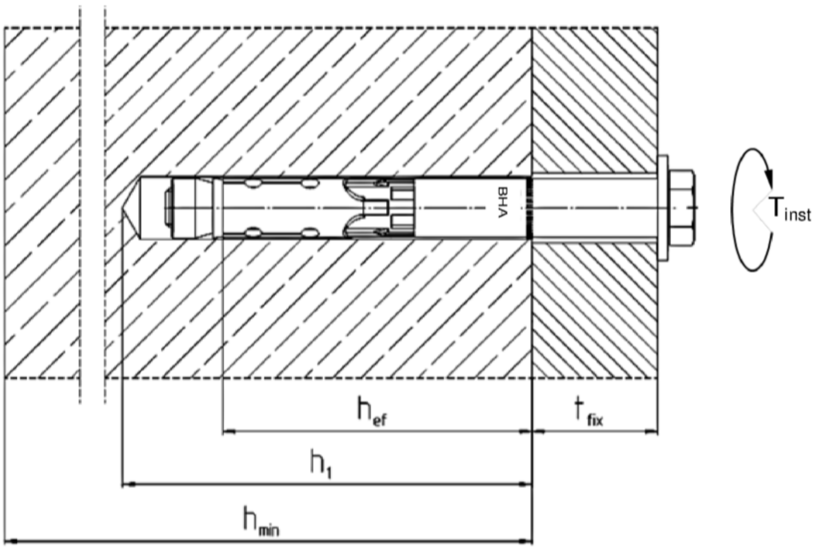
Design:

- Anchorages are to be designed under the responsibility of an engineer experienced in anchorages and concrete work
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.)
- Design of fastenings according to FprEN 1992-4: 2016 and EOTA Technical Report TR 055

Installation:

- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- Hammer or hollow drilling according to Annex B5 and B6
- In case of aborted hole: New hole must be drilled at a minimum distance of twice the depth of the aborted hole or closer, if the hole is filled with a high strength mortar and only if the hole is not in the direction of the oblique tensile or shear load

Berner High-Performance Anchor BHA, BHA-I	Annex B 1
Intended use Specifications	



h_{ef} = Effective embedment depth
t_{fix} = Thickness of the fixture
h_1 = Depth of drill hole to deepest point
h_{min} = Minimum thickness of concrete member
T_{inst} = Required setting torque

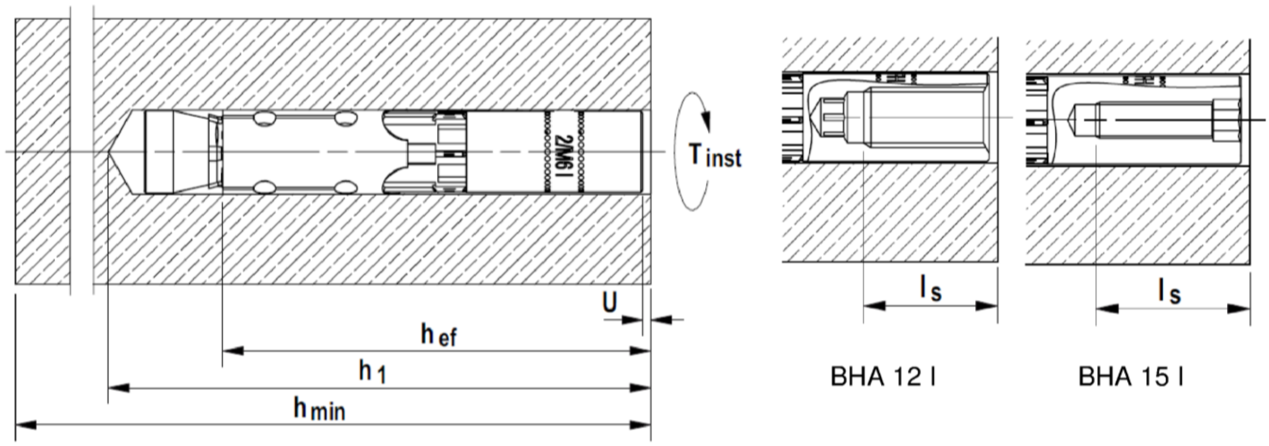
Table B2.1: Installation parameters BHA and BHA A4

<table>
<tr><th colspan="3">Anchor type BHA-S,-SK,-B,-H and
BHA-S A4, BHA-SK A4, BHA-B A4, BHA H A4</th><th>BHA 10</th><th>BHA 12</th><th>BHA 15</th><th>BHA 18</th><th>BHA 24</th><th>BHA 28</th><th>BHA 32</th></tr>
<tr><td>Nominal drill hole diameter</td><td>d_0</td><td rowspan="4">[mm]</td><td>10</td><td>12</td><td>15</td><td>18</td><td>24</td><td>28</td><td>32</td></tr>
<tr><td>Maximum diameter of drill bit</td><td>$d_{cut} \leq$</td><td>10,45</td><td>12,50</td><td>15,50</td><td>18,50</td><td>24,55</td><td>28,55</td><td>32,70</td></tr>
<tr><td>Depth of drill hole to deepest</td><td>$h_1 \geq$</td><td>55</td><td>80</td><td>90</td><td>105</td><td>125</td><td>155</td><td>180</td></tr>
<tr><td>Diameter of clearance hole</td><td>$d_f \leq$</td><td>12</td><td>14</td><td>17</td><td>20</td><td>26</td><td>31</td><td>35</td></tr>
<tr><td>Diameter of counter sunk</td><td>BHA-SK</td><td rowspan="2">[mm]</td><td>18</td><td>22</td><td>25</td><td>32</td><td rowspan="2" colspan="3">-</td></tr>
<tr><td>Depth of counter sunk, 90°</td><td>BHA-SK A4</td><td>5,0</td><td>5,8</td><td>5,8</td><td>8,0</td></tr>
<tr><td rowspan="6">Required setting torque</td><td>BHA-S</td><td rowspan="6">T_{inst} [Nm]</td><td rowspan="4">10</td><td>22,5</td><td>40</td><td rowspan="4">80</td><td>160</td><td>180</td><td>200</td></tr>
<tr><td>BHA-B</td><td>17,5</td><td>38</td><td>120</td><td>180</td><td>200</td></tr>
<tr><td>BHA-H</td><td rowspan="2">22,5</td><td rowspan="2">40</td><td>90</td><td colspan="2">-</td></tr>
<tr><td>BHA-SK</td><td colspan="3">-</td></tr>
<tr><td>BHA-S A4, BHA-B A4
BHA-H A4</td><td>15</td><td rowspan="2">25</td><td rowspan="2">40</td><td rowspan="2">100</td><td>160</td><td colspan="2">-</td></tr>
<tr><td>BHA-SK A4</td><td>10</td><td colspan="3">-</td></tr>
</table>

Berner High-Performance Anchor BHA, BHA-I

Intended use
Installation parameters BHA, BHA A4

Annex B 2



h_{ef} = Effective embedment depth
h_1 = Depth of drill hole to deepest point
h_{min} = Minimum thickness of conrete member
T_{inst} = Required setting torque
U = Required gap after torqueing
l_s = Screw-in depth

Table 3.1: Installation parameters BHA-I and BHA-I A4

Anchor type BHA-I and BHA-I A4				**BHA 12/M6 I**	**BHA 12/M8 I**	**BHA 15/M10 I**	**BHA 15/M12 I**
Nominal drill hole diameter	d_0		[mm]	12		15	
Maximum bit diameter	d_{cut}	≤	[mm]	12,50		15,50	
Depth of drill hole	h_1	≥	[mm]	85		95	
Diameter of clearance hole	d_f	≤	[mm]	7	9	12	14
Required gap after torquing[1)]	U		[mm]	3 - 5			
Required setting torque[1)]	T_{inst}		[Nm]	15		25	
Minimum screw-in depth	l_s	≥	[mm]	11 + U	13 + U	10 + U	12 + U
Maximum screw-in depth	l_s	≤	[mm]	20 + U			
Maximum torque on fixture in combination with screws and threaded rods strength class ≥ 5.8 resp. ≥ A50	max T_{fix}		[Nm]	3	8	15	20

[1)] At least one of the requirements concerning the gap U or the required setting torque T_{inst} have to be fulfilled

Berner High-Performance Anchor BHA, BHA-I

Intended use
Installation parameters BHA-I, BHA-I A4

Annex B 3

Table B4.1: Minimum thickness of concrete member, minimum spacing and minimum edge distances BHA, BHA A4

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4			**BHA 10**	**BHA 12**	**BHA 15**	**BHA 18**	**BHA 24**	**BHA 28**	**BHA 32**
Minimum thickness of concrete member	h_{min}	[mm]	80	120	140	160	200	250	300
Minimum spacing, cracked concrete	s_{min}	[mm]	40	50	60	70	80	100	120
	for c ≥		40	80	120	140	180	200	260
Minimum edge distance, cracked concrete	c_{min}		40	50	60	70	80	100	120
	for s ≥		40	80	120	160	200	220	280
Minimum spacing, uncracked concrete	s_{min}	[mm]	40	60	70	80	100	120	160
	for c ≥		70	100	100	160	200	220	360
Minimum edge distance, uncracked concrete	c_{min}		40	60	70	80	100	120	180
	for s ≥		70	100	140	200	220	240	380

Intermediate values may be calculated by linear interpolation

Table B4.2: Minimum thickness of concrete member, minimum spacing and minimum edge distances BHA-I, BHA-I A4

Anchor type BHA-I and BHA-I A4			**BHA 12/M6 I** **BHA 12/M8 I**	**BHA 15/M10 I** **BHA 15/M12 I**
Minimum thickness of concrete member	h_{min}	[mm]	125	150
Minimum spacing, cracked concrete	s_{min}	[mm]	50	60
	for c ≥		80	120
Minimum edge distance, cracked concrete	c_{min}		50	60
	for s ≥		80	120
Minimum spacing, uncracked concrete	s_{min}	[mm]	60	70
	for c ≥		100	100
Minimum edge distance, uncracked concrete	c_{min}		60	70
	for s ≥		100	140

Intermediate values may be calculated by linear interpolation.

Table B4.3: Minimum spacings and minimum edge distances of anchors under **fire exposure** for tension and shear loads

Anchor type			BHA 10	BHA 12 BHA 12-I	BHA 15 BHA 15-I	BHA 18	BHA 24	BHA 28	BHA 32
Spacing	$s_{cr,N}$	[mm]	4x h_{ef}						
	s_{min}		40	50	60	70	80	100	120
Edge distance	$c_{cr,N}$		2 x h_{ef}						
	c_{min}		c_{min} = 2 x h_{ef} , for fire exposure from more than one side c_{min} ≥ 300 mm						

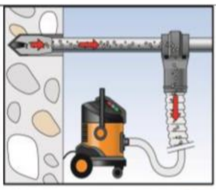
Berner High-Performance Anchor BHA, BHA-I

Intended use
Minimum thickness of concrete member, minimum spacings and min. edge distances
Minimum spacings and minimum edge distances of anchors under fire exposure

Annex B 4

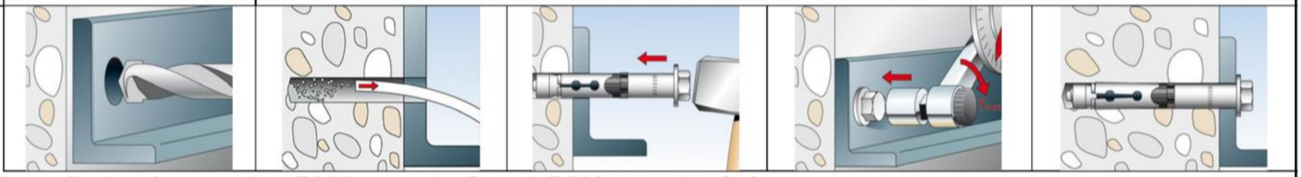
Installation instruction for the Berner High-Performance anchor
BHA 10 - BHA 32 and BHA 10 A4 - BHA 24 A4

Hollow drilling

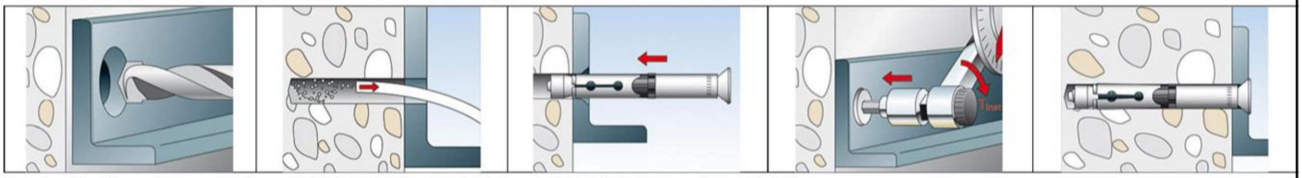


Continue with step 3, 4 and 5

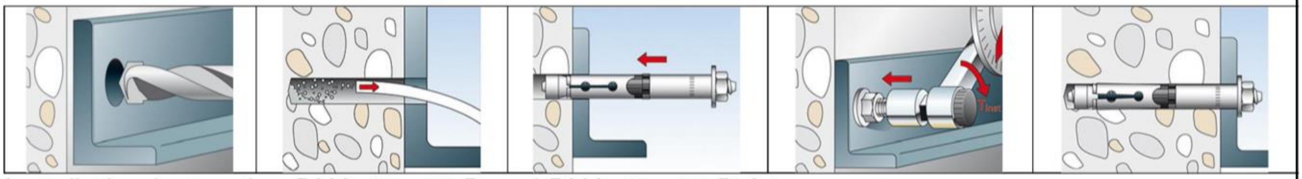
Hammer drilling



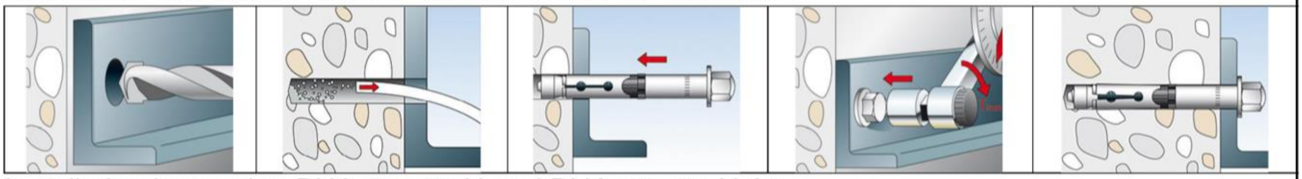
Installation instruction BHA 10 - 32 S and BHA 10 - 24 S A4



Installation instruction BHA 10 - 18 SK and BHA 10 - 18 SK A4



Installation instruction BHA 10 - 32 B and BHA 10 - 24 B A4

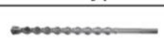


Installation instruction BHA 10 - 24 H and BHA 10 - 24 H A4

Step	1	2	3	4	5

Step	Description	
1	Create drill hole with hammer drill	Create drill hole with hollow drill and vacuum cleaner
2	Clean the hole	-
3	Set the fastener	
4	Apply T_{inst}	
5	Installed fastener	

Types of drill bits

Hammer drill 

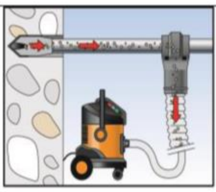
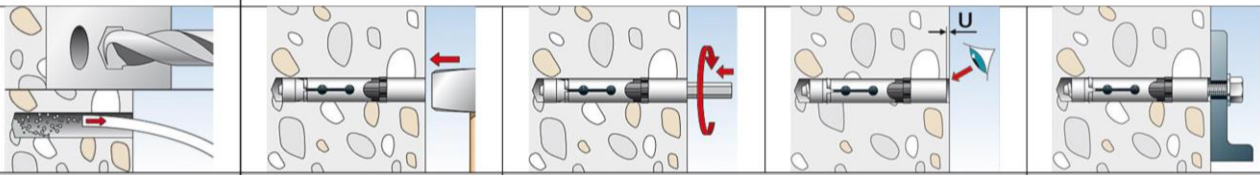
Hollow drill 

Berner High-Performance Anchor BHA, BHA-I

Intended use
Installation instructions BHA, BHA A4

Annex B 5

Installation instruction for the Berner High-Performance anchor internal thread
BHA-I and BHA-I A4

Hollow drilling		Continue with step 2, 3, and 4		
Hammer drilling				
Step	**1**	**2**	**3**	**4**

Step	Description	
1	Create drill hole with hammer drill, clean drill hole	Create drill hole with hollow drill and vacuum cleaner
2	Hammering in the anchor flushed with the surface of the concrete	
3	Tighten the anchor. The included hexagon bit in the package should be used. Other tightening methods are allowed. Tighten the anchor in the concrete until the gap U is 3 - 5 mm or the required setting torque T_{inst} is reached. Only one of the above requirements has to be fulfilled.	
4	Attach the fixture and use a suitable screw or anchor rod. The length of the screw or anchor rod should be determined depending on the thickness of fixture t_{fix}, admissible tolerances, and available thread length $l_{s,max}$ and $l_{s,min}$ including the gap U. Tighten the screw with the torque ≤ max T_{fix} (max T_{fix} see table B3.1)	

Types of drill bits	
Hammer drill	
Hollow drill	

Berner High-Performance Anchor BHA, BHA-I

Intended use
Installation instructions BHA-I, BHA-I A4

Annex B 6

Table C1.1: Performance characteristics of **tension resistance** under static and quasi-static loads **for BHA and BHA A4**

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4			**BHA 10**	**BHA 12**	**BHA 15**	**BHA 18**	**BHA 24**	**BHA 28**[3)]	**BHA 32**[3)]
Steel failure									
BHA	$N_{Rk,s}$	[kN]	16,1	29,3	46,4	67,4	125,3	195,8	282,0
BHA A4-B, -H	$N_{Rk,s}$	[kN]	16,1	29,3	46,4	67,4	125,3	-	
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,5						
BHA A4-S,-SK	$N_{Rk,s}$	[kN]	16,1	29,3	46,4	67,4	125,3	-	
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,6						
Pullout failure									
Characteristic resistance in cracked concrete C20/25 BHA and BHA A4	$N_{Rk,p}$	[kN]	7,5	12	16	25	2)		
Characteristic resistance in uncracked concrete C20/25 BHA	$N_{Rk,p}$	[kN]	2)						
Characteristic resistance in uncracked concrete C20/25 BHA A4	$N_{Rk,p}$	[kN]	2)	20	2)			–	
Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete	ψ_c	C25/30	1,12						
		C30/37	1,22						
		C35/45	1,32						
		C40/50	1,41						
		C45/55	1,50						
		C50/60	1,58						
Installation factor	γ_{inst}	[-]	1,0						
Concrete cone failure and splitting failure									
Effective embedment depth	h_{ef}	[mm]	40	60	70	80	100	125	150
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7[4)]						
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0[4)]						
Spacing	$s_{cr,N}$	[mm]	120	180	210	240	300	375	450
Edge distance	$c_{cr,N}$	[mm]	60	90	105	120	150	187,5	225
Spacing (splitting)	$s_{cr,sp}$	[mm]	190	300	320	340	380	480	570
Edge distance (splitting)	$c_{cr,sp}$	[mm]	95	150	160	170	190	240	285

1) In absence of other national regulations
2) Pullout failure not relevant
3) Only valid for zinc-plated version
4) Based on concrete strength as cylinder strength

Berner High-Performance Anchor BHA, BHA-I

Performances
Performance characteristics of tension resistance for BHA and BHA A4

Annex C 1

Table C2.1: Performance characteristics of **tension resistance** under static and quasi-static loads **for BHA-I and BHA-I A4**

Anchor type BHA-I and BHA-I A4			BHA 12/M6 I	BHA 12/M8 I	BHA 15/M10 I	BHA 15/M12 I
Steel failure						
Anchor in combination with screw / threaded rod of galvanised steel complying with DIN EN ISO 898						
Strength class 5.8	$N_{Rk,s}$	[kN]	10	19	29	43
Strength class 6.8	$N_{Rk,s}$	[kN]	12	23	35	44
Strength class 8.8	$N_{Rk,s}$	[kN]	16	27	44	44
Partial factor for steel failure	γ_{Ms} 1)	[-]	1,5			
Anchor in combination with screw / threaded rod of stainless steel complying with DIN EN ISO 3506						
Screw/thread strength class A50	$N_{Rk,s}$	[kN]	10	19	29	43
Partial factor for steel failure	γ_{Ms} 1)	[-]	2,86			
Screw/thread strength class A70	$N_{Rk,s}$	[kN]	14	26	41	54
Partial factor for steel failure	γ_{Ms} 1)	[-]	1,87			
Screw/thread strength class A80	$N_{Rk,s}$	[kN]	16	29	46	46
Partial factor for steel failure	γ_{Ms} 1)	[-]	1,60			
Pullout failure						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	9		12	
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	20		2)	
Increasing factors for $N_{Rk,p}$ for cracked and uncracked concrete	ψ_c	C25/30	1,12			
		C30/37	1,22			
		C35/45	1,32			
		C40/50	1,41			
		C45/55	1,50			
		C50/60	1,58			
Installation factor	γ_{inst}	[-]	1,0			
Concrete cone failure and splitting failure						
Effective embedment depth	h_{ef}	[mm]	60		70	
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7 3)			
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0 3)			
Spacing	$s_{cr,N}$	[mm]	180		210	
Edge distance	$c_{cr,N}$	[mm]	90		105	
Spacing (splitting)	$s_{cr,sp}$	[mm]	300		320	
Edge distance (splitting)	$c_{cr,sp}$	[mm]	150		160	

1) In absence of other national regulations
2) Pullout failure is not decisive
3) Based on concrete strength as cylinder strength

Berner High-Performance Anchor BHA, BHA-I

Performances
Performance characteristics of tension resistance for BHA-I and BHA-I A4

Annex C 2

Table C3.1: Performance characteristics of **shear resistance** for **BHA and BHA A4** under static and quasi-static loads

Anchor type BHA-S, -SK, -B, -H and BHA-S A4, -SK A4, -B A4, -H A4			**BHA 10**	**BHA 12**	**BHA 15**	**BHA 18**	**BHA 24**	**BHA 28** [3)]	**BHA 32** [3)]
Steel failure without lever arm									
BHA-S,	$V^0_{Rk,s}$	[kN]	18,0	33,0	59,0	76,0	146,0	176,4	217,0
BHA-B,-H	$V^0_{Rk,s}$	[kN]	16,0	27,2	42,8	61,9	119,0	148,8	169,0
BHA-SK	t_{fix} [2)]	[mm]	≥ 10		≥ 15		-		
	$V^0_{Rk,s}$	[kN]	18,0	33,0	59,0	76,0			
	t_{fix} [2)]	[mm]	< 10		< 15				
	$V^0_{Rk,s}$	[kN]	8,0	14,0	23,0	34,0			
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,25						
Factor for ductility	k_7	[-]	1,0						
BHA-S A4	$V^0_{Rk,s}$	[kN]	18,0	33,0	59,0	76,0	146,0	-	
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,33						
BHA-B A4,-H A4	$V^0_{Rk,s}$	[kN]	16,0	27,2	42,8	61,9	119,0	-	
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,25						
BHA-SK A4	t_{fix} [2)]	[mm]	≥ 10		≥ 15		-		
	$V^0_{Rk,s}$	[kN]	18,0	33,0	59,0	76,0			
	t_{fix} [2)]	[mm]	< 10		< 15				
	$V^0_{Rk,s}$	[kN]	8,0	14,0	23,0	34,0			
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,33						
Factor for ductility	k_7		1,0						
Steel failure with lever arm and concrete pryout failure									
Characteristic bending resistance BHA	$M^0_{Rk,s}$	[Nm]	12	30	60	105	266	518	896
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,25						
Characteristic bending resistance BHA A4	$M^0_{Rk,s}$	[Nm]	12	30	60	105	266	-	
Partial factor for steel failure -B,-H	γ_{Ms} [1)]	[-]	1,25						
Partial factor for steel failure -S,-SK	γ_{Ms} [1)]	[-]	1,33						
Factor for pryout failure	k_8	[-]	1,0	2,0					
Concrete edge failure									
Effective embedment depth for calculation	$l_f =$	[mm]	h_{ef}						
Outside diameter of a fastener	d_{nom}	[mm]	10	12	15	18	24	28	32

1) In absence of other national regulations
2) The thickness of the fixture has influence to the characteristic resistance for shear loads, steel failure without lever arm
3) Only valid for zinc-plated version

Berner High-Performance Anchor BHA, BHA-I	**Annex C 3**
Performances Performance characteristics of shear resistance for BHA and BHA A4	

Table C4.1: Performance characteristics of **shear resistance** for **BHA-I and BHA-I A4** under static and quasi-static loads

Anchor type BHA-I and BHA-I A4			BHA 12/M6 I	BHA 12/M8 I	BHA 15/M10 I	BHA 15/M12 I
Steel failure without lever arm						
Anchor in combination with screw / threaded rod of galvanised steel complying with DIN EN ISO 898:2013						
Strength class 5.8	$V^0_{Rk,s}$	[kN]	5	9	15	21
Strength class 6.8	$V^0_{Rk,s}$	[kN]	6	11	18	24
Strength class 8.8	$V^0_{Rk,s}$	[kN]	8	14	23	24
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,25			
Factor for ductility	k_7	[-]	1,0			
Anchor in combination with screw / threaded rod of stainless steel complying with DIN EN ISO 3506:2010						
Strength class A50	$V^0_{Rk,s}$	[kN]	5	9	15	21
Partial factor for steel failure	γ_{Ms} [1)]	[-]	2,38			
Strength class A70	$V^0_{Rk,s}$	[kN]	7	13	20	30
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,56			
Strength class A80	$V^0_{Rk,s}$	[kN]	8	15	23	32
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,33			
Factor for ductility	k_7	[-]	1,0			
Steel failure with lever arm and concrete pryout failure						
Anchor in combination with screw / threaded rod of galvanised steel complying with DIN EN ISO 898:2013						
Strength class 5.8	$M^0_{Rk,s}$	[Nm]	8	19	37	65
Strength class 6.8	$M^0_{Rk,s}$	[Nm]	9	23	44	78
Strength class 8.8	$M^0_{Rk,s}$	[Nm]	12	30	60	105
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,25			
Factor for ductility	k_7	[-]	1,0			
Anchor in combination with screw / threaded rod of stainless steel complying with DIN EN ISO 3506:2010						
Strength class A50	$M^0_{Rk,s}$	[Nm]	8	19	37	65
Partial factor for steel failure	γ_{Ms} [1)]	[-]	2,38			
Strength class A70	$M^0_{Rk,s}$	[Nm]	11	26	52	92
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,56			
Strength class A80	$M^0_{Rk,s}$	[Nm]	12	30	60	105
Partial factor for steel failure	γ_{Ms} [1)]	[-]	1,33			
Factor for ductility	k_7	[-]	1,0			
Factor for pryout failure	k_8	[-]	2,0			
Concrete edge failure						
Effective embedment depth for calculation	$l_f =$	[mm]	h_{ef}			
Outside diameter of fastener	d_{nom}	[mm]	12		15	

[1)] In absence of other national regulations

Berner High-Performance Anchor BHA, BHA-I

Performances
Performance characteristics of shear resistance for BHA-I and BHA-I A4

Annex C 4

Table C5.1: Performance characteristics of **tension resistance** under **fire exposure**

Anchor type		R30			R60		
		$N_{Rk,s,fi,30}$ [kN]	$N_{Rk,p,fi,30}$ [kN]	$N^0_{Rk,c,fi,30}$ [kN]	$N_{Rk,s,fi,60}$ [kN]	$N_{Rk,p,fi,60}$ [kN]	$N^0_{Rk,c,fi,60}$ [kN]
BHA 10, BHA 10 A4		0,2	1,8	1,8	0,2	1,8	1,8
BHA 12, BHA 12 A4		2,0	3,0	5,0	1,3	3,0	5,0
BHA 15, BHA 15 A4		3,2	4,0	7,4	2,3	4,0	7,4
BHA 18, BHA 18 A4		4,8	6,3	10,3	3,9	6,3	10,3
BHA 24, BHA 24 A4		8,9	9,0	18,0	7,3	9,0	18,0
BHA 28		13,9	12,6	31,4	11,3	12,6	31,4
BHA 32		20,0	16,5	49,6	16,3	16,5	49,6
BHA 12/M6-I,	5.8, A50[1]	0,1	2,3	5,0	0,1	2,3	5,0
BHA 12/M6-I A4	8.8, A70, A80[1) 2)]	0,2			0,2		
BHA 12/M8-I,	5.8, A50[1]	1,3			0,8		
BHA 12/M8-I A4	8.8, A70, A80[1) 2)]	2,0			1,3		
BHA 15/M10-I,	5.8, A50[1]	2,0	3,0	7,4	1,4	3,0	7,4
BHA 15/M10-I A4	8.8, A70, A80[1) 2)]	3,2			2,3		
BHA 15/M12-I,	5.8/A50[1]	3,0			2,4		
BHA 15/M12-I A4	8.8, A70, A80[1) 2)]	4,8			3,9		

Anchor type		R90			R120		
		$N_{Rk,s,fi,90}$ [kN]	$N_{Rk,p,fi,90}$ [kN]	$N^0_{Rk,c,fi,90}$ [kN]	$N_{Rk,s,fi,120}$ [kN]	$N_{Rk,p,fi,120}$ [kN]	$N^0_{Rk,c,fi,120}$ [kN]
BHA 10, BHA 10 A4		0,1	1,8	1,8	0,1	1,5	1,5
BHA 12, BHA 12 A4		0,6	3,0	5,0	0,2	2,4	4,0
BHA 15, BHA 15 A4		1,4	4,0	7,4	1,0	3,2	5,9
BHA 18, BHA 18 A4		3,0	6,3	10,3	2,6	5,0	8,2
BHA 24, BHA 24 A4		5,6	9,0	18,0	4,8	7,2	14,4
BHA 28		8,8	12,6	31,4	7,5	10,1	25,2
BHA 32		12,6	16,5	49,6	10,8	13,2	39,7
BHA 12/M6-I,	5.8, A50[1]	0,1	2,3	5,0	0,1	1,8	4,0
BHA 12/M6-I A4	8.8, A70, A80[1) 2)]	0,1			0,1		
BHA 12/M8-I,	5.8, A50[1]	0,4			0,1		
BHA 12/M8-I A4	8.8, A70, A80[1) 2)]	0,6			0,2		
BHA 15/M10-I,	5.8, A50[1]	0,9	3,0	7,4	0,6	2,4	5,9
BHA 15/M10-I A4	8.8, A70, A80[1) 2)]	1,4			1,0		
BHA 15/M12-I,	5.8/A50[1]	1,9			1,6		
BHA 15/M12-I A4	8.8, A70, A80[1) 2)]	3,0			2,6		

1) Intermediate values by linear interpolation
2) In combination with screw / threaded rod strength class 8.8, A70, A80

In absence of other national regulations the partial factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended

Berner High-Performance Anchor BHA, BHA-I	Annex C 5
Performances Performance characteristics of tension resistance under fire exposure	

Table C6.1: Performance characteristics of **shear resistance** under **fire exposure**

Anchor type		R30 $V_{Rk,s,fi,30}$ [kN]	R30 $M^0_{Rk,s,fi,30}$ [Nm]	R60 $V_{Rk,s,fi,60}$ [kN]	R60 $M^0_{Rk,s,fi,60}$ [Nm]
BHA 10, BHA 10 A4		0,3	0	0,3	0
BHA 12, BHA 12 A4		2,0	2	1,3	1
BHA 15, BHA 15 A4		3,2	4	2,3	3
BHA 18, BHA 18 A4		4,8	7	3,9	6
BHA 24, BHA 24 A4		8,9	19	7,3	15
BHA 28		13,9	37	11,3	30
BHA 32		20,0	64	16,3	52
BHA 12/M6 I,	5.8, A50[1)]	0,2	0	0,2	0
BHA 12/M6 I A4	8.8, A70, A80[1) 2)]	0,3	0	0,3	0
BHA 12/M8 I,	5.8, A50[1)]	1,3	1	0,8	1
BHA 12/M8-I A4	8.8, A70, A80[1) 2)]	2,0	2	1,3	1
BHA 15/M10 I,	5.8, A50[1)]	2,0	3	1,4	2
BHA 15/M10-I A4	8.8, A70, A80[1) 2)]	3,2	4	2,3	3
BHA 15/M12-I,	5.8/A50[1)]	3,0	4	2,4	4
BHA 15/M12-I A4	8.8, A70, A80[1) 2)]	4,8	7	3,9	6

Anchor type		R90 $V_{Rk,s,fi,90}$ [kN]	R90 $M^0_{Rk,s,fi,90}$ [Nm]	R120 $V_{Rk,s,fi,120}$ [kN]	R120 $M^0_{Rk,s,fi,120}$ [Nm]
BHA 10, BHA 10 A4		0,2	0	0,1	0
BHA 12, BHA 12 A4		0,6	1	0,2	0
BHA 15, BHA 15 A4		1,4	2	1,0	1
BHA 18, BHA 18 A4		3,0	5	2,6	4
BHA 24, BHA 24 A4		5,6	12	4,8	10
BHA 28		8,8	23	7,5	20
BHA 32		12,6	40	10,8	34
BHA 12/M6-I,	5.8, A50[1)]	0,1	0	0,1	0
BHA 12/M6-I A4	8.8, A70, A80[1) 2)]	0,2	0	0,1	0
BHA 12/M8-I,	5.8, A50[1)]	0,4	1	0,1	0
BHA 12/M8-I A4	8.8, A70, A80[1) 2)]	0,6	1	0,2	0
BHA 15/M10 I,	5.8, A50[1)]	0,9	2	0,6	1
BHA 15/M10-I A4	8.8, A70, A80[1) 2)]	1,4	3	1,0	1
BHA 15/M12 I,	5.8/A50[1)]	1,9	4	1,6	3
BHA 15/M12-I A4	8.8, A70, A80[1) 2)]	3,0	6	2,6	4

[1)] Intermediate values by linear interpolation
[2)] In combination with screw / threaded rod strength class 8.8, A70, A80

In absence of other national regulations the partial factor for resistance under fire exposure $\gamma_{M,fi}$ = 1,0 is recommended

Table C7.1: Performance characteristics of **tension and shear resistance** for **seismic performance category C1** for BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4				**BHA 12**	**BHA 15**	**BHA 18**	**BHA 24**	**BHA 28**[3]	**BHA 32**[3]
Steel failure									
Characteristic resistance of tension load C1	BHA-S,-SK,-B,-H -B A4, -H A4	$N_{Rk,s,C1}$	[kN]	29,3	46,4	67,4	125,3	195,8	282,0
		$\gamma_{Ms,C1}$ [1]	[-]	1,5					
	BHA-S A4,-SK A4	$N_{Rk,s,C1}$	[kN]	29,3	46,4	67,4	125,3	-	
		$\gamma_{Ms,C1}$ [1]	[-]	1,6					
Pullout failure									
Characteristic resistance of tension load in cracked concrete C1		$N_{Rk,P,C1}$	[kN]	12,0	16,0	25,0	36,0	50,3	66,1
		$\gamma_{Mp,C1}$ [1]	[-]	1,5					
Steel failure without lever arm									
Characteristic resistance of shear load C1									
BHA-S		$V^0_{Rk,s,C1}$	[kN]	25,0	41,0	60,0	123,0	141,0	200,0
BHA-B,-H		$V^0_{Rk,s,C1}$	[kN]	17,0	30,0	46,0	103,0	117,0	169,0
BHA-SK		t_{fix} [2]	[mm]	≥ 10	≥ 15		-		
		$V_{Rk,s,C1}$	[kN]	25,0	41,0	60,0			
		t_{fix} [2]	[mm]	< 10	< 15				
		$V_{Rk,s,C1}$	[kN]	11,0	16,0	27,0			
Partial factor for steel failure		$\gamma_{Ms,C1}$ [1]	[-]	1,25					
BHA-S A4		$V_{Rk,s,C1}$	[kN]	25,0	41,0	60,0	123,0	-	
Partial factor for steel failure		$\gamma_{Ms,C1}$ [1]	[-]	1,33					
BHA-B A4,-H A4		$V_{Rk,s,C1}$	[kN]	17,0	30,0	46,0	103,0	-	
Partial factor for steel failure		$\gamma_{Ms,C1}$ [1]	[-]	1,25					
BHA-SK A4		t_{fix} [2]	[mm]	≥ 10	≥ 15		-		
		$V_{Rk,s,C1}$	[kN]	25,0	41,0	60,0			
		t_{fix} [2]	[mm]	< 10	< 15				
		$V_{Rk,s,C1}$	[kN]	11,0	16,0	27,0			
Partial factor for steel failure		$\gamma_{Ms,C1}$ [1]	[-]	1,33					
Factor for annular gap		α_{gap}	[-]	0,50					

[1] In absence of other national regulations
[2] The thickness of the fixture has influence to the characteristic resistance for shear loads, steel failure without lever arm
[3] Only valid for zinc-plated version

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Table C8.1: Performance characteristics of **tension and shear resistance** for **seismic performance category C2** for BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4				**BHA 12**	**BHA 15**	**BHA 18**	**BHA 24**	**BHA 28**[3]	**BHA 32**[3]
Steel failure									
Characteristic resistance of tension load C2	BHA-S,-SK,-B,-H -B A4, -H A4	$N_{Rk,s,C2}$	[kN]	29,3	46,4	67,4	125,3	195,8	
		$\gamma_{Ms,C2}$[1]	[-]	1,5					
	BHA-S A4,-SK A4	$N_{Rk,s,C2}$	[kN]	29,3	46,4	67,4	125,3	-	
		$\gamma_{Ms,C2}$[1]	[-]	1,6					
Pullout failure									
Characteristic resistance of tension load in cracked concrete C2		$N_{Rk,P,C2}$	[kN]	6,2	11,3	21,8	43,0	65,9	
		$\gamma_{Mp,C2}$[1]	[-]	1,5					
Steel failure without lever arm									
Characteristic resistance of shear load C2									
BHA-S		$V_{Rk,s,C2}$	[kN]	14,7	28,9	41,0	100,7		
BHA-B,-H		$V_{Rk,s,C2}$	[kN]	9,8	20,9	34,1	61,9	67,2	
BHA-SK		t_{fix}[2]	[mm]	≥ 10	≥ 15		-		
		$V_{Rk,s,C2}$	[kN]	14,8	23,3	33,8			
		t_{fix}[2]	[mm]	< 10	< 15				
		$V_{Rk,s,C2}$	[kN]	6,3	9,1	15,1			
Partial factor for steel failure		$\gamma_{Ms,C2}$[1]	[-]	1,25					
BHA-S A4		$V_{Rk,s,C2}$	[kN]	14,7	28,9	41,0	100,7	-	
Partial factor for steel failure		$\gamma_{Ms,C2}$[1]	[-]	1,33					
BHA-B A4,-H A4		$V_{Rk,s,C2}$	[kN]	9,8	20,9	34,1	61,9	-	
Partial factor for steel failure		$\gamma_{Ms,C2}$[1]	[-]	1,25					
BHA-SK A4		t_{fix}[2]	[mm]	≥ 10	≥ 15		-		
		$V_{Rk,s,C2}$	[kN]	14,8	23,3	33,8			
		t_{fix}[2]	[mm]	< 10	< 15				
		$V_{Rk,s,C2}$	[kN]	6,3	9,1	15,1			
Partial factor for steel failure		$\gamma_{Ms,C2}$[1]	[-]	1,33					
Factor for annular gap		α_{gap}	[-]	0,50					

[1] In absence of other national regulations
[2] The thickness of the fixture has influence to the characteristic resistance for shear loads, steel failure without lever arm
[3] Only valid for zinc-plated version

Berner High-Performance Anchor BHA, BHA-I	**Annex C 8**
Performances Performance characteristics of tension and shear resistance for seismic performance category C2	

Table C9.1: Displacements under static and quasi static **tension loads** for BHA and BHA A4

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4			BHA 10	BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Tension load cracked concrete	N	[kN]	3,6	5,7	7,6	11,9	17,1	24,0	31,5
Corresponding displacements	δ_{N0}	[mm]	1,0	1,0	1,0	1,0	1,0	0,7	0,7
	$\delta_{N\infty}$	[mm]	1,7	1,6	1,6	1,6	1,8	1,3	1,1
Tension load uncracked concrete	N	[kN]	6,0	11,2	14,1	17,2	24,0	33,6	44,2
Corresponding displacements	δ_{N0}	[mm]	0,6	1,0	1,0	1,0	1,0	0,3	0,3
	$\delta_{N\infty}$	[mm]	1,7	1,6	1,6	1,6	1,8	1,3	1,1

Table C9.2: Displacements under static and quasi static **tension loads** for BHA-I and BHA-I A4

Anchor type BHA-I and BHA-I A4			BHA 12/M6 I BHA 12/M8 I	BHA 15/M10 I BHA 15/M12 I
Tension load cracked concrete	N	[kN]	4,3	5,7
Tension load uncracked concrete	N	[kN]	9,5	14,1
Corresponding displacements	δ_{N0}	[mm]	1,7	1,9
	$\delta_{N\infty}$	[mm]	2,2	2,9

Table C9.3: Displacements under static and quasi static **shear loads** for BHA-S and -SK

Anchor type BHA-S and BHA-SK			BHA 10	BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Shear load in cracked and uncracked concrete	V	[kN]	10,3	18,9	33,7	43,4	83,4	99,4	124,0
Corresponding displacements	δ_{V0}	[mm]	2,4	2,7	4,4	5,0	7,0	6,0	8,0
	$\delta_{V\infty}$	[mm]	3,6	4,1	6,6	7,5	10,5	9,0	12,0

Table C9.4: Displacements under static and quasi static **shear loads** for BHA-B and -H

Anchor type BHA-B and BHA-H			BHA 10	BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Shear load in cracked and uncracked concrete	V	[kN]	8,9	15,4	23,4	35,4	68,0	83,4	96,6
Corresponding displacements	δ_{V0}	[mm]	2,2	2,3	3,0	5,0	7,0	5,0	5,0
	$\delta_{V\infty}$	[mm]	3,3	3,5	4,5	7,5	10,5	7,5	7,5

Table C10.1: Displacements under static and quasi static **shear loads** for BHA-S A4, BHA-SK A4, BHA-B A4 and BHA-H A4

Anchor type BHA-S A4, -SK A4, -B A4, -H A4			BHA 10	BHA 12	BHA 15	BHA 18	BHA 24
Shear load in cracked and uncracked concrete	V	[kN]	10,3	16,0	24,6	37,7	68,0
Corresponding displacements	δ_{V0}	[mm]	3,5	3,5	3,7	5,7	9,0
	$\delta_{V\infty}$	[mm]	5,3	5,3	5,6	8,6	13,5

Table C10.2: Displacements under static and quasi static **shear loads** for BHA-I and BHA-I A4

Anchor type: BHA-I and BHA-I A4			BHA 12/M6 I	BHA 12/M8 I	BHA 15/M10 I	BHA 15/M12 I
Shear load in cracked and uncracked concrete	V	[kN]	4,6	8,3	13,3	13,7
Corresponding displacements	δ_{V0}	[mm]	2,6	2,6	2,2	2,2
	$\delta_{V\infty}$	[mm]	3,9	3,9	3,3	3,3

Table C10.3: Displacements under **tension loads** for **seismic performance category C2** for BHA and BHA A4

Anchor type BHA-S,-SK,-B,-H and BHA-S A4,-SK A4,-B A4,-H A4			BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Displacement DLS	$\delta_{N,C2\ (DLS)}$	[mm]	1,55	2,63	2,04	4,26	3,06	
Displacement ULS	$\delta_{N,C2\ (ULS)}$	[mm]	8,71	11,07	7,30	11,70	11,44	

Table C10.4: Displacements under **shear loads** for **seismic performance category C2** for BHA and BHA A4

Anchor type BHA-S,-SK and BHA-S A4,-SK A4			BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Displacement DLS	$\delta_{V,C2\ (DLS)}$	[mm]	3,53	4,18	4,67	5,59	4,79	
Displacement ULS	$\delta_{V,C2\ (ULS)}$	[mm]	6,62	7,38	9,03	14,09	9,95	

Anchor type BHA-B,-H and BHA-B A4,-H A4			BHA 12	BHA 15	BHA 18	BHA 24	BHA 28	BHA 32
Displacement DLS	$\delta_{V,C2\ (DLS)}$	[mm]	3,42	4,26	4,29	4,79		
Displacement ULS	$\delta_{V,C2\ (ULS)}$	[mm]	5,26	6,66	7,95	7,69	9,95	