

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

**ETA-17/0784**  
**of 6 October 2017**

English translation prepared by DIBt - Original version in German language

### General Part

Technical Assessment Body issuing the  
European Technical Assessment:

Trade name of the construction product

Product family  
to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment  
contains

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

Deutsches Institut für Bautechnik

SMART high load anchor type S-ZA

Mechanical anchor  
for use in concrete

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POLEN

pgb-Polska plant 4

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

EAD 330232-00-0601

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## Specific Part

### 1 Technical description of the product

The SMART highload anchor type S-ZA is an anchor made of galvanised steel or made of stainless steel which is placed into a drilled hole and anchored by torque-controlled expansion. The following anchor types are covered:

- Anchor type S-ZAK with threaded bolt,
- Anchor type S-ZAT with hexagon head screw,
- Anchor type S-ZAV with countersunk washer and countersunk screw.

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 for static and quasi-static loading	See Annex C1 to C5
Characteristic resistance for seismic performance category C1 and C2	See Annex C6 to C7
Displacements under tension and shear loads	See Annex C9 and C10

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

Essential characteristic	Performance
Reaction to fire	Anchorage satisfy requirements for Class A1
Resistance to fire	See Annex C8

**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 Nr. 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 with Deutsches Institut für Bautechnik.

Issued in Berlin on 6 October 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*Beglaubigt:*  
Baderschneider

## SMART highload anchor type S-ZA

### Anchor type SMART highload anchor type S-ZAK with threaded bolt



S-ZAK (M6-M20)  
S-ZAK (M8-M16) A4

### Anchor type SMART highload anchor type S-ZAT with hexagon head screw



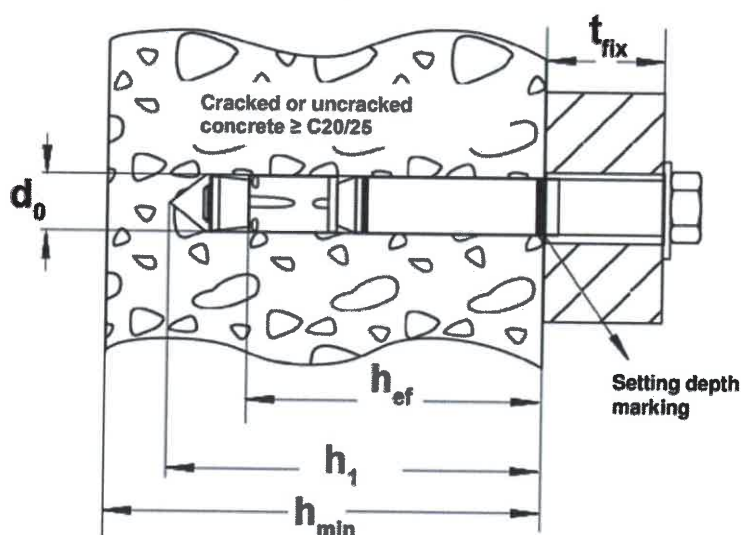
S-ZAT (M6-M20)  
S-ZAT (M8-M16) A4

### Anchor type SMART highload anchor type S-ZAV with countersunk washer and countersunk screw



S-ZAV (M6-M12)  
S-ZAV (M8-M12) A4

### Installation condition

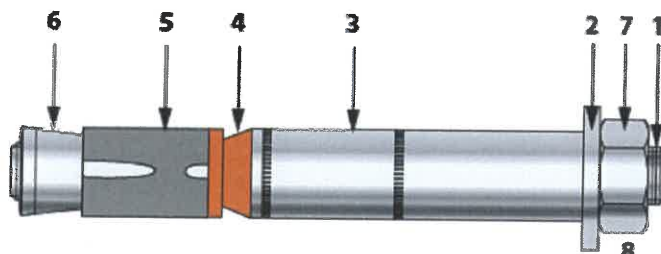


## SMART highload anchor type S-ZA

Product description  
Product and installation situation

Annex A1

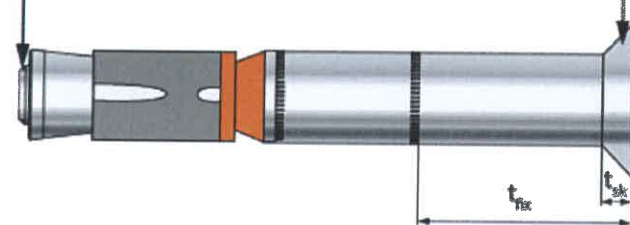
### S-ZAK



### S-ZAT




### S-ZAV



#### Marking:

expansion sleeve:

- Identifying mark of manufacturing plant 
- additional marking of stainless steel A4 A4
- Anchor identity (alternatively on distance sleeve) SZ
- size of thread (alternatively on distance sleeve) M10

Distance sleeve:

- Diameter 15
- max. thickness of fixture 25
- additional marking for countersunk version SK

additional marking on the washer of anchor size SZ 24/M16L

L

**Table A1: Designation of anchor parts and materials**

Part	Designation	Materials galvanised $\geq 5 \mu\text{m}$ , acc. to EN ISO 4042:1999	Stainless steel A4
1	Threaded bolt	Steel, Strength class 8.8, EN ISO 898-1:2013	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
2	Washer	Steel, EN 10139:1997	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
3	Distance sleeve	Precision steel tubes DIN 2394/2393	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
4	Ring	Polyethylene	Polyethylene
5	Expansion sleeve	Steel, EN 10139:1997	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
6	Threaded cone	Steel, Strength class 8, EN ISO 898-2:2012	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
7	Hexagon nut	Steel, Strength class 8, EN ISO 898-2:2012	ISO 3506, strength class 70, stainless steel 1.4401 or 1.4571, EN 10088:2005
8	Hexagon head screw	Steel, Strength class 8.8, EN ISO 898-1:2013	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
9	Countersunk screw	Steel, Strength class 8.8, EN ISO 898-1:2013	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005
10	Countersunk washer	Steel, EN 10083-2:2006	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2005, zinc plated

#### SMART highload anchor type S-ZA

Product description  
Marking and materials

**Annex A2**



## Specifications of intended use

SMART highload anchor type S-ZA, steel zinc plated	10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Static or quasi-static action	✓						
Seismic action (S-ZAK and S-ZAT)	-	C1 + C2					
Seismic action (S-ZAV)	-	C1 + C2				-	
Fire exposure	R 30 ... R 120						
SMART highload anchor type S-ZA, stainless steel A4	12/M8	15/M10	18/M12	24/M16			
Static or quasi-static action	✓						
Seismic action (S-ZAK and S-ZAT)	C1 + C2						
Seismic action (S-ZAV)	C1 + C2			-			
Fire exposure	R30 ... R120						

### Base materials:

- Cracked and uncracked concrete
- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000
- Strength classes C20/25 to C50/60 according to EN 206-1:2000

### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc plated steel or stainless steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel).

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

### Design:

- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e.g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages under static or quasi-static actions, seismic actions and under fire exposure are designed in accordance with FprEN 1992-4:2016 and 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.
- In case of aborted hole: new drilling at a minimum distance away of twice the depth of the aborted hole or smaller distance if the aborted drill hole is filled with high strength mortar and if under shear or oblique tension load it is not in the direction of load application.
- Anchor installation such that the effective anchorage depth is complied with. This compliance is ensured when the embedment mark of the anchor does not more exceed the concrete surface.
- Drill hole by hammer drilling only (use of vacuum drill bits is admissible)

## SMART highload anchor type S-ZA

Intended use  
Specifications

Annex B1

## Installation instructions

	<p>Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3.</p>
	<p>Blow out dust. Alternatively vacuum clean down to the bottom of the hole.</p>
	<p>Drive in anchor.</p>
	<p>Apply tightening torque <math>T_{inst}</math> by using calibrated torque wrench.</p>

### SMART highload anchor type S-ZA

Intended use  
Installation instructions

Annex B2



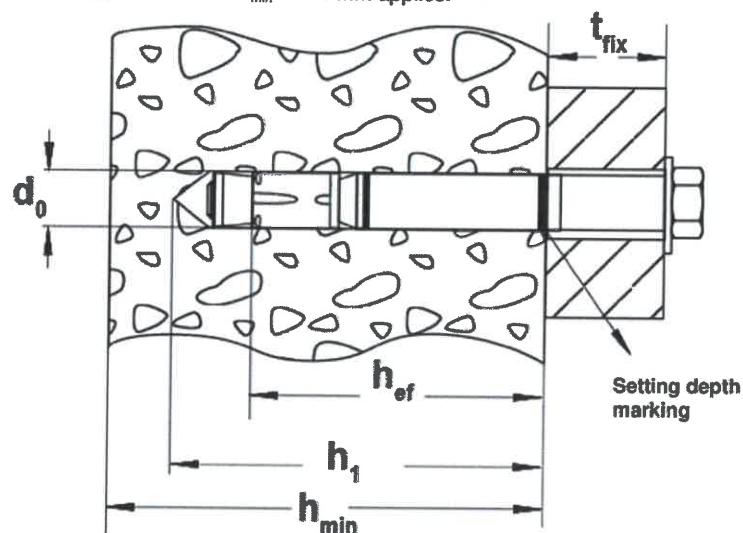
**Table B1: Installation parameters, steel zinc plated**

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Size of thread		[-]	M6	M8	M10	M12	M16	M16	M20
Effective anchorage depth	$h_{ef}$	[mm]	50	60	71	80	100	115	125
Nominal diameter of drill bit	$d_0 =$	[mm]	10	12	15	18	24	24	28
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45	12,5	15,5	18,5	24,55	24,55	28,55
Depth of drill hole	$h_1 \geq$	[mm]	65	80	95	105	130	145	160
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12	14	17	20	26	26	31
Thickness of fixture S-ZAK and S-ZAT	$t_{fix \min}$	[mm]	0	0	0	0	0	0	0
	$t_{fix \max}$	[mm]	200	200	200	250	300	300	300
Thickness of fixture S-ZAV	$t_{fix \min}^{2)}$	[mm]	8	10	14	18	-	-	-
	$t_{fix \max}$	[mm]	200	200	200	250	-	-	-
Thickness of countersunk washer S-ZAV	$t_{sk}$	[mm]	4	5	6	7	-	-	-
Required setting torque	$T_{inst}$ (S-ZAK, S-ZAT)	[Nm]	15	30	50	80	160	160	280
	$T_{inst}$ (S-ZAV)	[Nm]	10	25	55	70	-	-	-
Minimum thickness of member	$h_{min}$	[mm]	100	120	140	160	200	230	250
Minimum spacing <sup>1) 3)</sup>	$s_{min}$	[mm]	50	50	60	70	100	100	125
cracked concrete	for $c \geq$	[mm]	50	80	120	140	180	180	300
Minimum edge distance <sup>1) 3)</sup>	$c_{min}$	[mm]	50	55	60	70	100	100	180
cracked concrete	for $s \geq$	[mm]	50	100	120	160	220	220	540
Minimum spacing <sup>1) 3)</sup>	$s_{min}$	[mm]	50	60	60	70	100	100	125
uncracked concrete	for $c \geq$	[mm]	80	100	120	140	180	180	300
Minimum edge distance <sup>1) 3)</sup>	$c_{min}$	[mm]	50	60	60	70	100	100	180
uncracked concrete	for $s \geq$	[mm]	100	120	120	160	220	220	540

<sup>1)</sup> Intermediate values by linear interpolation

<sup>2)</sup> Depending on the existing shear load, the thickness of the fixture may be reduced to the thickness of the countersunk washer  $t_{sk}$  (see Annex A2). It must be verified that the present shear load can be transferred completely into the distance sleeve (bearing of hole).

<sup>3)</sup> For fire exposure from more than one side  $c \geq 300$  mm or  $c_{min} \geq 300$  mm applies.



**SMART highload anchor type S-ZA**

Intended use  
Installation parameters, steel zinc plated

**Annex B3**

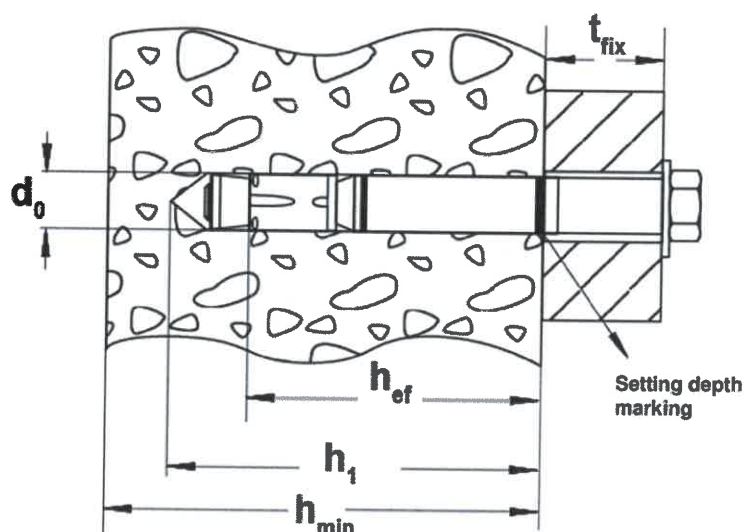
**Table B2: Installation parameters, stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
Size of thread		[-]	M8	M10	M12	M16
Effective anchorage depth	$h_{ef}$	[mm]	60	71	80	100
Nominal diameter of drill bit	$d_0 =$	[mm]	12	15	18	24
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	12,5	15,5	18,5	24,55
Depth of drill hole	$h_1 \geq$	[mm]	80	95	105	130
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20	26
Thickness of fixture S-ZAK and S-ZAT	$t_{fix \min}$	[mm]	0	0	0	0
	$t_{fix \max}$	[mm]	200	200	250	300
Thickness of fixture S-ZAV	$t_{fix \min}^{2)}$	[mm]	10	14	18	-
	$t_{fix \max}$	[mm]	200	200	250	-
Thickness of countersunk washer S-ZAV	$t_{sk}$	[mm]	5	6	7	-
Required setting torque	$T_{inst}$ (S-ZAK)	[Nm]	35	55	90	170
	$T_{inst}$ (S-ZAT)	[Nm]	30	50	80	170
	$T_{inst}$ (S-ZAV)	[Nm]	17,5	42,5	50	-
Minimum thickness of member	$h_{min}$	[mm]	120	140	160	200
Minimum spacing <sup>1) 3)</sup>	$s_{min}$	[mm]	50	60	70	80
cracked concrete	for $c \geq$	[mm]	80	120	140	180
Minimum edge distance <sup>1) 3)</sup>	$c_{min}$	[mm]	50	60	70	80
cracked concrete	for $s \geq$	[mm]	80	120	160	200
Minimum spacing <sup>1) 3)</sup>	$s_{min}$	[mm]	50	60	70	80
uncracked concrete	for $c \geq$	[mm]	80	120	140	180
Minimum edge distance <sup>1) 3)</sup>	$c_{min}$	[mm]	50	85	70	180
uncracked concrete	for $s \geq$	[mm]	80	185	160	80

<sup>1)</sup> Intermediate values by linear interpolation

<sup>2)</sup> Depending on the existing shear load, the thickness of the fixture may be reduced to the thickness of the countersunk washer  $t_{sk}$  (see Annex A2). It must be verified that the present shear load can be transferred completely into the distance sleeve (bearing of hole).

<sup>3)</sup> For fire exposure from more than one side  $c \geq 300$  mm or  $c_{min} \geq 300$  mm applies.



**SMART highload anchor type S-ZA**

Intended use  
Installation parameters, stainless steel A4

**Annex B4**

**Table C1:** Characteristic values for **tension load, cracked concrete**  
under static or quasi-static action, **steel zinc plated**

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20	
Installation safety factor		$\gamma_{inst}$	[-]	1,0						
Steel failure										
Characteristic resistance		$N_{Rk,s}$	[kN]	16	29	46	67	126	126	196
Partial safety factor		$\gamma_{Ms}$	[-]	1,5						
Pull-out failure										
Characteristic resistance in cracked concrete C20/25		$N_{Rk,p}$	[kN]	5	12	16	1)	1)	1)	1)
Increasing factor for $N_{Rk,p}$		$\psi_C$	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$						
Concrete cone failure										
Effective anchorage depth		$h_{ef}$	[mm]	50	60	71	80	100	115	125
Factor for $k_1$		$k_{cr,N}$	[-]	7,7						

1) Pull-out is not decisive.

**Table C2:** Characteristic values for **tension load, cracked concrete**  
under static or quasi-static action, **stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
Installation safety factor	$\gamma_{inst}$	[-]	1,0			
Steel failure						
S-ZAK						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial safety factor	$\gamma_{Ms}$	[-]	1,5			
S-ZAT and S-ZAV						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial safety factor	$\gamma_{Ms}$	[-]	1,87			
Pull-out failure						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	9	16	1)	1)
Increasing factor for $N_{Rk,p}$	$\psi_C$	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$			
Concrete cone failure						
Effective anchorage depth	$h_{ef}$	[mm]	60	71	80	100
Factor for $k_1$	$k_{cr,N}$	[-]	7,7			

1) Pull-out is not decisive.

#### SMART highload anchor type S-ZA

##### Performance

Characteristic values for **tension load in cracked concrete** under static or quasi-static action

**Annex C1**



**Table C3: Characteristic values for tension load in uncracked concrete, under static or quasi-static action, steel zinc plated**

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20	
Installation safety factor		$\gamma_{inst}$	[-]	1,0						
Steel failure										
Characteristic resistance		$N_{Rk,s}$	[kN]	16	29	46	67	126	126	196
Partial safety factor		$\gamma_{Ms}$	[-]	1,5						
Pull-out failure										
Characteristic resistance in uncracked concrete C20/25		$N_{Rk,p}$	[kN]	1)	20	1)	1)	1)	1)	1)
Splitting failure (The higher resistance of case 1 and case 2 may be applied.)										
Case 1										
Characteristic resistance in uncracked concrete C20/25		$N^0_{Rk,sp}$	[kN]	12	16	25	30	40	70	50
Edge distance		$C_{cr,sp}$	[mm]	1,5 $h_{ef}$						
Case 2										
Characteristic resistance in uncracked concrete C20/25		$N^0_{Rk,sp}$	[kN]	17,4	20,0	29,4	35,2	49,2	60,7	68,8
Edge distance		$C_{cr,sp}$	[mm]	2,5 $h_{ef}$				1,5 $h_{ef}$		2,5 $h_{ef}$
Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$		$\psi_C$	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$						
Concrete cone failure										
Effective Anchorage depth		$h_{ef}$	[mm]	50	60	71	80	100	115	125
Edge distance		$C_{cr,N}$	[mm]	1,5 $h_{ef}$						
Factor for $k_1$		$k_{ucr,N}$	[-]	11,0						

<sup>1)</sup> Pull-out is not decisive.

### SMART highload anchor type S-ZA

#### Performance

Characteristic values for tension load in uncracked concrete, under static or quasi-static action, steel zinc plated

**Annex C2**

**Table C4:** Characteristic values for **tension load** in **uncracked concrete** under static or quasi-static action, **stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
Installation safety factor	$\gamma_{inst}$	[-]	1,0			
Steel failure						
S-ZAK						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial safety factor	$\gamma_{Ms}$	[-]	1,5			
S-ZAT and S-ZAV						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial safety factor	$\gamma_{Ms}$	[-]	1,87			
Pull-out failure						
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	16	25	35	1)
Splitting failure						
Characteristic resistance in uncracked concrete C20/25	$N^0_{Rk,sp}$	[kN]	16	25	35	49,2
Edge distance	$c_{cr,sp}$	[mm]	180	235	265	300
Increasing factor for $N_{Rk,p}$ and $N^0_{Rk,sp}$	$\psi_C$	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$			
Concrete cone failure						
Effective anchorage depth	$h_{ef}$	[mm]	60	71	80	100
Edge distance	$c_{cr,N}$	[mm]	$1,5 h_{ef}$			
Factor for $k_1$	$k_{ucr,N}$	[-]	11,0			

1) Pull-out is not decisive.

#### SMART highload anchor type S-ZA

##### Performance

Characteristic values for **tension loads** in **uncracked concrete** under static or quasi-static action, **stainless steel A4**

**Annex C3**



**Table C5:** Characteristic values of **shear load** under static or quasi-static action,  
**steel zinc plated**

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Steel fallure without lever arm									
S-ZAK									
Characteristic resistance	$V_{Rk,s}$	[kN]	16	25	36	63	91	91	122
Factor	$k_7$	[-]	1,0						
S-ZAT									
Characteristic resistance	$V_{Rk,s}$	[kN]	18	30	48	73	126	126	150
Factor	$k_7$	[-]	1,0						
S-ZAV									
Characteristic resistance	$V_{Rk,s}$	[kN]	18	30	48	73	126	126	150
Factor	$k_7$	[-]	1,0						
Partial safety factor	$\gamma_{Ms}$	[-]	1,25						
Steel failure with lever arm									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	12	30	60	105	266	266	519
Partial safety factor	$\gamma_{Ms}$	[-]	1,25						
Concrete pry-out fallure									
Factor	$k_8$	[-]	1,8	2,0					
Concrete edge fallure									
Effective length of anchor in shear loading	$l_f$	[mm]	50	60	71	80	100	115	125
Outside diameter of anchor	$d_{nom}$	[mm]	10	12	15	18	24	24	28

**SMART highload anchor type S-ZA**

**Performance**  
Characteristic values for **shear load** under static or quasi-static action,  
**steel zinc plated**

**Annex C4**

**Table C6:** Characteristic values for **shear load** under static or quasi-static action, **stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
Steel failure without lever arm						
Characteristic resistance	$V_{Rk,s}$	[kN]	24	37	62	92
S-ZAK						
Factor	$k_7$	[-]	1,0			
Partial safety factor	$\gamma_{Ms}$	[-]	1,25			
S-ZAT						
Factor	$k_7$	[-]	1,0			
Partial safety factor	$\gamma_{Ms}$	[-]	1,36			
S-ZAV						
Factor	$k_7$	[-]	0,8			
Partial safety factor	$\gamma_{Ms}$	[-]	1,36			
Steel failure with lever arm						
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	232
S-ZAK						
Factor	$k_7$	[-]	1,0			
Partial safety factor	$\gamma_{Ms}$	[-]	1,25			
S-ZAT						
Factor	$k_7$	[-]	1,0			
Partial safety factor	$\gamma_{Ms}$	[-]	1,56			
S-ZAV						
Factor	$k_7$	[-]	0,8			
Partial safety factor	$\gamma_{Ms}$	[-]	1,56			
Concrete pry-out failure						
Factor	$k_8$	[-]	2,0			
Concrete edge failure						
Effective length of anchor in shear loading	$l_f$	[mm]	60	71	80	100
Outside diameter of anchor	$d_{nom}$	[mm]	12	15	18	24

**SMART highload anchor type S-ZA**

**Performance**

Characteristic values for **shear load** under static or quasi-static action, **stainless steel A4**

**Annex C5**

**Table C7:** Characteristic values for seismic action, Category C1 and C2, steel zinc plated

Anchor size			12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Tension load								
Installation safety factor		$\gamma_{inst}$	[-]	1,0				
Steel failure								
Characteristic tension resistance category C1	$N_{Rk,s,eq,C1}$	[kN]	29	46	67	126	126	196
Characteristic tension resistance category C2	$N_{Rk,s,eq,C2}$	[kN]	29	46	67	126	126	196
Partial safety factor		$\gamma_{Ms}$	[-]	1,5				
Pull-out failure								
Characteristic tension resistance category C1	$N_{Rk,p,eq,C1}$	[kN]	12	16	25	36	44,4	50,3
Characteristic tension resistance category C2	$N_{Rk,p,eq,C2}$	[kN]	5,4	16,4	22,6	29,0	41,2	43,6
Shear load								
Steel failure without lever arm								
S-ZAK								
Characteristic shear resistance category C1	$V_{Rk,s,eq,C1}$	[kN]	18,0	27,1	43,4	51,9	51,9	96,4
Characteristic shear resistance category C2	$V_{Rk,s,eq,C2}$	[kN]	12,7	20,5	31,5	50,1	50,1	67,1
S-ZAT								
Characteristic shear resistance category C1	$V_{Rk,s,eq,C1}$	[kN]	18,0	27,1	43,4	51,9	51,9	96,4
Characteristic shear resistance category C2	$V_{Rk,s,eq,C2}$	[kN]	12,7	20,5	31,5	69,3	69,3	67,1
S-ZAV								
Characteristic shear resistance category C1	$V_{Rk,s,eq,C1}$	[kN]	25,2	36,5	50,4	-	-	-
Characteristic shear resistance category C2	$V_{Rk,s,eq,C2}$	[kN]	19,2	29,3	39,4	-	-	-
Partial safety factor		$\gamma_{Ms}$	[-]	1,25				

**SMART highload anchor type S-ZA**

**Performance**  
Characteristic values for seismic action, steel zinc plated

**Annex C6**

**Table C8: Characteristic values for seismic action, Category C1 and C2, stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
Tension load						
Installation safety factor		$\gamma_{inst}$	[-]	1,0		
Steel failure						
Characteristic tension resistance, category C1	$N_{Rk,s,eq,C1}$	[kN]	26	41	60	110
Characteristic tension resistance, category C2	$N_{Rk,s,eq,C2}$	[kN]	26	41	60	110
Partial safety factor S-ZAK		$\gamma_{Ms}$	[-]	1,5		
Partial safety factor S-ZAT and S-ZAV		$\gamma_{Ms}$	[-]	1,87		
Pull-out failure						
Characteristic tension resistance, category C1	$N_{Rk,p,eq,C1}$	[kN]	9	16	26	36
Characteristic tension resistance, category C2	$N_{Rk,p,eq,C2}$	[kN]	4,8	16,5	24,8	44,5
Shear load						
Steel failure without lever arm						
S-ZAK						
Characteristic shear resistance, category C1	$V_{Rk,s,eq,C1}$	[kN]	9,6	13,3	25,4	75,4
Characteristic shear resistance, category C2	$V_{Rk,s,eq,C2}$	[kN]	9,7	14,0	18,0	32,2
Partial safety factor		$\gamma_{Ms}$	[-]	1,25		
S-ZAT						
Characteristic shear resistance, category C1	$V_{Rk,s,eq,C1}$	[kN]	9,6	13,3	25,4	75,4
Characteristic shear resistance, category C2	$V_{Rk,s,eq,C2}$	[kN]	9,7	14,0	18,0	32,2
Partial safety factor		$\gamma_{Ms}$	[-]	1,36		
S-ZAV						
Characteristic shear resistance, category C1	$V_{Rk,s,eq,C1}$	[kN]	11,5	23,3	31,6	-
Characteristic shear resistance, category C2	$V_{Rk,s,eq,C2}$	[kN]	10,8	17,4	15,4	-
Partial safety factor		$\gamma_{Ms}$	[-]	1,36		-

**SMART highload anchor type S-ZA**

**Performance**  
Characteristic values for seismic action, stainless steel A4

**Annex C7**



**Table C9:** Characteristic values under **fire exposure** in cracked and uncracked concrete C20/25 to C50/60

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Tension load									
Steel failure									
Steel zinc plated									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	1,0	1,9	4,3	6,3	11,6	18,3
	R60			0,8	1,5	3,2	4,6	8,6	13,5
	R90			0,6	1,0	2,1	3,0	5,0	7,7
	R120			0,4	0,8	1,5	2,0	3,1	4,9
Stainless steel A4									
Characteristic resistance	R30	$N_{Rk,s,fi}$	[kN]	-	6,1	10,2	15,7	29,2	-
	R60			-	4,4	7,3	11,1	20,6	-
	R90			-	2,6	4,3	6,4	12,0	-
	R120			-	1,8	2,8	4,1	7,7	-
Shear load									
Steel failure without lever arm									
Steel zinc plated									
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	1,0	1,9	4,3	6,3	11,6	18,3
	R60			0,8	1,5	3,2	4,6	8,6	13,5
	R90			0,6	1,0	2,1	3,0	5,0	7,7
	R120			0,4	0,8	1,5	2,0	3,1	4,9
Stainless steel A4									
Characteristic resistance	R30	$V_{Rk,s,fi}$	[kN]	-	14,3	22,7	32,8	61,0	-
	R60			-	11,1	17,6	25,5	47,5	-
	R90			-	7,9	12,6	18,3	34,0	-
	R120			-	6,3	10,0	14,6	27,2	-
Steel failure with lever arm									
Steel zinc plated									
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	0,8	2,0	5,6	9,7	24,8	42,4
	R60			0,6	1,5	4,1	7,2	18,3	29,8
	R90			0,4	1,0	2,7	4,7	11,9	17,1
	R120			0,3	0,8	1,9	3,1	6,6	10,7
Stainless steel A4									
Characteristic resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	-	6,2	13,2	24,4	61,8	-
	R60			-	4,5	9,4	17,2	43,6	-
	R90			-	2,7	5,6	10,0	25,3	-
	R120			-	1,8	3,6	6,4	16,2	-

If pull-out is not decisive in Equation (D.4) and (D.5) FprEN1992,  $N_{Rk,p}$  must be replaced by  $N^0_{Rk,c}$ .

#### SMART highload anchor type S-ZA

**Performance**  
Characteristic values under **fire exposure**

**Annex C8**



**Table C10:** Displacements under tension and shear load, **steel zinc plated**

Anchor size			10/M6	12/M8	15/M10	18/M12	24/M16	24/M16L	28/M20
Tension load									
Tension load in cracked concrete	N	[kN]	2,4	5,7	7,6	12,3	17,1	21,1	24
Displacement	$\delta_{N0}$	[mm]	0,5	0,5	0,5	0,7	0,8	0,7	0,9
	$\delta_{N\infty}$	[mm]	2,0	2,0	1,3	1,3	1,3	1,3	1,4
Tension load in uncracked concrete	N	[kN]	8,5	9,5	14,3	17,2	24	29,6	34
Displacement	$\delta_{N0}$	[mm]	0,8	1,0	1,1			1,3	0,3
	$\delta_{N\infty}$	[mm]	3,4			1,7		2,3	1,4
Seismic action C2									
Displacement for DLS	$\delta_{N,eq}$ (DLS)	[mm]	-	3,3	3,0	5,0	3,0	3,0	4,0
Displacement for ULS	$\delta_{N,eq}$ (ULS)	[mm]	-	12,2	11,3	16,0	9,2	9,2	13,8
Shear load									
S-ZAK									
Shear load in cracked and uncracked concrete	V	[kN]	9,1	14	20,7	35,1	52,1	52,1	77
Displacement	$\delta_{V0}$	[mm]	2,5	2,1	2,7	3,0	5,1	5,1	4,3
	$\delta_{V\infty}$	[mm]	3,8	3,1	4,1	4,5	7,6	7,6	6,5
Seismic action C2									
Displacement for DLS	$\delta_{V,eq}$ (DLS)	[mm]	-	2,3	3,1	3,0	2,6	2,6	1,6
Displacement for ULS	$\delta_{V,eq}$ (ULS)	[mm]	-	4,8	6,4	6,1	6,6	6,6	4,8
S-ZAT									
Shear load in cracked and uncracked concrete	V	[kN]	10,1	17,1	27,5	41,5	72	72	77
Displacement	$\delta_{V0}$	[mm]	2,9	2,5	3,6	3,5	7,0	7,0	4,3
	$\delta_{V\infty}$	[mm]	4,4	3,8	5,4	5,3	10,5	10,5	6,5
Seismic action C2									
Displacement for DLS	$\delta_{V,eq}$ (DLS)	[mm]	-	2,3	3,1	3,0	3,3	3,3	1,6
Displacement for ULS	$\delta_{V,eq}$ (ULS)	[mm]	-	4,8	6,4	6,1	8,2	8,2	4,8
S-ZAV									
Shear load in cracked and uncracked concrete	V	[kN]	10,1	17,1	27,5	41,5	72	72	77
Displacement	$\delta_{V0}$	[mm]	2,9	2,5	3,6	3,5	7,0	7,0	4,3
	$\delta_{V\infty}$	[mm]	4,4	3,8	5,4	5,3	10,5	10,5	6,5
Seismic action C2									
Displacement for DLS	$\delta_{V,eq}$ (DLS)	[mm]	-	3,1	3,9	3,9	-	-	-
Displacement for ULS	$\delta_{V,eq}$ (ULS)	[mm]	-	10,2	11,8	13,0	-	-	-

**SMART highload anchor type S-ZA**

**Performance**  
Displacements under tension and shear load, **steel zinc plated**

**Annex C9**

**Table C11: Displacements under tension and shear load, stainless steel A4**

Anchor size			12/M8	15/M10	18/M12	24/M16
<b>Tension load</b>						
Tension load in cracked concrete	N	[kN]	4,3	7,6	12,1	17,0
Displacement	$\delta_{N0}$	[mm]	0,5	0,5	1,3	0,5
	$\delta_{N\infty}$	[mm]	1,2	1,6	1,8	1,6
Tension load in uncracked concrete	N	[kN]	7,6	11,9	16,7	24,1
Displacement	$\delta_{N0}$	[mm]	0,2	0,3	1,2	1,5
	$\delta_{N\infty}$	[mm]	1,1	-	-	-
<b>Seismic action C2</b>						
Displacement for DLS	$\delta_{N,eq}$ (DLS)	[mm]	4,7	4,5	4,3	4,9
Displacement for ULS	$\delta_{N,eq}$ (ULS)	[mm]	13,3	12,7	9,7	10,1
<b>Shear load</b>						
Shear load in cracked concrete	V	[kN]	13,9	21,1	34,7	50,8
Displacement	$\delta_{V0}$	[mm]	3,4	4,9	4,8	6,7
	$\delta_{V\infty}$	[mm]	5,1	7,4	7,1	10,1
<b>Seismic action C2</b>						
<b>S-ZAK, S-ZAT</b>						
Displacement for DLS	$\delta_{V,eq}$ (DLS)	[mm]	2,8	3,1	2,6	3,3
Displacement for ULS	$\delta_{V,eq}$ (ULS)	[mm]	5,6	5,8	5,0	6,9
<b>S-ZAV</b>						
Displacement for DLS	$\delta_{V,eq}$ (DLS)	[mm]	2,5	2,8	2,9	-
Displacement for ULS	$\delta_{V,eq}$ (ULS)	[mm]	5,8	5,9	6,9	-

**SMART highload anchor type S-ZA**

**Performance**  
Displacements under tension and shear load, stainless steel A4

**Annex C10**