...eine starke Verbindung

DÉCLARATION DES PERFORMANCES

Numéro de DoP : **MKT-125** - fr

- ✧ **Code d'identification unique du produit type:** **Cheville d'ancrage fixation lourde SZ**
- ✧ **Usage(s) prévu(s):** Cheville mécanique dans le béton, voir l'annexe/Annex B
- ✧ **Fabricant:** MKT Metall-Kunststoff-Technik GmbH & Co.KG
Auf dem Immel 2
67685 Weilerbach
- ✧ **Le ou les systèmes d'évaluation et de vérification de la constance des performances du produit de construction:** 1
- ✧ **Document d'évaluation européen:** **EAD 330232-00-0601**
  - Évaluation technique européenne: **ETA-02/0030, 13.09.2019**
  - Organisme d'évaluation technique: DIBt, Berlin
  - Organisme(s) notifié(s): NB 1343 – MPA, Darmstadt
- ✧ **Performance(s) déclarée(s):**

Caractéristiques essentielles	Performances
Résistance mécanique et stabilité (BWR 1)	
Résistances caractéristiques sous traction (effets statiques et quasi statiques)	Annexe / Annex C1 – C4
Résistance caractéristique sous contrainte transversale (effets statiques et quasi statiques)	Annexe / Annex C5 – C6
Résistances caractéristiques pour les catégories de performance sismique C1 + C2	Annexe / Annex C7 – C8
Décalage	Annexe / Annex C10 – C11
Durabilité	Annexe / Annex B1
Sécurité en cas d'incendie (BWR 2)	
Le comportement du feu	Classe A1
Résistance au feu	Annexe / Annex C9

Les performances du produit identifié ci-dessus sont conformes aux performances déclarées. Conformément au règlement (EU) no 305/2011, la présente déclaration des performances est établie sous la seule responsabilité du fabricant mentionné ci-dessus.

Signé pour le fabricant et en son nom par:

Stefan Weustenhagen
(Directeur général)
Weilerbach, 13.09.2019

p.p.
Dipl.-Ing. Detlef Bigalke
(Directeur du développement de produits)

L'original de cette déclaration des performances a été rédigé en allemand. En cas de divergences dans la traduction, la version allemande fait foi.

Specification of intended use

Highload Anchor SZ, steel zinc plated	10/M6	12/M8	15/M10	18/M12	24/M16	24/ M16L	28/M20	32/M24
Static or quasi-static action	✓							
Seismic action (SZ-B and SZ-S)	-	C1 + C2						
Seismic action (SZ-SK)	-	C1 + C2			-			
Fire exposure	R 30 … R 120							

Highload Anchor SZ, stainless steel A4	12/M8	15/M10	18/M12	24/M16
Static or quasi-static action	✓			
Seismic action (SZ-B and SZ-S)	C1 + C2			
Seismic action (SZ-SK)	C1 + C2			-
Fire exposure	R30 … R120			

Base materials:

- Cracked and uncracked concrete
- Compacted, reinforced or unreinforced normal weight concrete (without fibers) according to EN 206:2013 + A1:2016
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016

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 conditions, 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.)

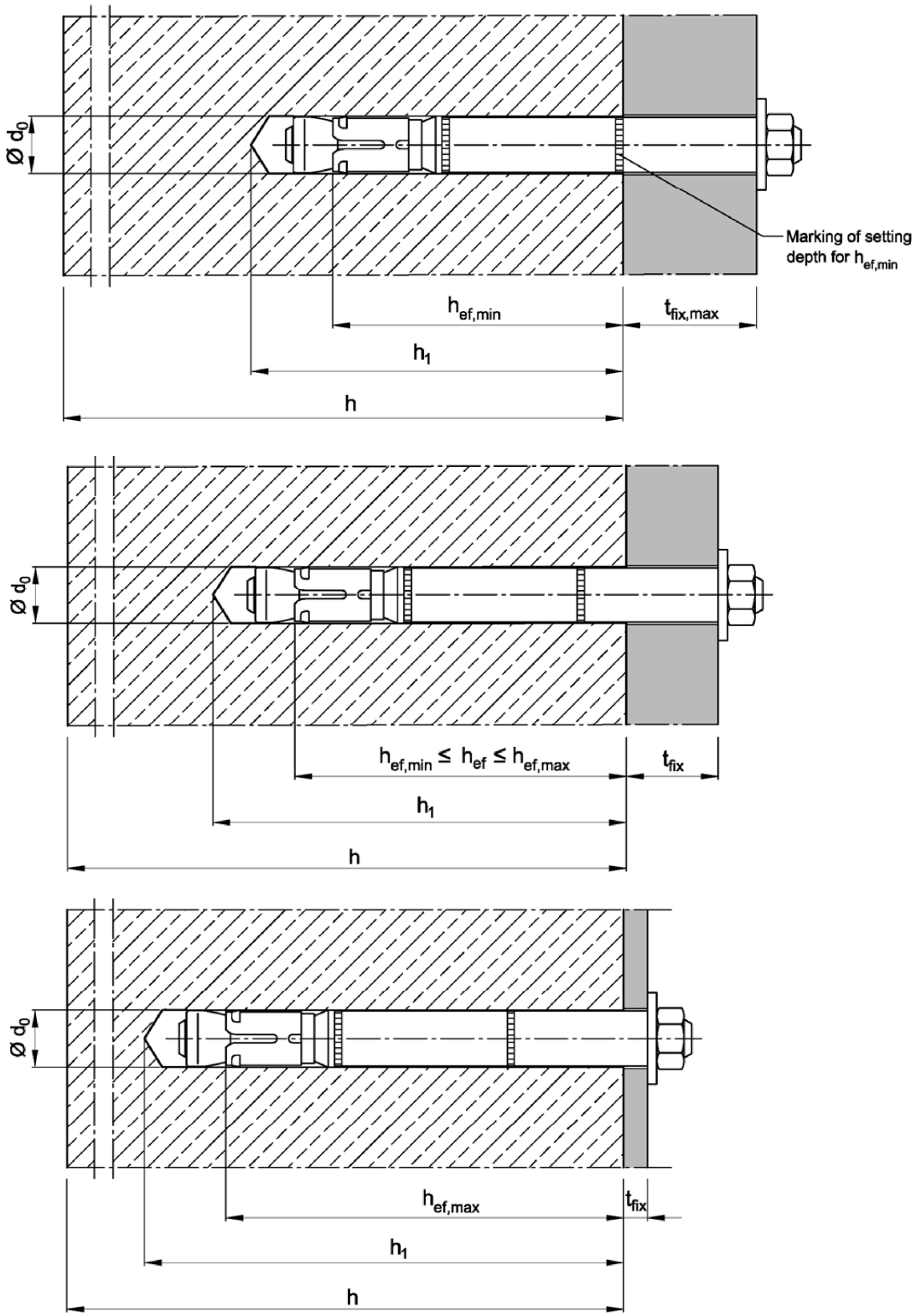
Design:

- 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 fastener is indicated on the design drawings (e.g. position of the fastener relative to reinforcement or to supports, etc.).
- Design according to EN 1992-4:2018 and Technical Report TR055

Installation:

- Fastener installation carried out by appropriately qualified personnel and under the obligation of the person responsible for technical matters on site.
- Compliance with the effective anchorage depth. For fastenings with anchorage depths $h_{ef} > h_{ef,min}$ the usable thickness of fixture is reduced by $h_{ef} - h_{ef,min}$.
- Use as supplied by the manufacturer without replacing individual parts.
- Drilling of hole only by hammer drilling (use of vacuum drill bits is admissible)

Installation situation



Highload Anchor SZ

Intended use
Installation situation

Annex B2

Table B1: Installation parameters, steel zinc plated

Fastener size			10/M6	12/M8	15/M10	18/M12	24/M16	24/ M16L	28/M20	32/M24
Size of thread		[-]	M6	M8	M10	M12	M16	M16	M20	M24
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	50	60	71	80	100	115	125	150
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	76	100	110	130	114	150	185	210
Nominal diameter of drill bit	d_0 =	[mm]	10	12	15	18	24	24	28	32
Cutting diameter of drill bit	$d_{cut} \leq$	[mm]	10,45	12,5	15,5	18,5	24,55	24,55	28,55	32,7
Depth of drill hole	$h_1 \geq$	[mm]	h_{ef} + 15	h_{ef} + 20	h_{ef} + 24	h_{ef} + 25	h_{ef} + 30	h_{ef} + 30	h_{ef} + 35	h_{ef} + 30
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	12	14	17	20	26	26	31	35
Thickness of countersunk washer SZ-SK	t_{sk}	[mm]	4	5	6	7	-	-	-	-
Minimum thickness of fixture SZ-SK	$t_{fix\ min}$ [2)]	[mm]	8	10	14	18	-	-	-	-
Installation torque	T_{inst} (SZ-B, SZ-S)	[Nm]	15	30	50	80	160	160	280	280
	T_{inst} (SZ-SK)	[Nm]	10	25	55	70	-	-	-	-
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 50	h_{ef} + 60	h_{ef} + 69	h_{ef} + 80	h_{ef} + 100	h_{ef} + 115	h_{ef} + 125	h_{ef} + 150
Minimum spacing [1) 3)]	s_{min}	[mm]	50	50	60	70	100	100	125	150
cracked concrete	for c ≥	[mm]	50	80	120	140	180	180	300	300
Minimum edge distance [1) 3)]	c_{min}	[mm]	50	55	60	70	100	100	200	150
cracked concrete	for s ≥	[mm]	50	100	120	160	220	220	350	300
Minimum spacing [1) 3)]	s_{min}	[mm]	50	60	60	70	100	100	125	150
uncracked concrete	for c ≥	[mm]	80	100	120	140	180	180	300	300
Minimum edge distance [1) 3)]	c_{min}	[mm]	50	60	60	70	100	100	200	150
uncracked concrete	for s ≥	[mm]	100	120	120	160	220	220	350	300

[1)] Intermediate values by linear interpolation
[2)] 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).
[3)] For fire exposure from more than one side c ≥ 300 mm or c_{min} ≥ 300 mm applies.

Highload Anchor SZ

Intended use
Installation parameters, **steel zinc plated**

Annex B3

Table B2: Installation parameters, stainless steel A4

Fastener size			12/M8	15/M10	18/M12	24/M16
Size of thread		[-]	M8	M10	M12	M16
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	60	71	80	100
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	100	110	130	150
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]	h_{ef} + 20	h_{ef} + 24	h_{ef} + 25	h_{ef} + 30
Diameter of clearance hole in the fixture	$d_f \leq$	[mm]	14	17	20	26
Thickness of countersunk washer SZ-SK	t_{sk}	[mm]	5	6	7	-
Minimum thickness of fixture SZ-SK	$t_{fix\ min}$ [2)]	[mm]	10	14	18	-
Installation torque	T_{inst} (SZ-B)	[Nm]	35	55	90	170
	T_{inst} (SZ-S)	[Nm]	30	50	80	170
	T_{inst} (SZ-SK)	[Nm]	17,5	42,5	50	-
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 60	h_{ef} + 69	h_{ef} + 80	h_{ef} + 100
Minimum spacing [1) 3)]	s_{min}	[mm]	50	60	70	80
cracked concrete	for c ≥	[mm]	80	120	140	180
Minimum edge distance [1) 3)]	c_{min}	[mm]	50	60	70	80
cracked concrete	for s ≥	[mm]	80	120	160	200
Minimum spacing [1) 3)]	s_{min}	[mm]	50	60	70	80
uncracked concrete	for c ≥	[mm]	80	120	140	180
Minimum edge distance [1) 3)]	c_{min}	[mm]	50	85	70	180
uncracked concrete	for s ≥	[mm]	80	185	160	80

[1)] Intermediate values by linear interpolation
[2)] 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).
[3)] For fire exposure from more than one side c ≥ 300 mm or c_{min} ≥ 300 mm applies.

Installation instructions

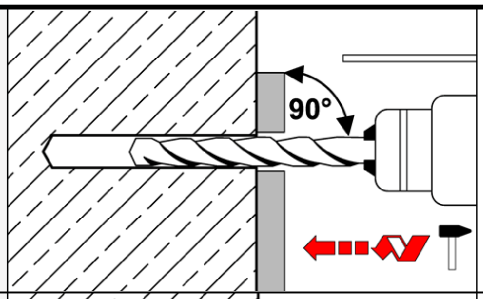
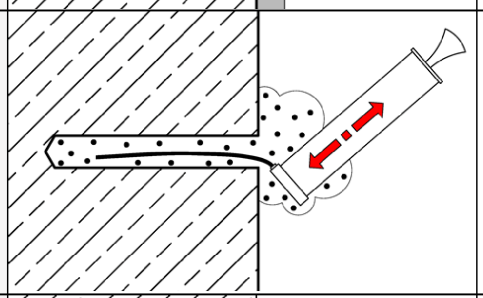
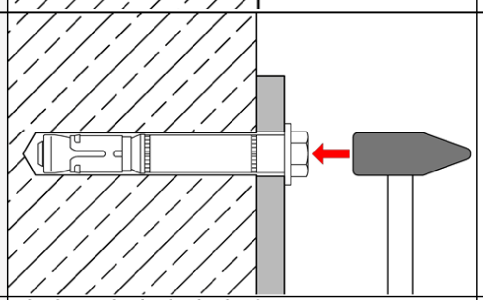
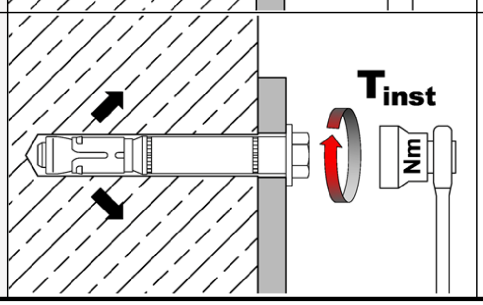
1		Drill hole perpendicular to concrete surface. If using a vacuum drill bit, proceed with step 3.
2		Blow out dust. Alternatively vacuum clean down to the bottom of the hole.
3		Drive in fastener.
4		Apply installation torque T_{inst}.

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

Fastener size			**10/M6**	**12/M8**	**15/M10**	**18/M12**	**24/M16**	**24/ M16L**	**28/M20**	**32/M24**
Installation factor	γ_{inst}	[-]	1,0							
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	16	29	46	67	126	126	196	282
Partial factor	γ_{Ms}	[-]	1,5							
Pull-out failure										
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	5	12	16	25	36	44	50	65
Increasing factor for $N_{Rk,p}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$							
Concrete cone failure										
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	50	60	71	80	100	115	125	150
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	76	100	110	130	114	150	185	210
Factor for cracked concrete	$k_1 = k_{cr,N}$	[-]	7,7							

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**
Installation factor	γ_{inst}	[-]	1,0			
Steel failure						
SZ-B						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial factor	γ_{Ms}	[-]	1,5			
SZ-S and SZ-SK						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial factor	γ_{Ms}	[-]	1,87			
Pull-out failure						
Characteristic resistance in cracked concrete C20/25	$N_{Rk,p}$	[kN]	9	16	25	36
Increasing factor for $N_{Rk,p}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$			
Concrete cone failure						
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	60	71	80	100
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	100	110	130	150
Factor for cracked concrete	$k_1 = k_{cr,N}$	[-]	7,7			

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

Fastener size			**10/M6**	**12/M8**	**15/M10**	**18/M12**	**24/M16**	**24/ M16L**	**28/M20**	**32/M24**
Installation factor	γ_{inst}	[-]	1,0							
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	16	29	46	67	126	126	196	282
Partial factor	γ_{Ms}	[-]	1,5							
Pull-out failure										
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	17	20	30	36	50	[1]	70	[1]
Increasing factor for $N_{Rk,p}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$					-	$\left(\frac{f_{ck}}{20}\right)^{0,5}$	-
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	70
Edge distance	$c_{cr,sp}$	[mm]	1,5 h_{ef}							
Increasing factor for $N^0_{Rk,sp}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$							
Case 2										
Characteristic resistance in uncracked concrete	$N^0_{Rk,sp}$	[kN]	min ($N_{Rk,p}$; $N^0_{Rk,c}$)							
Edge distance	$c_{cr,sp}$	[mm]	2,5 h_{ef}					1,5 h_{ef}	2,5 h_{ef}	2 h_{ef}
Concrete cone failure										
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	50	60	71	80	100	115	125	150
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	76	100	110	130	114	150	185	210
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}							
Factor for uncracked concrete	$k_1 = k_{ucr,N}$	[-]	11,0							

[1] $N_{Rk,p} = N^0_{Rk,c}$ calculated with $h_{ef,min}$

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**
Installation factor	γ_{inst}	[-]	1,0			
Steel failure						
SZ-B						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial factor	γ_{Ms}	[-]	1,5			
SZ-S and SZ-SK						
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	60	110
Partial factor	γ_{Ms}	[-]	1,87			
Pull-out failure						
Characteristic resistance in uncracked concrete C20/25	$N_{Rk,p}$	[kN]	16	25	35	50
Increasing factor for $N_{Rk,p}$	ψ_C	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,5}$			
Splitting failure						
Edge distance	$c_{cr,sp}$	[mm]	180	235	265	300
Concrete cone failure						
Minimum effective anchorage depth	$h_{ef,min}$	[mm]	60	71	80	100
Maximum effective anchorage depth	$h_{ef,max}$	[mm]	100	110	130	150
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}			
Factor for uncracked concrete	$k_1 = k_{ucr,N}$	[-]	11,0			

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

Fastener size			**10/M6**	**12/M8**	**15/M10**	**18/M12**	**24/M16**	**24/ M16L**	**28/M20**	**32/M24**
Steel failure without lever arm										
SZ-B										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	16	25	36	63	91	91	122	200
Ductility factor	k_7	[-]	1,0							
Partial factor	γ_{Ms}	[-]	1,25							
SZ-S and SZ-SK										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	18	30	48	73	126	126	150	200
Ductility factor	k_7	[-]	1,0							
Partial factor	γ_{Ms}	[-]	1,25							
Steel failure with lever arm										
SZ-B, SZ-S und SZ-SK										
Anchorage depth	$h_{ef,min} \geq$	[mm]	50	60	71	80	100	115	125	150
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	12	30	60	105	266	266	519	898
Partial factor	γ_{Ms}	[-]	1,25							
Anchorage depth	$h_{ef} \geq$	[mm]	64	73	90	106	138	138	158	188
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	40	58	119	234	529	529	847	1343
Partial factor	γ_{Ms}	[-]	1,25							
Concrete pry-out failure										
Pry-out factor	k_8	[-]	1,8 [1)]	2,0						
Concrete edge failure										
Effective length of fastener in shear loading	l_f	[mm]	h_{ef}							
Outside diameter of fastener	d_{nom}	[mm]	10	12	15	18	24	24	28	32

[1)] $k_8 = 2,0$ for $h_{ef} \geq 60$ mm

Highload Anchor SZ	
Performance Characteristic values for **shear load**, static or quasi-static action, **steel zinc plated**	**Annex C5**

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**
Steel failure without lever arm						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	24	37	62	92
SZ-B						
Ductility factor	k_7	[-]	1,0			
Partial factor	γ_{Ms}	[-]	1,25			
SZ-S						
Ductility factor	k_7	[-]	1,0			
Partial factor	γ_{Ms}	[-]	1,36			
SZ-SK						
Ductility factor	k_7	[-]	0,8			-
Partial factor	γ_{Ms}	[-]	1,36			-
Steel failure with lever arm						
Anchorage depth	$h_{ef,min} \geq$	[mm]	60	71	80	100
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	232
SZ-B						
Partial factor	γ_{Ms}	[-]	1,25			
SZ-S and SZ-SK						
Partial factor	γ_{Ms}	[-]	1,56			
SZ-B, SZ-S and SZ-SK						
Anchorage depth	$h_{ef} \geq$	[mm]	73	90	106	138
Characteristic bending resistance	$M^0_{Rk,s}$	[Nm]	103	211	374	847
Partial factor	γ_{Ms}	[-]	1,25			
Concrete pry-out failure						
Pry-out factor	k_8	[-]	2,0			
Concrete edge failure						
Effective length of fastener in shear loading	l_f	[mm]	h_{ef}			
Outside diameter of fastener	d_{nom}	[mm]	12	15	18	24

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**	**24/M16L**	**28/M20**	**32/M24**
Tension load									
Installation factor	γ_{inst}	[-]	1,0						
Steel failure									
Characteristic resistance category **C1**	$N_{Rk,s,eq,C1}$	[kN]	29	46	67	126	126	196	282
Characteristic resistance category **C2**	$N_{Rk,s,eq,C2}$	[kN]	29	46	67	126	126	196	282
Partial factor	γ_{Ms}	[-]	1,5						
Pull-out failure									
Characteristic resistance category **C1**	$N_{Rk,p,eq,C1}$	[kN]	12	16	25	36	44,4	50,3	63,3
Characteristic resistance category **C2**	$N_{Rk,p,eq,C2}$	[kN]	5,4	16,4	22,6	29,0	41,2	43,6	63,3
Shear load									
Steel failure without lever arm									
SZ-B									
Characteristic resistance category **C1**	$V_{Rk,s,eq,C1}$	[kN]	18,0	27,1	43,4	51,9	51,9	96,4	160,1
Characteristic resistance category **C2**	$V_{Rk,s,eq,C2}$	[kN]	12,7	20,5	31,5	50,1	50,1	67,1	108,1
SZ-S									
Characteristic resistance category **C1**	$V_{Rk,s,eq,C1}$	[kN]	18,0	27,1	43,4	51,9	51,9	96,4	160,1
Characteristic resistance category **C2**	$V_{Rk,s,eq,C2}$	[kN]	12,7	20,5	31,5	69,3	69,3	67,1	108,1
SZ-SK									
Characteristic resistance category **C1**	$V_{Rk,s,eq,C1}$	[kN]	25,2	36,5	50,4	-	-	-	-
Characteristic resistance category **C2**	$V_{Rk,s,eq,C2}$	[kN]	19,2	29,3	39,4	-	-	-	-
Factor for annular gap	α_{gap}	[-]	0,5						
Partial factor	γ_{Ms}	[-]	1,25						

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**
Tension load						
Installation factor	γ_{inst}	[-]	1,0			
Steel failure						
Characteristic resistance, category **C1**	$N_{Rk,s,eq,C1}$	[kN]	26	41	60	110
Characteristic resistance, category **C2**	$N_{Rk,s,eq,C2}$	[kN]	26	41	60	110
Partial factor **SZ-B**	γ_{Ms}	[-]	1,5			
Partial factor **SZ-S and SZ-SK**	γ_{Ms}	[-]	1,87			
Pull-out failure						
Characteristic resistance, category **C1**	$N_{Rk,p,eq,C1}$	[kN]	9	16	26	36
Characteristic resistance, category **C2**	$N_{Rk,p,eq,C2}$	[kN]	4,8	16,5	24,8	44,5
Shear load						
Steel failure without lever arm						
SZ-B						
Characteristic resistance, category **C1**	$V_{Rk,s,eq,C1}$	[kN]	9,6	13,3	25,4	75,4
Characteristic resistance, category **C2**	$V_{Rk,s,eq,C2}$	[kN]	9,7	14,0	18,0	32,2
Partial factor	γ_{Ms}	[-]	1,25			
SZ-S						
Characteristic resistance, category **C1**	$V_{Rk,s,eq,C1}$	[kN]	9,6	13,3	25,4	75,4
Characteristic resistance, category **C2**	$V_{Rk,s,eq,C2}$	[kN]	9,7	14,0	18,0	32,2
Partial factor	γ_{Ms}	[-]	1,36			
SZ-SK						
Characteristic resistance, category **C1**	$V_{Rk,s,eq,C1}$	[kN]	11,5	23,3	31,6	-
Characteristic resistance, category **C2**	$V_{Rk,s,eq,C2}$	[kN]	10,8	17,4	15,4	-
Partial factor	γ_{Ms}	[-]	1,36			-
Factor for annular gap	α_{gap}	[-]	0,5			

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

Fastener size				10/M6	12/M8	15/M10	18/M12	24/M16	24/ M16L	28/M20	32/M24
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	26,3
	R60			0,8	1,5	3,2	4,6	8,6		13,5	19,5
	R90			0,6	1,0	2,1	3,0	5,0		7,7	12,6
	R120			0,4	0,8	1,5	2,0	3,1		4,9	9,2
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	26,3
	R60			0,8	1,5	3,2	4,6	8,6		13,5	19,5
	R90			0,6	1,0	2,1	3,0	5,0		7,7	12,6
	R120			0,4	0,8	1,5	2,0	3,1		4,9	9,2
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 bending resistance	R30	$M^0_{Rk,s,fi}$	[Nm]	0,8	2,0	5,6	9,7	24,8		42,4	83,6
	R60			0,6	1,5	4,1	7,2	18,3		29,8	61,9
	R90			0,4	1,0	2,7	4,7	11,9		17,1	40,1
	R120			0,3	0,8	1,9	3,1	6,6		10,7	29,2
Stainless steel A4											
Characteristic bending 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	-	-	-

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

Fastener size			10/ M6	12/ M8	15/ M10	18/ M12	24/ M16	24 /M16L	28/ M20	32/ M24
Tension load										
Tension load in cracked concrete	N	[kN]	2,4	5,7	7,6	12,3	17,1	21,1	24	26,2
Displacement	δ_{N0}	[mm]	0,5	0,5	0,5	0,7	0,8	0,7	0,9	1,4
	$\delta_{N\infty}$	[mm]	2,0	2,0	1,3	1,3	1,3	1,3	1,4	1,9
Tension load in uncracked concrete	N	[kN]	8,5	9,5	14,3	17,2	24	29,6	34	43
Displacement	δ_{N0}	[mm]	0,8	1,0	1,1			1,3	0,3	0,7
	$\delta_{N\infty}$	[mm]	3,4		1,7			2,3	1,4	0,7
Seismic action C2										
Displacement for DLS	$\delta_{N,eq\ (DLS)}$	[mm]	-	3,3	3,0	5,0	3,0	3,0	4,0	5,3
Displacement for ULS	$\delta_{N,eq\ (ULS)}$	[mm]	-	12,2	11,3	16,0	9,2	9,2	13,8	12,4
Shear load										
SZ-B										
Shear load in cracked and uncracked concrete	V	[kN]	9,1	14	20,7	35,1	52,1	52,1	77	86,6
Displacement	δ_{V0}	[mm]	2,5	2,1	2,7	3,0	5,1	5,1	4,3	10,5
	$\delta_{V\infty}$	[mm]	3,8	3,1	4,1	4,5	7,6	7,6	6,5	15,8
Seismic action C2										
Displacement for DLS	$\delta_{V,eq\ (DLS)}$	[mm]	-	2,3	3,1	3,0	2,6	2,6	1,6	6,1
Displacement for ULS	$\delta_{V,eq\ (ULS)}$	[mm]	-	4,8	6,4	6,1	6,6	6,6	4,8	9,5
SZ-S										
Shear load in cracked and uncracked concrete	V	[kN]	10,1	17,1	27,5	41,5	72	72	77	86,6
Displacement	δ_{V0}	[mm]	2,9	2,5	3,6	3,5	7,0	7,0	4,3	10,5
	$\delta_{V\infty}$	[mm]	4,4	3,8	5,4	5,3	10,5	10,5	6,5	15,8
Seismic action C2										
Displacement for DLS	$\delta_{V,eq\ (DLS)}$	[mm]	-	2,3	3,1	3,0	3,3	3,3	1,6	6,1
Displacement for ULS	$\delta_{V,eq\ (ULS)}$	[mm]	-	4,8	6,4	6,1	8,2	8,2	4,8	9,5
SZ-SK										
Shear load in cracked and uncracked concrete	V	[kN]	10,1	17,1	27,5	41,5	-	-	-	-
Displacement	δ_{V0}	[mm]	2,9	2,5	3,6	3,5	-	-	-	-
	$\delta_{V\infty}$	[mm]	4,4	3,8	5,4	5,3	-	-	-	-
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	-	-	-	-

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

Fastener size			**12/M8**	**15/M10**	**18/M12**	**24/M16**
Tension load						
Tension load in cracked concrete	N	[kN]	4,3	7,6	12,1	17,0
Displacement	δ_{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	δ_{N0}	[mm]	0,2	0,3	1,2	1,5
	$\delta_{N\infty}$	[mm]	1,1	1,1	1,1	1,1
Seismic action C2						
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
Shear load						
Shear load in cracked concrete	V	[kN]	13,9	21,1	34,7	50,8
Displacement	δ_{V0}	[mm]	3,4	4,9	4,8	6,7
	$\delta_{V\infty}$	[mm]	5,1	7,4	7,1	10,1
Seismic action C2						
SZ-B and SZ-S						
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
SZ-SK						
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	-