Designated according to The Construction Products (Amendment etc.) (EU Exit) Regulations 2020

UK Technical Assessment	UKTA-0836-22/6209 of 16/09/2022
Technical Assessment Body issuing the UK Technical Assessment:	British Board of Agrément
Trade name of the construction product:	Highload Anchor SZ
Product family to which the construction product belongs:	Mechanical fasteners for use in concrete
Manufacturer:	MKT-Metall-Kunststoff-Technik GmbH & Co. KG Auf dem Immel 2 67685 Weilerbach Germany
Manufacturing plant(s):	MKT-Metall-Kunststoff-Technik GmbH & Co. KG Auf dem Immel 2 67685 Weilerbach Germany
This UK Technical Assessment contains:	23 pages including 3 annexes which form an integral part of this assessment
This UK Technical Assessment is issued in accordance with The Construction Products (Amendment etc.) (EU Exit) Regulations 2020 on the basis of:	UKAD 330232-00-0601: *Mechanical fasteners for use in concrete*

1 Technical description of the product

The Highload Anchor SZ is an anchor manufactured of galvanized steel or manufactured of stainless steel which is placed into a drilled hole and anchored by torque-controlled expansion. The following anchor types are covered:

- Anchor type SZ-B with threaded bolt,
- Anchor type SZ-S with hexagon head screw,
- Anchor type SZ-SK with countersunk washer and countersunk screw.

The product description is given in Annex A.

2 Specification of the intended use(s) in accordance with the applicable UK Assessment Document (hereinafter UKAD)

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 UK 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) Method A	See Annex C1 to C4
Characteristic resistance to shear load (static and quasi static loading)	See Annex C5 and C6
Characteristic resistance for seismic performance categories C1 and C2	See Annex C7 and C8
Displacements	See Annex C10 and C11
Durability	See Annex B1

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C9

3.3 Hygiene, health and the environment (BWR 3)

Not relevant

3.4 Safety and accessibility in use (BWR 4)

Not relevant

3.5 Protection against noise (BWR 5)

Not relevant

3.6 Energy economy and heat retention (BWR 6)

Not relevant

3.7 Sustainable use of natural resources (BWR 7)

Performance not assessed

4 Assessment and verification of constancy of performance (hereinafter AVCP) system applied

According to UKAD No. 330232-00-0601 and Annex V of the Construction Products Regulation (Regulation (EU) 305/2011) as brought into UK law and amended, the system of assessment and verification of constancy of performance (AVCP) 1 applies.

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable UKAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with the British Board of Agrément and made available to the UK Approved Bodies involved in the conformity attestation process.

5.1 UKCA marking for the product/ system must contain the following information:

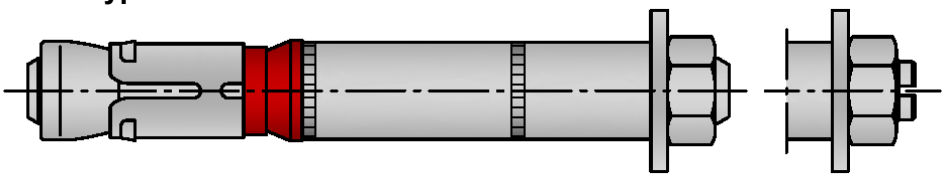
- Identification number of the Approved Body
- Name/address of the manufacturer of the product/ system
- Marking with intention of clarification of intended use
- Date of marking
- Number of certificate of constancy of performance
- UKTA number.

On behalf of the British Board of Agrément 	
Date of Issue: 16 September 2022	**Hardy Giesler** Chief Executive Officer

British Board of Agrément,
1st Floor Building 3,
Hatters Lane,
Croxley Park
Watford
WD18 8YG

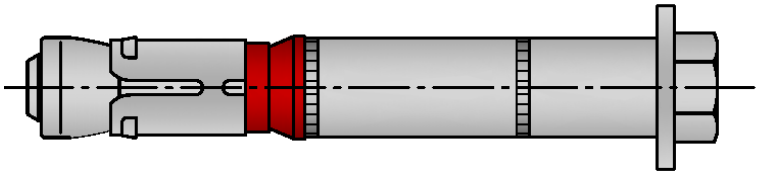
ANNEX A1
Product description / Installation

Fastener type SZ-B with threaded bolt



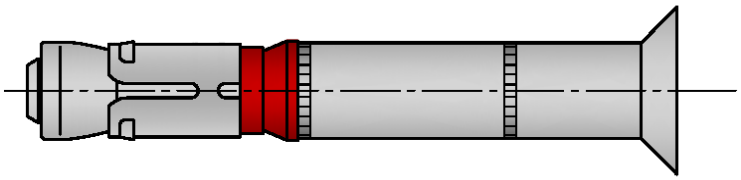
SZ-B (M6-M24)
SZ-B (M8-M16) A4

Fastener type SZ-S with hexagon head screw



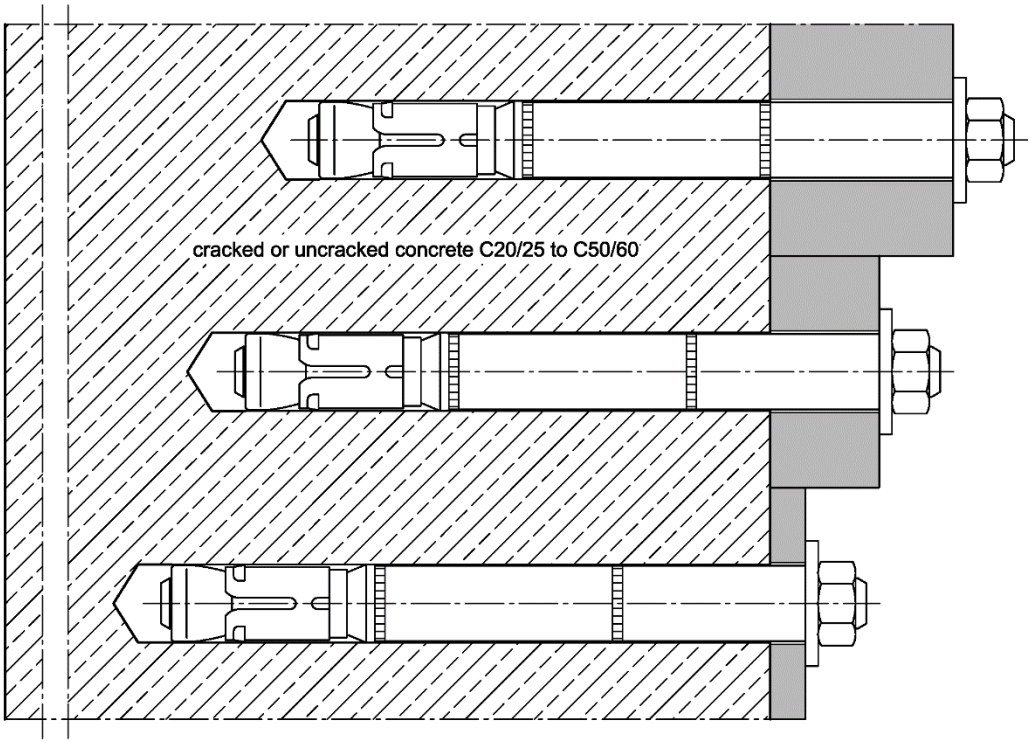
SZ-S (M6-M24)
SZ-S (M8-M16) A4

Fastener type SZ-SK with countersunk washer and countersunk screw



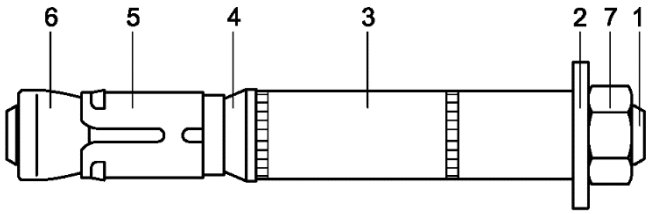
SZ-SK (M6-M12)
SZ-SK (M8-M12) A4

Installation situation

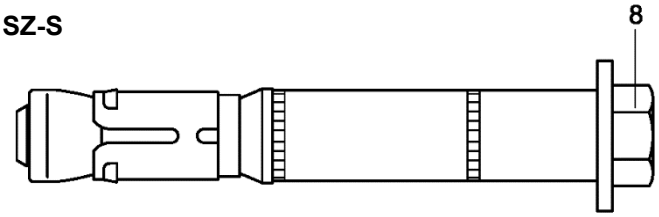


ANNEX A2
Product description / Marking and materials

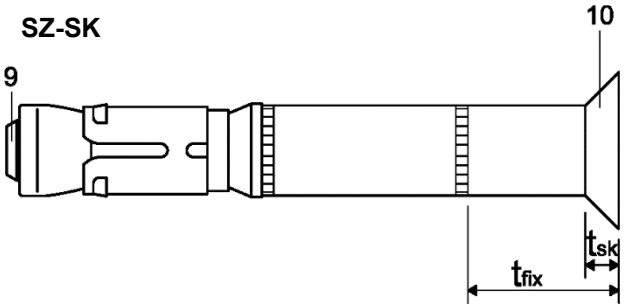
SZ-B



SZ-S



SZ-SK



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 $t_{fix,max}$ for $h_{ef,min}$ 25
- additional marking for countersunk version SK

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

Table A1: Designation of fastener parts and materials

Part	Designation	Materials galvanized ≥ 5 μm, 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 10088:2014
2	Washer	Steel, EN 10139:2016	Stainless steel, EN 10088:2014
3	Distance sleeve	Steel tube EN 10305-2:2016, EN 10305-3:2016;	Steel tube stainless steel, 1.4401, 1.4404 or 1.4571; EN 10217-7:2014, EN 10216-5:2013
4	Ring	Polyethylene	Polyethylene
5	Expansion sleeve	Steel, EN 10139:2016	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2014
6	Threaded cone	Steel EN 10083-2:2006	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2014
7	Hexagon nut	Steel, Strength class 8, EN ISO 898-2:2012	Stainless steel, strength class 70, EN ISO 3506-2:2009
8	Hexagon head screw	Steel, Strength class 8.8, EN ISO 898-1:2013	Stainless steel, strength class 70, EN ISO 3506-1:2009
9	Countersunk screw	Steel, Strength class 8.8, EN ISO 898-1:2013	Stainless steel, strength class 70, EN ISO 3506-1:2009
10	Countersunk washer	Steel, EN 10083-2:2006	Stainless steel, 1.4401, 1.4404 or 1.4571, EN 10088:2014, zinc plated

ANNEX B1
Intended Use / Specifications

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 fibres) 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:

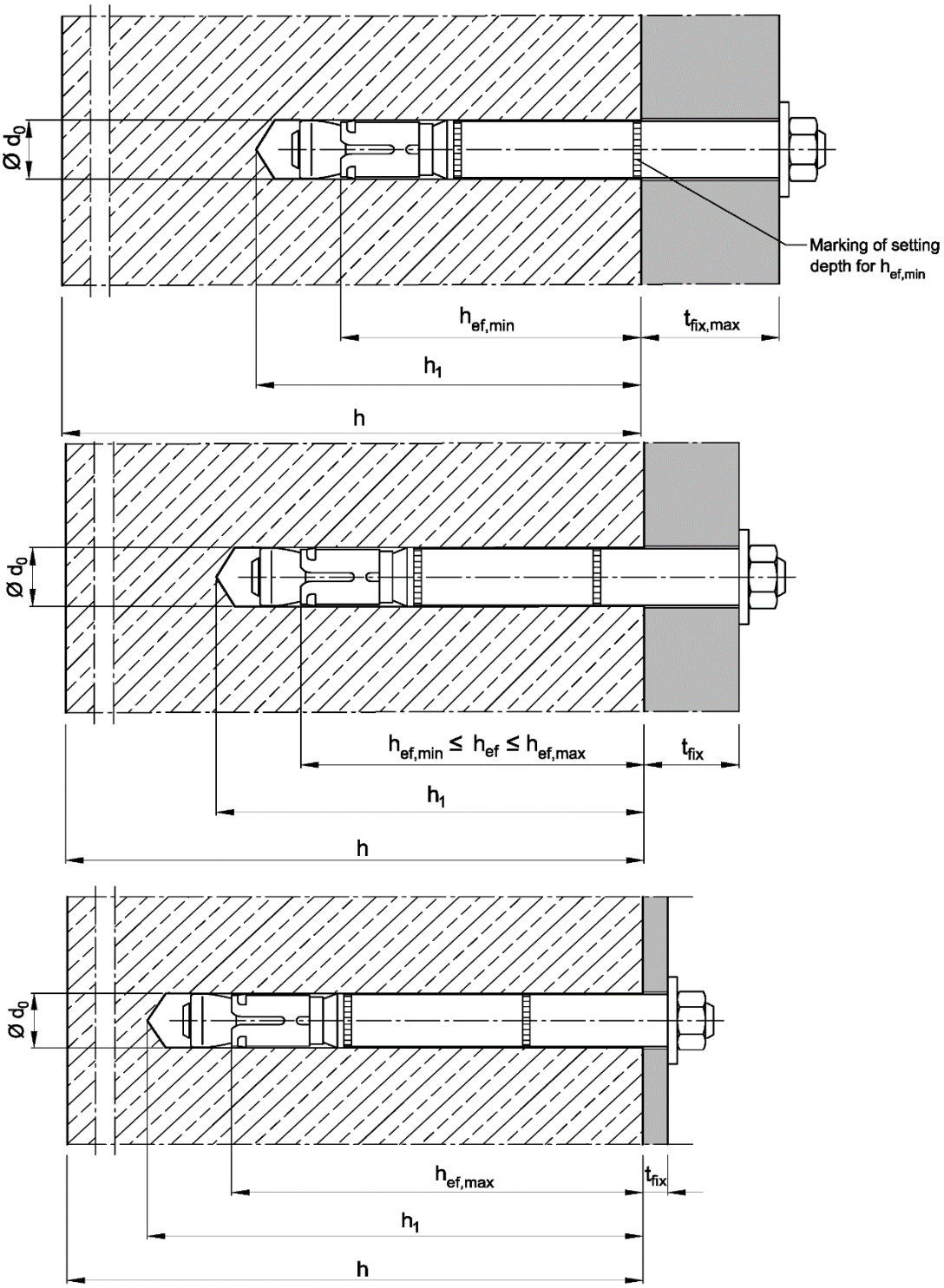
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e.g. position of the fastener 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)

ANNEX B2
Intended Use / Installation situation

Installation situation



ANNEX B3
Intended Use / Installation parameters, zinc plated steel

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.

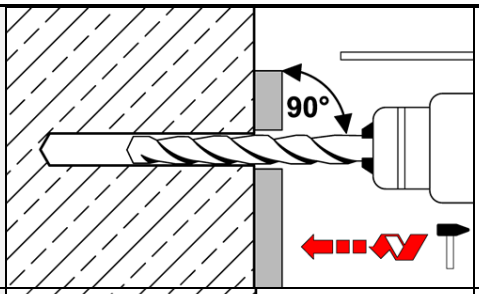
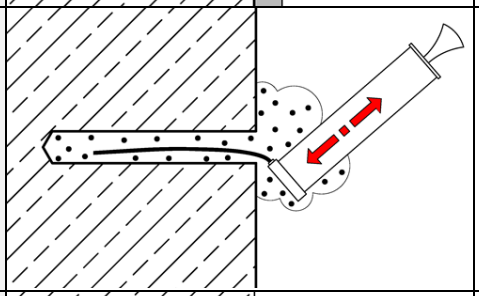
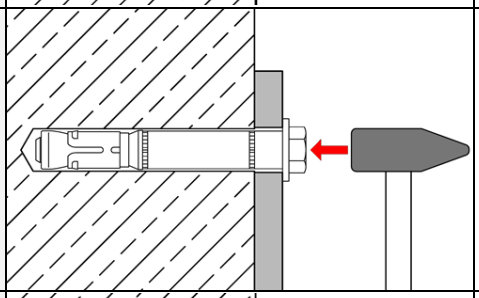
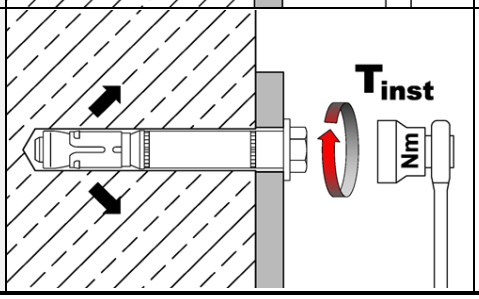
ANNEX B4
Intended Use / Installation parameters, stainless steel A4

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.

ANNEX B5
Intended Use / 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}.

ANNEX C1
Performance / Characteristics values for tensions loads, cracked concrete, zinc plated steel

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 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							

ANNEX C2
Performance / Characteristics values for tensions loads, cracked concrete, stainless steel A4

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			

ANNEX C3
Performance / Characteristics values for tensions loads, uncracked concrete, zinc plated steel

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 $h_{ef,min}$

ANNEX C4
Performance / Characteristics values for tensions loads, uncracked concrete, stainless steel A4

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			

ANNEX C5
Performance / Characteristics values for shear loads, zinc plated steel

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

ANNEX C6
Performance / Characteristics values for shear loads, stainless steel A4

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

ANNEX C7
Performance / Characteristics values for seismic action, zinc plated steel

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						

ANNEX C8
Performance / Characteristics values for seismic action, stainless steel A4

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			

ANNEX C9
Performance / Characteristics values under fire exposure

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	-	-	-

ANNEX C10
Performance / Displacements under tension and shear load, zinc plated steel

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	-	-	-	-

ANNEX C11
Performance / Displacements under tension and shear load, stainless steel A4

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	-

British Board of Agrément,
1st Floor Building 3
Hatters Lane
Croxley Park
Watford
WD18 8YG