INSTYTUT TECHNIKI BUDOWLANEJ

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European Technical Assessment

ETA-17/0679 of 03/11/2025

General Part

Technical Assessment Body issuing the European Technical Assessment	Instytut Techniki Budowlanej
Trade name of the construction product	RAMSAUER Anker Kleber 680
Product family to which the construction product belongs	Bonded fasteners for use in concrete
Manufacturer	Ramsauer GmbH & Co KG Alte Bundestrasse 147 5350 Strbl Austria
Manufacturing plant	Ramsauer GmbH & Co KG Manufacturing plant 1
This European Technical Assessment contains	32 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	European Assessment Document (EAD) 330499-02-0601 "Bonded fasteners and bonded expansion fasteners for use in concrete"
This version replace	ETA-17/0679 issued on 02/08/2017

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Specific Part

1 Technical description of the product

RAMSAUER Anker Kleber 680 are bonded fasteners (injection type) consisting of an injection mortar cartridge using an applicator gun equipped with a special mixing nozzle and steel element: commercial threaded rod of the sizes M8 to M30 with hexagon nut and washer or reinforcing bar (rebar) Ø8 to Ø32 mm.

The steel element is placed into a drilled hole previously injected (using an applicator gun) with a mortar with a slow and slight twisting motion. The steel element is anchored by the bond between steel element, mortar and concrete.

An illustration and the description of the products are given in Annex A.

2 Specification of the intended use in accordance with the applicable European Assessment Document (EAD)

The performances given in clause 3 are only valid if the fasteners are used in compliance with the specifications and conditions given in Annex B.

The provisions made in this European Technical Assessment are based on an assumed working life of the fastener of 50 and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer or the Technical Assessment Body, 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 Performance of the product

3.1.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load and shear load (static and quasi static loading), displacements	See Annex C1 to C7
Characteristic resistance for seismic performance category C1	See Annex C8
Characteristic resistance for seismic performance category C2	See Annex C9

3.1.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C10 to C12

3.2 Methods used for the assessment

The assessment has been made in accordance with EAD 330499-02-0601.

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

According to Decision 96/582/EC of the European Commission the system 1 of assessment and verification of constancy of performance applies (see Annex V to regulation (EU) No 305/2011).

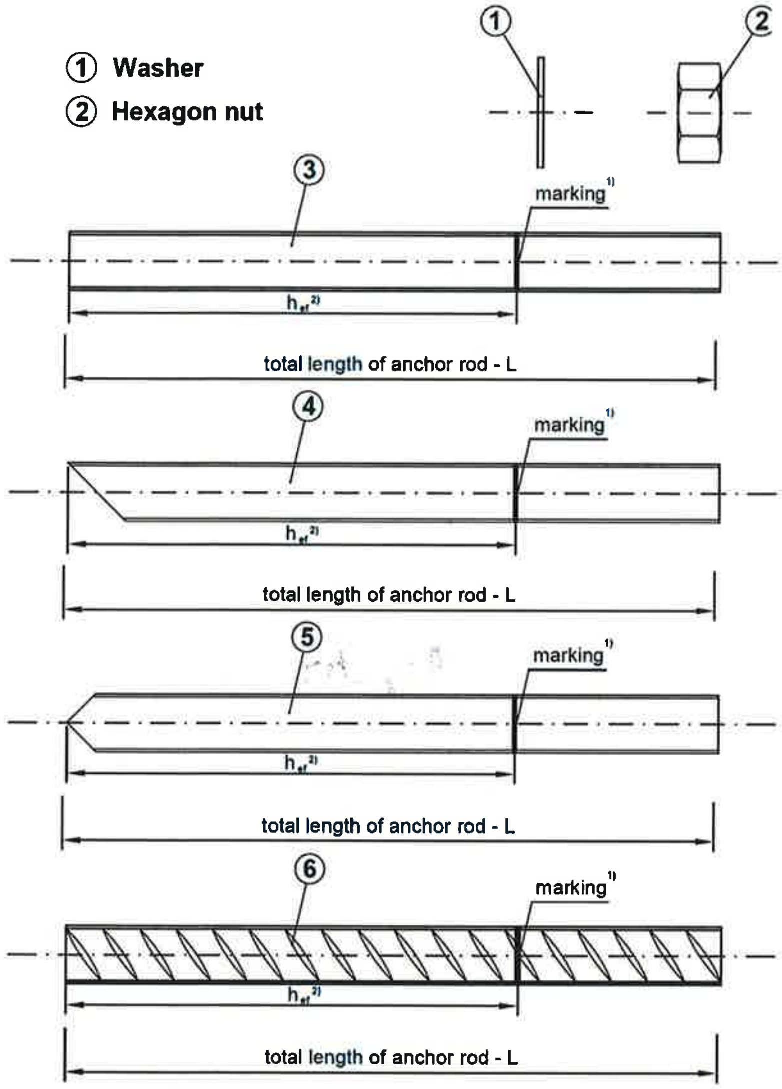
5 Technical details necessary for the implementation of the AVCP system, as provided in the applicable European Assessment Document (EAD)

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited in Instytut Techniki Budowlanej.

For type testing the results of the tests performed as part of the assessment for the European Technical Assessment shall be used unless there are changes in the production line or plant. In such cases the necessary type testing has to be agreed between Instytut Techniki Budowlanej and the notified body.

Issued in Warsaw on 03/11/2025 by Instytut Techniki Budowlanej

Anna Panek, MSc
Deputy Director of ITB



Filling washer
(to fill annular gap)

3) Version 1 – rod with flat end with marking on h_{ef}

4) Version 2 – rod with 45° cutted end with marking on h_{ef}

5) Version 3 – rod with V shape end with marking on h_{ef}

6) Rebar – ribbed reinforcing bar with marking on h_{ef}

1) Marking according to clause 1.1 of EAD 330499-02-0601
2) Effective anchorage depth according to Table B1 and B2 (Annex B2 and B3)

RAMSAUER Anker Kleber 680	**Annex A1** of European Technical Assessment ETA-17/0679
Product description Steel elements	

Table A1: Threaded rods

Designation	Material				
Steel, zinc plated **electroplated ≥ 5 µm acc. to EN ISO 4042** **hot-dip galvanized ≥ 40 µm acc. to EN ISO 1461**					
Threaded rod	**Property class**	**Characteristic steel ultimate strength**	**Characteristic steel yield strength**	**Fracture elongation**	EN ISO 898-1
	4.8	$f_{uk} \geq 400$ N/mm²	$f_{yk} \geq 320$ N/mm²	$A_5 > 8\%$ [1)]	
	5.8	$f_{uk} \geq 500$ N/mm²	$f_{yk} \geq 400$ N/mm²	$A_5 > 8\%$ [1)]	
	8.8	$f_{uk} \geq 800$ N/mm²	$f_{yk} \geq 640$ N/mm²	$A_5 \geq 12\%$ [1)]	
	10.9	$f_{uk} \geq 1000$ N/mm²	$f_{yk} \geq 900$ N/mm²	$A_5 > 9\%$ [1)]	
Hexagon nut	4	for class 4.8 rods			EN 898-2
	5	for class 5.8 rods			
	8	for class 8.8 rods			
	10	for class 10.9 rods			
Washer	Steel according to EN ISO 7089; corresponding to anchor rod material				
Stainless steel A2 **Stainless steel A4** **High corrosion resistance stainless steel (HCR)**	**(Materials) 1.4301, 1.4307, 1.4567, 1.4541** **(Materials) 1.4401, 1.4404, 1.4571, 1.4362, 1.4578** **(Materials) 1.4529, 1.4565**				
Threaded rod	**Property class**	**Characteristic steel ultimate strength**	**Characteristic steel yield strength**	**Fracture elongation**	EN 10088 EN ISO 3506
	50	$f_{uk} \geq 500$ N/mm²	$f_{yk} \geq 210$ N/mm²	$A_5 > 8\%$ [1)]	
	70	$f_{uk} \geq 700$ N/mm²	$f_{yk} \geq 450$ N/mm²	$A_5 \geq 12\%$ [1)]	
	80	$f_{uk} \geq 800$ N/mm²	$f_{yk} \geq 600$ N/mm²	$A_5 \geq 12\%$ [1)]	
Hexagon nut	50	for class 50 rods			EN 10088 EN ISO 3506
	70	for class 70 rods			
	80	for class 80 rods			
Washer	Steel according to EN 10088; corresponding to anchor rod material				

1) For seismic performance category C1 and C2, $A_5 > 19\%$

Commercial standard threaded rods may be used, with:

- material and mechanical properties according to Table A1,
- confirmation of material and mechanical properties by inspection certificate 3.1 according to EN 10204:2004,
- marking of the threaded rod with the embedment depth.

Note: Commercial standard threaded rods made of galvanized steel with property class above 8.8 are not permitted in some Member States.

RAMSAUER Anker Kleber 680	Annex A2 of European Technical Assessment ETA-17/0679
Product description Materials (1)	

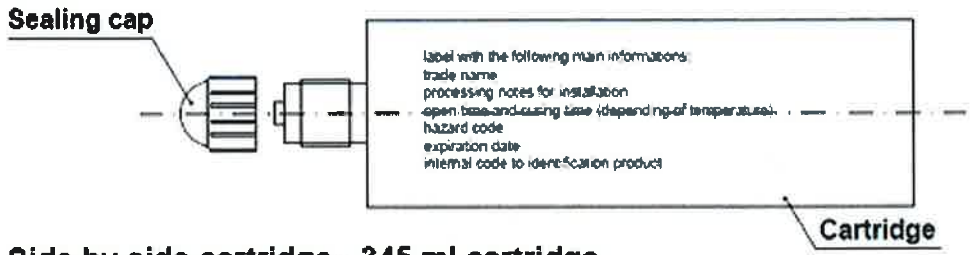
Table A2: Reinforcing bars (Rebar)

Designation	Material
Rebar according to EN 1992-1-1:2004+AC:2010	Bars and de-coiled rods Class B or C with f_{yk} and k according to EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$ Rib height of the bar (h) in the range 0,05d ≤ h ≤ 0,07d

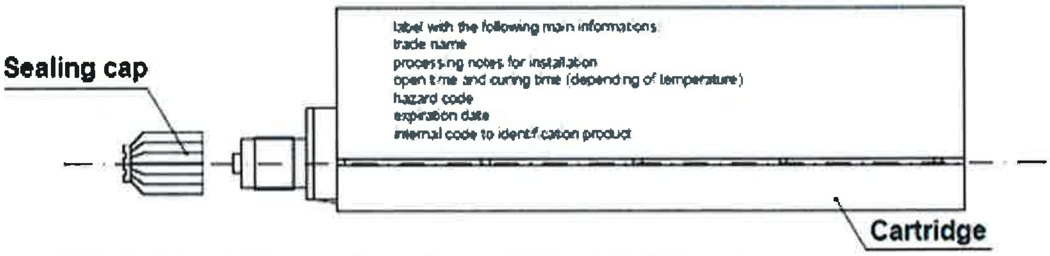
Table A3: Injection mortar

Product	Composition
RAMSAUER Anker Kleber 680 (two component injection mortar)	Additive: quartz Bonding agent: vinyl ester resin styrene free Hardener: dibenzoyl peroxide

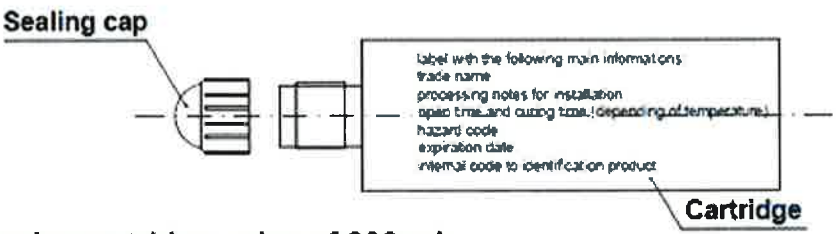
Coaxial cartridge - sizes from 75 ml to 420 ml



Side by side cartridge - 345 ml cartridge



CIC foil cartridge - sizes from 165 ml to 300 ml



Coaxial peeler cartridge - size of 280 ml

MIXER - the mixer is suitable for each type of cartridge

1) Variable length from 380 mm up to 1000 mm

RAMSAUER Anker Kleber 680	**Annex A4** of European Technical Assessment ETA-17/0679
Product description Cartridge types and sizes	

Specifications of intended use

Anchors subject to:

- Static and quasi-static loads: sizes from M8 to M30 and from Ø8 to Ø32.
- Seismic performance category C1: sizes from M12 to M20, rods with $f_{uk} \leq 800$ N/mm^2 and fracture elongation $A_5 \geq 19\%$.
- Seismic performance category C2: sizes M12 and M16, rods with $f_{uk} \leq 800$ N/mm^2 and fracture elongation $A_5 \geq 19\%$.
- Fire exposure: sizes from M10 to M20, steel class 5.8 to 8.8 and stainless steel A4.

Working life:

Working life of the bonded fasteners of 50 and/or 100 years.

Base material:

- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum to C50/60 at maximum according to EN 206.
- Uncracked concrete: sizes from M8 to M30 and from Ø8 to Ø32.
- Cracked concrete: sizes from M10 to M20.

Temperature range:

The anchors may be used in the following temperature range:

- -40°C to +40°C (max. short term temperature +40°C and max. long term temperature +24°C).
- -40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C).
- -40°C to +120°C (max. short term temperature +120°C and max. long term temperature +72°C).

Use conditions (environmental conditions):

- Structures subject to dry internal conditions: all materials according to Table A1 and A2.
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance class:
  - stainless steel A2 according to Annex A2, Table A1 - CRC II,
  - stainless steel A4 according to Annex A2, Table A1 - CRC III,
  - high corrosion resistance steel (HCR) according to Annex A2, Table A1 - CRC V.

Installation:

- Dry or wet concrete (use category I1): sizes from M8 to M30 and from Ø8 to Ø32.
- Flooded holes with the exception of seawater (use category I2): sizes from M8 to M30 and from Ø8 to Ø32.
- Installation direction D3 (downward and horizontal and upwards installation): sizes from M8 to M30 and from Ø8 to Ø32.
- The anchors are suitable for hammer drilled holes (HD), for hollow drill bit (HDB) and for compressed air drill (CA): sizes from M8 to M30 and from Ø8 to Ø32.

Design methods:

- 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 are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Anchorages under static or quasi-static loads are designed according to EN 1992-4 and EOTA Technical Report TR 055.
- Anchorages under seismic actions are designed according to EN 1992-4.
- Anchorages under fire exposure are designed according to EOTA Technical Report TR 082.

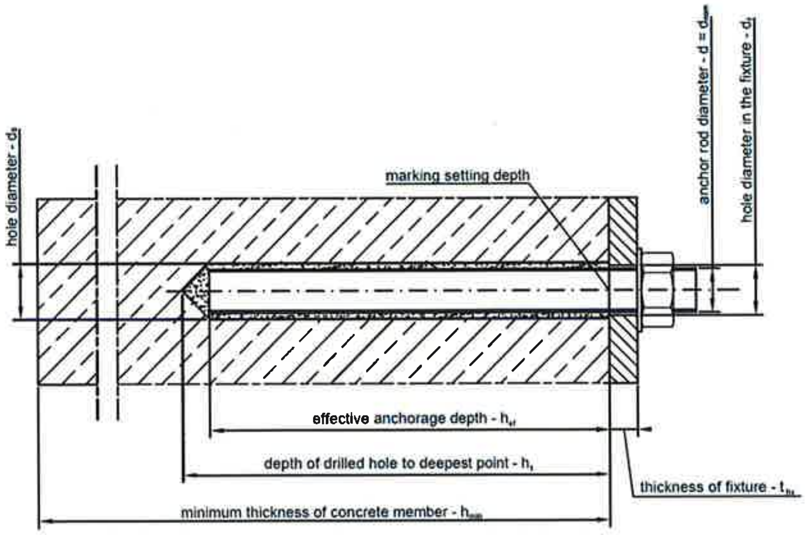


Table B1: Installation data for threaded rods

Size		M8	M10	M12	M16	M20	M24	M27	M30
Nominal drilling diameter	d_0 [mm]	10	12	14	18	22[1)] 24[1)]	28	30	35
Maximum diameter hole in the fixture	d_{fix} [mm]	9	12	14	18	22	26	30	33
Effective embedment depth	$h_{ef,min}$ [mm]	60	70	80	100	120	145	145	145
	$h_{ef,max}$ [mm]	160	200	240	320	400	480	540	600
Depth of the drilling hole	h_1 [mm]	h_{ef} + 5 mm							
Minimum thickness of the concrete slab	h_{min} [mm]	h_{ef} + 30 mm; ≥ 100 mm			$h_{ef} + 2d_0$				
Maximum setting torque moment	T_{fix} [N·m]	10	20	40	80	130	200	250	280
Thickness to be fixed	$t_{fix,min}$ [mm]	> 0							
	$t_{fix,max}$ [mm]	< 1500							
Minimum spacing	s_{min} [mm]	40	50	60	75	90	115	120	140
Minimum edge distance	c_{min} [mm]	35	40	45	50	55	60	75	80

1) Each of two given values can be used

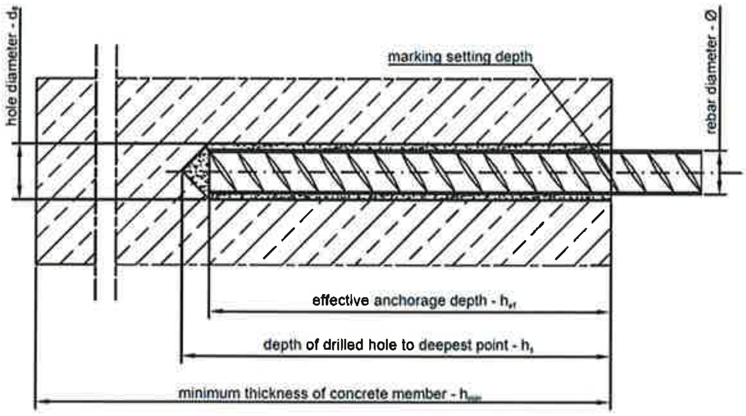


Table B2: Installation data for rebars

Size		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Nominal drilling diameter	d_0 [mm]	10[1)] 12[1)]	12[1)] 14[1)]	14[1)] 16[1)]	18	20	25	30	35	40
Effective embedment depth	$h_{ef,min}$ [mm]	60	70	80	80	100	120	150	180	200
	$h_{ef,max}$ [mm]	160	200	240	280	320	400	500	560	640
Depth of the drilling hole	h_1 [mm]	h_{ef} + 5 mm								
Minimum thickness of the concrete slab	h_{min} [mm]	h_{ef} + 30 mm; ≥ 100 mm		$h_{ef} + 2d_0$						
Minimum spacing	s_{min} [mm]	40	50	60	75	75	90	115	120	140
Minimum edge distance	c_{min} [mm]	35	40	45	50	50	55	60	75	80

[1)] Each of two given values can be used

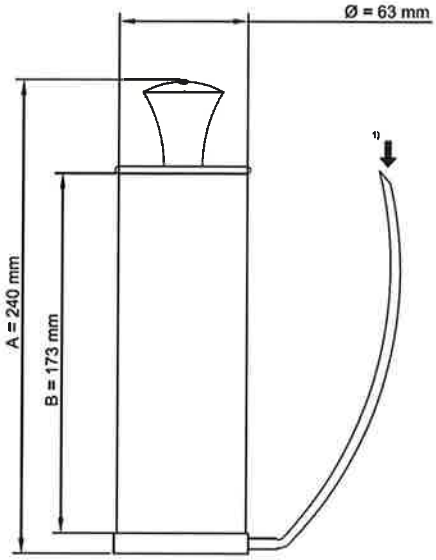
Table B3: Maximum processing time and minimum curing time

RAMSAUER Anker Kleber 680		
Concrete temperature [C°]	**Maximum processing time [min.]**	**Minimum curing time [1] [min.]**
-10	105	1440
-5	65	840
0	45	420
+5	25	90
+10	16	60
+15	11,5	45
+20	7,5	40
+25	5	35
+30	3	30
+35	2	25
+40	1	20

[1] The minimum time from the end of the mixing to the time when the anchor may be torque or loaded (whichever is longer). Cartridge temperature from +5°C to +30°C. Minimum cartridge temperature of +15°C for application where the concrete temperature is below 0°C.

For wet concrete and flooded holes, the curing time must be double.

Manual Blower pump: nominal dimensions



It is possible to use the mixer extensior with the manual blower pump.

However it is possible to blow the hole using the mechanical air system (compressed air) also with the mixer estension

Suitable min pressure 6 bar at 6 m³/h
Oil-free compressed air
Recommended air gun with an orifice opening of minimum 3.5 mm in diameter

1) Position to insert the mixer extension

Mixer extension (from 380 mm to 1000 mm) with nominal diameter 10 mm

RAMSAUER Anker Kleber 680	**Annex B5** of European Technical Assessment ETA-17/0679
Intended use Cleaning tools (1)	

Table B4: Standard brush diameter for threaded rods

Threaded rod diameter		M8	M10	M12	M16	M20	M24	M27	M30
d_0	Nominal drill hole [mm]	10	12	14	18	24	28	30	35
d_b	Brush diameter [mm]	12	14	16	20	26	30	35	37

Table B5: Standard brush diameter for rebar

Rebar diameter		Ø8		Ø10		Ø12		Ø14
d_0	Nominal drill hole [mm]	10[1)]	12[1)]	12[1)]	14[1)]	14[1)]	16[1)]	18
d_b	Brush diameter [mm]	12	14	14	16	16	18	20

[1)] Each of two given values can be used

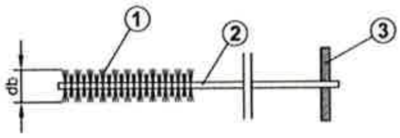
Table B6: Special brush diameter (mechanical brush) for threaded rods

Threaded rod diameter		M16	M20	M24	M27	M30
d_0	Nominal drill hole [mm]	18	24	28	30	35
d_b	Brush diameter [mm]	20	26	30	32	37

Table B7: Special brush diameter (mechanical brush) for rebar

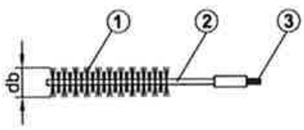
Threaded rod diameter		Ø8		Ø10		Ø12		Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
d_0	Nominal drill hole [mm]	10[1)]	12[1)]	12[1)]	14[1)]	14[1)]	16[1)]	18	20	25	30	35	40
d_b	Brush diameter [mm]	12	14	14	16	16	18	20	22	27	32	37	42

[1)] Each of two given values can be used

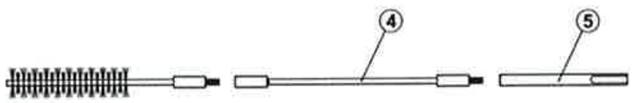


① Steel bristles
② Steel stem
③ Wood handle

Standard brush



① Steel bristles
② Steel stem
③ Threaded connection for drilling tool extension
④ Extension special brush
⑤ Drilling tool connection (SDS connection)



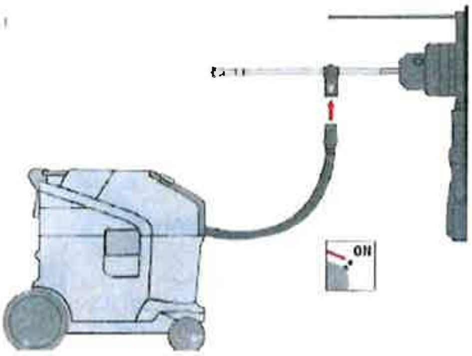
Special (mechanical) brush

Hollow Drill Bit (HDB)

This drilling method is a hammer drilling method.

This drilling system removes the dust and cleans the bore hole during the drilling operation when used in accordance with the user's manual.

This drilling system include a vacuum cleaner. A suitable dust extraction system must be used.
e.g. Bosch GAS 35 M AFC or a comparable dust extraction system with equivalent performance data.



Switch-on the vacuum cleaner before to drill

Table B8: HDB perforation diameter for threaded rods

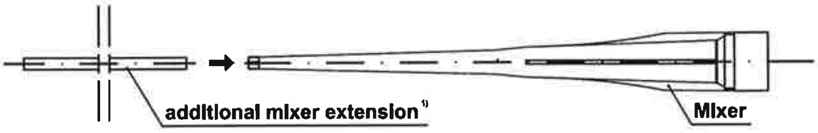
Threaded rod diameter		M8	M10	M12	M16	M20	M24	M27	M30
d_0	Nominal drill hole [mm]	10	12	14	18	24	28	30	35

Table B9: HDB perforation diameter for rebar

Rebar diameter		Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28
d_0	Nominal drill hole [mm]	10[1)] 12[1)]	12[1)] 14[1)]	14[1)] 16[1)]	18	20	25	30	35

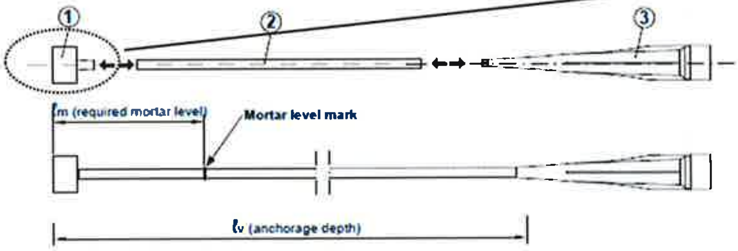
[1)] Each of two given values can be used

Use the mixer extension (assembled on the standard mixer) for the injection up to 300 mm if necessary.

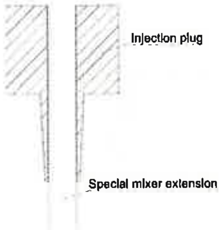


1) Variable length from 380 mm up to 1000 mm

Use this system for special conditions.



Insert the special mixer extension in the inner diameter of the injection plug up to reach the top of the plug



① Injection plug (nominal diameter according to the nominal diameter of drilled hole)

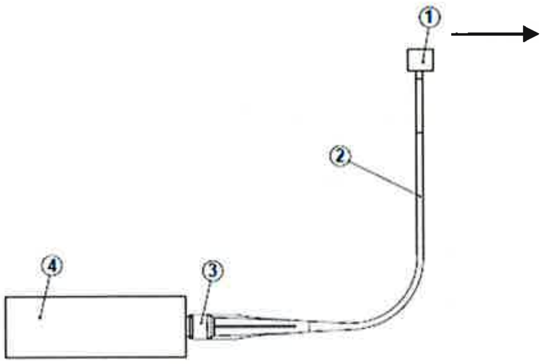
② Special mixer extension (variable length with external diameter 10 mm)
Mark the required mortar level ℓ_m and embedment depth ℓ_v with tape or marker on the injection extension. Quick estimation: $\ell_m = 1/3 \cdot \ell_v$
Continue injection until the mortar level mark ℓ_m becomes visible.

③ Mixer (suitable for all size of cartridge)

These tools allow the application in special conditions:
- installation with anchorage depth greater than 300 mm;
- overhead installation.
For these applications it is recommanded the use of pneumatic or battery dispenser.

System assembled

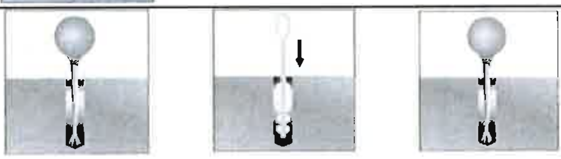
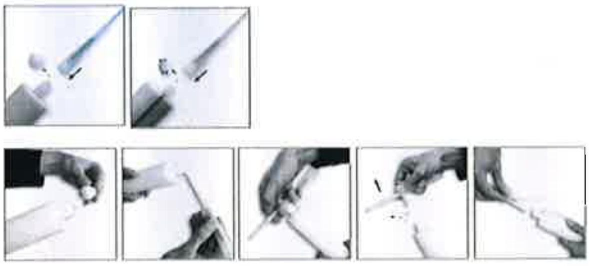
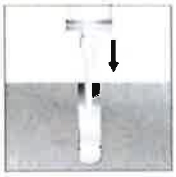
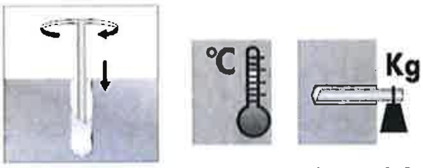
① Injection plug
② Special mixer extension
③ Mixer
④ Cartridge
⑤ Sample of dispenser



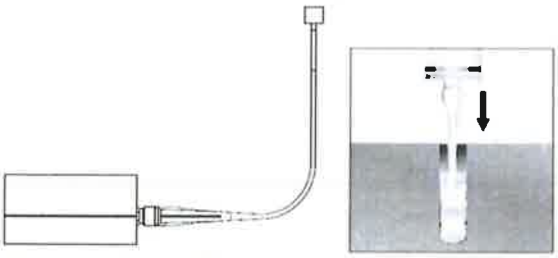
RAMSAUER Anker Kleber 680	Annex B8 of European Technical Assessment ETA-17/0679
Intended use Tools for installation (1)	

Table B10: Mortar injection pumps

Pumps (injection dispensers)	Cartridges	Types
 *Manual*	420 ml 400 ml 380 ml	Manual (up to 300 mm anchorage depth)
 *Manual*	345 ml 300 ml 280 ml 165 ml	Manual (up to 300 mm anchorage depth)
 *Manual*	300 ml 280 ml 165 ml	Manual (up to 300 mm anchorage depth)
 *Pneumatic*	825 ml	Pneumatic (up to 640 mm anchorage depth)
 *Pneumatic*	420 ml 400 ml 380 ml	Pneumatic (up to 640 mm anchorage depth)
 *Battery*	420 ml 400 ml 380 ml 345 ml 300 ml	Battery (up to 640 mm anchorage depth)

1		Drill the hole with the correct diameter and depth using a rotary percussive machine. Check the perpendicularity of the hole during the drilling operation. **In case of use of hollow drill bit (Annex B7) proceed directly to the clause 3.**
2	 **4x blower manual pump** **4x standard brush** **4x blower manual pump** **if necessary use a mixer extension for the blower operation (see Annex B5)**	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations, by at least 4 brushing operations followed again by at least 4 blowing operations; before brushing clean the brush and check (see Annex B6, standard brush) if the brush diameter is sufficient. For the blower tools see Annex B5.
3		For coaxial, peeler and side by side cartridges unscrew the front cup, screw on the mixer and insert the cartridge into the gun. For CIC sizes, unscrew the front cup, pull-out the steel closing clip according to the following operation: 1) Insert the mixer in the eye of the plastic extractor; 2) Pull the extractor to unhook the steel closing clip of the foil. In the version without the extractor cut the foil pack. After that screw on the mixer and insert the cartridge in the gun.
4		Before starting to use the cartridge, eject a first part of the product, being sure that the two components are completely mixed. The complete mixing is reached only after that the product, obtained by mixing the two components, comes out from the mixer with a uniform colour.
5	 **if necessary, use a mixer extension for the injection (see Annex B8)**	Fill the drilled hole uniformly starting from the drilled hole bottom, in order to avoid entrapment of the air; remove the mixer slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth.
6	 **ATTENTION: Steel elements dry and free oil and other contaminants**	Insert immediately the steel element (threaded rod or rebar), marked according to the proper anchorage depth, slowly and with a slight twisting motion, removing excess of injection mortar around the steel element. Observe the processing time according Annex B4. Wait the curing time according Annex B4.

RAMSAUER Anker Kleber 680	**Annex B10** of European Technical Assessment ETA-17/0679
Intended use Installation instruction up to 300 mm depth	

1	**See clause 1 Annex B10.** In case of use of hollow drill bit (HDB) proceed directly to the clause 3.	
2	 4 x 5 seconds 4x 4 x 5 seconds ATTENTION: compressed air free oil	Clean the hole from drilling dust: the hole shall be cleaned by at least 4 blowing operations (5 seconds for single operation) with compressed air, by at least 4 brushing operations with special brush followed again by at least 4 blowing operations (5 seconds for single operation) with compressed air. Before brushing clean the brush and check if the brush diameter is sufficient.
3	**See clause 3 Annex B10**	
4	**See clause 4 Annex B10**	
5		Before starting the injection, assemble the system according to Annex B8. After that, fill the drilled hole uniformly from the drilled hole bottom, in order to avoid entrapment of the air; remove the special mixer extension with injection plug slowly bit by bit during pressing-out; filling the drill hole with a quantity of the injection mortar corresponding to 2/3 of the drill hole depth. Procedure for overhead installation are detailed in Annex B12.
6	**See clause 6 Annex B10**	

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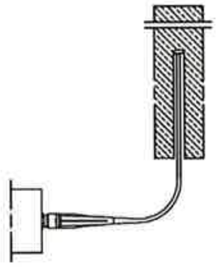
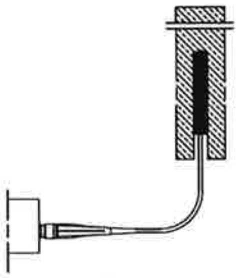
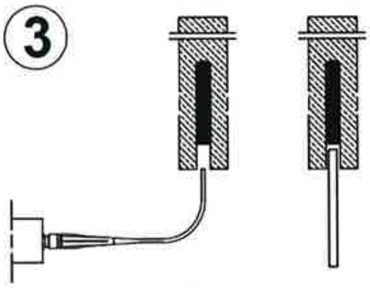
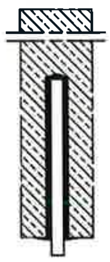
Intended use Installation instruction up to 640 mm depth	

Overhead installation procedure

In addition to standard procedure, for overhead installation, following the below procedure

① 	**1 - Start Injection** **Inject from the bottom of the hole. Use battery or pneumatic dispenser if the anchorage depth is grater than 200 mm.**
② 	**2 - Injection phase** **Inject the product about 2/3 of the hole depth. Remove the mixer extension slowly bit by bit during pressing-out.**
③ 	**3 - End Injection** **Remove the mixer extension. Insert immediately the steel element (turn the steel element during the insertion).**
④ 	**4 - End Installation** **To avoid the slipping of the steel element during the open time of the product (due to the steel element own weigth) use a temporary interlocking element (for ex. wedge of wood)**

RAMSAUER Anker Kleber 680	**Annex B12** of European Technical Assessment ETA-17/0679
Intended use Overhead installation instruction	

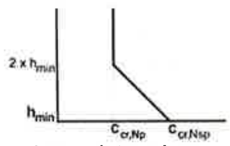
Table C1: Characteristic values for steel tension resistance and steel shear resistance – threaded rods.

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure – characteristic tension resistance										
Steel class 4.8	$N_{Rk,s}$	[kN]	15	23	34	63	98	141	183	224
Steel class 5.8	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	229	280
Steel class 8.8	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Steel class 10.9	$N_{Rk,s}$	[kN]	37	58	84	157	245	353	459	561
Stainless steel A2, A4, HCR class 50	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	229	280
Stainless steel A2, A4, HCR class 70	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	321	392
Stainless steel A4, HCR class 80	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Steel failure – characteristic tension resistance – partial factor										
Steel class 4.8	$\gamma_{Ms,N}$ 1)	[-]	1,50							
Steel class 5.8	$\gamma_{Ms,N}$ 1)	[-]	1,50							
Steel class 8.8	$\gamma_{Ms,N}$ 1)	[-]	1,50							
Steel class 10.9	$\gamma_{Ms,N}$ 1)	[-]	1,40							
Stainless steel A2, A4, HCR class 50	$\gamma_{Ms,N}$ 1)	[-]	2,86							
Stainless steel A2, A4, HCR class 70	$\gamma_{Ms,N}$ 1)	[-]	1,87							
Stainless steel A4, HCR class 80	$\gamma_{Ms,N}$ 1)	[-]	1,60							
Steel failure – characteristic shear resistance without lever arm										
Steel class 4.8	$V^0_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
Steel class 5.8	$V^0_{Rk,s}$	[kN]	9	14	21	39	61	88	115	140
Steel class 8.8	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Steel class 10.9	$V^0_{Rk,s}$	[kN]	18	29	42	78	122	176	230	280
Stainless steel A2, A4, HCR class 50	$V^0_{Rk,s}$	[kN]	9	14	21	39	61	88	115	140
Stainless steel A2, A4, HCR class 70	$V^0_{Rk,s}$	[kN]	13	20	29	55	86	124	160	196
Stainless steel A4, HCR class 80	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Steel failure – characteristic shear resistance with lever arm										
Steel class 4.8	$M^0_{Rk,s}$	[Nm]	15	30	52	133	260	449	666	900
Steel class 5.8	$M^0_{Rk,s}$	[Nm]	19	37	65	166	324	561	832	1125
Steel class 8.8	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1331	1799
Steel class 10.9	$M^0_{Rk,s}$	[Nm]	37	75	131	333	649	1123	1664	2249
Stainless steel A2, A4, HCR class 50	$M^0_{Rk,s}$	[Nm]	19	37	66	166	324	561	832	1124
Stainless steel A2, A4, HCR class 70	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454	786	1165	1574
Stainless steel A4, HCR class 80	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1331	1799
Steel failure – characteristic shear resistance – partial factor										
Steel class 4.8	$\gamma_{Ms,V}$ 1)	[-]	1,25							
Steel class 5.8	$\gamma_{Ms,V}$ 1)	[-]	1,25							
Steel class 8.8	$\gamma_{Ms,V}$ 1)	[-]	1,25							
Steel class 10.9	$\gamma_{Ms,V}$ 1)	[-]	1,50							
Stainless steel A2, A4, HCR class 50	$\gamma_{Ms,V}$ 1)	[-]	2,38							
Stainless steel A2, A4, HCR class 70	$\gamma_{Ms,V}$ 1)	[-]	1,56							
Stainless steel A4, HCR class 80	$\gamma_{Ms,V}$ 1)	[-]	1,33							

1) In the absence of other national regulation

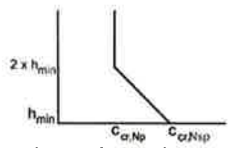
Fracture elongation threaded rod for seismic category C1 and C2 must be $A_5 \geq 19\%$.
Steel classes 10.9 are not covered for seismic application.

Table C2: Characteristic values for tension resistance in uncracked concrete under static and quasi-static loads – threaded rods. Working life of 50 and 100 years.

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure										
Characteristic resistance	$N_{Rk,s}$	[kN]	See Annex C1 – Table C1							
Partial factor	$\gamma_{Ms,N}$ 1)	[-]	See Annex C1 – Table C1							
Combined pull-out and concrete cone failure in uncracked concrete C20/25										
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	16,0	12,0	12,0	12,0	9,5	9,5	8,0	8,0
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	11,0	8,5	8,5	8,5	7,0	7,0	6,0	6,0
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	6,0	4,5	4,5	4,5	4,0	4,0	3,0	3,0
Increasing factor	ψ_c	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,3}$							
Sustained load factor for temperature range -40°C / +40°C	ψ^0_{sus} $\psi^0_{sus,100}$	[-]	0,72							
Sustained load factor for temperature range -40°C / +80°C			0,74							
Sustained load factor for temperature range -40°C / +120°C			0,75							
Concrete cone failure										
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0							
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}							
Spacing	$s_{cr,N}$	[mm]	3,0 h_{ef}							
Splitting failure										
Edge distance	$c_{cr,Nsp}$	[mm]	if $h = h_{min}$							
			$2,5 \cdot h_{ef}$		$2,0 \cdot h_{ef}$		$1,5 \cdot h_{ef}$			
			If $h_{min} < h < 2 \cdot h_{min}$							
			 interpolate values							
			if $h \geq 2 \cdot h_{min}$							
			$C_{cr,Np}$							
Spacing	$s_{cr,Nsp}$	[mm]	$2 \cdot C_{cr,sp}$							
Installation factor for combined pull-out, concrete cone and splitting failure										
Installation factor for category I1 1)	γ_{inst}	[-]	1,0							
Installation factor for category I2 1)			1,2							

1) In the absence of other national regulation

Table C3: Characteristic values for tension resistance in cracked concrete under static and quasi-static loads – threaded rods. Working life of 50 and 100 years.

Size			M10	M12	M16	M20
Steel failure						
Characteristic resistance	$N_{Rk,s}$	[kN]	See Annex C1 – Table C1			
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	See Annex C1 – Table C1			
Combined pull-out and concrete cone failure in cracked concrete C20/25						
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,cr,50}$	[N/mm²]	9,0	9,0	9,0	6,5
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,cr,50}$	[N/mm²]	6,5	6,5	6,5	4,5
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,cr,50}$	[N/mm²]	3,5	3,5	3,5	2,5
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,cr,100}$	[N/mm²]	8,5	8,5	8,0	5,5
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,cr,100}$	[N/mm²]	6,0	6,0	5,5	4,0
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,cr,100}$	[N/mm²]	3,0	3,0	3,0	2,0
Increasing factor	ψ_c	[-]	$(\frac{f_{ck}}{20})^{0.3}$			
Sustained load factor for temperature range -40°C / +40°C	ψ^0_{sus} $\psi^0_{sus,100}$	[-]	0,72			
Sustained load factor for temperature range -40°C / +80°C			0,74			
Sustained load factor for temperature range -40°C / +120°C			0,75			
Concrete cone failure						
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7			
Edge distance	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$			
Spacing	$s_{cr,N}$	[mm]	$3{,}0\ h_{ef}$			
Splitting failure						
Edge distance	$c_{cr,Nsp}$	[mm]	if $h = h_{min}$			
			$2{,}5 \cdot h_{ef}$	$2{,}0 \cdot h_{ef}$		$1{,}5 \cdot h_{ef}$
			If $h_{min} < h < 2 \cdot h_{min}$			
			 interpolate values			
			if $h \geq 2 \cdot h_{min}$			
			$c_{cr,Np}$			
Spacing	$s_{cr,Nsp}$	[mm]	$2 \cdot c_{cr,sp}$			
Installation factor for combined pull-out, concrete cone and splitting failure						
Installation factor for category I1 [1)]	γ_{inst}	[-]	1,0			
Installation factor for category I2 [1)]			1,2			

[1)] In the absence of other national regulation

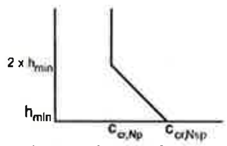
Table C4: Characteristic values for shear resistance in uncracked and cracked concrete under static and quasi-static loads – threaded rods. Working life of 50 and 100 years.

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure without lever arm										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	See Annex C1 – Table C1							
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	See Annex C1 – Table C1							
Ductility factor	k_7	[-]	1,0							
Steel failure with lever arm										
Characteristic resistance	$M^0_{Rk,s}$	[kN]	See Annex C1 – Table C1							
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	See Annex C1 – Table C1							
Concrete pry out failure										
Factor	k_8	[-]	2,0							
Installation factor	γ_{inst}	[-]	1,0							
Concrete edge failure										
Effective length of anchor under shear loading	l_f	[-]	$l_f = h_{ef}$ and $\leq 12\ d_{nom}$						$l_f = h_{ef}$ and $\leq$ max (8 d_{nom}; 300 mm)	
Installation factor	γ_{inst}	[-]	1,0							

[1] In the absence of other national regulation

RAMSAUER Anker Kleber 680	**Annex C4** of European Technical Assessment ETA-17/0679
Performances Characteristic values for shear resistance in uncracked and cracked concrete under static and quasi-static loads – threaded rods	

Table C5: Characteristic values for tension resistance in uncracked concrete under static and quasi-static loads – rebar. Working life of 50 and 100 years.

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure											
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \times f_{uk}$ [2)]								
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial factor	$\gamma_{Ms,N}$ [1)]	[-]	1,4								
Combined pull-out and concrete cone failure in uncracked concrete C20/25											
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	14,0	13,0	13,0	12,0	10,0	9,5	9,5	8,5	7,5
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	10,0	9,5	9,0	9,0	7,5	7,0	7,0	6,0	5,5
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,ucr,50}$ $\tau_{Rk,ucr,100}$	[N/mm²]	5,5	5,0	5,0	5,0	4,0	4,0	4,0	3,5	3,0
Increasing factor	ψ_c	[-]	$\left(\frac{f_{ck}}{20}\right)^{0,3}$								
Sustained load factor for temperature range -40°C / +40°C	ψ^0_{sus} $\psi^0_{sus,100}$	[-]	0,72								
Sustained load factor for temperature range -40°C / +80°C			0,74								
Sustained load factor for temperature range -40°C / +120°C			0,75								
Concrete cone failure											
Factor for uncracked concrete	$k_{ucr,N}$	[-]	11,0								
Edge distance	$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$								
Spacing	$s_{cr,N}$	[mm]	$3{,}0\ h_{ef}$								
Splitting failure											
Edge distance	$c_{cr,Nsp}$	[mm]	if $h = h_{min}$								
			$2{,}5 \cdot h_{ef}$		$2{,}0 \cdot h_{ef}$			$1{,}5 \cdot h_{ef}$			
			If $h_{min} < h < 2 \cdot h_{min}$								
			 interpolate values								
			if $h \geq 2 \cdot h_{min}$								
			$c_{cr,Np}$								
Spacing	$s_{cr,Nsp}$	[mm]	$2 \cdot c_{cr,sp}$								
Installation factor for combined pull-out, concrete cone and splitting failure											
Installation factor for category I1 [1)]	γ_{inst}	[-]	1,0								
Installation factor for category I2 [1)]			1,2								

[1)] In the absence of other national regulation
[2)] f_{uk} shall be taken from the specifications of reinforcing bars

Table C6: Characteristic values for shear resistance in uncracked concrete under static and quasi-static loads – rebar. Working life of 50 and 100 years.

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure without lever arm											
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0,5 \times A_s \times f_{uk}$ [2]								
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,5								
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Ductility factor	k_7	[-]	1,0								
Steel failure with lever arm											
Characteristic resistance	$M^0_{Rk,s}$	[kN]	$1,2 \times W_{el} \times f_{uk}$ [2]								
Elastic section modulus	W_{el}	[mm³]	50	98	170	269	402	785	1534	2155	3217
Partial factor	$\gamma_{Ms,V}$ [1]	[-]	1,5								
Concrete pry out failure											
Factor	k_8	[-]	2,0								
Installation factor	γ_{inst}	[-]	1,0								
Concrete edge failure											
Effective length of anchor under shear loading	l_f	[-]	$l_f = h_{ef}$ and $\leq 12\ d_{nom}$						$l_f = h_{ef}$ and $\leq \max(8\ d_{nom};\ 300\ mm)$		
Installation factor	γ_{inst}	[-]	1,0								

[1] In the absence of other national regulation
[2] f_{uk} shall be taken from the specifications of reinforcing bars

Table C7. Displacement under tension loads for uncracked concrete under static and quasi-static loads – threaded rods.

Size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic displacement in uncracked concrete C20/25 to C50/60 under tension loads										
Service load [1)]	F	[kN]	9,6	10,8	14,3	23,8	29,6	42,4	40,4	44,4
Displacement	δ_{N0}	[mm]	0,30	0,30	0,35	0,35	0,35	0,40	0,40	0,45
	$\delta_{N\infty}$	[mm]	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85

Table C8: Displacement under tension loads for cracked concrete under static and quasi-static loads – threaded rods.

Size			M10	M12	M16	M20
Characteristic displacement in cracked concrete C20/25 to C50/60 under tension loads						
Service load [1)]	F	[kN]	9,5	14,3	21,4	23,8
Displacement	δ_{N0}	[mm]	0,50	0,50	0,70	0,60
	$\delta_{N\infty}$	[mm]	0,85	0,85	0,85	0,85

Table C9: Displacement under shear loads for uncracked and cracked concrete under static and quasi-static loads – threaded rods.

Size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic displacement in cracked and uncracked concrete C20/25 to C50/60 under shear loads										
Service load [1)]	F	[kN]	3,7	5,8	8,4	15,7	24,5	35,3	45,5	55,6
Displacement	δ_{V0}	[mm]	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
	$\delta_{V\infty}$	[mm]	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0

Table C10: Displacement under tension loads for uncracked concrete under static and quasi-static loads – rebar.

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Characteristic displacement in uncracked concrete C20/25 to C50/60 under tension loads											
Service load [1)]	F	[kN]	10,1	13,6	17,2	20,1	23,9	41,2	53,3	64,1	67,3
Displacement	δ_{N0}	[mm]	0,33	0,33	0,40	0,41	0,42	0,45	0,45	0,47	0,48
	$\delta_{N\infty}$	[mm]	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85	0,85

Table C11: Displacement under shear loads for uncracked concrete under static and quasi-static loads – rebar.

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Characteristic displacement in uncracked concrete C20/25 to C50/60 under shear loads											
Service load [1)]	F	[kN]	13,2	20,6	29,6	40,3	52,7	82,3	128,6	161,3	210,6
Displacement	δ_{V0}	[mm]	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0	2,0
	$\delta_{V\infty}$	[mm]	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0	3,0

[1)] These values are suitable for each temperature range and categories specified in Annex B1

Table C12: Characteristic values for tension resistance for seismic performance category C1 – threaded rods. Working life of 50 and 100 years.

Size			**M12**	**M16**	**M20**
Steel failure					
Characteristic resistance	$N_{Rk,s,eq,C1}$	[kN]	1,0 x $N_{Rk,s}$		
Partial factor [1]	$\gamma_{Ms,N}$ [1]	[-]	See Annex C1 – Table C1		
Combined pull-out and concrete cone failure					
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,C1}$	[N/mm²]	4,2	3,7	3,7
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,C1}$	[N/mm²]	3,0	2,7	2,7
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,C1}$	[N/mm²]	1,6	1,4	1,4
Increasing factor for C30/37	ψ_c	[-]	1,0		
Increasing factor for C40/50					
Increasing factor for C50/60					
Installation factor for category I1 [1]	γ_{inst}	[-]	1,0		
Installation factor for category I2 [1]			1,2		

[1] In the absence of other national regulation

Table C13: Characteristic values for shear resistance for seismic performance category C1 – threaded rods. Working life of 50 and 100 years.

Size			**M12**	**M16**	**M20**
Steel failure					
Characteristic resistance	$V_{Rk,s,eq,C1}$	[kN]	0,7 x $V^0_{Rk,s}$		
Partial factor [1]	$\gamma_{Ms,V}$ [1]	[-]	See Annex C1 – Table C1		

[1] In the absence of other national regulation

Table C14: Reduction factor for annular gap. Working life of 50 and 100 years.

Reduction factor for annular gap			
Without annular gap filling	α_{gap}	[-]	0,5
With annular gap filling	α_{gap}	[-]	1,0

Table C15: Characteristic values for tension resistance for seismic performance category C2 – threaded rods. Working life of 50 and 100 years.

Size			**M12**	**M16**
Steel failure				
Characteristic resistance	$N_{Rk,s,eq,C2}$	[kN]	1,0 x $N_{Rk,s}$	
Partial factor [1)]	$\gamma_{Ms,N}$	[-]	See Annex C1 – Table C1	
Combined pull-out and concrete cone failure				
Characteristic bond resistance temperature range -40°C / +40°C	$\tau_{Rk,eq,C2}$	[N/mm²]	1,6	1,7
Characteristic bond resistance temperature range -40°C / +80°C	$\tau_{Rk,eq,C2}$	[N/mm²]	1,2	1,2
Characteristic bond resistance temperature range -40°C / +120°C	$\tau_{Rk,eq,C2}$	[N/mm²]	0,6	0,7
Increasing factor for C30/37	ψ_c	[-]	1,0	
Increasing factor for C40/50				
Increasing factor for C50/60				
Installation factor for category I1 [1)]	γ_{inst}	[-]	1,0	
Installation factor for category I2 [1)]			1,2	
[1)] In the absence of other national regulation				

Table C16: Characteristic values for shear resistance for seismic performance category C2 – threaded rods. Working life of 50 and 100 years.

Size			**M12**	**M16**
Steel failure				
Characteristic shear resistance	$V_{Rk,s,eq,C2}$	[kN]	0,53 x $V^0_{Rk,s}$	0,46 x $V^0_{Rk,s}$
Partial factor [1)]	$\gamma_{Ms,V}$	[-]	See Annex C1 – Table C1	
[1)] In the absence of other national regulation				

Table C17: Reduction factor for annular gap. Working life of 50 and 100 years.

Reduction factor for annular gap			
Without annular gap filling	α_{gap}	[-]	0,5
With annular gap filling	α_{gap}	[-]	1,0

Table C18: Displacements under tensile and shear loads for seismic performance category C2 – threaded rods.

Size			**M12**	**M16**
Displacements for tensile and shear load for seismic performance category C2				
Displacement in tensile at damage limitation state	$\delta_{N,eq,C2\,(DLS)}$	[mm]	0,20	0,23
Displacement in tensile at ultimate limit state	$\delta_{N,eq,C2\,(ULS)}$	[mm]	0,33	1,04
Displacement in shear at damage limitation state	$\delta_{V,eq,C2\,(DLS)}$	[mm]	2,01	0,70
Displacement in shear at ultimate limit state	$\delta_{V,eq,C2\,(ULS)}$	[mm]	4,68	2,12

Characteristic bond resistance of a single bonded fastener $\tau_{Rk,fi,p}(\theta)$ for concrete strength classes C20/25 to C50/60 with all drilling methods under fire conditions for working life of 50 and 100 years.

The characteristic bond resistance of a single bonded fastener under fire conditions $\tau_{Rk,fi,p}$ for a given temperature (θ) shall be calculated using the following equations:

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

$$\tau_{Rk,fi,p}(\theta) = k_{fi,p}(\theta) \cdot \tau_{Rk,cr,100,C20/25}$$

Where:

$$if\ \theta \leq \theta_{max} \quad k_{fi,p}(\theta) = k_{fi,p}(\theta) = 0{,}8049 \cdot e^{-0{,}0097 \cdot \theta} \leq 1{,}0$$

$$if\ \theta > \theta_{max} \quad k_{fi,p}(\theta) = k_{fi,p}(\theta) = 0$$

θ_{max} = 271°C

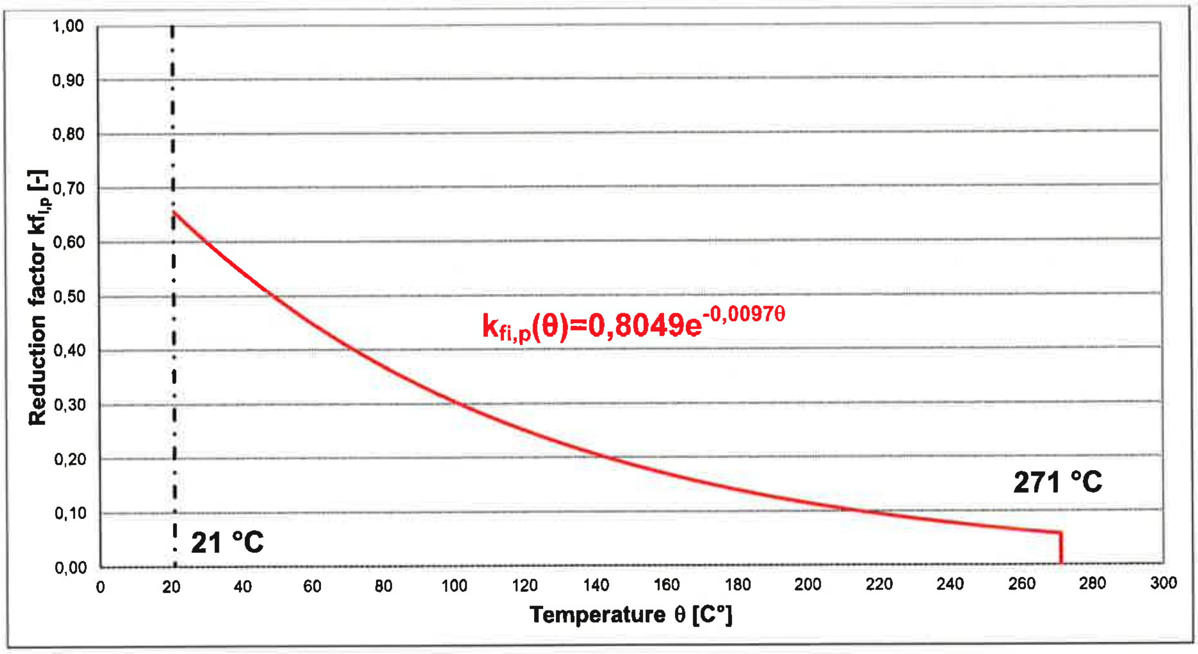
$\tau_{Rk,fi,p}$ = characteristic bond resistance for cracked concrete under fire exposure for a given temperature (θ)

$k_{fi,p(\theta)}$ = reduction factor for bond resistance under fire exposure

$\tau_{Rk,cr,C20/25}$ = characteristic bond resistance for cracked concrete for concrete strength class C20/25 for a working life of 50 years given in Table C3.

$\tau_{Rk,cr,100,C20/25}$ = characteristic bond resistance for cracked concrete for concrete strength class C20/25 for a working life of 100 years given in Table C3.

Figure C1: Reduction factor $k_{fi,p}(\theta)$



RAMSAUER Anker Kleber 680	**Annex C10** of European Technical Assessment ETA-17/0679
Performances Reduction factor for pull-out failure of single fasteners under fire conditions – threaded rods	

Table C19: Characteristic resistance under tension load in case of steel failure under fire conditions – threaded rods.

Size			M10	M12	M16	M20
Steel failure						
Steel class 5.8 to 8.8	$N_{Rk,s,fi\,(30)}$	[kN]	0,87	1,70	3,14	4,90
	$N_{Rk,s,fi\,(60)}$	[kN]	0,75	1,28	2,36	3,68
	$N_{Rk,s,fi\,(90)}$	[kN]	0,58	1,11	2,04	3,19
	$N_{Rk,s,fi\,(120)}$	[kN]	0,46	0,85	1,57	2,45
Stainless steel A4	$N_{Rk,s,fi\,(30)}$	[kN]	1,45	2,55	4,71	7,35
	$N_{Rk,s,fi\,(60)}$	[kN]	1,16	2,13	3,93	6,13
	$N_{Rk,s,fi\,(90)}$	[kN]	0,93	1,70	3,14	4,90
	$N_{Rk,s,fi\,(120)}$	[kN]	0,81	1,36	2,51	3,92

Table C20: Characteristic resistance under shear load with and without lever arm in case of steel failure under fire conditions – threaded rods.

Size			M10	M12	M16	M20
Steel failure						
Steel class 5.8 to 8.8	$V_{Rk,s,fi\,(30)}$	[kN]	0,87	1,70	3,14	4,90
	$V_{Rk,s,fi\,(60)}$	[kN]	0,75	1,28	2,36	3,68
	$V_{Rk,s,fi\,(90)}$	[kN]	0,58	1,11	2,04	3,19
	$V_{Rk,s,fi\,(120)}$	[kN]	0,46	0,85	1,57	2,45
Stainless steel A4	$V_{Rk,s,fi\,(30)}$	[kN]	1,45	2,55	4,71	7,35
	$V_{Rk,s,fi\,(60)}$	[kN]	1,16	2,13	3,93	6,13
	$V_{Rk,s,fi\,(90)}$	[kN]	0,93	1,70	3,14	4,90
	$V_{Rk,s,fi\,(120)}$	[kN]	0,81	1,36	2,51	3,92
Steel class 5.8 to 8.8	$M_{Rk,s,fi\,(30)}$	[Nm]	1,1	2,7	6,7	13,0
	$M_{Rk,s,fi\,(60)}$	[Nm]	1,0	2,0	5,0	9,7
	$M_{Rk,s,fi\,(90)}$	[Nm]	0,7	1,7	4,3	8,4
	$M_{Rk,s,fi\,(120)}$	[Nm]	0,6	1,3	3,3	6,5
Stainless steel A4	$M_{Rk,s,fi\,(30)}$	[Nm]	1,9	4,0	10,0	19,5
	$M_{Rk,s,fi\,(60)}$	[Nm]	1,5	3,3	8,3	16,2
	$M_{Rk,s,fi\,(90)}$	[Nm]	1,2	2,7	6,7	13,0
	$M_{Rk,s,fi\,(120)}$	[Nm]	1,0	2,1	5,3	10,4

Table C21: Characteristic resistance under tension load in case of concrete cone and splitting failure under fire conditions – threaded rods.

Size			M10	M12	M16	M20
Concrete cone failure						
Steel class 5.8 to 8.8 Stainless steel A4	$N^0_{Rk,c,fi\,(30)}$	[kN]	$\frac{h_{ef}}{200} \cdot N^0_{Rk,c} \leq N^0_{Rk,c}$			
	$N^0_{Rk,c,fi\,(60)}$	[kN]				
	$N^0_{Rk,c,fi\,(90)}$	[kN]				
	$N^0_{Rk,c,fi\,(120)}$	[kN]	$0{,}8 \cdot \frac{h_{ef}}{200} \cdot N^0_{Rk,c} \leq N^0_{Rk,c}$			
Characteristic spacing	$s_{cr,N,fi}$	[mm]	$4 \cdot h_{ef}$			
Characteristic edge distance	$c_{cr,N,fi}$	[mm]	$2 \cdot h_{ef}$			

Table C22: Characteristic resistance under shear load in case of pry-out failure under fire conditions – threaded rods.

Size			M10	M12	M16	M20
Pryout failure						
Steel class 5.8 to 8.8 Stainless steel A4	$V_{Rk,cp,fi\,(30)}$	[kN]	$k_8 \cdot N_{Rk,c,fi\,(90)}$			
	$V_{Rk,cp,fi\,(60)}$	[kN]				
	$V_{Rk,cp,fi\,(90)}$	[kN]				
	$V_{Rk,cp,fi\,(120)}$	[kN]	$k_8 \cdot N_{Rk,c,fi\,(120)}$			

Table C23: Characteristic resistance under shear load in case of concrete edge failure under fire conditions – threaded rods.

Size			M10	M12	M16	M20
Concrete edge failure						
Steel class 5.8 to 8.8 Stainless steel A4	$V_{Rk,c,fi\,(30)}$	[Nm]	$0{,}25 \cdot V^0_{Rk,c}$			
	$V_{Rk,c,fi\,(60)}$	[Nm]				
	$V_{Rk,c,fi\,(90)}$	[Nm]				
	$V_{Rk,c,fi\,(120)}$	[Nm]	$0{,}20 \cdot V^0_{Rk,c}$			