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European Technical Assessment

ETA-23/1032

(06.03.2024)

Trade name of the construction product	Chemical Anchor EASF, EASF-E, EASF-A
Product family to which the construction product belongs	Product Area Code: 33 Bonded fasteners for use in concrete
Manufacturer	CoreTech Ltd
23-0893 Manufacturing plant(s)	Core Tech Ltd Unit 5, Tech Innovation Park Cambridge Science Park Milton Road, Cambridge CB4 0GF United Kingdom
This European Technican Assessment contains	

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

23 pages including 19 Annexes which forms an integral part of this assessment Annex may contain confidential information and is/are not included in the European Technical Assessment when that assessment is publicly disseminated

EAD 330499-01-0601 Bonded Fasteners for Use In Concrete

1. Technical description of the product

METSAN Endüstriyel Yapıştırıcılar Ticaret A.Ş. has formally submitted a request for a Technical Assessment pertaining to bonded anchors, specifically those designed for non-cracked and cracked concrete, denoted as EASF, EASF-E, EASF-A. The comprehensive evaluation was conducted in adherence to the specifications outlined in EAD 330499-00-0601 [1].

The bonded anchor system comprises a cartridge housing injection mortar, with variants available in EASF, EASF-E, EASF-A, in conjunction with a steel element. The steel component is composed of a commercially available threaded rod, complete with a washer and hexagon nut, falling within the specified range of M8 to M30 or rebars from Ø8 to Ø32.

The installation process involves inserting the steel element into a pre-drilled aperture that has been filled with injection mortar. The structural integrity is achieved through the synergistic bond formed among the metal component, injection mortar, and the surrounding concrete medium.

For a comprehensive visual representation and detailed product description, please consult Annex A.

2. Specification of the intended use in accordance with the applicable EAD

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 provisions made in this European Technical Assessment are based on an assumed working life of the anchor of 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 products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for tension loads	See Annex C1, Annex C2, Annex C6
Characteristic resistance for shear loads	See Annex C3, Annex C4, Annex C7
Displacement	See Annex C5, Annex C8
Characteristic resistance for tension loads, seismic actions	See Annex C9, Annex C10

3.2 Hygiene, health and environment (BWR 3)

No performance determined.

3.3 Safety in use (BWR 4)

For basic requirement safety in use the same criteria are valid as for Basic Requirement Mechanical resistance and stability.

3.4 Sustainable use of natural resources (BWR 7)

For the sustainable use of natural resources no performance was determined for this product.

3.5 General aspects relating to fitness for use

Durability and serviceability are only ensured if the specifications of intended use according to Annex B 1 are kept.

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

According to the Decision 96/582/EC of the European Commission[1] the system of assessment verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) given in the

following table apply.

Product	Intended use	Level or class	System
Metal anchors for use in concrete	For fixing and/or supporting to concrete, structural elements (which contributes to the stability of the works) or heavy units	-	1

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

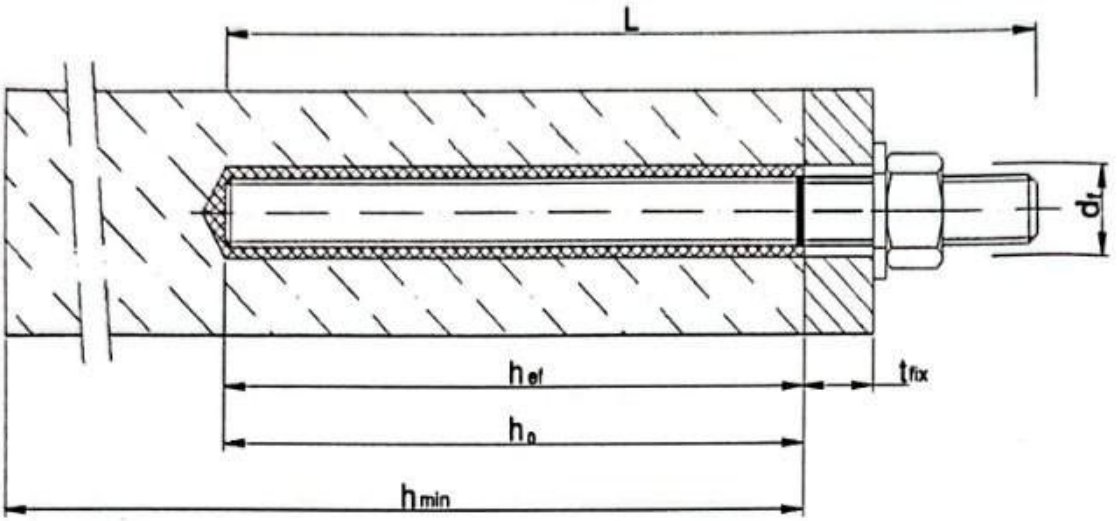
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited by the Technical Assessment Body. The notified product certification body shall visit the factory at least once a year for surveillance of the manufacturer.

Issued in British Board of Agrément
BRE Innovation Campus On 06.03.2024

BY
OLIVER BENNETT

Installed condition

Installation threaded rod



d_f = diameter of clearance hole in the fixture

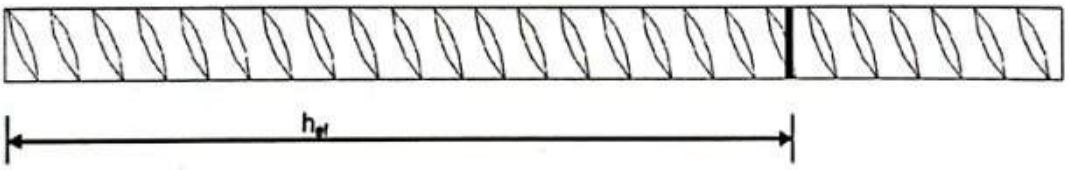
t_{fix} = thickness of fixture

h_{ef} = effective anchorage depth

h_0 = depth of drill hole

h_{min} = minimum thickness of member

Installation rebar

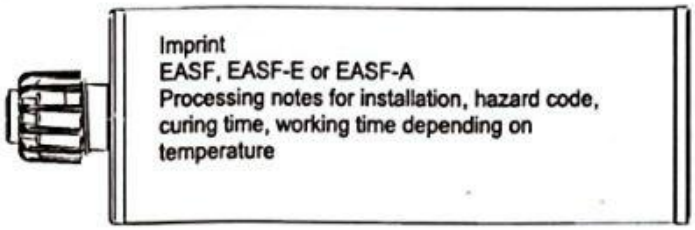


h_{ef} = effective anchorage depth

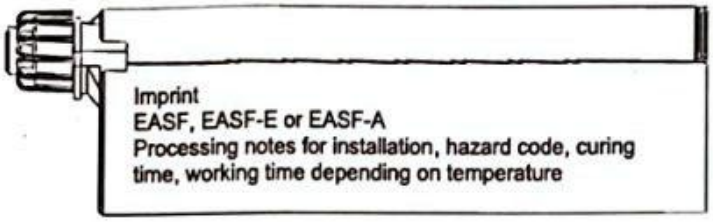
Injection system

Cartridge: EASF, EASF-E, EASF-A

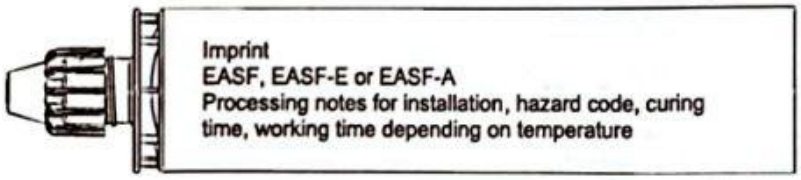
Type: Coaxial, 380ml up to 420ml cartridge



Type: Side-by-side, 345ml up to 360ml



Type: Foil tube, 165ml and 300ml cartridge

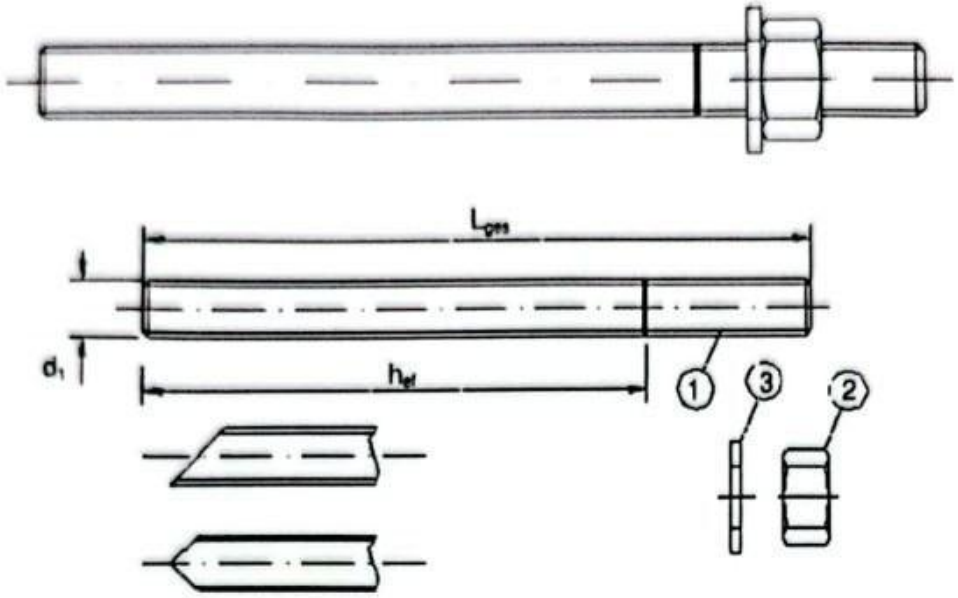


Static mixer A, B and C

Injection system EASF, EASF-E, EASF-A Chemical Anchor	Annex A2 of European Technical Assessment ETA-23/1032
Product description Injection system	

Threaded rod

Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut

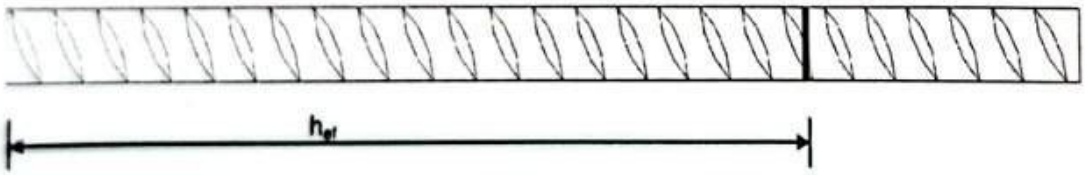


Commercial standard threaded rod with:

- Materials, dimensions, and mechanical properties according to Table A1
- Inspection certificate 3.1 according to EN 10204:2004
- Marking of embedment depth

Reinforcing bar

Reinforcing bar Ø8, Ø10, Ø12, Ø14, Ø16, Ø20, Ø25, Ø28, Ø32



Rebar:

- Minimum value of related rid area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rib height of the bar shall be in the rage $0,05*d \leq h \leq 0,07*d$

(d: Nominal diameter of the bar, h: Rip height of the bar)

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex A3** of European Technical Assessment ETA-23/1032
Product description Threaded rod and reinforcing bar	

Table A1: Materials

Part	Designation	Material
Steel, zinc plated ≥ 5 µm according to EN ISO 4042:1999 or Steel, hot-dip galvanised ≥ 40 µm according to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009		
1	Anchor rod	Steel, EN 10087:1998 or EN 10263:2001 Property class 4.6, 4.8, 5.8, 8.8, EN 1993-1-8:2005+AC:2009
2	Hexagon nut, EN ISO 4032:2012	Steel according to EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 or 4.8 rod) EN ISO 898-2:2012 Property class 5 (for class 5.8 rod) EN ISO 898-2:2021 Property class 8 (for class 8.8 rod) EN ISO 898-2:2021
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated or hot-dip galvanised
Stainless steel		
1	Anchor rod	Material 1.4401 / 1.4404 / 1.4571, EN 1088-1:2005 Property class 70 and 80, EN ISO 3506-1:2009
2	Hexagon nut, EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571, EN 1088-1:2005 Property class 70 and 80, EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401 / 1.4404 / 1.4571, EN 1088-1:2005
High corrosion resistance steel		
1	Anchor rod	Material 1.4529 / 1.4565 / 1.4547, EN 1088-1:2005 Property class 70 EN ISO 3506-1:2009
2	Hexagon nut, EN ISO 4032:2012	Material 1.4529 / 1.4565 / 1.4547, EN 1088-1:2005 Property class 70 EN ISO 3506-2:2009
3	Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565 / 1.4547, EN 1088-1:2005
Rebars		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C fyk and k according to NDP or NCL of EN 1992-1-1/NA:2013 fuk = ftk = k*fyk

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads: M8 to M30 and Ø8 to Ø32
- Seismic load (C1) : M8 to M30 and Ø8 to Ø32

Base materials:

- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000.
- Cracked and Non-cracked concrete: M8 to M30 and Ø8 to Ø32

Temperature range:

- I: -40°C to +40°C (max long-term temperature + 24 °C max short-term temperature + 40 °C)
- II: -40°C to +80°C (max long-term temperature + 50 °C max short-term temperature + 80 °C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (all materials)
- For the other environmental conditions according to EN 1993-1-2:2006+A1 2015 corresponding corrosion resistance classes :
  - Stainless steel A2 according to Annex A 4, Table A1: CRC II
  - Stainless steel A4 according to Annex A 4, Table A1: CRC III
  - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

Design:

- 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 actions are designed in accordance with:
  - EOTA Technical Report TR 029 "Design of bonded anchors", Edition September 2010 or
  - CEN/TS 1992-4:2009

Installation:

- Dry, wet and flooded holes(not sea water)
- Hole drilling by hammer or compressed air drill mode.
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Injection system EASF, EASF-E, EASF-A Chemical Anchor	Annex A5 of European Technical Assessment ETA-23/1032
Intended use Threaded rod and reinforcing bar	

Installation parameters

Table B1A: Installation parameters for threaded rod

Anchor size			M8	M10	M12	M16	M20	M24	M27	M30
Diameter of anchor bolt or thread diameter	d	mm	8	10	12	16	20	24	27	30
Nominal diameter of drill bit	d_0	mm	10	12	14	18	24	28	32	35
Diameter of clearance hole in the fixture (≤)	d_f	mm	9	12	14	18	22	26	30	33
Diameter of steel brush (≥)	d_b	mm	12	14	16	20	26	30	34	37
Minimum effective anchorage depth	$h_{ef,min}$	mm	60	60	70	80	90	96	108	120
Maximum effective anchorage depth (20*d)	$h_{ef,max}$	mm	160	200	240	320	400	480	540	600
Minimum thickness of the concrete member	h_{min}	mm	h_{ef}+30mm ≥100mm			$h_{ef} + 2*d_0$				
Nominal torque moment	T_{inst}	Nm	10	20	40	80	120	160	180	200
Thickness of the fixture	t_{fix}	mm	$0 < t_{fix} < 1500$							
Minimum spacing	s_{min}	mm	40	50	60	80	100	120	135	150
Minimum edge distance	c_{min}	mm	40	50	60	80	100	120	135	150

Table B1B: Installation parameters for reinforcing bar

Anchor size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Diameter of anchor	d	mm	8	10	12	14	16	20	25	28	32
Nominal diameter of drill bit	d_0	mm	12	14	16	18	20	24	32	35	40
Diameter of steel brush (≥)	d_b	mm	14	16	18	20	22	26	34	37	41
Minimum effective anchorage depth	$h_{ef,min}$	mm	60	60	70	75	80	90	100	112	128
Maximum effective anchorage depth	$h_{ef,max}$	mm	160	200	240	280	320	400	500	560	640
Minimum thickness of the concrete member	h_{min}	mm	h_{ef}+30mm ≥100mm		$h_{ef} + 2*d_0$						
Minimum spacing	s_{min}	mm	40	50	60	70	80	100	125	140	160
Minimum edge distance	c_{min}	mm	40	50	60	70	80	100	125	140	160

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex B1** of European Technical Assessment ETA-23/1032
Intended use Installation parameters	

Cleaning and setting tools

Cleaning brush (steel brush with steel bristles)

Table B2: Cleaning and setting parameters

Threaded Rod	d_0	d_b	$d_{b,min}$	Piston Plug
mm	mm	mm	mm	#
M8	10	12	10,5	Not required to use piston plug
M10	12	14	12,5	
M12	14	16	14,5	
M16	18	20	18,5	
M20	24	26	24,5	24
M24	28	30	28,5	28
M27	32	34	32,5	32
M30	35	37	35,5	35

Reinforcing Bar	d_0	d_b	$d_{b,min}$	Piston Plug
mm	mm	mm	mm	#
Ø8	12	14	12,5	Not required to use piston plug
Ø10	14	16	14,5	
Ø12	16	18	16,5	
Ø14	18	20	18,5	
Ø16	20	22	20,5	
Ø20	24	26	24,5	24
Ø25	32	34	32,5	32
Ø28	35	37	35,5	35
Ø32	40	41	40,5	40

Compressed air tool

d_0 between 10mm to 40mm

Hand operated blowing pump

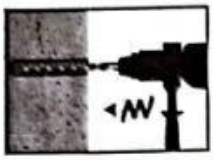
d_0 between 10mm to 20mm

Piston plug for overhead and horizontal installation

d_0 between 24mm to 40mm

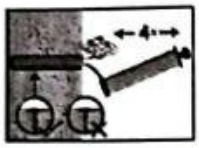
Injection system EASF, EASF-E, EASF-A Chemical Anchor	Annex B2 of European Technical Assessment ETA-23/1032
Intended use Cleaning and setting tools	

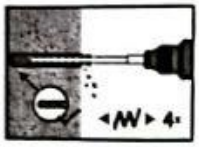
Installation instructions

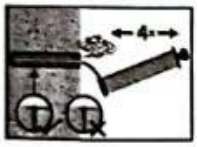


1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1A or Table B1B In case of aborted drill hole: the drill hole shall be filled with mortar.

a.







2. Hole cleaning

Attention! Standing water in the bore hole must be removed before cleaning.

a. Clean the hole with brush and hand pump:

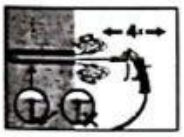
- starting from the drill hole bottom blow the hole at least 4 times using the hand pump,

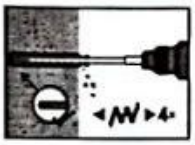
- using the specified brush, mechanically brush out the hole at least 4 times,

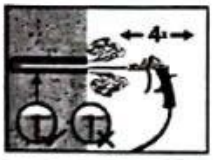
- starting from the drill hole bottom, blow at least 4 times with the hand pump.

The hand-pump can only be used for anchor sizes in non-cracked concrete up to bore hole diameter 20mm or embedment depth up to 240mm.

b.







b. Cleaning hole with compressed air:

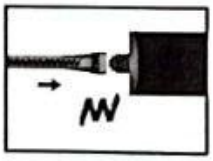
- starting from the drill hole bottom blow the hole at least 4 times by compressed air (6 atm),

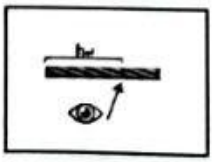
- using the specified brush, mechanically brush out the hole at least 4 times,

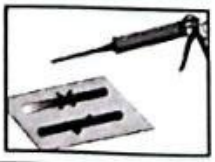
- blow the hole at least 4 times by compressed air (6 atm),

Compressed air (min.6 bar) can be used for all sizes in cracked and non-cracked concrete.

After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning repeated has to be directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.

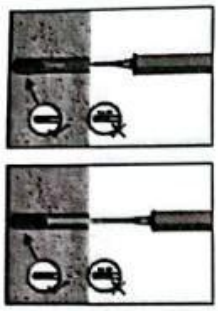
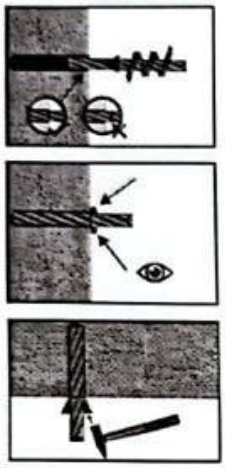
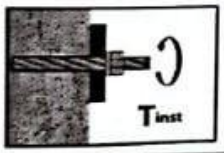






3. Attach a supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use.
For every working interruption longer than the recommended working time (Table B3) as well as for new cartridges, a new static-mixer shall be used.

Dispense to waste until even colour is obtained (min. 10 cm).

	4. Starting from the bottom or back of the cleaned anchor hole fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm and extension nozzle shall be used. In overhead installation to avoid the slipping of the stud during the open time of the product (due to the stud own weight) use a temporary interlocking element. Observe the gel-/ working times given in Table B3
	5. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached. The anchor should be free of dirt, grease, oil or other foreign material. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod should be fixed (e.g wedges).
	6. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured. (attend Table B3)
	7. After full curing, the add-on part can be installed with the max. torque (Table B1A) by using a calibrated torque wrench.

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex B3** of European Technical Assessment ETA-23/1032
Intended use Installation instructions	

Curing time

Table B3: Maximum working time and minimum curing time of EASF, EASF-E, EASF-A Chemical Anchor

Temperature of base material	Temperature of cartridge	Maximum working time twork			Minimum curing time[1] tload or tcure		
		EASF-A	EASF	EASF-E	EASF-A	EASF	EASF-E
-20°C to -11°C	-20°C to -11°C	45	-	-	960	-	-
-10°C to -1°C	-10°C to -1°C	20	-	-	360	-	-
0°C to +4°C	0°C to +4°C	6	-	-	240	-	-
+5°C to +9°C	+5°C to +9°C	3	10	-	75	150	-
+10°C to +19°C	+10°C to +19°C	1,5	6	15	45	80	300
+20°C to +24°C	+20°C to +24°C	1	5	10	30	45	150
+25°C to +29°C	+25°C to +29°C	-	3	7,5	-	35	85
+30°C to +34°C	+30°C to +34°C	-	-	5	-	-	50
+35°C to +39°C	+35°C to +39°C	-	-	3,5	-	-	40
+40°C to +45°C	+40°C to +45°C	-	-	2,5	-	-	35

1) In wet or water filled holes the curing times must be doubled.

Table C1: Characteristic values of tension loads under – static and quasi-static action

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure [1]										
Steel failure with standard threaded rod grade 5.8										
Characteristic resistance	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	228	280
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard threaded rod grade 8.8										
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard threaded rod grade 10.9										
Characteristic resistance	$N_{Rk,s}$	[kN]	37	58	84	157	245	353	459	561
Partial safety factor	γ_{Ms}	[-]	1,40							
Steel failure with standard threaded rod grade 12.9										
Characteristic resistance	$N_{Rk,s}$	[kN]	44	70	101	188	294	424	551	673
Partial safety factor	γ_{Ms}	[-]	1,40							
Steel failure with standard stainless steel threaded rod A4-70										
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393
Partial safety factor	γ_{Ms}	[-]	1,87							
Steel failure with standard stainless steel threaded rod A4-80										
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	γ_{Ms}	[-]	1,60							
Steel failure with standard high corrosion threaded rod grade 70										
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393
Partial safety factor	γ_{Ms}	[-]	1,87							
Combined pull-out and concrete cone failure (working life 50)										
Characteristic bond resistance in non-cracked concrete C20/25, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	15	13	12	12	11	10	9,5	8,5
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	12	10	10	10	9,0	7,5	6,5	6,5
Characteristic bond resistance in cracked concrete C20/25, working life 50 years										
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	10	9,0	8,5	8,5	7,5	7,0	6,5	6,0
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,50}$	[N/mm²]	8,0	7,0	7,0	7,0	6,0	5,5	5,0	5,0
Factors for cracked and non-cracked concrete C20/25										
Reduction factor for concrete	$\psi^0_{sus,50}$	40°C/24°C	0,77							
		80°C/50°C	0,70							
Increasing factor for concrete	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							

[1] in the absence of national regulations

Table C2: Characteristic values of tension loads under – static and quasi-static action

Concrete cone failure					
Factor for non-cracked concrete	$k_{ucr,N}$	[-]	11,0		
Factor for cracked concrete	$k_{cr,N}$	[-]	7,7		
Edge distance	$c_{cr,N}$	[mm]	$1,5 \cdot h_{ef}$		
Spacing	$s_{cr,N}$	[mm]	$3,0 \cdot h_{ef}$		
Splitting failure					
Edge distance	$c_{cr,sp}$ for h_{min}	[mm]	$2,5 \cdot h_{ef}$	$2,0 \cdot h_{ef}$	$1,5 \cdot h_{ef}$
	$c_{cr,sp}$ for $h^{2)} \geq 2 \cdot h_{ef}$	[mm]	$c_{cr,Np}$		
Spacing	$s_{cr,sp}$	[mm]	$2,0 \cdot c_{cr,sp}$		
Installation safety factors for combined pull-out, concrete cone and splitting failure					
Installation safety factors for dry and wet concrete	γ_{inst}	[-]	1,2		
Installation safety factors for flooded bore hole	γ_{inst}	[-]	1,4		

[1] in the absence of national regulations [2] h – concrete member thickness

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex C2** of European Technical Assessment ETA-23/1032
Performances Characteristic resistance under tension loads in non-cracked concrete -(Threaded Rod-rebar)	

Table C3: Characteristic resistance under shear load in non-cracked concrete – steel failure without lever arm

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure with standard threaded rod grade 5.8										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	7	11	15	28	43	62	80	99
Partial safety factor	γ_{Ms}	[-]	1,25							
Ductility factor	k_7	[-]	0,8							
Steel failure with standard threaded rod grade 8.8										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	10	16	24	44	69	99	129	157
Partial safety factor	γ_{Ms}	[-]	1,25							
Ductility factor	k_7	[-]	0,8							
Steel failure with standard threaded rod grade 10.9										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124	161	196
Partial safety factor	γ_{Ms}	[-]	1,50							
Ductility factor	k_7	[-]	0,8							
Steel failure with standard threaded rod grade 12.9										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	15	24	35	66	103	148	193	236
Partial safety factor	γ_{Ms}	[-]	1,50							
Ductility factor	k_7	[-]	0,8							
Steel failure with standard stainless steel threaded rod A4-70										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	9	14	21	39	60	87	113	137
Partial safety factor	γ_{Ms}	[-]	1,56							
Ductility factor	k_7	[-]	0,8							
Steel failure with standard stainless steel threaded rod A4-80										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	10	16	224	44	69	99	129	157
Partial safety factor	γ_{Ms}	[-]	1,33							
Ductility factor	k_7	[-]	0,8							
Steel failure with high corrosion stainless steel threaded rod grade 70										
Characteristic resistance	$V^0_{Rk,s}$	[kN]	9	14	21	39	60	87	113	137
Partial safety factor	γ_{Ms}	[-]	1,56							
Ductility factor	k_7	[-]	0,8							

Injection system EASF, EASF-E, EASF-A Chemical Anchor

Annex C3
of European Technical Assessment ETA-23/1032

Performances
Characteristic resistance under shear loads in non-cracked concrete (Threaded Rod)

Table C4: Characteristic values for shear load in non-cracked concrete – steel failure with lever arm

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure with standard threaded rod grade 5.8										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	19	38	66	166	325	561	832	1125
Partial safety factor	γ_{Ms}	[-]	1,25							
Steel failure with standard threaded rod grade 8.8										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1331	1799
Partial safety factor	γ_{Ms}	[-]	1,25							
Steel failure with standard threaded rod grade 10.9										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	37	75	131	333	649	1123	1665	2249
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard threaded rod grade 12.9										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	45	90	157	400	779	1347	1998	2699
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard stainless steel threaded rod A4-70										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	233	455	786	11165	1574
Partial safety factor	γ_{Ms}	[-]	1,56							
Steel failure with standard stainless steel threaded rod A4-80										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	30	60	105	266	519	898	1332	1799
Partial safety factor	γ_{Ms}	[-]	1,33							
Steel failure with high corrosion stainless steel threaded rod grade 70										
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	26	52	92	233	454	786	1165	1574
Partial safety factor	γ_{Ms}	[-]	1,56							

Injection system EASF, EASF-E, EASF-A Chemical Anchor

Annex C4
of European Technical Assessment
ETA-23/1032

Performances
Characteristic resistance under shear loads in non-cracked concrete (Threaded Rod)

Table C5: Concrete edge failure

Size			M8	M10	M12	M16	M20	M24	M27	M30
Concrete edge failure										
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Effective length of anchor shear loading	l_f	[mm]	min (h_{ef}; $12d_{nom}$)							
Installation Factor	γ_{inst}	-	1							

Table C6: Concrete pry-out failure

Factor	k_8	-	2
Installation Factor	γ_{inst}	-	1

Table C7: Displacement under tension load

Size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic displacement in non-cracked C20/25 to C50/60 concrete										
Temperature Range I : 40°C/24°C	$\delta_{N0\text{-factor}}$	[mm/(N/mm²)]	0,02	0,03	0,04	0,04	0,04	0,05	0,06	0,06
	$\delta_{N\infty\text{-factor}}$	[mm/(N/mm²)]	0,03	0,05	0,05	0,05	0,06	0,06	0,07	0,07
Temperature Range II: 80°C/50°C	$\delta_{N0\text{-factor}}$	[mm/(N/mm²)]	0,05	0,05	0,06	0,06	0,07	0,07	0,08	0,12
	$\delta_{N\infty\text{-factor}}$	[mm/(N/mm²)]	0,07	0,07	0,08	0,08	0,09	0,11	0,12	0,14
Characteristic displacement in cracked C20/25 to C50/60 concrete										
Temperature Range I : 40°C/24°C	$\delta_{N0\text{-factor}}$	[mm/(N/mm²)]	0,09	0,09	0,06	0,06	0,06	0,06	0,06	0,06
	$\delta_{N\infty\text{-factor}}$	[mm/(N/mm²)]	0,10	0,10	0,16	0,16	0,16	0,16	0,16	0,16
Temperature range II: 80°C/50°C	$\delta_{N0\text{-factor}}$	[mm/(N/mm²)]	0,22	0,22	0,18	0,18	0,18	0,18	0,18	0,18
	$\delta_{N\infty\text{-factor}}$	[mm/(N/mm²)]	0,28	0,28	0,26	0,26	0,26	0,26	0,26	0,26

Calculation of displacement: $\delta_{N0} = \delta_{N0\text{-factor}} \cdot \tau$; $\delta_N = \delta_{N\infty\text{-factor}} \cdot \tau$; (τ – action bond stress for tension)

Table C8: Displacement under shear loads load

Size			M8	M10	M12	M16	M20	M24	M27	M30
Characteristic displacement in non-cracked C20/25 to C50/60 concrete										
Displacement (All temperature ranges)	$\delta_{V0\text{-factor}}$	[mm/(kN)]	0,07	0,07	0,06	0,05	0,04	0,04	0,03	0,03
	$\delta_{V\infty\text{-factor}}$	[mm/(kN)]	0,08	0,08	0,08	0,07	0,06	0,05	0,04	0,04
Characteristic displacement in cracked C20/25 to C50/60 concrete										
Displacement (All temperature ranges)	$\delta_{V0\text{-factor}}$	[mm/(kN)]	0,14	0,13	0,12	0,12	0,10	0,09	0,07	0,07
	$\delta_{V\infty\text{-factor}}$	[mm/(kN)]	0,20	0,19	0,16	0,15	0,11	0,10	0,09	0,09

Calculation of the displacement: $\delta_{N0} = \delta_{N0\text{-factor}} \cdot V$; $\delta_N = \delta_{N\infty\text{-factor}} \cdot V$; (V – applied shear load)

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex C5** of European Technical Assessment ETA-23/1032
Performances Displacement (threaded rod)	

Table C9: Characteristic values of tension loads under – static and quasi-static action

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure [1]											
Steel failure with reinforcing bar BSt 420											
Characteristic resistance	$N_{Rk,s}$	[kN]	21	33	48	65	85	132	206	258	338
Partial safety factor	γ_{Ms}	[-]	1,50								
Steel failure with reinforcing bar BSt 430											
Characteristic resistance	$N_{Rk,s}$	[kN]	22	34	49	66	87	135	211	265	346
Partial safety factor	γ_{Ms}	[-]	1,50								
Steel failure with reinforcing bar BSt 480											
Characteristic resistance	$N_{Rk,s}$	[kN]	24	38	54	74	96	151	236	298	386
Partial safety factor	γ_{Ms}	[-]	1,50								
Steel failure with reinforcing bar BSt 500											
Characteristic resistance	$N_{Rk,s}$	[kN]	25	39	57	77	101	157	246	308	402
Partial safety factor	γ_{Ms}	[-]	1,50								
Steel failure with reinforcing bar BSt 550											
Characteristic resistance	$N_{Rk,s}$	[kN]	28	43	62	85	111	173	270	339	442
Partial safety factor	γ_{Ms}	[-]	1,50								
Combined pull-out and concrete cone failure (working life 50)											
Characteristic bond resistance in non-cracked concrete C20/25, working life 50 years											
Temperature range I: 40°C/24°C	$\tau_{Rk,ucr,50}$	[N/mm²]	15	13	12	12	12	11	11	9,5	8,0
Temperature range II: 80°C/50°C	$\tau_{Rk,ucr,50}$	[N/mm²]	12	10	10	10	10	9,0	7,0	6,5	6,0
Characteristic bond resistance in cracked concrete C20/25, working life 50 years											
Temperature range I: 40°C/24°C	$\tau_{Rk,cr,50}$	[N/mm²]	10	9,0	8,5	8,5	8,5	7,5	7,0	6,0	5,5
Temperature range II: 80°C/50°C	$\tau_{Rk,cr,50}$	[N/mm²]	8,0	7,0	7,0	7,0	7,0	6,0	5,5	5,0	4,5
Factors for cracked and non-cracked concrete C20/25											
Reduction factor for concrete	$\psi^0_{sus,50}$	40°C/24°C	0,77								
		80°C/50°C	0,70								
Increasing factor for concrete	ψ_c	C30/37	1,04								
		C40/50	1,07								
		C50/60	1,09								

[1] in the absence of national regulations

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex C6** of European Technical Assessment ETA-23/1032
Performances Characteristic resistance under tension loads in non-cracked concrete (Rebar)	

Table C10: Characteristic values of under shear load under static and quasi-static action

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Steel failure without lever arm											
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0,5 \times A_s \times f_{uk}$ [1]								
Crosssection Area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial safety factor	γ_{Ms}	[-]	1,5 [2]								
Ductulity factor	k_7	[-]	1,0								
Steel failure with lever arm											
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1,2 \times W_{el} \times f_{uk}$								
Crosssection Area	A_s	[mm³]	50	98	170	269	402	785	1534	2155	3217
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,5 [2]								

Table C11: Concrete edge failure

Size			Ø8	Ø10	Ø12	Ø14	Ø16	Ø20	Ø25	Ø28	Ø32
Concrete edge failure											
Outside diameter of anchor	d_{nom}		8	10	12	16	20	24	27	30	32
Effective length of anchor shear loading	l_f		$\min(h_{ef}; 12 \times d_{nom})$					$\min(hef; 12 \times 300mm)$			
Installation Factor	γ_{inst}	[-]	1								

Table C12: Concrete pry-out failure

Factor	k_8	-	2
Installation Factor	γ_{inst}	-	1

[1] fuk shall be taken from the specification of rebar.
[2] in the absence of national regulations

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex C7** of European Technical Assessment ETA-23/1032
Performances Characteristic values of under shear load under static and quasi-static action (Rebar)	

Table C13: Displacement under tension load

Size			ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ20	ϕ25	ϕ28	ϕ32
Characteristic displacement in non-cracked C20/25 to C50/60 concrete											
Temperature Range I : 40°C/24°C	$\delta_{N0\text{-}factor}$	[mm/(N/mm²)]	0,02	0,03	0,03	0,03	0,04	0,05	0,05	0,05	0,06
	$\delta_{N\infty\text{-}factor}$	[mm/(N/mm²)]	0,04	0,04	0,05	0,05	0,05	0,06	0,06	0,06	0,06
Temperature range II: 80°C/50°C	$\delta_{N0\text{-}factor}$	[mm/(N/mm²)]	0,04	0,05	0,07	0,08	0,08	0,09	0,11	0,12	0,13
	$\delta_{N\infty\text{-}factor}$	[mm/(N/mm²)]	0,07	0,07	0,09	0,11	0,13	0,15	0,17	0,17	0,18
Characteristic displacement in cracked C20/25 to C50/60 concrete											
Temperature Rande I : 40°C/24°C	$\delta_{N0\text{-}factor}$	[mm/(N/mm²)]	0,02	0,03	0,03	0,04	0,04	0,05	0,06	0,06	0,06
	$\delta_{N\infty\text{-}factor}$	[mm/(N/mm²)]	0,04	0,04	0,05	0,05	0,05	0,06	0,06	0,06	0,06
Temperature range II: 80°C/50°C	$\delta_{N0\text{-}factor}$	[mm/(N/mm²)]	0,20	0,20	0,18	0,18	0,18	0,18	0,18	0,18	0,18
	$\delta_{N\infty\text{-}factor}$	[mm/(N/mm²)]	0,30	0,30	0,26	0,26	0,26	0,26	0,26	0,26	0,26

Calculation of the displacement: $\delta_{N0} = \delta_{N0\text{-factor}} \cdot \tau$; $\delta_N = \delta_{N\infty\text{-factor}} \cdot \tau$; (τ – action bond stress for tension)

Table C14: Displacement under shear loads load

Size			ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ20	ϕ25	ϕ28	ϕ32
Characteristic displacement in non-cracked C20/25 to C50/60 concrete											
Displacement (All temperature ranges)	$\delta_{V0\text{-}factor}$	[mm/(kN)]	0,07	0,06	0,60	0,05	0,04	0,04	0,03	0,03	0,02
	$\delta_{V\infty\text{-}factor}$	[mm/(kN)]	0,09	0,09	0,08	0,07	0,07	0,07	0,06	0,05	0,04
Characteristic displacement in cracked C20/25 to C50/60 concrete											
Displacement (All temperature ranges)	$\delta_{V0\text{-}factor}$	[mm/(kN)]	0,11	0,11	0,09	0,09	0,08	0,08	0,07	0,06	0,06
	$\delta_{V\infty\text{-}factor}$	[mm/(kN)]	0,17	0,17	0,02	0,15	0,13	0,13	0,11	0,11	0,09

Calculation of the displacement: $\delta_{N0} = \delta_{N0\text{-factor}} \cdot V$; $\delta_N = \delta_{N\infty\text{-factor}} \cdot V$; (V – applied shear load)

Injection system EASF, EASF-E, EASF-A Chemical Anchor	**Annex C8** of European Technical Assessment ETA-23/1032
Performances Displacement (Rebar)	

Table C15: Characteristic values of tension loads under – seismic action. (C1)

Size			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure [1]										
Steel failure with standard threaded rod grade 5.8										
Characteristic resistance	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	228	280
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard threaded rod grade 8.8										
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	γ_{Ms}	[-]	1,50							
Steel failure with standard threaded rod grade 10.9										
Characteristic resistance	$N_{Rk,s}$	[kN]	37	58	84	157	245	353	459	561
Partial safety factor	γ_{Ms}	[-]	1,40							
Steel failure with standard threaded rod grade 12.9										
Characteristic resistance	$N_{Rk,s}$	[kN]	44	70	101	188	294	424	551	673
Partial safety factor	γ_{Ms}	[-]	1,40							
Steel failure with standard stainless steel threaded rod A4-70										
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393
Partial safety factor	γ_{Ms}	[-]	1,87							
Steel failure with standard stainless steel threaded rod A4-80										
Characteristic resistance	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	367	449
Partial safety factor	γ_{Ms}	[-]	1,60							
Steel failure with standard high corrosion threaded rod grade 70										
Characteristic resistance	$N_{Rk,s}$	[kN]	26	41	59	110	172	247	321	393
Partial safety factor	γ_{Ms}	[-]	1,87							
Combined pull-out and concrete cone failure										
Characteristic bond resistance in non-cracked and cracked concrete C20/25										
Temperature range I: 40°C/24°C	$\tau_{Rk,eq,C1}$	[N/mm²]	4.24	4.85	4.19	3.97	3.47	3.55	2.87	3.12
Temperature range II: 80°C/50°C	$\tau_{Rk,eq,C1}$	[N/mm²]	3.39	3.83	3.49	3.08	2.72	2.79	2.40	2.60
Installation factor dry and wet condition	ψ_{inst}	[-]	1,2							
Installation factor flooded hole condition			1,4							
Increasing factor for concrete	ψ_c	C30/37	1,04							
		C40/50	1,07							
		C50/60	1,09							

Table C17: Characteristic values of shear loads under – seismic action. (C1)

Steel failure			
Characteristic Shear Resistance	$V_{Rk,s,eq,C1}$	[kN]	$0,7 \times V^0_{Rk,s}$
Partial factor	γ_{Ms}	[-]	See Annex C3 - Table C3
[1] in the absence of national regulations			
Factor for annular gap	α_{gap}	[-]	0,5 (1,0) [2]

[2] Value in brackets valid for filled annular gap between anchor and clearance in the fixture.

Injection system EASF, EASF-E, EASF-A Chemical Anchor

Annex C9
of European Technical Assessment
ETA-23/1032

Performances
Characteristic resistance in tension and shear loads. Performance Category C1 (Threaded Rod)

Table C18: Characteristic values of tension loads under – seismic action. (C1)

Size			ϕ8	ϕ10	ϕ12	ϕ14	ϕ16	ϕ20	ϕ25	ϕ28	ϕ32
Steel failure [1]											
Steel failure											
Characteristic resistance	$N_{Rk,s,eq,C1}$	[-]	$0,5 \times A_s \times f_{uk}$ [1]								
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,5 [2]								
Combined pull-out and concrete cone failure											
Characteristic bond resistance in non-cracked and cracked concrete C20/25											
Temperature range I: 40°C/24°C	$\tau_{Rk,eq,C1}$	[N/mm²]	4.24	4.11	3.96	3.53	3.96	3.81	3.35	3.12	3.12
Temperature range II: 80°C/50°C	$\tau_{Rk,eq,C1}$	[N/mm²]	3.39	3.20	3.03	2.86	3.22	2.79	2.63	2.60	2.34
Installation factor dry and wet condition	ψ_{inst}	[-]	1,2								
Installation factor flooded hole condition			1,4								
Increasing factor for concrete	ψ_c	C30/37	1,04								
		C40/50	1,07								
		C50/60	1,09								

Table C19: Characteristic values of shear loads under – seismic action. (C1)

Steel failure											
Characteristic Shear Resistance	$V_{Rk,s,eq,C1}$	[kN]	$0.35 \times A_s \times f_{uk}$ [1]								
Cross section area	A_s	[mm²]	50	79	113	154	201	314	491	616	804
Partial factor	γ_{Ms}	[-]	1,5 [2]								
Factor for annular gap	α_{gap}	[-]	0,5 (1,0) [3]								

[1] f_{uk} shall be taken from specification of rebar
[2] in the absence of national regulations
[3] Value in brackets valid for filled annular gap between anchor and clearance in the fixture.

Injection system EASF, EASF-E, EASF-A Chemical Anchor

Annex C10
of European Technical Assessment
ETA-23/1032

Performances
Characteristic resistance in tension and shear loads. Performance Category C1 (Rebar)

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