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European Technical Assessment

ETA-10/0309 of 01/10/2015

English translation prepared by CSTB - Original version in French language

General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011:

Nom commercial Trade name

Famille de produit *Product family* Injection system SPIT EPCON C8 XTREM for cracked concrete

Cheville à scellement de type "à injection" pour fixation dans le béton fissuré et non fissuré : tiges filetées M8 à M30 et barres d'armatures Ø8 à Ø32.

Bonded injection type anchor for use in cracked and non-cracked concrete: Threaded rods M8 to M30 and rebars Ø8 to Ø32

Titulaire *Manufacturer*

Usine de fabrication Manufacturing plant Société SPIT Route de Lyon F-26501 BOURG-LES-VALENCE France

Société SPIT Route de Lyon F-26501 BOURG-LES-VALENCE France

intégrante de cette évaluation

integral part of this assessment

Cette evaluation contient: This Assessment contains

Base de l'ETE Basis of ETA

Cette evaluation remplace: *This Assessment replaces* ETAG 001, Edition April 2013 used as EAD ATE-10/0309 valide du 11/10/2010 au 11/10/2015

ETAG 001, Version April 2013, utilisée en tant que EAD

25 pages incluant 21 pages d'annexes qui font partie

25 pages including 21 pages of annexes which form an

ent replaces ETA-10/0309 with validity from 11/10/2010 to 11/10/2015

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Specific part

1 Technical description of the product

The Injection system SPIT EPCON C8 XTREM is an adhesive anchor consisting of a two component system delivered in unmixed condition in cartridges and of a steel element.

The steel element can be made of zinc plated carbon steel, reinforcing bar, stainless steel, or high corrosion resistant stainless steel (HCR).

The steel element is placed into a rotary/percussion drilled hole filled with the injection mortar and is anchored via the bond between the metal part and concrete.

An illustration of the product is provided in Annexes A.

2 Specification of the intended use

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annexes 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 right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance		
Characteristic resistance under tension loads in non-cracked concrete acc. TR029 or CEN/TS 1992-4, for threaded rods	See Annex C1		
Characteristic resistance under tension loads in cracked concrete acc. TR029 or CEN/TS 1992-4, for threaded rods	See Annex C2		
Characteristic resistance under shear loads in concrete acc. TR029 or CEN/TS 1992-4, for threaded rods	See Annex C 3		
Displacements for threaded rods	See Annex C4		
Characteristic resistance under tension loads in non-cracked concrete acc. TR029 or CEN/TS 1992-4, for rebars	See Annex C5		
Characteristic resistance under tension loads in cracked concrete acc. TR029 or CEN/TS 1992-4, for rebars	See Annex C6		
Characteristic resistance under shear loads in concrete acc. TR029 or CEN/TS 1992-4, for rebars	See Annex C7		
Displacements for rebars	See Annex C8		
Characteristic resistance under seismic action C1 acc. TR045, for threaded rods	See Annex C11		

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance			
Reaction to fire	Anchorages satisfy requirements for Class A1			
Resistance to fire	No performance determined (NPD)			

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances contained in this European Technical Assessment, there may be requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Directive, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

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

- 3.5 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)

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

3.8 General aspects relating to fitness for use

Durability and Serviceability are only ensured if the specifications of intended use according to Annex B1 are kept.

4 Assessment and verification of constancy of performance (AVCP)

According to the Decision 96/582/EC of the European Commission ¹, as amended, the system of assessment and 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	Ι	1

5 Technical details necessary for the implementation of the AVCP system

Technical details necessary for the implementation of the Assessment and verification of constancy of performance (AVCP) system are laid down in the control plan deposited at Centre Scientifique et Technique du Bâtiment.

The manufacturer shall, on the basis of a contract, involve a notified body approved in the field of anchors for issuing the certificate of conformity CE based on the control plan.

The original French version is signed by

Charles Baloche Technical Director

1

Injection mortar

Two component epoxy system



Marking

- Identifying mark of the producer **SPIT** Trade name **EPCON C8 XTREM** ٠
- •
- Expire date •
- Curing and processing time ٠
- Charge code number

Cartridges

400ml coaxial cartridge	
450ml side by side cartridge	
900ml side-by-side cartridge	
SPIT EPCON C8 XTREM	
Product description Mortar cartridges	Annex A1



- Pneumatic dispenser P450 / P900 / P400
- Manual dispenser M450 / M450 premium / M400

SPIT EPCON C8 XTREM	
Product description Mixing nozzles, extensions and dispensers	Annex A2



Product description

Steel elements

Annex A3

	i de la constante de		Telefence		
	Electr	roplated Version			
	M8 to M30 (standard commercial rods)	Carbon steel grade 5.8, 8.8 and 10.9 according to ISO 89 Zinc coating 5µm min. NF E25-009 Hot dip galvanized NE EN ISO 1461			
	MAXIMA M8 (produced by the manufacturer)	DIN 1654 part 2 or 4, co formed steel. Zinc coating 5µm min. N	Id formed steel or NFA 35053, col		
Threaded rods	MAXIMA M10 to M16 (produced by the manufacturer)	NFA 35053 cold formed Zinc coating 5µm min. N	steel IF E25-009		
	MAXIMA M20 to M30 (produced by the manufacturer)	11SMnPb37 according t Zinc coating 5µm min. N	to NF A35-561 NF E25-009		
Nut	-	Steel, EN 20898-2 Grade 6 or 8 Zinc coating 5µm min. NF E25-009			
Washer	-	Steel DIN 513 Zinc coating 5µm min. NF E25-009			
	Stainle	ess steel version			
Threaded rods (Maxima or std commercial rods)	Grade A4-80: M8 to M24 Grade A4-70: M30	X2CrNiMo 17.12.2 according to EN 10088-3			
Nut		Stainless steel A4-80 ac	cording to EN 20898-2		
Washer		Stainless steel A4 accor	rding to EN 20898-2		
	High resistance	e corrosion version (HC	R)		
Threaded rods	M8 to M30	Stainless steel HCR acc Rm ≥ 650 MPa acc. EN	2. EN 10088, 1.4529 / 1.4565 10088		
Nut	-	Stainless steel HCR acc Rm ≥ 650 MPa acc. EN	2. EN 10088, 1.4529 / 1.4565 10088		
Washer	-	Stainless steel HCR acc EN ISO 7089			
IT EPCON C8 X	TREM				

Table A2: Material properties for rebars

(Refer to EN 1992-1-1 Annex C Table C.1 and C.2N)

Product form		Bars and de-coiled rods			
Class		В	С		
Characteristic yield stree	ngth f _{yk} or f _{0,2k} (MPa)	400 t	o 600		
Minimum value of k = (ft	/f _y) _k	≥ 1,08 ≥ 1,15 < 1,35			
Characteristic strain at r	naximum force, ϵ_{uk} (%)	≥ 5,0 ≥ 7,5			
Bendability		Bend / Rebend test			
Maximum deviation from nominal mass (individual bar or wire) (%)	Nominal bar size (mm) ≤ 8 > 8	± 6,0 ± 4,5			
Minimum relative rib area, f _{R,min} (mm ²)	Nominal bar size (mm) 8 to 12 > 12	0,040 0,056			

High of the rib hrib:

The high of the rib h_{rib} must satisfy the equation $0,05 \text{ d} \le h_{rib} \le 0,07 \text{ d}$ with d = nominal diameter of the rebar.

SPIT EPCON C8 XTREM

Product description

Rebars

Specifications of intended use

Anchorages subject to:

- Static and quasi-static loads.
- Seismic loads (performance categories C1 for threaded rods of sizes M10, M12 and M16),

Base materials:

- Cracked concrete and non-cracked concrete.
- Reinforced or unreinforced normal weight concrete of strength classes C20/25 at least to C50/60 at most according to EN 206-1: 2000-12.

Temperature Range:

- Ta: 40°C to +40°C (max. short term temperature +40°C and max. long term temperature +24°C)
- Tb: 40°C to +80°C (max. short term temperature +80°C and max. long term temperature +50°C)

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel, stainless steel, high corrosion resistance steel).
- Structures subject to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel, high corrosion resistance steel).
- Structures subject to external atmospheric exposure including industrial and marine environment if no particular aggressive conditions exist (stainless steel, high corrosion resistance steel).
- Structures subject to any of the three above conditions, with particular aggressive conditions (high corrosion resistance steel).

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

Design:

- The anchorages are designed in accordance with the EOTA Technical Report TR 029 "Design of bonded anchors" or CEN/TS 1992-4-5" Design of fastenings for use in concrete" under the responsibility of an engineer experienced in anchorages and concrete work.
- For seismic applications the anchorages are designed in accordance with TR045 "Design of Metal Anchors For Use In Concrete Under Seismic Actions".
- 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.

Installation:

- Dry or wet concrete (use category 1) and in flooded holes (use category 2).
- Installation in cracked concrete for all sizes of threaded rods and rebars.
- All the diameters may be used in all the direction (floor, wall, overhead).
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Use of the anchor only as supplied by the manufacturer without exchanging the components of an anchor.
- Anchor installation in accordance with the manufacturer's specifications and drawings and using the appropriate tools (Annexes B2 to B5).
- Effective anchorage depth, edge distances and spacing not less than the specified values without minus tolerances.
- Hole drilling by hammer drill
- In case of aborted drill hole: the drill hole shall be filled with mortar.

SPIT EPCON C8 XTREM

Intended Use

Specifications

Annex B1

• For overhead installation, piston plugs shall be used, embedded metal parts shall be fixed during the curing time, e.g. with wedges.

Note:

Rebars may be used as anchor designed in accordance with the EOTA Technical Report TR 029 only. The basic assumptions for the design according to anchor theory shall be observed. This includes the consideration of tension and shear loads and the corresponding failure modes as well as the assumption that the base material (concrete structural element) remains essentially in the serviceability limit state (either non-cracked or cracked) when the connection is loaded to failure. Such applications are e.g. concrete overlay or shear dowel connections or the connections of a wall predominantly loaded by shear and compression forces with the foundation, where the rebars act as dowels to take up shear forces.

SPIT EPCON C8 XTREM

Intended Use

Specifications

Table B1a: Installation data with standard,	minimum and maximum embedment
depth for threaded rods	

Anchor size			M8	M10	M12	M16	M20	M24	M30
Diameter of anchor rod	d	[mm]	8	10	12	16	20	24	30
	min		40	40	48	64	80	96	120
Range of anchorage depth h_{ef} and bore hole depth h_{o}	max	[mm]	160	200	240	320	400	480	600
	std (1)		80	90	110	125	170	210	280
Nominal diameter of drill bit	d _o	[mm]	10	12	14	18	25	28	35
Diameter of clearance hole in the fixture	d _f	[mm]	9	12	14	18	22	26	33
Torque moment	T _{inst}	[Nm]	10	20	30	60	120	200	400
Minimum thickness of concrete member	h _{min}	[mm]	Max(h _{ef} + 30 ; 100)				h _{ef} +	· 2d _o	
Minimum spacing	S _{min}	[mm]	40	50	60	80	100	120	150
Minimum edge distance	C _{min}	[mm]	40	50	60	80	100	120	150

(1) Effective anchoring depth for SPIT MAXIMA threaded rods.



SPIT EPCON C8 XTREM Annex B2 Intended Use Installation data for threaded rods

Table B1b:	Installation data with standard, minimum and maximum embedment
	depth for rebars

Rebar size			Ø 8	Ø10	Ø12	Ø16	Ø 20	Ø 25	Ø 26	Ø 28	Ø 32
Diameter of rebar	d	[mm]	8	10	12	16	20	25	26	28	32
Range of anchorage depth h_{ef} and bore hole depth h_{o}	min	- [mm]	40	60	70	80	90	100	104	112	128
	max	- [mm] -	160	200	240	320	400	500	520	560	640
Nominal diameter of drill bit	d _o	[mm]	10	12	15	20	25	30	30	35	40
Minimum thickness of concrete member	h _{min}	[mm]	Max(h	n _{ef} + 30	; 100)			h _{ef} +	- 2d _o		
Minimum spacing	S _{min}	[mm]	40	50	60	80	100	125	130	140	160
Minimum edge distance	C _{min}	[mm]	40	50	60	80	100	125	130	140	160





Table B2a and Table B2b:	Dimensions of t	the cleaning tools
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			Threaded rods										
Dimensions		M8	M10	M12	M16	M20	M24	M30					
Ø drilled hole	[mm]	10	12	14	18	25	28	35					
Ø Air nozzle	[mm]	6	8	12	14	20	24	29					
Ø Brush	[mm]	11	13	15	20	26	30	37					

			Rebars											
Dimensions		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25	Ø26	Ø28	Ø32				
Ø drilled hole	[mm]	10	12	15	20	25	30	30	35	40				
Ø Air nozzle	[mm]	6	8	12	14	20	24	24	29	29				
Ø Brush	[mm]	11	13	16	22	26	32	32	37	42				

Air nozzle

Metal brush and extension

0 0

Table B3: Curing time

Temperature of	Gol timo	Curing time						
base material	Gertime	in dry concrete	in wet concrete					
5°C to 9°C	20 min	30 h	60 h					
10°C to 19°C	14 min	23 h	46 h					
20°C to 24°C	11 min	16 h	32 h					
25°C to 29°C	8 min	12 h	24 h					
30°C to 39°C	5 min	8 h	16 h					
40°C	5 min	6 h	12 h					

SPIT EPCON C8 XTREM

Intended Use

Cleaning tools, curing time



Installation instruction

Bore hole drilling

1 Drill hole of diameter (d₀) and depth (h₀) with a hammer drill set in rotation-hammer mode using an appropriately carbide drill bit.

Bore hole cleaning

- **2** Using compress air cleaning (mini 6 bars), use the appropriate extension and air nozzle, starting from the bottom of the hole blow out at least 2 times and until no dust is evacuated
- **3** Using the relevant SPIT brush and extension fitted on a drilling machine (brush dimensions in Tables B2), starting from the top of the hole in rotation, move downward to the bottom of the hole then move upward to the top of the hole. Repeat this operation.
- 4 Using compress air cleaning (mini 6 bars), use the appropriate extension and air nozzle, starting from the bottom of the hole blow out at least 2 times and until no dust is evacuated.









Injection

- 5 Screw the mixing nozzle onto the cartridge and dispense the first part to waste until an even colour is achieved for each new cartridge or mixing nozzle. Use tube extensions for holes deeper than 250 mm. Starting from the bottom of the hole, fill uniformly. In order to avoid air pocket, withdraw slowly the mixing nozzle while injecting the resin. Fill the hole until 1/2 full. For hole deeper than 350mm use piston plug.
- 6 Insert the rod or rebar, slowly and with a slight twisting motion in respect of the gel time indicated in Table B3. Remove excess resin from around the mouth of the hole before it sets. Control the embedment depth.

Setting the element

Do not disturb anchor before specified cure time (acc. to Table B3) Attach the fixture and tighten the nut at the specified torque (Table B1a)







SPIT EPCON C8 XTREM

Intended Use

Installation instructions

Annex B5

for threaded rods

Table C1: Characteristic resistances in tension loads in non-cracked concrete Design method A, acc. to TR 029 or CEN/TS 1992-4, for threaded rods Threaded rods **M8** M10 M12 M16 M20 M24 M30 Steel failure **N**Rk,s 1) Characteristic resistance "Maxima" rods 94 170 272 [kN] 22 35 51 118 Partial safety factor [-] 1.71 1.49 γMs,N N_{Rk,s} 79 123 Characteristic resistance "Grade 5.8" [kN] 18 29 42 177 281 Partial safety factor [-] 1,5 γMs,N N_{Rk,s} Characteristic resistance "Grade 8.8" [kN] 29 46 67 126 196 282 449 Partial safety factor [-] 1,5 γMs,N N_{Rk,s} Characteristic resistance "Grade 10.9" 37 245 561 [kN] 58 84 157 353 Partial safety factor 1,4 [-] γMs,N Characteristic resistance "Stainless steel A4" N_{Rk,s} [kN] 26 41 59 110 172 247 281 2,86 Partial safety factor [-] 1,87 γMs,N [kN] Characteristic resistance "Stainless steel HCR" 159 229 N_{Rk,s} 24 38 55 102 365 Partial safety factor γMs,N [-] 2,6 Combined Pull-out and Concrete cone failure²⁾ Characteristic bond resistance in non-cracked concrete C20/25 (used category 1: dry or wet concrete) Temperature range I³⁾: 40°C / 24 13,0 [N/mm²] 16,0 16,0 16,0 15,0 14,0 13,0 $\tau_{Rk,uncr}$ Temperature range II³: 80°C / 50 8<u>,5</u> [N/mm²] 9,0 9,0 9.0 8.0 7,5 7,0 $\tau_{Rk,uncr}$ $\gamma_{\rm Mp} = \gamma_{\rm Mc} = \gamma_{\rm Msp}^{1)}$ Partial safety factor 1,8⁴⁾ [-] Characteristic bond resistance in non-cracked concrete C20/25 (used category 2: flooded bore hole) Temperature range I³⁾: 40°C/24 [N/mm²] 14.0 13,0 13.0 12,0 11.0 14.0 14.0 $\tau_{Rk,uncr}$ Temperature range II³⁾: 80°C/50 [N/mm²] 7,5 τ_{Rk,uncr} 8,0 8,0 8,0 7,0 6,5 6,0 2,1⁵⁾ Partial safety factor [-] $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Msp}$ C25/30 1,02 1,03 1,03 1.04 1,05 1,06 1,07 C30/37 1,05 1,06 1,07 1,09 1,11 1,13 1,16 C35/40 1,08 1,10 1,11 1,14 1,17 1,21 1,26 Increasing factor for TRK.p ψ_{C} in non-cracked concrete C40/50 1,10 1,12 1,13 1,17 1,21 1,25 1,31 C45/55 1,11 1,13 1,15 1,20 1,24 1,29 1,36 C50/60 1,12 1,15 1,17 1,22 1,27 1,32 1,41 $k_{ucr}{}^{6)} \mbox{ or } k_{8}{}^{7)}$ Factor for non-cracked concrete [-] 10.1 Concrete cone failure Characteristic edge distance [mm] 1.5-hef C_{cr,N} Characteristic spacing S_{cr,N} [mm] 3.hef Splitting failure²⁾ h/h h / h_{ef} ≥ 2,0 1,0 h_{ef} 2.0 $2,0 > h / h_{ef} > 1,3$ 4,6 h_{ef} - 1,8 h Char. edge distance ccr.sp [mm] for 1.3 with h. concrete member thickness. h / h_{ef} ≤ 1,3 2,26 h_{ef} C_{cr,sp} h^{ef} effective anchorage depth 2,26 ⋅ h_{ef} 1.0 h Characteristic spacing [mm] 2 c_{cr,sp} $\mathbf{S}_{\text{cr,sp}}$ 1) 1.8⁴⁾ Partial safety factor (dry or wet concrete) [-] γ_{Msp} 2,1⁵⁾ 1) Partial safety factor (flooded bore hole) [-] γMsp ²⁾ For calculation of concrete failure and splitting see Annex B1. ¹⁾ In absence of national regulations. ³⁾ Explanation see Annex B1 ⁴⁾ The partial safety factor $\gamma_2 = 1,2$ is included. ⁵⁾ The partial safety factor $\gamma_2 = 1,4$ is included. ⁶⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009 ⁷⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, eq. (8) **SPIT EPCON C8 XTREM** Annex C1 Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in non-cracked concrete

Table C2:Characteristic resistanceDesign method A, acc. to	es for tens TR 029	sion loa or CEN	nds in c N/TS 19	racked 92-4 , f	concre or threa	ete aded ro	ds	
Threaded rods		M8	M10	M12	M16	M20	M24	M30
Steel failure								
Characteristic resistance "Maxima" rods	No. [kN]	22	35	51	Q/	118	170	272
Partial safety factor	$\frac{11Rk,s}{(M-N)^{1}}$		35	71	94	110	1 49	212
Characteristic resistance "Grade 5.8"	NRKS [kN]	18	29	42	79	123	177	281
Partial safety factor	/Ms,N ¹⁾ [-]				1,5			
Characteristic resistance "Grade 8.8"	N _{Rk,s} [kN]	29	46	67	126	196	282	449
Partial safety factor	/Ms,N ¹⁾ [-]		r	1	1,5	1	1	
Characteristic resistance "Grade 10.9"	N _{Rk,s} [kN]	37	58	84	157	245	353	561
Partial safety factor	<u>/Ms,N^{1/} [-]</u>			50	1,4	170	0.47	004
Characteristic resistance "Stainless steel A4"	NRk,s [KIN]	26	41	59	07	172	247	281
Characteristic resistance "Stainless steel HCP"	Ms,N [-]	24	38	55	0/ 102	150	220	2,00
Partial safety factor	$\frac{1}{(Ma N)} = \frac{1}{1}$	24	50	55	2.6	159	223	303
	2)				2,0			
Combined Pull-out and Concrete cone failure	, 							
Characteristic bond resistance in cracked concrete	e C20/25 (us	ed catego	ory 1: dry	or wet co	oncrete)	1	1	
Temperature range I ³⁾ : 40°C / 24 ⁴ τ _{Rk,cr}	[N/mm ²]	9,5	9,5	9,0	8,5	8,5	8,5	7,0
Temperature range II ⁻⁹ : 80°C / 50' $\tau_{Rk,cr}$	[N/mm ²]	5,5	5,5	5,0	4,5	4,5	4,5	4,0
Partial safety factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Ms}$	^{ip''} [-]				1,8 "			
Characteristic bond resistance in cracked concrete	e C20/25 (us	ed catego	ory 2: floc	ded bore	hole)			
$\frac{1}{\tau_{\text{Rk,cr}}} = \frac{1}{\tau_{\text{Rk,cr}}} + \frac{1}{\tau_$	[N/mm ²]	8,5	8,5	8,0	7,5	7,5	7,5	6,0
Temperature range II ⁻⁷ : 80°C / 50° τ _{Rk,cr}	[N/mm²]	4,5	4,5	4,5	4,0	4,0	4,0	3,5
Partial safety factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{Ms}$	¹ [-]				2,1 *			
	C25/30	1,02	1,02	1,02	1,03	1,03	1,04	1,05
	C30/37	1,04	1,05	1,05	1,06	1,07	1,09	1,10
Increasing factor for $\tau_{Rk,p}$	C35/40	1,06	1,07	1,08	1,10	1,11	1,13	1,16
in cracked concrete Ψ ^c	C40/50	1,07	1,08	1,09	1,11	1,14	1,16	1,19
	C45/55	1,08	1,09	1,11	1,13	1,16	1,18	1,22
	C50/60	1,09	1,10	1,12	1,15	1,17	1,20	1,25
Factor for non-cracked concrete k _{cr} ⁶⁾ or k	8 ⁷⁾ [-]				7.2			
Concrete cone failure								
Characteristic edge distance c _{cr.N}	[mm]				1,5∙h _{ef}			
Characteristic spacing s _{cr.N}	[mm]				3∙h _{ef}			
Splitting failure ²⁾								
					/1			
	h / h _{ef} ≥ 2,0	1,0	h _{ef}	n	/n _{ef} ∱			
					2,0 -			
Char. edge distance $c_{cr,sp}$ [mm] for 2,0 >	h / h _{ef} > 1,3	4,6 h _{ef}	- 1,8 h		1,3 -			
with h. concrete member thickness.				-				
h ^{ef} effective anchorage depth	h / h _{ef} ≤ 1,3	2,26	5 h _{ef}		T	1,0 ⋅ h _{ef} 2	,26 ⋅h _{ef}	,sp
Characteristic spacing Seren	[mm]				2 Cor sp			
Partial actatu factor (dry or wat concrete)	1) []				1 o ⁴⁾			
Partial safety factor (floaded bare hele) γ	<u>Msp [-]</u> 1) гі				1,0 2 1 ⁵⁾			
Faitial salety factor (nooded bore note) γ	Msp [-]				Ζ,Ι			
¹ In absence of national regulations.	2) 4) -	For calcula	tion of cor	ncrete failu	ire and spl	itting see A	nnex B1.	
⁵ Explanation see Annex B1	6)	i ne partial	safety fac	stor $\gamma_2 = 1,2$	is include	ing to CEN	UTE 1000	4.2000
The partial safety factor $\gamma_2 = 1,4$ is included.	TS 1002 4 5			iniy for des	sign accord	ang to CEr	N/15 1992	-4.2009
Farameter relevant only for design according to CEN	13 1992-4-5	2009, eq.	(0)					
JEIL EFUUN UO AIREMI								
	TO 4000			∧.	nney C'	2		
Design according to IR 029 or CEN	/15 1992-	4				-		
Characteristic values for tension loads i	n cracked	concret	e					
for threaded rods								

Table C3: Characteristic resistances for shear loads in cracked and non-cracked concrete Design method A. acc. to TR 029 or CEN/TS 1992-4. for threaded rods

<u>,</u>					, -				
Threaded rods			M8	M10	M12	M16	M20	M24	M30
Steel failure without lever arm									
Factor considering ductility ¹⁾	k ₂	[-]				1,0			
Characteristic resistance "Maxima" rods	$V_{Rk,s}$	[kN]	11	17	25	47	59	85	136
Factor considering ductility ¹⁾	k ₂	[-]		•		0,8			
Characteristic resistance "Grade 5.8"	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	140
Characteristic resistance "Grade 8.8"	V _{Rk,s}	[kN]	15	23	34	63	98	141	224
Characteristic resistance "Grade 10.9"	$V_{Rk,s}$	[kN]	18	29	42	79	123	177	281
Characteristic resistance "Stainless steel A4"	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	140
Characteristic resistance "Stainless steel HCR"	$V_{Rk,s}$	[kN]	12	19	27	51	80	115	182
Steel failure with lever arm									
Characteristic resistance "Maxima" rods	M ⁰ Rk,s	[Nm]	22	45	79	200	301	520	1052
Characteristic resistance "Grade 5.8"	M ⁰ _{Rk,s}	[Nm]	19	37	66	166	325	561	1125
Characteristic resistance "Grade 8.8"	M ⁰ _{Rk,s}	[Nm]	30	60	105	266	519	898	1799
Characteristic resistance "Grade 10.9"	M ⁰ Rk,s	[Nm]	37	75	131	333	649	1123	2249
Characteristic resistance "Stainless steel A4"	M ⁰ Rk,s	[Nm]	26	52	92	233	454	786	1125
Characteristic resistance "Stainless steel HCR"	M ⁰ Rk,s	[Nm]	24	49	85	216	422	730	1462
Partial safety factor									
Partial safety factor "Maxima" rods	γ _{Ms,V} ²⁾	[-]		1,	43			1,5	
Partial safety factor "Grade 5.8"	γ _{Ms,V} 2)	[-]				1,25			
Partial safety factor "Grade 8.8"	γ _{Ms,V} 2)	[-]				1,25			
Partial safety factor "Grade 10.9"	γ _{Ms.V} ²⁾	[-]				1,5			
Partial safety factor "Stainless steel A4"	$\gamma_{MsV}^{2)}$	[-]			1,	56			2,38
Partial safety factor "Stainless steel HCR"	2) VMs V ²⁾	[-]				2.17			
Concrete pryout failure	11113, 1					,			
k factor	k ³⁾	r 1	1.0	(for h	(0,		2.0 //		(ma ma)
K lactor	$k_{3}^{4)}$	[-]	1,0	(IOF N _{ef} <	60mm)	Or	2,0 (10	or n _{ef} ≥ 60	mm)
Partial safety factor	γ _{Mcp} ²⁾	[-]				1,5 ⁵⁾			
Concrete edge failure ⁶⁾									
Partial safety factor	γ _{Mc} ²⁾	[-]				1,5 ⁵⁾			
¹⁾ Parameter relevant only for design accor ²⁾ In absence of national regulations ³⁾ Parameter relevant only for design accor ⁴⁾ Parameter relevant only for design accor ⁵⁾ The partial safety factor $\gamma_2 = 1,0$ is includ ⁶⁾ Concrete edge failure see chapter 5.2.3.4	ding to (ding to T ding to (ed. 4 of Tecl	CEN/TS FR 029 CEN/TS hnical	S 1992-4), eq.(5.7 S 1992-4 Report T	-5:2009, [,]) -5:2009, [,] R 029.	6.3.2.1 § 6.3.3				

SPIT EPCON C8 XTREM

Design according to TR 029 or CEN/TS 1992-4

Characteristic values for shear loads for threaded rods

Annex C3

Threaded rods			M8	M10	M12	M16	M20	M24	M30
Non-cracked concrete	Temperatu	ure range I ²⁾ : 4(0°C / 24°(C					
Displacement	δ _{Ν0}	[mm/(N/mm²)]	0,02	0,02	0,03	0,04	0,06	0,07	0,09
Displacement	δ _{N∞}	[mm/(N/mm²)]	0,05	0,07	0,09	0,12	0,16	0,20	0,25
Non-cracked concrete	Temperatu	ure range II ²⁾ : 8	0°C / 50°	С					
Displacement	δ _{N0}	[mm/(N/mm²)]	0,02	0,02	0,03	0,04	0,06	0,07	0,09
Displacement	δ _{N∞}	[mm/(N/mm²)]	0,05	0,07	0,07	0,12	0,16	0,20	0,25
Cracked concrete Terr	perature ra	ange I ²⁾ :40°C	/ 24°C						
Displacement	δ _{Ν0}	[mm/(N/mm²)]	0,06	0,06	0,06	0,07	0,07	0,07	0,08
Displacement	δ _{N∞}	[mm/(N/mm²)]	0,16	0,17	0,18	0,19	0,20	0,22	0,24
Cracked concrete Terr	perature ra	ange II ²⁾ : 80°C /	/ 50°C						
Displacement	δ _{N0}	[mm/(N/mm²)]	0,06	0,06	0,06	0,07	0,07	0,07	0,08
Displacement	8	[mm/(N/mm²)]	0.16	0.17	0.18	0.19	0.20	0.22	0.24

Table C4: Displacements under tension loads ¹⁾, for threaded rods

¹⁾ Calculation of displacement under tension load: τ_{Sd} design value of bond stress. Displacement under short term loading = $\delta_{N0} \cdot \tau_{Sd} / 1.4$

Displacement under long term loading = $\delta_{N^{\infty}} \cdot \tau_{Sd} / 1.4$

²⁾ Explanations see Annex B1.

Table C5: Displacements under shear loads ¹⁾, for threaded rods

Threaded rods			M8	M10	M12	M16	M20	M24	M30
Displacement	δ_{v_0}	[mm/kN]	0,11	0,10	0,09	0,08	0,06	0,04	0,02
Displacement	δγ∞	[mm/kN]	0,17	0,15	0,14	0,12	0,09	0,06	0,03

¹⁾ Calculation of displacement under shear load: V_{Sd} design value of shear load. Displacement under short term loading = $\delta_{V0} \cdot V_{Sd} / 1,4$ Displacement under long term loading = $\delta_{V^{\infty}} \cdot V_{Sd} / 1,4$

SPIT EPCON C8 XTREM	
Design according to TR 029 or CEN/TS 1992-4	Annex C4
Displacements	
for threaded rods	

Table C6: Characteristic resis Design method A, a	ances for	r tensi 029_ o	on loa or CEN	ds in I I/TS 19	non-cr 992-4,	acked for re	conci bars	rete		
Rebars Bst 500s		φ 8	φ 10	φ 12	φ 16	ф 20	ф 25	ф 26	ф 28	 \$32
Steel failure										
Characteristic resistance $^{1)}$ N _{RI} Partial safety factor $^{2)}$ $\gamma_{Ms,t}$, <mark>s [kN]</mark> , ³⁾ [−]	28	43	62	111	173 1,4	270	292	339	442
Combined Pull-out and Concrete cone fa	ilure ⁴⁾									
Characteristic bond resistance in non-crac	ked concrete	C20/25	(used c	ategory	1: dry o	r wet co	ncrete)			
Temperature range 1 ⁵⁾ . 40°([N/mm ²]	14.0	14.0	14.0	14.0	13.0	13.0	13.0	13.0	12.0
Temperature range II ⁵ : 80°C Tek uncr	[N/mm ²]	8.0	8.0	7.5	7.5	7.5	7.5	7.0	7.0	7.0
Partial safety factor $\gamma_{MD} = \gamma_{MC} = \gamma_{MC}$	³⁾ [-]		-,-	.,.	.,.	1,8 ⁶⁾	.,.	.,.	.,.	.,.
Characteristic bond resistance in non-crac	ked concrete	C20/25	(used c	ategory	2: flood	ed bore	hole)			
Temperature range I^{5} : 40°C $\tau_{Rk,uncr}$	[N/mm ²]	13,0	13,0	12,0	12,0	12,0	12,0	12,0	11,0	11,0
Temperature range II ⁵⁾ : 80°C TRk,uncr	[N/mm ²]	7,0	7,0	7,0	7,0	6,5	6,5	6,5	6,5	6,0
Partial safety factor $\gamma_{Mp} = \gamma_{Mc} = \gamma_{N}$	³⁾ [-]					2,1 ⁷⁾				
	C25/30	1,02	1,03	1,03	1,04	1,05	1,06	1,06	1,07	1,08
	C30/37	1,05	1,06	1,07	1,09	1,11	1,14	1,14	1,15	1,18
Increasing factor for τ_{Rkp}	C35/40	1,08	1,10	1,11	1,14	1,17	1,22	1,22	1,24	1,27
in non-cracked concrete Ψ_c	C40/50	1,10	1,12	1,13	1,17	1,21	1,26	1,27	1,29	1,33
	C45/55	1,11	1,13	1,15	1,20	1,24	1,30	1,31	1,33	1,38
	C50/60	1,12	1,15	1,17	1,22	1,27	1,34	1,35	1,38	1,44
Factor for non-cracked concrete $k_{ucr}^{8)}$	or k ₈ 9) [-]					10,1				
Concrete cone failure										
Characteristic edge distance c _{cr,t}	۱ [mm]					1,5∙h _{ef}				
Characteristic spacing s _{cr,t}	ı [mm]					3∙h _{ef}				
Splitting failure ⁴⁾										
	h / h _{ef} ≥ 2,0		1,0 h	ef		h/h _{ef}				
Char. edge distance $c_{cr,sp}$ [mm] for 2,0 >	h / h _{ef} > 1,3	2	4,6 h _{ef} -	1,8 h		1,3 -				
with h. concrete member thickness, h ^{ef} effective anchorage depth	h / h _{ef} ≤ 1,3		2,26 ł	n _{ef}		-	1,0	h _{ef} 2,2	6·h _{ef} c _{cr}	,sp
Characteristic spacing S _{cr,sp}	[mm]					2 c _{cr,sp}				
Partial safety factor (dry or wet concrete)	γ _{Msp} ³⁾ [-]					1,8 ⁶⁾				
Partial safety factor (flooded bore hole)	γ _{Msp} ³⁾ [-]					2,1 ⁷⁾				
 The characteristic tension resistant calculated acc. Technical Report TR(e N _{Rk,s} for 029, Equatio	rebars n (5.1).	that do	not fulf	il the re	equirem	ents ac	c. DIN	488 sha	all be
²⁾ The partial safety factor $\gamma_{Ms,N}$ for reTR029, Eq. (3.3a).	bars that do	o not fu	lfil the r	equirem	ients ac	c. DIN	488 sha	all be ca	alculated	l acc.
³⁾ In absence of national regulations.										
⁴⁾ For calculation of concrete failure and	d splitting se	e Annex	сB1.							
⁵⁾ Explanations see Annex B1.										
The partial safety factor $\gamma_2 = 1,2$ is inc	cluded.									
The partial safety factor $\gamma_2 = 1,4$ is in	cluded.									
⁹⁾ Descent to relevant only for design at	cording to C	EN/IS	1992-4:	2009.						
Parameter relevant only for design a	cording to C	EN/IS	1992-4-	o:2009,	⊏q. (8).					
SPIT EPCON C8 XTREM										
Design according to TR 029 or	CEN/TS 1	992-4				Annex	C5			

Characteristic values for tension loads in non-cracked concrete for rebars

Rebars Bst 500s 48 410 412 416 420 425 426 428 43 Stree failure Characteristic resistance " Na _{b.6} [k11] 128 43 62 111 173 270 292 339 442 Consider Processor Procesor Procesor Processor Processor Processor Processor Processor	Table C7: Characteristic Design metho	resista d A, aco	nces for c. to TR	tensi 029 o	on loa r <mark>CEN</mark>	ds in d /TS 19	cracke 992-4 ,	d con for re	crete bars					
Steel failure Characteristic resistance '' Nex. [1] 11 173 270 292 339 442 Conditioned Pull-out and Concrete concrete concrete concrete concrete concrete concrete 1 Temperature range I*: 40°C Temperature range I*: 40°	Rebars Bst 500s			ф 8	φ 10	φ 12	φ 16	ф 20	ф 25	 \$ 26	ф 28	ф 32		
$ \begin{array}{c} \begin{array}{c} \begin{array}{c} \begin{array}{c} \label{constraints} \left[V \\ Partial safety factor & & & \\ \hline \end{tabular} \left\{ V \\ Partial safety factor & & & \\ \hline \end{tabular} \left\{ V \\ Partial safety factor & & \\ \hline \end{tabular} \left\{ V \\ \hline \end$	Steel failure													
Partial sately factor $\frac{7}{100000000000000000000000000000000000$	Characteristic resistance 1)	N _{Rk,s}	[kN]	28	43	62	111	173	270	292	339	442		
Combined Pull-out and Concrete Cone failure ⁴ Characteristic bond resistance in cracked concrete C20/25 (used category 1: dry or wet concrete) Temperature rangel ¹⁵ : 40° Teke Nimm ² 9 , 5 9 , 0 8 , 5 8 , 0 8 , 0 7 , 5 6 , 5 Temperature rangel ¹⁶ : 40° Teke Nimm ² 5 , 5 , 5 , 5 1 1 , 1 , 8 ¹ Characteristic bond resistance in cracked concrete C20/25 (used category 2: flooded bore hole) Temperature rangel ¹⁶ : 40° Teke Nimm ² 8 , 5 8 , 0 7 , 5 7 , 5 7 , 5 7 , 6 , 5 6 , 0 Temperature rangel ¹⁶ : 40° Teke Nimm ² 8 , 5 8 , 0 7 , 7 7 , 6 5 6 , 5 6 , 0 1 , 1 ,	Partial safety factor ²⁾	γ _{Ms,N} ³) [-]		-			1,4						
	Combined Pull-out and Concrete	cone fail	ure ⁴⁾											
$\begin{tabular}{ c c c c c c c c c c c c c c c c c c c$	Characteristic bond resistance in ci	racked cor	ncrete C20/	/25 (use	d catego	o ry 1: dr	y or wet	concre	te)					
Temperature range II ^N : 80°C Temperature range II ^N : 80°C 18.8° Temperature range II ^N : 80°C Characteristic bond resistance in cracked concrete C20/25 (used category 2: flooded bore hole) Temperature range II ^N : 80°C Temperature range II ^N : 10.11 11,11 11,11 11,11 11,11 11,11 11,11 11,11 11,11 11,11 11	Temperature range I ⁵ : 40°C	τ _{Rk,cr}	[N/mm²]	9,5	9,5	9,0	8,5	8,5	8,0	8,0	7,5	6,5		
Partial sately factor $\gamma_{Mb} = \gamma_{Mb} = \gamma_{Mb} = \gamma_{Mb}$ 1 1.8 °° Characteristic bord resistance on cracked concrete C2025 (used category 2: flooded bore hole) Image: Sort cracked concrete C2025 (used category 2: flooded bore hole) Partial sately factor $\gamma_{Mb} = \gamma_{Mb} = \gamma_{M$	Temperature range II ⁵⁾ : 80°C	τ _{Rk,cr}	[N/mm ²]	5,5	5,5	5,0	4,5	4,5	4,5	4,5	4,0	3,5		
Characteristic pack of the resistance in created concrete C2026 (used category 2: locade dore note) Temperature range 1 ¹⁵ : 40°C true. [Nmm?] 4,5 8,5 8,5 8,0 7,5 7,5 7,5 7,0 6,5 6,0 Partial safety factor $\gamma_{Me} = \gamma_{Me} = \gamma_{Me} = \frac{1}{10}$ 2,17 $\frac{225/30}{1.02}$ 1,02 1,02 1,02 1,03 1,04 1,04 1,04 1,04 1,04 1,04 1,05 1,06 1,07 1,09 1,01 1,11 1,14 1,16 1,17 1,18 1,12 1,16 1,17 1,18 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,14 1,16 1,17 1,18 1,12 1,26 1,25 1,08 1,09 1,11 1,11 1,14 1,16 1,17 1,18 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,11 1,14 1,16 1,17 1,18 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,11 1,14 1,16 1,17 1,12 1,22 1,23 1,26 1,26 1,08 1,09 1,11 1,12 1,16 1,17 1,12 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,11 1,14 1,16 1,17 1,12 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,11 1,14 1,16 1,17 1,21 1,22 1,23 1,26 1,26 1,00 1,10 1,11 1,13 1,16 1,19 1,19 1,21 1,22 1,22 1,23 1,26 1,26 1,26 1,26 1,26 1,26 1,26 1,26	Partial safety factor $\gamma_{Mp} = \gamma_{Mp}$	$\gamma_{Mc} = \gamma_{Msp}$	³ [-]			0 (1		1,8 %	\ \					
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Characteristic bond resistance in Ci	acked cor	Increte C20/	25 (use	d catego	ory 2: fic)	7.0	0.5	0.0		
$\frac{1}{100} + \frac{1}{100} + \frac{1}$	Temperature range II ⁵⁾ . 80°C	TRk,cr	[N/mm ²]	8,5 4.5	8,5 4.5	8,0 4 5	7,5 4.0	7,5	7,5 4.0	7,0	0,5	6,0 3,0		
$\frac{1}{10} \frac{1}{10} \frac$	Partial safety factor $\gamma_{Ma} = \gamma$	$\nabla \mathbf{K} \mathbf{K}, \mathbf{C} \mathbf{r}$	³⁾ [-]	т,5	-,5	т,5	7,0	2.1^{7}	7,0	т ,0	5,5	5,0		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		TWIC TWISP	C25/30	1.02	1.02	1.02	1.03	1.03	1.04	1.04	1.04	1.05		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$		-	C30/37	1,04	1,05	1,05	1,06	1,07	1,09	1,09	1,10	1,11		
$ \frac{ V_{c} }{ c } \frac{ V_{c} }{ c } \frac{ V_{c} }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c } \frac{ C }{ c $	Increasing factor for Take	-	C35/40	1,06	1,07	1,08	1,10	1,11	1,14	1,14	1,15	1,17		
$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	in cracked concrete	Ψc	C40/50	1,07	1,08	1,09	1,11	1,14	1,16	1,17	1,18	1,20		
C50/601,091,101,121,171,211,221,231,26Factor for cracked concrete k_{urr} % or k_8 %[]7,2Concrete cone failureCharacteristic edge distance $c_{or.N}$ [mm]1,5-hetCharacteristic spacing $s_{or.N}$ [mm]3-hetSplitting failure %M / het $\geq 2,0$ 1,0 het1,0 hetCharacteristic spacing $s_{or.N}$ [mm]Characteristic spacing $s_{or.N}$ [mm]3-hetSplitting failure %M / het $\geq 2,0$ 1,0 het1,0 hetCharacteristic spacing $s_{or.N}$ [mm]2,0 h / het $\geq 1,3$ 4,6 het -1,8 hN / het $\leq 1,3$ 2,26 het1,0 her2 c_{or.sp}Partial safety factor (dry or wet concrete) γ_{Mer} %Partial safety factor (dry or wet concrete) γ_{Mer} %1,0 her2 c_{or.sp}Partial safety factor (flooded bore hole) γ_{Mer} %Oth characteristic tension resistanceNot rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1).10 the characteristic tension resistanceNot rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a).In basence of national regulations.For calculation of concr		-	C45/55	1,08	1,09	1,11	1,13	1,16	1,19	1,19	1,21	1,23		
Factor for cracked concrete $k_{ucr}^{(0)}$ or $k_{0}^{(0)}$ [.] 7,2 Concrete cone failure Characteristic edge distance $c_{er,N}$ [mm] 1,5-her Characteristic spacing Ser,N [mm] 3-her Splitting failure ⁰ $h/h_{ef} \ge 2,0$ 1,0 her h/h_{ef} Characteristic spacing Ser,N [mm] $3-h_{ef}$ Splitting failure ¹ $2,0 > h/h_{ef} > 1,3$ $4,6 h_{ef} - 1,8 h$ $1,0 h_{ef}$ $2,0 > h/h_{ef} > 1,3$ $2,26 h_{ef}$ Characteristic spacing $S_{cr,sp}$ [mm] $2,26 h_{ef}$ $2,17$ $3 h_{ef}$ $3,1 h_{ef}$ $3,1 h_{ef}$ $3,1 h_{ef}$ $3,1 h_{ef}$ $3,1 h_$		-	C50/60	1,09	1,10	1,12	1,15	1,17	1,21	1,22	1,23	1,26		
Concrete cone failure Characteristic edge distance c _{cr.N} [mm] 1,5-her Characteristic spacing s _{cr.N} [mm] 3.her Splitting failure ⁴⁾ Char. edge distance $c_{cr.sp}$ [mm] for h / her > 1,3 4,6 her - 1,8 h h/her h/her c _{cr.sp} Char. edge distance $c_{cr.sp}$ [mm] 2 C _{cr.sp} Characteristic spacing s _{cr.sp} Imm] 2,26 her Characteristic spacing s _{cr.sp} Imm] 2 C _{cr.sp} Partial safety factor (flooded bore hole) y _{Meg} ³¹ [-] 2,1 ⁷¹ 1 1,8 ⁶⁰ Partial safety factor (flooded bore hole) y _{Meg} ³¹ [-] 2,1 ⁷¹ 1 1,8 ⁶⁰ 2,1 ⁷¹ 1 The partial safety factor y _{Meg} . for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 3 <th <="" colspan="2" td=""><td>Factor for cracked concrete</td><td>k_{ucr}⁸⁾ or</td><td>k₈ ⁹⁾ [-]</td><td></td><td></td><td></td><td></td><td>7,2</td><td></td><td></td><td></td><td></td></th>	<td>Factor for cracked concrete</td> <td>k_{ucr}⁸⁾ or</td> <td>k₈ ⁹⁾ [-]</td> <td></td> <td></td> <td></td> <td></td> <td>7,2</td> <td></td> <td></td> <td></td> <td></td>		Factor for cracked concrete	k _{ucr} ⁸⁾ or	k ₈ ⁹⁾ [-]					7,2				
Characteristic edge distance $c_{cr,N}$ [mm] 1.5-hef Characteristic spacing $s_{cr,N}$ [mm] 3-hef Splitting failure 4) Image: Characteristic spacing $h/h_{ef} \ge 2.0$ 1.0 hef $2.0 \ge h/h_{ef} \ge 2.0$ $1.0 h_{ef}$ Char. edge distance $c_{cr,sp}$ [mm] for $h'' = 1.3$ $2.0 \ge h/h_{ef} \ge 1.3$ $2.26 h_{ef}$ $1.0 h_{w}$ $2.26 h_{w}$ $2.0 \ge h/h_{ef} \ge 1.3$ $2.26 h_{ef}$ $1.0 h_{w}$ $2.26 h_{w}$ $c_{cr,sp}$ Characteristic spacing $S_{cr,sp}$ [mm] $2.c_{cr,sp}$ $1.0 h_{w}$ $2.26 h_{w}$ $c_{cr,sp}$ Partial safety factor (flooded bore hole) γ_{Mep}^{-3} [-] $1.8 \theta^{-1}$ $2.1 \gamma^{-1}$ 1) The characteristic tension resistance N _{Rk,8} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). $2.1 \gamma^{-1}$ $7 \gamma_{2} = 1.2 \gamma_{2} = $	Concrete cone failure			8										
Characteristic spacing $s_{cr,N}$ [mm] 3-her Splitting failure ⁴ Characteristic spacing $s_{cr,N}$ [mm] $rotomal (mm)$ 3-her Splitting failure ⁴ Char. edge distance $c_{cr,sp}$ [mm] for $2,0 > h / h_{ef} > 1,3$ 4,6 her - 1,8 h $h / h_{ef} \le 1,3$ 2,26 her $2,0 > h / h_{ef} \le 1,3$ 2,26 her $1,0 h_{ef}$ $2,26 h_{ef}$ $1,0 h_{ef}$ $2,26 h_{ef}$ $1,0 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$ $2,26 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$ $2,26 h_{ef}$ $2,27 h_{ef}$	Characteristic edge distance	Carl	[mm]					1.5.h.						
Splitting failure ⁴ $\frac{h / h_{ef} \ge 2,0 \qquad 1,0 \ h_{ef}}{2,0 > h / h_{ef} \ge 1,3 \qquad 4,6 \ h_{ef} - 1,8 \ h}$ with h. concrete member thickness, h ^{ard} effective anchorage depth $h / h_{ef} \le 1,3 \qquad 2,26 \ h_{ef}$ $2,0 > h / h_{ef} \le 1,3 \qquad 2,26 \ h_{ef}$ $2,0 > h / h_{ef} \le 1,3 \qquad 2,26 \ h_{ef}$ $2,0 > h_{ef} > 1,0 \ h_{ef} > 2,26 \ h_{ef}$ $2,0 > h_{ef} > 1,0 \ h_{ef} > 2,26 \ h_{ef} > 0,0 \ h_{ef} > 0,0 \ h_{ef} > 2,26 \ h_{ef} > 0,0 \ h_$	Characteristic spacing	Scr N	[mm]					3.hef						
Char. edge distance $c_{cr,sp}$ [mm] for $\frac{h / h_{ef} \ge 2,0}{2,0 > h / h_{ef} > 1,3}$ $\frac{4,6 h_{ef} - 1,8 h}{4,6 h_{ef} - 1,8 h}$ $\frac{1,0 h_{ef}}{1,3}$ $\frac{2,0 > h / h_{ef} > 1,3}{1,3}$ $\frac{2,0 > h / h_{ef} > 1,3}{2,26 h_{ef}}$ $\frac{1,0 h_{ef}}{1,3}$ $\frac{2,0 > h / h_{ef} > 1,3}{1,0 h_{ef}}$ $\frac{2,0 > h / h_{ef} > 1,3}{1,3}$ $\frac{2,0 > h / h_{ef} > 1,3}{1,0 h_{ef}}$ $\frac{1,0 h_{ef}}{1,3}$ $\frac{2,0 > h / h_{ef} > 1,3}{1,0 h_{ef}}$ $\frac{1,0 h_{ef}}{1,0 h_{ef}}$ $\frac{1,0 h_{ef}}{1,3}$	Splitting failure 4)	-01,14						0						
$\frac{h / h_{ef} \ge 2,0 \qquad 1,0 h_{ef}}{2,0 > h / h_{ef} > 1,3 \qquad 4,6 h_{ef} - 1,8 h}$ with h. concrete member thickness, h ^{df} effective anchorage depth $h / h_{ef} \le 1,3 \qquad 2,26 h_{ef}$ $\frac{2,0 > h / h_{ef} > 1,3 \qquad 2,26 h_{ef}}{1,0 h_{w} \qquad 2,26 h_{w}} e_{ex.ep}$ Characteristic spacing $s_{cr.sp}$ [mm] $2 c_{cr.sp}$ Partial safety factor (flooded bore hole) γ_{Meg}^{-3} [.] $1,8^{-6}$ Partial safety factor (flooded bore hole) γ_{Meg}^{-3} [.] $2,1^{77}$ $\frac{1}{1}$ The characteristic tension resistance N _{Rk,S} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). $\frac{2}{1}$ The partial safety factor $\gamma_{Me,N}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). $\frac{1}{1}$ In absence of national regulations. $\frac{1}{7}$ For calculation of concrete failure and splitting see Annex B1. $\frac{1}{5}$ Explanations see Annex B1. $\frac{1}{9}$ Parameter relevant only for design according to CEN/TS 1992-4:2009. $\frac{1}{9}$ Parameter relevant only for design according to CEN/TS 1992-4:2009, Eq. (8). $\frac{1}{9}$ Characteristic values for tension loads in cracked concrete								h/h _{ef} †						
Char. edge distance $c_{cr,sp}$ [mm] for $2,0 > h / h_{ef} > 1,3$ 4,6 h_{ef} - 1,8 h 13 with h. concrete member thickness, h ^{eff} effective anchorage depth h / h_{ef} \le 1,3 2,26 h _{eff} 13 Characteristic spacing S _{cr,sp} [mm] 2 c _{cr,sp} Partial safety factor (dry or wet concrete) γ_{hkp}^{-3} [-] 1,8 6 Partial safety factor (flooded bore hole) γ_{hkp}^{-3} [-] 2,1 7 1 The characteristic tension resistance N _{Rks} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). 2 2 The partial safety factor $\gamma_{Ms,N}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 1 nabsence of national regulations. 4 For calculation of concrete failure and splitting see Annex B1. 5 Explanations see Annex B1. 6 The partial safety factor $\gamma_2 = 1,2$ is included. 7 7 The partial safety factor $\gamma_2 = 1,4$ is included. 9 8 Parameter relevant only for design according to CEN/TS 1992-4:2009. 9 9 Parameter relevant only for design according to CEN/TS 1992-4:2009. 6 9 Parameter relevant only for design according to CEN/TS 1992-4:20		h	/ h _{ef} ≥ 2,0		1,0 h	ef		20-						
with h. concrete member thickness, h ^{eff} effective anchorage depth h / h _{eff} ≤ 1,3 2,26 h _{eff} 1.0 h _w 2.26 h _w ccr.sp Characteristic spacing S _{CT,Sp} [mm] 2 c _{cr.sp} Partial safety factor (dry or wet concrete) γ_{Msp} , 3 [-] 1,8 ° Partial safety factor (flooded bore hole) γ_{Msp} , 3 [-] 2,1 7' 1 The characteristic tension resistance N _{Rk,s} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). 2 The partial safety factor $\gamma_{Ms,N}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 3 In absence of national regulations. 4 For calculation of concrete failure and splitting see Annex B1. 5 Explanations see Annex B1. 6 The partial safety factor $\gamma_2 = 1,2$ is included. 7 The partial safety factor $\gamma_2 = 1,4$ is included. 8 Parameter relevant only for design according to CEN/TS 1992-4:2009. 9 Parameter relevant only for design according to CEN/TS 1992-4:52009, Eq. (8). SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4	Char. edge distance c _{cr,sp} [mm] for	2,0 > h	/ h _{ef} > 1,3	4	1,6 h _{ef} -	1,8 h		1,3						
Characteristic spacing $S_{cr,Sp}$ [mm] $2 c_{cr,Sp}$ Partial safety factor (dry or wet concrete) $\gamma_{Mep}^{(3)}$ [-] 1,8 6) Partial safety factor (flooded bore hole) $\gamma_{Mep}^{(3)}$ [-] 2,1 7) 1) The characteristic tension resistance N _{Rks} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). 2) 2) The partial safety factor $\gamma_{Me,N}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 3) In absence of national regulations. 4) For calculation of concrete failure and splitting see Annex B1. 5) Explanations see Annex B1. 6) The partial safety factor $\gamma_2 = 1,2$ is included. 7) 10 7) The partial safety factor $\gamma_2 = 1,4$ is included. 8) 192-4:2009. 8) Parameter relevant only for design according to CEN/TS 1992-4:2009. 8) 9) Parameter relevant only for design according to CEN/TS 1992-4:2009. 8) 9) Parameter relevant only for design according to CEN/TS 1992-4:2009. 8) 9) Parameter relevant only for design according to CEN/TS 1992-4:2009. Annex C6 Characteristic values for tension loa	with h. concrete member thickness, h ^{ef} effective anchorage depth	h	/ h _{ef} ≤ 1,3		2,26 ł) _{ef}		1	1,0	h _{ef} 2,26	6∙h _{ef} c _{cr}	sp		
Partial safety factor (dry or wet concrete) γ_{Mep}^{3} [-] 1,8 ° Partial safety factor (flooded bore hole) γ_{Mep}^{3} [-] 2,1 7 1) The characteristic tension resistance N _{Rk,s} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). 2,1 7 2) The partial safety factor $\gamma_{Ms,N}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 1 3) In absence of national regulations. 4 4) For calculation of concrete failure and splitting see Annex B1. 5 5) Explanations see Annex B1. 6 6) The partial safety factor $\gamma_2 = 1,2$ is included. 7 7) The partial safety factor $\gamma_2 = 1,4$ is included. 8 8) Parameter relevant only for design according to CEN/TS 1992-4:2009. 9 9) Parameter relevant only for design according to CEN/TS 1992-4:5:2009, Eq. (8). Annex C6 Annex C6	Characteristic spacing	Screp	[mm]					2 C _{cr sp}						
Partial safety factor (flooded bore hole) γ _{Msp} ³ [-] 2,1 ⁷⁾ 1) The characteristic tension resistance N _{Rks} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). 2) 2) The partial safety factor γ _{Ms,N} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). 3) In absence of national regulations. 3) In absence of national regulations. 4 For calculation of concrete failure and splitting see Annex B1. 5 5) Explanations see Annex B1. 6 7 The partial safety factor γ ₂ = 1,2 is included. 7) The partial safety factor γ ₂ = 1,4 is included. 8 Parameter relevant only for design according to CEN/TS 1992-4:2009. 9) Parameter relevant only for design according to CEN/TS 1992-4:2009. Eq. (8). SPIT EPCON C8 XTREM Annex C6	Partial safety factor (drv or wet co	ncrete)	(Msp ³⁾ [-]					1.8 ⁶⁾						
 ¹⁾ The characteristic tension resistance N_{Rk,s} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. Technical Report TR029, Equation (5.1). ²⁾ The partial safety factor γ_{Ms,N} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). ³⁾ In absence of national regulations. ⁴⁾ For calculation of concrete failure and splitting see Annex B1. ⁵⁾ Explanations see Annex B1. ⁶⁾ The partial safety factor γ₂ = 1,2 is included. ⁷⁾ The partial safety factor γ₂ = 1,4 is included. ⁸⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Annex C6 	Partial safety factor (flooded bore	hole) v	³⁾ [-]					2,1 7)						
 ²⁷ The partial safety factor γ_{MS,N} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. (3.3a). ³⁰ In absence of national regulations. ⁴¹ For calculation of concrete failure and splitting see Annex B1. ⁵² Explanations see Annex B1. ⁶³ The partial safety factor γ₂ = 1,2 is included. ⁷⁴ The partial safety factor γ₂ = 1,4 is included. ⁸⁴ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁵ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). ⁹⁶ SPIT EPCON C8 XTREM ⁹⁷ CEN/TS 1992-4 ⁹⁸ Characteristic values for tension loads in cracked concrete 	 The characteristic tension r calculated acc. Technical Re 	esistance port TR02	N _{Rk,s} for 9, Equation	rebars i n (5.1).	that do	not fulf	il the re	equirem	ents ac	c. DIN	488 sha	all be		
 ⁵⁾ Explanations see Annex B1. ⁶⁾ The partial safety factor γ₂ = 1,2 is included. ⁷⁾ The partial safety factor γ₂ = 1,4 is included. ⁸⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Annex C6 Characteristic values for tension loads in cracked concrete 	 ²⁷ The partial safety factor γ_{Ms} TR029, Eq. (3.3a). ³⁾ In absence of national regula ⁴⁾ For calculation of concrete factors. 	_{,N} for reba tions.	ars that do	o not ful	Ifil the r	equirem	ents ac	c. DIN ·	488 sha	II be ca	alculated	acc.		
⁶⁾ The partial safety factor $\gamma_2 = 1,2$ is included. ⁷⁾ The partial safety factor $\gamma_2 = 1,4$ is included. ⁸⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete	⁵⁾ Explanations see Δnnev R1		spirming set											
⁷⁾ The partial safety factor $\gamma_2 = 1,2$ is included. ⁸⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete	$^{6)}$ The partial safety factor $w_{-} = 7$	1 2 je inclu	Ided											
 ⁸⁾ Parameter relevant only for design according to CEN/TS 1992-4:2009. ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete 	⁷⁾ The partial safety factor $y_2 =$	1 <i>4</i> is inclu	ided											
 ⁹⁾ Parameter relevant only for design according to CEN/TS 1992-4-5:2009, Eq. (8). SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete 	⁸⁾ Parameter relevant only for d	esian acc	ordina to C	EN/TS	1992-4:	2009.								
SPIT EPCON C8 XTREM Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete	⁹⁾ Parameter relevant only for d	lesign acc	ording to C	EN/TS	1992-4-	5:2009,	Eq. (8).							
Design according to TR 029 or CEN/TS 1992-4 Annex C6 Characteristic values for tension loads in cracked concrete Annex C6	SPIT EPCON C8 XTREM													
	Design according to TR 02 Characteristic values for ten	Design according to TR 029 or CEN/TS 1992-4 Characteristic values for tension loads in cracked concrete							C6					

Table C8: Characteristic resistances for shear loads in cracked and non-cracked concrete Design method A, acc. to TR 029 or GEN/TS 1992-4, for rebars

Design me		, 400.		020				iicoui	0		
Rebars Bst 500s			φ 8	φ 10	φ 12	ф 16	¢ 20	¢ 25	ф 26	ф 28	ф <mark>3</mark> 2
Steel failure without lever ar	m										
Factor considering ductility 1)	k ₂	[-]					0,8				
Characteristic resistance ²⁾	$V_{Rk,s}$	[kN]	14	22	31	55	86	135	146	169	221
Steel failure with lever arm											
Characteristic resistance ³⁾	M ⁰ _{Rk,s}	[Nm]	33	65	112	265	518	1012	1139	1422	2123
Partial safety factor											
Partial safety factor 4)	γ _{Ms,V} ⁵⁾	[-]					1,5				
Concrete pryout failure											
k factor	k ⁶⁾ k ₃ ⁷⁾	[-]		1,0	(for h _{ef} <	60mm)	or	2,0 (f	or h _{ef} ≥ 6	0mm)	
Partial safety factor	γ _{Mcp} ⁵⁾	[-]					1,5 ⁸⁾				
Concrete edge failure 9)	•••										
Partial safety factor	γ _{Mc} ⁵⁾	[-]					1,5 ⁸⁾				
 Parameter relevant only ¹⁾ The characteristic tensic calculated acc. TR 029, 	for design ion resist Eq. (5.6).	n accor ance V	ding to (_{Rk,s} for	CEN/TS rebars t	1992-4:20 hat do r	009, 6.3.2 lot fulfil t	2.1 the requi	irements	acc. DI	N 488 s	hall be

³⁾ The characteristic bending resistance M⁰_{Rk,s} for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR 029, Eq. (5.6b).

⁴⁾ The partial safety factor $\gamma_{Ms,V}$ for rebars that do not fulfil the requirements acc. DIN 488 shall be calculated acc. TR029, Eq. 3.3b or 3.3c.

⁵⁾ In absence of national regulations

⁶⁾ Parameter relevant only for design according to TR 029, eq.(5.7)

7) Parameter relevant only for design according to CEN/TS 1992-4-5:2009, § 6.3.3

⁸⁾ The partial safety factor $\gamma_2 = 1,0$ is included.

⁹⁾ Concrete edge failure, see chapter 5.2.3.4 of TR 029.

SPIT EPCON C8 XTREM

Design according to TR 029 or CEN/TS 1992-4

Characteristic values for shear loads for rebars

Annex C7

Rebars Bst 500s	5		¢ 8	φ 10	φ 12	ф 16	φ 20	ф 25	 ¢ 26	ф 28	 \$32
Non-cracked conc	rete Temp	erature range I	²⁾ : 40°C	C/24°C							
Displacement	δ _{ΝΟ}	[mm/(N/mm²)]	0,02	0,02	0,03	0,04	0,06	0,07	0,07	0,08	0,09
Displacement	δ _{N∞}	[mm/(N/mm ²)]	0,05	0,07	0,00	0,12	0,16	0,20	0,21	0,23	0,27
Non-cracked conc	rete Temp	erature range I	I ²⁾ : 80°(C/50°C							
Displacement	δ _{ΝΟ}	[mm/(N/mm²)]	0,02	0,02	0,03	0,04	0,06	0,07	0,07	0,08	0,09
Displacement	δ _{N∞}	[mm/(N/mm ²)]	0,05	0,07	0,00	0,12	0,16	0,20	0,21	0,23	0,27
Cracked concrete	Temperati	ure range I ²⁾ :	40°C / 24	4°C							
Displacement	δηο	[mm/(N/mm²)]	0,06	0,06	0,06	0,07	0,07	0,08	0,08	0,08	0,08
Displacement	δ _{N∞}	[mm/(N/mm²)]	0,16	0,17	0,18	0,19	0,20	0,22	0,22	0,23	0,24
Cracked concrete	Temperati	ure range II ²⁾ : 8	80°C / 50	D°C							
Displacement	δ _{N0}	[mm/(N/mm²)]	0,06	0,06	0,06	0,07	0,07	0,08	0,08	0,08	0,08
Displacement	δ _{N∞}	[mm/(N/mm ²)]	0,16	0,17	0,18	0,19	0,20	0,22	0,22	0,23	0,24

1)

Calculation of displacement under tension load: τ_{Sd} design value of bond stress.

Displacement under short term loading = $\delta_{N0} \cdot \tau_{Sd} / 1.4$

Displacement under long term loading = $\delta_{N^{\infty}} \cdot \tau_{Sd} / 1,4$

²⁾ Explanations, see Annex B1.

Table C10: Displacements under shear loads ¹⁾, for rebars

Rebars Bst 500s			φ 8	φ 10	φ 12	φ 16	φ 20	 \$25	ф 26	φ 28	ф 32
Displacement	δνο	[mm/kN]	0,11	0,10	0,09	0,08	0,06	0,04	0,03	0,03	0,03
Displacement	δv∞	[mm/kN]	0,17	0,15	0,14	0,12	0,09	0,06	0,05	0,04	0,04

 $^{1)}$ Calculation of displacement under shear load: V_{Sd} design value of shear load.

Displacement under short term loading = $\delta_{\text{V0}} \cdot V_{\text{Sd}}$ / 1,4

Displacement under long term loading = $\delta_{v^{\infty}} \cdot V_{\text{Sd}} \, / \, 1,4$

SPIT EPCON C8 XTREM

Design according to TR 029 or CEN/TS 1992-4

Annex C8

Displacements for rebars

The seismic performance of anchors subjected to seismic loading is categorized by performance categories C1 and C2. Seismic performance category C1 provides anchor capacities only in terms of resistances at ultimate limit state, while seismic performance category C2 provides anchor capacities in terms of both resistances at ultimate limit state and displacements at damage limitation state and ultimate limit state.

Table C11 relates the seismic performance categories C1 and C2 to the seismicity level and building importance class. The level of seismicity is defined as a function of the product a_g . S, where a_g is the design ground acceleration on Type A ground and S the soil factor both in accordance with EN 1998-1.

The value of a_g or that of the product $a_g \cdot S$ used in a Member State to define thresholds for the seismicity classes may be found in its National Annex of EN 1998-1 and may be different to the values given in Table C11. Furthermore, the assignment of the seismic performance categories C1 and C2 to the seismicity level and building importance classes is in the responsibility of each individual Member State.

Table C11: Recommended seismic performance categories for metal anchors

Seismicity level ^a		Importance Class acc. to EN 1998-1:2004, 4.2.5						
Class	a _g ⋅S ^c	I	II	IV				
Very low ^b	<i>a</i> _g ·S≤0,05 <i>g</i>	No additional requirement						
Low ^b	0,05 <i>g</i> < <i>a</i> _g ⋅S ≤ 0,10 <i>g</i>	C1	C1 ^d c	C2				
> low	<i>a</i> g⋅S > 0,10 <i>g</i>	C1	C2					

a The values defining the seismicity levels are may be found in the National Annex of EN 1988-1.

b Definition according to EN 1998-1:2004, 3.2.1.

c a_g = design ground acceleration on Type A ground (EN 1998-1:2004, 3.2.1),

S = soil factor (see e.g. EN 1998-1:2004, 3.2.2).

- d C1 for Type 'B' connections (see TR045 §5.1) for fixings of non-structural elements to structures
- e C2 for Type 'A' connections (see TR045 § 5.1) for fixings structural elements to structures

SPIT EPCON C8 XTREM

Seismic performance categories

Table C12: Reduction factor α_{seis}						
Loading	Failure mode	α _{seis} - Single anchor ¹⁾	α _{seis} - Anchor Group			
Tension	Steel failure	1,0	1,0			
	Pull-out failure	1,0	0,85			
	Concrete cone failure	0,85	0,75			
	Splitting failure	1,0	0,85			
Shear	Steel failure	1,0	0,85			
	Concrete edge failure	1,0	0,85			
	Concrete pry-out failure	0,85	0,75			

¹⁾ In case of tension loading single anchor also addresses situations where only ONE anchor in a group of anchors is subjected to tension.

The seismic design shall be carried out according to TR045 Technical Report "Design of metal anchors for use in concrete under seismic actions". The characteristic seismic resistance $R_{k,seis}$ ($N_{Rk,seis}$, $V_{Rk,seis}$) of a fastening shall be calculated for each failure mode as follows :

 $R_{k,seis} = \alpha_{gap} \cdot \alpha_{seis} \cdot R^{U}_{k,seis}$

where

- α_{gap} Reduction factor to take into account inertia effects due to an annular gap between anchor and fixture in case of shear loading;
 - = 1.0 in case of no hole clearance between anchor and fixture;
 - = 0.5 in case of connections with standard hole clearance acc. TR 029 Table 4.1.
- α_{seis} Reduction factor to take into account the influence of large cracks and scatter of load/displacement curves, see Table C12;

 $R^{0}_{k,seis}$ Basic characteristic seismic resistance for a given failure mode :

For steel and pull-out failure under tension load and steel failure under shear load, $R^{0}_{k,seis}$ (i.e. $N_{Rk,s,seis}$, $N_{Rk,p,seis}$, $V_{Rk,s,seis}$) shall be taken from : - Annex C11 for performance category C1

For all other failure modes $R^{0}_{k,seis}$ shall be determined as for the design situation for static and quasi-static loading according to ETAG 001, Annex C (i.e. *Nrk,c*, *Nrk,sp*, *Vrk,c*, *Vrk,cp*).

SPIT EPCON C8 XTREM

Reduction factors and characteristic seismic resistances

Annex C10

Table C13: Characteristic resistances in case of seismic performance category C1 acc. TR045 "Design of Metal anchor under Seismic Actions"

Threaded rods			M8	M10	M12	M16	M20	M24	M30
	Tens	sion lo	ads						
Steel failure									
Seismic reduction factor	$\alpha_{N,seis}$	[-]	-		1,0		-	-	-
Characteristic resistance "Maxima" rods	N _{Rk,s,seis}	[kN]		35	51	94	-	-	-
Partial safety factor	1) γMs,seis	[-]		1,	71			1,49	
Characteristic resistance "Grade 5.8"	N _{Rk,s,seis}	[kN]	-	29	42	79	-	-	-
Characteristic resistance "Grade 8.8"	N _{Rk,s,seis}	[kN]	-	46	67	126	-	-	-
Partial safety factor	1) γMs,seis	[-]				1,50			
Characteristic resistance "Grade 10.9"	N _{Rk,s,seis}	[kN]				n.a.			
Partial safety factor	γMs,seis ¹	[-]				1,4	1		
Characteristic resistance "Stainless steel A4"	N _{Rk,s,seis}	[kN]	-	41	59	110	-	-	-
Partial safety factor	γMs,seis	[-]			1,	87	1		2,86
Characteristic resistance "Stainless steel HCR"	NRk,s,seis	[kN]	-	38	55	102	-	-	-
Partial safety factor	γMs,seis	[-]				2,6			
Combined pullout and concrete cone failur	е						1	1	1
Seismic reduction factor	α _{N,seis}	[-]	-	0,65	0,63	0,80	-	-	-
Characteristic bond resistance in cracked concre	ete C20/25 (u	ised cat	tegory 1	: dry or v	vet conc	rete)	1		
Temperature range I ² : 40°C / 24°C	τ _{Rk,p,seis} [N/mm²]	-	6,2	5,7	6,8	-	-	-
Temperature range II ² : 80°C / 50°C	τ _{Rk,p,seis} [N/mm²]	-	3,6	3,2	3,6	-	-	-
Partial safety factor	1) γMp,seis	[-]				1,8 ³⁾			
Characteristic bond resistance in cracked concre	ete C20/25 (u	ised cat	tegory 2	: floodec	l bore ho	ole)			
Temperature range I ² : 40°C / 24°C	τ _{Rk,p,seis} [[N/mm²]	-	5,5	5,1	6,0	-	-	-
Temperature range II ² : 80°C / 50°C	τ _{Rknseis} [N/mm²]	-	2,9	2,9	3,2	-	-	-
Partial safety factor	1) γMp,seis	[-]		1	1	2,1 ⁴⁾	•	1	
	She	ear loa	ds						
Steel failure without lever arm									
Seismic reduction factor	αv.seis	[-]	-		0,70 ^{*)}		-	-	-
Characteristic resistance "Maxima" rods	V _{Rk.s.seis}	[kN]	-	11,.9	17,5	32,9	-	-	-
Partial safety factor	1) γMs,seis	[-]		1,	43	•		1,5	•
Characteristic resistance "Grade 5.8"	V _{Rk,s,seis}	[kN]	-	10,.5	14,7	27,3	-	-	-
Characteristic resistance "Grade 8.8"	V _{Rk,s,seis}	[kN]	-	16,1	23,8	44,1	-	-	-
Partial safety factor	1) γMs,seis	[-]				1,25			
Characteristic resistance "Grade 10.9"	V _{Rk,s,seis}	[kN]				n.a.			
Partial safety factor	γMs,seis	[-]				1,5	1		1
Characteristic resistance "Stainless steel A4"	V _{Rk,s,seis}	[kN]	-	14	21	38,5	-	-	-
Partial safety factor	γMs,seis	[-]		10.0	1,	56	1	1	2,38
Characteristic resistance "Stainless steel HCR"	V _{Rk,s,seis}	[KN]	-	13,3	18,9	35,7	-	-	-
	γMs,seis ΄	[-]				2,17			
In absence of other national regulations.									
$\frac{1}{3}$ Explanation see Annex B1.									
The partial safety factor $\gamma_2 = 1,2$ is include	d.								
⁴ The partial safety factor $\gamma_2 = 1,4$ is include	d.								
*) Tests and account of the second	74 / 0 00 / 0				00447				
) I ests and assessment yield $\alpha_{V,seis} = [0,]$ for anchors does not allow $\alpha_{V,seis} > 0.7$ f	71 / 0,80 / 0, or anchors i	, 7 J. Hov Jsina co	wever, fr	om Oct. al standa	2014 (de ard rods	oc. 805),	EUTAE	xpert G	oup
The definition of seismic performance	category C	C1 is gi	iven in <i>i</i>	Annex (29.				

Annex C11

SPIT EPCON C8 XTREM

Design according to TR045

Characteristic resistance under seismic action (C1)	
for threaded rods	