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European Technical Assessment

ETA 14/0156 of 25/10/2021

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague	
Trade name of the construction product	MOPURE
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and uncracked concrete for a working life of 50 and/or 100 years
Manufacturer	Index Técnicas Expansivas, S.L. P.I. La Portalada II C. Segador 13 26006 Logroño Spain
Manufacturing plant	Index Plant 1
This European Technical Assessment contains	19 pages including 15 Annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with regulation (EU) No 305/2011, on the basis of	EAD 330499-01-0601 Bonded fasteners for use in concrete
This version replaces	ETA 14/0156 issued on 04/09/2014

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and should be identified as such.

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1. Technical description of the product

The MOPURE with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rod or rebar.

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

The illustration and the description of the product are given in 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 and/or 100 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 to tension load (static and quasi-static loading)	See Annex C 1, C 2
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 3, C 4
Displacements under short-term and long-term loading	See Annex C 5, C 6
Characteristic resistance for seismic performance categories C1	See Annex C 7

3.2 Hygiene, health and environment (BWR 3)

No performance determined.

3.3 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

[1] Official Journal of the European Communities L 254 of 08.10.1996

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

The factory production control shall be in accordance with the control plan which is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited at Technical and Test Institute for Construction Prague.[2] The results of factory production control shall be recorded and evaluated in accordance with the provisions of the control plan.

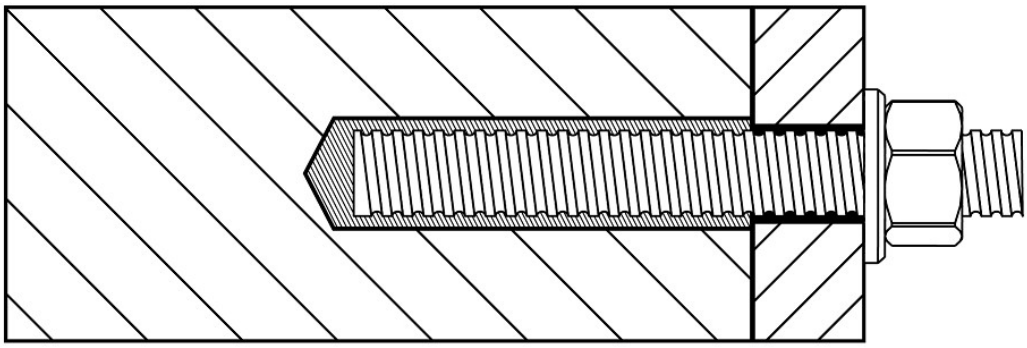
Issued in Prague on 25.10.2021

By

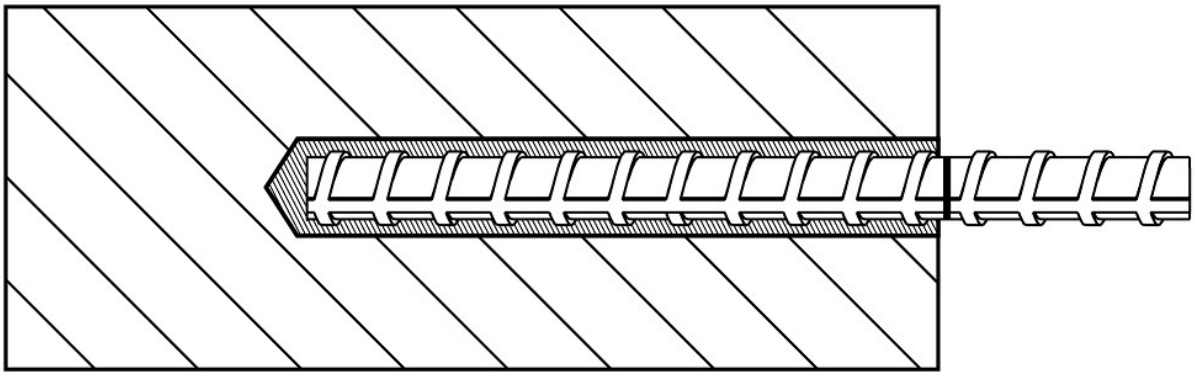
Ing. Mária Schaan
Head of the Technical Assessment Body

[2] The control plan is a confidential part of the documentation of the European Technical Assessment, but not published together with the ETA and only handed over to the approved body involved in the procedure of AVCP.

Threaded rod



Reinforcing bar



MOPURE	**Annex A 1**
Product description Installed conditions	

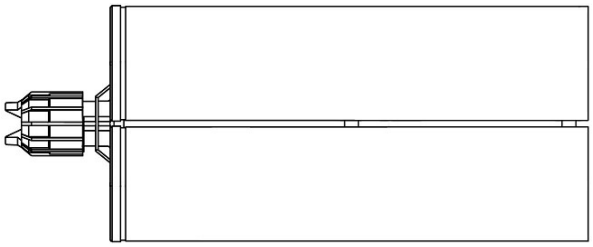
Cartridges

Universal cartridge (UVC)

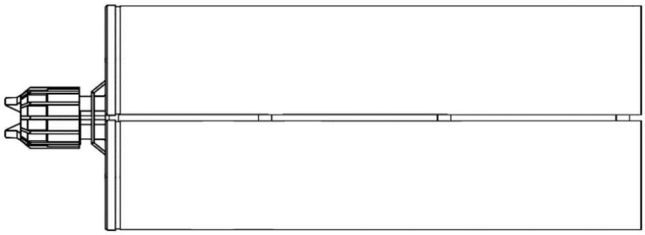
MOPURE 250 ml

Side by side cartridge (SBS)

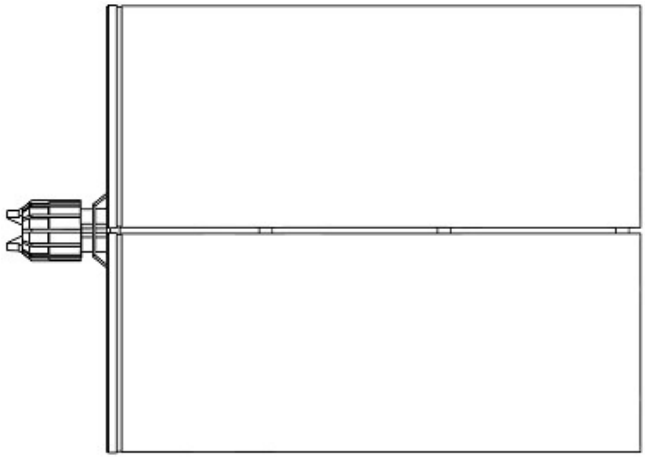
MOPURE 400 ml



MOPURE 600 ml



MOPURE 1500 ml

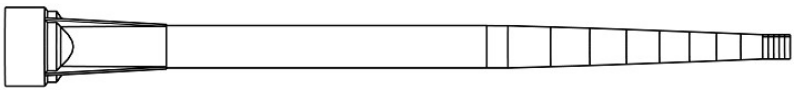


Marking of the mortar cartridges

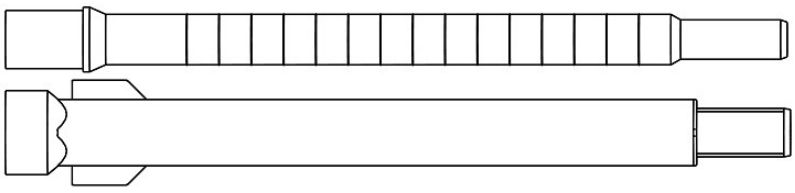
Identifying mark of the producer, Trade name, Charge code number, Storage life, Curing and processing time

Mixing nozzle

Q mixing nozzle

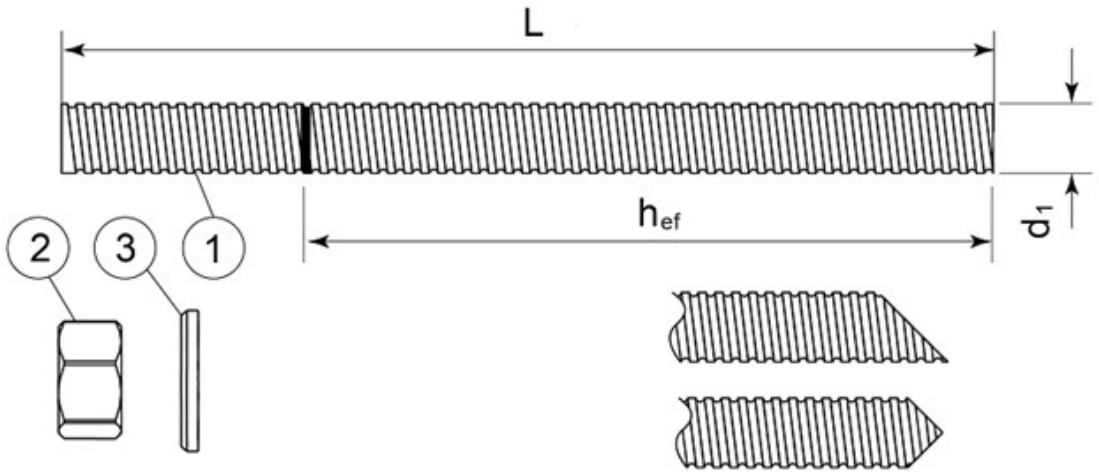


QH mixing nozzle



MOPURE	**Annex A 2**
Product description Injection system	

Threaded rod M10, M12, M16, M20, M24, M30



Standard commercial threaded rod with marked embedment depth

Part	Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042 or Steel, Hot-dip galvanized ≥ 40 µm acc. to EN ISO 1461 and EN ISO 10684		
1	Anchor rod	Steel, EN 10087 or EN 10263 Property class 5.8, 8.8, 10.9* EN ISO 898-1
2	Hexagon nut EN ISO 4032	According to threaded rod, EN 20898-2
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
Stainless steel		
1	Anchor rod	Material: A2-70, A4-70, A4-80, EN ISO 3506
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod
High corrosion resistant steel 1.4529		
1	Anchor rod	Material: 1.4529, EN 10088-1
2	Hexagon nut EN ISO 4032	According to threaded rod
3	Washer EN ISO 887, EN ISO 7089, EN ISO 7093 or EN ISO 7094	According to threaded rod

*Galvanized rod of high strength are sensitive to hydrogen induced brittle failure

MOPURE	**Annex A 3**
Product description Threaded rod and materials	

Rebar Ø10, Ø12, Ø16, Ø20, Ø25, Ø32

Standard commercial reinforcing bar with marked embedment depth

Product form		**Bars and de-coiled rods**	
Class		B	C
Characteristic yield strength f_{yk} or $f_{0,2k}$ (MPa)		400 to 600	
Minimum value of $k = (f_t/f_y)_k$		≥ 1,08	≥ 1,15 < 1,35
Characteristic strain at maximum force ε_{uk} (%)		≥ 5,0	≥ 7,5
Bendability		Bend/Rebend test	
Maximum deviation from nominal mass (individual bar) (%)	Nominal bar size (mm) ≤ 8 > 8	 ±6,0 ±4,5	
Bond: Minimum relative rib area, $f_{R,min}$	Nominal bar size (mm) 8 to 12 > 12	 0,040 0,056	

MOPURE	**Annex A 4**
Product description Rebars and materials	

Specifications of intended use

Anchorages subject to:
- Static and quasi-static load.
- Seismic actions category C1 (max w = 0,5 mm): threaded rods

Base materials
- Cracked and uncracked concrete.
- Reinforced or unreinforced normal weight concrete of strength class C20/25 at minimum and C50/60 at maximum according 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 +70°C (max. short. term temperature +70°C and max. long term temperature +40°C)
- Tc) -40°C to +80°C (max. short. term temperature +80°C and max. long term temperature +40°C)

Use conditions (Environmental conditions)
- (X1) Structures subject to dry internal conditions (zinc coated steel, stainless steel, high corrosion resistance steel).
- (X2) Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel A4, high corrosion resistant steel).
- (X3) Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions exist (high corrosion resistant 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).

Concrete conditions:
- I1 – installation in dry or wet (water saturated) concrete and use in service in dry or wet concrete.

Design:
- The anchorages are designed in accordance with the EN 1992-4 under the responsibility of an engineer experienced in anchorages and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings.
- Anchorages under seismic actions (cracked concrete) have to be designed in accordance with EN 1992-4.

Installation:
- Hole drilling by hammer drill mode.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

Installation direction:
- D3 – downward and horizontal and upwards (e.g. overhead) installation

MOPURE	**Annex B 1**
Intended use Specifications	

Applicator gun

A

B

C

D

E

Cartridge	Applicator gun
Universal 250 ml	A
Side by side 400 ml	B
Side by side 600 ml	C, D
Side by side 1500 ml	E

Cleaning brush

Size		M10	M12	M16	M20	M24	M30
Steel brush head diameter	[mm]	14	16	22	24	31	38
Steel brush head length	[mm]	75					
Min. overall brush length	[mm]	110					

Size		Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Steel brush head diameter	[mm]	16	18	22	27	35	43
Steel brush head length	[mm]	75					
Min. overall brush length	[mm]	110					

MOPURE

Intended use
Applicator guns
Cleaning brush

Annex B 2

Table B1: Installation parameters of threaded rod

Size			M10	M12	M16	M20	M24	M30
Nominal drill hole diameter	$Ød_0$	[mm]	12	14	18	22	26	35
Diameter of cleaning brush	d_b	[mm]	14	16	22	24	31	38
Torque moment	max T_{fix}	[Nm]	20	40	80	135	200	270
Depth of drill hole for $h_{ef,min}$	$h_0 = h_{ef}$	[mm]	60	70	80	90	96	120
Depth of drill hole for $h_{ef,max}$	$h_0 = h_{ef}$	[mm]	200	240	320	400	480	600
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$		

Table B2: Installation parameters of rebar

Size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Nominal drill hole diameter	$Ød_0$	[mm]	14	16	20	25	32	40
Diameter of cleaning brush	d_b	[mm]	16	18	22	27	35	43
Torque moment	T_{inst}	[Nm]	20	40	80	135	200	270
Depth of drill hole for $h_{ef,min}$	$h_0 = h_{ef}$	[mm]	60	70	80	90	100	128
Depth of drill hole for $h_{ef,max}$	$h_0 = h_{ef}$	[mm]	200	240	320	400	500	640
Minimum edge distance	c_{min}	[mm]	40	40	45	50	55	65
Minimum spacing	s_{min}	[mm]	40	40	45	50	55	65
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$		

Table B3: Minimum curing time

Concrete temperature [°C]	Gel time [minutes]	Cure time [hours]
+5 to +10	20	24
+10 to +15		12
+15 to +20	15	8
+20 to +25	11	7
+25 to +30	8	6
+30 to +35	6	5
+35 to +40	4	4
+40	3	3
Cartridge must be conditioned to minimum +10°C		

MOPURE

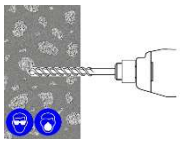
Intended use
Installation parameters
Curing time

Annex B 3

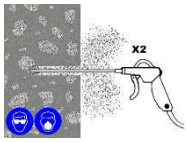
Installation procedure

Before commencing installation ensure the operative is equipped with appropriate personal protection equipment, SDS Hammer Drill, Air, Hole Cleaning Brush, good quality Dispensing Tool – either manual or power operated, Chemical cartridge with mixing nozzle and extension tube, if needed.

1. Using the SDS Hammer Drill in rotary hammer mode for drilling, with a carbide tipped drill bit of the appropriate size, drill the hole to the specified hole diameter and depth.

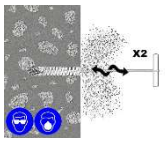


2. Insert the Air Lance to the bottom of the hole and depress the trigger for 2 seconds. The compressed air must be clean – free from water and oil – and at a minimum pressure of 6bar.



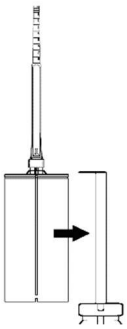
Perform the blowing operation twice.

3. Select the correct size Hole Cleaning Brush. Ensure that the brush is in good condition and the correct diameter. Insert the brush to the bottom of the hole, using a brush extension if needed to reach the bottom of the hole and withdraw with a twisting motion. *There should be positive interaction between the steel bristles of the brush and the sides of the drilled hole*.



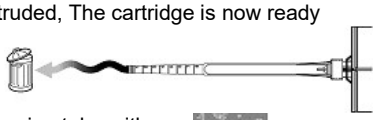
Perform the brushing operation twice.

4. Repeat 2
5. Repeat 3
6. Repeat 2
7. Select the appropriate static mixer nozzle, checking that the mixing elements are present and correct **(do not modify the mixer)**. Attach mixer nozzle to the cartridge. Check the Dispensing Tool is in good working order. Place the cartridge into the dispensing tool.

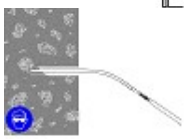


Note: The QH nozzle is in two sections. One section contains the mixing elements and the other section is an extension piece. Connect the extension piece to the mixing section by pushing the two sections firmly together until a positive engagement is felt.

8. Extrude some resin to waste until an even-colored mixture is extruded, The cartridge is now ready for use



9. Attach an extension tube with resin stopper (if required) to the end of the mixing nozzle with a push fit



(The extension tubes may be pushed into the resin stoppers and are held in place with a coarse internal thread).

10. Insert the mixing nozzle to the bottom of the hole. Extrude the resin and slowly withdraw the nozzle from the hole. **Ensure no air voids are created** as the nozzle is withdrawn. Inject resin until the hole is approximately ¾ full and remove the nozzle from the hole.

11. Select the steel anchor element ensuring it is free from oil or other contaminants, and mark with the required embedment depth. Insert the steel element into the hole using a back and forth twisting motion to ensure complete cover, until it reaches the bottom of the hole. Excess resin will be expelled from the hole evenly around the steel element and there shall be no gaps between the anchor element and the wall of the drilled hole.

12. Clean any excess resin from around the mouth of the hole.
13. Do not disturb the anchor until at least the minimum cure time has elapsed. Refer to the Working and Load Timetable to determine the appropriate cure time.

14. Position the fixture and tighten the anchor to the appropriate installation torque.

Do not over-torque the anchor as this could adversely affect its performance.

MOPURE

Intended use
Installation instructions

Annex B 4

Table C1: Design method EN 1992-4
Characteristic values of resistance to tension load of threaded rod

Steel failure – Characteristic resistance								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$N_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms}	[-]	1,5					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms}	[-]	1,5					
Steel grade **10.9***	$N_{Rk,s}$	[kN]	58	84	157	245	353	561
Partial safety factor	γ_{Ms}	[-]	1,4					
Stainless steel grade **A2-70, A4-70**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms}	[-]	1,9					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	46	67	126	196	282	449
Partial safety factor	γ_{Ms}	[-]	1,6					
Stainless steel grade **1.4529**	$N_{Rk,s}$	[kN]	41	59	110	172	247	393
Partial safety factor	γ_{Ms}	[-]	1,5					

Combined pullout and concrete cone failure in concrete C20/25								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,ucr}$	[N/mm²]	11,0	11,0	11,0	11,0	12,0	10,0
Temperature b) -40°C to +70°C	$\tau_{Rk,ucr}$	[N/mm²]	5,0	5,0	5,0	5,0	5,5	4,5
Temperature c) -40°C to +80°C	$\tau_{Rk,ucr}$	[N/mm²]	4,5	4,0	4,0	4,0	4,5	4,0
Installation safety factor	γ_{inst}	[-]	1,2	1,4				
Factor for uncracked concrete C30/37	ψ_c		1,12					
Factor for uncracked concrete C40/50			1,23					
Factor for uncracked concrete C50/60			1,30					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,cr}$	[N/mm²]	8,5	8,5	8,5	5,5	5,5	5,5
Temperature b) -40°C to +70°C	$\tau_{Rk,cr}$	[N/mm²]	3,5	3,5	4,0	2,0	2,0	2,0
Temperature c) -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	3,0	3,0	3,0	2,0	2,0	2,0
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,cr}$	[N/mm²]	5,5	5,5	5,5	3,5	3,5	3,5
Temperature b) -40°C to +70°C	$\tau_{Rk,cr}$	[N/mm²]	3,0	3,0	3,5	1,5	1,5	1,5
Temperature c) -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,0	2,0	1,5	1,5	1,5
Installation safety factor	γ_{inst}	[-]	1,2	1,4				
Factor for influence of sustained load for a working life 50 years T1: 24°C / 40°C	ψ^0_{sus}		0,80					
Factor for influence of sustained load for a working life 50 years T3: 50°C / 70°C			0,64					
Factor for influence of sustained load for a working life 50 years T2: 50°C / 80°C			0,55					
Factor for cracked concrete C30/37	ψ_c		1,03					
Factor for cracked concrete C40/50			1,06					
Factor for cracked concrete C50/60			1,07					

Concrete cone failure			
Factor for concrete cone failure for uncracked concrete	$k_{ucr,N}$	[-]	11
Factor for concrete cone failure for cracked concrete	$k_{cr,N}$		7,7
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$

Splitting failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2{,}0 \cdot h_{ef} \cdot \left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$					

MOPURE

Performances
Design according to EN 1992-4
Characteristic resistance for tension loads - threaded rod

Annex C 1

Table C2: Design method EN 1992-4
Characteristic values of resistance to tension load of rebar

Steel failure – Characteristic resistance								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	43	62	111	173	270	442
Partial safety factor	γ_{Ms}	[-]	1,4					

Combined pullout and concrete cone failure in concrete C20/25								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,ucr}$	[N/mm²]	11,0	11,0	12,0	12,0	12,0	12,0
Temperature b) -40°C to +70°C	$\tau_{Rk,ucr}$	[N/mm²]	5,0	5,0	5,5	5,5	5,5	5,5
Temperature c) -40°C to +80°C	$\tau_{Rk,ucr}$	[N/mm²]	4,5	4,5	4,5	4,5	4,5	4,5
Installation safety factor	γ_{inst}	[-]	1,2	1,4				
Factor for uncracked concrete C30/37	ψ_c		1,06					
Factor for uncracked concrete C40/50			1,11					
Factor for uncracked concrete C50/60			1,14					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,cr}$	[N/mm²]	8,5	8,5	6,5	6,5	4,5	4,5
Temperature b) -40°C to +70°C	$\tau_{Rk,cr}$	[N/mm²]	3,5	3,5	2,5	2,5	1,5	1,5
Temperature c) -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	3,0	3,0	2,0	2,0	1,5	1,5
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,cr}$	[N/mm²]	5,5	5,5	4,5	4,5	3,0	3,0
Temperature b) -40°C to +70°C	$\tau_{Rk,cr}$	[N/mm²]	3,0	3,0	2,5	2,5	1,5	1,5
Temperature c) -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	2,0	2,0	1,5	1,5	1,0	1,0
Installation safety factor	γ_{inst}	[-]	1,2	1,4				
Factor for influence of sustained load for a working life 50 years T1: 24°C / 40°C	ψ^0_{sus}		0,80					
Factor for influence of sustained load for a working life 50 years T3: 50°C / 70°C			0,64					
Factor for influence of sustained load for a working life 50 years T2: 50°C / 80°C			0,55					
Factor for cracked concrete C30/37	ψ_c		1,04					
Factor for cracked concrete C40/50			1,07					
Factor for cracked concrete C50/60			1,09					

Concrete cone failure			
Factor for concrete cone failure for uncracked concrete	$k_{ucr,N}$	[-]	11
Factor for concrete cone failure for cracked concrete	$k_{cr,N}$		7,7
Edge distance	$c_{cr,N}$	[mm]	$1{,}5h_{ef}$

Splitting failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Edge distance	$c_{cr,sp}$	[mm]	$1{,}0 \cdot h_{ef} \le 2{,}0 \cdot h_{ef} \cdot \left(2{,}5 - \frac{h}{h_{ef}}\right) \le 2{,}4 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot C_{cr,sp}$					

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Performances
Design according to EN 1992-4
Characteristic resistance for tension loads - rebar

Annex C 2

Table C3: Design method EN 1992-4
Characteristic values of resistance to shear load of threaded rod

Steel failure without lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$V_{Rk,s}$	[kN]	15	21	39	61	88	140
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **8.8**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **10.9***	$V_{Rk,s}$	[kN]	29	42	79	123	177	281
Partial safety factor	γ_{Ms}	[-]	1,5					
Stainless steel grade **A2-70, A4-70**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade **A4-80**	$V_{Rk,s}$	[kN]	23	34	63	98	141	224
Partial safety factor	γ_{Ms}	[-]	1,33					
Stainless steel grade **1.4529**	$V_{Rk,s}$	[kN]	20	30	55	86	124	196
Partial safety factor	γ_{Ms}	[-]	1,25					
Characteristic resistance of group of fasteners								
Ductility factor k_7 = 1,0 for steel with rupture elongation A_5 > 8%								

Steel failure with lever arm								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Steel grade **5.8**	$M^0_{Rk,s}$	[N.m]	37	66	166	325	561	1125
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **8.8**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **10.9***	$M^0_{Rk,s}$	[N.m]	75	131	333	649	1123	2249
Partial safety factor	γ_{Ms}	[-]	1,50					
Stainless steel grade **A2-70, A4-70**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade **A4-80**	$M^0_{Rk,s}$	[N.m]	60	105	266	519	898	1799
Partial safety factor	γ_{Ms}	[-]	1,33					
Stainless steel grade **1.4529**	$M^0_{Rk,s}$	[N.m]	52	92	233	454	786	1574
Partial safety factor	γ_{Ms}	[-]	1,25					
Concrete pryout failure								
Factor for resistance to pry-out failure	k_8	[-]	2					

Concrete edge failure								
Size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Outside diameter of fastener	d_{nom}	[mm]	10	12	16	20	24	30
Effective length of fastener	ℓ_f	[mm]	min (h_{ef}, 8 d_{nom})					

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Performances
Design according to EN 1992-4
Characteristic resistance for shear loads - threaded rod

Annex C 3

Table C4: Design method EN 1992-4
Characteristic values of resistance to shear load of rebar

Steel failure without lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	22	31	55	86	135	221
Partial safety factor	γ_{Ms}	[-]	1,5					
Characteristic resistance of group of fasteners								
Ductility factor k_7 = 1,0 for steel with rupture elongation A_5 > 8%								

Steel failure with lever arm								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Rebar BSt 500 S	$M^0_{Rk,s}$	[N.m]	65	112	265	518	1013	2122
Partial safety factor	γ_{Ms}	[-]	1,5					
Concrete pryout failure								
Factor for resistance to pry-out failure	k_8	[-]	2					

Concrete edge failure								
Size			**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**	**Ø32**
Outside diameter of fastener	d_{nom}	[mm]	10	12	16	20	25	32
Effective length of fastener	ℓ_f	[mm]	min (h_{ef}, 8 d_{nom})					

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Performances
Design according to EN 1992-4
Characteristic resistance for shear loads - rebar

Annex C 4

Table C5: Displacement of threaded rod

Tension load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Uncracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,168	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,239	0,293
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,371	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,234	0,283
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,352	0,426

Shear load

Anchor size			**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
Uncracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

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Performances
Displacement for threaded rod

Annex C 5

Table C6: Displacement of rebar

Tension load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Uncracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,080	0,092	0,118	0,143	0,174	0,206
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,113	0,131	0,167	0,203	0,248	0,293
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,176	0,204	0,260	0,316	0,385	0,455
Cracked concrete								
40°C / 24°C	δ_{N0}	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,119	0,136	0,168	0,201	0,242	0,283
70°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426
80°C / 40°C	δ_{N0}	[mm/(N/mm²)]	0,115	0,131	0,163	0,195	0,235	0,274
	$\delta_{N\infty}$	[mm/(N/mm²)]	0,179	0,204	0,253	0,303	0,365	0,426

Shear load

Anchor size			Ø10	Ø12	Ø16	Ø20	Ø25	Ø32
Uncracked concrete								
All temperatures	δ_{V0}	[mm/(N/mm²)]	0,23	0,16	0,09	0,05	0,04	0,04
	$\delta_{V\infty}$	[mm/(N/mm²)]	0,47	0,32	0,17	0,11	0,08	0,08

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Performances
Displacement for rebar

Annex C 6

Table C7: Reduction factors for seismic design category C1 for threaded rods

Size			M10	M12	M16	M20	M24	M30
Tension load								
Steel failure								
Characteristic resistance grade 5.8	$N_{Rk,s,eq}$	[kN]	29,0	42,2	78,5	122,5	176,5	280,5
Characteristic resistance grade 8.8	$N_{Rk,s,eq}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance grade 10.9	$N_{Rk,s,eq}$	[kN]	58,0	84,3	157,0	245,0	353,0	561,0
Characteristic resistance A2-70, A4-70	$N_{Rk,s,eq}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Characteristic resistance A4-80	$N_{Rk,s,eq}$	[kN]	46,4	67,4	125,6	196,0	282,4	448,8
Characteristic resistance 1.4529	$N_{Rk,s,eq}$	[kN]	40,6	59,0	109,9	171,5	247,1	392,7
Characteristic resistance to pull-out for a working life of 50 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,C1}$	[N/mm²]	8,5	8,2	6,7	4,3	3,7	2,5
Temperature b) -40°C to +70°C	$\tau_{Rk,C1}$	[N/mm²]	3,5	3,4	3,2	1,6	1,4	0,9
Temperature c) -40°C to +80°C	$\tau_{Rk,C1}$	[N/mm²]	3,0	2,9	2,4	1,6	1,4	0,9
Characteristic resistance to pull-out for a working life of 100 years								
Temperature a) -40°C to +40°C	$\tau_{Rk,C1}$	[N/mm²]	5,5	5,3	4,3	2,8	2,4	1,6
Temperature b) -40°C to +70°C	$\tau_{Rk,C1}$	[N/mm²]	2,4	2,3	2,2	1,1	0,9	0,6
Temperature c) -40°C to +80°C	$\tau_{Rk,C1}$	[N/mm²]	2,0	2,0	1,6	1,1	0,9	0,6
Installation safety factor	γ_{inst}	[-]	1,2	1,4				
Shear load								
Steel failure without lever arm								
Characteristic resistance grade 5.8	$V_{Rk,s,eq}$	[kN]	13,5	19,6	36,5	61,3	86,3	140,3
Characteristic resistance grade 8.8	$V_{Rk,s,eq}$	[kN]	21,6	32,3	58,4	98,0	141,2	224,4
Characteristic resistance grade 10.9	$V_{Rk,s,eq}$	[kN]	27,0	39,2	73,0	122,5	176,5	280,5
Characteristic resistance A2-70, A4-70	$V_{Rk,s,eq}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4
Characteristic resistance A4-80	$V_{Rk,s,eq}$	[kN]	21,6	31,3	58,4	98,0	141,2	224,4
Characteristic resistance 1.4529	$V_{Rk,s,eq}$	[kN]	18,9	27,4	51,2	85,8	123,6	196,4
Factor for annular gap	α_{gap}	[-]	0,5					

Note: Rebars are not qualified for seismic design

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Performances
Reduction factors for seismic design

Annex C 7