Technical and Test Institute for Construction Prague
Prosecká 811/76a
190 00 Prague
Czech Republic
eota@tzus.cz

Designated according to Article 29 of Regulation (EU) No 305/2011

Member of EOTA
www.eota.eu

European Technical Assessment

ETA 20/0873 of 18/08/2022

Technical Assessment Body issuing the ETA: Technical and Test Institute for Construction Prague	
Trade name of the construction product	MKW MKW Arctic
Product family to which the construction product belongs	Product area code: 33 Bonded injection type anchor for use in cracked and uncracked concrete
Manufacturer	Marcopol Sp. z o.o. Producent Śrub ul. Oliwska 100, 80-209 Chwaszczyno, Poland
Manufacturing plant	Plant 1
This European Technical Assessment contains	18 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 20/0873 issued on 19/11/2020

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

1. Technical description of the product

The MKW and MKW Arctic (faster curing time) with steel elements is bonded anchor (injection type).

Steel elements can be galvanized or stainless steel threaded rods or rebars.

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 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 to C 4
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 5, C 6
Displacements under short-term and long-term loading	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 Technický a zkušební ústav stavební Praha, s.p.[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 18.08.2022

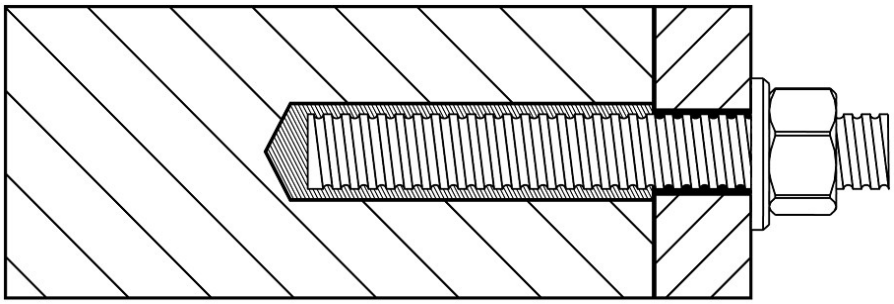
By

Ing. Jiří Studnička, Ph.D.
Head of the Technical Assessment Body

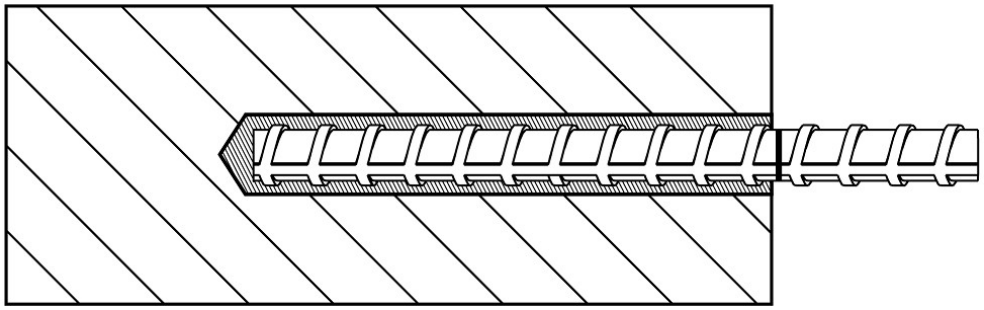
TECHNICKÝ A ZKUŠEBNÍ ÚSTAV STAVEBNÍ PRAHA, s.p.
Technical and Test Institute for Construction Prague, SOE
ZÚS
Czech Republic
Technical Assessment Body
Subjekt pro technické posuzování

[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



MKW, MKW Arctic	**Annex A 1**
Product description Installed conditions	

Coaxial cartridge

MKW, MKW Arctic 410 ml

Two part foil in a single piston component cartridge

MKW, MKW Arctic 165 ml
300 ml

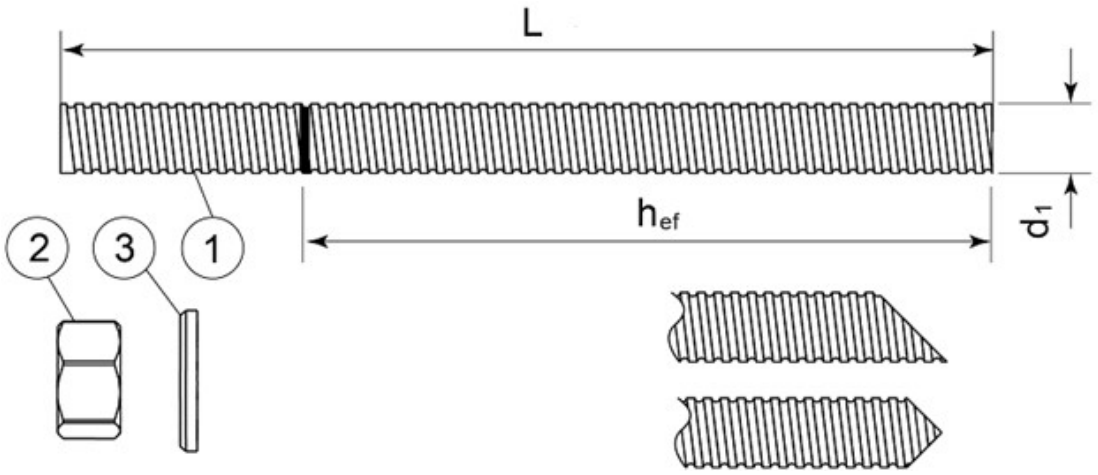
Marking of the mortar cartridges
Identifying mark of the producer, Trade name, Charge code number, Storage life, Curing and processing time

Mixing nozzle

EZ-Flow

MKW, MKW Arctic	**Annex A 2**
Product description Injection system	

Threaded rod M8, M10, M12, M16, M20, M24



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 or Steel, zinc diffusion coating ≥ 15 µm acc. to EN 13811		
1	Anchor rod	Steel, EN 10087 or EN 10263 Property class 4.6, 4.8, 5.6, 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	Anchor rod	Material: 1.4529, 1.4565, 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

MKW, MKW Arctic	**Annex A 3**
Product description Threaded rod and materials	

Rebar Ø8, Ø10, Ø12, Ø16, Ø20, Ø25

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	

MKW, MKW Arctic	
Product description Rebars and materials	**Annex A 4**

Specifications of intended use

Anchorages subject to:

- Static and quasi-static load

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

Temperature range:

- -40°C to +80°C (max. short. term temperature +80°C and max. long term temperature +50°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.
- I2 – installation in water-filled (not sea water) 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.

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.

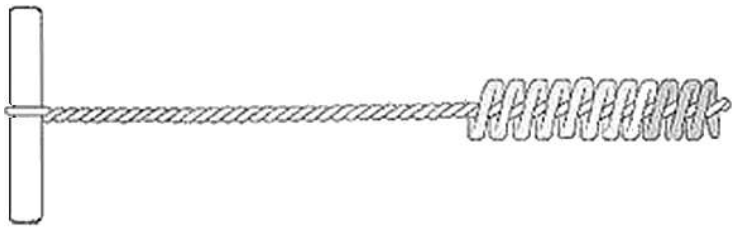
Installation direction:

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

MKW, MKW Arctic	**Annex B 1**
Intended use Specifications	

Applicator gun	Cartridge
	Coaxial cartridge
	Two part foil in a single piston component cartridge
	Two part foil in a single piston component cartridge

Cleaning brush

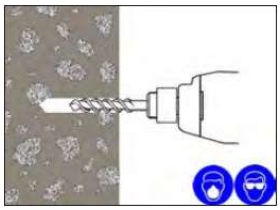


MKW, MKW Arctic	
Intended use Applicator guns Cleaning brush	**Annex B 2**

Installation instructions

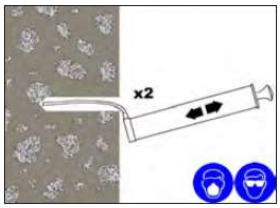
Before commencing installation ensure the operative is equipped with appropriate personal protection equipment, SDS Hammer Drill, Blow pump, Hole Cleaning Brush, good quality Dispensing Tool, Chemical cartridge with mixing nozzle and extension tube, if needed.

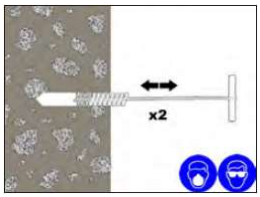
1. Drill the hole to the correct diameter and depth. This can be done with either a rotary percussion or rotary hammer drilling machine depending upon the substrate.

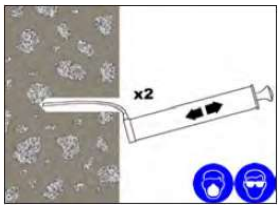


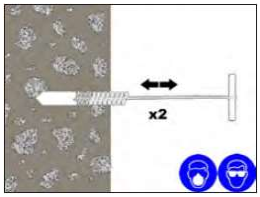
2. Thoroughly clean the hole in the following sequence using the brush with the required extensions and a blow pump.

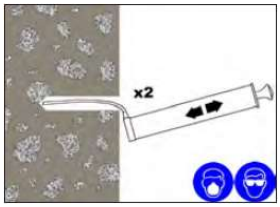
Blow Clean x2.
Brush Clean x2.
Blow Clean x2.
Brush Clean x2.
Blow Clean x2.





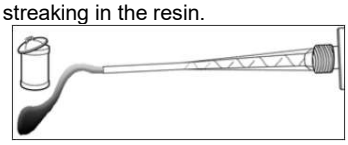






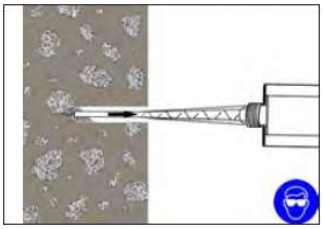
If the hole collects water after the initial cleaning this water must be removed before injecting the resin.

3. Select the appropriate static mixer nozzle for the installation, open the cartridge/foil and screw onto the mouth of the cartridge. Insert the cartridge into the correct applicator gun.
4. Extrude the first part of the cartridge to waste until an even colour has been achieved without streaking in the resin.

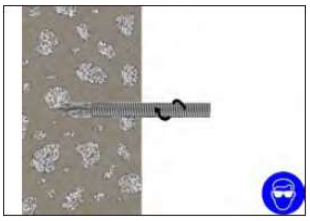


5. If necessary, cut the extension tube to the depth of the hole and push onto the end of the mixer nozzle, and (for threaded bar 16mm dia. or more) fit the correct resin stopper to the other end. Attach extension tubing and resin stopper.

6. Insert the mixer nozzle (resin stopper / extension tube if applicable) to the bottom of the hole. Begin to extrude the resin and slowly withdraw the mixer nozzle from the hole ensuring that there are no air voids as the mixer nozzle is withdrawn. Fill the hole to approximately ½ to ¾ full and remove the mixer nozzle completely.



7. Insert the clean threaded bar, free from oil or other release agents, to the bottom of the hole using a back and forth twisting motion ensuring all the threads are thoroughly coated. Adjust to the correct position within the stated working time.

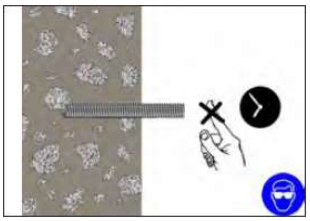


8. Any excess resin should be expelled from the hole evenly around the steel element showing that the hole is full.

   This excess resin should be removed from around the mouth of the hole before it sets.

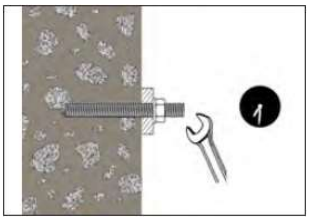
9. Leave the anchor to cure.

   Do not disturb the anchor until the appropriate loading/curing time has elapsed depending on the substrate conditions and ambient temperature.



10 Attach the fixture and tighten the nut to the recommended torque.

   Do not overtighten.



MKW, MKW Arctic

Intended use
Installation procedure

Annex B 3

Table B1: Installation parameters of threaded rod

Size			M8	M10	M12	M16	M20	M24
Nominal drill hole diameter	$Ød_0$	[mm]	10	12	14	18	22	26
Diameter of cleaning brush	d_b	[mm]	14	14	20	20	29	29
Torque moment	max T_{fix}	[Nm]	10	20	40	80	120	160
Depth of drill hole for $h_{ef,min}$	h_{ef}	[mm]	60	60	70	80	90	96
Depth of drill hole for $h_{ef,max}$	h_{ef}	[mm]	160	200	240	320	400	480
Depth of drill hole	h_0	[mm]	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5
Minimum edge distance	c_{min}	[mm]	40	40	50	70	80	100
Minimum spacing	s_{min}	[mm]	40	40	50	70	80	100
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$		

Table B2: Installation parameters of rebar

Size			Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Nominal drill hole diameter	$Ød_0$	[mm]	12	14	16	20 | 22	25	30 | 32
Diameter of cleaning brush	d_b	[mm]	14	14	19	22	29	40
Depth of drill hole for $h_{ef,min}$	h_{ef}	[mm]	60	60	70	80	90	100
Depth of drill hole for $h_{ef,max}$	h_{ef}	[mm]	160	200	240	320	400	480
Depth of drill hole	h_0	[mm]	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5	h_{ef}+5
Minimum edge distance	c_{min}	[mm]	40	40	50	70	80	100
Minimum spacing	s_{min}	[mm]	40	40	50	70	80	100
Minimum thickness of member	h_{min}	[mm]	h_{ef} + 30 mm ≥ 100 mm			h_{ef} + $2d_0$		

Table B3.1: Minimum curing time MKW

Resin cartridge temperature [°C]	T Work [mins]	Base material Temperature [°C]	T Load [mins]
min +5	18	min +5	145
+5 to +10	10	+5 to +10	
+10 to +20	6	+10 to +20	85
+20 to +25	5	+20 to +25	50
+25 to +30	4	+25 to +30	40
+30		+30	35

Table B3.2: Minimum curing time MKW Arctic

Resin cartridge temperature [°C]	T Work [mins]	Base material Temperature [°C]	T Load [mins]
+20	90	-20 to -15[1)]	110 hours
+20	35	-15 to -10[1)]	55 hours
+5	10	-10 to -5	30 hours
+5	3,5	-5 to 0	9 hours
+5	2	0 to +5	125
+5 to +10	2	+5 to +10	60
+10 to +20	2	+10 to +20	40
+20 to +25	1,5	+20 to +25	20
+25 to +30	1	+25 to +30	15
+30	1	+30	10

[1)] characteristic values of resistance see Annex C 2 and Annex C 4

T Work is typical gel time at highest base material temperature in the range.
T Load is minimum set time required until load can be applied at the lowest temperature in the range.

MKW, MKW Arctic

Intended use
Installation parameters
Curing time

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			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$N_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	2,00					
Steel grade **4.8**	$N_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	1,50					
Steel grade **5.6**	$N_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]	2,00					
Steel grade **5.8**	$N_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]	1,50					
Steel grade **8.8**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms}	[-]	1,50					
Steel grade **10.9**	$N_{Rk,s}$	[kN]	37	58	84	157	245	353
Partial safety factor	γ_{Ms}	[-]	1,33					
Stainless steel grade **A2-70, A4-70**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]	1,87					
Stainless steel grade **A4-80**	$N_{Rk,s}$	[kN]	29	46	67	126	196	282
Partial safety factor	γ_{Ms}	[-]	1,60					
High corrosion resistant steel grade **1.4529**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]	1,50					
High corrosion resistant steel grade **1.4565**	$N_{Rk,s}$	[kN]	26	41	59	110	172	247
Partial safety factor	γ_{Ms}	[-]	1,87					

Combined pullout and concrete cone failure in concrete C20/25								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,ucr}$	[N/mm²]	11	10	10	9	7,5	7
Dry, wet concrete, flooded hole								
Partial safety factor	γ_{inst}	[-]	1,2					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	5	5	4,5	4	4	4
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	4	4	3,5	3,5	3,5	3,5
Dry, wet concrete, flooded hole								
Partial safety factor	γ_{inst}	[-]	1,2					
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,79					
Factor for concrete: C25/30	ψ_c	[-]	1,04					
Factor for concrete: C30/37	ψ_c	[-]	1,08					
Factor for concrete: C35/45	ψ_c	[-]	1,12					
Factor for concrete: C40/50	ψ_c	[-]	1,15					
Factor for concrete: C45/55	ψ_c	[-]	1,17					
Factor for concrete: C50/60	ψ_c	[-]	1,19					

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			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Edge distance	$c_{cr,sp}$	[mm]	$2 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$					

MKW, MKW Arctic

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

Annex C 1

Table C1: Design method EN 1992-4
Characteristic values of resistance to tension load of threaded rod for MKW Arctic with installation temperature < -10°C

Steel failure – Characteristic resistance								
See Annex C 1								
Combined pullout and concrete cone failure in concrete C20/25								
Size				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years									
Temperature: -40°C to +80°C		$\tau_{Rk,ucr}$	[N/mm²]	10	9,5	9,5	8,5	7	6,5
Dry, wet concrete, flooded hole									
Partial safety factor		γ_{inst}	[-]	1,2					
Characteristic bond resistance in cracked concrete for a working life of 50 years									
Temperature: -40°C to +80°C		$\tau_{Rk,cr}$	[N/mm²]	4,5	4,5	4	3,5	3,5	3,5
Characteristic bond resistance in cracked concrete for a working life of 100 years									
Temperature: -40°C to +80°C		$\tau_{Rk,cr}$	[N/mm²]	3,5	3,5	3	3	3	3
Dry, wet concrete, flooded hole									
Partial safety factor		γ_{inst}	[-]	1,2					
Factor for influence of sustained load for a working life 50 years		ψ^0_{sus}	[-]	0,79					
Factor for concrete	C25/30	ψ_c	[-]	1,04					
	C30/37			1,08					
	C35/45			1,12					
	C40/50			1,15					
	C45/55			1,17					
	C50/60			1,19					
Concrete cone failure									
See Annex C 1									
Splitting failure									
See Annex C 1									

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

Steel failure – Characteristic resistance								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$N_{Rk,s}$	[kN]	28	43	62	111	173	270
Partial safety factor	γ_{Ms}	[-]	1,4					

Combined pullout and concrete cone failure in concrete C20/25								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,ucr}$	[N/mm²]	8,5	8	8	7	7	5,5
Dry, wet concrete, flooded hole								
Installation safety factor	γ_{inst}	[-]	1,2					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	4	3,5	3,5	3,5	3,5	2,5
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	3	3	2,5	2,5	2,5	2
Dry, wet concrete, flooded hole								
Installation safety factor	γ_{inst}	[-]	1,2					
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,79					
Factor for concrete C25/30	ψ_c	[-]	1,04					
Factor for concrete C30/37	ψ_c	[-]	1,08					
Factor for concrete C35/45	ψ_c	[-]	1,12					
Factor for concrete C40/50	ψ_c	[-]	1,15					
Factor for concrete C45/55	ψ_c	[-]	1,17					
Factor for concrete C50/60	ψ_c	[-]	1,19					

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			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Edge distance	$c_{cr,sp}$	[mm]	$2 \cdot h_{ef}$					
Spacing	$s_{cr,sp}$	[mm]	$2 \cdot c_{cr,sp}$					

MKW, MKW Arctic

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

Annex C 3

Table C2: Design method EN 1992-4
Characteristic values of resistance to tension load of rebar
MKW Arctic with installation temperature < -10°C

Steel failure – Characteristic resistance							
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
See Annex C 3								

Combined pullout and concrete cone failure in concrete C20/25								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Characteristic bond resistance in uncracked concrete for a working life of 50 years and 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,ucr}$	[N/mm²]	8	7	7,5	6	6	5
Dry, wet concrete, flooded hole								
Installation safety factor	γ_{inst}	[-]	1,2					
Characteristic bond resistance in cracked concrete for a working life of 50 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	3,5	3,5	3	3	3	2,5
Characteristic bond resistance in cracked concrete for a working life of 100 years								
Temperature: -40°C to +80°C	$\tau_{Rk,cr}$	[N/mm²]	2,5	2,5	2,5	2	2	2
Dry, wet concrete, flooded hole								
Installation safety factor	γ_{inst}	[-]	1,2					
Factor for influence of sustained load for a working life 50 years	ψ^0_{sus}	[-]	0,79					
Factor for concrete	C25/30	ψ_c	[-]	1,04				
	C30/37			1,08				
	C35/45			1,12				
	C40/50			1,15				
	C45/55			1,17				
	C50/60			1,19				

Concrete cone failure
See Annex C 3

Splitting failure
See Annex C 3

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

Steel failure without lever arm								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$V^0_{Rk,s}$	[kN]	7	12	17	31	49	71
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade **4.8**	$V^0_{Rk,s}$	[kN]	7	12	17	31	49	71
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **5.6**	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade **5.8**	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **8.8**	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **10.9**	$V^0_{Rk,s}$	[kN]	18	29	42	79	123	177
Partial safety factor	γ_{Ms}	[-]	1,5					
Stainless steel grade **A2-70, A4-70**	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade **A4-80**	$V^0_{Rk,s}$	[kN]	15	23	34	63	98	141
Partial safety factor	γ_{Ms}	[-]	1,33					
High corrosion resistant steel grade **1.4529**	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,25					
High corrosion resistant steel grade **1.4565**	$V^0_{Rk,s}$	[kN]	13	20	30	55	86	124
Partial safety factor	γ_{Ms}	[-]	1,56					
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			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Steel grade **4.6**	$M^{0}_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade **4.8**	$M^{0}_{Rk,s}$	[N.m]	15	30	52	133	260	449
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **5.6**	$M^{0}_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms}	[-]	1,67					
Steel grade **5.8**	$M^{0}_{Rk,s}$	[N.m]	19	37	66	166	325	561
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **8.8**	$M^{0}_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms}	[-]	1,25					
Steel grade **10.9**	$M^{0}_{Rk,s}$	[N.m]	37	75	131	333	649	1123
Partial safety factor	γ_{Ms}	[-]	1,50					
Stainless steel grade **A2-70, A4-70**	$M^{0}_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,56					
Stainless steel grade **A4-80**	$M^{0}_{Rk,s}$	[N.m]	30	60	105	266	519	898
Partial safety factor	γ_{Ms}	[-]	1,33					
High corrosion resistant steel grade **1.4529**	$M^{0}_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,25					
High corrosion resistant steel grade **1.4565**	$M^{0}_{Rk,s}$	[N.m]	26	52	92	233	454	786
Partial safety factor	γ_{Ms}	[-]	1,56					
Concrete pryout failure								
Factor for resistance to pry-out failure	k_8	[-]	2					

Concrete edge failure								
Size			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	24
Effective length of fastener	ℓ_f	[mm]	min (h_{ef}, 8 d_{nom})					

MKW, MKW Arctic

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

Annex C 5

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

Steel failure without lever arm								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$V_{Rk,s}$	[kN]	14	22	31	55	86	135
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			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Rebar BSt 500 S	$M^0_{Rk,s}$	[N.m]	33	65	112	265	518	1013
Partial safety factor	γ_{Ms}	[-]	1,5					
Concrete pryout failure								
Factor for resistance to pry-out failure	k_8	[-]	2					

Concrete edge failure								
Size			**Ø8**	**Ø10**	**Ø12**	**Ø16**	**Ø20**	**Ø25**
Outside diameter of fastener	d_{nom}	[mm]	8	10	12	16	20	25
Effective length of fastener	ℓ_f	[mm]	min (h_{ef}, 8 d_{nom})					

MKW, MKW Arctic

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

Annex C 6

Table C5: Displacement of threaded rod under tension and shear load

Size		M8	M10	M12	M16	M20	M24
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,030	0,024	0,026	0,026	0,022	0,023
$\delta_{N\infty}$	[mm/kN]	0,103	0,083	0,059	0,045	0,038	0,032
Cracked concrete							
δ_{N0}	[mm/kN]	0,056	0,044	0,058	0,063	0,044	0,035
$\delta_{N\infty}$	[mm/kN]	0,694	0,556	0,577	0,469	0,278	0,217
Shear load							
δ_{V0}	[mm/kN]	0,021	0,016	0,013	0,010	0,008	0,007
$\delta_{V\infty}$	[mm/kN]	0,031	0,024	0,020	0,015	0,012	0,010

Table C6: Displacement of rebar under tension and shear load

Size		Ø8	Ø10	Ø12	Ø16	Ø20	Ø25
Tension load							
Uncracked concrete							
δ_{N0}	[mm/kN]	0,037	0,033	0,036	0,031	0,025	0,023
$\delta_{N\infty}$	[mm/kN]	0,126	0,113	0,081	0,053	0,043	0,031
Cracked concrete							
δ_{N0}	[mm/kN]	0,067	0,054	0,071	0,047	0,044	0,043
$\delta_{N\infty}$	[mm/kN]	0,820	0,630	0,660	0,372	0,272	0,266
Shear load							
δ_{V0}	[mm/kN]	0,020	0,016	0,013	0,010	0,008	0,006
$\delta_{V\infty}$	[mm/kN]	0,030	0,025	0,019	0,015	0,012	0,008

MKW, MKW Arctic

Performances
Displacement for threaded rod and rebar

Annex C 7