Deutsches Institut für Bautechnik
DIBt

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Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Designated according to Article 29 of Regulation (EU) No 305/2011 and member of EOTA (European Organisation for Technical Assessment)

European Technical Assessment

ETA-16/0957 of 11 April 2017

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Friulsider Injection system KEM HYBRID for concrete
Product family to which the construction product belongs	Bonded anchor for use in concrete
Manufacturer	Friulsider S.p.A. Via Trieste 1 33048 SAN. GIOVANNI AL NATISONE ITALIEN
Manufacturing plant	Friulsider S.p.A. Plant 1 Germany
This European Technical Assessment contains	24 pages including 3 annexes which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	Guideline for European technical approval of "Metal anchors for use in concrete", ETAG 001 Part 5: "Bonded anchors", April 2013, used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.
This version replaces	ETA-16/0957 issued on 20 February 2017

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Specific Part

1 Technical description of the product

The "Friulsider Injection system KEM HYBRID for concrete" is a bonded anchor consisting of a cartridge with injection mortar KEM HYBRID and a steel element. The steel element consist of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30, reinforcing bar in the range of diameter ∅8 to ∅32 mm or internal threaded rod IG-M6 to IG-M20.

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

The product description is given in Annex A.

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

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 verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 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 and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance for static and quasi-static action and seismic performance categories C1, C2	See Annex C 1 to C 7
Displacements	See Annex C 8 to C 10

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 assessed

3.3 Hygiene, health and the environment (BWR 3)

Regarding dangerous substances there may be requirements (e.g. transposed European legislation and national laws, regulations and administrative provisions) applicable to the products falling within the scope of this European Technical Assessment. In order to meet the provisions of Regulation (EU) No 305/2011, these requirements need also to be complied with, when and where they apply.

3.4 Safety in use (BWR 4)

The essential characteristics regarding Safety in use are included under the Basic Works Requirement Mechanical resistance and stability.

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

In accordance with guideline for European technical approval ETAG 001, April 2013 used as European Assessment Document (EAD) according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

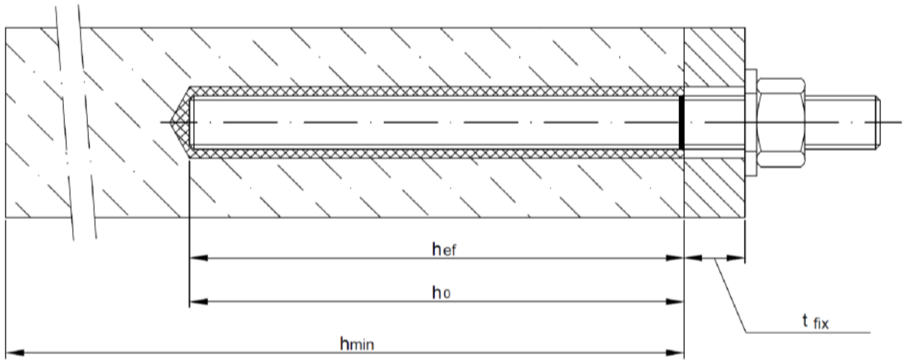
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 11 April 2017 by Deutsches Institut für Bautechnik

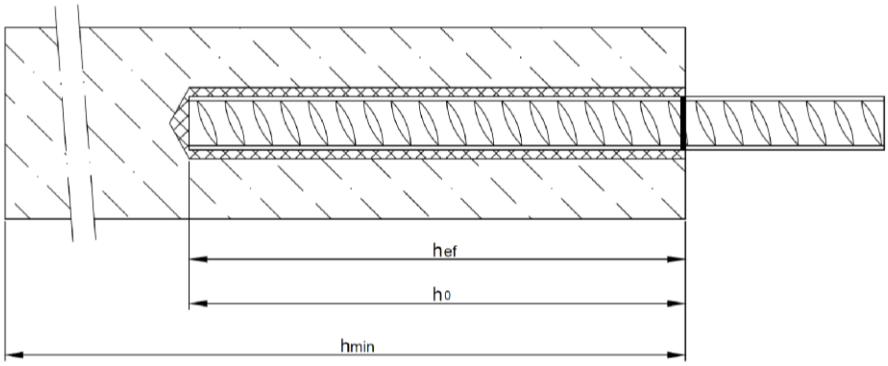
Uwe Bender
Head of Department

beglaubigt:
Baderschneider

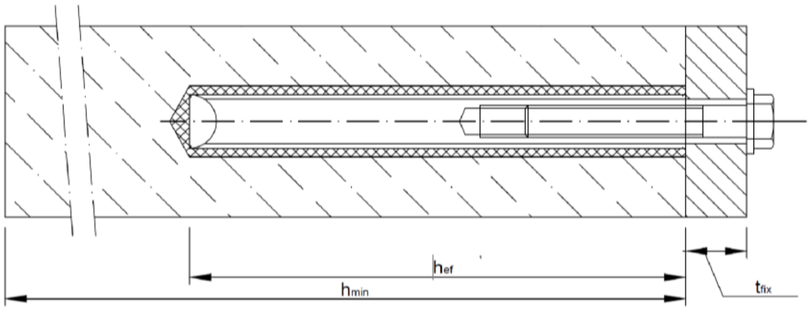
Installation threaded rod M8 to M30



Installation reinforcing bar Ø8 to Ø32



Installation internal threaded rod IG-M6 to IG-M20

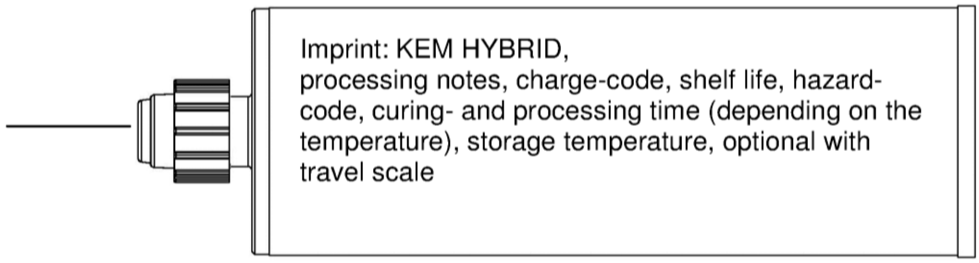


t_{fix} = thickness of fixture
h_{ef} = effective anchorage depth
h_0 = depth of drill hole
h_{min} = minimum thickness of member

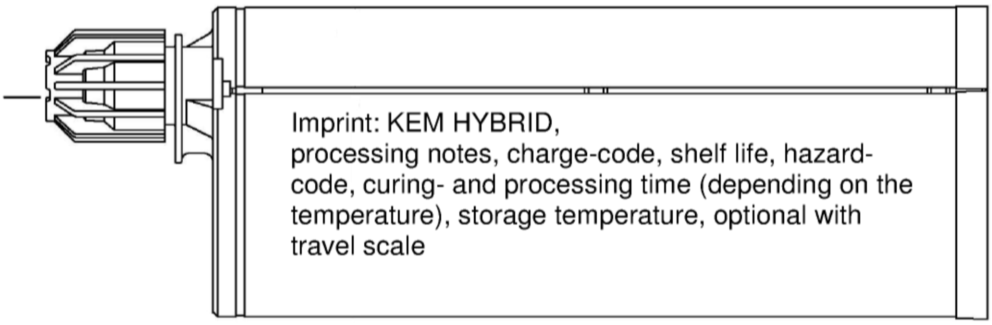
Friulsider Injection System KEM HYBRID for concrete	Annex A 1
Product description Installed condition	

Cartridge: KEM HYBRID

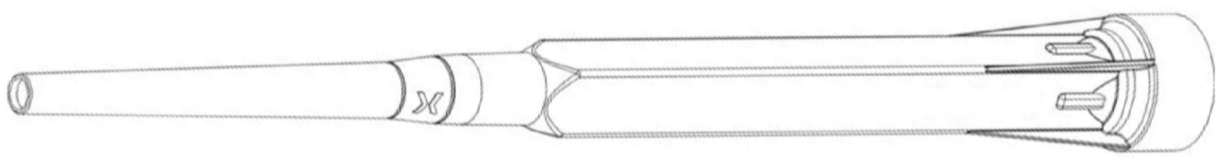
150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)



235 ml, 345 ml up to 360 ml and 825 ml cartridge (Type: "side-by-side")



Static Mixer



Friulsider Injection System KEM HYBRID for concrete	Annex A 2
Product description Injection system	

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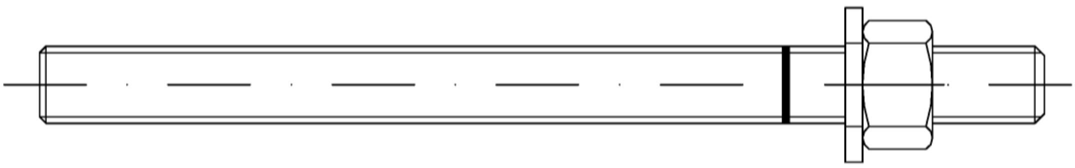
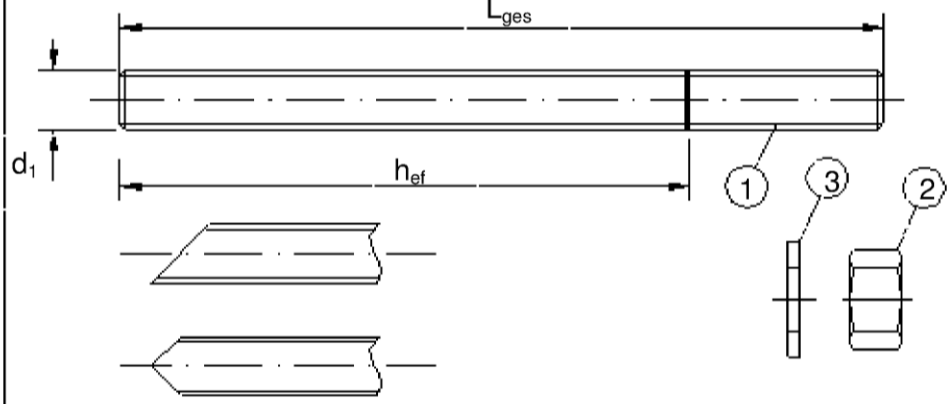
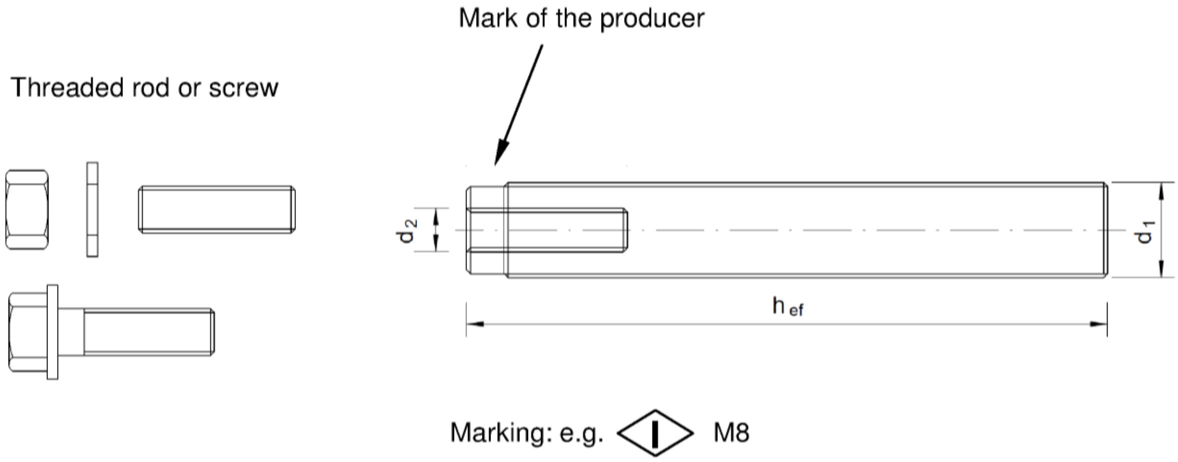
Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut



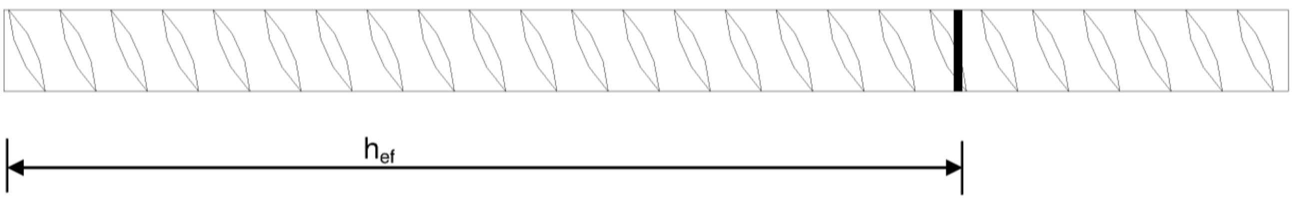


Commercial standard threaded rod with:
- Materials, dimensions and mechanical properties according to Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004
- Marking of embedment depth

Internal Threaded Sleeve IG-M6, IG-M8, IG-M10, IG-M12, IG-M16, IG-M20



Reinforcing bar ∅ 8, ∅ 10, ∅ 12, ∅ 14, ∅ 16, ∅ 20, ∅ 25, ∅ 28, ∅ 32



- Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- Rip height of the bar shall be in the range 0,05d ≤ h ≤ 0,07d
  (d: Nominal diameter of the bar; h: Rip height of the bar)

Friulsider Injection System KEM HYBRID for concrete	Annex A 3
Product description Threaded rod, Internal threaded sleeve and reinforcing bar	

Table A1: Materials

Designation	Material
Steel, zinc plated ≥ 5 µm acc. to EN ISO 4042:1999 or Steel, hot-dip galvanised ≥ 40 µm acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009	
Anchor rod	Steel, EN 10087:1998 or EN 10263:2001 Property class 4.6, 4.8, 5.6, 5.8, 8.8, EN 1993-1-8:2005+AC:2009 A_5 > 12% fracture elongation
Hexagon nut, EN ISO 4032:2012	Steel acc. to EN 10087:1998 or EN 10263:2001 Property class 4 (for class 4.6 and 4.8 rod) EN ISO 898-2:2012, Property class 5 (for class 5.6 and 5.8 rod) EN ISO 898-2:2012, Property class 8 (for class 8.8 rod) EN ISO 898-2:2012
Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Steel, zinc plated Property class 5.6, 5.8 and 8.8 EN ISO 898-1:2013
Internal threaded rod	Steel, zinc plated
Stainless steel	
Anchor rod	Material 1.4401 / 1.4404 / 1.4571, EN 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A_5 > 12% fracture elongation
Hexagon nut, EN ISO 4032:2012	Material 1.4401 / 1.4404 / 1.4571 EN 10088:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4401, 1.4404 or 1.4571, EN 10088-1:2005
Internal threaded rod	Stainless steel: 1.4401 / 1.4404 / 1.4571, EN 10088-1:2014 Property class 70 (for class 70 rod) EN ISO 3506-1:2009
High corrosion resistant steel	
Anchor rod	Material 1.4529 / 1.4565, EN 10088-1:2005, > M24: Property class 50 EN ISO 3506-1:2009 ≤ M24: Property class 70 EN ISO 3506-1:2009 A_5 > 12% fracture elongation
Hexagon nut, EN ISO 4032:2012	Material 1.4529 / 1.4565 EN 10088-1:2005, > M24: Property class 50 (for class 50 rod) EN ISO 3506-2:2009 ≤ M24: Property class 70 (for class 70 rod) EN ISO 3506-2:2009
Washer, EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 or EN ISO 7094:2000	Material 1.4529 / 1.4565, EN 10088-1:2005
Internal threaded rod	Stainless steel: 1.4529 / 1.4565, EN 10088-1:2014 Property class 70 (for class 70 rod) EN ISO 3506-1:2009
Reinforcing bars	
Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

Specifications of intended use

Anchorages subject to:
- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- Seismic action for Performance Category C1: M8 to M30, Rebar Ø8 to Ø32.
- Seismic action for Performance Category C2: M12

Base materials:
- Reinforced or unreinforced normal weight concrete according to EN 206-1:2000.
- Strength classes C20/25 to C50/60 according to EN 206-1:2000.
- Non-cracked concrete: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- Cracked concrete: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.

Temperature Range:
- I: - 40 °C to +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- II: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °C)
- III: - 40 °C to +160 °C (max long term temperature +100 °C and max short term temperature +160 °C)

Use conditions (Environmental conditions):
- Structures subject to dry internal conditions
  (zinc coated steel, stainless steel or high corrosion resistant steel).
- 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 or high corrosion resistant steel).
- 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).

Design:
- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- Anchorages under static or quasi-static actions are designed in accordance with:
  - EOTA Technical Report TR 029 "Design of bonded anchors", Edition September 2010 or
  - CEN/TS 1992-4:2009
- Anchorages under seismic actions (cracked concrete) are designed in accordance with:
  - EOTA Technical Report TR 045 "Design of Metal Anchors under Seismic Action", Edition February 2013
  - Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure.
  - Fastenings in stand-off installation or with a grout layer are not allowed.

Installation:
- Dry or wet concrete.
- Hole drilling by hammer or compressed air drill mode.
- Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the Internal threaded rod.

Friulsider Injection System KEM HYBRID for concrete	**Annex B 1**
Intended Use Specifications	

Table B1: Installation parameters for threaded rod

Anchor size		**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M 24**	**M 27**	**M 30**
Diameter of element	$d_1 = d_{nom}$ [mm] =	8	10	12	16	20	24	27	30
Nominal drill hole diameter	d_0 [mm] =	10	12	14	18	22	28	30	35
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	80	90	96	108	120
	$h_{ef,max}$ [mm] =	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture[1]	d_f [mm] =	9	12	14	18	22	26	30	33
Installation torque	T_{inst} [Nm] ≤	10	20	40[2]	60	100	170	250	300
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm			$h_{ef} + 2d_0$				
Minimum spacing	s_{min} [mm]	40	50	60	75	95	115	125	140
Minimum edge distance	c_{min} [mm]	35	40	45	50	60	65	75	80

[1] For larger clearance hole see TR029 section 1.1; for application under seismic loading the diameter of clearance hole in the fixture shall be at maximum d_1 + 1mm or alternatively the annular gap between fixture and anchor rod shall be filled force-fit with mortar.
[2] Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

Table B2: Installation parameters for rebar

Rebar size		**∅ 8**	**∅ 10**	**∅ 12**	**∅ 14**	**∅ 16**	**∅ 20**	**∅ 25**	**∅ 28**	**∅ 32**
Diameter of element	$d = d_{nom}$ [mm] =	8	10	12	14	16	20	25	28	32
Nominal drill hole diameter	d_0 [mm] =	12	14	16	18	20	25	32	35	40
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$ [mm] =	160	200	240	280	320	400	500	560	640
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2d_0$						
Minimum spacing	s_{min} [mm]	40	50	60	70	75	95	120	130	150
Minimum edge distance	c_{min} [mm]	35	40	45	50	50	60	70	75	85

Table B3: Installation parameters for Internal threaded rod

Anchor size		**IG-M 6**	**IG-M 8**	**IG-M 10**	**IG-M 12**	**IG-M 16**	**IG-M 20**
Internal diameter of sleeve	d_2 [mm] =	6	8	10	12	16	20
Outer diameter of sleeve[2]	$d_1 = d_{nom}$ [mm] =	10	12	16	20	24	30
Nominal drill hole diameter	d_0 [mm] =	12	14	18	22	28	35
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	70	80	90	96	120
	$h_{ef,max}$ [mm] =	200	240	320	400	480	600
Diameter of clearance hole in the fixture[1]	d_f [mm] =	7	9	12	14	18	22
Installation torque	T_{inst} [Nm] ≤	10	10	20	40	60	100
Thread engagement length Min/max	l_{IG} [mm] =	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	h_{min} [mm]	h_{ef} + 30 mm ≥ 100 mm		$h_{ef} + 2d_0$			
Minimum spacing	s_{min} [mm]	50	60	75	95	115	125
Minimum edge distance	c_{min} [mm]	40	45	50	60	65	75

[1] For larger clearance hole see TR029 section 1.1
[2] With metric threads according to EN 1993-1-8:2005+AC:2009

Friulsider Injection System KEM HYBRID for concrete

Intended Use
Installation parameters

Annex B 2

Table B4: Parameter cleaning and setting tools



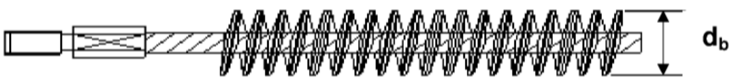



Threaded Rod	Rebar	Internal threaded rod	d_0 Drill bit - Ø	d_b Brush - Ø		$d_{b,min}$ min. Brush - Ø	Piston plug	Installation direction and use of piston plug		
(mm)	(mm)	(mm)	(mm)		(mm)	(mm)		↓	→	↑
M8			10	RB10	11,5	10,5	-	-	-	-
M10	8	IG-M6	12	RB12	13,5	12,5	-	-	-	-
M12	10	IG-M8	14	RB14	15,5	14,5	-	-	-	-
	12		16	RB16	17,5	16,5	-	-	-	-
M16	14	IG-M10	18	RB18	20,0	18,5	VS18	h_{ef} > 250 mm	h_{ef} > 250 mm	all
	16		20	RB20	22,0	20,5	VS20			
M20		IG-M12	22	RB22	24,0	22,5	VS22			
	20		25	RB25	27,0	25,5	VS25			
M24		IG-M16	28	RB28	30,0	28,5	VS28			
M27			30	RB30	31,8	30,5	VS30			
	25		32	RB32	34,0	32,5	VS32			
M30	28	IG-M20	35	RB35	37,0	35,5	VS35			
	32		40	RB40	43,5	40,5	VS40			

MAC - Hand pump (volume 750 ml)
Drill bit diameter (d_0): 10 mm to 20 mm
Drill hole depth (h_0): < 10 d_s
Only in non-cracked concrete

CAC - Rec. compressed air tool (min 6 bar)
Drill bit diameter (d_0): all diameters

Piston plug for overhead or horizontal installation VS
Drill bit diameter (d_0): 18 mm to 40 mm



Steel brush RB
Drill bit diameter (d_0): all diameters

Friulsider Injection System KEM HYBRID for concrete	**Annex B 3**
Intended Use Cleaning and setting tools	

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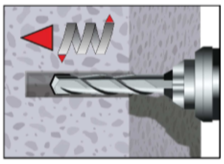
Installation instructions

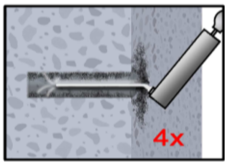
Drilling of the bore hole



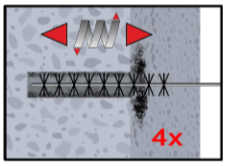
1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). In case of aborted drill hole: the drill hole shall be filled with mortar

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

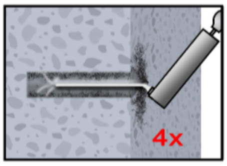
MAC: Cleaning for bore hole diameter $d_0 \leq 20$mm and bore hole depth $h_0 \leq 10d_s$ (uncracked concrete only!)



2a. Starting from the bottom or back of the bore hole, blow the hole clean by a hand pump (Annex B 3) a minimum of four times.

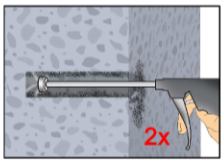


2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of four times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.

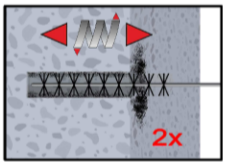


2c. Finally blow the hole clean again with a hand pump (Annex B 3) a minimum of four times.

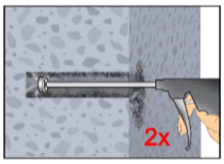
CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete



2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.



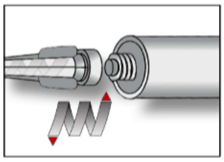
2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > $d_{b,min}$ (Table B4) a minimum of two times.
If the bore hole ground is not reached with the brush, a brush extension must be used.



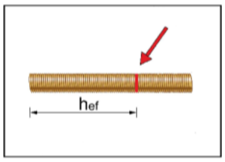
2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 3) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

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

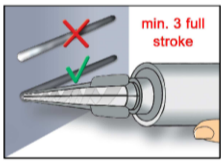
Installation instructions (continuation)



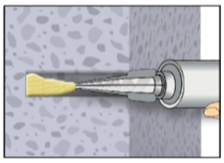
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool.
For every working interruption longer than the recommended working time (Table B5) as well as for new cartridges, a new static-mixer shall be used.



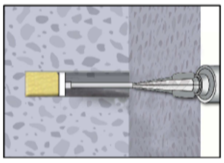
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



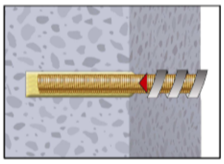
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour.



6. Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. For embedment larger than 190 mm an extension nozzle shall be used. Observe the gel-/ working times given in Table B5.

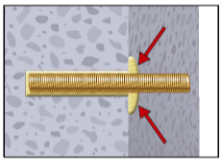


7. Piston Plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
   - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit-Ø $d_0 \geq 18$ mm and embedment depth $h_{ef} > 250$mm
   - Overhead assembly (vertical upwards direction): Drill bit-Ø $d_0 \geq 18$ mm

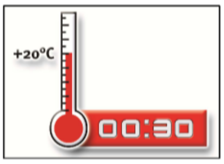


8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

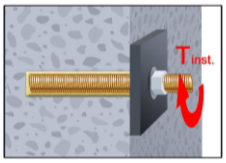
The anchor shall be free of dirt, grease, oil or other foreign material.



9. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).



10. Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B5).



11. After full curing, the add-on part can be installed with up to the max. torque (Table B1 or B3) by using a calibrated torque wrench.

Table B5: Maximum working time and minimum curing time

Concrete temperature	Gelling working time	Minimum curing time in dry concrete	Minimum curing time in wet concrete
- 5 °C to - 1 °C	50 min	5 h	10 h
0 °C to + 4 °C	25 min	3,5 h	7 h
+ 5 °C to + 9 °C	15 min	2 h	4 h
+ 10 °C to + 14 °C	10 min	1 h	2 h
+ 15 °C to + 19 °C	6 min	40 min	80 min
+ 20 °C to + 29 °C	3 min	30 min	60 min
+ 30 °C to + 40 °C	2 min	30 min	60 min
Cartridge temperature	+5°C to +40°C		

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

Size				M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Characteristic tension resistance, Steel failure											
Steel, Property class 4.6 and 4.8		$N_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
Steel, Property class 5.6 and 5.8		$N_{Rk,s}$	[kN]	18	29	42	78	122	176	230	280
Steel, Property class 8.8		$N_{Rk,s}$	[kN]	29	46	67	125	196	282	368	449
Nichtrostender Stahl A4 and HCR, Property class 50		$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
Nichtrostender Stahl A4 and HCR, Property class 70		$N_{Rk,s}$	[kN]	26	41	59	110	171	247	-	-
Characteristic tension resistance, Partial safety factor											
Steel, Property class 4.6		$\gamma_{Ms,N}$ [1]	[-]	2,0							
Steel, Property class 4.8		$\gamma_{Ms,N}$ [1]	[-]	1,5							
Steel, Property class 5.6		$\gamma_{Ms,N}$ [1]	[-]	2,0							
Steel, Property class 5.8		$\gamma_{Ms,N}$ [1]	[-]	1,5							
Steel, Property class 8.8		$\gamma_{Ms,N}$ [1]	[-]	1,5							
Stainless steel A4 and HCR, Property class 50		$\gamma_{Ms,N}$ [1]	[-]	2,86							
Stainless steel A4 and HCR, Property class 70		$\gamma_{Ms,N}$ [1]	[-]	1,87							
Characteristic shear resistance, Steel failure											
Without lever arm	Steel, Property class 4.6 and 4.8	$V_{Rk,s}$	[kN]	7	12	17	31	49	71	92	112
	Steel, Property class 5.6 and 5.8	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Steel, Property class 8.8	$V_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224
	Stainless steel A4 and HCR, Property class 50	$V_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A4 and HCR, Property class 70	$V_{Rk,s}$	[kN]	13	20	30	55	86	124	-	-
With lever arm	Steel, Property class 4.6 and 4.8	$M_{Rk,s}$	[Nm]	15	30	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	$M_{Rk,s}$	[Nm]	19	37	65	166	324	560	833	1123
	Steel, Property class 8.8	$M_{Rk,s}$	[Nm]	30	60	105	266	519	896	1333	1797
	Stainless steel A4 and HCR, Property class 50	$M_{Rk,s}$	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A4 and HCR, Property class 70	$M_{Rk,s}$	[Nm]	26	52	92	232	454	784	-	-
Characteristic shear resistance, Partial safety factor											
Steel, Property class 4.6		$\gamma_{Ms,V}$ [1]	[-]	1,67							
Steel, Property class 4.8		$\gamma_{Ms,V}$ [1]	[-]	1,25							
Steel, Property class 5.6		$\gamma_{Ms,V}$ [1]	[-]	1;67							
Steel, Property class 5.8		$\gamma_{Ms,V}$ [1]	[-]	1,25							
Steel, Property class 8.8		$\gamma_{Ms,V}$ [1]	[-]	1,25							
Stainless steel A4 and HCR, Property class 50		$\gamma_{Ms,V}$ [1]	[-]	2,38							
Stainless steel A4 and HCR, Property class 70		$\gamma_{Ms,V}$ [1]	[-]	1,56							

[1] in absence of national regulation

Friulsider Injection System KEM HYBRID for concrete

Performances
Characteristic values for steel tension resistance and steel shear resistance of threaded rods

Annex C 1

Table C2: Characteristic values of tension loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Anchor size threaded rod				**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M24**	**M 27**	**M 30**
Steel failure											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	see Table C1							
		$N_{Rk,s,C1}$	[kN]	1,0 • $N_{Rk,s}$							
		$N_{Rk,s,C2}$	[kN]	NPD		1,0 • $N_{Rk,s}$	No Performance Determined (NPD)				
Partial safety factor		$\gamma_{Ms,N}$	[-]	see Table C1							
Combined pull-out and concrete cone failure											
Characteristic bond resistance in non-cracked concrete C20/25											
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	17	17	16	15	14	13	13	13
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	15	14	14	13	12	12	11	11
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	12	12	11	10	9,5	9,0	9,0	9,0
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	6,5	7,0	7,5	8,5	8,5	8,5	8,5	8,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		3,6	NPD				
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,5	6,0	6,5	7,5	7,5	7,5	7,5	7,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		3,1	NPD				
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,0	5,5	6,0	6,5	6,5	6,5	6,5	6,5
		$\tau_{Rk,C2}$	[N/mm²]	NPD		2,5	NPD				
Increasing factors for concrete ψ_c		C25/30		1,02							
		C30/37		1,04							
		C35/45		1,07							
		C40/50		1,08							
		C45/55		1,09							
		C50/60		1,10							
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_8	[-]	10,1							
	Cracked concrete			7,2							
Concrete cone failure											
Factor according to CEN/TS 1992-4-5 Section 6.2.3.1	Non-cracked concrete	k_{ucr}	[-]	10,1							
	Cracked concrete	k_{cr}	[-]	7,2							
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}							
Axial distance		$s_{cr,N}$	[mm]	3,0 h_{ef}							
Splitting failure											
Edge distance	$h/h_{ef} \geq 2{,}0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}							
	$2{,}0 > h/h_{ef} > 1{,}3$			$2 \cdot h_{ef} \left(2{,}5 - \frac{h}{h_{ef}}\right)$							
	$h/h_{ef} \leq 1{,}3$			2,4 h_{ef}							
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Installation safety factor **(CAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0 (1,2)[1)]				1,2			
Installation safety factor **(MAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2				-			

[1)] Value in brackets for cracked concrete

Friulsider Injection System KEM HYBRID for concrete

Performances
Characteristic values of tension loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Annex C 2

Table C3: Characteristic values of shear loads for threaded rods under static, quasi-static action and seismic action (performance category C1+C2)

Anchor size threaded rod			**M 8**	**M 10**	**M 12**	**M 16**	**M 20**	**M24**	**M 27**	**M 30**
Steel failure without lever arm										
Characteristic shear resistance	$V_{Rk,s}$	[kN]	see Table C1							
	$V_{Rk,s,C1}$	[kN]	$0{,}70 \cdot V_{Rk,s}$							
	$V_{Rk,s,C2}$	[kN]	(NPD)		$0{,}80 \cdot V_{Rk,s}$	No Performance Determined (NPD)				
Partial safety factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Steel failure with lever arm										
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	see Table C1							
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)							
	$M^0_{Rk,s,C2}$	[Nm]	No Performance Determined (NPD)							
Partial safety factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Concrete pry-out failure										
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$	[-]	2,0							
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							
Concrete edge failure										
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$							
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	16	20	24	27	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0							

Table C4: Characteristic values of tension loads for internal threaded rods under static and quasi-static action

Anchor size internally threaded rods				IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Steel failure[1)]									
Characteristic tension resistance, Steel, strength class 5.8		$N_{Rk,s}$	[kN]	10	17	29	42	76	123
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,5					
Characteristic tension resistance, Steel, strength class 8.8		$N_{Rk,s}$	[kN]	16	27	46	67	121	196
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,5					
Characteristic tension resistance, Stainless Steel A4, Strength class 70		$N_{Rk,s}$	[kN]	14	26	41	59	110	172
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,87					
Combined pull-out and concrete cone failure									
Characteristic bond resistance in non-cracked concrete C20/25									
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	17	16	15	14	13	13
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	14	14	13	12	12	11
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	12	11	10	9,5	9,0	9,0
Characteristic bond resistance in cracked concrete C20/25									
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,5	8,5	8,5	8,5	8,5
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	6,0	6,5	7,5	7,5	7,5	7,5
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm²]	5,5	6,0	6,5	6,5	6,5	6,5
Increasing factors for concrete ψ_c		C25/30		1,02					
		C30/37		1,04					
		C35/45		1,07					
		C40/50		1,08					
		C45/55		1,09					
		C50/60		1,10					
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_8	[-]	10,1					
	Cracked concrete			7,2					
Concrete cone failure									
Factor according to CEN/TS 1992-4-5 Section 6.2.3.1	Non-cracked concrete	k_{ucr}	[-]	10,1					
	Cracked concrete	k_{cr}	[-]	7,2					
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}					
Axial distance		$s_{cr,N}$	[mm]	3,0 h_{ef}					
Splitting failure									
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}					
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef}\left(2,5 - \frac{h}{h_{ef}}\right)$					
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}					
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$					
Installation safety factor **(CAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0 (1,2)[2)]			1,2		
Installation safety factor **(MAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2			-		

1) Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internal threaded rod and the fastening element.

2) Value in brackets for cracked concrete.

Friulsider Injection System KEM HYBRID for concrete

Performances
Characteristic values of tension loads for internal threaded rods under static and quasi-static action

Annex C 4

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Table C5: Characteristic values of shear loads for internal threaded rods under static and quasi-static action

Anchor size for internally threaded rods			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Steel failure without lever arm[1]								
Characteristic shear resistance, Steel, strength class 5.8	$V_{Rk,s}$	[kN]	5	9	15	21	38	61
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance, Steel, strength class 8.8	$V_{Rk,s}$	[kN]	8	14	23	34	60	98
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance, Stainless Steel A4, Strength class 70	$V_{Rk,s}$	[kN]	7	13	20	30	55	86
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,56					
Steel failure with lever arm[1]								
Characteristic bending moment, Steel, strength class 5.8	$M^0_{Rk,s}$	[Nm]	8	19	37	66	167	325
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Steel, strength class 8.8	$M^0_{Rk,s}$	[Nm]	12	30	60	105	267	519
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Stainless Steel A4, Strength class 70	$M^0_{Rk,s}$	[Nm]	11	26	52	92	233	454
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,56					
Concrete pry-out failure								
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$	[-]	2,0					
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0					
Concrete edge failure								
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$					
Outside diameter of anchor	d_{nom}	[mm]	10	12	16	20	24	30
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0					

[1] Fastening screws or threaded rods (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure of the given strength class are valid for the internal threaded rod and the fastening element.

Friulsider Injection System KEM HYBRID for concrete

Performances
Characteristic values of shear loads for internal threaded rods under static and quasi-static action

Annex C 5

Table C6: Characteristic values of tension loads for rebar under static, quasi-static action and seismic action (performance category C1)

Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure												
Characteristic tension resistance		$N_{Rk,s} = N_{Rk,s,C1}$	[kN]	$A_s \cdot f_{uk}$ [2]								
Cross section area		A_s	[mm²]	50	79	113	154	201	214	491	616	804
Partial safety factor		$\gamma_{Ms,N}$	[-]	1,4[3]								
Combined pull-out and concrete cone failure												
Characteristic bond resistance in non-cracked concrete C20/25												
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	14	14	14	14	13	13	13	13	13
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	13	12	12	12	12	11	11	11	11
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm²]	10	10	9,5	9,5	9,5	9,0	9,0	9,0	9,0
Characteristic bond resistance in cracked concrete C20/25												
Temperature range I: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	5,0	5,5	6,0	6,0	7,5	7,5	7,5	7,5	8,0
Temperature range II: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	4,5	5,0	5,0	5,5	6,5	6,5	6,5	6,5	7,0
Temperature range III: 160°C/100°C	dry and wet concrete	$\tau_{Rk,cr} = \tau_{Rk,C1}$	[N/mm²]	4,0	4,5	4,5	5,0	5,5	6,0	6,0	5,5	6,5
Increasing factors for concrete ψ_c		C25/30		1,02								
		C30/37		1,04								
		C35/45		1,07								
		C40/50		1,08								
		C45/55		1,09								
		C50/60		1,10								
Factor according to CEN/TS 1992-4-5 Section 6.2.2.3	Non-cracked concrete	k_8	[-]	10,1								
	Cracked concrete			7,2								
Concrete cone failure												
Factor according to CEN/TS 1992-4-5 Section 6.2.3.1	Non-cracked concrete	k_{ucr}	[-]	10,1								
	Cracked concrete	k_{cr}	[-]	7,2								
Edge distance		$c_{cr,N}$	[mm]	1,5 h_{ef}								
Axial distance		$s_{cr,N}$	[mm]	3,0 h_{ef}								
Splitting failure												
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 h_{ef}								
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}}\right)$								
	$h/h_{ef} \leq 1,3$			2,4 h_{ef}								
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$								
Installation safety factor **(CAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,0 (1,2)[1]					1,2			
Installation safety factor **(MAC)** (dry and wet concrete)		$\gamma_2 = \gamma_{inst}$	[-]	1,2					-			

1) Value in brackets for cracked concrete
2) f_{uk} shall be taken from the specifications of reinforcing bars
3) in absence of national regulation

Friulsider Injection System KEM HYBRID for concrete

Performances
Characteristic values of tension loads for rebar under static, quasi-static action and seismic action (performace category C1)

Annex C 6

Table C7: Characteristic values of shear loads for rebar under static, quasi-static action and seismic action (performance category C1)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure without lever arm											
Characteristic shear resistance	$V_{Rk,s}$	[kN]	$0{,}50 \cdot N_{Rk,s}$								
	$V_{Rk,s,C1}$	[kN]	$0{,}37 \cdot N_{Rk,s}$								
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,5 2)								
Ductility factor according to CEN/TS 1992-4-5 Section 6.3.2.1	k_2		0,8								
Steel failure with lever arm											
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}$ 1)								
	$M^0_{Rk,s,C1}$	[Nm]	No Performance Determined (NPD)								
Elastic section modulus	W_{el}	[mm³]	50	98	170	269	402	785	1534	2155	3217
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,5 2)								
Concrete pry-out failure											
Factor k_3 in equation (27) of CEN/TS 1992-4-5 Section 6.3.3 Factor k in equation (5.7) of Technical Report TR 029	$k_{(3)}$	[-]	2,0								
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								
Concrete edge failure											
Effective length of anchor	l_f	[mm]	$l_f = \min(h_{ef}; 8\ d_{nom})$								
Outside diameter of anchor	d_{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation safety factor	$\gamma_2 = \gamma_{inst}$	[-]	1,0								

1) f_{uk} shall be taken from the specifications of reinforcing bars
2) in absence of national regulation

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Table C8: Displacements under tension load[1] (threaded rod)

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Non-cracked concrete C20/25 under static and quasi-static action										
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,037	0,039	0,042	0,044	0,046
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,047	0,051	0,054	0,057	0,060
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,038	0,041	0,044	0,046	0,048
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,049	0,053	0,056	0,059	0,062
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,121	0,126	0,131	0,142	0,153	0,163	0,171	0,179
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,146	0,157	0,168	0,176	0,184
Cracked concrete C20/25 under static, quasi-static and seismic C1 action										
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,090	0,095	0,099	0,103	0,106
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,116	0,122	0,128	0,133	0,137
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,093	0,098	0,103	0,107	0,110
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,121	0,127	0,133	0,138	0,143
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,349	0,367	0,385	0,399	0,412
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,321	0,330	0,340	0,358	0,377	0,396	0,410	0,424
Cracked concrete C20/25 under seismic C2 action										
All temperature ranges	$\delta_{N,seis(DLS)}$	[mm/(N/mm²)]	(NPD)		0,120	No Parameter Determined (NPD)				
	$\delta_{N,seis(ULS)}$	[mm/(N/mm²)]			0,140					

[1] Calculation of the displacement

$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension

$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C9: Displacements under shear load[1] (threaded rod)

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
Non-cracked and cracked concrete C20/25 under static, quasi-static and seismic C1 action										
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Cracked concrete C20/25 under seismic C2 action										
All temperature ranges	$\delta_{V,seis(DLS)}$	[mm/(kN)]	No Parameter Determined (NPD)		0,27	No Parameter Determined (NPD)				
	$\delta_{V,seis(ULS)}$	[mm/(kN)]			0,27					

[1] Calculation of the displacement

$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load

$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

Table C10: Displacements under tension load[1] (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25 under static and quasi-static action											
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,031	0,032	0,034	0,035	0,037	0,039	0,043	0,045	0,048
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,040	0,042	0,044	0,045	0,047	0,051	0,055	0,058	0,063
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,032	0,034	0,035	0,036	0,038	0,041	0,045	0,047	0,050
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,042	0,044	0,045	0,047	0,049	0,053	0,057	0,060	0,065
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,121	0,126	0,131	0,137	0,142	0,153	0,164	0,172	0,186
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,124	0,129	0,135	0,141	0,146	0,157	0,169	0,177	0,192
Cracked concrete C20/25 under static, quasi-static and seismic C1 action											
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,081	0,083	0,085	0,087	0,090	0,095	0,099	0,103	0,108
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,104	0,107	0,110	0,113	0,116	0,122	0,128	0,133	0,141
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,084	0,086	0,088	0,090	0,093	0,098	0,103	0,107	0,113
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,108	0,111	0,114	0,118	0,121	0,127	0,133	0,138	0,148
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,312	0,321	0,330	0,340	0,349	0,367	0,385	0,399	0,425
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,321	0,330	0,340	0,349	0,358	0,377	0,396	0,410	0,449

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C11: Displacement under shear load[1] (rebar)

Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
For concrete C20/25 under static, quasi-static and seismic C1 action											
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

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Table C12: Displacements under tension load[1] (Internal threaded rod)

Anchor size Internal threaded rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Non-cracked concrete C20/25 under static and quasi-static action								
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,032	0,034	0,037	0,039	0,042	0,046
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,042	0,044	0,047	0,051	0,054	0,060
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,034	0,035	0,038	0,041	0,044	0,048
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,044	0,045	0,049	0,053	0,056	0,062
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,126	0,131	0,142	0,153	0,163	0,179
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,129	0,135	0,146	0,157	0,168	0,184
Cracked concrete C20/25 under static and quasi-static action								
Temperature range I: 80°C/50°C	δ_{N0}-factor	[mm/(N/mm²)]	0,083	0,085	0,090	0,095	0,099	0,106
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,170	0,110	0,116	0,122	0,128	0,137
Temperature range II: 120°C/72°C	δ_{N0}-factor	[mm/(N/mm²)]	0,086	0,088	0,093	0,098	0,103	0,110
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,111	0,114	0,121	0,127	0,133	0,143
Temperature range III: 160°C/100°C	δ_{N0}-factor	[mm/(N/mm²)]	0,321	0,330	0,349	0,367	0,385	0,412
	$\delta_{N\infty}$-factor	[mm/(N/mm²)]	0,330	0,340	0,358	0,377	0,396	0,424

[1] Calculation of the displacement
$\delta_{N0} = \delta_{N0}\text{-factor} \cdot \tau$; τ: action bond stress for tension
$\delta_{N\infty} = \delta_{N\infty}\text{-factor} \cdot \tau$;

Table C13: Displacements under shear load[1] (Internal threaded rod)

Anchor size Internal threaded rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Non-cracked and cracked concrete C20/25 under static and quasi-static action								
All temperature ranges	δ_{V0}-factor	[mm/(kN)]	0,07	0,06	0,06	0,05	0,04	0,04
	$\delta_{V\infty}$-factor	[mm/(kN)]	0,10	0,09	0,08	0,08	0,06	0,06

[1] Calculation of the displacement
$\delta_{V0} = \delta_{V0}\text{-factor} \cdot V$; V: action shear load
$\delta_{V\infty} = \delta_{V\infty}\text{-factor} \cdot V$;

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Annex C 10