Deutsches Institut für Bautechnik
DIBt

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment

ETA-10/0012 of 15 February 2016

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	fischer injection system FIS EM
Product family to which the construction product belongs	Bonded anchor for use in concrete
Manufacturer	fischerwerke GmbH & Co. KG Otto-Hahn-Straße 15 79211 Denzlingen DEUTSCHLAND
Manufacturing plant	fischerwerke
This European Technical Assessment contains	32 pages including 3 annexes
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-10/0012 issued on 19 March 2015

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Specific Part

1 Technical description of the product

The fischer injection system FIS EM is a bonded anchor consisting of a cartridge with injection mortar fischer FIS EM and a steel element according to Annex A2.

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 values under static and quasi-static action for design according to TR 029 or CEN/TS 1992-4:2009, Displacements	See Annex C 1 to C 10
Characteristic values for seismic performance categories C1 and C2 for design according to Technical Report TR 045, Displacements	See Annex C 11 to C 14

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.

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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 European Assessment Document

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

Issued in Berlin on 15 February 2016 by Deutsches Institut für Bautechnik

Andreas Kummerow
p.p. Head of Department

beglaubigt:
Lange

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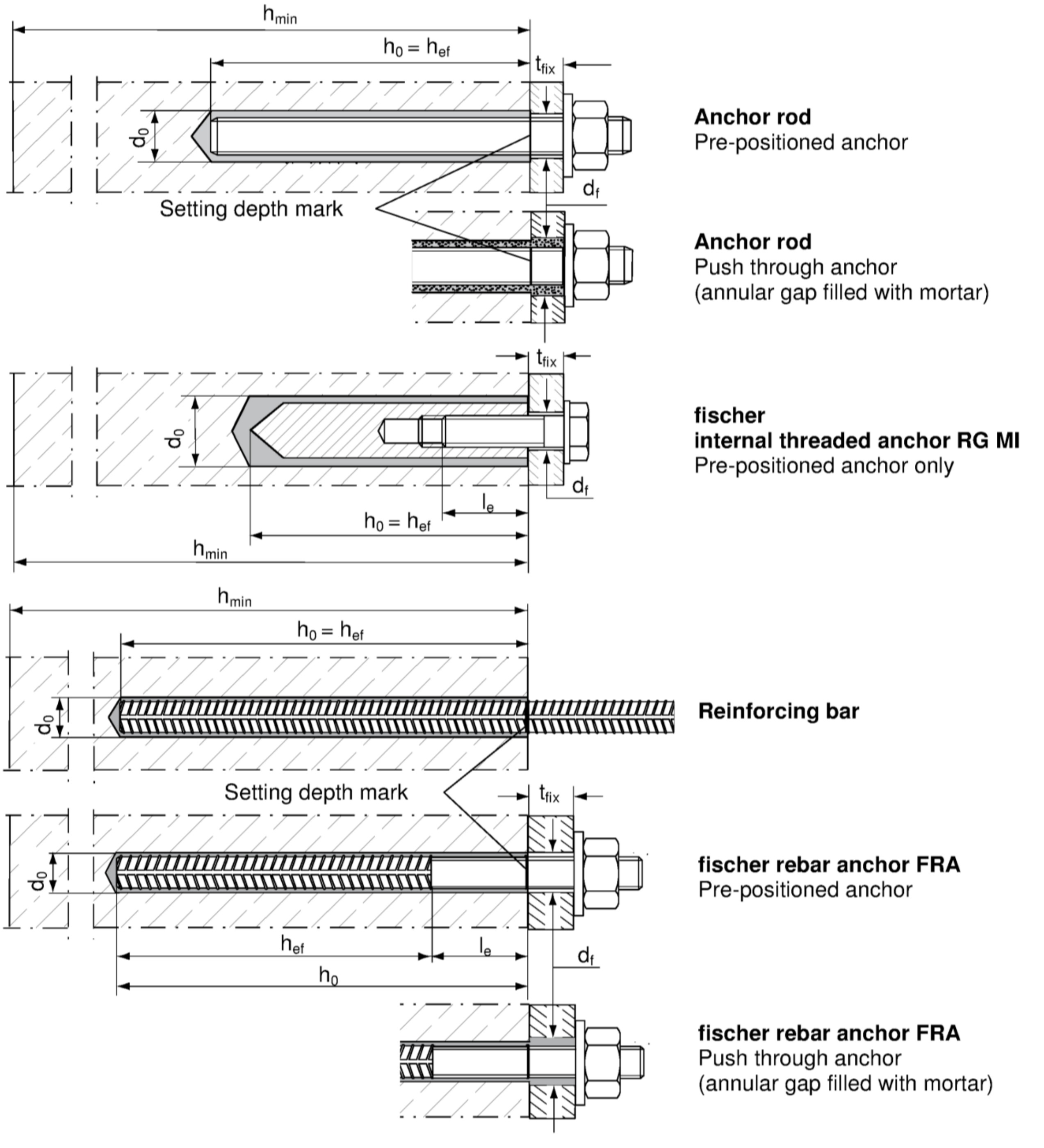
Installation conditions



fischer injection system FIS EM	**Annex A 1**
Product description Installation conditions	

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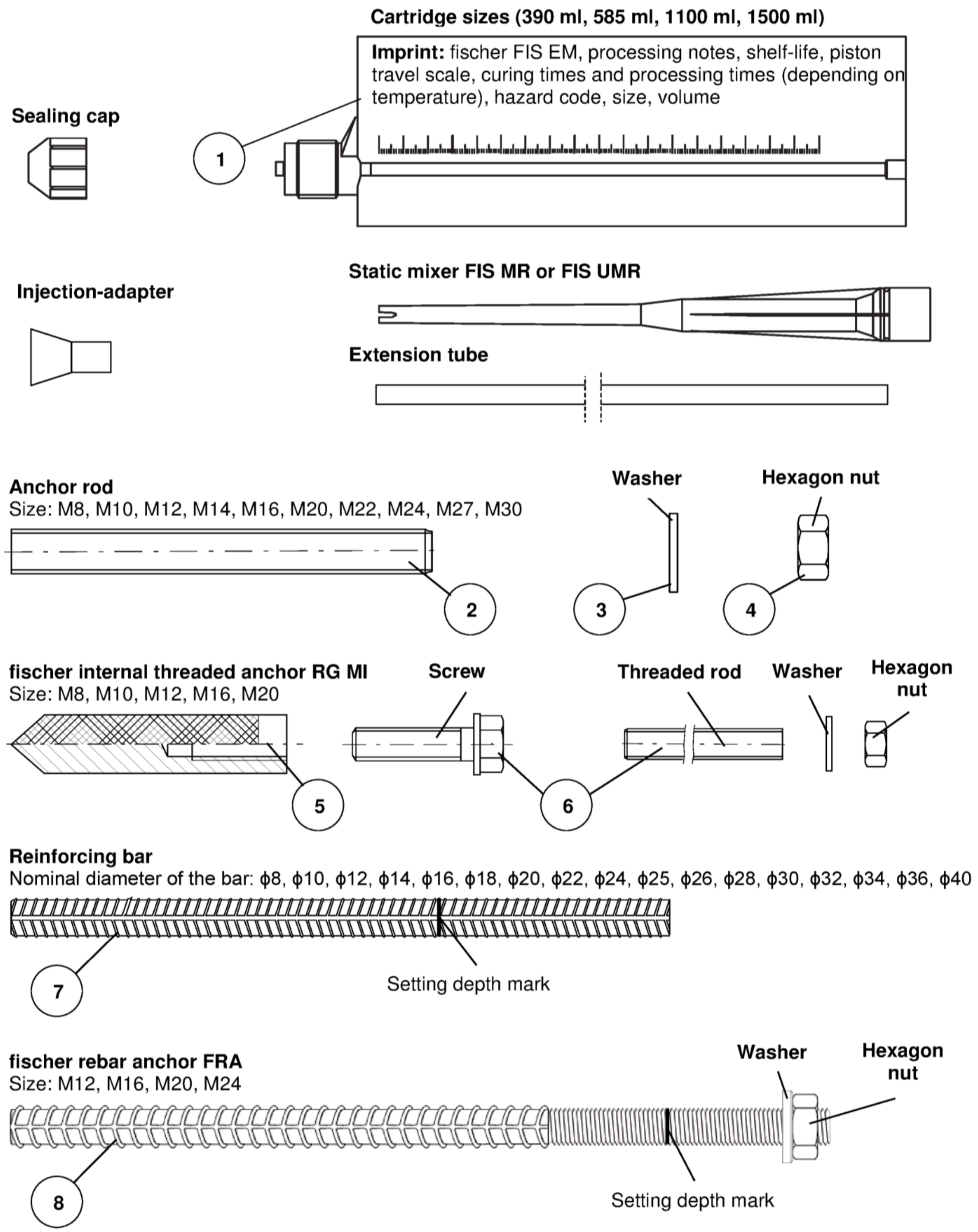

fischer injection system FIS EM	**Annex A 2**
Product description Cartridges / Static mixer / Steel elements	

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Table A1: Materials

Part	Designation	Material		
1	Mortar cartridge	Mortar, hardener, filler		
	Steel grade	Steel, zinc plated	Stainless steel A4	High corrosion resistant steel C
2	Anchor rod	Property class 5.8 or 8.8; EN ISO 898-1:2013 zinc plated ≥ 5 µm, EN ISO 4042:1999 A2K or hot-dip galvanised EN ISO 10684:2004 f_{uk} ≤ 1000 N/mm² A_5 > 12 % fracture elongation[1)]	Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; 1.4062, 1.4662, 1.4462 EN 10088-1:2014 f_{uk} ≤ 1000 N/mm² A_5 > 12 % fracture elongation[1)]	Property class 50 or 80 EN ISO 3506-1:2009 or property class 70 with f_{yk}= 560 N/mm² 1.4565; 1.4529 EN 10088-1:2014 f_{uk} ≤ 1000 N/mm² A_5 > 12 % fracture elongation[1)]
3	Washer ISO 7089:2000	zinc plated ≥ 5 µm, EN ISO 4042:1999 A2K or hot-dip galvanised EN ISO 10684:2004	1.4401; 1.4404; 1.4578;1.4571; 1.4439; 1.4362 EN 10088-1:2014	1.4565;1.4529 EN 10088-1:2014
4	Hexagon nut	Property class 5 or 8; EN ISO 898-2:2012 zinc plated ≥ 5 µm, ISO 4042:1999 A2K or hot-dip galvanised EN ISO 10684:2004	Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088-1:2014	Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4565; 1.4529 EN 10088-1:2014
5	fischer internal threaded anchor RG MI	Property class 5.8 ISO 898-1:2013 zinc plated ≥ 5 µm, ISO 4042:1999 A2K	Property class 70 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088-1:2014	Property class 70 EN ISO 3506-1:2009 1.4565; 1.4529 EN 10088-1:2014
6	Screw or anchor / threaded rod for fischer internal threaded anchor RG MI	Property class 5.8 or 8.8; EN ISO 898-1:2013 zinc plated ≥ 5 µm, ISO 4042:1999 A2K	Property class 70 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362 EN 10088-1:2014	Property class 70 EN ISO 3506-1:2009 1.4565; 1.4529 EN 10088-1:2014
7	Reinforcing bar EN 1992-1-1:2004 and AC:2010, Annex C	Bars and de-coiled rods, class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$		
8	fischer rebar anchor FRA	Rebar part: Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$	Threaded part: Property class 70 or 80 EN ISO 3506-1:2009 1.4565; 1.4529, 1.4401, 1.4404, 1.4571, 1.4578, 1.4439, 1.4362, 1.4062 EN 10088-1:2014	

1) For applications without requirements for seismic performance category C2 the fracture elongation may be in the range of A_5 > 8 % in accordance with TR029 Section 5.2.3.2 (Reductions for seismic performance category C1 must be noted)

fischer injection system FIS EM

Product description
Materials

Annex A 3

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Specifications of intended use (part 1)

Table B1: Overview use and performance categories

<table>
<tr><td colspan="2">Anchorages subject to</td><td colspan="8">FIS EM with …</td></tr>
<tr><td colspan="2"></td><td colspan="2">Anchor rod
</td><td colspan="2">fischer internal threaded anchor RG MI
</td><td colspan="2">Reinforcing bar
</td><td colspan="2">fischer rebar anchor FRA
</td></tr>
<tr><td>Hammer drilling with standard drill bit</td><td></td><td colspan="8">all sizes</td></tr>
<tr><td>Hammer drilling with hollow drill bit (Heller "Duster Expert" or Hilti "TE-CD, TE-YD”)</td><td></td><td colspan="8">Nominal drill bit diameter (d_0) 12 mm to 35 mm</td></tr>
<tr><td>Diamond drilling</td><td></td><td colspan="8">all sizes</td></tr>
<tr><td rowspan="2">Static and quasi static load, in</td><td>uncracked concrete</td><td rowspan="2">all sizes</td><td rowspan="2">Tables: C1, C5, C6, C10</td><td rowspan="2">all sizes</td><td rowspan="2">Tables: C2, C5, C7, C11</td><td rowspan="2">all sizes</td><td rowspan="2">Tables: C3, C5, C8, C12</td><td rowspan="2">all sizes</td><td rowspan="2">Tables: C4, C5, C9, C13</td></tr>
<tr><td>cracked concrete</td></tr>
<tr><td rowspan="2">Seismic performance category (only hammer drilling with Standard / hollow drill bits)</td><td>C1</td><td>M10 to M30</td><td>Tables: C14, C16, C17</td><td colspan="2" rowspan="2">---</td><td>ϕ10 to ϕ32</td><td>Tables: C15, C16, C18</td><td colspan="2" rowspan="2">---</td></tr>
<tr><td>C2</td><td>M12, M16, M20, M24</td><td>Tables: C14, C16, C19</td><td>---</td><td>---</td></tr>
<tr><td rowspan="2">Use category</td><td>dry or wet concrete</td><td colspan="8">all sizes</td></tr>
<tr><td>flooded hole</td><td colspan="8">all sizes</td></tr>
<tr><td colspan="2">Installation temperature</td><td colspan="8">+5 °C to +40 °C</td></tr>
<tr><td rowspan="2">In-service temperature</td><td>Temperature range I</td><td colspan="2">-40 °C to +60 °C</td><td colspan="6">(max. long term temperature +35 °C and max. short term temperature +60 °C)</td></tr>
<tr><td>Temperature range II</td><td colspan="2">-40 °C to +72 °C</td><td colspan="6">(max. long term temperature +50 °C and max. short term temperature +72 °C)</td></tr>
</table>

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Specifications of intended use (part 2)

Base materials:
- Reinforced or unreinforced normal weight concrete according to EN 206:2013
- Strength classes C20/25 to C50/60 according to EN 206:2013

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, to permanently damp internal conditions or in other particular aggressive conditions (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:
- Anchorages have to be designed by a responsible engineer with experience of concrete anchor design
- Verifiable calculation notes and drawings are to be 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 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) have to be 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:
- Anchor installation is to be carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- In case of aborted hole: The hole shall be filled with mortar
- Anchorage depth should be marked and adhered to on installation
- Overhead installation is allowed

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fischer injection system FIS EM	**Annex B 2**
Intended Use Specifications (part 2)	

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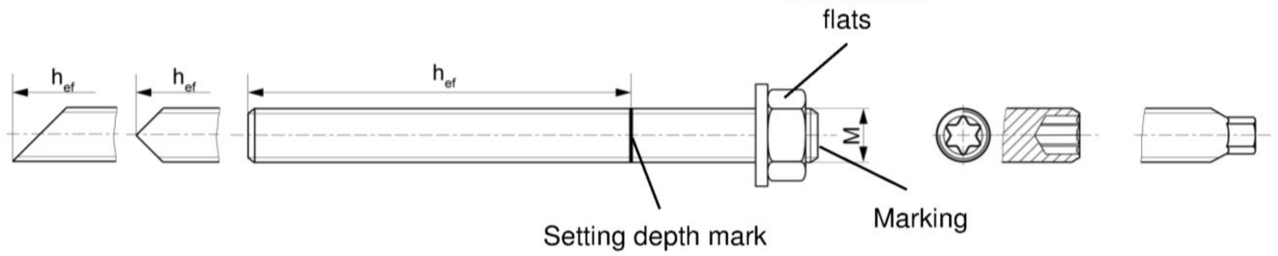
Table B2: Installation parameters for anchor rods

Size			**M8**	**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Width across flats	SW	[mm]	13	17	19	22	24	30	32	36	41	46
Nominal drill bit diameter	d_0	[mm]	12	14	14	16	18	24	25	28	30	35
Drill hole depth	h_0	[mm]	$h_0 = h_{ef}$									
Effective anchorage depth	$h_{ef,min}$	[mm]	60	60	70	75	80	90	93	96	108	120
	$h_{ef,max}$	[mm]	160	200	240	280	320	400	440	480	540	600
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	40	45	55	60	65	85	95	105	120	140
Diameter of clearance hole in the fixture[1)] pre-positioned anchorage	d_f	[mm]	9	12	14	16	18	22	24	26	30	33
Diameter of clearance hole in the fixture[1)] push through anchorage	d_f	[mm]	14	16	16	18	20	26	28	30	33	40
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 30$ (≥ 100)		$h_{ef} + 2d_0$							
Maximum installation torque	$T_{inst,max}$	[Nm]	10	20	40	50	60	120	135	150	200	300

[1)] For larger clearance holes in the fixture see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1

Anchor rod:



Marking (on random place) fischer anchor rod:
Property class 8.8, stainless steel, property class 80 or high corrosion resistant steel, property class 80: •
Stainless steel A4, property class 50 and high corrosion resistant steel, property class 50: ••
Or colour coding according to DIN 976-1

Commercial standard threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled:

- Materials, dimensions and mechanical properties according Annex A 3, Table A1
- Inspection certificate 3.1 according to EN 10204:2004, the documents have to be stored
- Setting depth is marked

fischer injection system FIS EM	**Annex B 3**
Intended Use Installation parameters anchor rods	

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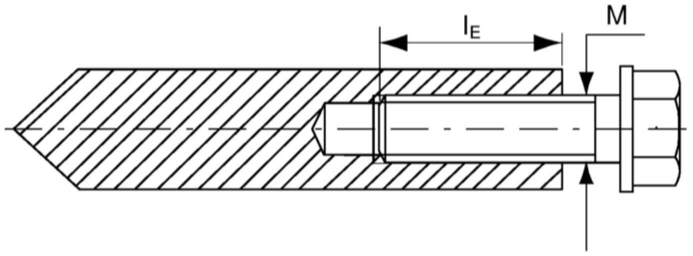
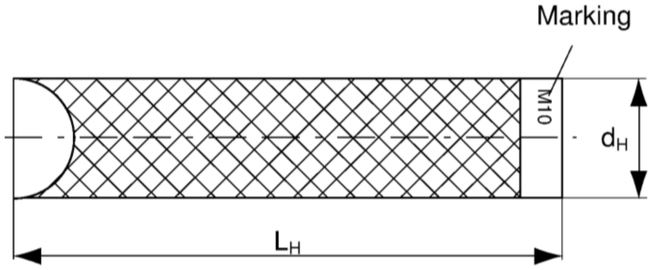
Table B3: Installation parameters for fischer internal threaded anchors RG MI

Size			**M8**	**M10**	**M12**	**M16**	**M20**
Diameter of anchor	d_H	[mm]	12	16	18	22	28
Nominal drill bit diameter	d_0	[mm]	14	18	20	24	32
Drill hole depth	h_0	[mm]	$h_0 = h_{ef}$				
Effective anchorage depth ($h_{ef} = L_H$)	h_{ef}	[mm]	90	90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	55	65	75	95	125
Diameter of clearance hole in the fixture[1)]	d_f	[mm]	9	12	14	18	22
Minimum thickness of concrete member	h_{min}	[mm]	120	125	165	205	260
Maximum screw-in depth	$l_{E,max}$	[mm]	18	23	26	35	45
Minimum screw-in depth	$l_{E,min}$	[mm]	8	10	12	16	20
Maximum installation torque	$T_{inst,max}$	[Nm]	10	20	40	80	120

[1)] For larger clearance holes in the fixture see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1

fischer internal threaded anchor RG MI





Marking: Anchor size
e.g.: **M10**

Stainless steel additional **A4**
e.g.: **M10 A4**

High corrosion resistant steel additional **C**
e.g.: **M10 C**

Retaining bolt or threaded rods (including nut and washer) must comply with the appropriate material and strength class of Annex A 3, Table A1

fischer injection system FIS EM	**Annex B 4**
Intended Use Installation parameters fischer internal threaded anchors RG MI	

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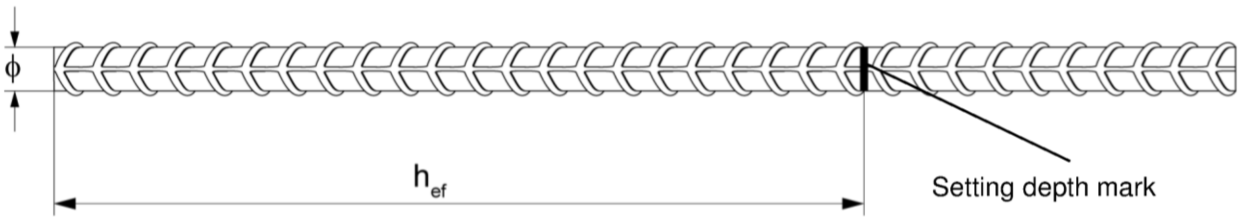
Table B4: Installation parameters for reinforcing bars

Nominal diameter of the bar	**ϕ**		**8[1)]**		**10[1)]**		**12[1)]**		**14**	**16**	**18**	**20**	**22**	**24**
Nominal drill bit diameter	d_0	[mm]	10	12	12	14	14	16	18	20	25	25	30	30
Drill hole depth	h_0		$h_0 = h_{ef}$											
Effective anchorage depth	$h_{ef,min}$		60		60		70		75	80	85	90	94	98
	$h_{ef,max}$		160		200		240		280	320	360	400	440	480
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		40		45		55		60	65	75	85	95	105
Minimum thickness of concrete member	h_{min}		$h_{ef} + 30$ (≥ 100)						$h_{ef} + 2d_0$					

Nominal diameter of the bar	**ϕ**		**25**	**26**	**28**	**30**	**32**	**34**	**36**	**40**	**---**
Nominal drill bit diameter	d_0	[mm]	30	35	35	40	40	40	45	55	---
Drill hole depth	h_0		$h_0 = h_{ef}$								
Effective anchorage depth	$h_{ef,min}$		100	104	112	120	128	136	144	160	---
	$h_{ef,max}$		500	520	560	600	640	680	720	800	---
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		110	120	130	140	160	170	180	200	---
Minimum thickness of concrete member	h_{min}		$h_{ef} + 2d_0$								

1) Both drill bit diameters can be used

Reinforcing bar



- The minimum value of related rib area $f_{R,min}$ must fulfil the requirements of EN 1992-1-1:2004+AC:2010
- The rib height must be within the range: $0{,}05 \cdot \phi \leq h_{rib} \leq 0{,}07 \cdot \phi$
  (ϕ = Nominal diameter of the bar , h_{rib} = rib height)

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fischer injection system FIS EM	**Annex B 5**
Intended Use Installation parameters reinforcing bars	

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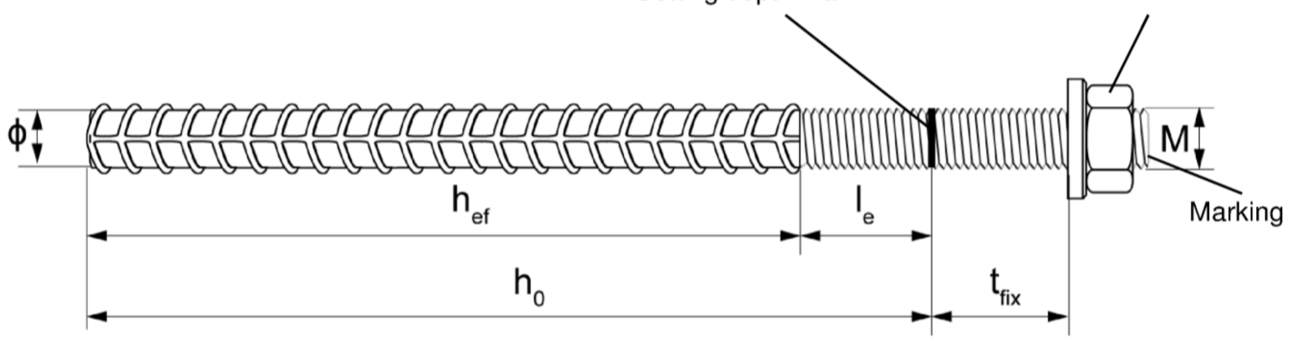
Table B5: Installation parameters for fischer rebar anchor FRA

Size				**M12**[1)]		**M16**	**M20**	**M24**
Nominal diameter of the bar		ϕ	[mm]	12		16	20	25
Width across flats		SW	[mm]	19		24	30	36
Nominal drill bit diameter		d_0	[mm]	14	16	20	25	30
Drill hole depth		h_0	[mm]	$h_{ef} + l_e$				
Effective anchorage depth		$h_{ef,min}$	[mm]	70		80	90	96
		$h_{ef,max}$	[mm]	140		220	300	380
Distance concrete surface to welded join		l_e	[mm]	100				
Minimum spacing and minimum edge distance		$s_{min} = c_{min}$	[mm]	55		65	85	105
Diameter of clearance hole in the fixture[2)]	pre-positioned anchorage	$\leq d_f$	[mm]	14		18	22	26
	push through anchorage	$\leq d_f$	[mm]	18		22	26	32
Minimum thickness of concrete member		h_{min}	[mm]	$h_0 + 30$ (≥ 100)		$h_0 + 2d_0$		
Maximum installation torque		$T_{inst,max}$	[Nm]	40		60	120	150

[1)] Both drill bit diameters can be used
[2)] For larger clearance holes in the fixture see TR 029, 4.2.2.1 or CEN/TS 1992-4-1:2009, 5.2.3.1

fischer rebar anchor FRA



Marking frontal e.g.: FRA (for stainless steel); FRA C (for high corrosion resistant steel)

fischer injection system FIS EM

Intended Use
Installation parameters rebar anchor FRA

Annex B 6

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Table B6: Parameters of steel brush FIS BS Ø

Drill bit diameter	d_0	[mm]	12	14	16	18	20	24	25	28	30	32	35	40	45	55
Steel brush diameter	d_b	[mm]	14	16	20		25	26	27	30	40			42	47	58

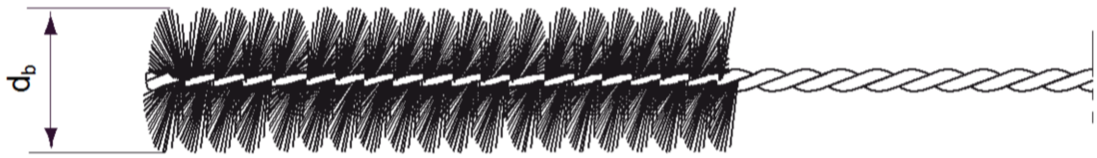

Table B7: Maximum processing time of the mortar and minimum curing time
(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

System temperature [°C]	Maximum processing time t_{work} [minutes]	Minimum curing time[1] t_{cure} [hours]
+5 to +10	120	40
≥ +10 to +20	30	18
≥ +20 to +30	14	10
≥ +30 to +40	7	5

[1] In wet concrete or flooded holes the curing times must be doubled

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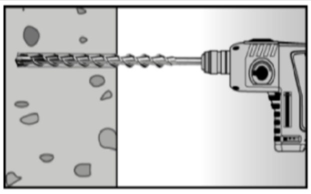
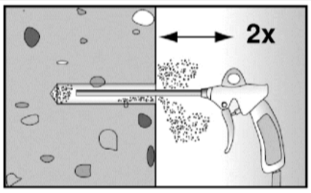
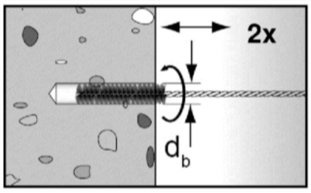
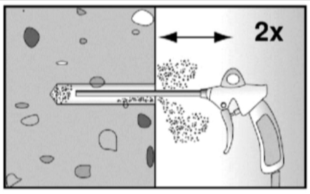
fischer injection system FIS EM

Intended Use
Cleaning tools
Processing times and curing times

Annex B 7

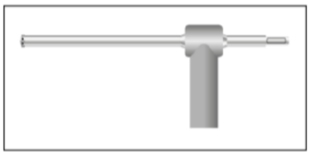
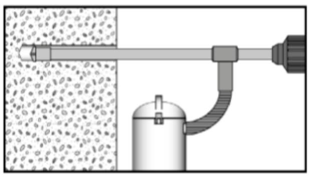
Installation instructions part 1

Drilling and cleaning the hole (hammer drilling with standard drill bit)

1		Drill the hole. Drill hole diameter $\mathbf{d_0}$ and drill hole depth $\mathbf{h_0}$ see **Tables B2, B3, B4, B5**
2		Blow out the drill hole twice, with oil-free compressed air (p ≥ 6 bar) 
3		Brush the drill hole twice. For drill hole diameter ≥ 30 mm use a power drill. For deep holes use an extension. Corresponding brushes see **Table B6**
4		Blow out the drill hole twice, with oil-free compressed air (p ≥ 6 bar) 

Go to step 6

Drilling and cleaning the hole (hammer drilling with hollow drill bit)

1		Check a suitable hollow drill (see **Table B1**) for correct operation of the dust extraction
2		Use a suitable dust extraction system, e.g. Bosch GAS 35 M AFC or a comparable dust extraction system with equivalent performance data Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process. Diameter of drill hole $\mathbf{d_0}$ and drill hole depth $\mathbf{h_0}$ see **Tables B2, B3, B4, B5**

Go to step 6

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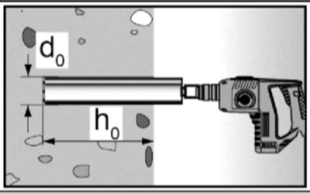
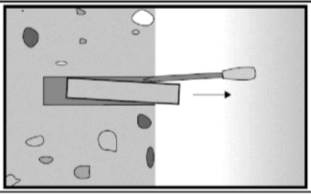
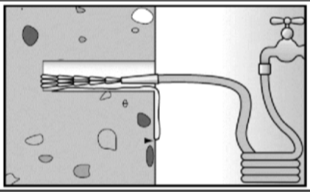
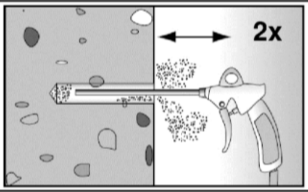
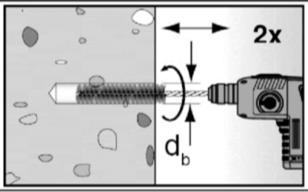
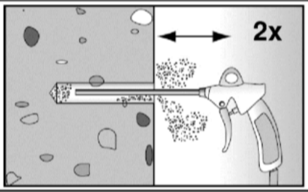
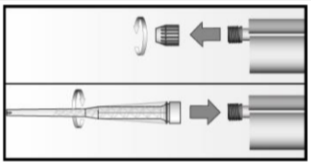
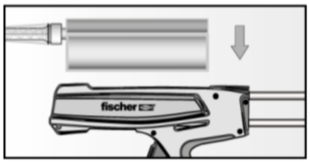
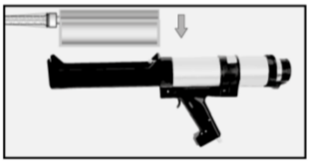
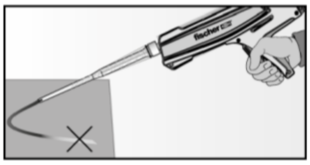
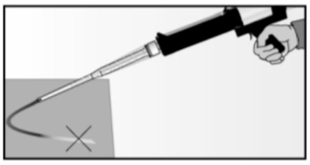
Installation instructions part 2

Drilling and cleaning the hole (wet drilling with diamond drill bit)

1		Drill the hole. Drill hole diameter $\mathbf{d_0}$ and drill hole depth $\mathbf{h_0}$ see **Tables B2, B3, B4, B5**		Break the drill core and draw it out
2		Flush the drill hole with clean water until it flows clear		
3		Blow out the drill hole twice, using oil-free compressed air (p > 6 bar)		
4		Brush the drill hole twice using a power drill. Corresponding brushes see **Table B6**		
5		Blow out the drill hole twice, using oil-free compressed air (p > 6 bar)		

Preparing the cartridge

6		Remove the sealing cap Screw on the static mixer (the spiral in the static mixer must be clearly visible)	
7			Place the cartridge into the dispenser
8			Extrude approximately 10 cm of material out until the resin is evenly grey in colour. Do not use mortar that is not uniformly grey

fischer injection system FIS EM	**Annex B 9**
Intended use Installation instructions part 2	

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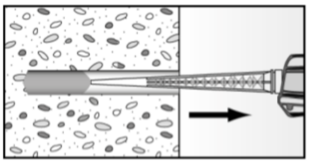
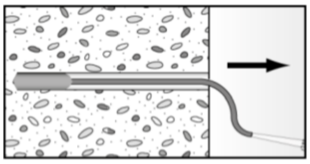
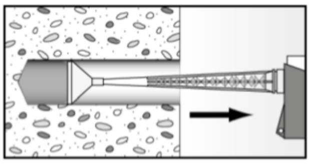
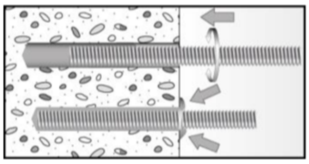
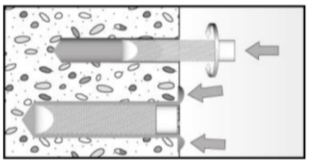
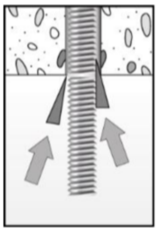
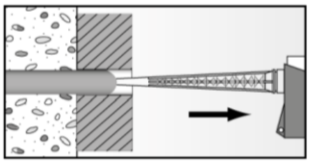
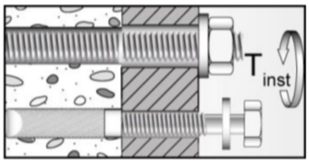
Installation instructions part 3

Injection of the mortar

9	 Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles	 For drill hole depth ≥ 150 mm use an extension tube	 For overhead installation, deep holes h_0 > 250 mm or drill hole diameter d_0 ≥ 40 mm use an injection-adapter

Installation of anchor rods or fischer internal threaded anchors RG MI

10	 	Only use clean and oil-free anchor elements. Mark the setting depth of the anchor. Press the threaded rod or fischer internal threaded RG MI anchor down to the bottom of the hole, turning it slightly while doing so. After inserting the anchor element, excess mortar must be emerged around the anchor element
	 For overhead installations support the anchor rod with wedges. (e.g. fischer centering wedges)	 For push through installation fill the annular gap with mortar

11	 Wait for the specified curing time t_{cure} see **Table B7**	**12**	 Mounting the fixture $T_{inst,max}$ see **Tables B2 and B3**

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Intended use
Installation instructions part 3

Annex B 10

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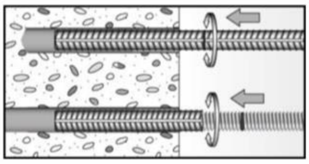
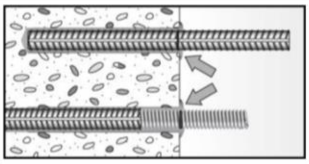
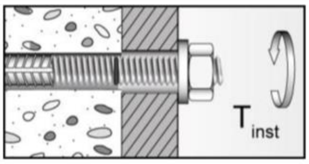
Installation instructions part 4

Installation reinforcing bars and fischer rebar anchor FRA

<table>
<tr><td rowspan="2">**10**</td><td></td><td colspan="3">Only use clean and oil-free reinforcing bars or fischer FRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the fischer FRA into the filled hole up to the setting depth mark</td></tr>
<tr><td></td><td colspan="3">When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole</td></tr>
<tr><td>**11**</td><td> Wait for the specified curing time t_{cure} see **Table B7**</td><td>**12**</td><td>
</td><td>Mounting the fixture $T_{inst,max}$ see **Table B5**</td></tr>
</table>

fischer injection system FIS EM	Annex B 11
Intended use Installation instructions part 4	

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Table C1: Characteristic values for the **steel bearing capacity** under tensile / shear load of **fischer anchor rods** and **standard threaded rods**

Size					M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Bearing capacity under tensile load, steel failure														
Charact.bearing capacity $N_{Rk,s}$	Steel zinc plated	Property class	5.8	[kN]	19	29	43	58	79	123	152	177	230	281
			8.8		29	47	68	92	126	196	243	282	368	449
	Stainless steel A4 and High corrosion resistant steel C		50		19	29	43	58	79	123	152	177	230	281
			70		26	41	59	81	110	172	212	247	322	393
			80		30	47	68	92	126	196	243	282	368	449
Partial safety factors[1]														
Partial safety factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	5.8	[-]	1,50									
			8.8		1,50									
	Stainless steel A4 and High corrosion resistant steel C		50		2,86									
			70		1,50[2] / 1,87									
			80		1,60									
Bearing capacity under shear load, steel failure														
without lever arm														
Charact.bearing capacity $V_{Rk,s}$	Steel zinc plated	Property class	5.8	[kN]	9	15	21	29	39	61	76	89	115	141
			8.8		15	23	34	46	63	98	122	141	184	225
	Stainless steel A4 and High corrosion resistant steel C		50		9	15	21	29	39	61	76	89	115	141
			70		13	20	30	40	55	86	107	124	161	197
			80		15	23	34	46	63	98	122	141	184	225
with lever arm														
Charact. bending moment $M^0_{Rk,s}$	Steel zinc plated	Property class	5.8	[Nm]	19	37	65	104	166	324	447	560	833	1123
			8.8		30	60	105	167	266	519	716	896	1333	1797
	Stainless steel A4 and High corrosion resistant steel C		50		19	37	65	104	166	324	447	560	833	1123
			70		26	52	92	146	232	454	626	784	1167	1573
			80		30	60	105	167	266	519	716	896	1333	1797
Partial safety factors[1]														
Partial safety factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	5.8	[-]	1,25									
			8.8		1,25									
	Stainless steel A4 and High corrosion resistant steel C		50		2,38									
			70		1,25[2] / 1,56									
			80		1,33									

[1] In absence of other national regulations
[2] Only admissible for steel C, with f_{yk} / f_{uk} ≥ 0,8 and A_5 > 12 % (e.g. fischer anchor rods)

fischer injection system FIS EM

Performances
Characteristic steel bearing capacity of fischer anchor rods and standard threaded rods

Annex C 1

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Table C2: Characteristic values for the **steel bearing capacity** under tensile / shear load of **fischer internal threaded anchors RG MI**

Size					M8	M10	M12	M16	M20
Bearing capacity under tensile load, steel failure									
Characteristic bearing capacity with screw	$N_{Rk,s}$	Property class	5.8	[kN]	19	29	43	79	123
			8.8		29	47	68	108	179
		Property class 70	A4		26	41	59	110	172
			C		26	41	59	110	172
Partial safety factors[1]									
Partial safety factor	$\gamma_{Ms,N}$	Property class	5.8	[-]	1,50				
			8.8		1,50				
		Property class 70	A4		1,87				
			C		1,87				
Bearing capacity under shear load, steel failure									
without lever arm									
Characteristic bearing capacity with screw	$V_{Rk,s}$	Property class	5.8	[kN]	9,2	14,5	21,1	39,2	62,0
			8.8		14,6	23,2	33,7	54,0	90,0
		Property class 70	A4		12,8	20,3	29,5	54,8	86,0
			C		12,8	20,3	29,5	54,8	86,0
with lever arm									
Characteristic bending moment with screw	$M^0_{Rk,s}$	Property class	5.8	[Nm]	20	39	68	173	337
			8.8		30	60	105	266	519
		Property class 70	A4		26	52	92	232	454
			C		26	52	92	232	454
Partial safety factors[1]									
Partial safety factor	$\gamma_{Ms,V}$	Property class	5.8	[-]	1,25				
			8.8		1,25				1,25 / 1,50[2]
		Property class 70	A4		1,56				
			C		1,56				

[1] In absence of other national regulations
[2] Only for steel failure without lever arm

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Table C3: Characteristic values for the **steel bearing capacity** under tensile / shear load of **reinforcing bars**

Nominal diameter of the bar		**ϕ**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**25**	**26**	**28**	**30**	**32**	**34**	**36**	**40**
Bearing capacity under tensile load, steel failure																			
Characteristic bearing capacity	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ [1)]																
Bearing capacity under shear load, steel failure																			
without lever arm																			
Characteristic bearing capacity	$V_{Rk,s}$	[kN]	$0{,}5 \cdot A_s \cdot f_{uk}$ [1)]																
Ductility factor acc. to CEN/TS 1992-4-5:2009 Section 6.3.2.1	k_2	[-]	0,8																
with lever arm																			
Characteristic bending moment	$M^0_{Rk,s}$	[Nm]	$1{,}2 \cdot W_{el} \cdot f_{uk}$ [1)]																

1) f_{uk} or f_{yk} respectively must be taken from the specifications of the reinforcing bar

Table C4: Characteristic values for the **steel bearing capacity** under tensile / shear load of **fischer rebar anchors FRA**

Size			**M12**	**M16**	**M20**	**M24**
Bearing capacity under tensile load, steel failure						
Characteristic bearing capacity	$N_{Rk,s}$	[kN]	63	111	173	270
Partial safety factors[1)]						
Partial safety factor	$\gamma_{Ms,N}$	[-]	1,4			
Bearing capacity under shear load, steel failure						
without lever arm						
Characteristic bearing capacity	$V_{Rk,s}$	[kN]	30	55	86	124
with lever arm						
Characteristic bearing capacity	$M^0_{Rk,s}$	[Nm]	92	233	454	785
Partial safety factors[1)]						
Partial safety factor	$\gamma_{Ms,V}$	[-]	1,56			

1) In absence of other national regulations

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Table C5: General design factors for the bearing capacity under tensile / shear load; **uncracked or cracked concrete**

Size				**All Sizes**
Bearing capacity under tensile load				
Factors acc. to CEN/TS 1992-4:2009 Section 6.2.2.3				
Uncracked concrete		k_{ucr}	[-]	10,1
Cracked concrete		k_{cr}	[-]	7,2
Factors for the compressive strength of concrete > C20/25				
Increasing factor for τ_{Rk}	C25/30	Ψ_c	[-]	1,02
	C30/37			1,04
	C35/45			1,06
	C40/50			1,07
	C45/55			1,08
	C50/60			1,09
Splitting failure				
Edge distance	$h / h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	$1,0\ h_{ef}$
	$2,0 > h / h_{ef} > 1,3$			$4,6\ h_{ef} - 1,8\ h$
	$h / h_{ef} \leq 1,3$			$2,26\ h_{ef}$
Spacing		$s_{cr,sp}$	[mm]	$2\ c_{cr,sp}$
Bearing capacity under shear load				
Installation safety factors				
All installation conditions		$\gamma_2 = \gamma_{inst}$	[-]	1,0
Concrete pry-out failure				
Factor k acc. to TR029 Section 5.2.3.3 resp. k_3 acc. to CEN/TS 1992-4-5:2009 Section 6.3.3		$k_{(3)}$	[-]	2,0
Concrete edge failure				
The value of h_{ef} (= l_f) under shear load			[mm]	min (h_{ef}; 8d)
Calculation diameters				

Size			M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
fischer anchor rods and standard threaded rods	d	[mm]	8	10	12	14	16	20	22	24	27	30
fischer internal threaded anchors RG MI	d	[mm]	12	16	18	-	22	28	-	-	-	-
fischer rebar anchors FRA	d	[mm]	-	-	12	-	16	20	-	25	-	-

Nominal diameter of the bar	ϕ		8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
Reinforcing bar	d	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40

fischer injection system FIS EM

Performances
General design factors relating to the characteristic bearing capacity under tensile / shear load

Annex C 4

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Table C6: Characteristic values of **resistance** for **fischer anchor rods** and **standard threaded rods** in hammer or diamond drilled holes; **uncracked or cracked concrete**

Size			**M8**	**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Combined pullout and concrete cone failure												
Calculation diameter	d	[mm]	8	10	12	14	16	20	22	24	27	30
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)												
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm^2]	16	16	15	14	14	13	13	13	12	12
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm^2]	15	14	14	13	13	12	12	12	11	11
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)												
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm^2]	16	16	15	13	13	11	11	10	10	9
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm^2]	15	14	14	13	12	11	10	10	9	9
Diamond-drilling (dry and wet concrete as well as flooded hole)												
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm^2]	16	15	13	12	12	10	10	10	9	9
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm^2]	15	14	12	11	11	10	9	9	8	8
Installation safety factors												
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0						1,2			
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4									
Cracked concrete												
Characteristic bond resistance in cracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry and wet concrete)												
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm^2]	7	7	7	7	6	6	7	7	7	7
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm^2]	7	7	7	7	6	6	7	7	7	7
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)												
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm^2]	6	7,5	7,5	7	6	6	6	6	6	6
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm^2]	6	7	7	7	6	6	6	6	6	6
Installation safety factors												
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0						1,2			
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,2					1,4				

[1] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

fischer injection system FIS EM

Performances
Characteristic values for static or quasi-static action under tensile load for fischer anchor rods and standard threaded rods (uncracked or cracked concrete)

Annex C 5

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Table C7: Characteristic values of **resistance** for **fischer internal threaded anchors RG MI** in hammer or diamond drilled holes; **uncracked or cracked concrete**

Size			**M8**	**M10**	**M12**	**M16**	**M20**
Combined pullout and concrete cone failure							
Calculation diameter	d	[mm]	12	16	18	22	28
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)							
Temperature range[1)] I	$\tau_{Rk,ucr}$	[N/mm²]	15	14	14	13	12
Temperature range[1)] II	$\tau_{Rk,ucr}$	[N/mm²]	14	13	13	12	11
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)							
Temperature range[1)] I	$\tau_{Rk,ucr}$	[N/mm²]	14	12	12	11	10
Temperature range[1)] II	$\tau_{Rk,ucr}$	[N/mm²]	13	12	11	10	9
Diamond-drilling (dry and wet concrete as well as flooded hole)							
Temperature range[1)] I	$\tau_{Rk,ucr}$	[N/mm²]	13	12	11	10	9
Temperature range[1)] II	$\tau_{Rk,ucr}$	[N/mm²]	12	11	10	9	8
Installation safety factors							
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0			1,2	
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4				
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry and wet concrete)							
Temperature range[1)] I	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	7	7
Temperature range[1)] II	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	7	7
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)							
Temperature range[1)] I	$\tau_{Rk,cr}$	[N/mm²]	7	6,5	6	6	6
Temperature range[1)] II	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	6	6
Installation safety factors							
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0			1,2	
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,2			1,4	

[1)] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

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Table C8: Characteristic values of **resistance** for **reinforcing bars** in hammer or diamond drilled holes; **uncracked or cracked concrete**

Nominal diameter of the bar		**ϕ**	**8**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**25**	**26**	**28**	**30**	**32**	**34**	**36**	**40**
Combined pullout and concrete cone failure																			
Calculation diameter	d	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
Uncracked concrete																			
Characteristic bond resistance in uncracked concrete C20/25																			
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)																			
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	16	16	15	14	14	14	13	13	13	13	13	12	12	12	12	12	11
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	15	14	14	13	13	13	12	12	12	12	11	11	11	11	11	11	10
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)																			
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	16	16	14	13	12	12	11	11	10	10	10	10	9	9	9	8	8
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	15	14	13	12	12	11	11	10	10	9	9	9	9	8	8	8	8
Diamond-drilling (dry and wet concrete as well as flooded hole)																			
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	16	15	13	12	12	11	10	10	10	9	9	9	9	8	8	8	7
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	15	14	12	11	11	10	10	9	9	9	8	8	8	8	7	7	7
Installation safety factors																			
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0							1,2									
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4																
Cracked concrete																			
Characteristic bond resistance in cracked concrete C20/25																			
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry and wet concrete)																			
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm²]	7	7	7	7	6	6	6	7	7	7	7	7	7	5	5	5	5
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm²]	7	7	7	7	6	6	6	7	7	7	7	7	7	5	5	5	5
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)																			
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm²]	6	7,5	6,5	6,5	6,5	6	6	6	6	6	6	6	6	5	5	5	5
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm²]	6	6,5	6,5	6	6	6	6	6	6	6	6	6	6	5	5	5	5
Installation safety factors																			
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0							1,2									
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,2						1,4										

[1] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

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Performances
Characteristic values for static or quasi-static action under tensile load for reinforcing bars (uncracked or cracked concrete)

Annex C 7

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Table C9: Characteristic values of **resistance** for **fischer rebar anchors FRA** in hammer or diamond drilled holes; **uncracked or cracked concrete**

Size			**M12**	**M16**	**M20**	**M24**
Combined pullout and concrete cone failure						
Calculation diameter	d	[mm]	12	16	20	25
Uncracked concrete						
Characteristic bond resistance in uncracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)						
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	15	14	13	13
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	14	13	12	12
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)						
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	14	12	11	10
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	13	12	11	9
Diamond-drilling (dry and wet concrete as well as flooded hole)						
Temperature range[1] I	$\tau_{Rk,ucr}$	[N/mm²]	13	12	10	9
Temperature range[1] II	$\tau_{Rk,ucr}$	[N/mm²]	12	11	10	9
Installation safety factors						
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0			1,2
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4			
Cracked concrete						
Characteristic bond resistance in cracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry and wet concrete)						
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	7
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	7
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)						
Temperature range[1] I	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	6
Temperature range[1] II	$\tau_{Rk,cr}$	[N/mm²]	7	6	6	6
Installation safety factors						
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0			1,2
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,2		1,4	

[1] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

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Table C10: Displacements for anchor rods

Size		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Displacement-Factors for tensile load[1)]											
Uncracked or cracked concrete; Temperature range I, II											
$\delta_{N0\text{-Factor}}$	$[mm/(N/mm^2)]$	0,07	0,08	0,09	0,09	0,10	0,11	0,11	0,12	0,12	0,13
$\delta_{N\infty\text{-Factor}}$	$[mm/(N/mm^2)]$	0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,19
Displacement-Factors for shear load[2)]											
Uncracked or cracked concrete; Temperature range I, II											
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V\infty\text{-Factor}}$	[mm/kN]	0,27	0,22	0,18	0,16	0,14	0,11	0,10	0,09	0,08	0,07

[1)] Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Ed}$

$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Ed}$

(τ_{Ed}: Design value of the applied tensile stress)

[2)] Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Ed}$

$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Ed}$

(V_{Ed}: Design value of the applied shear force)

Table C11: Displacements for fischer internal threaded anchors RG MI

Size		M8	M10	M12	M16	M20
Displacement-Factors for tensile load[1)]						
Uncracked or cracked concrete; Temperature range I, II						
$\delta_{N0\text{-Factor}}$	$[mm/(N/mm^2)]$	0,09	0,10	0,10	0,11	0,13
$\delta_{N\infty\text{-Factor}}$	$[mm/(N/mm^2)]$	0,13	0,15	0,16	0,17	0,19
Displacement-Factors for shear load[2)]						
Uncracked or cracked concrete; Temperature range I, II						
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,12	0,09	0,08	0,07	0,05
$\delta_{V\infty\text{-Factor}}$	[mm/kN]	0,18	0,14	0,12	0,10	0,08

[1)] Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Ed}$

$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Ed}$

(τ_{Ed}: Design value of the applied tensile stress)

[2)] Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Ed}$

$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Ed}$

(V_{Ed}: Design value of the applied shear force)

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Performances
Displacements for anchor rods and fischer internal threaded anchors RG MI

Annex C 9

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Table C12: Displacements for **reinforcing bars**

Nominal diameter of the bar	ϕ	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
Displacement-Factors for tensile load[1]																		
Uncracked or cracked concrete; Temperature range I, II																		
$\delta_{N0\text{-Factor}}$	[mm/(N/mm²)]	0,07	0,08	0,09	0,09	0,10	0,10	0,11	0,11	0,12	0,12	0,12	0,13	0,13	0,13	0,14	0,14	0,15
$\delta_{N\infty\text{-Factor}}$		0,11	0,12	0,13	0,14	0,15	0,16	0,16	0,17	0,18	0,18	0,18	0,19	0,19	0,20	0,20	0,21	0,22
Displacement-Factors for shear load[2]																		
Uncracked or cracked concrete; Temperature range I, II																		
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,08	0,07	0,07	0,06	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,04
$\delta_{V\infty\text{-Factor}}$		0,27	0,22	0,18	0,16	0,14	0,12	0,11	0,10	0,09	0,09	0,08	0,08	0,07	0,07	0,06	0,06	0,05

[1] Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Ed}$

$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Ed}$

(τ_{Ed}: Design value of the applied tensile stress)

[2] Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Ed}$

$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Ed}$

(V_{Ed}: Design value of the applied shear force)

Table C13: Displacements for **fischer rebar anchors FRA**

Size		M12	M16	M20	M24
Displacement-Factors for tensile load[1]					
Uncracked or cracked concrete; Temperature range I, II					
$\delta_{N0\text{-Factor}}$	[mm/(N/mm²)]	0,09	0,10	0,11	0,12
$\delta_{N\infty\text{-Factor}}$		0,13	0,15	0,16	0,18
Displacement-Factors for shear load[2]					
Uncracked or cracked concrete; Temperature range I, II					
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,12	0,09	0,07	0,06
$\delta_{V\infty\text{-Factor}}$		0,18	0,14	0,11	0,09

[1] Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Ed}$

$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Ed}$

(τ_{Ed}: Design value of the applied tensile stress)

[2] Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Ed}$

$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Ed}$

(V_{Ed}: Design value of the applied shear force)

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Performances
Displacements for reinforcing bars and fischer rebar anchors FRA

Annex C 10

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Table C14: Characteristic values for the **steel bearing capacity** under tensile / shear load of **fischer anchor rods** and **standard threaded rods** under seismic action performance category **C1 or C2**

Size					**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Bearing capacity under tensile load, steel failure[1)]													
fischer anchor rods and standard threaded rods, performance category C1													
Charact.bearing capacity $N_{Rk,s,C1}$	Steel zinc plated	Property class	5.8	[kN]	29	43	58	79	123	152	177	230	281
			8.8		47	68	92	126	196	243	282	368	449
	Stainless steel A4 and High corrosion resistant steel C		50		29	43	58	79	123	152	177	230	281
			70		41	59	81	110	172	212	247	322	393
			80		47	68	92	126	196	243	282	368	449
fischer anchor rods and standard threaded rods, performance category C2													
Charact.bearing capacity $N_{Rk,s,C2}$	Steel zinc plated	Property class	5.8	[kN]	---	39	---	72	108	---	177	---	---
			8.8		---	61	---	116	173	---	282	---	---
	Stainless steel A4 and High corrosion resistant steel C		50		---	39	---	72	108	---	177	---	---
			70		---	53	---	101	152	---	247	---	---
			80		---	61	---	116	173	---	282	---	---
Bearing capacity under shear load, steel failure without lever arm[1)]													
fischer anchor rods, performance category C1													
Charact.bearing capacity $V_{Rk,s,C1}$	Steel zinc plated	Property class	5.8	[kN]	15	21	29	39	61	76	89	115	141
			8.8		23	34	46	63	98	122	141	184	225
	Stainless steel A4 and High corrosion resistant steel C		50		15	21	29	39	61	76	89	115	141
			70		20	30	40	55	86	107	124	161	197
			80		23	34	46	63	98	122	141	184	225
Standard threaded rods, performance category C1													
Charact.bearing capacity $V_{Rk,s,C1}$	Steel zinc plated	Property class	5.8	[kN]	11	15	20	27	43	53	62	81	99
			8.8		16	24	32	44	69	85	99	129	158
	Stainless steel A4 and High corrosion resistant steel C		50		11	15	20	27	43	53	62	81	99
			70		14	21	28	39	60	75	87	113	138
			80		16	24	32	44	69	85	99	129	158
fischer anchor rods and standard threaded rods, performance category C2													
Charact.bearing capacity $V_{Rk,s,C2}$	Steel zinc plated	Property class	5.8	[kN]	---	14	---	27	43	---	62	---	---
			8.8		---	22	---	44	69	---	99	---	---
	Stainless steel A4 and High corrosion resistant steel C		50		---	14	---	27	43	---	62	---	---
			70		---	20	---	39	60	---	87	---	---
			80		---	22	---	44	69	---	99	---	---

1) Partial safety factors for performance category C1 or C2 see Table C16, for fischer anchor rods FIS A / RGM the factor for steel ductility is 1,0

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Performances
Characteristic steel bearing capacity of fischer anchor rods and standard threaded rods under seismic action (performance category C1 or C2)

Annex C 11

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Table C15: Characteristic values for the **steel bearing capacity** under tensile / shear load of **reinforcing bars (B500B)** under seismic action performance category **C1**

Nominal diameter of the bar		**ϕ**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**25**	**26**	**28**	**30**	**32**
Bearing capacity under tensile load, steel failure[1]															
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1															
Characteristic bearing capacity	$N_{Rk,s,C1}$	[kN]	44	63	85	111	140	173	209	249	270	292	339	389	443
Bearing capacity under shear load, steel failure without lever arm[1]															
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1															
Characteristic bearing capacity	$V_{Rk,s,C1}$	[kN]	15	22	30	39	49	61	74	88	95	102	119	137	155

[1] Partial safety factors for performance category C1 see Table C16

Table C16: Partial safety factors of **fischer anchor rods, standard threaded rods** and **reinforcing bars (B500B)**
under seismic action performance category **C1 or C2**

Size		**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**				
Nominal diameter of the bar	**ϕ**	**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**25**	**26**	**28**	**30**	**32**

Bearing capacity under tensile load, steel failure[1]					
Partial safety factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	5.8	[-]	1,50
			8.8		1,50
	Stainless steel A4 and High corrosion resistant steel C		50		2,86
			70		1,50[2] / 1,87
			80		1,60
	Reinforcing bar		B500B		1,40
Bearing capacity under shear load, steel failure[1]					
Partial safety factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	5.8	[-]	1,25
			8.8		1,25
	Stainless steel A4 and High corrosion resistant steel C		50		2,38
			70		1,25[2] / 1,56
			80		1,33
	Reinforcing bar		B500B		1,50

[1] In absence of other national regulations
[2] Only admissible for steel C, with $f_{yk} / f_{uk} \geq 0,8$ and $A_5 > 12$ % (e.g. fischer anchor rods)

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Table C17: Characteristic values of **resistance** for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C1**

Size				**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Characteristic bond resistance, combined pullout and concrete cone failure												
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)												
Temperature range[1)]	I	$\tau_{Rk,C1}$	[N/mm²]	7,0	7,0	6,7	6,5	5,7	6,7	6,7	6,7	6,7
Temperature range[1)]	II	$\tau_{Rk,C1}$	[N/mm²]	7,0	7,0	6,7	5,7	5,7	6,7	6,7	6,7	6,7
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)												
Temperature range[1)]	I	$\tau_{Rk,C1}$	[N/mm²]	7,5	7,5	6,5	5,7	5,7	6,7	5,7	5,7	5,7
Temperature range[1)]	II	$\tau_{Rk,C1}$	[N/mm²]	6,8	6,8	6,5	5,7	5,7	5,7	5,7	5,7	5,7
Installation safety factors												
Bearing capacity under tensile load												
Dry and wet concrete		$\gamma_2 = \gamma_{inst}$	[-]	1,0					1,2			
Flooded hole		$\gamma_2 = \gamma_{inst}$	[-]	1,2				1,4				
Bearing capacity under shear load												
All installation conditions		$\gamma_2 = \gamma_{inst}$	[-]	1,0								

[1)] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

Table C18: Characteristic values of **resistance** for **reinforcing bars** in hammer drilled holes under seismic action performance category **C1**

Nominal diameter of the bar	**ϕ**			**10**	**12**	**14**	**16**	**18**	**20**	**22**	**24**	**25**	**26**	**28**	**30**	**32**
Characteristic bond resistance, combined pullout and concrete cone failure																
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)																
Temperature range[1)]	I	$\tau_{Rk,C1}$	[N/mm²]	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8
Temperature range[1)]	II	$\tau_{Rk,C1}$	[N/mm²]	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)																
Temperature range[1)]	I	$\tau_{Rk,C1}$	[N/mm²]	7,5	7,0	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7
Temperature range[1)]	II	$\tau_{Rk,C1}$	[N/mm²]	6,8	6,8	5,8	5,8	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8
Installation safety factors																
Bearing capacity under tensile load																
Dry and wet concrete		$\gamma_2 = \gamma_{inst}$	[-]	1,0							1,2					
Flooded hole		$\gamma_2 = \gamma_{inst}$	[-]	1,2					1,4							
Bearing capacity under shear load																
All installation conditions		$\gamma_2 = \gamma_{inst}$	[-]	1,0												

[1)] I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

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Performances
Characteristic values under seismic action (performance category C1) for fischer anchor rods, standard threaded rods and reinforcing bars

Annex C 13

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Table C19: Characteristic values of **resistance** for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C2**

Size				**M12**	**M16**	**M20**	**M24**
Characteristic bond resistance, combined pullout and concrete cone failure							
Hammer-drilling with standard drill bit or hollow drill bit (dry and wet concrete)							
Temperature range[1)]	I	$\tau_{Rk,C2}$	[N/mm²]	2,2	3,5	1,8	2,4
	II			2,2	3,5	1,8	2,4
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)							
Temperature range[1)]	I	$\tau_{Rk,C2}$	[N/mm²]	2,3	3,5	1,8	2,1
	II			2,3	3,5	1,8	2,1
Installation safety factors							
Bearing capacity under tensile load							
Dry and wet concrete		$\gamma_2 = \gamma_{inst}$	[-]	1,0			1,2
Flooded hole				1,2		1,4	
Bearing capacity under shear load							
All installation conditions		$\gamma_2 = \gamma_{inst}$	[-]	1,0			
Displacement-Factors for tensile load[2)]							
$\delta_{N,(DLS)\text{-Factor}}$			[mm/(N/mm²)]	0,09	0,10	0,11	0,12
$\delta_{N,(ULS)\text{-Factor}}$				0,15	0,17	0,17	0,18
Displacement-Factors for shear load[3)]							
$\delta_{V,(DLS)\text{-Factor}}$			[mm/kN]	0,18	0,10	0,07	0,06
$\delta_{V,(ULS)\text{-Factor}}$				0,25	0,14	0,11	0,09

1) I: 35 °C / 60 °C; II: 50 °C / 72 °C; see Annex B 1

2) Calculation of effective displacement:

$\delta_{N,(DLS)} = \delta_{N,(DLS)\text{-Factor}} \cdot \tau_{Ed}$

$\delta_{N,(ULS)} = \delta_{N,(ULS)\text{-Factor}} \cdot \tau_{Ed}$

(τ_{Ed}: Design value of the applied tensile stress)

3) Calculation of effective displacement:

$\delta_{V,(DLS)} = \delta_{V,(DLS)\text{-Factor}} \cdot V_{Ed}$

$\delta_{V,(ULS)} = \delta_{V,(ULS)\text{-Factor}} \cdot V_{Ed}$

(V_{Ed}: Design value of the applied shear force)

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Performances
Characteristic values under seismic action (performance category C2) for fischer anchor rods and standard threaded rods

Annex C 14

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