

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments



European Technical Assessment

ETA-17/0979
of 6 December 2018

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 Plus

Product family to which the construction product belongs

Bonded fastener for use in concrete

Manufacturer

fischerwerke GmbH & Co. KG
Otto-Hahn-Straße 15
79211 Denzlingen
DEUTSCHLAND

Manufacturing plant

fischerwerke

This European Technical Assessment contains

37 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

EAD 330499-01-0601

This version replaces

ETA-17/0979 issued on 6 April 2018

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Specific Part

1 Technical description of the product

The "fischer injection system FIS EM Plus" is a bonded fastener consisting of a cartridge with injection mortar fischer FIS EM Plus and a steel element according to Annex A5.

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, displacements	See Annex C 1 to C 10
Characteristic values for seismic performance categories C1 and C2, displacements	See Annex C 11 to C 14

3.2 Hygiene, health and the environment (BWR 3)

Essential characteristic	Performance
Content, emission and/or release of dangerous substances	No performance assessed

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

In accordance with EAD 330499-01-0601 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

English translation prepared by DIBt

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 6 December 2018 by Deutsches Institut für Bautechnik

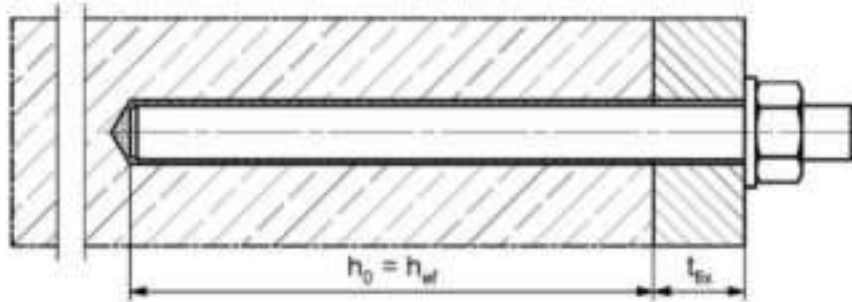
BD Dipl.-Ing. Andreas Kummerow
Head of Department

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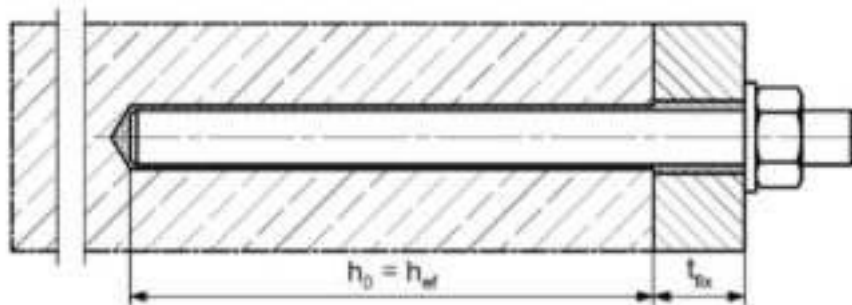
Installation conditions part 1

fischer anchor rod

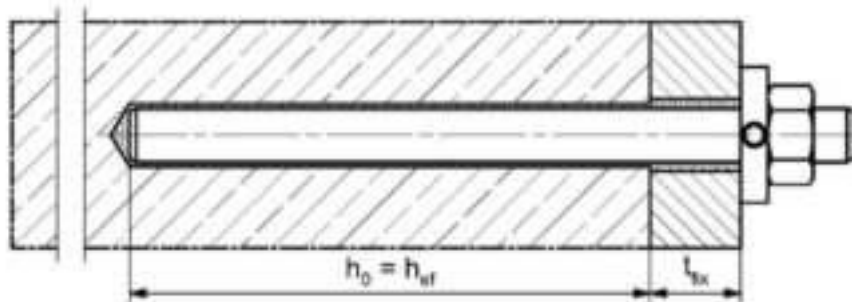
Pre positioned installation



Push through installation (annular gap filled with mortar)



Pre-positioned or push through installation with subsequently pressed filling disk (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{eff} = effective embedment depth

t_{fix} = thickness of fixture

fischer injection system FIS EM Plus

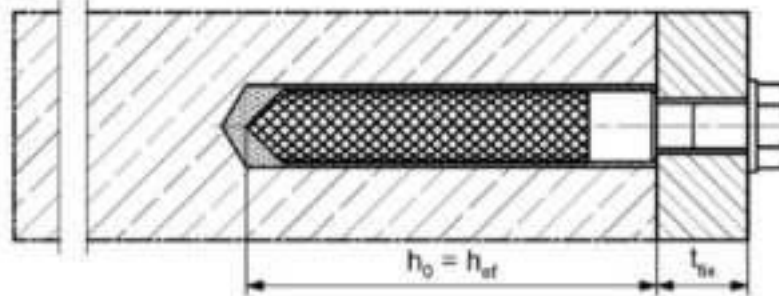
Product description
Installation conditions part 1

Annex A 1

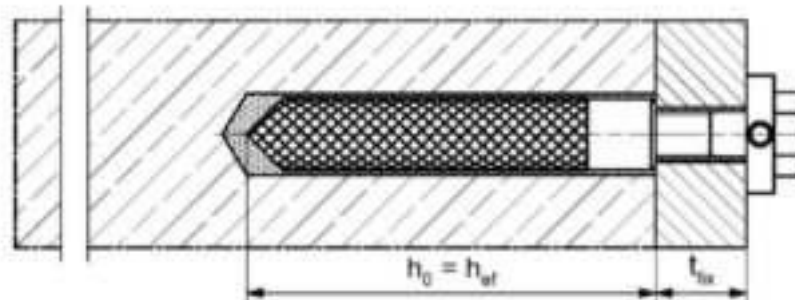
Installation conditions part 2

fischer internal threaded anchor RG MI

Pre positioned installation



Pre-positioned installation with subsequently pressed filling disk (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

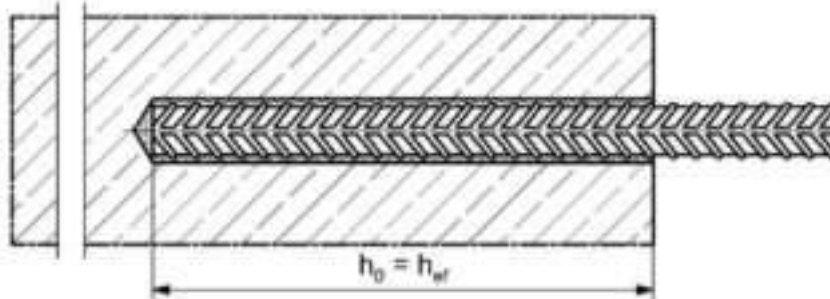
fischer injection system FIS EM Plus

Product description
Installation conditions part 2

Annex A 2

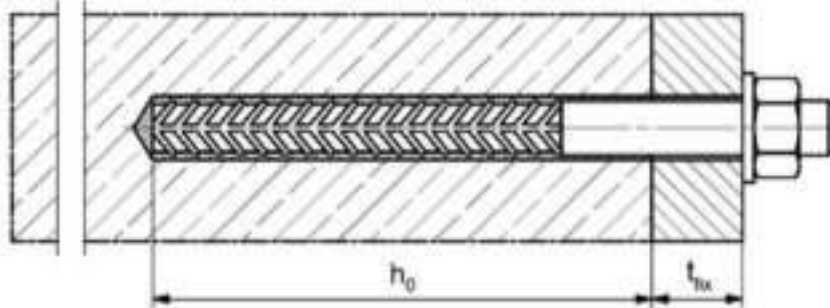
Installation conditions part 3

Reinforcing bar

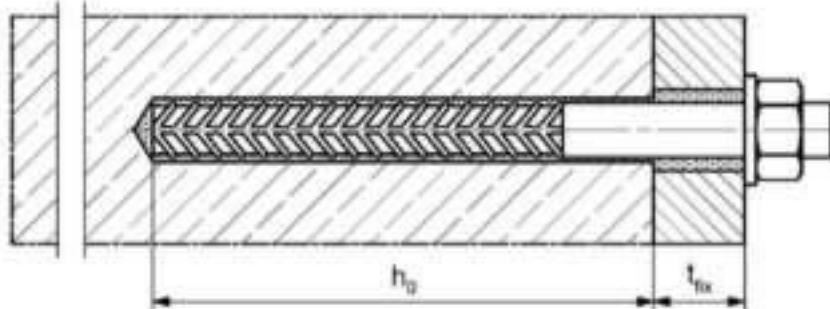


fischer rebar anchor FRA

Pre positioned installation



Push through installation (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

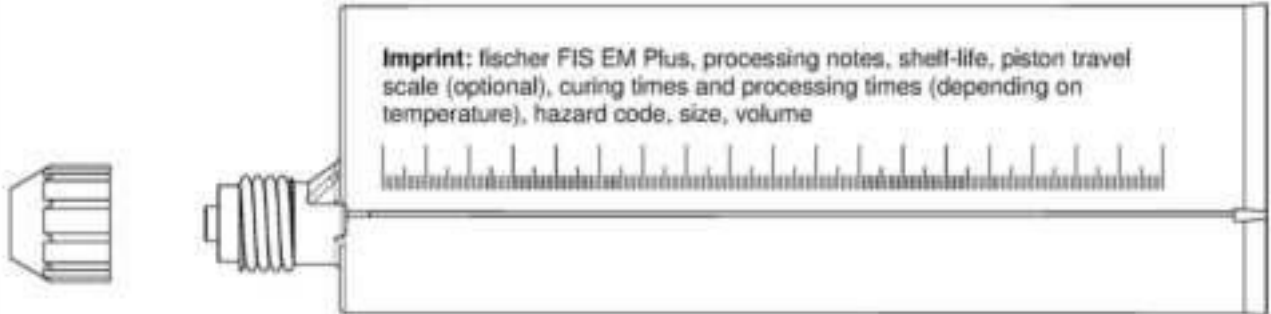
fischer injection system FIS EM Plus

Product description
Installation conditions part 3

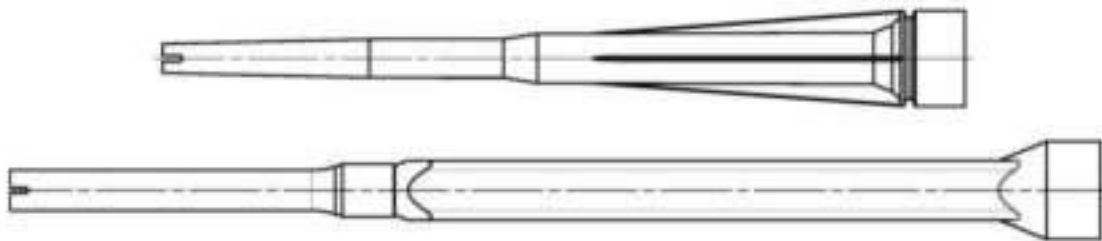
Annex A 3

Overview system components part 1

Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1100 ml, 1500 ml



Static mixer FIS MR Plus or UMR



Injection adapter and Extension tube for static mixer



Cleaning brush BS / BSB



Blow-out pump ABP



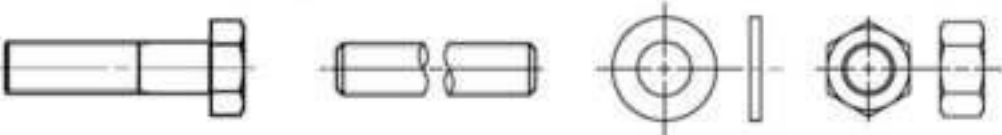
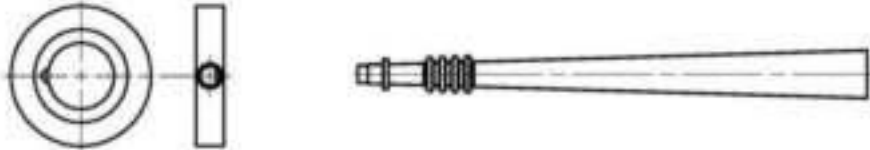




Figures not to scale

fischer injection system FIS EM Plus

System description
Overview system components part 1;
cartridges / static mixer / accessories








Annex A 4

Overview system components part 2	
fischer anchor rod Size: M8, M10, M12, M14, M16, M20, M22, M24, M27, M30	
	
fischer internal threaded anchor RG MI Size: M8, M10, M12, M16, M20	
	
Screw / threaded rod / washer / hexagon nut	
	
fischer filling disk FFD with injection adapter	
	
Reinforcing bar Nominal diameter: $\phi 8$, $\phi 10$, $\phi 12$, $\phi 14$, $\phi 16$, $\phi 18$, $\phi 20$, $\phi 22$, $\phi 24$, $\phi 25$, $\phi 26$, $\phi 28$, $\phi 30$, $\phi 32$, $\phi 34$, $\phi 36$, $\phi 40$	
	
fischer rebar anchor FRA Size: M12, M16, M20, M24	
	
Figures not to scale	
fischer injection system FIS EM Plus	Annex A 5
System description Overview system components part 2; steel components	

English translation prepared by DIBt

Part	Designation	Material		
1	Injection 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 $\geq 5 \mu\text{m}$, EN ISO 4042:1999 A2K or hot-dip galvanized $\geq 40 \mu\text{m}$ EN ISO 10684:2004 $f_{tk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation	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 $f_{tk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation	Property class 50 or 80 EN ISO 3506-1:2009 or property class 70 with $f_{yk} = 560 \text{ N/mm}^2$ 1.4565; 1.4529; EN 10088-1:2014 $f_{tk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation
Fracture elongation $A_5 > 8 \%$, for applications without requirements for seismic performance category C2				
3	Washer ISO 7089:2000	zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:1999 A2K or hot-dip galvanized $\geq 40 \mu\text{m}$ 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 $\geq 5 \mu\text{m}$, ISO 4042:1999 A2K or hot-dip galvanized $\geq 40 \mu\text{m}$ 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 $\geq 5 \mu\text{m}$, 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	Commercial standard 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 $\geq 5 \mu\text{m}$, ISO 4042:1999 A2K $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2009 1.4565; 1.4529; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation
7	fischer filling disk FFD similar to DIN 6319-G	zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:1999 A2K or hot-dip galvanized $\geq 40 \mu\text{m}$ 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
8	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 $f_{tk} = f_{tk} = k \cdot f_{yk}$		
9	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 $f_{tk} = f_{tk} = k \cdot f_{yk}$	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	
fischer injection system FIS EM Plus				Annex A 6
Product description Materials				

English translation prepared by DIBt

Specifications of intended use (part 1)									
Table B1.1: Overview use and performance categories									
Anchorages subject to		FIS EM Plus with ...							
		Anchor rod 	fischer internal threaded anchor RG MI 	Reinforcing bar 	fischer rebar anchor FRA 				
Hammer drilling with standard drill bit 		all sizes							
Hammer drilling with hollow drill bit (fischer "FHD", Heiler "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD") 		Nominal drill bit diameter (d_0) 12 mm to 35 mm							
Diamond drilling 		all sizes							
Static and quasi static load, in	uncracked concrete	all sizes	Tables: C1.1 C4.1	all sizes	Tables: C2.1 C4.1 C6.1 C9.2	all sizes	Tables: C3.1 C4.1 C7.1 C10.1	all sizes	Tables: C3.2 C4.1 C8.1 C10.2
	cracked concrete		C5.1 C9.1						
Seismic performance category (only hammer drilling with standard / hollow drill bits)	C1	M10 to M30	Tables: C11.1 C12.2 C13.1			$\phi 10$ to $\phi 32$	Tables: C12.1 C12.2 C13.2		
	C2	M12 M16 M20 M24	Tables: C11.1 C12.2 C14.1			-	-		
Use category	11 dry or wet concrete	all sizes							
	12 water filled hole	all sizes							
Installation direction		D3 (downward and horizontal and upwards (e.g. overhead) installation)							
Installation temperature		$T_{i,min} = -5\text{ °C}$ to $T_{i,max} = +40\text{ °C}$							
In-service temperature	Temperature range I	-40 °C to +60 °C		(max. short term temperature +60 °C ; max. long term temperature +35 °C)					
	Temperature range II	-40 °C to +72 °C		(max. short term temperature +72 °C ; max. long term temperature +50 °C)					
fischer injection system FIS EM Plus									
Intended use Specifications (part 1)								Annex B 1	

Specifications of intended use (part 2)

Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres of strength classes C20/25 to C50/60 according to EN 206-1:2013

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 seismic loading are designed in accordance with: EN 1992-4:2018 and EOTA Technical Report TR 055. Anchorages shall be positioned outside of critical regions (e.g. plastic hinges) of the concrete structure. Fastening in stand-off installation or with a grout layer under seismic action are not covered in this European Technical Assessment (ETA).

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

fischer injection system FIS EM Plus

Intended use
Specifications (part 2)

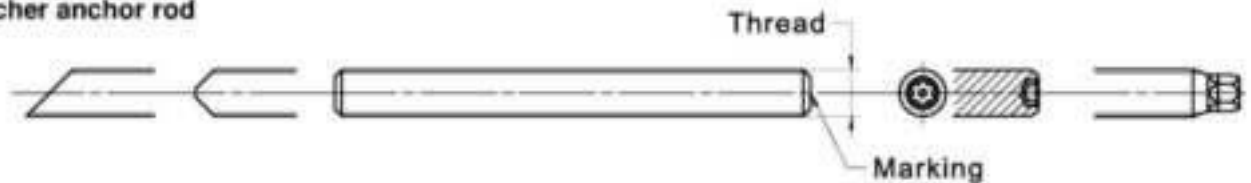
Annex B 2

English translation prepared by DIBt

Table B3.1: Installation parameters for anchor rods

Anchor rods		Thread	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 hole diameter	d_0		10	12	14	16	18	24	25	28	30	35	
Drill hole depth	h_0		$h_0 = h_{ef}$										
Effective embedment depth	$h_{ef, min}$		60	60	70	75	80	90	93	96	108	120	
	$h_{ef, max}$		160	200	240	280	320	400	440	480	540	600	
Diameter of the clearance hole of the fixture	pre positioned installation d_i		9	12	14	16	18	22	24	26	30	33	
	push through installation d_i		12	14	16	18	20	26	28	30	33	40	
Minimum thickness of concrete member	h_{min}		$h_{ef} + 30$ (≥ 100)			$h_{ef} + 2d_0$							
Maximum torque moment for attachment of the fixture	max T_{fix}		[Nm]	10	20	40	50	60	120	135	150	200	300

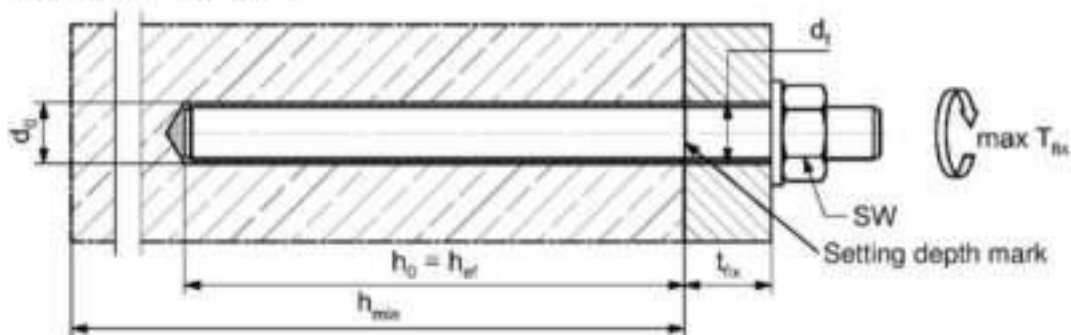
fischer anchor rod



Marking (on random place) fischer anchor rod:

Property class 8.8, stainless steel, property class 80 and high corrosion resistant steel, property class 80: •
Stainless steel A4, property class 50 and high corrosion resistant steel, property class 50: ••
Alternatively: Colour coding according to DIN 976-1

Installation conditions:



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

- Materials, dimensions and mechanical properties according to Annex A 6, Table A6.1
- Inspection certificate 3.1 according to EN 10204:2004, the documents have to be stored
- Setting depth is marked

Figures not to scale

fischer injection system FIS EM Plus

Intended use
Installation parameters anchor rods

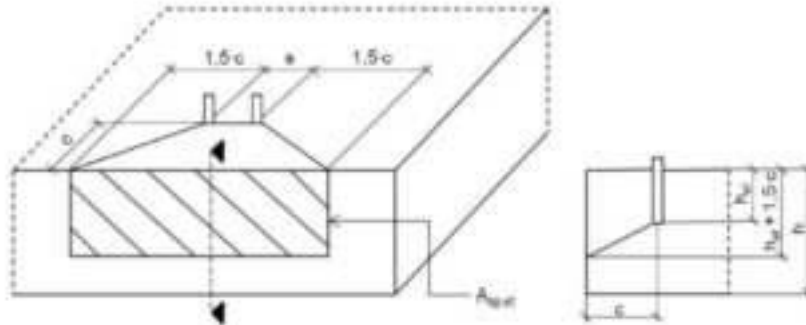
Annex B 3

English translation prepared by DIBt

Table B4.1: Minimum spacing and minimum edge distance for anchor rods and reinforcing bars												
Anchor rods			M8	M10	M12	M14	M16	-	M20	M22	M24	
Reinforcing bars (nominal diameter)		ϕ	8	10	12	14	16	18	20	22	24	
Minimum edge distance												
Uncracked / cracked concrete		C_{min}	40	45	45	45	50	55	55	55	60	
Minimum spacing		S_{min}	according to Annex B5									
Minimum spacing												
Uncracked / cracked concrete		S_{min}	40	45	55	60	65	85	85	95	105	
Minimum edge distance		C_{min}	according to Annex B5									
Required projecting area												
Uncracked concrete		$A_{sp,req}$	[1000	8	13	22	23	24	38,5	38,5	39,5	40
Cracked concrete			mm ²]	6,5	10	16,5	17,5	18,5	29,5	29,5	30	30,5
Anchor rods												
Anchor rods			-	-	M27	-	M30	-	-	-	-	
Reinforcing bars (nominal diameter)		ϕ	25	26	-	28	30	32	34	36	40	
Minimum edge distance												
Uncracked / cracked concrete		C_{min}	75	75	75	80	80	120	120	135	175	
Minimum spacing		S_{min}	according to Annex B5									
Minimum spacing												
Uncracked / cracked concrete		S_{min}	120	120	120	140	140	160	160	160	160	
Minimum edge distance		C_{min}	according to Annex B5									
Required projecting area												
Uncracked concrete		$A_{sp,req}$	[1000	47,5	47,5	47,5	64	64	64	64	64	64
Cracked concrete			mm ²]	36,5	36,5	36,5	49	49	49	49	49	49
<p>Splitting failure for minimum edge distance and spacing in dependence of the effective embedment depth h_{ef}.</p> <p>For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:</p> $A_{sp,req} < A_{sp,l}$ <p>$A_{sp,req}$ = required projecting area $A_{sp,l} = A_{sp,ef}$ = effective projecting area (according to Annex B5)</p>												
fischer injection system FIS EM Plus										Annex B 4		
Intended use Minimum spacing and edge distance for anchor rods and reinforcing bars												

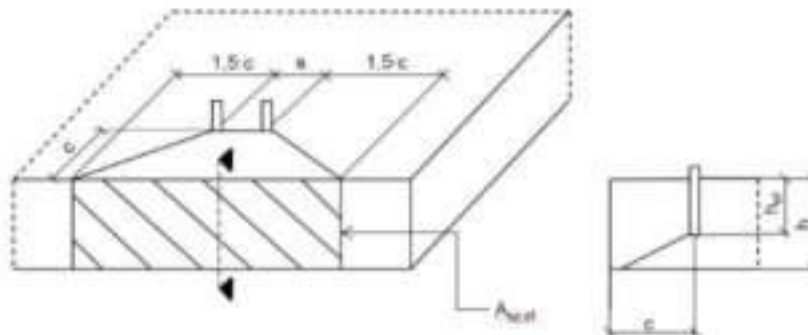
English translation prepared by DIBt

Table B5.1: Effective projecting area $A_{sp,1}$ with concrete member thickness $h > h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single anchor	$A_{sp,1} = (3 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	with $c \geq c_{min}$
Group of anchors with $s > 3 \cdot c$	$A_{sp,1} = (6 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,1} = (3 \cdot c + s) \cdot (h_{ef} + 1,5 \cdot c)$	[mm ²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B5.2: Effective projecting area $A_{sp,1}$ with concrete member thickness $h \leq h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$



Single anchor	$A_{sp,1} = 3 \cdot c \cdot \text{existing } h$	[mm ²]	with $c \geq c_{min}$
Group of anchors with $s > 3 \cdot c$	$A_{sp,1} = 6 \cdot c \cdot \text{existing } h$	[mm ²]	
Group of anchors with $s \leq 3 \cdot c$	$A_{sp,1} = (3 \cdot c + s) \cdot \text{existing } h$	[mm ²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Edge distance and axial spacing shall be rounded to at least 5 mm

Figures not to scale

fischer injection system FIS EM Plus

Intended use

Minimum thickness of concrete member for anchor rods,
minimum spacing and edge distance

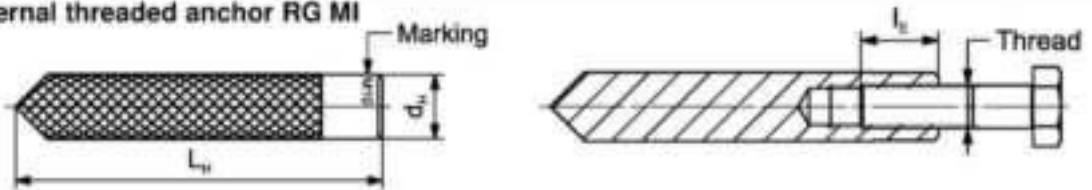
Annex B 5

English translation prepared by DIBt

Table B6.1: Installation parameters plus minimum spacing and minimum edge distance for fischer internal threaded anchors RG MI

Internal threaded anchors RG MI	Thread	M8	M10	M12	M16	M20
Diameter of anchor $d_{nom} = d_{st}$	[mm]	12	16	18	22	28
Nominal drill hole diameter d_0		14	18	20	24	32
Drill hole depth h_0		$h_0 = h_{ef} = L_H$				
Effective embedment depth ($h_{ef} = L_H$)		90	90	125	160	200
Minimum spacing and minimum edge distance $S_{min} = C_{min}$		55	65	75	95	125
Diameter of clearance hole in the fixture d_f		9	12	14	18	22
Minimum thickness of concrete member h_{min}		120	125	165	205	260
Maximum screw-in depth $l_{E,max}$		18	23	26	35	45
Minimum screw-in depth $l_{E,min}$		8	10	12	16	20
Maximum torque moment for attachment of the fixture $max T_{fix}$ [Nm]			10	20	40	80

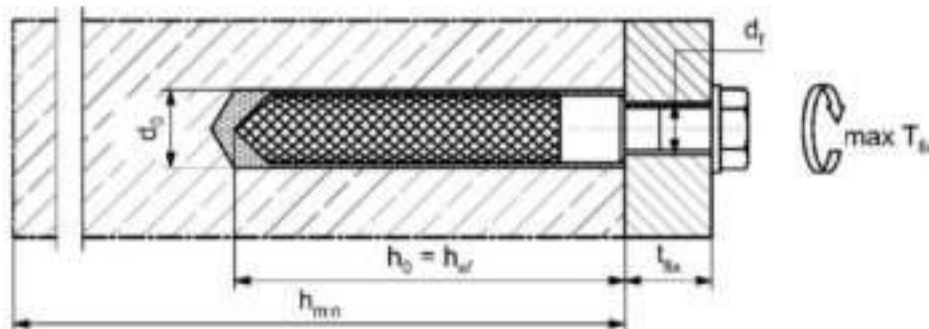
fischer internal threaded anchor RG MI



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 6, Table A6.1

Installation conditions:




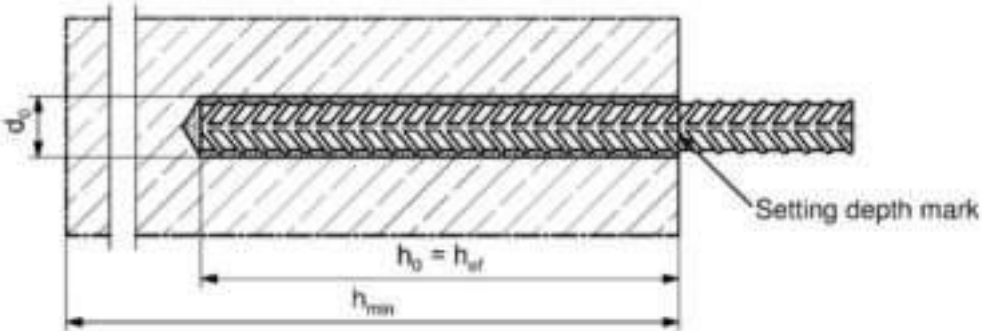
Figures not to scale

fischer injection system FIS EM Plus

Intended use
Installation parameters internal threaded anchors RG MI

Annex B 6

English translation prepared by DIBt

Table B7.1: Installation parameters for reinforcing bars															
Nominal diameter of the bar		ϕ	8¹⁾		10¹⁾		12¹⁾		14	16	18	20	22	24	
Nominal drill hole 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 embedment 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 thickness of concrete member	h_{min}		$h_{ef} + 30$ (≥ 100)				$h_{ef} + 2d_0$								
Nominal diameter of the bar															
Nominal diameter of the bar		ϕ	25		26		28		30	32	34	36	40	-	
Nominal drill hole diameter	d_0	[mm]	30	35	35	40	40	40	45	55	-				
Drill hole depth	h_0		$h_0 = h_{ef}$												
Effective embedment depth	$h_{ef,min}$		100	104	112	120	128	136	144	160	-				
	$h_{ef,max}$		500	520	560	600	640	680	720	800	-				
Minimum thickness of concrete member	h_{min}		$h_{ef} + 2d_0$												
<p>¹⁾ Both drill hole diameters can be used</p>															
<p>Reinforcing bar</p>  <ul style="list-style-type: none"> 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: $0,05 \cdot \phi \leq h_{rb} \leq 0,07 \cdot \phi$ (ϕ = Nominal diameter of the bar , h_{rb} = rib height) 															
<p>Installation conditions:</p>  <p style="text-align: right;">Figures not to scale</p>															
fischer injection system FIS EM Plus										Annex B 7					
<p>Intended use Installation parameters reinforcing bars</p>															

English translation prepared by DIBt

Table B8.1: Installation parameters plus minimum spacing and minimum edge distance for fischer rebar anchor FRA

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

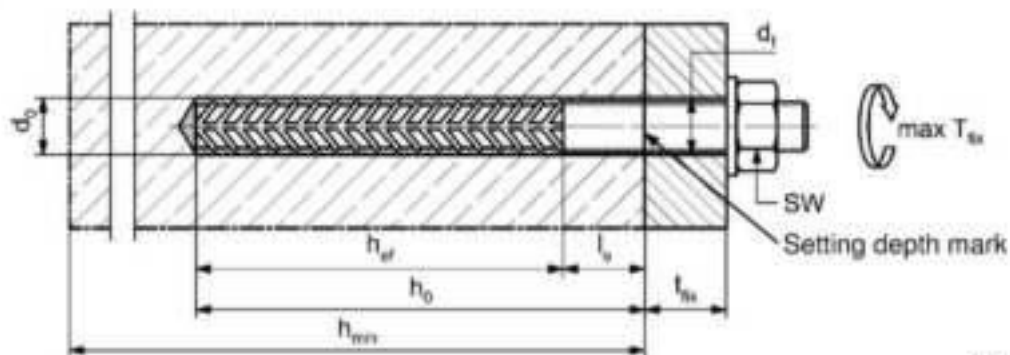
¹⁾ Both drill hole diameters can be used

fischer rebar anchor FRA



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

Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use
Installation parameters rebar anchor FRA

Annex B 8

English translation prepared by DIBt

Table B9.1: Parameters of the cleaning brush BS (steel brush)

The size of the cleaning brush refers to the drill hole diameter

Nominal drill hole diameter	d_0	[mm]	10	12	14	16	18	20	24	25	28	30	32	35	40	45	55
Steel brush diameter	d_b		11	14	16	20	25	26	27	30	40	42	47	58			



Table B9.2 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)

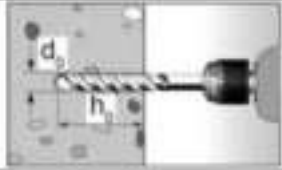
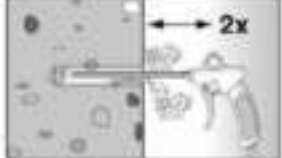

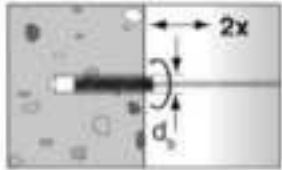
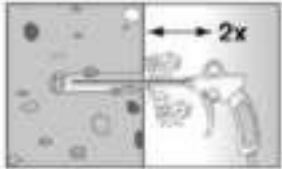


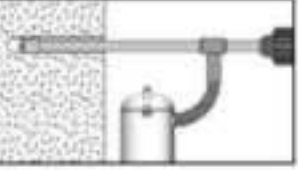
Temperature at anchoring base [°C]	Maximum processing time t_{work}	Minimum curing time t_{cure}
-5 to -1	240 min	200 h
±0 to +4	150 min	90 h
+5 to +9	120 min	40 h
+10 to +19	30 min	18 h
+20 to +29	14 min	10 h
+30 to +40	7 min	5 h

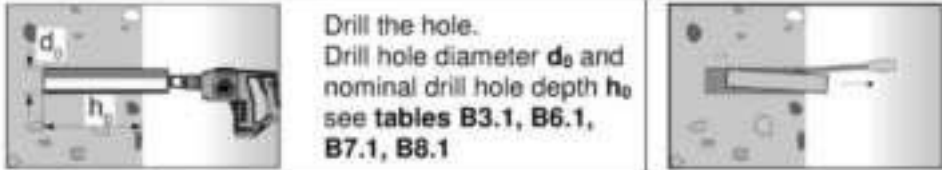

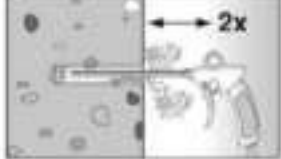
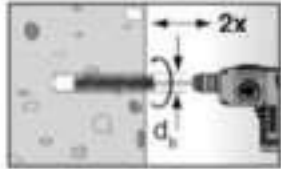
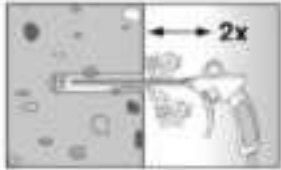
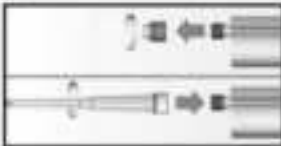


¹⁾ In wet concrete or water filled holes the curing times must be doubled

fischer injection system FIS EM Plus

Intended use
Cleaning brush (steel brush)
Processing time and curing time

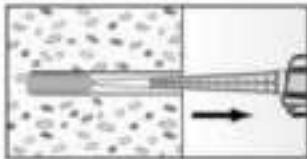
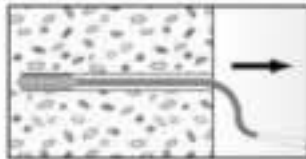
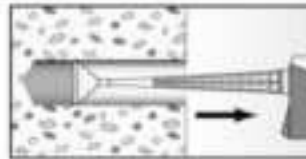
Annex B 9

Installation instructions part 1	
Drilling and cleaning the hole (hammer drilling with standard drill bit)	
1	 <p>Drill the hole. Nominal drill hole diameter d_0 and drill hole depth h_0 see tables B3.1, B6.1, B7.1, B8.1</p>
2	 <p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air ($p \geq 6$ bar)</p> 
3	 <p>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 B9.1</p>
4	 <p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air ($p \geq 6$ bar)</p> 
Go to step 6	
Drilling and cleaning the hole (hammer drilling with hollow drill bit)	
1	 <p>Check a suitable hollow drill (see table B1.1) for correct operation of the dust extraction</p>
2	 <p>Use a suitable dust extraction system, e. g. Bosch GAS 35 M AFC or a comparable dust extraction system with equivalent performance data</p> <p>Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Nominal drill hole diameter d_0 and drill hole depth h_0 see tables B3.1, B6.1, B7.1, B8.1</p>
Go to step 6	
fischer injection system FIS EM Plus	
Intended use Installation instructions part 1	
Annex B 10	

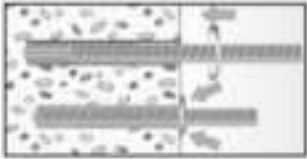


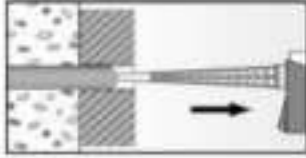



Installation instructions part 2		
Drilling and cleaning the hole (wet drilling with diamond drill bit)		
1		Drill the hole. Drill hole diameter d_0 and nominal drill hole depth h_0 see tables B3.1 , B6.1 , B7.1 , B8.1
2		Flush the drill hole with clean water until it flows clear
3		Blow out the drill hole twice, using oil-free compressed air ($p > 6$ bar)
4		Brush the drill hole twice using a power drill. Corresponding brushes see table B9.1
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 Plus		Annex B 11
Intended use Installation instructions part 2		

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 ($d_0 \geq 40$ mm) use an injection-adapter

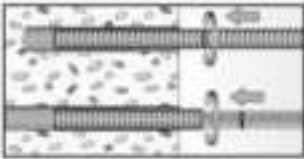
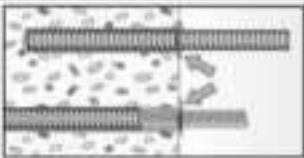

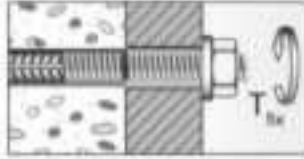
Installation of anchor rods or fischer internal threaded anchors RG MI

10			Only use clean and oil-free anchor elements. Mark the setting depth of the anchor. Push the anchor 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)	
11		Wait for the specified curing time t_{cure} see table B9.2	12
			
			Mounting the fixture max T_{fix} see tables B3.1 and B6.1
Option		After the minimum curing time is reached, the gap between anchor and fixture (annular clearance) may be filled with mortar via the fischer filling disc FFD. Compressive strength ≥ 50 N/mm ² (e.g. fischer injection mortars FIS HB, FIS SB, FIS V, FIS EM Plus) ATTENTION: Using fischer filling disk FFD reduces t_{fix} (usable length of the anchor)	

fischer injection system FIS EM Plus

Intended use
Installation instructions part 3

Annex B 12

Installation instructions part 4			
Installation reinforcing bars and fischer rebar anchor FRA			
10		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	
		When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole.	
11		Wait for the specified curing time t_{cure} see table B9.2	
	12		Mounting the fixture max T_{fix} see table B8.1
fischer injection system FIS EM Plus			Annex B 13
Intended use Installation instructions part 4			

English translation prepared by DIBt

Table C1.1: Essential characteristics for the steel bearing capacity under tensile / shear load of fischer anchor rods and standard threaded rods													
Anchor rod / standard threaded rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30		
Bearing capacity under tensile load, steel failure													
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	5.8	19(17)	29(27)	43	58	79	123	152	177	230	281	
		8.8	29(27)	47(43)	68	92	126	196	243	282	368	449	
	Stainless steel A4 and high corrosion resistant steel C	Property class	50 [kN]	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 factors ¹⁾													
Partial factor $\gamma_{Mk,N}$	Steel zinc plated	5.8	1,50										
		8.8	1,50										
	Stainless steel A4 and high corrosion resistant steel C	Property class	50 [-]	2,86									
			70	1,50 ²⁾ / 1,87									
			80	1,60									
Bearing capacity under shear load, steel failure													
without lever arm													
Characteristic resistance $V_{Rk,s}$	Steel zinc plated	5.8	9(8)	15(13)	21	29	39	61	76	89	115	141	
		8.8	15(13)	23(21)	34	46	63	98	122	141	184	225	
	Stainless steel A4 and high corrosion resistant steel C	Property class	50 [kN]	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
Ductility factor	k_v	[-]	1,0										
with lever arm													
Charact. resistance $M_{Rk,s}$	Steel zinc plated	5.8	19(16)	37(33)	65	104	166	324	447	560	833	1123	
		8.8	30(26)	60(53)	105	167	266	519	716	896	1333	1797	
	Stainless steel A4 and high corrosion resistant steel C	Property class	50 [Nm]	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 factors ¹⁾													
Partial factor $\gamma_{Mk,V}$	Steel zinc plated	5.8	1,25										
		8.8	1,25										
	Stainless steel A4 and high corrosion resistant steel C	Property class	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 $f_{yk} / f_{tk} \geq 0,8$ and $A_5 > 12\%$ (e.g. fischer anchor rods) ³⁾ Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hotdip galvanized standard threaded rods according to EN ISO 10684:2004+AC:2009													
fischer injection system FIS EM Plus										Annex C 1			
Performance Essential characteristics for the steel bearing capacity of fischer anchor rods and standard threaded rods													

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English translation prepared by DIBt

Table C2.1: Essential characteristics for the steel bearing capacity under tensile / shear load of fischer internal threaded anchors RG MI										
fischer internal threaded anchors RG MI				M8	M10	M12	M16	M20		
Bearing capacity under tensile load, steel failure										
Charact. resistance 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 factors¹⁾										
Partial factors	$\gamma_{Ms,N}$	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										
Charact. resistance 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	
Ductility factor			k_T	[-]	1,0					
With lever arm										
Charact. resistance with screw	$M_{Rk,s}$	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 factors¹⁾										
Partial factors	$\gamma_{Ms,V}$	Property class	5.8	[-]	1,25					
			8.8		1,25					
		Property class 70	A4		1,56					
			C		1,56					
¹⁾ In absence of other national regulations ²⁾ Only for steel failure without lever arm										
fischer injection system FIS EM Plus								Annex C 2		
Performance Essential characteristics for the steel bearing capacity of fischer internal threaded anchor RG MI										

English translation prepared by DIBt

Table C3.1: Essential characteristics 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 resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{yk}^{1)}$															
Bearing capacity under shear load, steel failure																		
Without lever arm																		
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$0,5 \cdot A_s \cdot f_{yk}^{1)}$															
Ductility factor	k_T	[-]	0,8															
With lever arm																		
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{ef} \cdot f_{yk}^{1)}$															
¹⁾ f_{yk} or f_{yk} respectively must be taken from the specifications of the reinforcing bar																		
Table C3.2: Essential characteristics for the steel bearing capacity under tensile / shear load of fischer rebar anchors FRA																		
fischer rebar anchor FRA			M12	M16	M20	M24												
Bearing capacity under tensile load, steel failure																		
Characteristic resistance	$N_{Rk,s}$	[kN]	63	111	173	270												
Partial factor¹⁾																		
Partial factor	$\gamma_{Ms,N}$	[-]	1,4															
Bearing capacity under shear load, steel failure																		
Without lever arm																		
Characteristic resistance	$V^0_{Rk,s}$	[kN]	30	55	86	124												
Ductility factor	k_T	[-]	1,0															
With lever arm																		
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	92	233	454	785												
Partial factor¹⁾																		
Partial factor	$\gamma_{Ms,V}$	[-]	1,56															
¹⁾ In absence of other national regulations																		
fischer injection system FIS EM Plus															Annex C 3			
Performance Essential characteristics for the steel bearing capacity of reinforcing bars and fischer rebar anchors FRA																		

English translation prepared by DIBt

Table C4.1: Essential characteristics under tensile / shear load																			
Size		All sizes																	
Tensile load																			
Uncracked concrete	$k_{cor,N}$	[-]	11,0																
Cracked concrete	$k_{cr,N}$		7,7																
Factors for the compressive strength of concrete > C20/25																			
Increasing factor for f_{tk}	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	$s_{cr,sp}$			2 $c_{cr,sp}$															
Concrete cone failure																			
Edge distance	$c_{cr,N}$	[mm]	1,5 h_{ef}																
Spacing	$s_{cr,N}$		2 $c_{cr,N}$																
Shear load																			
Installation factor	γ_{inst}	[-]	1,0																
Concrete pry-out failure																			
Factor for pry-out failure	k_a	[-]	2,0																
Concrete edge failure																			
The value of h_{ef} (=h) under shear load		[-]	Conditions according to 1992-4:2018; Section 7.43																
Calculation diameters																			
Size			M8	M10	M12	M14	M16	M20	M22	M24	M27	M30							
fischer anchor rods and standard threaded rods	d_{nom}	[mm]	8	10	12	14	16	20	22	24	27	30							
fischer internal threaded anchors RG MI	d_{nom}		12	16	18	-	22	28	-	-	-	-							
fischer rebar anchor FRA	d_{nom}		-	-	12	-	16	20	-	25	-	-							
Size (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_{nom}	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
fischer injection system FIS EM Plus											Annex C 4								
Performance Essential characteristics under tensile / shear load																			

English translation prepared by DIBt

Table C5.1: Essential characteristics of tensile resistance for fischer anchor rods and standard threaded rods in hammer or diamond drilled holes; uncracked or cracked concrete														
Anchor rod / standard threaded rod		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 or wet concrete)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	18	18	18	17	17	16	15	15	14	
	II: 50 °C / 72 °C				18	17	17	16	16	15	14	14	14	13
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	16	16	15	13	13	11	11	10	10	9
	II: 50 °C / 72 °C				15	14	14	13	12	11	10	10	9	9
Diamond-drilling (dry or wet concrete as well as water filled hole)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	16	15	13	12	12	10	10	10	9	9
	II: 50 °C / 72 °C				15	14	12	11	11	10	9	9	8	8
Installation factors														
Dry or wet concrete		γ _{inst}	[-]	1,0										
Water filled hole				1,4										
Cracked concrete														
Characteristic bond resistance in cracked concrete C20/25														
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	7,5	7,5	9	8,5	8,5	8,5	8,5	8,5	8,5	8,5
	II: 50 °C / 72 °C				7,5	7,5	9	8,5	8,5	8,5	8,5	8,5	8,5	8,5
Diamond - drilling (dry or wet concrete)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	7	7	7	7	6	6	7	7	7	7
	II: 50 °C / 72 °C				7	7	7	7	6	6	7	7	7	7
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)														
Tem- perature range	I: 35 °C / 60 °C		T _{Rk,cr}	[N/mm ²]	6	7,5	7,5	7	6	6	6	6	6	6
	II: 50 °C / 72 °C				6	7	7	7	6	6	6	6	6	6
Installation factors														
Dry or wet concrete		γ _{inst}	[-]	1,0										
Water filled hole				1,2				1,4						
fischer injection system FIS EM Plus											Annex C 5			
Performance Essential characteristics of tensile resistance for fischer anchor rod and standard threaded rods														

English translation prepared by DIBt

Table C6.1: Essential characteristics of tensile resistance for fischer internal threaded anchors RG MI in hammer or diamond drilled holes; uncracked or cracked concrete							
Internal threaded anchor RG MI		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							
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>							
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	15	14	14	13	12
	II: 50 °C / 72 °C		14	13	13	12	11
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>							
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	14	12	12	11	10
	II: 50 °C / 72 °C		13	12	11	10	9
<u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>							
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	13	12	11	10	9
	II: 50 °C / 72 °C		12	11	10	9	8
Installation factors							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
<u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u>							
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	7	6	6	7	7
	II: 50 °C / 72 °C		7	6	6	7	7
<u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u>							
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	7	6,5	6	6	6
	II: 50 °C / 72 °C		7	6	6	6	6
Installation factors							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
fischer injection system FIS EM Plus						Annex C 6	
Performance Essential characteristics of tensile resistance for fischer internal threaded anchors RG MI							

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Table C7.1: Essential characteristics of tensile resistance for reinforcing bars in hammer or diamond drilled holes; uncracked or cracked concrete		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 or wet concrete)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	16	15	15	14	14	13	13	13	12	12	12	12	12	11	11	11	
	II: 50 °C / 72 °C			15	14	14	13	13	12	12	12	12	11	11	11	11	11	11	11	10
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	16	16	14	13	12	12	11	11	10	10	10	10	9	9	9	8	8
	II: 50 °C / 72 °C			15	14	13	12	12	11	11	10	10	9	9	9	9	9	8	8	8
Diamond-drilling (dry or wet concrete as well as water filled hole)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	16	15	13	12	12	11	10	10	10	9	9	9	9	8	8	8	7
	II: 50 °C / 72 °C			15	14	12	11	11	10	10	9	9	9	8	8	8	8	7	7	7
Installation factors																				
Dry or wet concrete		γ_{inst}	[-]	1,0																
Water filled hole		γ_{inst}	[-]	1,4																
Cracked concrete																				
Characteristic bond resistance in cracked concrete C20/25																				
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
	II: 50 °C / 72 °C			7	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Diamond-drilling (dry or wet concrete)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	7	7	7	7	6	6	6	7	7	7	7	7	7	5	5	5	5
	II: 50 °C / 72 °C			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 (water filled hole)																				
Temperature range	I: 35 °C / 60 °C	$f_{Rk,d}$	[N/mm ²]	6	7,5	6,5	6,5	6,5	6	6	6	6	6	6	6	6	5	5	5	5
	II: 50 °C / 72 °C			6	6,5	6,5	6	6	6	6	6	6	6	6	6	6	6	5	5	5
Installation factors																				
Dry or wet concrete		γ_{inst}	[-]	1,0																
Water filled hole		γ_{inst}	[-]	1,2								1,4								
fischer injection system FIS EM Plus																	Annex C 7			
Performance Essential characteristics of tensile resistance for reinforcing bars																				

Table C8.1: Essential characteristics of tensile resistance for fischer rebar anchors FRA in hammer or diamond drilled holes; uncracked or cracked concrete							
fischer rebar anchor FRA		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 or wet concrete)							
Tem- perature range	I: 35 °C / 60 °C	T _{Rk,ucr}	[N/mm ²]	15	14	13	12
	II: 50 °C / 72 °C			14	13	12	12
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Tem- perature range	I: 35 °C / 60 °C	T _{Rk,ucr}	[N/mm ²]	14	12	11	10
	II: 50 °C / 72 °C			13	12	11	9
Diamond-drilling (dry or wet concrete as well as water filled hole)							
Tem- perature range	I: 35 °C / 60 °C	T _{Rk,ucr}	[N/mm ²]	13	12	10	9
	II: 50 °C / 72 °C			12	11	10	9
Installation factors							
Dry or wet concrete				1,0			
Water filled hole	γ _{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 or wet concrete)							
Tem- perature range	I: 35 °C / 60 °C	T _{Rk,cr}	[N/mm ²]	8	8	8	8
	II: 50 °C / 72 °C			8	8	8	8
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)							
Tem- perature range	I: 35 °C / 60 °C	T _{Rk,cr}	[N/mm ²]	7	6	6	6
	II: 50 °C / 72 °C			7	6	6	6
Installation factors							
Dry or wet concrete				1,0			
Water filled hole	γ _{inst}	[-]		1,2		1,4	
fischer injection system FIS EM Plus						Annex C 8	
Performance Essential characteristics of tensile resistance for fischer rebar anchors FRA							

English translation prepared by DIBt

Table C9.1: Displacements for anchor rods											
Anchor rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Displacement-Factors for tensile load¹⁾											
Uncracked or cracked concrete; Temperature range I, II											
δ_{NO} -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
$\delta_{N,c}$ -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,19
Displacement-Factors for shear load²⁾											
Uncracked or cracked concrete; Temperature range I, II											
δ_{VO} -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V,c}$ -Factor		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: $\delta_{NO} = \delta_{NO-Factor} \cdot \sigma_{Ed}$ $\delta_{N,c} = \delta_{N,c-Factor} \cdot \sigma_{Ed}$ (σ_{Ed} : Design value of the applied tensile stress)						²⁾ Calculation of effective displacement: $\delta_{VO} = \delta_{VO-Factor} \cdot V_{Ed}$ $\delta_{V,c} = \delta_{V,c-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force)					
Table C9.2: Displacements for fischer internal threaded anchors RG MI											
Internal threaded anchor RG MI		M8	M10	M12	M16	M20					
Displacement-Factors for tensile load¹⁾											
Uncracked or cracked concrete; Temperature range I, II											
δ_{NO} -Factor	[mm/(N/mm ²)]	0,09	0,10	0,10	0,11	0,13					
$\delta_{N,c}$ -Factor		0,13	0,15	0,16	0,17	0,19					
Displacement-Factors for shear load²⁾											
Uncracked or cracked concrete; Temperature range I, II											
δ_{VO} -Factor	[mm/kN]	0,12	0,09	0,08	0,07	0,05					
$\delta_{V,c}$ -Factor		0,18	0,14	0,12	0,10	0,08					
¹⁾ Calculation of effective displacement: $\delta_{NO} = \delta_{NO-Factor} \cdot \sigma_{Ed}$ $\delta_{N,c} = \delta_{N,c-Factor} \cdot \sigma_{Ed}$ (σ_{Ed} : Design value of the applied tensile stress)						²⁾ Calculation of effective displacement: $\delta_{VO} = \delta_{VO-Factor} \cdot V_{Ed}$ $\delta_{V,c} = \delta_{V,c-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force)					
fischer injection system FIS EM Plus										Annex C 9	
Performance Displacements for anchor rods and fischer internal threaded anchors RG MI											

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Table C10.1: 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 load¹⁾																		
Uncracked or cracked concrete; Temperature range I, II																		
δ_{NO} -Factor	[mm/(N/mm ²)]	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
δ_{Nc} -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 load²⁾																		
Uncracked or cracked concrete; Temperature range I, II																		
δ_{V0} -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
δ_{Vc} -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: $\delta_{NO} = \delta_{NO-Factor} \cdot \sigma_{Ed}$ $\delta_{Nc} = \delta_{Nc-Factor} \cdot \sigma_{Ed}$ (σ_{Ed} : Design value of the applied tensile stress)									²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0-Factor} \cdot V_{Ed}$ $\delta_{Vc} = \delta_{Vc-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force)									

Table C10.2: Displacements for fischer rebar anchors FRA

fischer rebar anchor FRA	M12	M16	M20	M24	
Displacement-Factors for tensile load¹⁾					
Uncracked or cracked concrete; Temperature range I, II					
δ_{NO} -Factor	[mm/(N/mm ²)]	0,09	0,10	0,11	0,12
δ_{Nc} -Factor		0,13	0,15	0,16	0,18
Displacement-Factors for shear load²⁾					
Uncracked or cracked concrete; Temperature range I, II					
δ_{V0} -Factor	[mm/kN]	0,12	0,09	0,07	0,06
δ_{Vc} -Factor		0,18	0,14	0,11	0,09
¹⁾ Calculation of effective displacement: $\delta_{NO} = \delta_{NO-Factor} \cdot \sigma_{Ed}$ $\delta_{Nc} = \delta_{Nc-Factor} \cdot \sigma_{Ed}$ (σ_{Ed} : Design value of the applied tensile stress)			²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0-Factor} \cdot V_{Ed}$ $\delta_{Vc} = \delta_{Vc-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force)		

fischer injection system FIS EM Plus

Performance
Displacements for reinforcing bars and fischer rebar anchors FRA

Annex C 10

English translation prepared by DIBt

Table C11.1: Essential characteristics 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											
Anchor rod / standard threaded rod			M10	M12	M14	M16	M20	M22	M24	M27	M30
Bearing capacity under tensile load, steel failure¹⁾											
fischer anchor rods and standard threaded rods, performance category C1											
Characteristic resistance $N_{Rk,s,eq,C1}$	Steel zinc plated	5.8	29(27)	43	58	79	123	152	177	230	281
		8.8	47(43)	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											
Characteristic resistance $N_{Rk,s,eq,C2}$	Steel zinc plated	5.8	-	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 arm¹⁾											
fischer anchor rods, performance category C1											
Characteristic resistance $V_{Rk,s,eq,C1}^0$	Steel zinc plated	5.8	15(13)	21	29	39	61	76	89	115	141
		8.8	23(21)	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											
Characteristic resistance $V_{Rk,s,eq,C1}^0$	Steel zinc plated	5.8	11(9)	15	20	27	43	53	62	81	99
		8.8	16(14)	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											
Characteristic resistance $V_{Rk,s,eq,C2}^0$	Steel zinc plated	5.8	-	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 factors for performance category C1 or C2 see table C12.2; for fischer anchor rods FIS A / RGM the factor for steel ductility is 1,0 ²⁾ Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hotdip galvanized standard threaded rods according to EN ISO 10684:2004+AC:2009.											
fischer injection system FIS EM Plus										Annex C 11	
Performance Essential characteristics for the steel bearing capacity for fischer anchor rods and standard threaded rods under seismic action (performance category C1 / C2)											

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English translation prepared by DIBt

Table C12.1: Essential characteristics 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 failure¹⁾															
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1															
Characteristic resistance	$N_{Rk,s,eq,C1}$ [kN]	44	63	85	111	140	173	209	249	270	292	339	389	443	
Bearing capacity under shear load, steel failure without lever arm¹⁾															
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1															
Characteristic resistance	$V_{Rk,s,eq,C1}^0$ [kN]	15	22	30	39	49	61	74	88	95	102	119	137	155	
¹⁾ Partial factors for performance category C1 see table C12.2															
Table C12.2: Partial factors for fischer anchor rods, standard threaded rods and reinforcing bars (B500B) under seismic action performance category C1 or C2															
Anchor rod / standard threaded rod		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
Tensile load, steel failure¹⁾															
Partial factor $\gamma_{Mk,N}$	Steel zinc plated	Property class	5.8	1,50											
			8.8	1,50											
	Stainless steel A4 and high corrosion resistant steel C	50	70	1,50 ²⁾ / 1,87											
			80	1,60											
	Reinforcing bar	B500B	1,40												
	Shear load, steel failure¹⁾														
Partial factor $\gamma_{Mk,V}$	Steel zinc plated	Property class	5.8	1,25											
			8.8	1,25											
	Stainless steel A4 and high corrosion resistant steel C	50	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 $f_{yk} / f_{tk} \geq 0,8$ and $A_s > 12\%$ (e.g. fischer anchor rods)															
fischer injection system FIS EM Plus										Annex C 12					
Performance Essential characteristics for the steel bearing capacity for reinforcing bars under seismic action (performance category C1); partial safety factors (performance category C1 / C2)															

English translation prepared by DIBt

Table C13.1: Essential characteristics of resistance for fischer anchor rods and standard threaded rods in hammer drilled holes under seismic action performance category C1															
Anchor rod / standard threaded rod		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 or wet concrete)															
Tem- perature range	I: 35 °C / 60 °C	[N/mm ²]	7,0	7,0	6,7	6,0	5,7	6,7	6,7	6,7	6,7				
	II: 50 °C / 72 °C		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 (water filled hole)															
Tem- perature range	I: 35 °C / 60 °C	[N/mm ²]	7,5	7,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7				
	II: 50 °C / 72 °C		6,8	6,8	6,5	5,7	5,7	5,7	5,7	5,7	5,7				
Installation factors															
tensile load															
Dry or wet concrete	γ_{inst}	[-]	1,0												
Water filled hole	γ_{inst}	[-]	1,2				1,4								
shear load															
All installation conditions	γ_{inst}	[-]	1,0												
Table C13.2: Essential characteristics 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 or wet concrete)															
Tem- perature range	I: 35 °C / 60 °C	[N/mm ²]	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
	II: 50 °C / 72 °C		7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	6,7
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)															
Tem- perature range	I: 35 °C / 60 °C	[N/mm ²]	7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8
	II: 50 °C / 72 °C		6,5	6,5	5,8	5,8	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7
Installation factors															
Tensile load															
Dry or wet concrete	γ_{inst}	[-]	1,0												
Water filled hole	γ_{inst}	[-]	1,2				1,4								
Shear load															
All installation conditions	γ_{inst}	[-]	1,0												
fischer injection system FIS EM Plus											Annex C 13				
Performance Essential characteristics under seismic action (performance category C1) for fischer anchor rods, standard threaded rods and reinforcing bars															

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English translation prepared by DIBt

Table C14.1: Essential characteristics of resistance for fischer anchor rods and standard threaded rods in hammer drilled holes under seismic action performance category C2						
Anchor rod / standard threaded rod		M12	M16	M20	M24	
Characteristic bond resistance, combined pullout and concrete cone failure						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	3,5	5,8	5,0	3,1
	II: 50 °C / 72 °C		3,3	5,5	4,7	2,9
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 35 °C / 60 °C	[N/mm ²]	3,5	5,8	5,0	3,1
	II: 50 °C / 72 °C		3,3	5,5	4,7	2,9
Installation factors						
Tensile load						
Dry or wet concrete	γ_{inst}	[-]	1,0			
Water filled hole			1,2	1,4		
Shear load						
All installation conditions	γ_{inst}	[-]	1,0			
Displacement-Factors for tensile load¹⁾						
$\delta_{N,(DLS)}$ -Factor	[mm/(N/mm ²)]	0,09	0,10	0,11	0,12	
$\delta_{N,(ULS)}$ -Factor		0,15	0,17	0,17	0,18	
Displacement-Factors for shear load²⁾						
$\delta_{V,(DLS)}$ -Factor	[mm/kN]	0,18	0,10	0,07	0,06	
$\delta_{V,(ULS)}$ -Factor		0,25	0,14	0,11	0,09	
¹⁾ Calculation of effective displacement: $\delta_{N,(DLS)} = \delta_{N,(DLS)\text{-Factor}} \cdot \sigma_{Ed}$ $\delta_{N,(ULS)} = \delta_{N,(ULS)\text{-Factor}} \cdot \sigma_{Ed}$ (σ_{Ed} : Design value of the applied tensile stress)			²⁾ 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)			
fischer injection system FIS EM Plus					Annex C 14	
Performance Essential characteristics under seismic action (performance category C2) for fischer anchor rods and standard threaded rods						