Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

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

European Technical Assessment

ETA-15/0440 of 13 December 2017

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	fischer injection system FIS EB
Product family to which the construction product belongs	Injection system for use in concrete
Manufacturer	fischerwerke GmbH & Co. KG Otto-Hahn-Straße 15 79211 Denzlingen DEUTSCHLAND
Manufacturing plant	fischerwerke
This European Technical Assessment contains	26 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	ETAG 001 Part 5: "Bonded anchors", April 2013, used as EAD according to Article 66 Paragraph 3 of Regulation (EU) No 305/2011.
This version replaces	ETA-15/0440 issued on 6 July 2015

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Specific Part

1 Technical description of the product

The fischer injection system FIS EB is a bonded anchor consisting of a cartridge with injection mortar fischer FIS EB and a steel element.

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 6
Characteristic values for seismic performance categories C1 and C2 5, Displacements	See Annex C 7 to C 10

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Anchorages satisfy requirements for Class A1
Resistance to fire	No performance assessed

3.3 Hygiene, health and the environment (BWR 3)

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

3.4 Safety in use (BWR 4)

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

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

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

The system to be applied is: 1

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable European Assessment Document

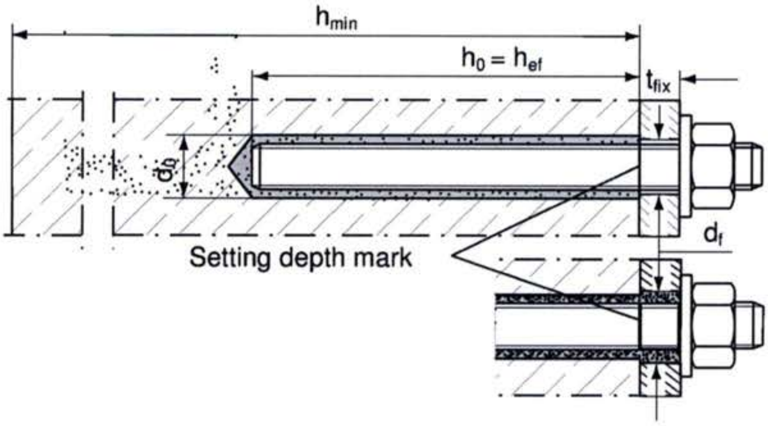
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 13 December 2017 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

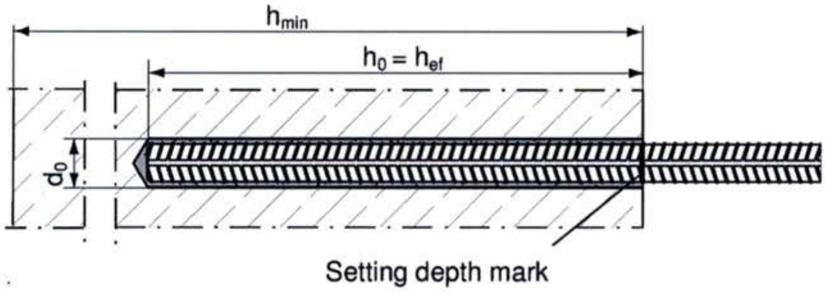
beglaubigt:
Baderschneider

Installation conditions



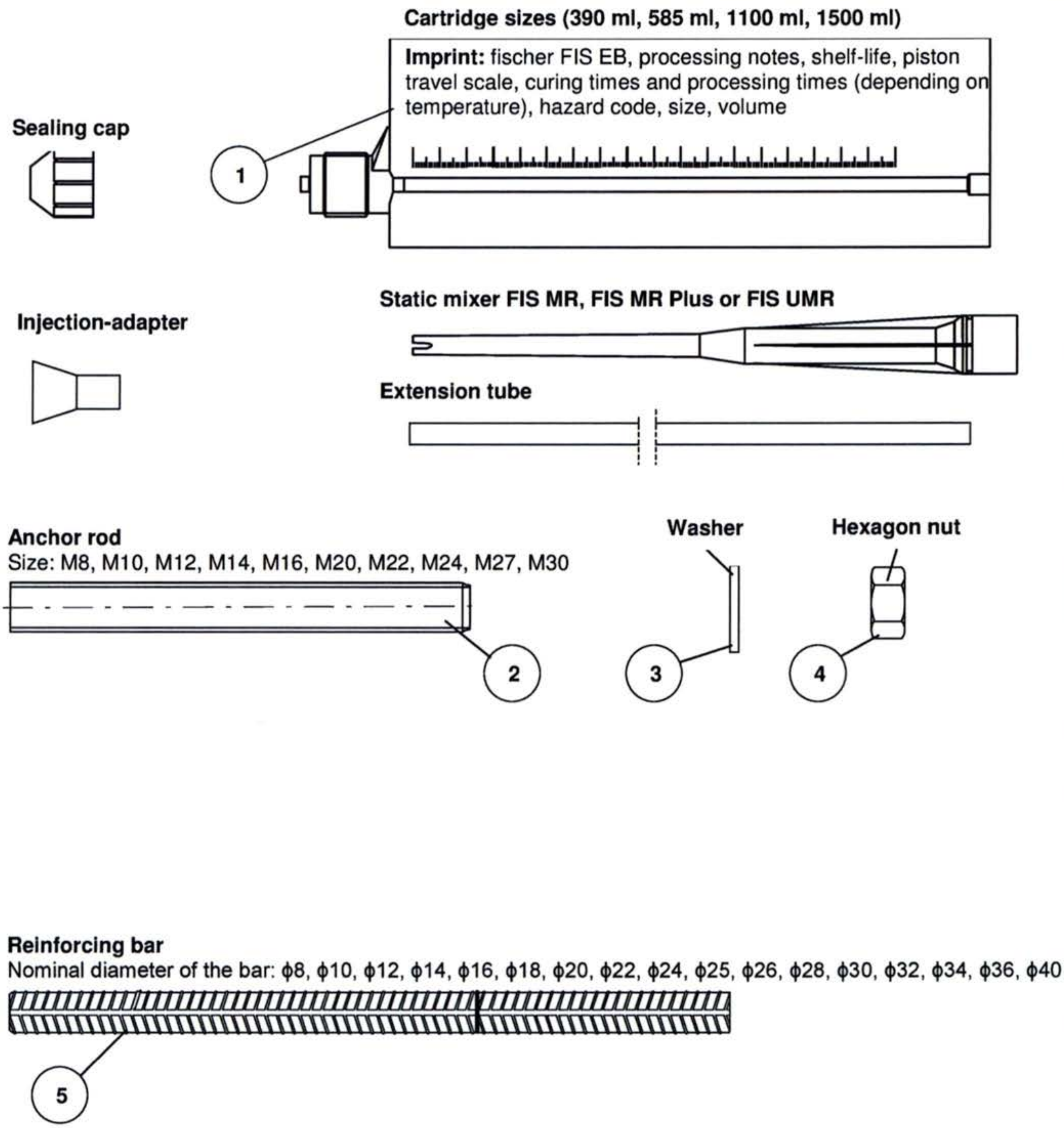
Anchor rod
Pre-positioned anchor

Anchor rod
Push through anchor
(annular gap filled with mortar)



Reinforcing bar

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



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

Table A1: Materials

Part	Designation	Material	
1	Mortar cartridge	Mortar, hardener, filler	
	Steel grade	Steel, zinc plated	Stainless steel A4
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 galvanized ≥ 40 µm EN ISO 10684:2004 f_{uk} ≤ 1000 N/mm² 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_{uk} ≤ 1000 N/mm² A_5 > 12 % fracture elongation[1)]
		fracture elongation A_5 > 8 % for applications without requirements for seismic performance category C2	
3	Washer ISO 7089:2000	zinc plated ≥ 5 µm, EN ISO 4042:1999 A2K or hot-dip galvanized ≥ 40 µm EN ISO 10684:2004	1.4401; 1.4404; 1.4578;1.4571; 1.4439; 1.4362 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 galvanized ≥ 40 µm 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
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 $f_{uk} = f_{tk} = k \cdot f_{yk}$	

fischer injection system FIS EB

Product description
Materials

Annex A 3

Specifications of intended use (part 1)

Table B1: Overview use and performance categories

Anchorages subject to		**FIS EB with ...**			
		Anchor rod 		Reinforcing bar 	
Hammer drilling with standard drill bit		all sizes			
Hammer drilling with hollow drill bit (Heller "Duster Expert" or 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, C3, C4, C6	all sizes	Tables: C2, C3, C5, C7
	cracked concrete				
Seismic performance category (only hammer drilling with Standard / hollow drill bits)	C1	M10 to M30	Tables: C8, C10, C11	ϕ10 to ϕ32	Tables: C9, C10, C12
	C2	M12, M16, M20, M24	Tables: C8, C10, C13	---	---
Use category	dry or wet concrete	all sizes			
	flooded hole	all sizes			
Installation temperature		+5 °C to +40 °C			
In-service temperature		-40 °C to +72 °C	(max. long term temperature +50 °C and max. short term temperature +72 °C)		

fischer injection system FIS EB

Intended use
Specifications (part 1)

Annex B 1

Specifications of intended use (part 2)

Base materials:

- Reinforced or unreinforced normal weight concrete Strength classes C20/25 to C50/60 according to EN 206-1:2000

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions
(zinc coated steel, stainless 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)

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 in anchorages and concrete work
- 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 under seismic action 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

fischer injection system FIS EB	
Intended use Specifications (part 2)	**Annex B 2**

Table B2: Installation parameters for anchor rods

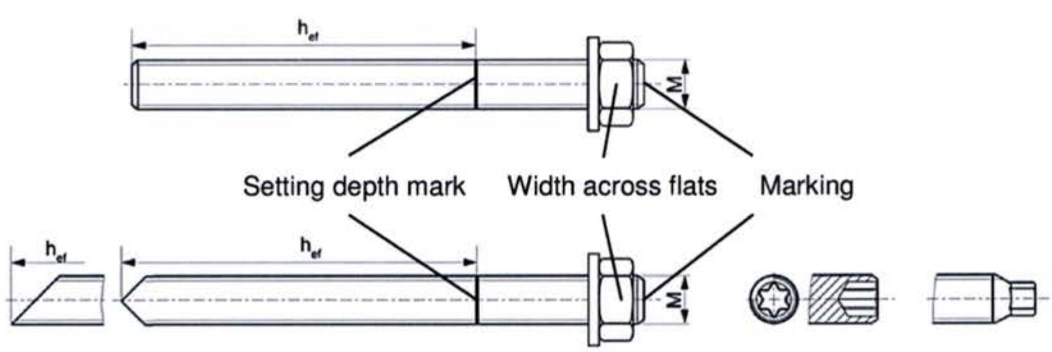
Size				**M8**	**M10**	**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Width across flats		SW	[mm]	13	17	19	22	24	30	32	36	41	46
Nominal drill bit diameter		d_0	[mm]	12	14	14	16	18	24	25	28	30	35
Drill hole depth		h_0	[mm]	$h_0 = h_{ef}$									
Effective anchorage depth		$h_{ef,min}$	[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
	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:

fischer FIS A

fischer RG M



Marking (on random place) fischer anchor rod FIS A or RG M:
Property class 8.8: •
Stainless steel A4, 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

Deutsches Institut für Bautechnik

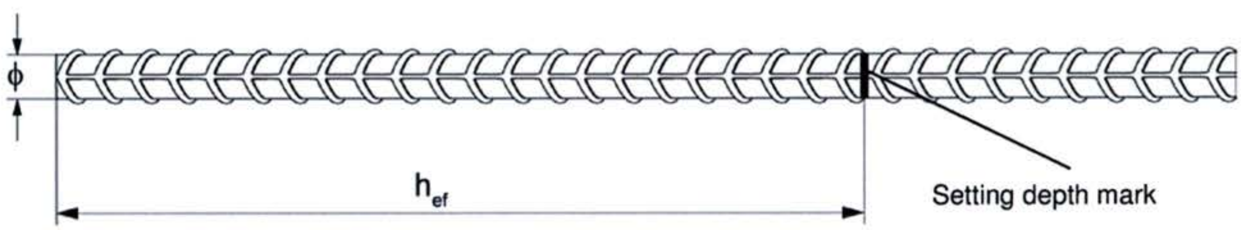
Table B3: Installation parameters for reinforcing bars

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	[mm]	$h_0 = h_{ef}$								
Effective anchorage depth	$h_{ef,min}$	[mm]	60	60	70	75	80	85	90	94	98
	$h_{ef,max}$	[mm]	160	200	240	280	320	360	400	440	480
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	40	45	55	60	65	75	85	95	105
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 30$ (≥ 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	[mm]	$h_0 = h_{ef}$								
Effective anchorage depth	$h_{ef,min}$	[mm]	100	104	112	120	128	136	144	160	---
	$h_{ef,max}$	[mm]	500	520	560	600	640	680	720	800	---
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$	[mm]	110	120	130	140	160	170	180	200	---
Minimum thickness of concrete member	h_{min}	[mm]	$h_{ef} + 2d_0$								

[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)

fischer injection system FIS EB

Intended use
Installation parameters reinforcing bars

Annex B 4

Table B4: Parameters of cleaning brush (steel brush) 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		14	16	20		25	26	27	30	40			42	47	58

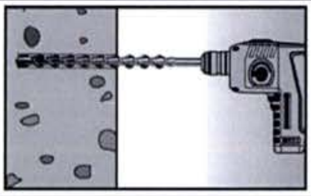
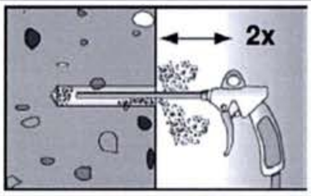
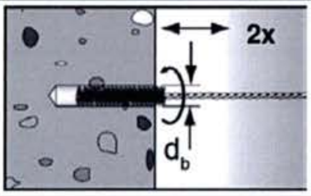
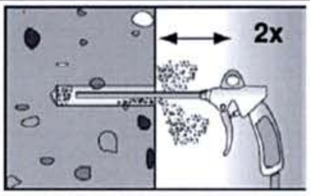
Table B5: Maximum processing time of the mortar and minimum curing time
(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

System temperature [°C]	Maximum processing time t_{work} [minutes]	Minimum curing time[1)] t_{cure} [hours]
+5 to +10	120	45
> +10 to +20	30	22
> +20 to +30	14	12
> +30 to +40	7	6

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

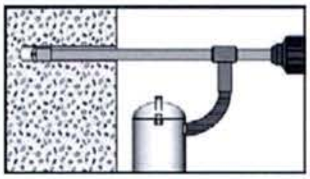
Installation instructions part 1

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

1		Drill the hole. Drill hole diameter **d_0** and drill hole depth **h_0** see **Tables B2, B3**	
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 B4**	
4		Blow out the drill hole twice, with oil-free compressed air (p ≥ 6 bar)	

Go to step 6

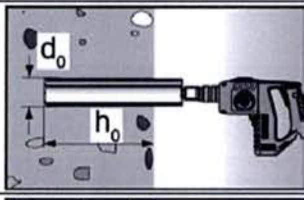
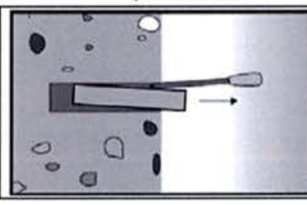
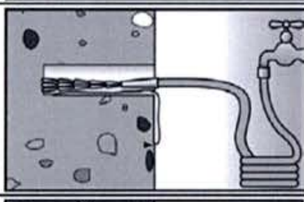
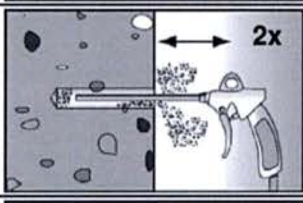
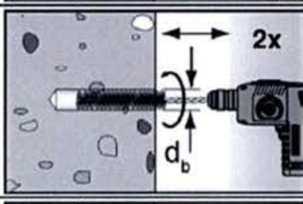
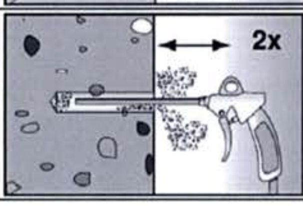
Drilling and cleaning the hole (hammer drilling with hollow drill bit)

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 **d_0** and drill hole depth **h_0** see **Tables B2, B3**

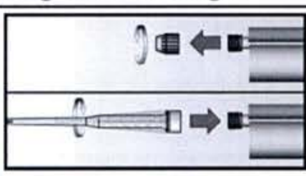
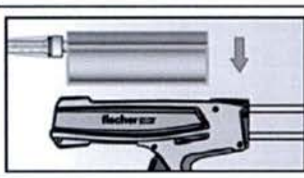
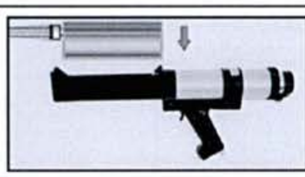
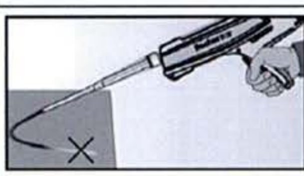
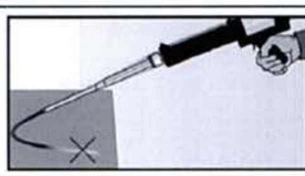
Go to step 6

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**		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 B4**		
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 EB	**Annex B 7**
Intended use Installation instructions part 2	

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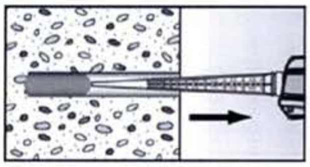
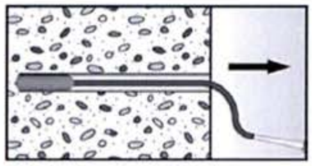
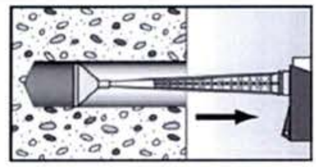
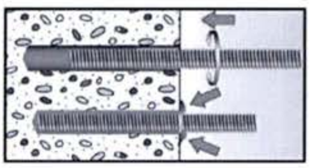
DIBt

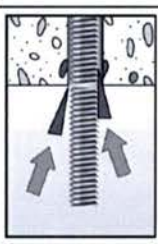
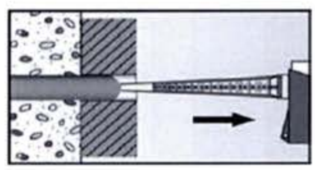
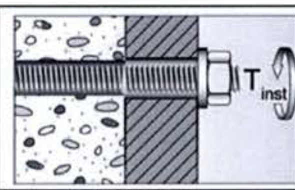
Installation instructions part 3

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

10		Only use clean and oil-free anchor elements. Mark the setting depth of the anchor. Press the threaded rod 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. If not, pull out the anchor element immediately and reinject mortar

	 For overhead installations support the anchor rod with wedges. (e.g. fischer centering wedges) until the the mortar begins to cure		 For push through installation fill the annular gap with mortar
11	 Wait for the specified curing time t_{cure} see **Table B5**	12	 Mounting the fixture $T_{inst,max}$ see **Table B2**

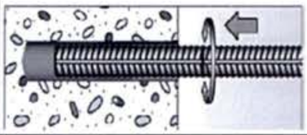
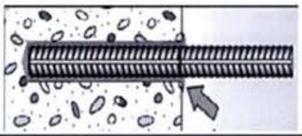
fischer injection system FIS EB

Intended use
Installation instructions part 3

Annex B 8

Installation instructions part 4

Installation reinforcing bars

10		Only use clean and oil-free reinforcing bars. Mark the setting depth. Turn while using force to push the reinforcing bar 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. If not, pull out the anchor element immediately and reinject mortar
11		Wait for the specified curing time t_{cure} see **Table B5**

fischer injection system FIS EB

Intended use
Installation instructions part 4

Annex B 9

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		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		50		2,86									
			70		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		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
Duktilitätsfaktor gemäß CEN/TS 1992-4-5:2009 Abschnitt 6.3.2.1			k_2	[-]	1,0									
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		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		50		2,38									
			70		1,56									
			80		1,33									

[1)] In absence of other national regulations

fischer injection system FIS EB

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

Annex C 1

Table C2: 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

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Performances
Characteristic steel bearing capacity of reinforcing bars

Annex C 2

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Table C3: 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		$s_{cr,sp}$		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

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

Table C4: Characteristic values of **resistance** for **fischer anchor rods** and **standard threaded rods** under **tensile load** 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)												
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	10	9	9	8	8	8	7,5	7,5
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)												
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	10	9	8	7,5	7	7	6	6
Diamond-drilling (dry and wet concrete)												
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	8	7,5	7,5	7	6	6	5,5	5,5
Diamond-drilling (flooded hole)												
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	8	7,5	7,5	7	6	6	5,5	5,5
Installation safety factors												
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0						1,2			
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4									
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)												
	$\tau_{Rk,cr}$	[N/mm²]	5	5	5	5	4	4	5	5	5	5
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)												
	$\tau_{Rk,cr}$	[N/mm²]	4	5	5	5	4	4	4	4	4	4
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				

Table C5: Characteristic values of **resistance under tensile load** 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)																			
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	10	9	9	9	8	8	8	8	7,5	7,5	7,5	7,5	7,5	7,5	7
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)																			
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	9	8	7,5	8	7,5	7	7	6	6	6	6	5,5	5,5	5,5	5,5
Diamond-drilling (dry and wet concrete as well as flooded hole)																			
	$\tau_{Rk,ucr}$	[N/mm²]	11	10	8	7,5	7,5	7	7	6	6	6	5,5	5,5	5,5	5,5	5	5	5
Installation safety factors																			
Dry and wet concrete	$\gamma_2 = \gamma_{inst}$	[-]	1,0							1,2									
Flooded hole	$\gamma_2 = \gamma_{inst}$	[-]	1,4																
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)																			
	$\tau_{Rk,cr}$	[N/mm²]	5	5	5	5	4	4	4	5	5	5	5	5	5	3,5	3,5	3,5	3,5
Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (flooded hole)																			
	$\tau_{Rk,cr}$	[N/mm²]	4	4,5	4,5	4	4	4	4	4	4	4	4	4	4	3,5	3,5	3,5	3,5
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										

Table C6: 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											
$\delta_{N0\text{-Factor}}$	[mm/(N/mm²)]	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/mm²)]	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											
$\delta_{V0\text{-Factor}}$	[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 C7: 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																		
$\delta_{N0\text{-Factor}}$	[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
$\delta_{N\infty\text{-Factor}}$	[mm/(N/mm²)]	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																		
$\delta_{V0\text{-Factor}}$	[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
$\delta_{V\infty\text{-Factor}}$	[mm/kN]	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 C8: Characteristic values for the **steel bearing capacity** 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		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		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		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		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		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 C10, for fischer anchor rods FIS A / RGM the factor for steel ductility is 1,0

Table C9: Characteristic values for the **steel bearing capacity** 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 C10

Table C10: 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																
	Steel zinc plated	Property class	8.8	[-]	1,50																
	Stainless steel A4	Property class	50	[-]	2,86																
	Stainless steel A4	Property class	70	[-]	1,87																
	Stainless steel A4	Property class	80	[-]	1,60																
	Reinforcing bar[2)]	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																
	Steel zinc plated	Property class	8.8	[-]	1,25																
	Stainless steel A4	Property class	50	[-]	2,38																
	Stainless steel A4	Property class	70	[-]	1,56																
	Stainless steel A4	Property class	80	[-]	1,33																
	Reinforcing bar[2)]	B500B		[-]	1,50																

[1)] In absence of other national regulations

[2)] Reinforcing bars only seismic action category C1

Table C11: 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)											
	$\tau_{Rk,C1}$	[N/mm²]	4,9	4,9	4,6	4,0	4,0	4,6	4,6	4,6	4,6
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)											
	$\tau_{Rk,C1}$	[N/mm²]	4,7	4,7	4,5	4,0	4,0	4,0	4,0	4,0	4,0
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								

Table C12: 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)															
	$\tau_{Rk,C1}$	[N/mm²]	4,9	4,9	4,6	4,0	4,0	4,0	4,6	4,6	4,6	4,6	4,6	4,6	3,4
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)															
	$\tau_{Rk,C1}$	[N/mm²]	4,7	4,7	4,1	4,1	4,0	4,0	4,0	4,0	4,0	4,0	4,0	4,0	3,4
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												

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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 9

Table C13: 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)						
	$\tau_{Rk,C2}$	[N/mm²]	1,5	2,5	1,3	1,7
Hammer-drilling with standard drill bit or hollow drill bit (flooded hole)						
	$\tau_{Rk,C2}$	[N/mm²]	1,6	2,5	1,3	1,4
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			
Displacement-Factors for tensile load[1)]						
$\delta_{N,(DLS)\text{-Factor}}$		[mm/(N/mm²)]	0,09	0,10	0,11	0,12
$\delta_{N,(ULS)\text{-Factor}}$		[mm/(N/mm²)]	0,15	0,17	0,17	0,18
Displacement-Factors for shear load[2)]						
$\delta_{V,(DLS)\text{-Factor}}$		[mm/kN]	0,18	0,10	0,07	0,06
$\delta_{V,(ULS)\text{-Factor}}$		[mm/kN]	0,25	0,14	0,11	0,09

[1)] 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)

[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)