DECLARATION OF PERFORMANCE

DoP 0340

for fischer injection system FIS EB II (Bonded fastener for use in concrete) EN

1. Unique identification code of the product-type: **DoP 0340**

2. Intended use/es: **Post-installed fastening in cracked or uncracked concrete, see appendix, especially annexes B1 - B11.**

3. Manufacturer: **fischerwerke GmbH & Co. KG, Otto-Hahn-Straße 15, 79211 Denzlingen, Germany**

4. Authorised representative: **–**

5. System/s of AVCP: **1**

6. European Assessment Document: **EAD 330499-02-0601, Edition 04/2023**
   European Technical Assessment: **ETA-21/0469; 2023-07-25**
   Technical Assessment Body: **DIBt- Deutsches Institut für Bautechnik**
   Notified body/ies: **2873 TU Darmstadt**

7. Declared performance/s:

Mechanical resistance and stability (BWR 1)

Characteristic resistance to tension load (static and quasi-static loading):

1) Resistance to steel failure: see appendix, especially annexes C1, C2
2) Resistance to combined pull- out and concrete cone failure: see appendix, especially annexes C4 - C6
3) Resistance to concrete cone failure: see appendix, especially annex C3
4) Edge distance to prevent splitting under load: see appendix, especially annex C3
5) Robustness: see appendix, especially annexes C3 - C6
6) Maximum installation torque: see appendix, especially annexes B3, B5
7) Minimum edge distance and spacing, member thickness: see appendix, especially annexes B3 - B7

Characteristic resistance to shear load (static and quasi-static loading):

8) Resistance to steel failure: see appendix, especially annexes C1, C2
9) Resistance to pry-out failure: see appendix, especially annex C3
10) Resistance to concrete edge failure: see appendix, especially annex C3

Displacements under short-term and long-term loading:

11) Displacements under short-term and long-term loading: see appendix, especially annex C7
12) Resistance in steel fibre reinforced concrete: NPD

Characteristic resistance and displacements for seismic performance categories C1 and C2:

13) Resistance to tension load, category C1: see appendix, especially annexes C8 - C11
14) Resistance to tension load, category C2: see appendix, especially annexes C8 - C10, C12, C13
15) Resistance to shear load, category C1: see appendix, especially annexes C8 - C10
16) Resistance to shear load, category C2: see appendix, especially annexes C8 - C10, C12, C13

Safety in case of fire (BWR 2)

17) Reaction to fire: Class (A1)

Resistance to fire:

18) Fire resistance to steel failure (tension load): see appendix, especially annexes C14, C15
19) Bond resistance under fire conditions: see appendix, especially annex C16
20) Fire resistance to steel failure under shear loading: see appendix, especially annexes C14, C15

Hygiene, health and the environment (BWR 3)

21) Content, emission and/or release of dangerous substances: NPD

8. Appropriate Technical Documentation and/or Specific Technical Documentation: **–**

The performance of the product identified above is in conformity with the set of declared performance/s. This declaration of performance is issued, in accordance with Regulation (EU) No 305/2011, under the sole responsibility of the manufacturer identified above.

Signed for and on behalf of the manufacturer by:

Dr.-Ing. Oliver Geibig, Managing Director Business Units & Engineering

Jürgen Grün, Managing Director Chemistry & Quality

Tumlingen, 2023-08-15

This DoP has been prepared in different languages. In case there is a dispute on the interpretation the English version shall always prevail.

The Appendix includes voluntary and complementary information in English language exceeding the (language-neutrally specified) legal requirements.

Translation guidance Essential Characteristics and Performance Parameters for Annexes

Mechanical resistance and stability (BWR 1)		
Characteristic resistance to tension load (static and quasi-static loading):		
1	Resistance to steel failure:	$N_{Rk,s}$ [kN]
2	Resistance to combined pull- out and concrete cone failure:	τ_{Rk} and/or $\tau_{Rk,100}$ [N/mm²], ψ_c, ψ^0_{sus}, $\psi_{sus,100}$ [-] (BF)
	Resistance to pull-out failure:	$N_{Rk,p}$ and/or $N_{Rk,p,100}$ [kN], ψ_c [-] (BEF)
3	Resistance to concrete cone failure:	$c_{cr,N}$ [mm], $k_{cr,N}$, $k_{ucr,N}$ [-]
4	Edge distance to prevent splitting under load:	$c_{cr,sp}$ [mm]
5	Robustness:	γ_{inst} [-]
6	Maximum installation torque:	max T_{inst} [Nm] (BF)
	Installation torque:	T_{inst} [Nm] (BEF)
7	Minimum edge distance,spacing and member thickness:	c_{min}, s_{min}, h_{min} [mm]
Characteristic resistance to shear load (static and quasi-static loading):		
8	Resistance to steel failure:	$V^0_{Rk,s}$ [kN], $M^0_{Rk,s}$ [Nm], k_7 [-]
9	Resistance to pry-out failure:	k_8 [-]
10	Resistance to concrete edge failure:	d_{nom}, l_f [mm]
Displacements under short-term and long-term loading:		
11	Displacements under short-term and long-term loading:	δ_0, δ_∞ [mm or mm/(N/mm²)]
12	Resistance in steel fibre reinforced concrete:	Description
Characteristic resistance and displacements for seismic performance categories C1 and C2:		
13	Resistance to tension for seismic performance category C1	$N_{Rk,s,C1}$ [kN] (all) $\tau_{Rk,C1}$ [N/mm²] (BF) $N_{Rk,p,C1}$ [kN] (BEF)
14	Resistance to tension for seismic performance category C2	$N_{Rk,s,C2}$ [kN] (all) $\tau_{Rk,C2}$ [N/mm²] (BF) $N_{Rk,p,C2}$ [kN] (BEF) $\delta_{N,C2}$ [mm] (all)
15	Resistance to tension for seismic performance category C1	$V_{Rk,s,C1}$ [kN] (all)
16	Resistance to tension for seismic performance category C2	$V_{Rk,s,C2}$ [kN] (all) $\delta_{V,C2}$ [mm] (all)
Hygiene, health and the environment (BWR 3)		
17	Reaction to fire	Class
Resistance to fire		
18	Fire resistance to steel failure (tension load):	$N_{Rk,s,fi}$ [kN]
19	Bond resistance under fire conditions:	$k_{fi,p}$ (θ) [-], $\tau_{Rk,fi}$ (θ) [N/mm²] (BF)
20	Fire resistance to steel failure under shear loading:	$V_{Rk,s,fi}$ [kN], $M^0_{Rk,s,fi}$ [Nm]
Hygiene, health and the environment (BWR 3)		
21	Content, emission and/or release of dangerous substances:	Description/Level

Specific Part

1 Technical description of the product

The fischer injection system FIS EB II is a bonded fastener consisting of a cartridge with injection mortar fischer FIS EB II and a steel element according to Annex A 4.

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

The product description is given in Annex A.

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

The performances given in Section 3 are only valid if the anchor is used in compliance with the specifications and conditions given in Annex B.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1 to C 6, B 3 to B7
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1 to C 3
Displacements under short-term and long-term loading	See Annex C 7
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C 8 to C 13

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 14 to C 16

3.3 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

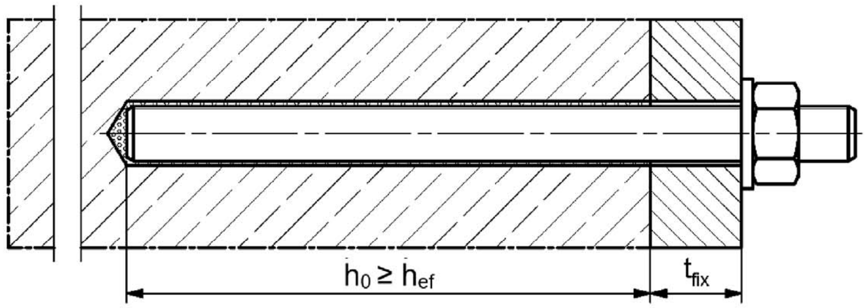
In accordance with EAD 330499-02-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

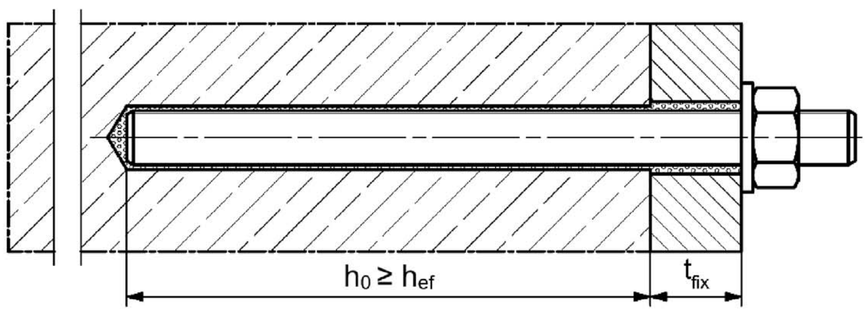
Installation conditions part 1

fischer anchor rod FIS A / RG (Anchor rod) and commercial standard threaded rods (Threaded rod)

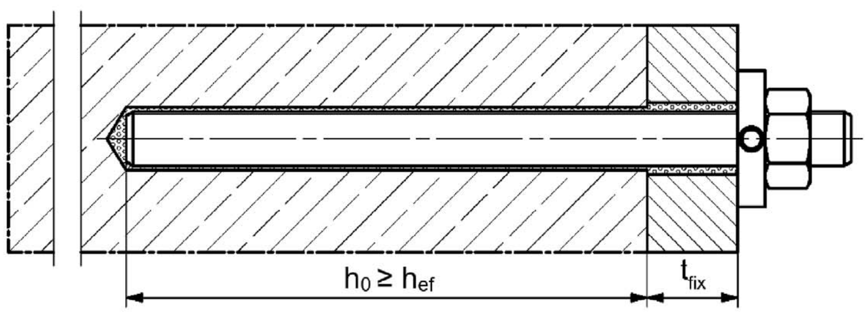
Pre-positioned installation



Push through installation (annular gap filled with mortar)



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



Figures not to scale

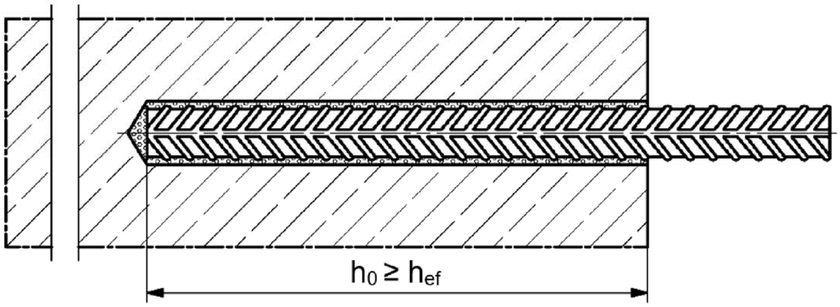
h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

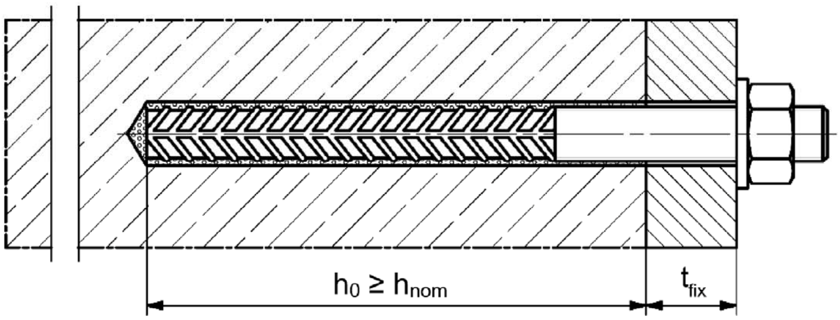
Installation conditions part 2

Reinforcing bar (Rebar)

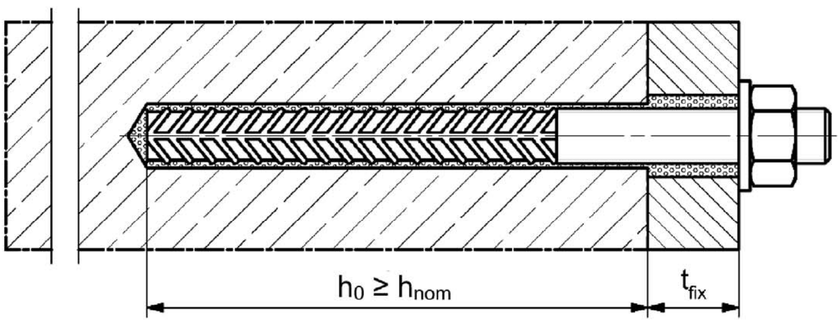


fischer rebar anchor FRA (fischer FRA)

Pre-positioned installation



Push through installation (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

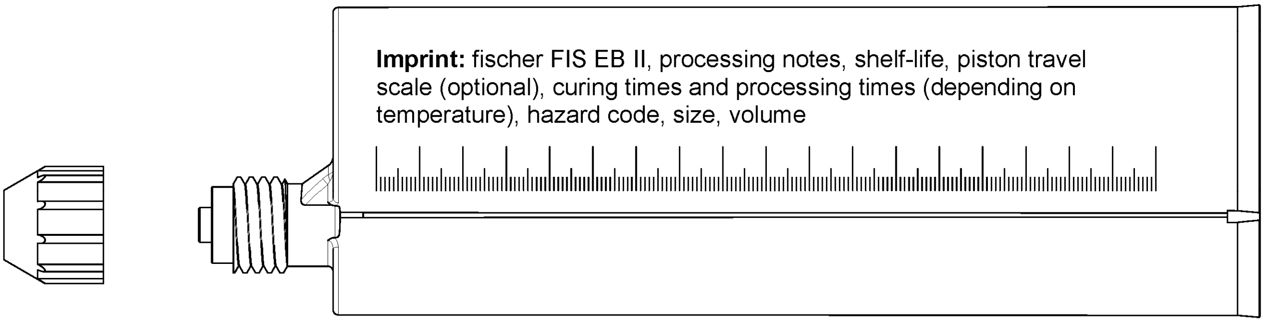
h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

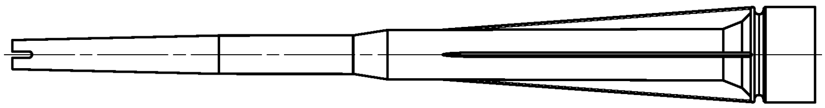
h_{nom} = overall fastener embedment depth in the concrete

Overview system components part 1

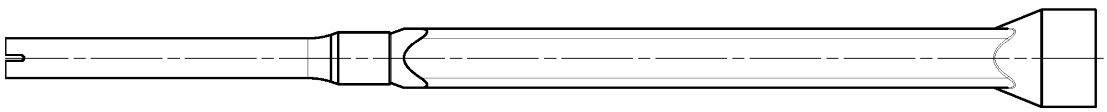
Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1100 ml, 1500 ml



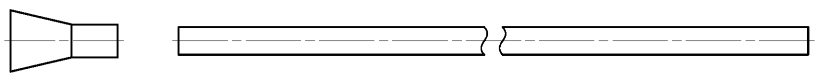
Static mixer FIS MR Plus for Injection cartridge 390 ml



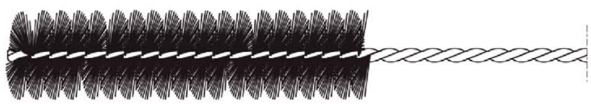
Static mixer FIS UMR Injection cartridges ≥ 585 ml



Injection adapter and extension tube Ø 9 for static mixer FIS MR Plus;
Injection adapter and extension tube Ø 9 or Ø 15 for static mixer FIS UMR



Cleaning brush BS



Blow-out pump AB G

Compressed-air cleaning tool ABP

Figures not to scale

fischer injection system FIS EB II

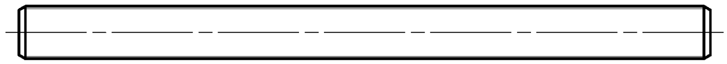
Product description
Overview system components part 1; cartridges / static mixer / accessories

Annex A 3

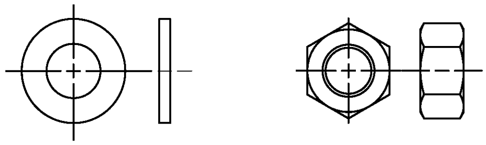
Overview system components part 2

Anchor rod

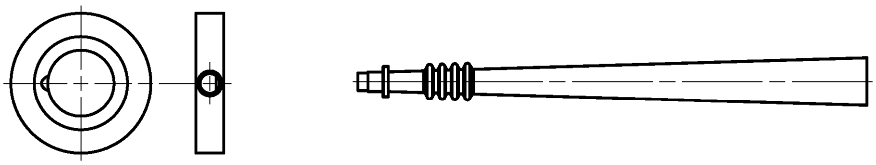
Size: M8, M10, M12, M16, M20, M24, M27, M30



Washer / hexagon nut

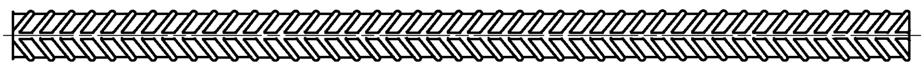


fischer filling disk with injection adapter



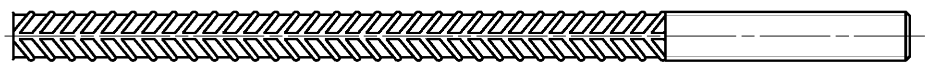
Rebar

Nominal diameter: ϕ8, ϕ10, ϕ12, ϕ14, ϕ16, ϕ20, ϕ25, ϕ26, ϕ28, ϕ30, ϕ32



fischer FRA, FRA HCR

Size: M12, M16, M20, M24



Figures not to scale

Table A5.1: Materials

Part	Designation	Material		
1	Injection cartridge	Mortar, hardener, filler		
	Steel grade	Steel zinc plated	Stainless steel R acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2006+A1:2015	High corrosion resistant steel HCR acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4:2006+A1:2015
2	Anchor rod or Threaded rod	Property class 4.8, 5.8 or 8.8; EN ISO 898-1:2013 electroplated ≥ 5 µm, DIN EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009 f_{uk} ≤ 1000 N/mm^2 fracture elongation A_5 > 12 %	Property class 50, 70 or 80; EN ISO 3506-1:2020 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/mm^2 fracture elongation A_5 > 12 %	Property class 50 or 80; EN ISO 3506-1:2020 or property class 70 1.4565; 1.4529; EN 10088-1:2014 f_{uk} ≤ 1000 N/mm^2 fracture elongation A_5 > 12 %
		Fracture elongation A_5 > 8 % for applications without requirements for seismic performance category C2		
3	Washer ISO 7089:2000	electroplated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	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 acc. EN ISO 898-2:2012 electroplated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4565; 1.4529 EN 10088-1:2014
5	fischer filling disk	electroplated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	1.4565;1.4529; EN 10088-1:2014
6	Rebar 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 NCI according to EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$ (A_5 > 12 %)		
		Fracture elongation A_5 > 8 % for applications without requirements for seismic performance category C2		
7	fischer FRA	Rebar part: Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCI of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$ (A_5 > 12 %) Threaded part: Property class 80 EN ISO 3506-1:2020	1.4401, 1.4404, 1.4571, 1.4578, 1.4439, 1.4362, 1.4062 acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2006+A1:2015 1.4565; 1.4529 acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4: 2006+A1:2015 f_{uk} ≤ 1000 N/mm^2; fracture elongation A_5 > 12 %	
		Fracture elongation A_5 > 8 % for applications without requirements for seismic performance category C2		

Specifications of intended use part 1

Table B1.1: Overview use and performance categories

Anchorages subject to		FIS EB II with …		
		Anchor rod, Threaded rod 	Rebar 	fischer FRA 
Hammer drilling with standard drill bit		all sizes		
Static and quasi-static loading, in	uncracked concrete / cracked concrete	all sizes; Tables: C1.1, C3.1, C4.1, C7.1	all sizes; Tables: C2.1, C3.1, C5.1, C7.2	all sizes; Tables: C2.2, C3.1, C6.1, C7.2
Use category	I1 dry or wet concrete	all sizes		
	I2 water filled hole	all sizes		
Seismic performance category	C1	Tables: C8.1, C9.3, C10.1, C11.1	Tables: C9.1, C9.3, C10.1, C11.2	Tables: C9.2, C9.3, C10.1, C11.2
	C2	Tables: C8.1, C10.1, C12.1	Tables: C9.1, C10.1, C13.1	Tables: C9.2, C10.1, C13.1
Installation direction		D3 (downward and horizontal and upwards (e.g. overhead))		
Installation temperature		$T_{i,min}$ = +5 °C to $T_{i,max}$ = +40 °C		
Resistance to fire		Tables: C14.1, Annex: C 16	Tables: C15.1, Annex: C 16	Tables: C15.1, Annex C 16
Service temperature	Temperature range I	-40 °C to +43 °C	(max. short term temperature +43 °C; max. long term temperature +24 °C)	
	Temperature range II	-40 °C to +60 °C	(max. short term temperature +60 °C; max. long term temperature +43 °C)	
	Temperature range III	-40 °C to +72 °C	(max. short term temperature +72 °C; max. long term temperature +50 °C)	

[1] No performance assessed

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 206:2013+A2:2021.

Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel, stainless steel or high corrosion resistant steel).
- For all other conditions according to EN1993-1-4:2006+A1:2015 corresponding to corrosion resistance classes to Annex A 5 Table 5.1.

Design:

- Fastenings are designed under the responsibility of an engineer experienced in fastenings and concrete work.
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the fastener is indicated on the design drawings (e. g. position of the fastener relative to reinforcement or to supports, etc.).
- Fastenings are designed in accordance with: EN 1992-4:2018 and TR 082 from June 2023.

Installation:

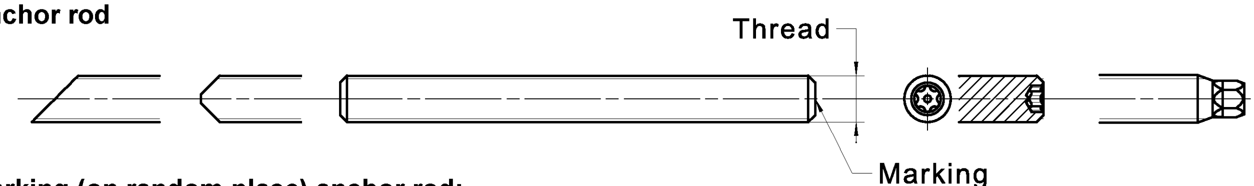
- Fastener installation is to be carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Fastening depth should be marked and adhered to installation.
- Overhead installation is allowed (necessary equipment see installation instruction).

Table B3.1: Installation parameters for **Anchor rods**

Anchor rods			**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Nominal drill hole diameter	d_0	[mm]	10	12	14	18	24	28	30	35
Drill hole depth	h_0	[mm]	$h_0 \geq h_{ef}$							
Effective embedment depth	$h_{ef, min}$	[mm]	60	60	70	80	90	96	108	120
	$h_{ef, max}$	[mm]	160	200	240	320	400	480	540	600
Simplified spacing and edge distance [1]	$s = c$	[mm]	40	45	55	65	85	105	120	140
Diameter of the clearance hole of the fixture – pre-positioned installation	d_f	[mm]	9	12	14	18	22	26	30	33
Diameter of the clearance hole of the fixture – push through installation	d_f	[mm]	12	14	16	20	26	30	33	40
Minimum thickness of concrete member	h_{min}	[mm]	h_{ef} + 30 (≥ 100)			h_{ef} + $2d_0$				
Maximum installation torque	max T_{inst}	[Nm]	10	20	40	60	120	150	200	300

[1] Detailed calculation according to Annex B 6 and B 7

Anchor rod

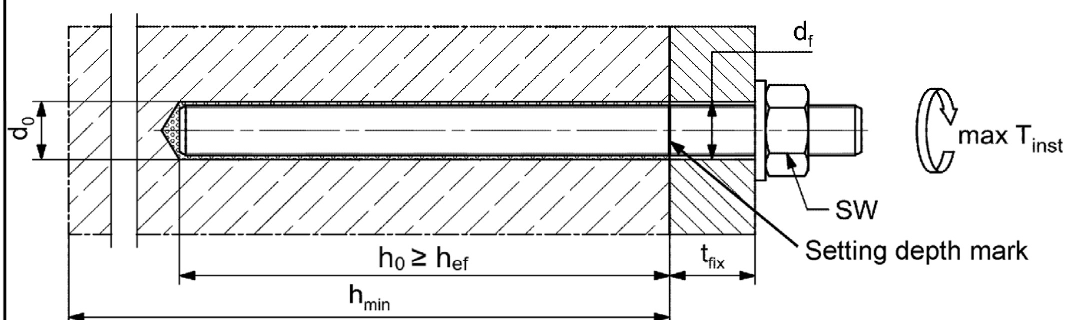


Marking (on random place) anchor rod:

Steel electroplated PC[1] 8.8	● or +	Steel hot-dip PC[1] 8.8	●
High corrosion resistant steel HCR PC[1] 50	●	High corrosion resistant steel HCR PC[1] 70	-
High corrosion resistant steel HCR PC[1] 80	(	Stainless steel R property class 50	~
Stainless steel R property class 80	∗		
Alternatively: Colour coding according to DIN 976-1: 2016			

[1] PC = property class

Installation conditions:



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 5, Table A5.1
- Inspection certificate 3.1 according to EN 10204:2004, the documents shall be stored
- Setting depth is marked

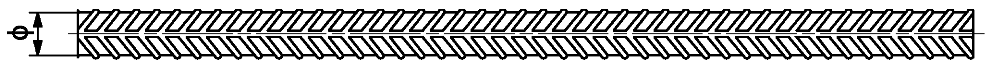
Figures not to scale

Table B4.1: Installation parameters for **Rebars**

Nominal diameter of the rebar		**ϕ**	**8**[1)]		**10**[1)]		**12**[1)]		**14**	**16**	**20**	**25**	**26**	**28**	**30**	**32**
Nominal drill hole diameter	d_0	[mm]	10	12	12	14	14	16	18	20	25	30	35	35	40	40
Drill hole depth	h_0		$h_0 \geq h_{ef}$													
Effective embedment depth	$h_{ef,min}$		60		60		70		75	80	90	100	104	112	120	128
	$h_{ef,max}$		160		200		240		280	320	400	500	520	560	600	640
Simplified spacing and edge distance [2)]	s = c		40		45		55		60	65	85	120	120	140	140	160
Minimum thickness of concrete member	h_{min}		h_{ef} + 30 (≥ 100)					$h_{ef} + 2d_0$								

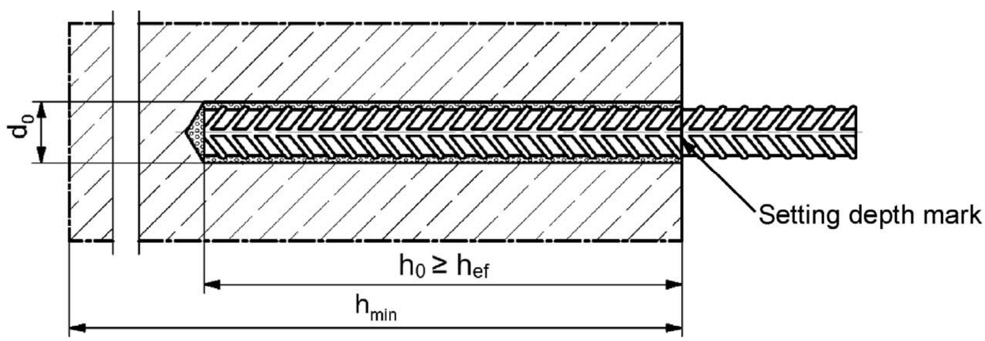
[1)] Both drill hole diameters can be used
[2)] Detailed calculation according to Annex B 6 und B 7

Rebar



- 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 rebar, h_{rib} = rib height)

Installation conditions:



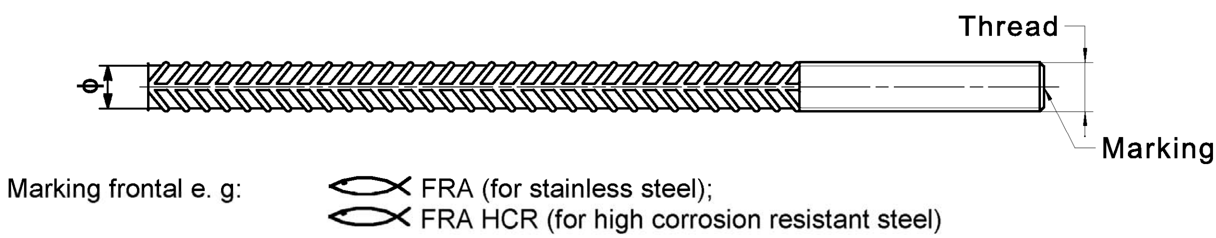
Figures not to scale

Table B5.1: Installation parameters for **fischer FRA**

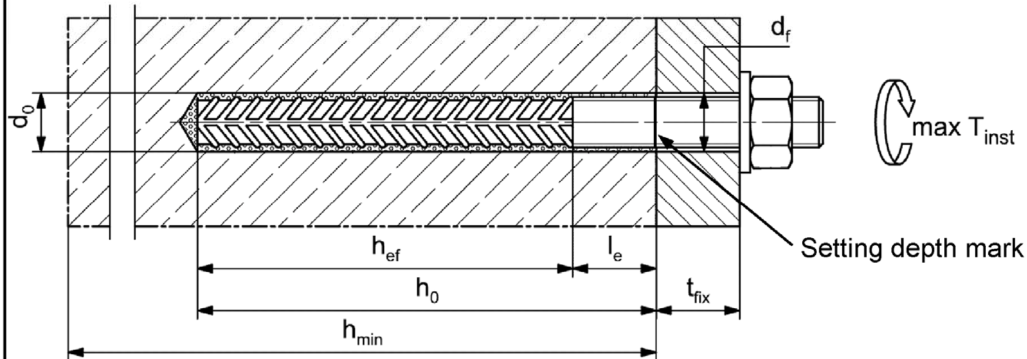
fischer FRA				**M12**[1)]		**M16**	**M20**	**M24**
Nominal diameter of the rebar		ϕ	[mm]	12		16	20	25
Nominal drill hole diameter		d_0	[mm]	14	16	20	25	30
Drill hole depth		h_0	[mm]	$h_{ef} + l_e$				
Effective embedment depth		$h_{ef,min}$	[mm]	70		80	90	96
		$h_{ef,max}$	[mm]	140		220	300	380
Distance concrete surface to welded joint		l_e	[mm]	100				
Simplified spacing and edge distance [2)]		s = c	[mm]	55		65	85	105
Diameter of clearance hole in the fixture	pre-positioned anchorage	$\leq d_f$	[mm]	14		18	22	26
	push through anchorage	$\leq d_f$	[mm]	18		22	26	32
Minimum thickness of concrete member		h_{min}	[mm]	$h_0 + 30$ (≥ 100)	$h_0 + 2d_0$			
Maximum torque moment for attachment of the fixture		max T_{inst}	[Nm]	40		60	120	150

1) Both drill hole diameters can be used
2) Detailed calculation according to Annex B 6 and B 7

fischer FRA



Installation conditions:



Figures not to scale

Table B6.1: Minimum spacing and minimum edge distance for **Anchor rods, Rebars and fischer FRA**

Anchor rods			**M8**	**M10**	**M12**	**-**	**M16**	**M20**
Rebars / fischer FRA (nominal diameter)	**ϕ**		**8**	**10**	**12**	**14**	**16**	**20**
Minimum edge distance								
Uncracked / cracked concrete	c_{min}	[mm]	40	45	45	45	50	55
Spacing	s	[mm]	according to Annex B 7					
Minimum spacing								
Uncracked / cracked concrete	s_{min}	[mm]	40	45	55	60	65	85
Edge distance	c	[mm]	according to Annex B 7					
Required projecting area								
Uncracked concrete	$A_{sp,req}$	[1000 mm²]	8,0	13,0	22,0	23,0	24,0	38,5
Cracked concrete	$A_{sp,req}$	[1000 mm²]	6,5	10,0	16,5	17,5	18,5	29,5

Anchor rods			**M24**	**-**	**-**	**M27**	**-**	**M30**	**-**
Rebars / fischer FRA (nominal diameter)	**ϕ**		**-**	**25**	**26**	**-**	**28**	**30**	**32**
Minimum edge distance									
Uncracked / cracked concrete	c_{min}	[mm]	60	75	75	75	80	80	120
Spacing	s	[mm]	according to Annex B 7						
Minimum spacing									
Uncracked / cracked concrete	s_{min}	[mm]	105	120	120	120	140	140	160
Edge distance	c	[mm]	according to Annex B 7						
Required projecting area									
Uncracked concrete	$A_{sp,req}$	[1000 mm²]	40,0	47,5	47,5	47,5	64,0	64,0	64,0
Cracked concrete	$A_{sp,req}$	[1000 mm²]	30,5	36,5	36,5	36,5	49,0	49,0	49,0

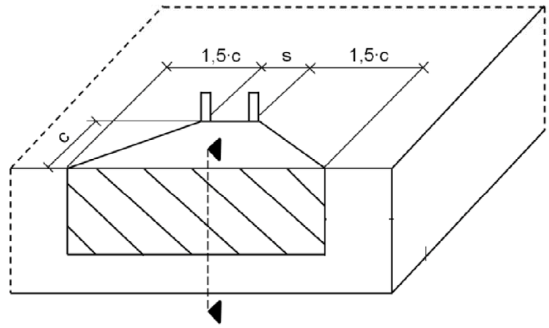
Splitting failure for minimum edge distance and spacing in dependence of the effective embedment depth h_{ef}.

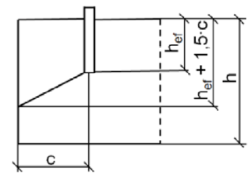
For the calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

$$\mathbf{A_{sp,req} < A_{sp}}$$

$A_{sp,req}$ = required projecting area
A_{sp} = projecting area (according to Annex B 7)

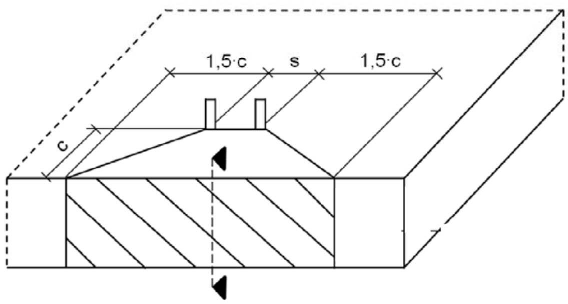
Table B7.1: Projecting area A_{sp} with concrete member thickness $h > h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$

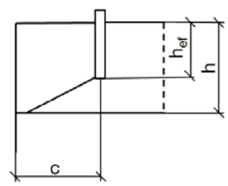




Single fastener	$A_{sp} = (3 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm²]	with $c \geq c_{min}$
Group of fastener with $s > 3 \cdot c$	$A_{sp} = (6 \cdot c) \cdot (h_{ef} + 1,5 \cdot c)$	[mm²]	
Group of fastener with $s \leq 3 \cdot c$	$A_{sp} = (3 \cdot c + s) \cdot (h_{ef} + 1,5 \cdot c)$	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

Table B7.2: Projecting area A_{sp} with concrete member thickness $h \leq h_{ef} + 1,5 \cdot c$ and $h \geq h_{min}$





Single fastener	$A_{sp} = 3 \cdot c \cdot$ existing h	[mm²]	with $c \geq c_{min}$
Group of fastener with $s > 3 \cdot c$	$A_{sp} = 6 \cdot c \cdot$ existing h	[mm²]	
Group of fastener with $s \leq 3 \cdot c$	$A_{sp} = (3 \cdot c + s) \cdot$ existing h	[mm²]	with $c \geq c_{min}$ and $s \geq s_{min}$

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

Figures not to scale

Table B8.1: Parameters of the **cleaning brush** BS (steel brush with steel bristles)

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	35	40
Steel brush diameter BS	d_b		11	14	16	20		25	26	27	30	40		42

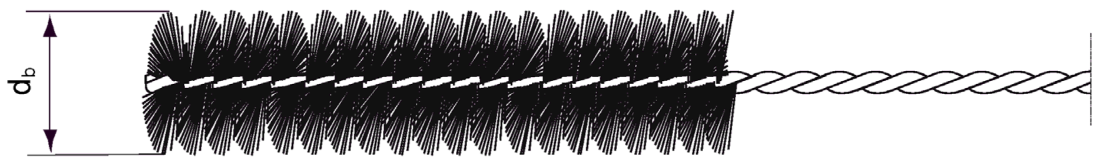


Table B8.2: Conditions for use **static mixer** without an **extension tube**

Nominal drill hole diameter	d_0	[mm]	10	12	14	16	18	20	24	25	28	30	35	40
Drill hole depth h_0 by using	FIS MR Plus		≤ 90		≤ 120	≤ 140	≤ 150	≤ 160	≤ 190	≤ 210				
	FIS UMR		-	-	≤ 90	≤ 160	≤ 180	≤ 190	≤ 220		≤ 250			

Table B8.3 **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 10	180 min	96 h
> 10 to 15	90 min	60 h
> 15 to 20	60 min	36 h
> 20 to 30	30 min	24 h
> 30 to 40	15 min	12 h

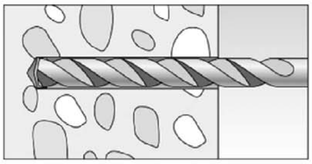
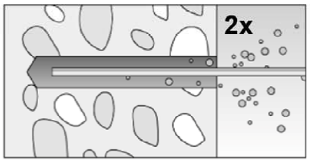
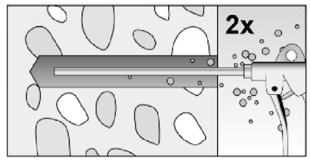
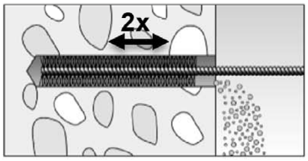
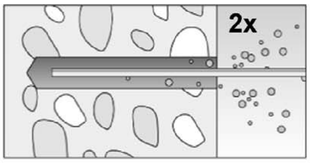
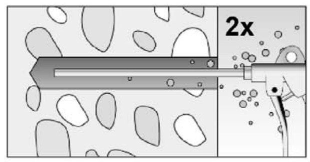
fischer injection system FIS EB II

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

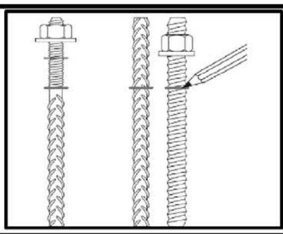
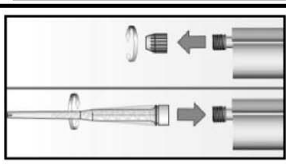
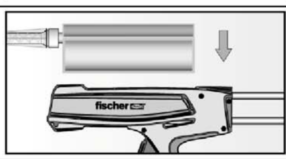
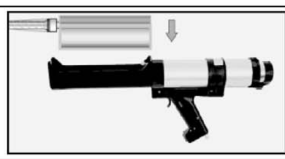
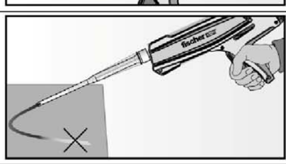
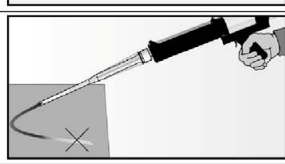
Annex B 8

Installation instructions part 1

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

1		Drill the hole. Nominal drill hole diameter $\mathbf{d_0}$ and drill hole depth $\mathbf{h_0}$ see **Tables B3.1, B4.1, B5.1.**		
2		Clean the drill hole: For $h_{ef} \leq 12d$ and $d_0 < 18$ mm blow out the hole twice by hand.		For $h_{ef} > 12d$ and / or $d_0 \geq 18$ mm blow out the hole twice with oil-free compressed air ($p \geq 6$ bar).
3		Brush the drill hole twice. For drill hole diameter $d_0 \geq 18$ mm and / or $h_{ef} > 12d$ use a power drill. For deep holes use an extension. Corresponding brushes see **Table B8.1.**		
4		Clean the drill hole: For $h_{ef} \leq 12d$ and $d_0 < 18$ mm blow out the hole twice by hand.		For $h_{ef} > 12d$ and / or $d_0 \geq 18$ mm blow out the hole twice with oil-free compressed air ($p \geq 6$ bar).

Preparing

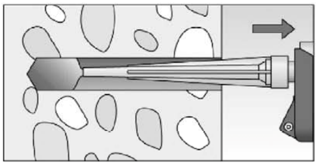
5			Mark the setting depth of the steel element
6			Remove the sealing cap Screw on the static mixer (the spiral in the static mixer must be clearly visible).
7			Place the cartridge into the dispenser.
8			Extrude approximately 10 cm of material out until the resin is evenly grey in colour. Do not use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

Go to Step 9

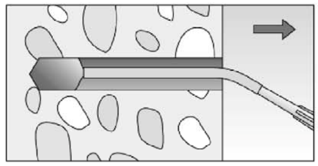
Installation instructions part 2

Injection of the mortar

9

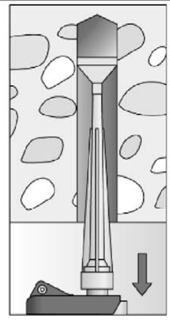


Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles.



The conditions for mortar injection without extension tube can be found in **Table B8.2**

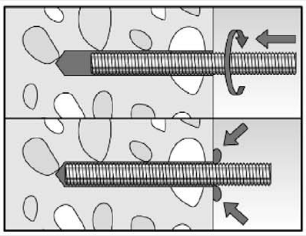
For deeper drill holes, than those mentioned in **Table B8.2,** use a suitable extension tube.



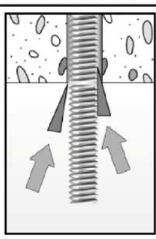
For overhead installation, deep holes (h_0 > 250 mm) or drill hole diameter (d_0 ≥ 30 mm) use an injection-adapter.

Installation of Anchor rods

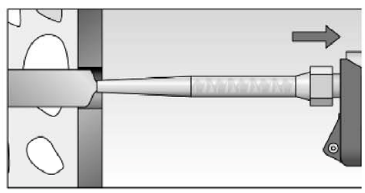
10



Only use clean and oil-free anchor elements.
Push the anchor rod with the setting depth mark 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) or fischer overhead clips.

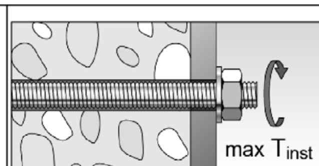


For push through installation fill the annular gap with mortar.

11

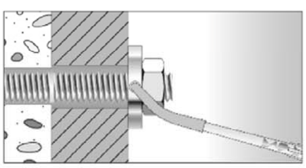
Wait for the specified curing time t_{cure} see **Table B8.3.**

12



Mounting the fixture max T_{inst} see **Table B3.1.**

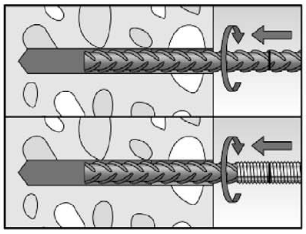
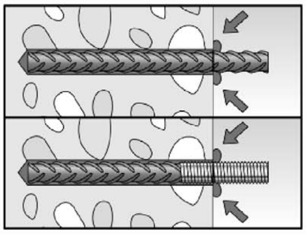
Option



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.
Compressive strength ≥ 50 N/mm² (e.g. fischer injection mortars FIS EB II, FIS SB, FIS V Plus, FIS EM Plus).
ATTENTION:
Using fischer filling disk reduces t_{fix} (usable length of the anchor).

Installation instructions part 3

Installation Rebars and fischer FRA

10		Only use clean and oil-free rebars or fischer FRA. Push the rebar or the fischer FRA with the setting depth mark into the filled hole up to the setting depth mark. Recommendation: Rotation back and forth of the rebar or the fischer FRA makes pushing easy.
		When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole.

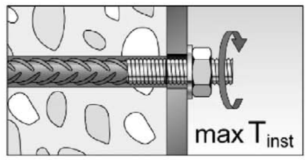
11	 Wait for the specified curing time t_{cure} see **Table B8.3**	12		Mounting the fixture max T_{inst} see **Table B5.1**

Table C1.1: Characteristic resistance to **steel failure** under **tension** and **shear loading** of **Anchor rods** and **Threaded rods**

Anchor rod / Threaded rod		Property class		M8	M10	M12	M16	M20	M24	M27	M30
Characteristic resistance to steel failure under tension loading [3]											
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	4.8	[kN]	14,6 (13,2)	23,2 (21,4)	33,7	62,8	98,0	141,2	183,6	224,4
		5.8		18,3 (16,6)	29,0 (26,8)	42,1	78,5	122,5	176,5	229,5	280,5
		8.8		29,2 (26,5)	46,4 (42,8)	67,4	125,6	196,0	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR	50		18,3	29,0	42,1	78,5	122,5	176,5	229,5	280,5
		70		25,6	40,6	59,0	109,9	171,5	247,1	321,3	392,7
		80		29,2	46,4	67,4	125,6	196,0	282,4	367,2	448,8
Partial factors [1]											
Partial factor γ_{Ms}	Steel zinc plated	4.8	[-]	1,50							
		5.8		1,50							
		8.8		1,50							
	Stainless steel R and high corrosion resistant steel HCR	50		2,86							
		70		1,87 / fischer HCR: 1,50							
		80		1,60							
Characteristic resistance to steel failure under shear loading [3]											
without lever arm											
Characteristic resistance $V^0_{Rk,s}$	Steel zinc plated	4.8	[kN]	8,7 (7,9)	13,9 (12,8)	20,2	37,6	58,8	84,7	110,1	134,6
		5.8		10,9 (9,9)	17,4 (16,0)	25,2	47,1	73,5	105,9	137,7	168,3
		8.8		14,6 (13,2)	23,2 (21,4)	33,7	62,8	98,0	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR	50		9,1	14,5	21,0	39,2	61,2	88,2	114,7	140,2
		70		12,8	20,3	29,5	54,9	85,7	123,5	160,6	196,3
		80		14,6	23,2	33,7	62,8	98,0	141,2	183,6	224,4
Ductility factor		k_7	[-]	1,0							
with lever arm											
Characteristic resistance $M^0_{Rk,s}$	Steel zinc plated	4.8	[Nm]	14,9 (12,9)	29,9 (26,5)	52,3	132,9	259,6	448,8	665,7	899,5
		5.8		18,7 (16,1)	37,3 (33,2)	65,4	166,2	324,6	561,0	832,2	1124,4
		8.8		29,9 (25,9)	59,8 (53,1)	104,6	265,9	519,3	897,6	1331,5	1799,0
	Stainless steel R and high corrosion resistant steel HCR	50		18,7	37,3	65,4	166,2	324,6	561,0	832,2	1124,4
		70		26,2	52,3	91,5	232,6	454,4	785,4	1165	1574,1
		80		29,9	59,8	104,6	265,9	519,3	897,6	1331,5	1799,0
Partial factors [1]											
Partial factor γ_{Ms}	Steel zinc plated	4.8	[-]	1,25							
		5.8		1,25							
		8.8		1,25							
	Stainless steel R and high corrosion resistant steel HCR	50		2,38							
		70		1,56 / fischer HCR: 1,25 [2]							
		80		1,33							

[1] In absence of other national regulations.
[2] Only admissible for high corrosion resistant steel HCR, with $f_{yk}/f_{uk} \leq 0,8$ and $f_{uk} \leq 800$ N/mm² (e.g. anchor rods).
[3] Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot dip galvanized threaded rods according to EN ISO 10684:2004+AC:2009.

Table C2.1: Characteristic resistance to **steel failure** under tension and shear loading of **Rebars**

Nominal diameter of the rebar		ϕ	8	10	12	14	16	20	25	26	28	30	32
Characteristic resistance to steel failure under tension loading													
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}$ 2)										
Characteristic resistance to steel failure under shear loading													
Without lever arm													
Characteristic resistance	$V^0_{Rk,s}$	[kN]	k_6 1) $\cdot A_s \cdot f_{uk}$ 2)										
Ductility factor	k_7	[-]	1,0										
With lever arm													
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}$ 2)										

1) In accordance with EN 1992-4:2018 section 7.2.2.3.1
k_6 = 0,6 for fasteners made of carbon steel with $f_{uk} \leq 500$ N/mm²
= 0,5 for fasteners made of carbon steel with $500 < f_{uk} \leq 1000$ N/mm²
= 0,5 for fasteners made of stainless steel

2) f_{uk} respectively shall be taken from the specifications of the rebar.

Table C2.2: Characteristic resistance to **steel failure** under tension ans shear loading of **fischer FRA**

fischer FRA			M12	M16	M20	M24
Characteristic resistance to steel failure under tension loading						
Characteristic resistance	$N_{Rk,s}$	[kN]	62,1	110,5	172,7	263,0
Partial factor1)						
Partial factor	γ_{Ms}	[-]	1,4			
Characteristic resistance to steel failure under shear loading						
Without lever arm						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	33,7	62,8	98,0	141,2
Ductility factor	k_7	[-]	1,0			
With lever arm						
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	104,8	266,3	519,2	898,0
Partial factor1)						
Partial factor	γ_{Ms}	[-]	1,25			

1) In absence of other national regulations.

Table C3.1: Characteristic resistance to **concrete failure** under **tension and shear loading**

Size			All sizes	
Tension loading				
Installation factor	γ_{inst}	[-]	See annex C 4 to C 6	
Factors for the compressive strength of concrete > C20/25				
			Uncracked concrete	Cracked concrete
Increasing factor ψ_c for cracked or uncracked concrete $\tau_{Rk\,(X,Y)} = \psi_c \cdot \tau_{Rk\,(C20/25)}$	C25/30	[-]	1,05	1,02
	C30/37		1,09	1,05
	C35/45		1,12	1,06
	C40/50		1,16	1,08
	C45/55		1,19	1,09
	C50/60		1,21	1,11

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				
Uncracked concrete		$k_{ucr,N}$	[-]	11,0
Cracked concrete		$k_{cr,N}$		7,7
Edge distance		$c_{cr,N}$	[mm]	$1{,}5\ h_{ef}$
Spacing		$s_{cr,N}$		$2\ c_{cr,N}$

Factors for sustained tension loading					
Temperature range		[-]	24 °C / 43 °C	43 °C / 60 °C	50 °C / 72 °C
Factor	ψ^0_{sus}	[-]	0,66	0,61	0,60

Shear loading			
Installation factor	γ_{inst}	[-]	1,0
Concrete pry-out failure			
Factor for pry-out failure	k_8	[-]	2,0
Concrete edge failure			
Effective length of fastener for shear loading	l_f	[mm]	for $d_{nom} \leq 24$ mm: min (h_{ef}; 12 d_{nom}) for $d_{nom} > 24$ mm: min (h_{ef}; 8 d_{nom}; 300 mm)

Effective diameter of the fastener d_{nom}										
Size			M8	M10	M12	M16	M20	M24	M27	M30
Anchor rods and Threaded rods	d_{nom}	[mm]	8	10	12	16	20	24	27	30
fischer FRA	d_{nom}		-[1)]	-[1)]	12	16	20	25	-[1)]	-[1)]

Size (nominal diameter of the rebar)		ϕ	8	10	12	14	16	20	25	26	28	30	32
Rebar	d_{nom}	[mm]	8	10	12	14	16	20	25	26	28	30	32

[1)] Anchor type not part of the assessment

Table C4.1: Characteristic resistance to **combined pull-out** and **concrete failure** for **Anchor rods** and **Threaded rods** in hammer drilled holes; **uncracked or cracked concrete**

Anchor rod / Threaded rod				**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Combined pullout and concrete cone failure											
Calculation diameter		d	[mm]	8	10	12	16	20	24	27	30
Uncracked concrete											
Characteristic bond resistance in uncracked concrete C20/25											
Hammer-drilling with standard drill bit (dry or wet concrete)											
Tem-perature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	14,0	14,0	14,0	14,0	13,0	12,0	12,0
	II: 43 °C / 60 °C			14,0	13,0	13,0	12,0	11,0	10,0	8,5	8,5
	III: 50 °C / 72 °C			9,0	9,0	9,0	9,0	9,0	8,5	8,0	7,5
Hammer-drilling with standard drill bit (water filled hole)											
Tem-perature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	14,0	14,0	14,0	14,0	12,0	12,0	12,0
	II: 43 °C / 60 °C			12,0	11,0	11,0	10,0	9,5	8,5	8,5	8,5
	III: 50 °C / 72 °C			9,0	9,0	9,0	8,5	8,0	7,5	7,0	6,5
Installation factors											
Dry or wet concrete		γ_{inst}	[-]	1,2							
Water filled hole				1,4							
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit (dry or wet concrete)											
Tem-perature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,0	6,5	6,0	6,0	5,5	5,5
	II: 43 °C / 60 °C			6,5	6,5	6,5	6,0	6,0	6,0	5,5	5,5
	III: 50 °C / 72 °C			6,0	6,0	6,0	5,5	5,5	5,5	5,0	5,0
Hammer-drilling with standard drill bit (water filled hole)											
Tem-perature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,0	6,5	6,0	6,0	5,5	5,5
	II: 43 °C / 60 °C			5,5	5,5	5,5	5,0	4,5	4,5	4,0	4,0
	III: 50 °C / 72 °C			5,5	5,5	5,5	5,0	4,0	4,0	4,0	4,0
Installation factors											
Dry or wet concrete		γ_{inst}	[-]	1,2							
Water filled hole				1,4							

Table C5.1: Characteristic resistance to **combined pull-out** and **concrete failure** for **Rebars** in hammer drilled holes; **uncracked or cracked concrete**

Rebars			**ϕ**	**8**	**10**	**12**	**14**	**16**	**20**	**25**	**26**	**28**	**30**	**32**
Combined pullout and concrete cone failure														
Calculation diameter		d	[mm]	8	10	12	14	16	20	25	26	28	30	32
Uncracked concrete														
Characteristic bond resistance in uncracked concrete C20/25														
Hammer-drilling with standard drill bit (dry or wet concrete)														
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	14,0	14,0	13,0	13,0	12,0	11,0	11,0	11,0	11,0	11,0
	II: 43 °C / 60 °C			14,0	13,0	13,0	12,0	11,0	10,0	10,0	9,0	8,5	8,0	8,0
	III: 50 °C / 72 °C			9,0	9,0	9,0	9,0	9,0	9,0	8,5	8,5	8,0	8,0	7,5
Hammer-drilling with standard drill bit (water filled hole)														
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	14,0	14,0	12,0	12,0	12,0	11,0	11,0	11,0	11,0	11,0
	II: 43 °C / 60 °C			11,0	11,0	10,0	9,5	9,5	9,0	8,5	8,5	8,5	7,5	7,5
	III: 50 °C / 72 °C			9,0	9,0	9,0	8,5	8,0	7,5	7,0	6,5	6,5	6,0	6,0
Installation factors														
Dry or wet concrete		γ_{inst}	[-]	1,2										
Water filled hole				1,4										
Cracked concrete														
Characteristic bond resistance in cracked concrete C20/25														
Hammer-drilling with standard drill bit (dry or wet concrete)														
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,0	6,5	6,5	6,0	6,0	5,5	5,5	5,5	5,5
	II: 43 °C / 60 °C			6,5	6,5	6,5	6,0	6,0	6,0	5,5	5,5	5,5	5,0	5,0
	III: 50 °C / 72 °C			6,0	6,0	6,0	6,0	5,5	5,5	5,5	5,0	5,0	5,0	4,5
Hammer-drilling with standard drill bit (water filled hole)														
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	7,0	7,0	7,0	6,5	6,0	6,0	5,5	5,5	5,5	5,5
	II: 43 °C / 60 °C			5,5	5,5	5,5	5,0	5,0	4,5	4,0	4,0	4,0	4,0	3,5
	III: 50 °C / 72 °C			5,5	5,5	5,5	5,0	5,0	4,0	4,0	4,0	4,0	4,0	3,5
Installation factors														
Dry or wet concrete		γ_{inst}	[-]	1,2										
Water filled hole				1,4										

Table C6.1: Characteristic resistance for **combined pull-out** and **concrete failure** for **fischer FRA** in hammer drilled holes; **uncracked or cracked concrete**

fischer 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 (dry or wet concrete)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	13,0	12,0	11,0
	II: 43 °C / 60 °C			13,0	11,0	10,0	10,0
	III: 50 °C / 72 °C			9,0	9,0	9,0	8,5
Hammer-drilling with standard drill bit (water filled hole)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,ucr}$	[N/mm²]	14,0	12,0	12,0	11,0
	II: 43 °C / 60 °C			10,0	9,5	9,0	8,5
	III: 50 °C / 72 °C			9,0	8,0	7,5	7,0
Installation factors							
Dry or wet concrete		γ_{inst}	[-]	1,2			
Water filled hole				1,4			
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,5	6,0	6,0
	II: 43 °C / 60 °C			6,5	6,0	6,0	5,5
	III: 50 °C / 72 °C			6,0	5,5	5,5	5,5
Hammer-drilling with standard drill bit (water filled hole)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,5	6,0	6,0
	II: 43 °C / 60 °C			5,5	5,0	4,5	4,0
	III: 50 °C / 72 °C			5,5	5,0	4,0	4,0
Installation factors							
Dry or wet concrete		γ_{inst}	[-]	1,2			
Water filled hole				1,4			

Table C7.1: Displacements for Anchor rods and Threaded rods

Anchor rod		M8	M10	M12	M16	M20	M24	M27	M30
Displacement-Factors for tension loading[1]									
Uncracked or cracked concrete; Temperature range I, II, III									
$\delta_{N0\text{-Factor}}$	[mm/(N/mm²)]	0,08	0,08	0,09	0,10	0,11	0,12	0,12	0,13
$\delta_{N\infty\text{-Factor}}$		0,11	0,12	0,13	0,15	0,16	0,17	0,18	0,19
Displacement-Factors for shear loading[2]									
Uncracked or cracked concrete; Temperature range I, II, III									
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,19	0,15	0,13	0,10	0,08	0,07	0,06	0,05
$\delta_{V\infty\text{-Factor}}$		0,28	0,22	0,19	0,14	0,11	0,10	0,09	0,08

1) Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$

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

τ = acting bond strength under tension loading

2) Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$

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

V = acting shear loading

Table C7.2: Displacements for Rebars and fischer FRA

Nominal diameter of the rebar	ϕ	8	10	12	14	16	20	25	26	28	30	32
fischer FRA		-[1]	-[1]	M12	-[1]	M16	M20	M24	-[1]	-[1]	-[1]	-[1]
Displacement-Factors for tension loading[2]												
Uncracked or cracked concrete; Temperature range I, II, III												
$\delta_{N0\text{-Factor}}$	[mm/(N/mm²)]	0,08	0,08	0,09	0,10	0,10	0,11	0,12	0,12	0,13	0,13	0,13
$\delta_{N\infty\text{-Factor}}$		0,11	0,12	0,13	0,14	0,15	0,16	0,18	0,18	0,19	0,19	0,20
Displacement-Factors for shear loading[3]												
Uncracked or cracked concrete; Temperature range I, II, III												
$\delta_{V0\text{-Factor}}$	[mm/kN]	0,19	0,15	0,13	0,11	0,10	0,08	0,06	0,06	0,06	0,05	0,05
$\delta_{V\infty\text{-Factor}}$		0,28	0,22	0,19	0,16	0,14	0,11	0,09	0,09	0,08	0,08	0,07

1) Anchor type not part of the assessment

2) Calculation of effective displacement:

$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$

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

τ = acting bond strength under tension loading

3) Calculation of effective displacement:

$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$

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

V = acting shear loading

Table C8.1: Characteristics resistance to **steel failure** under tension / shear loading of **Anchor rods** and **Threaded rods** under seismic action performance category **C1 or C2**

Anchor rod / Threaded rod					**M12**	**M14**	**M16**	**M20**	**M22**	**M24**	**M27**	**M30**
Characteristic resistance to steel failure under tension loading[1)]												
Anchor rods and Threaded rods, performance category C1												
Characteristic resistance $N_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	[kN]	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
			5.8		42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			8.8		67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR		50		42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
			70		59,0	80,5	109,9	171,5	212,1	247,1	321,3	392,7
			80		67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
Anchor rods and Threaded rods, performance category C2												
Characteristic resistance $N_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	[-]	30,3	-[2)]	56,5	88,2	-[2)]	141,2	-[2)]	-[2)]
			5.8		37,9	-[2)]	70,6	110,2	-[2)]	176,5	-[2)]	-[2)]
			8.8		60,6	-[2)]	113,0	176,4	-[2)]	282,4	-[2)]	-[2)]
	Stainless steel R and high corrosion resistant steel HCR		50		37,9	-[2)]	70,6	110,2	-[2)]	176,5	-[2)]	-[2)]
			70		53,1	-[2)]	98,9	154,3	-[2)]	247,1	-[2)]	-[2)]
			80		60,6	-[2)]	113,0	176,4	-[2)]	282,4	-[2)]	-[2)]
Characteristic resistance to steel failure under shear loading without lever arm[1)]												
Anchor rods, performance category C1												
Characteristic resistance $V^0_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	[kN]	20,2	27,6	37,6	58,8	72,7	84,7	110,1	134,6
			5.8		25,2	34,5	47,1	73,5	90,9	105,9	137,7	168,3
			8.8		33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR		50		21,0	28,7	39,2	61,2	75,7	88,2	114,7	140,2
			70		29,5	40,2	54,9	85,7	106,0	123,5	160,6	196,3
			80		33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
Threaded rods, performance category C1												
Characteristic resistance $V^0_{Rk,s,C1}$	Steel zinc plated	Property class	4.8	[kN]	14,1	19,3	26,3	41,1	50,9	59,3	77,1	94,2
			5.8		17,7	24,1	32,9	51,4	63,6	74,1	96,3	117,8
			8.8		23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0
	Stainless steel R and high corrosion resistant steel HCR		50		14,7	20,1	27,4	42,8	53,0	61,7	80,3	98,1
			70		20,6	28,1	38,4	60,0	74,2	86,4	112,4	137,4
			80		23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0
Anchor rods and Threaded rods, performance category C2												
Characteristic resistance $V^0_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	[-]	13,3	-[2)]	28,2	45,2	-[2)]	77,0	-[2)]	-[2)]
			5.8		16,6	-[2)]	35,3	56,5	-[2)]	96,3	-[2)]	-[2)]
			8.8		22,2	-[2)]	47,1	75,4	-[2)]	128,4	-[2)]	-[2)]
	Stainless steel R and high corrosion resistant steel HCR		50		13,9	-[2)]	29,4	47,1	-[2)]	80,3	-[2)]	-[2)]
			70		19,4	-[2)]	41,2	66,0	-[2)]	112,4	-[2)]	-[2)]
			80		22,2	-[2)]	47,1	75,4	-[2)]	128,4	-[2)]	-[2)]

[1)] Partial factors for performance category C1 or C2 see **table C10.1**; for anchor rods the factor for steel ductility is 1,0

[2)] No performance assessed

Table C9.1: Characteristic resistance to **steel failure** under tension / shear loading of **Rebars (B500B)** under seismic action performance category **C1 or C2**

Nominal diameter of the rebar		**ϕ**	**12**	**14**	**16**	**20**	**25**	**26**	**28**	**30**
Characteristic resistance to steel failure under tension loading[1]										
Rebar B500B acc. to DIN 488-2:2009-08, performance category C1										
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	61,0	83,1	108,5	169,5	265,1	286,2	332,6	381,2
Rebar B500B acc. to DIN 488-2:2009-08, performance category C2										
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	54,9	-[2]	97,6	152,6	-[2]	-[2]	-[2]	-[2]
Characteristic resistance to steel failure under shear loading, without lever arm[1]										
Rebar B500B acc. to DIN 488-2:2009-08, performance category C1										
Characteristic resistance	$V^0_{Rk,s,C1}$	[kN]	21,3	29,1	37,9	59,3	92,7	100,1	116,4	133,4
Rebar B500B acc. to DIN 488-2:2009-08, performance category C2										
Characteristic resistance	$V^0_{Rk,s,C2}$	[kN]	20,1	-[2]	40,7	65,2	-[2]	-[2]	-[2]	-[2]

[1] Partial factors for performance category C1 or C2 see table C10.1
[2] No performance assessed

Table C9.2: Characteristic resistance to **steel failure** under tension / shear loading of **fischer FRA** under seismic action performance category **C1 or C2**

fischer FRA			**M12**	**M16**	**M20**	**M24**
Characteristic resistance to steel failure under tension loading[1]						
fischer FRA, performance category C1						
Characteristic resistance	$N_{Rk,s,C1}$	[kN]	62,1	110,5	172,7	263,0
fischer FRA, performance category C2						
Characteristic resistance	$N_{Rk,s,C2}$	[kN]	55,8	99,4	155,4	-[2]
Characteristic resistance to steel failure under shear loading, without lever arm[1]						
fischer FRA, performance category C1						
Characteristic resistance	$V^0_{Rk,s,C1}$	[kN]	33,7	62,8	98,0	141,2
fischer FRA, performance category C2						
Characteristic resistance	$V^0_{Rk,s,C2}$	[kN]	22,2	47,1	75,4	-[2]

[1] Partial factors for performance category C1 or C2 see table C10.1
[2] No performance assessed

Table C10.1: Partial factors for **Anchor rods, Threaded rods**, **Rebars (B500B)** and **fischer FRA** under seismic action performance category **C1 or C2**

		M12	M16	M20	M24	M27	M30
Anchor rod / Threaded rod		**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
fischer FRA		**M12**	**M16**	**M20**	**M24**	**-**[3)]	**-**[3)]

Nominal diameter of the rebar	**ϕ**	**12**	**14**	**16**	**20**	**25**	**26**	**28**	**30**

Tension loading, steel failure[1)]					
Partial factor γ_{Ms}	Steel zinc plated	Property class	4.8	[-]	1,50
			5.8		1,50
			8.8		1,50
	Stainless steel R and high corrosion resistant steel HCR		50		2,86
			70		1,87 / fischer HCR: 1,50
			80		1,60
	Rebar		B500B		1,40
	fischer		FRA		1,40

Shear loading, steel failure[1)]					
Partial factor γ_{Ms}	Steel zinc plated	Property class	4.8	[-]	1,25
			5.8		1,25
			8.8		1,25
	Stainless steel R and high corrosion resistant steel HCR		50		2,38
			70		1,56 / fischer HCR: 1,25[2)]
			80		1,33
	Rebar		B500B		1,50
	fischer		FRA		1,50

1) In absence of other national regulations
2) Only admissible for high corrosion resistant steel HCR, with $f_{yk}/f_{uk} \leq 0{,}8$ and $f_{uk} \leq 800$ N/mm² (e.g. anchor rods)
3) Anchor type not part of the assessment

Table C11.1: Characteristics **resistance** for **combined pull-out** and **concrete failure** for **Anchor rods** and **Threaded rods** in hammer drilled holes under seismic action performance category **C1**

Anchor rod / Threaded rod				**M12**	**M16**	**M20**	**M24**	**M27**	**M30**
Characteristic bond resistance, combined pull-out and concrete cone failure									
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)									
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C1}$	[N/mm²]	6,5	5,6	5,0	5,5	5,5	5,5
	II: 43 °C / 60 °C			6,5	5,6	5,0	5,5	5,5	5,5
	III: 50 °C / 72 °C			5,7	5,5	5,0	5,0	5,0	5,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)									
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C1}$	[N/mm²]	6,5	5,0	4,7	4,7	4,7	4,7
	II: 43 °C / 60 °C			6,5	5,0	4,7	4,7	4,7	4,7
	III: 50 °C / 72 °C			5,7	5,5	5,0	5,0	5,0	5,0
Installation factors									
Tension loading									
Dry or wet concrete		γ_{inst}	[-]	1,2					
Water filled hole				1,4					

Table C11.2: Characteristics **resistance** for **combined pull-out** and **concrete failure** for **Rebars** and **fischer FRA** in hammer drilled holes under seismic action performance category **C1**

Nominal diameter of the rebar			**ϕ**	**12**	**14**	**16**	**20**	**25**	**26**	**28**	**30**
fischer FRA				**M12**	**-** [1)]	**M16**	**M20**	**M24**	**-** [1)]	**-** [1)]	**-** [1)]
Characteristic bond resistance, combined pull-out and concrete cone failure											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C1}$	[N/mm²]	6,5	6,0	6,0	6,0	5,5	5,5	5,5	5,5
	II: 43 °C / 60 °C			6,5	6,0	6,0	6,0	5,5	5,5	5,5	5,5
	III: 50 °C / 72 °C			5,7	5,5	5,5	5,0	5,0	5,0	5,0	5,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C1}$	[N/mm²]	6,5	6,0	5,0	4,7	4,7	4,7	4,7	4,7
	II: 43 °C / 60 °C			6,5	6,0	5,0	4,7	4,7	4,7	4,7	4,7
	III: 50 °C / 72 °C			5,7	5,5	5,5	4,7	4,7	4,7	4,7	4,7
Installation factors											
Tension loading											
Dry or wet concrete		γ_{inst}	[-]	1,2							
Water filled hole				1,4							

1) Anchor type not part of the assessment

Table C12.1: Characteristics **resistance** for **combined pull-out** and **concrete failure** for **Anchor rods** and **Threaded rods** in hammer drilled holes under seismic action performance category **C2**

Anchor rod / Threaded rod				M12	M16	M20	M24
Characteristic bond resistance, combined pull-out and concrete cone failure							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C2}$	[N/mm²]	3,5	5,0	3,5	3,5
	II: 43 °C / 60 °C			3,5	5,0	3,5	3,5
	III: 50 °C / 72 °C			2,7	3,8	2,6	2,9
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C2}$	[N/mm²]	3,5	5,6	3,8	3,0
	II: 43 °C / 60 °C			3,5	5,2	3,6	3,0
	III: 50 °C / 72 °C			2,7	3,8	2,6	2,8
Installation factors							
Tension loading							
Dry or wet concrete		γ_{inst}	[-]	1,2			
Water filled hole				1,4			
Displacement-Factors for tension loading[1)]							
$\delta_{N,(DLS)}$-Factor			[mm/(N/mm²)]	0,06	0,11	0,08	0,12
$\delta_{N,(ULS)}$-Factor				0,13	0,14	0,09	0,18
Displacement-Factors for shear loading[2)]							
$\delta_{V,(DLS)}$-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:

$\delta_{N,C2(DLS)} = \delta_{N,(DLS)\text{-Factor}} \cdot \tau$

$\delta_{N,C2(ULS)} = \delta_{N,(ULS)\text{-Factor}} \cdot \tau$

τ = acting bond strength under tension loading

2) Calculation of effective displacement:

$\delta_{V,C2(DLS)} = \delta_{V,(DLS)\text{-Factor}} \cdot V$

$\delta_{V,C2(ULS)} = \delta_{V,(ULS)\text{-Factor}} \cdot V$

V = acting shear loading

Table C13.1: Characteristics **resistance** for **combined pull-out** and **concrete failure** for **Rebars** and **fischer FRA** in hammer drilled holes under seismic action performance category **C2**

Nominal diameter of the rebar		ϕ		**12**	**16**	**20**
fischer FRA				**M12**	**M16**	**M20**
Characteristic bond resistance, combined pull-out and concrete cone failure						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C2}$	[N/mm²]	3,5	5,0	3,5
	II: 43 °C / 60 °C			3,5	5,0	3,5
	III: 50 °C / 72 °C			2,7	3,8	2,6
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 43 °C	$\tau_{Rk,C2}$	[N/mm²]	3,5	5,6	3,8
	II: 43 °C / 60 °C			3,5	5,2	3,6
	III: 50 °C / 72 °C			2,7	3,8	2,6
Installation factors						
Tension loading						
Dry or wet concrete		γ_{inst}	[-]		1,2	
Water filled hole					1,4	
Displacement-Factors for tension loading[1]						
$\delta_{N,(DLS)\text{-Factor}}$			[mm/(N/mm²)]	0,06	0,11	0,08
$\delta_{N,(ULS)\text{-Factor}}$				0,13	0,14	0,09
Displacement-Factors for shear loading[2]						
$\delta_{V,(DLS)\text{-Factor}}$			[mm/kN]	0,18	0,10	0,07
$\delta_{V,(ULS)\text{-Factor}}$				0,25	0,14	0,11

[1] Calculation of effective displacement:

$\delta_{N,C2(DLS)} = \delta_{N,(DLS)\text{-Factor}} \cdot \tau$

$\delta_{N,C2(ULS)} = \delta_{N,(ULS)\text{-Factor}} \cdot \tau$

τ = acting bond strength under tension loading

[2] Calculation of effective displacement:

$\delta_{V,C2(DLS)} = \delta_{V,(DLS)\text{-Factor}} \cdot V$

$\delta_{V,C2(ULS)} = \delta_{V,(ULS)\text{-Factor}} \cdot V$

V = acting shear loading

Table C14.1: Fire resistance to steel failure under tension and shear loading of Anchor rods and Threaded rods

Fire resistance to steel failure under tension and shear loading						
Anchor rod / Threaded rod	**R30**			**R60**		
Steel zinc plated	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	0,4	0,4	0,4	0,3	0,3	0,3
M10	0,9	0,9	1,1	0,8	0,8	1,0
M12	1,7	1,7	2,6	1,3	1,3	2,0
M16	3,1	3,1	6,7	2,4	2,4	5,0
M20	4,9	4,9	13,0	3,7	3,7	9,7
M24	7,1	7,1	22,5	5,3	5,3	16,8
M27	9,2	9,2	33,3	6,9	6,9	25,0
M30	11,2	11,2	45,0	8,4	8,4	33,7
Anchor rod / Threaded rod	**R90**			**R120**		
Steel zinc plated	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,3	0,3	0,3	0,2	0,2	0,2
M10	0,6	0,6	0,7	0,5	0,5	0,6
M12	1,1	1,1	1,7	0,8	0,8	1,3
M16	2,0	2,0	4,3	1,6	1,6	3,3
M20	3,2	3,2	8,4	2,5	2,5	6,5
M24	4,6	4,6	14,6	3,5	3,5	11,2
M27	6,0	6,0	21,6	4,6	4,6	16,6
M30	7,3	7,3	29,2	5,6	5,6	22,5
Anchor rod / Threaded rod	**R30**			**R60**		
Stainless steel R and high corrosion resistant steel HCR	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	0,7	0,7	0,7	0,6	0,6	0,6
M10	1,5	1,5	1,9	1,2	1,2	1,5
M12	2,5	2,5	3,9	2,1	2,1	3,3
M16	4,7	4,7	10,0	3,9	3,9	8,3
M20	7,4	7,4	19,5	6,1	6,1	16,2
M24	10,6	10,6	33,7	8,8	8,8	28,1
M27	13,8	13,8	49,9	11,5	11,5	41,6
M30	16,8	16,8	67,5	14,0	14,0	56,2
Anchor rod / Threaded rod	**R90**			**R120**		
Stainless steel R and high corrosion resistant steel HCR	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,4	0,4	0,4	0,4	0,4	0,4
M10	0,9	0,9	1,2	0,8	0,8	1,0
M12	1,7	1,7	2,6	1,3	1,3	2,1
M16	3,1	3,1	6,7	2,5	2,5	5,3
M20	4,9	4,9	13,0	3,9	3,9	10,4
M24	7,1	7,1	22,5	5,6	5,6	18,0
M27	9,2	9,2	33,3	7,3	7,3	26,6
M30	11,2	11,2	45,0	9,0	9,0	36,0

Table C15.1: **Fire resistance** to **steel failure** under **tension** and **shear loading** of **Rebars** and **fischer FRA**

Fire resistance to steel failure under tension and shear loading						
Rebar	**R30**			**R60**		
Bars and de-coiled rods	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
ϕ 8	0,5	0,5	0,6	0,5	0,5	0,5
ϕ 10	1,2	1,2	1,8	1,0	1,0	1,5
ϕ 12	2,3	2,3	4,1	1,7	1,7	3,0
ϕ 14	3,1	3,1	6,5	2,3	2,3	4,9
ϕ 16	4,0	4,0	9,6	3,0	3,0	7,2
ϕ 20	6,3	6,3	18,8	4,7	4,7	14,1
ϕ 25	9,8	9,8	36,8	7,4	7,4	27,6
ϕ 26	10,6	10,6	41,4	8,0	8,0	31,1
ϕ 28	12,3	12,3	51,8	9,2	9,2	38,8
ϕ 30	14,1	14,1	63,6	10,6	10,6	47,7
ϕ 32	16,1	16,1	77,2	12,1	12,1	57,9
Rebar	**R90**			**R120**		
Bars and de-coiled rods	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
ϕ 8	0,4	0,4	0,4	0,3	0,3	0,3
ϕ 10	0,8	0,8	1,2	0,6	0,6	0,9
ϕ 12	1,5	1,5	2,6	1,1	1,1	2,0
ϕ 14	2,0	2,0	4,2	1,5	1,5	3,2
ϕ 16	2,6	2,6	6,3	2,0	2,0	4,8
ϕ 20	4,1	4,1	12,2	3,1	3,1	9,4
ϕ 25	6,4	6,4	23,9	4,9	4,9	18,4
ϕ 26	6,9	6,9	26,9	5,3	5,3	20,7
ϕ 28	8,0	8,0	33,6	6,2	6,2	25,9
ϕ 30	9,2	9,2	41,4	7,1	7,1	31,8
ϕ 32	10,5	10,5	50,2	8,0	8,0	38,6
fischer FRA	**R30**			**R60**		
Stainless steel R and high corrosion resistant steel HCR	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M12	2,5	2,5	3,9	2,1	2,1	3,3
M16	4,7	4,7	10,0	3,9	3,9	8,3
M20	7,4	7,4	19,5	6,1	6,1	16,2
M24	10,6	10,6	33,7	8,8	8,8	28,1
fischer FRA	**R90**			**R120**		
Stainless steel R and high corrosion resistant steel HCR	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M12	1,7	1,7	2,6	1,3	1,3	2,1
M16	3,1	3,1	6,7	2,5	2,5	5,3
M20	4,9	4,9	13,0	3,9	3,9	10,4
M24	7,1	7,1	22,5	5,6	5,6	18,0

Characteristic bond resistance for cracked concrete under fire conditions for Anchor rods, Threaded rods, Rebars and fischer FRA for hammer drilled holes

The characteristic bond resistance for cracked concrete under fire conditions for a given temperature $\tau_{Rk,fi}(\theta)$ has to be calculated by the following equation:

$$\tau_{Rk,fi}(\theta) = k_{fi,p}(\theta) \cdot \tau_{Rk,cr,C20/25}$$

θ	=	Temperature in °C in the mortar layer
$\tau_{Rk,fi}(\theta)$	=	Characteristic bond resistance for cracked and uncracked concrete under fire exposure for a given temperature in N/mm² for concrete classes C20/25 to C50/60
$k_{fi,p}(\theta)$	=	Reduction factor under fire conditions
$\tau_{Rk,cr,C20/25}$	=	Characteristic bond resistance for cracked concrete C20/25 in N/mm², given in Table C4.1, Table C5.1 or Table C6.1, respectively

Anchor rods and Threaded rods	If: $\theta > 20$ °C If: $\theta > \theta_{max} = 373$ °C	$k_{fi,p}(\theta) = 61,573 \cdot \theta^{-1,400} \geq 1,0$ $k_{fi,p}(\theta) = 0$	see Figure C16.1
Rebars and fischer FRA	If: $\theta > 23$ °C If: $\theta > \theta_{max} = 236$ °C	$k_{fi,p}(\theta) = 252,678 \cdot \theta^{-1,777} \geq 1,0$ $k_{fi,p}(\theta) = 0$	see Figure C16.2

Figure C16.1: Graph of reduction factor $k_{fi,p}$ (θ) for anchor rods threaded rods

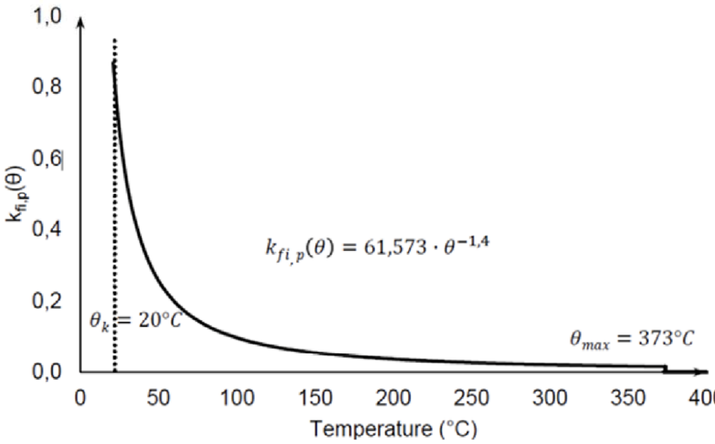


Figure C16.2: Graph of reduction factor $k_{fi,p}$ (θ) for rebars and fischer FRA