

PRESTANDEDEKLARATION

DoP 0190

för fischer injektionssystem FIS EM Plus (Metallankare för användning i betong)

SV

| | | | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| 1. <u>Produkttypens unika identifikationskod:</u> | DoP 0190 | | |
| 2. <u>Avsedd användning/avsedda användningar:</u> | Infästning i efterhand i sprucken och osprucken betong. Se bilaga, särskilt bilagor B1- B13 | | |
| 3. <u>Tillverkare:</u> | fischerwerke GmbH & Co. KG, Otto-Hahn-Straße 15, 79211 Denzlingen, Tyskland | | |
| 4. <u>Tillverkarens representant:</u> | – | | |
| 5. <u>System för bedömning och fortlöpande kontroll av prestanda:</u> | 1 | | |
| 6. <u>Europeiskt bedömningsdokument:</u> Europeisk teknisk bedömning: Tekniskt bedömningsorgan: Anmält/anmälda organ: | EAD 330499-01-0601 ETA-17/0979; 2020-06-17 DIBt- Deutsches Institut für Bautechnik 1343 MPA Darmstadt / 2873 TU Darmstadt | | |
| 7. <u>Angiven prestanda:</u> Mekanisk hållfasthet och stabilitet (BWR 1) Karakteristisk bärförmåga för spänning (för statisk och kvasi-statisk belastning): | Stålets motståndskraft: Motstånd mot kombinerat fel vid utdragning och betongkon: Motstånd i betongkonen: Kantavstånd för att slippa sprickor under last: Kraftighet: Maximal vridkraft vid installation: Minsta kant- och axelavstånd: | Bilagor C1- C3 Bilagor C5- C12 Bilagor C4 Bilagor C4 Bilagor C4 Bilagor B6- B8 Bilagor B4, B5 | $E_s = 210\,000\text{ MPa}$ $\psi_{sub}^0 = \text{NPD}$ |
| Karakteristisk bärförmåga för skjuvning (för statisk och kvasi-statisk belastning): | Motstånd i stålet: Motstån mot fläkning: Motstånd mot skador i betong: | Bilagor C1- C3 Bilagor C4 Bilagor C4 | |
| Karakteristiskt motstånd och Förskjutningar för seismiska prestandakategorier C1 och C2: | Motstånd mot draglast, förskjutningar, kategori C1: Motstånd mot draglast, förskjutningar, kategori C2: Motstånd mot tvärlast, förskjutningar, kategori C1: Motstånd mot tvärlast, förskjutningar, kategori C2: Faktor cirkulärt hål: | Bilagor C15- C17 Bilagor C15, C16, C18 Bilagor C15- C17 Bilagor C15, C16, C18 Bilagor C15 | |
| Förflyttningar under kort- och långvarig belastning: | Förflyttningar under kort- och långvarig belastning: | Bilagor C13, C14 | |
| Hygien, hälsa och miljö (BWR 3) Innehåll, frisläppning och / eller frisläppning av farliga ämnen: | NPA | | |



8. Lämplig teknisk dokumentation och/eller särskild teknisk dokumentation: -

Prestandan för ovanstående produkt överensstämmer med den angivna prestandan. Denna prestandadeklaration har utfärdats i enlighet med förordning (EU) nr 305/2011 på eget ansvar av den tillverkare som anges ovan.

Undertecknad på tillverkarens vägnar av:

Thilo Pregartner, Dr.-Ing.
Tumlingen, 2020-07-02

Peter Schillinger, Dipl.-Ing.

Denna DoP har förberetts på olika språk. I händelse av tvist om tolkningen ska den engelska versionen alltid råda.

Bilagan innehåller frivilliga och kompletterande information på engelska som överskrider (det specifika språkets) lagkrav.

Specific Part

1 Technical description of the product

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

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

The product description is given in Annex A.

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

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

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 or 100 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 B 3 to B 8, C 1 to C 12 |
| Characteristic resistance to shear load (static and quasi-static loading) | See Annex C 1 to C 4 |
| Displacements under short-term and long-term loading | See Annex C 13 and C 14 |
| Characteristic resistance and displacements for seismic performance categories C1 and C2 | See Annex C 15 to C 18 |

3.2 Hygiene, health and the environment (BWR 3)

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

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

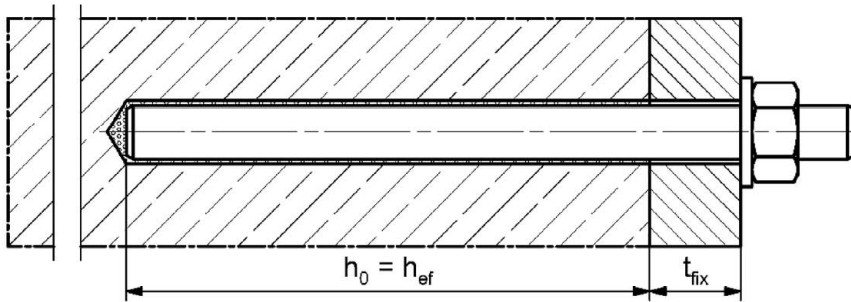
In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

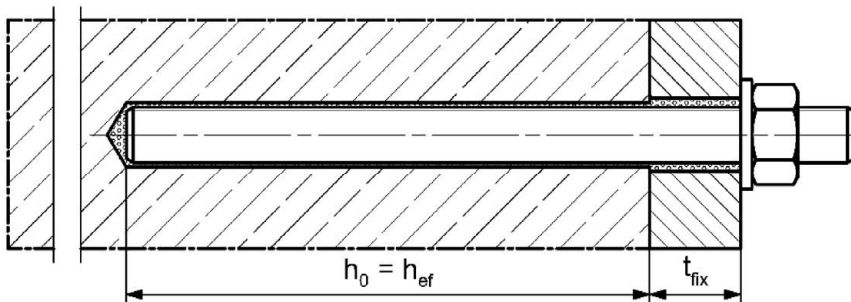
Installation conditions part 1

fischer anchor rod

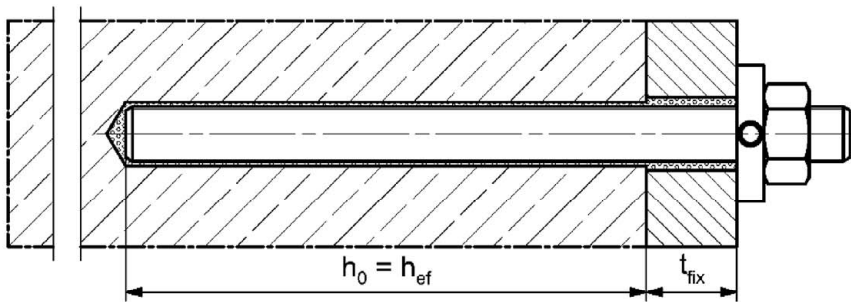
Pre-positioned installation



Push through installation (annular gap filled with mortar)



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



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

fischer injection system FIS EM Plus

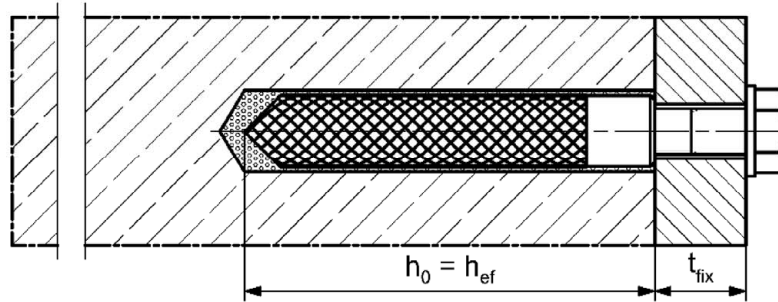
Product description
Installation conditions part 1

Annex A 1
Appendix 3/ 39

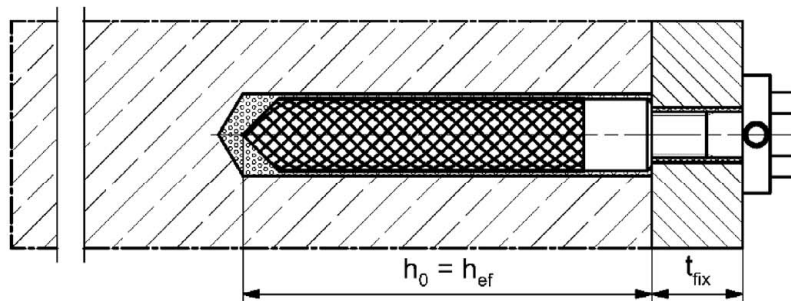
Installation conditions part 2

fischer internal threaded anchor RG MI

Pre-positioned installation



Pre-positioned installation with subsequently injected fischer filling disc (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

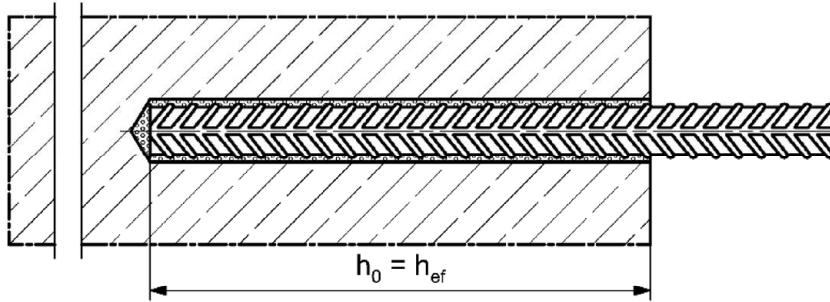
fischer injection system FIS EM Plus

Product description
Installation conditions part 2

Annex A 2
Appendix 4/ 39

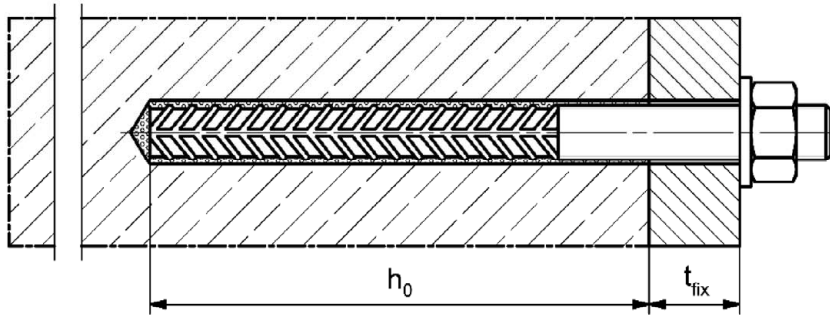
Installation conditions part 3

Reinforcing bar

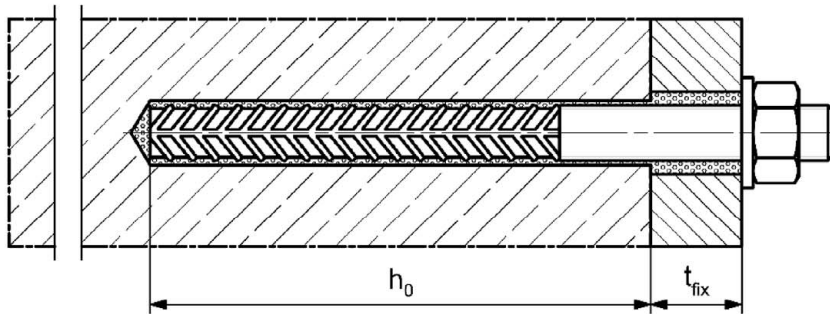


fischer rebar anchor FRA

Pre-positioned installation



Push through installation (annular gap filled with mortar)



Figures not to scale

h_0 = drill hole depth

h_{ef} = effective embedment depth

t_{fix} = thickness of fixture

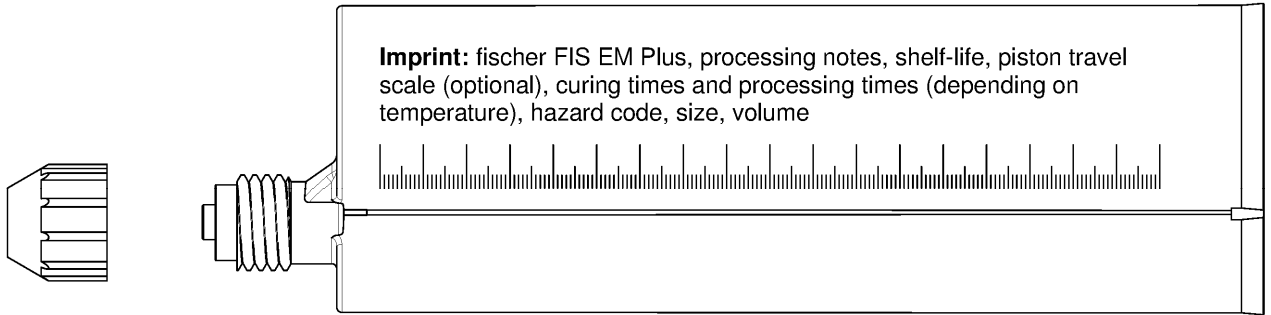
fischer injection system FIS EM Plus

Product description
Installation conditions part 3

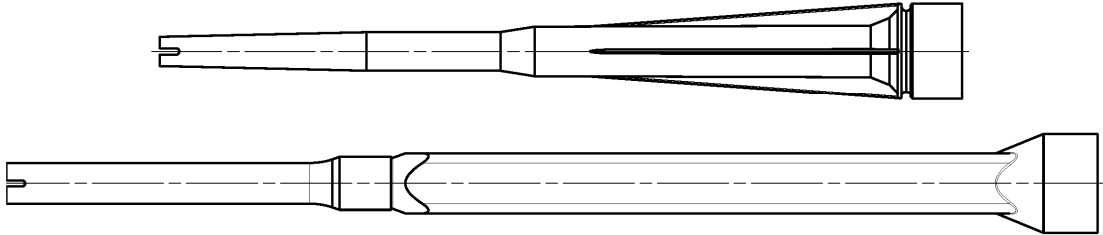
Annex A 3
Appendix 5/ 39

Overview system components part 1

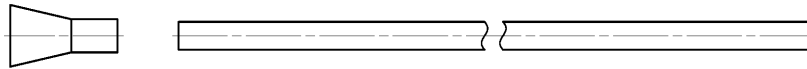
Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1100 ml, 1500 ml



Static mixer FIS MR Plus or UMR



Injection adapter and Extension tube for static mixer



Cleaning brush BS / BSB



Blow-out pump ABP



Figures not to scale

fischer injection system FIS EM Plus

Product description

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

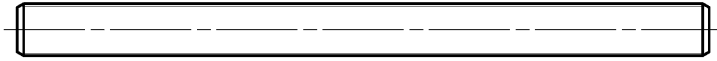
Annex A 4

Appendix 6/ 39

Overview system components part 2

fischer anchor rod

Size: M8, M10, M12, M14, M16, M20, M22, M24, M27, M30

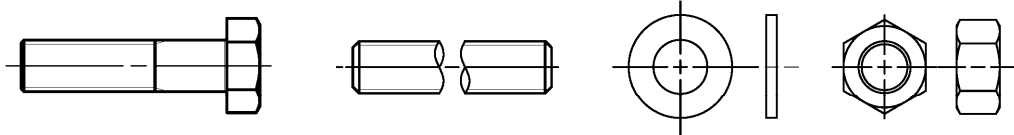


fischer internal threaded anchor RG MI

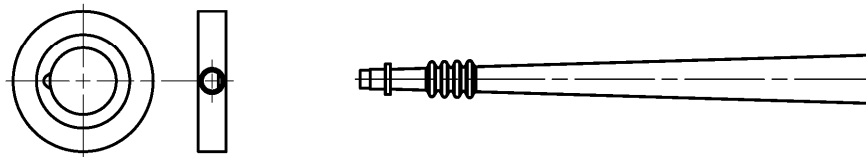
Size: M8, M10, M12, M16, M20



Screw / threaded rod / washer / hexagon nut



fischer filling disc with injection adapter



Reinforcing bar

Nominal diameter: $\phi 8$, $\phi 10$, $\phi 12$, $\phi 14$, $\phi 16$, $\phi 18$, $\phi 20$, $\phi 22$, $\phi 24$, $\phi 25$, $\phi 26$, $\phi 28$, $\phi 30$, $\phi 32$, $\phi 34$, $\phi 36$, $\phi 40$



fischer rebar anchor FRA

Size: M12, M16, M20, M24



Figures not to scale

fischer injection system FIS EM Plus

Product description

Overview system components part 2;
steel components

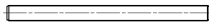






Annex A 5
Appendix 7/ 39

Table A6.1: Materials

| Part | Designation | Material | | |
|--------------------------------------|--------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | Injection cartridge | Mortar, hardener, filler | | |
| | Steel grade | Steel | Stainless steel R | High corrosion resistant steel HCR |
| | | zinc plated | acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2015 | acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4:2015 |
| 2 | Anchor rod | Property class 4.8, 5.8 or 8.8; EN ISO 898-1:2013 zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation | Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; 1.4062, 1.4662, 1.4462; EN 10088-1:2014 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation | Property class 50 or 80 EN ISO 3506-1:2009 or property class 70 with $f_{yk} = 560 \text{ N/mm}^2$ 1.4565; 1.4529; EN 10088-1:2014 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12\%$ fracture elongation |
| | | Fracture elongation $A_5 > 8 \%$, for applications without requirements for seismic performance category C2 | | |
| 3 | Washer ISO 7089:2000 | zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004 | 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 | 1.4565; 1.4529; EN 10088-1:2014 |
| 4 | Hexagon nut | Property class 4, 5 or 8; EN ISO 898-2:2012 zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004 | Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 | Property class 50, 70 or 80 EN ISO 3506-1:2009 1.4565; 1.4529 EN 10088-1:2014 |
| 5 | fischer internal threaded anchor RG MI | Property class 5.8 ISO 898-1:2013 zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) | Property class 70 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 | Property class 70 EN ISO 3506-1:2009 1.4565; 1.4529; EN 10088-1:2014 |
| 6 | Commercial standard screw or threaded rod for fischer internal threaded anchor RG MI | Property class 5.8 or 8.8; EN ISO 898-1:2013 zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) $A_5 > 8 \%$ fracture elongation | Property class 70 EN ISO 3506-1:2009 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation | Property class 70 EN ISO 3506-1:2009 1.4565; 1.4529; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation |
| 7 | fischer filling disc similar to DIN 6319-G | zinc plated $\geq 5 \mu\text{m}$, ISO 4042:2018/Zn5/An(A2K) or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004 | 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 | 1.4565; 1.4529; EN 10088-1:2014 |
| 8 | Reinforcing bar EN 1992-1-1:2004 and AC:2010, Annex C | Bars and de-coiled rods, class B or C with f_{yk} and k according to NDP or NCL according to EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$ | | |
| 9 | fischer rebar anchor FRA | Rebar part: Bars and de-coiled rods class B or C with f_{yk} and k according to NDP or NCL of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$ | Threaded part: Property class 70 or 80 EN ISO 3506-1:2009 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 1993-1-4:2015 1.4565; 1.4529 acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4:2015 | |
| fischer injection system FIS EM Plus | | | | Annex A 6 Appendix 8/ 39 |
| Product description Materials | | | | |

Specifications of intended use (part 1)

Table B1.1: Overview use and performance categories

| Anchorages subject to | | FIS EM Plus with ... | | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------|----------------------------------------------------|
| | | Anchor rod  | fischer internal threaded anchor RG MI  | Reinforcing bar  | | fischer rebar anchor FRA  | | | |
| Hammer drilling with standard drill bit  | | all sizes | | | | | | | |
| Hammer drilling with hollow drill bit (fischer "FHD", Heller "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD", DreBo „D-Plus“, DreBo „D-Max“)  | | Nominal drill bit diameter (d_0) 12 mm to 35 mm | | | | | | | |
| Diamond drilling  | | all sizes | | | | | | | |
| Static and quasi static load, in | uncracked concrete | all sizes | Tables: C1.1 C4.1 C5.1 C6.1 C13.1 | all sizes | Tables: C2.1 C4.1 C7.1 C8.1 C13.2 | all sizes | Tables: C3.1 C4.1 C9.1 C10.1 C14.1 | all sizes | Tables: C3.2 C4.1 C11.1 C12.1 C14.2 |
| | cracked concrete | | | | | | | | |
| Seismic performance category (only hammer drilling with standard / hollow drill bits) | C1 | M10 to M30 | Tables: C15.1 C16.2 C17.1 | -1) | -1) | -1) | Tables: C16.1 C16.2 C17.2 | -1) | -1) |
| | C2 | M12 M16 M20 M24 | Tables: C15.1 C16.2 C18.1 | | | | -1) | | |
| Use category | I1 dry or wet concrete | all sizes | | | | | | | |
| | I2 water filled hole | all sizes (not permitted in combined with working life 100 years) | | | | | | | |
| Installation direction | D3 (downward and horizontal and upwards (e.g. overhead) installation) | | | | | | | | |
| Installation temperature | $T_{i,min} = -5\text{ °C}$ to $T_{i,max} = +40\text{ °C}$ | | | | | | | | |
| In-service temperature | Temperature range I | -40 °C to +60 °C | | (max. short term temperature +60 °C; max. long term temperature +35 °C) | | | | | |
| | Temperature range II | -40 °C to +72 °C | | (max. short term temperature +72 °C; max. long term temperature +50 °C) | | | | | |

¹⁾ no performance assessed

fischer injection system FIS EM Plus

Intended use
Specifications (part 1)

Annex B 1
Appendix 9/ 39

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+A1:2016

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 EN1993-1-4:2015 corresponding to corrosion resistance classes to Annex A 6 table A6.1.

Design:

- Anchorages have to be designed by a responsible engineer with experience of concrete anchor design.
- Verifiable calculation notes and drawings are to be prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed in accordance with:
EN 1992-4:2018 and EOTA Technical Report TR 055, Edition February 2018

Installation:

- Anchor installation is to be carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site
- In case of aborted hole: The hole shall be filled with mortar
- Anchorage depth should be marked and adhered to on installation
- Overhead installation is allowed

fischer injection system FIS EM Plus

Intended use
Specifications (part 2)

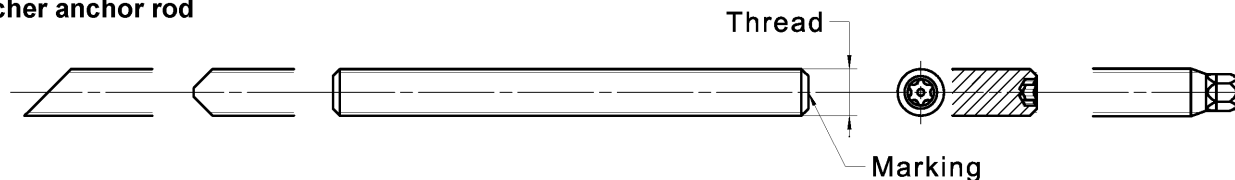
Annex B 2
Appendix 10/ 39

Table B3.1: Installation parameters for anchor rods

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

¹⁾ Both drill hole diameters can be used

fischer anchor rod



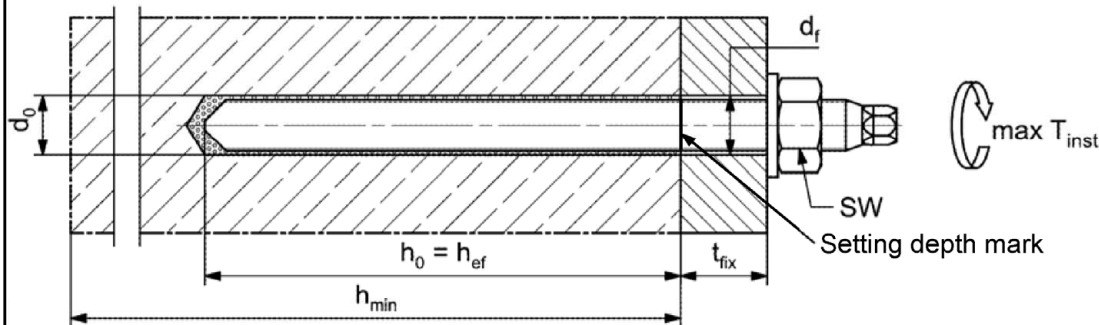
Marking (on random place) fischer anchor rod:

| | | | |
|--------------------------------------------------------|--------|--------------------------------------------------------|---|
| Steel zinc plated 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:



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

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

Figures not to scale

fischer injection system FIS EM Plus

Intended use

Installation parameters anchor rods

Annex B 3

Appendix 11/ 39

Table B4.1: Minimum spacing and minimum edge distance for **anchor rods** and **reinforcing bars**

| Anchor rods | | M8 | M10 | M12 | M14 | M16 | - | M20 | M22 | M24 |
|--------------------------------------------|--------------|-------------------------|-----------------------|------|------|------|------|------|------|------|
| Reinforcing bars (nominal diameter) ϕ | | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 |
| Minimum edge distance | | | | | | | | | | |
| Uncracked / cracked concrete | c_{min} | [mm] | 40 | 45 | 45 | 45 | 50 | 55 | 55 | 60 |
| Minimum spacing | s_{min} | | according to Annex B5 | | | | | | | |
| Minimum spacing | | | | | | | | | | |
| Uncracked / cracked concrete | s_{min} | [mm] | 40 | 45 | 55 | 60 | 65 | 85 | 85 | 105 |
| Minimum edge distance | c_{min} | | according to Annex B5 | | | | | | | |
| Required projecting area | | | | | | | | | | |
| Uncracked concrete | $A_{sp,req}$ | [1000 mm ²] | 8 | 13 | 22 | 23 | 24 | 38,5 | 38,5 | 40 |
| Cracked concrete | | | 6,5 | 10 | 16,5 | 17,5 | 18,5 | 29,5 | 29,5 | 30,5 |
| Anchor rods | | | | | | | | | | |
| Reinforcing bars (nominal diameter) ϕ | | - | - | M27 | - | M30 | - | - | - | - |
| Reinforcing bars (nominal diameter) ϕ | | 25 | 26 | - | 28 | 30 | 32 | 34 | 36 | 40 |
| Minimum edge distance | | | | | | | | | | |
| Uncracked / cracked concrete | c_{min} | [mm] | 75 | 75 | 75 | 80 | 80 | 120 | 120 | 175 |
| Minimum spacing | s_{min} | | according to Annex B5 | | | | | | | |
| Minimum spacing | | | | | | | | | | |
| Uncracked / cracked concrete | s_{min} | [mm] | 120 | 120 | 120 | 140 | 140 | 160 | 160 | 160 |
| Minimum edge distance | c_{min} | | according to Annex B5 | | | | | | | |
| Required projecting area | | | | | | | | | | |
| Uncracked concrete | $A_{sp,req}$ | [1000 mm ²] | 47,5 | 47,5 | 47,5 | 64 | 64 | 64 | 64 | 64 |
| Cracked concrete | | | 36,5 | 36,5 | 36,5 | 49 | 49 | 49 | 49 | 49 |

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:

$$A_{sp,req} < A_{sp,t}$$

$A_{sp,req}$ = required projecting area

$A_{sp,t} = A_{sp,ef}$ = effective projecting area (according to Annex B5)

fischer injection system FIS EM Plus

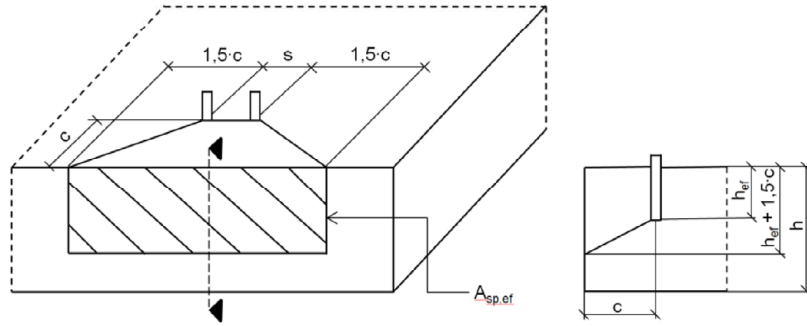
Intended use

Minimum spacing and edge distance for anchor rods and reinforcing bars

Annex B 4

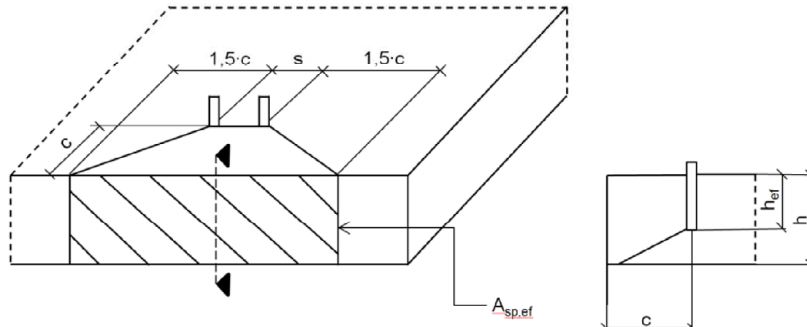
Appendix 12/ 39

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



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

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



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

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

Figures not to scale

fischer injection system FIS EM Plus

Intended use

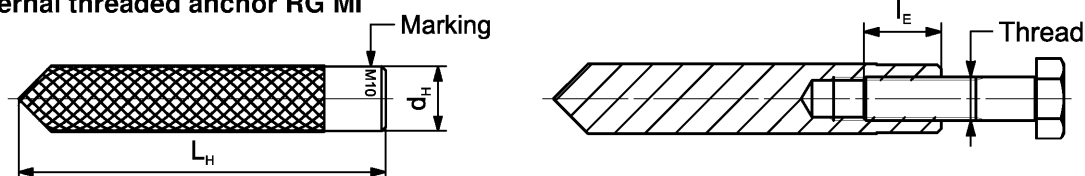
Minimum thickness of concrete member for anchor rods,
minimum spacing and edge distance

Annex B 5
Appendix 13/ 39

Table B6.1: Installation parameters for **fischer internal threaded anchors RG MI**

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

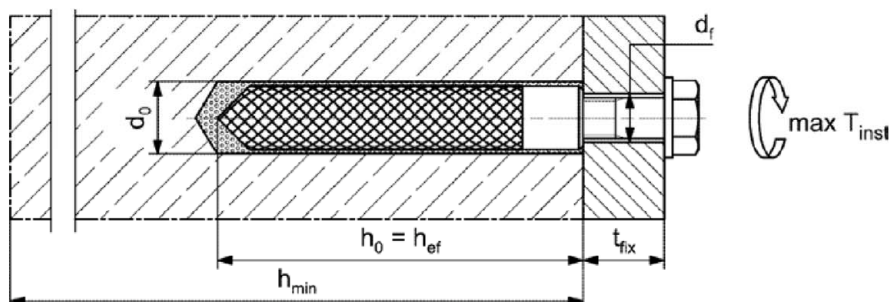
fischer internal threaded anchor RG MI



Marking: Anchor size e. g.: **M10**
 Stainless steel → additional **R**; e.g.: **M10 R**
 High corrosion resistant steel → additional **HCR**; e.g.: **M10 HCR**

Retaining bolt or threaded rods (including nut and washer) must comply with the appropriate material and strength class of Annex A 6, Table A6.1

Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use

Installation parameters internal threaded anchors RG MI

Annex B 6

Appendix 14/ 39

Table B7.1: Installation parameters for reinforcing bars ¹⁾

| Nominal diameter of the bar | | ϕ | 8 ²⁾ | 10 ²⁾ | 12 ²⁾ | 14 | 16 | 18 | 20 | 22 | 24 | | | |
|--------------------------------------|--------------|--------|---------------------------------|------------------|------------------|-----|-----------------|-----|-----|-----|-----|----|----|----|
| Nominal drill hole diameter | d_0 | [mm] | 10 | 12 | 12 | 14 | 14 | 16 | 18 | 20 | 25 | 25 | 30 | 30 |
| Drill hole depth | h_0 | | $h_0 = h_{ef}$ | | | | | | | | | | | |
| Effective embedment depth | $h_{ef,min}$ | | 60 | 60 | 70 | 75 | 80 | 85 | 90 | 94 | 98 | | | |
| | $h_{ef,max}$ | | 160 | 200 | 240 | 280 | 320 | 360 | 400 | 440 | 480 | | | |
| Minimum thickness of concrete member | h_{min} | | $h_{ef} + 30$ (≥ 100) | | | | $h_{ef} + 2d_0$ | | | | | | | |

| Nominal diameter of the bar | | ϕ | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 | - | |
|--------------------------------------|--------------|--------|-----------------|-----|-----|-----|-----|-----|-----|-----|---|--|
| Nominal drill hole diameter | d_0 | [mm] | 30 | 35 | 35 | 40 | 40 | 40 | 45 | 55 | - | |
| Drill hole depth | h_0 | | $h_0 = h_{ef}$ | | | | | | | | | |
| Effective embedment depth | $h_{ef,min}$ | | 100 | 104 | 112 | 120 | 128 | 136 | 144 | 160 | - | |
| | $h_{ef,max}$ | | 500 | 520 | 560 | 600 | 640 | 680 | 720 | 800 | - | |
| Minimum thickness of concrete member | h_{min} | | $h_{ef} + 2d_0$ | | | | | | | | | |

¹⁾ minimum spacing and minimum edge distance see Annex B 4

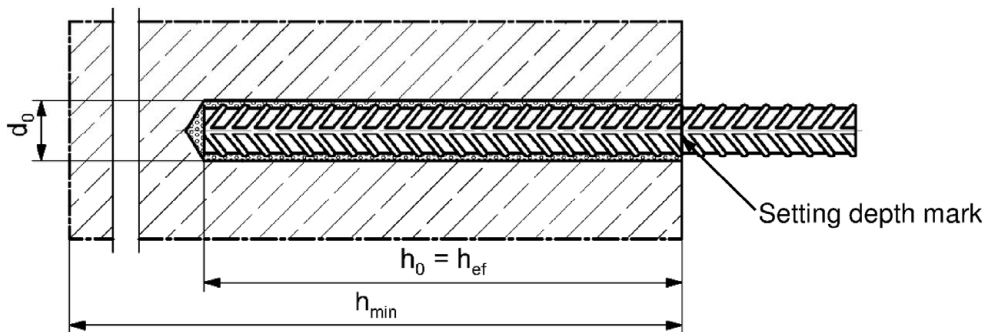
²⁾ Both drill hole diameters can be used

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)

Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use
Installation parameters reinforcing bars

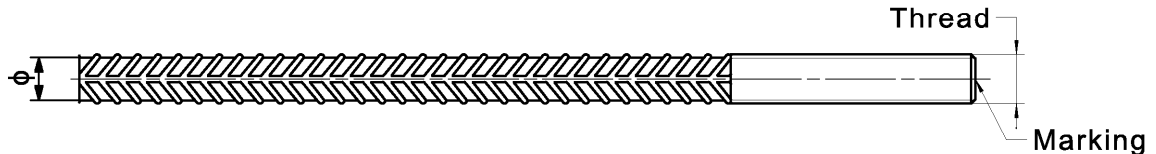
Annex B 7
Appendix 15/ 39



Table B8.1: Installation parameters for **fischer rebar anchor FRA**

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

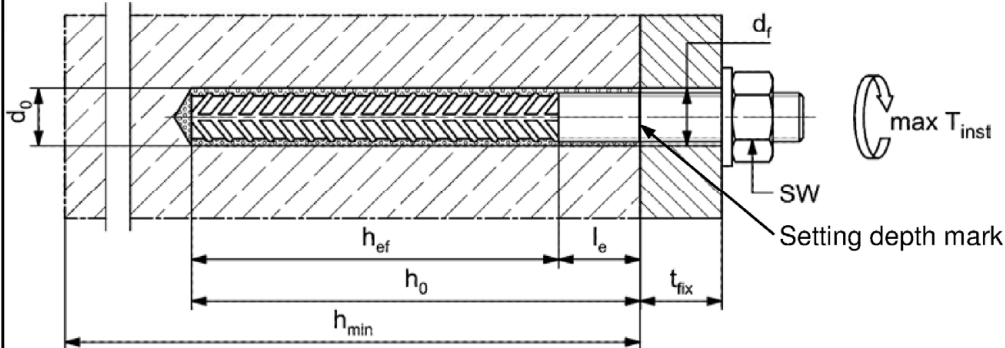
¹⁾ Both drill hole diameters can be used

fischer rebar anchor FRA



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

Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use

Installation parameters rebar anchor FRA

Annex B 8

Appendix 16/ 39

Table B9.1: Parameters of the **cleaning brush BS / BSB** (steel brush with steel bristles)

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

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

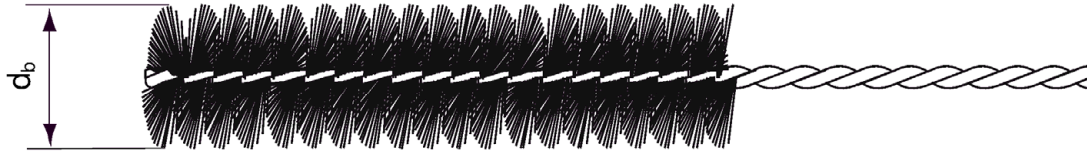


Table B9.2 **Maximum processing time** of the mortar and **minimum curing time** (During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

| Temperature at anchoring base [°C] | Maximum processing time t_{work} | Minimum curing time ¹⁾ t_{cure} |
|------------------------------------|------------------------------------|----------------------------------------------|
| -5 to 0 ²⁾ | 240 min | 200 h |
| > 0 to 5 ²⁾ | 150 min | 90 h |
| > 5 to 10 | 120 min | 40 h |
| > 10 to 20 | 30 min | 18 h |
| > 20 to 30 | 14 min | 10 h |
| > 30 to 40 | 7 min | 5 h |

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

²⁾ Minimal cartridge temperature +5°C

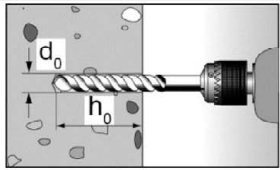
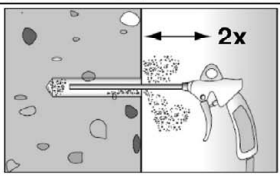

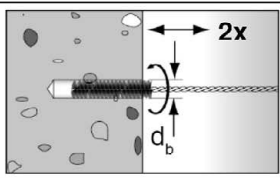
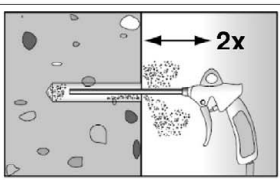

fischer injection system FIS EM Plus

Intended use

Cleaning brush (steel brush)
Processing time and curing time


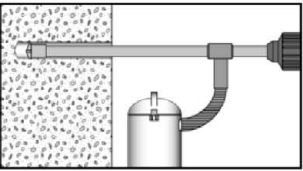
Installation instructions part 1

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

| | | |
|---|-----------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 |  | <p>Drill the hole. Nominal drill hole diameter d_0 and drill hole depth h_0 see tables B3.1, B6.1, B7.1, B8.1</p> |
| 2 |  | <p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air ($p \geq 6$ bar)</p>  |
| 3 |  | <p>Brush the drill hole twice. For drill hole diameter ≥ 30 mm use a power drill. For deep holes use an extension. Corresponding brushes see table B9.1</p> |
| 4 |  | <p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air ($p \geq 6$ bar)</p>  |

Go to step 6

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

| | | |
|---|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 |  | <p>Check a suitable hollow drill (see table B1.1) for correct operation of the dust extraction</p> |
| 2 |  | <p>Use a suitable dust extraction system, e. g. fischer FVC 35 M or a comparable dust extraction system with equivalent performance data</p> <p>Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Nominal drill hole diameter d_0 and drill hole depth h_0 see tables B3.1, B6.1, B7.1, B8.1</p> |

Go to step 6

fischer injection system FIS EM Plus

Intended use

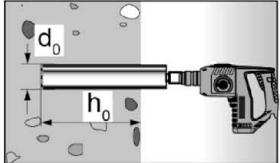
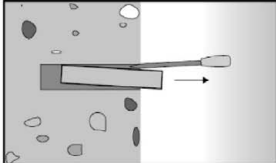
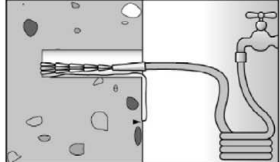
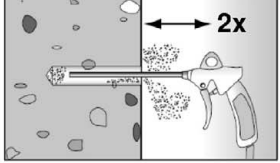
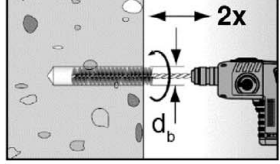
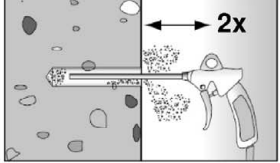
Installation instructions part 1

Annex B 10

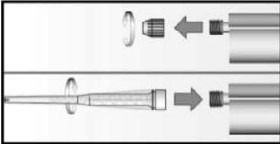

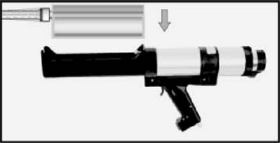


Appendix 18/ 39

Installation instructions part 2

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

| | | | | |
|---|------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|-------------------------------------------|
| 1 |  | <p>Drill the hole. Drill hole diameter d_0 and nominal drill hole depth h_0 see tables B3.1, B6.1, B7.1, B8.1</p> |  | <p>Break the drill core and remove it</p> |
| 2 |  | <p>Flush the drill hole with clean water until it flows clear</p> | | |
| 3 |  | <p>Blow out the drill hole twice, using oil-free compressed air ($p > 6$ bar)</p> | | |
| 4 |  | <p>Brush the drill hole twice using a power drill. Corresponding brushes see table B9.1</p> | | |
| 5 |  | <p>Blow out the drill hole twice, using oil-free compressed air ($p > 6$ bar)</p> | | |

Preparing the cartridge

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

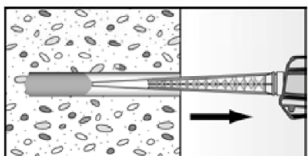
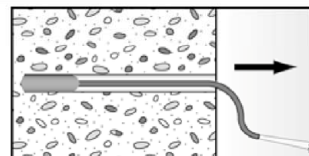
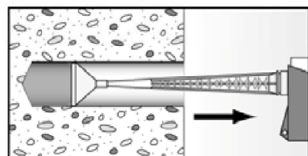
fischer injection system FIS EM Plus

Intended use
Installation instructions part 2

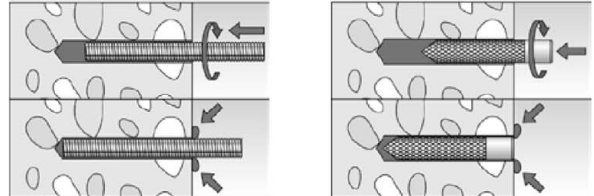
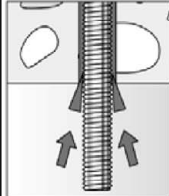
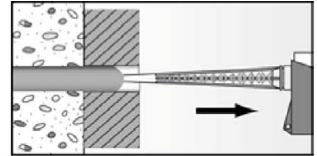

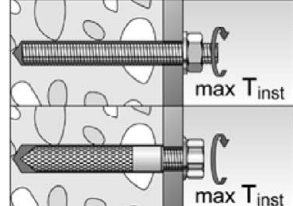
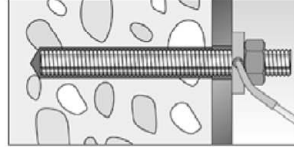
Annex B 11
Appendix 19/ 39

Installation instructions part 3

Injection of the mortar

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

Installation of anchor rods or fischer internal threaded anchors RG MI

| | | |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>10</p> |  | <p>Only use clean and oil-free metal parts. Mark the setting depth of the metal parts. Push the anchor rod or fischer internal threaded RG MI anchor down to the bottom of the hole, turning it slightly while doing so. After inserting the metal part, excess mortar must be emerged around the anchor element.</p> |
| |  <p>For overhead installations support the metal part with wedges (e. g. fischer centering wedges) or fischer overhead clips.</p> |  <p>For push through installation fill the annular gap with mortar</p> |
| <p>11</p> |  <p>Wait for the specified curing time t_{cure} see table B9.2</p> | <p>12</p>  <p>Mounting the fixture $\max T_{inst}$ see tables B3.1 and B6.1</p> |
| <p>Option</p> |  | <p>After the minimum curing time is reached, the gap between metal part 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 HB, FIS SB, FIS V, FIS EM Plus) ATTENTION: Using fischer filling disc reduces t_{fix} (usable length of the anchor)</p> |

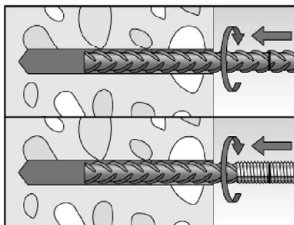
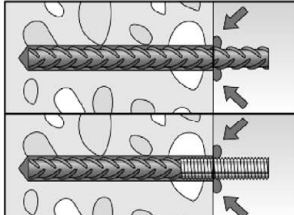

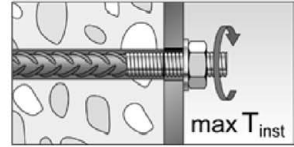
fischer injection system FIS EM Plus

Intended use
Installation instructions part 3

Annex B 12
Appendix 20/ 39

Installation instructions part 4

Installation reinforcing bars and fischer rebar anchor FRA

| | | | |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 10 |  | <p>Only use clean and oil-free reinforcing bars or fischer FRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the fischer FRA into the filled hole up to the setting depth mark</p> | |
| 10 |  | <p>When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole.</p> | |
| 11 |  <p>Wait for the specified curing time t_{cure} see table B9.2</p> | 12 |  <p>Mounting the fixture $\max T_{inst}$ see table B8.1</p> |

fischer injection system FIS EM Plus

Intended use
 Installation instructions part 4

Annex B 13
 Appendix 21/ 39

Table C1.1: Characteristic values for **steel failure** under tension / shear load of **fischer anchor rods** and **standard threaded rods**

| Anchor rod / standard threaded rod | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | | |
|------------------------------------------------------------------------|----------------------------------------------------------|--------------------|------|---------------------------|--------|-----|-----|-----|-----|-----|-----|------|------|
| Bearing capacity under tension load, steel failure³⁾ | | | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s}$ | Steel zinc plated | Property class 4.8 | [kN] | 15(13) | 23(21) | 33 | 46 | 63 | 98 | 121 | 141 | 184 | 224 |
| | | 5.8 | | 19(17) | 29(27) | 43 | 58 | 79 | 123 | 152 | 177 | 230 | 281 |
| | | 8.8 | | 29(27) | 47(43) | 68 | 92 | 126 | 196 | 243 | 282 | 368 | 449 |
| | Stainless steel R and high corrosion resistant steel HCR | 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 factors ¹⁾ | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,N}$ | 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 | | 1,50 ²⁾ / 1,87 | | | | | | | | | |
| | | 80 | | 1,60 | | | | | | | | | |
| Bearing capacity under shear load, steel failure³⁾ | | | | | | | | | | | | | |
| without lever arm | | | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s}^0$ | Steel zinc plated | Property class 4.8 | [kN] | 9(8) | 14(13) | 20 | 28 | 38 | 59 | 73 | 85 | 110 | 135 |
| | | 5.8 | | 11(10) | 17(16) | 25 | 34 | 47 | 74 | 91 | 106 | 138 | 168 |
| | | 8.8 | | 15(13) | 23(21) | 34 | 46 | 63 | 98 | 122 | 141 | 184 | 225 |
| | Stainless steel R and high corrosion resistant steel HCR | 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 |
| Ductility factor | k ₇ | [-] | 1,0 | | | | | | | | | | |
| with lever arm | | | | | | | | | | | | | |
| Charact. resistance $M_{Rk,s}^0$ | Steel zinc plated | Property class 4.8 | [Nm] | 15(13) | 30(27) | 52 | 83 | 133 | 259 | 357 | 448 | 665 | 899 |
| | | 5.8 | | 19(16) | 37(33) | 65 | 104 | 166 | 324 | 447 | 560 | 833 | 1123 |
| | | 8.8 | | 30(26) | 60(53) | 105 | 167 | 266 | 519 | 716 | 896 | 1333 | 1797 |
| | Stainless steel R and high corrosion resistant steel HCR | 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 factors ¹⁾ | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,V}$ | 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 | | 1,25 ²⁾ / 1,56 | | | | | | | | | |
| | | 80 | | 1,33 | | | | | | | | | |

¹⁾ In absence of other national regulations

²⁾ Only admissible for high corrosion resist. steel HCR, with $f_{yk}/f_{uk} \geq 0,8$ and $A_5 > 12\%$ (e.g. fischer anchor rods)

³⁾ Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot dip galvanised standard threaded rods according to EN ISO 10684:2004+AC:2009

fischer injection system FIS EM Plus

Performances

Characteristic values for steel failure under tension / shear load of fischer anchor rods and standard threaded rods

Annex C 1

Appendix 22/ 39

Table C2.1: Characteristic values for **steel failure** under tension / shear load of **fischer internal threaded anchors RG MI**

| fischer internal threaded anchors RG MI | | | | M8 | M10 | M12 | M16 | M20 |
|-----------------------------------------------------------|-----------------|-------|------|------|------|------|------|------|
| Bearing capacity under tension load, steel failure | | | | | | | | |
| Charact. resistance with screw | Property class | 5.8 | [kN] | 19 | 29 | 43 | 79 | 123 |
| | | 8.8 | | 29 | 47 | 68 | 108 | 179 |
| | | R | | 26 | 41 | 59 | 110 | 172 |
| | | HCR | | 26 | 41 | 59 | 110 | 172 |
| Partial factors¹⁾ | | | | | | | | |
| Partial factors | $\gamma_{Ms,N}$ | 5.8 | [-] | 1,50 | | | | |
| | | 8.8 | | 1,50 | | | | |
| | | R | | 1,87 | | | | |
| | | HCR | | 1,87 | | | | |
| Bearing capacity under shear load, steel failure | | | | | | | | |
| Without lever arm | | | | | | | | |
| Charact. resistance with screw | Property class | 5.8 | [kN] | 9,2 | 14,5 | 21,1 | 39,2 | 62,0 |
| | | 8.8 | | 14,6 | 23,2 | 33,7 | 54,0 | 90,0 |
| | | R | | 12,8 | 20,3 | 29,5 | 54,8 | 86,0 |
| | | HCR | | 12,8 | 20,3 | 29,5 | 54,8 | 86,0 |
| Ductility factor | | k_7 | [-] | 1,0 | | | | |
| With lever arm | | | | | | | | |
| Charact. resistance with screw | Property class | 5.8 | [Nm] | 20 | 39 | 68 | 173 | 337 |
| | | 8.8 | | 30 | 60 | 105 | 266 | 519 |
| | | R | | 26 | 52 | 92 | 232 | 454 |
| | | HCR | | 26 | 52 | 92 | 232 | 454 |
| Partial factors¹⁾ | | | | | | | | |
| Partial factors | $\gamma_{Ms,V}$ | 5.8 | [-] | 1,25 | | | | |
| | | 8.8 | | 1,25 | | | | |
| | | R | | 1,56 | | | | |
| | | HCR | | 1,56 | | | | |

¹⁾ In absence of other national regulations

fischer injection system FIS EM Plus

Performances

Characteristic values for steel failure under tension / shear load of fischer internal threaded anchor RG MI

Table C3.1: Characteristic values for **steel failure** under tension / 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 tension load, steel failure | | | | | | | | | | | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | $A_s \cdot f_{uk}^{1)}$ | | | | | | | | | | | | | | | | |
| Bearing capacity under shear load, steel failure | | | | | | | | | | | | | | | | | | | |
| Without lever arm | | | | | | | | | | | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s}^0$ | [kN] | $0,5 \cdot A_s \cdot f_{uk}^{1)}$ | | | | | | | | | | | | | | | | |
| Ductility factor | k_7 | [-] | 1,0 | | | | | | | | | | | | | | | | |
| With lever arm | | | | | | | | | | | | | | | | | | | |
| Characteristic resistance | $M_{Rk,s}^0$ | [Nm] | $1,2 \cdot W_{el} \cdot f_{uk}^{1)}$ | | | | | | | | | | | | | | | | |

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

Table C3.2: Characteristic values for **steel failure** under tension / shear load of **fischer rebar anchors FRA**

| fischer rebar anchor FRA | | M12 | M16 | M20 | M24 | |
|-----------------------------------------------------------|-----------------|------|------|-----|-----|-----|
| Bearing capacity under tension load, steel failure | | | | | | |
| Characteristic resistance | $N_{Rk,s}$ | [kN] | 63 | 111 | 173 | 270 |
| Partial factor¹⁾ | | | | | | |
| Partial factor | $\gamma_{Ms,N}$ | [-] | 1,4 | | | |
| Bearing capacity under shear load, steel failure | | | | | | |
| Without lever arm | | | | | | |
| Characteristic resistance | $V_{Rk,s}^0$ | [kN] | 30 | 55 | 86 | 124 |
| Ductility factor | k_7 | [-] | 1,0 | | | |
| With lever arm | | | | | | |
| Characteristic resistance | $M_{Rk,s}^0$ | [Nm] | 92 | 233 | 454 | 785 |
| Partial factor¹⁾ | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,56 | | | |

¹⁾ In absence of other national regulations

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| fischer injection system FIS EM Plus | Annex C 3 Appendix 24/ 39 |
| Performances Characteristic values for steel failure under tension / shear load of reinforcing bars and fischer rebar anchors FRA | |

| Table C4.1: Characteristic values for concrete failure under tension / shear load | | | | | | | | | | | | | | | | | | | | | |
|----------------------------------------------------------------------------------------------|--------------------------|-----------------|---------------|----------------------------------------------------------------------------------------------------------------------------|----------------------|-----|-----|-----|-----|-----|-----|-------------------------------------|-----|----|----|----|----|----|----|----|----|
| Size | | | | All sizes | | | | | | | | | | | | | | | | | |
| Tension load | | | | | | | | | | | | | | | | | | | | | |
| Installation factor | | γ_{inst} | [-] | See annex C 5 to C 12 and C 17 to C 18 | | | | | | | | | | | | | | | | | |
| 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 $C_{cr,sp}$ | | | | | | | | | | | | | | | | | | |
| 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 load | | | | | | | | | | | | | | | | | | | | | |
| Factor | | Ψ_{sus}^0 | [-] | -1) | | | | | | | | | | | | | | | | | |
| Shear load | | | | | | | | | | | | | | | | | | | | | |
| 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 in 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) | | | | | | | | | | | | | | | | | |
| Calculation diameters | | | | | | | | | | | | | | | | | | | | | |
| Size | | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | | | | | | | | | |
| fischer anchor rods and standard threaded rods | | d_{nom} | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 22 | 24 | 27 | 30 | | | | | | | | |
| fischer internal threaded anchors RG MI | | d_{nom} | | 12 | 16 | 18 | -2) | 22 | 28 | -2) | -2) | -2) | -2) | | | | | | | | |
| fischer rebar anchor FRA | | d_{nom} | | -2) | -2) | 12 | -2) | 16 | 20 | -2) | 25 | -2) | -2) | | | | | | | | |
| Size (nominal diameter of the bar) | | | ϕ | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 | |
| Reinforcing bar | | | d_{nom} | [mm] | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
| 1) No performance assessed | | | | | | | | | | | | | | | | | | | | | |
| 2) Anchor type not part of the ETA | | | | | | | | | | | | | | | | | | | | | |
| fischer injection system FIS EM Plus | | | | | | | | | | | | Annex C 4 Appendix 25/ 39 | | | | | | | | | |
| Performances Characteristic values for concrete failure under tension / shear load | | | | | | | | | | | | | | | | | | | | | |

Table C5.1: Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| Anchor rod / standard threaded rod | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|----------------------|-----|-----|-----|-----|-----|-----|-------------------------------------|-----|-----|-----|
| Combined pullout and concrete cone failure | | | | | | | | | | | | | |
| Calculation diameter | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 22 | 24 | 27 | 30 | |
| Uncracked concrete | | | | | | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 18 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 15 | 14 |
| | II: 50 °C / 72 °C | | | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 14 | 14 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 16 | 15 | 13 | 13 | 11 | 11 | 10 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 15 | 14 | 14 | 13 | 12 | 11 | 10 | 10 | 9 | 9 |
| <u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 13 | 12 | 12 | 10 | 10 | 10 | 9 | 9 |
| | II: 50 °C / 72 °C | | | 15 | 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 |
| Installation factors | | | | | | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | | | | | | |
| Water filled hole | | | 1,4 | | | | | | | | | | |
| Cracked concrete | | | | | | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| | II: 50 °C / 72 °C | | | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| <u>Diamond - drilling (dry or wet concrete)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 |
| | II: 50 °C / 72 °C | | | 7 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u> | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 6 | 7,5 | 7,5 | 7 | 6 | 6 | 6 | 6 | 6 | 6 |
| | II: 50 °C / 72 °C | | | 6 | 7 | 7 | 7 | 6 | 6 | 6 | 6 | 6 | 6 |
| Installation factors | | | | | | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | | | | | | |
| Water filled hole | | | 1,2 | | | | 1,4 | | | | | | |
| fischer injection system FIS EM Plus | | | | | | | | | | | | | |
| Performances Characteristic values for combined pull-out and concrete failure for fischer anchor rod and standard threaded rods; working life 50 years | | | | | | | | | | Annex C 5 Appendix 26/ 39 | | | |

Table C6.1: Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| Anchor rod / standard threaded rod | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | | |
|-----------------------------------------------------------------------------------|-------------------|-----------------------|----------------------|------|------|------|------|------|------|------|------|------|------|
| Combined pullout and concrete cone failure | | | | | | | | | | | | | |
| Calculation diameter | d | [mm] | 8 | 10 | 12 | 14 | 16 | 20 | 22 | 24 | 27 | 30 | |
| Uncracked concrete | | | | | | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 18 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 15 | 14 |
| | II: 50 °C / 72 °C | | | 18 | 17 | 17 | 16 | 16 | 15 | 14 | 14 | 14 | 14 |
| Diamond-drilling (dry or wet concrete) | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 13 | 12 | 12 | 10 | 10 | 10 | 9 | 9 |
| | II: 50 °C / 72 °C | | | 15 | 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 |
| Installation factors | | | | | | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
| | II: 50 °C / 72 °C | | | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| Cracked concrete | | | | | | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| | II: 50 °C / 72 °C | | | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| Diamond - drilling (dry or wet concrete) | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 |
| | II: 50 °C / 72 °C | | | 7 | 7 | 7 | 7 | 6 | 6 | 7 | 7 | 7 | 7 |
| Installation factors | | | | | | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| | II: 50 °C / 72 °C | | | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |

1) **Calculation of characteristic bond resistance in uncracked concrete $\tau_{Rk,100, ucr}$:**

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) **Calculation of characteristic bond resistance in cracked concrete $\tau_{Rk,100, cr}$:**

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

Performances

Characteristic values for combined pull-out and concrete failure for fischer anchor rod and standard threaded rods; working life 100 years

Table C7.1: Characteristic values for **combined pull-out** and concrete failure for **fischer internal threaded anchors RG MI** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| Internal threaded anchor RG MI | | | M8 | M10 | M12 | M16 | M20 | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|----------------------|-----|-----|-----|-------------------------------------|----|
| Combined pullout and concrete cone failure | | | | | | | | |
| Calculation diameter | d | [mm] | 12 | 16 | 18 | 22 | 28 | |
| Uncracked concrete | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 15 | 14 | 14 | 13 | 12 |
| | II: 50 °C / 72 °C | | | 14 | 13 | 13 | 12 | 11 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 14 | 12 | 12 | 11 | 10 |
| | II: 50 °C / 72 °C | | | 13 | 12 | 11 | 10 | 9 |
| Diamond-drilling (dry or wet concrete as well as water filled hole) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 13 | 12 | 11 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 12 | 11 | 10 | 9 | 8 |
| Installation factors | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | |
| Water filled hole | | | 1,4 | | | | | |
| Cracked concrete | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 6 | 6 | 7 | 7 |
| | II: 50 °C / 72 °C | | | 7 | 6 | 6 | 7 | 7 |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 6,5 | 6 | 6 | 6 |
| | II: 50 °C / 72 °C | | | 7 | 6 | 6 | 6 | 6 |
| Installation factors | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | |
| Water filled hole | | | 1,2 | | | 1,4 | | |
| | | | | | | | | |
| fischer injection system FIS EM Plus | | | | | | | Annex C 7 Appendix 28/ 39 | |
| Performances Characteristic values for combined pull-out and concrete failure for fischer internal threaded anchors RG MI; working life 50 years | | | | | | | | |

Table C8.1: Characteristic values for **combined pull-out** and concrete failure for **fischer internal threaded anchors RG MI** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| Internal threaded anchor RG MI | | | M8 | M10 | M12 | M16 | M20 | |
|--------------------------------------------------------------------------------------------------------|-------------------|-----------------------|----------------------|------|------|------|------|------|
| Combined pullout and concrete cone failure | | | | | | | | |
| Calculation diameter | d | [mm] | 12 | 16 | 18 | 22 | 28 | |
| Uncracked concrete | | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 15 | 14 | 14 | 13 | 12 |
| | II: 50 °C / 72 °C | | | 14 | 13 | 13 | 12 | 11 |
| Diamond-drilling (dry or wet concrete) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 13 | 12 | 11 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 12 | 11 | 10 | 9 | 8 |
| Installation factors | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
| | II: 50 °C / 72 °C | | | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 |
| Cracked concrete | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete) | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 6 | 6 | 7 | 7 |
| | II: 50 °C / 72 °C | | | 7 | 6 | 6 | 7 | 7 |
| Installation factors | | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 |
| | II: 50 °C / 72 °C | | | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 |

1) Calculation of characteristic bond resistance in uncracked concrete $\tau_{Rk,100, ucr}$:

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) Calculation of characteristic bond resistance in cracked concrete $\tau_{Rk,100, cr}$:

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

Performances

Characteristic values for combined pull-out and concrete failure for fischer internal threaded anchors RG MI; working life 100 years

Table C9.1: Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| 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 or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | |
| | II: 50 °C / 72 °C | | | | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 10 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 16 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 |
| | II: 50 °C / 72 °C | | | | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 |
| Diamond-drilling (dry or wet concrete as well as water filled hole) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 13 | 12 | 12 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 7 |
| | II: 50 °C / 72 °C | | | | 15 | 14 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 |
| Installation factors | | | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | | | | | | | | | | | | | | | | | 1,0 | |
| Water filled hole | | | | | | | | | | | | | | | | | | | | 1,4 | |
| Cracked concrete | | | | | | | | | | | | | | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | |
| | II: 50 °C / 72 °C | | | | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Diamond-drilling (dry or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 |
| | II: 50 °C / 72 °C | | | | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole) | | | | | | | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | | $\tau_{Rk,cr}$ | [N/mm ²] | 6 | 7,5 | 6,5 | 6,5 | 6,5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 | 5 |
| | II: 50 °C / 72 °C | | | | 6 | 6,5 | 6,5 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 5 | 5 | 5 |
| Installation factors | | | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | | | | | | | | | | | | | | | | | 1,0 | |
| Water filled hole | | | | 1,2 | | | | | | | | 1,4 | | | | | | | | | |
| fischer injection system FIS EM Plus | | | | | | | | | | | | | | | | | | Annex C 9 Appendix 30/ 39 | | | |
| Performances | | Characteristic values for combined pull-out and concrete failure for reinforcing bars; working life 50 years | | | | | | | | | | | | | | | | | | | |

Table C10.1: Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| 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 or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | |
| | II: 50 °C / 72 °C | | | | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 |
| Diamond-drilling (dry or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | | $\tau_{Rk,ucr}$ | [N/mm ²] | 16 | 15 | 13 | 12 | 12 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 7 | |
| | II: 50 °C / 72 °C | | | | 15 | 14 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 |
| Installation factors | | | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | | | | | | | | | | | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | | $\alpha_{100\ years}$ | [-] | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | |
| | II: 50 °C / 72 °C | | | | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| Cracked concrete | | | | | | | | | | | | | | | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | | | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | |
| | II: 50 °C / 72 °C | | | | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Diamond-drilling (dry or wet concrete) | | | | | | | | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 | |
| | II: 50 °C / 72 °C | | | | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 7 | 5 | 5 | 5 | 5 |
| Installation factors | | | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | | | | | | | | | | | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | | $\alpha_{100\ years}$ | [-] | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| | II: 50 °C / 72 °C | | | | 0,60 | 0,85 | 0,80 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |

1) Calculation of characteristic bond resistance in uncracked concrete $\tau_{Rk,100, ucr}$:

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) Calculation of characteristic bond resistance in cracked concrete $\tau_{Rk,100, cr}$:

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

Performances

Characteristic values for combined pull-out and concrete failure for reinforcing bars; working life 100 years

Annex C 10

Appendix 31/ 39

Table C11.1: Characteristic values for **combined pull-out** and concrete failure for **fischer rebar anchors FRA** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 50 years**

| fischer rebar anchor FRA | | | M12 | M16 | M20 | M24 | |
|----------------------------------------------------------------------------------------------------------------------------------------------|-------------------|-----------------|----------------------|-----|-----|--------------------------------------|----|
| Combined pullout and concrete cone failure | | | | | | | |
| Calculation diameter | d | [mm] | 12 | 16 | 20 | 25 | |
| Uncracked concrete | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 15 | 14 | 13 | 12 |
| | II: 50 °C / 72 °C | | | 14 | 13 | 12 | 12 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 14 | 12 | 11 | 10 |
| | II: 50 °C / 72 °C | | | 13 | 12 | 11 | 9 |
| <u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 13 | 12 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 12 | 11 | 10 | 9 |
| Installation factors | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | |
| Water filled hole | | | | 1,4 | | | |
| Cracked concrete | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 8 | 8 | 8 | 8 |
| | II: 50 °C / 72 °C | | | 8 | 8 | 8 | 8 |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (water filled hole)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 7 | 6 | 6 | 6 |
| | II: 50 °C / 72 °C | | | 7 | 6 | 6 | 6 |
| Installation factors | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | |
| Water filled hole | | | | 1,2 | | 1,4 | |
| fischer injection system FIS EM Plus | | | | | | | |
| Performances Characteristic values for combined pull-out and concrete failure for fischer rebar anchors FRA; working life 50 years | | | | | | Annex C 11 Appendix 32/ 39 | |

Table C12.1: Characteristic values for **combined pull-out** and concrete failure for **fischer rebar anchors FRA** in hammer or diamond drilled holes; **uncracked or cracked concrete; working life 100 years**

| fischer rebar anchor FRA | | | M12 | M16 | M20 | M24 | |
|---------------------------------------------------------------------------------------------------------------|-------------------|-----------------------|----------------------|------|------|------|------|
| Combined pullout and concrete cone failure | | | | | | | |
| Calculation diameter | d | [mm] | 12 | 16 | 20 | 25 | |
| Uncracked concrete | | | | | | | |
| Characteristic bond resistance in uncracked concrete C20/25 | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 15 | 14 | 13 | 12 |
| | II: 50 °C / 72 °C | | | 14 | 13 | 12 | 12 |
| <u>Diamond-drilling (dry or wet concrete)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm ²] | 13 | 12 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 12 | 11 | 10 | 9 |
| Installation factors | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [N/mm ²] | 0,75 | 0,75 | 0,75 | 0,75 |
| | II: 50 °C / 72 °C | | | 0,60 | 0,65 | 0,65 | 0,65 |
| Cracked concrete | | | | | | | |
| Characteristic bond resistance in cracked concrete C20/25 | | | | | | | |
| <u>Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete)</u> | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm ²] | 8 | 8 | 8 | 8 |
| | II: 50 °C / 72 °C | | | 8 | 8 | 8 | 8 |
| Installation factors | | | | | | | |
| Dry or wet concrete | γ_{inst} | [-] | 1,0 | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,80 | 0,65 | 0,65 | 0,65 |
| | II: 50 °C / 72 °C | | | 0,80 | 0,65 | 0,65 | 0,65 |

1) **Calculation of characteristic bond resistance in uncracked concrete $\tau_{Rk,100, ucr}$:**

$$\tau_{Rk,100, ucr} = \alpha_{100\ years} \cdot \tau_{Rk,ucr}$$

2) **Calculation of characteristic bond resistance in cracked concrete $\tau_{Rk,100, cr}$:**

$$\tau_{Rk,100, cr} = \alpha_{100\ years} \cdot \tau_{Rk,cr}$$

fischer injection system FIS EM Plus

Performances

Characteristic values for pull-out and concrete failure for fischer rebar anchors FRA; working life 100 years

Annex C 12

Appendix 33/ 39

| Table C13.1: Displacements for anchor rods | | | | | | | | | | | |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|
| Anchor rod | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 |
| Displacement-Factors for tension load¹⁾ | | | | | | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | | | | | | |
| δ_{N0} -Factor | [mm/(N/mm ²)] | 0,07 | 0,08 | 0,09 | 0,09 | 0,10 | 0,11 | 0,11 | 0,12 | 0,12 | 0,13 |
| $\delta_{N\infty}$ -Factor | | 0,11 | 0,12 | 0,13 | 0,14 | 0,15 | 0,16 | 0,17 | 0,18 | 0,19 | 0,19 |
| Displacement-Factors for shear load²⁾ | | | | | | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | | | | | | |
| δ_{V0} -Factor | [mm/kN] | 0,18 | 0,15 | 0,12 | 0,10 | 0,09 | 0,07 | 0,07 | 0,06 | 0,05 | 0,05 |
| $\delta_{V\infty}$ -Factor | | 0,27 | 0,22 | 0,18 | 0,16 | 0,14 | 0,11 | 0,10 | 0,09 | 0,08 | 0,07 |
| 1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$ (τ_{Ed} : Design value of the applied tensile stress) | | | | | | 2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force) | | | | | |

Table C13.2: Displacements for fischer internal threaded anchors RG MI

| Internal threaded anchor RG MI | | M8 | M10 | M12 | M16 | M20 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Displacement-Factors for tension load¹⁾ | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | |
| δ_{N0} -Factor | [mm/(N/mm ²)] | 0,09 | 0,10 | 0,10 | 0,11 | 0,13 |
| $\delta_{N\infty}$ -Factor | | 0,13 | 0,15 | 0,16 | 0,17 | 0,19 |
| Displacement-Factors for shear load²⁾ | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | |
| δ_{V0} -Factor | [mm/kN] | 0,12 | 0,09 | 0,08 | 0,07 | 0,05 |
| $\delta_{V\infty}$ -Factor | | 0,18 | 0,14 | 0,12 | 0,10 | 0,08 |
| 1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$ (τ_{Ed} : Design value of the applied tensile stress) | | | | 2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force) | | |

| | | |
|--------------------------------------------------------------------------------------------------|--|--------------------------------------|
| fischer injection system FIS EM Plus | | Annex C 13 Appendix 34/ 39 |
| Performances Displacements for anchor rods and fischer internal threaded anchors RG MI | | |

Table C14.1: Displacements for reinforcing bars

| Nominal diameter of the bar ϕ | | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|------|------|------|------|------|------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|------|------|------|------|------|------|
| Displacement-Factors for tension load¹⁾ | | | | | | | | | | | | | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | | | | | | | | | | | | | |
| δ_{N0} -Factor | [mm/(N/mm ²)] | 0,07 | 0,08 | 0,09 | 0,09 | 0,10 | 0,10 | 0,11 | 0,11 | 0,12 | 0,12 | 0,12 | 0,13 | 0,13 | 0,13 | 0,14 | 0,14 | 0,15 |
| $\delta_{N\infty}$ -Factor | | 0,11 | 0,12 | 0,13 | 0,14 | 0,15 | 0,16 | 0,16 | 0,17 | 0,18 | 0,18 | 0,18 | 0,19 | 0,19 | 0,20 | 0,20 | 0,21 | 0,22 |
| Displacement-Factors for shear load²⁾ | | | | | | | | | | | | | | | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | | | | | | | | | | | | | | | |
| δ_{V0} -Factor | [mm/kN] | 0,18 | 0,15 | 0,12 | 0,10 | 0,09 | 0,08 | 0,07 | 0,07 | 0,06 | 0,06 | 0,06 | 0,05 | 0,05 | 0,05 | 0,04 | 0,04 | 0,04 |
| $\delta_{V\infty}$ -Factor | | 0,27 | 0,22 | 0,18 | 0,16 | 0,14 | 0,12 | 0,11 | 0,10 | 0,09 | 0,09 | 0,08 | 0,08 | 0,07 | 0,07 | 0,06 | 0,06 | 0,05 |
| 1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$ (τ_{Ed} : Design value of the applied tensile stress) | | | | | | | | | 2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force) | | | | | | | | | |

Table C14.2: Displacements for fischer rebar anchors FRA

| fischer rebar anchor FRA | M12 | M16 | M20 | M24 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|------|
| Displacement-Factors for tension load¹⁾ | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | |
| δ_{N0} -Factor | 0,09 | | 0,10 | 0,12 |
| $\delta_{N\infty}$ -Factor | 0,13 | | 0,15 | 0,18 |
| Displacement-Factors for shear load²⁾ | | | | |
| Uncracked or cracked concrete; Temperature range I, II | | | | |
| δ_{V0} -Factor | 0,12 | | 0,09 | 0,06 |
| $\delta_{V\infty}$ -Factor | 0,18 | | 0,14 | 0,09 |
| 1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau_{Ed}$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau_{Ed}$ (τ_{Ed} : Design value of the applied tensile stress) | | 2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V_{Ed}$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V_{Ed}$ (V_{Ed} : Design value of the applied shear force) | | |

fischer injection system FIS EM Plus

Performance

Displacements for reinforcing bars and fischer rebar anchors FRA

Table C15.1: Characteristic values for steel failure under tension / shear load of fischer anchor rods and standard threaded rods under seismic action performance category C1 or C2

| Anchor rod / standard threaded rod | | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | | | | |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|-------------------|----------------|-------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Bearing capacity under tension load, steel failure¹⁾ | | | | | | | | | | | | | | |
| fischer anchor rods and standard threaded rods, performance category C1²⁾ | | | | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s,C1}$ | Steel zinc plated | Property class | 5.8 | [kN] | 29(27) | 43 | 58 | 79 | 123 | 152 | 177 | 230 | 281 | |
| | | | 8.8 | | 47(43) | 68 | 92 | 126 | 196 | 243 | 282 | 368 | 449 | |
| | Stainless steel R and high corrosion resistant steel HCR | | 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 C2²⁾ | | | | | | | | | | | | | |
| | Characteristic resistance $N_{Rk,s,C2}$ | Steel zinc plated | Property class | 5.8 | [-] | - ⁴⁾ | 39 | - ⁴⁾ | 72 | 108 | - ⁴⁾ | 177 | - ⁴⁾ | - ⁴⁾ |
| | | | | 8.8 | | - ⁴⁾ | 61 | - ⁴⁾ | 116 | 173 | - ⁴⁾ | 282 | - ⁴⁾ | - ⁴⁾ |
| Stainless steel R and high corrosion resistant steel HCR | | 50 | | | - ⁴⁾ | 39 | - ⁴⁾ | 72 | 108 | - ⁴⁾ | 177 | - ⁴⁾ | - ⁴⁾ | |
| | | 70 | | | - ⁴⁾ | 53 | - ⁴⁾ | 101 | 152 | - ⁴⁾ | 247 | - ⁴⁾ | - ⁴⁾ | |
| | | 80 | | - ⁴⁾ | 61 | - ⁴⁾ | 116 | 173 | - ⁴⁾ | 282 | - ⁴⁾ | - ⁴⁾ | | |
| Bearing capacity under shear load, steel failure without lever arm¹⁾ | | | | | | | | | | | | | | |
| fischer anchor rods, performance category C1²⁾ | | | | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s,C1}$ | | Steel zinc plated | Property class | 5.8 | [kN] | 17(16) | 25 | 34 | 47 | 74 | 91 | 106 | 138 | 168 |
| | 8.8 | | | | 23(21) | 34 | 46 | 63 | 98 | 122 | 141 | 184 | 225 | |
| | Stainless steel R and high corrosion resistant steel HCR | 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 C1²⁾ | | | | | | | | | | | | | |
| | Characteristic resistance $V_{Rk,s,C1}$ | Steel zinc plated | Property class | 5.8 | [kN] | 12(11) | 17 | 24 | 33 | 52 | 64 | 74 | 97 | 118 |
| | | | | 8.8 | | 16(14) | 24 | 32 | 44 | 69 | 85 | 99 | 129 | 158 |
| Stainless steel R and high corrosion resistant steel HCR | | 50 | | | 11 | 15 | 20 | 27 | 43 | 53 | 62 | 81 | 99 | |
| | | 70 | | | 14 | 21 | 28 | 39 | 60 | 75 | 87 | 113 | 138 | |
| | | 80 | | 16 | 24 | 32 | 44 | 69 | 85 | 99 | 129 | 158 | | |
| fischer anchor rods and standard threaded rods, performance category C2 | | | | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s,C2}$ | | Steel zinc plated | Property class | 5.8 | [-] | - ⁴⁾ | 14 | - ⁴⁾ | 27 | 43 | - ⁴⁾ | 62 | - ⁴⁾ | - ⁴⁾ |
| | | | | 8.8 | | - ⁴⁾ | 22 | - ⁴⁾ | 44 | 69 | - ⁴⁾ | 99 | - ⁴⁾ | - ⁴⁾ |
| | Stainless steel R and high corrosion resistant steel HCR | 50 | | | - ⁴⁾ | 14 | - ⁴⁾ | 27 | 43 | - ⁴⁾ | 62 | - ⁴⁾ | - ⁴⁾ | |
| | | 70 | | | - ⁴⁾ | 20 | - ⁴⁾ | 39 | 60 | - ⁴⁾ | 87 | - ⁴⁾ | - ⁴⁾ | |
| | | 80 | | - ⁴⁾ | 22 | - ⁴⁾ | 44 | 69 | - ⁴⁾ | 99 | - ⁴⁾ | - ⁴⁾ | | |
| | Factor for the annular gap | α_{gap} | [-] | 0,5 (1,0) ³⁾ | | | | | | | | | | |

¹⁾ Partial factors for performance category C1 or C2 see table C1.1;

for fischer anchor rods FIS A / RGM the factor for steel ductility is 1,0

²⁾ Values in brackets are valid for undersized threaded rods with smaller stress area A_s for hot dip galvanised standard threaded rods according to EN ISO 10684:2004+AC:2009.

³⁾ Values in brackets are valid for filled annular gaps between the anchor rod and the through-hole in the attachment. It is necessary to use the fischer filling disc according to Annex A 1

⁴⁾ No performance assessed

fischer injection system FIS EM Plus

Performances

Characteristic values for steel failure under tension / shear load for fischer anchor rods and standard threaded rods under seismic action (performance category C1 / C2)

Annex C 15

Appendix 36/ 39

Table C16.1: Characteristic values for **steel failure** under tension / shear load for **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 tension load, steel failure¹⁾ | | | | | | | | | | | | | | | |
| Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1 | | | | | | | | | | | | | | | |
| Characteristic resistance | $N_{Rk,s,C1}$ | [kN] | 44 | 63 | 85 | 111 | 140 | 173 | 209 | 249 | 270 | 292 | 339 | 389 | 443 |
| Bearing capacity under shear load, steel failure without lever arm¹⁾ | | | | | | | | | | | | | | | |
| Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1 | | | | | | | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s,C1}$ | [kN] | 15 | 22 | 30 | 39 | 49 | 61 | 74 | 88 | 95 | 102 | 119 | 137 | 155 |

¹⁾ Partial factors for performance category C1 see table C16.2

Table C16.2: **Partial factors** for **fischer anchor rods, standard threaded rods** and **reinforcing bars (B500B)** under seismic action performance category **C1 or C2**

| Anchor rod / standard threaded rod | | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | M32 | | | |
|-------------------------------------------------|----------------------------------------------------------|----------------|---------------------------|-----|------|-----|-----|-----|-----|-----|-----|----|----|----|
| Nominal diameter of the bar | ϕ | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 |
| Tension load, steel failure¹⁾ | | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,N}$ | Steel zinc plated | Property class | 5.8 | [-] | 1,50 | | | | | | | | | |
| | | | 8.8 | | 1,50 | | | | | | | | | |
| | Stainless steel R and high corrosion resistant steel HCR | 50 | 2,86 | | | | | | | | | | | |
| | | 70 | 1,50 ²⁾ / 1,87 | | | | | | | | | | | |
| | | 80 | 1,60 | | | | | | | | | | | |
| | Reinforcing bar | B500B | 1,40 | | | | | | | | | | | |
| Shear load, steel failure¹⁾ | | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,V}$ | Steel zinc plated | Property class | 5.8 | [-] | 1,25 | | | | | | | | | |
| | | | 8.8 | | 1,25 | | | | | | | | | |
| | Stainless steel R and high corrosion resistant steel HCR | 50 | 2,38 | | | | | | | | | | | |
| | | 70 | 1,25 ²⁾ / 1,56 | | | | | | | | | | | |
| | | 80 | 1,33 | | | | | | | | | | | |
| | Reinforcing bar | B500B | 1,50 | | | | | | | | | | | |

¹⁾ In absence of other national regulations

²⁾ Only admissible for high corrosion resistant steel HCR, with $f_{yk} / f_{uk} \geq 0,8$ and $A_5 > 12 \%$ (e.g. fischer anchor rods)

fischer injection system FIS EM Plus

Performances

Characteristic values for steel failure under tension/shear load for reinforcing bars under seismic action (performance category C1); partial factors (perform. category C1 / C2)

Annex C 16

Appendix 37/ 39

Table C17.1: Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C1**; **working life 50 and 100 years**

| Anchor rod / standard threaded rod | | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 | |
|------------------------------------------------------------------------------------------|-------------------|-----------------|----------------------|-------------------|-----|-----|-----|-------------------|-----|-----|-----|
| Characteristic bond resistance, combined pullout and concrete cone failure | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | $\tau_{RK,C1}$ | [N/mm ²] | 7,0 | 7,0 | 6,7 | 6,0 | 5,7 | 6,7 | 6,7 | 6,7 |
| | II: 50 °C / 72 °C | | | 7,0 | 7,0 | 6,7 | 5,7 | 5,7 | 6,7 | 6,7 | 6,7 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | $\tau_{RK,C1}$ | [N/mm ²] | 7,5 | 7,5 | 6,5 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| | II: 50 °C / 72 °C | | | 6,8 | 6,8 | 6,5 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| Installation factors | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | | | | | |
| Water filled hole | | | | 1,2 ¹⁾ | | | | 1,4 ¹⁾ | | | |

¹⁾ Not permitted in combination with working life 100 years

Table C17.2: Characteristic values for **combined pull-out** and concrete failure for **reinforcing bars** in hammer drilled holes under seismic action performance category **C1**; **working life 50 and 100 years**

| Nominal diameter of the bar | | ϕ | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 |
|------------------------------------------------------------------------------------------|-------------------|-----------------|----------------------|-------------------|-----|-----|-----|-----|-----|-------------------|-----|-----|-----|-----|-----|
| Characteristic bond resistance, combined pullout and concrete cone failure | | | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | $\tau_{RK,C1}$ | [N/mm ²] | 7,0 | 7,0 | 6,7 | 5,7 | 5,7 | 5,7 | 6,7 | 6,7 | 6,7 | 6,7 | 6,7 | 4,8 |
| | II: 50 °C / 72 °C | | | 7,0 | 7,0 | 6,7 | 5,7 | 5,7 | 5,7 | 6,7 | 6,7 | 6,7 | 6,7 | 6,7 | 6,7 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | | | | | | | | | | |
| Tem- perature range | I: 35 °C / 60 °C | $\tau_{RK,C1}$ | [N/mm ²] | 7,5 | 6,5 | 6,5 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 4,8 |
| | II: 50 °C / 72 °C | | | 6,5 | 6,5 | 5,8 | 5,8 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| Installation factors | | | | | | | | | | | | | | | |
| Dry or wet concrete | | γ_{inst} | [-] | 1,0 | | | | | | | | | | | |
| Water filled hole | | | | 1,2 ¹⁾ | | | | | | 1,4 ¹⁾ | | | | | |

¹⁾ Not permitted in combination with working life 100 years

fischer injection system FIS EM Plus

Performances

Characteristic values for combined pull-out and concrete failure under seismic action (C1 for fischer anchor rods, stand. thread. rods and reinf. bars; working life 50 and 100 years)

Annex C 17

Appendix 38/ 39

Table C18.1: Characteristic values for **combined pull-out** and concrete failure for **fischer anchor rods** and **standard threaded rods** in hammer drilled holes under seismic action performance category **C2**; **working life 50 and 100 years**

| Anchor rod / standard threaded rod | | M12 | M16 | M20 | M24 | |
|------------------------------------------------------------------------------------------|-------------------|-------------------------------------|-------------------|-------------------|-----|-----|
| Characteristic bond resistance, combined pullout and concrete cone failure | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,C2}$ [N/mm ²] | 3,5 | 5,8 | 5,0 | 3,1 |
| | II: 50 °C / 72 °C | | 3,3 | 5,5 | 4,7 | 2,9 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,C2}$ [N/mm ²] | 3,5 | 5,8 | 5,0 | 3,1 |
| | II: 50 °C / 72 °C | | 3,3 | 5,5 | 4,7 | 2,9 |
| Installation factors | | | | | | |
| Dry or wet concrete | | γ_{inst} [-] | 1,0 | | | |
| Water filled hole | | | 1,2 ¹⁾ | 1,4 ¹⁾ | | |

¹⁾ Not permitted in combination with working life 100 years

Displacement-Factors for tension load¹⁾

| | | | | | |
|------------------------------|---------------------------|------|------|------|------|
| $\delta_{N,C2}$ (DLS)-Factor | [mm/(N/mm ²)] | 0,09 | 0,10 | 0,11 | 0,12 |
| $\delta_{N,C2}$ (ULS)-Factor | | 0,15 | 0,17 | 0,17 | 0,18 |

Displacement-Factors for shear load²⁾

| | | | | | |
|------------------------------|---------|------|------|------|------|
| $\delta_{V,C2}$ (DLS)-Factor | [mm/kN] | 0,18 | 0,10 | 0,07 | 0,06 |
| $\delta_{V,C2}$ (ULS)-Factor | | 0,25 | 0,14 | 0,11 | 0,09 |

¹⁾ Calculation of effective displacement:

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

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

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

²⁾ Calculation of effective displacement:

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

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

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

fischer injection system FIS EM Plus

Performances

Characteristic values for combined pull-out and concrete failure under seismic action (C2) for fischer anchor rods and standard threaded rods; working life 50 and 100 years

Annex C 18

Appendix 39/ 39