Deutsches Institut für Bautechnik

Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments

Member of EOTA

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

# European Technical Assessment ETA-17/0979 of 17 June 2020

English translation prepared by DIBt - Original version in German language

**General Part**

| | |
|---|---|
| Technical Assessment Body issuing the European Technical Assessment: | Deutsches Institut für Bautechnik |
| Trade name of the construction product | fischer Injection System FIS EM PLUS |
| Product family to which the construction product belongs | Bonded fastener for use in concrete |
| Manufacturer | fischerwerke GmbH & Co. KG<br>Otto-Hahn-Straße 15<br>79211 Denzlingen<br>DEUTSCHLAND |
| Manufacturing plant | fischerwerke |
| This European Technical Assessment contains | 41 pages including 3 annexes which form an integral part of this assessment |
| This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of | EAD 330499-01-0601 |
| This version replaces | ETA-17/0979 issued on 22 July 2019 |

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## Specific Part

### 1 Technical description of the product

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

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

The product description is given in Annex A.

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

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

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of the anchor of at least 50 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

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

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

Issued in Berlin on 17 June 2020 by Deutsches Institut für Bautechnik

BD Dipl.-Ing. Andreas Kummerow
Head of Department

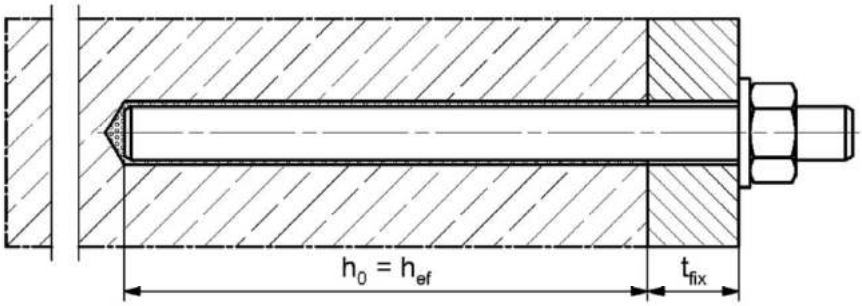
*beglaubigt:*
Baderschneider

Deutsches Institut für Bautechnik DIBt

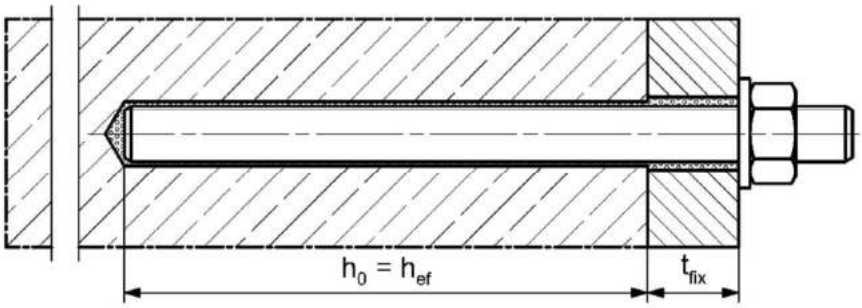
## Installation conditions part 1

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)

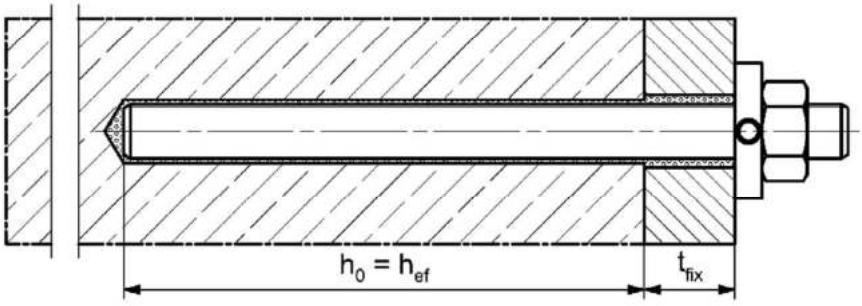



Figure A 1.1

$h_0$ = 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

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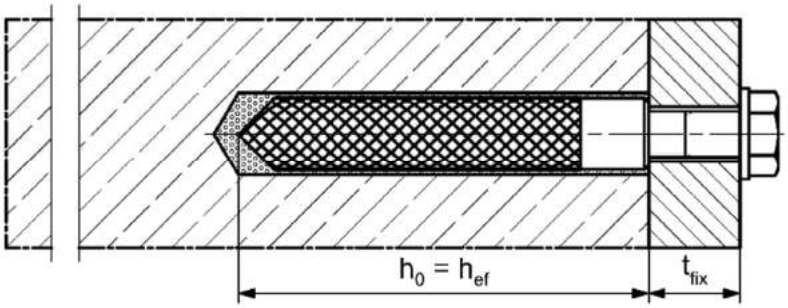
## Installation conditions part 2

**fischer internal threaded anchor RG M**

**Pre-positioned installation**




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

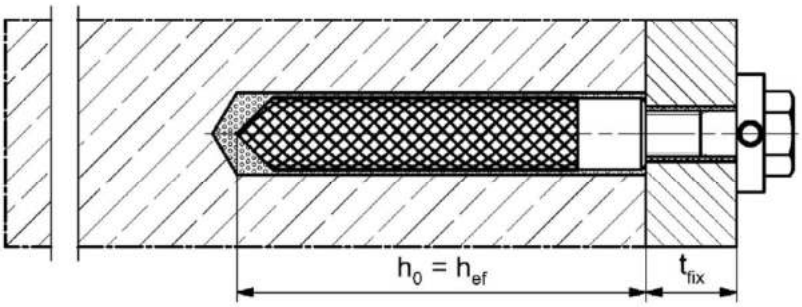



Figure A 2.1

$h_0$ = drill hole depth

$h_{ef}$ = effective embedment depth

$t_{fix}$ = thickness of fixture

fischer injection system FIS EM Plus

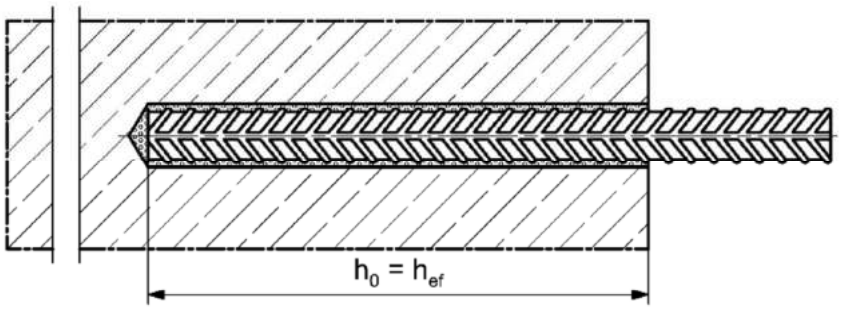
**Product description**
Installation conditions part 2

**Annex A 2**

Deutsches Institut für Bautechnik DIBt

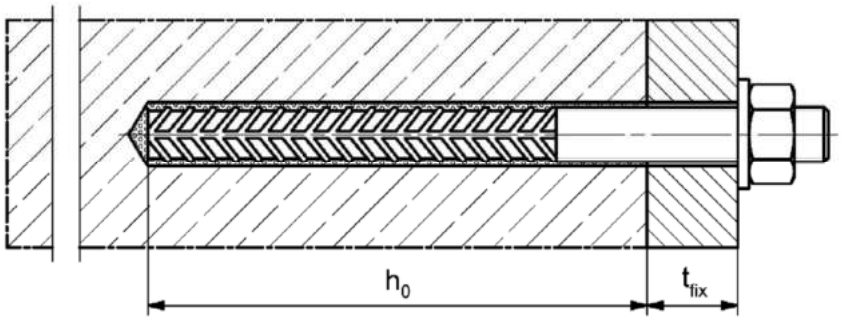
## Installation conditions part 3

**Reinforcing bar**




**fischer rebar anchor FRA**

**Pre-positioned installation**




**Push through installation** (annular gap filled with mortar)

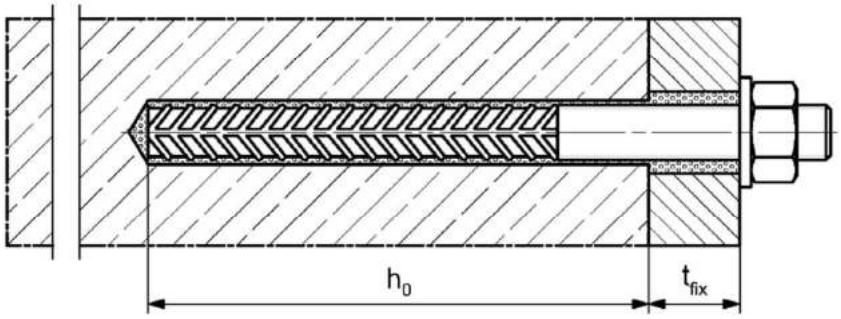



Figure A 3.1

$h_0$ = drill hole depth

$h_{ef}$ = effective embedment depth

$t_{fix}$ = thickness of fixture

fischer injection system FIS EM Plus

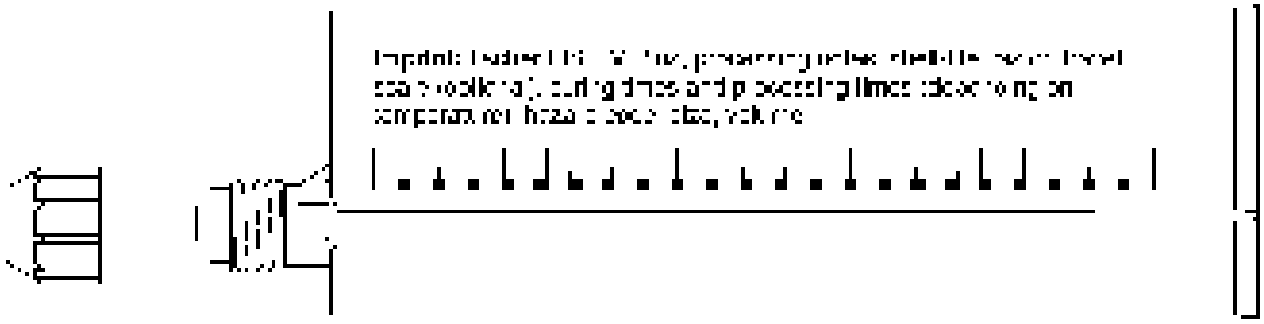
**Product description**
Installation conditions part 3

Annex A 3

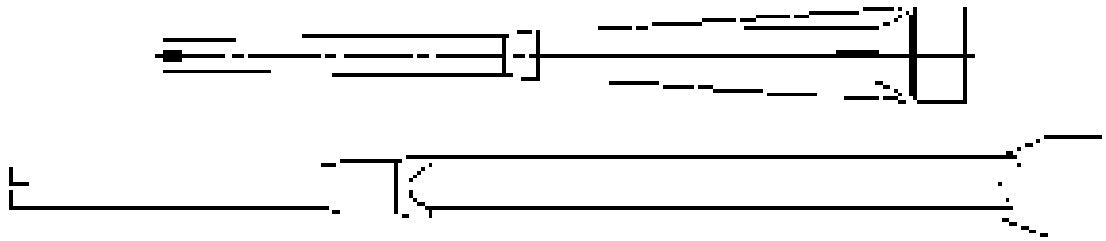
Deutsches Institut für Bautechnik DIBt

## Overview system components part 1

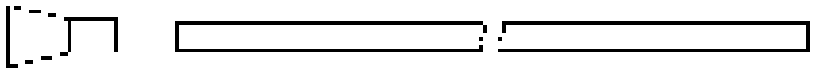
**Injection cartridge (coaxial cartridge) with sealing cap: Size: 280 ml, 585 ml, 1100 ml, 1500 ml**



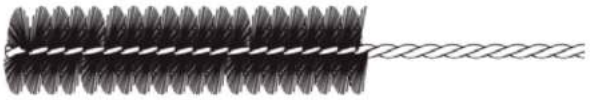
**Static mixer FIS MR Plus or FIS MR**



**Injection adapter and Extension tube for static mixer**



**Cleaning brush BS / BSB**



**Blow-out pump ABP**

Figures not to scale

| | |
|---|---|
| Fischer injection system FIS V Plus<br><br>**Product description**<br>Overview system components part 1;<br>cartridges / static mixer / accessories | **Annex A 4** |

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## Overview system components part 2

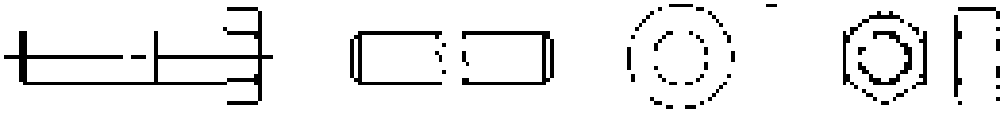
Fischer anchor rod

Size: VR, M10, M12, M14, M16, V20, M22, M24, V27, M30

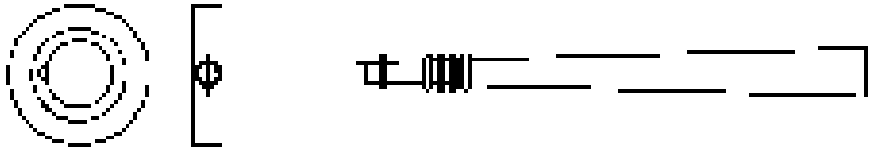
Fischer internal threaded anchor RG M

Size: VR, M10, M12, M16, M20

Screw / threaded rod + washer + hexagon nut



Fischer filling disc with injection adapter



Reinforcing bar

Nominal diameter: ø8, ø10, ø12, ø14, ø16, ø18, ø20, ø22, ø24, ø25, ø26, ø28, ø30, ø32, ø34, ø36, ø40

Fischer rebar anchor FRA

Size: M12, M16, M20, M24

Figures not to scale

Fischer injection system FIS -M (P) ne

Product description
Overview system components part 2;
steel components

Annex A 5

## Table A6.1: Materials

| Part | Designation | Material | | |
|---|---|---|---|---|
| 1 | Injection mortar | Mortar, hardener, filler | | |
| | Steel grade | Steel<br>Zinc coated | Stainless steel R<br>acc. to EN 10088-1:2014<br>Corrosion resistance class CRC II<br>acc. to EN 1993-1-4:2006 | High corrosion resistant steel HCR<br>acc. to EN 10088-1:2014<br>Corrosion resistance class CRC V<br>acc. to EN 1993-1-4:2006 |
| 2 | Anchor rod | Property class 5.8, 8.8 or 10.9 acc. to EN ISO 898-1:2013<br>zinc coated ≥ 5 µm,<br>ISO 4042:2018-7 n+A4 (A4)<br>or hot-dip galvanized ≥ 40 µm<br>EN ISO 10684:2004+AC:2009<br>$f_{yk}$ and $f_{uk}$ see Annex B<br>$A_5$ > 8 %<br>ductile steel behaviour | Property class 70 or 80<br>EN ISO 3506-1:2009<br>1.4401, 1.4404, 1.4578, 1.4362, 1.4439, 1.4462, 1.4062, 1.4162, 1.4662<br>EN 10088-3:2014<br>$f_{yk}$ and $f_{uk}$ see Annex B<br>$A_5$ > 8 %<br>ductile steel behaviour | Property class 70 or 80<br>EN ISO 3506-1:2009<br>1.4529, 1.4565, 1.4547, 1.4439, 1.4529, 1.4565, 1.4547, 1.4439, 1.4529, 1.4565, 1.4547, 1.4439, 

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## Specifications of intended use (part 1)

### Table B1.1: Overview use and performance categories

| Anchorages subject to: | | FIS EM Plus with ... | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Anchor rod | | Internal threaded anchor FIS HI | | Reinforcing bar | | Internal threaded sleeve FIS A | |
| 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 loading in | uncracked concrete | all sizes | Tables: C1.1 C4.1 C6.1 C8.1 C10.1 | all sizes | Tables: C2.1 C5.1 C7.1 C9.1 C10.2 | all sizes | Tables: C3.1 C4.1 C5.1 C6.1 C11.1 | all sizes | Tables: C3.2 C4.1 C11.1 C12.1 C12.2 |
| | cracked concrete | | | | | | | | |
| Seismic performance category (only Hammer drilling with std. / hollow drill bit) | C1 | M8 to M24 | other: C1.1 C1.2 C1.1 | | | ϕ10 to ϕ32 | other: C1.1 C1.2 C1.1 | | |
| | C2 | M12 M16 M20 M24 | other: C5.1 C6.2 C6.1 | | | | | | |
| Use category | dry or wet concrete | all sizes | | | | | | | |
| | water filled hole | all sizes and permitted in combination with working life 100 years | | | | | | | |
| Installation direction | | D3 (downward and horizontal and upwards (e.g. overhead) installation) | | | | | | | |
| Installation temperature | | $T_{inst}$ = -5 °C to $T_{inst}$ = +40 °C | | | | | | | |
| In-service temperature | Temperature range I | -40 °C to +80 °C | max. short term temperature +50 °C; max. long term temperature +35 °C | | | | | | |
| | Temperature range II | -40 °C to +120 °C | max. short term temperature +72 °C; max. long term temperature +43 °C | | | | | | |

Installation overhead: see table C5.1

| fischer injection system FIS EM Plus | Annex B 1 |
|---|---|
| Intended use<br>Specifications (part 1) | |

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## Specifications of intended use (part 2)

**Base materials:**

- Concrete: Anchoring in non-cracked concrete C20/25 to C50/60, according to EN 206:2013+A1:2016

**Use conditions (Environmental conditions):**

- Structures subject to dry internal conditions (all materials),
  in the coated steel, stainless steel or high corrosion resistance steel)
- External atmospheric conditions according to EN 1993-1-4:2015 corresponding to corrosion resistance classes according to Annex A (type A5)

**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 anchorage must be indicated on the design drawings (e.g. position and dimensions of anchor, embedment depth, etc.).
- Anchorages are designed in accordance with:
  EN 1992-4:2018 and TR CEN/TS 1992-4-1:2009, Edition February 2010

**Installation:**

- Anchor installation and installation supervision only by appropriately qualified personnel and under the supervision of the responsible technical consultant on site
- Installation of the anchor only as specified in the manufacturer's instructions
- Anchorage depth should be marked and checked before installation
- Overhead installation is allowed

| | |
|---|---|
| Fischer injection system FIS V Plus<br><br>Intended use<br>Specifications (part 2) | Annex B 2 |

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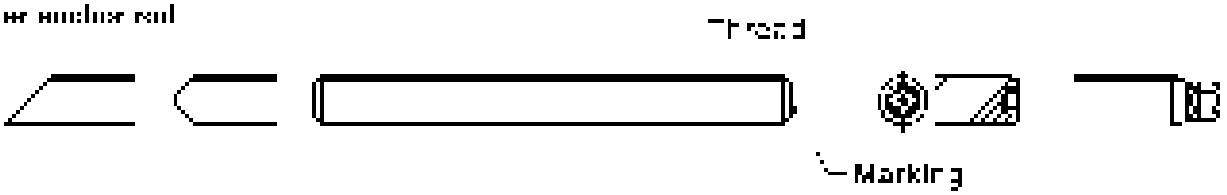
## Table B3.1: Installation parameters for anchor rods

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

1) Round drill hole diameter according to recommendation.

fischer anchor rod

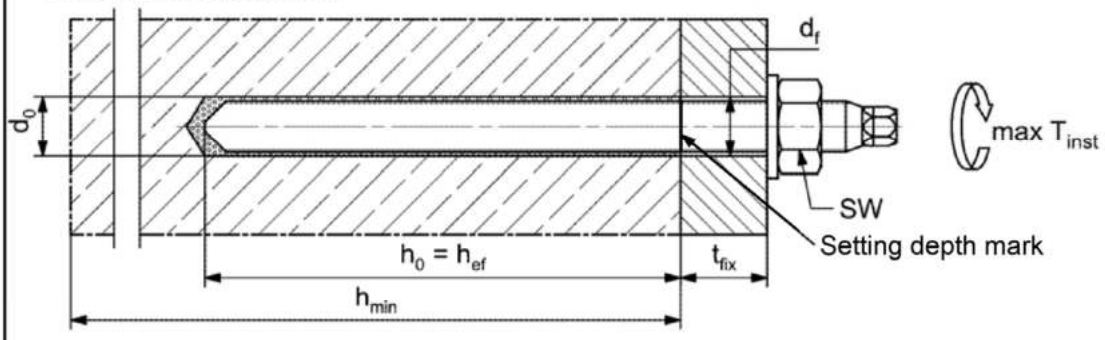



Marking (on random place) fischer anchor rod:

| | | | |
|---|---|---|---|
| Steel zinc plated PC 8.8 | ● or + | Steel hot-dip galvanized PC 8.8 | ● |
| High corrosion resistant steel HCR PC 80 | ■ | High corrosion resistant steel HCR PC 50 | ▲ |
| 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 -M Plus

**Intended use**
Installation parameters anchor rods

Annex B 3

Deutsches Institut für Bautechnik DIBt

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

| Anchor rods | | | M8 | M10 | M12 | M14 | M16 | - | M20 | M22 | M24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reinforcing bars (nominal diameter)** | | **ϕ** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** |
| **Minimum edge distance** | | | | | | | | | | | |
| Uncracked / cracked concrete | $c_{min}$ | [mm] | 40 | 45 | 45 | 45 | 50 | 55 | 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 | 95 | 105 |
| Minimum edge distance | $c_{min}$ | | according to Annex B5 | | | | | | | | |
| **Required projecting area** | | | | | | | | | | | |
| Uncracked concrete | $A_{sp,req}$ | [1000 mm²] | 8 | 13 | 22 | 28 | 24 | 38,5 | 39,5 | 55,5 | 80 |
| Cracked concrete | | | 6,5 | 10 | 16,5 | 17,5 | 18,5 | 20,5 | 23,5 | 30 | 30,5 |

| Anchor rods | | | - | - | M27 | - | M30 | - | - | - | - |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reinforcing bars (nominal diameter)** | | **ϕ** | **25** | **26** | **-** | **28** | **30** | **32** | **34** | **36** | **40** |
| **Minimum edge distance** | | | | | | | | | | | |
| Uncracked / cracked concrete | $c_{min}$ | [mm] | 75 | 75 | 75 | 80 | 80 | 120 | 120 | 135 | 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 | 160 |
| Minimum edge distance | $c_{min}$ | | according to Annex B5 | | | | | | | | |
| **Required projecting area** | | | | | | | | | | | |
| Uncracked concrete | $A_{sp,req}$ | [1000 mm²] | 47,5 | 47,5 | 47,5 | 64 | 64 | 64 | 64 | 64 | 64 |
| Cracked concrete | | | 36,5 | 36,5 | 36,5 | 49 | 49 | 49 | 49 | 49 | 49 |

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

For the relevant combination of minimum spacing and minimum edge distance and concrete conditions (cracked / uncracked concrete) and load direction (tension load) the following equation must be fulfilled:

$$A_{sp,req} \leq A_{sp,e}$$

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

$A_{sp,e} = A_{sp,e}$ = effective projecting area according to Annex B6.1

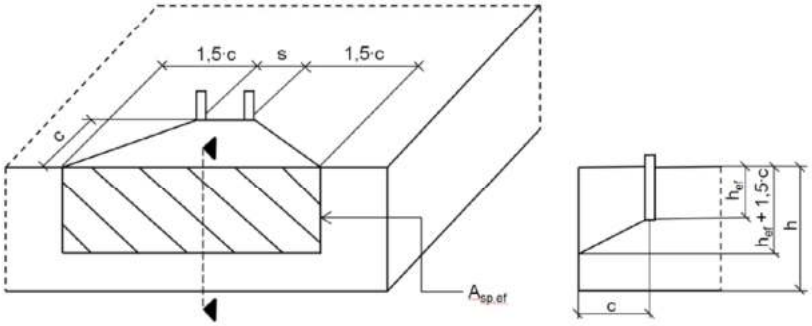
Headed injection system EPCON C8 with M8 to M24

**Intended use**
Minimum spacing and edge distance for anchor rods and reinforcing bars

**Annex B 4**

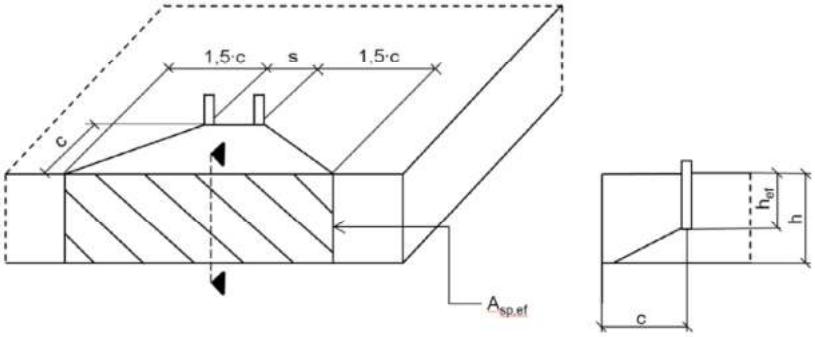
Deutsches Institut für Bautechnik DIBt

**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 | | $A_{sp,t} = (3 \cdot c_1 + h_{ef} + 1{,}5 \cdot c)^2$ | [mm²] | with $c_1 \leq c$ |
| Group of anchors with | $s \leq 3 \cdot c$ | $A_{sp,t} = (3 \cdot c_1 + s) \cdot (h_{ef} + 1{,}5 \cdot c)$ | [mm] | with $c_1 \leq c$ |
| Group of anchors with | $s > 3 \cdot c$ | $A_{sp,t} = (3 \cdot c_1 + 3 \cdot c + s) \cdot (h_{ef} + 1{,}5 \cdot c)$ | [mm²] | with $c_1 \leq c$ and $s \leq 3 \cdot c$ |

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




| | | | | |
|---|---|---|---|---|
| Single anchor | | $A_{sp,t} = 3 \cdot c \cdot$ existing h | [mm²] | with $c_1 \leq c$ |
| Group of anchors with | $s \leq 3 \cdot c$ | $A_{sp,t} = 3 \cdot c \cdot$ existing h | [mm²] | with $c_1 \leq c$ |
| Group of anchors with | $s > 3 \cdot c$ | $A_{sp,t} = (3 \cdot c + s) \cdot$ existing h | [mm²] | with $c_1 \leq c$ and $s \leq 3 \cdot c$ |

Edge distance and axial spacing shall be chosen so that $A_{sp,t} \geq A_{sp,t,ef}$ min

Figures not to scale

Injection system HIT-MP plus

Intended use
Minimum thickness of concrete member and edge dist.,
minimum spacing and edge distance

Annex B 5

Table B6.1: Installation parameters for fischer internal threaded anchors IG-M

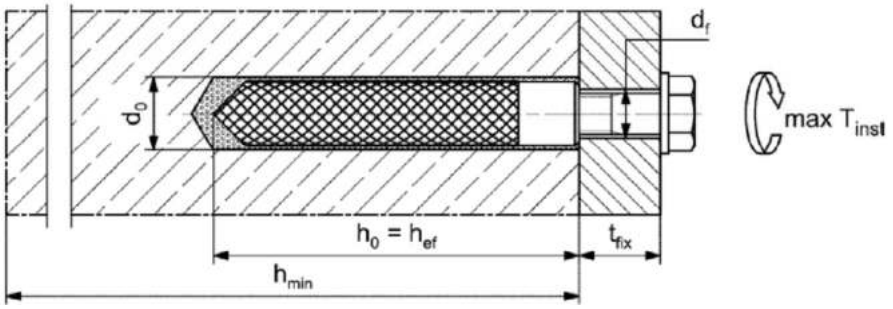
| Internal threaded anchors IG-M | Thread | | M8 | M10 | M12 | M16 | M20 |
|---|---|---|---|---|---|---|---|
| Diameter of anchor | $d_{nom}$ | [mm] | 10 | 12 | 16 | 20 | 25 |
| Nominal drill hole diameter | $d_0$ | | 10 | 12 | 16 | 24 | 32 |
| Drill hole depth | $h_0$ | | $h_{ef}$ + $h_{ef}$ | | | | |
| Effective embedment depth | $h_{ef}$ | | 90 | 94 | 125 | 160 | 200 |
| Minimum base material thickness<br>Minimum edge distance | $h_{min}$<br>$c_{min}$ | | 55 | 62 | 75 | 95 | 125 |
| Diameter of clearance hole in the fixture | $d_f$ | | 9 | 12 | 14 | 18 | 22 |
| Minimum thickness of fixture | $t_{fix}$ | | 10 | 10 | 15 | 20 | 25 |
| Maximum screw-in depth | $l_{max}$ | | 15 | 20 | 25 | 35 | 45 |
| Minimum screw-in depth | $l_{min}$ | | 8 | 10 | 12 | 16 | 20 |
| Maximum installation torque | $max\ T_{inst}$ | [Nm] | 10 | 20 | 40 | 80 | 160 |

fischer internal threaded anchor IG-M

**Marking:** Anchor sleeve e.g.: M10
Stainless steel additional R: e.g.: M10 H
[illegible] additional HCR: e.g.: M10 HCR

Related fischer threaded rods (property class and corrosion resistance) must comply with the appropriate materials and strength class of Annex A 3, Table A2.

**Installation conditions:**




Figures not to scale

fischer injection system FIS -M IG

**Intended use**
Installation parameters internal threaded anchors -IG M

Annex B 6

Table B7.1: Installation parameters for reinforcing bars [1]

| Nominal diameter of the bar | | $d_s$ | 8 [2] | 10 [2] | 12 [2] | 14 | 16 | 18 | 20 | 22 | 24 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | $d_0$ | | 10 | 12 | 14 | 16 | 20 | 22 | 25 | 30 | 30 |
| Drill hole depth | $h_0$ | | $h_0 = h_{ef}$ | | | | | | | | |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 60 | 60 | 70 | 75 | 80 | 90 | 90 | 96 | 96 |
| | $h_{ef,max}$ | | 160 | 200 | 240 | 280 | 320 | 360 | 400 | 440 | 480 |
| Minimum thickness of concrete member | $h_{min}$ | | $h_{ef} + 30$ ($\geq 100$) | | | | $h_{ef} + 2d_0$ | | | | |

| Nominal diameter of the bar | | $d_s$ | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 | - |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | $d_0$ | | 30 | 35 | 35 | 40 | 40 | 40 | 45 | 55 | - |
| Drill hole depth | $h_0$ | | $h_0 = h_{ef}$ | | | | | | | | |
| Effective embedment depth | $h_{ef,min}$ | [mm] | 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] Intermediate values of the effective embedment depth may be installed. The relevant values for $h_{ef}$ and $h_{min}$ may be determined by linear interpolation.
[2] Only applicable for post-installed rebar connections

Reinforcing bar

- The minimum value of the effective embedment depth must be $h_{ef} \geq \max(2{,}5 \cdot d_s; 50\,\text{mm})$
- The drill hole depth must be within the range: $h_{ef} + 1{,}0 \cdot d_s \leq h_0 \leq h_{ef} + 2{,}0 \cdot d_s$
  ($d_s$ = Nominal diameter of the bar, $h_0$ = drill hole depth)

Installation conditions:

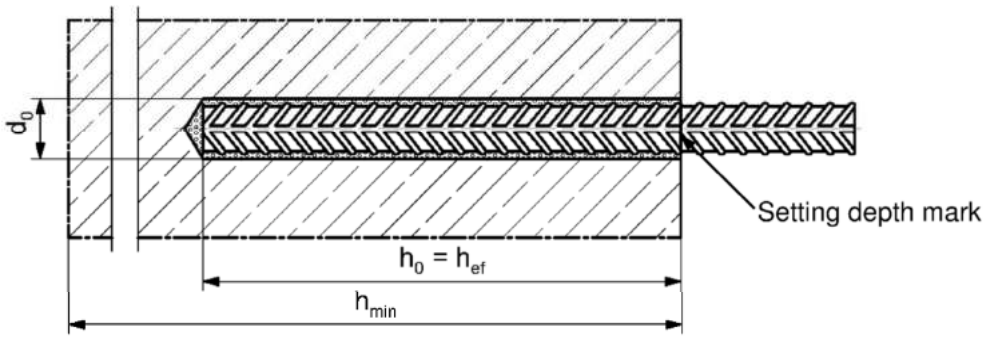



Figure not to scale

Reactive injection system HIT-MP Plus

Intended use
Installation parameters for reinforcing bars

Annex B 7

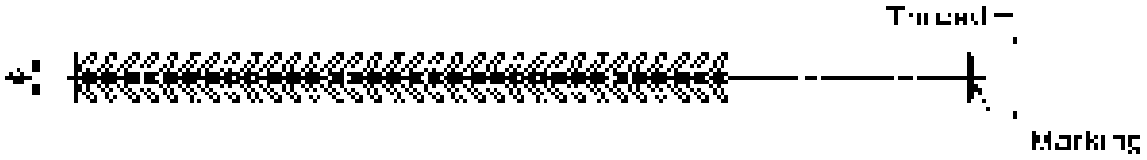
Deutsches Institut für Bautechnik DIBt

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

| Rebar anchor FRA | | Thread | M12[1] | M16 | M20 | M24 |
|---|---|---|---|---|---|---|
| Nominal diameter of the bar | $d$ | [mm] | 12 | 16 | 20 | 25 |
| Wrench dimension | SW | | 19 | 24 | 30 | 36 |
| Nominal diameter of drill hole | $d_0$ | | 14 | 18 | 24 | 28 | 32 |
| Drill hole depth | $h_0$ | | $h_{ef}$ + $l_e$ | | | |
| effective embedment depth | $h_{ef}$ | | 70 | 90 | 96 | 96 |
| | $h_{ef,red}$ | | 170 | 220 | 300 | 300 |
| Clearance concrete surface to welded joint | $l_e$ | | 40 | | | |
| Minimum spacing and minimum edge distance | $s_{min}$<br>$c_{min}$ | | 55 | 65 | 80 | 100 |
| Diameter of clearance hole in the fixture: pre-positioned anchorage | $d_f$ | | 14 | 18 | 22 | 26 |
| push-through anchorage | $d_f$ | | 13 | 22 | 26 | 32 |
| Minimum thickness of concrete member | $h_{min}$ | | $h_{ef}$ + 30 | | $h_{ef}$ + 2$d_0$ | |
| Maximum installation torque | max $T_{inst}$ | [Nm] | 40 | 80 | 120 | 150 |

[1] Both drill hole diameters can be used

Flexible rebar anchor FRA




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

**Installation conditions:**

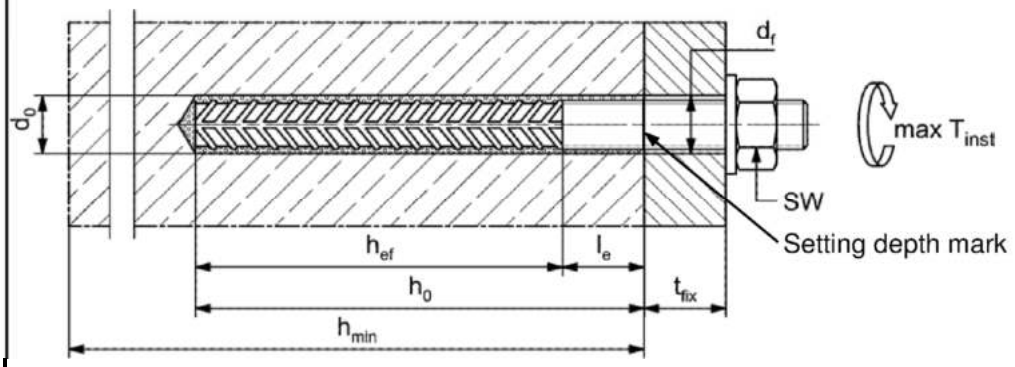



Figure not to scale

Flexible injection system FIS -M12 to

**Intended use**
Installation conditions flexible rebar anchor FRA

Annex B 6

Deutsches Institut für Bautechnik DIBt

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

The values of the tolerances of the dimensions

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | $d_0$ | [mm] | 10 | 12 | 14 | 16 | 18 | 20 | 24 | 25 | 28 | 30 | 32 | 35 | 40 | 45 | 55 |
| Brush diameter according to BS | $d_b$ | | 11 | 14 | 16 | 20 | | 25 | 25 | 27 | 30 | 40 | | | | | |
| Steel brush according to DIBt | $d_b$ | | - | - | - | - | | - | - | - | - | - | | | 42 | 47 | 57 |

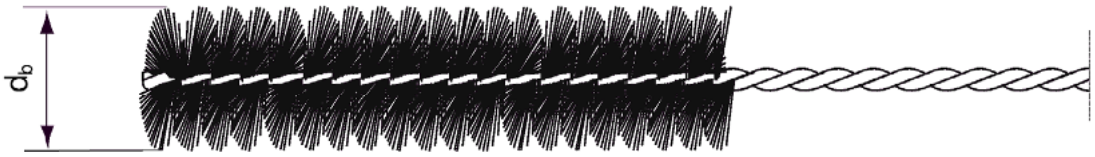



Table B9.2 Maximum processing time of the mortar and minimum curing time (During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

| Temperature at the time of placing the mortar [°C] | Maximum processing time $t_{work}$ | Minimum curing time $t_{cure}$ |
|---|---|---|
| -5 °C to 0 °C | 240 min | 360 h |
| > 0 °C to 5 °C | 150 min | 168 h |
| > 5 °C to 10 °C | 120 min | 48 h |
| > 10 °C to 20 °C | 90 min | 24 h |
| > 20 °C to 30 °C | 60 min | 12 h |
| > 30 °C to 40 °C | 45 min | 8 h |

a) Intermediate values may be linearly interpolated. The minimum curing time must be kept.
b) Maximum permissible concrete temperature 50 °C

Bonded injection system for M10 to M30

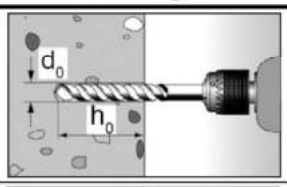
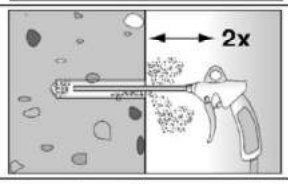
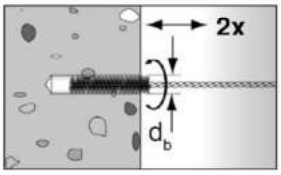
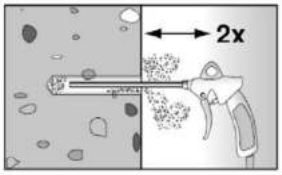
**Intended use**
Cleaning brush, steel brush
Processing time and curing time

**Annex B 9**

Deutsches Institut für Bautechnik DIBt

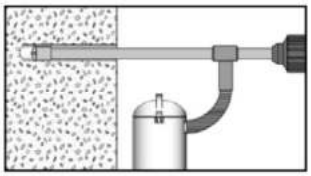
## Installation instructions part 1

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

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

Go to step 6

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

| | | |
|---|---|---|
| 1 | | Check a suitable hollow drill (see **table B1.1**)<br>for correct operation of the dust extraction |
| 2 |  | Use a suitable dust extraction system, e. g.<br>fischer FVC 35 M or a comparable dust extraction system<br>with equivalent performance data<br><br>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 $\mathbf{d_0}$ and drill hole depth $\mathbf{h_0}$<br>see **tables B3.1, B6.1, B7.1, B8.1** |

Go to step 6

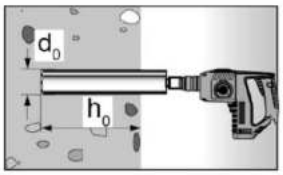
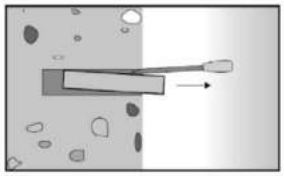
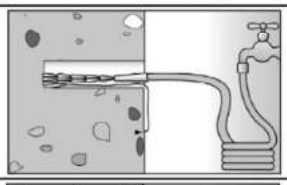
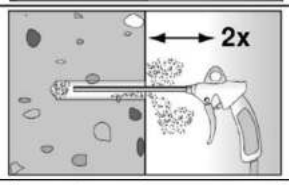
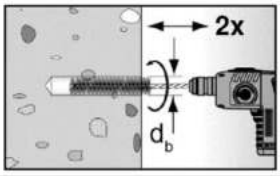
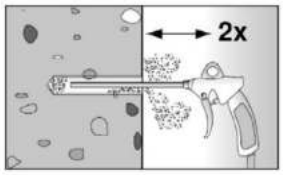
[illegible] injection system FIS -MP [illegible]

**Intended use**
Installation instructions part 1

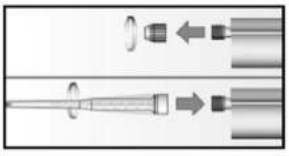
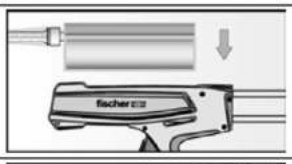
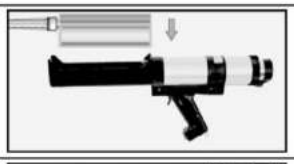
**Annex B 10**

## Installation instructions part 2

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

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

### Preparing the cartridge

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

fischer injection system FIS -MP Plus

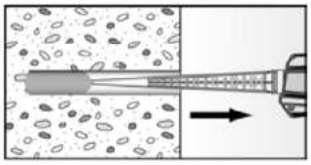
Intended use
Installation instructions part 2

Annex B 11

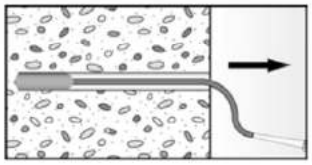
## Installation instructions part 3

Injection of the mortar

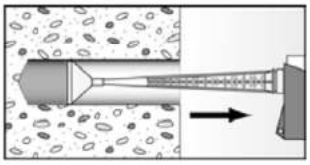
**9**



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



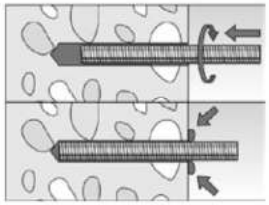
Drill hole depth ≥ 150 mm use an extension or luer

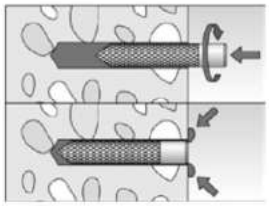


For overhead installation, deep holes (h > 250 mm), small hole diameter (d ≤ 20 mm) use fischer injector adapter

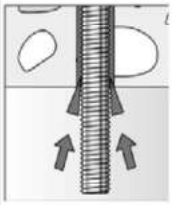
Installation of anchor rods or fischer internal threaded anchors RG MI

**10**

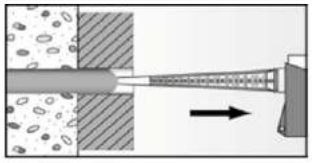




Only use clean and oil-free metal parts.
Mark the setting depth of the metal parts. Push the anchor rod or fischer internal threaded RG MI anchor down to the bottom of the hole, turning it slightly while doing so.
After inserting the metal part, excess mortar must be emerged around the anchor element.



For overhead installations support the metal part with wedges (e. g. fischer centering wedges) or fischer overhead clips.

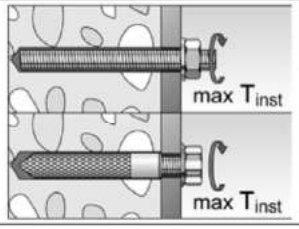


For push through installation fill the annular gap with mortar

**11**

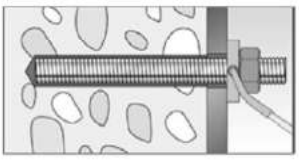
Wait for the specified curing time $t_{cure}$ see **table B9.2**

**12**




Mounting the fixture max $T_{inst}$ see **tables B3.1 and B6.1**

**Option**



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)

fischer injection system FIS -M IR

**Intended use**
Installation instructions part 3

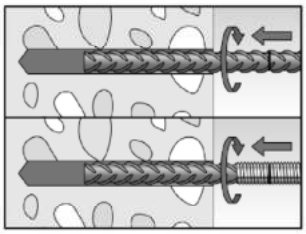
**Annex B 12**

Deutsches Institut für Bautechnik DIBt

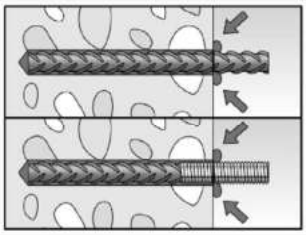
## Installation instructions part 4

Installation reinforcing bars and fischer rebar anchor FRA

**10**



Only use clean and oil-free reinforcing bars or fischer FRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the fischer FRA into the filled hole up to the setting depth mark

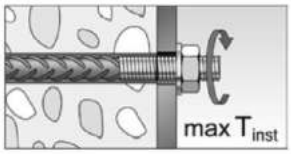


When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole.

**11**

Wait for the specified curing time $t_{cure}$ see **table B9.2**

**12**




Mounting the fixture max $T_{inst}$ see **table B8.1**

fischer injection system FIS -M FRA

**Intended use**
Installation instructions part 4

**Annex B 13**

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**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 failure**[3] | | | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s}$ | Steel zinc plated | Property class | 4.8 | 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 | 16 | 28 | 42 | 59 | 79 | 123 | 152 | 177 | 230 | 281 |
| | | | 70 | 28 | 41 | 59 | 81 | 110 | 172 | 213 | 247 | 322 | 393 |
| | | | 80 | 32 | 47 | 68 | 93 | 126 | 196 | 243 | 282 | 368 | 449 |
| **Partial factors** [1] | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms}$ | Steel zinc plated | Property class | 4.8 | 1,50 | | | | | | | | | |
| | | | 5.8 | 1,50 | | | | | | | | | |
| | | | 8.8 | 1,50 | | | | | | | | | |
| | Stainless steel R and high corrosion resistant steel HCR | | 50 | 2,86 | | | | | | | | | |
| | | | 70 | 1,87 - 2,31 | | | | | | | | | |
| | | | 80 | 1,60 | | | | | | | | | |
| **Bearing capacity under shear load, steel failure**[3] | | | | | | | | | | | | | |
| **without lever arm** | | | | | | | | | | | | | |
| Characteristic resistance $V^0_{Rk,s}$ | Steel zinc plated | Property class | 4.8 | 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 | 169 |
| | | | 8.8 | 15(13) | 23(21) | 34 | 46 | 63 | 98 | 122 | 141 | 184 | 225 |
| | Stainless steel R and high corrosion resistant steel HCR | | 50 | 8 | 15 | 21 | 29 | 39 | 61 | 76 | 88 | 115 | 141 |
| | | | 70 | 13 | 20 | 30 | 40 | 55 | 86 | 107 | 124 | 161 | 197 |
| | | | 80 | 16 | 23 | 34 | 46 | 63 | 98 | 122 | 141 | 184 | 225 |
| Ductility factor | | | | 1,0 | | | | | | | | | |
| **with lever arm** | | | | | | | | | | | | | |
| Characteristic resistance $M^0_{Rk,s}$ | Steel zinc plated | Property class | 4.8 | 15(13) | 30(27) | 52 | 83 | 133 | 260 | 357 | 449 | 666 | 839 |
| | | | 5.8 | 19(17) | 37(33) | 65 | 104 | 166 | 324 | 445 | 561 | 832 | 1049 |
| | | | 8.8 | 30(26) | 60(53) | 105 | 167 | 266 | 519 | 713 | 898 | 1332 | 1679 |
| | Stainless steel R and high corrosion resistant steel HCR | | 50 | 16 | 31 | 55 | 87 | 139 | 272 | 374 | 471 | 699 | 881 |
| | | | 70 | 26 | 52 | 92 | 146 | 232 | 454 | 624 | 784 | 1165 | 1469 |
| | | | 80 | 30 | 60 | 105 | 167 | 266 | 519 | 713 | 898 | 1332 | 1679 |
| **Partial factors** [1] | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms}$ | Steel zinc plated | Property class | 4.8 | 1,25 | | | | | | | | | |
| | | | 5.8 | 1,25 | | | | | | | | | |
| | | | 8.8 | 1,25 | | | | | | | | | |
| | Stainless steel R and high corrosion resistant steel HCR | | 50 | 2,38 | | | | | | | | | |
| | | | 70 | 1,56 - 1,96 | | | | | | | | | |
| | | | 80 | 1,33 | | | | | | | | | |

[1] In absence of other national regulations
[2] Only applicable for high corrosion resistant steel HCR with $A_5 \geq 8\%$ and $A_5 \geq 12\%$ (ductile steel)
[3] Values in brackets are valid for undersize threaded rods with smaller stress area for hot dip galvanized standard threaded rods according to DIN ISO 10684:2004+AC:2009

fischer injection system FIS -M FIS ...

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

**Annex C 1**

**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 | $N_{Rk,s}$ | Property class | 5.8 | [kN] | 19 | 29 | 43 | 79 | 123 |
| | | | 8.8 | | 29 | 47 | 68 | 108 | 179 |
| | | Property class 70 | R | | 26 | 41 | 59 | 110 | 172 |
| | | | HCR | | 26 | 41 | 59 | 110 | 172 |
| **Partial factors**[1] | | | | | | | | | |
| Partial factors | $\gamma_{Ms}$ | Property class | 5.8 | | | | 1,50 | | |
| | | | 8.8 | | | | 1,50 | | |
| | | Property class 70 | R | | | | 1,87 | | |
| | | | HCR | | | | 1,87 | | |
| **Bearing capacity under shear load, steel failure** | | | | | | | | | |
| **Without lever arm** | | | | | | | | | |
| Charact. resistance with screw | $V^0_{Rk,s}$ | Property class | 5.8 | [kN] | 9,2 | 14,5 | 21,1 | 39,2 | 62,0 |
| | | | 8.8 | | 14,3 | 23,2 | 33,7 | 54,9 | 86,0 |
| | | Property class 70 | R | | 12,3 | 20,3 | 29,5 | 54,8 | 86,0 |
| | | | HCR | | 12,3 | 20,3 | 29,5 | 54,8 | 86,0 |
| Ductility factor | $k_7$ | | | | | | 1,0 | | |
| **With lever arm** | | | | | | | | | |
| Charact. resistance with screw | $M^0_{Rk,s}$ | Property class | 5.8 | [Nm] | 20 | 37 | 60 | 173 | 337 |
| | | | 8.8 | | 30 | 60 | 105 | 266 | 519 |
| | | Property class 70 | R | | 25 | 52 | 92 | 232 | 454 |
| | | | HCR | | 25 | 52 | 92 | 232 | 454 |
| **Partial factors**[1] | | | | | | | | | |
| Partial factors | $\gamma_{Ms}$ | Property class | 5.8 | | | | 1,25 | | |
| | | | 8.8 | | | | 1,25 | | |
| | | Property class 70 | R | | | | 1,50 | | |
| | | | HCR | | | | 1,50 | | |

[1] In absence of national regulations

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**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 | $V^0_{Rk,s}$ | [kN] | $0,5 \cdot A_s \cdot f_{uk}$ [1)] | | | | | | | | | | | | | | | | |
| Ductility factor | $k_7$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| **With lever arm** | | | | | | | | | | | | | | | | | | | |
| Characteristic resistance | $M^0_{Rk,s}$ | [Nm] | $1,2 \cdot W_{el} \cdot f_{uk}$ [1)] | | | | | | | | | | | | | | | | |

1) $f_{uk}$ or $k \cdot f_{yk}$ may 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 factor**[1)] | | | | | | |
| Partial factor | $\gamma_{Ms,N}$ | [-] | 1,4 | | | |
| **Bearing capacity under shear load, steel failure** | | | | | | |
| **Without lever arm** | | | | | | |
| Characteristic resistance | $V^0_{Rk,s}$ | [kN] | 30 | 55 | 86 | 124 |
| Ductility factor | $k_7$ | [-] | 1,0 | | | |
| **With lever arm** | | | | | | |
| Characteristic resistance | $M^0_{Rk,s}$ | [Nm] | 52 | 133 | 454 | 786 |
| **Partial factor**[1)] | | | | | | |
| Partial factor | $\gamma_{Ms,V}$ | [-] | 1,5 | | | |

1) In absence of other national regulations

fischer injection system FIS -M12 to M24

Performances
Characteristic values for steel failure under shear load of reinforcing bars and fischer rebar anchors FRA

Annex C 3

Deutsches Institut für Bautechnik DIBt

**Table C4.1:** Characteristic values for **concrete failure** under tension / shear load

| **Size** | | | **All sizes** |
|---|---|---|---|
| **Tension load** | | | |
| Installation factor | $\gamma_{inst}$ | [-] | See annex B 5 for C 20/25 and C 12/15 to C 16 |
| **Factors for the compressive strength of concrete > C20/25** | | | |
| increasing factors for $N_{Rk}$ | C25/30 | $\psi_c$ | 1,02 |
| | C30/37 | | 1,04 |
| | C35/45 | | 1,05 |
| | C40/50 | | 1,07 |
| | C45/55 | | 1,08 |
| | C50/60 | | 1,09 |
| **Splitting failure** | | | |
| Edge distance | $c_{cr,sp}$ | [mm] | $1,0\ h_{ef}$ |
| | $2\ c_{cr,sp} = h_{min} = 1,5\ h_{ef}$ | | $4,6\ h_{ef} - 1,8\ h$ |
| | $h_{min} < 1,5\ h_{ef}$ | | $5,86\ h_{ef}$ |
| 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 | $\Psi^0_{sus}$ | [-] | -[1] |
| **Shear load** | | | |
| Installation factor | $\gamma_{inst}$ | [-] | 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 $d_{nom}$)<br>for $d_{nom} > 24$ mm: min ($h_{ef}$; 8 $d_{nom}$; 300 mm) |
| **Calculation diameters** | | | |

| Size | | | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| fischer anchor rods and standard threaded rods | $d_{nom}$ | [mm] | 10 | 12 | 14 | 16 | 20 | 22 | 24 | 27 | 30 |
| fischer internal threaded anchor FIS A | $d_{nom}$ | | 16 | 18 | 22 | 24 | 28 | 30 | 32 | 35 | 40 |
| fischer rebar anchor FRA | $d_{nom}$ | | 12 | 14 | 16 | 18 | 22 | 24 | 26 | 28 | 32 |

| Size (nominal diameter of the bar) | | | 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] See for type and size of the FTA

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**Table C5.1:** Characteristic values for combined pull-out and concrete failure for Hacher anchor rods and standard threaded rods in hammer drilled 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** | | | | | | | | | | | | |
| Hammer drilling with standard drill bit or hollow drill bit and dry or wet concrete | | | | | | | | | | | | |
| Temperature range I: 40 °C / 72 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 18 | 18 | 18 | 17 | 17 | 16 | 15 | 15 | 15 | 14 |
| Temperature range II: 80 °C / 122 °C | | | 13 | 13 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9,5 |
| Hammer drilling with standard drill bit or hollow drill bit and water filled hole | | | | | | | | | | | | |
| Temperature range I: 40 °C / 72 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 16 | 15 | 14 | 13 | 11 | 11 | 10 | 10 | 9,5 |
| Temperature range II: 80 °C / 122 °C | | | 11 | 11 | 10 | 10 | 9,5 | 8,5 | 8,5 | 8,0 | 8,0 | 7,5 |
| Installation factors | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 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 dry or wet concrete | | | | | | | | | | | | |
| Temperature range I: 40 °C / 72 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7,5 | 7,5 | 8 | 8,5 | 9,0 | 8,5 | 8,5 | 8,5 | 8,5 | 9,0 |
| Temperature range II: 80 °C / 122 °C | | | 7,5 | 7,5 | 8 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| Hammer drilling with standard drill bit or hollow drill bit and water filled hole | | | | | | | | | | | | |
| Temperature range I: 40 °C / 72 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 7 | 7 | 7 | 8 | 6 | 7 | 7 | 7 | 7 |
| Temperature range II: 80 °C / 122 °C | | | 7 | 7 | 7 | 7 | 8 | 6 | 7 | 7 | 7 | 7 |
| Hammer drilling with standard drill bit or hollow drill bit and dry or wet concrete (water filled hole) | | | | | | | | | | | | |
| Temperature range I: 40 °C / 72 °C | $\tau_{Rk,cr}$ | [N/mm²] | 6 | 7,5 | 7,5 | 7 | 8 | 6 | 6 | 6 | 6 | 6 |
| Temperature range II: 80 °C / 122 °C | | | 6 | 7 | 7 | 7 | 8 | 6 | 6 | 6 | 6 | 6 |
| Installation factors | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| Water filled hole | | | 1,2 | | | | | 1,4 | | | | |

Hacher injection system HIS-MP plus

Performances
Characteristic values for combined pull-out and concrete failure for Hacher anchor rod and standard threaded rods; working life 50 years

Annex C 5

Deutsches Institut für Bautechnik DIBt

**Table C6.1: Characteristic values for combined pull-out and concrete failure for flasher 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) | | | | | | | | | | | | | |
| Tem-perature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 18 | 18 | 18 | 17 | 17 | 18 | 18 | 15 | 15 | 14 |
| | II: 50 °C / 72 °C | | | 19 | 17 | 17 | 16 | 15 | 15 | 14 | 14 | 14 | 13 |
| Diamond drilling (dry or wet concrete) | | | | | | | | | | | | | |
| Tem-perature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 18 | 18 | 18 | 17 | 17 | 18 | 18 | 15 | 15 | 14 |
| | II: 50 °C / 72 °C | | | 15 | 14 | 12 | 11 | 11 | 10 | 9 | 9 | 8 | 8 |
| **Installation factors** | | | | | | | | | | | | | |
| Dry or wet concrete | | $\gamma_{inst}$ | [-] | 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) | | | | | | | | | | | | | |
| Tem-perature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| | II: 50 °C / 72 °C | | | 7,5 | 7,5 | 9 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 | 8,5 |
| Diamond drilling (dry or wet concrete) | | | | | | | | | | | | | |
| Tem-perature range | I: 35 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm²] | 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 | | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | |
| Working life 100 years | I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 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 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |

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

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

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

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

Flasher injection system FIS -M12 ...

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

Annex C 6

Deutsches Institut für Bautechnik DIBt

**Table C7.1:** Characteristic values for combined pull-out and concrete failure for Hilacher 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** | | | | | | | |
| Hammering with standard drill bit or hollow drill bit and diamond drilling (dry or water saturated concrete) | | | | | | | |
| Temperature range: 80 °C / 50 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 14 | 13 | 12 |
| Temperature range: 80 °C / 72 °C | | | 14 | 13 | 13 | 12 | 11 |
| Hammering with standard drill bit or hollow drill bit and diamond drilling (water filled hole) | | | | | | | |
| Temperature range: 80 °C / 50 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 14 | 12 | 12 | 11 | 10 |
| Temperature range: 80 °C / 72 °C | | | 13 | 12 | 11 | 10 | 9 |
| Diamond drilling (dry or water saturated concrete) | | | | | | | |
| Temperature range: 80 °C / 50 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 13 | 12 | 11 | 10 | 9 |
| Temperature range: 80 °C / 72 °C | | | 12 | 11 | 10 | 9 | 8 |
| **Installation factors** | | | | | | | |
| Dry or water saturated concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| Water filled hole | | | 1,4 | | | | |
| **Cracked concrete** | | | | | | | |
| **Characteristic bond resistance in cracked concrete C20/25** | | | | | | | |
| Hammering with standard drill bit or hollow drill bit and diamond drilling (dry or water saturated concrete) | | | | | | | |
| Temperature range: 80 °C / 50 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 9 | 9 | 7 | 7 |
| Temperature range: 80 °C / 72 °C | | | 7 | 9 | 9 | 7 | 7 |
| Hammering with standard drill bit or hollow drill bit and diamond drilling (water filled hole) | | | | | | | |
| Temperature range: 80 °C / 50 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 9,0 | 9 | 6 | 6 |
| Temperature range: 80 °C / 72 °C | | | 7 | 9 | 9 | 6 | 6 |
| **Installation factors** | | | | | | | |
| Dry or water saturated concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | |
| Water filled hole | | | 1,2 | | | 1,4 | |

Table C8.1: Characteristic values for combined pull-out and concrete failure for Hacher 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 and diamond-drilling (dry or wet concrete) | | | | | | | |
| Temperature range | 25 °C / 50 °C | $\tau_{Rk,ucr}$ [N/mm²] | 15 | 14 | 14 | 13 | 12 |
| | 50 °C / 72 °C | | 14 | 13 | 13 | 12 | 11 |
| Hammer-drilling (dry or wet concrete) | | | | | | | |
| Temperature range | 25 °C / 50 °C | $\tau_{Rk,ucr}$ [N/mm²] | 13 | 12 | 11 | 10 | 9 |
| | 50 °C / 72 °C | | 12 | 11 | 10 | 9 | 8 |
| Installation factors | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | - | | | 1,0 | | |
| Working life 100 years | 25 °C / 50 °C | $\gamma_{ucr}$ | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
| | 50 °C / 72 °C | | 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 and diamond-drilling (dry or wet concrete) | | | | | | | |
| Temperature range | 25 °C / 50 °C | $\tau_{Rk,cr}$ [N/mm²] | 7 | 6 | 6 | 7 | 7 |
| | 50 °C / 72 °C | | 7 | 8 | 8 | 7 | 7 |
| Installation factors | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | - | | | 1,0 | | |
| Working life 100 years | 25 °C / 50 °C | $\gamma_{cr}$ | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 |
| | 50 °C / 72 °C | | 0,80 | 0,80 | 0,80 | 0,80 | 0,80 |

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

$\tau_{Rk,ucr} = \gamma_{inst} \cdot \tau_{Rk,ucr}$

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

$\tau_{Rk,cr} = \gamma_{inst} \cdot \tau_{Rk,cr}$

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

| Nominal diameter of the bar | | $\phi$ | 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 | | | | | | | | | | | | | | | | | | | |
| cm pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 |
| | 50 °C / 80 °C | | | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Hammer drilling with standard drill bit or hollow drill bit; water filled hole | | | | | | | | | | | | | | | | | | | |
| cm pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 |
| | 50 °C / 72 °C | | | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 |
| Diamond drilling dry or wet concrete as well as water filled hole | | | | | | | | | | | | | | | | | | | |
| min pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 15 | 14 | 12 | 12 | 11 | 10 | 10 | 10 | 9 | 9 | 9 | 9 | 9 | 9 | 8 |
| | 50 °C / 72 °C | | | 15 | 14 | 13 | 11 | 11 | 10 | 10 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 8 | 7 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 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 | | | | | | | | | | | | | | | | | | | |
| cm pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | 50 °C / 72 °C | | | 7 | 7 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| Hammer drilling (dry or wet concrete) | | | | | | | | | | | | | | | | | | | |
| cm pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 |
| | 50 °C / 72 °C | | | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 6 | 6 | 6 | 6 |
| Hammer drilling with standard drill bit or hollow drill bit and diamond drilling (water filled hole) | | | | | | | | | | | | | | | | | | | |
| Temp. pre-qualified range | 25 °C / 60 °C | $\tau_{Rk,cr}$ | [N/mm²] | 6 | 7,0 | 8,0 | 8,0 | 8,0 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| | 50 °C / 72 °C | | | 6 | 6,5 | 8,0 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| Water filled hole | | | 2 | | | | | | | | | | | | | | | | |
| | | | 4 | | | | | | | | | | | | | | | | |

Hammer injection system HIT-MP Plus

Performances
Characteristic values for combined pull-out and concrete failure for reinforcing bars; working life 50 years

**Annex C 9**

Deutsches Institut für Bautechnik DIBt

**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 | $\phi$ | 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: 35 °C / 24 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 18 | 15 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 10 | 11 | 11 | 11 |
| Temperature range: 59 °C / 35 °C | | | 15 | 14 | 12 | 11 | 11 | 10 | 9 | 8 | 8 | | | | | 9 | 10 | 10 | 10 |
| Diamond drilling (dry or wet concrete) | | | | | | | | | | | | | | | | | | | |
| Temperature range: 35 °C / 24 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 18 | 15 | 13 | 12 | 12 | 11 | 10 | 10 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 | 7 |
| Temperature range: 59 °C / 35 °C | | | 15 | 14 | 12 | 11 | 11 | 10 | 9 | 8 | 8 | 8 | 8 | 7 | 7 | 7 | 7 | 7 | 7 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| Working life 100 years: Temperature range: 35 °C / 24 °C | $k_{ucr,100}$ | [-] | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 | 10,5 |
| Working life 100 years: Temperature range: 59 °C / 35 °C | | | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 | 10,2 |
| **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: 35 °C / 24 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 7 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Temperature range: 59 °C / 35 °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: 35 °C / 24 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 7 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 8 |
| Temperature range: 59 °C / 35 °C | | | 7 | 7 | 7 | 7 | 8 | 8 | 8 | 6 | 6 | 6 | 7 | 7 | 7 | 8 | 8 | 8 | 8 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| Working life 100 years: Temperature range: 35 °C / 24 °C | $k_{cr,100}$ | [-] | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 | 7,35 |
| Working life 100 years: Temperature range: 59 °C / 35 °C | | | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 | 7,14 |

a) Calculation of characteristic bond resistance in uncracked concrete $T_{Rk,ucr}$:

$T_{Rk,ucr} = \gamma_{inst} \cdot \tau_{Rk,ucr}$

b) Calculation of characteristic bond resistance in cracked concrete $T_{Rk,cr}$:

$T_{Rk,cr} = \gamma_{inst} \cdot \tau_{Rk,cr}$

Fischer injection system FIS V Plus

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

**Annex C 10**

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** | | | | | | |
| Hammer drilling with standard drill bit or hollow drill bit and dry or wet concrete | | | | | | |
| Temperature range I: 58 °C / 40 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 13 | 12 |
| Temperature range II: 80 °C / 72 °C | | | 14 | 12 | 12 | 11 |
| Hammer drilling with standard drill bit or hollow drill bit and water filled holes | | | | | | |
| Temperature range I: 58 °C / 40 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 13 | 12 | 12 | 11 |
| Temperature range II: 80 °C / 72 °C | | | 12 | 11 | 10 | 9 |
| **Installation factors** | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 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: 58 °C / 40 °C | $\tau_{Rk,cr}$ | [N/mm²] | 9 | 8 | 8 | 8 |
| Temperature range II: 80 °C / 72 °C | | | 8 | 8 | 8 | 8 |
| Hammer drilling with standard drill bit or hollow drill bit and diamond drilling (water filled holes) | | | | | | |
| Temperature range I: 58 °C / 40 °C | $\tau_{Rk,cr}$ | [N/mm²] | 7 | 6 | 6 | 6 |
| Temperature range II: 80 °C / 72 °C | | | 7 | 6 | 6 | 6 |
| **Installation factors** | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | |
| Water filled hole | | | 1,2 | | 1,4 | |

fischer injection system FIS-MP plus

Performances
Characteristic values for combined pull-out and concrete failure for fischer rebar anchors FRA, working life 50 years

Annex C 11

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** | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit and diamond-drilling (dry or wet concrete) | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 13 | 12 |
| | II: 50 °C / 72 °C | | | 14 | 12 | 12 | 12 |
| Diamond drilling (dry or wet concrete) | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 13 | 12 | 10 | 9 |
| | II: 50 °C / 72 °C | | | 12 | 11 | 10 | 9 |
| Installation factors | | | | | | | |
| Dry or wet concrete | | $\gamma_{inst}$ | [-] | 1,0 | | | |
| Sustaining for 50 years | I: 35 °C / 60 °C | $\tau_{Rk,sus}$ | [N/mm²] | 0,70 | 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** | | | | | | | |
| 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/mm²] | 8 | 8 | 8 | 8 |
| | II: 50 °C / 72 °C | | | 8 | 8 | 8 | 8 |
| Installation factors | | | | | | | |
| Dry or wet concrete | | $\gamma_{inst}$ | [-] | 1,0 | | | |
| Sustaining for 50 years | I: 35 °C / 60 °C | $\tau_{Rk,sus}$ | [N/mm²] | 0,70 | 0,75 | 0,75 | 0,75 |
| | II: 50 °C / 72 °C | | | 0,60 | 0,65 | 0,65 | 0,65 |

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

$\tau_{Rk,ucr} = \tau_{Rk,ucr} \cdot \gamma_{inst}$

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

$\tau_{Rk,cr} = \tau_{Rk,cr} \cdot \gamma_{inst}$

fischer injection system FIS -M12 to

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

Annex C 12

Deutsches Institut für Bautechnik DIBt

**Table C13.1: Displacements for anchor rods**

| Anchor rod | | M8 | M10 | M12 | M14 | M16 | M20 | M22 | M24 | M27 | M30 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Displacement-Factors for tension load[1)]** | | | | | | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | | | | | | |
| $\delta_{N0\text{-Factor}}$ | [mm/(N/mm²)] | 0,07 | 0,08 | 0,09 | 0,09 | 0,10 | 0,11 | 0,11 | 0,12 | 0,12 | 0,13 |
| $\delta_{N\infty\text{-Factor}}$ | | 0,11 | 0,12 | 0,13 | 0,14 | 0,15 | 0,16 | 0,17 | 0,18 | 0,19 | 0,19 |
| **Displacement-Factors for shear load[2)]** | | | | | | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | | | | | | |
| $\delta_{V0\text{-Factor}}$ | [mm/kN] | 0,12 | 0,09 | 0,08 | 0,07 | 0,06 | 0,05 | 0,05 | 0,05 | 0,05 | 0,05 |
| $\delta_{V\infty\text{-Factor}}$ | | 0,21 | 0,22 | 0,19 | 0,18 | 0,16 | 0,14 | 0,13 | 0,12 | 0,11 | 0,10 |

[1)] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Rd}$
$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Rd}$
($\tau_{Rd}$: Design value of the applied bond stress)

[2)] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Rd}$
$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Rd}$
($V_{Rd}$: 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 load[1)]** | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | |
| $\delta_{N0\text{-Factor}}$ | [mm/(N/mm²)] | 0,09 | 0,10 | 0,10 | 0,11 | 0,13 |
| $\delta_{N\infty\text{-Factor}}$ | | 0,13 | 0,15 | 0,16 | 0,17 | 0,19 |
| **Displacement-Factors for shear load[2)]** | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | |
| $\delta_{V0\text{-Factor}}$ | [mm/kN] | 0,12 | 0,09 | 0,08 | 0,07 | 0,05 |
| $\delta_{V\infty\text{-Factor}}$ | | 0,19 | 0,16 | 0,12 | 0,10 | 0,08 |

[1)] Calculation of effective displacement:
$\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau_{Rd}$
$\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau_{Rd}$
($\tau_{Rd}$: Design value of the applied bond stress)

[2)] Calculation of effective displacement:
$\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V_{Rd}$
$\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V_{Rd}$
($V_{Rd}$: Design value of the applied shear force)

fischer injection system FIS -MI Plus

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

Annex C 13

Deutsches Institut für Bautechnik DIBt

**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 load[1)]** | | | | | | | | | | | | | | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | | | | | | | | | | | | | | |
| $\delta_{N0}$-Factor | [mm/(N/mm²)] | | 0,07 | 0,08 | 0,09 | 0,09 | 0,10 | 0,10 | 0,11 | 0,11 | 0,12 | 0,12 | 0,12 | 0,13 | 0,13 | 0,13 | 0,14 | 0,14 | 0,15 |
| $\delta_{N\infty}$-Factor | | | 0,11 | 0,12 | 0,13 | 0,14 | 0,15 | 0,16 | 0,16 | 0,17 | 0,18 | 0,18 | 0,18 | 0,19 | 0,19 | 0,20 | 0,20 | 0,21 | 0,22 |
| **Displacement-Factors for shear load[2)]** | | | | | | | | | | | | | | | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | | | | | | | | | | | | | | | |
| $\delta_{V0}$-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 |

[illegible]

**Table C14.2: Displacements for fischer rebar anchors FRA**

| fischer rebar anchor FRA | | M12 | M16 | M20 | M24 |
|---|---|---|---|---|---|
| **Displacement-Factors for tension load[1)]** | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | |
| $\delta_{N0}$-Factor | [mm/(N/mm²)] | 0,09 | 0,10 | 0,11 | 0,12 |
| $\delta_{N\infty}$-Factor | | 0,13 | 0,15 | 0,16 | 0,18 |
| **Displacement-Factors for shear load[2)]** | | | | | |
| **Uncracked or cracked concrete; Temperature range I, II** | | | | | |
| [illegible] | [mm/kN] | [illegible] | [illegible] | [illegible] | [illegible] |
| [illegible] | | [illegible] | [illegible] | [illegible] | [illegible] |

[illegible]

fischer injection system FIS -M12 to

Performance
Displacements for reinforcing bars and fischer rebar anchors FRA

Annex C 14

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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 failure[1]** | | | | | | | | | | | |
| **fischer anchor rods and standard threaded rods, performance category C1[2]** | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s,C1}$ | Steel zinc plated | 5.8 | 29(27) | 43 | 58 | 79 | 123 | 152 | 177 | 230 | 281 |
| | | 8.8 | 47(43) | 69 | 92 | 126 | 196 | 243 | 282 | 368 | 449 |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | 39 | 58 | 78 | 110 | 172 | 212 | 247 | 322 | 393 |
| | | 70 | 41 | 59 | 81 | 110 | 172 | 212 | 247 | 322 | 393 |
| | | 80 | 47 | 68 | 92 | 126 | 196 | 243 | 282 | 368 | 449 |
| **fischer anchor rods and standard threaded rods, performance category C2[2]** | | | | | | | | | | | |
| Characteristic resistance $N_{Rk,s,C2}$ | Steel zinc plated | 5.8 | - | 30 | - | 79 | 108 | - | 177 | - | - |
| | | 8.8 | - | 51 | - | 116 | 172 | - | 282 | - | - |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | - | 39 | - | 72 | 108 | - | 177 | - | - |
| | | 70 | - | 53 | - | 101 | 152 | - | 247 | - | - |
| | | 80 | -[4] | 61 | -[4] | 116 | 173 | -[4] | 282 | -[4] | -[4] |
| **Bearing capacity under shear load, steel failure without lever arm[1]** | | | | | | | | | | | |
| **fischer anchor rods, performance category C1[2]** | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s,C1}$ | Steel zinc plated | 5.8 | 17(16) | 25 | 34 | 47 | 71 | 91 | 106 | 139 | 169 |
| | | 8.8 | 27(25) | 41 | 54 | 74 | 113 | 141 | 169 | 208 | 253 |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | 23 | 34 | 46 | 63 | 98 | 122 | 147 | 180 | 220 |
| | | 70 | 29 | 40 | 55 | 77 | 113 | 141 | 169 | 208 | 253 |
| | | 80 | 33 | 46 | 63 | 88 | 129 | 162 | 194 | 239 | 290 |
| **Standard threaded rods, performance category C1[3]** | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s,C1}$ | Steel zinc plated | 5.8 | 12(11) | 17 | 24 | 33 | 52 | 64 | 74 | 97 | 118 |
| | | 8.8 | 19(18) | 24 | 32 | 44 | 69 | 86 | 99 | 129 | 158 |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | 14 | 19 | 26 | 37 | 58 | 72 | 83 | 109 | 133 |
| | | 70 | 17 | 24 | 32 | 44 | 69 | 86 | 99 | 129 | 158 |
| | | 80 | 19 | 24 | 32 | 44 | 69 | 86 | 99 | 129 | 158 |
| **fischer anchor rods and standard threaded rods, performance category C2** | | | | | | | | | | | |
| Characteristic resistance $V_{Rk,s,C2}$ | Steel zinc plated | 5.8 | - | 14 | - | 37 | 49 | - | 83 | - | - |
| | | 8.8 | - | 22 | - | 44 | 69 | - | 99 | - | - |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | - | 14 | - | 37 | 49 | - | 83 | - | - |
| | | 70 | - | 20 | - | 39 | 60 | - | 87 | - | - |
| | | 80 | - | 22 | - | 44 | 69 | - | 99 | - | - |
| Factor for the annular gap | | | $\alpha_{gap}$ = 0.5 (1.0)[5] | | | | | | | | |

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

[1] Fischer anchor rods: Ductile steel failure acc. to EN 1993-1-4:2015+A1:2016

[2] Values in accordance with for standardized threaded rods with material properties according to EN ISO 10684:2004+AC:2009

[3] Values in accordance with for fischer anchor rods increased corrosion and also the thicknesses of the galvanization is sufficient to use the factor for hot dip galvanized steel acc. to EN ISO 1461:2009

[4] No performance assessed

| | |
|---|---|
| fischer injection system FIS HM Plus | Annex C 15 |
| **Performances**<br>Characteristic values for steel failure under tension and shear load for fischer anchor rods and standard threaded rods under seismic action performance category C1 or C2 | |

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**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 failure[1)]** | | | | | | | | | | | | | | | |
| **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 arm[1)]** | | | | | | | | | | | | | | | |
| **Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1** | | | | | | | | | | | | | | | |
| Characteristic resistance | $V_{Rk,s,C1}$ | [kN] | 22 | 32 | 43 | 58 | 76 | 97 | 118 | 140 | 152 | 165 | 191 | 220 | 250 |

[illegible] Partial factors in 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** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nominal diameter of the bar** | | **ϕ** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **25** | **26** | **28** | **30** | **32** |
| **Tension load, steel failure[1)]** | | | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,N}$ | Steel zinc plated | 5.8 | 1,50 | | | | | | | | | | | | |
| | | 8.8 | 1,50 | | | | | | | | | | | | |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | 2,86 | | | | | | | | | | | | |
| | | 70 | 1,87 [illegible] | | | | | | | | | | | | |
| | | 80 | [illegible] | | | | | | | | | | | | |
| | Perforated sleeve | Property class | [illegible] | | | | | | | | | | | | |
| **Shear load, steel failure[1)]** | | | | | | | | | | | | | | | |
| Partial factor $\gamma_{Ms,V}$ | Steel zinc plated | 5.8 | 1,25 | | | | | | | | | | | | |
| | | 8.8 | 1,25 | | | | | | | | | | | | |
| | Stainless steel A4 and high corrosion resistant steel HCR | 50 | 2,38 | | | | | | | | | | | | |
| | | 70 | 1,56 [illegible] | | | | | | | | | | | | |
| | | 80 | [illegible] | | | | | | | | | | | | |
| | Perforated sleeve | Property class | [illegible] | | | | | | | | | | | | |

[illegible] In absence of other national regulations
[illegible] Only admissible for high corrosion resistant steel (CRC III) in Table C16.2 and A4 in Table C16.2 for element under water

fischer injection system FIS -M [illegible]

**Performances**
Characteristic values for steel failure under tension load for reinforcing bars under seismic action (performance category C1), partial factors (performance category C1, C2)

**Annex C 16**

Table C17.1: Characteristic values for combined pull-out and concrete failure for Hacher 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)** | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,c}$ [N/mm²] | 7,0 | 7,0 | 6,7 | 6,0 | 5,7 | 6,7 | 6,7 | 6,7 | 6,7 |
| | II: 50 °C / 72 °C | | 6,0 | 6,0 | 5,7 | 5,1 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| **Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)** | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | $\tau_{Rk,c}$ [N/mm²] | 6,5 | 6,5 | 6,0 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| | II: 50 °C / 72 °C | | 6,0 | 6,0 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 |
| **Installation factors** | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ [-] | | 1,0 | | | | | | | | |
| Water filled hole | | | 1,2 [1] | | | | 1,4 [1] | | | | |

[1] Not permitted for seismic action for 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 | $\phi$ | 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)** | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °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 | 4,8 |
| | II: 50 °C / 72 °C | 7,0 | 7,0 | 6,7 | 5,7 | 5,7 | 5,7 | 5,7 | 6,7 | 6,7 | 5,7 | 5,7 | 5,7 | 4,8 |
| **Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)** | | | | | | | | | | | | | | |
| Temperature range | I: 35 °C / 60 °C | 7,0 | 6,5 | 6,5 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 4,8 |
| | II: 50 °C / 72 °C | 6,5 | 6,5 | 5,8 | 5,8 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 5,7 | 4,8 |
| **Installation factors** | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ [-] | 1,0 | | | | | | | | | | | | |
| Water filled hole | | 1,2 [1] | | | | | 1,4 [1] | | | | | | | |

[1] Not permitted for seismic action for working life 100 years

Hacher injection system HIT-MP plus

Performances
Characteristic values for combined pull-out and concrete failure under seismic action for post-installed anchor rods, standard threaded rods and reinforcing bars; working life 50 and 100 years

Annex C 17

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**Table C18.1: Characteristic values for combined pull-out and concrete failure for Hacher anchor rods and standard threaded rods in hammer drilled mortar 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 I: | 35 °C / 60 °C | $\tau_{Rk,C2}$ [N/mm²] | 3,5 | 5,8 | 5,0 | 3,1 |
| Temperature 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 I: | 35 °C / 60 °C | $\tau_{Rk,C2}$ [N/mm²] | 3,5 | 5,5 | 5,0 | 3,1 |
| Temperature II: | 50 °C / 72 °C | | 3,3 | 5,5 | 4,7 | 2,9 |
| Installation factors | | | | | | |
| Dry or wet concrete | | | 1,2 | | | |
| Water filled hole | | | 1,4[1] | | | 1,4[1] |
| [1] Not permitted in combination with working life 100 years | | | | | | |
| **Displacement-Factors for tension load[1)]** | | | | | | |
| $\delta_{N,C2}$ (DLS)-Factor | [mm/(N/mm²)] | | 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 load[2)]** | | | | | | |
| $\delta_{V,C2}$ (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 |

Combination of displacements:

$\delta_{N,C2(DLS)} = \delta_{N,C2(DLS)} \cdot \tau_{Ed}$ [mm] — $\delta_{V,C2(DLS)} = \delta_{V,C2(DLS)} \cdot V_{Ed}$ [mm]

$\delta_{N,C2(ULS)} = \delta_{N,C2(ULS)} \cdot \tau_{Ed}$ [mm] — $\delta_{V,C2(ULS)} = \delta_{V,C2(ULS)} \cdot V_{Ed}$ [mm]

$\tau_{Ed}$: Design value of the applied bond stress [N/mm²] — $V_{Ed}$: Design value of the applied shear force [kN]

Hacher injection system HIS-MP plus

Performances

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

**Annex C 18**