# VYHLÁSENIE O PARAMETROCH

## DoP 0308

pre fischer chemický kotviaci systém FIS EM Plus (Malta pre dodatočne nainštalované armovacie spoje) SK

1. Jedinečný identifikačný kód typu výrobku: **DoP 0308**

2. Zamýšľané použitie/použitia: **Systém pre dodatočne vlepovanú betonársku výstuž (roxory) s vylepšenými kontaktnými a štiepnymi vlastnosťami.. pozri prílohu, najmä prílohy B1-B9.**

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

4. Splnomocnený zástupca: **–**

5. Systém(-y) posudzovania a overovania nemennosti parametrov: **1**

6. Európsky hodnotiaci dokument: **EAD 332402-00-0601-v01, Edition 10/2020**
   Európske technické posúdenie: **ETA-22/0001; 2022-06-08**
   Orgán technického posudzovania: **DIBt- Deutsches Institut für Bautechnik**
   Notifikovaný(-é) subjekt(-y): **2873 TU Darmstadt**

7. Deklarované parametre:
   **Mechanická odolnosť a stabilita (BWR 1)**
   **Charakteristická odolnosť v ťahu (statické a kvázistatické zaťaženie):**
   Odolnosť voči kombinovanému zlyhaniu vytiahnutím a porušením betónu v trhlinovom betóne.: Prílohy C2, C3
   Odolnosť voči porušeniu betónového kužeľa: Prílohe C1
   Robustnos: Prílohy C1-C3
   Odolnosť voči zlyhaniu kombinácie kontaktných a štiepnych vlastností: Prílohe C1
   Odolnosť trhlinového betónu voči kombinovanému zlyhaniu vytrhnutím a porušením betónu: Prílohy C2, C3

8. Vhodná technická dokumentácia a/alebo špecifická technická dokumentácia: **–**

Uvedené parametre výrobku sú v zhode so súborom deklarovaných parametrov. Toto vyhlásenie o parametroch sa v súlade s nariadením (EÚ) č. 305/2011 vydáva na výhradnú zodpovednosť uvedeného výrobcu.

Podpísal(-a) za a v mene výrobcu:

Dr.-Ing. Oliver Geibig, konateľ oddelenia Produkt management & vývoj

Jürgen Grün, konateľ oddelenia Chemická výroba & kvalita

Tumlingen, 2022-06-22

Toto vyhlásenie o vlastnostiach bolo vyhotovené v rôznych jazykoch. V prípade, že dôjde k rozdielnemu výkladu má anglická verzia vždy prednosť.

Príloha obsahuje dobrovoľné a doplňujúce informácie v anglickom jazyku. Tieto vychádzajú zo zákonom stanovených požiadaviek (jazykovo neutrálnych) .

**Specific Part**

## 1 Technical description of the product

The subject of this European technical assessment is the post-installed connection, by anchoring or overlap connection joint, of reinforcing bars (rebars) in existing structures made of normal weight concrete, using the fischer injection system FIS EM Plus in accordance with the regulations for reinforced concrete construction.
Reinforcing bars with a diameter $\phi$ from 8 to 40 mm according to Annex A and the injection mortar FIS EM Plus are used for the post-installed rebar connection. The rebar is placed into a drilled hole filled with injection mortar and is anchored via the bond between embedded reinforcing bar, 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 rebar connection 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 rebar connections of at least 50 and/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 C 1 to C 3 |

### 3.2 Safety in case of fire (BWR 2)

| Essential characteristic | Performance |
|---|---|
| Reaction to fire | Class A1 |

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

In accordance with European Assessment Document EAD No. 332402-00-0601, the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

## Installation conditions and application examples reinforcing bars

**Figure A1.1:**

Column / wall to foundation / slab

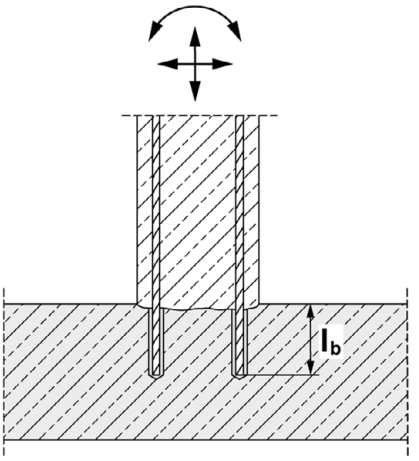
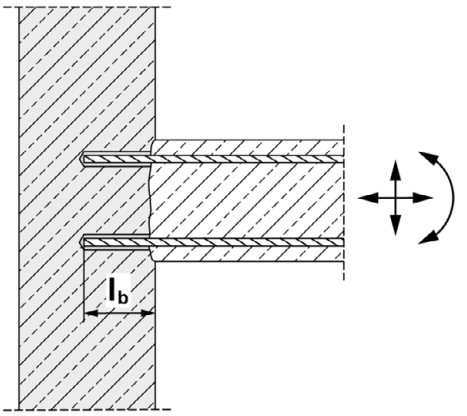



**Figure A1.2:**

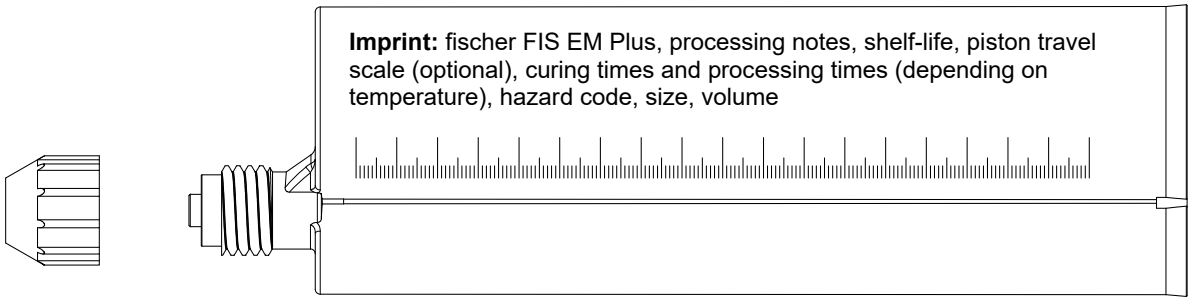
Slab / beam to wall or beam to column



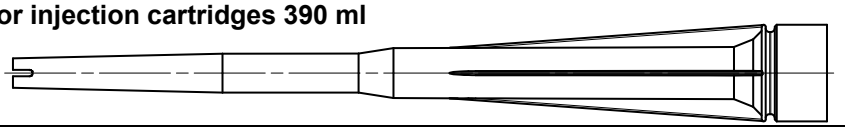

Figures not to scale

## Overview system components

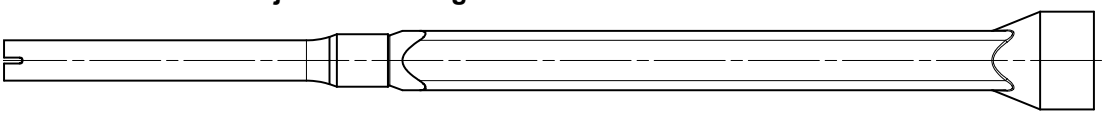
**Injection cartridge (shuttle cartridge) FIS EM Plus with sealing cap; Sizes: 390 ml, 585 ml, 1100 ml, 1500 ml**



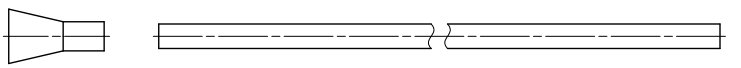

**Static mixer FIS MR Plus for injection cartridges 390 ml**



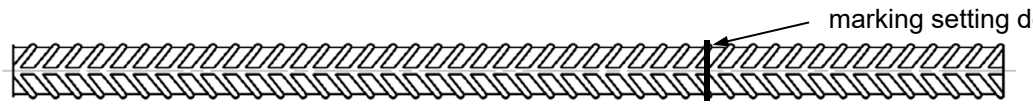
**Static mixer FIS UMR for injection cartridges ≥ 585 ml**



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

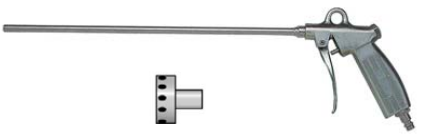


**Reinforcing bar (rebar)** Sizes: ϕ8, ϕ10, ϕ12, ϕ14, ϕ16, ϕ20, ϕ22, ϕ24, ϕ25, ϕ26, ϕ28, ϕ30, ϕ 32, ϕ34, ϕ36, ϕ40




**fischer cleaning brush**

**Compressed-air cleaning tool with fischer compressed-air nozzle**



Figures not to scale

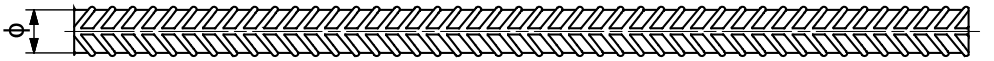
**fischer injection system FIS EM Plus**

**Product description**
Overview system components: injection mortar, static mixer, injection adapter, reinforcing bar, cleaning tools

**Annex A 2**

## Properties of reinforcing bars (rebar)

**Figure A3.1:**



- The minimum value of related rib area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010
- The maximum outer rebar diameter over the ribs shall be:
  - The nominal diameter of the bar with rib $\phi + 2 \cdot h$ ($h \leq 0{,}07 \cdot \phi$)
  - ($\phi$: Nominal diameter of the bar; $h_{rib}$ = rib height of the bar)

## Table A3.1: Installation conditions for rebars

| **Nominal diameter of the bar** | | **ϕ** | **8[1)]** | | **10[1)]** | | **12[1)]** | | **14** | **16** | **20** | **22** | **24** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | $d_0$ | [mm] | 10 | 12 | 12 | 14 | 14 | 16 | 18 | 20 | 25 | 30 | 30 |
| Drill hole depth | $h_0$ | | $h_0 \geq l_b$ | | | | | | | | | | |
| Effective embedment depth | $l_b = l_v$ | | acc. to static calculation | | | | | | | | | | |
| Minimum thickness of concrete member | $h_{min}$ | | $l_b + 30$ ($\geq 100$) | | | | | | $l_b + 2d_0$ | | | | |

| **Nominal diameter of the bar** | | **ϕ** | **25[1)]** | | **26** | **28** | **30** | **32** | **34** | **36** | **40** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Nominal drill hole diameter | $d_0$ | [mm] | 30 | 35 | 35 | 35 | 40 | 40 | 40 | 45 | 55 |
| Drill hole depth | $h_0$ | | $h_0 \geq l_b$ | | | | | | | | |
| Effective embedment depth | $l_b = l_v$ | | acc. to static calculation | | | | | | | | |
| Minimum thickness of concrete member | $h_{min}$ | | $l_b + 2d_0$ | | | | | | | | |

[1)] Both drill hole diameters can be used

## Table A3.2: Materials of rebars

| **Designation** | **Reinforcing bar (rebar)** |
|---|---|
| Reinforcing bar<br>EN 1992-1-1:2004+AC:2010, Annex C | Bars and de-coiled rods class B or C with<br>$f_{yk}$ and k according to NDP or NCI of EN 1992-1-1/NA<br>$f_{uk} = f_{tk} = k \cdot f_{yk}$ |

## Specifications of intended use part 1

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

| Fastenings subject to | | **FIS EM Plus with …** | |
|---|---|---|---|
| | | Reinforcing bar  | |
| 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 ($d_0$)<br>12 mm to 35 mm | |
| Use category | I1 dry or wet concrete | all sizes | |
| | I2 water filled hole | all sizes (not permitted in combination with working life 100 years) | |
| Characteristic resistance under static and quasi static loading, | in uncracked concrete | all sizes | Tables:<br>C1.1<br>C1.2<br>C2.1<br>C3.1 |
| | in cracked concrete | all sizes | |
| Seismic performance category | C1 | -[1)] | |
| | C2 | | |
| Installation direction | | D3 (downward and horizontal and upwards (e.g. overhead)) | |
| Installation temperature | | $T_{i,min}$ = -5 °C to $T_{i,max}$ = +40 °C | |
| Service temperature | Temperature range I | -40°C to +60°C | (max. short term temperature +60 °C; max. long term temperature +35 °C) |
| | Temperature range II | -40 °C to +72 °C | (max. short term temperature +72 °C; max. long term temperature +50 °C) |

[1)] No performance assessed

## Specifications of intended use part 2

**Anchorages subject to:**

- Static and quasi-static loading: reinforcing bar (rebar) size 8 mm to 40 mm

**Base materials:**

- Compacted reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013+A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013+A1:2016
- Maximum chloride content of 0,40 % (CL 0.40) related to the cement content according to EN 206:2013+A1:2016
- Non-carbonated concrete
  Note: In case of a carbonated surface of the existing concrete structure, the carbonated layer shall be removed in the area of the post-installed rebar connection with a diameter of $\phi$ + 60 mm prior to the installation of the new rebar. The depth of concrete to be removed shall correspond to at least the minimum concrete cover in accordance with EN 1992-1-1 :2004+AC:2010. The foregoing may be neglected if building components are new and not carbonated and if building components are in dry conditions.

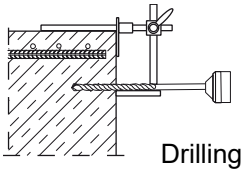
**Design:**

- Fastenings are designed under the responsibility of an engineer experienced in fastenings and concrete work.
- Verifiable calculation notes and drawings are prepared taking account of the forces to be transmitted.
- Design under static and quasi static loading in accordance with EOTA Technical Report TR 069 October 2019.
- The actual position of the reinforcement in the existing structure shall be determined on the basis of the construction documentation and taken into account when designing.
- The shear force must be transferred via the rough joint; the subsequent reinforcement must not be applied for shear force transfer.

**Installation:**

- Rebar installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Check the position of the existing rebars (if the position of existing rebars is not known, it shall be determined using a rebar detector suitable for this purpose as well as on the basis of the construction documentation and then marked on the building component for the overlap joint).
- Rebars in overhead installation have to be fixed in their position until the injection mortar is cured.

**Table B3.1: Minimum concrete cover $c_{min}$ [1] depending on the drilling method and the drilling tolerance [2]**

| Drilling method | nominal diameter of reinforcing bar $\phi$ [mm] | Minimum concrete cover $c_{min}$ | | |
|---|---|---|---|---|
| | | Without drilling aid [mm] | With drilling aid [mm] | |
| Hammer drilling with standard drill bit | < 25 | 30 mm + 0,06 $l_b \geq 2\ \phi$ | 30 mm + 0,02 $l_b \geq 2\ \phi$ |  Drilling aid |
| | ≥ 25 | 40 mm + 0,06 $l_b \geq 2\ \phi$ | 40 mm + 0,02 $l_b \geq 2\ \phi$ | |
| Hammer drilling with hollow drill bit (fischer “FHD”, Heller "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD") | < 25 | 30 mm + 0,06 $l_b \geq 2\ \phi$ | 30 mm + 0,02 $l_b \geq 2\ \phi$ | |
| | ≥ 25 | 40 mm + 0,06 $l_b \geq 2\ \phi$ | 40 mm + 0,02 $l_b \geq 2\ \phi$ | |

[1] Note: The minimum concrete cover as specified in EN 1992-1-1:2004+AC:2010 must be observed.
[2] Minimum clear spacing is a = max (40 mm; 4 · $\phi$)

**Table B3.2: Dispensers and cartridge sizes corresponding to maximum embedment depth $l_{b,max}$**

| reinforcing bars (rebar) | Manual dispenser | Pneumatic or cordless dispenser (small) | Pneumatic or cordless dispenser (large) |
|---|---|---|---|
| | Cartridge size 390 ml, 585 ml | Cartridge size 390 ml, 585 ml | Cartridge size 1500 ml |
| $\phi$ [mm] | $l_{b,max}$ [mm] | $l_{b,max}$ [mm] | $l_{b,max}$ [mm] |
| 8 | 1000 | 1000 | 1800 |
| 10 | | | |
| 12 | | 1200 | |
| 14 | | | |
| 16 | | 1500 | |
| 20 | 700 | 1300 | |
| 22 / 24 / 25 | | 1000 | 2000 |
| 26 / 28 | 500 | 700 | |
| 30 / 32 / 34 | no performance assessed | 500 | |
| 36 / 40 | | | |

Figures not to scale

**Table B4.1:** Conditions for use **static mixer** without an **extension tube**

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

**Table B4.2:** **Working times** $t_{work}$ and **curing times** $t_{cure}$

| Temperature at anchoring base [°C] | Maximum processing time [1] $t_{work}$ | Minimum curing time [2] $t_{cure}$ |
|---|---|---|
| -5 to 0 | 240 min [3] | 200 h |
| >0 to 5 | 150 min [3] | 90 h |
| >5 to 10 | 120 min [3] | 40 h |
| >10 to 20 | 30 min | 18 h |
| >20 to 30 | 14 min | 10 h |
| >30 to 40 | 7 min [4] | 5 h |

[1] Maximum time from the beginning of the injection to rebar / fischer rebar anchor setting and positioning
[2] For wet concrete the curing time must be doubled
[3] If the temperature in the concrete falls below 10°C the cartridge has to be warmed up to +15°C.
[4] If the temperature in the concrete exceeds 30 °C the cartridge has to be cooled down to +15°C up to 20°C

**Table B4.3:** Installation tools for drilling and cleaning the bore hole and injection of the mortar

| reinforcing bars (rebar) | Drilling and cleaning | | | | Injection | |
|---|---|---|---|---|---|---|
| | Nominal drill bit diameter | Diameter of cutting edge | Steel brush diameter | Diameter of cleaning nozzle[3] | Diameter of extension tube | Injection adapter |
| ϕ [mm] | $d_0$ [mm] | $d_{cut}$ [mm] | $d_b$ [mm] | [mm] | [mm] | [colour] |
| 8[1] | 10[2] | ≤ 10,50 | 11 | --- | 9 | --- |
| | 12 | ≤ 12,50 | 14 | 11 | | nature |
| 10[1] | 12 | ≤ 12,50 | 14 | | | |
| | 14 | ≤ 14,50 | 16 | | | blue |
| 12[1] | 14 | ≤ 14,50 | 16 | 15 | | |
| | 16 | ≤ 16,50 | 20 | | | red |
| 14 | 18 | ≤ 18,50 | 20 | | 9 or 15 | yellow |
| 16 | 20 | ≤ 20,55 | 25 | 19 | | green |
| 20 | 25 | ≤ 25,55 | 27 | | | black |
| 22 / 24 | 30 | ≤ 30,55 | 32 | 28 | | grey |
| 25[1] | 30 | ≤ 30,55 | 32 | | | grey |
| | 35 | ≤ 35,70 | 37 | | | brown |
| 26 / 28 | 35 | ≤ 35,70 | 37 | | | brown |
| 30 / 32 / 34 | 40[2] | ≤ 40,70 | 42 | 38 | | red |
| 36 | 45[2] | ≤ 45,70 | 47 | | | yellow |
| 40 | 55[2] | ≤ 55,70 | 58 | | | nature |

[1] Both drill bit diameters can be used
[2] Only hammer drilling with standard drill bit
[3] Cleaning nozzle and extension is only necessary if bore hole depth is greater than the length of compressed-air cleaning tool

**fischer injection system FIS EM Plus**

**Intended Use**
Working times and curing times;
Installation tools for drilling and cleaning the bore hole and injection of the mortar

**Annex B 4**

## Safety regulations

Review the Safety Data Sheet (SDS) before use for proper and safe handling!

Wear well-fitting protective goggles and protective gloves when working with mortar FIS EM Plus.

Important: Observe the instructions for use provided with each cartridge.

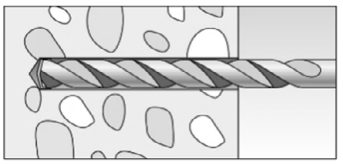
## Installation instruction part 1

Hole drilling

Note: Before drilling, remove carbonated concrete; clean contact areas (see Annex B 2)
In case of aborted drill holes the drill hole shall be filled with mortar.

**1a**

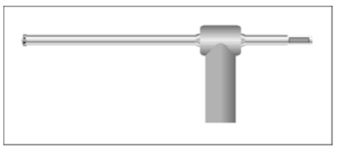
**Hammer drilling with standard drill bit**



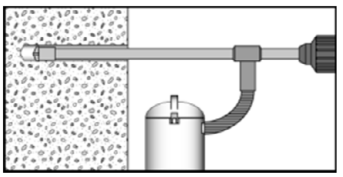
Drill the hole to the required embedment depth using a hammer drill with carbide drill bit set in rotation hammer mode.
Nominal drill hole diameter $\mathbf{d_0}$ (see **table B4.3)** and drill hole depth $\mathbf{h_0}$ (see **table A3.1**).

**1b**

**Hammer drilling with hollow drill bit**

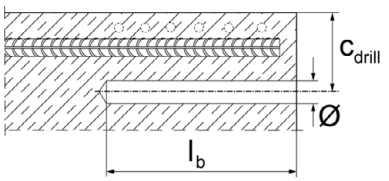


Check a suitable hollow drill (see **table B1.1**) for correct operation of the dust extraction.

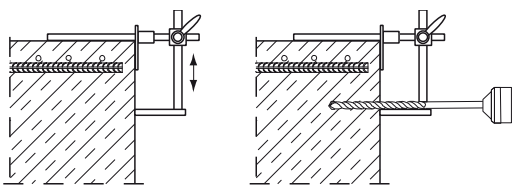


Drill the hole to the required embedment depth using a hammer drill with hollow drill bit in rotation hammer mode.
Dust extraction conditions see drill hole cleaning **Annex B 6**.
Nominal drill hole diameter $\mathbf{d_0}$ (see **table B4.3)** and drill hole depth $\mathbf{h_0}$ **(**see **table A3.1).**

**2**




Measure and control concrete cover c
($c_{drill}$ = c + Ø / 2)
Drill parallel to surface edge and to existing rebar.
Where applicable use fischer drilling aid.



For holes $l_b$ > 20 cm use drilling aid.
Three different options can be considered:

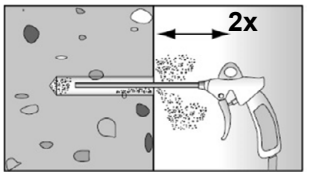
A) fischer drilling aid
B) Slat or spirit level
C) Visual check

Minimum concrete cover $c_{min}$ see **table B3.1**

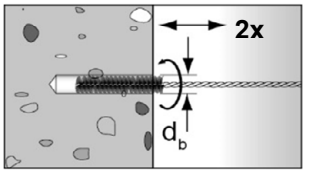
## Installation instruction part 2

Drill hole cleaning (hammer drilling with standard drill bit)

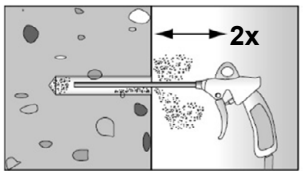
**3a**




Cleaning the drill hole.
Blow out the drill hole twice, with oil free compressed air (p ≥ 6 bar).
If the drill hole depth is greater than the length of the compressed-air cleaning tool, an extension and appropriate fischer cleaning nozzle must be used.
Corresponding diameters see **table B4.3**




Brush the drill hole twice. For drill hole diameter ≥ 30 mm use a power drill.
For deep holes use an extension. Corresponding brushes see **table B4.3**

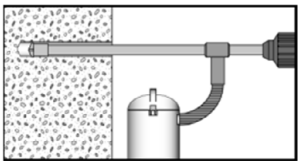



Cleaning the drill hole:
Blow out the drill hole twice, with oil free compressed air (p ≥ 6 bar)
If the drill hole depth is greater than the length of the compressed-air cleaning tool, an extension and appropriate fischer cleaning nozzle must be used.
Corresponding diameters see **table B4.3**

Go to step 4

Drill hole cleaning (hammer drilling with hollow drill bit)

**3b**

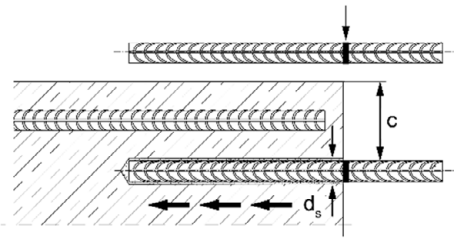
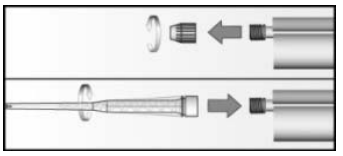
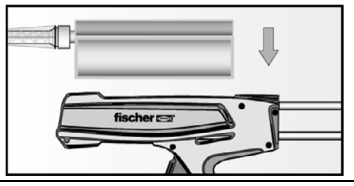
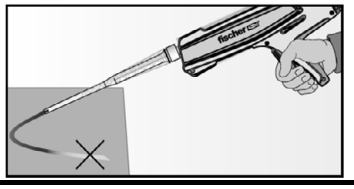


Use a suitable dust extraction system, e. g.
fischer FVC 35 M or a comparable dust extraction system with equivalent performance data.

Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Check the hollow drill for correct operation of the dust extraction.
No further cleaning steps necessary.

Go to step 4

## Installation instruction part 3
## Reinforcing bars (rebar) and cartridge preparation

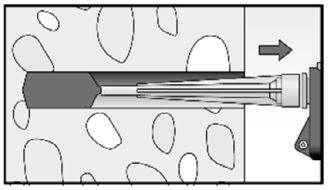
| | | |
|---|---|---|
| **4** |  | Before use, make asure that the rebar is dry and free of oil or other residue.<br>Mark the embedment depth $l_b$ (e.g. with tape)<br>Insert rebar in borehole, to verify drill hole depth and setting depth $l_b$ |
| **5** |  | Twist off the sealing cap<br>Twist on the static mixer (the spiral in the static mixer must be clearly visible). |
| **6** |  | Place the cartridge into a suitable dispenser. |
| **7** |  | Press out approximately 10 cm of mortar until the resin is permanently grey in colour. Mortar which is not grey in colour will not cure and must be disposed. |

Go to step 8

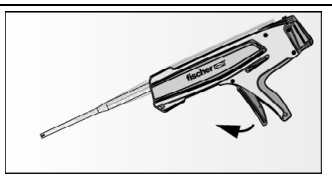
## Installation instruction part 4; Installation with FIS EM Plus

## Injection of the mortar without extension tube

**8a**



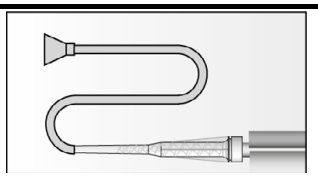
Inject the mortar from the back of the hole towards the front and slowly withdraw the static mixer step by step with each trigger pull.
Avoid bubbles.
Fill holes approximately 2/3 (for $h_0 = l_b$) full, to ensure that the annular gap between the rebar and the concrete will be completely filled with adhesive over the entire embedment length. For $h_0 > l_b$ more mortar is needed.
The conditions for mortar injection without extension tube can be found in **table B4.1**



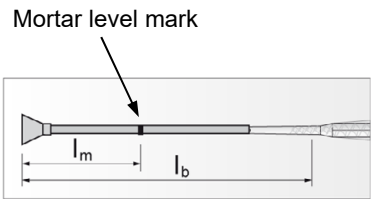
After injecting, release the dispenser. This will prevent further mortar discharge from the static mixer.

## Injection of the mortar with extension tube

**8b**



Assemble mixing nozzle FIS MR Plus or FIS UMR, extension tube and appropriate injection adapter (see **table B4.3**)

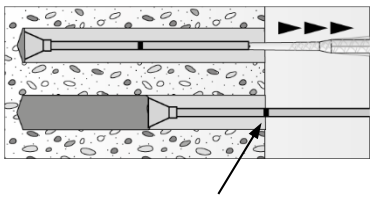



Mark the required mortar level $l_m$ and embedment depth $l_b$ with tape or marker on the injection extension tube.
a) Estimation:

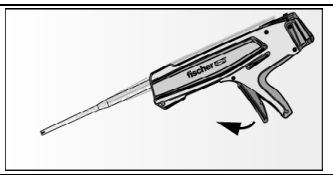
$$l_m = \frac{1}{3} \cdot l_b \text{ [mm]}$$

b) Precise equation for optimum mortar volume:

$$l_m = l_b \cdot \left( (1{,}2 \cdot \frac{d_S^2}{d_0^2} - 0{,}2) \right) \text{ [mm]}$$




Insert injection adapter to back of the hole. Begin injection allowing the pressure of the injected adhesive mortar to push the injection adapter towards the front of the hole. Do not actively pull out!
Fill holes approximately 2/3 (for $h_0 = l_b$) full, to ensure that the annular gap between the rebar and the concrete will be completely filled with adhesive over the embedment length. For $h_0 > l_b$ more mortar is needed.
When using an injection adapter continue injection until the mortar level mark $l_m$ becomes visible.
Maximum embedment depth, see **table B3.2**

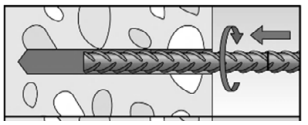
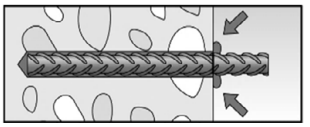
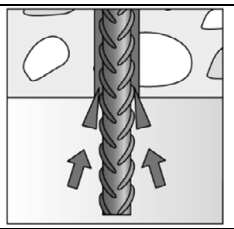


After injecting, release the dispenser. This will prevent further mortar discharge from the static mixer.

Go to step 9

## Installation instruction part 5; Installation with FIS EM Plus

Insert rebar

| | | |
|---|---|---|
| **9** |  | Insert the rebar slowly twisted into the borehole until the embedment mark is reached.<br>Recommendation:<br>Rotation back and forth of the reinforcement bar makes pushing easy |
| **10** |  | After installing the rebar the annular gap must be completely filled with mortar.<br><br>Proper installation<br>• Desired embedment depth is reached $l_b$: embedment mark at concrete surface<br>• Excess mortar flows out of the borehole after the rebar have been fully inserted up to the embedment mark. |
| **11** |  | For overhead installation, support the rebar and secure it from falling till mortar started to harden, e.g. using wedges. |
| **12** |  | Observe the working time "$t_{work}$" (see **table B4.2**), which varies according to temperature of base material. Minor adjustments to the rebar position may be performed during the working time<br><br>Full load may be applied only after the curing time "$t_{cure}$" has elapsed (see **table B4.2**) |

## Table C1.1 **Characteristic resistance** under **tension loading** for **reinforcing bars**

| **Size** | | | **All sizes** |
|---|---|---|---|
| **Characteristic resistance under tension loading** | | | |
| Installation factor | $\gamma_{inst}$ | [-] | See annex C 2 to C 3 |
| **Factors for the compressive strength of concrete > C20/25** | | | |
| Increasing factor $\psi_c$ for cracked or uncracked concrete $\tau_{Rk,C(X/Y)} = \psi_c \cdot \tau_{Rk\,(C20/25)}$ | C25/30 | [-] | 1,02 |
| | C30/37 | | 1,04 |
| | C35/45 | | 1,06 |
| | C40/50 | | 1,07 |
| | C45/55 | | 1,08 |
| | C50/60 | | 1,09 |
| **Concrete cone failure** | | | |
| Uncracked concrete | $k_{ucr,N}$ | [-] | 11,0 |
| Cracked concrete | $k_{cr,N}$ | | 7,7 |
| Edge distance | $c_{cr,N}$ | [mm] | $1,5 \cdot l_b$ |
| Spacing | $s_{cr,N}$ | | $3 \cdot l_b$ |
| **Factors for sustained tension loading** | | | |
| Factor | $\psi^0_{sus}$ | [-] | -[1)] |

[1)] No performance assessed

## Table C1.2: **Essential characteristics** under tension loading **for reinforcing bars** in hammer drilled holes; uncracked or cracked concrete; working life 50 and 100 years

| **Nominal diameter of the bar** | | **ϕ** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **25** | **26** | **28** | **30** | **32** | **34** | **36** | **40** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bond-splitting failure for working life of 50 and 100 years** | | | | | | | | | | | | | | | | | | | |
| Calculation diameter | d | [mm] | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
| Hammer-drilling with standard drill bit or hollow drill bit for 50 and 100 years | | | | | | | | | | | | | | | | | | | |
| Product basic factor | $A_k$ | [-] | 4,4 | | | | | | | | | | | | | | | | |
| Exponent for influence of concrete compressive strength | sp1 | | 0,33 | | | | | | | | | | | | | | | | |
| Exponent for influence of rebar diameter ϕ | sp2 | | 0,34 | | | | | | | | | | | | | | | | |
| Exponent for influence of concrete cover $c_d$ | sp3 | | 0,62 | | | | | | | | | | | | | | | | |
| Exponent for influence of side concrete cover ($c_{max}$ / $c_d$) | sp4 | | 0,33 | | | | | | | | | | | | | | | | |
| Exponent for influence of anchorage length $l_b$ | lb1 | | 0,68 | | | | | | | | | | | | | | | | |

**Table C2.1** **Characteristic resistance** under tension loading **for reinforcing bars** in hammer drilled holes; uncracked or cracked concrete; working life 50 years

| **Nominal diameter of the bar** | | **ϕ** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **25** | **26** | **28** | **30** | **32** | **34** | **36** | **40** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Combined pullout and concrete cone failure** | | | | | | | | | | | | | | | | | | | |
| Calculation diameter | d | [mm] | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
| **Uncracked concrete** | | | | | | | | | | | | | | | | | | | |
| **Characteristic bond resistance in uncracked concrete C20/25** | | | | | | | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | | | | | | | |
| Temperature range I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 |
| Temperature range II: 50 °C / 72 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 |
| Hammer-drilling with standard drill bit or hollow drill bit (water filled hole) | | | | | | | | | | | | | | | | | | | |
| Temperature range I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 16 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 10 | 10 | 9 | 9 | 9 | 8 | 8 |
| Temperature range II: 50 °C / 72 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 13 | 12 | 12 | 11 | 11 | 10 | 10 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| Water filled hole | $\gamma_{inst}$ | [-] | 1,4 | | | | | | | | | | | | | | | | |
| **Influence of cracked concrete on combined pullout and concrete cone failure for working life of 50 years** | | | | | | | | | | | | | | | | | | | |
| Factor for influence of cracked concrete ✓ | $\Omega_{cr}$ | [-] | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,93 | 0,93 | 0,93 | 0,93 |

**Table C3.1: Characteristic resistance** under tension loading **for reinforcing bars** in hammer drilled holes; uncracked or cracked concrete; working life 100 years

| **Nominal diameter of the bar** | | **ϕ** | **8** | **10** | **12** | **14** | **16** | **18** | **20** | **22** | **24** | **25** | **26** | **28** | **30** | **32** | **34** | **36** | **40** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Combined pullout and concrete cone failure** | | | | | | | | | | | | | | | | | | | |
| Calculation diameter | d | [mm] | 8 | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 25 | 26 | 28 | 30 | 32 | 34 | 36 | 40 |
| **Uncracked concrete** | | | | | | | | | | | | | | | | | | | |
| **Characteristic bond resistance in uncracked concrete C20/25** | | | | | | | | | | | | | | | | | | | |
| Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete) | | | | | | | | | | | | | | | | | | | |
| Temperature range I: 35 °C / 60 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 16 | 15 | 15 | 14 | 14 | 13 | 13 | 13 | 12 | 12 | 12 | 12 | 12 | 12 | 11 | 11 | 11 |
| Temperature range II: 50 °C / 72 °C | $\tau_{Rk,ucr}$ | [N/mm²] | 15 | 14 | 14 | 13 | 13 | 12 | 12 | 12 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 10 | 10 |
| **Installation factors** | | | | | | | | | | | | | | | | | | | |
| Dry or wet concrete | $\gamma_{inst}$ | [-] | 1,0 | | | | | | | | | | | | | | | | |
| Temperature range I: 35 °C / 60 °C | $\alpha_{100\ years}$ | [-] | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 | 0,75 |
| Temperature range II: 50 °C / 72 °C | $\alpha_{100\ years}$ | [-] | 0,55 | 0,60 | 0,60 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 | 0,65 |
| **Influence of cracked concrete on combined pullout and concrete cone failure for working life of 100 years** | | | | | | | | | | | | | | | | | | | |
| Factor for influence of cracked concrete | $\Omega_{cr}$ | [-] | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 | 0,91 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,92 | 0,93 | 0,93 | 0,93 | 0,93 |

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

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