

## DÉCLARATION DES PERFORMANCES

### DoP 0351

pour le système d'injection fischer FIS EM PLUS (fixation à scellement pour utilisation dans le béton)

FR

1. Code d'identification unique du type de produit: DoP 0351
2. Usage(s) prévu(s): Fixation dans du béton fissuré ou non fissuré, voir annexes, en particulier les annexes B1 - B17.
3. Fabricant: fischerwerke GmbH & Co. KG, Otto-Hahn-Straße 15, 79211 Denzlingen, Allemagne
4. Mandataire: -
5. Système(s) d'évaluation et de vérification de la constance des performances: 1
6. Document d'évaluation européen: EAD 330499-02-0601, Edition 12/2023  
Evaluation Technique Européenne: ETA-17/0979; 2024-04-22  
Organisme d'évaluation technique: DIBt- Deutsches Institut für Bautechnik  
Organisme(s) notifié(s): 2873 TU Darmstadt
7. Performance(s) déclarée(s):  
**Résistance mécanique et stabilité (BWR 1)**  
**Résistance caractéristique à la charge de traction (charge statique et quasi-statique):**
  - 1) Résistance à la rupture de l'acier (charge de traction): voir annexes, en particulier les annexes C1, C2, C3, C19, C21, C23
  - 2) Résistance à la rupture par extraction glissement: et rupture du cône béton: voir annexes, en particulier les annexes C4 - C16, C24 - C34
  - 3) Résistance à la rupture du cône béton: voir annexes, en particulier annexe C4, C24
  - 4) Distance au bord pour éviter la rupture par fendage sous charge: voir annexes, en particulier annexe C4, C24
  - 5) Robustesse: voir annexes, en particulier les annexes C4 - C16, C24 - C34
  - 6) Couple de serrage maxi: voir annexes, en particulier les annexes B3, B4, B8, B9, B12
  - 7) Distance au bord et entraxe mini, Epaisseur du support: voir annexes, en particulier les annexes B3 - B12**Résistance caractéristique à la charge de cisaillement (charge statique et quasi-statique):**
  - 8) Résistance à la rupture de l'acier: voir annexes, en particulier les annexes C1, C2, C3, C20, C22, C23
  - 9) Résistance à la rupture par effet de levier: voir annexes, en particulier les annexes C4, C24
  - 10) Résistance à la rupture du béton en bord de dalle: voir annexes, en particulier les annexes C4, C24**Déplacements sous charge à court et long terme:**
  - 11) Déplacements sous charge à court et long terme: voir annexes, en particulier les annexes C17, C18, C35, C36
  - 12) Résistance du béton armé de fibres d'acier: NPD**Résistance caractéristique et déplacements pour les catégories de performance sismique C1 et C2:**
  - 13) Résistance à la charge de traction, catégorie C1: voir annexes, en particulier les annexes C37 - C41, C43 - C47
  - 14) Résistance à la charge de traction, catégorie C2: voir annexes, en particulier les annexes C38, C39, C42
  - 15) Résistance à la charge de cisaillement, catégorie C1: voir annexes, en particulier les annexes C37 - C39, C43 - C45
  - 16) Résistance à la charge de cisaillement, catégorie C2: voir annexes, en particulier les annexes C38, C39**Sécurité en cas d'incendie (BWR 2)**
  - 17) Réaction au feu: Classe (A1)**Résistance au feu:**
  - 18) Résistance en cas d'incendie, rupture de l'acier (charge de traction) : voir annexes, en particulier les annexes C48 - C51
  - 19) Résistance de l'adhérence dans des conditions d'incendie: voir annexes, en particulier annexe C51
  - 20) Résistance en cas d'incendie, rupture de l'acier (charge de cisaillement) : voir annexes, en particulier les annexes C48 - C51**Hygiène, santé et environnement (BWR 3)**
  - 21) Contenu, émission et/ou rejet de substances dangereuses: NPD
8. Documentation technique appropriée et/ou documentation technique spécifique: -

Les performances du produit identifié ci-dessus sont conformes aux performances déclarées. Conformément au règlement (UE) no 305/2011, la présente déclaration des performances est établie sous la seule responsabilité du fabricant mentionné ci-dessus.

Signé pour le fabricant et en son nom par:



Dr.-Ing. Oliver Geibig, Directeur Général Business Units & Ingénierie  
Tumlingen, 2024-05-06



Jürgen Grün, Directeur Général Chimie & Qualité

Cette DoP a été préparée en plusieurs langues. En cas de différend relatif à l'interprétation, la version anglaise prévaudra.

L'annexe comprend des informations volontaires et complémentaires en langue anglaise dépassant les exigences légales (spécifiées de manière neutre).

Translation guidance Essential Characteristics and Performance Parameters for Annexes

**Guide de traduction des caractéristiques essentielles et des paramètres de performance pour les annexes**

Mechanical resistance and stability (BWR 1)		
<b>Résistance mécanique et stabilité (BWR 1)</b>		
Characteristic resistance to tension load (static and quasi-static loading):		
<b>Résistance caractéristique à la charge de traction (charge statique et quasi-statique):</b>		
1	Resistance to steel failure: <b>Résistance à la rupture de l'acier (charge de traction):</b>	$N_{Rk,s}$ [kN]
2	Resistance to combined pull-out and concrete cone failure:  Resistance to pull-out failure: <b>Résistance à l'extraction glissement:</b>	$\tau_{Rk}$ and/or $\tau_{Rk,100}$ [N/mm <sup>2</sup> ], $\psi_c, \psi_{sus}, \psi_{sus,100}$ [-] (BF)  $N_{Rk,p}$ and/or $N_{Rk,p,100}$ [kN], $\psi_c$ [-] (BEF)
3	Resistance to concrete cone failure: <b>Résistance à la rupture du cône béton:</b>	$c_{cr,N}$ [mm], $k_{cr,N}$ , $k_{ucr,N}$ [-]
4	Edge distance to prevent splitting under load: <b>Distance au bord pour éviter la rupture par fendage sous charge:</b>	$c_{cr,sp}$ [mm]
5	Robustness: <b>Robustesse:</b>	$\gamma_{inst}$ [-]
6	Maximum installation torque:  Installation torque: <b>Couple de serrage:</b>	$\max T_{inst}$ [Nm] (BF)  $T_{inst}$ [Nm] (BEF)
7	Minimum edge distance, spacing and member thickness: <b>Distance au bord et entraxe mini, Epaisseur du support:</b>	$c_{min}, s_{min}, h_{min}$ [mm]
Characteristic resistance to shear load (static and quasi-static loading):		
<b>Résistance caractéristique à la charge de cisaillement (charge statique et quasi-statique):</b>		
8	Resistance to steel failure: <b>Résistance à la rupture de l'acier:</b>	$V_{Rk,s}$ [kN], $M_{Rk,s}^0$ [Nm], $k_7$ [-]
9	Resistance to pry-out failure: <b>Résistance à la rupture par effet de levier:</b>	$k_8$ [-]
10	Resistance to concrete edge failure: <b>Résistance à la rupture du béton en bord de dalle:</b>	$d_{nom}, l_f$ [mm]
Displacements under short-term and long-term loading:		
<b>Déplacements sous charge à court et long terme:</b>		
11	Displacements under short-term and long-term loading: <b>Déplacements sous charge à court et long terme:</b>	$\delta_0, \delta_\infty$ [mm or mm/(N/mm <sup>2</sup> )]
12	Resistance in steel fibre reinforced concrete: <b>Résistance du béton armé de fibres d'acier:</b>	Description
Characteristic resistance and displacements for seismic performance categories C1 and C2:		
<b>Résistance caractéristique et déplacements pour les catégories de performance sismique C1 et C2:</b>		
13	Resistance to tension for seismic performance category C1 <b>Résistance à la charge de traction, catégorie C1:</b>	$N_{Rk,s,C1}$ [kN] (all) $T_{Rk,C1}$ [N/mm <sup>2</sup> ] (BF) $N_{Rk,p,C1}$ [kN] (BEF)
14	Resistance to tension for seismic performance category C2 <b>Résistance à la charge de traction, catégorie C2:</b>	$N_{Rk,s,C2}$ [kN] (all) $T_{Rk,C2}$ [N/mm <sup>2</sup> ] (BF) $N_{Rk,p,C2}$ [kN] (BEF) $\delta_{N,C2}$ [mm] (all)
15	Resistance to shear for seismic performance category C1 <b>Résistance à la charge de cisaillement, catégorie C1:</b>	$V_{Rk,s,C1}$ [kN] (all)
16	Resistance to shear for seismic performance category C2 <b>Résistance à la charge de cisaillement, catégorie C2:</b>	$V_{Rk,s,C2}$ [kN] (all) $\delta_{V,C2}$ [mm] (all)
Safety in case of fire (BWR 2)		
<b>Sécurité en cas d'incendie (BWR 2)</b>		
17	Reaction to fire <b>Réaction au feu:</b>	Class Classe (A1)
Resistance to fire		
<b>Résistance au feu:</b>		
18	Fire resistance to steel failure (tension load): <b>Résistance en cas d'incendie, rupture de l'acier (charge de traction) :</b>	$N_{Rk,s,fi}$ [kN]
19	Bond resistance under fire conditions: <b>Résistance de l'adhérence dans des conditions d'incendie:</b>	$k_{fi,p}(\theta)$ [-], $T_{Rk,fi}(\theta)$ [N/mm <sup>2</sup> ] (BF)
20	Fire resistance to steel failure under shear loading: <b>Résistance en cas d'incendie, rupture de l'acier (charge de cisaillement) :</b>	$V_{Rk,s,fi}$ [kN], $M_{Rk,s,fi}^0$ [Nm]
Hygiene, health and the environment (BWR 3)		
<b>Hygiène, santé et environnement (BWR 3)</b>		
21	Content, emission and/or release of dangerous substances: <b>Contenu, émission et/ou rejet de substances dangereuses:</b>	Description/Level

## 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 B3 to B12, C1 to C16, C19, C21, C23, C24, C25 to C34
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C1 to C4, C20, C22, C23, C24
Displacements under short-term and long-term loading	See Annex C17, C18, C35, C36
Characteristic resistance and displacements for seismic performance categories C1 and C2	See Annex C37 to C47

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

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C48 to C51

#### 3.3 Hygiene, health and the environment (BWR 3)

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

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

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

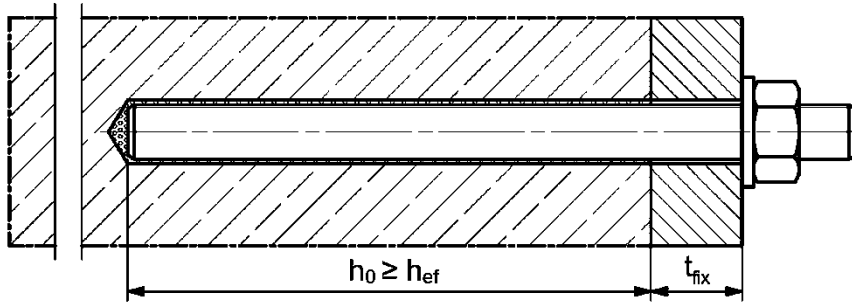
The system to be applied is: 1



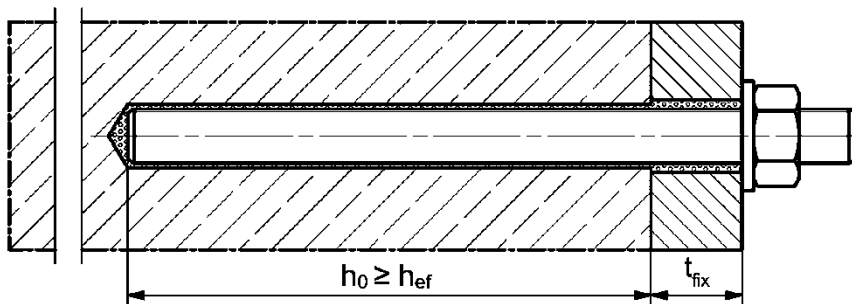
## Installation conditions part 1

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

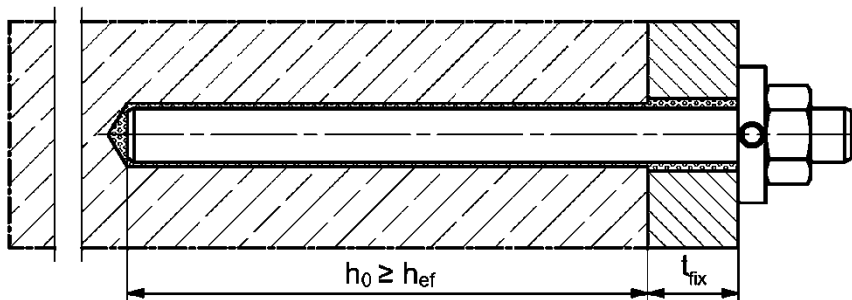
### Pre-positioned installation



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



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



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

fischer injection system FIS EM Plus

**Product description**  
Installation conditions part 1

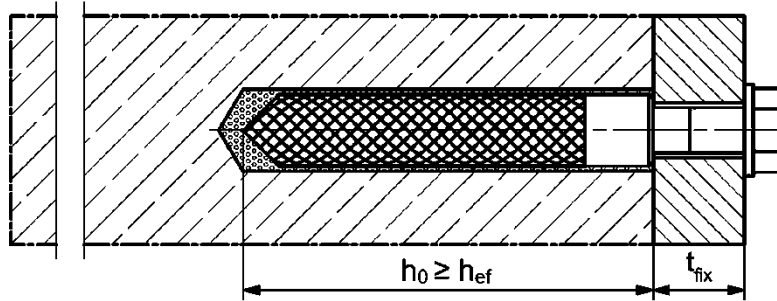
**Annex A1**

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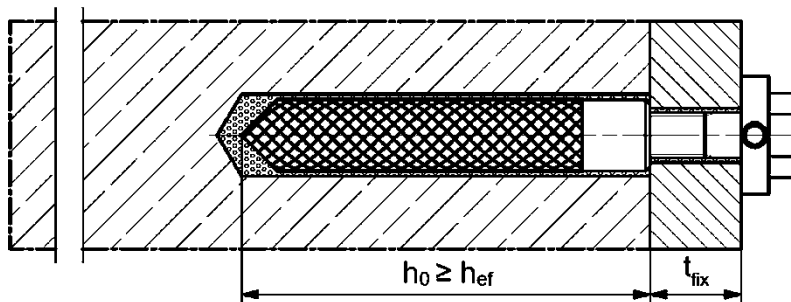
## Installation conditions part 2

fischer internal threaded anchor RG M I (fischer RG M I)

Pre-positioned installation



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



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

fischer injection system FIS EM Plus

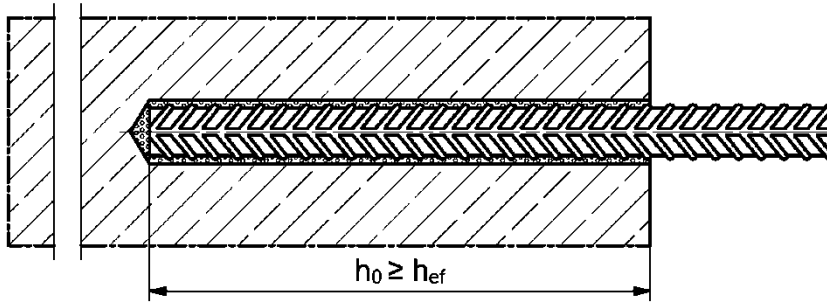
**Product description**  
Installation conditions part 2

**Annex A2**

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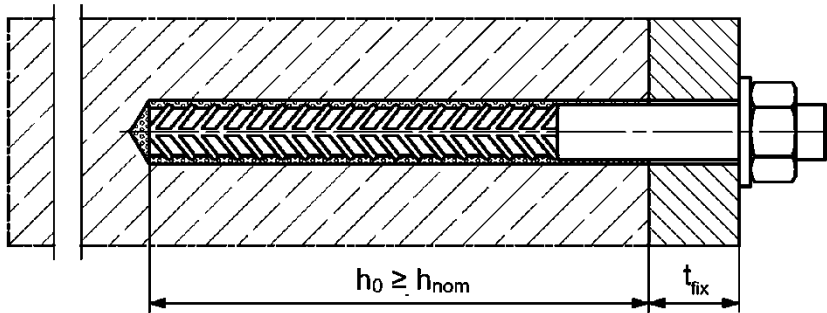
# Installation conditions part 3

## Reinforcing bar

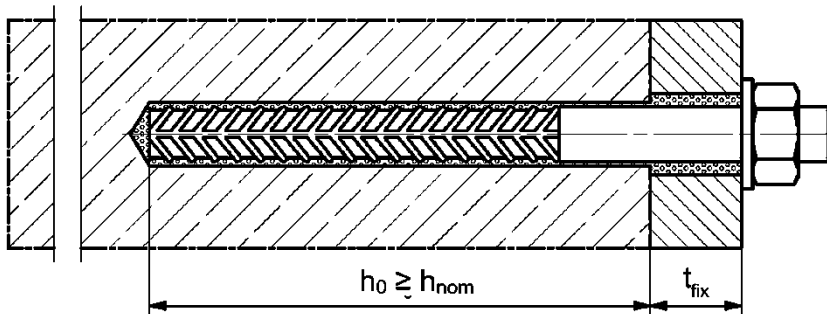


## fischer rebar anchor FRA (fischer FRA)

### Pre-positioned installation



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



Figures not to scale

$h_0$  = drill hole depth

$h_{ef}$  = effective embedment depth

$t_{fix}$  = thickness of fixture

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

fischer injection system FIS EM Plus

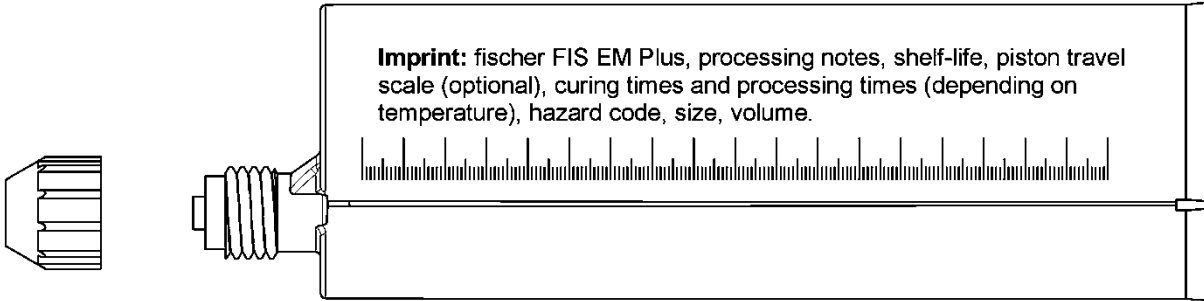
**Product description**  
Installation conditions part 3

**Annex A3**

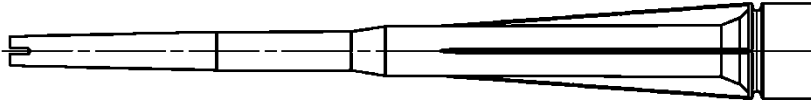
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# Overview system components part 1

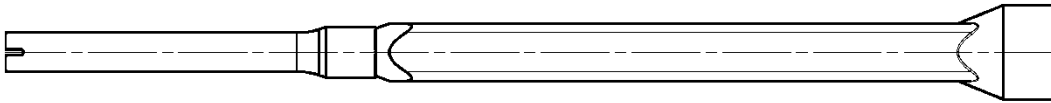
**Injection cartridge (shuttle cartridge) with sealing cap; Size: 390 ml, 585 ml, 1500 ml**



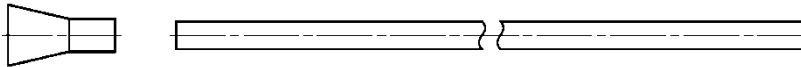
**Static mixer FIS MR Plus for injection cartridges  $\leq$  390 ml**



**Static mixer FIS UMR for injection cartridges  $>$  390 ml**



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



**Cleaning brush BS / BSB**



**Compressed-air cleaning tool ABP**



Figures not to scale

fischer injection system FIS EM Plus

**Product description**

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

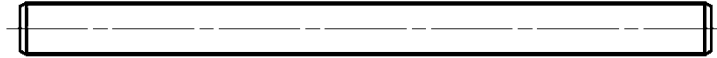
**Annex A4**

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## Overview system components part 2

### Anchor rod / Threaded rod

Metric size: M8, M10, M12, M14, M16, M20, M22, M24, M27, M30  
Fractional size: 3/8", 1/2", 5/8", 3/4", 7/8", 1", 1 1/8"

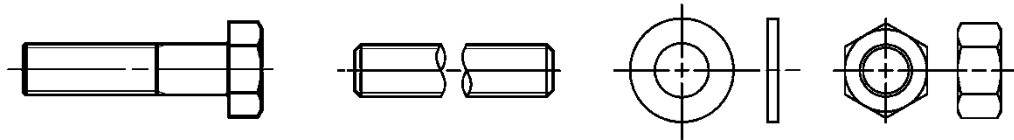


### fischer RG M I

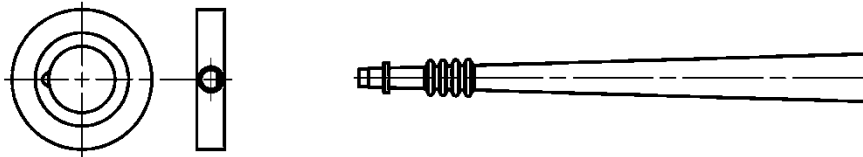
Metric size: M8, M10, M12, M16, M20  
Fractional size: 3/8", 1/2", 5/8", 3/4"



### Screw / Anchor rod / Threaded rod / washer / hexagon nut



### fischer filling disc with injection adapter



### Reinforcing bar

Nominal diameter:  
Metric size:  $\phi 8$ ,  $\phi 10$ ,  $\phi 12$ ,  $\phi 14$ ,  $\phi 16$ ,  $\phi 18$ ,  $\phi 20$ ,  $\phi 22$ ,  $\phi 24$ ,  $\phi 25$ ,  $\phi 26$ ,  $\phi 28$ ,  $\phi 30$ ,  $\phi 32$ ,  $\phi 34$ ,  $\phi 36$ ,  $\phi 40$   
Fractional size: #3 (3/8"), #4 (1/2"), #5 (5/8"), #6 (3/4"), #7 (7/8"), #8 (1"), #9 (1,128"), #10 (1,270")



### fischer FRA

Metric size: M12, M16, M20, M24



Figures not to scale

### fischer injection system FIS EM Plus

#### Product description

Overview system components part 2;  
steel components

### Annex A5

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**Table A6.1: Materials, metric sizes**

Part	Designation	Material		
1	Injection cartridge	Mortar, hardener, filler		
	Steel grade	Steel zinc plated (zp, hdg)	Stainless steel R acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4: 2006+A2:2020	High corrosion resistant steel HCR acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4: 2006+A2:2020
2	Anchor rod / Threaded rod	Property class 4.8, 5.8 or 8.8; EN ISO 898-1:2013 zp ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation <sup>1)</sup>	Property class 50, 70 or 80; EN ISO 3506-1:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; 1.4062; 1.4662; 1.4462; EN 10088-1:2014 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation <sup>1)</sup>	Property class 50, 70 or 80; EN ISO 3506-1:2020 or property class HCR 70 with $f_{yk} = 560 \text{ N/mm}^2$ ; 1.4565; 1.4529; EN 10088-1:2014 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation <sup>1)</sup>
3	Washer ISO 7089:2000	zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	1.4565; 1.4529; EN 10088-1:2014
4	Hexagon nut	Property class 4, 5 or 8 acc. EN ISO 898-2:2012 zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	Property class 50, 70 or 80 acc. EN ISO 3506-2:2020 1.4565; 1.4529; EN 10088-1:2014
5	fischer RG M I	Property class 5.8 EN ISO 898-1:2013 zinc plated ≥ 5 µm, EN ISO 4042:2022	Property class 70 EN ISO 3506-1:2020; 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	Property class 70 EN ISO 3506-1:2020 1.4565; 1.4529; EN 10088-1:2014
6	Commercial standard screw or Anchor rod / Threaded rod for fischer RG M I	Property class 5.8 or 8.8; EN ISO 898-1:2013 zinc plated ≥ 5 µm, EN ISO 4042:2022 $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2020 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation	Property class 70 EN ISO 3506-1:2020 1.4565; 1.4529; EN 10088-1:2014 $A_5 > 8 \%$ fracture elongation
7	fischer filling disc similar to DIN 6319-G	zinc plated ≥ 5 µm, EN ISO 4042:2022 or hot dip galvanised ≥ 40 µm EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014	1.4565; 1.4529; EN 10088-1:2014
8	Rebar	EN 1992-1-1:2004 and AC:2010, Annex C Bars and de-coiled rods, class B or C with $f_{yk}$ and $k$ according to NDP or NCI according to EN 1992-1-1/NA; $f_{uk} = f_{tk} = k \cdot f_{yk}$ ( $A_5 > 12 \%$ ) <sup>1)</sup>		
9	fischer FRA	Rebar part: Bars and de-coiled rods class B or C with $f_{yk}$ and $k$ according to NDP or NCI of EN 1992-1-1:2004+AC:2010 $f_{uk} = f_{tk} = k \cdot f_{yk}$ ( $A_5 > 8 \%$ ) Threaded part: Property class 80 EN ISO 3506-1:2020	1.4401, 1.4404, 1.4571, 1.4578, 1.4439, 1.4362, 1.4062 acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4:2006+A1:2015 1.4565; 1.4529 acc. to EN 10088-1:2014 Corrosion resistance class CRC V acc. to EN 1993-1-4: 2006+A1:2015 $f_{uk} \leq 1000 \text{ N/mm}^2$ ; fracture elongation $A_5 > 8 \%$	

<sup>1)</sup> Fracture elongation  $A_5 > 8 \%$ , for applications without requirements for seismic performance category C1 or C2

fischer injection system FIS EM Plus

Product description part 1  
Materials, metric sizes

**Annex A6**

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**Table A7.1: Materials, fractional sizes**

Part	Designation	Material	
1	Injection cartridge	Mortar, hardener, filler	
	Steel grade	Steel zinc plated (zp, hdg)	Stainless steel R Corrosion resistance class CRC III acc. to EN 1993-1-4: 2006+A1:2015
2	Fractional Threaded rod	ASTM F568M-07, Class 5.8 $f_{uk} = 500 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022 ASTM F1554-20, Grade 36 $f_{uk} = 400 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022 ASTM F1554-20, Grade 55 $f_{uk} = 517 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; zinc plated $\geq 5 \mu\text{m}$ ; EN ISO 4042:2022 ASTM F1554-20, Grade 105 $f_{uk} = 862 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022 ASTM A193/A193M-23, Grade B7 $f_{uk} = 862 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022	ASTM F593M-13ae1, Alloy Group 2 $f_{uk} = 689 \text{ N/mm}^2$ , $f_{uk} \leq 5/8 \text{ in. (CW1)}$ $f_{uk} = 586 \text{ N/mm}^2$ , $f_{uk} \geq 3/4 \text{ in. (CW2)}$ $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; ASTM A193/A193M-23, Grade B8M, Class 1 $f_{uk} = 517 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> ; ASTM A193/A193M-23, Grade B8M, Class 2B $f_{uk} = 655 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup>
3	Washer	ASTM F436/F436M-19 zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004+AC:2009	ASTM A240/A240M-23a Type 316
4	Hexagon nut	ASTM A563/A563M-23, Grade DH or ASTM A194/A194M-23, Grade 2H for Threaded rod material ASTM F568M-07, Class 5.8 or ASTM F1554-20, Grade 36, 55, 105 ASTM A194/A194M-23, Grade 2H / 4 / 7 for Threaded rod material ASTM A193/A193M-23, B7 zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022	ASTM F593M-13ae1, Alloy Group 2 for Threaded rod material: ASTM F593M-13ae1, Alloy Group 2 / ASTM A193/A193M-23, Grade 8M for Threaded rod material: ASTM A193/A193M-23, Grade B8M, Class 1 or ASTM A193/A193M-23, Grade B8M, Class 2B
5	fischer RG M I	Property class 5.8 EN ISO 898-1:2013 zinc plated $\geq 5 \mu\text{m}$ , ISO 4042:2022	Property class 70; EN ISO 3506-1:2020; 1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014
6	Commercial standard screw or Threaded rod for fischer RG M I	See Table A7.1, line 2, steel zinc plated, EN ISO 4042:2022	See Table A7.1, line 2, stainless steel R
7	fischer filling disc similar to DIN 6319-G	zinc plated $\geq 5 \mu\text{m}$ , EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004+AC:2009	1.4401; 1.4404; 1.4578; 1.4571; 1.4439; 1.4362; EN 10088-1:2014
8	Reinforcing bar	ASTM A615/A615M-22 (ASTM A767/A767M-19) Grade 40, $f_{uk} = 414 \text{ N/mm}^2$ , $f_{yk} = 276 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> Grade 60, $f_{uk} = 621 \text{ N/mm}^2$ , $f_{yk} = 414 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> Grade 75, $f_{uk} = 689 \text{ N/mm}^2$ , $f_{yk} = 517 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> Grade 60, $f_{uk} = 552 \text{ N/mm}^2$ , $f_{yk} = 414 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup> Grade 80, $f_{uk} = 689 \text{ N/mm}^2$ , $f_{yk} = 552 \text{ N/mm}^2$ , $A_5 > 12 \%$ fracture elongation <sup>1)</sup>	

<sup>1)</sup> Fracture elongation  $A_5 > 8 \%$ , for applications without requirements for seismic performance category C1 or C2

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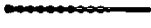


**Product description**  
Materials, fractional sizes

**Annex A7**

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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 / Threaded rod 		fischer RG M I 		Reinforcing bar 		fischer FRA 	
Hammer drilling with standard drill bit 	all sizes								
Hammer drilling with hollow drill bit 	Nominal drill bit diameter (d <sub>0</sub> ) 12 mm to 35 mm; 7/16" to 1 3/8" (fischer "FHD", Heller "Duster Expert"; Bosch „Speed Clean“; Hilti "TE-CD, TE-YD", DreBo „D-Plus“, DreBo „D-Max“)								
Diamond drilling 	all sizes								
Static and quasi static load, in uncracked / cracked concrete	Metric sizes	M8 to M30	Annexes: C1, C4 – C6, C17	M8 to M20	Annexes: C2, C4, C7, C8, C17	φ8 to φ40	Annexes: C3, C4, C9 – C13, C18	M12 to M24	Annexes: C3, C4, C14 – C16, C18
	Fractional sizes	3/8" to 1 1/8"	Annexes: C19, C20, C24 – C28, C35	3/8" to 3/4"	Annexes: C21, C22, C24, C29 – C31, C35	#3 to #10	Annexes: C23, C24, C32 – C34, C36	- <sup>1)</sup>	
Seismic performance category (only hammer drilling with standard / hollow drill bits)	C1	M10 to M30	Annexes: C37, C39, C40	- <sup>1)</sup>	- <sup>1)</sup>	φ10 to φ32	Annexes: C38, C39, C41	- <sup>1)</sup>	- <sup>1)</sup>
		3/8" to 1 1/8"	Annexes: C43, C45, C46			#3 to #10	Annexes: C44, C45, C47		
	C2	M12, M16, M20, M24	Annexes: C38, C39, C42			- <sup>1)</sup>			
Use category	I1	dry or wet concrete		all sizes					
	I2	water filled hole		all sizes (not permitted for diamond drilling in combination with cracked concrete and working life 100 years)					
Installation direction		D3 (downward and horizontal and upwards (e.g. overhead) installation)							
Installation temperature		T <sub>i,min</sub> = -5 °C to T <sub>i,max</sub> = +40 °C for the standard variation of temperature after installation							
Resistance to fire		Annexes: C48 – C51		- <sup>1)</sup>		- <sup>1)</sup>		- <sup>1)</sup>	
In-service temperature	Temperature range I	-40 °C to +40 °C			(max. short term temperature +40 °C; max. long term temperature +24 °C)				
	Temperature range II	-40 °C to +60 °C			(max. short term temperature +60 °C; max. long term temperature +35 °C)				
	Temperature range III	-40 °C to +72 °C			(max. short term temperature +72 °C; max. long term temperature +50 °C)				

<sup>1)</sup> no performance assessed.

fischer injection system FIS EM Plus

Intended use  
Specifications part 1

**Annex B1**

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## Specifications of intended use part 2

### Base materials:

- Compacted reinforced or unreinforced normal weight concrete without fibres of strength classes C20/25 to C50/60 according to EN 206:2013+A2:2021.

### Use conditions (Environmental conditions):

- Fastener intended for use in structures subject to dry, internal conditions (all materials).
- For all other conditions according to EN 1993-1-4:2006+A1:2015 corresponding to corrosion resistance classes to Annex A6 table A6.1 (metric sizes) or Annex A7 table A7.1 (fractional sizes).

### Design:

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

### Installation:

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

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**Intended use**  
Specifications part 2

**Annex B2**

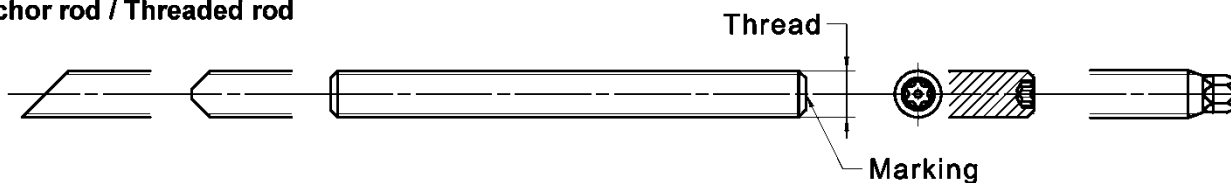
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**Table B3.1: Installation parameters for metric Anchor rods / Threaded rods**

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

<sup>1)</sup> Both drill hole diameters can be used.

**Anchor rod / Threaded rod**



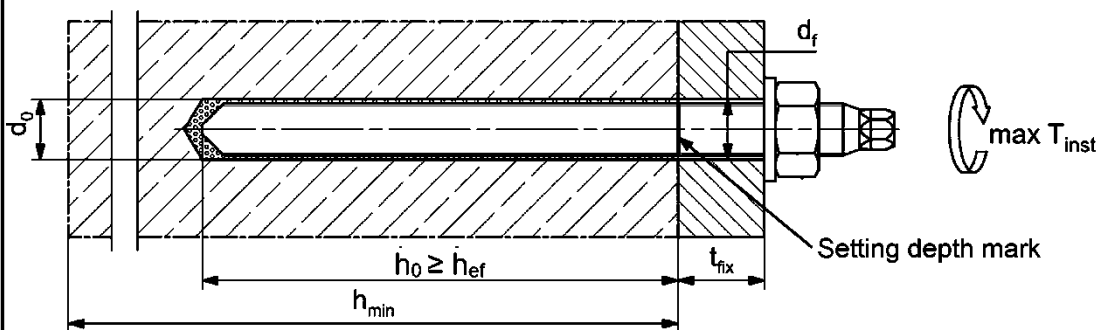
**Marking (on random place) anchor rod:**

Steel zinc plated PC <sup>1)</sup> 8.8	• or +	Steel hot-dip PC <sup>1)</sup> 8.8	•
High corrosion resistant steel HCR PC <sup>1)</sup> 50	•	High corrosion resistant steel HCR PC <sup>1)</sup> 70	-
High corrosion resistant steel HCR PC <sup>1)</sup> 80	(	Stainless steel R property class 50	~
Stainless steel R property class 80	*		

Alternatively: Colour coding according to DIN 976-1:2016

<sup>1)</sup> PC = property class

**Installation conditions:**



**Threaded rods, washers and hexagon nuts may also be used if the following requirements are fulfilled**

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

Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters Anchor rods / Threaded rods (metric size)

**Annex B3**

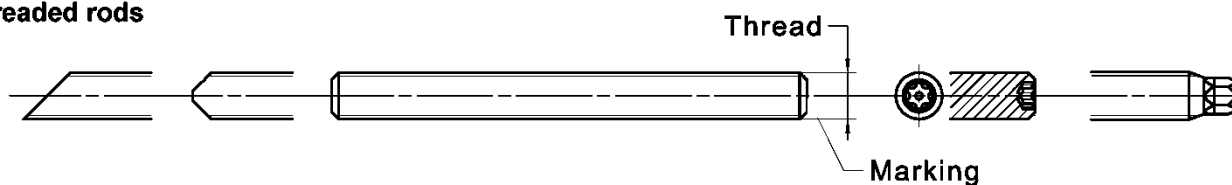
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**Table B4.1: Installation parameters for fractional Threaded rods**

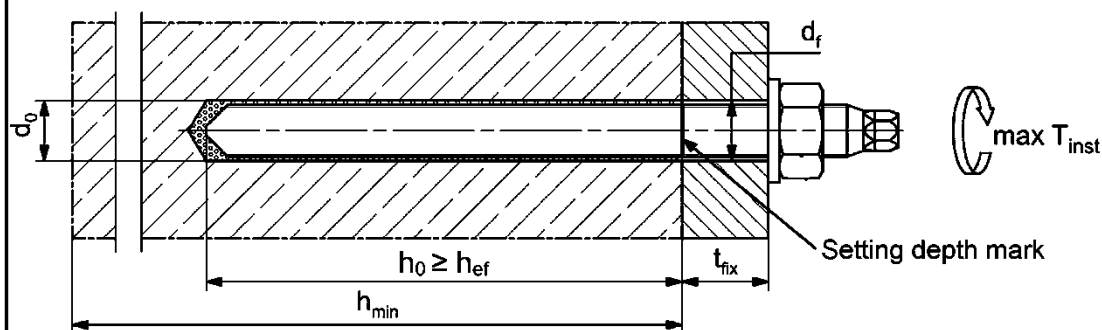
Threaded rods		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
Nominal drill hole diameter	$d_0$	[mm]	11,1	14,3	19,1	22,2	25,4	31,8		
		[inch]	7/16	9/16	3/4	7/8	1	1 1/8	1 1/4	
Drill hole depth	$h_0$	$h_0 \geq h_{ef}$								
Effective embedment depth	$h_{ef, min}$	60,0	70,0	79,0	89,0	89,0	102,0	178,0		
	$h_{ef, max}$	191,0	254,0	318,0	381,0	445,0	508,0	572,0		
Diameter of the clearance hole of the fixture	pre-positioned installation	$d_f$	[mm]	8,9	11,9	14,0	16,0	18,0	22,1	23,9
	push through installation			11,9	14,0	16,0	18,0	20,1	25,9	27,9
Minimum thickness of concrete member	$h_{min}$	$h_{ef} + 30$		$h_{ef} + 2d_0$						
Maximum installation torque	$\max T_{inst}$	[Nm]	18	41	60	107	136	173	180	

1) Both drill hole diameters can be used.

**Threaded rods**



**Installation conditions:**



**Additional requirements for Threaded rods, washers and hexagon nuts:**

- Materials, dimensions, and mechanical properties according to **Annex A7, Table A7.1**.
- Inspection certificate 3.1 according to EN 10204:2004, the documents shall be stored.
- Setting depth is marked.

Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters Threaded rods (fractional size)

**Annex B4**

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**Table B5.1: Minimum spacing and minimum edge distance for metric Anchor rods and metric reinforcing bars**

Metric Anchor rods		M8	M10	M12	M14	M16	-	M20	M22	M24	
Metric Reinforcing bars (nominal diameter)	$\phi$	8	10	12	14	16	18	20	22	24	
<b>Minimum edge distance</b>											
Uncracked / cracked concrete	$c_{min}$	[mm]	40	45	45	45	50	55	55	60	
Minimum spacing	$s_{min}$	[mm]	according to Annex B7								
<b>Minimum spacing</b>											
Uncracked / cracked concrete	$s_{min}$	[mm]	40	45	55	60	65	85	85	105	
Minimum edge distance	$c_{min}$	[mm]	according to Annex B7								
<b>Required projecting area</b>											
Uncracked concrete	$A_{sp,req}$	[1000 mm <sup>2</sup> ]	8	13	21,5	23	24	38,5	38,5	39,5	40
Cracked concrete		[mm <sup>2</sup> ]	6,5	10	16,5	17,5	18,5	29,5	29,5	30	30,5
Anchor rods		-	-	M27	-	M30	-	-	-	-	
Reinforcing bars (nominal diameter)	$\phi$	25	26	-	28	30	32	34	36	40	
<b>Minimum edge distance</b>											
Uncracked / cracked concrete	$c_{min}$	[mm]	75	75	75	80	80	120	120	135	175
Minimum spacing	$s_{min}$	[mm]	according to Annex B7								
<b>Minimum spacing</b>											
Uncracked / cracked concrete	$s_{min}$	[mm]	120	120	120	140	140	160	160	160	160
Minimum edge distance	$c_{min}$	[mm]	according to Annex B7								
<b>Required projecting area</b>											
Uncracked concrete	$A_{sp,req}$	[1000 mm <sup>2</sup> ]	47,5	47,5	47,5	64	64	64	64	64	64
Cracked concrete		[mm <sup>2</sup> ]	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 calculation of minimum spacing and minimum edge distance of anchors in combination with different embedment depths and thicknesses of concrete members the following equation shall be fulfilled:

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

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

$A_{sp,t}$  = effective projecting area (according to **Annex B7**)

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**Intended use**

Minimum spacing and edge distance for Anchor rods and reinforcing bars

**Annex B5**

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**Table B6.1: Minimum spacing and minimum edge distance for fractional Threaded rods and reinforcing bars**

Fractional Threaded rods		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	-	
Fractional Reinforcing bars		#3	#4	#5	#6	#7	#8	#9	#10	
<b>Minimum edge distance</b>										
Uncracked / cracked concrete	$C_{min}$	[mm]	45	45	50	55	60	75	80	120
Minimum spacing	$S_{min}$		according to Annex B7							
<b>Minimum spacing</b>										
Uncracked / cracked concrete	$S_{min}$	[mm]	45	60	65	85	105	120	140	160
Minimum edge distance	$C_{min}$		according to Annex B7							
<b>Required projecting area</b>										
Uncracked concrete	$A_{sp,req}$	[1000	12,5	21,0	24,5	36,0	39,5	43,5	40,5	64,5
Cracked concrete		mm <sup>2</sup> ]	9,5	16,0	18,5	27,5	30,0	33,5	31,0	49,5

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

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

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

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

$A_{sp,t}$  = effective projecting area (according to **Annex B7**)

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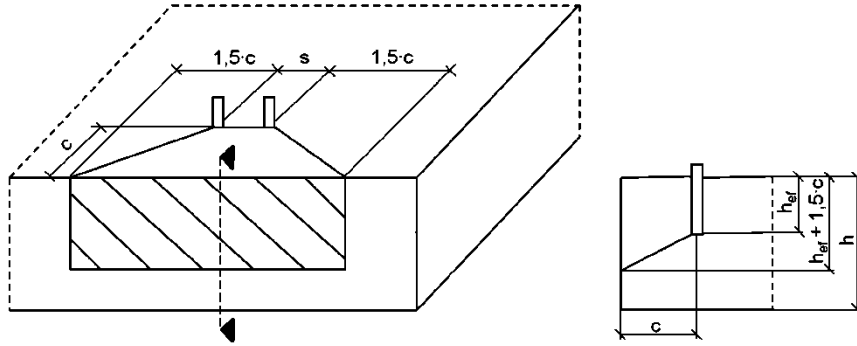
**Intended use**

Minimum spacing and edge distance for Anchor rods and reinforcing bars

**Annex B6**

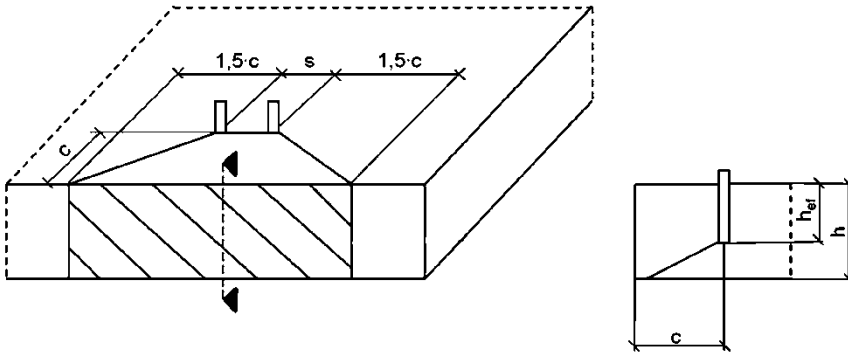
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**Table B7.1: Projecting area  $A_{sp,t}$  with concrete member thickness  $h > h_{ef} + 1,5 \cdot c$  and  $h \geq h_{min}$**



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

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



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

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

Figures not to scale

fischer injection system FIS EM Plus

**Intended use**

Minimum thickness of concrete member for Anchor rods / Threaded rods, minimum spacing and edge distance

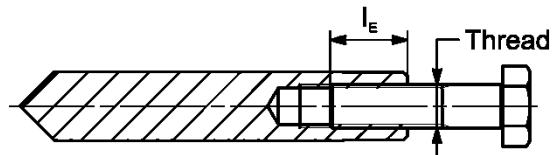
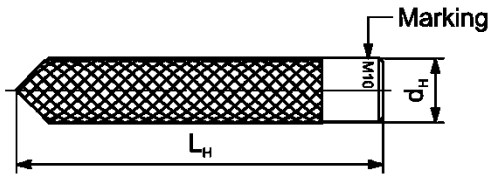
**Annex B7**

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**Table B8.1: Installation parameters for metric fischer RG M I**

fischer RG M I		Thread	M8	M10	M12	M16	M20
Diameter of anchor	$d_{nom} = d_H$	[mm]	12	15,7	18	22	28
Nominal drill hole diameter	$d_0$		14	18	20	24	32
Drill hole depth	$h_0$		$h_0 \geq h_{ef} = L_H$				
Effective embedment depth ( $h_{ef} = L_H$ )	$h_{ef}$		90	90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		55	65	75	95	125
Diameter of clearance hole in the fixture	$d_f$		9	12	14	18	22
Minimum thickness of concrete member	$h_{min}$		120	125	165	205	260
Maximum screw-in depth	$l_{E,max}$		18	23	26	35	45
Minimum screw-in depth	$l_{E,min}$	8	10	12	16	20	
Maximum installation torque	$\max T_{inst}$	[Nm]	10	20	40	80	120

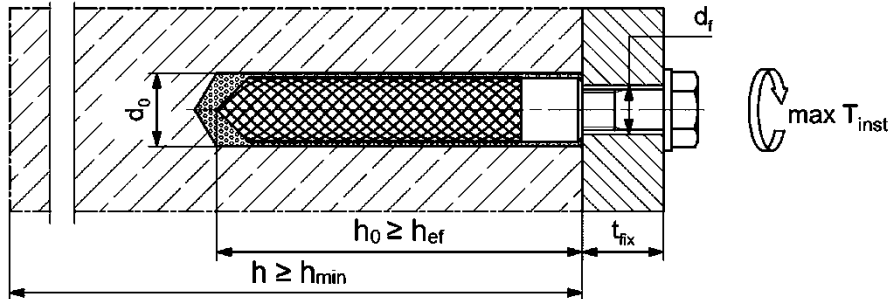
**fischer RG M I**



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

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

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
 Installation parameters internal threaded anchors RG M I (metric size)

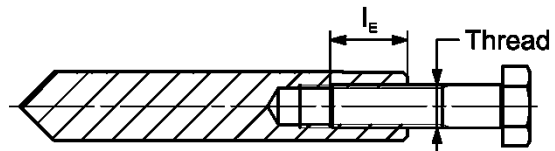
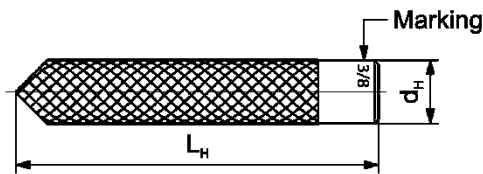
**Annex B8**

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**Table B9.1: Installation parameters for fractional fischer RG M I**

fischer RG M I		Thread	3/8"	1/2"	5/8"	3/4"
Diameter of anchor	$d_{nom} = d_H$	[mm]	15,7	18	22	28
Nominal drill hole diameter	$d_0$		18	20	24	32
		[inch]	3/4	13/16	1	1 1/4
Drill hole depth	$h_0$	[mm]	$h_0 \geq h_{ef} = L_H$			
Effective embedment depth ( $h_{ef} = L_H$ )	$h_{ef}$		90	125	160	200
Minimum spacing and minimum edge distance	$s_{min} = c_{min}$		65	75	95	125
Diameter of clearance hole in the fixture	$d_f$		12	14	18	22
Minimum thickness of concrete member	$h_{min}$		125	165	205	260
Maximum screw-in depth	$l_{E,max}$		23	26	35	45
Minimum screw-in depth	$l_{E,min}$		10	12	16	20
Maximum installation torque	$\max T_{inst}$		[Nm]	20	40	80

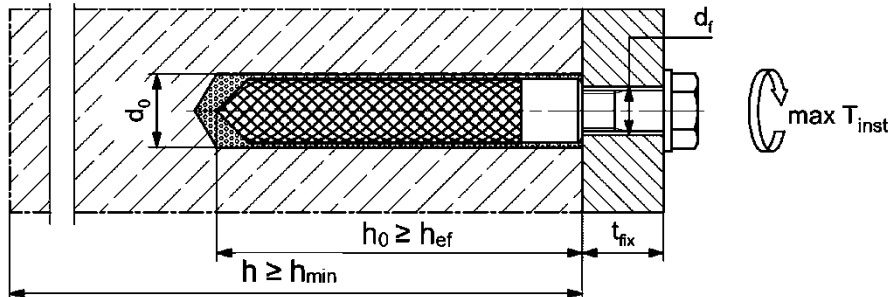
**fischer RG M I**



**Marking:** Anchor size e. g.: **M 3/8**  
 Stainless steel → additional **R**; e.g.: **M 3/8 R**

Retaining screw or threaded rods (including nut and washer) must comply with the appropriate material and strength class of **Annex A7, Table A7.1**.

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
 Installation parameters internal threaded anchors RG M I (fractional size)

**Annex B9**

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**Table B10.1: Installation parameters for metric reinforcing bars <sup>1)</sup>**

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

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

1) Detailed calculation according to **Annex B7**.

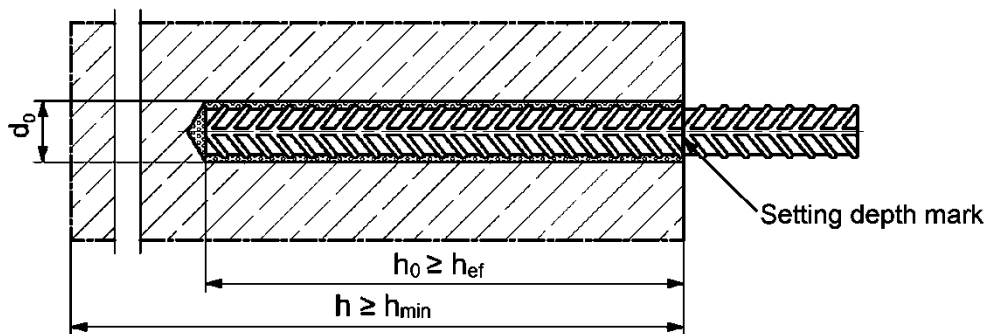
2) Both drill hole diameters can be used.

**Reinforcing bar**



- The minimum value of related rib area  $f_{R,min}$  must fulfil the requirements of EN 1992-1-1:2004+AC:2010
- The rib height must be within the range:  $0,05 \cdot \phi \leq h_{rib} \leq 0,07 \cdot \phi$   
( $\phi$  = Nominal diameter of the bar,  $h_{rib}$  = rib height)

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters reinforcing bars (metric size)

**Annex B10**

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**Table B11.1: Installation parameters for fractional reinforcing bars <sup>1)</sup>**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10	
Nominal drill hole diameter	$d_0$	[mm]	12,7	15,9	19,1	22,2	28,6	31,8	34,9	38,1
		[inch]	1/2	5/8	3/4	7/8	1 1/8	1 1/4	1 3/8	1 1/2
Drill hole depth	$h_0$	$h_0 \geq h_{ef}$								
Effective embedment depth	$h_{ef,min}$	60	70	79	89	89	102	114	127	
	$h_{ef,max}$	[mm]	191	254	318	381	445	508	572	635
Minimum thickness of concrete member	$h_{min}$	$h_{ef} + 30$		$h_{ef} + 2d_0$						

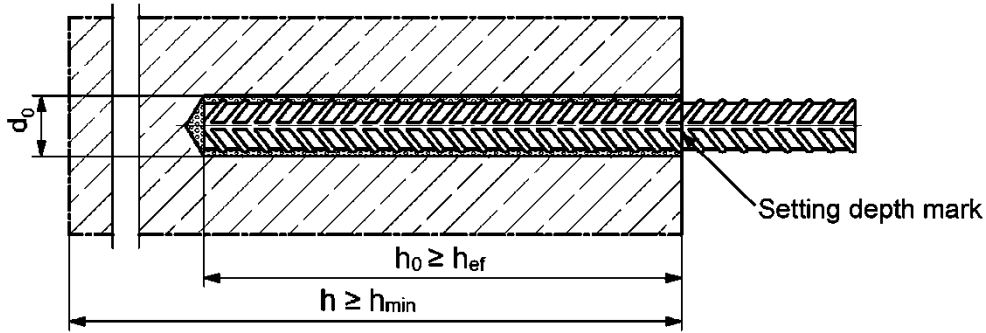
<sup>1)</sup> Detailed calculation according to **Annex B7**.

**Reinforcing bar**



- Reinforcing bars, acc. to ASTM A615/A615M-22 (ASTM A767/A767M-19).  
Materials, dimensions, and mechanical properties according to **Annex A7, Table A7.1**.

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters reinforcing bars (fractional size)

**Annex B11**

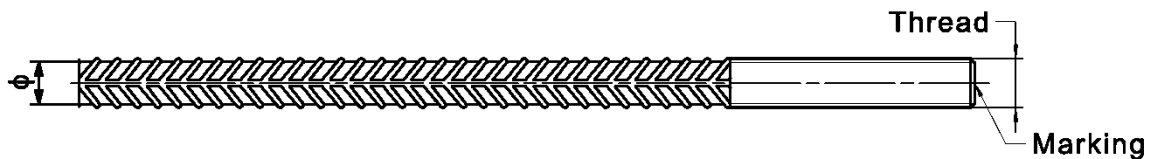
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**Table B12.1: Installation parameters for metric fischer FRA**

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

1) Both drill hole diameters can be used.

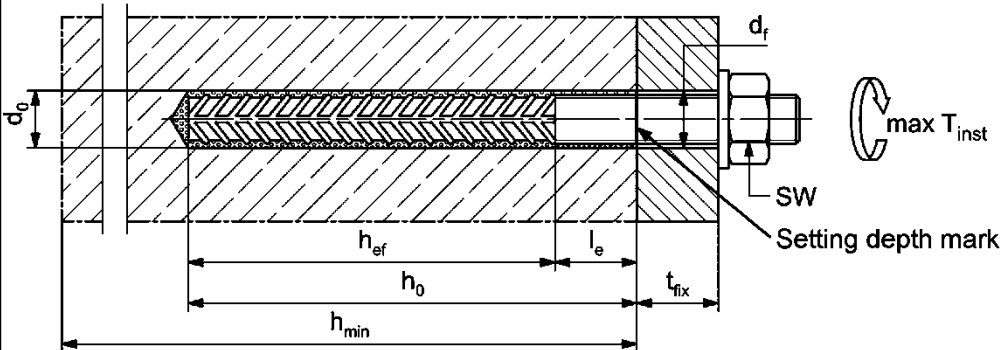
**fischer FRA**



Marking frontal e.g.:

- FRA (for stainless steel R)
- FRA HCR (for high corrosion resistant steel HCR)

**Installation conditions:**



Figures not to scale

fischer injection system FIS EM Plus

**Intended use**  
Installation parameters fischer FRA (metric size)

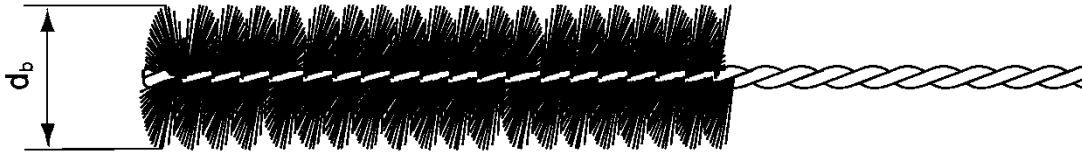
**Annex B12**

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**Table B13.1: Parameters of the cleaning brush BS / BSB (steel brush with steel bristles)**

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

Nominal drill hole diameter $d_0$	[mm]	10	12	14	16	18	20	24	25	28	30	32	35	40	45	55
	[inch]	-	7/16	1/2	5/8	3/4	13/16	1		1 1/8	1 1/4		1 3/8	1 1/2	-	-
Steel brush diameter BS $d_b$	[mm]	11	14	16	20		25	26	27	30	40			-	-	-
Steel brush diameter BSB $d_b$	[mm]	-	-	-	-		-	-	-	-	-			42	47	58



**Table B13.2: Conditions for use static mixer without an extension tube**

Nominal drill hole diameter $d_0$	[mm]	10	12	14	16	18	20	24	25	28	30	32	35	40	45	55
	[inch]	-	7/16	1/2	5/8	3/4	13/16	1		1 1/8	1 1/4		1 3/8	1 1/2	-	-
Drill hole depth $h_0$ by using	FIS MR Plus [mm]	≤ 90		≤ 120	≤ 140	≤ 150	≤ 160	≤ 190	≤ 210							
	FIS UMR [mm]	-		≤ 90	≤ 160	≤ 180	≤ 190	≤ 220		≤ 250						

**Table B13.3: Maximum processing time of the mortar and minimum curing time**  
(During the curing time of the mortar the concrete temperature may not fall below the listed minimum temperature)

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

<sup>1)</sup> In wet concrete or water filled holes the curing times must be doubled.

<sup>2)</sup> Minimal cartridge temperature +5 °C.

fischer injection system FIS EM Plus

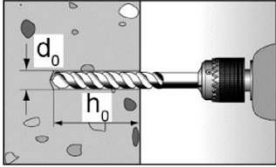
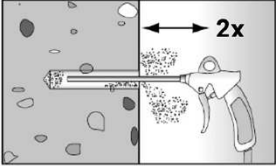

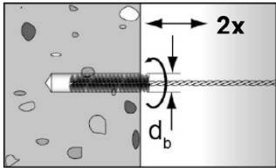
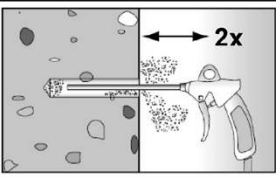

**Intended use**  
Cleaning brush (steel brush)  
Processing time and curing time

**Annex B13**

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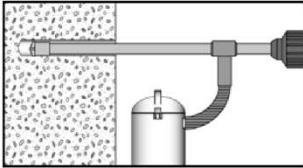
## Installation instructions part 1

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

1		<p>Drill the hole. Nominal drill hole diameter <math>d_0</math> and drill hole depth <math>h_0</math> see <b>Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</b></p>
2		<p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air (<math>p \geq 6</math> bar).</p> 
3		<p>Brush the drill hole twice. For drill hole diameter <math>\geq 30</math> mm use a power drill. For deep holes use an extension. Corresponding brushes see <b>Table B13.1.</b></p>
4		<p>Cleaning the drill hole: Blow out the drill hole twice, with oil free compressed air (<math>p \geq 6</math> bar).</p> 

Go to step 6

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

1		<p>Check a suitable hollow drill (see <b>Table B1.1</b>) for correct operation of the dust extraction.</p>
2		<p>Use a suitable dust extraction system, e. g. fischer FVC 35 M or a comparable dust extraction system with equivalent performance data.</p> <p>Drill the hole with hollow drill bit. The dust extraction system has to extract the drill dust nonstop during the drilling process and must be adjusted to maximum power. Nominal drill hole diameter <math>d_0</math> and drill hole depth <math>h_0</math> see <b>Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</b></p>

Go to step 6

fischer injection system FIS EM Plus

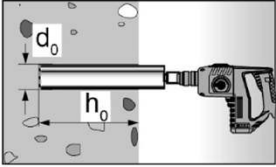
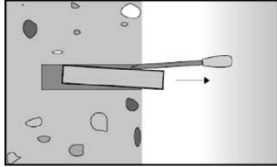
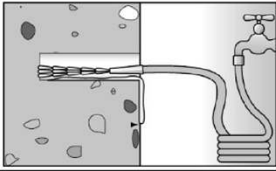
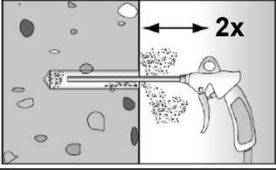
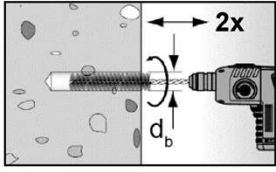
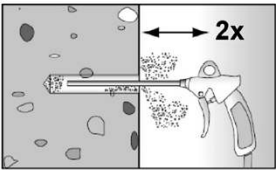
**Intended use**  
Installation instructions part 1

**Annex B14**

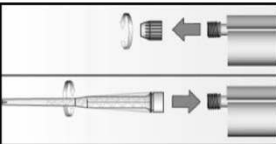

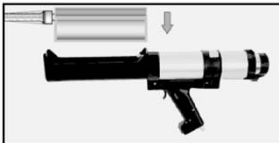


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## Installation instructions part 2

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

1		<p>Drill the hole. Drill hole diameter <math>d_0</math> and nominal drill hole depth <math>h_0</math> see <b>Tables B3.1, B4.1, B8.1, B9.1, B10.1, B11.1, B12.1.</b></p>		<p>Break the drill core and remove it</p>
2		<p>Flush the drill hole with clean water until it flows clear</p>		
3		<p>Blow out the drill hole twice, using oil-free compressed air (<math>p &gt; 6</math> bar)</p>		
4		<p>Brush the drill hole twice using a power drill. Corresponding brushes see <b>Table B13.1</b></p>		
5		<p>Blow out the drill hole twice, using oil-free compressed air (<math>p &gt; 6</math> bar)</p>		

### Preparing the cartridge

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

fischer injection system FIS EM Plus

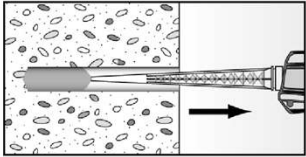
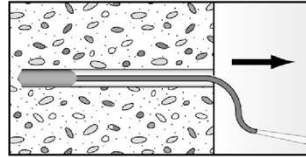
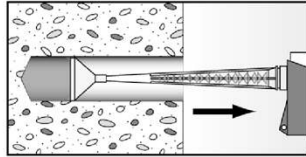
**Intended use**  
Installation instructions part 2

**Annex B15**

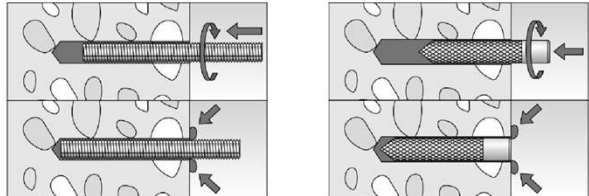
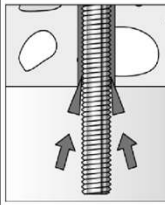
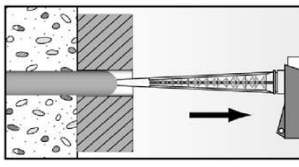
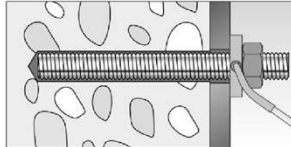
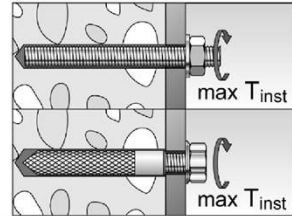
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# Installation instructions part 3

## Injection of the mortar

<p>9</p>	 <p>Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles.</p>	 <p>The conditions for mortar injection without extension tube can be found in <b>Table B13.2</b></p> <p>For deeper drill holes, than those mentioned in <b>Table B13.2</b>, use a suitable extension tube.</p>	 <p>For overhead installation, deep holes (<math>h_0 &gt; 250</math> mm) or drill hole diameter (<math>d_0 \geq 30</math> mm / 1 1/8") use an injection-adapter.</p>
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## Installation of Anchor rods, threaded rods or fischer internal threaded anchors RG M I

<p>10</p>		<p>Only use clean and oil-free metal parts. Mark the setting depth of the metal parts. Push the anchor rod, threaded rod or fischer RG M I anchor down to the bottom of the hole, turning it slightly while doing so.</p> <p>After inserting the metal part, excess mortar must be emerged around the anchor element. If not, pull out the metal part immediately and reinject mortar.</p>
<p>11</p>	 <p>For overhead installations support the metal part with wedges (e.g., fischer centering wedges) or fischer overhead clips.</p>	 <p>For push through installation fill the annular gap with mortar.</p>
<p>Option</p>	 <p>After the minimum curing time is reached, the gap between metal part and fixture (annular clearance) may be filled with mortar via the fischer filling disc. Compressive strength <math>\geq 50</math> N/mm<sup>2</sup> (e.g., fischer injection mortars FIS EM Plus, FIS HB, FIS SB, FIS V Plus)</p> <p>ATTENTION: Using fischer filling disc reduces <math>t_{fix}</math> (usable length of the anchor).</p>	<p>12</p>  <p>Mounting the fixture max <math>T_{inst}</math> see <b>Tables B3.1, B4.1, B8.1 and B9.1.</b></p>

fischer injection system FIS EM Plus

Intended use  
Installation instructions part 3

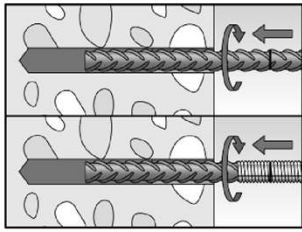
**Annex B16**

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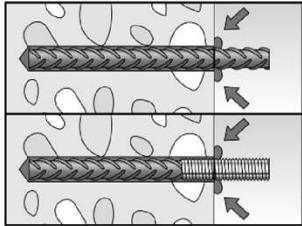
## Installation instructions part 4

### Installation reinforcing bars and fischer 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.



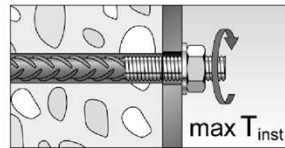
When the setting depth mark is reached, excess mortar must be emerged from the mouth of the drill hole. If not, pull out the anchor element immediately and reinject mortar.

11



Wait for the specified curing time  $t_{cure}$  see Table B13.3.

12



Mounting the fixture  
 $\max T_{inst}$   
see Table B12.1.

fischer injection system FIS EM Plus

**Intended use**  
Installation instructions part 4

**Annex B17**

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

Anchor rod / Threaded rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30		
<b>Characteristic resistance to steel failure under tension loading<sup>3)</sup></b>													
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	Property class 4.8	[kN]	14,6(13,2)	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
		5.8		18,3(16,6)	29,0(26,8)	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
		8.8		29,2(26,5)	46,4(42,8)	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR	50		18,3	29,0	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
		70		25,6	40,6	59,0	80,5	109,9	171,5	212,1	247,1	321,3	392,7
		80		29,2	46,4	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
<b>Partial factors <sup>1)</sup></b>													
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class 4.8	[-]	1,50									
		5.8		1,50									
		8.8		1,50									
	Stainless steel R and high corrosion resistant steel HCR	50		2,86									
		70		1,87 / fischer HCR: 1,50									
		80		1,60									
<b>Characteristic resistance to steel failure under shear loading<sup>3)</sup></b>													
<b>without lever arm</b>													
Characteristic resistance $V_{Rk,s}^0$	Steel zinc plated	Property class 4.8	[kN]	8,7(7,9)	13,9(12,8)	20,2	27,6	37,6	58,8	72,7	84,7	110,1	134,6
		5.8		10,9(9,9)	17,4(16,0)	25,2	34,5	47,1	73,5	90,9	105,9	137,7	168,3
		8.8		14,6(13,2)	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR	50		9,1	14,5	21,0	28,7	39,2	61,2	75,7	88,2	114,7	140,2
		70		12,8	20,3	29,5	40,2	54,9	85,7	106,0	123,5	160,6	196,3
		80		14,6	23,2	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
Ductility factor	$k_7$	[-]	1,0										
<b>with lever arm</b>													
Charact. resistance $M_{Rk,s}^0$	Steel zinc plated	Property class 4.8	[Nm]	14,9(12,9)	29,9(26,5)	52,3	83,5	132,9	259,6	357,1	448,8	665,7	899,5
		5.8		18,7(16,1)	37,3(33,2)	65,4	104,4	166,2	324,6	446,4	561,0	832,2	1124,4
		8.8		29,9(25,9)	59,8(53,1)	104,6	167,0	265,9	519,3	714,2	897,6	1331,5	1799,0
	Stainless steel R and high corrosion resistant steel HCR	50		18,7	37,3	65,4	104,4	166,2	324,6	446,4	561,0	832,2	1124,4
		70		26,2	52,3	91,5	146,1	232,6	454,4	624,9	785,4	1165,0	1574,1
		80		29,9	59,8	104,6	167,0	265,9	519,3	714,2	897,6	1331,5	1799,0
<b>Partial factors <sup>1)</sup></b>													
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class 4.8	[-]	1,25									
		5.8		1,25									
		8.8		1,25									
	Stainless steel R and high corrosion resistant steel HCR	50		2,38									
		70		1,56 / fischer HCR: 1,25 <sup>2)</sup>									
		80		1,33									

1) In absence of other national regulations.

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

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

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under tension / shear loading of metric Anchor rods / Threaded rods

**Annex C1**

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**Table C2.1: Characteristic resistance to steel failure under tension / shear loading of metric fischer RG M I**

fischer RG M I		RG M I	Screw		M8	M10	M12	M16	M20
<b>Characteristic resistance to steel failure under tension loading</b>									
Characteristic resistance with screw	Property class	5.8	5.8	[kN]	18,3	29,0	42,1	78,3	122,4
			8.8		29,2	46,4	67,4	106,7	180,2
	Property class	R-70 / HCR-70	R-70 / commercial standard		25,6	40,6	59,0	109,6	171,3
			HCR-70		25,6	40,6	59,0	109,6	171,3
<b>Partial factors<sup>1)</sup></b>									
Partial factors	Property class	5.8	5.8	[-]	1,50				
			8.8		1,50				
	Property class	R-70 / HCR-70	R-70 / commercial standard		1,87				
			HCR-70		1,50				
<b>Characteristic resistance to steel failure under shear loading</b>									
<b>Without lever arm</b>									
Characteristic resistance with screw	Property class	5.8	5.8	[kN]	10,9	17,4	25,2	47,1	73,5
			8.8		14,6	23,2	33,7	62,8	98,0
	Property class	R-70 / HCR-70	R-70 / commercial standard		12,8	20,3	29,5	54,9	85,7
			HCR-70		12,8	20,3	29,5	54,9	85,7
Ductility factor			$k_7$	[-]	1,0				
<b>With lever arm</b>									
Characteristic resistance with screw	Property class	5.8	5.8	[Nm]	18,7	37,3	65,4	166,2	324,6
			8.8		29,9	59,8	104,6	265,9	519,3
	Property class	R-70 / HCR-70	R-70 / commercial standard		26,2	52,3	91,5	232,6	454,4
			HCR-70		26,2	52,3	91,5	232,6	454,4
<b>Partial factors<sup>1)</sup></b>									
Partial factors	Property class	5.8	5.8	[-]	1,25				
			8.8		1,25				
	Property class	R-70 / HCR-70	R-70 / commercial standard		1,56				
			HCR-70		1,25				

<sup>1)</sup> In absence of other national regulations.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under tension / shear loading of metric fischer RG M I

**Annex C2**

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**Table C3.1: Characteristic resistance to steel failure under tension / shear loading of metric reinforcing bars**

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

1)  $f_{uk}$  respectively shall be taken from the specifications of the reinforcing bar.

2) In accordance with EN 1992-4:2018 section 7.2.2.3.1:

$k_6 = 0,6$  for fasteners made of carbon steel with  $f_{uk} \leq 500 \text{ N/mm}^2$ ,

= 0,5 for fasteners made of carbon steel with  $500 \text{ N/mm}^2 < f_{uk} \leq 1000 \text{ N/mm}^2$ ,

= 0,5 for fasteners made of stainless steel.

**Table C3.2: Characteristic resistance to steel failure under tension / shear loading of metric fischer FRA**

fischer FRA		M12	M16	M20	M24	
<b>Characteristic resistance to steel failure under tension loading</b>						
Characteristic resistance	$N_{Rk,s}$	[kN]	62,1	110,5	172,7	263,0
<b>Partial factor<sup>1)</sup></b>						
Partial factor	$\gamma_{Ms,N}$	[-]	1,40			
<b>Characteristic resistance to steel failure under shear loading</b>						
<b>Without lever arm</b>						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	33,7	62,8	98,0	141,2
Ductility factor	$k_7$	[-]	1,0			
<b>With lever arm</b>						
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	104,8	266,3	519,2	898,0
<b>Partial factor<sup>1)</sup></b>						
Partial factor	$\gamma_{Ms,V}$	[-]	1,25			

1) In absence of other national regulations.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under tension / shear loading of metric reinforcing bars and metric fischer FRA

**Annex C3**

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**Table C4.1: Characteristic resistance for concrete failure under tension / shear loading (metric size)**

Size		All sizes																	
<b>Tension loading</b>																			
Installation factor	$\gamma_{inst}$	[-]	See annex C5 to C16, C40 and C41																
<b>Factors for the compressive strength of concrete &gt; C20/25</b>																			
Increasing factor $\psi_c$ for cracked or uncracked concrete $\tau_{RK(X,Y)} = \psi_c \cdot \tau_{RK(C20/25)}$	C25/30	$\psi_c$	[-]	1,02															
	C30/37			1,04															
	C35/45			1,06															
	C40/50			1,07															
	C45/55			1,08															
	C50/60			1,09															
<b>Splitting failure</b>																			
Edge distance	$h / h_{ef} \geq 2,0$	$C_{cr,sp}$	[mm]	1,0 $h_{ef}$															
	$2,0 > h / h_{ef} > 1,3$			4,6 $h_{ef} - 1,8 h$															
	$h / h_{ef} \leq 1,3$			2,26 $h_{ef}$															
Spacing	$S_{cr,sp}$			2 $C_{cr,sp}$															
<b>Concrete cone failure</b>																			
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 $C_{cr,N}$																
<b>Factors for sustained tension loading</b>																			
Temperature range			24 °C / 40 °C	35 °C / 60 °C	50 °C / 72 °C														
Factor	$\psi_{sus}^0$		0,77	0,60	0,48														
Factor	$\psi_{sus,100}^0$		0,77	0,60	0,71														
<b>Shear loading</b>																			
Installation factor	$\gamma_{inst}$	[-]	1,0																
<b>Concrete pry-out failure</b>																			
Factor for pry-out failure	$k_8$	[-]	2,0																
<b>Concrete edge failure</b>																			
Effective length of fastener for shear loading	$l_f$	[mm]	for $d_{nom} \leq 24$ mm: min ( $h_{ef}$ , 12 $d_{nom}$ ) for $d_{nom} > 24$ mm: min ( $h_{ef}$ , max (8 $d_{nom}$ ; 300 mm))																
<b>Effective diameter of the fastener <math>d_{nom}</math></b>																			
Size			M8	M10	M12	M14	M16	M20	M22	M24	M27	M30							
Anchor rods and Threaded rods	$d_{nom}$	[mm]	8	10	12	14	16	20	22	24	27	30							
fischer RG M I	$d_{nom}$		12	15,7	18	- <sup>1)</sup>	22	28	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>							
fischer FRA	$d_{nom}$		- <sup>1)</sup>	- <sup>1)</sup>	12	- <sup>1)</sup>	16	20	- <sup>1)</sup>	25	- <sup>1)</sup>	- <sup>1)</sup>							
Size (nominal diameter of the bar)	$\phi$		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

<sup>1)</sup> Anchor type not part of the assessment.

fischer injection system FIS EM Plus										<b>Annex C4</b> Appendix 30 / 77	
<b>Performance</b> Characteristic resistance for concrete failure under tension / shear loading (metric size)											

**Table C5.1: Characteristic resistance to combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer or diamond drilled holes; uncracked or cracked concrete; working life 50 years**

Anchor rod / Threaded rod		M8 <sup>1)</sup>	M10	M12	M14	M16	M20	M22	M24	M27	M30			
<b>Combined pull-out and concrete cone failure</b>														
Calculation diameter	d	[mm]	8	10	12	14	16	20	22	24	27	30		
<b>Uncracked concrete</b>														
<b>Characteristic bond resistance in uncracked concrete C20/25</b>														
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	20,8	19,7	18,8	18,1	17,6	16,7	16,3	16,0	15,5	15,1	
	II: 35 °C / 60 °C			18,0	18,0	18,0	17,0	17,0	16,0	15,0	15,0	15,0	15,0	14,0
	III: 50 °C / 72 °C			18,0	17,0	17,0	16,0	16,0	15,0	14,0	14,0	14,0	14,0	13,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	20,8	19,7	18,8	17,9	16,9	15,3	14,4	13,8	13,2	12,3	
	II: 35 °C / 60 °C			16,0	16,0	15,0	13,0	13,0	11,0	11,0	10,0	10,0	10,0	9,0
	III: 50 °C / 72 °C			15,0	14,0	14,0	13,0	12,0	11,0	10,0	10,0	10,0	9,0	9,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>														
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0											
Water filled hole			1,4											
Diamond-drilling (dry or wet concrete)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	16,0	15,0	13,5	12,8	12,4	11,6	11,3	10,9	10,5	10,3	
	II: 35 °C / 60 °C			16,0	15,0	13,0	12,0	12,0	10,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C			15,0	14,0	12,0	11,0	11,0	10,0	9,0	9,0	8,0	8,0	
Diamond-drilling (water filled hole)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	16,0	16,8	15,5	14,3	13,6	12,0	11,5	10,9	10,3	9,9	
	II: 35 °C / 60 °C			16,0	15,0	13,0	12,0	12,0	10,0	10,0	10,0	9,0	9,0	
	III: 50 °C / 72 °C			15,0	14,0	12,0	11,0	11,0	10,0	9,0	9,0	8,0	8,0	
<b>Installation factors; Diamond-drilling</b>														
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0											
Water filled hole			1,4											
<b>Cracked concrete</b>														
<b>Characteristic bond resistance in cracked concrete C20/25</b>														
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,7	9,0	10,1	8,5	9,5	8,5	8,5	8,5	8,5	8,5	
	II: 35 °C / 60 °C			7,7	9,0	10,1	8,5	9,5	8,5	8,5	8,5	8,5	8,5	
	III: 50 °C / 72 °C			7,2	8,5	9,5	8,5	8,9	8,5	8,5	8,5	8,5	8,5	
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,6	7,7	8,7	7,0	7,7	6,0	6,0	6,0	6,0	6,0	
	II: 35 °C / 60 °C			6,6	7,7	8,7	7,0	7,7	6,0	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C			6,2	7,3	8,1	7,0	7,3	6,0	6,0	6,0	6,0	6,0	
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>														
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0											
Water filled hole			1,2				1,4							
Diamond-drilling (dry or wet concrete)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
	II: 35 °C / 60 °C			7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
	III: 50 °C / 72 °C			7,0	7,0	7,0	7,0	6,0	6,0	7,0	7,0	7,0	7,0	
Diamond-drilling (water filled hole)														
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	7,5	7,5	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
	II: 35 °C / 60 °C			6,0	7,5	7,5	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C			6,0	7,0	7,0	7,0	6,0	6,0	6,0	6,0	6,0	6,0	
<b>Installation factors; Diamond-drilling</b>														
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0											
Water filled hole			1,2				1,4							

<sup>1)</sup> Not allowed for hollow drill bit.

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**Performance**

Characteristic resistance to combined pull-out and concrete failure for Anchor rods and Threaded rods; working life 50 years

**Annex C5**

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**Table C6.1: Characteristic resistance to combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years**

Anchor rod / Threaded rod		M8 <sup>1)</sup>	M10	M12	M14	M16	M20	M22	M24	M27	M30			
<b>Combined pull-out and concrete cone failure</b>														
Calculation diameter	d	[mm]	8	10	12	14	16	20	22	24	27	30		
<b>Uncracked concrete</b>														
<b>Characteristic bond resistance in uncracked concrete C20/25</b>														
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$	[N/mm <sup>2</sup> ]	17,1	16,1	15,4	14,9	14,4	13,7	13,4	13,1	12,7	12,4	
	II: 35 °C / 60 °C			13,5	13,5	13,5	12,8	12,8	12,0	11,3	11,3	11,3	11,3	10,5
	III: 50 °C / 72 °C			9,9	10,2	10,2	10,4	10,4	9,8	9,1	9,1	9,1	9,1	8,5
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$	[N/mm <sup>2</sup> ]	17,1	16,2	15,4	14,7	13,9	12,5	11,8	11,3	10,8	10,1	
	II: 35 °C / 60 °C			12,0	12,0	11,3	9,8	9,8	8,3	8,3	7,5	7,5	7,5	6,8
	III: 50 °C / 72 °C			8,3	8,4	8,4	8,5	7,8	7,2	6,5	6,5	6,5	5,9	5,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>														
Dry or wet concrete												1,0		
Water filled hole		$\gamma_{inst}$	[-]									1,4		
<b>Diamond-drilling (dry or wet concrete)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$	[N/mm <sup>2</sup> ]	12,0	12,3	11,6	11,1	10,5	10,1	9,5	9,3	8,9	8,8	
	II: 35 °C / 60 °C			12,0	11,3	9,8	9,0	9,0	7,5	7,5	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C			8,3	8,4	7,2	7,2	7,2	6,5	5,9	5,9	5,9	5,2	5,2
<b>Diamond-drilling (water filled hole)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$	[N/mm <sup>2</sup> ]	12,0	13,8	12,7	11,7	11,2	10,0	9,4	8,9	8,4	8,1	
	II: 35 °C / 60 °C			12,0	11,3	9,8	9,0	9,0	7,5	7,5	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C			8,3	8,4	7,2	7,2	7,2	6,5	5,9	5,9	5,9	5,2	5,2
<b>Installation factors</b>														
Dry or wet concrete												1,0		
Water filled hole		$\gamma_{inst}$	[-]									1,4		
<b>Cracked concrete</b>														
<b>Characteristic bond resistance in cracked concrete C20/25</b>														
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	5,7	7,0	7,6	7,4	7,2	6,9	6,8	6,7	6,5	6,3	
	II: 35 °C / 60 °C			5,7	7,0	7,6	7,4	7,2	6,9	6,8	6,7	6,5	6,3	
	III: 50 °C / 72 °C			5,4	6,6	7,2	7,0	6,8	6,4	6,4	6,3	6,1	6,0	
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	4,9	6,0	6,5	6,1	5,9	4,9	4,8	4,7	4,6	4,4	
	II: 35 °C / 60 °C			4,9	6,0	6,5	6,1	5,9	4,9	4,8	4,7	4,6	4,4	
	III: 50 °C / 72 °C			4,6	5,7	6,1	5,7	5,5	4,5	4,5	4,4	4,3	4,3	
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>														
Dry or wet concrete												1,0		
Water filled hole		$\gamma_{inst}$	[-]			1,2					1,4			
<b>Diamond-drilling (dry or wet concrete)</b>														
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	
	II: 35 °C / 60 °C			4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	
	III: 50 °C / 72 °C			4,2	6,0	5,6	4,6	3,9	3,9	4,6	4,6	4,6	4,6	4,6
<b>Installation factors</b>														
Dry or wet concrete		$\gamma_{inst}$	[-]									1,0		

<sup>1)</sup> Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for Anchor rods and Threaded rods in hammer or diamond drilled holes; working life 100 years

**Annex C6**

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**Table C7.1: Characteristic resistance to combined pull-out and concrete failure for metric fischer RG M I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 50 years**

fischer RG M I		M8	M10	M12	M16	M20	
<b>Combined pull-out and concrete cone failure</b>							
Calculation diameter	d [mm]	12	15,7	18	22	28	
<b>Uncracked concrete</b>							
<b>Characteristic bond resistance in uncracked concrete C20/25</b>							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	18,8	17,6	17,0	16,2	15,3
			15,0	14,0	14,0	13,0	12,0
			14,0	13,0	13,0	12,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	18,8	16,9	15,8	14,3	12,8
			14,0	12,0	12,0	11,0	10,0
			13,0	12,0	11,0	10,0	9,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,4				
<b>Diamond-drilling (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	13,3	12,3	11,9	11,2	10,4
			13,0	12,0	11,0	10,0	9,0
			12,0	11,0	10,0	9,0	8,0
<b>Diamond-drilling (water filled hole)</b>							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	15,1	13,6	12,6	11,4	10,2
			13,0	12,0	11,0	10,0	9,0
			12,0	11,0	10,0	9,0	8,0
<b>Installation factors; Diamond-drilling</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,4				
<b>Cracked concrete</b>							
<b>Characteristic bond resistance in cracked concrete C20/25</b>							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,cr}$ [N/mm <sup>2</sup> ]	7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,cr}$ [N/mm <sup>2</sup> ]	7,0	6,5	6,0	6,0	6,0
			7,0	6,5	6,0	6,0	6,0
			7,0	6,0	6,0	6,0	6,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,2		1,4		
<b>Diamond-drilling (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,cr}$ [N/mm <sup>2</sup> ]	7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
			7,0	6,0	6,0	7,0	7,0
<b>Diamond-drilling (water filled hole)</b>							
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{RK,cr}$ [N/mm <sup>2</sup> ]	7,0	6,5	6,0	6,0	6,0
			7,0	6,5	6,0	6,0	6,0
			7,0	6,0	6,0	6,0	6,0
<b>Installation factors; Diamond-drilling</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,2		1,4		

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for fischer RG M I; working life 50 years

**Annex C7**

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**Table C8.1: Characteristic resistance to combined pull-out and concrete failure for metric fischer RG M I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years**

fischer RG M I		M8	M10	M12	M16	M20	
<b>Combined pull-out and concrete cone failure</b>							
Calculation diameter	d [mm]	12	15,7	18	22	28	
<b>Uncracked concrete</b>							
<b>Characteristic bond resistance in uncracked concrete C20/25</b>							
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	15,4	14,4	14,0	13,3	12,6
	II: 35 °C / 60 °C		11,3	10,5	10,5	9,8	9,0
	III: 50 °C / 72 °C		7,7	7,8	7,8	7,8	7,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	15,4	13,9	13,0	11,7	10,5
	II: 35 °C / 60 °C		10,5	9,0	9,0	8,3	7,5
	III: 50 °C / 72 °C		7,2	7,2	6,6	6,5	5,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,4				
<b>Diamond-drilling (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	10,9	10,1	9,8	9,2	8,6
	II: 35 °C / 60 °C		9,8	9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,6	6,0	5,9	5,2
<b>Diamond-drilling (water filled hole)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	12,5	11,2	10,3	9,3	8,4
	II: 35 °C / 60 °C		9,8	9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,6	6,0	5,9	5,2
<b>Installation factors; Diamond-drilling</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,4				
<b>Cracked concrete</b>							
<b>Characteristic bond resistance in cracked concrete C20/25</b>							
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm <sup>2</sup> ]	4,2	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		4,2	5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		4,2	5,1	4,8	4,6	4,6
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm <sup>2</sup> ]	4,2	5,5	4,8	3,9	3,9
	II: 35 °C / 60 °C		4,2	5,5	4,8	3,9	3,9
	III: 50 °C / 72 °C		4,2	5,1	4,8	3,9	3,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,2	1,4			
<b>Diamond-drilling (dry or wet concrete)</b>							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm <sup>2</sup> ]	4,2	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		4,2	5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		4,2	5,1	4,8	4,6	4,6
<b>Installation factors; Diamond-drilling</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for fischer RG M I; working life 100 years

**Annex C8**

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

Nominal diameter of the bar		$\phi$	8 <sup>1)</sup>	10	12	14	16	18	20	22	24		
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
<b>Uncracked concrete</b>													
<b>Characteristic bond resistance in uncracked concrete C20/25</b>													
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	16,0	16,8	16,1	15,5	15,0	14,6	14,2	14,0	13,6	
	II: 35 °C / 60 °C			16,0	15,0	15,0	14,0	14,0	13,0	13,0	13,0	13,0	12,0
	III: 50 °C / 72 °C			15,0	14,0	14,0	13,0	13,0	12,0	12,0	12,0	12,0	12,0
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	16,0	16,8	16,1	14,9	14,4	13,4	13,0	12,1	11,8	
	II: 35 °C / 60 °C			16,0	16,0	14,0	13,0	12,0	12,0	11,0	11,0	10,0	
	III: 50 °C / 72 °C			15,0	14,0	13,0	12,0	12,0	11,0	11,0	10,0	10,0	
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
<u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	16,0	15,0	13,0	12,0	12,0	11,0	10,0	10,0	10,0	
	II: 35 °C / 60 °C			16,0	15,0	13,0	12,0	12,0	11,0	10,0	10,0	10,0	
	III: 50 °C / 72 °C			15,0	14,0	12,0	11,0	11,0	10,0	10,0	9,0	9,0	
<b>Installation factors; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
Nominal diameter of the bar		$\phi$	25	26	28	30 <sup>1)</sup>	32 <sup>1)</sup>	34 <sup>1)</sup>	36 <sup>1)</sup>	40 <sup>1)</sup>			
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
<b>Uncracked concrete</b>													
<b>Characteristic bond resistance in uncracked concrete C20/25</b>													
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	13,5	13,3	13,1	12,9	12,7	12,5	12,4	12,1		
	II: 35 °C / 60 °C			12,0	12,0	12,0	12,0	12,0	11,0	11,0	11,0		
	III: 50 °C / 72 °C			11,0	11,0	11,0	11,0	11,0	11,0	10,0	10,0		
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	11,5	11,4	10,6	10,5	10,3	9,0	8,0	8,0		
	II: 35 °C / 60 °C			10,0	10,0	10,0	9,0	9,0	9,0	8,0	8,0		
	III: 50 °C / 72 °C			9,0	9,0	9,0	9,0	8,0	8,0	8,0	8,0		
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
<u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	9,0	9,0	9,0	9,0	8,0	8,0	8,0	7,0		
	II: 35 °C / 60 °C			9,0	9,0	9,0	9,0	8,0	8,0	8,0	8,0		
	III: 50 °C / 72 °C			9,0	8,0	8,0	8,0	8,0	7,0	7,0	7,0		
<b>Installation factors; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									

<sup>1)</sup> Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

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

**Annex C9**

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**Table C10.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years part 1**

Nominal diameter of the bar		$\phi$	8 <sup>1)</sup>	10	12	14	16	18	20	22	24		
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
<b>Cracked concrete</b>													
<b>Characteristic bond resistance in cracked concrete C20/25</b>													
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C				7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C				7,0	7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	
	II: 35 °C / 60 °C				6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				6,0	6,5	6,5	6,0	6,0	6,0	6,0	6,0	6,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,2				1,4					
<b>Diamond-drilling (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	
	II: 35 °C / 60 °C				7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C				7,0	7,0	7,0	7,0	6,0	6,0	6,0	7,0	7,0
<b>Diamond-drilling (water filled hole)</b>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	
	II: 35 °C / 60 °C				6,0	7,5	6,5	6,5	6,5	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				6,0	6,5	6,5	6,0	6,0	6,0	6,0	6,0	6,0
<b>Installation factors; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,2				1,4					

<sup>1)</sup> Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 50 years part 1

**Annex C10**

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**Table C11.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years part 2**

Nominal diameter of the bar		$\phi$	25	26	28	30 <sup>1)</sup>	32 <sup>1)</sup>	34 <sup>1)</sup>	36 <sup>1)</sup>	40 <sup>1)</sup>		
<b>Combined pull-out and concrete cone failure</b>												
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40	
<b>Cracked concrete</b>												
<b>Characteristic bond resistance in cracked concrete C20/25</b>												
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	8,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C				8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C				8,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	6,0	6,0	6,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0
	III: 50 °C / 72 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>												
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0								
Water filled hole				1,4								
<b>Diamond-drilling (dry or wet concrete)</b>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	7,0	7,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				7,0	7,0	7,0	7,0	5,0	5,0	5,0	5,0
	III: 50 °C / 72 °C				7,0	7,0	7,0	7,0	5,0	5,0	5,0	5,0
<b>Diamond-drilling (water filled hole)</b>												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	6,0	6,0	6,0	5,0	5,0	5,0	
	II: 35 °C / 60 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0
	III: 50 °C / 72 °C				6,0	6,0	6,0	6,0	5,0	5,0	5,0	5,0
<b>Installation factors; Diamond-drilling</b>												
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0								
Water filled hole				1,4								

<sup>1)</sup> Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for reinforcing bars; working life 50 years part 2

**Annex C11**

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**Table C12.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; uncracked concrete; working life 100 years**

Nominal diameter of the bar		$\phi$	8 <sup>1)</sup>	10	12	14	16	18	20	22	24		
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
<b>Uncracked concrete</b>													
<b>Characteristic bond resistance in uncracked concrete C20/25</b>													
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	12,0	13,8	13,2	12,7	12,3	12,0	11,6	11,5	11,2
	II: 35 °C / 60 °C				12,0	11,3	11,3	10,5	10,5	9,8	9,8	9,8	9,0
	III: 50 °C / 72 °C				8,3	8,4	8,4	8,5	8,5	7,8	7,8	7,8	7,8
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	12,0	13,8	13,2	12,2	11,8	11,0	10,7	9,9	9,7
	II: 35 °C / 60 °C				12,0	12,0	10,5	9,8	9,0	9,0	8,3	8,3	7,5
	III: 50 °C / 72 °C				8,3	8,4	7,8	7,8	7,8	7,2	7,2	6,5	6,5
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
<u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	12,0	11,3	9,8	9,0	9,0	8,3	7,5	7,5	7,5
	II: 35 °C / 60 °C				12,0	11,3	9,8	9,0	9,0	8,3	7,5	7,5	7,5
	III: 50 °C / 72 °C				8,3	8,4	7,2	7,2	7,2	6,5	6,5	5,9	5,9
<b>Installation factors; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
Nominal diameter of the bar		$\phi$	25	26	28	30 <sup>1)</sup>	32 <sup>1)</sup>	34 <sup>1)</sup>	36 <sup>1)</sup>	40 <sup>1)</sup>			
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
<b>Uncracked concrete</b>													
<b>Characteristic bond resistance in uncracked concrete C20/25</b>													
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	11,1	10,9	10,8	10,6	10,5	10,3	10,1	9,9	
	II: 35 °C / 60 °C				9,0	9,0	9,0	9,0	9,0	8,3	8,3	8,3	
	III: 50 °C / 72 °C				7,2	7,2	7,2	7,2	7,2	7,2	6,5	6,5	
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	9,4	9,3	8,7	8,6	8,5	6,8	6,0	6,0	
	II: 35 °C / 60 °C				7,5	7,5	7,5	6,8	6,8	6,8	6,0	6,0	
	III: 50 °C / 72 °C				5,9	5,9	5,9	5,9	5,2	5,2	5,2	5,2	
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
<u>Diamond-drilling (dry or wet concrete as well as water filled hole)</u>													
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm <sup>2</sup> ]	6,8	6,8	6,8	6,8	6,0	6,0	6,0	5,3	
	II: 35 °C / 60 °C				6,8	6,8	6,8	6,8	6,0	6,0	6,0	6,0	
	III: 50 °C / 72 °C				5,9	5,2	5,2	5,2	5,2	4,6	4,6	4,6	
<b>Installation factors; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									

<sup>1)</sup> Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

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

**Annex C12**

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**Table C13.1: Characteristic resistance to combined pull-out and concrete failure for metric reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 100 years**

Nominal diameter of the bar		$\phi$	8 <sup>1)</sup>	10	12	14	16	18	20	22	24		
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24	
<b>Cracked concrete</b>													
<b>Characteristic bond resistance in cracked concrete C20/25</b>													
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	
	II: 35 °C / 60 °C			4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	5,2
	III: 50 °C / 72 °C			4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2	5,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	3,6	6,4	5,2	4,2	4,2	3,9	3,9	3,9	3,9	
	II: 35 °C / 60 °C			3,6	6,4	5,2	4,2	4,2	3,9	3,9	3,9	3,9	
	III: 50 °C / 72 °C			3,6	5,5	5,2	3,9	3,9	3,9	3,9	3,9	3,9	
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,2				1,4					
<b>Diamond-drilling (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
	II: 35 °C / 60 °C			4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
	III: 50 °C / 72 °C			4,2	6,0	5,6	4,6	3,9	3,9	3,9	4,6	4,6	
<b>Installation factor; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Nominal diameter of the bar		$\phi$	25	26	28	30 <sup>1)</sup>	32 <sup>1)</sup>	34 <sup>1)</sup>	36 <sup>1)</sup>	40 <sup>1)</sup>			
<b>Combined pull-out and concrete cone failure</b>													
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40		
<b>Cracked concrete</b>													
<b>Characteristic bond resistance in cracked concrete C20/25</b>													
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
	II: 35 °C / 60 °C			5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
	III: 50 °C / 72 °C			5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	5,2	
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	3,9	3,9	3,9	3,9	3,3	3,8	3,8	3,8		
	II: 35 °C / 60 °C			3,9	3,9	3,9	3,9	3,3	3,8	3,8	3,8		
	III: 50 °C / 72 °C			3,9	3,9	3,9	3,9	3,3	3,3	3,3	3,3		
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									
Water filled hole				1,4									
<b>Diamond-drilling (dry or wet concrete)</b>													
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
	II: 35 °C / 60 °C			4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
	III: 50 °C / 72 °C			4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3		
<b>Installation factor; Diamond-drilling</b>													
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0									

<sup>1)</sup> Not allowed for hollow drill bit.

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**Performance**

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

**Annex C13**

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**Table C14.1: Characteristic resistance to combined pull-out and concrete failure for metric fischer FRA in hammer or diamond drilled holes; uncracked concrete; working life 50 years**

fischer FRA		M12	M16	M20	M24	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	12	16	20	25	
<b>Uncracked concrete</b>						
<b>Characteristic bond resistance in uncracked concrete C20/25</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ]	16,1	15,0	14,2	13,5
	II: 35 °C / 60 °C		15,0	14,0	13,0	12,0
	III: 50 °C / 72 °C		14,0	13,0	12,0	11,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ]	16,1	14,4	13,0	11,5
	II: 35 °C / 60 °C		14,0	12,0	11,0	10,0
	III: 50 °C / 72 °C		13,0	12,0	11,0	9,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$ [-]	[-]	1,0			
Water filled hole			1,4			
<b>Diamond-drilling (dry or wet concrete as well as water filled hole)</b>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$ [N/mm <sup>2</sup> ]	13,0	12,0	10,0	9,0
	II: 35 °C / 60 °C		13,0	12,0	10,0	9,0
	III: 50 °C / 72 °C		12,0	11,0	10,0	9,0
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$ [-]	[-]	1,0			
Water filled hole			1,4			

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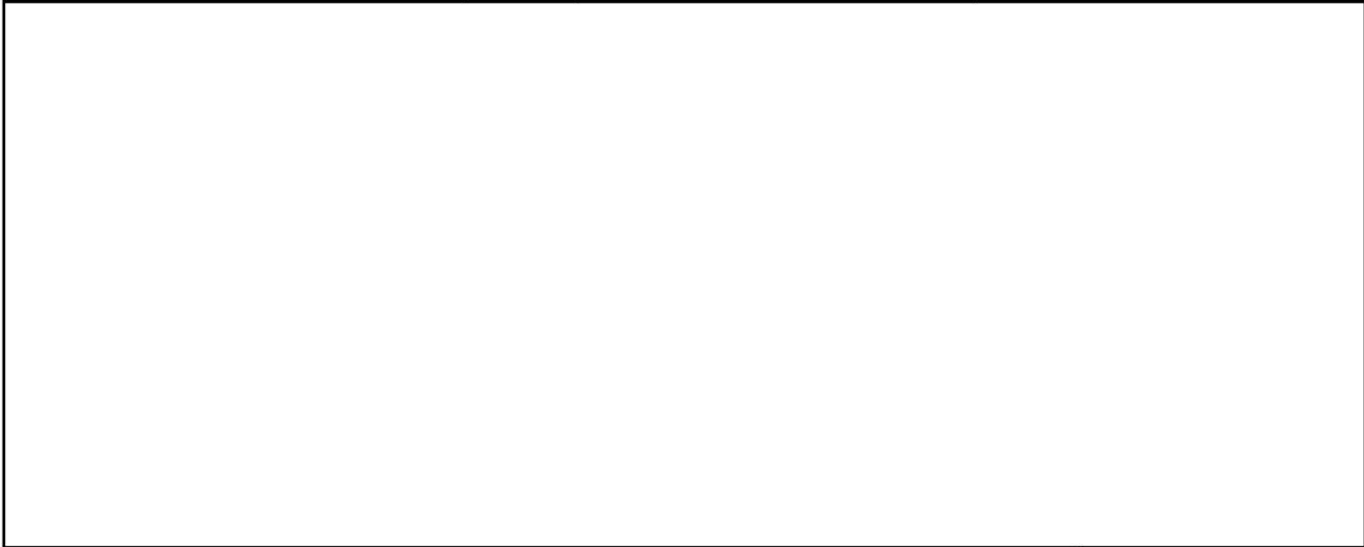
**Performance**

Characteristic resistance to combined pull-out and concrete failure for fischer FRA; working life 50 years

**Annex C14**

**Table C15.1: Characteristic resistance to combined pull-out and concrete failure for metric fischer FRA in hammer or diamond drilled holes; cracked concrete; working life 50 years**

fischer FRA		M12	M16	M20	M24	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	12	16	20	25	
<b>Cracked concrete</b>						
<b>Characteristic bond resistance in cracked concrete C20/25</b>						
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]	8,0	8,0	8,0	8,0
	II: 35 °C / 60 °C		8,0	8,0	8,0	8,0
	III: 50 °C / 72 °C		8,0	8,0	8,0	8,0
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]	6,5	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,5	6,0	6,0
	III: 50 °C / 72 °C		6,5	6,0	6,0	6,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,2	1,4		
<u>Diamond-drilling (dry or wet concrete)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]	7,0	6,0	6,0	7,0
	II: 35 °C / 60 °C		7,0	6,0	6,0	7,0
	III: 50 °C / 72 °C		7,0	6,0	6,0	7,0
<u>Diamond-drilling (water filled hole)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]	6,5	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,5	6,0	6,0
	III: 50 °C / 72 °C		6,5	6,0	6,0	6,0
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,2	1,4		



<b>Table C16.1: Characteristic resistance to combined pull-out and concrete failure for metric fischer FRA in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years</b>						
<b>fischer FRA</b>		<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	12	16	20	25	
<b>Uncracked concrete</b>						
<b>Characteristic bond resistance in uncracked concrete C20/25</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	13,2 11,3 8,4	12,3 10,5 8,5	11,6 9,8 7,8	11,1 9,0 7,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	13,2 10,5 7,8	11,8 9,0 7,8	10,7 8,3 7,2	9,4 7,5 5,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			
<b>Diamond-drilling (dry or wet concrete as well as water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	9,8 9,8 7,2	9,0 9,0 7,2	7,5 7,5 6,5	6,8 6,8 5,9
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			
<b>fischer FRA</b>		<b>M12</b>	<b>M16</b>	<b>M20</b>	<b>M24</b>	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	12	16	20	25	
<b>Cracked concrete</b>						
<b>Characteristic bond resistance in cracked concrete C20/25</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$ [N/mm <sup>2</sup> ]	6,4 6,4 6,4	5,2 5,2 5,2	5,2 5,2 5,2	5,2 5,2 5,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$ [N/mm <sup>2</sup> ]	5,2 5,2 5,2	4,2 4,2 3,9	3,9 3,9 3,9	3,9 3,9 3,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,2		1,4	
<b>Diamond-drilling (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$ [N/mm <sup>2</sup> ]	5,6 5,6 5,6	3,9 3,9 3,9	3,9 3,9 3,9	4,6 4,6 4,6
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
<b>fischer injection system FIS EM Plus</b>					<b>Annex C16</b> Appendix 42 / 77	
<b>Performance</b> Characteristic resistance to combined pull-out and concrete failure for fischer FRA; working life 100 years						



<b>Table C17.1: Displacements for metric Anchor rods / Threaded rods</b>											
<b>Anchor rod / Threaded rod</b>		<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M14</b>	<b>M16</b>	<b>M20</b>	<b>M22</b>	<b>M24</b>	<b>M27</b>	<b>M30</b>
<b>Displacement-Factors for tension loading<sup>1)</sup></b>											
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>											
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	0,07	0,08	0,09	0,09	0,10	0,11	0,11	0,12	0,12	0,13
$\delta_{N\infty}$ -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,19
<b>Displacement-Factors for shear loading<sup>2)</sup></b>											
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>											
$\delta_{V0}$ -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V\infty}$ -Factor		0,27	0,22	0,18	0,16	0,14	0,11	0,10	0,09	0,08	0,07
1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading						2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading					

**Table C17.2: Displacements for metric fischer RG M I**

<b>fischer RG M I</b>		<b>M8</b>	<b>M10</b>	<b>M12</b>	<b>M16</b>	<b>M20</b>
<b>Displacement-Factors for tension loading<sup>1)</sup></b>						
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>						
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	0,09	0,10	0,10	0,11	0,13
$\delta_{N\infty}$ -Factor		0,13	0,15	0,16	0,17	0,19
<b>Displacement-Factors for shear loading<sup>2)</sup></b>						
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>						
$\delta_{V0}$ -Factor	[mm/kN]	0,12	0,09	0,08	0,07	0,05
$\delta_{V\infty}$ -Factor		0,18	0,14	0,12	0,10	0,08
1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading				2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading		

fischer injection system FIS EM Plus

**Performance**

Displacements for metric Anchor rods / Threaded rods and fischer RG M I

**Annex C17**

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**Table C18.1: Displacements for metric reinforcing bars**

Nominal diameter of the bar $\phi$	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40	
<b>Displacement-Factors for tension loading<sup>1)</sup></b>																		
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>																		
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	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
<b>Displacement-Factors for shear loading<sup>2)</sup></b>																		
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>																		
$\delta_{V0}$ -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
1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau$ $\tau =$ acting bond strength under tension loading									2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V$ $V =$ acting shear loading									

**Table C18.2: Displacements for metric fischer FRA**

fischer FRA	M12	M16	M20	M24
<b>Displacement-Factors for tension loading<sup>1)</sup></b>				
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>				
$\delta_{N0}$ -Factor	0,09		0,10	0,11
$\delta_{N\infty}$ -Factor	0,13		0,15	0,16
<b>Displacement-Factors for shear loading<sup>2)</sup></b>				
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>				
$\delta_{V0}$ -Factor	0,12		0,09	0,07
$\delta_{V\infty}$ -Factor	0,18		0,14	0,11
1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau$ $\tau =$ acting bond strength under tension loading			2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V$ $V =$ acting shear loading	

fischer injection system FIS EM Plus	<b>Annex C18</b> Appendix 44 / 77
<b>Performance</b> Displacements for reinforcing bars and fischer FRA	

**Table C19.1: Characteristic resistance to steel failure under tension loading for fractional Threaded rods part 1**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
<b>Characteristic resistance to steel failure under tension loading</b>										
Characteristic resistance $R_{k,s}$	Steel zinc plated	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9	148,9	195,4	246,0
		F1554, Grade 36		19,9	36,5	58,3	86,2	119,1	156,2	196,7
		F1554, Grade 55		25,8	47,3	75,3	111,5	154,0	202,0	254,4
		F1554, Grade 105		43,0	78,8	125,6	185,9	256,7	336,8	424,0
	Stainless steel R	A193, B7		43,0	78,8	125,6	185,9	256,7	336,8	424,0
		F593, Alloy Group 2		34,4	63,0	100,5	126,4	174,5	229,0	288,3
		A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5	154,0	202,0	254,4
		A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3	195,1	255,9	322,2

**Partial factors <sup>1)</sup>**

Partial factor $\gamma_{M_s,N}$	Steel zinc plated	F568M, Class 5.8	[-]	1,50	
		F1554, Grade 36		1,94	
		F1554, Grade 55		1,64	
		F1554, Grade 105		1,43	
	Stainless steel R	A193, B7		1,43	
		F593, Alloy Group 2		1,85	2,27
		A193, Grade B8M, Class 1		3,00	
		A193, Grade B8M, Class 2B		1,52	

<sup>1)</sup> In absence of other national regulations.

**Table C20.1: Characteristic resistance to steel failure under shear loading for fractional Threaded rods part 2**

Threaded rod		3/8	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
<b>Characteristic resistance to steel failure under shear loading</b>										
<b>without lever arm</b>										
Characteristic resistance $V_{Rk,s}^0$	Steel zinc plated	F568M, Class 5.8	[kN]	15,0	27,4	43,7	64,7	89,3	117,2	147,6
		F1554, Grade 36		11,9	21,9	34,9	51,7	71,4	93,7	118,0
		F1554, Grade 55		12,9	23,6	37,6	55,7	77,0	101,0	127,2
		F1554, Grade 105		21,5	39,4	62,8	92,9	128,3	168,4	212,0
	Stainless steel R	A193, B7		21,5	39,4	62,8	92,9	128,3	168,4	212,0
		F593, Alloy Group 2		17,2	31,5	50,2	63,2	87,2	114,5	144,1
		A193, Grade B8M, Class 1		12,9	23,6	37,6	55,7	77,0	101,0	127,2
		A193, Grade B8M, Class 2B		16,3	29,9	47,7	70,6	97,5	127,9	161,1
Ductility factor		$k_6$	[-]		1,0					
<b>with lever arm</b>										
Charact. resistance $M_{Rk,s}^0$	Steel zinc plated	F568M, Class 5.8	[Nm]	29,9	74,0	148,9	268,2	435,1	653,8	923,5
		F1554, Grade 36		23,9	59,2	119,1	214,5	348,0	522,9	738,6
		F1554, Grade 55		30,9	76,6	154,0	277,4	450,0	676,1	955,1
		F1554, Grade 105		51,5	127,6	256,8	462,4	750,0	1126,9	1591,9
	Stainless steel R	A193, B7		51,5	127,6	256,8	462,4	750,0	1126,9	1591,9
		F593, Alloy Group 2		41,2	102,1	205,4	314,4	510,0	766,3	1082,5
		A193, Grade B8M, Class 1		30,9	76,6	154,0	277,4	450,0	676,1	955,1
		A193, Grade B8M, Class 2B		39,1	97,0	195,1	351,4	570,0	856,4	1209,8
<b>Partial factors <sup>1)</sup></b>										
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	F568M, Class 5.8	[-]	1,25						
		F1554, Grade 36		1,61						
		F1554, Grade 55		1,36						
		F1554, Grade 105		1,50						
	Stainless steel R	A193, B7		1,50						
		F593, Alloy Group 2		1,54					1,89	
		A193, Grade B8M, Class 1		2,50						
		A193, Grade B8M, Class 2B		1,27						
<sup>1)</sup> In absence of other national regulations.										

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under tension / shear loading for fractional Anchor rods / Threaded rods part 2

**Annex C20**

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**Table C21.1: Characteristic resistance to steel failure under tension loading for fractional fischer RG M I part 1**

fischer RG M I		RG M I	Screw		3/8"	1/2"	5/8"	3/4"
<b>Characteristic resistance to steel failure under tension loading</b>								
Characteristic resistance with screw $N_{Rk,s}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9
			F1554, Grade 36		20,0	36,6	58,3	86,3
			F1554, Grade 55		25,8	47,3	75,3	111,5
			F1554, Grade 105		43,1	76,4	110,8	186,0
			A193, B7		43,1	76,4	110,8	186,0
	Property class, Stainless steel R	70	F593, Alloy Group 2		34,4	63,0	100,4	126,4
			A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5
			A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3
	<b>Partial factors<sup>1)</sup></b>							
Partial factors $\gamma_{Ms,N}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[-]	1,50			
			F1554, Grade 36		1,94			
			F1554, Grade 55		1,64			
			F1554, Grade 105		1,43	1,50		
			A193, B7		1,43	1,50		
	Property class, Stainless steel R	70	F593, Alloy Group 2		1,85		2,27	
			A193, Grade B8M, Class 1		3,00			
			A193, Grade B8M, Class 2B		1,52			

<sup>1)</sup> In absence of other national regulations.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under tension loading for fractional fischer RG M I part 1

**Annex C21**

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**Table C22.1: Characteristic resistance to steel failure under shear loading for fractional fischer RG M I part 2**

fischer RG M I		RG M I	Screw		3/8"	1/2"	5/8"	3/4"		
<b>Characteristic resistance to steel failure under shear loading</b>										
<b>Without lever arm</b>										
Characteristic resistance with screw $V^0_{Rk,s}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[kN]	15,0	27,4	43,7	64,7		
			F1554, Grade 36		11,9	21,9	34,9	51,7		
			F1554, Grade 55		12,9	23,6	37,6	55,7		
			F1554, Grade 105		21,5	39,4	62,8	92,9		
			A193, B7		21,5	39,4	62,8	92,9		
	Property class, Stainless steel R	70	F593, Alloy Group 2		17,2	31,5	50,2	63,2		
			A193, Grade B8M, Class 1		12,9	23,6	37,6	55,7		
			A193, Grade B8M, Class 2B		16,3	29,9	47,7	70,6		
	<b>With lever arm</b>									
	Characteristic resistance with screw $M^0_{Rk,s}$	Property class, Steel zinc plated	5.8		F568M, Class 5.8	[Nm]	29,9	74,0	148,9	268,2
F1554, Grade 36				23,9	59,2		119,1	214,5		
F1554, Grade 55				30,9	76,6		154,0	277,4		
F1554, Grade 105				51,5	127,6		256,8	462,4		
A193, B7				51,5	127,6		256,8	462,4		
Property class, Stainless steel R		70	F593, Alloy Group 2	41,2	102,1		205,4	314,4		
			A193, Grade B8M, Class 1	30,9	76,6		154,0	277,4		
			A193, Grade B8M, Class 2B	39,1	97,0		195,1	351,4		
<b>Partial factors <sup>1)</sup></b>										
Partial factors $\gamma_{Ms,V}$	Property class, Steel zinc plated	5.8	F568M, Class 5.8	[-]	1,25					
			F1554, Grade 36		1,61					
			F1554, Grade 55		1,36					
			F1554, Grade 105		1,50					
			A193, B7		1,50					
	Property class, Stainless steel R	70	F593, Alloy Group 2		1,54		1,89			
			A193, Grade B8M, Class 1		2,50					
			A193, Grade B8M, Class 2B		1,27					

<sup>1)</sup> In absence of other national regulations.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to steel failure under shear loading for fractional fischer RG M I part 2

**Annex C22**

**Table C23.1: Characteristic resistance to steel failure under tension / shear loading for fractional reinforcing bars**

Rebar size	#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>
<b>Characteristic resistance to steel failure under tension loading</b>								
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{3)}$					
<b>Characteristic resistance to steel failure under shear loading</b>								
<b>Without lever arm</b>								
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$k_6^{2)}) \cdot A_s \cdot f_{uk}^{3)}$					
Ductility factor	$k_7$	[-]	1,0					
<b>With lever arm</b>								
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{3)}$					

- 1) Not allowed for hollow drill bit.
- 2) In accordance with EN 1992-4:2018 section 7.2.2.3.1:  
 $k_6 = 0,6$  for fasteners made of carbon steel with  $f_{uk} \leq 500 \text{ N/mm}^2$ ,  
 $= 0,5$  for fasteners made of carbon steel with  $500 \text{ N/mm}^2 < f_{uk} \leq 1000 \text{ N/mm}^2$ ,  
 $= 0,5$  for fasteners made of stainless steel.
- 3)  $f_{uk}$  respectively shall be taken from the specifications of the reinforcing bar.

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**Performance**

Characteristic resistance to steel failure under tension / shear loading for reinforcing bars

**Annex C23**

<b>Table C24.1: Characteristic resistance for concrete failure under tension / shear loading for fractional sizes</b>											
<b>Size</b>			<b>All sizes</b>								
<b>Characteristic resistance to concrete failure under tension loading</b>											
Installation factor		$\gamma_{inst}$	[-]		See Annex C25 to C34, C46 and C47						
<b>Factors for the compressive strength of concrete &gt; C20/25</b>											
Increasing factor $\psi_c$ for cracked or uncracked concrete $\tau_{Rk(X,Y)} = \psi_c \cdot \tau_{Rk(C20/25)}$		$\psi_c$	[-]	C25/30	1,02						
				C30/37	1,04						
				C35/45	1,06						
				C40/50	1,07						
				C45/55	1,08						
				C50/60	1,09						
<b>Splitting failure</b>											
Edge distance		$C_{cr,sp}$	[mm]	$h / h_{ef} \geq 2,0$	1,0 $h_{ef}$						
				$2,0 > h / h_{ef} > 1,3$	4,6 $h_{ef}$ - 1,8 h						
				$h / h_{ef} \leq 1,3$	2,26 $h_{ef}$						
Spacing		$S_{cr,sp}$		2 $C_{cr,sp}$							
<b>Concrete cone failure</b>											
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 $C_{cr,N}$							
<b>Factors for sustained tension loading</b>											
Temperature range				24 °C / 40 °C	35 °C / 60 °C	50 °C / 72 °C					
Factor		$\psi_{SUS}^0$		0,77	0,60	0,48					
Factor		$\psi_{SUS,100}^0$		0,77	0,60	0,71					
<b>Characteristic resistance to concrete failure under shear loading</b>											
Installation factor		$\gamma_{inst}$	[-]		1,0						
<b>Concrete pry-out failure</b>											
Factor for pry-out failure		$k_8$	[-]		2,0						
<b>Concrete edge failure</b>											
Effective length of fastener in shear loading		$l_f$	[mm]	for $d_{nom} \leq 24$ mm: min ( $h_{ef}$ , 12 $d_{nom}$ ) for $d_{nom} > 24$ mm: min ( $h_{ef}$ , max (8 $d_{nom}$ ; 300 mm))							
<b>Calculation diameters</b>											
Size				3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
Anchor rods and Threaded rods		$d_{nom}$	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
fischer RG M I		$d_{nom}$		15,7	18,0	22,0	28,0	- <sup>1)</sup>	- <sup>1)</sup>	- <sup>1)</sup>	
Rebar size				#3	#4	#5	#6	#7	#8	#9	#10
Reinforcing bar		$d_{nom}$	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3
<sup>1)</sup> Anchor type not part of the assessment.											
fischer injection system FIS EM Plus								<b>Annex C24</b> Appendix 50 / 77			
<b>Performance</b> Characteristic resistance for concrete failure under tension / shear loading for fractional sizes											



**Table C25.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; uncracked concrete; working life 50 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"		
<b>Combined pull-out and concrete cone failure</b>										
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
<b>Uncracked concrete</b>										
<b>Characteristic bond resistance in uncracked concrete C20/25</b>										
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	20,0	18,6	17,7	16,8	16,2	15,8	15,3
	II: 35 °C / 60 °C			18,0	18,0	17,0	16,0	15,0	15,0	14,0
	III: 50 °C / 72 °C			17,0	17,0	16,0	15,0	14,0	14,0	13,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	20,0	18,6	17,0	15,4	14,3	13,7	12,8
	II: 35 °C / 60 °C			16,0	15,0	13,0	11,0	11,0	10,0	9,0
	III: 50 °C / 72 °C			14,0	14,0	12,0	11,0	10,0	9,0	9,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							
Water filled hole			1,4							
<b>Diamond-drilling (dry or wet concrete)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	14,4	13,3	12,3	11,8	11,3	10,8	10,3
	II: 35 °C / 60 °C			15,0	13,0	12,0	10,0	10,0	9,0	9,0
	III: 50 °C / 72 °C			14,0	12,0	11,0	10,0	9,0	8,0	8,0
<b>Diamond-drilling (water filled hole)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	17,3	15,0	13,6	12,4	11,5	10,8	10,1
	II: 35 °C / 60 °C			15,0	13,0	12,0	10,0	10,0	9,0	9,0
	III: 50 °C / 72 °C			14,0	12,0	11,0	10,0	9,0	8,0	8,0
<b>Installation factors; Diamond-drilling</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							
Water filled hole			1,4							

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods; working life 50 years

**Annex C25**

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**Table C26.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; cracked concrete; working life 50 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"			
<b>Combined pull-out and concrete cone failure</b>											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6		
<b>Cracked concrete</b>											
<b>Characteristic bond resistance in cracked concrete C20/25</b>											
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	8,7	9,9	9,5	8,5	8,5	8,5	
	II: 35 °C / 60 °C				8,7	9,9	9,5	8,5	8,5	8,5	8,5
	III: 50 °C / 72 °C				8,2	9,3	8,9	8,5	8,5	8,5	8,5
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,5	8,5	7,8	6,0	6,0	6,0	
	II: 35 °C / 60 °C				7,5	8,5	7,8	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				7,0	8,0	7,3	6,0	6,0	6,0	6,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2		1,4					
<b>Diamond-drilling (dry or wet concrete)</b>											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	6,0	6,0	7,0	7,0	
	II: 35 °C / 60 °C				7,0	7,0	6,0	6,0	7,0	7,0	7,0
	III: 50 °C / 72 °C				7,0	7,0	6,0	6,0	7,0	7,0	7,0
<b>Diamond-drilling (water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	7,5	7,5	6,0	6,0	6,0	6,0	
	II: 35 °C / 60 °C				7,5	7,5	6,0	6,0	6,0	6,0	6,0
	III: 50 °C / 72 °C				7,0	7,0	6,0	6,0	6,0	6,0	6,0
<b>Installation factors; Diamond-drilling</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2		1,4					

fischer injection system FIS EM Plus

**Performance**  
 Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods; working life 50 years

**Annex C26**  
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**Table C27.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; uncracked concrete; working life 100 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
<b>Combined pull-out and concrete cone failure</b>									
Calculation diameter	d [mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
<b>Uncracked concrete</b>									
<b>Characteristic bond resistance in uncracked concrete C20/25</b>									
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	16,4	15,3	14,5	13,8	13,3	12,9	12,6
	II: 35 °C / 60 °C		13,5	13,5	12,8	12,0	11,3	11,3	10,5
	III: 50 °C / 72 °C		10,2	10,2	10,4	9,8	9,1	9,1	8,5
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	16,4	15,3	13,9	12,6	11,7	11,2	10,5
	II: 35 °C / 60 °C		12,0	11,3	9,8	8,3	8,3	7,5	6,8
	III: 50 °C / 72 °C		8,4	8,4	7,8	7,2	6,5	5,9	5,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>									
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0						
Water filled hole			1,4						
<b>Diamond-drilling (dry or wet concrete)</b>									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	11,8	10,8	10,1	9,7	9,3	8,8	8,5
	II: 35 °C / 60 °C		11,3	9,8	9,0	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C		8,4	7,2	7,2	6,5	5,9	5,2	5,2
<b>Diamond-drilling (water filled hole)</b>									
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	14,2	12,3	11,2	10,2	9,4	8,9	8,3
	II: 35 °C / 60 °C		11,3	9,8	9,0	7,5	7,5	6,8	6,8
	III: 50 °C / 72 °C		8,4	7,2	7,2	6,5	5,9	5,2	5,2
<b>Installation factors; Diamond-drilling</b>									
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0						
Water filled hole			1,4						

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; working life 100 years

**Annex C27**

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**Table C28.1: Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; cracked concrete; working life 100 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"			
<b>Combined pull-out and concrete cone failure</b>											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6		
<b>Cracked concrete</b>											
<b>Characteristic bond resistance in cracked concrete C20/25</b>											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	7,0	7,5	7,2	6,9	6,8	6,5	6,3
	II: 35 °C / 60 °C				7,0	7,5	7,2	6,9	6,8	6,5	6,3
	III: 50 °C / 72 °C				6,6	7,1	6,8	6,4	6,4	6,1	6,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	6,0	6,5	5,9	4,9	4,8	4,6	4,4
	II: 35 °C / 60 °C				6,0	6,5	5,9	4,9	4,8	4,6	4,4
	III: 50 °C / 72 °C				5,6	6,1	5,5	4,5	4,5	4,3	4,3
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2	1,4						
Diamond-drilling (dry or wet concrete)											
Tem- perature range	I: 24 °C / 40 °C		$\tau_{RK,100,cr}$	[N/mm <sup>2</sup> ]	6,0	5,6	3,9	3,9	4,6	4,6	4,6
	II: 35 °C / 60 °C				6,0	5,6	3,9	3,9	4,6	4,6	4,6
	III: 50 °C / 72 °C				6,0	5,6	3,9	3,9	4,6	4,6	4,6
<b>Installation factors; Diamond-drilling</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							

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**Performance**

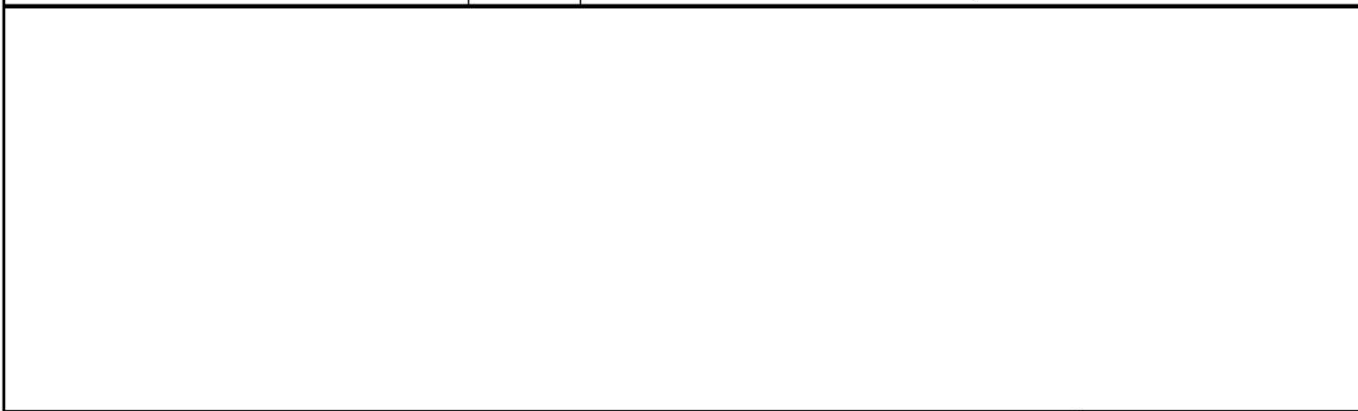
Characteristic resistance to combined pull-out and concrete failure for fractional Threaded rods in hammer or diamond drilled holes; working life 100 years

**Annex C28**

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**Table C29.1: Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I in hammer or diamond drilled holes; uncracked concrete; working life 50 years**

fischer RG M I		3/8"	1/2"	5/8"	3/4"	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	15,7	18,0	22,0	28,0	
<b>Uncracked concrete</b>						
<b>Characteristic bond resistance in uncracked concrete C20/25</b>						
<u>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	17,6	17,0	16,2	15,3
	II: 35 °C / 60 °C		14,0	14,0	13,0	12,0
	III: 50 °C / 72 °C		13,0	13,0	12,0	11,0
<u>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	16,9	15,8	14,3	12,8
	II: 35 °C / 60 °C		12,0	12,0	11,0	10,0
	III: 50 °C / 72 °C		12,0	11,0	10,0	9,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			
<u>Diamond-drilling (dry or wet concrete)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	12,3	11,9	11,2	10,4
	II: 35 °C / 60 °C		12,0	11,0	10,0	9,0
	III: 50 °C / 72 °C		11,0	10,0	9,0	8,0
<u>Diamond-drilling (water filled hole)</u>						
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$ [N/mm <sup>2</sup> ]	13,6	12,6	11,4	10,2
	II: 35 °C / 60 °C		12,0	11,0	10,0	9,0
	III: 50 °C / 72 °C		11,0	10,0	9,0	8,0
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			



**Table C30.1: Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I in hammer or diamond drilled holes; cracked concrete; working life 50 years**

<b>fischer RG M I</b>		<b>3/8"</b>	<b>1/2"</b>	<b>5/8"</b>	<b>3/4"</b>		
<b>Combined pull-out and concrete cone failure</b>							
Calculation diameter	d	[mm]	<b>15,7</b>	<b>18,0</b>	<b>22,0</b>		
<b>Cracked concrete</b>							
<b>Characteristic bond resistance in cracked concrete C20/25</b>							
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	6,0	7,0	7,0
	II: 35 °C / 60 °C			6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C			6,0	6,0	7,0	7,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,5	6,0	6,0	6,0
	II: 35 °C / 60 °C			6,5	6,0	6,0	6,0
	III: 50 °C / 72 °C			6,0	6,0	6,0	6,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,2	1,4			
<b>Diamond-drilling (dry or wet concrete)</b>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,0	6,0	7,0	7,0
	II: 35 °C / 60 °C			6,0	6,0	7,0	7,0
	III: 50 °C / 72 °C			6,0	6,0	7,0	7,0
<b>Diamond-drilling (water filled hole)</b>							
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	6,5	6,0	6,0	6,0
	II: 35 °C / 60 °C			6,5	6,0	6,0	6,0
	III: 50 °C / 72 °C			6,0	6,0	6,0	6,0
<b>Installation factors; Diamond-drilling</b>							
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0				
Water filled hole			1,2	1,4			

<b>Table C31.1: Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I in hammer or diamond drilled holes; uncracked or cracked concrete; working life 100 years</b>						
<b>fischer RG M I</b>		<b>3/8"</b>	<b>1/2"</b>	<b>5/8"</b>	<b>3/4"</b>	
<b>Combined pull-out and concrete cone failure</b>						
Calculation diameter	d [mm]	<b>15,7</b>	<b>18,0</b>	<b>22,0</b>	<b>28,0</b>	
<b>Uncracked concrete</b>						
<b>Characteristic bond resistance in uncracked concrete C20/25</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	14,4	14,0	13,3	12,6
	II: 35 °C / 60 °C		10,5	10,5	9,8	9,0
	III: 50 °C / 72 °C		7,8	7,8	7,8	7,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	13,9	13,0	11,7	10,5
	II: 35 °C / 60 °C		9,0	9,0	8,3	7,5
	III: 50 °C / 72 °C		7,2	6,6	6,5	5,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			
<b>Diamond-drilling (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	10,1	9,8	9,2	8,6
	II: 35 °C / 60 °C		9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,0	5,9	5,2
<b>Diamond-drilling (water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,ucr}$ [N/mm <sup>2</sup> ]	11,2	10,3	9,3	8,4
	II: 35 °C / 60 °C		9,0	8,3	7,5	6,8
	III: 50 °C / 72 °C		6,6	6,0	5,9	5,2
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,4			
<b>Cracked concrete</b>						
<b>Characteristic bond resistance in cracked concrete C20/25</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm <sup>2</sup> ]	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		5,1	4,8	4,6	4,6
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,100,cr}$ [N/mm <sup>2</sup> ]	5,5	4,8	3,9	3,9
	II: 35 °C / 60 °C		5,5	4,8	3,9	3,9
	III: 50 °C / 72 °C		5,1	4,8	3,9	3,9
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,2	1,4		
<b>Diamond-drilling (dry or wet concrete)</b>						
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,cr}$ [N/mm <sup>2</sup> ]	5,1	4,8	4,6	4,6
	II: 35 °C / 60 °C		5,1	4,8	4,6	4,6
	III: 50 °C / 72 °C		5,1	4,8	4,6	4,6
<b>Installation factors; Diamond-drilling</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
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<b>Performance</b> Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I; working life 100 years						

<b>Table C32.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; uncracked concrete; working life 50 years</b>											
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>		
<b>Combined pull-out and concrete cone failure</b>											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
<b>Uncracked concrete</b>											
<b>Characteristic bond resistance in uncracked concrete C20/25</b>											
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	17,0	15,9	15,1	14,4	13,9	13,4	13,1	12,7
	II: 35 °C / 60 °C			15,0	15,0	14,0	13,0	13,0	12,0	12,0	12,0
	III 50 °C / 72 °C			14,0	14,0	13,0	12,0	12,0	11,0	11,0	11,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	17,0	15,9	14,5	13,2	12,3	11,6	10,5	10,2
	II: 35 °C / 60 °C			16,0	14,0	12,0	11,0	11,0	10,0	10,0	9,0
	III 50 °C / 72 °C			14,0	13,0	12,0	11,0	10,0	9,0	9,0	8,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,4							
<b>Diamond-drilling (dry or wet concrete as well as water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	15,0	13,0	12,0	10,0	10,0	9,0	9,0	8,0
	II: 35 °C / 60 °C			15,0	13,0	12,0	10,0	10,0	9,0	9,0	8,0
	III 50 °C / 72 °C			14,0	12,0	11,0	10,0	9,0	9,0	8,0	8,0
<b>Installation factors; Diamond-drilling</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,4							
<sup>1)</sup> Not allowed for drilling with hollow drill bit.											

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**Performance**

Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; working life 50 years

**Annex C32**

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**Table C33.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; cracked concrete; working life 50 years**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>		
<b>Combined pull-out and concrete cone failure</b>											
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
<b>Cracked concrete</b>											
<b>Characteristic bond resistance in cracked concrete C20/25</b>											
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,cr}$	[N/mm <sup>2</sup> ]	7,0	8,0	8,0	8,0	8,0	8,0	8,0	
	II: 35 °C / 60 °C			7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
	III 50 °C / 72 °C			7,0	8,0	8,0	8,0	8,0	8,0	8,0	8,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,cr}$	[N/mm <sup>2</sup> ]	7,5	6,5	6,5	6,0	6,0	6,0	5,0	
	II: 35 °C / 60 °C			7,5	6,5	6,5	6,0	6,0	6,0	6,0	5,0
	III 50 °C / 72 °C			6,5	6,5	6,0	6,0	6,0	6,0	6,0	5,0
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2	1,4						
<b>Diamond-drilling (dry or wet concrete)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,cr}$	[N/mm <sup>2</sup> ]	7,0	7,0	6,0	6,0	7,0	7,0	5,0	
	II: 35 °C / 60 °C			7,0	7,0	6,0	6,0	7,0	7,0	7,0	5,0
	III 50 °C / 72 °C			7,0	7,0	6,0	6,0	7,0	7,0	7,0	5,0
<b>Diamond-drilling (water filled hole)</b>											
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,cr}$	[N/mm <sup>2</sup> ]	7,5	6,5	6,5	6,0	6,0	6,0	5,0	
	II: 35 °C / 60 °C			7,5	6,5	6,5	6,0	6,0	6,0	6,0	5,0
	III 50 °C / 72 °C			6,5	6,5	6,0	6,0	6,0	6,0	6,0	5,0
<b>Installation factors; Diamond-drilling</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2	1,4						

<sup>1)</sup> Not allowed for drilling with hollow drill bit.

fischer injection system FIS EM Plus

**Performance**

Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; working life 50 years

**Annex C33**

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**Table C34.1: Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars in hammer or diamond drilled holes; uncracked and cracked concrete; working life 100 years**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>	
<b>Combined pull-out and concrete cone failure</b>										
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3
<b>Uncracked concrete</b>										
<b>Characteristic bond resistance in uncracked concrete C20/25</b>										
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	14,0	13,0	12,4	11,9	11,4	11,0	10,8	10,5
	II: 35 °C / 60 °C		11,3	11,3	10,5	9,8	9,8	9,0	9,0	9,0
	III 50 °C / 72 °C		8,4	8,4	8,5	7,8	7,8	7,2	7,2	7,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	13,9	13,0	11,9	11,0	10,1	9,5	8,6	8,5
	II: 35 °C / 60 °C		12,0	10,5	9,0	8,3	8,3	7,5	7,5	6,8
	III 50 °C / 72 °C		8,4	7,8	7,8	7,2	6,5	5,9	5,9	5,2
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							
Water filled hole			1,4							
<b>Diamond-drilling (dry or wet concrete as well as water filled hole)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm <sup>2</sup> ]	11,3	9,8	9,0	7,5	7,5	6,8	6,8	6,0
	II: 35 °C / 60 °C		11,3	9,8	9,0	7,5	7,5	6,8	6,8	6,0
	III 50 °C / 72 °C		8,4	7,2	7,2	6,5	5,9	5,9	5,2	5,2
<b>Installation factors</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							
Water filled hole			1,4							
<b>Cracked concrete</b>										
<b>Characteristic bond resistance in cracked concrete C20/25</b>										
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm <sup>2</sup> ]	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
	II: 35 °C / 60 °C		6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
	III 50 °C / 72 °C		6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm <sup>2</sup> ]	6,4	5,2	4,2	3,9	3,9	3,9	3,9	3,3
	II: 35 °C / 60 °C		6,4	5,2	4,2	3,9	3,9	3,9	3,9	3,3
	III 50 °C / 72 °C		5,5	5,2	3,9	3,9	3,9	3,9	3,9	3,3
<b>Installation factors; Hammer-drilling with standard drill bit or hollow drill bit</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							
Water filled hole			1,2						1,4	
<b>Diamond-drilling (dry or wet concrete)</b>										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm <sup>2</sup> ]	6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
	II: 35 °C / 60 °C		6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
	III 50 °C / 72 °C		6,0	5,6	3,9	3,9	4,6	4,6	4,6	3,3
<b>Installation factors</b>										
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0							

<sup>1)</sup> Not allowed for drilling with hollow drill bit.

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**Performance**

Characteristic resistance to combined pull-out and concrete failure for fractional reinforcing bars; uncracked and cracked concrete; working life 100 years

**Annex C34**

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**Table C35.1: Displacements for fraction Threaded rods**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
<b>Displacement-Factors for tension loading<sup>1)</sup></b>								
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>								
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	0,08	0,09	0,10	0,11	0,11	0,12	0,13
$\delta_{N\infty}$ -Factor		0,12	0,13	0,15	0,16	0,17	0,19	0,19
<b>Displacement-Factors for shear loading<sup>2)</sup></b>								
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>								
$\delta_{V0}$ -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,05	0,05
$\delta_{V\infty}$ -Factor		0,22	0,18	0,14	0,11	0,10	0,08	0,07
<sup>1)</sup> Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading				<sup>2)</sup> Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading				

**Table C35.2: Displacements for fractional fischer RG M I**

fischer RG M I		3/8"	1/2"	5/8"	3/4"
<b>Displacement-Factors for tension loading<sup>1)</sup></b>					
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>					
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	0,10	0,10	0,11	0,13
$\delta_{N\infty}$ -Factor		0,15	0,16	0,17	0,19
<b>Displacement-Factors for shear loading<sup>2)</sup></b>					
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>					
$\delta_{V0}$ -Factor	[mm/kN]	0,09	0,08	0,07	0,05
$\delta_{V\infty}$ -Factor		0,14	0,12	0,10	0,08
<sup>1)</sup> Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ $\tau =$ acting bond strength under tension loading			<sup>2)</sup> Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ $V =$ acting shear loading		

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<b>Performance</b> Displacements for fractional Threaded rods and fractional fischer RG M I	

**Table C36.1: Displacements for fractional reinforcing bars**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10
<b>Displacement-Factors for tension loading<sup>1)</sup></b>									
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>									
$\delta_{N0}$ -Factor	[mm/(N/mm <sup>2</sup> )]	0,08	0,09	0,10	0,11	0,11	0,12	0,13	0,13
$\delta_{N\infty}$ -Factor		0,12	0,13	0,15	0,16	0,17	0,18	0,19	0,20
<b>Displacement-Factors for shear loading<sup>2)</sup></b>									
<b>Uncracked or cracked concrete; Temperature range I, II, III</b>									
$\delta_{V0}$ -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,06	0,05	0,05
$\delta_{V\infty}$ -Factor		0,22	0,18	0,14	0,11	0,10	0,09	0,08	0,07

1) Calculation of effective displacement:

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

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

$\tau$  = acting bond strength under tension loading

2) Calculation of effective displacement:

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

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

$V$  = acting shear loading

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**Performance**

Displacements for fractional reinforcing bars

**Annex C36**

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**Table C37.1: Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods and Threaded rods under seismic action performance category C1**

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30		
<b>Characteristic resistance to steel failure under tension loading <sup>1)</sup></b>												
<b>Anchor rods and Threaded rods, performance category C1<sup>2)</sup></b>												
Characteristic resistance $N_{Rk,s,C1}$	Steel zinc plated	Property class 4.8	[kN]	23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
		5.8		29,0(26,8)	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
		8.8		46,4(42,8)	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
	Stainless steel R and high corrosion resistant steel HCR	50		29,0	42,1	57,5	78,5	122,5	151,5	176,5	229,5	280,5
		70		40,6	59,0	80,5	109,9	171,5	212,1	247,1	321,3	392,7
		80		46,4	67,4	92,0	125,6	196,0	242,4	282,4	367,2	448,8
<b>Characteristic resistance to steel failure under shear loading without lever arm <sup>1)</sup></b>												
<b>Anchor rods, performance category C1<sup>2)</sup></b>												
Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class 4.8	[kN]	13,9(12,8)	20,2	27,6	37,6	58,8	72,7	84,7	110,1	134,6
		5.8		17,4(16,0)	25,2	34,5	47,1	73,5	90,9	105,9	137,7	168,3
		8.8		23,2(21,4)	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
	Stainless steel R and high corrosion resistant steel HCR	50		14,5	21,0	28,7	39,2	61,2	75,7	88,2	114,7	140,2
		70		20,3	29,5	40,2	54,9	85,7	106,0	123,5	160,6	196,3
		80		23,2	33,7	46,0	62,8	98,0	121,2	141,2	183,6	224,4
<b>Threaded rods, performance category C1<sup>2)</sup></b>												
Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class 4.8	[kN]	9,7(9,0)	14,1	19,3	26,3	41,1	50,9	59,3	77,1	97,2
		5.8		12,1(11,2)	17,7	24,1	32,9	51,4	63,6	74,1	96,3	117,8
		8.8		16,2(15,0)	23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0
	Stainless steel R and high corrosion resistant steel HCR	50		10,1	14,7	20,1	27,4	42,8	53,0	61,7	80,3	98,1
		70		14,2	20,6	28,1	38,4	60,0	74,2	86,4	112,4	137,4
		80		16,2	23,6	32,2	43,9	68,6	84,8	98,8	128,5	157,0

<sup>1)</sup> Partial factors for performance category C1 or C2 see table C39.1; for Anchor rods the factor for steel ductility is 1,0.

<sup>2)</sup> Values in brackets are valid for undersized Threaded rods with smaller stress area  $A_s$  for hot dip galvanised Threaded rods according to EN ISO 10684:2004+AC:2009.

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**Performance**

Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods / Threaded rods under seismic action performance category C1

**Annex C37**

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**Table C38.1: Characteristic resistance to steel failure under tension / shear loading for metric Anchor rods and Threaded rods under seismic action performance category C2**

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30			
<b>Characteristic resistance to steel failure under tension loading <sup>1)</sup></b>													
<b>Anchor rods and Threaded rods, performance category C2</b>													
Characteristic resistance $N_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	[kN]	- <sup>2)</sup>	30,3	- <sup>2)</sup>	56,5	88,2	- <sup>2)</sup>	141,2	- <sup>2)</sup>	- <sup>2)</sup>
			5.8		- <sup>2)</sup>	37,9	- <sup>2)</sup>	70,6	110,2	- <sup>2)</sup>	176,5	- <sup>2)</sup>	- <sup>2)</sup>
			8.8		- <sup>2)</sup>	60,6	- <sup>2)</sup>	113,0	176,4	- <sup>2)</sup>	282,4	- <sup>2)</sup>	- <sup>2)</sup>
	Stainless steel R and high corrosion resistant steel HCR		50		- <sup>2)</sup>	37,9	- <sup>2)</sup>	70,6	110,2	- <sup>2)</sup>	176,5	- <sup>2)</sup>	- <sup>2)</sup>
			70		- <sup>2)</sup>	53,1	- <sup>2)</sup>	98,9	154,3	- <sup>2)</sup>	247,1	- <sup>2)</sup>	- <sup>2)</sup>
			80		- <sup>2)</sup>	60,6	- <sup>2)</sup>	113,0	176,4	- <sup>2)</sup>	282,4	- <sup>2)</sup>	- <sup>2)</sup>
<b>Characteristic resistance to steel failure under shear loading without lever arm <sup>1)</sup></b>													
<b>Anchor rods, performance category C2</b>													
Characteristic resistance $V_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	[kN]	- <sup>2)</sup>	13,3	- <sup>2)</sup>	28,2	45,2	- <sup>2)</sup>	77,0	- <sup>2)</sup>	- <sup>2)</sup>
			5.8		- <sup>2)</sup>	16,6	- <sup>2)</sup>	35,3	56,5	- <sup>2)</sup>	96,3	- <sup>2)</sup>	- <sup>2)</sup>
			8.8		- <sup>2)</sup>	22,2	- <sup>2)</sup>	47,1	75,4	- <sup>2)</sup>	128,4	- <sup>2)</sup>	- <sup>2)</sup>
	Stainless steel R and high corrosion resistant steel HCR		50		- <sup>2)</sup>	13,9	- <sup>2)</sup>	29,4	47,1	- <sup>2)</sup>	80,3	- <sup>2)</sup>	- <sup>2)</sup>
			70		- <sup>2)</sup>	19,4	- <sup>2)</sup>	41,2	66,0	- <sup>2)</sup>	112,4	- <sup>2)</sup>	- <sup>2)</sup>
			80		- <sup>2)</sup>	22,2	- <sup>2)</sup>	47,1	75,4	- <sup>2)</sup>	128,4	- <sup>2)</sup>	- <sup>2)</sup>
<b>Threaded rods, performance category C2</b>													
Characteristic resistance $V_{Rk,s,C2}$	Steel zinc plated	Property class	4.8	[kN]	- <sup>2)</sup>	14,1	- <sup>2)</sup>	26,3	41,1	- <sup>2)</sup>	59,3	- <sup>2)</sup>	- <sup>2)</sup>
			5.8		- <sup>2)</sup>	17,7	- <sup>2)</sup>	32,9	51,4	- <sup>2)</sup>	74,1	- <sup>2)</sup>	- <sup>2)</sup>
			8.8		- <sup>2)</sup>	23,6	- <sup>2)</sup>	43,9	68,6	- <sup>2)</sup>	98,8	- <sup>2)</sup>	- <sup>2)</sup>
	Stainless steel R and high corrosion resistant steel HCR		50		- <sup>2)</sup>	14,7	- <sup>2)</sup>	27,4	42,8	- <sup>2)</sup>	61,7	- <sup>2)</sup>	- <sup>2)</sup>
			70		- <sup>2)</sup>	20,6	- <sup>2)</sup>	38,4	60,0	- <sup>2)</sup>	86,4	- <sup>2)</sup>	- <sup>2)</sup>
			80		- <sup>2)</sup>	23,6	- <sup>2)</sup>	43,9	68,6	- <sup>2)</sup>	98,8	- <sup>2)</sup>	- <sup>2)</sup>

<sup>1)</sup> Partial factors for performance category C2 see table C39.1; for Anchor rods the factor for steel ductility is 1,0.

<sup>2)</sup> No performance assessed.

**Table C38.2: Characteristic resistance to steel failure under tension / shear loading for metric reinforcing bars (B500B) under seismic action performance category C1**

Nominal diameter of the bar	$\phi$	10	12	14	16	18	20	22	24	25	26	28	30	32
<b>Characteristic resistance to steel failure under tension loading <sup>1)</sup></b>														
<b>Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1</b>														
Characteristic resistance	$N_{Rk,s,C1}$ [kN]	42,3	61,0	83,1	108,5	137,1	169,5	205,2	244,0	265,1	286,2	332,6	381,2	434,1
<b>Characteristic resistance to steel failure under shear loading, without lever arm <sup>1)</sup></b>														
<b>Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1</b>														
Characteristic resistance	$V_{Rk,s,C1}$ [kN]	14,8	21,3	29,1	37,9	48,0	59,3	71,8	85,4	92,7	100,1	116,4	133,4	151,9

<sup>1)</sup> Partial factors for performance category C1 see table C39.1.

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**Performance**

Characteristic resistance to steel failure for metric Anchor rods / Threaded rods and reinforcing bars under seismic action performance category C2 and C1 respectively

**Annex C38**

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**Table C39.1: Partial factors for metric Anchor rods, Threaded rods and reinforcing bars (B500B) under seismic action performance category C1 or C2**

<b>Anchor rod / Threaded rod</b>		<b>M10 to M30</b>
<b>Nominal diameter of the bar</b>	<b>φ</b>	<b>10 to 32</b>

**Tension loading, steel failure<sup>3)</sup>**

Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	5.8	[-]	1,50
			8.8		1,50
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	[-]	2,86
			70		1,87 / Anchor rod HCR: 1,50
			80		1,60
	Reinforcing bar		B500B		1,40

**Shear loading, steel failure<sup>3)</sup>**

Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	5.8	[-]	1,25
			8.8		1,25
	Stainless steel R and high corrosion resistant steel HCR	Property class	50	[-]	2,38
			70		1,56 / Anchor rod HCR: 1,25 <sup>2)</sup>
			80		1,33
	Reinforcing bar		B500B		1,50

- 1) Anchor type not part of the assessment.
- 2) Only admissible for high corrosion resistant steel HCR, with  $f_{yk} / f_{uk} \geq 0,8$  and  $A_5 > 12 \%$  (e.g. Anchor rods).
- 3) In absence of other national regulations.

**Table C40.1: Characteristic resistance for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C1; working life 50 years**

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>											
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	7,0	7,0	6,7	6,0	5,7	6,7	6,7	6,7	
	II: 35 °C / 60 °C		7,0	7,0	6,7	6,0	5,7	6,7	6,7	6,7	6,7
	III: 50 °C / 72 °C		7,0	7,0	6,7	5,7	5,7	6,7	6,7	6,7	6,7
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	7,5	7,5	6,5	5,7	5,7	5,7	5,7	5,7	
	II: 35 °C / 60 °C		7,5	7,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7
	III: 50 °C / 72 °C		6,8	6,8	6,5	5,7	5,7	5,7	5,7	5,7	5,7
<b>Installation factors</b>											
<b>Tension loading</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2			1,4				

**Table C40.2: Characteristic resistance for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C1; working life 100 years**

Anchor rod / Threaded rod		M10	M12	M14	M16	M20	M22	M24	M27	M30	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>											
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	5,5	5,3	5,8	4,6	4,6	5,4	5,3	5,1	
	II: 35 °C / 60 °C		5,5	5,3	5,8	4,6	4,6	5,4	5,3	5,1	5,0
	III: 50 °C / 72 °C		5,5	5,3	5,5	4,3	4,3	5,0	5,0	4,8	4,8
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	5,9	5,6	5,7	4,3	4,6	4,6	4,5	4,3	
	II: 35 °C / 60 °C		5,9	5,6	5,7	4,3	4,6	4,6	4,5	4,3	4,2
	III: 50 °C / 72 °C		5,3	5,1	5,3	4,3	4,3	4,3	4,2	4,1	4,0
<b>Installation factors</b>											
<b>Tension loading</b>											
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0							
Water filled hole				1,2			1,4				

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**Performance**

Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for Anchor rods / Threaded rods; working life 50 and 100 years

**Annex C40**

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**Table C41.1: Characteristic resistance for combined pull-out and concrete failure for metric reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 50 years**

Nominal diameter of the bar		$\phi$	10	12	14	16	18	20	22	24	25	26	28	30	32	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>																
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm <sup>2</sup> ]	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	4,8	
	II: 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
	III: 50 °C / 72 °C			7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	6,7	4,8
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm <sup>2</sup> ]	7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8	
	II: 35 °C / 60 °C			7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	4,8	
	III: 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	4,8	

**Installation factors**

**Tension loading**

Dry or wet concrete	$\gamma_{inst}$	[-]	1,0												
Water filled hole			1,2						1,4						

**Table C41.2: Characteristic resistance for combined pull-out and concrete failure for metric reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 100 years**

Nominal diameter of the bar		$\phi$	10	12	14	16	18	20	22	24	25	26	28	30	32	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>																
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm <sup>2</sup> ]	6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	3,1	
	II: 35 °C / 60 °C			6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	4,4	3,1
	III: 50 °C / 72 °C			6,0	5,6	4,4	3,7	3,7	3,7	4,4	4,4	4,4	4,4	4,4	4,4	3,1
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm <sup>2</sup> ]	6,4	5,2	4,2	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	
	II: 35 °C / 60 °C			6,4	5,2	4,2	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	
	III: 50 °C / 72 °C			5,5	5,2	3,8	3,8	3,7	3,7	3,7	3,7	3,7	3,7	3,7	3,1	

**Installation factors**

**Tension loading**

Dry or wet concrete	$\gamma_{inst}$	[-]	1,0												
Water filled hole			1,2						1,4						

fischer injection system FIS EM Plus	<b>Annex C41</b> Appendix 67 / 77
<b>Performance</b> Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for and reinforcing bars; working life 50 and 100 years	

**Table C42.1: Characteristic resistance for combined pull-out and concrete failure for metric Anchor rods and Threaded rods in hammer drilled holes under seismic action performance category C2; working life 50 and 100 years**

Anchor rod / Threaded rod		M12	M16	M20	M24	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>						
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>						
Tem- per- a-ture range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$ [N/mm <sup>2</sup> ]	3,5	5,8	5,0	3,1
	II: 35 °C / 60 °C		3,5	5,8	5,0	3,1
	III: 50 °C / 72 °C		3,3	5,5	4,7	2,9
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>						
Tem- per- a-ture range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$ [N/mm <sup>2</sup> ]	3,5	5,8	5,0	3,1
	II: 35 °C / 60 °C		3,5	5,8	5,0	3,1
	III: 50 °C / 72 °C		3,3	5,5	4,7	2,9
<b>Installation factors</b>						
<b>Tension loading</b>						
Dry or wet concrete	$\gamma_{inst}$	[-]	1,0			
Water filled hole			1,2	1,4		
<b>Displacement-Factors for tension loading<sup>1)</sup></b>						
$\delta_{N,C2(50\%)-Factor}$	[mm/(N/mm <sup>2</sup> )]	0,09	0,10	0,11	0,12	
$\delta_{N,C2(100\%)-Factor}$		0,15	0,17	0,17	0,18	
<b>Displacement-Factors for shear loading<sup>2)</sup></b>						
$\delta_{V,C2(50\%)-Factor}$	[mm/kN]	0,18	0,10	0,07	0,06	
$\delta_{V,C2(100\%)-Factor}$		0,25	0,14	0,11	0,09	
<sup>1)</sup> Calculation of effective displacement: $\delta_{N,C2(50\%)} = \delta_{N,C2(50\%)-Factor} \cdot \tau$ $\delta_{N,C2(100\%)} = \delta_{N,C2(100\%)-Factor} \cdot \tau$ $\tau$ = acting bond strength under tension loading			<sup>2)</sup> Calculation of effective displacement: $\delta_{V,C2(50\%)} = \delta_{V,C2(50\%)-Factor} \cdot V$ $\delta_{V,C2(100\%)} = \delta_{V,C2(100\%)-Factor} \cdot V$ $V$ = acting shear loading			
fischer injection system FIS EM Plus					<b>Annex C42</b> Appendix 68 / 77	
<b>Performance</b> Characteristic resistance for combined pull-out and concrete failure under seismic action (C2) for Anchor rods and Threaded rods; working life 50 and 100 years						

**Table C43.1: Characteristic resistance to steel failure under tension or shear loading for fractional Threaded rods under seismic action performance category C1**

<b>Threaded rod</b>	<b>3/8"</b>	<b>1/2"</b>	<b>5/8"</b>	<b>3/4"</b>	<b>7/8"</b>	<b>1"</b>	<b>1 1/8"</b>
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**Characteristic resistance to steel failure under tension loading <sup>1)</sup>**

**Threaded rods, performance category C1**

Characteristic resistance $N_{Rk,s,C1}$	Steel zinc plated	Property class	F568M, Class 5.8	[kN]	25,0	45,7	72,9	107,9	148,9	195,4	246,0
			F1554, Grade 36		19,9	36,5	58,3	86,2	119,1	156,2	196,7
			F1554, Grade 55		25,8	47,3	75,3	111,5	154,0	202,0	254,4
			F1554, Grade 105		43,0	78,8	125,6	185,9	256,7	336,8	424,0
	Stainless steel R		A193, B7		43,0	78,8	125,6	185,9	256,7	336,8	424,0
			F593, Alloy Group 2		34,4	63,0	100,5	126,4	174,5	229,0	288,3
			A193, Grade B8M, Class 1		25,8	47,3	75,3	111,5	154,0	202,0	254,4
			A193, Grade B8M, Class 2B		32,7	59,9	95,4	141,3	195,1	255,9	322,2

**Characteristic resistance to steel failure under shear loading without lever arm <sup>1)</sup>**

**Threaded rods, performance category C1**

Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class	F568M, Class 5.8	[kN]	12,0	21,9	34,9	51,7	53,6	70,3	88,5
			F1554, Grade 36		8,3	15,3	24,4	36,2	50,0	65,6	82,6
			F1554, Grade 55		10,3	18,9	30,1	44,6	46,2	60,6	76,3
			F1554, Grade 105		15,0	27,6	43,9	65,0	89,8	117,8	148,4
	Stainless steel R		A193, B7		17,2	31,5	50,2	74,3	77,0	101,0	127,2
			F593, Alloy Group 2		13,7	25,2	40,2	50,5	52,3	68,7	86,5
			A193, Grade B8M, Class 1		10,3	18,9	30,1	44,6	46,2	60,6	76,3
			A193, Grade B8M, Class 2B		13,1	23,9	38,1	56,5	58,5	76,7	96,6

<sup>1)</sup> Partial factors for performance category C1 or see table C45.1

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**Performance**

Characteristic resistance to steel failure under tension or shear loading for Anchor rods and Threaded rods under seismic action (performance category C1)

**Annex C43**

**Table C44.1:** Characteristic resistance to **steel failure** under tension / shear loading for **fractional reinforcing bars** under seismic action performance category **C1**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10	
<b>Characteristic resistance to steel failure under tension loading <sup>1)</sup></b>										
<b>Reinforcing bar materials, performance category C1</b>										
Characteristic resistance $N_{Rk,s,C1}$	A615 (A767), Grade 40	[kN]	29,3	53,3	82,3	117,4	160,0	210,9	266,8	338,8
	A615 (A767), Grade 60		44,0	80,0	123,4	176,2	240,1	316,4	400,2	508,2
	A615 (A767), Grade 75		48,9	88,9	137,2	195,8	266,8	351,6	444,7	564,6
	A706 (A767), Grade 60		39,1	71,1	109,7	156,6	213,4	281,3	355,7	451,7
<b>Characteristic resistance to steel failure under shear loading, without lever arm<sup>1)</sup></b>										
<b>Reinforcing bar materials, performance category C1</b>										
Characteristic resistance $V_{Rk,s,C1}$	A615 (A767), Grade 40	[kN]	13,0	23,6	36,5	52,1	71,0	93,6	118,4	150,4
	A615 (A767), Grade 60		16,3	29,6	45,6	65,2	88,8	117,0	148,0	188,0
	A615 (A767), Grade 75		18,1	32,9	50,7	72,4	98,7	130,1	164,5	208,9
	A706 (A767), Grade 60		14,4	26,3	40,6	57,9	78,9	104,0	131,6	167,1

<sup>1)</sup> Partial factors for performance category C1 see table C45.1.

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**Performance**

Characteristic resistance to steel failure under tension/shear loading for fractional reinforcing bars under seismic action (performance category C1)

**Annex C44**

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**Table C45.1: Partial factors for fractional Threaded rods and reinforcing bars under seismic action performance category C1**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10
<b>Tension loading, steel failure<sup>1)</sup></b>									
Partial factor $\gamma_{Ms,N}$	Threaded rod, zinc plated	F568M, Class 5.8					1,50		
		F1554, Grade 36					1,94		
		F1554, Grade 55					1,64		
		F1554, Grade 105					1,43		
		A193, B7					1,43		
	Threaded rod, stainless steel R	F593, Alloy Group 2	1,85				2,27		
		A193, Grade B8M, Class 1					3,00		
		A193, Grade B8M, Class 2B					1,52		
	Reinforcing bar	A615 (A767), Grade 40					1,80		
		A615 (A767), Grade 60					1,80		
		A615 (A767), Grade 75					1,60		
		A706 (A767), Grade 60					1,60		
<b>Shear loading, steel failure<sup>1)</sup></b>									
Partial factor $\gamma_{Ms,V}$	Threaded rod, zinc plated	F568M, Class 5.8					1,25		
		F1554, Grade 36					1,61		
		F1554, Grade 55					1,36		
		F1554, Grade 105					1,50		
		A193, B7					1,50		
	Threaded rod, stainless steel R	F593, Alloy Group 2	1,54				1,89		
		A193, Grade B8M, Class 1					2,50		
		A193, Grade B8M, Class 2B					1,27		
	Reinforcing bar	A615 (A767), Grade 40					1,50		
		A615 (A767), Grade 60					1,50		
		A615 (A767), Grade 75					1,33		
		A706 (A767), Grade 60					1,33		

<sup>1)</sup> In absence of other national regulations.

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**Performance**

Partial factors for Threaded rods and reinforcing bars under seismic action performance category C1 (fractional size)

**Annex C45**

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**Table C46.1: Characteristic resistance for combined pull-out and concrete failure for fractional Threaded rods in hammer drilled holes under seismic action performance category C1; working life 50 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>									
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>									
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	8,5	9,0	9,1	8,5	8,5	8,2	7,1
	II: 35 °C / 60 °C		8,5	9,0	9,1	8,5	8,5	8,2	7,1
	III: 50 °C / 72 °C		8,0	8,5	8,5	8,5	8,5	8,2	7,1
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>									
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	7,4	7,7	7,5	6,0	6,0	5,8	5,0
	II: 35 °C / 60 °C		7,4	7,7	7,5	6,0	6,0	5,8	5,0
	III: 50 °C / 72 °C		6,9	7,3	7,0	6,0	6,0	5,8	5,0
<b>Installation factors</b>									
<b>Tension loading</b>									
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0					
Water filled hole				1,2		1,4			

**Table C46.2: Characteristic resistance for combined pull-out and concrete failure for fractional Threaded rods in hammer drilled holes under seismic action performance category C1; working life 100 years**

Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>									
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>									
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	6,8	6,8	6,9	6,9	6,8	6,3	5,3
	II: 35 °C / 60 °C		6,8	6,8	6,9	6,9	6,8	6,3	5,3
	III: 50 °C / 72 °C		6,4	6,4	6,5	6,4	6,4	5,9	5,1
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>									
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$ [N/mm <sup>2</sup> ]	5,9	5,9	5,7	4,9	4,8	4,4	3,7
	II: 35 °C / 60 °C		5,9	5,9	5,7	4,9	4,8	4,4	3,7
	III: 50 °C / 72 °C		5,5	5,5	5,3	4,5	4,5	4,2	3,6
<b>Installation factors</b>									
<b>Tension loading</b>									
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0					
Water filled hole				1,2		1,4			

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**Performance**

Characteristic resist. for combined pull-out and concrete failure under seismic action (C1) for Anchor rods / Threaded rods; working life 50 and 100 years (fractional size)

**Annex C46**

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**Table C47.1: Characteristic resistance for combined pull-out and concrete failure for fractional reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 50 years**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>										
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm <sup>2</sup> ]	6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
	II: 35 °C / 60 °C		6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
	III: 50 °C / 72 °C		6,2	7,0	7,0	7,0	7,0	7,0	7,0	7,0
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm <sup>2</sup> ]	6,6	5,7	5,7	5,3	5,3	5,3	5,3	4,4
	II: 35 °C / 60 °C		6,6	5,7	5,7	5,3	5,3	5,3	5,3	4,4
	III: 50 °C / 72 °C		5,7	5,7	5,3	5,3	5,3	5,3	5,3	4,4
<b>Installation factors</b>										
<b>Tension loading</b>										
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0						
Water filled hole				1,2			1,4			

<sup>1)</sup> Not allowed for drilling with hollow drill bit.

**Table C47.2: Characteristic resistance for combined pull-out and concrete failure for fractional reinforcing bars in hammer drilled holes under seismic action performance category C1; working life 100 years**

Rebar size		#3	#4	#5	#6	#7	#8	#9	#10 <sup>1)</sup>	
<b>Characteristic bond resistance, combined pull-out and concrete cone failure</b>										
<b>Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm <sup>2</sup> ]	5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
	II: 35 °C / 60 °C		5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
	III: 50 °C / 72 °C		5,2	5,6	4,6	4,6	4,6	4,6	4,6	4,6
<b>Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)</b>										
Tem- perature range	I: 24 °C / 40 °C	$\tau_{RK,C1}$ [N/mm <sup>2</sup> ]	5,6	4,6	3,7	3,4	3,4	3,4	3,4	2,9
	II: 35 °C / 60 °C		5,6	4,6	3,7	3,4	3,4	3,4	3,4	2,9
	III: 50 °C / 72 °C		4,9	4,6	3,4	3,4	3,4	3,4	3,4	2,9
<b>Installation factors</b>										
<b>Tension loading</b>										
Dry or wet concrete		$\gamma_{inst}$	[-]	1,0						
Water filled hole				1,2			1,4			

<sup>1)</sup> Not allowed for drilling with hollow drill bit.

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**Performance**

Characteristic resistance for combined pull-out and concrete failure under seismic action (C1) for and reinforcing bars; working life 50 and 100 years (fractional size)

**Annex C47**

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**Table C48.1: Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 1**

**Fire resistance to steel failure under tension and shear loading**

Anchor rod / Threaded rod ISO 898-1 Class 5.8 and higher	R30			R60		
	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	1,6	1,6	1,7	1,2	1,2	1,2
M10	3,3	3,3	4,2	2,3	2,3	3,0
M12	5,8	5,8	9,1	4,0	4,0	6,2
M14	6,6	6,6	12,0	4,6	4,6	8,4
M16	10,9	10,9	15,1	7,5	7,5	11,2
M20	11,1	11,1	29,4	8,2	8,2	21,8
M22	13,7	13,7	40,5	10,1	10,1	30,0
M24	16,0	16,0	50,9	11,8	11,8	37,7
M27	20,8	20,8	75,5	15,4	15,4	56,0
M30	25,4	25,4	102,0	18,8	18,8	75,6
Anchor rod / Threaded rod ISO 898-1 Class 5.8 and higher	R90			R120		
	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,8	0,8	0,8	0,6	0,6	0,6
M10	1,4	1,4	1,8	0,9	0,9	1,1
M12	2,1	2,1	3,3	1,2	1,2	1,9
M14	2,7	2,7	4,9	1,7	1,7	3,2
M16	4,0	4,0	7,3	2,3	2,3	5,3
M20	5,3	5,3	14,2	3,9	3,9	10,4
M22	6,6	6,6	19,5	4,8	4,8	14,3
M24	7,7	7,7	24,6	5,6	5,6	18,0
M27	10,0	10,0	36,4	7,3	7,3	26,7
M30	12,3	12,3	49,3	9,0	9,0	36,1

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**Performance**

Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 1

**Annex C48**

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**Table C49.1: Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 2**

Anchor rods R and HCR and Threaded rod, EN ISO 3506-1 Class A4-50 and higher	R30			R60		
	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
M8	0,7	0,7	0,7	0,5	0,5	0,6
M10	1,4	1,4	1,8	1,1	1,1	1,5
M12	2,5	2,5	3,9	2,1	2,1	3,9
M14	3,4	3,4	6,2	2,8	2,8	6,2
M16	4,7	4,7	9,9	3,9	3,9	9,9
M20	7,3	7,3	19,4	6,1	6,1	19,4
M22	9,0	9,0	26,7	7,5	7,5	26,7
M24	10,5	10,5	33,6	8,8	8,8	28,0
M27	13,7	13,7	49,9	11,4	11,4	41,6
M30	16,8	16,8	67,4	14,0	14,0	56,2
Anchor rods R and HCR and Threaded rod, EN ISO 3506-1 Class A4-50 and higher	R90			R120		
	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
M8	0,4	0,4	0,4	0,3	0,3	0,3
M10	0,9	0,9	1,2	0,8	0,8	1,0
M12	1,6	1,6	3,9	1,3	1,3	3,9
M14	2,3	2,3	6,2	1,8	1,8	6,2
M16	3,1	3,1	9,9	2,5	2,5	9,9
M20	4,9	4,9	19,4	3,9	3,9	19,4
M22	6,0	6,0	26,7	4,8	4,8	26,7
M24	7,0	7,0	22,4	5,6	5,6	17,9
M27	9,1	9,1	33,2	7,3	7,3	26,6
M30	11,2	11,2	44,9	8,9	8,9	35,9

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**Performance**

Fire resistance to steel failure under tension and shear loading for metric Anchor rods and Threaded rods part 2

**Annex C49**

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**Table C50.1: Fire resistance to steel failure under tension and shear loading for fractional Threaded rods**

<b>Fire resistance to steel failure under tension and shear loading</b>						
<b>Threaded rod</b>	<b>R30</b>			<b>R60</b>		
Steel zinc plated; detailed materials see Table A7.1, part No 2 <sup>1)</sup>	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
3/8"	2,7	2,7	3,2	1,9	1,9	2,3
1/2"	5,9	5,9	9,6	4,1	4,1	6,7
5/8"	6,7	6,7	13,7	4,9	4,9	10,1
3/4"	9,7	9,7	24,3	7,2	7,2	18,0
7/8"	13,5	13,5	39,4	10,0	10,0	29,2
1"	17,7	17,7	59,3	13,1	13,1	43,9
1 1/8"	22,3	22,3	83,8	16,5	16,5	62,2
<b>Threaded rod</b>	<b>R90</b>			<b>R120</b>		
Steel zinc plated; detailed materials see Table A7.1, part No 2 <sup>1)</sup>	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
3/8"	1,1	1,1	1,4	0,8	0,8	0,9
1/2"	2,3	2,3	3,7	1,3	1,3	2,2
5/8"	3,6	3,6	7,5	2,2	2,2	4,5
3/4"	4,7	4,7	11,7	3,4	3,4	8,6
7/8"	6,5	6,5	19,0	4,7	4,7	13,9
1"	8,5	8,5	28,6	6,2	6,2	20,9
1 1/8"	10,7	10,7	40,5	7,9	7,9	29,6
<b>Threaded rod</b>	<b>R30</b>			<b>R60</b>		
Stainless steel R; detailed materials see Table A7.1, part No 2	$N_{Rk,s,fi,30}$ [kN]	$V_{Rk,s,fi,30}$ [kN]	$M^0_{Rk,s,fi,30}$ [Nm]	$N_{Rk,s,fi,60}$ [kN]	$V_{Rk,s,fi,60}$ [kN]	$M^0_{Rk,s,fi,60}$ [Nm]
3/8"	1,1	1,1	1,4	0,9	0,9	1,1
1/2"	2,7	2,7	4,4	2,2	2,2	3,7
5/8"	4,3	4,3	8,9	3,6	3,6	7,4
3/4"	6,4	6,4	16,1	5,4	5,4	13,4
7/8"	8,9	8,9	26,1	7,4	7,4	21,7
1"	11,7	11,7	39,2	9,7	9,7	32,6
1 1/8"	14,7	14,7	55,4	12,3	12,3	46,2
<b>Threaded rod</b>	<b>R90</b>			<b>R120</b>		
Stainless steel R; detailed materials see Table A7.1, part No 2	$N_{Rk,s,fi,90}$ [kN]	$V_{Rk,s,fi,90}$ [kN]	$M^0_{Rk,s,fi,90}$ [Nm]	$N_{Rk,s,fi,120}$ [kN]	$V_{Rk,s,fi,120}$ [kN]	$M^0_{Rk,s,fi,120}$ [Nm]
3/8"	0,7	0,7	0,9	0,6	0,6	0,7
1/2"	1,8	1,8	2,9	1,4	1,4	2,3
5/8"	2,9	2,9	5,9	2,3	2,3	4,7
3/4"	4,3	4,3	10,7	3,4	3,4	8,5
7/8"	5,9	5,9	17,4	4,7	4,7	13,9
1"	7,8	7,8	26,1	6,2	6,2	20,9
1 1/8"	9,8	9,8	36,9	7,8	7,8	29,5

<sup>1)</sup> No performance assessed for ASTM F1554 Grade 36.

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**Performance**

Fire resistance to steel failure under tension and shear loading for fractional Threaded rods

**Annex C50**

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## Characteristic bond resistance for cracked concrete under fire conditions for metric and fractional Anchor rods and Threaded rods in hammer drilled holes with standard drill bit or hollow drill bit

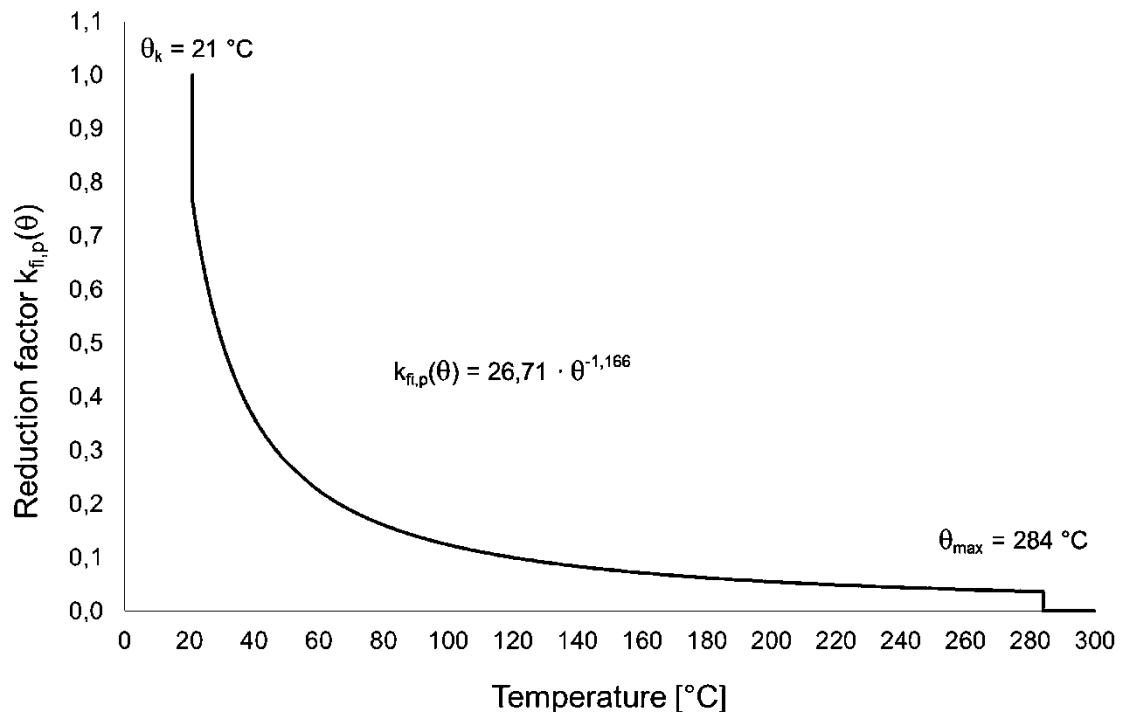
The characteristic bond resistance for cracked concrete under fire conditions for a given temperature

$\tau_{Rk,fi}(\theta)$  has to be calculated by the following equation:

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

$\theta$	=	Temperature in °C in the mortar layer	
$\tau_{Rk,fi}(\theta)$	=	Characteristic bond resistance for cracked concrete under fire exposure for a given temperature in N/mm <sup>2</sup> for concrete classes C20/25 to C50/60	
$k_{fi,p}(\theta)$	=	Reduction factor under fire conditions	
$\tau_{Rk,cr,C20/25}$	=	Characteristic bond resistance for cracked concrete C20/25 in N/mm <sup>2</sup> , given in Table C5.1, Table C6.1, Table C26.1 or Table C28.1, respectively	
Anchor rods or Threaded rods	If: $\theta > 21$ °C	$k_{fi,p}(\theta) = 26,71 \cdot \theta^{-1,166} \leq 1,0$	see Figure C51.1
	If: $\theta > \theta_{max} = 284$ °C	$k_{fi,p}(\theta) = 0$	

**Figure C51.1:** Graph of reduction factor  $k_{fi,p}(\theta)$  for Anchor rods or Threaded rods



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### Performance

Characteristic bond resistance under fire conditions for anchor rods and threaded rods

**Annex C51**

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