

IZJAVA O LASTNOSTIH

DoP 0351

za fischer sistem za vbrzganje FIS EM PLUS (pritrdni pritrdilni element za uporabo v betonu)

SL

1. Enotna identifikacijska oznaka tipa proizvoda: DoP 0351
2. Predvidena uporaba: Za vgrajeno v razpokan in nerazpokan beton, glej dodatek, zlasti priloge B1 - B17.
3. Proizvajalec: fischerwerke GmbH & Co. KG, Otto-Hahn-Straße 15, 79211 Denzlingen, Nemčija
4. Pooblaščen zastopnik: -
5. Sistemi ocenjevanja in preverjanja nespremenljivosti lastnosti: 1
6. Evropski ocenjevalni dokument: EAD 330499-02-0601, Edition 12/2023
Evropska tehnična ocena: ETA-17/0979; 2024-04-22
Organ za tehnično ocenjevanje: DIBt- Deutsches Institut für Bautechnik
Priglašeni organi: 2873 TU Darmstadt
7. Navedene lastnosti:
Mehanska odpornost in stabilnost (BWR 1)
Karakteristična odpornost na napetostno obremenitev (statična in kvazistatična obremenitev):
 - 1) Odpornost pri odpovedi jekla: glej dodatek, zlasti prilogah C1, C2, C3, C19, C21, C23
 - 2) Odpor na kombinirani izvek in odpoved betonskega stožca: glej dodatek, zlasti prilogah C4 - C16, C24 - C34
 - 3) Odpornost na odpoved v betonski coni: glej dodatek, zlasti priloge C4, C24
 - 4) Razdalja od roba betona za preprečevanje loma pod obremenitvijo: glej dodatek, zlasti priloge C4, C24
 - 5) Robusnost: glej dodatek, zlasti prilogah C4 - C16, C24 - C34
 - 6) Največji zatezni navor: glej dodatek, zlasti prilogah B3, B4, B8, B9, B12
 - 7) Najmanjša razdalja do roba betona in razmik, Debelina elementa- podlage: glej dodatek, zlasti prilogah B3 - B12**Karakteristična odpornost proti strižni obremenitvi (statična in kvazistatična obremenitev):**
 - 8) Odpornost na odpoved jekla: glej dodatek, zlasti prilogah C1, C2, C3, C20, C22, C23
 - 9) Odpornost na neuspešno odstranitev: glej dodatek, zlasti prilogah C4, C24
 - 10) Odpornost na odpoved od roba betona: glej dodatek, zlasti prilogah C4, C24**Zamenjave pri kratkoročnem in dolgoročnem nalaganju:**
 - 11) Zamenjave pri kratkoročnem in dolgoročnem nalaganju: glej dodatek, zlasti prilogah C17, C18, C35, C36
 - 12) Odpornost betona, ojačenega z jeklenimi vlakni: NPD**Karakteristična odpornost in premiki za kategoriji seizmičnih lastnosti C1 in C2:**
 - 13) Odpornost na napetost, kategorija C1: glej dodatek, zlasti prilogah C37 - C41, C43 - C47
 - 14) Odpornost na napetost, kategorija C2: glej dodatek, zlasti prilogah C38, C39, C42
 - 15) Odpornost na strižno obremenitev, kategorija C1: glej dodatek, zlasti prilogah C37 - C39, C43 - C45
 - 16) Odpornost na strižno obremenitev, kategorija C2: glej dodatek, zlasti prilogah C38, C39**Varnost v primeru požara (BWR 2)**
 - 17) Odzivnost na ogenj: Razred (A1)**Odpornost proti ognju:**
 - 18) Požarna odpornost pri odpovedi jekla (napetostna obremenitev): glej dodatek, zlasti prilogah C48 - C51
 - 19) Odpornost spojev v požarnih razmerah: glej dodatek, zlasti priloge C51
 - 20) Požarna odpornost pri odpovedi jekla (strižna obremenitev): glej dodatek, zlasti prilogah C48 - C51**Higiena, zdravje in okolje (BWR 3)**
 - 21) Vsečina, emisije in / ali sproščanje nevarnih snovi: NPD
8. Ustrezna tehnična dokumentacija in/ali specifična tehnična dokumentacija: -

Lastnosti proizvoda, navedenega zgoraj, so v skladu z navedenimi lastnostmi. Za izdajo te izjave o lastnostih je v skladu z Uredbo (EU) št. 305/2011 odgovoren izključno proizvajalec, naveden zgoraj.

Podpisal za in v imenu proizvajalca:



Dr.-Ing. Oliver Geibig, Generalni direktor poslovne enote in inženiringa
Tumlingen, 2024-05-06

Jürgen Grün, Generalni direktor za kemijo in kvaliteto

Ta izjava o lastnostih je bila pripravljena v različnih jezikih. V primeru nerazumevanja, se vedno upošteva angleška različica.

Priloga vsebuje informacije v angleškem jeziku, ki presegajo zakonske zahteve.

Translation guidance Essential Characteristics and Performance Parameters for Annexes

Navodila za prevajanje. Bistvene značilnosti in parametri za pravilno delovanje priloge

Mechanical resistance and stability (BWR 1)		
Mehanska odpornost in stabilnost (BWR 1)		
Characteristic resistance to tension load (static and quasi-static loading):		
Karakteristična odpornost na napetostno obremenitev (statična in kvazistatična obremenitev):		
1	Resistance to steel failure: Odpornost pri odpovedi jekla:	$N_{Rk,s}$ [kN]
2	Resistance to combined pull-out and concrete cone failure: Resistance to pull-out failure: Odpornost na izvlek:	τ_{Rk} and/or $\tau_{Rk,100}$ [N/mm ²], ψ_c , ψ_{sus}^0 , $\psi_{sus,100}$ [-] (BF) $N_{Rk,p}$ and/or $N_{Rk,p,100}$ [kN], ψ_c [-] (BEF)
3	Resistance to concrete cone failure: Odpornost na odpoved v betonski coni:	$c_{cr,N}$ [mm], $k_{cr,N}$, $k_{ucr,N}$ [-]
4	Edge distance to prevent splitting under load: Razdalja od roba betona za preprečevanje loma pod obremenitvijo:	$c_{cr,sp}$ [mm]
5	Robustness: Robusnost:	γ_{inst} [-]
6	Maximum installation torque: Installation torque: Zatezni navor:	$\max T_{inst}$ [Nm] (BF) T_{inst} [Nm] (BEF)
7	Minimum edge distance, spacing and member thickness: Najmanjša razdalja do roba betona in razmik, Debelina elementa- podlage:	c_{min} , s_{min} , h_{min} [mm]
Characteristic resistance to shear load (static and quasi-static loading):		
Karakteristična odpornost proti strižni obremenitvi (statična in kvazistatična obremenitev):		
8	Resistance to steel failure: Odpornost na odpoved jekla:	$V_{Rk,s}^0$ [kN], $M_{Rk,s}^0$ [Nm], k_7 [-]
9	Resistance to pry-out failure: Odpornost na neuspešno odstranitev:	k_8 [-]
10	Resistance to concrete edge failure: Odpornost na odpoved od roba betona:	d_{nom} , l_f [mm]
Displacements under short-term and long-term loading:		
Zamenjave pri kratkoročnem in dolgoročnem nalaganju:		
11	Displacements under short-term and long-term loading: Zamenjave pri kratkoročnem in dolgoročnem nalaganju:	δ_0 , δ_∞ [mm or mm/(N/mm ²)]
12	Resistance in steel fibre reinforced concrete: Odpornost betona, ojačenega z jeklenimi vlakni:	Description
Characteristic resistance and displacements for seismic performance categories C1 and C2:		
Karakteristična odpornost in premiki za kategoriji seizmičnih lastnosti C1 in C2:		
13	Resistance to tension for seismic performance category C1 Odpornost na napetost, kategorija C1:	$N_{Rk,s,C1}$ [kN] (all) $\tau_{Rk,C1}$ [N/mm ²] (BF) $N_{Rk,p,C1}$ [kN] (BEF)
14	Resistance to tension for seismic performance category C2 Odpornost na napetost, kategorija C2:	$N_{Rk,s,C2}$ [kN] (all) $\tau_{Rk,C2}$ [N/mm ²] (BF) $N_{Rk,p,C2}$ [kN] (BEF) $\delta_{N,C2}$ [mm] (all)
15	Resistance to shear for seismic performance category C1 Odpornost na strižno obremenitev, kategorija C1:	$V_{Rk,s,C1}$ [kN] (all)
16	Resistance to shear for seismic performance category C2 Odpornost na strižno obremenitev, kategorija C2:	$V_{Rk,s,C2}$ [kN] (all) $\delta_{V,C2}$ [mm] (all)
Safety in case of fire (BWR 2)		
Varnost v primeru požara (BWR 2)		
17	Reaction to fire Odzivnost na ogenj:	Class Razred (A1)
Resistance to fire		
Odpornost proti ognju:		
18	Fire resistance to steel failure (tension load): Požarna odpornost pri odpovedi jekla (napetostna obremenitev):	$N_{Rk,s,fi}$ [kN]
19	Bond resistance under fire conditions: Odpornost spojev v požarnih razmerah:	$k_{fi,p}(\theta)$ [-], $\tau_{Rk,fi}(\theta)$ [N/mm ²] (BF)
20	Fire resistance to steel failure under shear loading: Požarna odpornost pri odpovedi jekla (strižna obremenitev):	$V_{Rk,s,fi}$ [kN], $M_{Rk,s,fi}^0$ [Nm]
Hygiene, health and the environment (BWR 3)		
Higiena, zdravje in okolje (BWR 3)		
21	Content, emission and/or release of dangerous substances: Vsebina, emisije in / ali sproščanje nevarnih snovi:	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

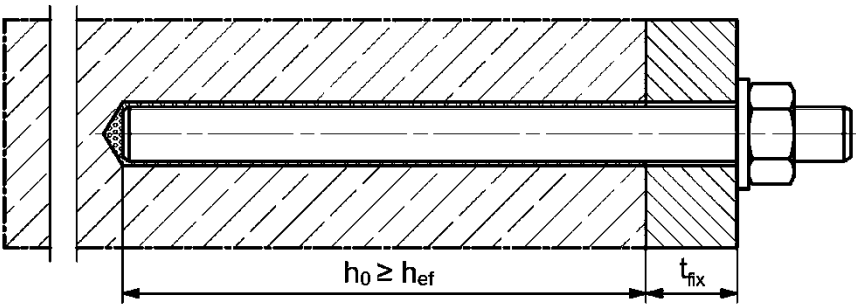
In accordance with the European Assessment Document EAD 330499-02-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

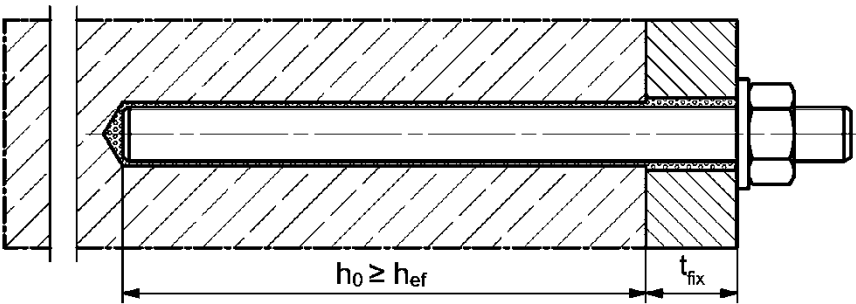
Installation conditions part 1

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

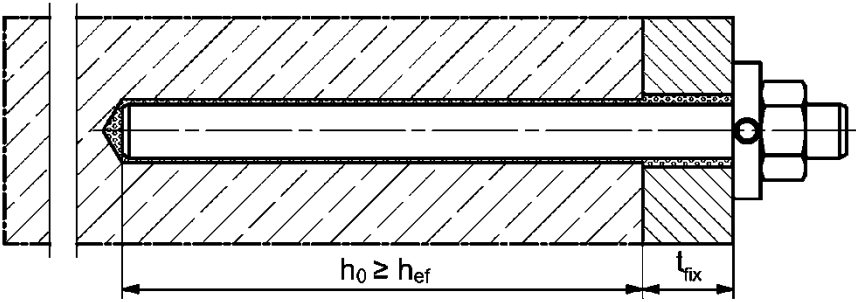
Pre-positioned installation



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

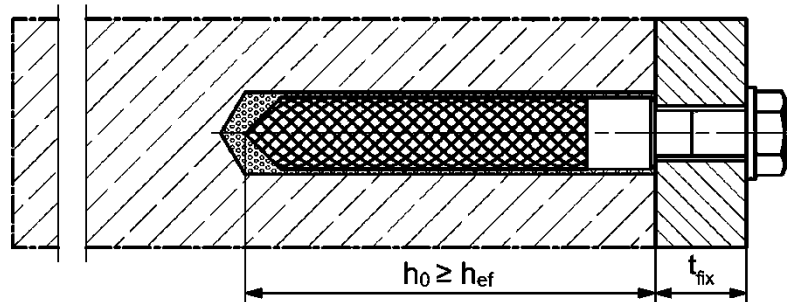
Annex A1

Appendix 3 / 77

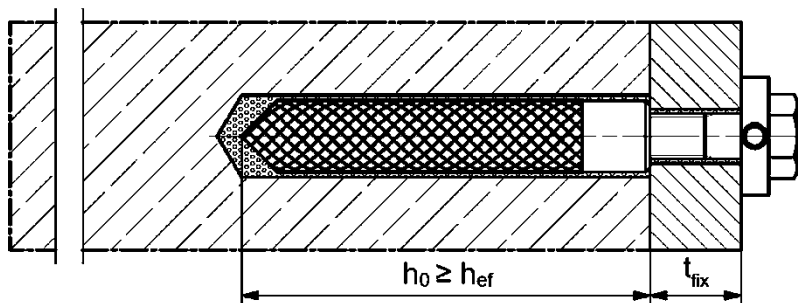
Installation conditions part 2

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
 t_{fix} = thickness of fixture

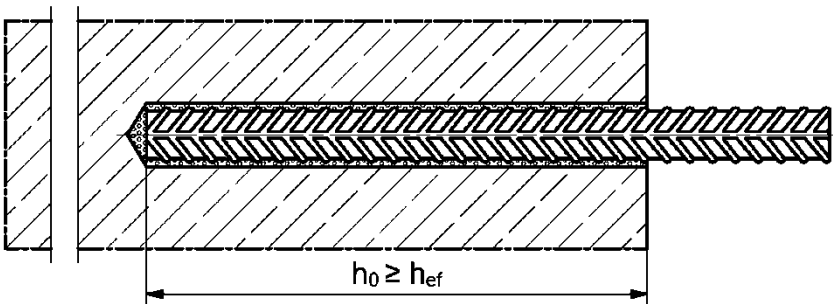
h_{ef} = effective embedment depth

fischer injection system FIS EM Plus

Product description
Installation conditions part 2

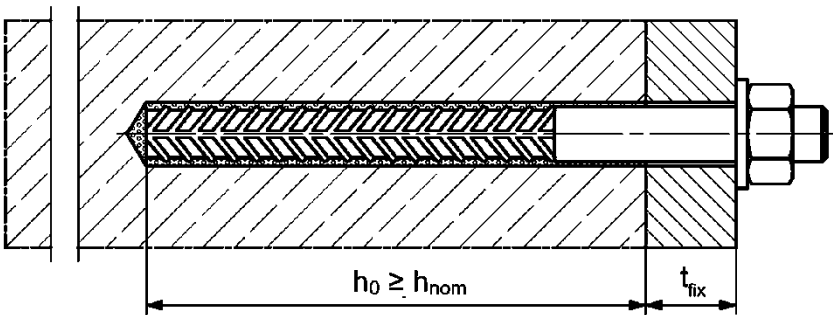
Installation conditions part 3

Reinforcing bar

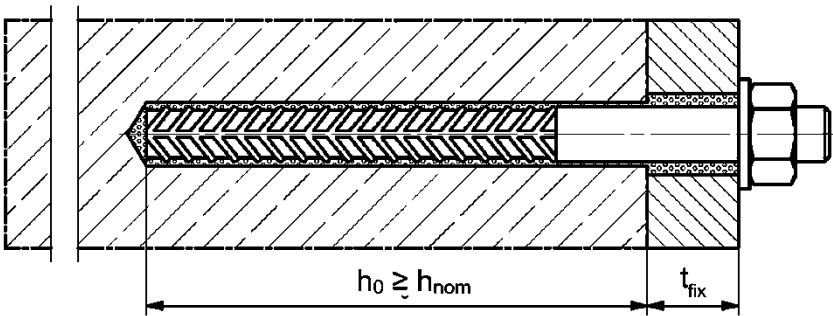


fischer rebar anchor FRA (fischer FRA)

Pre-positioned installation



Push through installation (annular gap filled with mortar)



Figures not to scale

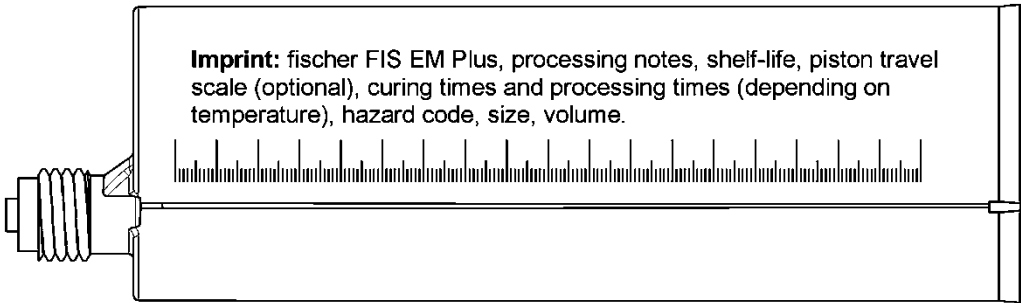
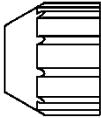
h_0 = drill hole depth	h_{ef} = effective embedment depth
t_{fix} = thickness of fixture	h_{nom} = overall fastener embedment depth in the concrete

fischer injection system FIS EM Plus

Product description
Installation conditions part 3

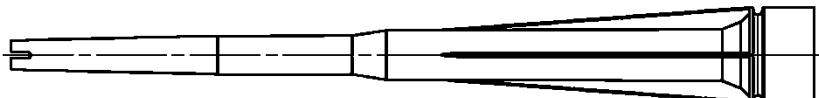
Overview system components part 1

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

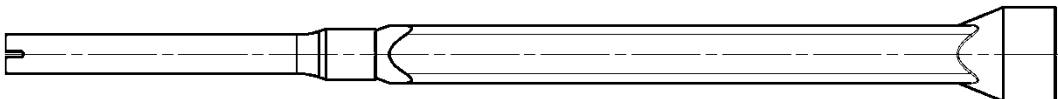


Imprint: fischer FIS EM Plus, processing notes, shelf-life, piston travel scale (optional), curing times and processing times (depending on temperature), hazard code, size, volume.

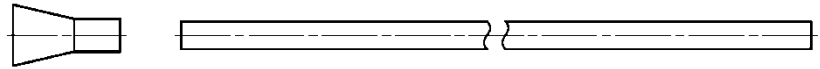
Static mixer FIS MR Plus for injection cartridges ≤ 390 ml



Static mixer FIS UMR for injection cartridges > 390 ml



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



Cleaning brush BS / BSB



Compressed-air cleaning tool ABP

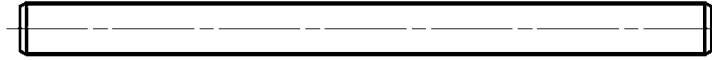


Figures not to scale

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"

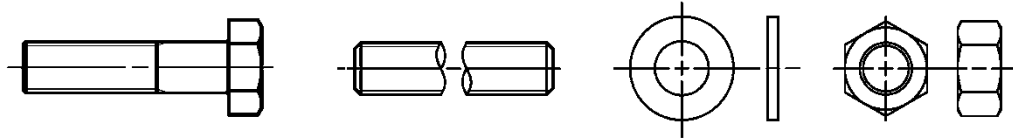


fischer RG M I

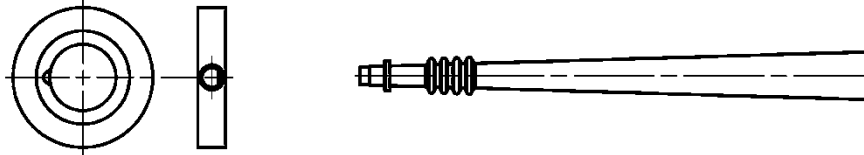
Metric size: M8, M10, M12, M16, M20
Fractional size: 3/8", 1/2", 5/8", 3/4"



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

Appendix 7 / 77

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	High corrosion resistant steel HCR
			acc. to EN 10088-1:2014 Corrosion resistance class CRC III acc. to EN 1993-1-4: 2006+A2:2020	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 $\geq 5 \mu\text{m}$, EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ EN ISO 10684:2004+AC:2009 $f_{uk} \leq 1000 \text{ N/mm}^2$ $A_5 > 12 \%$ fracture elongation ¹⁾	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 ¹⁾	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 ¹⁾
3	Washer ISO 7089:2000	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	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 $\geq 5 \mu\text{m}$, EN ISO 4042:2022 or hot dip galvanised $\geq 40 \mu\text{m}$ 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 $\geq 5 \mu\text{m}$, 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 $\geq 5 \mu\text{m}$, 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 $\geq 5 \mu\text{m}$, 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	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; $f_{uk} = f_{tk} = k \cdot f_{yk}$ ($A_5 > 12 \%$) ¹⁾		
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 $A_5 > 8 \%$	

¹⁾ 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

Appendix 8 / 77

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 ¹⁾ ; 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 ¹⁾ ; 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 ¹⁾ ; 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 ¹⁾ ; 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 ¹⁾ ; zinc plated $\geq 5 \mu\text{m}$, EN ISO 4042:2022	ASTM F593M-13ae1, Alloy Group 2 $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} \leq 5/8 \text{ in. (CW1)}$ $f_{uk} = 586 \text{ N/mm}^2$, $f_{yk} \geq 3/4 \text{ in. (CW2)}$ $A_5 > 12 \%$ fracture elongation ¹⁾ ; ASTM A193/A193M-23, Grade B8M, Class 1 $f_{uk} = 517 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ ; ASTM A193/A193M-23, Grade B8M, Class 2B $f_{uk} = 655 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾
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 ¹⁾ Grade 60, $f_{uk} = 621 \text{ N/mm}^2$, $f_{yk} = 414 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 75, $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} = 517 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 60, $f_{uk} = 552 \text{ N/mm}^2$, $f_{yk} = 414 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾ Grade 80, $f_{uk} = 689 \text{ N/mm}^2$, $f_{yk} = 552 \text{ N/mm}^2$, $A_5 > 12 \%$ fracture elongation ¹⁾	

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

fischer injection system FIS EM Plus

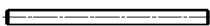
Product description
Materials, fractional sizes

Annex A7

Appendix 9 / 77

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 ₀) 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	- ¹⁾	
Seismic performance category (only hammer drilling with standard / hollow drill bits)	C1	M10 to M30	Annexes: C37, C39, C40	- ¹⁾		φ10 to φ32	Annexes: C38, C39, C41	- ¹⁾	
		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			- ¹⁾			
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 _{i,min} = -5 °C to T _{i,max} = +40 °C for the standard variation of temperature after installation							
Resistance to fire		Annexes: C48 – C51		- ¹⁾		- ¹⁾		- ¹⁾	
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)					

¹⁾ no performance assessed.

fischer injection system FIS EM Plus

Intended use
Specifications part 1

Annex B1

Appendix 10 / 77

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).

fischer injection system FIS EM Plus

Intended use
Specifications part 2

Annex B2

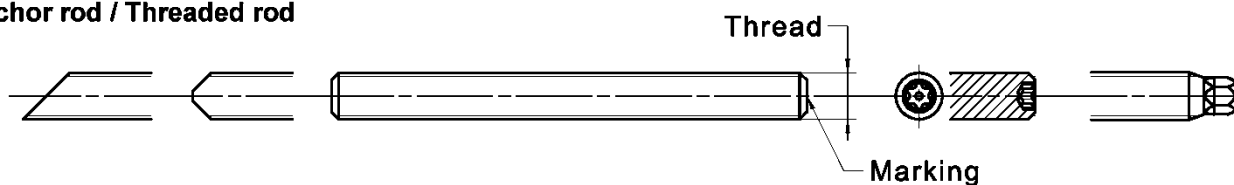
Appendix 11 / 77

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	[mm]	10	12	14	16	18	22 24 ¹⁾	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

¹⁾ Both drill hole diameters can be used.

Anchor rod / Threaded rod



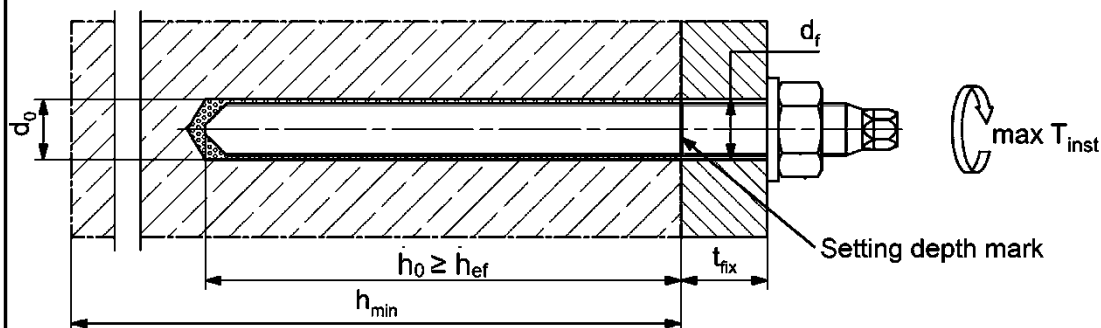
Marking (on random place) anchor rod:

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

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

¹⁾ PC = property class

Installation conditions:



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

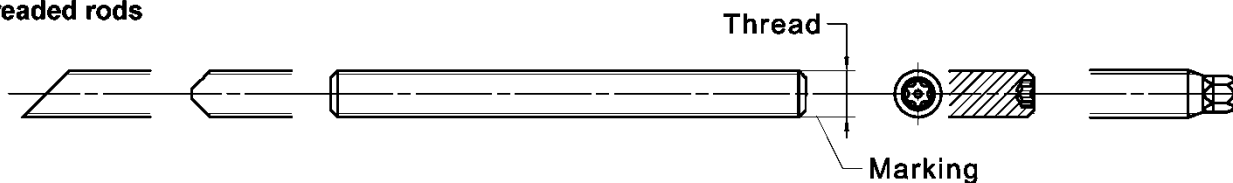
Appendix 12 / 77

Table B4.1: Installation parameters for fractional Threaded rods

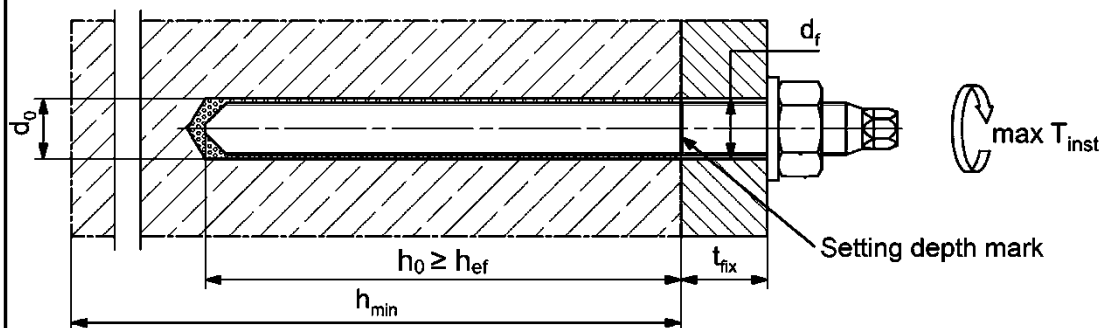
Threaded rods		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
Nominal drill hole diameter d_0	[mm]	11,1	14,3	19,1	22,2	25,4	28,6	31,8
	[inch]	7/16	9/16	3/4	7/8	1	1 1/8	1 1/4
Drill hole depth h_0		$h_0 \geq h_{ef}$						
Effective embedment depth	$h_{ef, min}$	60,0	70,0	79,0	89,0	89,0	102,0	178,0
	$h_{ef, max}$	191,0	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
	push through installation d_f		11,9	14,0	16,0	18,0	20,1	25,9
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

Appendix 13 / 77

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) ϕ			8	10	12	14	16	18	20	22	24
Minimum edge distance											
Uncracked / cracked concrete	C_{min}	[mm]	40	45	45	45	50	55	55	55	60
Minimum spacing	S_{min}		according to Annex B7								
Minimum spacing											
Uncracked / cracked concrete	S_{min}	[mm]	40	45	55	60	65	85	85	95	105
Minimum edge distance	C_{min}		according to Annex B7								
Required projecting area											
Uncracked concrete	$A_{sp,req}$	[1000	8	13	21,5	23	24	38,5	38,5	39,5	40
Cracked concrete		mm ²]	6,5	10	16,5	17,5	18,5	29,5	29,5	30	30,5
Anchor rods			-	-	M27	-	M30	-	-	-	-
Reinforcing bars (nominal diameter) ϕ			25	26	-	28	30	32	34	36	40
Minimum edge distance											
Uncracked / cracked concrete	C_{min}	[mm]	75	75	75	80	80	120	120	135	175
Minimum spacing	S_{min}		according to Annex B7								
Minimum spacing											
Uncracked / cracked concrete	S_{min}	[mm]	120	120	120	140	140	160	160	160	160
Minimum edge distance	C_{min}		according to Annex B7								
Required projecting area											
Uncracked concrete	$A_{sp,req}$	[1000	47,5	47,5	47,5	64	64	64	64	64	64
Cracked concrete		mm ²]	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**)

fischer injection system FIS EM Plus

Intended use

Minimum spacing and edge distance for Anchor rods and reinforcing bars

Annex B5

Appendix 14 / 77

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
Minimum edge distance										
Uncracked / cracked concrete	c_{min}	[mm]	45	45	50	55	60	75	80	120
Minimum spacing	s_{min}		according to Annex B7							
Minimum spacing										
Uncracked / cracked concrete	s_{min}	[mm]	45	60	65	85	105	120	140	160
Minimum edge distance	c_{min}		according to Annex B7							
Required projecting area										
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 ²]	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**)

fischer injection system FIS EM Plus

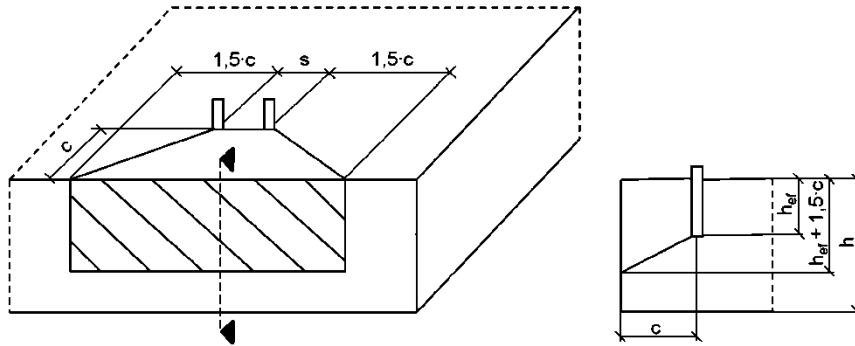
Intended use

Minimum spacing and edge distance for Anchor rods and reinforcing bars

Annex B6

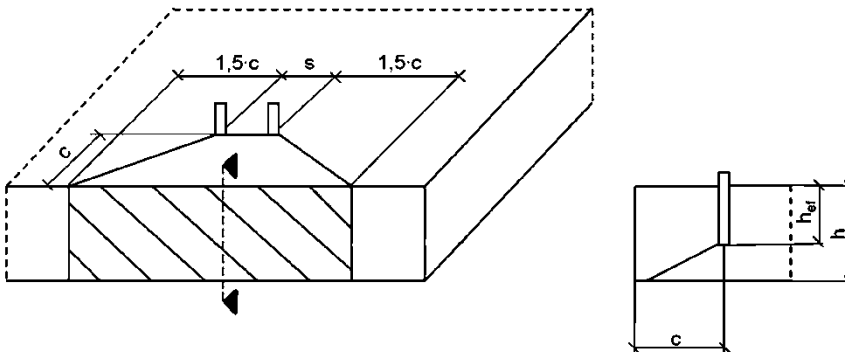
Appendix 15 / 77

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

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

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

Figures not to scale

fischer injection system FIS EM Plus

Intended use

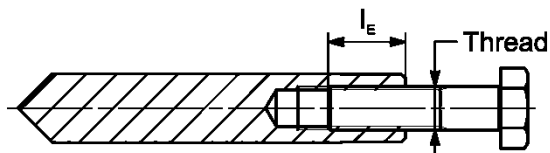
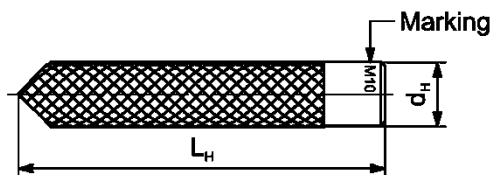
Minimum thickness of concrete member for Anchor rods / Threaded rods,
minimum spacing and edge distance

Annex B7

Appendix 16 / 77

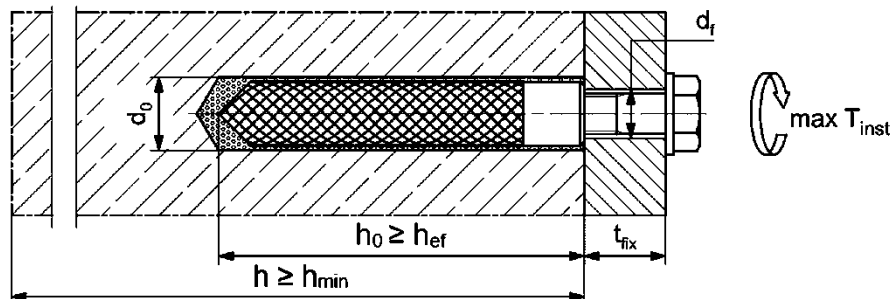
Table B8.1: Installation parameters for metric fischer RG M I

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

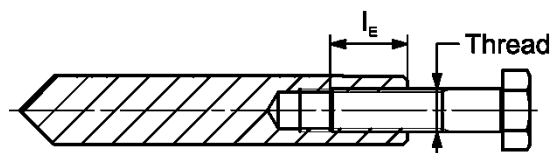
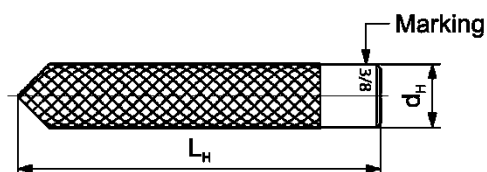
Installation parameters internal threaded anchors RG M I (metric size)

Annex B8

Appendix 17 / 77

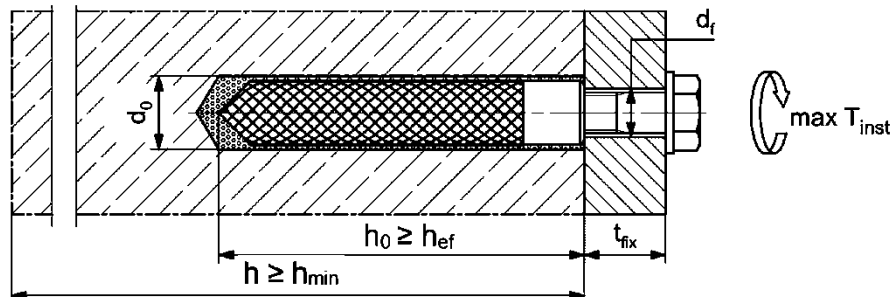
Table B9.1: Installation parameters for fractional fischer RG M I

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	120

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

Appendix 18 / 77

Table B10.1: Installation parameters for metric reinforcing bars ¹⁾

Nominal diameter of the bar		ϕ	8 ²⁾		10 ²⁾		12 ²⁾	14	16	18	20	22	24	
Nominal drill hole diameter	d ₀	[mm]	10	12	12	14	14	16	18	20	25	25	30	30
Drill hole depth	h ₀		h ₀ ≥ h _{ef}											
Effective embedment depth	h _{ef,min}		60	60	70	75	80	85	90	94	98			
	h _{ef,max}		160	200	240	280	320	360	400	440	480			
Minimum thickness of concrete member	h _{min}		h _{ef} + 30					h _{ef} + 2d ₀						

Nominal diameter of the bar ϕ		25	26	28	30	32	34	36	40	-
Nominal drill hole diameter d_0	[mm]	30	35	35	40	40	40	45	55	-
Drill hole depth h_0		$h_0 \geq h_{ef}$								
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**.

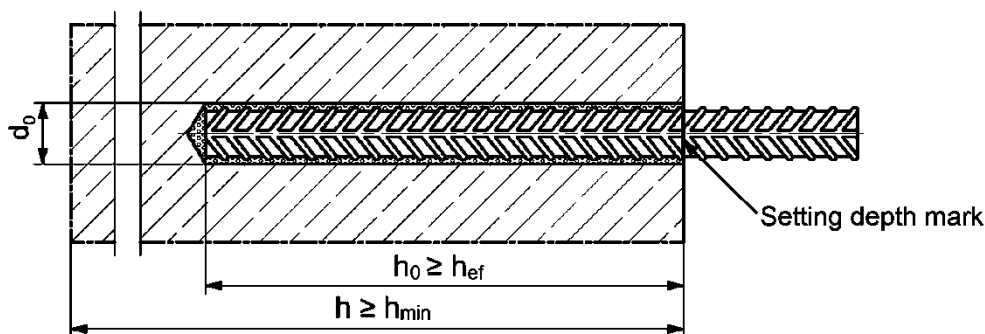
2) Both drill hole diameters can be used.

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: $0,05 \cdot \phi \leq h_{rib} \leq 0,07 \cdot \phi$
(ϕ = Nominal diameter of the bar, h_{rib} = rib height)

Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use

Installation parameters reinforcing bars (metric size)

Annex B10

Appendix 19 / 77

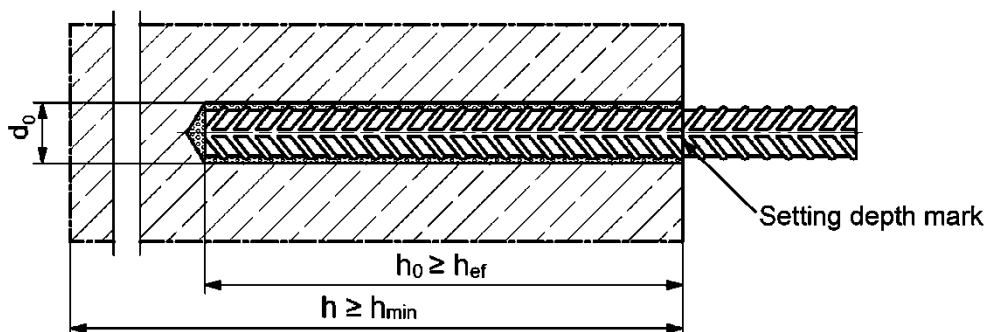
Table B11.1: Installation parameters for fractional reinforcing bars ¹⁾

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	[mm]	h ₀ ≥ h _{ef}							
Effective embedment depth	h _{ef,min}		60	70	79	89	89	102	114	127
	h _{ef,max}		191	254	318	381	445	508	572	635
Minimum thickness of concrete member	h _{min}		h _{ef} + 30		h _{ef} + 2d ₀					

¹⁾ 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

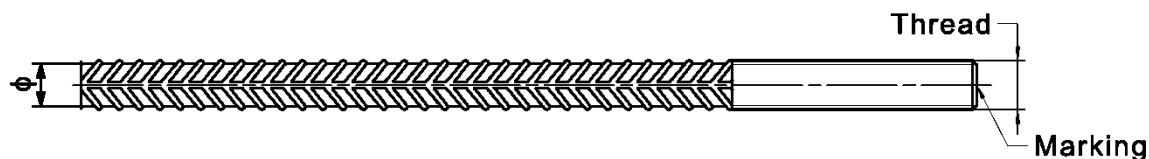
Appendix 20 / 77

Table B12.1: Installation parameters for metric fischer FRA

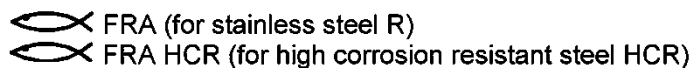
fischer FRA		Thread	M12 ¹⁾		M16	M20	M24
Nominal diameter of the bar	ϕ	[mm]	12		16	20	25
Nominal drill hole diameter	d_0		14	16	20	25	30
Drill hole depth	h_0		$h_{ef} + l_e = h_{nom}$				
Effective embedment depth	$h_{ef,min}$		70		80	90	96
	$h_{ef,max}$		140		220	300	380
Distance concrete surface to 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.

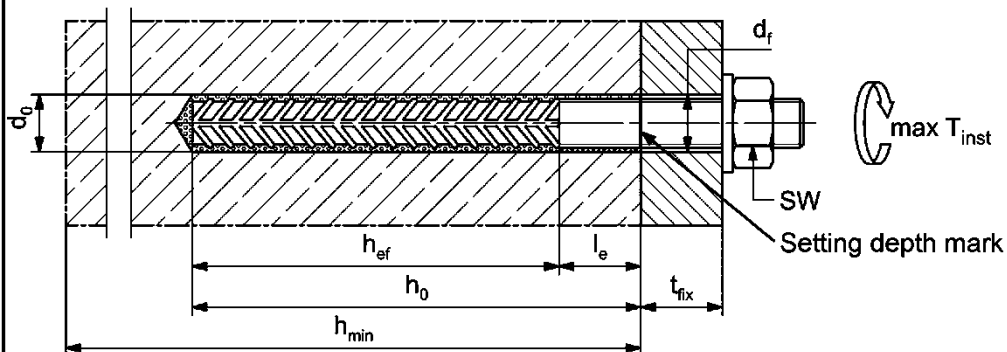
fischer FRA



Marking frontal e.g.:



Installation conditions:



Figures not to scale

fischer injection system FIS EM Plus

Intended use

Installation parameters fischer FRA (metric size)

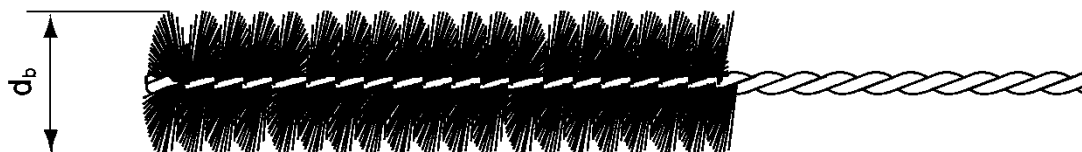
Annex B12

Appendix 21 / 77

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 ¹⁾ t_{cure}
-5 to 0 ²⁾	240 min	200 h
> 0 to 5 ²⁾	150 min	90 h
> 5 to 10	120 min	40 h
> 10 to 20	30 min	18 h
> 20 to 30	14 min	10 h
> 30 to 40	7 min	5 h

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

²⁾ Minimal cartridge temperature +5 °C.

fischer injection system FIS EM Plus

Intended use

Cleaning brush (steel brush)

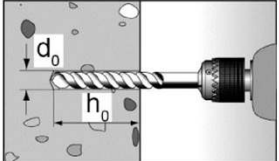
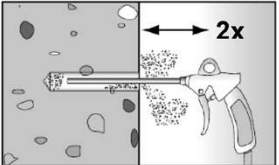
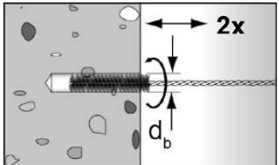
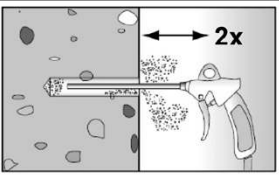
Processing time and curing time

Annex B13

Appendix 22 / 77

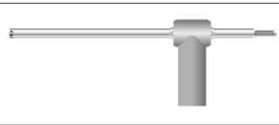
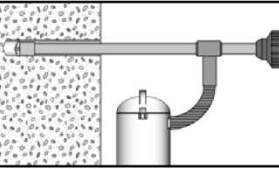
Installation instructions part 1

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

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

Go to step 6

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

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

Go to step 6

fischer injection system FIS EM Plus

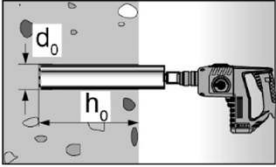
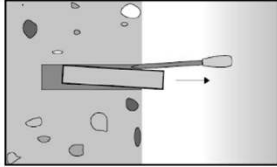
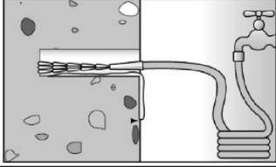
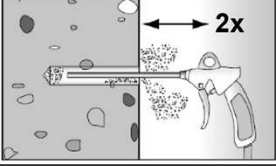
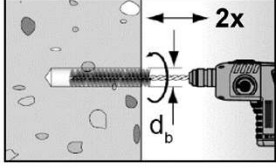
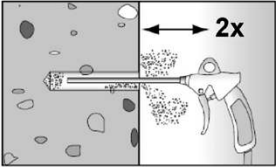
Intended use
Installation instructions part 1

Annex B14

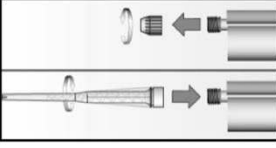
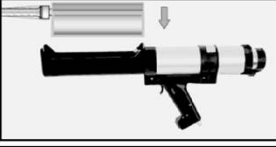
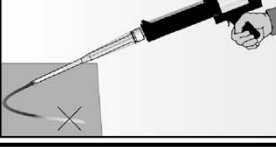
Appendix 23 / 77

Installation instructions part 2

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

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

Preparing the cartridge

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

fischer injection system FIS EM Plus

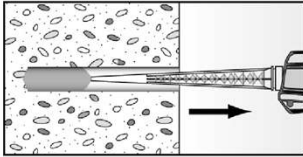
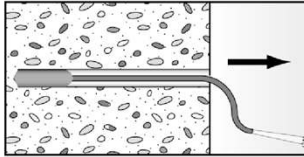
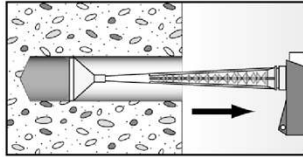
Intended use
Installation instructions part 2

Annex B15

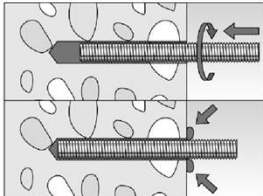
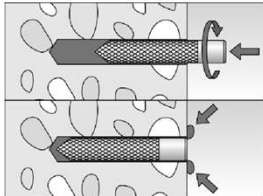
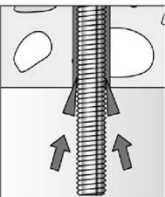
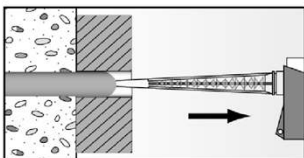
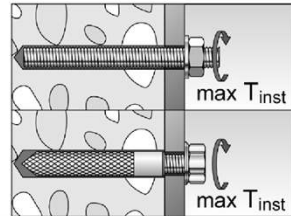
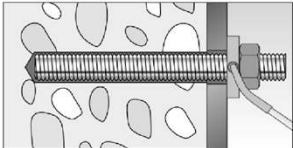
Appendix 24 / 77

Installation instructions part 3

Injection of the mortar

9	 Fill approximately 2/3 of the drill hole with mortar. Always begin from the bottom of the hole and avoid bubbles.	 The conditions for mortar injection without extension tube can be found in Table B13.2 For deeper drill holes, than those mentioned in Table B13.2, use a suitable extension tube.	 For overhead installation, deep holes ($h_0 > 250 \text{ mm}$) or drill hole diameter ($d_0 \geq 30 \text{ mm} / 1 \frac{1}{8}"$) use an injection-adapter.
---	--	--	---

Installation of Anchor rods, threaded rods or fischer internal threaded anchors RG M I

10	 	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. 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.
	 For overhead installations support the metal part with wedges (e.g., fischer centering wedges) or fischer overhead clips.	 For push through installation fill the annular gap with mortar.
11	 Wait for the specified curing time t_{cure} see Table B13.3.	12  Mounting the fixture max T_{inst} see Tables B3.1, B4.1, B8.1 and B9.1.
Option	 After the minimum curing time is reached, the gap between metal part and fixture (annular clearance) may be filled with mortar via the fischer filling disc. Compressive strength $\geq 50 \text{ N/mm}^2$ (e.g., fischer injection mortars FIS EM Plus, FIS HB, FIS SB, FIS V Plus) ATTENTION: Using fischer filling disc reduces t_{fix} (usable length of the anchor).	

fischer injection system FIS EM Plus

Intended use
Installation instructions part 3

Annex B16

Appendix 25 / 77

Installation instructions part 4

Installation reinforcing bars and fischer FRA

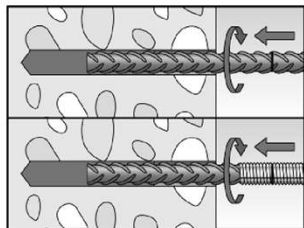
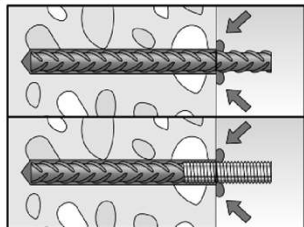
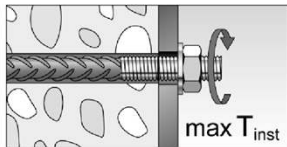
10		Only use clean and oil-free reinforcing bars or fischer FRA. Mark the setting depth. Turn while using force to push the reinforcement bar or the fischer FRA into the filled hole up to the setting depth mark.			
		When the setting depth mark is reached, excess mortar must be emerged from the mouth 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 .

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		
Characteristic resistance to steel failure under tension loading ³⁾														
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	
Partial factors ¹⁾														
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	4.8	[-]	1,50									
			5.8		1,50									
			8.8		1,50									
	Stainless steel R and high corrosion resistant steel HCR		50		2,86									
			70		1,87 / fischer HCR: 1,50									
			80		1,60									
Characteristic resistance to steel failure under shear loading ³⁾														
without lever arm														
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										
with lever arm														
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
Partial factors ¹⁾														
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	4.8	[-]	1,25									
			5.8		1,25									
			8.8		1,25									
	Stainless steel R and high corrosion resistant steel HCR		50		2,38									
			70		1,56 / fischer HCR: 1,25 ²⁾									
			80		1,33									
1) 2) 3)														

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

Appendix 27 / 77

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
Characteristic resistance to steel failure under tension loading										
Characteristic resistance with screw	N _{Rk,s}	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
Partial factors ¹⁾										
Partial factors	γ _{Ms,N}	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				
Characteristic resistance to steel failure under shear loading										
Without lever arm										
Characteristic resistance with screw	V ⁰ _{Rk,s}	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			
With lever arm										
Characteristic resistance with screw	M ⁰ _{Rk,s}	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
Partial factors ¹⁾										
Partial factors	γ _{Ms,V}	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				

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 fischer RG M I

Annex C2

Appendix 28 / 77

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

Nominal diameter of the bar	ϕ	8	10	12	14	16	20	25	28
Characteristic resistance to steel failure under tension loading									
Characteristic resistance	$N_{Rk,s}$	[kN]	$A_s \cdot f_{uk}^{1)}$						
Characteristic resistance to steel failure under shear loading									
Without lever arm									
Characteristic resistance	$V^0_{Rk,s}$	[kN]	$k_6^{2)}) \cdot A_s \cdot f_{uk}^{1)}$						
Ductility factor	k_7	[-]	1,0						
With lever arm									
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	$1,2 \cdot W_{el} \cdot f_{uk}^{1)}$						
1) f_{uk} 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
Characteristic resistance to steel failure under tension loading						
Characteristic resistance	$N_{Rk,s}$	[kN]	62,1	110,5	172,7	263,0
Partial factor ¹⁾						
Partial factor	$\gamma_{Ms,N}$	[-]	1,40			
Characteristic resistance to steel failure under shear loading						
Without lever arm						
Characteristic resistance	$V^0_{Rk,s}$	[kN]	33,7	62,8	98,0	141,2
Ductility factor	k_7	[-]	1,0			
With lever arm						
Characteristic resistance	$M^0_{Rk,s}$	[Nm]	104,8	266,3	519,2	898,0
Partial factor ¹⁾						
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

Appendix 29 / 77

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

Size				All sizes																	
Tension loading																					
Installation factor		γ_{inst}	[-]	See annex C5 to C16, C40 and C41																	
Factors for the compressive strength of concrete > C20/25																					
Increasing factor ψ_c for cracked or uncracked concrete $\tau_{Rk}(X,Y) = \psi_c \cdot \tau_{Rk}(C20/25)$	C25/30	Ψ_c	[-]	1,02																	
	C30/37			1,04																	
	C35/45			1,06																	
	C40/50			1,07																	
	C45/55			1,08																	
	C50/60			1,09																	
Splitting failure																					
Edge distance	$h / h_{ef} \geq 2,0$	$C_{cr,sp}$	[mm]	1,0 h_{ef}																	
	$2,0 > h / h_{ef} > 1,3$			4,6 h_{ef} - 1,8 h																	
	$h / h_{ef} \leq 1,3$			2,26 h_{ef}																	
Spacing		$S_{cr,sp}$		2 $C_{cr,sp}$																	
Concrete cone failure																					
Uncracked concrete		$k_{ucr,N}$	[-]	11,0																	
Cracked concrete		$k_{cr,N}$		7,7																	
Edge distance		$C_{cr,N}$	[mm]	1,5 h_{ef}																	
Spacing		$S_{cr,N}$		2 $C_{cr,N}$																	
Factors for sustained tension loading																					
Temperature range				24 °C / 40 °C				35 °C / 60 °C				50 °C / 72 °C									
Factor			ψ_{sus}^0		0,77				0,60				0,48								
Factor			$\psi_{sus,100}^0$		0,77				0,60				0,71								
Shear loading																					
Installation factor		γ_{inst}	[-]	1,0																	
Concrete pry-out failure																					
Factor for pry-out failure		k_8	[-]	2,0																	
Concrete edge failure																					
Effective length of fastener for shear loading		l_f	[mm]	for $d_{nom} \leq 24$ mm: min (h_{ef} ; 12 d_{nom}) for $d_{nom} > 24$ mm: min (h_{ef} ; max (8 d_{nom} ; 300 mm))																	
Effective diameter of the fastener d_{nom}																					
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	- ¹⁾	22	28	- ¹⁾	- ¹⁾	- ¹⁾	- ¹⁾								
fischer FRA		d_{nom}		- ¹⁾	- ¹⁾	12	- ¹⁾	16	20	- ¹⁾	25	- ¹⁾	- ¹⁾								
Size (nominal diameter of the bar)			ϕ	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40	
Reinforcing bar			d_{nom}	[mm]	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
¹⁾ Anchor type not part of the assessment.																					
fischer injection system FIS EM Plus														Annex C4 Appendix 30 / 77							
Performance 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 ¹⁾	M10	M12	M14	M16	M20	M22	M24	M27	M30	
Combined pull-out and concrete cone failure													
Calculation diameter		d	[mm]	8	10	12	14	16	20	22	24	27	30
Uncracked concrete													
Characteristic bond resistance in uncracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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	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	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 ²]	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	9,0
	III: 50 °C / 72 °C			15,0	14,0	14,0	13,0	12,0	11,0	10,0	10,0	9,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{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 ²]	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 ²]	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
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,4									
Cracked concrete													
Characteristic bond resistance in cracked concrete C20/25													
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)													
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit													
Dry or wet concrete		γ_{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 ²]	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 ²]	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
Installation factors; Diamond-drilling													
Dry or wet concrete		γ_{inst}	[-]	1,0									
Water filled hole				1,2				1,4					

¹⁾ 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; working life 50 years

Annex C5

Appendix 31 / 77

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

¹⁾ 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

Appendix 32 / 77

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	
Combined pull-out and concrete cone failure							
Calculation diameter	d [mm]	12	15,7	18	22	28	
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm²]	18,8	17,6	17,0	16,2	15,3
perature II: 35 °C / 60 °C			15,0	14,0	14,0	13,0	12,0
range III: 50 °C / 72 °C			14,0	13,0	13,0	12,0	11,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm²]	18,8	16,9	15,8	14,3	12,8
perature II: 35 °C / 60 °C			14,0	12,0	12,0	11,0	10,0
range III: 50 °C / 72 °C			13,0	12,0	11,0	10,0	9,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Diamond-drilling (dry or wet concrete)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm²]	13,3	12,3	11,9	11,2	10,4
perature II: 35 °C / 60 °C			13,0	12,0	11,0	10,0	9,0
range III: 50 °C / 72 °C			12,0	11,0	10,0	9,0	8,0
Diamond-drilling (water filled hole)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm²]	15,1	13,6	12,6	11,4	10,2
perature II: 35 °C / 60 °C			13,0	12,0	11,0	10,0	9,0
range III: 50 °C / 72 °C			12,0	11,0	10,0	9,0	8,0
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,4				
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,0	6,0	7,0	7,0
perature II: 35 °C / 60 °C			7,0	6,0	6,0	7,0	7,0
range III: 50 °C / 72 °C			7,0	6,0	6,0	7,0	7,0
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,5	6,0	6,0	6,0
perature II: 35 °C / 60 °C			7,0	6,5	6,0	6,0	6,0
range III: 50 °C / 72 °C			7,0	6,0	6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete	γ_{inst}	[-]	1,0				
Water filled hole			1,2		1,4		
Diamond-drilling (dry or wet concrete)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,0	6,0	7,0	7,0
perature II: 35 °C / 60 °C			7,0	6,0	6,0	7,0	7,0
range III: 50 °C / 72 °C			7,0	6,0	6,0	7,0	7,0
Diamond-drilling (water filled hole)							
Tem- I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm²]	7,0	6,5	6,0	6,0	6,0
perature II: 35 °C / 60 °C			7,0	6,5	6,0	6,0	6,0
range III: 50 °C / 72 °C			7,0	6,0	6,0	6,0	6,0
Installation factors; Diamond-drilling							
Dry or wet concrete	γ_{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

Appendix 33 / 77

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	
Combined pull-out and concrete cone failure								
Calculation diameter		d	[mm]	12	15,7	18	22	28
Uncracked concrete								
Characteristic bond resistance in uncracked concrete C20/25								
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$	[N/mm²]	15,4	14,4	14,0	13,3	12,6
				11,3	10,5	10,5	9,8	9,0
				7,7	7,8	7,8	7,8	7,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$	[N/mm²]	15,4	13,9	13,0	11,7	10,5
				10,5	9,0	9,0	8,3	7,5
				7,2	7,2	6,6	6,5	5,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit								
Dry or wet concrete		γ_{inst}	[-]	1,0				
Water filled hole				1,4				
Diamond-drilling (dry or wet concrete)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$	[N/mm²]	10,9	10,1	9,8	9,2	8,6
				9,8	9,0	8,3	7,5	6,8
				6,6	6,6	6,0	5,9	5,2
Diamond-drilling (water filled hole)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,ucr}$	[N/mm²]	12,5	11,2	10,3	9,3	8,4
				9,8	9,0	8,3	7,5	6,8
				6,6	6,6	6,0	5,9	5,2
Installation factors; Diamond-drilling								
Dry or wet concrete		γ_{inst}	[-]	1,0				
Water filled hole				1,4				
Cracked concrete								
Characteristic bond resistance in cracked concrete C20/25								
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$	[N/mm²]	4,2	5,1	4,8	4,6	4,6
				4,2	5,1	4,8	4,6	4,6
				4,2	5,1	4,8	4,6	4,6
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$	[N/mm²]	4,2	5,5	4,8	3,9	3,9
				4,2	5,5	4,8	3,9	3,9
				4,2	5,1	4,8	3,9	3,9
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit								
Dry or wet concrete		γ_{inst}	[-]	1,0				
Water filled hole				1,2		1,4		
Diamond-drilling (dry or wet concrete)								
Tem- perature range	I: 24 °C / 40 °C II: 35 °C / 60 °C III: 50 °C / 72 °C	$\tau_{Rk,100,cr}$	[N/mm²]	4,2	5,1	4,8	4,6	4,6
				4,2	5,1	4,8	4,6	4,6
				4,2	5,1	4,8	4,6	4,6
Installation factors; Diamond-drilling								
Dry or wet concrete		γ_{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

Appendix 34 / 77

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		ϕ	8 ¹⁾	10	12	14	16	18	20	22	24	
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Nominal diameter of the bar		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾		
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40	
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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	
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 ²]	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	
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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	
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								

¹⁾ 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

Appendix 35 / 77

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

¹⁾ 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

Appendix 36 / 77

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		ϕ	25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾	
Combined pull-out and concrete cone failure											
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	8,0	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
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 ²]	6,0	6,0	6,0	6,0	5,0	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,4							
Diamond-drilling (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	7,0	7,0	7,0	7,0	5,0	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
Diamond-drilling (water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	6,0	6,0	6,0	6,0	5,0	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
Installation factors; Diamond-drilling											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,4							

¹⁾ 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

Appendix 37 / 77

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

¹⁾ 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

Appendix 38 / 77

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		ϕ	8 ¹⁾	10	12	14	16	18	20	22	24	
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	8	10	12	14	16	18	20	22	24
Cracked concrete												
Characteristic bond resistance in cracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
	III: 50 °C / 72 °C			4,2	6,0	6,4	5,2	5,2	5,2	5,2	5,2	5,2
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,2						1,4		
Diamond-drilling (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Installation factor; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Nominal diameter of the bar		ϕ		25	26	28	30 ¹⁾	32 ¹⁾	34 ¹⁾	36 ¹⁾	40 ¹⁾	
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	25	26	28	30	32	34	36	40	
Cracked concrete												
Characteristic bond resistance in cracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	3,9	3,9	3,9	3,9	3,3	3,8	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	3,8
	III: 50 °C / 72 °C			3,9	3,9	3,9	3,9	3,3	3,3	3,3	3,3	3,3
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	4,6	4,6	4,6	4,6	3,3	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	3,3
	III: 50 °C / 72 °C			4,6	4,6	4,6	4,6	3,3	3,3	3,3	3,3	3,3
Installation factor; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
1) Not allowed for hollow drill bit.												

¹⁾ Not allowed for hollow drill bit.

fischer injection system FIS EM Plus

Performance

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

Annex C13

Appendix 39 / 77

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	
Combined pull-out and concrete cone failure							
Calculation diameter		d	[mm]	12	16	20	25
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete		γ_{inst}	[-]	1,0			
Water filled hole				1,4			
Diamond-drilling (dry or wet concrete as well as water filled hole)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling							
Dry or wet concrete		γ_{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 fischer FRA;
working life 50 years

Annex C14

Appendix 40 / 77

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	
Combined pull-out and concrete cone failure							
Calculation diameter		d	[mm]	12	16	20	25
Cracked concrete							
Characteristic bond resistance in cracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete		γ_{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 ²]	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
Diamond-drilling (water filled hole)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$	[N/mm ²]	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
Installation factors; Diamond-drilling							
Dry or wet concrete		γ_{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 FRA;
working life 50 years

Annex C15

Appendix 41 / 77

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

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

Table C17.1: Displacements for metric Anchor rods / Threaded rods

Anchor rod / Threaded rod		M8	M10	M12	M14	M16	M20	M22	M24	M27	M30
Displacement-Factors for tension loading ¹⁾											
Uncracked or cracked concrete; Temperature range I, II, III											
δ _{N0} -Factor	[mm/(N/mm ²)]	0,07	0,08	0,09	0,09	0,10	0,11	0,11	0,12	0,12	0,13
δ _{N∞} -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,17	0,18	0,19	0,19
Displacement-Factors for shear loading ²⁾											
Uncracked or cracked concrete; Temperature range I, II, III											
δ _{V0} -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,07	0,07	0,06	0,05	0,05
δ _{V∞} -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:						2) Calculation of effective displacement:					
δ _{N0} = δ _{N0-Factor} · τ						δ _{V0} = δ _{V0-Factor} · V					
δ _{N∞} = δ _{N∞-Factor} · τ						δ _{V∞} = δ _{V∞-Factor} · V					
τ = acting bond strength under tension loading						V = acting shear loading					

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

fischer RG M I		M8	M10	M12	M16	M20
Displacement-Factors for tension loading¹⁾						
Uncracked or cracked concrete; Temperature range I, II, III						
δ_{N0} -Factor	[mm/(N/mm ²)]	0,09	0,10	0,10	0,11	0,13
$\delta_{N\infty}$ -Factor		0,13	0,15	0,16	0,17	0,19
Displacement-Factors for shear loading²⁾						
Uncracked or cracked concrete; Temperature range I, II, III						
δ_{V0} -Factor	[mm/kN]	0,12	0,09	0,08	0,07	0,05
$\delta_{V\infty}$ -Factor		0,18	0,14	0,12	0,10	0,08
¹⁾ Calculation of effective displacement: $\delta_{N0} = \delta_{N0\text{-Factor}} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty\text{-Factor}} \cdot \tau$ τ = acting bond strength under tension loading				²⁾ Calculation of effective displacement: $\delta_{V0} = \delta_{V0\text{-Factor}} \cdot V$ $\delta_{V\infty} = \delta_{V\infty\text{-Factor}} \cdot V$ V = acting shear loading		

fischer injection system FIS EM Plus

Performance

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

Annex C17

Appendix 43 / 77

Table C18.1: Displacements for metric reinforcing bars																		
Nominal diameter of the bar	ϕ	8	10	12	14	16	18	20	22	24	25	26	28	30	32	34	36	40
Displacement-Factors for tension loading ¹⁾																		
Uncracked or cracked concrete; Temperature range I, II, III																		
δ_{N0} -Factor	[mm/(N/mm ²)]	0,07	0,08	0,09	0,09	0,10	0,10	0,11	0,11	0,12	0,12	0,12	0,13	0,13	0,13	0,14	0,14	0,15
$\delta_{N\infty}$ -Factor		0,11	0,12	0,13	0,14	0,15	0,16	0,16	0,17	0,18	0,18	0,18	0,19	0,19	0,20	0,20	0,21	0,22
Displacement-Factors for shear loading ²⁾																		
Uncracked or cracked concrete; Temperature range I, II, III																		
δ_{V0} -Factor	[mm/kN]	0,18	0,15	0,12	0,10	0,09	0,08	0,07	0,07	0,06	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,04
$\delta_{V\infty}$ -Factor		0,27	0,22	0,18	0,16	0,14	0,12	0,11	0,10	0,09	0,09	0,08	0,08	0,07	0,07	0,06	0,06	0,05
1) Calculation of effective displacement: $\delta_{N0} = \delta_{N0}\text{-Factor} \cdot \tau$ $\delta_{N\infty} = \delta_{N\infty}\text{-Factor} \cdot \tau$ τ = acting bond strength under tension loading 2) Calculation of effective displacement: $\delta_{V0} = \delta_{V0}\text{-Factor} \cdot V$ $\delta_{V\infty} = \delta_{V\infty}\text{-Factor} \cdot V$ V = acting shear loading																		

Table C18.2: Displacements for metric fischer FRA

fischer FRA		M12	M16	M20	M24
Displacement-Factors for tension loading ¹⁾					
Uncracked or cracked concrete; Temperature range I, II, III					
δ _{N0} -Factor	[mm/(N/mm²)]	0,09	0,10	0,11	0,12
δ _{N∞} -Factor		0,13	0,15	0,16	0,18
Displacement-Factors for shear loading ²⁾					
Uncracked or cracked concrete; Temperature range I, II, III					
δ _{V0} -Factor	[mm/kN]	0,12	0,09	0,07	0,06
δ _{V∞} -Factor		0,18	0,14	0,11	0,09
1) Calculation of effective displacement:			2) Calculation of effective displacement:		
δ _{N0} = δ _{N0} -Factor · τ			δ _{V0} = δ _{V0} -Factor · V		
δ _{N∞} = δ _{N∞} -Factor · τ			δ _{V∞} = δ _{V∞} -Factor · V		
τ = acting bond strength under tension loading			V = acting shear loading		

fischer injection system FIS EM Plus

Performance

Displacements for reinforcing bars and fischer FRA

Annex C18

Appendix 44 / 77

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"	
Characteristic resistance to steel failure under tension loading											
Characteristic resistance $N_{Rk,s}$	Steel zinc plated	Property class	[kN]	F568M, Class 5.8	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
				A193, B7	43,0	78,8	125,6	185,9	256,7	336,8	424,0
	Stainless steel R			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 ¹⁾											
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	[-]	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
	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						

¹⁾ In absence of other national regulations.

fischer injection system FIS EM Plus

Performance

Characteristic resistance to steel failure under tension / shear loading for fractional Threaded rods part 1

Annex C19

Appendix 45 / 77

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"	
Characteristic resistance to steel failure under shear loading										
without lever arm										
Characteristic resistance $V_{Rk,s}$	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
		A193, B7		21,5	39,4	62,8	92,9	128,3	168,4	212,0
	Stainless steel R	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							
with lever arm										
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
		A193, B7		51,5	127,6	256,8	462,4	750,0	1126,9	1591,9
	Stainless steel R	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
Partial factors ¹⁾										
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						
		A193, B7		1,50						
	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						

¹⁾ 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

Appendix 46 / 77

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"
Characteristic resistance to steel failure under tension loading								
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
Partial factors ¹⁾								
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			

¹⁾ 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

Appendix 47 / 77

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"
Characteristic resistance to steel failure under shear loading								
Without lever arm								
Characteristic resistance with screw	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
With lever arm								
Characteristic resistance with screw	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
Partial factors ¹⁾								
Partial factors	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			

¹⁾ 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

Appendix 48 / 77

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 ¹⁾
Characteristic resistance to steel failure under tension loading								
Characteristic resistance	N _{Rk,s}	[kN]	A _s · f _{uk} ³⁾					
Characteristic resistance to steel failure under shear loading								
Without lever arm								
Characteristic resistance	V ⁰ _{Rk,s}	[kN]	k ₆ ²⁾ · A _s · f _{uk} ³⁾					
Ductility factor	k ₇	[-]	1,0					
With lever arm								
Characteristic resistance	M ⁰ _{Rk,s}	[Nm]	1,2 · W _{el} · 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.

fischer injection system FIS EM Plus

Performance

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

Annex C23

Appendix 49 / 77

Table C24.1: Characteristic resistance for concrete failure under tension / shear loading for fractional sizes

Size			All sizes									
Characteristic resistance to concrete failure under tension loading												
Installation factor		γ_{inst}	[-]	See Annex C25 to C34, C46 and C47								
Factors for the compressive strength of concrete > C20/25												
Increasing factor ψ_c for cracked or uncracked concrete $\tau_{Rk}(X,Y) = \psi_c \cdot \tau_{Rk}(C20/25)$		C25/30	ψ_c	[-]	1,02							
		C30/37			1,04							
		C35/45			1,06							
		C40/50			1,07							
		C45/55			1,08							
		C50/60			1,09							
Splitting failure												
Edge distance		$h / h_{ef} \geq 2,0$	$C_{cr,sp}$	[mm]	1,0 h_{ef}							
		$2,0 > h / h_{ef} > 1,3$			4,6 h_{ef} - 1,8 h							
		$h / h_{ef} \leq 1,3$			2,26 h_{ef}							
Spacing		$S_{cr,sp}$			2 $C_{cr,sp}$							
Concrete cone failure												
Uncracked concrete		$k_{ucr,N}$	[-]	11,0								
Cracked concrete		$k_{cr,N}$		7,7								
Edge distance		$C_{cr,N}$	[mm]	1,5 h_{ef}								
Spacing		$S_{cr,N}$		2 $C_{cr,N}$								
Factors for sustained tension loading												
Temperature range				24 °C / 40 °C			35 °C / 60 °C			50 °C / 72 °C		
Factor			ψ_{sus}^0	0,77			0,60			0,48		
Factor			$\psi_{sus,100}^0$	0,77			0,60			0,71		
Characteristic resistance to concrete failure under shear loading												
Installation factor		γ_{inst}	[-]	1,0								
Concrete pry-out failure												
Factor for pry-out failure		k_8	[-]	2,0								
Concrete edge failure												
Effective length of fastener 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))								
Calculation diameters												
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	- ¹⁾	- ¹⁾	- ¹⁾		
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	
¹⁾ Anchor type not part of the assessment.												
fischer injection system FIS EM Plus									Annex C24 Appendix 50 / 77			
Performance 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"	
Combined pull-out and concrete cone failure										
Calculation diameter	d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
Uncracked concrete										
Characteristic bond resistance in uncracked concrete C20/25										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit										
Dry or wet concrete	γ_{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 ²]	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
Diamond-drilling (water filled hole)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling										
Dry or wet concrete	γ_{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

Appendix 51 / 77

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"		
Combined pull-out and concrete cone failure											
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{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 ²]	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
Diamond-drilling (water filled hole)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,cr}$	[N/mm ²]	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
Installation factors; Diamond-drilling											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,2			1,4				

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"		
Combined pull-out and concrete cone failure											
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6	
Uncracked concrete											
Characteristic bond resistance in uncracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,4							
Diamond-drilling (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Diamond-drilling (water filled hole)											
Temperature range	I: 24 °C / 40 °C		$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling											
Dry or wet concrete		γ_{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

Appendix 53 / 77

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"	
Combined pull-out and concrete cone failure										
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,6
Cracked concrete										
Characteristic bond resistance in cracked concrete C20/25										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit										
Dry or wet concrete		γ_{inst}	[-]	1,0						
Water filled hole				1,2			1,4			
Diamond-drilling (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Installation factors; Diamond-drilling										
Dry or wet concrete		γ_{inst}	[-]	1,0						

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 C28

Appendix 54 / 77

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"	
Combined pull-out and concrete cone failure							
Calculation diameter		d	[mm]	15,7	18,0	22,0	28,0
Uncracked concrete							
Characteristic bond resistance in uncracked concrete C20/25							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$	[N/mm ²]	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
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 ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit							
Dry or wet concrete		γ_{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 ²]	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
Diamond-drilling (water filled hole)							
Temperature range	I: 24 °C / 40 °C	$\tau_{RK,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling							
Dry or wet concrete		γ_{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 fischer RG M I; working life 50 years

Annex C29

Appendix 55 / 77

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

fischer RG M I		3/8"	1/2"	5/8"	3/4"
Combined pull-out and concrete cone failure					
Calculation diameter	d	[mm]	15,7	18,0	22,0
Cracked concrete					
Characteristic bond resistance in cracked concrete C20/25					
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)					
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,0	6,0	7,0
	II: 35 °C / 60 °C		6,0	6,0	7,0
	III: 50 °C / 72 °C		6,0	6,0	7,0
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 ²]	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,0	6,0
	III: 50 °C / 72 °C		6,0	6,0	6,0
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit					
Dry or wet concrete	γ_{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 ²]	6,0	6,0	7,0
	II: 35 °C / 60 °C		6,0	6,0	7,0
	III: 50 °C / 72 °C		6,0	6,0	7,0
Diamond-drilling (water filled hole)					
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,cr}$ [N/mm ²]	6,5	6,0	6,0
	II: 35 °C / 60 °C		6,5	6,0	6,0
	III: 50 °C / 72 °C		6,0	6,0	6,0
Installation factors; Diamond-drilling					
Dry or wet concrete	γ_{inst}	[-]	1,0		
Water filled hole			1,2	1,4	
fischer injection system FIS EM Plus					Annex C30 Appendix 56 / 77
Performance Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I; working life 50 years					

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						
fischer RG M I		3/8"	1/2"	5/8"	3/4"	
Combined pull-out and concrete cone failure						
Calculation diameter d		[mm]	15,7	18,0	22,0	28,0
Uncracked concrete						
Characteristic bond resistance in uncracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete		γ_{inst} [-]	1,0			
Water filled hole			1,4			
Diamond-drilling (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm²]	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
Diamond-drilling (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$ [N/mm²]	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
Installation factors; Diamond-drilling						
Dry or wet concrete		γ_{inst} [-]	1,0			
Water filled hole			1,4			
Cracked concrete						
Characteristic bond resistance in cracked concrete C20/25						
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)						
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$ [N/mm²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit						
Dry or wet concrete		γ_{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/mm²]	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
Installation factors; Diamond-drilling						
Dry or wet concrete		γ_{inst} [-]	1,0			
fischer injection system FIS EM Plus					Annex C31 Appendix 57 / 77	
Performance						
Characteristic resistance to combined pull-out and concrete failure for fractional fischer RG M I; working life 100 years						

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

Rebar size			#3	#4	#5	#6	#7	#8	#9	#10 ¹⁾		
Combined pull-out and concrete cone failure												
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3	
Uncracked concrete												
Characteristic bond resistance in uncracked concrete C20/25												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								
Diamond-drilling (dry or wet concrete as well as water filled hole)												
Tem- perature range	I: 24 °C / 40 °C		$\tau_{Rk,ucr}$	[N/mm ²]	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
Installation factors; Diamond-drilling												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,4								

¹⁾ 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 C32

Appendix 58 / 77

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

¹⁾ 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

Appendix 59 / 77

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 ¹⁾	
Combined pull-out and concrete cone failure											
Calculation diameter		d	[mm]	9,5	12,7	15,9	19,1	22,2	25,4	28,7	32,3
Uncracked concrete											
Characteristic bond resistance in uncracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,4							
Diamond-drilling (dry or wet concrete as well as water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,ucr}$	[N/mm ²]	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
Installation factors											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,4							
Cracked concrete											
Characteristic bond resistance in cracked concrete C20/25											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,100,cr}$	[N/mm ²]	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
Installation factors; Hammer-drilling with standard drill bit or hollow drill bit											
Dry or wet concrete		γ_{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 ²]	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
Installation factors											
Dry or wet concrete		γ_{inst}	[-]	1,0							

¹⁾ Not allowed for drilling with hollow drill bit.

¹⁾ 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; uncracked and cracked concrete; working life 100 years

Annex C34

Appendix 60 / 77

Table C35.1: Displacements for fraction Threaded rods								
Threaded rod		3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
Displacement-Factors for tension loading ¹⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ _{N0} -Factor	[mm/(N/mm ²)]	0,08	0,09	0,10	0,11	0,11	0,12	0,13
δ _{N∞} -Factor		0,12	0,13	0,15	0,16	0,17	0,19	0,19
Displacement-Factors for shear loading ²⁾								
Uncracked or cracked concrete; Temperature range I, II, III								
δ _{V0} -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,05	0,05
δ _{V∞} -Factor		0,22	0,18	0,14	0,11	0,10	0,08	0,07
1) Calculation of effective displacement:					2) Calculation of effective displacement:			
δ _{N0} = δ _{N0-Factor} · τ					δ _{V0} = δ _{V0-Factor} · V			
δ _{N∞} = δ _{N∞-Factor} · τ					δ _{V∞} = δ _{V∞-Factor} · V			
τ = acting bond strength under tension loading					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"
Displacement-Factors for tension loading ¹⁾					
Uncracked or cracked concrete; Temperature range I, II, III					
δ _{N0} -Factor	[mm/(N/mm ²)]	0,10	0,10	0,11	0,13
δ _{N∞} -Factor		0,15	0,16	0,17	0,19
Displacement-Factors for shear loading ²⁾					
Uncracked or cracked concrete; Temperature range I, II, III					
δ _{V0} -Factor	[mm/kN]	0,09	0,08	0,07	0,05
δ _{V∞} -Factor		0,14	0,12	0,10	0,08
1) Calculation of effective displacement:			2) Calculation of effective displacement:		
δ _{N0} = δ _{N0-Factor} · τ			δ _{V0} = δ _{V0-Factor} · V		
δ _{N∞} = δ _{N∞-Factor} · τ			δ _{V∞} = δ _{V∞-Factor} · V		
τ = acting bond strength under tension loading			V = acting shear loading		

fischer injection system FIS EM Plus

Performance

Displacements for fractional Threaded rods and fractional fischer RG M I

Annex C35

Appendix 61 / 77

Table C36.1: Displacements for fractional reinforcing bars									
Rebar size		#3	#4	#5	#6	#7	#8	#9	#10
Displacement-Factors for tension loading ¹⁾									
Uncracked or cracked concrete; Temperature range I, II, III									
δ _{N0} -Factor	[mm/(N/mm ²)]	0,08	0,09	0,10	0,11	0,11	0,12	0,13	0,13
δ _{N∞} -Factor		0,12	0,13	0,15	0,16	0,17	0,18	0,19	0,20
Displacement-Factors for shear loading ²⁾									
Uncracked or cracked concrete; Temperature range I, II, III									
δ _{V0} -Factor	[mm/kN]	0,15	0,12	0,09	0,07	0,07	0,06	0,05	0,05
δ _{V∞} -Factor		0,22	0,18	0,14	0,11	0,10	0,09	0,08	0,07
1) Calculation of effective displacement: δ _{N0} = δ _{N0} -Factor · τ δ _{N∞} = δ _{N∞} -Factor · τ τ = acting bond strength under tension loading					2) Calculation of effective displacement: δ _{V0} = δ _{V0} -Factor · V δ _{V∞} = δ _{V∞} -Factor · V V = acting shear loading				
fischer injection system FIS EM Plus								Annex C36 Appendix 62 / 77	
Performance Displacements for fractional reinforcing bars									

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	
Characteristic resistance to steel failure under tension loading ¹⁾													
Anchor rods and Threaded rods, performance category C1 ²⁾													
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
Characteristic resistance to steel failure under shear loading without lever arm ¹⁾													
Anchor rods, performance category C1 ²⁾													
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
Threaded rods, performance category C1 ²⁾													
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

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

²⁾ Values in brackets are valid for undersized Threaded rods with smaller stress area A_s for hot dip galvanised 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 for metric Anchor rods / Threaded rods under seismic action performance category C1

Annex C37

Appendix 63 / 77

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

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

²⁾ 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 ϕ		10	12	14	16	18	20	22	24	25	26	28	30	32
Characteristic resistance to steel failure under tension loading ¹⁾														
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1														
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
Characteristic resistance to steel failure under shear loading, without lever arm ¹⁾														
Reinforcing bar B500B acc. to DIN 488-2:2009-08, performance category C1														
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

¹⁾ Partial factors for performance category C1 see table C39.1.

fischer injection system FIS EM Plus

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

Appendix 64 / 77

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

Anchor rod / Threaded rod				M10 to M30	
Nominal diameter of the bar ϕ				10 to 32	
Tension loading, steel failure ³⁾					
Partial factor $\gamma_{Ms,N}$	Steel zinc plated	Property class	5.8	[-]	1,50
			8.8		1,50
	Stainless steel R and high corrosion resistant steel HCR		50		2,86
			70		1,87 / Anchor rod HCR: 1,50
			80		1,60
	Reinforcing bar	B500B			1,40
Shear loading, steel failure ³⁾					
Partial factor $\gamma_{Ms,V}$	Steel zinc plated	Property class	5.8	[-]	1,25
			8.8		1,25
	Stainless steel R and high corrosion resistant steel HCR		50		2,38
			70		1,56 / Anchor rod HCR: 1,25 ²⁾
			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
Characteristic bond resistance, combined pull-out and concrete cone failure												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm²]	7,0	7,0	6,7	6,0	5,7	6,7	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm²]	7,5	7,5	6,5	5,7	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
Installation factors												
Tension loading												
Dry or wet concrete	γ_{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
Characteristic bond resistance, combined pull-out and concrete cone failure												
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	5,5	5,3	5,8	4,6	4,6	5,4	5,3	5,1	5,0
	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)												
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	5,9	5,6	5,7	4,3	4,6	4,6	4,5	4,3	4,2
	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
Installation factors												
Tension loading												
Dry or wet concrete		γ_{inst}	[-]	1,0								
Water filled hole				1,2				1,4				

fischer injection system FIS EM Plus

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

Appendix 66 / 77

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			ϕ	10	12	14	16	18	20	22	24	25	26	28	30	32
Characteristic bond resistance, combined pull-out and concrete cone failure																
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	7,0	7,0	6,7	5,7	5,7	5,7	6,7	6,7	6,7	6,7	6,7	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	7,5	6,5	6,5	5,7	5,7	5,7	5,7	5,7	5,7	5,7	5,7	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	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	5,7	4,8
Installation factors																
Tension loading																
Dry or wet concrete		γ_{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			ϕ	10	12	14	16	18	20	22	24	25	26	28	30	32
Characteristic bond resistance, combined pull-out and concrete cone failure																
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	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
	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)																
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	6,4	5,2	4,2	3,7	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	3,7	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	3,7	3,1
Installation factors																
Tension loading																
Dry or wet concrete		γ_{inst}	[-]	1,0												
Water filled hole				1,2						1,4						

fischer injection system FIS EM Plus

Performance

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

Annex C41

Appendix 67 / 77

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	
Characteristic bond resistance, combined pull-out and concrete cone failure							
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)							
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C2}$	[N/mm ²]	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

Installation factors

Tension loading

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

Displacement-Factors for tension loading¹⁾

$\hat{\sigma}_{N,C2(50\%)}\text{-Factor}$	[mm/(N/mm ²)]	0,09	0,10	0,11	0,12
$\hat{\sigma}_{N,C2(100\%)}\text{-Factor}$		0,15	0,17	0,17	0,18

Displacement-Factors for shear loading²⁾

$\delta_{V,C2(50\%)}\text{-Factor}$	[mm/kN]	0,18	0,10	0,07	0,06
$\delta_{V,C2(100\%)}\text{-Factor}$		0,25	0,14	0,11	0,09

1) Calculation of effective displacement:

$$\delta_{N,C2(50\%)} = \delta_{N,C2(50\%)\text{-Factor}} \cdot \tau$$

$$\delta_{N,C2(100\%)} = \delta_{N,C2(100\%)\text{-Factor}} \cdot \tau$$

τ = acting bond strength under tension loading

2) Calculation of effective displacement:

$$\delta_{V,C2(50\%)} = \delta_{V,C2(50\%)\text{-Factor}} \cdot V$$

$$\delta_{V,C2(100\%)} = \delta_{V,C2(100\%)\text{-Factor}} \cdot V$$

V = acting shear loading

fischer injection system FIS EM Plus

Performance

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

Annex C42

Appendix 68 / 77

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

Threaded rod	3/8"	1/2"	5/8"	3/4"	7/8"	1"	1 1/8"
--------------	------	------	------	------	------	----	--------

Characteristic resistance to steel failure under tension loading ¹⁾

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 ¹⁾

Threaded rods, performance category C1

Characteristic resistance $V_{Rk,s,C1}$	Steel zinc plated	Property class	[kN]	F568M, Class 5.8	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

¹⁾ Partial factors for performance category C1 or see table C45.1

fischer injection system FIS EM Plus

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

Appendix 69 / 77

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	
Characteristic resistance to steel failure under tension loading ¹⁾										
Reinforcing bar materials, performance category C1										
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
Characteristic resistance to steel failure under shear loading, without lever arm ¹⁾										
Reinforcing bar materials, performance category C1										
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
¹⁾ Partial factors for performance category C1 see table C45.1.										

fischer injection system FIS EM Plus	Annex C44 Appendix 70 / 77
Performance Characteristic resistance to steel failure under tension/shear loading for fractional reinforcing bars under seismic action (performance category C1)	

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
Tension loading, steel failure ¹⁾										
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						
Shear loading, steel failure ¹⁾										
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						

¹⁾ In absence of other national regulations.

fischer injection system FIS EM Plus

Performance

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

Annex C45

Appendix 71 / 77

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"	
Characteristic bond resistance, combined pull-out and concrete cone failure										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm²]	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
Installation factors										
Tension loading										
Dry or wet concrete		γ_{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"	
Characteristic bond resistance, combined pull-out and concrete cone failure										
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)										
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	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
Installation factors										
Tension loading										
Dry or wet concrete		γ_{inst}	[-]	1,0						
Water filled hole				1,2		1,4				

fischer injection system FIS EM Plus

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

Appendix 72 / 77

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 ¹⁾	
Characteristic bond resistance, combined pull-out and concrete cone failure											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	6,2	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	6,6	5,7	5,7	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
Installation factors											
Tension loading											
Dry or wet concrete		γ_{inst}	[-]	1,0							
Water filled hole				1,2			1,4				

¹⁾ 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 ¹⁾		
Characteristic bond resistance, combined pull-out and concrete cone failure											
Hammer-drilling with standard drill bit or hollow drill bit (dry or wet concrete)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	5,2	5,6	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
Hammer-drilling with standard drill bit or hollow drill bit (water filled hole)											
Temperature range	I: 24 °C / 40 °C	$\tau_{Rk,C1}$	[N/mm ²]	5,6	4,6	3,7	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
Installation factors											
Tension loading											
Dry or wet concrete	γ_{inst}	[-]	1,0								
Water filled hole			1,2			1,4					

¹⁾ Not allowed for drilling with hollow drill bit.

fischer injection system FIS EM Plus

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

Appendix 73 / 77

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

fischer injection system FIS EM Plus

Performance

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

Annex C48

Appendix 74 / 77

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

fischer injection system FIS EM Plus

Performance

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

Annex C49

Appendix 75 / 77

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

Fire resistance to steel failure under tension and shear loading

Threaded rod	R30			R60		
Steel zinc plated; detailed materials see Table A7.1, part No 2 ¹⁾	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
Threaded rod	R90			R120		
Steel zinc plated; detailed materials see Table A7.1, part No 2 ¹⁾	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
Threaded rod	R30			R60		
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
Threaded rod	R90			R120		
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

¹⁾ No performance assessed for ASTM F1554 Grade 36.

fischer injection system FIS EM Plus

Performance

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

Annex C50

Appendix 76 / 77

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:

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

- θ

=

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/mm² for concrete classes C20/25 to C50/60
- $k_{fi,p}(\theta)$

=

Reduction factor under fire conditions
- $\tau_{Rk,cr,C20/25}$

=

Characteristic bond resistance for cracked concrete C20/25 in N/mm², given in Table C5.1, Table C6.1, Table C26.1 or Table C28.1, respectively
- Anchor rods or Threaded rods

If: $\theta > 21\text{ °C}$
If: $\theta > \theta_{max} = 284\text{ °C}$

$k_{fi,p}(\theta) = 26,71 \cdot \theta^{-1,166} \leq 1,0$
 $k_{fi,p}(\theta) = 0$

see Figure C51.1

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

