



Public-law institution jointly founded by the federal states and the Federation

European Technical Assessment Body for construction products



European Technical Assessment

ETA-12/0167 of 4 November 2025

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the **European Technical Assessment:**

Trade name of the construction product

Product family to which the construction product belongs

Manufacturer

Manufacturing plant

This European Technical Assessment contains

This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of

This version replaces

Deutsches Institut für Bautechnik

Walsywa Injection system WQI 44 PLUS for concrete

Bonded fasteners and bonded expansion fasteners for use in concrete

Walsywa Indústria e Comércio de Produtos Metalúrgicos Ltd Presbítero Plinio Alves de Souza, 800 JARDIM ERMIDA I JUNDIAÍ - SP, 13212-181 BRASILIEN

Walsywa ind. e Com. De Prod. Met. Ltda, Plant 2 Germany

34 pages including 3 annexes which form an integral part of this assessment

EAD 330499-02-0601, Edition 12/2023

ETA-12/0167 issued on 9 April 2015

DIBt | Kolonnenstraße 30 B | 10829 Berlin | GERMANY | Phone: +493078730-0 | FAX: +493078730-320 | Email: dibt@dibt.de | www.dibt.de 8.06.01-187/25

European Technical Assessment ETA-12/0167

English translation prepared by DIBt



Page 2 of 34 | 4 November 2025

The European Technical Assessment is issued by the Technical Assessment Body in its official language. Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document and shall be identified as such.

Communication of this European Technical Assessment, including transmission by electronic means, shall be in full. However, partial reproduction may only be made with the written consent of the issuing Technical Assessment Body. Any partial reproduction shall be identified as such.

This European Technical Assessment may be withdrawn by the issuing Technical Assessment Body, in particular pursuant to information by the Commission in accordance with Article 25(3) of Regulation (EU) No 305/2011.

Z192847.25 8.06.01-187/25



Page 3 of 34 | 4 November 2025

Specific Part

1 Technical description of the product

The "Walsywa Injection system WQI 44 PLUS for concrete" is a bonded anchor consisting of a cartridge with injection mortar WQI 44 Plus and a steel element. The steel element consists of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30 or reinforcing bar in the range of \varnothing 8 to \varnothing 32 mm or an internal threaded anchor rod IG-M6 to IG-M20.

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 fastener 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 fastener of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex B 3, C 1, C 2, C 3, C 5 and C 7
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 4, C 6 and C 8
Displacements (static and quasi-static loading)	See Annex C 9 to C 11
Characteristic resistance for seismic performance categories C1	See Annex C 12 and C 13
Characteristic resistance and displacements for seismic performance categories C2	No performance assessed

3.2 Safety in case of fire (BWR 2)

Essential characteristic	Performance
Reaction to fire	Class A1
Resistance to fire	See Annex C 14 to C 16

3.3 Hygiene, health and the environment (BWR 3)

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

Z192847.25 8.06.01-187/25

European Technical Assessment ETA-12/0167

English translation prepared by DIBt



Page 4 of 34 | 4 November 2025

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

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

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

Issued in Berlin on 4 November 2025 by Deutsches Institut für Bautechnik

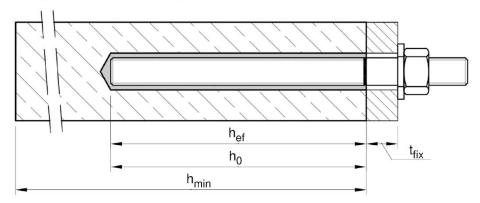
Dipl.-Ing. Beatrix Wittstock Head of Section beglaubigt: Baderschneider

Z192847.25 8.06.01-187/25

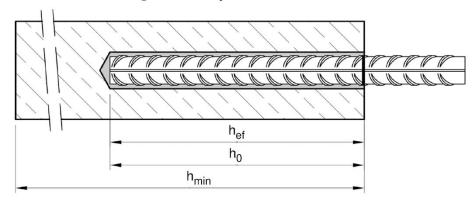


Installation threaded rod M8 up to M30

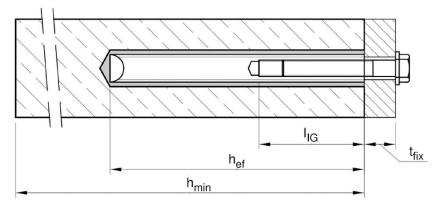
prepositioned installation or push through installation (annular gap filled with mortar)



Installation reinforcing bar Ø8 up to Ø32



Installation internal threaded anchor rod IG-M6 up to IG-M20



 t_{fix} = thickness of fixture h_0 = nominal drill hole diameter

 h_{ef} = effective embedment depth I_{IG} = thread engagement length

h_{min} = minum thickness of member

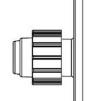
Walsywa Injection system WQI 44 PLUS for concrete Product description Installed condition Annex A 1



Cartridge system

Coaxial Cartridge:

150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml



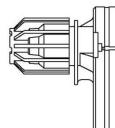
Imprint:

WQI 44 Plus

Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Side-by-Side Cartridge:

235 ml, 345 ml up to 360 ml and 825 ml



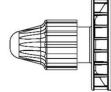
Imprint:

WQI 44 Plus

Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Foil tube Cartridge:

165 ml and 300 ml



Imprint:

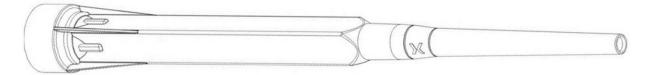
WQI 44 Plus

Processing and safety instructions, shelf life, charge number, manufacturer's information, quantity information

Static mixer WQI 44 Plus static mixer



Static mixer PM-19E



Piston plug VS and mixer extension VL



Walsywa Injection system WQI 44 PLUS for concrete

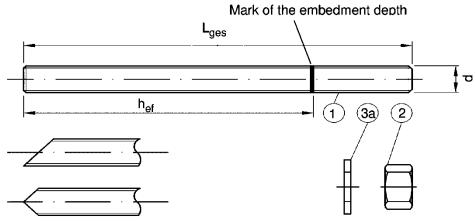
Product description

Injection system

Annex A 2



Threaded rod M8 up to M30 with washer and hexagon nut

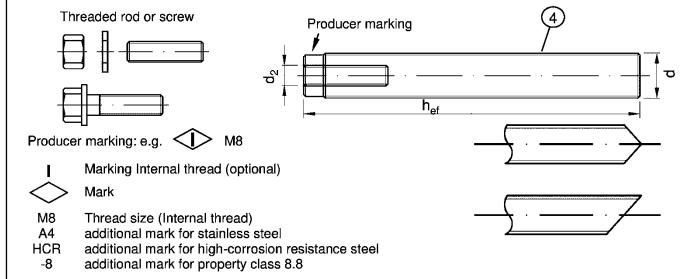


Commercial standard rod with:

- Materials, dimensions and mechanical properties acc. to Table A1
- Inspection certificate 3.1 acc. to EN 10204:2004. The document shall be stored.
- Marking of embedment depth

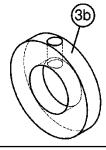
For hot dip galvanized elements, the requirements with regards to the combination of nuts and rods according to EN ISO 10684:2004+AC:2009 Annex F shall be considered.

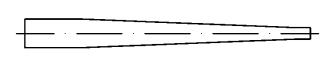
Internal threaded rod IG-M6 to IG-M20



Filling washer VFS

Mixer reduction nozzle MR





Walsywa Injection system WQI 44 PLUS for concrete

Product description

Threaded rod; Internal threaded rod Filling washer; Mixer reduction nozzle

Annex A 3



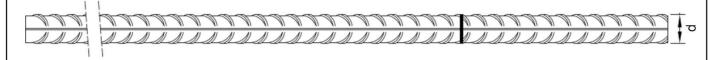
-	ble A1: Mate	erials				
Par	Designation	Material				
Stee - z - h	el, zinc plated (Steel inc plated ≥ 1 ot-dip galvanised ≥ 1	acc. to EN ISO 683-4:2 5 µm acc. to EN ISO	4042 146	2:2022 or 1:2022 and EN ISO 10684:	2004+AC:2009 or	
Sileraraized		Property class		Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
			4.6	f _{uk} = 400 N/mm ²	f _{yk} = 240 N/mm ²	A ₅ > 8%
1	Threaded rod		4.8	f _{uk} = 400 N/mm ²	f _{yk} = 320 N/mm ²	A ₅ > 8%
• 6	Tim Sudded Tod	acc. to EN ISO 898-1:2013		f _{uk} = 500 N/mm ²	f _{yk} = 300 N/mm ²	A ₅ > 8%
		EN 130 696-1.2013		f _{uk} = 500 N/mm ²	f _{vk} = 400 N/mm ²	A ₅ > 8%
				f _{uk} = 800 N/mm ²	f _{vk} = 640 N/mm ²	A ₅ ≥ 8%
		lace to	4	for anchor rod class 4.6 o	1.7	
2	Hexagon nut	acc. to EN ISO 898-2:2022	5	for anchor rod class 5.6 o	r 5.8	
			8	for anchor rod class 8.8		
3a	Washer	(e.g.: EN ISO 887:20	006, E	galvanised or sherardized EN ISO 7089:2000, EN ISO	O 7093:2000 or EN ISC	7094:2000)
3b_	Filling washer	Steel, zinc plated, ho	t-dip	galvanised or sherardized		1
4	Internal threaded	Property class		Characteristic steel ultimate tensile strength	Characteristic steel yield strength	Elongation at fracture
	i iliterriai tilieaded					
4	anchor rod	acc. to		f _{uk} = 500 N/mm ²	$f_{yk} = 400 \text{ N/mm}^2$	A ₅ > 8%
4	The state of the s	acc. to EN ISO 898-1:2013		f _{uk} = 500 N/mm ²		
Stai Stai	anchor rod nless steel A2 (Mate	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1	8.8 .431 .457	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023)	A ₅ > 8%
Stai Stai	anchor rod nless steel A2 (Mate	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1	8.8 .431 .457	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t 1 .4565, acc. to EN 10088 Characteristic steel	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel	A ₅ > 8% A ₅ > 8%
Stai Stai Hig	nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class	8.8 .431 .457	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. t 1 / 1.4362 or 1.4578, acc. t 1.4565, acc. to EN 10088	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023)	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at
Stai Stai Hig	anchor rod nless steel A2 (Mate	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class acc. to	8.8 .431 .457 529 or	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{1 / 1.4567 or 1.4541, acc. t} \\ \text{1 / 1.4362 or 1.4578, acc. t} \\ \text{1 .4565, acc. to EN 10088} \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength	A ₅ > 8% A ₅ > 8% Elongation at fracture
Stai Stai Hig	nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class	8.8 .431 .457 529 or	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1.4565, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \end{aligned}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$
Stai Stai Hig	nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020	8.8 .431 .457 529 or	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{1 / 1.4567 or 1.4541, acc. t} \\ \text{1 / 1.4362 or 1.4578, acc. t} \\ \text{1 .4565, acc. to EN 10088} \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$
Stai Stai Hig	nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 acc. to	8.8 .431 .457 529 or 50 70 80	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{1 / 1.4567 or 1.4541, acc. t} \\ \text{1 / 1.4362 or 1.4578, acc. t} \\ \text{1 / 1.4365, acc. to EN 10088} \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$
Stai Stai Hig	anchor rod nless steel A2 (Materials and Materials and Ma	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 ace steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 acc. to EN ISO 3506-1:2020	8.8 .431 .457 529 or 50 70 80 50 70 80	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \\ \text{for anchor rod class } 80 \\ \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 8\%$
Stai Stai Hig	anchor rod nless steel A2 (Materials and Materials and Ma	EN ISO 898-1:2013 erial 1.4301 / 1.4307 / 1 erial 1.4401 / 1.4404 / 1 erial 1.4401 / 1.4404 / 1 erial 1.450 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529	8.8 .431 .457 629 or 50 70 80 70 80 71.43 71.44 9 or 1	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 8\%$ $1:2023$ $1:2023$
Stai Stai Hig	anchor rod nless steel A2 (Materials and Materials and Ma	EN ISO 898-1:2013 Prial 1.4301 / 1.4307 / 1 Prial 1.4401 / 1.4404 / 1 Ice steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529 (e.g.: EN ISO 887:20	8.8 .431 .457 529 or 50 70 80 70 80 71.43 71.44 9 or 1	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 \text{ / } 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 \text{ / } 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 \text{ / } 1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \\ \text{for anchor rod class } 80 \\ 07 \text{ / } 1.4311 \text{ / } 1.4567 \text{ or } 1.4 \\ 04 \text{ / } 1.4571 \text{ / } 1.4362 \text{ or } 1.4 \\ .4565, \text{ acc. to EN } 10088-1 \\ \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 8\%$ $1:2023$ $1:2023$
Stai Stai Hig	anchor rod nless steel A2 (Material Material Ma	EN ISO 898-1:2013 Prial 1.4301 / 1.4307 / 1 Prial 1.4401 / 1.4404 / 1 Ice steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4529 (e.g.: EN ISO 887:20	8.8 .431 .457 529 or 50 70 80 70 80 71.43 71.44 9 or 1	$\begin{split} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \\ \text{for anchor rod class } 80 \\ 07 / 1.4311 / 1.4567 \text{ or } 1.4 \\ 04 / 1.4571 / 1.4362 \text{ or } 1.4 \\ .4565, \text{ acc. to EN } 10088-1 \\ \text{EN ISO } 7089:2000, \text{ EN ISO} \end{split}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ²	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 8\%$ $1:2023$ $1:2023$ $1:2023$
Stai Stai Hig	anchor rod nless steel A2 (Materials steel A4 (Materials st	EN ISO 898-1:2013 Prial 1.4301 / 1.4307 / 1 Prial 1.4401 / 1.4404 / 1 Ice steel (Material 1.45 Property class acc. to EN ISO 3506-1:2020 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4524 (e.g.: EN ISO 887:20 Stainless steel A4, H	8.8 .431 .457 529 or 50 70 80 70 80 71.43 71.44 9 or 1	$f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ $1 / 1.4567 \text{ or } 1.4541, \text{ acc. t}$ $1 / 1.4362 \text{ or } 1.4578, \text{ acc. t}$ $1 / 1.4365, \text{ acc. to EN } 10088$ $Characteristic steel$ $ultimate tensile strength$ $f_{uk} = 500 \text{ N/mm}^2$ $f_{uk} = 700 \text{ N/mm}^2$ $f_{uk} = 800 \text{ N/mm}^2$ $for anchor rod class 50$ $for anchor rod class 70$ $for anchor rod class 80$ $07 / 1.4311 / 1.4567 \text{ or } 1.4$ $04 / 1.4571 / 1.4362 \text{ or } 1.4$ $.4565, \text{ acc. to EN } 10088-1$ $EN ISO 7089:2000, EN ISO$ $orrosion resistance steel$ $Characteristic steel$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2023) o EN 10088-1:2023) -1:2023) Characteristic steel yield strength f _{yk} = 210 N/mm ² f _{yk} = 450 N/mm ² f _{yk} = 600 N/mm ² 541, acc. to EN 10088-578, acc. to EN 10088-:2023 D 7093:2000 or EN ISC	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 8\%$ $A_5 \ge 8\%$ $1:2023$ $1:2023$ $1:2023$ $1:2023$ $1:2023$ Elongation at

²⁾ for IG-M20 only property class 50
3) Property class 80 only for stainless steel A4 and HCR

Walsywa Injection system WQI 44 PLUS for concrete	
Product description Materials threaded rod and internal threaded rod	Annex A 4







Minimum value of related rip area $f_{R,min}$ according to EN 1992-1-1:2004+AC:2010 Rib height of the bar shall be in the range $0.05d \le h_{rib} \le 0.07d$ (d: Nominal diameter of the bar; h_{rib} : Rib height of the bar)

Table A2: Materials Reinforcing bar

Part	Designation	Material
Reba	ar	
	Reinforcing steel according to EN 1992 1 1:2004+AC:2010, Annex C	Bars and rebars from ring class B or C f_{yk} and k according to NDP or NCI according to EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

Walsywa Injection system WQI 44 PLUS for concrete	
Product description Materials reinforcing bar	Annex A 5



Specification of the intended use

Fasteners subject to (Static and quasi-static loads):

	Working life 50 years		Working life	100 years
Base material	uncracked concrete	cracked concrete	uncracked concrete	cracked concrete
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to M30, Ø8 to Ø32, IG-M6 to IG-M20		No performand	ce assessed
Temperature Range	I: -40°C to +40°C ¹⁾ II: -40°C to +80°C ²⁾ III: -40°C to +120°C ³⁾		No performanc	e assessed

Fasteners subject to (seismic action):

	Performance Category C1	Performance Category C2
Base material	Cracked and uncracked concrete	
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to M30, Ø8 to Ø32	No performance assessed
Temperature Range	I: - 40°C to +40°C ¹⁾ II: - 40°C to +80°C ²⁾ III: - 40°C to +120°C ³⁾	No performance assessed

Fasteners subject to (fire exposure):

Base material	Cracked and uncracked concrete
HD: Hammer drilling HDB: Hammer drilling with hollow drill bit CD: Compressed air drilling	M8 to M30, ∅8 to ∅32, IG-M6 to IG-M20
Temperature Range:	I: -40°C to +40°C ¹⁾ II: -40°C to +80°C ²⁾ III: -40°C to +120°C ³⁾

Walsywa Injection system WQI 44 PLUS for concrete	
Intended Use Specifications	Annex B 1

^{1) (}max. long-term temperature +24°C and max. short-term temperature +40°C)

^{2) (}max. long-term temperature +50°C and max. short-term temperature +80°C)

^{3) (}max. long-term temperature +72°C and max. short-term temperature +120°C)



Base material:

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

Use conditions (Environmental conditions):

- 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 class:
 - Stainless steel Stahl A2 according to Annex A 4, Table A1: CRC II
 - Stainless steel Stahl A4 according to Annex A 4, Table A1: CRC III
 - High corrosion resistance steel HCR according to Annex A 4, Table A1: CRC V

Design:

- Verifiable calculation notes and drawings are 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.).
- Fasteners are designed under the responsibility of an engineer experienced in fasteners and concrete work.
- The fasteners are designed in accordance to EN 1992-4:2018 and Technical Report TR 055,
 Edition February 2018

Installation:

- Dry, wet concrete or flooded bore holes (not sea-water).
- Hole drilling by hammer (HD), hollow (HDB) or compressed air (CD).
- Overhead installation allowed.
- Fastener installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.
- Installation temperature in concrete:

MOLAA DI .	-10°C up to +40°C for the standard variation of temperature after installa	4.5
WQI 44 Plus:	= 1894 Tunito +/884 Tior the etandard Variation of temperature affor inetalia	MONTE
VVGI 44 I IUS.	- 10 C up to +40 C tot the standard variation of temperature after installa	LUUII.

Walsywa Injection system WQI 44 PLUS for concrete	
Intended Use Specifications (Continued)	Annex B 2



Table B1:	Installation pa	arame	ters	for thre	eaded	rod	
Threaded rod					M8	M10	M12

Threaded rod					M10	M12	M16	M20	M24	M27	M30
Diameter of elemen	Diameter of element d = e			8	10	12	16	20	24	27	30
Nominal drill hole di	ameter	d_0	[mm]	10	12	14	18	24	28	32	35
Effective embedmen	nt donth	h _{ef,min}	[mm]	60	60	70	80	90	96	108	120
	Effective embedment depth		[mm]	160	200	240	320	400	480	540	600
Diameter of	Prepositioned ins	ſ	[mm]	9	12	14	18	22	26	30	33
clearance hole in the fixture	Push through installation df		[mm]	12	14	16	20	24	30	33	40
Maximum installatio	n torque	max T _{inst}	[Nm]	10	20	40	60	100	170	250	300
Minimum thickness of member		h _{min}	[mm]	_	_f + 30 m : 100 mr			ŀ	n _{ef} + 2do)	
Minimum spacing		s _{min}	[mm]	40	50	60	80	100	120	135	150
Minimum edge dista	nce	c _{min}	[mm]	40	50	60	80	100	120	135	150

Table B2: Installation parameters for reinforcing bar

Reinforcing bar				Ø 12 ¹⁾	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
$d = d_{nom}$	[mm]	8	10	12	14	16	20	25	28	32
d ₀	[mm]	10 12	12 14	14 16	18	20	25	32	35	40
h _{ef,min}	[mm]	60	60	70	75	80	90	100	112	128
h _{ef,max}	[mm]	160	200	240	280	320	400	500	560	640
h _{min}	[mm]	, .					h _{ef} + 2	!d ₀		
s _{min}	[mm]	40 50		60	70	80	100	125	140	160
c _{min}	[mm]	40	50	60	70	80	100	125	140	160
	d ₀ h _{ef,min} h _{ef,max} h _{min}	d ₀ [mm] h _{ef,min} [mm] h _{ef,max} [mm] h _{min} [mm]	$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$							

¹⁾ both nominal drill hole diameter can be used

Table B3: Installation parameters for Internal threaded anchor rod

Internal threaded anchor rod	IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20				
Internal diameter of anchor rod	d ₂		6	8	10	12	16	20		
Outer diameter of anchor rod1)	d = d _{nom}	[mm]	10	12	16	20	24	30		
Nominal drill hole diameter	d ₀		12	14	18	24	28	35		
Effective embedment depth	h _{ef,min}	[mm]	60	70	80	90	96	120		
Effective embedment depth	h _{ef,max}		200	240	320	400	480	600		
Diameter of clearance hole in the fixture	d _f ≤	[mm]	7	9	12	14	18	22		
Maximum installation torque	max T _{inst}	[Nm]	10	10	20	40	60	100		
Thread engagement length min/max	l _{IG}	[mm]	8/20	8/20	10/25	12/30	16/32	20/40		
Minimum thickness of member	h _{min}	[mm]		h _{ef} + 30 mm ≥ 100 mm			- 2d ₀			
Minimum spacing	s _{min}	[mm]	50	60	80	100	120	150		
Minimum edge distance	c _{min}	[mm]	50	60	80	100	120	150		
1) With marking through according to EN 1000 1 0,0000										

¹⁾ With metric threads according to EN 1993-1-8:2005+AC:2009

Walsywa Injection system WQI 44 PLUS for concrete

Intended Use

Installation parameters

Annex B 3



Table B4	Table B4: Parameter cleaning and installation tools												
Threaded Rod	Re- inforcing bar	Internal threaded anchor rod	d ₀ Drill bit - Ø HD, HDB, CD	Ø Bruch Ø min.		Piston plug		Installation direction and u of piston plug					
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		1	\rightarrow	1			
M8	8		10	WQI10	12	10,5		.,					
M10	8 / 10	IG-M6	12	WQI12	14	12,5		No plug	roquirod				
M12	10 / 12	IG-M8	14	WQI14	16	14,5		No plug	required				
	12		16	WQI16		16,5		·	ν ₁				
M16	14	IG-M10	18	WQI18	20	18,5	VS18						
	16		20	WQI20	22	20,5	VS20						
M20		IG-M12	24	WQI24	26	24,5	VS24	h _{ef} >	h _{ef} >				
	20		25	WQI25	27	25,5	VS25	250 mm	250 mm	all			
M24		IG-M16	28	WQI28	_	28,5	VS28	250 111111	250 11111				
M27	25		32	WQI32	34	32,5	VS32						
M30	28	IG-M20	35	WQI35		35,5	VS35						
	32		40	WQI40	41,5	40,5	VS40						

Cleaning and installation tools

Hand pump

(Volume 750 ml, $h_0 \le 10 d_s$, $d_0 \le 20 mm$)



Compressed air tool

(min 6 bar)



Brush WQI



Piston Plug VS



Brush extension RBL



Walsywa Injection system WQI 44 PLUS for concrete	
Intended Use Cleaning and installation tools	Annex B 4



Table B5:	Worki	ng time and c					
Tempera	ture in bas	se material	Maximum working time	Minimum curing time ¹⁾			
	Т		t _{gel}	t _{cure}			
- 10°C	to	- 6°C	90 min ²⁾	24 h			
- 5 °C to - 1 °C		- 1 °C	90 min	14 h			
0°C	0°C to + 4°C		45 min	7 h			
+ 5°C	to	+ 9°C	25 min	2 h			
+ 10°C	to	+ 19°C	15 min	80 min			
+ 20°C	to	+ 29°C	6 min	45 min			
+ 30°C	to	+ 34°C	4 min	25 min			
+ 35°C	to	to + 39 °C 2 min		20 min			
	+40°C		1,5 min 15 min				
Cartr	idge tempe	erature	+5°C to +40°C				

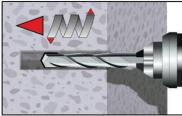
¹⁾ The minimum curing time is only valid for dry base material. In wet base material the curing time must be doubled.
2) Cartridge temperature must be at least +15°C

Walsywa Injection system WQI 44 PLUS for concrete	
Intended Use Working time and curing time	Annex B 5



Installation instructions

Drilling of the bore hole



Hammer drilling (HD) / Compressed air drilling (CD)

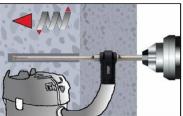
Drill a hole to the required embedment depth.

Drill a hole to the required embedment depth.

Drill bit diameter according to Table B1, B2 or B3.

Aborted drill holes shall be filled with mortar.

Proceed with Step 2 (CAC and MAC).



1b. Hollow drill bit system (HDB)

Drill a hole to the required embedment depth.

Drill bit diameter according to Table B1, B2 or B3.

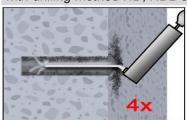
Aborted drill holes shall be filled with mortar.

Proceed with Step 2 (CAC and MAC).

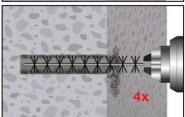
Attention! Standing water in the bore hole must be removed before cleaning

Manual Air Cleaning (MAC)

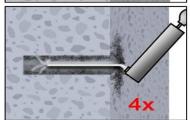
for bore hole diameter $d_0 \le 20$ mm and bore hole depth $h_0 \le 10d_{nom}$ ($d_0 < 14$ mm uncracked concrete only) with drilling method HD, HDB and CD



Blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).



Brush the bore hole minimum 4x with brush WQI according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension RBL shall be used.)



2c.

Finally blow the bore hole clean minimum 4x from the bottom or back by hand pump (Annex B 4).

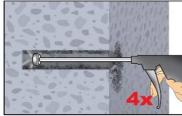
Walsywa Injection system WQI 44 PLUS for concrete Intended Use Installation instructions Annex B 6



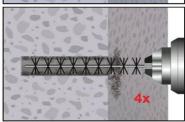
Installation instructions (continuation)

Compressed Air Cleaning (CAC):

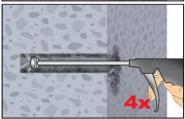
All diameter with drilling method HD, HDB and CD



2a. Blow the bore hole clean minimum 4x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

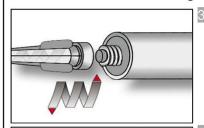


Brush the bore hole minimum 4x with brush WQI according to Table B4 over the entire embedment depth in a twisting motion. (If necessary, a brush extension RBL shall be used.)



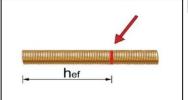
Finally blow the bore hole clean minimum 4x with compressed air (min. 6 bar) (Annex B 4) over the entire embedment depth until return air stream is free of noticeable dust. (If necessary, an extension shall be used.)

Cleaned bore hole has to be protected against re-contamination in an appropriate way, If necessary, repeat cleaning process directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.



Screw on static-mixing nozzle WQI 44 Plus static mixer/PM-19E and load the cartridge into an appropriate dispensing tool. With foil tube cartridges cut off the foil tube clip before use.

For every working interruption longer than the maximum working time t_{work} (Annex B 5) as well as for new cartridges, a new static-mixer shall be used.



Mark embedment depth on the anchor rod.

The anchor rod shall be free of dirt, grease, oil or other foreign material.

Walsywa Injection system WQI 44 PLUS for concrete

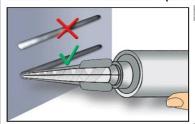
Intended Use

Installation instructions (continuation)

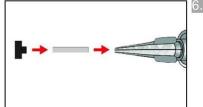
Annex B 7



Installation instructions (continuation)

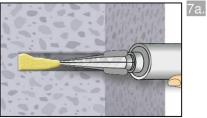


Not proper mixed mortar is not sufficient for fastening. Dispense and discard mortar until an uniform grey or red colour is shown (at least 3 full strokes, for foil tube cartridges at least 6 full storkes).



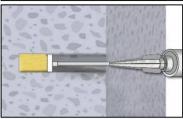
Piston plugs VS and mixer nozzle extensions VL shall be used according to Table B4 for the following applications:

- Horizontal and vertical downwards direction: Drill bit-Ø d₀ ≥ 18 mm and embedment depth h_{ef} > 250mm
- Vertical upwards direction: Drill bit- \emptyset d₀ \geq 18 mm Assemble mixing nozzle, mixer extension and piston plug before injecting mortar.



Injecting mortar without piston plug VS:

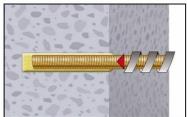
Starting at bottom of the hole and fill the hole up to approximately two-thirds with adhesive. (If necessary, a mixer nozzle extension shall be used.) Slowly withdraw of the static mixing nozzle avoid creating air pockets. Observe the temperature related working time t_{work} (Annex B 5).



Injecting mortar with piston plug VS:

Starting at bottom of the hole and fill the hole up to approximately two-thirds with adhesive. (If necessary, a mixer nozzle extension shall be used.) During injection the piston plug is pushed out of the bore hole by the back pressure of the mortar.

Observe the temperature related working time t_{work} (Annex B 5). .



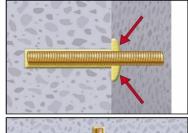
8.

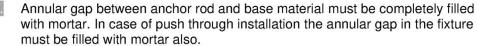
Insert the anchor rod while turning slightly up to the embedment mark.

Walsywa Injection system WQI 44 PLUS for concrete	
Intended Use Installation instructions (continuation)	Annex B 8

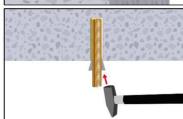


Installation instructions (continuation)

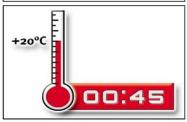




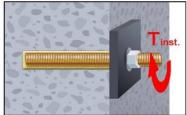
Otherwise, the installation must be repeated starting from step 7 before the maximum working time t_{work} has expired.



 For application in vertical upwards direction the anchor rod shall be fixed (e.g. wedges).



Temperature related curing time t_{cure} (Annex B 5) must be observed.
 Do not move or load the fastener during curing time.



2. Install the fixture by using a calibrated torque wrench. Observe maximum installation torque (Table B1, B2 or B3).

In case of static requirements (e.g. seismic), fill the annular gab in the fixture with mortar (Annex A 3). Therefore replace the washer by the filling washer VFS and use the mixer reduction nozzle MR.

Walsywa Injection system WQI 44 PLUS for concrete

Intended Use

Installation instructions (continuation)

Annex B 9



7	Table C1: Characteristic values for steel tension resistance and steel shear resistance of threaded rods										
Th	readed rod			M8	M10	M12	M16	M20	M24	M27	M30
Cr	oss section area	As	[mm²]	36,6	58	84,3	157	245	353	459	561
Cr	naracteristic tension resistance, Steel failu	re ¹⁾	ı	•	•			<u> </u>	ı	J.	
Ste	eel, Property class 4.6 and 4.8	N _{Rk,s}	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
Ste	eel, Property class 5.6 and 5.8	N _{Rk,s}	[kN]	18 (17)	29 (27)	42	78	122	176	230	280
Ste	eel, Property class 8.8	N _{Rk,s}	[kN]	29 (27)	46 (43)	67	125	196	282	368	449
Sta	ainless steel A2, A4 and HCR, class 50	$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281
Sta	ainless steel A2, A4 and HCR, class 70	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	_3)	_3)
Sta	ainless steel A4 and HCR, class 80	N _{Rk,s}	[kN]	29	46	67	126	196	282	_3)	_3)
Cł	naracteristic tension resistance, Partial fac	tor ²⁾									
Ste	eel, Property class 4.6 and 5.6	γ _{Ms,N}	[-]				2,0	0			
Ste	eel, Property class 4.8, 5.8 and 8.8	γMs,N	[-]				1,5	5			
Sta	ainless steel A2, A4 and HCR, class 50	γ _{Ms,N}	[-]				2,8	6			
Sta	ainless steel A2, A4 and HCR, class 70	γ _{Ms,N}	[-]				1,8	7			
-	ainless steel A4 and HCR, class 80	γMs,N	[-]				1,6	6			
Cł	naracteristic shear resistance, Steel failure	1)								1	1
_	Steel, Property class 4.6 and 4.8	V ⁰ Rk,s	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
arn	Steel, Property class 5.6 and 5.8	V ⁰ Rk,s	[kN]	11 (10)	17 (16)	25	4 7	74	106	138	168
eve!	Steel, Property class 8.8	V ⁰ Rk,s	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
<u>‡</u>	Stainless steel A2, A4 and HCR, class 50	V ⁰ Rk,s	[kN]	9	15	21	39	61	88	115	140
Without lever	Stainless steel A2, A4 and HCR, class 70	V ⁰ Rk,s	[kN]	13	20	30	55	86	124	_3)	_3)
>	Stainless steel A4 and HCR, class 80	V ⁰ Rk,s	[kN]	15	23	34	63	98	141	_3)	_3)
	Steel, Property class 4.6 and 4.8	M ^U Rk,s	[Nm]	15 (13)	30 (27)	52	133	260	449	666	900
arm	Steel, Property class 5.6 and 5.8	M ⁰ Rk,s	[Nm]	19 (16)	37 (33)	65	166	324	560	833	1123
lever 8	Steel, Property class 8.8	M ⁰ Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
고 마	Stainless steel A2, A4 and HCR, class 50	M ⁰ Rk,s	[Nm]	19	37	66	167	325	561	832	1125
×	Stainless steel A2, A4 and HCR, class 70	M ⁰ Rk,s	[Nm]	26	52	92	232	454	784	_3)	_3)
	Stainless steel A4 and HCR, class 80	М ⁰ _{Rk,s}	[Nm]	30	59	105	266	519	896	_3)	_3)
Cr	naracteristic shear resistance, Partial facto										
St	eel, Property class 4.6 and 5.6	γ _{Ms,V}	[-]				1,6	57			
St	eel, Property class 4.8, 5.8 and 8.8	γ _{Ms,V}	[-]				1,2	25			
Sta	ainless steel A2, A4 and HCR, class 50	γMs,V	[-]				2,3	8			
Sta	ainless steel A2, A4 and HCR, class 70	γ _{Ms,V}	[-]				1,5	66			
Sta	ainless steel A4 and HCR, class 80	γ _{Ms,V}	[-]		· ·		1,3	33			
1 47							–				

¹⁾ Values are only valid for the given stress area A_s. 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.

³⁾ Fastener type not part of the ETA

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods	Annex C 1

²⁾ in absence of national regulation



Table C2:	Characteristic v	alues of te	nsion load	s under static and quasi-static action
Fastener				All Anchor types and sizes
Concrete cone f	ailure			·
Uncracked concre	ete	k _{ucr,N}	[-]	11,0
Cracked concrete)	k _{cr,N}	[-]	7,7
Edge distance		c _{cr,N}	[mm]	1,5 h _{ef}
Axial distance		s _{cr,N}	[mm]	2 c _{cr,N}
Splitting				
	h/h _{ef} ≥ 2,0			1,0 h _{ef}
Edge distance	2,0 > h/h _{ef} > 1,3	c _{cr,sp}	[mm]	$2 \cdot h_{ef} \left(2,5 - \frac{h}{h_{ef}} \right)$
	h/h _{ef} ≤ 1,3			2,4 h _{ef}
Axial distance	•	s _{cr,sp}	[mm]	2 c _{cr,sp}

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values for Concrete cone failure and Splitting with all kind of action	Annex C 2



Throse	ded rod	aracteristic va			M8	M10	M12		M20	M24	M27	M30
Steel fa					IAIO	IVITO	141 1 2	IVITO	IVIZU	10124	IVIZI	IVISO
Charac	cteristic tension re	esistance	N _{Rk,s}	[kN]			A _s · f _l	_{Jk} (or s	ee Tab	le C1)		
Partial			γ _{Ms,N}	[-]	see Table C1							
		d concrete failure stance in uncracke	d concrete C20	0/25								
Onarac	I: 40°C/24°C	Stance in uncracke	Concrete Ozt		10	12	12	12	12	11	10	9,0
Эğе	II: 80°C/50°C	Dry, wet			7,5	9,0	9,0	9,0	9,0	8,5	7,5	6,5
re ra	III: 120°C/72°6	concrete			5,5	6,5	6,5	6,5	6,5	6,5	5,5	5,0
Temperature range	I: 40°C/24°C		^τ Rk,ucr	[N/mm²]	7,5	8,5	8,5	8,5				<u> </u>
Lemp	II: 80°C/50°C	flooded bore hole			5,5	6,5	6,5	6,5	١	lo Perfe Asse	ormano essed	e
ı	III: 120°C/72°C				4,0	5,0	5,0	5,0				
Charac		stance in cracked o	concrete C20/2	25		ı				I		
o)	I: 40°C/24°C	Dw. wat			4,0	5,0	5,5	5,5	5,5	5,5	6,5	6,5
rang	II: 80°C/50°C	Dry, wet concrete			2,5	3,5	4,0	4,0	4,0	4,0	4,5	4,5
Temperature range	III: 120°C/72°C	3	τ _{Rk,cr}	[N/mm²]	2,0	2,5	3,0	3,0	3,0	3,0	3,5	3,5
npera	I: 40°C/24°C	flooded bore			4,0	4,0	5,5	5,5		No Performa		` <u> </u>
Ter	II: 80°C/50°C	hole			2,5	3,0	4,0	4,0	Assessed			,0
Dadula	III: 120°C/72°0		vested sense	da 000/05	2,0	2,5	3,0	3,0				
		in cracked and und	Tacked concre	1e C20/25								
Temperature range	I: 40°C/24°C	Dry, wet concrete and		0,73								
mperat range	II: 80°C/50°C	flooded bore hole	Ψ ⁰ sus	[-]	0,65							
	III: 120°C/72°0	٠			0,57							
	sing factors for co		Ψc	[-]					20) 0,11	OE)		
	cteristic bond resi concrete strengtl	stance depending		τ _{Rk,ucr} =					_{cr} (C20/ _{cr} (C20/			
	rete cone failure			τ _{Rk,cr} =			Ψα	: 'Rk,c	or(Ozon			
	ant parameter							see Ta	able C2	ı		
Splitti i Releva	ng ant parameter							see Ta	able C2			
Install	lation factor		1	1	· · · · · · · · · · · · · · · · · · ·	ı						
for dry	and wet concrete	•	 _{v·} ,	[-]	1,0				1,2	In David		
for floo	oded bore hole Yinst [-] 1,4						No Performance Assessed					
Wals	sywa Injection	system WQI 44 F	PLUS for con	crete								
	ormances acteristic values	of tension loads u	nder static and	d quasi-stat	ic actio	on (Thr	eaded	rod)		Anne	x C 3	3



Table C4: Characteristic	values	of sh	ear lo	ads ur	nder s	tatic a	nd qu	asi-st	atic acti	on
Threaded rod		M8	M10	M12	M16	M20	M24	M27	M30	
Steel failure without lever arm		'		'	•	•	•		•	
Characteristic shear resistance Steel, strength class 4.6, 4.8, 5.6 and 5.8	V ⁰ Rk,s	[kN]			0,6 •	A _s • f _{uk}	(or see	Table C	1)	
Characteristic shear resistance Steel, strength class 8.8 Stainless Steel A2, A4 and HCR, all classes	V ⁰ Rk,s	[kN]			0,5 •	A _s ∙ f _{uk}	(or see	Table C	1)	
Partial factor	γ _{Ms,V}	[-]				see	Table C	:1		
Ductility factor	k ₇	[-]					1,0			
Steel failure with lever arm	1									
Characteristic bending moment	M ⁰ Rk,s	[Nm]			1,2 • 1	W _{el} • f _{ul}	(or see	Table 0	21)	
Elastic section modulus	W _{el}	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	γ _{Ms,V}	[-]				see	Table C	:1		
Concrete pry-out failure										
Factor	k ₈	[-]					2,0			
Installation factor	γinst	[-]	1,0							
Concrete edge failure										
Effective length of fastener	l _f	[mm]	min(h _{ef} ; 12 · d _{nom}) min(h _{ef} ; 300mm)						300mm)	
Outside diameter of fastener	d _{nom}	[mm]	8 10 12 16 20 24 27 30						30	
Installation factor	γ _{inst}	[-]	1,0							

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of shear loads under static and quasi-static action (Threaded rod)	Annex C 4



Internal threaded anchor rod Steel failure ¹⁾	s			IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Characteristic tension resistant	ce, 5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123		
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196		
Partial factor, strength class 5.8	8 and 8.8	γ _{Ms,N}	[-]		1	1	,5				
Characteristic tension resistand Steel A4 and HCR, Strength cl	ce, Stainless	N _{Rk,s}	[kN]	14	26	41	59	110	124		
Partial factor		γ _{Ms,N}	[-]		•	1,87			2,86		
Combined pull-out and conc	rete cone failı										
Characteristic bond resistance	in uncracked	concrete	C20/25								
l: 40°C/24°C	Dn. wot			12	12	12	12	11	9,0		
ember and the second se	Dry, wet concrete			9,0	9,0	9,0	9,0	8,5	6,5		
E	Concrete	J 7	[N/mm2]	6,5	6,5	6,5	6,5	6,5	5,0		
产 현 <u>I: 40°C/24°C</u>	flooded bore	"Rk,ucr	[N/mm²]	8,5	8,5	8,5					
ច្ច <u>II: 80°C/50°C</u>	hole			6,5	6,5	6,5	No Perfe	ormance A	ssesse		
: III: 120°C/72°C				5,0	5,0	5,0					
Characteristic bond resistance 1: 40°C/24°C	in cracked cor	ncrete C2	20/25 I	F 0	5,5	5,5	5,5	_ E E	C E		
II: 80°C/50°C	Dry, wet			5,0 3,5	4,0	4,0	4,0	5,5 4,0	6,5 4,5		
II: 80°C/50°C II: 40°C/24°C II: 80°C/50°C II: 80°C/50°	concrete			2,5	3,0	3,0	3,0	3,0	3,5		
III: 120°C/72°C			[N/mm ²]	4,0	5,5	5,5	3,0	3,0	3,3		
		flooded bore			3,0	4,0	4,0	No Perf	ormance A	000000	
III: 120°C/72°C	hole			2,5	3,0	3,0	140 1 611	Jimanoc 7			
Reduktion factor $\psi^0_{ ext{sus}}$ in crac	ked and uncra	cked con	crete C2		, ,	,					
<u>Ф</u> I: 40°С/24°С	Dry, wet					0,	73				
Emberature II: 40°C/24°C III: 80°C/50°C III: 120°C/72°C	concrete and flooded bore	Ψ^0_{sus}	[-]			0,	65				
년 III: 120°C/72°C	hole						,57				
ncreasing factors for concrete		Ψc	[-]	(f _{ck} / 20) ^{0,11}							
Characteristic bond resistance	depending on	τ	Rk,ucr =			Ψc • τ _{Rk,u}	cr(C20/25)	ı			
he concrete strength class		τ _{Rk,cr} =				_{cr} (C20/25)					
Concrete cone failure											
Relevant parameter						see Ta	able C2				
Splitting failure						T	hla CO				
Relevant parameter						see 18	able C2				
nstallation factor		T				4	,2				
or dry and wet concrete or flooded bore hole		γ _{inst}	[-]		1,4	I		ormance A	ceases		
1) Fastenings (incl. nut and was	har) must sam	alse seeista sta		<u></u>							

¹⁾ Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of tension loads under static and quasi-static action (Internal threaded anchor rod)	Annex C 5

²⁾ For IG-M20 strength class 50 is valid



Internal threaded anchor rods				IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
Steel failure without lever arm ¹)					•	•	•	
Characteristic shear resistance,	5.8	V ⁰ _{Rk,s}	[kN]	5	9	15	21	38	61
Steel, strength class	8.8	V ⁰ Rk,s	[kN]	8	14	23	34	60	98
Partial factor, strength class 5.8 a	and 8.8	γ _{Ms,V}	[-]				1,25		
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		V ⁰ Rk,s	[kN]	7	13	20	30	55	40
Partial factor		γ _{Ms,V}	[-]			1,56			2,38
Ductility factor		k ₇	[-]				1,0		
Steel failure with lever arm1)		_							
Characteristic bending moment,	5.8	M ⁰ Rk,s	[Nm]	8	19	37	66	167	325
Steel, strength class	8.8	M ⁰ Rk,s	[Nm]	12	30	60	105	267	519
Partial factor, strength class 5.8 a	and 8.8	γ _{Ms,V}	[-]				1,25		
Characteristic bending moment, Stainless Steel A4 and HCR, Strength class 70 ²⁾		M ⁰ Rk,s	[Nm]	11	26	52	92	233	456
Partial factor		γ _{Ms,V}	[-]			1,56			2,38
Concrete pry-out failure									
Factor		k ₈	[-]				2,0		
Installation factor		γinst	[-]	1,0					
Concrete edge failure		•	•						
Effective length of fastener		l _f	[mm]	all min/h · 10 a d \					min (h _{ef} ; 300mn
Outside diameter of fastener		d _{nom}	[mm]] 10 12 16 20 24 30					
Installation factor		γ _{inst}	[-]	1,0					

¹⁾ Fastenings (incl. nut and washer) must comply with the appropriate material and property class of the internal threaded rod. The characteristic tension resistance for steel failure is valid for the internal threaded rod and the fastening element.

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of shear loads under static and quasi-static action (Internal threaded anchor rod)	Annex C 6

²⁾ For IG-M20 strength class 50 is valid



Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
Steel failure	T.,											
Characteristic tension resistance	N _{Rk,s}	[kN]				/	\s • f _{uk}			616		
Cross section area	A _s	[mm²]	50	50 79 113 154 201 314 491							804	
Partial factor	γMs,N	[-]					$1,4^{2)}$					
Combined pull-out and concrete fail												
Characteristic bond resistance in uncra	cked conc	rete C20/25	10									
<u>υ 1: 40°C/24°C</u> Dry, wet				12	12	12	12	12	11	10	8,5	
3 II. 60°C/50°C			7,5	9,0	9,0	9,0	9,0	9,0	8,0	7,0	6,0	
iii: 120°C/72°C concrete	τ _{Rk,ucr}	[N/mm²]	5,5	6,5	6,5	6,5	6,5	6,5	6,0	5,0	4,5	
1: 40°C/24°C flooded	i in,uoi	[7,5	8,5	8,5	8,5	8,5	N	lo Perfo	ormano	e	
II: 80°C/50°C bore hole			5,5	6,5	6,5	6,5	6,5		Asse			
Characteristic bond resistance in crack	od congrat	0.00/25	4,0	5,0	5,0	5,0	5,0					
1· 40°C/24°C	eu concret	<u>e 020/25</u>	4,0	5,0	5,5	5,5	5,5	5,5	5,5	6,5	6,5	
II: 80°C/50°C Dry, wet			2,5	3,5	4,0	4,0	4,0	4,0	4,0	4,5	4,5	
1: 40°C/24°C Dry, wet concrete 1: 40°C/24°C 1: 40°C/24°C 1: 40°C/24°C 1: 80°C/50°C			2,0	2,5	3,0	3,0	3,0	3,0	3,0	3,5	3,5	
III: 120°C/72°C Concrete 1: 40°C/24°C fleeded	τ _{Rk,cr} [N	[N/mm²]	4,0	4,0	5,5	5,5	5,5	No Performance				
II: 80°C/50°C			2,5	3,0	4,0	4,0	4,0					
III: 120°C/72°C bore hole			2,0	2,5	3,0	3,0	3,0	Assessed				
Reduktion factor $\psi^0_{ extsf{SUS}}$ in cracked and	uncracked	concrete C	20/25									
			0,73									
III: 120°C/72°C Dry, wet concrete and flooded bore hole	$\Psi^0_{ ext{sus}}$	[-]	0,65									
flooded bore hole			0,57									
Increasing factors for concrete	Ψ _C	[-]				(f _{Cl}	_{<} / 20) ⁽),11				
Characteristic bond resistance		τ _{Rk,ucr} =				ψ _c • τ _F	Rk,ucr(C	20/25)				
depending on the concrete strength class		τ _{Rk,cr} =				Ψ _C •τ	Rk,cr(C	20/25)				
Concrete cone failure												
Relevant parameter						see	Table	C2				
Splitting												
Relevant parameter						see	Table	C2				
Installation factor				,								
for dry and wet concrete			1,0				1					
for flooded bore hole		[-]	1,4 No Performance Assessed									

Walsywa Injection system WQI 44 PLUS for concrete	
Performances	Annex C 7
Characteristic values of tension loads under static and quasi-static action	
(Reinforcing bar)	



Table C8: Characteristi	c values	of shea	ır load	ds un	der st	latic a	and q	uasi-	static	actio	n
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Steel failure without lever arm			•		•	•		•			
Characteristic shear resistance	V ⁰ Rk,s	[kN]				0,5	0 • A _s •	f _{uk} 1)			
Cross section area	A _s	[mm²]	50	79	113	154	201	314	491	616	804
Partial factor	γ _{Ms,V}	[-]					1,5 ²⁾				
Ductility factor	k ₇	[-]					1,0				
Steel failure with lever arm											
Characteristic bending moment	[Nm]				1.2	· W _{el} ·	f _{uk} 1)				
Elastic section modulus	W _{el}	[mm³]	50	98	170	269	402	785	1534	2155	3217
Partial factor	γ _{Ms,V}	[-]					1,5 ²⁾	•			
Concrete pry-out failure	•		•								
Factor	k ₈	[-]					2,0				
Installation factor	γinst	[-]					1,0				
Concrete edge failure											
Effective length of fastener	l _f	[mm]		mi	n(h _{ef} ; 1	2 • d _{no}	m)		min(h _{ef} ; 300	mm)
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	14	16	20	25	28	32
Installation factor	γ _{inst}	[-]					1,0				

 $^{^{1)}}$ f_{uk} shall be taken from the specifications of reinforcing bars

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of shear loads under static and quasi-static action (Reinforcing bar)	Annex C 8

²⁾ in absence of national regulation



Table C9:	Displacem	ents under tensio	n load	1)							
Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30	
Uncracked concrete	e C20/25 und	ler static and quasi-st	atic action	on							
Temperature range	δ _{N0} -factor	[mm/(N/mm²)]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049	
I: 40°C/24°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,030	0,033	0,037	0,045	0,052	0,060	0,065	0,071	
Temperature range	δ_{N0} -factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119	
II: 80°C/50°C δ _{N∞} -fact		[mm/(N/mm²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172	
Temperature range	δ _{N0} -factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119	
III: 120°C/72°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172	
Cracked concrete C	20/25 under	static and quasi-stati	c action								
Temperature range	δ _{N0} -factor	[mm/(N/mm²)]	0,0	90	0,070						
I: 40°C/24°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,1	05			0,1	05			
Temperature range	δ _{N0} -factor	[mm/(N/mm²)]	0,2	219	0,170						
II: 80°C/50°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,2	255			0,2	245			
Temperature range	δ_{N0} -factor	[mm/(N/mm²)]	0,2	219			0,1	70			
III: 120°C/72°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,2	255			0,2	245			

¹⁾ Calculation of the displacement

 $\delta_{N0} = \delta_{N0}$ -factor $\cdot \tau$;

τ: action bond stress for tension

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

Table C10: Displacements under shear load¹⁾

Threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Uncracked concre	ete C20/25 und	der static and quasi-st	atic acti	on						
All temperature δνο-factor [mm/kN]		0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03	
ranges	δ _{V∞} -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
Cracked concrete C20/25 under static and quasi-stat		c action								
All temperature	δ _{v0} -factor	[mm/kN]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07
ranges	δ _{v∞} -factor	[mm/kN]	0,18	0,18	0,17	0,15	0,14	0,13	0,12	0,10

¹⁾ Calculation of the displacement

 $\delta v_0 = \delta v_0$ -factor $\cdot V$;

V: action shear load

 $\delta_{V\infty} = \delta_{V\infty}$ -factor $\cdot V$;

Walsywa Injection system WQI 44 PLUS for concrete	
Performances	Annex
Displacements under static and quasi-static action	
(threaded rods)	

Z194195.25 8.06.01-187/25

C 9



isplaceme	nts under tens	sion load	[1)				
nchor rod		IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20
C20/25 unde	er static and quasi	-static acti	on				
δ _{N0} -factor	[mm/(N/mm²)]	0,023	0,026	0,031	0,036	0,041	0,049
δ _{N∞} -factor	[mm/(N/mm²)]	0,033	0,037	0,045	0,052	0,060	0,071
δ _{N0} -factor	[mm/(N/mm²)]	0,056	0,063	0,075	0,088	0,100	0,119
δ _{N∞} -factor	[mm/(N/mm²)]	0,081	0,090	0,108	0,127	0,145	0,172
δ _{N0} -factor	[mm/(N/mm ²)]	0,056	0,063	0,075	0,088	0,100	0,119
δ _{N∞} -factor	[mm/(N/mm²)]	0,081	0,090	0,108	0,127	0,145	0,172
20/25 under s	tatic and quasi-st	atic action					
δ _{N0} -factor	[mm/(N/mm²)]	0,090			0,070		
δ _{N∞} -factor	[mm/(N/mm²)]	0,105			0,105		
δ _{N0} -factor	[mm/(N/mm²)]	0,219			0,170		
δ _{N∞} -factor	[mm/(N/mm ²)]	0,255			0,245		
δ _{N0} -factor	[mm/(N/mm²)]	0,219		·	0,170		
δ _{N∞} -factor	[mm/(N/mm²)]	0,255			0,245		
	nchor rod δ_{N0} -factor	nchor rod $\begin{array}{lll} & \textbf{C20/25 under static and quasi} \\ & \textbf{\delta}_{N0}\text{-factor} & [\text{mm/(N/mm}^2)] \\ & \delta_{N\circ}\text{-factor} & [\text{mm/(N/mm}^2)] \\ \end{array}$	nchor rod $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	nchor rod IG-M6 IG-M8 IG-M10 δ C20/25 under static and quasi-static action δ_{N0} -factor [mm/(N/mm²)] 0,023 0,026 0,031 δ_{N0} -factor [mm/(N/mm²)] 0,033 0,037 0,045 δ_{N0} -factor [mm/(N/mm²)] 0,056 0,063 0,075 δ_{N0} -factor [mm/(N/mm²)] 0,081 0,090 0,108 δ_{N0} -factor [mm/(N/mm²)] 0,081 0,090 0,108 20/25 under static and quasi-static action δ_{N0} -factor [mm/(N/mm²)] 0,090 δ_{N0} -factor [mm/(N/mm²)] 0,219 δ_{N0} -factor [mm/(N/mm²)] 0,255 δ_{N0} -factor [mm/(N/mm²)] 0,219 δ_{N0} -factor [mm/(N/mm²)] 0,219 δ_{N0} -factor [mm/(N/mm²)] 0,255	nchor rod IG-M6 IG-M8 IG-M10 IG-M12 C20/25 under static and quasi-static action δ_{No} -factor [mm/(N/mm²)] 0,023 0,026 0,031 0,036 δ_{No} -factor [mm/(N/mm²)] 0,033 0,037 0,045 0,052 δ_{No} -factor [mm/(N/mm²)] 0,056 0,063 0,075 0,088 δ_{No} -factor [mm/(N/mm²)] 0,081 0,090 0,108 0,127 δ_{No} -factor [mm/(N/mm²)] 0,081 0,090 0,108 0,127 20/25 under static and quasi-static action δ_{No} -factor [mm/(N/mm²)] 0,090 0,108 0,127 δ_{No} -factor [mm/(N/mm²)] 0,090 0,070 0,070 0,070 δ_{No} -factor [mm/(N/mm²)] 0,219 0,170 0,170 0,245 δ_{No} -factor [mm/(N/mm²)] 0,219 0,170 0,170 δ_{No} -factor [mm/(N/mm²)] 0,219 0,170 δ_{No} -factor [mm/(N/mm²)] 0,255 0,245 <td> IG-M6 IG-M8 IG-M10 IG-M12 IG-M16 IG</td>	IG-M6 IG-M8 IG-M10 IG-M12 IG-M16 IG

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \ \cdot \ \tau;$

 τ : action bond stress for tension

 $\delta_{N\infty} = \delta_{N\infty}$ -factor $\cdot \tau$;

Table C12: Displacements under shear load¹

Internal threaded	IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Uncracked and c	racked concrete	C20/25 under s	tatic and q	uasi-static a	action			
All temperature	I temperature δνο-factor [mm/kN]			0,06	0,06	0,05	0,04	0,04
ranges	δ _{V∞} -factor	[mm/kN]	0,10	0,09	0,08	0,08	0,06	0,06

¹⁾ Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor \cdot V;

V: action shear load

 $\delta_{V\infty} = \delta_{V\infty}\text{-factor }\cdot V;$

Walsywa Injection system WQI 44 PLUS for concrete	
Performances	Annex C 10
Displacements under static and quasi-static action	
(Internal threaded anchor rod)	



Table C13: Di	splaceme	ents under te	ension	load ¹⁾	(rebar))					
Anchor size reint	forcing bar		Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Uncracked concre	ete C20/25 u	ınder static and	quasi-s	tatic act	ion						
Temperature	δ _{N0} -factor	[mm/(N/mm²)]	0,021	0,023	0,026	0,028	0,031	0,036	0,043	0,047	0,052
range I: 40°C/24°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,030	0,033	0,037	0,041	0,045	0,052	0,061	0,071	0,075
Temperature	δ _{N0} -factor	[mm/(N/mm²)]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
range II: 80°C/50°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Temperature	.		0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
range III: 120°C/72°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Cracked concrete	C20/25 und	ler static and qu	ıasi-stat	ic actior	1						
Temperature	δ _{N0} -factor	[mm/(N/mm²)]	0,0	90		0,070					
range I: 40°C/24°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,1	105				0,105			
Temperature	δ _{N0} -factor	[mm/(N/mm²)]	0,2	219				0,170			
range II: 80°C/50°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,2	255				0,245			
Temperature	δ _{N0} -factor	[mm/(N/mm²)]	0,2	219				0,170			
range III: 120°C/72°C	δ _{N∞} -factor	[mm/(N/mm²)]	0,2	255				0,245			

¹⁾ Calculation of the displacement

 $\delta_{N0} = \delta_{N0}$ -factor $\cdot \tau$;

 $\delta_{N\infty} = \delta_{N\infty}$ -factor $\cdot \tau$;

 τ : action bond stress for tension

Table C14: Displacement under shear load¹⁾ (rebar)

Anchor size reinfo	Anchor size reinforcing bar		Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Uncracked concret	te C20/25 u	inder static and	quasi-s	tatic acti	ion						
All temperature	δ _{v0} -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
ranges	δ _{ν∞} -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04
Cracked concrete C20/25 under static and q		ler static and qu	asi-stat	ic action	1						
All temperature	δ_{V0} -factor	[mm/kN]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,06
	δ _{V∞} -factor	[mm/kN]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,10

¹⁾ Calculation of the displacement

 $\delta v_0 = \delta v_0 \text{-factor} \cdot V;$ $\delta v_\infty = \delta v_\infty \text{-factor} \cdot V;$

V: action shear load

Walsywa Injection system WQI 44 PLUS for concrete	
Performances	Annex C 11
Displacements under static and quasi-static action	
(Reinforcing bar)	



Table		acteristic va ormance ca			sion lo	ad	s un	der s	eismi	c acti	on			
	led rod						M8	M10	M12	M16	M20	M24	M27	M30
Steel fa			1							4.0	.			
	teristic tension resis	stance	N _{Rk,s,ee}	q,C1	[kN]						N _{Rk,s}			
Partial Combine	factor ned pull-out and o	oporata failura	γ _{Ms,N}		[-]					see Ta	ble C1			
	teristic bond resista			acked	concrete	C2	20/25							
	I: 40°C/24°C						2,5	3,1	3,7	3,7	3,7	3,8	4,5	4,5
ange	II: 80°C/50°C	Dry, wet concrete		Ok on C1			1,6	2,2	2,7	2,7	2,7	2,8	3,1	3,1
Temperature range	III: 120°C/72°C		$-\tau_{Rk,eq,C}$	N 4	[N/mm	121	1,3	1,6	2,0	2,0	2,0	2,1	2,4	2,4
)era	I: 40°C/24°C		nk,eq,c	1117,04,01			2,5	2,5	3,7	3,7				
Temp	II: 80°C/50°C	flooded bore hole					1,6	1,9	2,7	2,7	N		ormand essed	e
	III: 120°C/72°C						1,3	1,6	2,0	2,0				
	sing factors for cond		Ψc		[-]					1,	,0			
on the	teristic bond resista concrete strength c ation factor			τ	Rk,eq,C1	=			Ψc *	^τ Rk,eq,	C1(C20)/25)		
	and wet concrete						1,0				1,2			
	ded bore hole	γ _{inst} [-]			1,4				No Performance Assessed					
Thread	(perf	ormance ca	tegory	C1)	M8	М	110	W12	M16	M20	M24	M2	7	M30
	ailure without leve	er arm												
Charac (Seismi	teristic shear resist	ance V _{RI}	x,s,eq,C1	[kN]		0,70 · V ⁰ _{Rk,s}								
Partial ·	factor	Ϋ́M	s,V	[-]					see 1	Гable С	:1			
Factor	for annular gap	$\alpha_{\mathbf{g}_i}$	ap	[-]					0,5	(1,0)1)				
1) Valu Ann	Factor for annular gap (-)													



Table C17: Characteristic (performance			n Ioa	ds un	der s	eismi	ic act	ion				
Reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
Steel failure												
Characteristic tension resistance	N _{Rk,s,eq,C1}	[kN]	1,0 • A _s • f _{uk} 1)									
Cross section area	As	[mm²]	50	79	113	154	201	314	491	616	804	
Partial factor	γMs,N	[-]	1,42)									
Combined pull-out and concrete fail												
Characteristic bond resistance in uncra	cked and cra	cked con	crete C	20/25								
<u>1: 40°C/24°C</u> Dry, wet			2,5	3,1	3,7	3,7	3,7	3,7	3,8	4,5	4,5	
3 80°0/30°0	7		1,6	2,2	2,7	2,7	2,7	2,7	2,8	3,1	3,1	
Till: 120°C/72°C concrete		[N/mm²]	1,3	1,6	2,0	2,0	2,0	2,0	2,1	2,4	2,4	
हैं <u>I: 40°C/24°C</u> flooded	^τ Rk, eq,C1		2,5	2,5	3,7	3,7	3,7					
चि <u>II: 80°C/50°C</u> bore hole			1,6	1,9	2,7	2,7	2,7	No Performance Assessed				
III: 120°C/72°C Bore Hole			1,3	1,6	2,0	2,0	2,0		7330	sseu		
Increasing factors for concrete	Ψc	[-]					1,0					
Characteristic bond resistance		•										
depending on the concrete strength	τ _{Βι}	k,eq,C1 =	Ψ _c • τ _{Rk,eq,C1} (C20/25)									
class		٠,٥٩,٥١	/ ακ,θά,στι /									
Installation factor												
for dry and wet concrete			1,2				1	,2				
for flooded bore hole	γinst	[-]	1,4 No Performance								e	

¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars

Table C18: Characteristic values of shear loads under seismic action (performance category C1)

Reinforcing bar	Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32				
Steel failure without lever arm													
Characteristic shear resistance	$0.35 \cdot A_s \cdot f_{uk}^{2}$												
Cross section area	A _s	[mm²]	50	79	113	154	201	314	491	616	804		
Partial factor	γ _{Ms,V}	[-]	1,5 ²⁾										
Factor for annular gap	$\alpha_{\sf gap}$	[-]	0,5 (1,0)3)										

¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars

Walsywa Injection system WQI 44 PLUS for concrete	
Performances	Annex C 13
Characteristic values of tension loads and shear loads under seismic action	
(performance category C1) (Reinforcing bar)	

²⁾ in absence of national regulation

²⁾ in absence of national regulation

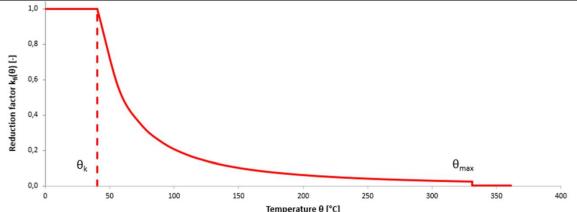
³⁾ Value in brackets valid for filled annular gab between fastener and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended



Table C19: Characteristic values of tension and shear loads under fire exposure in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)

Threaded rod						M10	M12	M16	M20	M24	M27	M30
Steel failure												
Characteristic tension			Fire exposur e time [min]	30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2
resistance; Steel, Stainless	N	[LAI]		60	0,9	1,4	2,3	4,2	6,6	9,5	12,4	15,1
Steel A2, A4 and HCR, strength class 5.8 resp. 50	$N_{Rk,s,fi}$	[kN]		90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7
and higher				120	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9

Characteristic bond resistance in cracked and uncracked concrete C20/25 up to C50/60 under fire conditions for a given temperature θ



				Tempe	erature θ [°	C]								
Characteristic bond resistance for a given temperature (θ)	$\tau_{Rk,fi}(\theta)$		[N/mm	²]	k _{fi,p} (θ) • τ _{Rk,cr,(C20/25)} 1)									
Steel failure without lever	arm													
Characteristic shear resistance; Steel, Stainless			Fire	30	1,1	1,7	3,0	5,7	8,8	12,7	16,5	20,2		
		[kN]	AVNOSUR	60	0,9	1,4	2,3	4,2	6,6	9,5	12,4	15,1		
Steel A2, A4 and HCR, strength class 5.8 resp. 50	$V_{Rk,s,fi}$			90	0,7	1,0	1,6	3,0	4,7	6,7	8,7	10,7		
and higher				120	0,5	0,8	1,2	2,2	3,4	4,9	6,4	7,9		
Steel failure with lever arn	n													
Characteristic bending			Fire	30	1,1	2,2	4,7	12,0	23,4	40,4	59,9	81,0		
moment; Steel, Stainless	M0	[Nm	exposur	60	0,9	1,8	3,5	9,0	17,5	30,3	44,9	60,7		
Steel A2, A4 and HCR, strength class 5.8 resp. 50	M ⁰ _{Rk,s,fi}]]	e time	90	0,7	1,3	2,5	6,3	12,3	21,3	31,6	42,7		
and higher			[min]	120	0,5	1,0	1,8	4,7	9,1	15,7	23,3	31,5		

τ_{Rk,cr,(C20/25)} characteristic bond resistance for cracked concrete for concrete strength class C20/25 for the relevant temperature range

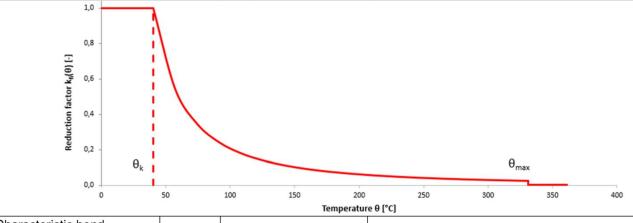
Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of tension and shear loads under fire exposure (internal threaded anchor rod)	Annex C 14



Table C20: Characteristic values of tension and shear loads under fire exposure in hammer drilled holes (HD), compressed air drilled holes (CD) and in hammer drilled holes with hollow drill bit (HDB)

Internal threaded anchor ro	ods		IG-M6	IG-M8	IG-M10	IG-M12	IG-M16	IG-M20		
Steel failure										
Characteristic tension			Fire	30	0,3	1,1	1,7	3,0	5,7	8,8
resistance; Steel, Stainless	N _{Rk,s,fi}	FI - N 17	exposure	60	0,2	0,9	1,4	2,3	4,2	6,6
Steel A4 and HCR, strength		[kN]	time	90	0,2	0,7	1,0	1,6	3,0	4,7
class 5.8 and 8.8 resp. 70			[min]	120	0,1	0,5	0,8	1,2	2,2	3,4
Characteristic band resists	in ava	م امماء		مرمما ممت	arata COC	/0E to	CENICO .	adau fiva		

Characteristic bond resistance in cracked and uncracked concrete C20/25 up to C50/60 under fire conditions for a given temperature θ



	iemperature of CJ													
Characteristic bond resistance for a given temperature (<i>θ</i>)	$\tau_{Rk,fi}(\theta)$		[N/mm²	2]	$k_{fi,p}(\theta) \cdot \tau_{Rk,cr,(C20/25)}^{1)}$									
teel failure without lever arm														
Characteristic sheer	naracteristic shear			30	0,3	1,1	1,7	3,0	5,7	8,8				
resistance; Steel, Stainless	V	I I I N I I	Fire exposure	60	0,2	0,9	1,4	2,3	4,2	6,6				
Steel A4 and HCR, strength	ICR, strength VRk,s,fi	[KIN]	time [min]	90	0,2	0,7	1,0	1,6	3,0	4,7				
class 5.8 and 8.8 resp. 70				120	0,1	0,5	0,8	1,2	2,2	3,4				
Steel failure with lever arm														
Characteristic bending			Fire	30	0,2	1,1	2,2	4,7	12,0	23,4				
	N/10	[MIM]	ovnocuro	60	0,2	0,9	1,8	3,5	9,0	17,5				
Steel A4 and HCR, strength	M ⁰ Rk,s,fi	[Nm]		90	0,1	0,7	1,3	2,5	6,3	12,3				
ICIASS 5 & AND 8 & FEST 70	I	1	i imini i											

120

0,1

0,5

1,0

1,8

9,1

τ_{Rk,cr,(C20/25)} characteristic bond resistance for cracked concrete for concrete strength class C20/25 for the relevant temperature range

Walsywa Injection system WQI 44 PLUS for concrete	
Performances Characteristic values of tension and shear loads under fire exposure (internal threaded anchor rod)	Annex C 15



Table C21: Char	racterist	ic va	lues of	tensio	n and	d she	ar lo	 ads เ	unde	r fire	expc	sure	in	
	mer drill ed holes						air d	rilled	hole	s (Cl	D) an	d in	hamr	mer
Reinforcing bar					Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure														
			Fire	30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	16,1
Characteristic tension	N _{Rk,s,fi}	[kN]	exposure	60	0,5	1,0	1,7	2,3	3,0	4,7	6,8	7,4	9,2	12,1
resistance; BSt 500	KK,S,II	[KIA]	time [min]	90	0,4	0,8	1,5	2,0	2,6	4,1	5,9	6,4	8,0	10,5
	<u> </u>			120	0,3	0,6	1,1	1,5	2,0	3,1	4,5	4,9	6,2	8,0
Characteristic bond res given temperature θ	sistance in	crac	ked and u	ncracke	d cond	crete C	20/25	up to	C50/6	0 unde	er fire	condi	tions f	for a
given temperature o			θ < 2	1°C					1	,0				
Temperature reduction	$k_{fi,p}(\theta)$	[-]	21°C ≤ θ	1000				0,8	1 • e ^{-0,}	1	1,0			
factor	11,6		$\theta > 24$	U-100 AT 200						,0	,			
Reduction factor k _{fl} (θ) [-]	θ_k	_	_						e) _{max}				
0,0	O _k									max				
0	50		100	Terr	150 nperature	- A [°C]	2	200		250		30	0	
Characteristic bond resistance for a given temperature (θ)	$\tau_{Rk,fi}(\theta)$		[N/mm²		k _{fi,p} (θ) • τ _{Rk,cr,(C20/25)} ¹⁾									
Steel failure without lev	ver arm		T	- 22	3.5								T	Ι
			Fire	30	0,5	1,2	2,3	3,1	4,0	6,3	9,0	9,8	12,3	-
Characteristic shear resistance; BSt 500	$V_{Rk,s,fi}$	[kN]	exposure time	60	0,5	1,0	1,7	2,3	3,0	4,7	6,8	7,4	9,2	12,1
resistance, but our	211.00	2002	[min]	90	0,4	0,8	1,5	2,0	2,6	4,1 3,1	5,9 4,5	6,4	8,0	10,5
Steel failure with lever	arm			120	0,3	0,6	1,1	1,5	2,0	٥, ١	4,5	4,9	6,2	8,0
Ottor fullare man iere.				30	0,6	1,8	4,1	6,5	9,7	18,8	32,6	36,8	51,7	77,2
Characteristic bending		[Nimal	Fire exposure	300,000	0,5	1,5	3,1	4,8	7,2	14,1	24,4	27,6	38,8	_
moment; BSt 500	M ⁰ Rk,s,fi	[Nm]	time	90	0,4	1,2	2,6	4,2	6,3	12,3	21,2	23,9	33,6	_
			[min]	120	0,3	0,9	2,0	3,2	4,8	9,4	16,3	18,4	25,9	_
1) TRk,cr,(C20/25) characte temperature range	eristic bond	resist	ance for cra							_				
Walsywa Injection sy	stem WQI	44 P	LUS for c	oncrete	i								c C 16	
Performances Characteristic values							,				А	nnex		J