



Approval body for construction products and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and Laender Governments



European Technical Assessment

ETA-20/0202 of 17 April 2020

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

Deutsches Institut für Bautechnik

VJ Technology Injection system XPE440 for concrete

Bonded fastener for use in concrete

VJ Technology Ltd.
Brunswick Road; Cobbs Wood Ind. Estate
ASHFORD KENT TN23 1EN .
GROSSBRITANNIEN

Plant 1, Germany

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

EAD 330499-01-0601



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Specific Part

1 Technical description of the product

The "VJ Technology Injection System XPE440 for concrete" is a bonded anchor consisting of a cartridge with injection XPE440 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 IT-M6 to IT-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 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 years and/or 100 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance			
Characteristic resistance to tension load	See Annex			
(static and quasi-static loading)	B2, C 1 to C 5, C 7 to C 9, C 11 to C 13			
Characteristic resistance to shear load	See Annex			
(static and quasi-static loading)	C 1, C 6, C 10, C 14			
Displacements under short-term and long-term loading	See Annex			
	C 15 to C 17			
Characteristic resistance and displacements for seismic	See Annex			
performance categories C1 and C2	C 18 to C 23			

3.2 Hygiene, health and the environment (BWR 3)

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

Z24194.20 8.06.01-19/20



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

In accordance with the European Assessment Document EAD 330499-01-0601 the applicable European legal act is: [96/582/EC].

The system to be applied is: 1

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

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

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

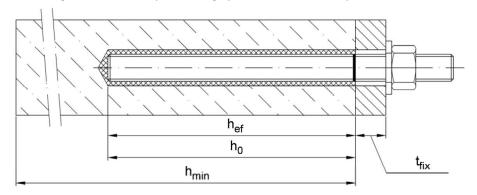
BD Dipl.-Ing. Andreas Kummerow Head of Department

beglaubigt.
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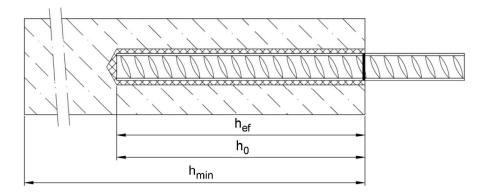


Installation threaded rod M8 up to M30

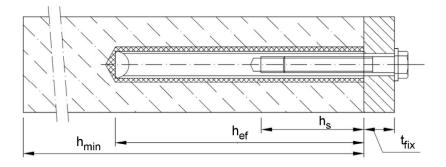
prepositioned installation or push through installation (annular gap filled with mortar)



Installation reinforcing bar Ø8 up to Ø32



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



 t_{fix} = thickness of fixture

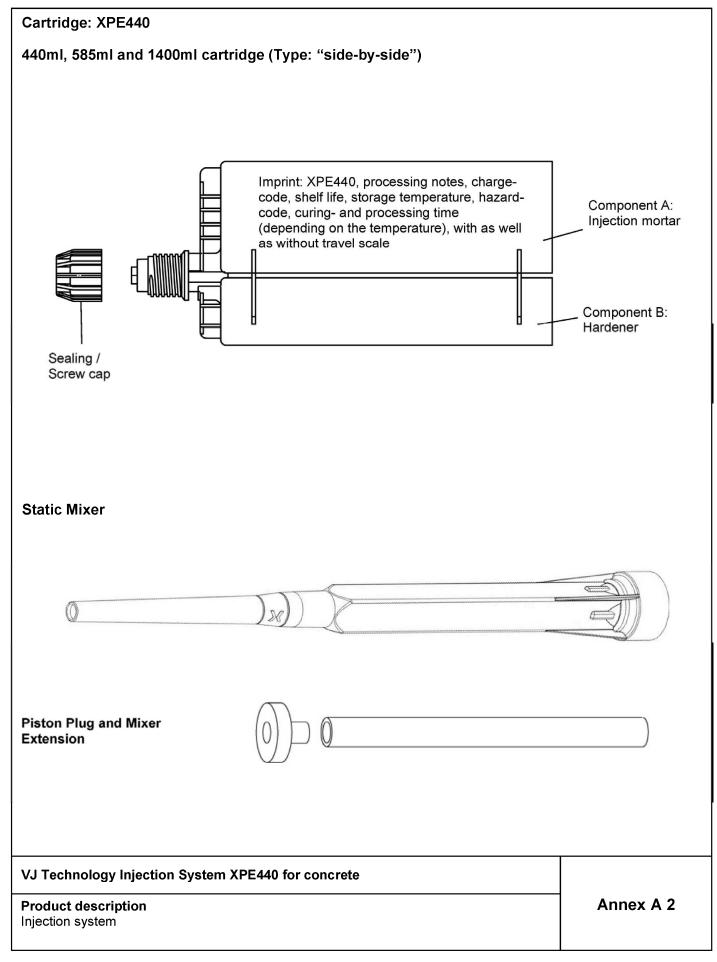
h_{ef} = effective anchorage depth

 h_0 = depth of drill hole

 h_{min} = minimum thickness of member

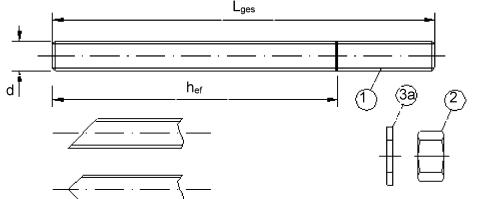
VJ Technology Injection System XPE440 for concrete	
Product description Installed condition	Annex A 1







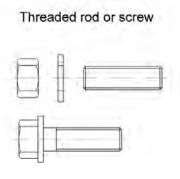


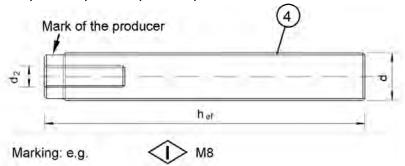


Commercial standard threaded rod with:

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

Internal threaded anchor rod IT-M6, IT-M8, IT-M10, IT-M12, IT-M16, IT-M20





Marking Internal thread

Mark

M8 Thread size (Internal thread)
A4 additional mark for stainless steel

HCR additional mark for high-corrosion resistance steel

Filling washer and mixer reduction nozzle for filling the annular gap between anchor rod and fixture







VJ Technology Injection System XPE440 for concrete

Product description

Threaded rod, internal threaded rod and filling washer

Annex A 3



ıd	ble A1: Mater	ials				
Parl	Designation	Material				
		acc. to EN 10087:1998 5 µm acc. to EN ISC				
h	ot-dip galvanised ≥ 4	io μm acc. to EN ISC	146	1:2009 and EN ISO 10684:	2004+AC:2009 or	
S	nerardized ≥ △	15 μm acc. to EN ISC	1766		Tax	1
		Property class		Characteristic steel	Characteristic steel	Elongation at
			4.0	ultimate tensile strength f _{uk} = 400 N/mm ²	yield strength	fracture A ₅ > 8%
				****	f _{yk} = 240 N/mm ²	
1	Threaded rod	acc. to		f _{uk} = 400 N/mm ²	f _{yk} = 320 N/mm ²	A ₅ > 8%
		EN ISO 898-1:2013		f _{uk} = 500 N/mm ²	f _{yk} = 300 N/mm ²	A ₅ > 8%
				f _{uk} = 500 N/mm ²	f _{yk} = 400 N/mm ²	A ₅ > 8%
				f _{uk} = 800 N/mm²	f _{yk} = 640 N/mm²	$A_5 \ge 12\%^{3}$
_		acc. to	4	for anchor rod class 4.6 o		
2	Hexagon nut	EN ISO 898-2:2012	5	for anchor rod class 5.6 o	r 5.8	
		Ctool zine plated ha	8 2+ din	for anchor rod class 8.8		
3а	Washer			galvanised or sherardized EN ISO 7089:2000, EN ISC	7093:2000 or EN ISO	7094:2000)
3b	Filling washer			galvanised or sherardized		
		Property class		Characteristic steel	Characteristic steel	Elongation at
	Internal threaded			ultimate tensile strength	yield strength	fracture
4	michial illicaucu					
4	anchor rod	acc. to	5.8	f _{uk} = 500 N/mm ²	f _{yk} = 400 N/mm ²	A ₅ > 8%
4		acc. to EN ISO 898-1:2013		f _{uk} = 500 N/mm²		
Stai	anchor rod nless steel A2 (Mate	EN ISO 898-1:2013	8.8 1.431	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. t	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014)	A ₅ > 8%
Stai Stai	anchor rod nless steel A2 (Mate nless steel A4 (Mate	EN ISO 898-1:2013 rrial 1.4301 / 1.4307 / 1 rrial 1.4401 / 1.4404 / 1	8.8 1.431 1.457	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 10088-1:2014) o EN 10088-1:2014)	A ₅ > 8%
Stai Stai	anchor rod nless steel A2 (Mate nless steel A4 (Mate	EN ISO 898-1:2013 rrial 1.4301 / 1.4307 / 1 rrial 1.4401 / 1.4404 / 1	8.8 1.431 1.457	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 r 1.4565, acc. to EN 10088	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014)	A ₅ > 8% A ₅ > 8%
Stai Stai	anchor rod nless steel A2 (Mate nless steel A4 (Mate	EN ISO 898-1:2013 rrial 1.4301 / 1.4307 / 1 rrial 1.4401 / 1.4404 / 1	8.8 1.431 1.457	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 r 1.4565, acc. to EN 10088 Characteristic steel	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) Characteristic steel	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at
Stai Stai Higl	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class	8.8 1.431 1.457 529 o	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 r 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) Characteristic steel yield strength	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture
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itai itai ligi	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class	8.8 1.431 1.457 529 or 50 70	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 r 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ²	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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 $A_5 \ge 8\%$ $A_5 \ge 12\%$
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Stai Stai Higl	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan Threaded rod ¹⁾⁴⁾	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 acc. to	8.8 1.431 1.457 529 or 50 70 80 50	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4565, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \end{aligned}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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 $A_5 \ge 8\%$ $A_5 \ge 12\%$
Stai Stai Higl	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 acc. to EN ISO 3506-	8.8 1.431 1.457 529 or 50 70 80 50 70	$\begin{aligned} f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ 1 / 1.4567 \text{ or } 1.4541, \text{ acc. t} \\ 1 / 1.4362 \text{ or } 1.4578, \text{ acc. t} \\ 1 / 1.4365, \text{ acc. to EN } 10088 \\ \text{Characteristic steel} \\ \text{ultimate tensile strength} \\ f_{uk} &= 500 \text{ N/mm}^2 \\ f_{uk} &= 700 \text{ N/mm}^2 \\ f_{uk} &= 800 \text{ N/mm}^2 \\ \text{for anchor rod class } 50 \\ \text{for anchor rod class } 70 \end{aligned}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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 $A_5 \ge 8\%$ $A_5 \ge 12\%$
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Stai Stai High	anchor rod nless steel A2 (Material nless steel A4 (Material nless steel	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 acc. to EN ISO 3506- 1:2009 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20	8.8 1.431 1.457 529 or 70 80 70 80 7 1.43 7 1.44 9 or 1	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ² f _{uk} = 800 N/mm ² for anchor rod class 50 for anchor rod class 70 for anchor rod class 80 07 / 1.4311 / 1.4567 or 1.4 1.4565, acc. to EN 10088-1 EN ISO 7089:2000, EN ISC orrosion resistance steel	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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-: 2014 0 7093:2000 or EN ISO	A ₅ > 8% A ₅ > 8% Elongation at fracture A ₅ \geq 8% A ₅ \geq 12% 3) A ₅ \geq 12% 3) 1:2014 1:2014 7094:2000)
Stai Stai Higl	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan) Threaded rod ¹⁾⁴⁾ Hexagon nut ¹⁾⁴⁾ Washer	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 acc. to EN ISO 3506- 1:2009 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20	8.8 1.431 1.457 529 or 70 80 70 80 7 1.43 7 1.44 9 or 1	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ² f _{uk} = 800 N/mm ² for anchor rod class 50 for anchor rod class 70 for anchor rod class 80 for 1.4311 / 1.4567 or 1.4 (1.4565, acc. to EN 10088-1 EN ISO 7089:2000, EN ISO orrosion resistance steel	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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-: 2014 0 7093:2000 or EN ISO Characteristic steel	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014 1:2014 7094:2000) Elongation at
Stai Stai Higl	anchor rod nless steel A2 (Material nless steel A4 (Material nless steel A4) Threaded rod 1)4) Hexagon nut 1)4) Washer Filling washer	EN ISO 898-1:2013 Irial 1.4301 / 1.4307 / 1 Irial 1.4401 / 1.4404 / 1 Ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20 Stainless steel A4, H Property class	8.8 1.431 1.457 529 or 70 80 70 80 7 1.43 7 1.44 9 or 1 006, E	$\begin{aligned} &f_{uk} = 500 \text{ N/mm}^2 \\ &f_{uk} = 800 \text{ N/mm}^2 \\ &1 / 1.4567 \text{ or } 1.4541, \text{ acc. tr.} \\ &1 / 1.4362 \text{ or } 1.4578, \text{ acc. tr.} \\ &1 / 1.4365, \text{ acc. to EN } 10088 \\ &Characteristic steel \\ &ultimate tensile strength \\ &f_{uk} = 500 \text{ N/mm}^2 \\ &f_{uk} = 700 \text{ N/mm}^2 \\ &f_{uk} = 800 \text{ N/mm}^2 \\ &for \text{ anchor rod class } 50 \\ &for \text{ anchor rod class } 50 \\ &for \text{ anchor rod class } 80 \\ &107 / 1.4311 / 1.4567 \text{ or } 1.4 \\ &1.4565, \text{ acc. to EN } 10088-1 \\ &EN \text{ ISO } 7089:2000, \text{ EN } \text{ ISO } \\ &corrosion \text{ resistance steel} \\ &Characteristic \text{ steel} \\ &ultimate \text{ tensile strength} \end{aligned}$	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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-: 2014 7093:2000 or EN ISO Characteristic steel yield strength	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014 1:2014 7:094:2000) Elongation at fracture
Stai Stai Higl	anchor rod nless steel A2 (Mate nless steel A4 (Mate n corrosion resistan) Threaded rod ¹⁾⁴⁾ Hexagon nut ¹⁾⁴⁾ Washer	EN ISO 898-1:2013 rial 1.4301 / 1.4307 / 1 rial 1.4401 / 1.4404 / 1 ce steel (Material 1.45 Property class acc. to EN ISO 3506- 1:2009 acc. to EN ISO 3506- 1:2009 A2: Material 1.4301 / A4: Material 1.4401 / HCR: Material 1.452 (e.g.: EN ISO 887:20 Stainless steel A4, H	8.8 1.431 1.457 529 or 70 80 70 80 7 1.43 7 1.44 9 or 1 006, E	f _{uk} = 500 N/mm ² f _{uk} = 800 N/mm ² 1 / 1.4567 or 1.4541, acc. to 1.4565, acc. to EN 10088 Characteristic steel ultimate tensile strength f _{uk} = 500 N/mm ² f _{uk} = 700 N/mm ² f _{uk} = 800 N/mm ² for anchor rod class 50 for anchor rod class 70 for anchor rod class 80 for 1.4311 / 1.4567 or 1.4 (1.4565, acc. to EN 10088-1 EN ISO 7089:2000, EN ISO orrosion resistance steel	f _{yk} = 400 N/mm ² f _{yk} = 640 N/mm ² o EN 10088-1:2014) o EN 10088-1:2014) -1: 2014) 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-: 2014 0 7093:2000 or EN ISO Characteristic steel	$A_5 > 8\%$ $A_5 > 8\%$ Elongation at fracture $A_5 \ge 8\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ $A_5 \ge 12\%$ 1:2014 1:2014 7:094:2000)

¹⁾ Property class 70 or 80 for anchor rods up to M24 and Internal threaded anchor rods up to IT-M16,

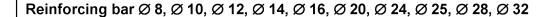
⁴⁾ Property class 80 only for stainless steel A4 and HCR

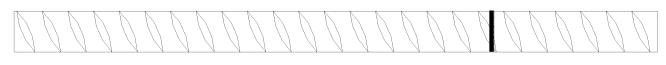
VJ Technology Injection System XPE440 for concrete	
Product description Materials threaded rod and internal threaded rod	Annex A 4

²⁾ for IT-M20 only property class 50

 $^{^{3)}\,}A_5 > 8\%$ fracture elongation if \underline{no} requirement for performance category C2 exists









- 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 ≤ h ≤ 0,07d
 (d: Nominal diameter of the bar; h: Rip height of the bar)

Table A2: Materials

Part	Designation	Material
Reinf	orcing bars	
1	EN 1992-1-1-2004+4(`-2010 Anney (`	Bars and de-coiled rods class B or C f_{yk} and k according to NDP or NCL of EN 1992-1-1/NA $f_{uk} = f_{tk} = k \cdot f_{yk}$

VJ Technology Injection System XPE440 for concrete

Product description
Materials reinforcing bar

Annex A 5



Specifications of intended use										
Anchorages subject to (for a s	ervice life of 50 ye	ars):								
	Static and qua	si-static loads	Seismic action for Performance Category C1	Seismic action for Performance Category C2						
Base material	Non-cracked concrete	cracked concrete	Cracked and non-	-cracked concrete						
Hammer drilling (HD), Hammer drilling with hollow drill bit (HDB) or compressed air drilling (CD)	M8 to Ø8 to IT-M6 to	Ø32,	M8 to M30, Ø8 to Ø32	M12 to M24						
Diamond drilling (DD)	M8 to M30, Ø8 to Ø32, IT-M6 to IT-M20	Ø8 to Ø32, No performance		No performance assessed						
Temperature Range:	I: - 40 °C to +40 °C (max long term temperature +24 °C and max short term temperature +40 °C) II: - 40 °C to +72 °C (max long term temperature +50 °C and max short term temperature +72 °C)									

Anchorages subject to (for a service life of 100 years):

	Static and qua	si-static loads	Seismic action for Performance Category C1	Seismic action for Performance Category C2		
Base material	Non-cracked concrete	cracked concrete	Cracked and non-cracked concrete			
Hammer drilling (HD), Hammer drilling with hollow drill bit (HDB) or compressed air drilling (CD)	M8 to Ø8 to IT-M6 to	Ø32,	M8 to M30, Ø8 to Ø32	M12 to M24		
Diamond drilling (DD)	No performance assessed No performance assessed		No performance assessed	No performance assessed		
Temperature Range:	(max long term te		°C to +40 °C and max short term te	emperature +40 °C)		

Base materials:

- Compacted, reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013 + A1:2016.
- Strength classes C20/25 to C50/60 according to EN 206:2013 + A1:2016.

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

VJ Technology Injection System XPE440 for concrete	
Intended Use Specifications	Annex B 1

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English translation prepared by DIBt



Design:

- Verifiable calculation notes and drawings are prepared taking account of the loads to be anchored. The position of the anchor is indicated on the design drawings (e. g. position of the anchor relative to reinforcement or to supports, etc.).
- Anchorages are designed under the responsibility of an engineer experienced in anchorages and concrete work.
- The anchorages 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), compressed air (CD) or diamond drill mode (DD).
- · Overhead installation allowed.
- Anchor installation carried out by appropriately qualified personnel and under the supervision of the person responsible for technical matters of the site.

VJ Technology Injection System XPE440 for concrete	
Intended Use Specifications	Annex B 2



Table B1: Ir	Table B1: Installation parameters for threaded rod										
Anchor size		M8	M10	M12	M16	M20	M24	M27	M30		
Diameter of elemen	t	d = d _{nom}	[mm]	8	10	12	16	20	24	27	30
Nominal drill hole di	ameter	d ₀	[mm]	10	12	14	18	22	28	30	35
Effective embedmer	Effective and advantage of		[mm]	60	60	70	80	90	96	108	120
Effective embedmer	it deptii	h _{ef,max}	[mm]	160	200	240	320	400	480	540	600
Diameter of	Prepositioned ins		[mm]	9	12	14	18	22	26	30	33
clearance hole in the fixture	Push through i	nstallation d _f	[mm]	12	14	16	20	24	30	33	40
Maximum torque mo	ment	T _{inst} ≤	[Nm]	10	20	40 ¹⁾	60	100	170	250	300
Minimum thickness	of member	h _{min}	[mm]		_f + 30 m : 100 mr		h _{ef} + 2d ₀				
Minimum spacing		s _{min}	[mm]	40	50	60	75	95	115	125	140
Minimum edge dista	ince	c _{min}	[mm]	35	40	45	50	60	65	75	80

¹⁾ Maximum Torque moment for M12 with steel Grade 4.6 is 35 Nm

Table B2: Installation parameters for rebar

		Ø 8 ¹⁾											
Anchor size				Ø 10 ¹⁾	Ø 12	21) 9	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Diameter of element	d = d _{nom}	[mm]	8	10	12		14	16	20	24	25	28	32
Nominal drill hole diameter	d_0	[mm]	10 12	12 14	14 1	6	18	20	25	32	32	35	40
Effective embedment depth	h _{ef,min}	[mm]	60	60	70		75	80	90	96	100	112	128
Effective embedment depth	$h_{ef,max}$	[mm]	160	200	240)	280	320	400	480	500	560	640
Minimum thickness of member	h _{min}	[mm]	h _{ef} + 30 mm ≥ 100 mm		≥				h _{et}	+ 2d ₀			
Minimum spacing	s _{min}	[mm]	40	40 50			70	75	95	120	120	130	150
Minimum edge distance	c_{min}	[mm]	35	40	45		50	50	60	70	70	75	85

¹⁾ both nominal drill hole diameter can be used

Table B3: Installation parameters for Internal threaded anchor rod

Anchor size			IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20	
Internal diameter of anchor rod	d ₂	[mm]	6	8	10	12	16	20	
Outer diameter of anchor rod ¹⁾	d = d _{nom}	[mm]	10	12	16	20	24	30	
Nominal drill hole diameter	d ₀	[mm]	12	14	18	22	28	35	
Cffeeting ambadment death	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 torque moment	T _{inst} ≤	[Nm]	10	10	20	40	60	100	
Thread engagement length min/max	I _{IG}	[mm]	8/20	8/20	10/25	12/30	16/32	20/40	
Minimum thickness of member	h _{min}	[mm]		30 mm 0 mm	h _{ef} + 2d ₀				
Minimum spacing	s _{min}	[mm]	50	60	75	95	115	140	
Minimum edge distance	c _{min}	[mm]	40	45	50	60	65	80	

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

VJ Technology Injection System XPE440 for concrete Intended Use Installation parameters Annex B 3

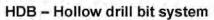


Table B4	: Parar	neter clea	ning and s			S				
Threaded Rod	Rebar	Internal threaded anchor rod	d ₀ Drill bit - Ø HD, HDB, CD, DD	I	l _b h - Ø	d _{b,min} min. Brush - Ø	Piston plug		nstallation direction an of piston plug	
[mm]	[mm]	[mm]	[mm]		[mm]	[mm]		1		1
M8	8		10	PP10	11,5	10,5				
M10	8 / 10	IT-M6	12	PP12	13,5	12,5		No olua	roquirod	
M12	10 / 12	IT-M8	14	PP14	15,5	14,5		No plug	required	
	12		16	PP16	17,5	16,5				
M16	14	IT-M10	18	PP18	20,0	18,5	BR18			
	16		20	PP20	22,0	20,5	BR20			
M20		IT-M12	22	PP22	24,0	22,5	BR22			
	20		25	PP25	27,0	25,5	BR25	h _{ef} >	h _{ef} >	
M24		IT-M16	28	PP28	30,0	28,5	BR28	250 mm	250 mm	all
M27			30	PP30	31,8	30,5	BR30	230 111111	230 111111	
	24 / 25		32	PP32	34,0	32,5	BR32	_		
M30	28	IT-M20	35	PP35	37,0	35,5	BR35	1		
	32		40	PP40	43,5	40,5	BR40			

CAC - Rec. compressed air tool (min 6 bar)

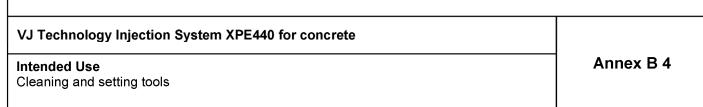
Drill bit diameter (d₀): all diameters





Drill bit diameter (d₀): all diameters

The hollow drill bit system contains the Heller Duster Expert hollow drill bit and a class M vacuum with minimum negative pressure of 253 hPa <u>and</u> flow rate of minimum 150 m³/h (42 l/s).





Installation instructions

Drilling of the bore hole (HD, HDB, CD)



Hammer (HD) or compressed air drilling (CD)

Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). Proceed with Step 2. In case of aborted drill hole, the drill hole shall be filled with mortar.



10 Hollow drill bit system (HDB) (see Annex B 3)

Drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). This drilling system removes the dust and cleans the bore hole during drilling (all conditions). Proceed with Step 3. In case of aborted drill hole, the drill hole shall be filled with mortar.

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

CAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked and cracked concrete



Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.



Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > d_{b,min} (Table B4) a minimum of two times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.



Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

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

VJ Technology Injection System XPE440 for concrete

Intended Use Installation instructions

Annex B 5



Installation instructions

Drilling of the bore hole (DD)



Diamond drilling (DD)

Drill with diamond drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3). Proceed with Step 2. In case of aborted drill hole, the drill hole shall be filled with mortar.

SPCAC: Cleaning for dry, wet and water-filled bore holes with all diameter in uncracked concrete



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

2a Rinsing with water until clear water comes out.



Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > d_{b,min} (Table B4) a minimum of two times in a twisting motion.
If the bore hole ground is not reached with the brush, a brush extension must be used.



2c. Rinsing again with water until clear water comes out.



Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.



Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush > d_{b,min} (Table B4) a minimum of two times in a twisting motion.

If the bore hole ground is not reached with the brush, a brush extension must be used.



Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 4) a minimum of two times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

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

VJ Technology Injection System XPE440 for concrete

Intended Use

Installation instructions

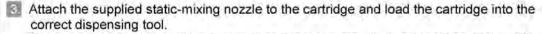
Annex B 6

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Installation instructions (continuation)





For every working interruption longer than the recommended working time (Table B5) as well as for new cartridges, a new static-mixer shall be used.



Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey or red colour.



Starting from the bottom or back of the cleaned anchor hole, fill the hole up to approximately two-thirds with adhesive. Slowly withdraw the static mixing nozzle as the hole fills to avoid creating air pockets. If the bottom or back of the anchor hole is not reached, an appropriate extension nozzle must be used. Observe the gel-/ working times given in Table B5.



- Piston plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
 - Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit-Ø d₀ ≥ 18 mm and embedment depth h_{ef} > 250mm
 - Overhead assembly (vertical upwards direction): Drill bit-Ø d₀ ≥ 18 mm



B Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

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



After inserting the anchor, the annular gab between anchor rod and concrete, in case of a push through installation additionally also the fixture, must be complete filled with mortar. If excess mortar is not visible at the top of the hole, the requirement is not fulfilled and the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).



Allow the adhesive to cure to the specified time prior to applying any load or torque. Do not move or load the anchor until it is fully cured (attend Table B5).



After full curing, the add-on part can be installed with up to the max. torque (Table B1 or B3) by using a calibrated torque wrench. In case of prepositioned installation the annular gab between anchor and fixture can be optional filled with mortar. Therefor substitute the washer by the filling washer and connect the mixer reduction nozzle to the tip of the mixer. The annular gap is filled with mortar, when mortar oozes out of the washer.

VJ Technology Injection System XPE440 for concrete

Intended Use

Installation instructions (continuation)

Annex B 7



Table B5:	Ma	aximum w	orking time and minir	num curing time				
Concrete	temp	erature	Gelling working time	Minimum curing time in dry concrete	Minimum curing time in wet concrete			
+ 5 °C	to	+ 9 °C	80 min	48 h	96 h			
+ 10 °C	to	+ 14 °C	60 min	28 h	56 h			
+ 15 °C	to	+ 19 °C	40 min	18 h	36 h			
+ 20 °C	to	+ 24 °C	30 min	12 h	24 h			
+ 25 °C	to	+ 34 °C	12 min	9 h	18 h			
+ 35 °C	to	+ 39 °C	8 min	6 h	12 h			
+4	0 °C		8 min	4 h	8 h			
Cartridge	temp	erature	+5°C to +40°C					

VJ Technology Injection System XPE440 for concrete	
Intended Use Curing time	Annex B 8



Т	able C1: Characteristic values for resistance of threaded		l tens	sion re	sistan	ce an	d stee	el she	ar		
Siz	ze			M8	M10	M12	M16	M20	M24	M27	M30
Cr	oss section area	A _s	[mm²]	36,6	58	84,3	157	245	353	459	561
Ch	aracteristic tension resistance, Steel failu	re ¹⁾		•							
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	-	-
Sta	ainless steel A4 and HCR, class 80	N _{Rk,s}	[kN]	29	46	67	126	196	282	-	-
Ch	aracteristic tension resistance, Partial fac	tor ²⁾									
Ste	eel, Property class 4.6 and 5.6	$\gamma_{Ms,N}$	[-]				2,0	כ			
Ste	eel, Property class 4.8, 5.8 and 8.8	$\gamma_{Ms,N}$	[-]				1,	5			
Sta	ainless steel A2, A4 and HCR, class 50	γ _{Ms,N}	[-]				2,8	6			
Stainless steel A2, A4 and HCR, class 70 $\gamma_{Ms,N}$ [-] 1,87											
Stainless steel A4 and HCR, class 80 $\gamma_{Ms,N}$ [-]						1,6	3				
Ch	aracteristic shear resistance, Steel failure										
_	Steel, Property class 4.6 and 4.8	V ⁰ _{Rk,s}	[kN]	9 (8)	14 (13)	20	38	59	85	110	135
arm	Steel, Property class 5.6 and 5.8	$V^0_{Rk,s}$	[kN]	11 (10)	17 (16)	25	47	74	106	138	168
Without lever	Steel, Property class 8.8	$V^0_{Rk,s}$	[kN]	15 (13)	23 (21)	34	63	98	141	184	224
out	Stainless steel A2, A4 and HCR, class 50	$V^0_{Rk,s}$	[kN]	9	15	21	39	61	88	115	140
Vitho	Stainless steel A2, A4 and HCR, class 70	$V^{0}_{Rk,s}$	[kN]	13	20	30	55	86	124	-	-
>	Stainless steel A4 and HCR, class 80	V ⁰ Rk,s	[kN]	15	23	34	63	98	141	-	-
	Steel, Property class 4.6 and 4.8	M ⁰ 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
	Steel, Property class 8.8	M ⁰ Rk,s	[Nm]	30 (26)	60 (53)	105	266	519	896	1333	1797
Vith lever	Stainless steel A2, A4 and HCR, class 50	M ⁰ Rk.s	[Nm]	19	37	66	167	325	561	832	1125
Ν	Stainless steel A2, A4 and HCR, class 70	M ⁰ Rk,s	[Nm]	26	52	92	232	454	784	-	-
	Stainless steel A4 and HCR, class 80	М ⁰ _{Rk,s}	[Nm]	30	59	105	266	519	896	-	-
Ch	aracteristic shear resistance, Partial facto	r ²⁾									
Ste	eel, Property class 4.6 and 5.6	$\gamma_{Ms,V}$	[-]				1,6	7			
Ste	eel, Property class 4.8, 5.8 and 8.8	γMs,V	[-]				1,2	5			
Sta	ainless steel A2, A4 and HCR, class 50	$\gamma_{Ms,V}$	[-]				2,3	8			
Sta	ainless steel A2, A4 and HCR, class 70	$\gamma_{Ms,V}$	[-]				1,5	6			
Sta	ainless steel A4 and HCR, class 80	γMs,V	[-]				1,3	3			

¹⁾ Values are only valid for the given stress area As. 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. $^{2)}$ in absence of national regulation

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values for steel tension resistance and steel shear resistance of threaded rods	Annex C 1



	Characteristic val action	ues for Co	ncrete cone fa	ilure and Splitting with all kind of
Anchor				All Anchor type and sizes
Concrete cone f	ailure		·	
Non-cracked con	crete	k _{ucr,N}	[-]	11,0
Cracked concrete		k _{cr,N}	[-]	7,7
Edge distance		c _{cr,N}	[mm]	1,5 h _{ef}
Axial distance	Axial distance		[mm]	2 c _{cr,N}
Splitting			<u>.</u>	
	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 sn}	[mm]	2 C _{cr sp}

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values for Concrete cone failure and Splitting with all kind of action	Annex C 2



	od			M8	M10	M12	M16	M20	M24	M27	M30			
Steel failure		TNI		ı		۸ ۲								
Characteristic tension res	sistance	N _{Rk,s}	[kN]	A _s · f _{uk} (or see Table C1)										
Partial factor		$\gamma_{Ms,N}$	[-]				see Ta	able C1						
Combined pull-out and														
Characteristic bond resis holes (CD)	tance in non-crac	ked concrete	C20/25 in har	nmer d	drilled h	oles (H	D) and	compr	essed	air drill	ed			
한 라 : 40°C/24°C	Dry, wet			20	20	19	19	18	17	16	16			
angera	concrete and flooded bore	^τ Rk,ucr	[N/mm²]	20	20	19	19	10	17	16				
₩ II: 72°C/50°C	hole			15	15	15	14	13	13	12	12			
Characteristic bond resis	tance in non-crac	ked concrete	C20/25 in har	mmer d	drilled h	oles wi	th hollo	w drill	bit (HD	В)				
<u>ല</u> I: 40°C/24°C	Dry, wet			17	16	16	16	15	14	14	13			
1: 40°C/24°C 1: 72°C/50°C 1: 40°C/24°C 1: 72°C/50°C	concrete		[N1/ = 25	14	14	14	13	13	12	12	11			
I: 40°C/24°C	flooded bore	^τ Rk,ucr	[N/mm²]	16	16	16	15	15	14	14	13			
ਜ਼ਿ ਜ਼ਿ: 72°C/50°C	hole			14	14	14	13	13	12	12	11			
Characteristic bond resis		concrete C20/	25 in hamme	r drilled	holes	(HD) ,								
and with hollow drill bit (F	10B)													
Temperature L: 40°C/24°C angle II: 72°C/50°C	Dry, wet concrete and	^τ Rk,cr	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5			
و ق اا: 72°C/50°C	flooded bore hole	TXX,CI	[]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0			
Reduction factor ψ^0_{sus} in holes (CD) and with hollo		-cracked cond	crete C20/25 i	n hamı	mer dril	led hol	es (HD), comp	oressed	d air dri	lled			
L: 40°C/24°C and the result of the result o	Dry, wet concrete and	Ψ ⁰ sus	0,80											
II: 72°C/50°C	flooded bore hole		[-]	0,68										
		C25/30 C30/37						02						
	l			1,04										
			1,07											
•	ncrete	C35/45			1,08									
•	ncrete	C40/50					1	nα	1,09					
· ·	ncrete	C40/50 C45/55												
Ψс	ncrete	C40/50												
Ψc Concrete cone failure	ncrete	C40/50 C45/55						10						
Ψc Concrete cone failure Relevant parameter	ncrete	C40/50 C45/55					1,	10						
Increasing factors for cor Ψc Concrete cone failure Relevant parameter Splitting Relevant parameter	ncrete	C40/50 C45/55					1,	10 able C2						
Concrete cone failure Relevant parameter Splitting Relevant parameter Installation factor		C40/50 C45/55					see Ta	10 able C2 able C2						
Concrete cone failure Relevant parameter Splitting Relevant parameter Installation factor for dry and wet concrete	(HD; HDB, CD)	C40/50 C45/55 C50/60	[-]				see Ta	10 able C2 able C2						
Vc Concrete cone failure Relevant parameter Splitting	(HD; HDB, CD)	C40/50 C45/55	[-]				see Ta	10 able C2 able C2						
Concrete cone failure Relevant parameter Splitting Relevant parameter Installation factor for dry and wet concrete	(HD; HDB, CD)); HDB, CD)	C40/50 C45/55 C50/60					see Ta	10 able C2 able C2						



I .	cteristic value		on loads	unde	r stat	ic an	d qua	si-sta	atic a	ction	
Anchor size threaded ro	od			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure			,			•	•				
Characteristic tension res	istance	N _{Rk,s}	[kN]			$A_{s} \cdot f_{l}$	_{uk} (or s	ee Tab	le C1)		
Partial factor		γ _{Ms,N}	[-]				see Ta	able C1			
Combined pull-out and	concrete failure	•	'								
Characteristic bond resist holes (CD)	ance in non-cracl	ked concrete C	20/25 in har	nmer d	Irilled h	oles (⊦	ID) and	compr	essed	air drill	ed
Temperature range :I C/24°C C/24°C	Dry, wet concrete and flooded bore hole	^T Rk,ucr,100	[N/mm²]	20	20	19	19	18	17	16	16
Characteristic bond resist	ance in non-cracl	ked concrete C	20/25 in har	nmer d	Irilled h	oles w	ith hollo	w drill	bit (HD	B)	
e di				17	16	16	16	15	14	14	13
Temperature l: 40°C/24°C and described limits 1: 40°C/24°C 1	flooded bore hole	^τ Rk,ucr,100	[N/mm²]	16	16	16	15	15	14	14	13
Characteristic bond resist	⊥ tance in cracked o	concrete C20/2	_i 5 in hamme	r drilled	l holes	(HD) .	compre	essed a	ir drille	d holes	s (CD)
and with hollow drill bit (H						. , ,					
Temperature range : C/24°C	Dry, wet concrete and flooded bore hole	^T Rk,cr,100	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5
		C25/30	•				1,	02			
		C30/37						04			
Increasing factors for con	crete	C35/45		1,07							
Ψс		C40/50 C45/55		1,08							
		C45/55		1,09 1,10							
Concrete cone failure		1000/00					•,	10			
Relevant parameter							see Ta	able C2			
Splitting											
Relevant parameter							see Ta	ble C2			
Installation factor											
for dry and wet concrete (•	γ_{inst}	[-]					,0			
for flooded bore hole (HD	; нив, си)						1	,2			
VJ Technology Injecti	on System XPE	440 for conci	rete						Anne	x C 4	

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Characteristic values of tension loads under static and quasi-static action

for flooded bore hole (DD)



	cteristic value ervice life of		n loads	unde	r stat	ic an	d qua	si-sta	atic a	ction	
Anchor size threaded ro	od			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure											
Characteristic tension res	[kN]			$A_{s} \cdot f_{l}$	_{uk} (or s	ee Tab	le C1)				
Partial factor		γ _{Ms,N}	[-]				see Ta	ble C1			
Combined pull-out and	concrete failure	,	1								
Characteristic bond resis	tance in non-cracl	ked concrete C2	20/25 in dia	mond o	drilled h	oles (E	DD)				
I: 40°C/24°C ange II: 72°C/50°C	l l	_	[N/mm²] -	15	14	14	13	12	12	11	11
ender II: 72°C/50°C		^τ Rk,ucr		12	12	11	10	9,5	9,5	9,0	9,0
Reduction factor ψ ⁰ sus in	non-cracked cond	crete C20/25 in	diamond dr	illed ho	oles (DI	D)					
II: 72°C/50°C	Dry, wet concrete and	Ψ^0 sus	r.1	0,77							
	flooded bore hole	Ψ sus	[-]	0,72							
	•	C25/30	•	1,04							
		C30/37		1,08							
Increasing factors for cor	ocrete	C35/45		1,12							
Ψс		C40/50		1,15							
		C45/55		1,17							
Compute comp failure		C50/60		1,19							
Concrete cone failure							200 To	ble C2			
Relevant parameter Splitting							See 1a	ible CZ			
Relevant parameter					see Table C2						
Installation factor							000 10	1010 02			
for dry and wet concrete	(DD)	T					1	,0			
for flooded bore hole (DD	, ,	γ _{inst}	[-]	1,2			, -	1,4			

1,2

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action	Annex C 5



Anchor size 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 and 5.6, 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 strength classes	V ⁰ Rk,s	[kN]	0,5 ⋅ A _s ⋅ f _{uk} (or see Table C1)							
Partial factor	$\gamma_{Ms,V}$	[-]	see Table C1							
Ductility factor	k ₇	[-]	1,0							
Steel failure with lever arm	1									
Characteristic bending moment	M ⁰ Rk,s	[Nm]			1,2 • \	N _{el} ∙ f _{uk}	(or see	Table C	21)	
Elastic section modulus	W _{el}	[mm³]	31	62	109	277	541	935	1387	1874
Partial factor	$\gamma_{Ms,V}$	[-]				see	Table C	:1		
Concrete pry-out failure										
Factor	k ₈	[-]					2,0			
Installation factor	γ_{inst}	[-]	1,0							
Concrete edge failure										
Effective length of fastener	I _f	[mm]	min(h _{ef} ; 12 • d _{nom}) min(h _{ef} ; 300r						300mm)	
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ inst	[-]					1,0			

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of shear loads under static and quasi-static action	Annex C 6



	stic values ce life of 50				,	ન					
Anchor size internal threaded	d anchor rods			IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20		
Steel failure ¹⁾		1	1		ı	.					
Characteristic tension resistand	ce, <u>5.8</u>	$N_{Rk,s}$	[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	$\gamma_{Ms,N}$	[-]		1,5						
Characteristic tension resistant Steel A4 and HCR, Strength cla		N _{Rk,s}	[kN]	14	26	41	59	110	124		
Partial factor		$\gamma_{Ms,N}$	[-]			1,87			2,86		
Combined pull-out and conc	rete cone failui	e									
Characteristic bond resistanc holes (CD)	e in non-cracke	ed concre	ete C20/2	5 in hamn	ner drilled	holes (HD) and com	pressed a	air drilled		
I: 40°C/24°C	Dry, wet			20	19	19	18	17	16		
Temperature II: 72°C/50°C	concrete and flooded bore hole	^τ Rk,ucr	[N/mm²]	15	15	14	13	13	12		
Characteristic bond resistance	1	concrete	C20/25 in	hammer	drilled hol	es with ho	llow drill b	it (HDB)			
l: 40°C/24°C	Dry, wet			16	16	16	15	14	13		
Temperature II: 72°C/50°C	concrete		FN1/ 27	14	14	13	13	12	11		
range I: 40°C/24°C	flooded bore	^τ Rk,ucr	[N/mm²]	16	16	15	15	14	13		
II: 72°C/50°C	hole			14	14	13	13	12	11		
Characteristic bond resistance and with hollow drill bit (HDB)	in cracked cond	rete C20	/25 in ham	nmer drille	d holes (H	ID), comp	ressed air	drilled ho	les (CD)		
Temperature : 40°C/24°C	Dry, wet concrete and	^T Rk,cr	[N/mm²]	7,0	8,5	8,5	8,5	8,5	8,5		
range II: 72°C/50°C	flooded bore hole			6,0	7,0	7,0	7,0	7,0	7,0		
Reduction factor ψ^0_{sus} in crac			oncrete C	20/25 in I	hammer d	rilled hole:	s (HD), co	mpressed	air		
drilled holes (CD) and with hol	1	3)	1								
Temperature : 40°C/24°C range II. 70°C/50°C	Dry, wet concrete and flooded bore	Ψ ⁰ sus	[-]	0,80							
II: 72°C/50°C	hole			0,68							
			5/30				02				
			0/37				04				
Increasing factors for concrete			5/45				07				
$\Psi_{ extsf{c}}$			0/50 5/55	1,08 1,09							
			0/60				10				
Concrete cone failure			.,			-,					
Relevant parameter						see Ta	ble C2				
Splitting failure											
Relevant parameter						see Ta	ble C2				
Installation factor											
for dry and wet concrete (HD; HDB, CD) for flooded base hele (HD; HDB, CD)											
for flooded bore hole (HD; HDB	, CD)	inst	[-]			1	,2				
 Fastenings (incl. nut and was The characteristic tension res For IT-M20 strength class 50 	istance for steel								d rod.		
VJ Technology Injection S	ystem XPE44() for con	crete								
Performances Characteristic values of tension							⊢ ,	Annex C	7		

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Characteristic values of tension loads under static and quasi-static action



Table C8: Characte for a serv	ristic values			ds unde	er statio	and qu	uasi-sta	tic actio	วท	
Anchor size internal thread	ed anchor rod	s		IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20	
Steel failure ¹⁾										
Characteristic tension resista	nce, 5.8	N _{Rk,s}	[kN]	10	17	29	42	76	123	
Steel, strength class	teel, strength class 8.8		[kN]	16	27	46	67	121	196	
Partial factor, strength class 5	5.8 and 8.8	$N_{Rk,s}$ $\gamma_{Ms,N}$	[-]			1	,5		<u> </u>	
Characteristic tension resista Steel A4 and HCR, Strength		N _{Rk,s}	[kN]	14	26	41	59	110	124	
Partial factor		γ _{Ms,N}	[-]			1,87			2,86	
Combined pull-out and con	crete cone fail									
Characteristic bond resistan holes (CD)	ice in non-crac	ked concre	ete C20/2	5 in hamn	ner drilled	holes (HD) and con	npressed a	air drilled	
Temperature I: 40°C/24°C range	Dry, wet concrete and flooded bore hole	^T Rk,ucr,100	[N/mm²]	20	19	19	18	17	16	
Characteristic bond resistance	e in non-cracke	d concrete	C20/25 in	hammer	drilled hol	es with ho	llow drill b	oit (HDB)		
Temperature I: 40°C/24°C	Dry, wet concrete			16	16	16	15	14	13	
range I: 40°C/24°C	flooded bore hole	^τ Rk,ucr,100	[14/111111-]	16	16	15	15	14	13	
Characteristic bond resistance and with hollow drill bit (HDB)		ncrete C20/	/25 in ham	nmer drille	ed holes (H	HD), comp	ressed air	r drilled ho	les (CD)	
Temperature I: 40°C/24°C range	Dry, wet concrete and flooded bore hole	^T Rk,cr,100	[N/mm²]	6,5	7,5	7,5	7,5	7,5	7,5	
		C25				1,	02			
		C30					04			
Increasing factors for concret	е	C35				-	07			
$\Psi_{ extsf{C}}$		C40 C45		1,08 1,09						
		C45					10			
Concrete cone failure		1 300				•,				
Relevant parameter						see Ta	able C2			
Splitting failure										
Relevant parameter						see Ta	able C2			
Installation factor										
for dry and wet concrete (HD;	HDB, CD)	26.	r 1			1	,0			
for flooded bore hole (HD; HD	B, CD)	γinst	[-]			1	,2			

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.

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action	Annex C 8

²⁾ For IT-M20 strength class 50 is valid



Anchor size internal threade	d anchor rods			IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20		
Steel failure ¹⁾						1					
Characteristic tension resistance, 5.8		N _{Rk,s}	[kN]	10	10 17 29 42 7			76	123		
Steel, strength class	8.8	N _{Rk,s}	[kN]	16	27	46	67	121	196		
Partial factor, strength class 5.	8 and 8.8	γ _{Ms,N}	[-]		•	1	,5				
Characteristic tension resistan Steel A4 and HCR, Strength c		N _{Rk,s}	[kN]	14	26	41	59	110	124		
Partial factor	γ _{Ms,N}	[-]			1,87			2,86			
Combined pull-out and cond	rete cone failu	ıre									
Characteristic bond resistance	ce in non-crack	ced concre	ete C20/2	in diamo	ond drilled	l holes (DI	O)				
Temperature I: 40°C/24°C	Dry, wet concrete and	TDI	[N/mm²]	14	14	13	12	12	11		
range II: 72°C/50°C	flooded bore hole	^τ Rk,ucr	[14/11111]	12	11	10	9,5	9,5	9,0		
Reduction factor $\psi^0_{\mbox{ sus}}$ in nor	n-cracked cond	rete C20/	25 in diam	ond drille	d holes ([DD)					
Temperature I: 40°C/24°C	Dry, wet concrete and	Ψ ⁰ sus	[-]	0,77							
range II: 72°C/50°C	flooded bore hole	Ψ sus	[-]	0,72							
			5/30				04				
			0/37			,	08				
Increasing factors for concrete	!		5/45	1,12							
$\Psi_{ extsf{c}}$		-	0/50 5/55			<u> </u>	15 17				
			0/60								
Concrete cone failure		1 00	0,00			• ,					
Relevant parameter						see Ta	able C2				
Splitting failure											
Relevant parameter see Table C2											
Installation factor											
for dry and wet concrete (DD)		γ_{inst}	[-]			1	,0				
for flooded bore hole (DD)		l'illist	[]	1,2 1,4							

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.

For IT-M20 strength class 50 is valid

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action	Annex C 9

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Anahar aiza far intarnal thread	ad anch	or rodo		IT-M6	IT MAG	IT MAA	IT MAG	IT MAG	IT-M20
Anchor size for internal thread	ed anch	or roas		11-W6	IT-M8	IT-M10	IT-M12	IT-M16	11-WIZU
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	$\gamma_{Ms,V}$	[-]				1,25		
Characteristic shear resistance, Stainless Steel A4 and HCR, Strength class 70 ²⁾		V ⁰ Rk,s	[kN]	7	7 13 20 30 55				
Partial factor		$\gamma_{Ms,V}$	[-]			1,56			2,38
Ductility factor		k ₇	[-]	1,0					
Steel failure with lever arm ¹⁾									
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		$\gamma_{Ms,V}$	[-]		2,38				
Concrete pry-out failure									
Factor		k ₈	[-]				2,0		
Installation factor		γinst	[-]	1,0					
Concrete edge failure									
Effective length of fastener		I _f	[mm]	min(h _{ef} ; 12 · d _{nom}) min(h _{ef} ; 3					min(h _{ef} ; 300mm
Outside diameter of fastener		d _{nom}	[mm]	10	12	16	20	24	30
Installation factor		γinst	[-]		•	•	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.

2) For IT-M20 strength class 50 is valid

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of shear loads under static and quasi-static action	Annex C 10



Table C11: Cha	racteristic va a service life			oads	und	er st	atic	and c	quasi	i-stat	ic ac	tion	
Anchor size reinforci				Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure					I								
Characteristic tension	resistance	N _{Rk,s}	[kN]					A_s •	f _{uk} 1)				
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ _{Ms,N}	[-]	1,42)									
Combined pull-out ar													
Characteristic bond re	esistance in non	-cracked co	ncrete C2	20/25 i	n ham	mer dr	illed h	oles (F	ID) an	d com	presse	ed air c	Irilled
Temperature 1: 40°C/24°C 1: 72°C/50°C	Dry, wet concrete and	^T Rk,ucr	[N/mm²]	16	16	16	16	16	16	15	15	15	15
다. 72°C/50°C	flooded bore hole	TKK,UCI	[,]	12	12	12	12	12	12	12	12	11	11
Characteristic bond res	sistance in non-c	racked conc	rete C20/2	25 in ha	ammei	drille	d holes	with I	nollow	drill bi	it (HDE	3)	
<u>ဗ</u> <u>l: 40°C/24°C</u>	Dry, wet			14	14	13	13	13	13	13	13	13	13
en	concrete	$\Big]_{ au_{-}}$	[N/mm²]	12	12	12	11	11	11	11	11	11	11
ଞ୍ଚଳ ।: 40°C/24°C	flooded bore	^τ Rk,ucr	[N/mm²]	13	13	13	13	13	13	13	13	13	13
μ II: 72°C/50°C	hole			11	11	11	11	11	11	11	11	11	11
Characteristic bond rea		ed concrete	C20/25 in	hamm	er drill	ed hol	es (H), con	press	ed air	drilled	holes	(CD)
हु है ।: 40°C/24°C	iconcrete and i			7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
e		^τ Rk,cr	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor ψ^0_{su} drilled holes (CD) and φ	ed concre	te C20)/25 in	hamm	ner dril	led ho	les (HI	D), cor	mpress	sed air			
I: 40°C/24°C an be a li: 72°C/50°C	Dry, wet concrete and flooded bore	Ψ ⁰ sus	[-]	0,80									
II: 72°C/50°C	hole	sus [1]		0,68									
		C25		1,02									
		C30		1,04									
Increasing factors for Ψ_c	onciele	C35		1,07 1,08									
'		C40							09				
		C50							10				
Concrete cone failure	9	•											
Relevant parameter								see Ta	ble C	2			
Splitting													
Relevant parameter								see Ta	ble C	2			
Installation factor		T		ı									
for dry and wet concrete (HD; HDB, CD) for flooded bore hole (HD; HDB, CD) 7inst [-]													
1) f _{uk} shall be taken from 2) in absence of national	n the specification	l ns of reinforci	ng bars						<u>,∠</u>				
VJ Technology Inje	-	(PE440 for	concrete										
Performances Characteristic values of	of tension loads ur	ider static an	d quasi-sta	itic acti	on					A	nnex	C 11	



Anchor size reinforcia	ng bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure													
Characteristic tension r	esistance	N _{Rk,s}	[kN]					A_s •	f_{uk}^{1}				
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ _{Ms,N}	[-]	1,4 ²⁾									
Combined pull-out an	d concrete failu	ire											
Characteristic bond re holes (CD)	sistance in non-	-cracked co	ncrete C2	0/25 i	n ham	mer dr	illed h	oles (H	ID) an	d com	presse	ed air d	Irilled
Temperature range :: O ₀ P5/O ₀	Dry, wet concrete and flooded bore hole	^T Rk,ucr,100	[N/mm²]	16	16	16	16	16	16	15	15	15	15
Characteristic bond res	istance in non-c	racked conc	rete C20/2	5 in ha	ammer	drille	holes	with I	nollow	drill bi	t (HDE	3)	
rature Be : 40°C/24°C	l: 40°C/24°C Dry, wet concrete l: 40°C/24°C flooded bore hole			14	14	13	13	13	13	13	13	13	13
ege I: 40°C/24°C			[N/mm²] -	13	13	13	13	13	13	13	13	13	13
Characteristic bond res	istance in cracke	ed concrete	C20/25 in	hamm	er drill	ed hol	es (HD	D), con	npress	ed air	drilled	holes	(CD)
and with hollow drill bit	(HDB)		 					ı	I	ı	ı	Ι	
Temperature range :I :L C\2,0 C\2	Dry, wet concrete and flooded bore hole	^τ Rk,cr,100	[N/mm²]	6,5	6,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5	7,5
		C25	/30	1,02									
		C30		1,04									
Increasing factors for c	oncrete	C35	/45						07				
Ψ_{C}		C40							80				
		C45							09				
Concrete cone failure		C50	/60					1,	10				
Relevant parameter	·							see Ta	able C	2			
Splitting							•		10.00	_			
Relevant parameter							see Ta	ble C	2				
Installation factor										_			
	e (HD: HDB. CD)							1	.0				
for dry and wet concrete (HD; HDB, CD) for flooded bore hole (HD; HDB, CD) Yinst [-]					1,0								

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action	Annex C 12



	Table C13: Characteristic values of tension loads under static and quasi-static action for a service life of 50 years												
Anchor size reinforci	ng bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure					•	•				•	•	'	•
Characteristic tension	resistance	$N_{Rk,s}$	[kN]					A _s ·	f _{uk} 1)				
Cross section area		A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor		γ _{Ms,N}	[-]					1,	4 ²⁾				
Combined pull-out ar			•										
Characteristic bond resistance in non-cracked concrete C20/25 in diamond drilled holes (DD)													
I: 40°C/24°C	concrete and	^τ Rk,ucr	[N/mm²]	14	13	13	13	12	12	11	11	11	11
He die II: 72°C/50°C	II: 72°C/50°C flooded bore hole		[14/111111]	11	11	10	10	10	9,5	9,5	9,5	9,0	9,0
Reduction factor ψ ⁰ su	_s in non-cracked	d concrete C	20/25 in o	diamor	nd drill	ed hol	es (DD))					
nperature range : 40°C/24°C	Dry, wet concrete and	0	[-]	0,77									
I: 40°C/24°C	flooded bore hole	Ψ^0 sus		0,72									
	•	C25	/30	1,04									
		C30,	/37	1,08									
Increasing factors for o	concrete	C35	/45	1,12									
Ψс		C40							15				
		C45							17				
0 (()		C50	/60					1,	19				
Concrete cone failure	9			I									
Relevant parameter								see 1	able C	2			
Splitting									- 1-1 - 01				
Relevant parameter								see 18	able C				
Installation factor	to (DD)		Ι					4					
for dry and wet concrete for flooded bore hole (I		γ _{inst}	[-]		1	,2		<u> </u>	,0	1	,4		
To hooded bote fible (t	<i></i>		L	<u> </u>	- '	,_		<u> </u>		<u>'</u>	,⊸r		

 $^{^{1)}\,}f_{uk}$ shall be taken from the specifications of reinforcing bars $^{2)}$ in absence of national regulation

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under static and quasi-static action	Annex C 13



Table C14: Characteristic	c values o	f shear	load	ls un	der	stati	c and	d qua	asi-st	atic ad	ction	
Anchor size reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure without lever arm			•	•	•	•	•	•		•	•	
Characteristic shear resistance	V ⁰ Rk,s	[kN]					0,5	·As	f _{uk} 1)			
Cross section area	A _s	[mm²]	50 79 113 154 201 314 452 491 616 804							804		
Partial factor	γ _{Ms,V}	[-]		•				1,52)			
Ductility factor	k ₇	[-]						1,0				
Steel failure with lever arm		•	•									
Characteristic bending moment	M ⁰ _{Rk,s}	[Nm]					1.2	• W _{el}	• f _{uk} 1)			
Elastic section modulus	W _{el}	[mm³]	50	98	170	269	402	785	1357	1534	2155	3217
Partial factor	γ _{Ms,V}	[-]		•	•	•		1,5 ²)			
Concrete pry-out failure		•										
Factor	k ₈	[-]						2,0				
Installation factor	γ _{inst}	[-]						1,0				
Concrete edge failure		•	•									
Effective length of fastener	I _f	[mm]			min(h	n _{ef} ; 12	• d _{nor}	_n)		min(h _{ef} ; 300	mm)
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γ _{inst}	[-]		-	•	•		1,0				

 $^{^{1)}\,}f_{uk}$ shall be taken from the specifications of reinforcing bars $^{2)}$ in absence of national regulation

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of shear loads under static and quasi-static action	Annex C 14



Table C17:	Displacements under tension load ¹⁾ in hammer drilled holes (HD)
	compressed air drilled holes (CD) and with hollow drill bit (HDB)

Anchor size threaded ro	od		M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked concrete (C20/25 unde	static and quasi-	-static a	ction for	a servi	ce life of	f 50 year	rs		
Temperature range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
Temperature range II:	δ _{N0} -factor	[mm/(N/mm²)]	0,038	0,039	0,040	0,044	0,047	0,051	0,052	0,055
72°C/50°C	$\delta_{ extsf{N}\infty}$ -factor	[mm/(N/mm²)]	0,047	0,049	0,051	0,055	0,059	0,064	0,067	0,070
Cracked concrete C20/25 under static and quasi-static action for a service life of 50 years										
Temperature range I:	δ _{N0} -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171
Temperature range II:	δ_{N0} -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,259	0,154	0,163	0,172	0,181	0,189	0,207	0,229
Non-cracked concrete (C20/25 unde	static and quasi-	-static a	ction for	a servi	ce life of	f 100 yea	ars		
Temperature range I:	δ _{N0} -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,033	0,035	0,038	0,039	0,041
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,030	0,031	0,033	0,036	0,038	0,040	0,042
Cracked concrete C20/2	25 under stat	ic and quasi-stati	ic action	for a se	ervice lif	e of 100	years			
Temperature range I:	δ_{N0} -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \quad \tau; \qquad \qquad \tau \text{: action bond stress for tension}$

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

Table C15: Displacements under tension load¹⁾ in diamond drilled holes (DD)

Anchor size threaded ro	M8	M10	M12	M16	M20	M24	M27	M30		
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years										
Temperature range I: 40°C/24°C	δ_{N0} -factor	[mm/(N/mm²)]	0,011	0,012	0,012	0,013	0,014	0,014	0,015	0,015
	$\delta_{ extsf{N}\infty}$ -factor	[mm/(N/mm²)]	0,018	0,019	0,019	0,020	0,022	0,023	0,024	0,025
Temperature range II:	δ_{N0} -factor	[mm/(N/mm²)]	0,013	0,014	0,014	0,015	0,016	0,016	0,018	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,052	0,053	0,055	0,058	0,062	0,065	0,068	0,070

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \quad \cdot \tau; \qquad \qquad \tau\text{: action bond stress for tension}$

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

Table C16: Displacements under shear load²⁾ for all drilling methods

Anchor size thread	M8	M10	M12	M16	M20	M24	M27	M30		
Non-cracked and cracked concrete C20/25 under static and quasi-static action										
All temperature	$\delta_{ m V0}$ -factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
ranges	$\delta_{ m V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

²⁾ Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor · V; V: action shear load

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

VJ Technology Injection System XPE440 for concrete

Performances

Displacements under static and quasi-static action (threaded rods)

Annex C 15



Table C18: Displacements under tension load	d ¹⁾ in hammer drilled holes (HD),
compressed air drilled holes (CD)	and with hollow drill bit (HDB)

Anchor size Internal thre	eaded anchor	rod	IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20	
Non-cracked concrete C	20/25 under st	atic and quasi-s	tatic actio	n for a ser	vice life of	50 years	•		
Temperature range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,029	0,030	0,033	0,035	0,038	0,041	
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,029	0,030	0,033	0,035	0,038	0,041	
Temperature range II:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,039	0,040	0,044	0,047	0,051	0,055	
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,049	0,051	0,055	0,059	0,064	0,070	
Cracked concrete C20/25 under static and quasi-static action for a service life of 50 years									
Temperature range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,071	0,072	0,074	0,076	0,079	0,082	
40°C/24°C	$\delta_{ extsf{N}\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,171	
Temperature range II:	δ_{N0} -factor	[mm/(N/mm²)]	0,095	0,096	0,099	0,102	0,106	0,110	
72°C/50°C	$\delta_{ extsf{N}\infty}$ -factor	[mm/(N/mm²)]	0,154	0,163	0,172	0,181	0,189	0,229	
Non-cracked concrete C	20/25 under st	atic and quasi-s	tatic actio	n for a ser	vice life of	100 years			
Temperature range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,029	0,030	0,033	0,035	0,038	0,041	
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,030	0,031	0,033	0,036	0,038	0,042	
Cracked concrete C20/2	5 under static	and quasi-static	action for	a service	life of 100	years			
Temperature range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,071	0,072	0,074	0,076	0,079	0,082	
40°C/24°C	$\delta_{ extsf{N}\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,171	

¹⁾ Calculation of the displacement

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

 τ : action bond stress for tension

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

Table C19: Displacements under tension load¹⁾ in diamond drilled holes (DD)

Anchor size Internal thre	od	IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20					
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temperature range I: 40°C/24°C	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,012	0,012	0,013	0,014	0,014	0,015				
	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,019	0,019	0,020	0,022	0,023	0,025				
Temperature range II:	$\delta_{ extsf{N0}} extsf{-factor}$	[mm/(N/mm²)]	0,014	0,014	0,015	0,016	0,016	0,018				
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,053	0,055	0,058	0,062	0,065	0,070				

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \cdot \tau;$ $\delta_{\text{N}\infty} = \delta_{\text{N}\infty}\text{-factor} \cdot \tau;$ τ : action bond stress for tension

Table C20: Displacements under shear load²⁾ for all drilling methods

Anchor size Internal threaded anchor rod			IT-M6	IT-M8	IT-M10	IT-M12	IT-M16	IT-M20	
Non-cracked and cracked concrete C20/25 under static and quasi-static action									
All temperature	$\delta_{ m V0}$ -factor	[mm/kN]	0,07	0,06	0,06	0,05	0,04	0,04	
ranges	$\delta_{ m V\infty}$ -factor	[mm/kN]	0,10	0,09	0,08	0,08	0,06	0,06	

²⁾ Calculation of the displacement

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

V: action shear load

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

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Performances

Displacements under static and quasi-static action (Internal threaded anchor rod)

Annex C 16



Table C21:	Displacements under tension load ¹⁾ in hammer drilled holes (HD),
	compressed air drilled holes (CD) and with hollow drill bit (HDB)

Anchor size reinfo	orcing bar		Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temp range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
Temp range II:	δ_{N0} -factor	[mm/(N/mm²)]	0,038	0,039	0,040	0,042	0,044	0,047	0,051	0,051	0,054	0,058
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,047	0,049	0,051	0,053	0,055	0,059	0,065	0,065	0,068	0,072
Cracked concrete	C20/25 und	er static and qu	asi-stat	ic actio	n for a	service	life of	50 yea	rs			
Temp range I:	δ_{N0} -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temp range II:	δ_{N0} -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260
Non-cracked con-	crete C20/25	under static an	d quasi	-static	action t	for a se	rvice li	fe of 10	0 years	;		
Temp range I:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,028	0,029	0,030	0,031	0,033	0,035	0,038	0,038	0,040	0,043
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,028	0,030	0,031	0,032	0,033	0,036	0,039	0,039	0,041	0,043
Cracked concrete C20/25 under static and quasi-static action for a service life of 100 years												
Temp range l:	δ_{N0} -factor	[mm/(N/mm²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194

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 C22: Displacements under tension load¹⁾ in diamond drilled holes (DD)

	-											
Anchor size reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked concrete C20/25 under static and quasi-static action for a service life of 50 years												
Temp range I:	δ_{N0} -factor	[mm/(N/mm²)]	0,008	0,009	0,009	0,01	0,011	0,012	0,013	0,013	0,014	0,015
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,018	0,018	0,019	0,020	0,021	0,024	0,027	0,027	0,028	0,031
Temp range II:	$\delta_{ extsf{N0}}$ -factor	[mm/(N/mm²)]	0,009	0,011	0,011	0,012	0,013	0,014	0,015	0,015	0,016	0,018
72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,048	0,051	0,054	0,058	0,061	0,068	0,076	0,076	0,081	0,088

¹⁾ Calculation of the displacement

 $\delta_{\text{N0}} = \delta_{\text{N0}}\text{-factor} \quad \cdot \tau; \qquad \quad \tau\text{: action bond stress for tension}$

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

Table C23: Displacements under shear load²⁾ for all drilling methods

Anchor size reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
For concrete C20/25 under static and quasi-static action												
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	0,03
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04

²⁾ Calculation of the displacement

 $\delta_{V0} = \delta_{V0}$ -factor \cdot V: action shear load

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

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Performances

Displacements under static and quasi-static action (rebar)

Annex C 17



Allelie	or size threaded rod				M8	M10	M12	M16	M20	M24	M27	M30
Steel 1	ailure				•	•						
Chara (Seism	cteristic tension resis nic C1)	tance	N _{Rk,s,eq,C1}	[kN]	1,0 • N _{Rk,s}							
(Seism Steel, Stainle	cteristic tension resis nic C2) strength class 8.8 ess Steel A4 and HCF th class ≥70	·	N _{Rk,s,eq,C2}	[kN]	performance 1,0 • N _{Rk,s} performance						perfor	lo mance ssed
Partial	factor		γ _{Ms,N}	[-]			•	see Ta	able C1		•	
Comb	ined pull-out and co	oncrete failure										
	cteristic bond resistar holes (CD) and with			d concrete	C20/25	in ham	nmer dr	rilled ho	oles (Hi	D), con	npresse	ed air
ഉ	I. 40°C/24°C		^τ Rk,eq,C1	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5
Temperature range	I: 40°C/24°C	Dry, wet concrete and	^τ Rk,eq,C2	[N/mm²]	NF	PA ¹⁾	5,8	4,8	5,0	5,1	NF	PA ¹⁾
empe ran	II: 72°C/50°C	flooded bore hole	^τ Rk,eq,C1	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0
μ̈	II. 72 C/50 C	THOIC .	^τ Rk,eq,C2	[N/mm²]	NF	PA ¹⁾	5,0	4,1	4,3	4,4	NF	PA ¹⁾
	ction factor $\psi^0_{ extstyle $			concrete C	20/25	in ham	mer dı	rilled he	oles (H	ID), co	mpress	sed ai
Temperature range	l: 40°C/24°C	Dry, wet concrete and	Ψ ⁰ sus	[-]				0,	80			
Temperar	II: 72°C/50°C	flooded bore hole	Ψ sus	[-]	0,68							
Increa	sing factors for concr	ete ψ _C	C25/30 to	C50/60				1	,0			
	ete cone failure											
Concr	ant parameter							see Ta	able C2			
Concr Releva					1				11 00			
Concr Releva Splitti	ng											
Concr Releva Splitti Releva	ng ant parameter							see Ta	able UZ			
Concr Releva Splitti Releva Install	ng	D: HDB CD)			1				,0			

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1+C2)	Annex C 18



Table C25: Characteristi (performance				unde	r seis	mic a	ction			
Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Steel failure										
Characteristic shear resistance (Seismic C1)	V _{Rk,s,eq,C1}	[kN]				0,70) • V ⁰ Rk	,,s		
Characteristic shear resistance (Seismic C2), Steel, strength class 8.8 Stainless Steel A4 and HCR, Strength class ≥70	V _{Rk,s,eq,C2}	[kN]	perfor	lo mance issed		0,70 •	V ⁰ Rk,s			ormance assed
Partial factor	γ _{Ms,V}	[-]				see	Table C	21		
Ductility factor	k ₇	[-]					1,0			
Concrete pry-out failure										
Factor	k ₈	[-]					2,0			
Installation factor	γ _{inst}	[-]					1,0			
Concrete edge failure		•								
Effective length of fastener	I _f	[mm]	[mm] $\min(h_{ef}; 12 \cdot d_{nom})$ $\min(h_{ef}; 300)$							
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	16	20	24	27	30
Installation factor	γ _{inst}	[-]				•	1,0			•
Factor for annular gap	$\alpha_{\sf gap}$	[-]	[-] 0,5 (1,0) ¹⁾							

¹⁾ Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of shear loads under seismic action (performance category C1+C2)	Annex C 19



Table C26: Characteristic va (performance ca			oads	und	er se	eismi	c act	ion				
Anchor size reinforcing bar		Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	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	A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ _{Ms,N}	[-]					1,	4 ²⁾				
Combined pull-out and concrete fail	ıre											
Characteristic bond resistance in crack drilled holes (CD) and with hollow drill		cracked co	ncrete	C20/2	25 in h	amme	r drille	d hole	s (HD)	, comp	oresse	d air
Dry, wet concrete and flooded bore hole	^τ Rk,eq,C1	[N/mm²]	7,0	7,0	8,5	8,5	8,5	8,5	8,5	8,5	8,5	8,5
ଧି ହ ଆ: 72°C/50°C flooded bore hole	^τ Rk,eq,C1	[N/mm²]	6,0	6,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0	7,0
Reduction factor $\psi^0_{{\rm sus}}$ in cracked and drilled holes (CD) and with hollow drill		ed concre	te C20)/25 in	hamn	ner dril	led ho	les (H	D), cor	mpress	sed air	
l: 40°C/24°C Dry, wet concrete and flooded bore	\\ \0	r.1					0,	80				
I: 40°C/24°C Dry, wet concrete and flooded bore hole	Ψ ⁰ sus	[-]					0,	68				
Increasing factors for concrete ψ _C	C25/30 to	C50/60					1	,0				
Concrete cone failure	•											
Relevant parameter							see Ta	ble C	2			
Splitting												
Relevant parameter see Table C2												
Installation factor												
for dry and wet concrete (HD; HDB, CD) γ _{inst}	[-]						,0				
for flooded bore hole (HD; HDB, CD)		L J					1	,2				

 $^{^{\}rm 1)}\,f_{uk}$ shall be taken from the specifications of reinforcing bars $^{\rm 2)}$ in absence of national regulation

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of tension loads under seismic action (performance category C1)	Annex C 20



Table C27: Characteristic (performance			oads	unc	ler s	eism	ic a	ction	1			
Anchor size reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Steel failure												
Characteristic shear resistance	V _{Rk,s,eq,C1}	[kN]					0,35	·As	f _{uk} 1)			
Cross section area	A _s	[mm²]	50	79	113	154	201	314	452	491	616	804
Partial factor	γ _{Ms,V}	[-]						1,5 ²⁾				
Ductility factor	k ₇	[-]	1,0									
Concrete pry-out failure		•	•									
Factor	k ₈	[-]						2,0				
Installation factor	γ _{inst}	[-]						1,0				
Concrete edge failure	•	'	•									
Effective length of fastener	I _f	[mm]		ı	min(h _e	_{ef} ; 12 •	d _{nom})		min(h _{ef} ; 300	mm)
Outside diameter of fastener	d _{nom}	[mm]	8	10	12	14	16	20	24	25	28	32
Installation factor	γ _{inst}	[-]	[-] 1,0									
actor for annular gap α_{gap} [-] $0.5 \ (1.0)^3$												

VJ Technology Injection System XPE440 for concrete	
Performances Characteristic values of shear loads under seismic action (performance category C1)	Annex C 21

 ¹⁾ f_{uk} shall be taken from the specifications of reinforcing bars
 2) in absence of national regulation
 3) Value in brackets valid for filled annular gab between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is recommended.



Table C28: Displa	Table C28: Displacement under tension load ¹⁾ (threaded rod)													
Anchor size threaded rod M8 M10 M12 M16 M20 M24 M27 M3														
Non-cracked and cracked concrete C20/25 under seismic C1 action														
Temperature range I:	$\delta_{ extsf{N0}} extsf{-factor}$	[mm/(N/mm²)]	0,069	0,071	0,072	0,074	0,076	0,079	0,081	0,082				
40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,193	0,115	0,122	0,128	0,135	0,142	0,155	0,171				
Temperature range II: 72°C/50°C	δ_{N0} -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,099	0,102	0,106	0,109	0,110				
	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,259	0,154	0,163	0,172	0,181	0,189	0,207	0,229				

Table C29: Displacements under tension load¹⁾ (rebar)

Anchor size reinforcing bar			Ø8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
Non-cracked and cracked concrete C20/25 under seismic C1 action												
Temperature	$\delta_{ extsf{N0}} extsf{-} extsf{factor}$	[mm/(N/mm²)]	0,069	0,071	0,072	0,073	0,074	0,076	0,079	0,079	0,081	0,084
range l: 40°C/24°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,115	0,122	0,128	0,135	0,142	0,155	0,171	0,171	0,181	0,194
Temperature	δ_{N0} -factor	[mm/(N/mm²)]	0,092	0,095	0,096	0,098	0,099	0,102	0,106	0,106	0,109	0,113
range II: 72°C/50°C	$\delta_{N\infty}$ -factor	[mm/(N/mm²)]	0,154	0,163	0,172	0,181	0,189	0,207	0,229	0,229	0,242	0,260

¹⁾ Calculation of the displacement

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

 $\delta_{N\infty} = \delta_{N\infty}$ -factor $\cdot \tau$; (τ : action bond stress for tension)

Table C30: Displacements under shear load²⁾ (threaded rod)

Anchor size threaded rod				M10	M12	M16	M20	M24	M27	M30
Non-cracked and	cracked concrete C	20/25 under seis	mic C1	action						
All temperature	$\delta_{ m V0}$ -factor	[mm/kN]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
ranges	$\delta_{\!$	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05

Table C31: Displacements under shear load²⁾ (rebar)

Anchor size reinforcing bar				Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 24	Ø 25	Ø 28	Ø 32
For concrete C20/25 under seismic C1 action												
All temperature	$\delta_{ m V0}$ -factor	[mm/kN]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03	0,03
ranges	$\delta_{V\infty}$ -factor	[mm/kN]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05	0,04	0,04

²⁾ Calculation of the displacement

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

 $\delta_{V\infty} = \delta_{V\infty}$ -factor · V; (V: action shear load)

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Performances Displacements under seismic C1 action (threaded rods and rebar)	Annex C 22

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English translation prepared by DIBt



Table C33: Di	Table C33: Displacements under tension load (threaded rod)													
Anchor size threaded rod M8 M10 M12 M16 M20 M24 M27 M30														
Non-cracked and cracked concrete C20/25 under seismic C2 action														
All temperature	All temperature δ _{N,C2(DLS)} [mm] No 0,21 0,24 0,27 0,36 No													
ranges	δ _{N,C2(ULS)}	[mm]		mance issed	0,54	0,51	0,54	0,63	perforr assa					

Table C34: Displacements under shear load (threaded rod)

Anchor size threaded rod			M8	M10	M12	M16	M20	M24	M27	M30
Non-cracked and cracked concrete C20/25 under seismic C2 action										
All temperature	$\delta_{V,C2(DLS)}$	[mm]	N		3,1	3,4	3,5	4,2		lo
ranges	$\delta_{V,C2(ULS)}$	[mm]	perforr assa		6,0	7,6	7,3	10,9	assa	mance ssed

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Performances Displacements under seismic C2 action (threaded rods)	Annex C 23