

Approval body for construction products  
and types of construction

Bautechnisches Prüfamt

An institution established by the Federal and  
Laender Governments



## European Technical Assessment

ETA-10/0167  
of 16 May 2018

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

Soudal Injection System VE-SF for concrete

Bonded fastener for use in concrete

SOULDAL N.V.  
Everdongenlaan 18-20  
2300 Turnhout  
BELGIEN

Soudal NV, Plant1 Germany

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

EAD 330499-00-0601

**European Technical Assessment**

**ETA-10/0167**

English translation prepared by DIBt

**Page 2 of 25 | 16 May 2018**

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## Specific Part

### 1 Technical description of the product

The "Soudal Injection system VE-SF for concrete" is a bonded anchor consisting of a cartridge with injection mortar Soudafix VE400-SF and a steel element. The steel element consist of a commercial threaded rod with washer and hexagon nut in the range of M8 to M30, reinforcing bar in the range of diameter  $\varnothing 8$  to  $\varnothing 32$  mm or internal threaded 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 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. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

#### 3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	Performance
Characteristic resistance to tension load (static and quasi-static loading)	See Annex C 1, C 2, C 4 and C 6
Characteristic resistance to shear load (static and quasi-static loading)	See Annex C 1, C 3, C 5 and C 7
Displacements (static and quasi-static loading)	See Annex C 8 to C 10
Characteristic resistance for seismic performance category C1	See Annex C 2, C 3, C 6 and C 7
Characteristic resistance and displacements for seismic performance category C2	No performance assessed

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

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

English translation prepared by DIBt

**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 330499-00-0601 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**

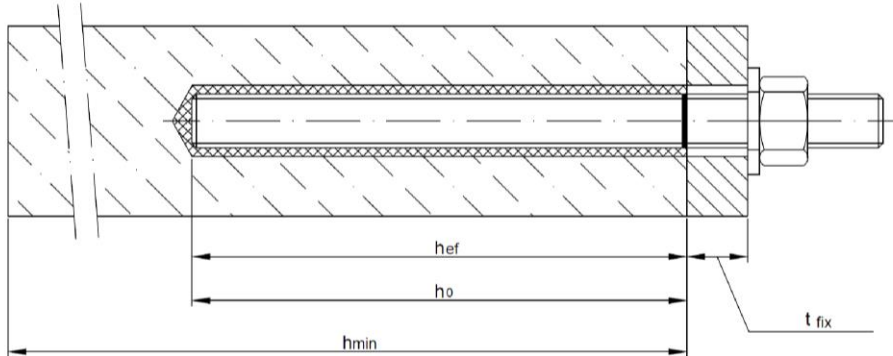
Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at Deutsches Institut für Bautechnik.

Issued in Berlin on 16 May 2018 by Deutsches Institut für Bautechnik

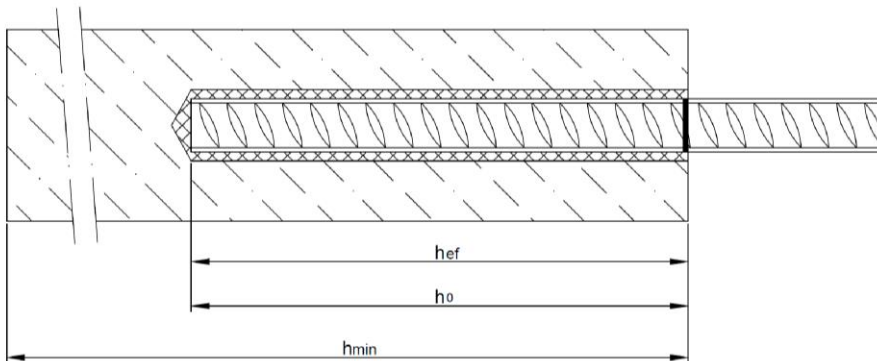
BD Dipl.-Ing. Andreas Kummerow  
Head of Department

*beglaubigt:*  
Baderschneider

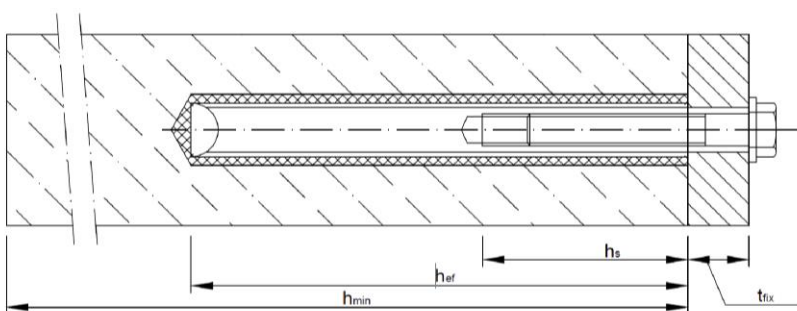
### Installation threaded rod M8 up to M30



### Installation reinforcing bar $\varnothing 8$ up to $\varnothing 32$



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



- $t_{fix}$  = thickness of fixture
- $h_{ef}$  = effective anchorage depth
- $h_0$  = depth of drill hole
- $h_{min}$  = minimum thickness of member

**Soudal Injection system VE-SF for concrete**

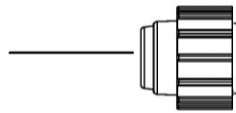
**Product description**  
Installed condition

**Annex A 1**

**Cartridge: Soudafix VE400-SF**

**150 ml, 280 ml, 300 ml up to 333 ml and 380 ml up to 420 ml cartridge (Type: coaxial)**

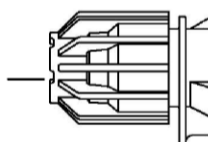
Sealing/Screw cap



Imprint: Soudafix VE400-SF, processing notes, charge-code, shelf life, storage temperature, hazard-code, curing- and processing time (depending on the temperature), with as well as without travel scale

**235 ml, 345 ml up to 360 ml and 825 ml cartridge (Type: "side-by-side")**

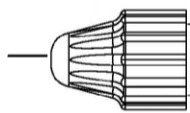
Sealing/Screw cap



Imprint: Soudafix VE400-SF, processing notes, charge-code, shelf life, storage temperature, hazard-code, curing- and processing time (depending on the temperature), with as well as without travel scale

**165 ml and 300 ml cartridge (Type: "foil tube")**

Sealing/Screw cap



Imprint: Soudafix VE400-SF, processing notes, charge-code, shelf life, storage temperature, hazard-code, curing- and processing time (depending on the temperature), with as well as without travel scale

**Static Mixer**

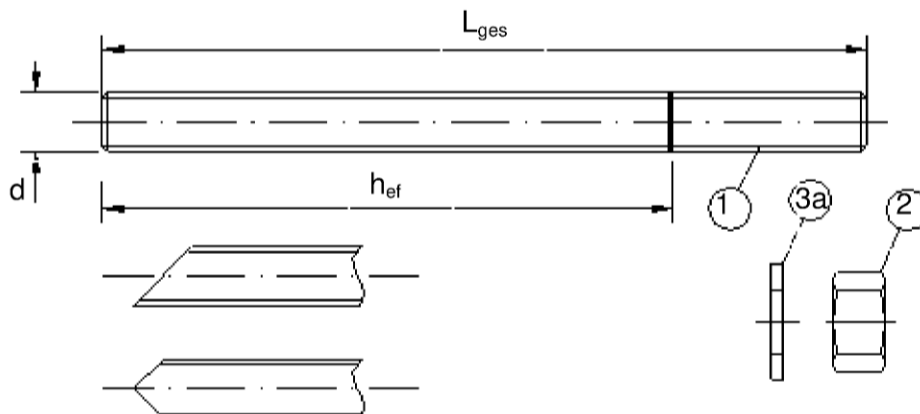


**Soudal Injection system VE-SF for concrete**

**Product description**  
Injection system

**Annex A 2**

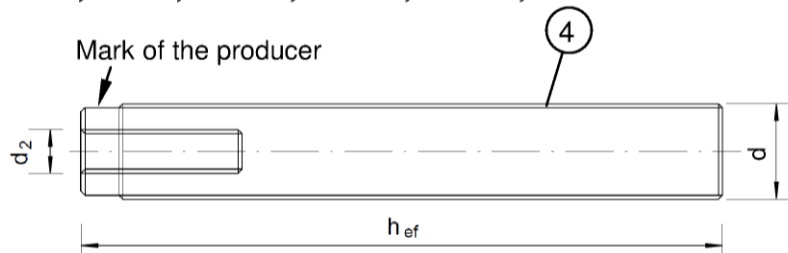
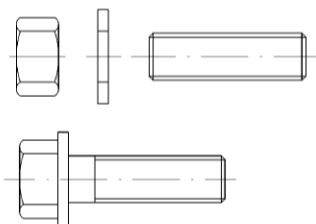
### Threaded rod M8, M10, M12, M16, M20, M24, M27, M30 with washer and hexagon nut





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

Threaded rod or Screw

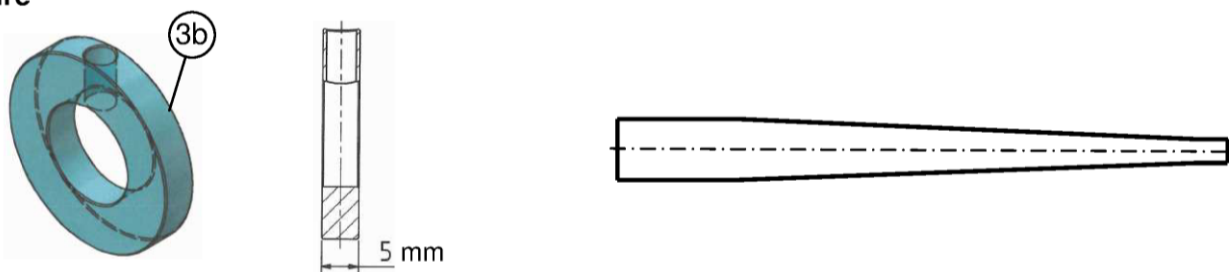


Marking: e.g.  M8

 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



**Soudal Injection system VE-SF for concrete**

**Product description**

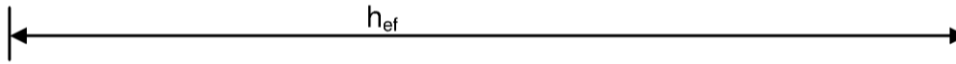
Threaded rod, internal threaded rod and filling washer

**Annex A 3**

<b>Table A1: Materials</b>				
<b>Designation</b>		<b>Material</b>		
<b>Steel, zinc plated ( Steel acc. to EN 10087:1998 or EN 10263:2001)</b>				
zinc plated $\geq 5 \mu\text{m}$ acc. to EN ISO 4042:1999 odr hot-dip galvanised $\geq 40 \mu\text{m}$ acc. to EN ISO 1461:2009 and EN ISO 10684:2004+AC:2009 or sherardized $\geq 40 \mu\text{m}$ acc. to DIN EN 17668:2016-06				
1	Anchor rod	Property class acc. to EN ISO 898-1:2013	4.6	$f_{uk}=400 \text{ N/mm}^2$ ; $f_{yk}=240 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			4.8	$f_{uk}=400 \text{ N/mm}^2$ ; $f_{yk}=320 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			5.6	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=300 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			5.8	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=400 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			8.8	$f_{uk}=800 \text{ N/mm}^2$ ; $f_{yk}=640 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
2	Hexagon nut	Property class acc. to EN ISO 898-2:2012	4	for anchor rod class 4.6 or 4.8
			5	for anchor rod class 5.6 or 5.8
			8	for anchor rod class 8.8
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Steel, zinc plated, hot-dip galvanised or sherardized		
3b	Filling washer			
4	Internal threaded anchor rod	Property class acc. to EN ISO 898-1:2013	5.8	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=400 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			8.8	$f_{uk}=800 \text{ N/mm}^2$ ; $f_{yk}=640 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
<b>Stainless steel A2 ( Material 1.4301 / 1.4303 / 1.4307 / 1.4567 oder 1.4541, acc. to EN 10088-1:2014)</b>				
<b>and</b>				
<b>Stainless steel A4 ( Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, acc. to EN 10088-1:2014)</b>				
1	Anchor rod <sup>1)3)</sup>	Property class acc. to EN ISO 3506-1:2009	50	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			70	$f_{uk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			80	$f_{uk}=800 \text{ N/mm}^2$ ; $f_{yk}=600 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
2	Hexagon nut <sup>1)3)</sup>	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	A2: Material 1.4301 / 1.4303 / 1.4307 / 1.4567 or 1.4541, EN 10088-1:2014 A4: Material 1.4401 / 1.4404 / 1.4571 / 1.4362 or 1.4578, EN 10088-1:2014		
3b	Filling washer <sup>4)</sup>			
4	Internal threaded anchor rod <sup>1)2)</sup>	Property class acc. to EN ISO 3506-1:2009	50	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			70	$f_{uk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
<b>High corrosion resistance steel ( Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014)</b>				
1	Anchor rod <sup>1)</sup>	Property class acc. to EN ISO 3506-1:2009	50	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			70	$f_{uk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			80	$f_{uk}=800 \text{ N/mm}^2$ ; $f_{yk}=600 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
2	Hexagon nut <sup>1)</sup>	Property class acc. to EN ISO 3506-1:2009	50	for anchor rod class 50
			70	for anchor rod class 70
			80	for anchor rod class 80
3a	Washer, (z.B.: EN ISO 887:2006, EN ISO 7089:2000, EN ISO 7093:2000 oder EN ISO 7094:2000)	Material 1.4529 or 1.4565, acc. to EN 10088-1: 2014		
3b	Filling washer			
4	Internal threaded anchor rod <sup>1)2)</sup>	Property class acc. to EN ISO 3506-1:2009	50	$f_{uk}=500 \text{ N/mm}^2$ ; $f_{yk}=210 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
			70	$f_{uk}=700 \text{ N/mm}^2$ ; $f_{yk}=450 \text{ N/mm}^2$ ; $A_5 > 8\%$ fracture elongation
<sup>1)</sup> Property class 70 for anchor rods up to M24 and Internal threaded anchor rods up to IG-M16, <sup>2)</sup> for IG-M20 only property class 50 <sup>3)</sup> Property class 70 only for stainless steel A4 <sup>4)</sup> Filling washer only with stainless steel A4				
<b>Soudal Injection system VE-SF for concrete</b>				<b>Annex A 4</b>
<b>Product description</b> Materials threaded rod and internal threaded rod				



**Reinforcing bar  $\varnothing 8, \varnothing 10, \varnothing 12, \varnothing 14, \varnothing 16, \varnothing 20, \varnothing 25, \varnothing 28, \varnothing 32$**



- 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  $0,05d \leq h \leq 0,07d$   
(d: Nominal diameter of the bar; h: Rip height of the bar)

**Table A2: Materials**

Part	Designation	Material
<b>Reinforcing bars</b>		
1	Rebar EN 1992-1-1:2004+AC:2010, Annex C	Bars and de-coiled rods class B or C $f_{yk}$ and k according to NDP or NCL of EN 1992-1-1/NA:2013 $f_{uk} = f_{tk} = k \cdot f_{yk}$

**Soudal Injection system VE-SF for concrete**

**Product description**  
Materials reinforcing bar

**Annex A 5**

## Specifications of intended use

### Anchorage subject to:

- Static and quasi-static loads: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- Seismic action for Performance Category C1: M8 to M30 (except hot-dip galvanised rods), Rebar Ø8 to Ø32.

### Base materials:

- Reinforced or unreinforced normal weight concrete without fibres according to EN 206:2013.
- Strength classes C20/25 to C50/60 according to EN 206:2013.
- Non-cracked concrete: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- Cracked concrete: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.

### 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 +80 °C (max long term temperature +50 °C and max short term temperature +80 °C)
- III: - 40 °C to +120 °C (max long term temperature +72 °C and max short term temperature +120 °C)

### Use conditions (Environmental conditions):

- Structures subject to dry internal conditions (zinc coated steel, stainless steel A2 resp. A4 or high corrosion resistant steel).
- Structures subject to external atmospheric exposure (including industrial and marine environment) and to permanently damp internal condition, if no particular aggressive conditions exist (stainless steel A4 or high corrosion resistant steel).
- Structures subject to external atmospheric exposure and to permanently damp internal condition, if other particular aggressive conditions exist (high corrosion resistant steel).

Note: Particular aggressive conditions are e.g. permanent, alternating immersion in seawater or the splash zone of seawater, chloride atmosphere of indoor swimming pools or atmosphere with extreme chemical pollution (e.g. in desulphurization plants or road tunnels where de-icing materials are used).

### 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:
  - FprEN 1992-4:2017 and Technical Report TR055

### Installation:

- Dry or wet concrete: M8 to M30, Rebar Ø8 to Ø32, IG-M6 to IG-M20.
- Flooded holes (not sea water): M8 to M16, Rebar Ø8 to Ø16, IG-M6 to IG-M10.
- Hole drilling by hammer (HD), hollow (HDB) or compressed air drill mode (CD).
- 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.

**Soudal Injection system VE-SF for concrete**

**Intended Use  
Specifications**

**Annex B 1**

**Table B1: Installation parameters for threaded rod**

Anchor size		M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
Outer diameter of anchor	$d_{nom}$ [mm] =	8	10	12	16	20	24	27	30
Nominal drill hole diameter	$d_0$ [mm] =	10	12	14	18	24	28	32	35
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	80	90	96	108	120
	$h_{ef,max}$ [mm] =	160	200	240	320	400	480	540	600
Diameter of clearance hole in the fixture	$d_f$ [mm] ≤	9	12	14	18	22	26	30	33
Diameter of steel brush	$d_b$ [mm] ≥	12	14	16	20	26	30	34	37
Maximum torque moment	$T_{inst}$ [Nm] ≤	10	20	40	80	120	160	180	200
Minimum thickness of member	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$				
Minimum spacing	$s_{min}$ [mm]	40	50	60	80	100	120	135	150
Minimum edge distance	$c_{min}$ [mm]	40	50	60	80	100	120	135	150

**Table B2: Installation parameters for rebar**

Rebar size		Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
Outer diameter of anchor	$d_{nom}$ [mm] =	8	10	12	14	16	20	25	28	32
Nominal drill hole diameter	$d_0$ [mm] =	12	14	16	18	20	24	32	35	40
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	60	70	75	80	90	100	112	128
	$h_{ef,max}$ [mm] =	160	200	240	280	320	400	500	580	640
Diameter of steel brush	$d_b$ [mm] ≥	14	16	18	20	22	26	34	37	41,5
Minimum thickness of member	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$					
Minimum spacing	$s_{min}$ [mm]	40	50	60	70	80	100	125	140	160
Minimum edge distance	$c_{min}$ [mm]	40	50	60	70	80	100	125	140	160

**Table B3: Installation parameters for internal threaded anchor rod**

Size internal threaded anchor rod		IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
Internal diameter of anchor	$d_2$ [mm] =	6	8	10	12	16	20
Outer diameter of anchor <sup>1)</sup>	$d_{nom}$ [mm] =	10	12	16	20	24	30
Nominal drill hole diameter	$d_0$ [mm] =	12	14	18	22	28	35
Effective anchorage depth	$h_{ef,min}$ [mm] =	60	70	80	90	96	120
	$h_{ef,max}$ [mm] =	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	$l_{IG}$ [mm] =	8/20	8/20	10/25	12/30	16/32	20/40
Minimum thickness of member	$h_{min}$ [mm]	$h_{ef} + 30 \text{ mm} \geq 100 \text{ mm}$			$h_{ef} + 2d_0$		
Minimum spacing	$s_{min}$ [mm]	50	60	80	100	120	150
Minimum edge distance	$c_{min}$ [mm]	50	60	80	100	120	150




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

**Soudal Injection system VE-SF for concrete**

**Intended Use**  
Installation parameters

**Annex B 2**

**Table B4: Parameter cleaning and setting tools**

Threaded Rod	Rebar	Internal threaded Anchor rod	$d_0$ Drill bit - $\varnothing$ HD, HDB, CA	$d_b$ Brush - $\varnothing$		$d_{b,min}$ min. Brush - $\varnothing$	Piston plug	Installation direction and use of piston plug		
				(mm)	(mm)					
M8			10	RBT10	12	10,5	-	-	-	-
M10	8	IG-M6	12	RBT12	14	12,5	-	-	-	-
M12	10	IG-M8	14	RBT14	16	14,5	-	-	-	-
	12		16	RBT16	18	16,5				
M16	14	IG-M10	18	RBT18	20	18,5	VS18	$h_{ef} > 250$ mm	$h_{ef} > 250$ mm	all
	16		20	RBT20	22	20,5	VS20			
M20	20	IG-M12	24	RBT24	26	24,5	VS24			
M24		IG-M16	28	RBT28	30	28,5	VS28			
M27	25		32	RBT32	34	32,5	VS32			
M30	28	IG-M20	35	RBT35	37	35,5	VS35			
	32		40	RBT40	41,5	40,5	VS40			



**MAC - Hand pump (volume 750 ml)**  
Drill bit diameter ( $d_0$ ): 10 mm to 20 mm  
Drill hole depth ( $h_0$ ):  $< 10 d_{nom}$   
Only in non-cracked concrete



**CAC - Rec. compressed air tool (min 6 bar)**  
Drill bit diameter ( $d_0$ ): all diameters



**Piston plug for overhead or horizontal installation VS**  
Drill bit diameter ( $d_0$ ): 18 mm to 40 mm



**Steel brush RBT**  
Drill bit diameter ( $d_0$ ): all diameters

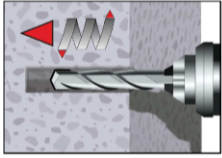
**Soudal Injection system VE-SF for concrete**

**Intended Use**  
Cleaning and setting tools

**Annex B 3**

## Installation instructions

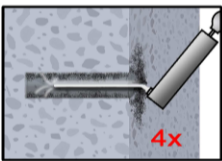
### Drilling of the bore hole



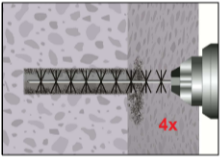
1. Drill with hammer drill a hole into the base material to the size and embedment depth required by the selected anchor (Table B1, B2, or B3), with hammer (HD), hollow (HDB) or compressed air (CD) drilling. The use of a hollow drill bit is only in combination with a sufficient vacuum permitted.  
In 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.**

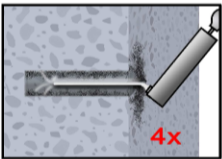
### MAC: Cleaning for bore hole diameter $d_0 \leq 20\text{mm}$ and bore hole depth $h_0 \leq 10d_{\text{nom}}$ (uncracked concrete only!)



- 2a. Starting from the bottom or back of the bore hole, blow the hole clean by a hand pump <sup>1)</sup> (Annex B 3) a minimum of four times.



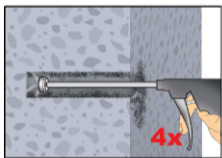
- 2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush  $> d_{b,\text{min}}$  (Table B4) a minimum of four times in a twisting motion.  
If the bore hole ground is not reached with the brush, a brush extension must be used.



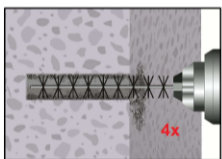
- 2c. Finally blow the hole clean again with a hand pump (Annex B 3) a minimum of four times.

<sup>1)</sup> It is permitted to blow bore holes with diameter between 14 mm and 20 mm and an embedment depth up to  $10d_{\text{nom}}$  also in cracked concrete with hand-pump.

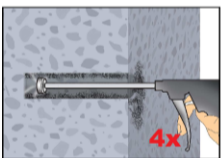
### CAC: Cleaning for all bore hole diameter in uncracked and cracked concrete



- 2a. Starting from the bottom or back of the bore hole, blow the hole clean with compressed air (min. 6 bar) (Annex B 3) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.



- 2b. Check brush diameter (Table B4). Brush the hole with an appropriate sized wire brush  $> d_{b,\text{min}}$  (Table B4) a minimum of four times.  
If the bore hole ground is not reached with the brush, a brush extension must be used.



- 2c. Finally blow the hole clean again with compressed air (min. 6 bar) (Annex B 3) a minimum of four times until return air stream is free of noticeable dust. If the bore hole ground is not reached an extension must be used.

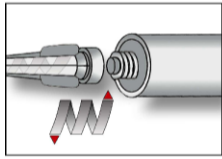
**After cleaning, the bore hole has to be protected against re-contamination in an appropriate way, until dispensing the mortar in the bore hole. If necessary, the cleaning has to be repeated directly before dispensing the mortar. In-flowing water must not contaminate the bore hole again.**

### Soudal Injection system VE-SF for concrete

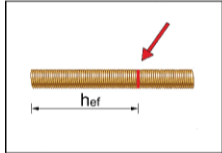
Intended Use  
Installation instructions

**Annex B 4**

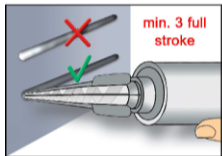
## Installation instructions (continuation)



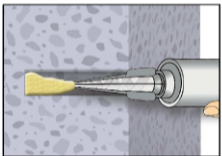
3. Attach the supplied static-mixing nozzle to the cartridge and load the cartridge into the correct dispensing tool. Cut off the foil tube clip before use.  
For every working interruption longer than the recommended working time (Table B5 or B6) as well as for new cartridges, a new static-mixer shall be used.



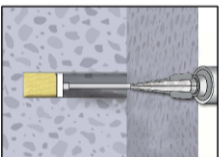
4. Prior to inserting the anchor rod into the filled bore hole, the position of the embedment depth shall be marked on the anchor rods.



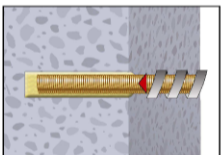
5. Prior to dispensing into the anchor hole, squeeze out separately a minimum of three full strokes and discard non-uniformly mixed adhesive components until the mortar shows a consistent grey colour. For foil tube cartridges it must be discarded a minimum of six full strokes.



6. 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. For embedment larger than 190 mm an extension nozzle shall be used. Observe the gel-/ working times given in Table B5 or B6.

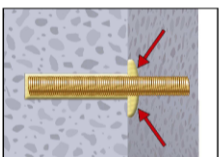


7. Piston Plugs and mixer nozzle extensions shall be used according to Table B4 for the following applications:
- Horizontal assembly (horizontal direction) and ground erection (vertical downwards direction): Drill bit- $\varnothing d_0 \geq 18$  mm and embedment depth  $h_{ef} > 250$ mm
  - Overhead assembly (vertical upwards direction): Drill bit- $\varnothing d_0 \geq 18$  mm

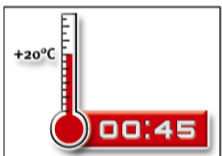


8. Push the threaded rod or reinforcing bar into the anchor hole while turning slightly to ensure positive distribution of the adhesive until the embedment depth is reached.

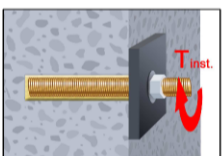
The anchor shall be free of dirt, grease, oil or other foreign material.



9. Be sure that the anchor is fully seated at the bottom of the hole and that excess mortar is visible at the top of the hole. If these requirements are not maintained, the application has to be renewed. For overhead application the anchor rod shall be fixed (e.g. wedges).



10. 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 or B6).



11. 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. It can be optional filled the annular gap between anchor and fixture 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.

### Soudal Injection system VE-SF for concrete

#### Intended Use

Installation instructions (continuation)

### Annex B 5

**Table B5: Maximum Working time and minimum curing time  
Soudafix VE400-SF**

Concrete temperature	Gelling- / working time	Minimum curing time in dry concrete <sup>1)</sup>
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 +39°C	2 min	20 min
+40°C	1,5 min	15 min
Cartridge temperature	+5°C to +40°C	

<sup>1)</sup> In wet concrete the curing time must be doubled.

**Soudal Injection system VE-SF for concrete**

**Intended Use**  
Curing time

**Annex B 6**

**Table C1: Characteristic values for steel tension resistance and steel shear resistance of threaded rods**

Size			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30	
<b>Characteristic tension resistance, Steel failure</b>											
Steel, Property class 4.6 and 4.8	$N_{Rk,s}$	[kN]	15	23	34	63	98	141	184	224	
Steel, Property class 5.6 and 5.8	$N_{Rk,s}$	[kN]	18	29	42	78	122	176	230	280	
Steel, Property class 8.8	$N_{Rk,s}$	[kN]	29	46	67	125	196	282	368	449	
Stainless steel A2, A4 and HCR, Property class 50	$N_{Rk,s}$	[kN]	18	29	42	79	123	177	230	281	
Stainless steel A2, A4 and HCR, Property class 70	$N_{Rk,s}$	[kN]	26	41	59	110	171	247	-	-	
Stainless steel A4 and HCR, Property class 80	$N_{Rk,s}$	[kN]	29	46	67	126	196	282	-	-	
<b>Characteristic tension resistance, Partial factor</b>											
Steel, Property class 4.6	$\gamma_{Ms,N}^{1)}$	[-]					2,0				
Steel, Property class 4.8	$\gamma_{Ms,N}^{1)}$	[-]					1,5				
Steel, Property class 5.6	$\gamma_{Ms,N}^{1)}$	[-]					2,0				
Steel, Property class 5.8	$\gamma_{Ms,N}^{1)}$	[-]					1,5				
Steel, Property class 8.8	$\gamma_{Ms,N}^{1)}$	[-]					1,5				
Stainless steel A2, A4 and HCR, Property class 50	$\gamma_{Ms,N}^{1)}$	[-]					2,86				
Stainless steel A2, A4 and HCR, Property class 70	$\gamma_{Ms,N}^{1)}$	[-]					1,87				
Stainless steel A4 and HCR, Property class 80	$\gamma_{Ms,N}^{1)}$	[-]					1,6				
<b>Characteristic shear resistance, Steel failure</b>											
Without lever arm	Steel, Property class 4.6 and 4.8	$V_{Rk,s}^0$	[kN]	9	14	20	38	59	85	110	135
	Steel, Property class 5.6 and 5.8	$V_{Rk,s}^0$	[kN]	9	15	21	39	61	88	115	140
	Steel, Property class 8.8	$V_{Rk,s}^0$	[kN]	15	23	34	63	98	141	184	224
	Stainless steel A2, A4 and HCR, Property class 50	$V_{Rk,s}^0$	[kN]	9	15	21	39	61	88	115	140
	Stainless steel A2, A4 and HCR, Property class 70	$V_{Rk,s}^0$	[kN]	13	20	30	55	86	124	-	-
	Stainless steel A4 and HCR, Property class 80	$V_{Rk,s}^0$	[kN]	15	23	34	63	98	141	-	-
With lever arm	Steel, Property class 4.6 and 4.8	$M_{Rk,s}^0$	[Nm]	15	30	52	133	260	449	666	900
	Steel, Property class 5.6 and 5.8	$M_{Rk,s}^0$	[Nm]	19	37	65	166	324	560	833	1123
	Steel, Property class 8.8	$M_{Rk,s}^0$	[Nm]	30	60	105	266	519	896	1333	1797
	Stainless steel A2, A4 and HCR, Property class 50	$M_{Rk,s}^0$	[Nm]	19	37	66	167	325	561	832	1125
	Stainless steel A2, A4 and HCR, Property class 70	$M_{Rk,s}^0$	[Nm]	26	52	92	232	454	784	-	-
	Stainless steel A4 and HCR, Property class 80	$M_{Rk,s}^0$	[Nm]	30	59	105	266	519	896	-	-
<b>Characteristic shear resistance, Partial factor</b>											
Steel, Property class 4.6	$\gamma_{Ms,V}^{1)}$	[-]					1,67				
Steel, Property class 4.8	$\gamma_{Ms,V}^{1)}$	[-]					1,25				
Steel, Property class 5.6	$\gamma_{Ms,V}^{1)}$	[-]					1,67				
Steel, Property class 5.8	$\gamma_{Ms,V}^{1)}$	[-]					1,25				
Steel, Property class 8.8	$\gamma_{Ms,V}^{1)}$	[-]					1,25				
Stainless steel A2, A4 and HCR, Property class 50	$\gamma_{Ms,V}^{1)}$	[-]					2,38				
Stainless steel A2, A4 and HCR, Property class 70	$\gamma_{Ms,V}^{1)}$	[-]					1,56				
Stainless steel A4 and HCR, Property class 80	$\gamma_{Ms,V}^{1)}$	[-]					1,33				

<sup>1)</sup> in absence of national regulation

**Soudal Injection system VE-SF for concrete**

**Performances**

Characteristic values for steel tension resistance and steel shear resistance of threaded rods

**Annex C 1**



**Table C2: Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)**

Anchor size threaded rod				M 8	M 10	M 12	M 16	M 20	M 24	M 27	M 30
<b>Steel failure</b>											
Characteristic tension resistance		$N_{Rk,s}$	[kN]	see Table C1							
		$N_{Rk,s,eq}$	[kN]	$1,0 \cdot N_{Rk,s}$							
Partial factor		$\gamma_{Ms,N}$	[-]	see Table C1							
<b>Combined pull-out and concrete failure</b>											
Characteristic bond resistance in non-cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	10	12	12	12	12	11	10	9
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	8,5	8,5	8,5	No Performance Determined (NPD)			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	9	9	9	9	8,5	7,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	No Performance Determined (NPD)			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	6,5	5,5	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,0	5,0	No Performance Determined (NPD)			
Characteristic bond resistance in cracked concrete C20/25											
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,5	5,5	5,5	5,5	6,5	6,5
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	2,5	3,1	3,7	3,7	3,7	3,8	4,5	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	4,0	5,5	5,5	No Performance Determined (NPD)			
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	2,5	2,5	3,7	3,7	No Performance Determined (NPD)			
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,5	4,0	4,0	4,0	4,0	4,5	4,5
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,6	2,2	2,7	2,7	2,7	2,8	3,1	3,1
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	4,0	4,0	No Performance Determined (NPD)			
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,6	1,9	2,7	2,7	No Performance Determined (NPD)			
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	3,0	3,5	3,5
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	2,1	2,4	2,4
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	No Performance Determined (NPD)			
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	No Performance Determined (NPD)			
Increasing factors for concrete (only static or quasi-static actions) $\psi_c$		C25/30		1,02							
		C30/37		1,04							
		C35/45		1,07							
		C40/50		1,08							
		C45/55		1,09							
		C50/60		1,10							
<b>Concrete cone failure</b>											
Non-cracked concrete		$k_{ucr,N}$	[-]	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 $c_{cr,N}$							
<b>Splitting</b>											
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 $h_{ef}$							
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$							
	$h/h_{ef} \leq 1,3$			2,4 $h_{ef}$							
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$							
Installation factor (dry and wet concrete)		$\gamma_{inst}$	[-]	1,0	1,2						
Installation factor (flooded bore hole)		$\gamma_{inst}$	[-]	1,4					No Performance Determined (NPD)		
<b>Soudal Injection system VE-SF for concrete</b>										<b>Annex C 2</b>	
<b>Performances</b> Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)											

<b>Table C3: Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1)</b>										
Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
<b>Steel failure without lever arm</b>										
Characteristic shear resistance	$V_{Rk,s}^0$	[kN]	see Table C1							
	$V_{Rk,s,eq}$	[kN]	$0,70 \cdot V_{Rk,s}^0$							
Partial factor	$\gamma_{Ms,v}$	[-]	see Table C1							
Ductility factor	$k_7$	[-]	1,0							
<b>Steel failure with lever arm</b>										
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	see Table C1							
	$M_{Rk,s,eq}^0$	[Nm]	No Performance Determined (NPD)							
Partial factor	$\gamma_{Ms,v}$	[-]	see Table C1							
<b>Concrete pry-out failure</b>										
Factor	$k_g$	[-]	2,0							
Installation factor	$\gamma_{inst}$	[-]	1,0							
<b>Concrete edge failure</b>										
Effective length of fastener	$l_f$	[mm]	$l_f = \min(h_{ef}; 8 d_{nom})$							
Outside diameter of fastener	$d_{nom}$	[mm]	8	10	12	16	20	24	27	30
Installation factor	$\gamma_{inst}$	[-]	1,0							
<b>Factor for annular gap</b>	$\alpha_{gap}$	[-]	$0,5 (1,0)^{1)}$							
<sup>1)</sup> Value in brackets valid for filled annular gap between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is required										
<b>Soudal Injection system VE-SF for concrete</b>									<b>Annex C 3</b>	
<b>Performances</b> Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1)										

**Table C4: Characteristic values of tension loads under static and quasi-static action**

Anchor size internal threaded anchor rods			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20	
<b>Steel failure<sup>1)</sup></b>									
Characteristic tension resistance, Steel, strength class 5.8	$N_{Rk,s}$	[kN]	10	17	29	42	76	123	
Partial factor	$\gamma_{Ms,N}$	[-]	1,5						
Characteristic tension resistance, Steel, strength class 8.8	$N_{Rk,s}$	[kN]	16	27	46	67	121	196	
Partial factor	$\gamma_{Ms,N}$	[-]	1,5						
Characteristic tension resistance, Stainless Steel A4, Strength class 70	$N_{Rk,s}$	[kN]	14	26	41	59	110	124	
Partial factor	$\gamma_{Ms,N}$	[-]	1,87						
<b>Combined pull-out and concrete cone failure</b>									
Characteristic bond resistance in non-cracked concrete C20/25									
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	12	12	12	12	11	9
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	8,5	8,5	8,5	No Performance Determined (NPD)		
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	9	9	9	9	8,5	6,5
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	6,5	6,5	6,5	No Performance Determined (NPD)		
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	6,5	6,5	6,5	6,5	6,5	5,0
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,0	5,0	5,0	No Performance Determined (NPD)		
Characteristic bond resistance in cracked concrete C20/25									
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	5,0	5,5	5,5	5,5	5,5	6,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	5,5	5,5	No Performance Determined (NPD)		
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	3,5	4,0	4,0	4,0	4,0	4,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	3,0	4,0	4,0	No Performance Determined (NPD)		
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	3,0	3,0	3,0	3,5
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	3,0	No Performance Determined (NPD)		
Increasing factors for concrete $\psi_c$	C25/30			1,02					
	C30/37			1,04					
	C35/45			1,07					
	C40/50			1,08					
	C45/55			1,09					
C50/60			1,10						
<b>Concrete cone failure</b>									
Non-cracked concrete	$k_{ucr,N}$	[-]	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 $c_{cr,N}$						
<b>Splitting failure</b>									
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 $h_{ef}$					
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$					
	$h/h_{ef} \leq 1,3$			2,4 $h_{ef}$					
Axial distance	$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$						
Installation factor (dry and wet concrete)	$\gamma_{inst}$	[-]	1,2						
Installation factor (flooded bore hole)	$\gamma_{inst}$	[-]	1,4			-			
<sup>1)</sup> Fastening screws or threaded rods (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 of the given strength class are valid for the internal threaded rod and the fastening element. <sup>2)</sup> For IG-M20 strength class 50 is valid									
<b>Soudal Injection system VE-SF for concrete</b>							<b>Annex C 4</b>		
<b>Performances</b> Characteristic values of tension loads under static and quasi-static action									

**Table C5: Characteristic values of shear loads under static and quasi-static action**

Anchor size for internal threaded anchor rods			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
<b>Steel failure without lever arm<sup>1)</sup></b>								
Characteristic shear resistance, Steel, strength class 5.8	$V_{FRk,s}^0$	[kN]	5	9	15	21	38	61
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance, Steel, strength class 8.8	$V_{FRk,s}^0$	[kN]	8	14	23	34	60	98
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic shear resistance, Stainless Steel A4, Strength class 70 <sup>2)</sup>	$V_{FRk,s}^0$	[kN]	7	13	20	30	55	40
Partial factor	$\gamma_{Ms,V}$	[-]	1,56					
Ductility factor	$k_7$	[-]	1,0					
<b>Steel failure with lever arm<sup>1)</sup></b>								
Characteristic bending moment, Steel, strength class 5.8	$M_{FRk,s}^0$	[Nm]	8	19	37	66	167	325
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Steel, strength class 8.8	$M_{FRk,s}^0$	[Nm]	12	30	60	105	267	519
Partial factor	$\gamma_{Ms,V}$	[-]	1,25					
Characteristic bending moment, Stainless Steel A4, Strength class 70 <sup>2)</sup>	$M_{FRk,s}^0$	[Nm]	11	26	52	92	233	456
Partial factor	$\gamma_{Ms,V}$	[-]	1,56					
<b>Concrete pry-out failure</b>								
Factor	$k_8$	[-]	2,0					
Installation factor	$\gamma_{inst}$	[-]	1,0					
<b>Concrete edge failure</b>								
Effective length of fastener	$l_f$	[mm]	$l_f = \min(h_{ef}; 8 d_{nom})$					
Outside diameter of fastener	$d_{nom}$	[mm]	10	12	16	20	24	30
Installation factor	$\gamma_{inst}$	[-]	1,0					

<sup>1)</sup> Fastening screws or threaded rods (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 of the given strength class are valid for the internal threaded rod and the fastening element.

<sup>2)</sup> For IG-M20 strength class 50 is valid

**Soudal Injection system VE-SF for concrete**

**Performances**

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

**Annex C 5**

<b>Table C6: Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)</b>													
Anchor size reinforcing bar				Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
<b>Steel failure</b>													
Characteristic tension resistance	$N_{Rk,s}$		[kN]	$A_s \cdot f_{uk}^{1)}$									
	$N_{Rk,s,eq}$		[kN]	$1,0 \cdot A_s \cdot f_{uk}^{1)}$									
Cross section area	$A_s$		[mm <sup>2</sup> ]	50	79	113	154	201	314	491	616	804	
Partial factor	$\gamma_{Ms,N}$		[-]	1,4 <sup>2)</sup>									
<b>Combined pull-out and concrete failure</b>													
Characteristic bond resistance in non-cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	10	12	12	12	12	12	11	10	8,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	8,5	8,5	8,5	8,5	No Performance Determined (NPD)				
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	7,5	9	9	9	9	9	8,0	7,0	6,0	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	No Performance Determined (NPD)				
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	5,5	6,5	6,5	6,5	6,5	6,5	6,0	5,0	4,5	
	flooded bore hole	$\tau_{Rk,ucr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,0	5,0	5,0	No Performance Determined (NPD)				
Characteristic bond resistance in cracked concrete C20/25													
Temperature range I: 40°C/24°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	5,0	5,5	5,5	5,5	5,5	5,5	6,5	6,5	
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	2,5	3,1	3,7	3,7	3,7	3,7	3,8	4,5	4,5	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	4,0	4,0	5,5	5,5	5,5	No Performance Determined (NPD)				
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	2,5	2,5	3,7	3,7	3,7	No Performance Determined (NPD)				
Temperature range II: 80°C/50°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,5	4,0	4,0	4,0	4,0	4,0	4,5	4,5	
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,6	2,2	2,7	2,7	2,7	2,7	2,8	3,1	3,1	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,5	3,0	4,0	4,0	4,0	No Performance Determined (NPD)				
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,6	1,9	2,7	2,7	2,7	No Performance Determined (NPD)				
Temperature range III: 120°C/72°C	dry and wet concrete	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	3,0	3,0	3,5	3,5	
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	2,0	2,1	2,4	2,4	
	flooded bore hole	$\tau_{Rk,cr}$	[N/mm <sup>2</sup> ]	2,0	2,5	3,0	3,0	3,0	No Performance Determined (NPD)				
		$\tau_{Rk,eq}$	[N/mm <sup>2</sup> ]	1,3	1,6	2,0	2,0	2,0	No Performance Determined (NPD)				
Increasing factors for concrete (only static or quasi-static actions) $\psi_c$	C25/30			1,02									
	C30/37			1,04									
	C35/45			1,07									
	C40/50			1,08									
	C45/55			1,09									
	C50/60			1,10									
<b>Concrete cone failure</b>													
Non-cracked concrete		$k_{ucr,N}$	[-]	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 $c_{cr,N}$									
<b>Splitting</b>													
Edge distance	$h/h_{ef} \geq 2,0$	$c_{cr,sp}$	[mm]	1,0 $h_{ef}$									
	$2,0 > h/h_{ef} > 1,3$			$2 \cdot h_{ef} \left( 2,5 - \frac{h}{h_{ef}} \right)$									
	$h/h_{ef} \leq 1,3$			2,4 $h_{ef}$									
Axial distance		$s_{cr,sp}$	[mm]	2 $c_{cr,sp}$									
Installation factor (dry and wet concrete)		$\gamma_{inst}$	[-]	1,0	1,2								
Installation factor (flooded bore hole)		$\gamma_{inst}$	[-]	1,4						No Performance Determined (NPD)			
<sup>1)</sup> $f_{uk}$ shall be taken from the specifications of reinforcing bars <sup>2)</sup> in absence of national regulation													
<b>Soudal Injection system VE-SF for concrete</b>											<b>Annex C 6</b>		
<b>Performances</b> Characteristic values of tension loads under static, quasi-static action and seismic action (performance category C1)													

<b>Table C7: Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1)</b>											
Anchor size reinforcing bar			Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32
<b>Steel failure without lever arm</b>											
Characteristic shear resistance	$V_{Rk,s}^0$	[kN]	$0,50 \cdot A_s \cdot f_{uk}^{1)}$								
	$V_{Rk,s,eq}$	[kN]	$0,35 \cdot A_s \cdot f_{uk}^{1)}$								
Cross section area	$A_s$	[mm <sup>2</sup> ]	50	79	113	154	201	214	491	616	804
Partial factor	$\gamma_{Ms,v}$	[-]	1,5 <sup>2)</sup>								
Ductility factor	$k_7$	[-]	1,0								
<b>Steel failure with lever arm</b>											
Characteristic bending moment	$M_{Rk,s}^0$	[Nm]	$1.2 \cdot W_{el} \cdot f_{uk}^{1)}$								
	$M_{Rk,s,eq}^0$	[Nm]	No Performance Determined (NPD)								
Elastic section modulus	$W_{el}$	[mm <sup>3</sup> ]	50	98	170	269	402	785	1534	2155	3217
Partial factor	$\gamma_{Ms,v}$	[-]	1,5 <sup>2)</sup>								
<b>Concrete pry-out failure</b>											
Factor	$k_8$	[-]	2,0								
Installation factor	$\gamma_{inst}$	[-]	1,0								
<b>Concrete edge failure</b>											
Effective length of fastener	$l_f$	[mm]	$l_f = \min(h_{ef}, 8 d_{nom})$								
Outside diameter of fastener	$d_{nom}$	[mm]	8	10	12	14	16	20	25	28	32
Installation factor	$\gamma_{inst}$	[-]	1,0								
<b>Factor for annular gap</b>	$\alpha_{gap}$	[-]	0,5 (1,0) <sup>1)</sup>								
<sup>1)</sup> $f_{uk}$ shall be taken from the specifications of reinforcing bars <sup>2)</sup> in absence of national regulation <sup>3)</sup> Value in brackets valid for filled annular gap between anchor and clearance hole in the fixture. Use of special filling washer Annex A 3 is required											
<b>Soudal Injection system VE-SF for concrete</b>										<b>Annex C 7</b>	
<b>Performances</b> Characteristic values of shear loads under static, quasi-static action and seismic action (performance category C1)											

**Table C8: Displacements under tension load<sup>1)</sup> (threaded rod)**

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
<b>Non-cracked concrete C20/25</b>										
Temperature range I: 40°C/24°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,021	0,023	0,026	0,031	0,036	0,041	0,045	0,049
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,030	0,033	0,037	0,045	0,052	0,060	0,065	0,071
Temperature range II: 80°C/50°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
Temperature range III: 120°C/72°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,075	0,088	0,100	0,110	0,119
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,108	0,127	0,145	0,159	0,172
<b>Cracked concrete C20/25</b>										
Temperature range I: 40°C/24°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,090			0,070				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,105			0,105				
Temperature range II: 80°C/50°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245				
Temperature range III: 120°C/72°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170				
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245				

<sup>1)</sup> Calculation of the displacement

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

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

**Table C9: Displacements under shear load<sup>1)</sup> (threaded rod)**

Anchor size threaded rod			M 8	M 10	M 12	M 16	M 20	M24	M 27	M 30
<b>For non-cracked concrete C20/25</b>										
All temperature ranges	δ <sub>V0</sub> -factor	[mm/(kN)]	0,06	0,06	0,05	0,04	0,04	0,03	0,03	0,03
	δ <sub>V∞</sub> -factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,05
<b>For cracked concrete C20/25</b>										
All temperature ranges	δ <sub>V0</sub> -factor	[mm/(kN)]	0,12	0,12	0,11	0,10	0,09	0,08	0,08	0,07
	δ <sub>V∞</sub> -factor	[mm/(kN)]	0,18	0,18	0,17	0,15	0,14	0,13	0,12	0,10

<sup>1)</sup> Calculation of the displacement

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

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

**Soudal Injection system VE-SF for concrete**

**Performances**  
Displacements (threaded rods)

**Annex C 8**

**Table C10: Displacements under tension load<sup>1)</sup> (rebar)**

Anchor size reinforcing bar		Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
<b>Non-cracked concrete C20/25</b>											
Temperature range I: 40°C/24°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,021	0,023	0,026	0,028	0,031	0,036	0,043	0,047	0,052
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,030	0,033	0,037	0,041	0,045	0,052	0,061	0,071	0,075
Temperature range II: 80°C/50°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
Temperature range III: 120°C/72°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,050	0,056	0,063	0,069	0,075	0,088	0,104	0,113	0,126
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,072	0,081	0,090	0,099	0,108	0,127	0,149	0,163	0,181
<b>Cracked concrete C20/25</b>											
Temperature range I: 40°C/24°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,090			0,070					
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,105			0,105					
Temperature range II: 80°C/50°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170					
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245					
Temperature range III: 120°C/72°C	δ <sub>N0</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170					
	δ <sub>N∞</sub> -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245					

<sup>1)</sup> Calculation of the displacement

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

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

**Table C11: Displacement under shear load<sup>1)</sup> (rebar)**

Anchor size reinforcing bar		Ø 8	Ø 10	Ø 12	Ø 14	Ø 16	Ø 20	Ø 25	Ø 28	Ø 32	
<b>Non-cracked concrete C20/25</b>											
All temperature ranges	δ <sub>V0</sub> -factor	[mm/(kN)]	0,06	0,05	0,05	0,04	0,04	0,04	0,03	0,03	0,03
	δ <sub>V∞</sub> -factor	[mm/(kN)]	0,09	0,08	0,08	0,06	0,06	0,05	0,05	0,04	0,04
<b>Cracked concrete C20/25</b>											
All temperature ranges	δ <sub>V0</sub> -factor	[mm/(kN)]	0,12	0,12	0,11	0,11	0,10	0,09	0,08	0,07	0,06
	δ <sub>V∞</sub> -factor	[mm/(kN)]	0,18	0,18	0,17	0,16	0,15	0,14	0,12	0,11	0,10

<sup>1)</sup> Calculation of the displacement

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

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

**Soudal Injection system VE-SF for concrete**

**Performances**  
Displacements (rebar)

**Annex C 9**



**Table C12: Displacements under tension load<sup>1)</sup> (Internal threaded anchor rod)**

Anchor size Internal threaded anchor rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
<b>Non-cracked concrete C20/25 under static and quasi-static action</b>								
Temperature range I: 40°C/24°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,023	0,026	0,031	0,036	0,041	0,049
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,033	0,037	0,045	0,052	0,060	0,071
Temperature range II: 80°C/50°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,056	0,063	0,075	0,088	0,100	0,119
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,081	0,090	0,108	0,127	0,145	0,172
Temperature range III: 120°C/72°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,056	0,063	0,075	0,088	0,100	0,119
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,081	0,090	0,108	0,127	0,145	0,172
<b>Cracked concrete C20/25 under static and quasi-static action</b>								
Temperature range I: 40°C/24°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,090			0,070		
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,105			0,105		
Temperature range II: 80°C/50°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170		
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245		
Temperature range III: 120°C/72°C	$\delta_{N0}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,219			0,170		
	$\delta_{N\infty}$ -factor	[mm/(N/mm <sup>2</sup> )]	0,255			0,245		

<sup>1)</sup> Calculation of the displacement

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

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

**Table C13: Displacements under shear load<sup>1)</sup> (Internal threaded anchor rod)**

Anchor size Internal threaded anchor rod			IG-M 6	IG-M 8	IG-M 10	IG-M 12	IG-M 16	IG-M 20
<b>Non-cracked and cracked concrete C20/25 under static and quasi-static action</b>								
All temperature ranges	$\delta_{V0}$ -factor	[mm/(kN)]	0,07	0,06	0,06	0,05	0,04	0,04
	$\delta_{V\infty}$ -factor	[mm/(kN)]	0,10	0,09	0,08	0,08	0,06	0,06

<sup>1)</sup> Calculation of the displacement

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

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

**Soudal Injection system VE-SF for concrete**

**Performances**

Displacements (Internal threaded anchor rod)

**Annex C 10**